

SITE PLAN SUBMISSION PACKAGE

FOR

**33 DANTON DRIVE
METHUEN, MA 01844**

Prepared for:

Nabil Boghos
1630 Osgood Street #1210
North Andover, MA 01845

Prepared by:

Design Consultants, Inc.
120 Middlesex Avenue, Suite 20
Somerville, Massachusetts 02145

**Project No. 2020-041
November 4th, 2020**





Design Consultants, Inc.

Civil Engineering
Transportation/Traffic
Water/Wastewater
Geotechnical
Land Surveying
Environmental
Planning

November 4, 2020

Bill Buckley, Director of Economic and Community Development
Jodie Geary; Planning Coordination and Administration
Methuen City Hall
41 Pleasant
Methuen, Massachusetts 01844

RE: Site Plan Review Submittal
33 Danton Drive
Methuen, Massachusetts

Dear Bill:

On behalf of Nabil Boghos, Design Consultants Inc. (DCI) is submitting the enclosed Application for Site Plan Review at 33 Danton Drive. The following package and table of contents go into specifics regarding the contents of the submittal package. However, the package covers all the requirements of the published application checklist and the requested materials from our meeting on October 13th, 2020.

Additionally, two checks in the amount of \$5,000 for Peer Review Escrow and \$9,330 for the Application Fee will be dropped off by our client sometime today in the box at City Hall in regards to this application.

We should note for this review, the Wetlands across Danton Drive have not been delineated yet. We were scheduled to delineate them on October 26th, 2020. However, the wetlands consultant had to delay due to a potential COVID-19 outbreak at the company. We are rescheduling sometime this month and will have them delineated soon. As the wetlands are not on the project and are located across the street from the project, we would not expect that they will impact the project's site plan review. A subsequent submission to the conservation commission will be made as soon the consultant is available to delineate the wetlands.

If you have any questions or comments, please contact me. Thank you in advance for your time and assistance, and we look forward to presenting this proposal at the December 4th meeting.

Sincerely,

Stephen B. Sawyer, PE
Senior Project Manager

Included Items

Site Plan Application – 16 Copies

Project Plans – 9 2'x3' copies of the project plan set.

Project Plans – 8 11"x17" copies of the project plan set.

Design Calculations – 3 copies

Stormwater Management Plan – 3 copies

Traffic Memorandum – 3 copies

Certified List of Abutters, Address Labels, Certificate of Mailing & Proof of payment to Eagle Tribune

Included With Application Package Under Separate Cover

Check for Administrative Fees

Check for \$5,000 Project Review Fee

SITE PLAN APPLICATION



**CITY OF METHUEN
COMMUNITY DEVELOPMENT BOARD**

APPLICATION FOR SITE PLAN APPROVAL

APPLICANT: Nabil Boghos, JBX Realty

ADDRESS: 1630 Osgood Street #1210
North Andover, MA 01845

1. Application is hereby made for a Site Plan Approval under Section XII of the City of Methuen Comprehensive Zoning Ordinance.
2. Assessor's parcel ID of all affected parcels, location and general description of property bounded and described as follows:
412-131-6AA

b. Premises affected are in Zoning District IL

3. Ownership:

- a. Name and address of owner (if joint ownership, give all names):
JBX Realty, LLC
1630 Osgood Street #1210
North Andover, MA 01845

b. If applicant is not owner, check his/her interest in the premises:

	Prospective Purchaser Name	Address
	Lessee Name	Address
	Other Explain:	

4. General description of structure(s) and site:

Site:	The site will mainly consist of the proposed building, the surrounding parking, truck docks and landscaping. The site has been designed in line with the surrounding developments.
Building Size (inc. height & # of stories):	45' one story high
Site Amenities:	Includes truck docks & on site parking per the included plan
Exterior Building Construction:	Exterior will consist of insulated steel panels, with a TPO roof.
Interior Building Construction:	Interior of the building will be constructed of steel framing with approximately 5000 sf of office space. there are no refrigeration units planned at this time and hours of operation will be 7 to 7 daily

G001 to B-2

Refer to plans numbered: _____ submitted with this application.

** In addition to the drainage calculations submitted, the Community Development Board may require the completion of traffic impact studies and review by the Commonwealth of Massachusetts.*

5. Deed recorded in Registry of Deeds in: Book: 15735, Page: 78 or

Land Court Certificate Number: _____, Book: _____ Page: _____

I agree to pay for advertising in newspaper and incidental expenses:

SIGNED: _____

PRINTED: _____

DATED: _____

PROJECT PLANS – 2' X 3'

SITE PLAN APPROVAL

33 DANTON DRIVE

METHUEN, MASSACHUSETTS

PREPARED FOR:
NABIL BOGHOS

1630 OSGOOD STREET, #1210
NORTH ANDOVER, MA 01845

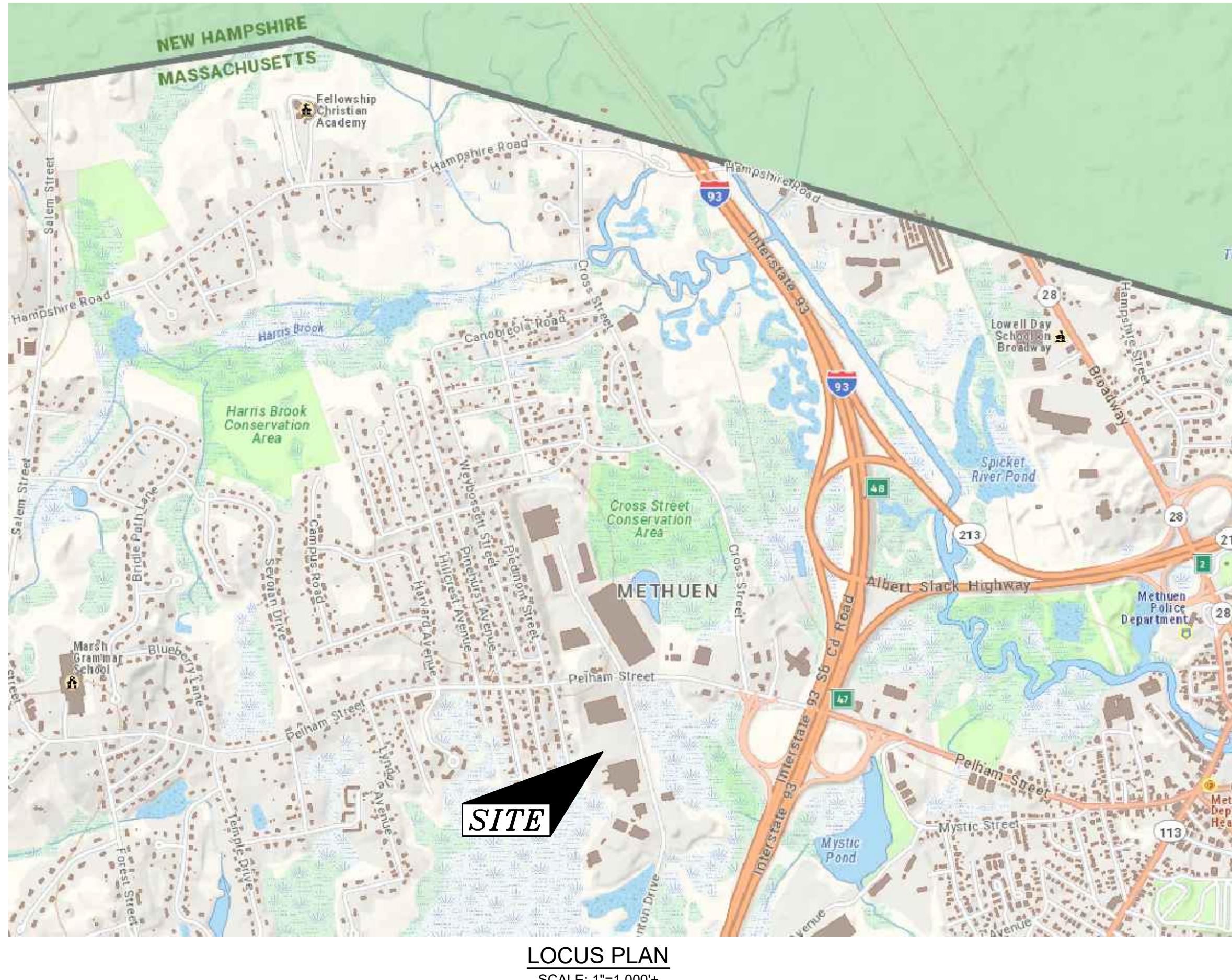


DEVELOPER:
NABIL BOGHOS
1630 OSGOOD STREET, #1210
NORTH ANDOVER, MA 01845
(978) 655-4455

PROJECT TEAM

PROJECT:
33 DANTON DRIVE
METHUEN, MA 01845

SHEET LIST TABLE	
SHEET NUMBER	SHEET TITLE
G001	TITLE SHEET
V101	EXISTING CONDITIONS PLAN
C101	SITE PLAN
C102	GRADING PLAN
C103	UTILITY PLAN
C104	EROSION & SEDIMENT CONTROL PLAN
C501 - C503	CIVIL DETAILS
L-1	LANDSCAPE PLAN
E-1	PHOTOMETRIC PLAN
B-1 TO B-2	BUILDING RENDERINGS



ZONING TABLE		
ZONE	IL (LIMITED INDUSTRIAL)	
DIMENSIONAL CONTROLS	REQUIRED	PROPOSED
MIN. AREA (SF)	40,000	135,680
MIN. FRONTAGE (FT)	100	241.56
FRONT YARD SETBACK (FT)	60	80
SIDE YARD SETBACK (FT)	30(3)	32
REAR YARD SETBACK (FT)	30(3)	139
MAX. HEIGHT	45	45
MAX. LOT COVERAGE (%)	35	44.4
MAX BUILDING SIZE	47,488	62,000
OPEN SPACE	N/A	26% (35,283 SF)
PARKING	1 PER 1,200 SF = 52	54

FOOTNOTES:
3. WHERE ABUTTING A RESIDENTIAL OR MULTI-FAMILY DISTRICT, SEE SECTION VI-B(12) FOR ADDITIONAL REQUIREMENTS.

LOCUS TITLE INFORMATION

33 DANTON DRIVE
OWNER: JBX REALTY, LLC
DEED REFERENCE: BK. 15735 PG. 995
PLAN REFERENCE: 17872 (2018)
ASSESSORS: PARCEL ID 412-131-6AA

STAMP:

TITLE
SHEET

SHEET NAME:

G001

SHT NO:
DR BY: RB
CHK BY: WK
PROJ NO: 2020-041
DATE: 9/20/2020
SCALE: NTS

GENERAL NOTES

ALL WORK PERFORMED AS PART OF THIS PROJECT SHALL CONFORM TO THE STANDARDS OF THE CITY OF METHUEN, DEPT. OF PUBLIC WORKS AND ANY OTHER AGENCY WITH AUTHORITY IN THIS AREA.

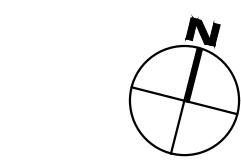
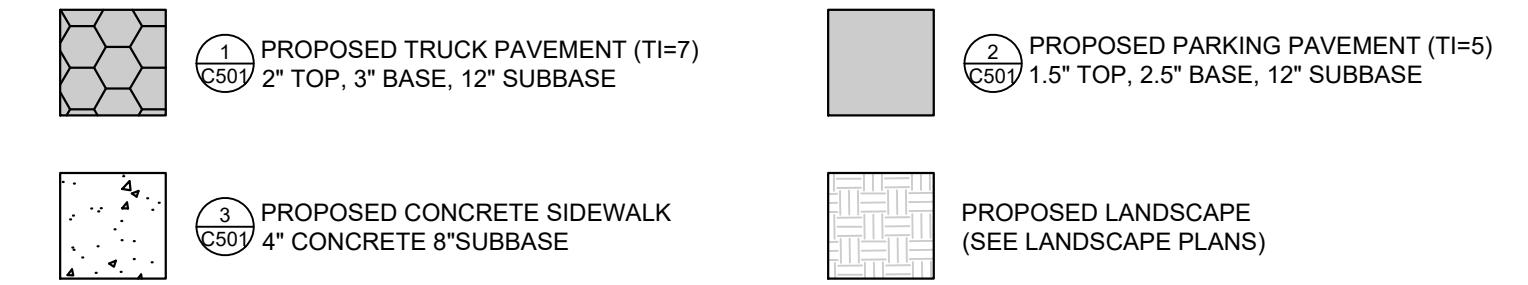
CONTRACTOR TO MAINTAIN WORK AREA IN A CLEAN CONDITION. NO CONSTRUCTION DEBRIS SHALL BE ALLOWED TO ACCUMULATE WITHIN THE WORKSITE AND NO DIRT, GRAVEL, ETC. SHALL BE ALLOWED TO ACCUMULATE ON THE PUBLIC RIGHT-OF-WAY.

AREAS OUTSIDE THE LIMITS OF PROPOSED WORK DISTURBED BY THE CONTRACTOR'S OPERATIONS SHALL BE RESTORED BY THE CONTRACTOR TO THEIR ORIGINAL CONDITION AT THE CONTRACTOR'S EXPENSE.

SHEET NOT

ALL RADIIES SHALL BE 3' UNLESS OTHERWISE SHOWN

LEGEND



NORT



DEVELOPER:
NABIL BOGHOS
1630 OSGOOD STREET, #1210
NORTH ANDOVER, MA 01845
(978) 655-4455

PROJECT TEAM

**PROJECT:
33 DANTON DRIVE
METHUEN, MA 01844**

PROJECT IN

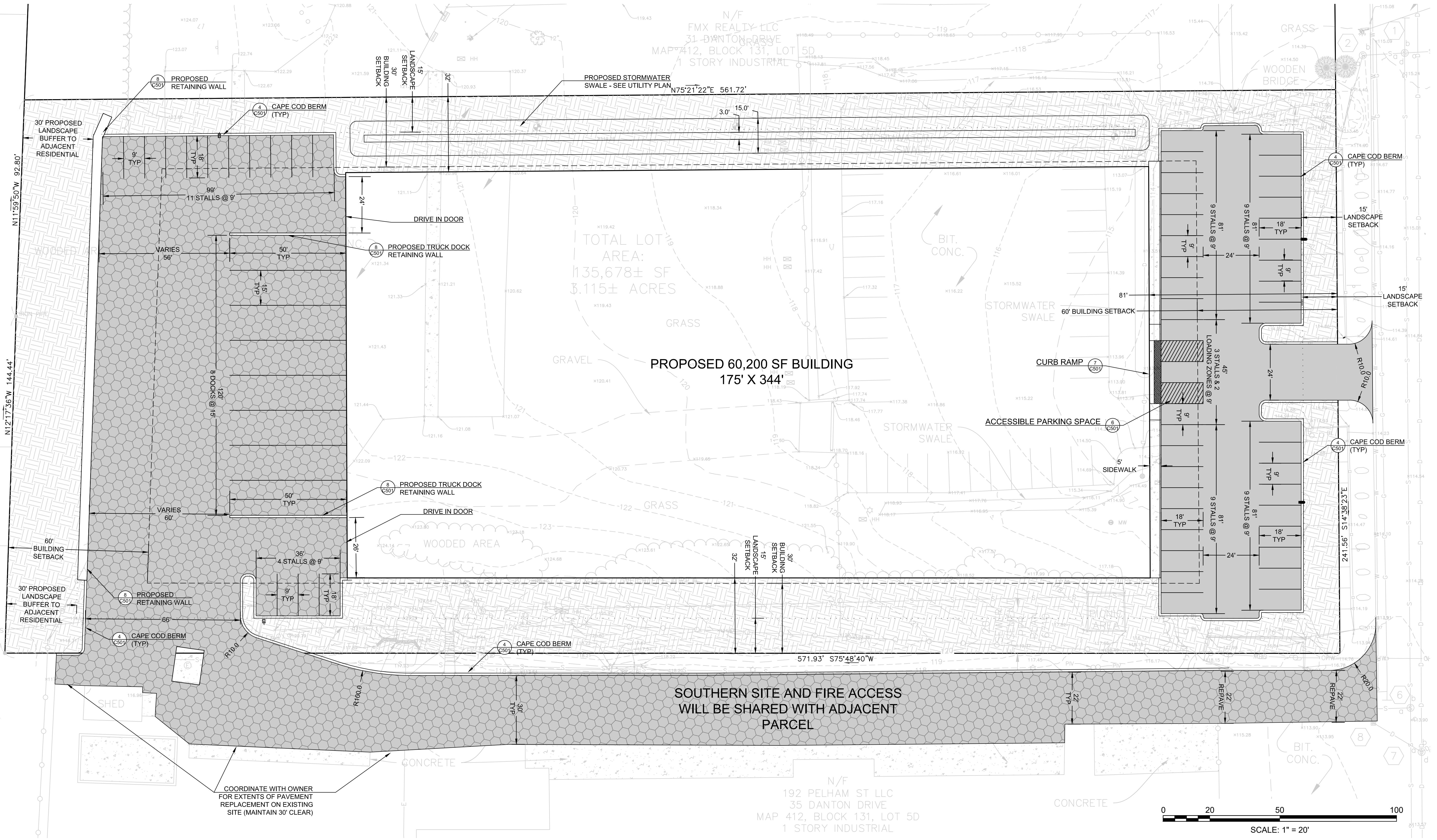
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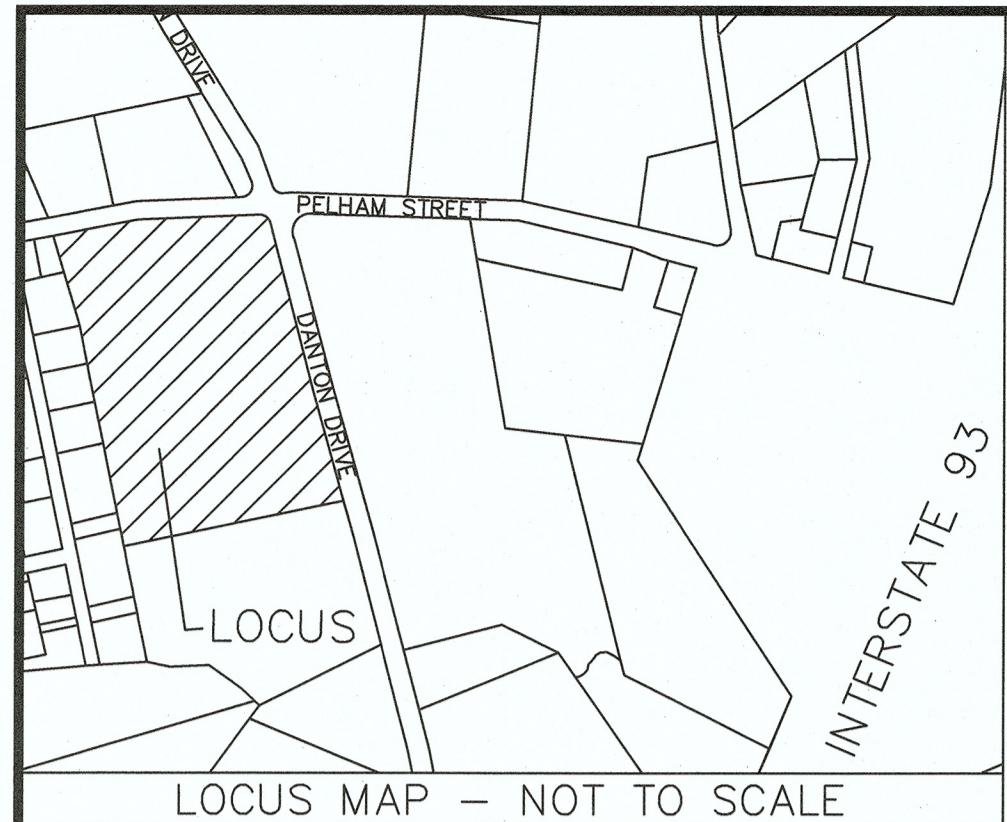
Ergonomics in Design, Vol. 22, No. 1, March 2011, 11–16
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10.1177/1063240310375710
<http://ed.sagepub.com>

SITE PLA

SHEET NAME

SHT NO:
DR BY: JEH
CHK BY: SS
PROJ NO: 2020-041
DATE: 11/4/2020
SCALE: 1"=20'





N/F
FMX REALTY LLC
31 DANTON DRIVE
MAP 412, BLOCK 131, LOT 5D
1 STORY INDUSTRIAL

N/F
GARY & TINA HEANEY
58 SPENCER STREET
MAP 412, BLOCK 131,
LOT 6
1 STORY RESIDENTIAL

N/F
CHRISTOPHER GRIER
60 SPENCER STREET
MAP 412, BLOCK 131,
LOT 7
1 STORY RESIDENTIAL

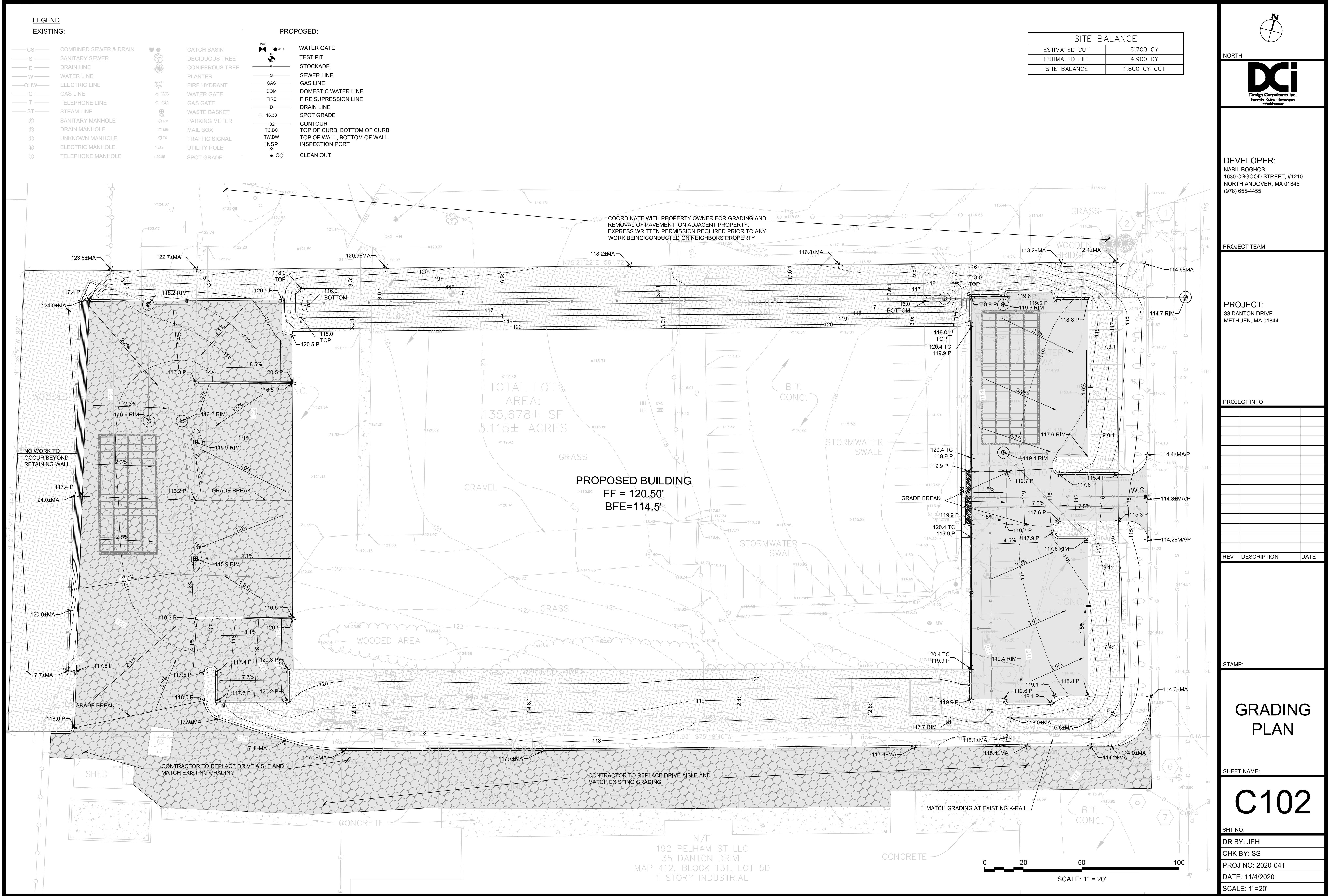
N/F
THOMAS WHITTAKER
62 SPENCER STREET
MAP 412, BLOCK 131,
LOT 9
UNDEVELOPED LAND

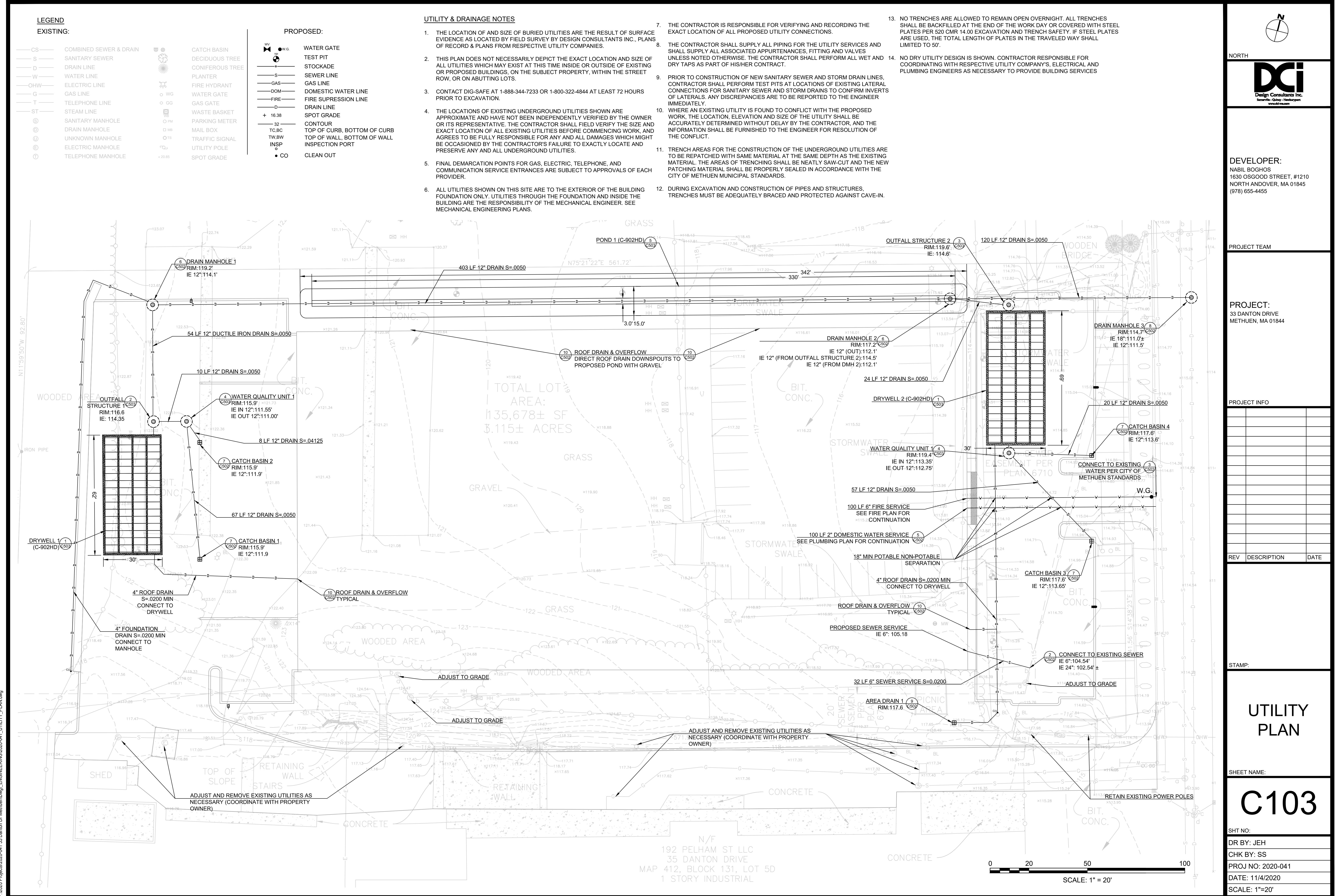
N/F
CITY OF METHUEN
64 SPENCER STREET
MAP 412, BLOCK 131,
LOT 10
UNDEVELOPED LAND

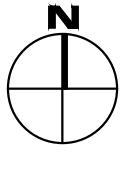
GRASS

TBM 402
X CUT BOLT LIGHT POLE
ELEV.=122.80 (NAVD 88
DATUM)

HH







EROSION AND SEDIMENT CONTROL NOTES

- ALL WORK PERFORMED AS PART OF THIS PROJECT SHALL CONFORM TO THE STANDARDS OF THE TOWN OF MELVIN, DEPT. OF PUBLIC WORKS AND ANY OTHER AGENCY WITH AUTHORITY IN THIS AREA.
- CONTRACTOR TO MAINTAIN WORK AREA IN A CLEAN CONDITION. NO CONSTRUCTION DEBRIS SHALL BE ALLOWED TO ACCUMULATE WITHIN THE WORKSITE AND NO DIRT, GRAVEL, ETC. SHALL BE ALLOWED TO ACCUMULATE ON THE PUBLIC RIGHT-OF-WAY.
- AREAS OUTSIDE THE LIMITS OF PROPOSED WORK DISTURBED BY THE CONTRACTOR'S OPERATIONS SHALL BE RESTORED BY THE CONTRACTOR TO THEIR ORIGINAL CONDITION AT THE CONTRACTOR'S EXPENSE.
- CONTRACTOR SHALL INSTALL SILT SACKS IN ALL CATCH BASINS DOWNGRADE OF SITE PRIOR TO COMMENCEMENT OF WORK
- MINIMIZE TOTAL AREA OF DISTURBANCE AND PROTECT NATURAL FEATURES AND SOIL.
- THE CONTRACTOR SHALL SEQUENCE ALL ACTIVITIES TO MINIMIZE SIMULTANEOUS AREAS OF DISTURBANCE. MASS CLEARINGS AND GRADING OF THE ENTIRE SITE SHALL BE AVOIDED.
- MINIMIZE SOIL EROSION AND CONTROL SEDIMENTATION DURING CONSTRUCTION.
- DIVERT UNCONTAMINATED WATER AROUND DISTURBED AREAS.
- INSTALL AND MAINTAIN ALL EROSION AND SEDIMENT CONTROL MEASURES IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS AND GOOD ENGINEERING PRACTICES OR THE 2008 EPA'S CONSTRUCTION GENERAL PERMIT.
- PROTECT AND MANAGE ON AND OFF-SITE MATERIAL STORAGE AREAS (OVERBURDEN AND STOCKPILES OF DIRT, BORROW AREAS, OR OTHER AREAS USED SOLELY BY THE PERMITTED PROJECT ARE CONSIDERED A PART OF THE PROJECT).
- COMPLY WITH APPLICABLE FEDERAL STATE AND LOCAL LAWS AND REGULATIONS INCLUDING WASTE DISPOSAL, SANITARY SEWER OR SEPTIC SYSTEM REGULATIONS, AND AIR QUALITY REQUIREMENTS, INCLUDING DUST CONTROL.
- SEDIMENT SHALL BE REMOVED ONCE THE VOLUME REACHES $\frac{1}{2}$ TO $\frac{1}{3}$ THE HEIGHT OF THE EROSION CONTROL DEVICE. SEDIMENT SHALL BE REMOVED FROM SILT FENCE PRIOR TO REACHING THE LOAD-BEARING CAPACITY OF THE SILT FENCE WHICH MAY BE LOWER THAN $\frac{1}{2}$ TO $\frac{1}{3}$ THE HEIGHT.
- SEDIMENT FROM SEDIMENT TRAPS OR SEDIMENTATION PONDS SHALL BE REMOVED WHEN DESIGN CAPACITY HAS BEEN REDUCED BY 50 PERCENT.
- BMPs TO BE USED FOR INFILTRATION AFTER CONSTRUCTION SHALL NOT BE USED AS BMPs DURING CONSTRUCTION UNLESS OTHERWISE APPROVED BY THE BOARD. MANY INFILTRATION TECHNOLOGIES ARE NOT DESIGNED TO HANDLE THE HIGH CONCENTRATIONS OF SEDIMENTS TYPICALLY FOUND IN CONSTRUCTION RUNOFF, AND THUS MUST BE PROTECTED FROM CONSTRUCTION RELATED SEDIMENT LOADINGS.
- SOIL STOCKPILES MUST BE STABILIZED OR COVERED AT THE END OF EACH WORKDAY. STOCKPILE SIDE SLOPES SHALL NOT BE GREATER THAN 2:1. ALL STOCKPILES SHALL BE SURROUNDED BY SEDIMENT CONTROLS.
- FOR ACTIVE CONSTRUCTION AREAS SUCH AS BORROW OR STOCKPILE AREAS, ROADWAY IMPROVEMENTS AND AREAS WITHIN 50 FEET OF A BUILDING UNDER CONSTRUCTION, A PERIMETER SEDIMENT CONTROL SYSTEM SHALL BE INSTALLED AND MAINTAINED TO CONTAIN SOIL.
- A TRACKING PAD OR OTHER APPROVED STABILIZATION METHOD SHALL BE CONSTRUCTED AT ALL ENTRANCE/EXIST POINTS OF THE SITE TO REDUCE THE AMOUNT OF SOIL CARRIED ONTO ROADWAYS AND OFF THE SITE.
- ON THE CUT SIDE OF ROADS, DITCHES SHALL BE STABILIZED IMMEDIATELY WITH ROCK RIP-RAP OR OTHER NON-ERODIBLE LINERS, OR WHERE APPROPRIATE, VEGETATIVE MEASURES SUCH AS HYDROSEEDING OR JUTE MATTING.
- PERMANENT SEEDING SHALL BE UNDERTAKEN IN THE SPRING FROM MARCH THROUGH MAY, AND IN LATE SUMMER AND EARLY FALL FROM AUGUST TO OCTOBER 15. DURING THE PEAK SUMMER MONTHS AND IN THE FALL AFTER OCTOBER 15, WHEN SEEDING IS FOUND TO BE IMPRACTICAL, APPROPRIATE TEMPORARY STABILIZATION SHALL BE APPLIED. PERMANENT SEEDING MAY BE UNDERTAKEN DURING THE SUMMER IF PLANS PROVIDE FOR ADEQUATE MULCHING AND WATERING.
- ALL SLOPES STEEPER THAN 3:1 (H:V, 33.3%) AS WELL AS PERIMETER DIKES, SEDIMENT BASINS OR TRAPS, AND EMBANKMENTS MUST, UPON COMPLETION, BE IMMEDIATELY STABILIZED WITH SOD, SEED AND ANCHORED STRAW MULCH, OR OTHER APPROVED STABILIZATION MEASURES. AREAS OUTSIDE OF THE PERIMETER SEDIMENT CONTROL SYSTEM MUST NOT BE DISTURBED.
- TEMPORARY SEDIMENT TRAPPING DEVICES MUST NOT BE REMOVED UNTIL PERMANENT STABILIZATION IS ESTABLISHED IN ALL CONTRIBUTORY DRAINAGE AREAS.
- ALL TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES SHALL BE REMOVED AFTER FINAL SITE STABILIZATION. DISTURBED SOIL AREAS RESULTING FROM THE REMOVAL OF TEMPORARY MEASURES SHALL BE PERMANENTLY STABILIZED WITHIN 30 DAYS OF REMOVAL.
- PREVENT OFF-SITE VEHICLE TRACKING OF SEDIMENTS.
- DUST SHALL BE CONTROLLED AT THE SITE.
- ALL PREVIOUSLY DISTURBED LAND SHALL BE STABILIZED BY APPROVED METHODS AFTER 14 DAYS IF LEFT UNDISTURBED. THIS INCLUDES STOCKPILES, CONSTRUCTION ENTRANCES, GRADED AREAS AND OTHER CONSTRUCTION ACTIVITY RELATED CLEARING.
- IF WORK IS HALTED OVER WINTER MONTHS THE CONTRACTOR SHALL BE RESPONSIBLE FOR STABILIZING THE AREA THROUGH GROUNDCOVER PRACTICES.

SOIL CHARACTERISTICS

THE NRCS WEB SOIL SURVEY IDENTIFY THE EXISTING SITE SOILS AS BEING HINCKLEY LOAMY SAND. SITE SPECIFIC SOIL TEST PITS CONFIRM THE SOILS TO BE LOAMY SAND.

SEQUENCE OF MAJOR ACTIVITIES

THE TOTAL AREA TO BE DISTURBED IS APPROXIMATELY 1.35± ACRES.

- DEMOLISH EXISTING BUILDING
- INSTALL INLET SEDIMENT BARRIERS
- REMOVE EXISTING PAVEMENT AND OTHER MISC STRUCTURES.
- CONSTRUCT BUILDING AND UTILITIES.
- CONSTRUCT PAVEMENT DRAINAGE SYSTEMS AND FINAL STABILIZATION OF SITE.
- CONSTRUCT LANDSCAPING.
- REMOVE EROSION CONTROLS.

EROSION AND SEDIMENT CONTROLS AND STABILIZATION PRACTICES

STABILIZATION: AN AREA SHALL BE CONSIDERED STABILIZED ONCE ONE OF THE FOLLOWING HAS OCCURRED:

- A MINIMUM OF 85% VEGETATIVE GROWTH HAS BEEN ESTABLISHED
- A MINIMUM OF 3' OF NON-ERODIBLE MATERIAL SUCH AS STONE OR RIP-RAP HAS BEEN INSTALLED
- EROSION CONTROL BLANKETS HAVE BEEN PROPERLY INSTALLED.

STABILIZATION SHALL BE INITIATED ON ALL LOAM STOCKPILES AND DISTURBED AREAS WHERE CONSTRUCTION ACTIVITY WILL NOT OCCUR FOR MORE THAN THIRTY (30) CALENDAR DAYS BY THE FOURTEENTH (14TH) DAY AFTER CONSTRUCTION ACTIVITY HAS PERMANENTLY OR TEMPORARILY CEASED IN THAT AREA. ALL DISTURBED AREAS SHALL BE STABILIZED WITHIN 60 DAYS OF INITIAL DISTURBANCE. ALL CUT AND FILL SLOPES AND ROADWAYS SHALL BE STABILIZED WITHIN 72 HOURS OF ACHIEVING GRADE. STABILIZATION MEASURES TO BE USED INCLUDE:

- TEMPORARY SEEDING.
- MULCHING.
- JUTE MATTING.

DURING CONSTRUCTION, RUNOFF WILL BE DIVERTED AROUND THE SITE WITH EARTH DIKES. PIPING OR STABILIZED CHANNELS WHERE POSSIBLE. SHEET RUNOFF FROM THE SITE WILL BE FILTERED THROUGH HAY BALE BARRIERS AND/OR SILT FENCES. ALL STORM DRAIN INLETS SHALL BE PROVIDED WITH BARRIER FILTERS. ALL CATCH BASINS WILL BE COVERED WITH A GEOTEXTILE FABRIC PRIOR TO THE BASE PAVEMENT COURSE BEING PLACED.

OFF SITE VEHICLE TRACKING

STABILIZED CONSTRUCTION ENTRANCES SHALL BE INSTALLED AT ALL EGRESSES TO THE SITE AND MAINTAINED FOR THE DURATION OF CONSTRUCTION.

TIMING OF CONTROLS/MEASURES

AS INDICATED IN THE SEQUENCE OF MAJOR ACTIVITIES THE INLET SEDIMENT BARRIERS SHALL BE INSTALLED PRIOR TO COMMENCING ANY CLEARING OR GRAVING OF THE SITE. STRUCTURAL CONTROLS SHALL BE INSTALLED CONCURRENTLY WITH THE APPLICABLE ACTIVITY. AREAS WHERE CONSTRUCTION ACTIVITY TEMPORARILY CEASES FOR MORE THAN THIRTY (30) DAYS WILL BE STABILIZED WITH A TEMPORARY SEED AND MULCH WITHIN FOURTEEN (14) DAYS OF THE LAST DISTURBANCE. ONCE CONSTRUCTION ACTIVITY CEASES PERMANENTLY IN AN AREA, SILT FENCES AND HAY BALE BARRIERS AND ANY EARTH/DIKES WILL BE REMOVED ONCE PERMANENT MEASURES ARE ESTABLISHED.

SPILL CLEAN-UP & NOTIFICATION PROCEDURES

BE PREPARED TO CONTAIN SPILLS TO PREVENT SPREADING. SPILL KITS ARE RECOMMENDED TO BE KEPT ON HAND BY ANYONE WORKING ON SITE. SPILL CLEANUP MATERIALS RECOMMENDED TO BE KEPT ON HAND MAY INCLUDE: SORBENT MATERIALS SUCH AS CLAY (KITTY LITTER), POLYPROPYLENE BOOMS AND PADS, RAGS AND SAWDUST TO CONTAIN SPILLS IMMEDIATELY.

IN THE EVENT OF SPILL OCCURRENCE, THE FOLLOWING ACTIONS ARE TO BE TAKEN:

- CONTAIN THE SPILL IMMEDIATELY, IF SAFE TO DO SO.
- WEAR PERSONAL PROTECTIVE EQUIPMENT (PPE), IF NECESSARY & WHEN TIME ALLOW.
- CONTINUE TO CONTAIN THE SPILL USING ABSORBENT OR ABSORBENT SOCKS OR BOOMS TO MINIMIZE THE EXTENT OF THE SPILL.
- PROTECT SENSITIVE RECEPTORS SUCH AS DRAINS, STORM DRAINS, SURFACE WATER BODIES, AND MINIMIZE THE AMOUNT OF UNCONTROLLED SPILL.
- BLOCK OFF THE SPILL AREA WITH "CAUTION" TAPE. THE AREA SHOULD CONSIST OF THE ENTIRE SPILL AREA PLUS A BUFFER OF AT LEAST THREE FEET.
- FOR SPILLS LESS THAN 5 GALLONS ON AN IMPERVIOUS SURFACE, ATTEMPT TO CONFINE AND CLEAN THE SPILL.
- FOR SILTS GREATER THAN 5 GALLONS, ATTEMPT TO CONFINE AND CALL A REINFORCED CONTRACTOR IF ASSISTANCE IS REQUIRED WITH PRODUCT RECOVERY AND CONTAINMENT.
- CORROSIVE SPILLS SHOULD BE NEUTRALIZED USING AN APPROPRIATE NEUTRALIZING AGENTS.
- CLEAN UP THE SPILL FROM THE PERIMETER INWARD USING APPROPRIATE ABSORBENT (CLAYS, PADS, PILLWS, ETC).
- COLLECT ALL CONTAMINATED MEDIA IN DRUMS, IF QUANTITIES PERMIT.
- CLEAN ALL REUSABLE EQUIPMENT USING RAGS AND CLEANERS APPROPRIATE.
- DISPOSE OF ALL DISPOSABLE EQUIPMENT (e.g. PPE) IN DRUMS.
- WASH HANDS AND OTHER BODY SURFACES THAT MAY HAVE CONTACTED THE SPILLED MATERIAL.
- AFTER THE SPILL HAS BEEN CLEANUP, PROVIDE WRITTEN DOCUMENTATION OF THE SPILL AND REPORT TO THE CITY, IF REQUIRED.

ADDITIONAL NOTES FOR WINTER CONSTRUCTION

- ALL PROPOSED POST-DEVELOPMENT LANDSCAPED AREAS WHICH DO NOT EXHIBIT A MINIMUM OF 85% VEGETATIVE GROWTH BY NOVEMBER 15TH, OR WHICH ARE DISTURBED AFTER NOVEMBER 15TH, SHALL BE STABILIZED BY SEEDING AND INSTALLING EROSION CONTROL BLANKETS ON SLOPES GREATER THAN 4:1 AND SEEDING AND PLACING 3 TO 4 TONS OF MULCH PER ACRE, SECURED WITH ANCHORED NETTING. ELSEWHERE, THE PLACEMENT OF EROSION CONTROL BLANKETS OR MULCH AND NETTING SHALL NOT OCCUR OVER ACCUMULATED SNOW OR FROZEN GROUND.
- AFTER NOVEMBER 15TH, ALL TRAVEL SURFACES SHALL BE PROTECTED WITH A MINIMUM OF 3-INCHES OF CRUSHED GRAVEL OR IF CONSTRUCTION IS TO CONTINUE THROUGH THE WINTER SEASON BE CLEARED OF ANY ACCUMULATED SNOWFALL AFTER EACH STORM EVENT

DUST CONTROL

- THE CONTRACTOR SHALL BE RESPONSIBLE TO CONTROL DUST THROUGHOUT THE CONSTRUCTION PERIOD. DUST CONTROL METHODS SHALL INCLUDE, BUT NOT LIMITED TO SPRINKLING WATER ON EXPOSED AREAS, COVERING LOADED DUMP TRUCKS LEAVING THE SITE, AND TEMPORARY MULCHING. DUST CONTROL MEASURES SHALL BE UTILIZED SO AS TO PREVENT THE MIGRATION OF DUST FROM THE SITE TO ADJACENT AREAS.

STABILIZED CONSTRUCTION ENTRANCE

1. SPECIFICATIONS

- AGGREGATE SIZE: USE 1.5-INCH TO 3-INCH STONE, OR RECLAIMED OR RECYCLED CONCRETE EQUIVALENT.
- AGGREGATE THICKNESS: NOT LESS THAN SIX (6) INCHES.
- WIDTH: TWELVE (12) FOOT MINIMUM, BUT NOT LESS THAN THE FULL WIDTH OF POINTS WHERE INGRESS OR EGRESS OCCURS.
- LENGTH: AS REQUIRED, BUT NOT LESS THAN FIFTY (50) FEET.
- GEOTEXTILE: TO BE PLACED OVER THE ENTIRE AREA TO BE COVERED WITH AGGREGATE. PIPING OF SURFACE WATER UNDER ENTRANCE SHALL BE PROVIDED AS REQUIRED.

2. MAINTENANCE

- THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OF SEDIMENT ONTO PUBLIC RIGHT-OF-WAY. WHEN WASHING IS REQUIRED, IT SHALL BE DONE ON AN AREA STABILIZED WITH AGGREGATE WHICH DRAINS INTO AN APPROVED SEDIMENT TRAPPING DEVICE. ALL SEDIMENT SHALL BE PREVENTED FROM ENTERING STORM DRAINS, DITCHES, OR WATERWAYS.

WASTE DISPOSAL

1. WASTE MATERIALS

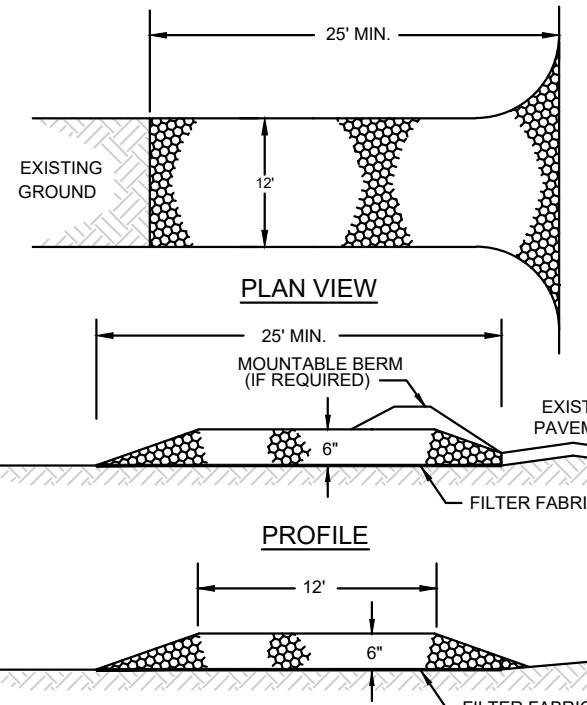
- ALL WASTE MATERIALS WILL BE COLLECTED AND STORED IN SECURELY LIDDED RECEPTACLES. ALL TRASH AND CONSTRUCTION DEBRIS FROM THE SITE WILL BE DEPOSITED IN A DUMPSITE. NO CONSTRUCTION WASTE MATERIALS WILL BE BURIED ON SITE. ALL PERSONNEL WILL BE INSTRUCTED REGARDING THE CORRECT PROCEDURE FOR WASTE DISPOSAL BY THE SUPERINTENDENT.

2. HAZARDOUS WASTE

- ALL HAZARDOUS WASTE MATERIALS WILL BE DISPOSED OF IN THE MANNER SPECIFIED BY LOCAL OR STATE REGULATION OR BY THE MANUFACTURER. SITE PERSONNEL WILL BE INSTRUCTED IN THESE PRACTICES BY THE SUPERINTENDENT.

3. SANITARY WASTE

- ALL SANITARY WASTE WILL BE COLLECTED FROM THE PORTABLE UNITS A MINIMUM OF ONCE PER WEEK BY A LICENSED SANITARY WASTE MANAGEMENT CONTRACTOR.



CONSTRUCTION SPECIFICATIONS

STONE SIZE - 1.5-INCH TO 3-INCH ROCK (100% PASSING 1.5-INCH SIEVE)

LENGTH - 25 FOOT MINIMUM.

THICKNESS - SIX (6) INCHES (MINIMUM).

WIDTH - 12' MINIMUM

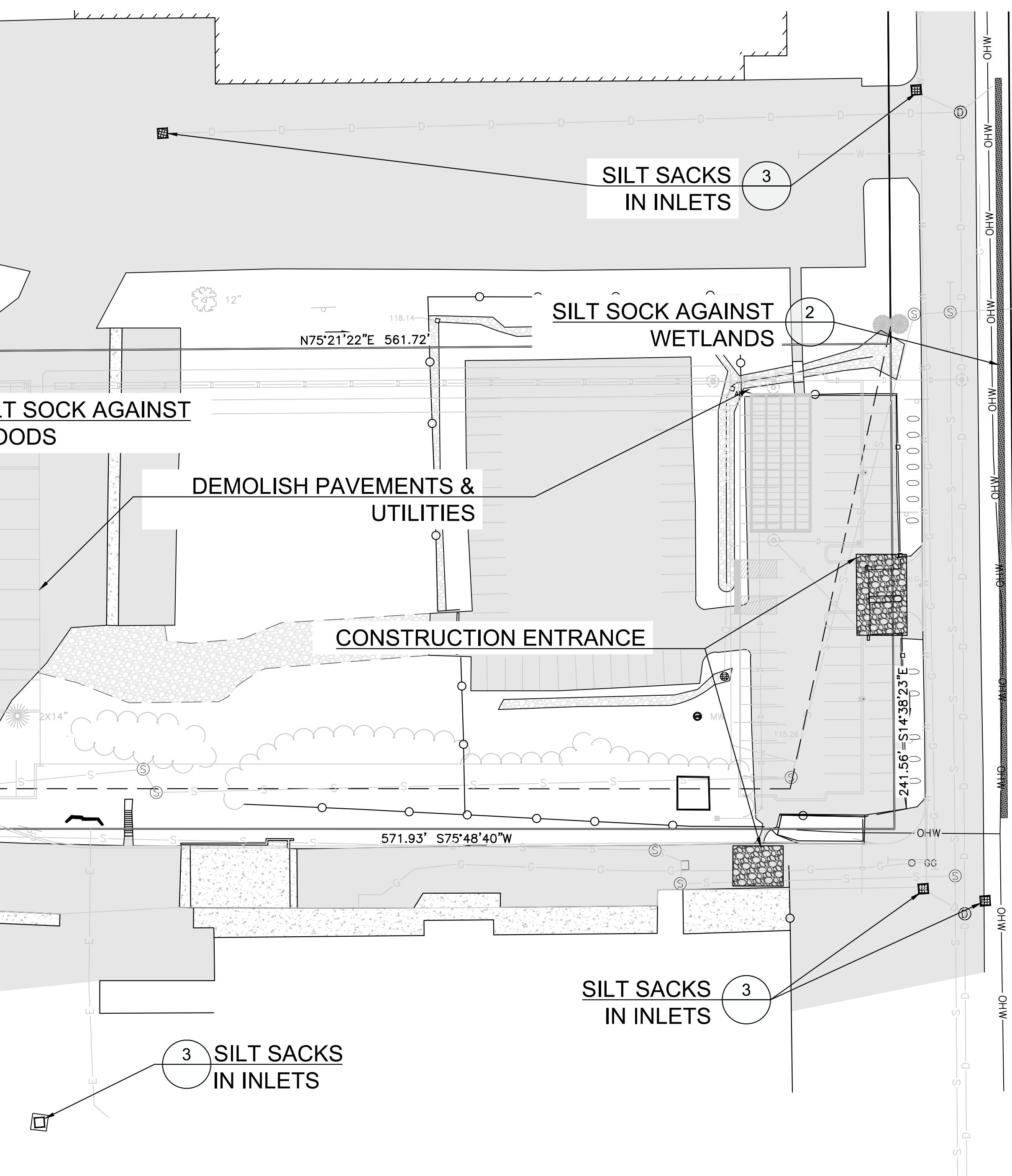
FILTER FABRIC - MIRAFI 600X OR APPROVED EQUAL.

INSTALLATION - THE AREA OF THE ENTRANCE SHOULD BE CLEARED OF ALL VEGETATION, ROOTS, AND OTHER OBSTRUCTIONAL MATERIAL. A ROAD STABILIZATION FILTER CLOTH CAN BE PLACED ON THE SUBGRADE PRIOR TO THE STABILIZED CONSTRUCTION ENTRANCE. DUST CONTROL MEASURES SHOULD BE PLACED TO THE SPECIFIED DIMENSIONS.

MAINTENANCE - THE ENTRANCE SHOULD BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OF SEDIMENT ONTO PUBLIC RIGHTS-OF-WAY. THIS WILL REQUIRE PERIODIC TOP DRESSING WITH STABILIZED MATERIAL AS NEEDED. ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRAPPED ONTO PUBLIC RIGHTS-OF-WAY MUST BE REMOVED IMMEDIATELY.

1 CONSTRUCTION ENTRANCE

NOT TO SCALE



EROSION & SEDIMENT CONTROL PLAN

SHEET NAME:

C104

SHT NO:

DR BY: JEH

CHK BY: SS

PROJ NO: 2020-041

DATE: 11/4/2020

SCALE: 1"=40'

DEVELOPER:
 NABIL BOGHOS
 1630 OSGOOD STREET, #1210
 NORTH ANDOVER, MA 01845
 (978) 655-4455

PROJECT TEAM

PROJECT:
 33 DANTON DRIVE
 METHUEN, MA 01844

PROJECT INFO

REV DESCRIPTION DATE

STAMP:

UTILITY DETAILS

SHEET NAME:

C502

SHT NO:

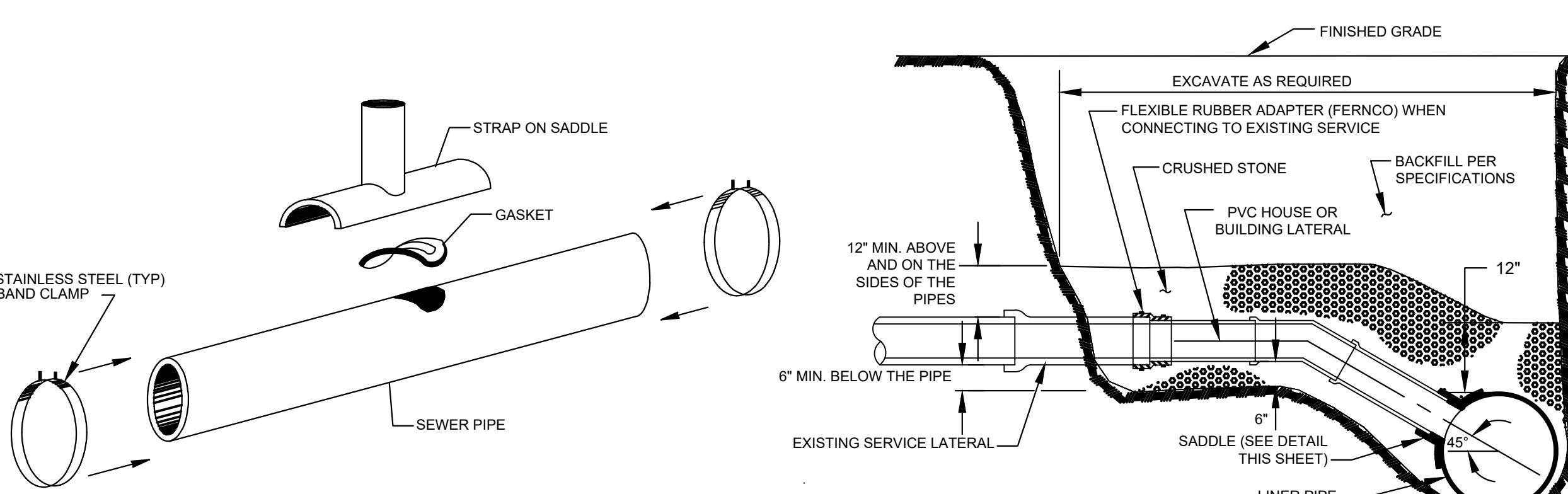
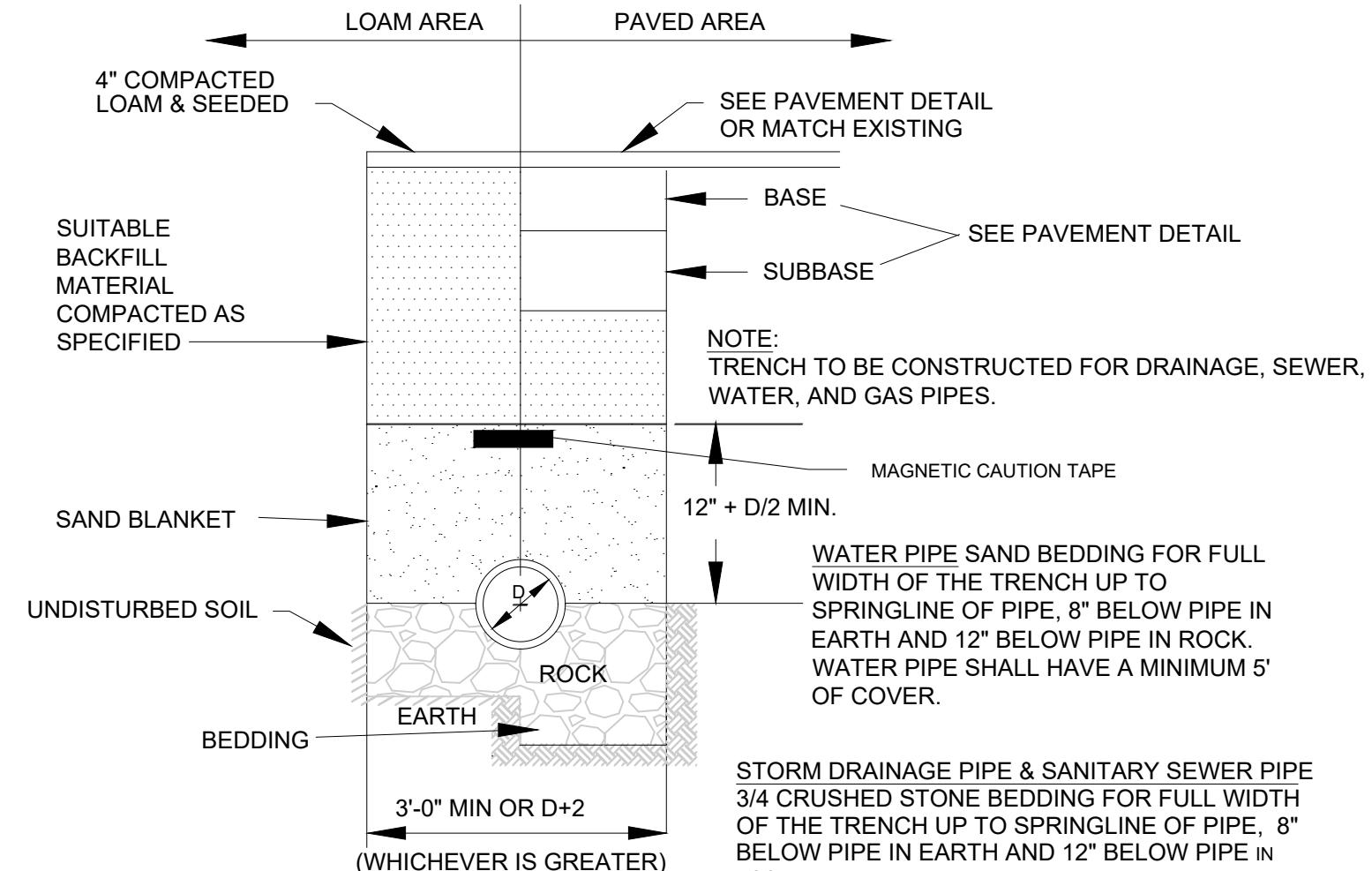
DR BY: JEH

CHK BY: SS

PROJ NO: 2020-041

DATE: 11/4/2020

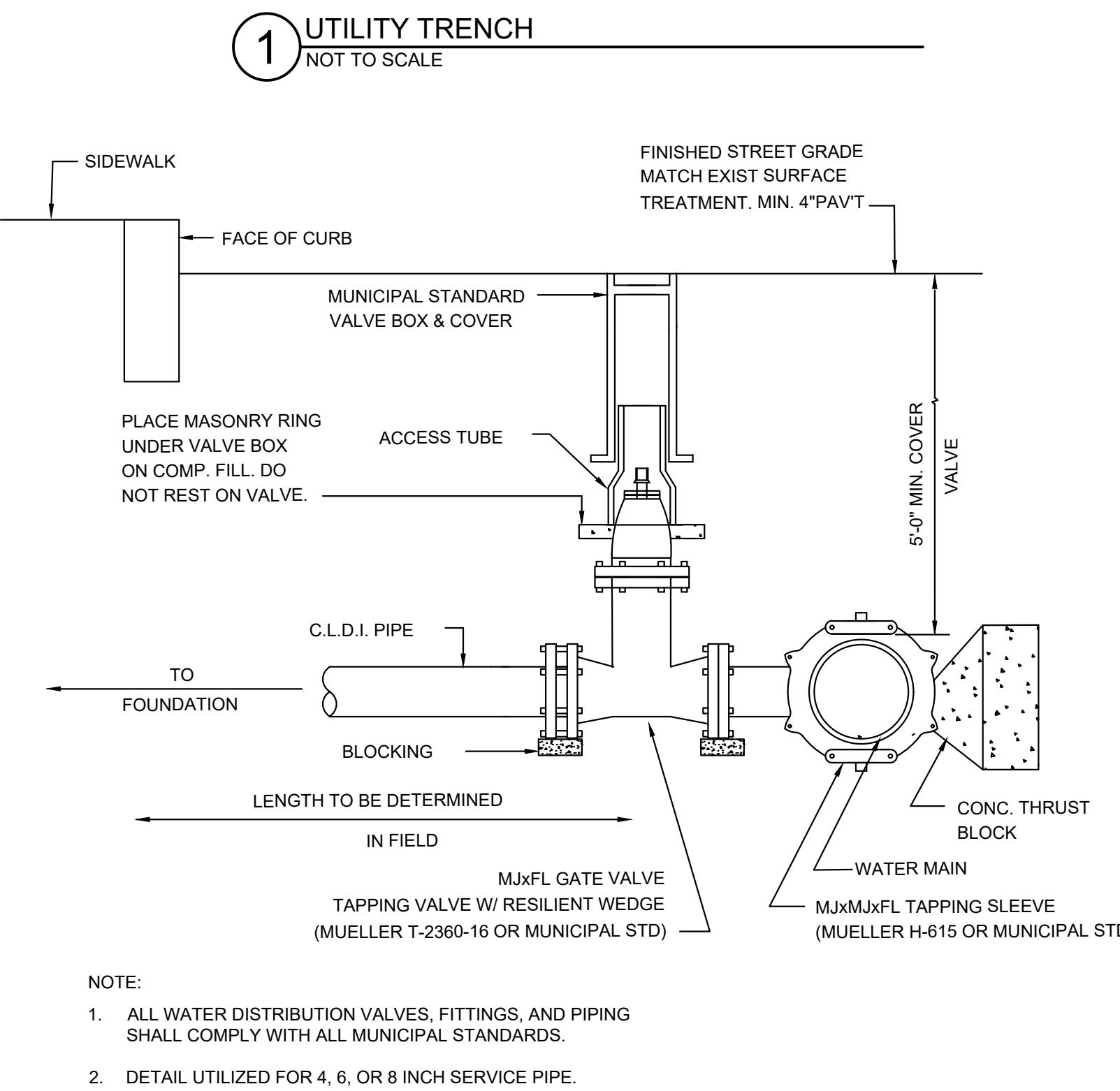
SCALE: NTS



BACKFILL MATERIAL BELOW PAVED OR CONCRETE AREAS, BEDDING MATERIAL, AND SAND BLANKET SHALL BE COMPAKTED TO NOT LESS THAN 95% OF AASHTO T 99, METHOD C. SUITABLE BACKFILL MATERIAL BELOW LOAM AREAS SHALL BE COMPAKTED TO NOT LESS THAN 90% OF AASHTO T 99, METHOD C.

SADDLE CONNECTION - PLAN
NOT TO SCALE

SADDLE CONNECTION - SECTION
NOT TO SCALE



② SANITARY SEWER SERVICE
NOT TO SCALE

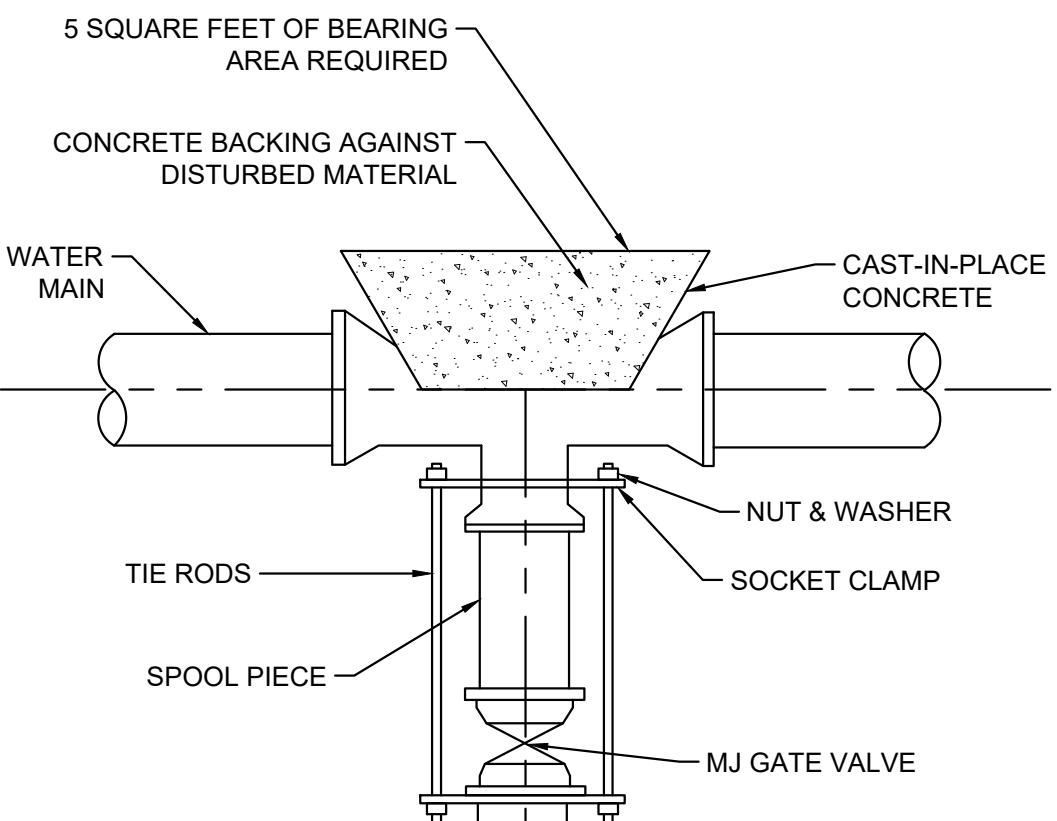
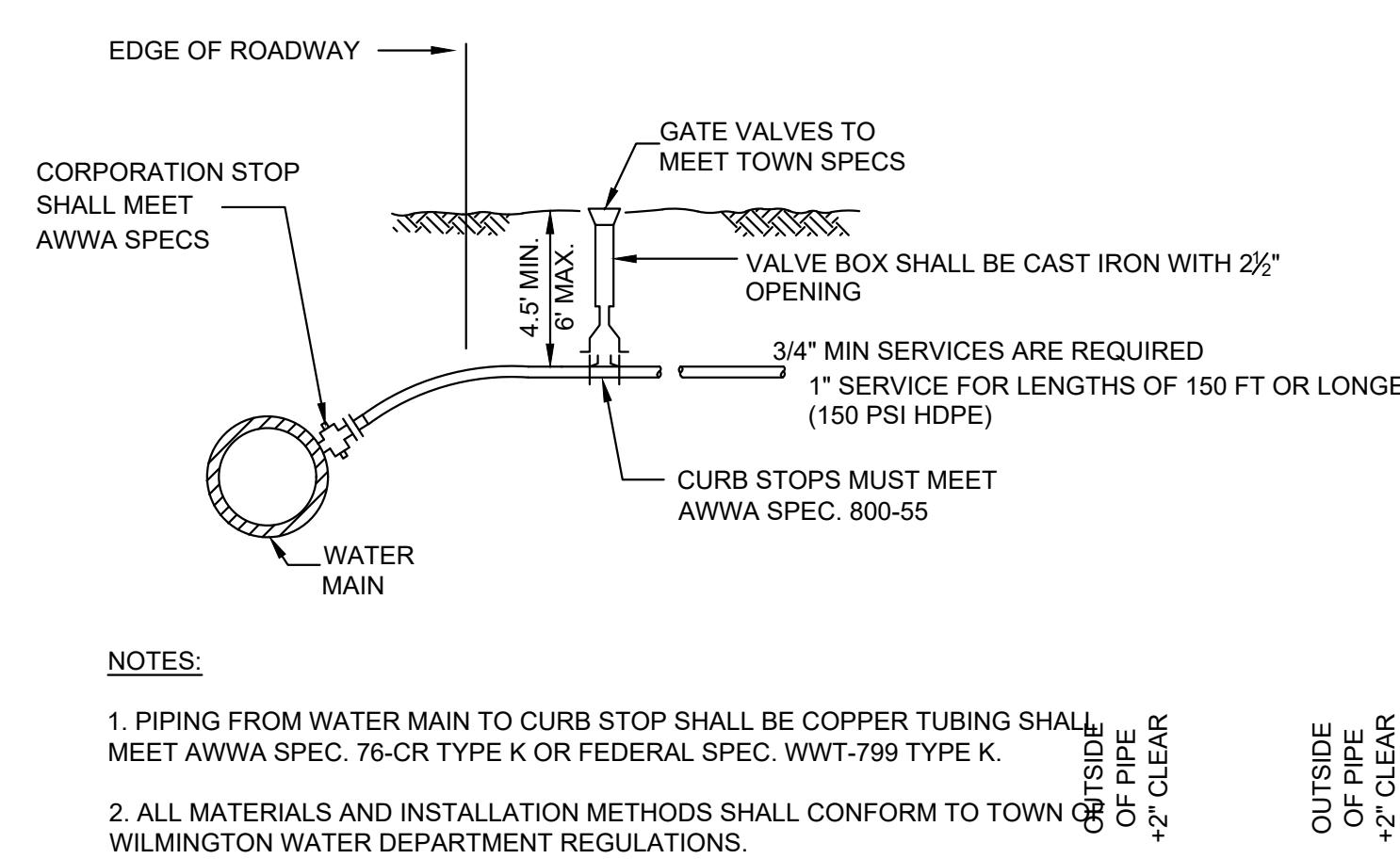
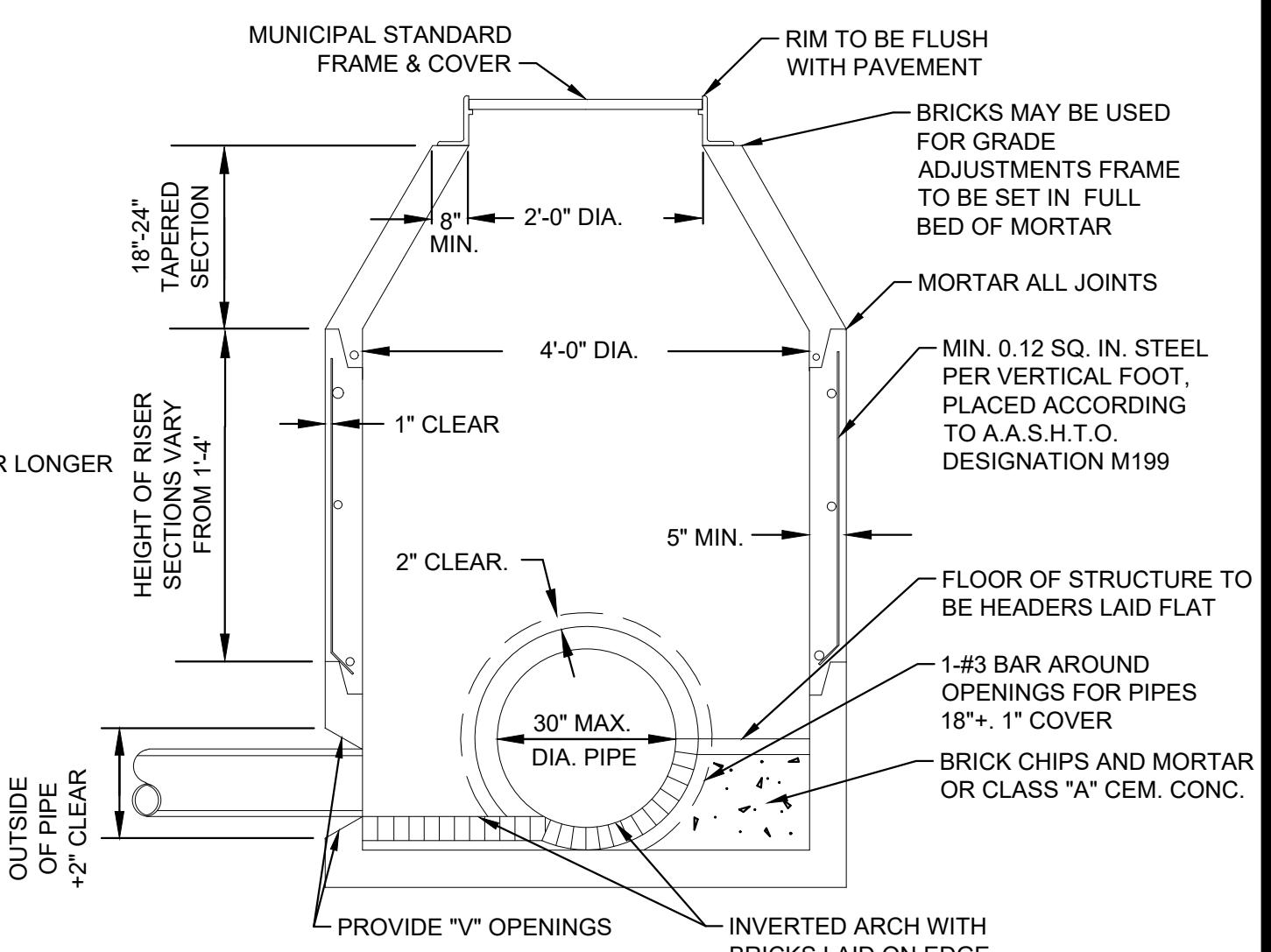


TABLE OF BEARING AREAS IN SQUARE FEET AGAINST UNDISTURBED MATERIAL FOR WATER MAIN FITTINGS			
SIZE OF MAIN (IN.)	45° BEND	TEES & PLUGS	22.5° BEND
8" OR LESS	4	5	2
10"	6	8	3
12"	9	12	5
16"	12	16	7
20"	20	25	10

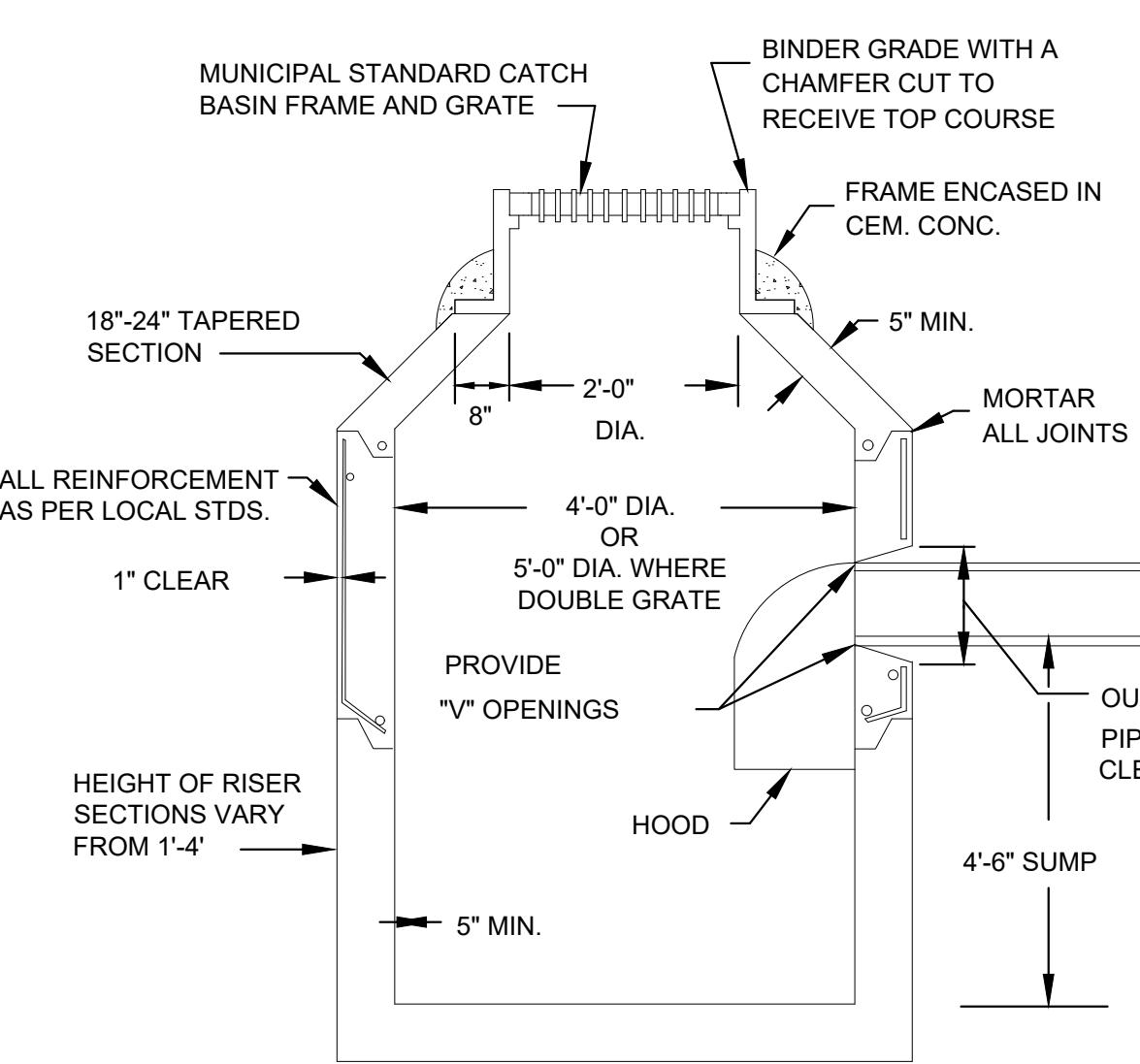


⑤ DOMESTIC WATER SERVICE CONNECTION
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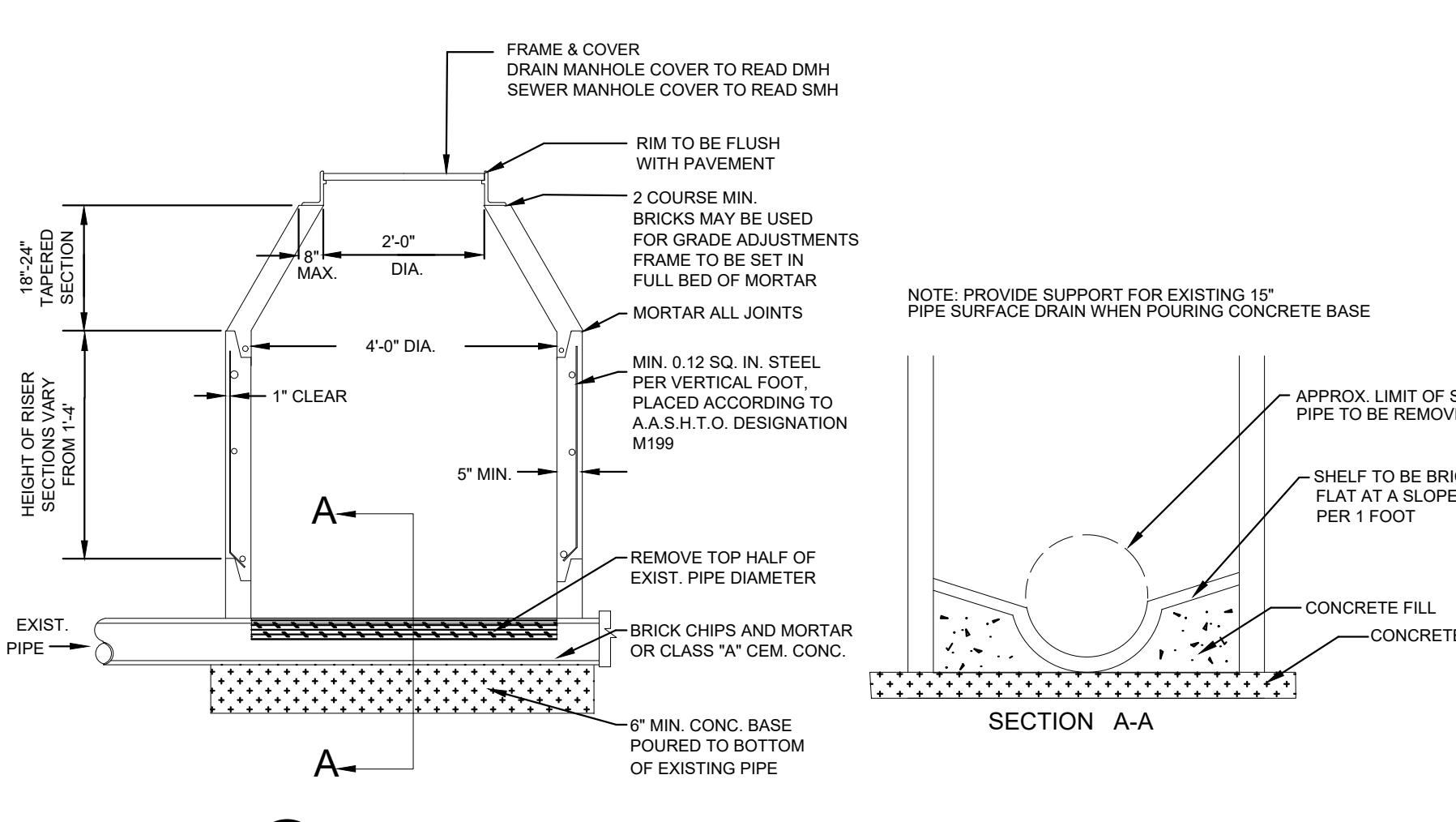


⑥ PRECAST CONCRETE DRAIN MANHOLE
NOT TO SCALE

③ WATER MAIN CONNECTION AT STREET MAIN
NOT TO SCALE



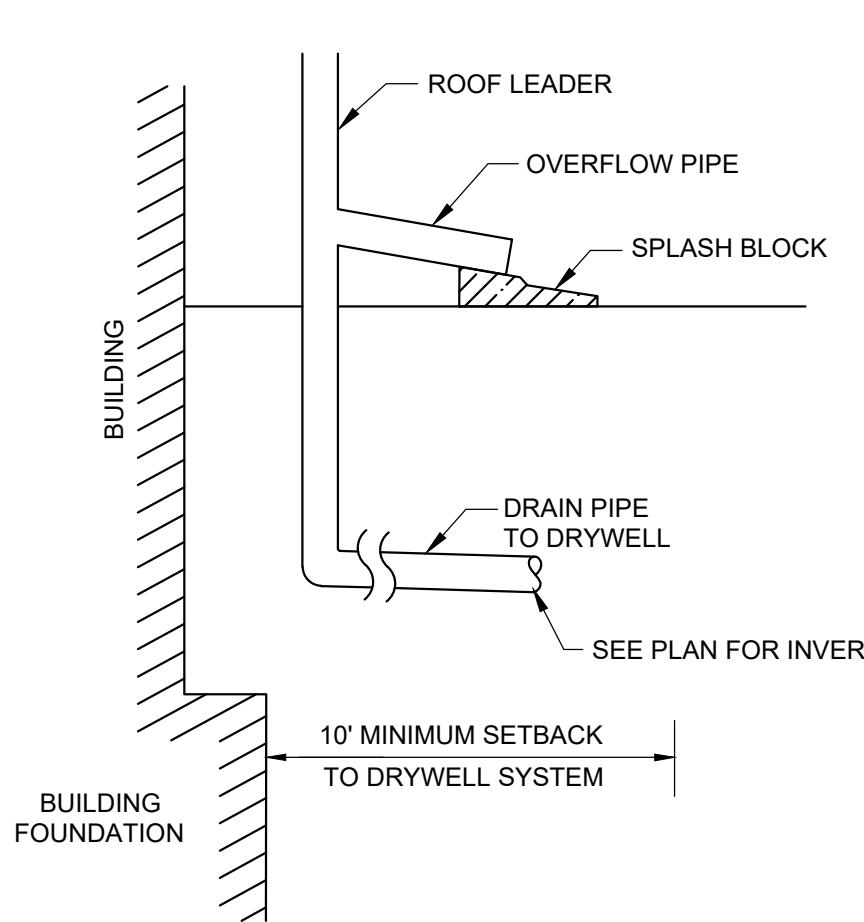
④ THRUST BLOCKING
NOT TO SCALE



⑨ AREA DRAIN
NOT TO SCALE

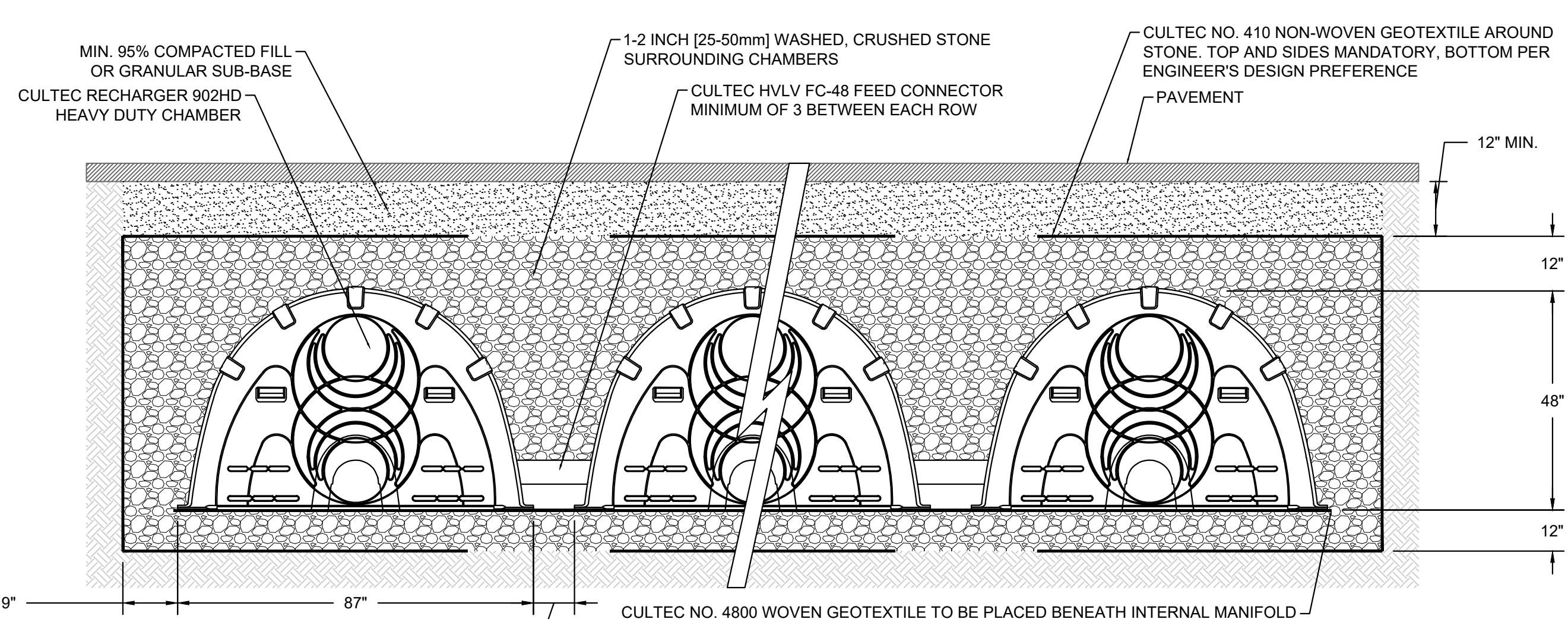
⑩ ROOF DRAIN & OVERFLOW
NOT TO SCALE

⑦ CB (CATCH BASIN)
NOT TO SCALE



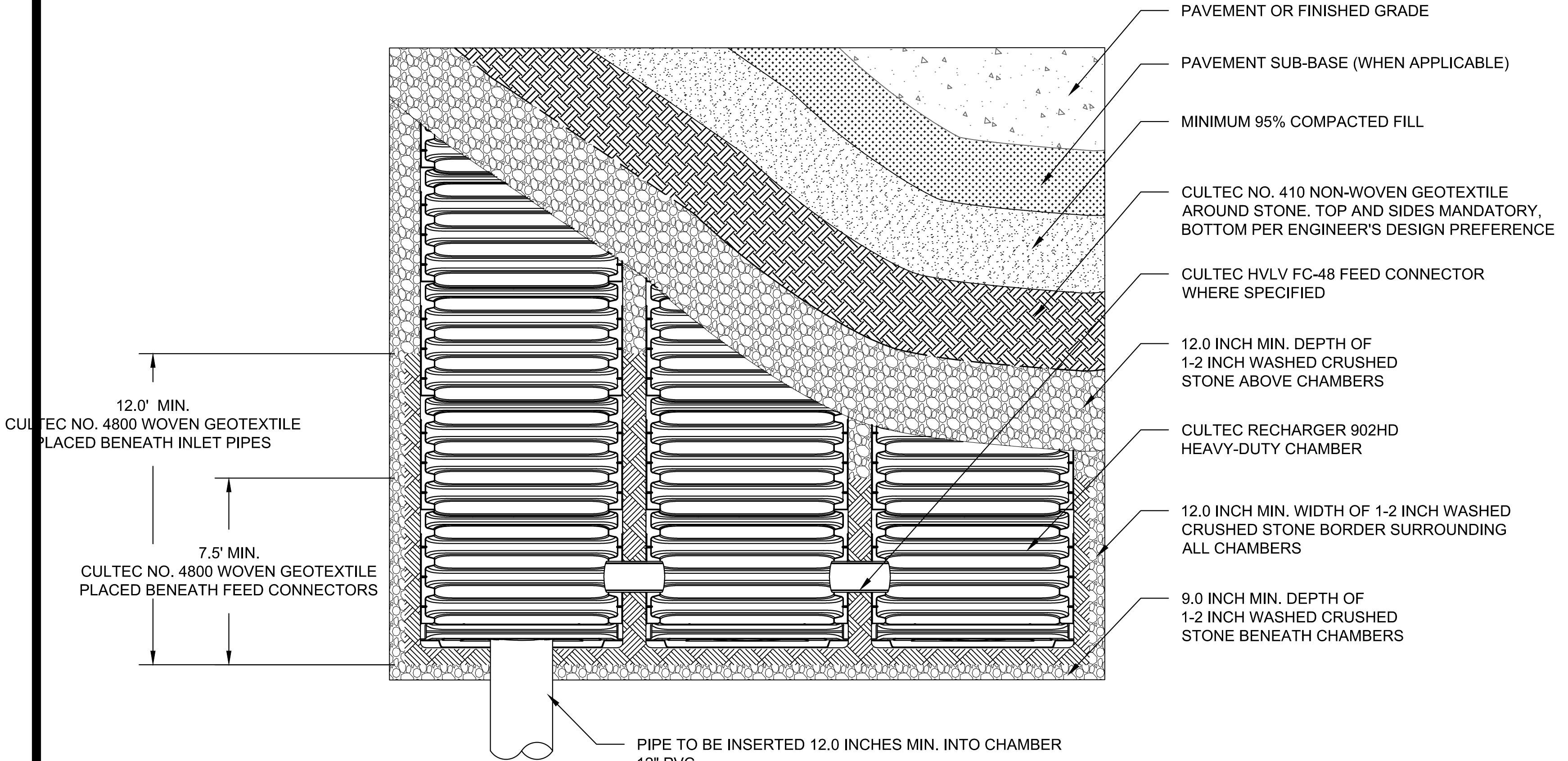
INFILTRATION TRENCH TABLE

SYSTEM NUMBER	RECHARGER CHAMBER TYPE	CHAMBER NUMBER	CHAMBER LAYOUT (ROW X COLUMN)	LOWEST FINISHED GRADE	TOP OF ROCK	TOP OF CHAMBER	INVERT IN	INVERT OUT	BOTTOM OF CHAMBER	BOTTOM OF ROCK	HYDROCAD ID	NOTES
DRYWELL 1	C-902HD	64	4 X 16	116.6	115.10	114.10	110.25	110.25	110.25	109.50	100P	TRAFFIC RATING REQUIRED
DRYWELL 2	C-902HD	72	4 X 18	119.4	117.60	116.60	112.75	112.75	112.75	112.00	120P	TRAFFIC RATING REQUIRED

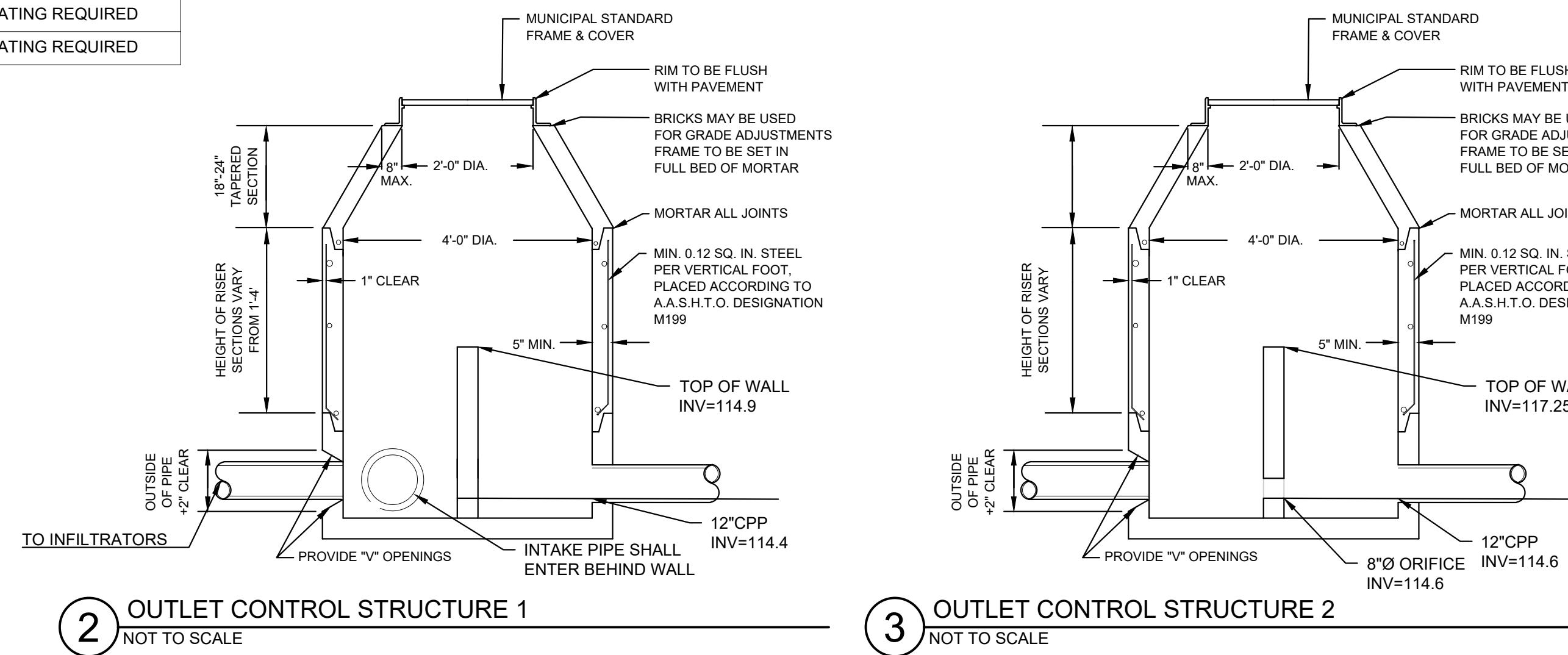


NOTES:

1. THE CHAMBERS SHALL BE DESIGNED AND TESTED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS." THE LOAD CONFIGURATION SHALL INCLUDE:
 1. INSTANTANEOUS AASHTO DESIGN TRUCK LIVE LOAD AT MINIMUM COVER
 - 1.b. MAXIMUM PERMANENT (50-YEAR) COVER LOAD
 - 1.c. 1-WEEK PARKED AASHTO DESIGN TRUCK LOAD
2. THE CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F3430-20 "STANDARD SPECIFICATION FOR CELLULAR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS"
3. THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE RESISTANCE TO THE LOADS AND LOAD FACTORS AS DEFINED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12, WHEN INSTALLED ACCORDING TO CULTEC'S RECOMMENDED INSTALLATION INSTRUCTIONS. THE STRUCTURAL DESIGN OF THE CHAMBERS SHALL INCLUDE THE FOLLOWING:
 - 3.a. THE CREEP MODULUS SHALL BE 50-YEAR AS SPECIFIED IN ASTM F3430
 - 3.b. THE MINIMUM SAFETY FACTOR FOR LIVE LOADS SHALL BE 1.75
 - 3.c. THE MINIMUM SAFETY FACTOR FOR DEAD LOADS SHALL BE 1.95

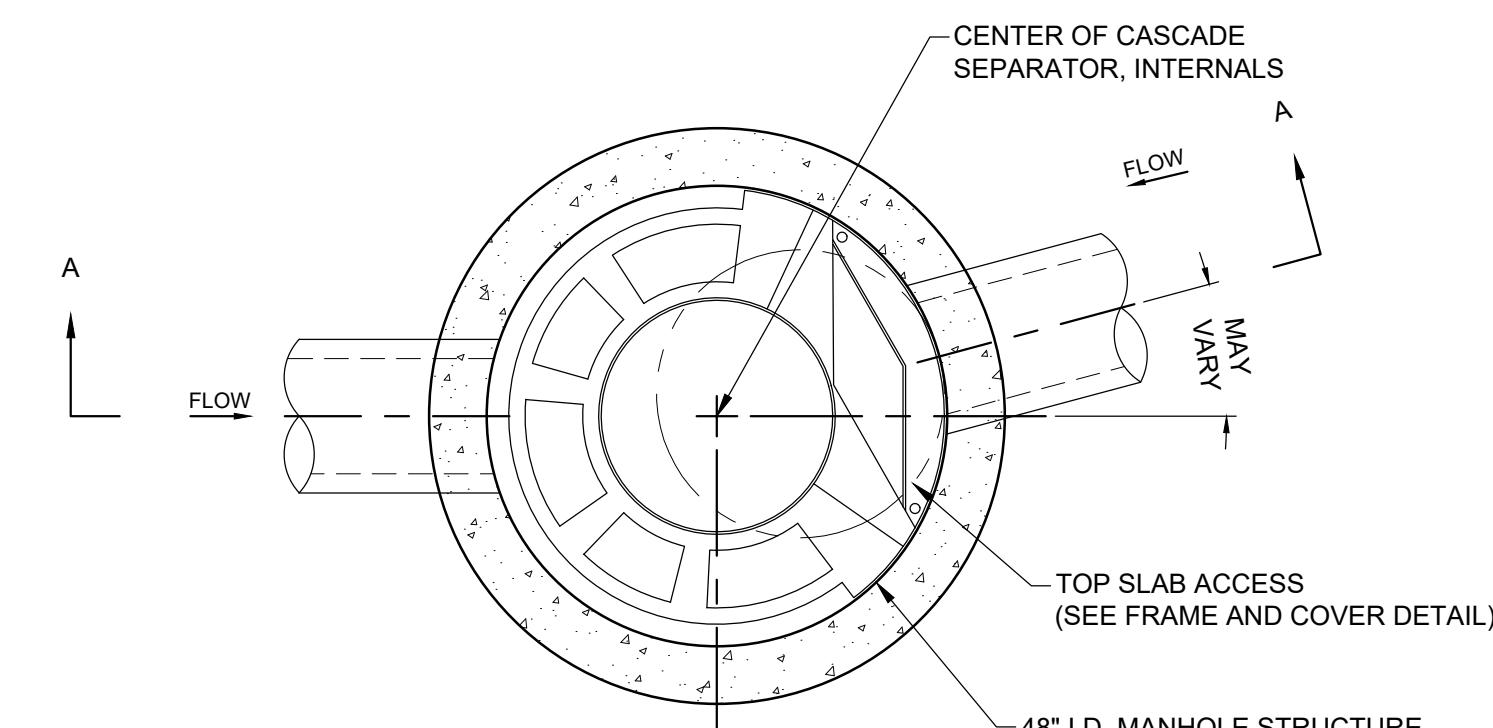


1 DRYWELL/INFILTRATION SYSTEM
NOT TO SCALE

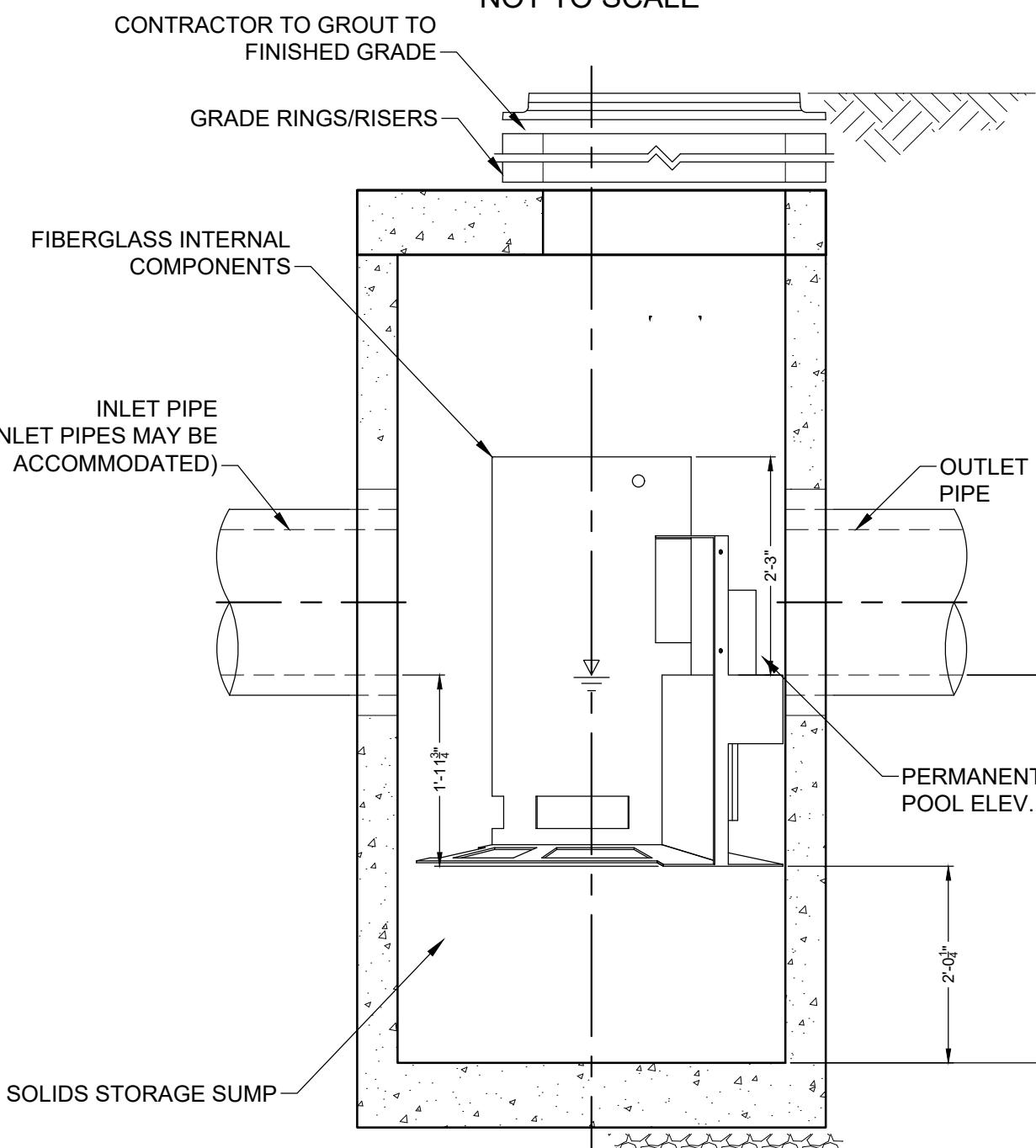


2 OUTLET CONTROL STRUCTURE 1
NOT TO SCALE

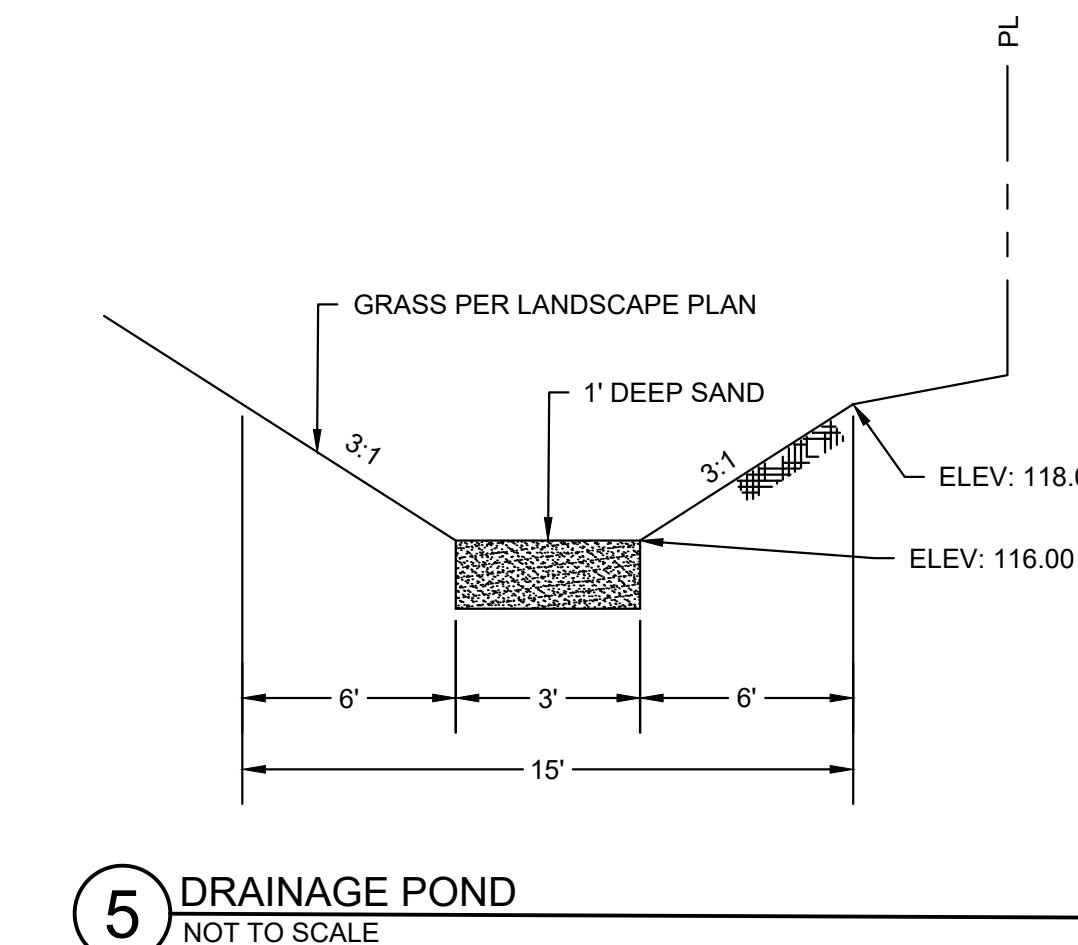
3 OUTLET CONTROL STRUCTURE 2
NOT TO SCALE



PLAN VIEW B-B
NOT TO SCALE



ELEVATION A-A
NOT TO SCALE



5 DRAINAGE POND
NOT TO SCALE

4 WATER QUALITY UNIT - CONTECH CASCADE
NOT TO SCALE



DEVELOPER:
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1630 OSGOOD STREET, #1210
NORTH ANDOVER, MA 01845
(978) 655-4455

PROJECT:
33 DANTON DRIVE
METHUEN, MA 01844

PROJECT INFO

REV DESCRIPTION DATE

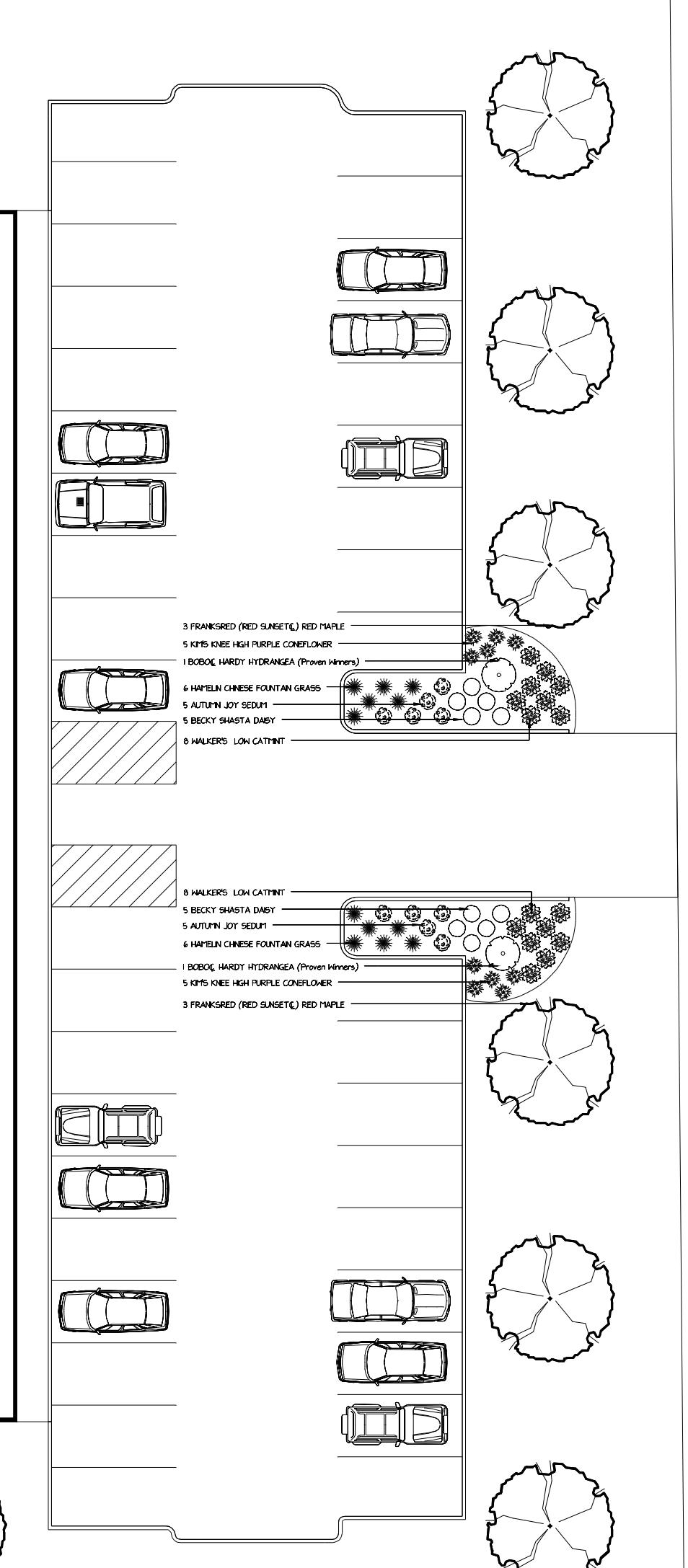
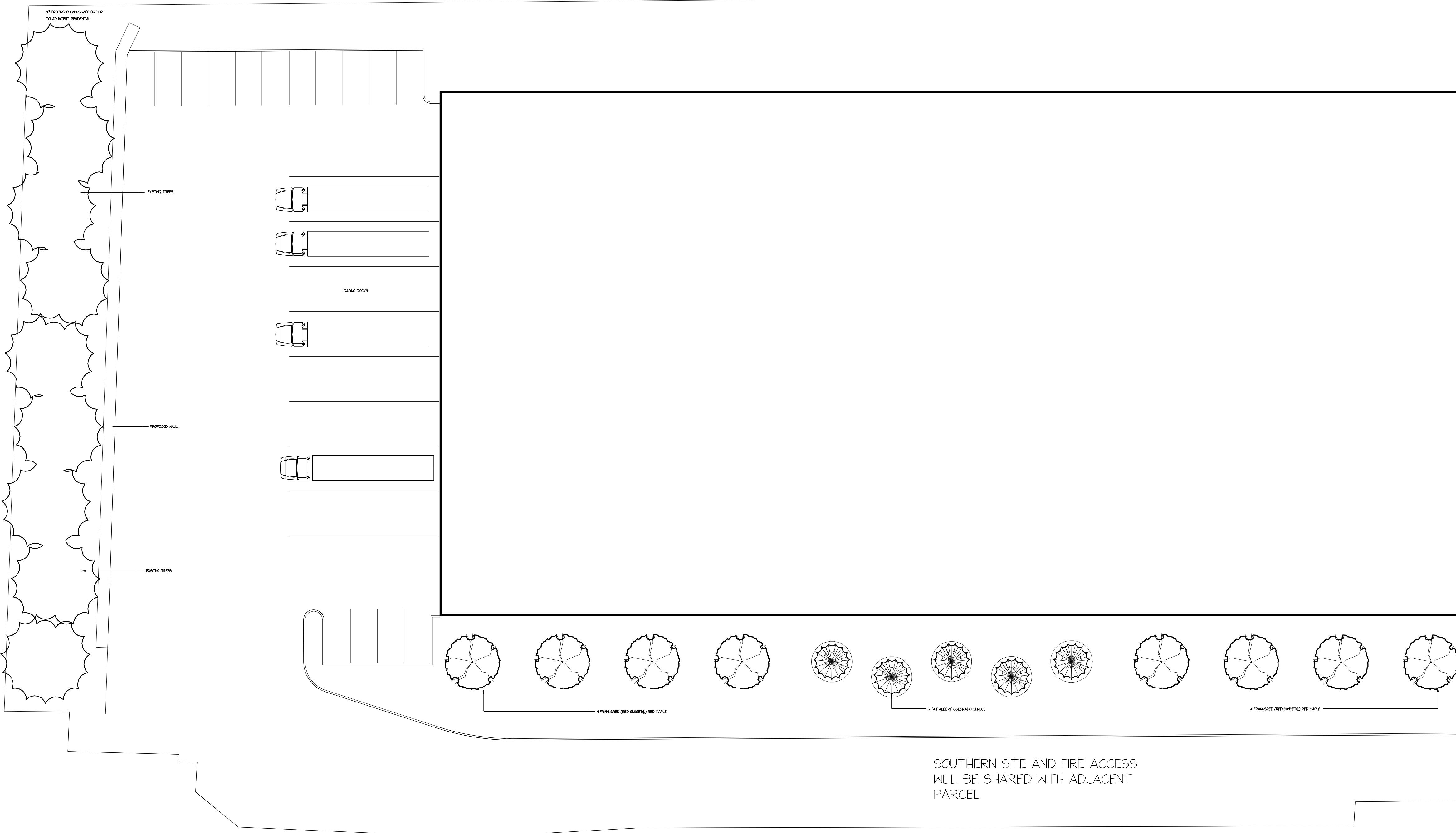
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DRAINAGE DETAILS

SHEET NAME:

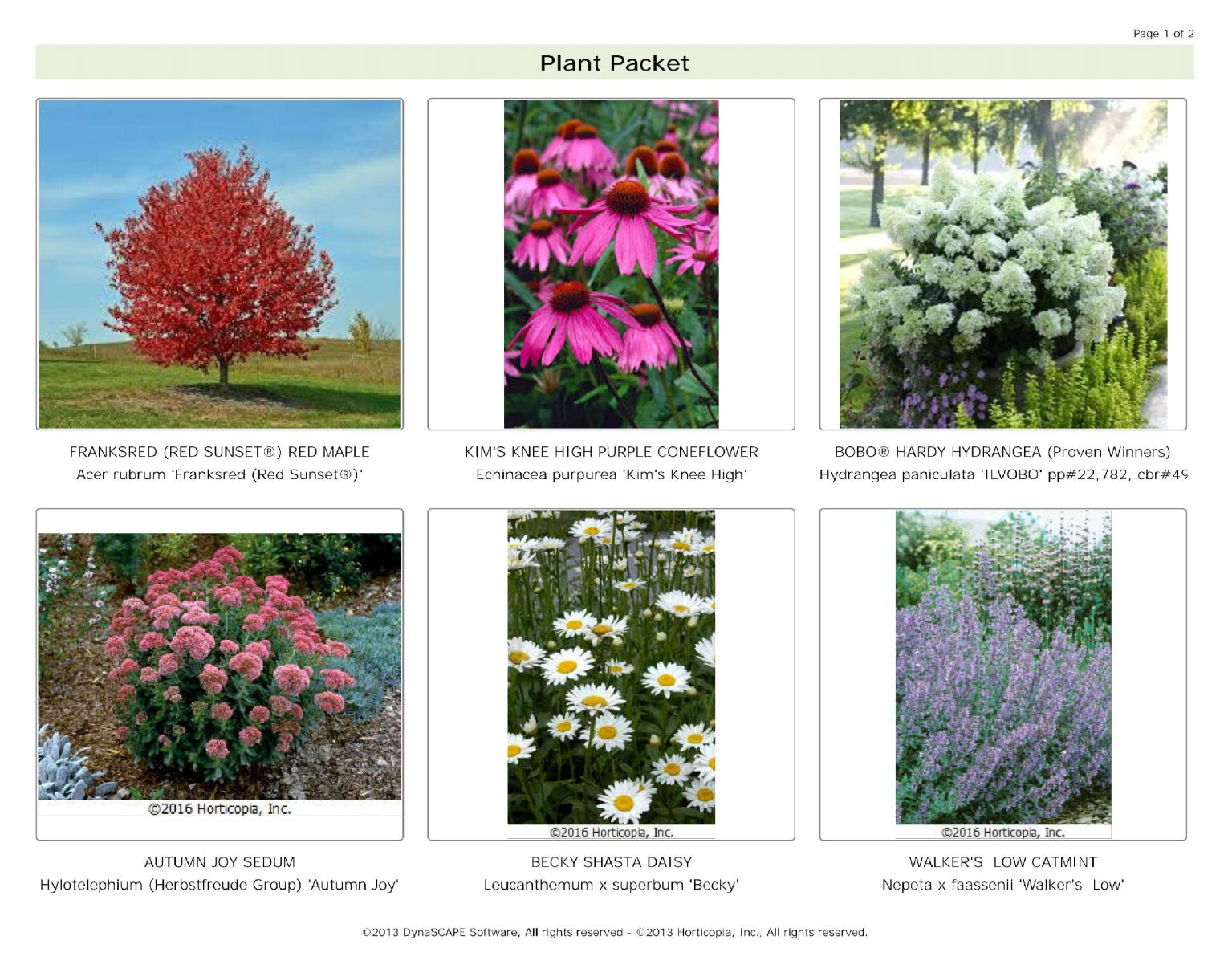
C503

SHT NO:
DR BY: JEH
CHK BY: SS
PROJ NO: 2020-041
DATE: 11/4/2020
SCALE: NTS



NOTES

33 DANTON DRIVE
METHUEN, MA



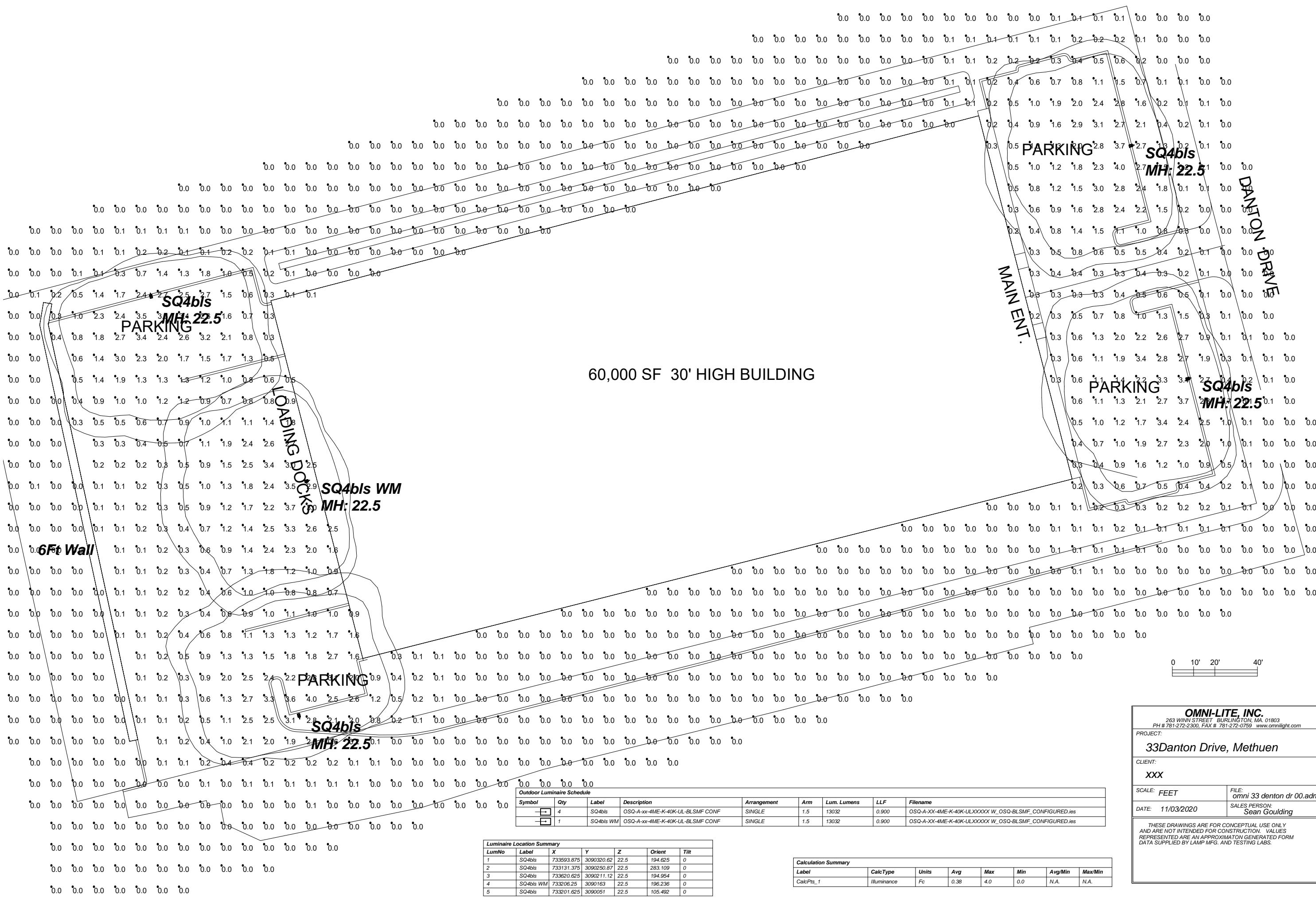
0 10' 20' 40'

SCALE: 1" = 20'

SCALE: 1" = 20'
DRAWN BY KR
CHECKED BY
DATE 11-3-20
DATE OF PRINT

PROJECT NO.
SHEET NO.
L-1

Powered by DynaSCAPE





NORTH
DCI
Design Consultants Inc.
Somerville - South Shore
www.dciinc.com

CLIENT:
NAME
STREET
TOWN, MA ZIP

DEVELOPER:
NABIL BOGHOS
1630 OSGOOD STREET, #1210
NORTH ANDOVER, MA 01845
(978) 655-4455

PROJECT TEAM

PROJECT:
33 DANTON DRIVE
METHUEN, MA 01844

PROJECT INFO

REV DESCRIPTION DATE

STAMP:

**BUILDING
RENDERING
NE**

SHEET NAME:

B-1

SHT NO:
DR BY: JEH
CHK BY: SS
PROJ NO: 2020-041
DATE: 11/4/2020
SCALE: 1"=20'



NORTH



CLIENT:
NAME
STREET

DEVELOPER:
NABIL BOGHOS
1630 OSGOOD STREET, #1210
NORTH ANDOVER, MA 01845
(978) 655-4455

PROJECT TEAM

PROJECT:
33 DANTON DRIVE
METHUEN, MA 01844

PROJECT INFO

REV	DESCRIPTION	DATE
-----	-------------	------

STAMP:

BUILDING RENDERING SW

SHEET NAME: _____

B-2

SHT NO:

CC BY-NC-ND

DR BY. JEH

CHK BY: SS

PROJ NO: 2020-04

DATE: 11/4/20

SCALE: 1" = 20'

SCALE. 1 -20

Danton Drive 33 Plant List

Plants

Quantity	Botanical Name	Common Name	Size
14	<i>Acer rubrum</i> 'Franksred (Red Sunset®)'	FRANKSRED (RED SUNSET®) RED MAPLE	2.5-3" cal
10	<i>Echinacea purpurea</i> 'Kim's Knee High'	KIM'S KNEE HIGH PURPLE CONEFLOWER	1gal
2	<i>Hydrangea paniculata</i> 'ILVOBO' pp#22,782, cbr#4910 (Proven Winners)	BOBO® HARDY HYDRANGEA (Proven Winners)	3gal
10	<i>Hylotelephium</i> (Herbstfreude Group) 'Autumn Joy'	AUTUMN JOY SEDUM	1gal
10	<i>Leucanthemum x superbum</i> 'Becky'	BECKY SHASTA DAISY	1gal
16	<i>Nepeta x faassenii</i> 'Walker's Low'	WALKER'S LOW CATMINT	1gal
12	<i>Pennisetum alopecuroides</i> 'Hamelin'	HAMELIN CHINESE FOUNTAIN GRASS	2gal
5	<i>Picea pungens</i> 'Fat Albert'	FAT ALBERT COLORADO SPRUCE	8-10'

OSQ Series

OSQ™ LED Area/Flood Luminaire featuring Cree TrueWhite® Technology – Medium

Rev. Date: V25 03/31/2020

Product Description

The OSQ™ Area/Flood luminaire blends extreme optical control, advanced thermal management and modern, clean aesthetics. Built to last, the housing is rugged cast aluminum with an integral, weathertight LED driver compartment. Versatile mounting configurations offer simple installation. Its slim, low-profile design minimizes wind load requirements and blends seamlessly into the site providing even, quality illumination. The 'B' Input power designator is a suitable upgrade for HID applications up to 250 Watt, and the 'K' Input power designator is a suitable upgrade for HID applications up to 400 Watt.

Applications: Parking lots, walkways, campuses, car dealerships, office complexes, tunnels, underpasses, and internal roadways

Performance Summary

Utilizes Cree TrueWhite® Technology on 5000K Luminaires

NanoOptic® Precision Delivery Grid™ optic

Assembled in the U.S.A. of U.S. and imported parts

Initial Delivered Lumens: Up to 17,291

Efficacy: Up to 136 LPW

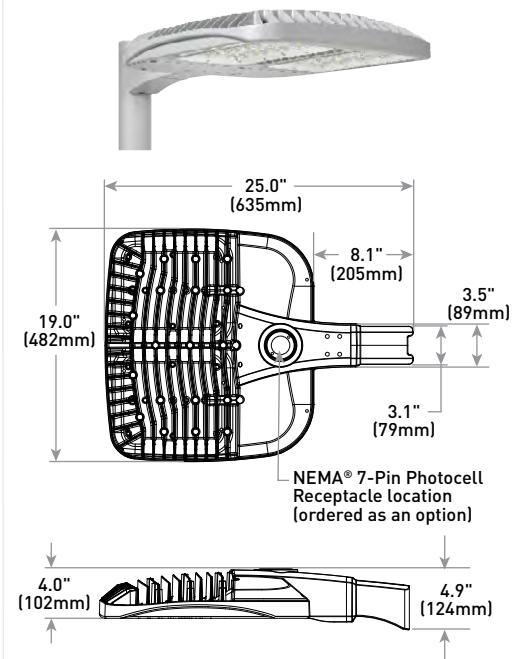
CRI: Minimum 70 CRI (3000K, 4000K & 5700K); 90 CRI (5000K)

CCT: 3000K, 4000K, 5000K, 5700K

Limited Warranty: 10 years on luminaire; 10 years on Colorfast DeltaGuard® finish; up to 5 years for Synapse® accessories; 1 year on luminaire accessories

*See <http://creelighting.com/warranty> for warranty terms. For Synapse accessories, consult Synapse spec sheets for details on warranty terms.

DA Mount



Weight

28.9 lbs. (13.1kg)

Ordering Information

Fully assembled luminaire is composed of two components that must be ordered separately:

Example: Mount: OSQ-B-AAV + Luminaire: OSQ-A-NM-2ME-B-40K-UL-SV

Mount (Luminaire must be ordered separately)*	
OSQ-	
OSQ-B-AA Adjustable Arm	Color Options: SV Silver
OSQ-DA Direct Arm	BZ Bronze
OSQ-M-TSP Transportation Mount (stainless steel; do not specify color)	BK Black
OSQ-TM Trunnion Mount	WH White

* Reference EPA and pole configuration suitability data beginning on page 9

Luminaire (Mount must be ordered separately)										
OSQ	A	NM								
Product	Version	Mounting	Optic	Input Power Designator	CCT	Voltage	Color Options	Options		
OSQ	A	NM No Mount	Asymmetric 2ME* Type II Medium 3ME* Type III Medium	B 86W K 130W Z 53W	30K 3000K, 70 CRI 40K 4000K, 70 CRI 50K 5000K, 90 CRI 57K 5700K, 70 CRI	UL Universal 120-277V UH Universal 347-480V - Available with B & K Input Power Designators only	BK Black BZ Bronze SV Silver WH White	PML Programmable Multi-Level, up to 40' Mounting Height - Refer to PML spec sheet for details - Intended for downlight applications at 0° tilt PML2 Programmable Multi-Level, 10-30' Mounting Height - Refer to PML spec sheet for details - Intended for downlight applications at 0° tilt Q9/Q6/Q5/Q4/Q3/Q2/Q1 Field Adjustable Output - Must select Q9, Q6, Q5, Q4, Q3, Q2, or Q1 - Offers full range adjustability - Refer to pages 11-12 for power and lumen values - Available with B & K Input Power Designators only - Not available with PML or PML2 options	R	NEMA® 7-Pin Photocell Receptacle - 7-pin receptacle per ANSI C136.41 - Intended for downlight applications with maximum 45° tilt - Factory connected 0-10V dim leads - 18" (457mm) seven-conductor cord exits luminaire - Requires photocell or shorting cap by others
			Symmetric 5ME Type V Medium 5SH Type V Short WSN Wide Sign 15D 15° Flood	25D 25° Flood 40D 40° Flood 60D 60° Flood					RL	Rotate Left - LED and optic are rotated to the left - Refer to RR/RL configuration diagram on page 13 for optic directionality
									RR	Rotate Right - LED and optic are rotated to the right - Refer to RR/RL configuration diagram on page 13 for optic directionality

* Available with Backlight Shield when ordered with field-installed accessory (see table above)



US: creelighting.com (800) 236-6800

Canada: creelighting-canada.com (800) 473-1234

CREE  **LIGHTING**

Product Specifications

CREE TRUEWHITE® TECHNOLOGY

A revolutionary way to generate high-quality white light, Cree TrueWhite® Technology is a patented approach that delivers an exclusive combination of 90+ CRI, beautiful light characteristics and lifelong color consistency, all while maintaining high luminous efficacy – a true no compromise solution.

CONSTRUCTION & MATERIALS

- Slim, low profile design minimizes wind load requirements
- Luminaire housing is rugged die cast aluminum with an integral, weathertight LED driver compartment and high-performance heat sink
- Convenient interlocking mounting method on direct arm mount. Mounting adaptor is rugged die cast aluminum and mounts to 3" (76mm) or larger square or round pole, secured by two 5/16-18 UNC bolts spaced on 2" (51mm) centers
- Mounting for the adjustable arm mount adaptor is rugged die cast aluminum and mounts to 2" (51mm) IP, 2.375" (60mm) O.D. tenon
- Adjustable arm mount can be adjusted 180° in 2.5° increments
- Transportation mount is constructed of 316 stainless steel and mounts to surface with (4) 3/8" fasteners by others
- Trunnion mount is constructed of A500 and A1011 steel and is adjustable from 0-180° in 15° degree increments. Trunnion mount secures to surface with (1) 3/4" bolt or (2) 1/2" or 3/8" bolts
- Includes 18" (340mm) 18/5 or 16/5 cord exiting the luminaire. When ordered with R option, 18" (340mm) 18/7 or 16/7 cord is provided
- Designed for uplight and downlight applications
- Exclusive Colorfast DeltaGuard® finish features an E-Coat epoxy primer with an ultra-durable powder topcoat, providing excellent resistance to corrosion, ultraviolet degradation and abrasion. Silver, bronze, black, and white are available
- **Weight:** OSQ-DA: 28.9 lbs. (13.1kg); OSQ-B-AA: 28.4 lbs. (12.9kg); OSQ-M-TSP: 42 lbs. (19.1kg); OSQ-TM: 32.6 lbs. (14.8kg)

ELECTRICAL SYSTEM

- **Input Voltage:** 120-277V or 347-480V, 50/60Hz, Class 1 drivers
- **Power Factor:** > 0.9 at full load
- **Total Harmonic Distortion:** < 20% at full load
- Integral 10kV surge suppression protection standard
- When code dictates fusing, a slow blow fuse or type C/D breaker should be used to address inrush current
- Consult factory if in-luminaire fusing is required
- Designed with 0-10V dimming capabilities. Controls by others
- Refer to Dimming spec sheet for details
- **Maximum 10V Source Current:** 1.0mA

REGULATORY & VOLUNTARY QUALIFICATIONS

- cULus Listed
- Suitable for wet locations
- Enclosure rated IP66 per IEC 60529 when ordered without R option
- Consult factory for CE Certified products
- Certified to ANSI C136.31-2001, 3G bridge and overpass vibration standards with AA, DA, TM, and TSP mounts
- ANSI C136.2 10kV surge protection, tested in accordance with IEEE/ANSI C62.41.2
- Meets FCC Part 15, Subpart B, Class A limits for conducted and radiated emissions
- Luminaire and finish endurance tested to withstand 5,000 hours of elevated ambient salt fog conditions as defined in ASTM Standard B 117
- Meets Buy American requirements within ARRA
- DLC and DLC Premium qualified versions available with 70 CRI. Some exceptions apply. Please refer to <https://www.designlights.org/search/> for most current information
- RoHS compliant. Consult factory for additional details
- Dark Sky Friendly, IDA Approved when ordered with 30K CCT and direct or transportation mounts only. Please refer to <https://www.darksky.org/our-work/lighting/lighting-for-industry/fsa/fsa-products/> for most current information
- **CA RESIDENTS WARNING:** Cancer and Reproductive Harm – www.p65warnings.ca.gov

Product Specifications

SYNAPSE® SIMPLYSNAP INTELLIGENT CONTROL

The Synapse SimplySNAP platform is a highly intuitive connected lighting solution featuring zone dimming, motion sensing, and daylight harvesting with utility-grade power monitoring and support of up to 1000 nodes per gateway. The system features a reliable and robust self-healing mesh network with a browser-based interface that runs on smartphones, tablets, and PCs. The Twist-Lock Lighting Controller (TL7-B2) and Site Controller (SS450-002) take the OSQ Series to a new performance plateau, providing extreme energy productivity, code compliance and a better light experience.

Electrical Data*						
Input Power Designator	System Watts 120-480V	Total Current (A)				
		120V	208V	240V	277V	347V
B	86	0.73	0.43	0.37	0.32	0.25
K	130	1.09	0.65	0.56	0.49	0.38
Z	53**	0.46	0.26	0.22	0.19	N/A

* Electrical data at 25°C (77°F). Actual wattage may differ by +/- 10% when operating between 120-277V or 347-480V +/- 10%

** Available with UL voltage only

OSQ Series Ambient Adjusted Lumen Maintenance¹

Ambient	Optic	Initial LMF	25K hr Reported ² LMF	50K hr Reported ² LMF	75K hr Reported ² LMF	100K hr Reported ² LMF
5°C (41°F)	Asymmetric	1.04	1.03	1.01	0.99	0.97
	Symmetric	1.05	1.04	1.03	1.03	1.02
10°C (50°F)	Asymmetric	1.03	1.02	1.00	0.98	0.96
	Symmetric	1.04	1.03	1.02	1.01	1.00
15°C (59°F)	Asymmetric	1.02	1.01	0.99	0.97	0.95
	Symmetric	1.02	1.02	1.01	1.00	0.99
20°C (68°F)	Asymmetric	1.01	1.00	0.98	0.96	0.94
	Symmetric	1.01	1.01	1.00	0.99	0.98
25°C (77°F)	Asymmetric	1.00	0.99	0.97	0.95	0.93
	Symmetric	1.00	0.99	0.98	0.98	0.97

¹ Lumen maintenance values at 25°C (77°F) are calculated per IES TM-21 based on IES LM-80 report data for the LED package and in-situ luminaire testing. Luminaire ambient temperature factors (LATF) have been applied to all lumen maintenance factors. Please refer to the [Temperature Zone Reference Document](#) for outdoor average nighttime ambient conditions.

² In accordance with IES TM-21, Reported values represent interpolated values based on time durations that are up to 6x the tested duration in the IES LM-80 report for the LED.

Accessories

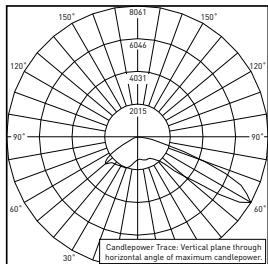
Field-Installed			
Backlight Shield OSQ-BLSMF - Front facing optics OSQ-BLSMR - Rotated optics	Hand-Held Remote XA-SENSREM - For successful implementation of the programmable multi-level option, a minimum of one hand-held remote is required	Bird Spikes OSQ-MED-BRDSPK	Shorting Cap XA-XSLSHRT
Synapse Wireless Control Accessories			
Twist-Lock Lighting Controller TL7-B2 - Suitable for 120-277V (UL) voltage only - Requires NEMA ANSI C136.41 7-Pin Dimming Receptacle - Not for use with PML or Q options - Provides On/Off switching, dimming, power metering, digital sensor input, and status monitoring of luminaires - Refer to TL7-B2 spec sheet for details			
SimplySNAP On-Site Controller SS450-002 - Verizon® LTE-enabled - Designed for indoor applications - Refer to SS450-002 spec sheet for details			
Building Management System (BMS) Gateway BMS-GW-002 - Required for BACnet integration - Refer to BMS-GW-002 spec sheet for details			
Outdoor Antennas (Optional, for increased range, 8dB gain) KIT-ANT420SM - Kit includes antenna, 20' cable and bracket KIT-ANT360 - Kit includes antenna, 30' cable and bracket KIT-ANT600 - Kit includes antenna, 50' cable and bracket - Refer to Outdoor antenna spec sheet for details			
SimplySNAP Central Base Station CBSSW-450-002 - Includes On-Site Controller (SS450-002) and 5-button switch - Indoor and Outdoor rated - Refer to CBSSW-450-002 spec sheet for details			
Synapse Wireless Sensor WSN-DPM - Motion and light sensor - Control multiple zones - Refer to WSN-DPM spec sheet for details			

OSQ™ LED Area/Flood Luminaire featuring Cree TrueWhite® Technology – Medium

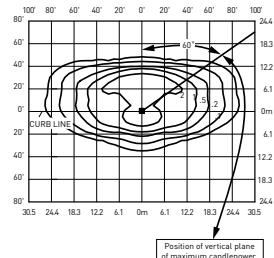
Photometry

All published luminaire photometric testing performed to IES LM-79-08 standards. To obtain an IES file specific to your project consult: <https://creelighting.com/products/outdoor/area/osq-series>

2ME



RESTL Test Report #: PL08877-001A
OSQ-A--2ME-B-30K-UL**
Initial Delivered Lumens: 10,381



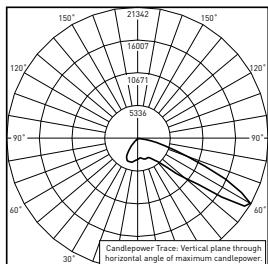
OSQ-A--2ME-B-40K-UL**
Mounting Height: 25' (7.6m) A.F.G.
Initial Delivered Lumens: 11,424
Initial FC at grade

Type II Medium Distribution

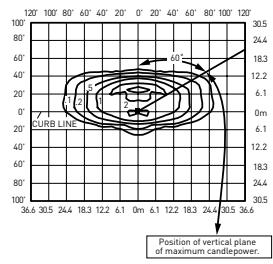
Input Power Designator	3000K (70 CRI)		4000K (70 CRI)		5000K (90 CRI)		5700K (70 CRI)	
	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11
B	10,738	B2 U0 G2	11,424	B2 U0 G2	9,350	B2 U0 G2	11,648	B2 U0 G2
K	16,022	B3 U0 G3	16,959	B3 U0 G3	14,000	B3 U0 G2	17,291	B3 U0 G3
Z	6,481	B2 U0 G1	6,896	B2 U0 G1	5,750	B1 U0 G1	7,031	B2 U0 G1

* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens

** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit: <https://www.ies.org/wp-content/uploads/2017/03/TM-15-11BUGRatingsAddendum.pdf>. Valid with no tilt



CESTL Test Report #: PL07700-001A
OSQ-A--2ME-U-57K-UL w/OSQ-BLSLF**
Initial Delivered Lumens: 22,822



OSQ-A--2ME-B-40K-UL w/OSQ-BLSMF**
Mounting Height: 25' (7.6m) A.F.G.
Initial Delivered Lumens: 8,779
Initial FC at grade

Type II Medium w/BLS Distribution

Input Power Designator	3000K (70 CRI)		4000K (70 CRI)		5000K (90 CRI)		5700K (70 CRI)	
	Initial Delivered Lumens*	BUG Ratings** Per TM 15 11	Initial Delivered Lumens*	BUG Ratings** Per TM 15 11	Initial Delivered Lumens*	BUG Ratings** Per TM 15 11	Initial Delivered Lumens*	BUG Ratings** Per TM 15 11
B	8,251	B2 U0 G2	8,779	B2 U0 G2	7,200	B1 U0 G1	8,950	B2 U0 G2
K	12,312	B2 U0 G2	13,032	B2 U0 G2	10,750	B2 U0 G2	13,286	B2 U0 G2
Z	4,980	B1 U0 G1	5,299	B1 U0 G1	4,420	B1 U0 G1	5,402	B1 U0 G1

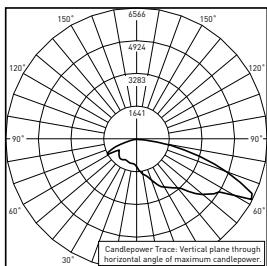
* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens

** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit: <https://www.ies.org/wp-content/uploads/2017/03/TM-15-11BUGRatingsAddendum.pdf>. Valid with no tilt

Photometry

All published luminaire photometric testing performed to IES LM-79-08 standards. To obtain an IES file specific to your project consult:
<https://creelighting.com/products/outdoor/area/osq-series>

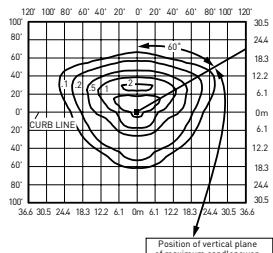
3ME



RESTL Test Report #: PL08876-001A

OSQ-A-**-3ME-B-30K-UL

Initial Delivered Lumens: 10,421



OSQ-A-**-3ME-B-40K-UL

Mounting Height: 25' (7.6m) A.F.G.

Initial Delivered Lumens: 11,424

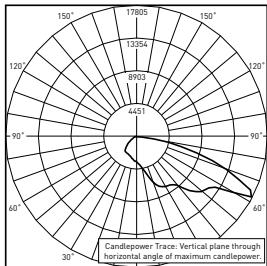
Initial FC at grade

Type III Medium Distribution

Input Power Designator	3000K (70 CRI)		4000K (70 CRI)		5000K (90 CRI)		5700K (70 CRI)	
	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11
B	10,738	B3 U0 G3	11,424	B3 U0 G3	9,350	B2 U0 G2	11,648	B3 U0 G3
K	16,022	B3 U0 G3	16,959	B3 U0 G3	14,000	B3 U0 G3	17,291	B3 U0 G3
Z	6,481	B2 U0 G2	6,896	B2 U0 G2	5,750	B2 U0 G2	7,031	B2 U0 G2

* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens

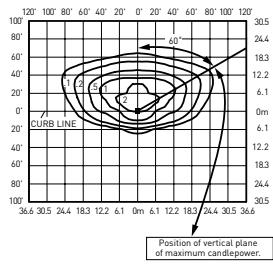
** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit: <https://www.ies.org/wp-content/uploads/2017/03/TM-15-11BUGRatingsAddendum.pdf>. Valid with no tilt



CESTL Test Report #: PL07699-001A

OSQ-A-**-3ME-U-57K-UL w/OSQ-BLSMF

Initial Delivered Lumens: 23,601



OSQ-A-**-3ME-B-40K-UL w/OSQ-BLSMF

Mounting Height: 25' (7.6m) A.F.G.

Initial Delivered Lumens: 9,019

Initial FC at grade

Type III Medium w/BLS Distribution

Input Power Designator	3000K (70 CRI)		4000K (70 CRI)		5000K (90 CRI)		5700K (70 CRI)	
	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11
B	8,477	B1 U0 G2	9,019	B1 U0 G2	7,400	B1 U0 G2	9,196	B1 U0 G2
K	12,649	B2 U0 G2	13,389	B2 U0 G2	11,050	B2 U0 G2	13,650	B2 U0 G2
Z	5,117	B1 U0 G1	5,444	B1 U0 G1	4,540	B1 U0 G1	5,551	B1 U0 G1

* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens

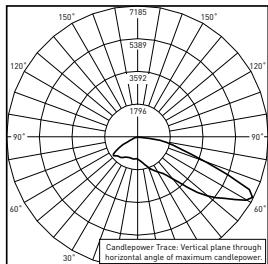
** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit: <https://www.ies.org/wp-content/uploads/2017/03/TM-15-11BUGRatingsAddendum.pdf>. Valid with no tilt

OSQ™ LED Area/Flood Luminaire featuring Cree TrueWhite® Technology – Medium

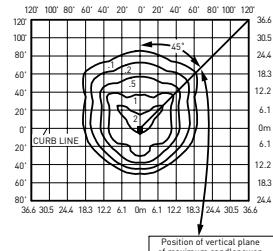
Photometry

All published luminaire photometric testing performed to IES LM-79-08 standards. To obtain an IES file specific to your project consult: <https://creelighting.com/products/outdoor/area/osq-series>

4ME



RESTL Test Report #: PL08878-001A
OSQ-A-**-4ME-B-30K-UL
Initial Delivered Lumens: 10,230



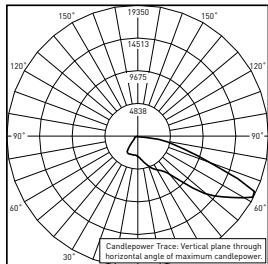
OSQ-A-**-4ME-B-40K-UL
Mounting Height: 25' (7.6m) A.F.G.
Initial Delivered Lumens: 11,424
Initial FC at grade

Type IV Medium Distribution

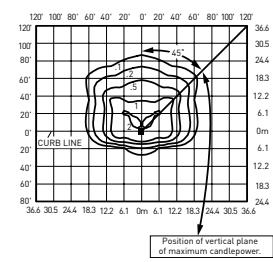
Input Power Designator	3000K (70 CRI)		4000K (70 CRI)		5000K (90 CRI)		5700K (70 CRI)	
	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11
B	10,738	B2 U0 G2	11,424	B2 U0 G2	9,350	B2 U0 G2	11,648	B2 U0 G2
K	16,022	B3 U0 G3	16,959	B3 U0 G3	14,000	B3 U0 G3	17,291	B3 U0 G3
Z	6,481	B2 U0 G2	6,896	B2 U0 G2	5,750	B2 U0 G1	7,031	B2 U0 G2

* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens

** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit: <https://www.ies.org/wp-content/uploads/2017/03/TM-15-11BUGRatingsAddendum.pdf>. Valid with no tilt



CESTL Test Report #: PL07692-001A
OSQ-A-**-4ME-B-57K-UL w/OSQ-BLSLF
Initial Delivered Lumens: 22,793



OSQ-A-**-4ME-B-40K-UL w/OSQ-BLSMF
Mounting Height: 25' (7.6m) A.F.G.
Initial Delivered Lumens: 8,779
Initial FC at grade

Type IV Medium w/BLS Distribution

Input Power Designator	3000K (70 CRI)		4000K (70 CRI)		5000K (90 CRI)		5700K (70 CRI)	
	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11
B	8,251	B1 U0 G2	8,779	B1 U0 G2	7,200	B1 U0 G2	8,950	B1 U0 G2
K	12,312	B2 U0 G2	13,032	B2 U0 G2	10,750	B2 U0 G2	13,286	B2 U0 G2
Z	4,980	B1 U0 G1	5,299	B1 U0 G1	4,420	B1 U0 G1	5,402	B1 U0 G1

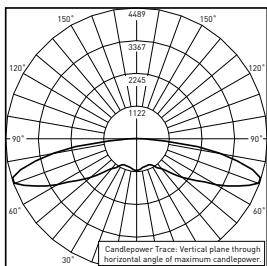
* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens

** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit: <https://www.ies.org/wp-content/uploads/2017/03/TM-15-11BUGRatingsAddendum.pdf>. Valid with no tilt

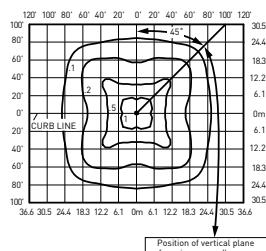
Photometry

All published luminaire photometric testing performed to IES LM-79-08 standards. To obtain an IES file specific to your project consult: <https://creelighting.com/products/outdoor/area/osq-series>

5ME



RESTL Test Report #: PL08534-001B
OSQ-A-**-5ME-B-40K-UL
Initial Delivered Lumens: 10,519



OSQ-A-**-5ME-B-40K-UL
Mounting Height: 25' (7.6m) A.F.G.
Initial Delivered Lumens: 10,867
Initial FC at grade

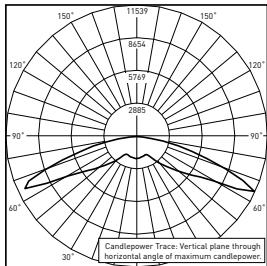
Type V Medium Distribution

Input Power Designator	3000K (70 CRI)		4000K (70 CRI)		5000K (90 CRI)		5700K (70 CRI)	
	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11
B	10,232	B4 U0 G3	10,867	B4 U0 G3	10,000	B4 U0 G3	11,056	B4 U0 G3
K	15,063	B4 U0 G4	15,999	B4 U0 G4	14,925	B4 U0 G4	16,277	B4 U0 G4
Z	5,257	B3 U0 G3	6,086	B3 U0 G3	6,175	B3 U0 G3	6,192	B3 U0 G3

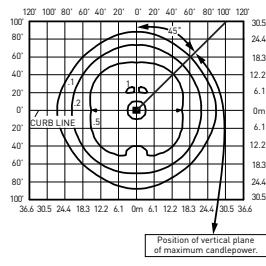
* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens

** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit: <https://www.ies.org/wp-content/uploads/2017/03/TM-15-11BUGRatingsAddendum.pdf>. Valid with no tilt

5SH



CESTL Test Report #: PL10754-001A
OSQ-A-**-5SH-U-40K-UL
Initial Delivered Lumens: 25,679



OSQ-A-**-5SH-B-40K-UL
Mounting Height: 25' (7.6m) A.F.G.
Initial Delivered Lumens: 11,478
Initial FC at grade

Type V Short Distribution

Input Power Designator	3000K (70 CRI)		4000K (70 CRI)		5000K (90 CRI)		5700K (70 CRI)	
	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11
B	10,806	B4 U0 G2	11,478	B4 U0 G2	10,575	B4 U0 G2	11,678	B4 U0 G2
K	15,909	B4 U0 G3	16,897	B4 U0 G3	15,800	B4 U0 G3	17,191	B4 U0 G3
Z	5,552	B3 U0 G1	6,428	B3 U0 G2	6,525	B3 U0 G2	6,539	B3 U0 G2

* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens

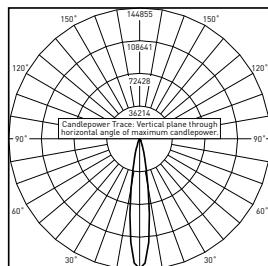
** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit: <https://www.ies.org/wp-content/uploads/2017/03/TM-15-11BUGRatingsAddendum.pdf>. Valid with no tilt

OSQ™ LED Area/Flood Luminaire featuring Cree TrueWhite® Technology – Medium

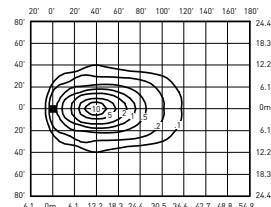
Photometry

All published luminaire photometric testing performed to IES LM-79-08 standards. To obtain an IES file specific to your project consult: <https://creelighting.com/products/outdoor/area/osq-series>

15D



CESTL Test Report #: PL07689-001A
OSQ-A-**-15D-U-30K-UL
Initial Delivered Lumens: 23,254



OSQ-A-**-15D-B-40K-UL
Mounting Height: 25' (7.6m) A.F.G., 60° Tilt
Initial Delivered Lumens: 11,478
Initial FC at grade

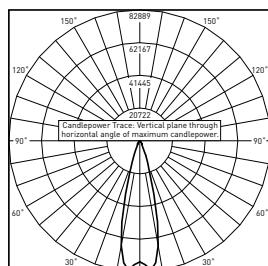
15° Flood Distribution

Input Power Designator	3000K (70 CRI)	4000K (70 CRI)	5000K (90 CRI)	5700K (70 CRI)
	Initial Delivered Lumens*	Initial Delivered Lumens*	Initial Delivered Lumens*	Initial Delivered Lumens*
B	10,806	11,478	10,575	11,678
K	15,909	16,897	15,800	17,191
Z	5,552	6,428	6,525	6,539

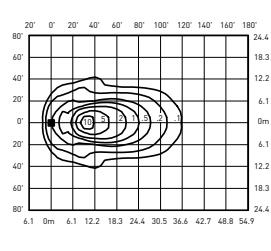
* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens

** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit: <https://www.ies.org/wp-content/uploads/2017/03/TM-15-11BUGRatingsAddendum.pdf>. Valid with no tilt

25D



CESTL Test Report #: PL07696-001A
OSQ-A-**-25D-U-30K-UL
Initial Delivered Lumens: 23,265



OSQ-A-**-25D-B-40K-UL
Mounting Height: 25' (7.6m) A.F.G., 60° Tilt
Initial Delivered Lumens: 11,478
Initial FC at grade

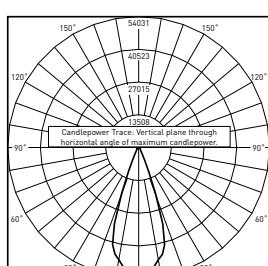
25° Flood Distribution

Input Power Designator	3000K (70 CRI)	4000K (70 CRI)	5000K (90 CRI)	5700K (70 CRI)
	Initial Delivered Lumens*	Initial Delivered Lumens*	Initial Delivered Lumens*	Initial Delivered Lumens*
B	10,806	11,478	10,575	11,678
K	15,909	16,897	15,800	17,191
Z	5,552	6,428	6,525	6,539

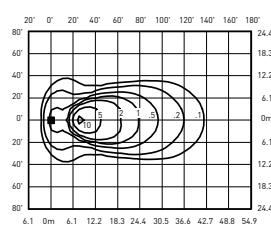
* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens

** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit: <https://www.ies.org/wp-content/uploads/2017/03/TM-15-11BUGRatingsAddendum.pdf>. Valid with no tilt

40D



CESTL Test Report #: PL07697-001A
OSQ-A-**-40D-U-30K-UL
Initial Delivered Lumens: 22,943



OSQ-A-**-40D-B-40K-UL
Mounting Height: 25' (7.6m) A.F.G., 60° Tilt
Initial Delivered Lumens: 11,478
Initial FC at grade

40° Flood Distribution

Input Power Designator	3000K (70 CRI)	4000K (70 CRI)	5000K (90 CRI)	5700K (70 CRI)
	Initial Delivered Lumens*	Initial Delivered Lumens*	Initial Delivered Lumens*	Initial Delivered Lumens*
B	10,806	11,478	10,575	11,678
K	15,909	16,897	15,800	17,191
Z	5,552	6,428	6,525	6,539

* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens

** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit: <https://www.ies.org/wp-content/uploads/2017/03/TM-15-11BUGRatingsAddendum.pdf>. Valid with no tilt

US: creelighting.com (800) 236-6800

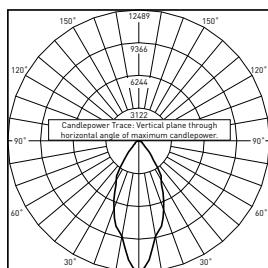
Canada: creelighting-canada.com (800) 473-1234

CREE  **LIGHTING**

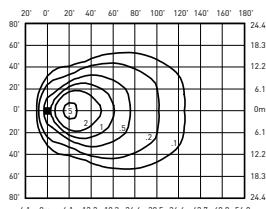
Photometry

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<https://creelighting.com/products/outdoor/area/osq-series>

60D



CESTL Test Report #: PL08100-001B
 OSQ-A-**-60D-B-30K-UL
 Initial Delivered Lumens: 10,079



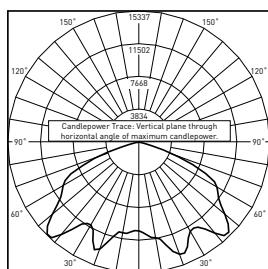
OSQ-A-**-60D-B-40K-UL
 Mounting Height: 25' [7.6m] A.F.G., 60° Tilt
 Initial Delivered Lumens: 11,478
 Initial FC at grade

60° Flood Distribution				
Input Power Designator	3000K (70 CRI)	4000K (70 CRI)	5000K (90 CRI)	5700K (70 CRI)
B	10,806	11,478	10,575	11,678
K	15,909	16,897	15,800	17,191
Z	5,552	6,428	6,525	6,539

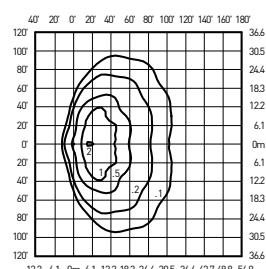
* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens

** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit:
<https://www.ies.org/wp-content/uploads/2017/03/TM-15-11BUGRatingsAddendum.pdf>. Valid with no tilt

WSN



CESTL Test Report #: PL07695-001A
 OSQ-A-**-WSN-U-30K-UL
 Initial Delivered Lumens: 23,116



OSQ-A-**-WSN-B-40K-UL
 Mounting Height: 25' [7.6m] A.F.G., 60° Tilt
 Initial Delivered Lumens: 11,478
 Initial FC at grade

Wide Sign Distribution				
Input Power Designator	3000K (70 CRI)	4000K (70 CRI)	5000K (90 CRI)	5700K (70 CRI)
B	10,806	11,478	10,575	11,678
K	15,909	16,897	15,800	17,191
Z	5,552	6,428	6,525	6,539

* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens

** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit:
<https://www.ies.org/wp-content/uploads/2017/03/TM-15-11BUGRatingsAddendum.pdf>. Valid with no tilt

OSQ™ LED Area/Flood Luminaire featuring Cree TrueWhite® Technology – Medium

Luminaire EPA

Adjustable Arm Mount – OSQ-B-AA Weight: 28.4 lbs. (12.9kg)							
Single	2 @ 180°	2 @ 90°	3 @ 90°	3 @ 120°	3 @ 180°	4 @ 180°	4 @ 90°
Tenon Configuration (0°–80° Tilt) ; If used with Cree Lighting tenons, please add tenon EPA with Luminaire EPA							
							
PB-1A*; PT-1; PW-1A3**	PB-2A*; PB-2R2.375; PD-2A4(180); PT-2(180); PW-2A3**	PB-2A*; PD-2A4(90); PT-2(90)	PB-3A*; PD-3A4(90); PT-3(90)	PB-3A*; PT-3(120)	PB-3A*; PB-3R2.375	PB-4A*(180)	PB-4A*(90); PB-4R2.375; PD-4A4(90); PT-4(90)
0° Tilt							
0.74	1.48	1.19	1.93	1.63	3.33	4.66	2.38
10° Tilt							
0.75	1.48	1.49	2.23	2.15	4.22	5.84	2.98
20° Tilt							
1.12	1.48	1.86	2.60	2.85	5.31	7.32	3.72
30° Tilt							
1.46	1.48	2.20	2.94	3.56	6.34	8.68	4.40
45° Tilt							
1.96	1.96	2.69	3.43	4.54	7.83	10.68	5.38
60° Tilt							
2.33	2.33	3.07	3.81	5.11	8.94	12.16	6.14
70° Tilt							
2.49	2.49	3.23	3.97	5.11	9.43	12.80	6.46
80° Tilt							
2.58	2.58	3.32	4.06	5.11	9.71	13.16	6.64
Tenon Configuration (90° Tilt) ; If used with Cree Lighting tenons, please add tenon EPA with Luminaire EPA							
PB-1A*; PT-1; PW-1A3**	PB-2A*; PB-2R2.375; PD-2A4(180); PT-2(180); PW-2A3**	PB-2A*	PB-3A*	PB-3A*; PT-3(120)	PB-3A*; PB-3R2.375	PB-4A*(180)	PB-4A*(90); PB-4R2.375
90° Tilt							
2.61	2.61	4.44	6.05	5.11	9.79	13.28	10.39

* Specify pole size: 3 (3"), 4 (4"), 5 (5"), or 6 (6") for single, double or triple luminaire orientation or 4 (4"), 5 (5"), or 6 (6") for quad luminaire orientation

** These EPA values must be multiplied by the following ratio: Fixture Mounting Height/Total Pole Height. Specify pole size: 3 (3"), 4 (4"), 5 (5"), or 6 (6")

Tenon EPA

Part Number	EPA
PB-1A*	None
PB-2A*	0.82
PB-3A*	1.52
PB-4A*(180)	2.22
PB-4A*(90)	1.11
PB-2R2.375	0.92
PB-3R2.375	1.62
PB-4R2.375	2.32
PD Series Tenons	0.09
PT Series Tenons	0.10
PW-1A3**	0.47
PW-2A3**	0.94
WM-2	0.08
WM-4	0.25
WM-DM	None

* Specify pole size: 3 (3"), 4 (4"), 5 (5"), or 6 (6") for single, double or triple luminaire orientation or 4 (4"), 5 (5"), or 6 (6") for quad luminaire orientation

** These EPA values must be multiplied by the following ratio: Fixture Mounting Height/Total Pole Height. Specify pole size: 3 (3"), 4 (4"), 5 (5"), or 6 (6")

Tenons and Brackets* (must specify color)			
Square Internal Mount Vertical Tenons (Steel)			
- Mounts to 3-6" (76-152mm) square aluminum or steel poles	PB-1A* – Single	PB-4A*(90) – 90° Quad	Round External Mount Vertical Tenons (Steel)
PB-2A* – 180° Twin	PB-2A* – 180° Twin	PB-4A*(180) – 180° Quad	- Mounts to 2.375" (60mm) O.D. round aluminum or steel poles or tenons
PB-3A* – 180° Triple	PB-3A* – 180° Triple	PB-3A* – 180° Triple	PB-2R2.375 – Twin
Square Internal Mount Horizontal Tenons (Aluminum)			
- Mounts to 4" (102mm) square aluminum or steel poles	PD-2A4(90) – 90° Twin	PD-4A4(90) – 90° Triple	Round External Mount Horizontal Tenons (Aluminum)
PD-2A4(180) – 180° Twin	PD-2A4(180) – 180° Twin	PD-4A4(180) – 90° Quad	- Mounts to 2.375" (60mm) O.D. round aluminum or steel poles or tenons
Wall Mount Brackets			
- Mounts to wall or roof	WM-2 – Horizontal for OSQ-B-AA mount	WM-4 – L-Shape for OSQ-B-AA mount	- Mounts to square pole with PB-1A* tenon
WM-4 – L-Shape for OSQ-B-AA mount	WM-DM – Plate for OSQ-DA mount	PT-1 – Single (Vertical)	PT-3(90) – 90° Triple
WM-DM – Plate for OSQ-DA mount		PT-2(90) – 90° Twin	PT-3(120) – 120° Triple
Mid-Pole Bracket			
- Mounts to square pole	PW-1A3** – Single	PW-2A3** – Double	PW-1A3** – Single
PW-2A3** – Double			PW-2A3** – Double
Ground Mount Post			
- For ground-mounted flood luminaires	PGM-1 – for OSQ-B-AA mount		

* Refer to the [Bracket and Tenons spec sheet](#) for more details

US: creelighting.com (800) 236-6800
Canada: creelighting-canada.com (800) 473-1234

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Luminaire EPA

Direct Arm Mount – OSQ-DA Weight: 28.9 lbs. (13.1kg)					
Single	2 @ 180°	2 @ 90°	3 @ 90°	3 @ 120°	4 @ 90°
					
0.74	1.48	1.19	1.93	1.63	2.38

Direct Mount Configurations

Compatibility with OSQ-DA Direct Mount Bracket					
Input Power Designator	2 @ 90°	2 @ 180°	3 @ 90°	3 @ 120°	4 @ 90°
3" Square					
B, K & Z	N/A	✓	N/A	N/A	N/A
3" Round					
B, K & Z	N/A	✓	N/A	N/A	N/A
4" Square					
B, K & Z	✓	✓	✓	N/A	✓
4" Round					
B, K & Z	✓	✓	✓	✓	✓
5" Square					
B, K & Z	✓	✓	✓	N/A	✓
5" Round					
B, K & Z	✓	✓	✓	✓	✓
6" + Square					
B, K & Z	✓	✓	✓	N/A	✓
6" + Round					
B, K & Z	✓	✓	✓	✓	✓

Luminaire EPA

Trunnion Mount – OSQ-TM Weight: 32.6 lbs. (14.8kg)	
Single	
0° Tilt	
0.75	
15° Tilt	
0.99	
30° Tilt	
1.57	
45° Tilt	
2.07	
60° Tilt	
2.46	
75° Tilt	
2.67	
90° Tilt	
2.33	

Field Adjustable Output (Q9/Q6/Q5/Q4/Q3/Q2/Q1) Option Description:

The Field Adjustable Output option enables the OSQ area luminaires to be tuned to the exact needs of a particular application through multiple levels of adjustment. When ordered with the Q option, the luminaire will be shipped from the factory at the selected Q setting and will be fully adjustable between the nine settings.

Q Option Power & Lumen Data – Designator B

Q Option Setting	CCT/CRI	System Watts	Lumen Values						Optics Qualified on DLC QPL	
		120-480V	Asymmetric	5ME	5SH & Floods	2ME w/ BLS	3ME w/ BLS	4ME w/BLS	Standard	Premium
Q9 [Full Power]	30K (70 CRI)	86	10,738	10,232	10,806	8,251	8,477	8,251	5ME	2ME, 3ME, 4ME, 5SH, 15D, 25D, 40D, 60D, WSN
	40K (70 CRI)		11,424	10,867	11,478	8,779	9,019	8,779	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
	50K (90 CRI)		9,350	10,000	10,575	7,200	7,400	7,200	TBD	TBD
	57K (70 CRI)		11,648	11,056	11,678	8,950	9,196	8,950	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
Q6	30K (70 CRI)	77	9,449	9,004	9,509	7,261	7,460	7,261	5ME	2ME, 3ME, 4ME, 5SH, 15D, 25D, 40D, 60D, WSN
	40K (70 CRI)		10,053	9,563	10,101	7,726	7,937	7,726	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
	50K (90 CRI)		8,350	8,950	9,450	6,425	6,600	6,425	TBD	TBD
	57K (70 CRI)		10,250	9,729	10,277	7,876	8,092	7,876	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
Q5	30K (70 CRI)	72	8,913	8,492	8,969	6,848	7,036	6,848	5ME	2ME, 3ME, 4ME, 5SH, 15D, 25D, 40D, 60D, WSN
	40K (70 CRI)		9,482	9,020	9,527	7,287	7,486	7,287	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
	50K (90 CRI)		7,525	8,050	8,525	5,775	5,950	5,775	TBD	TBD
	57K (70 CRI)		9,668	9,176	9,693	7,429	7,633	7,429	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
Q4	30K (70 CRI)	62	7,731	7,367	7,780	5,941	6,103	5,941	5ME	2ME, 3ME, 4ME, 5SH, 15D, 25D, 40D, 60D, WSN
	40K (70 CRI)		8,225	7,824	8,264	6,321	6,494	6,321	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
	50K (90 CRI)		6,575	7,025	7,425	5,050	5,175	5,050	TBD	TBD
	57K (70 CRI)		8,387	7,960	8,408	6,444	6,621	6,444	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
Q3	30K (70 CRI)	53	6,550	6,241	6,592	5,033	5,171	5,033	5ME	2ME, 3ME, 4ME, 5SH, 15D, 25D, 40D, 60D, WSN
	40K (70 CRI)		6,969	6,629	7,002	5,355	5,502	5,355	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
	50K (90 CRI)		5,575	5,975	6,325	4,290	4,410	4,290	TBD	TBD
	57K (70 CRI)		7,105	6,744	7,124	5,460	5,610	5,460	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
Q2	30K (70 CRI)	45	5,476	5,218	5,511	4,208	4,323	4,208	5ME	2ME, 3ME, 4ME, 5SH, 15D, 25D, 40D, 60D, WSN
	40K (70 CRI)		5,826	5,542	5,854	4,477	4,600	4,477	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
	50K (90 CRI)		4,550	4,890	5,175	3,500	3,590	3,500	TBD	TBD
	57K (70 CRI)		5,940	5,639	5,956	4,565	4,690	4,565	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
Q1	30K (70 CRI)	34	4,188	3,990	4,214	3,218	3,306	3,218	5ME	2ME, 3ME, 4ME, 5SH, 15D, 25D, 40D, 60D, WSN
	40K (70 CRI)		4,455	4,238	4,476	3,424	3,517	3,424	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
	50K (90 CRI)		3,500	3,770	3,980	2,690	2,760	2,690	TBD	TBD
	57K (70 CRI)		4,543	4,312	4,554	3,491	3,586	3,491	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN

Field Adjustable Output (Q9/Q6/Q5/Q4/Q3/Q2/Q1) Option Description:

The Field Adjustable Output option enables the OSQ area luminaires to be tuned to the exact needs of a particular application through multiple levels of adjustment. When ordered with the Q option, the luminaire will be shipped from the factory at the selected Q setting and will be fully adjustable between the nine settings.

Q Option Power & Lumen Data – Designator K

Q Option Setting	CCT/CRI	System Watts	Lumen Values					Optics Qualified on DLC QPL		
			120-480V	Asymmetric	5ME	5SH & Floods	2ME w/BLS	3ME w/BLS	4ME w/BLS	Standard
Q9 (Full Power)	30K (70 CRI)	130	16,022	15,063	15,909	12,312	12,649	12,312	5ME	2ME, 3ME, 4ME, 5SH, 15D, 25D, 40D, 60D, WSN
	40K (70 CRI)		16,959	15,999	16,897	13,032	13,389	13,032	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
	50K (90 CRI)		14,000	14,925	15,800	10,750	11,050	10,750	TBD	TBD
	57K (70 CRI)		17,291	16,277	17,191	13,286	13,650	13,286	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
Q6	30K (70 CRI)	117	14,099	13,255	14,000	10,835	11,131	10,835	5ME	2ME, 3ME, 4ME, 5SH, 15D, 25D, 40D, 60D, WSN
	40K (70 CRI)		14,924	14,079	14,869	11,468	11,782	11,468	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
	50K (90 CRI)		12,500	13,350	14,100	9,600	9,875	9,600	TBD	TBD
	57K (70 CRI)		15,216	14,324	15,128	11,692	12,012	11,692	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
Q5	30K (70 CRI)	110	13,298	12,502	13,204	10,219	10,499	10,219	5ME	2ME, 3ME, 4ME, 5SH, 15D, 25D, 40D, 60D, WSN
	40K (70 CRI)		14,076	13,279	14,025	10,817	11,113	10,817	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
	50K (90 CRI)		11,250	12,050	12,725	8,650	8,900	8,650	TBD	TBD
	57K (70 CRI)		14,352	13,510	14,269	11,027	11,330	11,027	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
Q4	30K (70 CRI)	93	11,536	10,845	11,454	8,865	9,107	8,865	5ME	2ME, 3ME, 4ME, 5SH, 15D, 25D, 40D, 60D, WSN
	40K (70 CRI)		12,210	11,519	12,166	9,383	9,640	9,383	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
	50K (90 CRI)		9,825	10,525	11,100	7,550	7,750	7,550	TBD	TBD
	57K (70 CRI)		12,450	11,719	12,378	9,566	9,828	9,566	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
Q3	30K (70 CRI)	80	9,773	9,188	9,704	7,510	7,716	7,510	5ME	2ME, 3ME, 4ME, 5SH, 15D, 25D, 40D, 60D, WSN
	40K (70 CRI)		10,345	9,759	10,307	7,950	8,167	7,950	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
	50K (90 CRI)		8,350	8,950	9,475	6,425	6,600	6,425	TBD	TBD
	57K (70 CRI)		10,548	9,929	10,487	8,104	8,327	8,104	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
Q2	30K (70 CRI)	67	8,171	7,682	8,114	6,279	6,451	6,279	5ME	2ME, 3ME, 4ME, 5SH, 15D, 25D, 40D, 60D, WSN
	40K (70 CRI)		8,649	8,159	8,617	6,646	6,828	6,646	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
	50K (90 CRI)		6,825	7,325	7,725	5,250	5,375	5,250	TBD	TBD
	57K (70 CRI)		8,818	8,301	8,767	6,776	6,962	6,776	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
Q1	30K (70 CRI)	51	6,249	5,875	6,205	4,802	4,933	4,802	5ME	2ME, 3ME, 4ME, 5SH, 15D, 25D, 40D, 60D, WSN
	40K (70 CRI)		6,614	6,240	6,590	5,082	5,222	5,082	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN
	50K (90 CRI)		5,250	5,650	5,975	4,030	4,150	4,030	TBD	TBD
	57K (70 CRI)		6,743	6,348	6,704	5,182	5,324	5,182	N/A	2ME, 3ME, 4ME, 5ME, 5SH, 15D, 25D, 40D, 60D, WSN

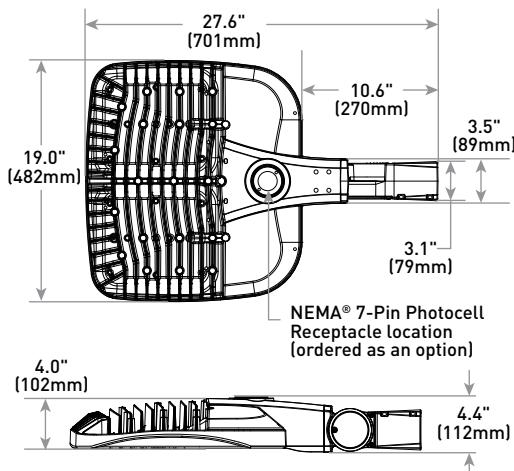
OSQ™ LED Area/Flood Luminaire featuring Cree TrueWhite® Technology – Medium

AA Mount

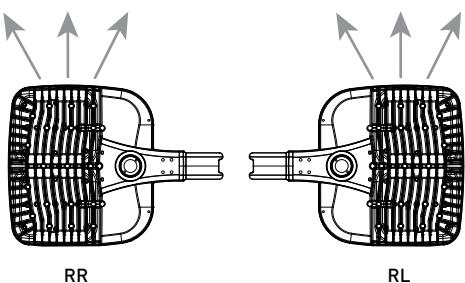


Weight

28.4 lbs. (12.9kg)



RR/RL Configuration



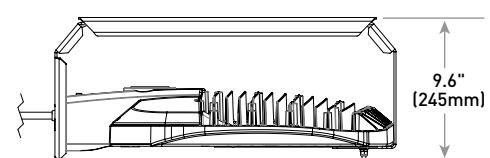
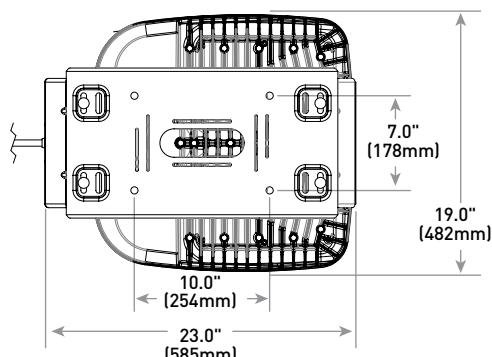
TSP Mount



Weight

42.0 lbs. (19.1kg)

OSQ Large luminaire shown.



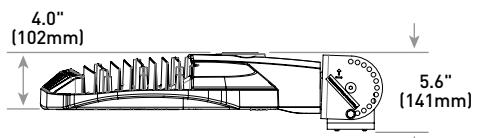
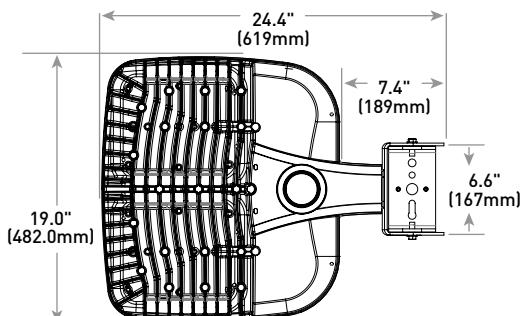
TM Mount



Weight

32.6 lbs. (14.8kg)

OSQ Large luminaire shown.



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A COMPANY OF **IDEAL INDUSTRIES, INC.**

Job: 33 Danton Drive
Item: Heavy Duty Pavement
Date: November 4, 2020
By: JEH

SECTION
5.00" AC / 12.00" AB

INPUTS		
Traffic Index	TI	7.00
R-Value of Subgrade (Assume 5 if Unknown)	R _{Subgrade}	50.00
PAVEMENT SECTION REQUIREMENTS		
Gravel Equivalent - Total Section	GE _{Total}	1.12 ft
⇒ 0.0032 x TI x (100 - R _{Subgrade})		
Safety Factor (Use for TI ≥ 7)	F _s	0.20
⇒ Use 0.20 for AC/AB or 0.10 for Full Depth AC		
ASPHALT CONCRETE SECTION		
R-Value - Sub Base	R _{AB}	78.00
⇒ R-Value for Sub Base		
Gravel Equivalent - Hot Mix Asphalt	GE _{HMA}	0.49 ft
⇒ 0.0032 x TI x (100 - R _{AB})		
Final Gravel Equivalent - Hot Mix Asphalt	GE _{HMA}	0.69 ft
⇒ GE _{HMA} + Safety Factor		
Gravel Factor - Hot Mix Asphalt	G _{f-AC}	2.14
⇒ 5.67 / TI ^{0.5} For AC Thickness ≤ 6 in		
⇒ 7 x T _{AC} ^{0.33} / TI ^{0.5} For AC Thickness > 6 in		
Calculated Thickness Required	T _{AC-Calc}	3.88 in
⇒ GE _{HMA} / G _{f-AC}		

AC Thickness Used	T _{AC}	5.00 in
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SUBBASE SECTION		
Gravel Equivalent - HMA Actual	GE _{HMA}	0.89 ft
⇒ G _{f-AC} x T _{AC}		
Gravel Equivalent - Subbase	GE _{AB}	0.23 ft
⇒ GE _{Total} - GE _{HMA}		
Gravel Factor - Subbase	G _{f-AB}	1.10
Calculated Thickness Required	T _{AB-Calc}	4.00 in
⇒ GE _{AB} / G _{f-AB}		

Subbase Thickness Used	T _{AB}	12.00 in
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Job: 33 Danton Drive
Item: Driveway Pavement
Date: November 4, 2020
By: JEH

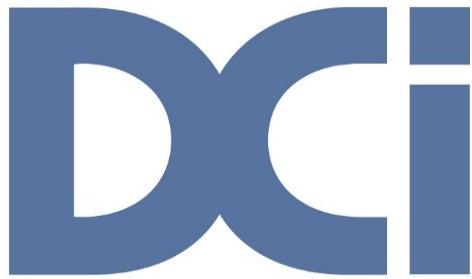
SECTION
4.00" AC / 12.00" AB

INPUTS		
Traffic Index	TI	5.00
R-Value of Subgrade (Assume 5 if Unknown)	R _{Subgrade}	50.00
PAVEMENT SECTION REQUIREMENTS		
Gravel Equivalent - Total Section	GE _{Total}	1.12 ft
⇒ 0.0032 x TI x (100 - R _{Subgrade})		
Safety Factor (Use for TI ≥ 7)	F _s	0.20
⇒ Use 0.20 for AC/AB or 0.10 for Full Depth AC		
ASPHALT CONCRETE SECTION		
R-Value - Sub Base	R _{AB}	78.00
⇒ R-Value for Sub Base		
Gravel Equivalent - Hot Mix Asphalt	GE _{HMA}	0.35 ft
⇒ 0.0032 x TI x (100 - R _{AB})		
Final Gravel Equivalent - Hot Mix Asphalt	GE _{HMA}	0.35 ft
⇒ GE _{HMA} + Safety Factor		
Gravel Factor - Hot Mix Asphalt	G _{f-AC}	2.54
⇒ 5.67 / TI ^{0.5} For AC Thickness ≤ 6 in		
⇒ 7 x T _{AC} ^{0.33} / TI ^{0.5} For AC Thickness > 6 in		
Calculated Thickness Required	T _{AC-Calc}	1.67 in
⇒ GE _{HMA} / G _{f-AC}		

AC Thickness Used	T _{AC}	4.00 in
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SUBBASE SECTION		
Gravel Equivalent - HMA Actual	GE _{HMA}	0.63 ft
⇒ G _{f-AC} x T _{AC}		
Gravel Equivalent - Subbase	GE _{AB}	0.17 ft
⇒ GE _{Total} - GE _{HMA}		
Gravel Factor - Subbase	G _{f-AB}	1.10
Calculated Thickness Required	T _{AB-Calc}	4.00 in
⇒ GE _{AB} / G _{f-AB}		

Subbase Thickness Used	T _{AB}	12.00 in
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Dirt Balance Calculations

33 Danton Drive

Methuen, MA

11/4/2020

#	Pavement Section	Depth(ft)	Area (sf)	Volume (cy)
1.	Foundation Section	0.92	60,205.00	2044.00
2.	Heavy Duty Paving (5" AC over 12" AB)	1.42	23,057.00	1209.78
3.	Parking Area (4" AC over 12" AB)	1.33	12,527.00	618.62
4.	Sidewalk (4" Concrete over 6" AB)	0.83	894.00	27.59
	Total		96,683.00	3,899.99

Cubic Yards					
CAD Volume	CUT	6,668.00			
	FILL	7,382.00			
Subsidance	0.1	69,218.00	SF	256.36	CY
Total Fill		7,638.36	CY		
Fill factor	15%	8,784.12	CY		
Total Fill		4,884.13	CY		
	Balance	(1,783.87)	CY		
	Say	(1,800.00)	CY		

THIS PLAN IS FORMATTED TO PLOT AT SIZE ARCH D 24" X 36"

STORMWATER MANAGEMENT PLAN

STORMWATER MANAGEMENT REPORT

FOR

**33 DANTON DRIVE
METHUEN, MA 01844**

Prepared for:

Nabil Boghos
1630 Osgood Street #1210
North Andover, MA 01845

Prepared by:

Design Consultants, Inc.
120 Middlesex Avenue, Suite 20
Somerville, Massachusetts 02145

**Project No. 2020-041
November 4th, 2020**



TABLE OF CONTENTS

TABLE OF CONTENTS.....	1
INTRODUCTION.....	1
SITE INFORMATION.....	1
Included Properties:	1
Zoning and Planning:	1
Topography & Existing Conditions:	1
Flood Hazard Zone:.....	1
STORMWATER REGULATORY REQUIREMENTS & ANALYSIS APPROACH	1
Software Tools:.....	2
SOILS	2
EXISTING STORMWATER CONDITION	2
Watershed & Sub-Watersheds	2
Existing Site Infrastructure:	3
Times of Concentration:	4
PROPOSED STORMWATER CONDITION	4
Sub-Watershed Adjustments:	4
Times of Concentration:	6
MASSDEP STANDARD COMPLIANCE	6
Standard 1-No New Untreated Stormwater Discharges:	6
Standard 2-Peak Rate Attenuation:.....	6
Standard 3-Stormwater Recharge:.....	7
Standard 4-Water Quality:	7
Standard 5-Higher Pollutant Loads:.....	8
Standard 6-Critical Areas:	8
Standard 7-Redevelopment:	8
Standard 8-Construction Pollution & Prevention Plan:.....	8
Standard 9-Operation and Maintenance Plan:.....	8
Standard 10-Illicit Discharge Plan:.....	8
CONCLUSION	8

APPENDICES

Appendix A	MassDEP Checklist
Appendix B	Existing Conditions Plan
Appendix C	Utility Site Plan
Appendix D	Existing & Proposed Catchment Areas
Appendix E	FEMA Flood Insurance Rate Map
Appendix F	Soils Information
Appendix G	Existing & Proposed Hydrology
Appendix H	Water Quality Calculations
Appendix I	Operation & Maintenance Plan

INTRODUCTION

Jessica's Bakery proposes to remove the existing trailer yard located at 33 Danton Drive, Methuen, and construct a 60,000 SF warehouse building in its place. The purpose of this report is to explain the design of the onsite storm drainage.

SITE INFORMATION

Included Properties:

412-131-6AA

Zoning and Planning:

The parcel included in this study is zoned industrial. This report does not go into specifics about the site's specific planning and zoning requirements. For more information, see Methuen's Zoning Ordinances.

Topography & Existing Conditions:

The subject site topography slopes consistently from the west to the east, toward Danton Drive. The elevation grades from approximately 124' to 114' (NAVD88 Datum) across the site. The site was previous used as a trailer yard/parking facility and has a current impervious area of about 40%. The parcel in question has an area of 135,678 (+/-) square feet. *(See Appendix B: Existing Conditions Plan)*

Flood Hazard Zone:

In reviewing FEMA documents for the area, the site falls within FIRM Panel 25009C0202F. Portions of the site fall under zone X, the 0.2% annual hazard area, and directly adjacent to the site across Danton Drive is a wetland classified as Zone AE. However, the site does not come close to any of the FEMA cross-sections or the floodway. The closest FEMA cross-sections to the site are sections I or H, which show a Base Flood Elevation (BFE) of 114.5 to 112 feet. **No portions of the parcel or the project fall within the Special Flood Hazard Areas.** Copies of FIRM Panel 25009C0202F and relevant portions of FIS 25009CV003C are included in Appendix E: FEMA Flood Insurance Rate Map.

STORMWATER REGULATORY REQUIREMENTS & ANALYSIS APPROACH

The governing stormwater requirements for stormwater on the proposed project is the Massachusetts Stormwater Handbook issued by MassDEP. The following report explains how the standards are met and provides an overview of the project's impact on the surrounding stormwater infrastructure.

The premise of the stormwater analysis for the project is that by mitigating the hydrologic impacts of the project, the project will mitigate any impact of the project on the surrounding environment. The project analysis conducted does not include a hydraulic analysis of Peat Meadow Brook or the existing city or 35 Danton Drive conveyance system (nor could one be conducted with the information at this time). It is assumed that the existing offsite, downstream conveyance systems are able to convey the existing drainage to the satisfaction of the City of Methuen. The only hydraulic analysis conducted for the project is for the onsite gravity conveyance system.

Additionally, the limits of the hydrologic analysis are limited to the areas described in this report. It is assumed that a direct “apples to apples” comparison of the drainage areas on the project site with the same times of concentrations will adequately represent the project’s effect on the surrounding environment (i.e., Existing drainage patterns and flow times will not significantly change due to unknown factors).

Software Tools:

The analysis for the proposed project used a variety of tools to provide the necessary calculations in line with the Massachusetts Stormwater Handbook. The project’s main analysis was conducted with HydroCAD, a computer program based on USDA’s Technical Release TR-55, Urban Hydrology for Small Watersheds. HydroCAD allows for variable rainfall intensity throughout the storm duration, peaking near the middle of the Type III, 24-hour storm. All other calculations were conducted using Microsoft Excel with templates provided from MassDEP.

SOILS

Typically, an analysis of the soils on site would be conducted with Natural Resources Conservation Service (NRCS) Web Soil Survey. However, the initial results of this survey were inconclusive at the project. Therefore, DCI and EBI Consulting conducted a field investigation on October 22, 2020 of the underlying soils onsite. The results of these investigations, including an NRCS report, test pit logs, and a locus map showing the test pit locations and the proposed drainage facility’s is shown in Appendix F: Soils Information.

Generally speaking, the site consists of very well-drained sand and sandy loam throughout the A, B, and C layers. There is evidence near the northern to NW portion of the site of small pockets of an impervious layer. With test pit 4 showing redox and potentially perched stormwater. Along with infiltration test at pits 5 and 6 showing much lower rates than expected from the soil type, or that would be consistent with the rest of the site. However, on the whole, the site can be classified as excellently draining soils.

Based on the results of this investigation, the site has been classified as Type A Hydraulic Soil Group (HSG), and HSG A was used in all project analysis. Groundwater nor evidence of groundwater was not encountered during the soil investigation. Due to the HSG A soil type onsite, DCI does not expect groundwater to be encountered in the vicinity of the surface. Including any impact from Peat Meadow Brook and the adjacent wetland (as a losing stream) due to the distance away from these resources.

EXISTING STORMWATER CONDITION

Watershed & Sub-Watersheds:

The existing site and the surrounding area drains to Peat Meadow Brook. Peat Meadow Brook drains a portion of western Methuen bounded by Harris Brook to the north and Bartlett Brook to the south. Peat Meadow Brook itself is a tributary of the Spicket River and meets the Spicket River near the Interstate 93 and Highway 213 Interchange. The Spicket River makes its way to the Merrimack River near downtown Lawrence, eventually making it to the Atlantic Ocean.

The main complication of the project site's drainage design was that the project site consists of multiple sub-watersheds of Peat Meadow Brook. These sub-watershed areas are defined as follows:

1. The most western portion of the site drains to the small pond area that is a part of Peat Meadow Brook to the west of the industrial development. While it is a very minor portion of the site that is mostly wooded and likely contributes very little runoff, we assume that the runoff from the project site makes its way to Spencer Street and drains southward to Peat Meadow Brook.
2. The southwestern portion of the site drains to Peat Meadow Brook after the small pond area through a drainage system on 35 Danton Drive. This drainage system is hard piped with catch basins and underground storm drainage piping. This area's drainage eventually makes it to an independent outfall at the downstream portion of Peat Meadow Brook.
3. The remainder of the site flows to Danton Drive. Like the 35 Danton Drive drainage area, the Danton Drive sub-watershed consists of underground drainage pipes and catch basin collection systems and eventually makes it to an outfall point at the Peat Meadow Brook & Danton Drive crossing. For project analysis purposes, this sub-watershed was broken up into two watersheds based on their entry locations to the Danton Drive conveyance pipe.
 - o An analysis point was placed at the lowest outfall point on the project—the catch basins between 33 Danton Drive and 25 Danton Drive.
 - o An additional analysis point was assumed for the site's portions that drains north to 31 Danton Drive and meets the 18" conveyance pipe about 150' north of the project.

This created four (4) design or analysis points. A general overview of these sub-watersheds, including overall delineations and outfall points, is shown in the first figure in Appendix D for clarity. See [Appendix D, Existing & Proposed Drainage Areas](#), for a full definition of the watersheds used on the project. Including impervious areas, landscaped areas, and other pertinent information. In total, 194,136sf of drainage area was analyzed for project impact.

Existing Site Infrastructure:

The existing site has a set of stormwater and conveyance swales that can be seen on the existing conditions plan. It appears as though the stormwater from the lower parking lots on the site was addressed with these swales. DCI's expectation is that these swales were installed by the development of the front parking lots in the mid-2000' to address stormwater quality. This is based on historical satellite imagery. However, no design calculations have been discovered regarding these swales.

These stormwater swales and their underdrains were investigated by DCI. We found no evidence of an overflow or a connection to the existing storm drain system in Danton Drive. There is clear evidence of an underdrain throughout the conveyance swales on the uphill portions. However, there is no evidence that this underdrain continues beyond the area drain discovered at the top of the swale's last segment. The last and deeper section

of swale shows no evidence of storm drainage infrastructure. We suspect that based on the soil type at the project site, the swales are expected to infiltrate and convey the rainwater to the last section of the swales where the rainwater was to be held in the swale until it could be infiltrated into the ground. Since there is no clear outfall for the project, we suspect that excess runoff during major rainfall events overland releases onto Danton Drive itself—eventually making it to the catch basins at the analysis point. However, without design plans or calculations to corroborate, we can only speculate.

Regardless of its true purpose/intent, it is clear that the storm drainage conveyance swales will physically store stormwater during runoff events. Therefore, we included them in the hydrologic model to accurately represent current project conditions. We also placed the project's underground storm drain connection at the assumed existing Danton Drive outfall location. This assumes that the underdrain carried through the last swale to the 18" drain in Danton Drive. The intent is to mimic any existing connection of the site to the 18" trunk line in Danton Drive.

Times of Concentration:

Of the four analysis points and their associated areas in the project analysis, only one analysis point (two analysis areas) has a flow path long enough to exceed the 6-minute minimum by TR-55. The main Danton Drive analysis point has a much longer time of concentration (t_c) as the majority of the water flows down the entire length of the site before reaching the analysis point. These flow paths and their associated inputs for the time of concentration calculations are shown in [Appendix D: Existing & Proposed Drainage Areas](#). It should be noted that the time of concentration's in the analysis will not correctly represent the project's impact on Peat Meadow Brook as a full analysis of the impact on Peat Meadow Brook is beyond the scope of our analysis. The hydrologic analysis for the watershed of Peat Meadow Brook was ended at the limits shown in [Appendix D: Existing & Proposed Catchment Areas](#).

PROPOSED STORMWATER CONDITION

To develop the 60,200 SF building at the project site, multiple stormwater mitigation measures are proposed across the site. Three infiltration facilities are proposed with collection and pretreatment measures around the site. [Appendix C: Utility Site Plan](#) shows these facilities & [Appendix A: MassDEP Checklist](#) includes a MassDEP checklist showing compliance with the ten(10) required stormwater standards.

Sub-Watershed Adjustments:

To place the building onsite with the required parking, landscape areas, and associated amenities, the existing drainage patterns from the site will need to be slightly modified. The table below goes into detail regarding the changes in the drainage areas.

Table 1-Project Area Comparison

	Project Site	Area to 35 Danton Drive	Area to 31 Danton Drive	Woods Behind Project
HydroCAD Numbers	10S & 11S (Existing) 100S to 130S (Proposed)	20S (Existing) 200S (Proposed)	30S (Existing) 300S (Proposed)	40S (Existing) 400S (Proposed)
Total Existing Area (sf)	155,485	20,048	6,694	11,909
Total Proposed Area (sf)	165,098	15,734	3,690	2,295
Difference (sf)	9,613	-4,314	-3,004	-2,295

The main modification to the drainage areas is that minor amounts of each of the areas draining to 31, 35 Danton Drive & the Woods behind the project will drain to the project's outfall. This creates a twofold benefit for Peat Meadow Brook. First, it increases the mitigation requirements and increases the groundwater recharge reducing the area's runoff contribution to Peat Meadow Brook during peak events. Second, it places the entry point for the runoff contributions during peak events further downstream on Peat Meadow Brook than they previously were. Typically, this results in a reduced risk of flooding upstream as peak flows are discharged earlier in a flood, creating additional flood storage upstream that would have been used up by the existing drainage contributions.

Additionally, the project proposes to increase the impervious areas in each drainage area, as shown in the table below.

Table 2-Impervious Area Comparison

	Project Site	Area to 35 Danton Drive	Area to 31 Danton Drive	Woods Behind Project
HydroCAD Numbers	10S & 11S (Existing) 100S to 130S (Proposed)	20S (Existing) 200S (Proposed)	30S (Existing) 300S (Proposed)	40S (Existing) 400S (Proposed)
Existing Impervious	50.49%	52.50%	21.05%	0%
Proposed Impervious	69.89%	53.50%	0%	0%
Difference (sf)	19.41%	1.0%	-21.05%	0%

An analysis of the site's impervious area shows that the project will increase imperviousness by about 20% across the project site. The onsite stormwater system will mitigate this increase. Note that the increase in impervious percentage from 20S to 200S comes from reducing the contributing area to the sub-watershed in the analysis. The

actual impervious area to the existing outfall on 35 Danton Drive will be reduced by approximately 2,100sf.

Proposed Stormwater Infrastructure:

The project proposes to use infiltration and collection devices around the site to mitigate and clean the stormwater runoff bound for Peat Meadow Brook. Per the requirements of the standards listed in later sections of this report, a majority of the runoff will be infiltrated back into the ground via infiltration systems. There will be three (3) main infiltration systems onsite, with two underground infiltration trenches that will collect the front and back parking lots, respectively. These trenches will use Cultec storage devices for structural support and increases in storage volume. The final infiltration system onsite will be a mini infiltration pond that will collect the majority of the clean roof runoff.

The two additional sub-watersheds (from two to 4) in the proposed outfall for the project break the respective areas draining to each of these infiltration devices out for sizing, analysis, and design. These sizing's analysis and design can be found in the appendices and the MassDEP Standard Compliance Section.

Times of Concentration:

Due to the proposed infiltration facilities, only one analysis area will have a flow path long enough to exceed the 6-minute minimum by TR-55 in the proposed design. The Danton Drive Drainage Area will mostly remain unchanged and will match the time of concentration from the existing conditions. All other drainage areas will use the 6-minute minimum from TR-55.

MASSDEP STANDARD COMPLIANCE

Standard 1-No New Untreated Stormwater Discharges:

The project proposes no new discharge points. Nor untreated stormwater.

Standard 2-Peak Rate Attenuation: A hydrologic analysis with HydroCAD of the pre-development and post-development condition was conducted on the proposed site and the surrounding area. This analysis was performed using the inputs previously identified in earlier sections of this report. Per the Stormwater Management Handbook, the 2-year, 10-year, and 100-year rainfall storms were analyzed following the Hydrology Handbook for Conservation Commissioners for this standard. The results of this Hydrologic Analysis are included in Appendix G: Existing and Proposed Hydrology. The following tables are summaries of these results.

Table 3-Hydrological Design Point Summary

	Design Point 1		Design Point 2		Design Point 3		Design Point 4	
	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed
Storm Event (Year)	Peak Runoff (CFS)							
2	3.09	0.91	0.38	0.32	0.00	0.00	0.00	0.00
10	6.29	3.28	0.98	0.80	0.08	0.00	0.00	0.00
100	16.64	16.62	2.70	2.16	0.50	0.12	0.27	0.21

Table 4-Project Hydrological Impact on Peat Meadow Brook

Description	Existing Conditions		Proposed Conditions	
Drainage Area	194,136 +/- Square Feet		194,136 +/- Square Feet	
Storm Event (Year)	Peak Runoff (CFS)	Runoff Volume (AF)	Offsite Peak Runoff (CFS)	Offsite Runoff Volume (AF)
2	1.19	0.287	1.19	0.105
10	7.10	0.661	3.81	0.356
100	19.36	1.829	18.21	1.560

The results in the table above show the project's compliance with Standard 3. Also, by maintaining the pre to post rates for design point 1, it can be inferred that the project will have no impact on the hydraulic capacity of the existing storm drainage in Danton Drive.

Standard 3-Stormwater Recharge:

Standard 3 was met by using three infiltration devices, one infiltration pond, and two underground infiltrators. The calculations showing requirements for these devices are shown in Appendix H: Water Quality Calculations. Drawdown calculations are demonstrated with the HydroCAD model results, and the infiltration rates used for each facility are from the soil investigation shown in Appendix F: Soil Information. No outflow from these devices was allowed in the design before the volume required for recharge, and Standard 4's water quality was filled in the infiltration devices.

A mounding analysis was not conducted or is required due to the lack of groundwater at the site. Drawdown for the site is met within 72 hours, and the proposed facilities provide the necessary storage based on the MassDEP requirements for Standard 3.

Standard 4-Water Quality:

The project is in an area with a rapid infiltration rate and likely has a land use for a higher potentially pollutant load. This subjects the project to the 1.0-inch runoff requirement (rather than 0.5") and the 44% TSS pretreatment requirement.

To meet these requirements for Water Quality, the project will employ Deep Sump Hooded Catch Basins with CDS units to pretreat the new pavement to the 44% TSS removal requirements. Additionally, to meet the full 80% TSS requirement, the infiltration facilities will be included in the TSS calculation. A full calculation of the TSS removal for the project for each facility is included in Appendix H: Water Quality Calculations.

As the larger of the two between the recharge requirements and the water quality requirements, the water quality volume requirements control the infiltration devices' volume design. The outfall pipes for the peak rate attenuation design is only placed above this volume. Tables showing these elevation-storage volume comparisons can be found in Appendix G: Existing & Proposed Hydrology. This can be corroborated with the outfall pipes on the design plans. The calculations showing the Water Quality Volume Requirements are shown in Appendix H: Water Quality Calculations.

Standard 5-Higher Pollutant Loads:

The final project use is possibly subject to an NPDES general industrial permit. Depending on the definition of food processing. However, the designer is unaware of this determination at this time and should follow the existing permitting on 35 Danton Drive. Regardless of whether the proposed use is subject to the NPDES permit, the project was designed with LUHPPL's to allow the site to be compliant in any future uses that require an NPDES permit.

Standard 6-Critical Areas:

The project is not subject to this standard.

Standard 7-Redevelopment:

The project is not subject to this standard.

Standard 8-Construction Pollution & Prevention Plan:

An Erosion and Sedimentation Control Plan has been included with the project plans, and an SWPPP will be filed prior to project disturbance.

Standard 9-Operation and Maintenance Plan:

An O&M plan has been included in Appendix I: Operations & Maintenance Plan and provides guidance for all BMP's included in the project.

Standard 10-Illicit Discharge Plan:

An Illicit Discharge Compliance Statement will be submitted prior to the discharge to post-construction BMPs.

CONCLUSION

Based on DCI's analysis of the existing and proposed conditions, the proposed site condition meets the stormwater management criteria set out by MassDEP for new developments. The results of these analyses indicate that the proposed project will mitigate the stormwater impact of the increases in the impervious area due to the development of a 60,200sf building, reducing the peak flows to Peat Meadow Brook, adding groundwater recharge, and removing the required TSS from the proposed development. This leads DCI to determine that the proposed project will not significantly impact the hydrologic characteristics of Peat Meadow Brook, and the mitigation measures included with the development will provide an adequate level of flood and stormwater quality protection to the public.

Appendix A

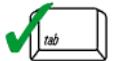
MASSDEP CHECKLIST



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 8²
- 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

Signature and Date

Checklist

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

- New development
- Redevelopment
- Mix of New Development and Redevelopment



Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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



Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

- Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.
- Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.
- Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

- Soil Analysis provided.
- Required Recharge Volume calculation provided.
- Required Recharge volume reduced through use of the LID site Design Credits.
- Sizing the infiltration, BMPs is based on the following method: Check the method used.
 - Static
 - Simple Dynamic
 - Dynamic Field¹
- Runoff from all impervious areas at the site discharging to the infiltration BMP.
- Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.
- Recharge BMPs have been sized to infiltrate the Required Recharge Volume.
- Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:
 - Site is comprised solely of C and D soils and/or bedrock at the land surface
 - M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
 - Solid Waste Landfill pursuant to 310 CMR 19.000
 - Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.
- Calculations showing that the infiltration BMPs will drain in 72 hours are provided.
- Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

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



Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

- The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.
- Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

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

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

- A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.
- Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:
 - is within the Zone II or Interim Wellhead Protection Area
 - is near or to other critical areas
 - is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
 - involves runoff from land uses with higher potential pollutant loads.
- The Required Water Quality Volume is reduced through use of the LID site Design Credits.
- Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.



Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

- The BMP is sized (and calculations provided) based on:
 - The ½" or 1" Water Quality Volume or
 - The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.
- The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the proprietary BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.
- A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

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

- The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted **prior to** the discharge of stormwater to the post-construction stormwater BMPs.
- The NPDES Multi-Sector General Permit does **not** cover the land use.
- LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.
- All exposure has been eliminated.
- All exposure has **not** been eliminated and all BMPs selected are on MassDEP LUHPPL list.
- The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

- The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.
- Critical areas and BMPs are identified in the Stormwater Report.



Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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



Checklist for Stormwater Report

Checklist (continued)

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

- The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has **not** been included in the Stormwater Report but will be submitted **before** land disturbance begins.
- The project is **not** covered by a NPDES Construction General Permit.
- The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.
- The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

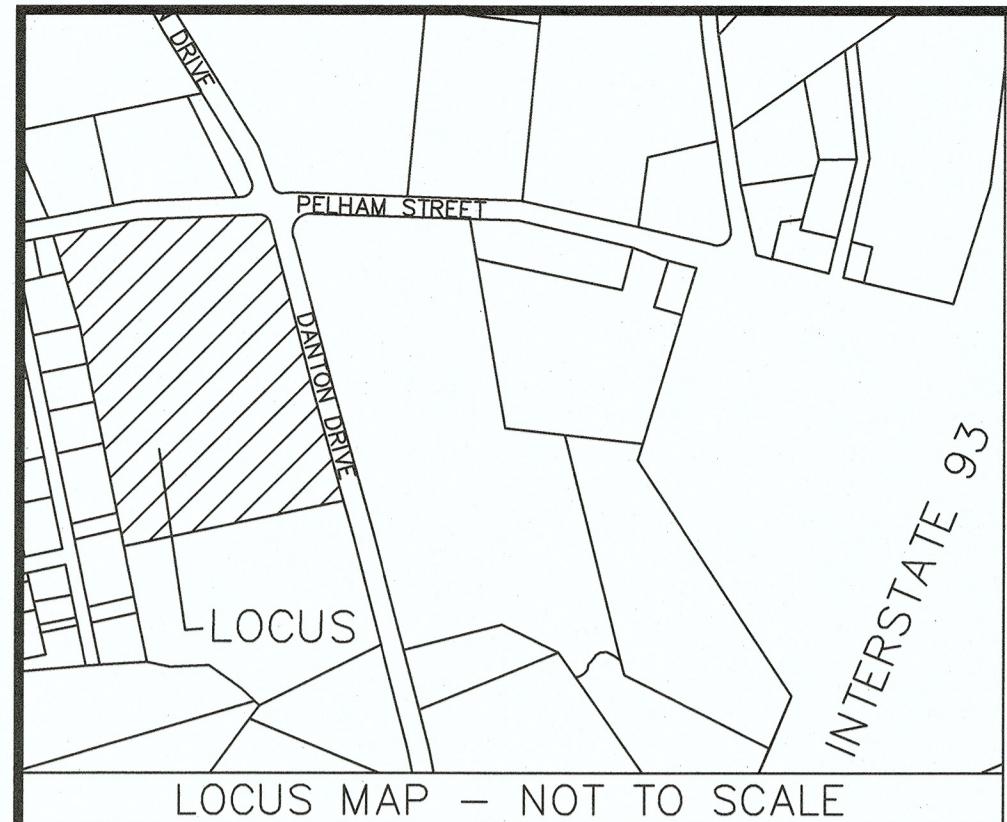
- The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
 - Name of the stormwater management system owners;
 - Party responsible for operation and maintenance;
 - Schedule for implementation of routine and non-routine maintenance tasks;
 - Plan showing the location of all stormwater BMPs maintenance access areas;
 - Description and delineation of public safety features;
 - Estimated operation and maintenance budget; and
 - Operation and Maintenance Log Form.
- The responsible party is **not** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:
 - A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
 - A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

- The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;
- An Illicit Discharge Compliance Statement is attached;
- NO Illicit Discharge Compliance Statement is attached but will be submitted **prior to** the discharge of any stormwater to post-construction BMPs.

Appendix B

EXISTING CONDITIONS PLAN



N/F
FMX REALTY LLC
31 DANTON DRIVE
MAP 412, BLOCK 131, LOT 5D
1 STORY INDUSTRIAL

N/F
GARY & TINA HEANEY
58 SPENCER STREET
MAP 412, BLOCK 131,
LOT 6
1 STORY RESIDENTIAL

N/F
CHRISTOPHER GRIER
60 SPENCER STREET
MAP 412, BLOCK 131,
LOT 7
1 STORY RESIDENTIAL

N/F
THOMAS WHITTAKER
62 SPENCER STREET
MAP 412, BLOCK 131,
LOT 9
UNDEVELOPED LAND

N/F
CITY OF METHUEN
64 SPENCER STREET
MAP 412, BLOCK 131,
LOT 10
UNDEVELOPED LAND

GRASS

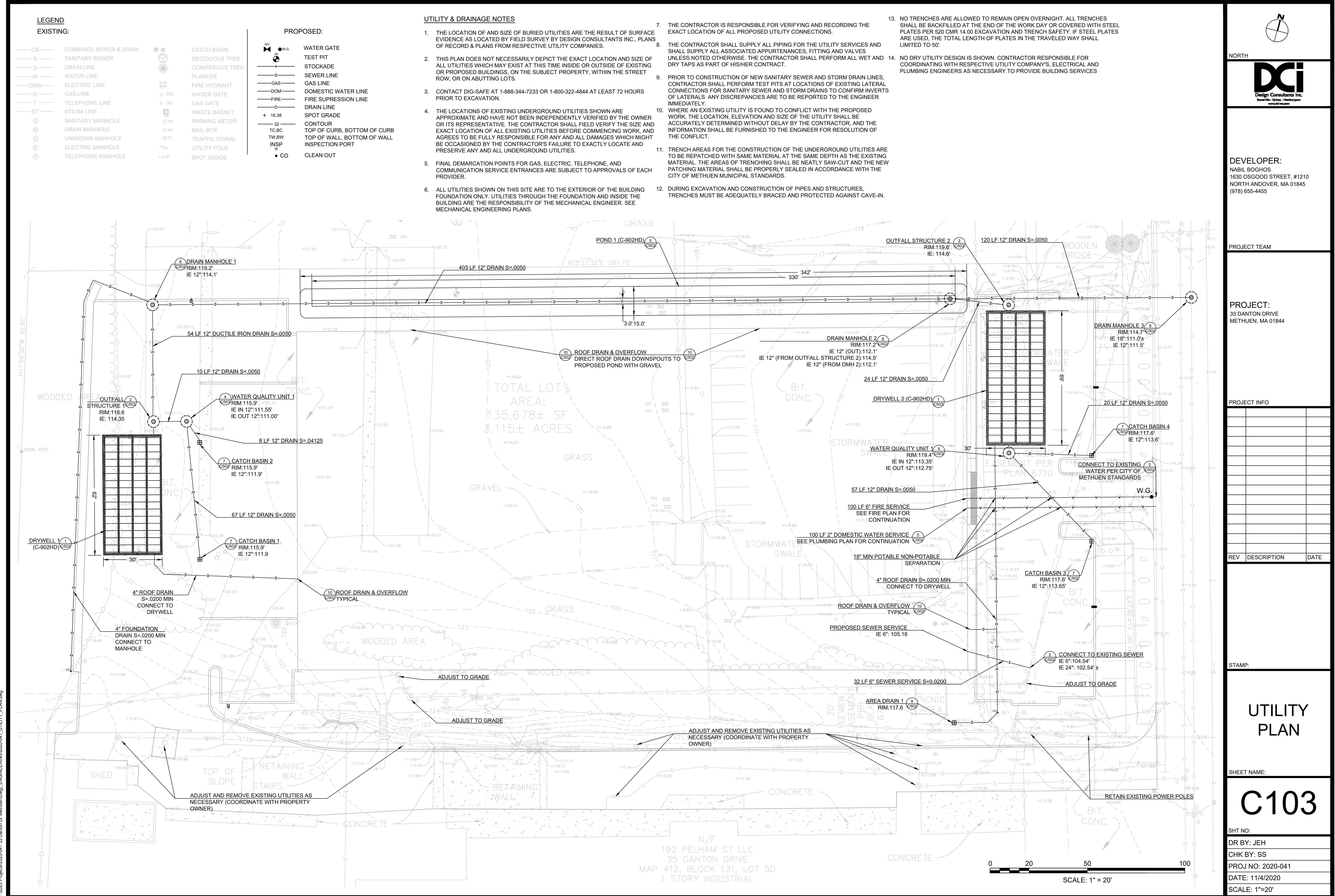
RAIL

TBM 402
X CUT BOLT LIGHT POLE
ELEV.=122.80 (NAVD 88
DATUM)

BIT. CONC.

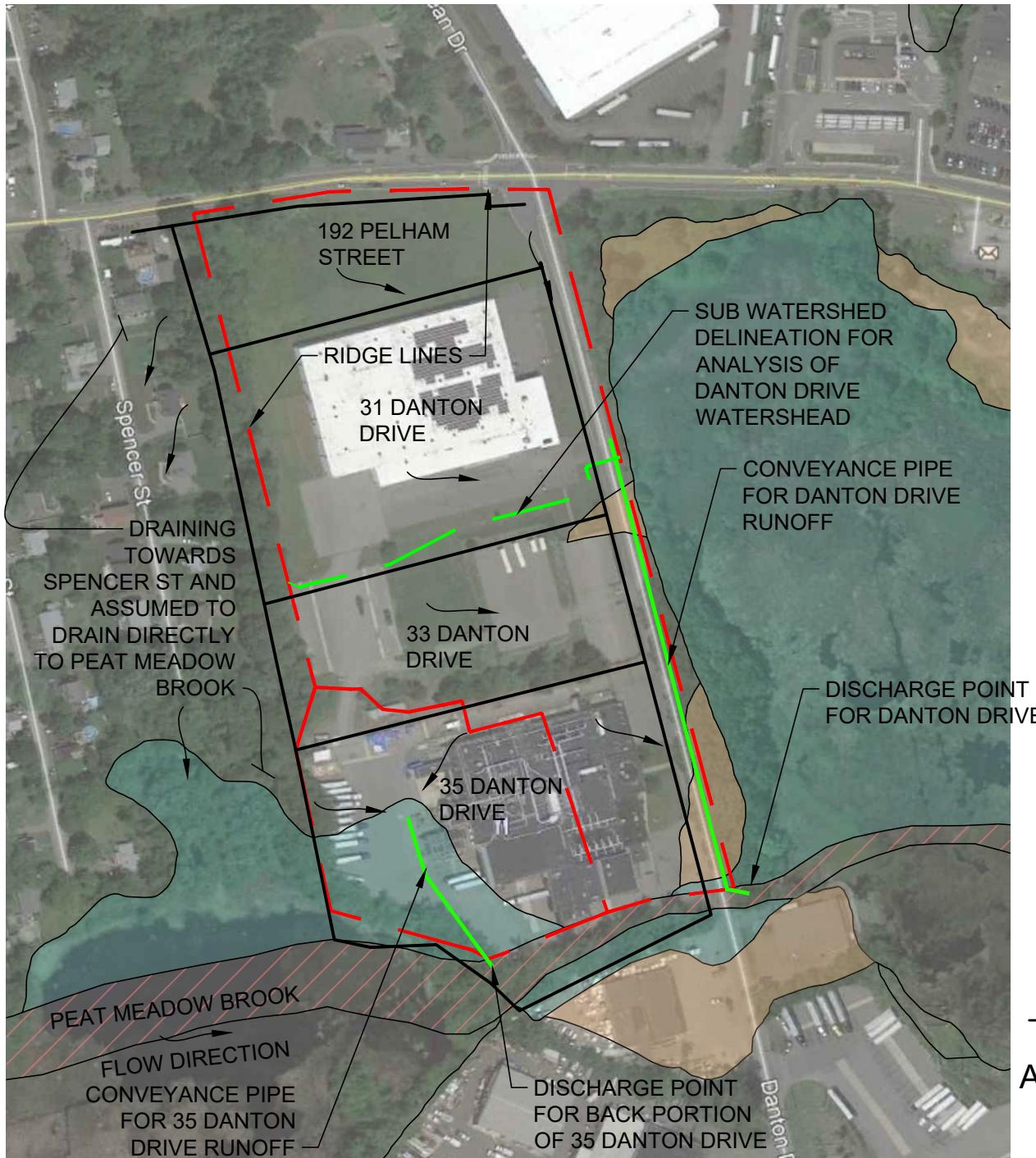
Appendix C

UTILITY SITE PLAN



Appendix D

EXISTING & PROPOSED CATCHMENT AREAS



N

NORTH



OWNER:
NABIL BOGHOS
1630 Osgood Street #1210
North Andover, MA 01845

33 DANTON
DRIVE

PROJECT INFO

REV DESCRIPTION DATE

STAMP:

EXISTING
DRAINAGE
AREA PLAN

SHEET NAME:

D1.0

SHT NO:

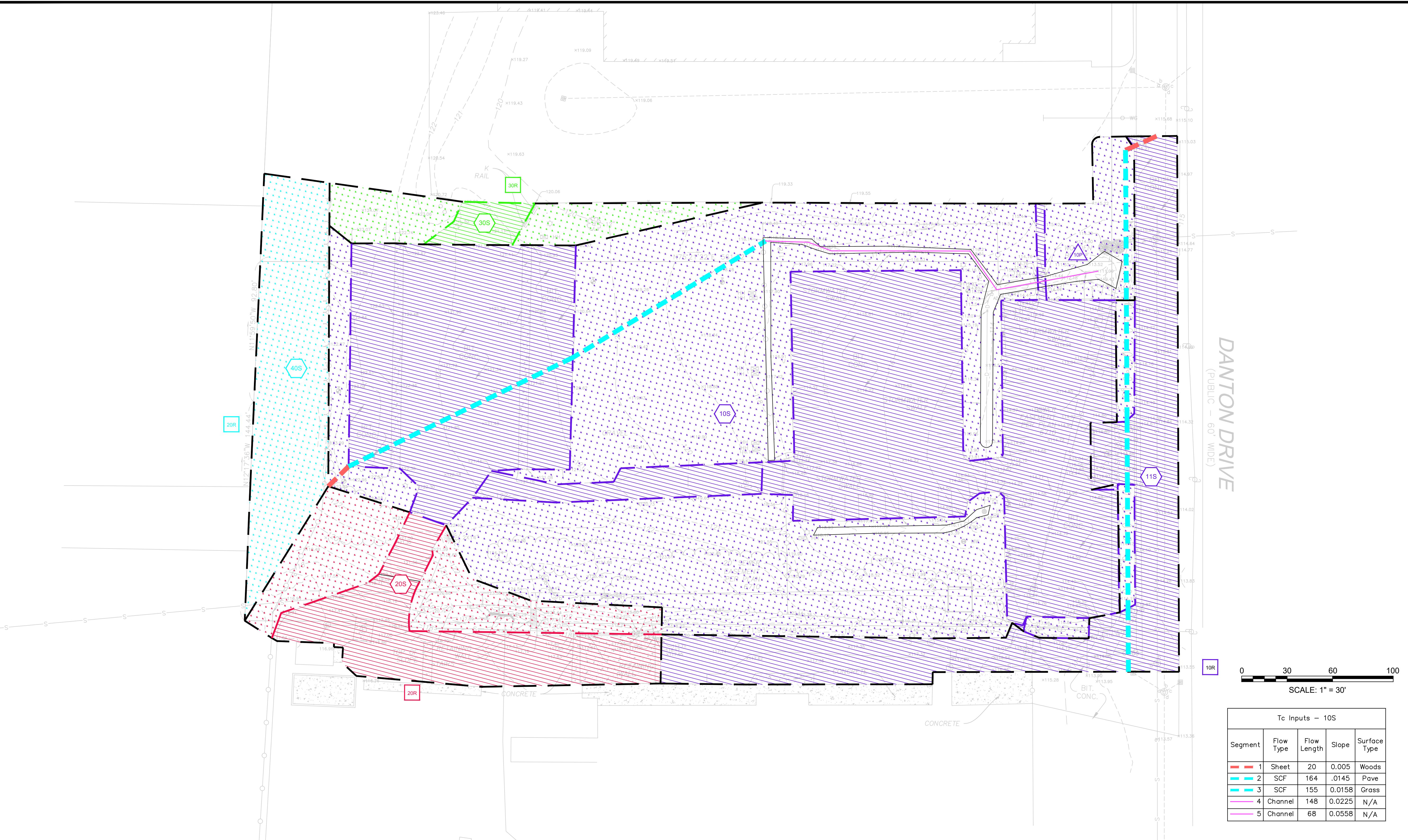
DR BY: JEH

CHK BY: SS

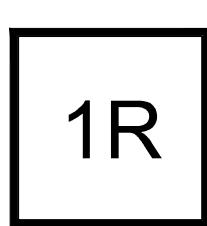
PROJ NO: 2020-041

DATE: 10/30/2020

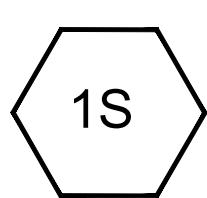
SCALE: AS SHOWN



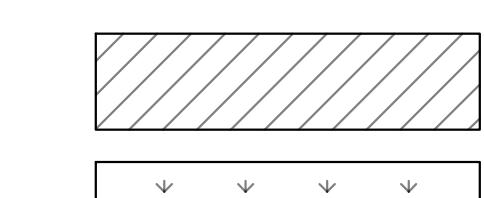
LEGEND



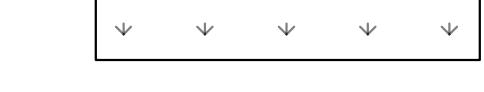
DESIGN POINT



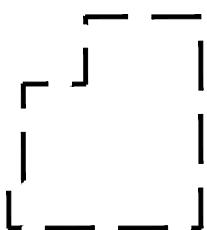
SUBCATCHMENT



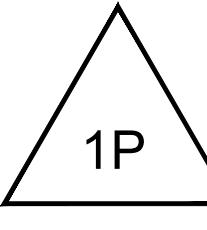
IMPERVIOUS AREA



LANDSCAPE

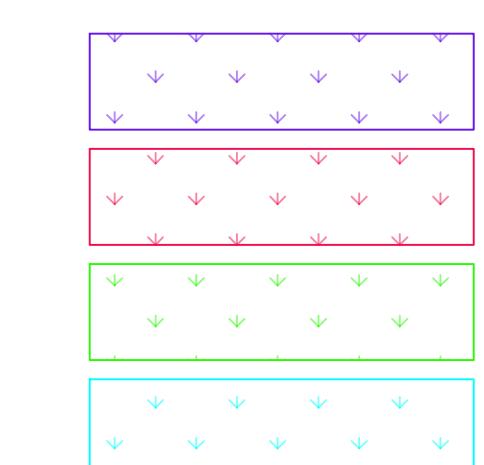


SUBCATCHMENT BOUNDARY



POND

SUB WATERSHED AREAS - COLORS



- TO PROJECT OUTFALL
- TO 35 DANTON DRIVE
- TO 31 DANTON DRIVE
- TO SPENCER STREET

Tc Inputs - 10S

Segment	Flow Type	Flow Length	Slope	Surface Type
1	Sheet	20	0.005	Woods
2	SCF	164	.0145	Pave
3	SCF	155	0.0158	Grass
4	Channel	148	0.0225	N/A
5	Channel	68	0.0558	N/A

Tc Inputs - 11S

Segment	Flow Type	Flow Length	Slope	Surface Type
1	Sheet	10	0.02	Pave
2	SCF	178	.0050	Grass
3	SCF	42	.0050	Pave
4	SCF	81	.0050	Grass
5	SCF	42	.0050	Pave



Appendix E

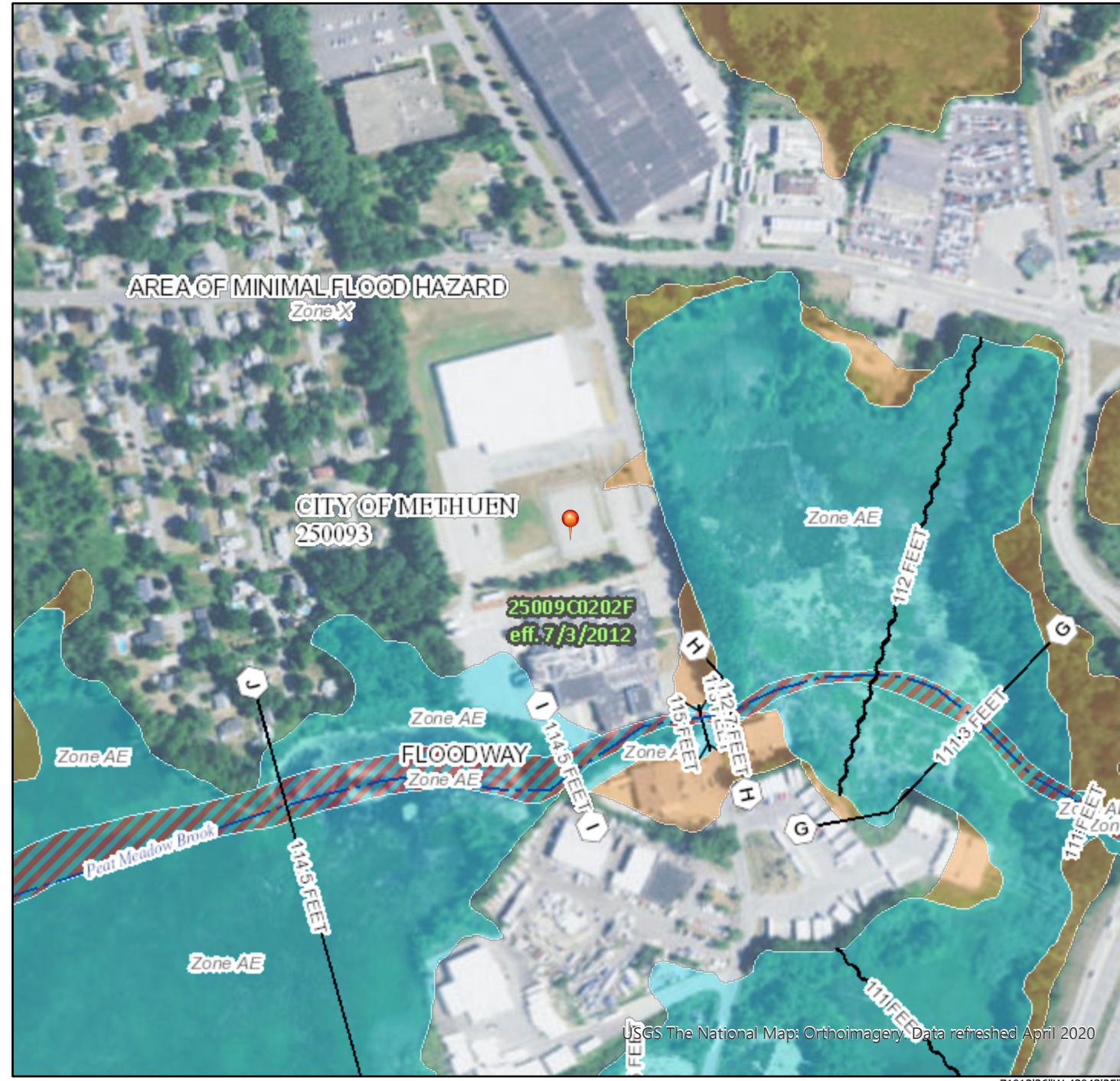
FEMA FLOOD INSURANCE RATE MAP

National Flood Hazard Layer FIRMette



FEMA

71°13'3" W 42°43'52" N



Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

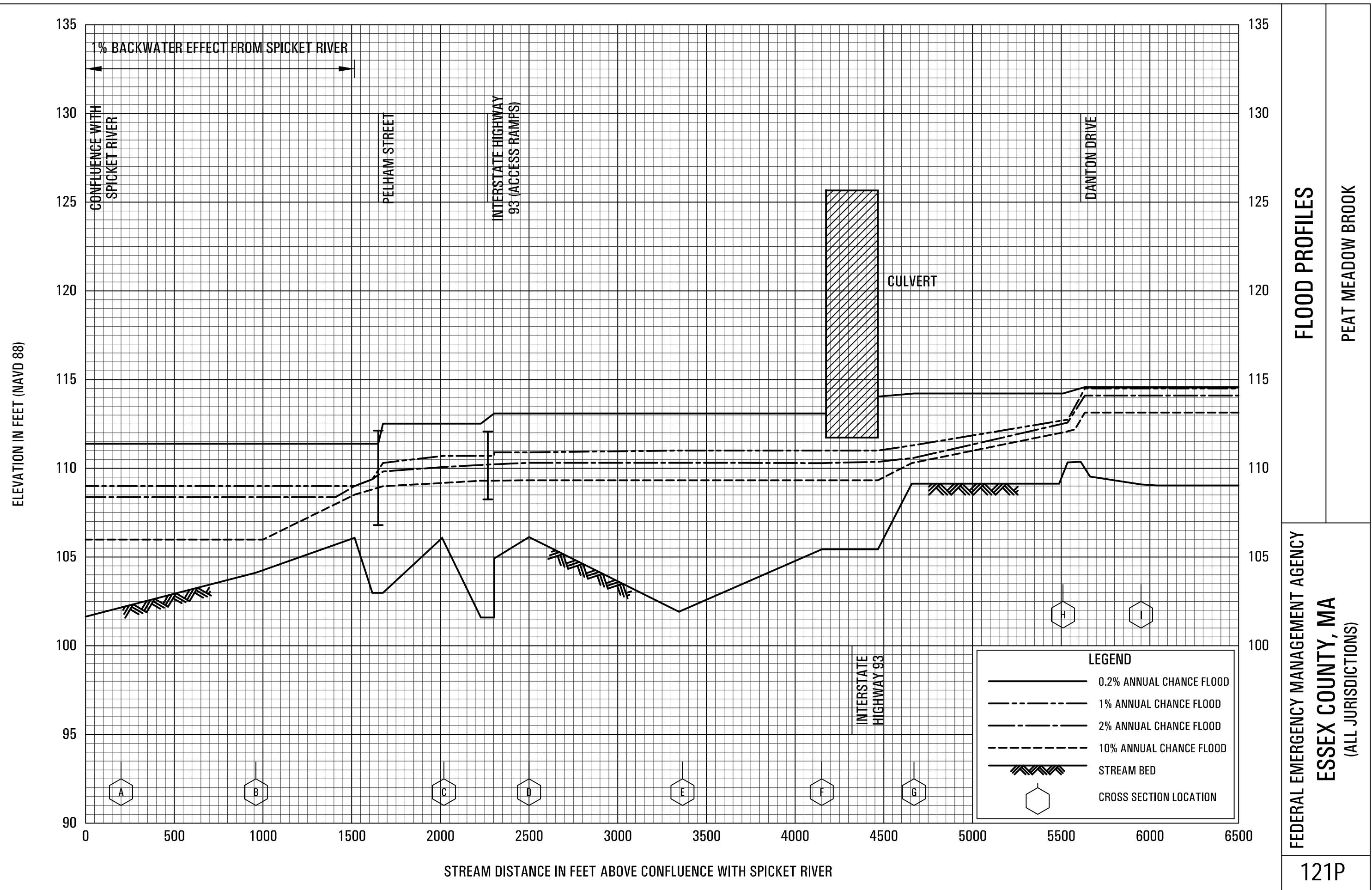
SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) Zone A, V, A99
	With BFE or Depth Zone AE, AO, AH, VE, AR
	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
	Future Conditions 1% Annual Chance Flood Hazard Zone X
	Area with Reduced Flood Risk due to Levee. See Notes. Zone X
	Area with Flood Risk due to Levee Zone D
OTHER AREAS	NO SCREEN Area of Minimal Flood Hazard Zone X
	Effective LOMRs
GENERAL STRUCTURES	Area of Undetermined Flood Hazard Zone
OTHER FEATURES	— — — Channel, Culvert, or Storm Sewer
	Levee, Dike, or Floodwall
	 20.2 Cross Sections with 1% Annual Chance
	17.5 Water Surface Elevation
	 — — Coastal Transect
	~~~~ 513 ~~~ Base Flood Elevation Line (BFE)
	— — — Limit of Study
	— — — Coastal Transect Baseline
	— — — Profile Baseline
	— — — Hydrographic Feature
<b>MAP PANELS</b>	 Digital Data Available
	 No Digital Data Available
	 Unmanned

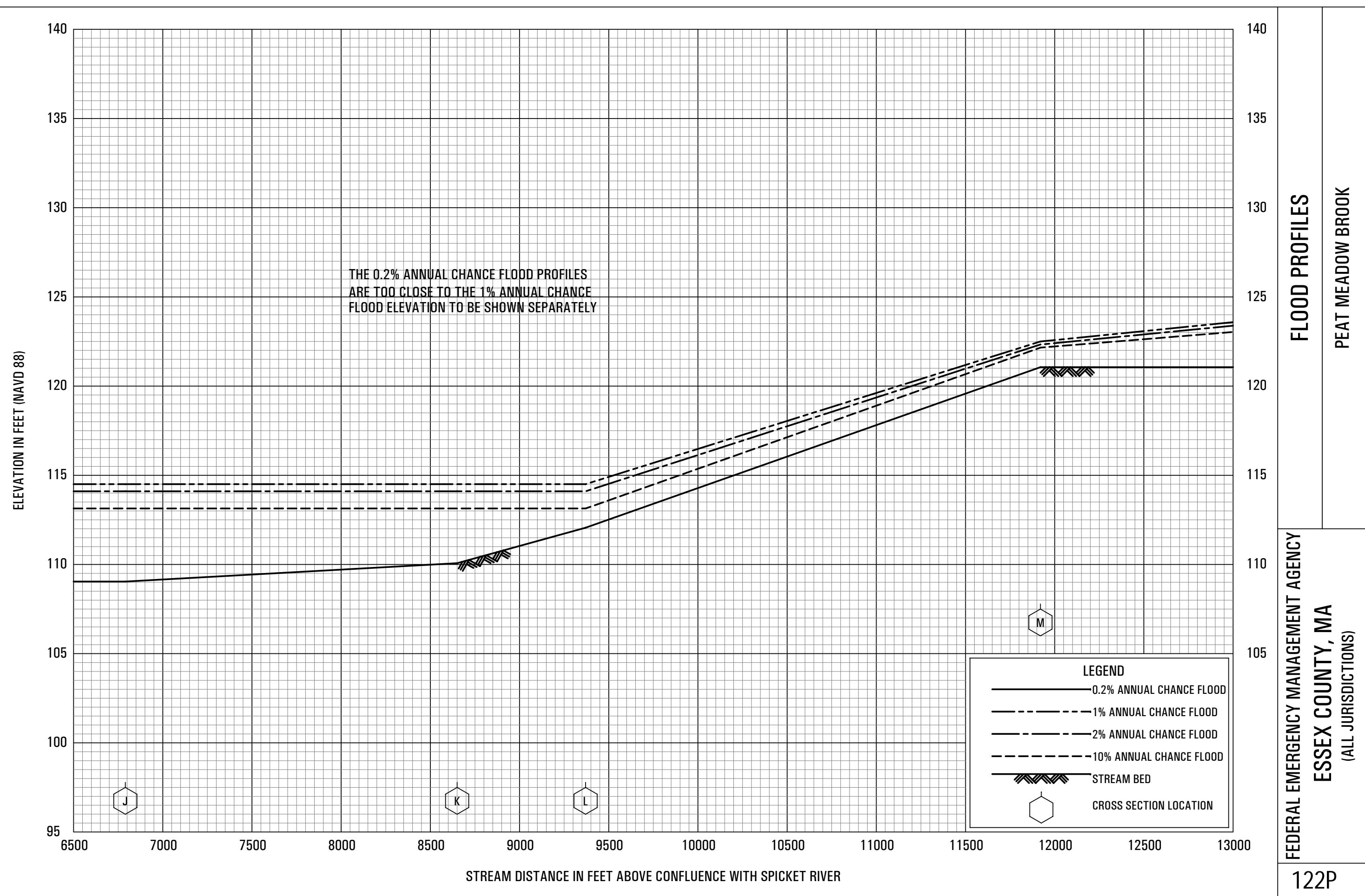
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

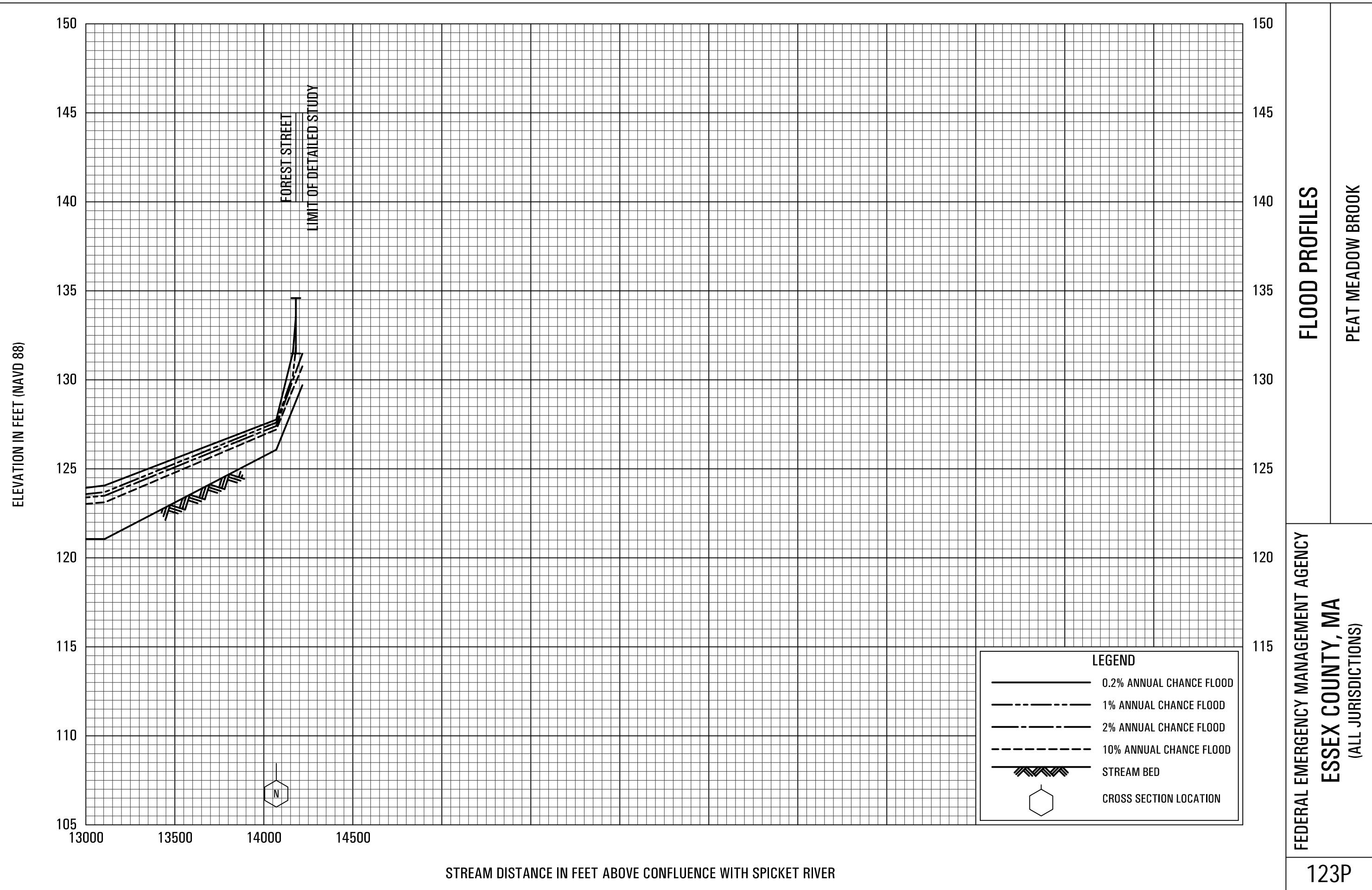
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **8/19/2020 at 1:35 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.







## Appendix F

# SOILS INFORMATION



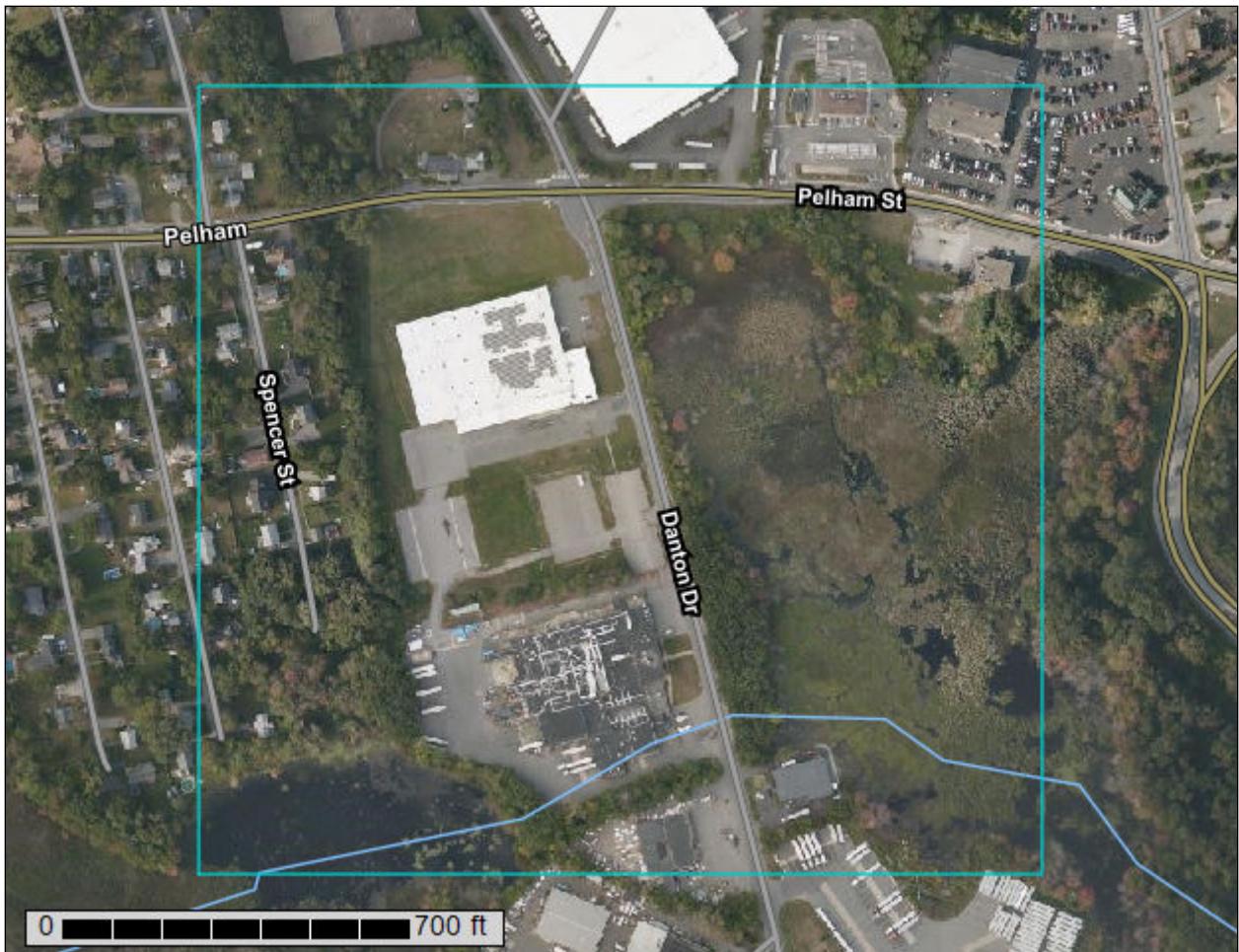
United States  
Department of  
Agriculture

**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



# Preface

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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](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951)).

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

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

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

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# Contents

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<b>Preface</b> .....	2
<b>How Soil Surveys Are Made</b> .....	5
<b>Soil Map</b> .....	8
Soil Map.....	9
Legend.....	10
Map Unit Legend.....	11
Map Unit Descriptions.....	11
Essex County, Massachusetts, Northern Part.....	14
52A—Freetown muck, 0 to 1 percent slopes.....	14
73A—Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony.....	15
255B—Windsor loamy sand, 3 to 8 percent slopes.....	17
256A—Deerfield loamy fine sand, 0 to 3 percent slopes.....	18
420B—Canton fine sandy loam, 3 to 8 percent slopes.....	20
421B—Canton fine sandy loam, 0 to 8 percent slopes, very stony.....	21
421C—Canton fine sandy loam, 8 to 15 percent slopes, very stony.....	23
421D—Canton fine sandy loam, 15 to 25 percent slopes, very stony.....	25
422C—Canton fine sandy loam, 8 to 15 percent slopes, extremely stony.....	26
600—Pits, gravel.....	28
651—Udorthents, smoothed.....	28
<b>References</b> .....	30
<b>Glossary</b> .....	32

# How Soil Surveys Are Made

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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

## Custom Soil Resource Report

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

# **Soil Map**

---

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

## Custom Soil Resource Report Soil Map



Soil Map may not be valid at this scale.

Map Scale: 1:4,090 if printed on A landscape (11" x 8.5") sheet.

A horizontal scale bar with tick marks at 0, 50, 100, 200, and 300 meters. The word "Meters" is written at the end of the bar.

Map projection: Web Mercator. Corner coordinates: WGS84. Edge ticks: 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 16, Jun 9, 2020

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

Date(s) aerial images were photographed: Aug 28, 2019—Sep 20, 2019

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
52A	Freetown muck, 0 to 1 percent slopes	21.9	35.2%
73A	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony	1.4	2.2%
255B	Windsor loamy sand, 3 to 8 percent slopes	3.8	6.0%
256A	Deerfield loamy fine sand, 0 to 3 percent slopes	1.6	2.5%
420B	Canton fine sandy loam, 3 to 8 percent slopes	1.1	1.8%
421B	Canton fine sandy loam, 0 to 8 percent slopes, very stony	4.3	6.9%
421C	Canton fine sandy loam, 8 to 15 percent slopes, very stony	1.5	2.4%
421D	Canton fine sandy loam, 15 to 25 percent slopes, very stony	0.0	0.1%
422C	Canton fine sandy loam, 8 to 15 percent slopes, extremely stony	1.3	2.1%
600	Pits, gravel	1.2	2.0%
651	Udorthents, smoothed	24.1	38.7%
<b>Totals for Area of Interest</b>		<b>62.2</b>	<b>100.0%</b>

## 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

## Custom Soil Resource Report

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

### 52A—Freetown muck, 0 to 1 percent slopes

#### Map Unit Setting

*National map unit symbol:* 2t2q9

*Elevation:* 0 to 1,110 feet

*Mean annual precipitation:* 36 to 71 inches

*Mean annual air temperature:* 39 to 55 degrees F

*Frost-free period:* 140 to 240 days

*Farmland classification:* Not prime farmland

#### Map Unit Composition

*Freetown and similar soils:* 85 percent

*Minor components:* 15 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Freetown

##### Setting

*Landform:* Kettles, swamps, depressions, depressions, bogs, marshes

*Landform position (two-dimensional):* Toeslope

*Landform position (three-dimensional):* Tread, dip

*Down-slope shape:* Concave

*Across-slope shape:* Concave

*Parent material:* Highly decomposed organic material

##### Typical profile

*Oe - 0 to 2 inches:* mucky peat

*Oa - 2 to 79 inches:* muck

##### Properties and qualities

*Slope:* 0 to 1 percent

*Surface area covered with cobbles, stones or boulders:* 0.0 percent

*Depth to restrictive feature:* More than 80 inches

*Drainage class:* Very poorly drained

*Runoff class:* Negligible

*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 0 to 6 inches

*Frequency of flooding:* Rare

*Frequency of ponding:* Frequent

*Available water capacity:* Very high (about 19.2 inches)

##### Interpretive groups

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 5w

*Hydrologic Soil Group:* B/D

*Ecological site:* F144AY043MA - Acidic Organic Wetlands

*Hydric soil rating:* Yes

#### Minor Components

##### Swansea

*Percent of map unit:* 5 percent

*Landform:* Swamps, bogs, kettles, depressions, depressions, marshes

*Landform position (two-dimensional):* Toeslope  
*Landform position (three-dimensional):* Tread, dip  
*Down-slope shape:* Concave  
*Across-slope shape:* Concave  
*Hydric soil rating:* Yes

#### **Scarboro**

*Percent of map unit:* 5 percent  
*Landform:* Depressions, drainageways  
*Landform position (two-dimensional):* Toeslope  
*Landform position (three-dimensional):* Base slope, tread, dip  
*Down-slope shape:* Concave  
*Across-slope shape:* Concave  
*Hydric soil rating:* Yes

#### **Whitman**

*Percent of map unit:* 5 percent  
*Landform:* Depressions, drainageways  
*Landform position (two-dimensional):* Toeslope  
*Landform position (three-dimensional):* Base slope  
*Down-slope shape:* Concave  
*Across-slope shape:* Concave  
*Hydric soil rating:* Yes

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

#### **Map Unit Setting**

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

#### **Map Unit Composition**

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

#### **Description of Whitman, Extremely Stony**

##### **Setting**

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

### Typical profile

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

### Properties and qualities

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

### Interpretive groups

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

### Minor Components

#### Ridgebury, extremely stony

*Percent of map unit*: 10 percent  
*Landform*: Drumlins, drainageways, hills, ground moraines, depressions  
*Landform position (two-dimensional)*: Toeslope, footslope  
*Landform position (three-dimensional)*: Base slope, head slope  
*Down-slope shape*: Concave  
*Across-slope shape*: Concave  
*Hydric soil rating*: Yes

#### Scarboro

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

#### Swansea

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

#### Woodbridge, extremely stony

*Percent of map unit*: 1 percent  
*Landform*: Drumlins, hills, ground moraines  
*Landform position (two-dimensional)*: Backslope, footslope, summit

*Landform position (three-dimensional):* Side slope, crest  
*Down-slope shape:* Concave  
*Across-slope shape:* Linear  
*Hydric soil rating:* No

## 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 240 days  
*Farmland classification:* Farmland of statewide importance

### Map Unit Composition

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

### Description of Windsor, Loamy Sand

#### Setting

*Landform:* Outwash terraces, deltas, outwash plains, dunes  
*Landform position (three-dimensional):* Tread, riser  
*Down-slope shape:* Linear, convex  
*Across-slope shape:* Linear, convex  
*Parent material:* Loose sandy glaciofluvial deposits derived from granite and/or loose sandy glaciofluvial deposits derived from schist and/or loose sandy glaciofluvial deposits derived from gneiss

#### Typical profile

*O - 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:* Low  
*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 (0.0 to 1.9 mmhos/cm)  
*Available water capacity:* Low (about 4.5 inches)

### Interpretive groups

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 2s  
*Hydrologic Soil Group:* A  
*Ecological site:* F144AY022MA - Dry Outwash  
*Hydric soil rating:* No

### Minor Components

#### Hinckley, loamy sand

*Percent of map unit:* 10 percent  
*Landform:* Outwash plains, eskers, kames, deltas  
*Landform position (two-dimensional):* Summit, shoulder, backslope  
*Landform position (three-dimensional):* Nose slope, side slope, crest, head slope, rise  
*Down-slope shape:* Convex  
*Across-slope shape:* Linear, convex  
*Hydric soil rating:* No

#### Deerfield, loamy sand

*Percent of map unit:* 5 percent  
*Landform:* Terraces, deltas, outwash plains  
*Landform position (two-dimensional):* Footslope  
*Landform position (three-dimensional):* Tread, talus  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*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 plains, outwash deltas, outwash terraces, kame terraces  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Linear, concave, convex  
*Across-slope shape:* Concave, linear, convex

*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 capacity:* 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, outwash plains, outwash deltas, kame terraces  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Linear, convex, concave  
*Across-slope shape:* Concave, linear, convex  
*Hydric soil rating:* No

**Wareham**

*Percent of map unit:* 5 percent  
*Landform:* Depressions, drainageways  
*Down-slope shape:* Concave  
*Across-slope shape:* Concave  
*Hydric soil rating:* Yes

**Sudbury**

*Percent of map unit:* 2 percent  
*Landform:* Outwash terraces, outwash deltas, kame terraces, outwash plains  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Convex, linear, concave  
*Across-slope shape:* Concave, linear, convex  
*Hydric soil rating:* No

**Ninigret**

*Percent of map unit:* 1 percent  
*Landform:* Outwash terraces, outwash plains, kame terraces  
*Landform position (three-dimensional):* Tread

*Down-slope shape:* Linear, convex

*Across-slope shape:* Concave, convex

*Hydric soil rating:* No

## 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:* Ridges, moraines, hills

*Landform position (two-dimensional):* Backslope, summit, shoulder

*Landform position (three-dimensional):* Side slope, crest, nose 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

*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 capacity:* 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: Ground moraines, drumlins, hills*

*Landform position (two-dimensional): Backslope, footslope, summit*

*Landform position (three-dimensional): Side slope, crest*

*Down-slope shape: Linear, convex*

*Across-slope shape: Convex*

*Hydric soil rating: No*

#### **Montauk**

*Percent of map unit: 5 percent*

*Landform: Hills, ground moraines, moraines, drumlins*

*Landform position (two-dimensional): Backslope, shoulder, summit*

*Landform position (three-dimensional): Side slope, crest*

*Down-slope shape: Linear, convex*

*Across-slope shape: Convex*

*Hydric soil rating: No*

#### **Charlton**

*Percent of map unit: 4 percent*

*Landform: Hills, ground moraines, ridges*

*Landform position (two-dimensional): Backslope, shoulder, summit*

*Landform position (three-dimensional): Crest, side slope*

*Down-slope shape: Linear, convex*

*Across-slope shape: Convex*

*Hydric soil rating: No*

#### **Swansea**

*Percent of map unit: 1 percent*

*Landform: Depressions, marshes, kettles, swamps, bogs*

*Down-slope shape: Concave*

*Across-slope shape: Concave*

*Hydric soil rating: Yes*

## **421B—Canton fine sandy loam, 0 to 8 percent slopes, very stony**

### **Map Unit Setting**

*National map unit symbol: 2w81I*

*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: Farmland of statewide importance*

### Map Unit Composition

*Canton, very stony, and similar soils:* 80 percent

*Minor components:* 20 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Canton, Very Stony

#### Setting

*Landform:* Ridges, hills, moraines

*Landform position (two-dimensional):* Summit, shoulder, backslope

*Landform position (three-dimensional):* Side slope, crest, nose 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:* 0 to 8 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 capacity:* 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

#### Scituate, very stony

*Percent of map unit:* 9 percent

*Landform:* Ground moraines, drumlins, hills

*Landform position (two-dimensional):* Footslope, backslope, summit

*Landform position (three-dimensional):* Side slope, crest

*Down-slope shape:* Linear, convex

*Across-slope shape:* Convex

*Hydric soil rating:* No

**Montauk, very stony**

*Percent of map unit:* 5 percent

*Landform:* Hills, ground moraines, recessional moraines, drumlins

*Landform position (two-dimensional):* Backslope, shoulder, summit

*Landform position (three-dimensional):* Side slope, crest

*Down-slope shape:* Linear, convex

*Across-slope shape:* Convex

*Hydric soil rating:* No

**Gloucester, very stony**

*Percent of map unit:* 4 percent

*Landform:* Ridges, hills, moraines

*Landform position (two-dimensional):* Summit, backslope, shoulder

*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:* 2 percent

*Landform:* Kettles, swamps, bogs, depressions, marshes

*Down-slope shape:* Concave

*Across-slope shape:* Concave

*Hydric soil rating:* Yes

## **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:* Hills, ridges, moraines

*Landform position (two-dimensional):* Backslope

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear, convex

*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 capacity:* 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:* Drumlins, hills, ground moraines, recessional moraines  
*Landform position (two-dimensional):* Backslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear, convex  
*Across-slope shape:* Convex  
*Hydric soil rating:* No

#### Scituate, very stony

*Percent of map unit:* 5 percent  
*Landform:* Ground moraines, drumlins, hills  
*Landform position (two-dimensional):* Foothslope, backslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear, convex  
*Across-slope shape:* Convex  
*Hydric soil rating:* No

#### Chatfield, very stony

*Percent of map unit:* 3 percent  
*Landform:* Ridges, hills  
*Landform position (two-dimensional):* Backslope, shoulder, summit  
*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:* Kettles, swamps, bogs, depressions, marshes

*Down-slope shape:* Concave

*Across-slope shape:* Concave

*Hydric soil rating:* Yes

## 421D—Canton fine sandy loam, 15 to 25 percent slopes, very stony

### Map Unit Setting

*National map unit symbol:* vj5c

*Elevation:* 0 to 1,000 feet

*Mean annual precipitation:* 45 to 54 inches

*Mean annual air temperature:* 43 to 54 degrees F

*Frost-free period:* 145 to 240 days

*Farmland classification:* Not prime farmland

### Map Unit Composition

*Canton and similar soils:* 85 percent

*Minor components:* 15 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Canton

#### Setting

*Landform:* Hills

*Landform position (two-dimensional):* Backslope

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Convex

*Parent material:* Friable coarse-loamy eolian deposits over friable sandy and gravelly basal till derived from granite and gneiss

#### Typical profile

*H1 - 0 to 6 inches:* fine sandy loam

*H2 - 6 to 33 inches:* fine sandy loam

*H3 - 33 to 60 inches:* gravelly loamy sand

#### Properties and qualities

*Slope:* 15 to 25 percent

*Surface area covered with cobbles, stones or boulders:* 1.6 percent

*Depth to restrictive feature:* 18 to 36 inches to strongly contrasting textural stratification

*Drainage class:* Well drained

*Capacity of the most limiting layer to transmit water (Ksat):* High (2.00 to 6.00 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water capacity:* Low (about 4.5 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 6s

*Hydrologic Soil Group:* A

*Ecological site:* F144AY034CT - Well Drained Till Uplands

*Hydric soil rating:* No

**Minor Components**

**Scituate**

*Percent of map unit:* 10 percent

*Hydric soil rating:* No

**Charlton**

*Percent of map unit:* 5 percent

*Hydric soil rating:* No

## 422C—Canton fine sandy loam, 8 to 15 percent slopes, extremely stony

**Map Unit Setting**

*National map unit symbol:* 2w815

*Elevation:* 0 to 1,310 feet

*Mean annual precipitation:* 36 to 71 inches

*Mean annual air temperature:* 39 to 55 degrees F

*Frost-free period:* 145 to 240 days

*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Canton, extremely stony, and similar soils:* 80 percent

*Minor components:* 20 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Canton, Extremely Stony**

**Setting**

*Landform:* Ridges, hills, moraines

*Landform position (two-dimensional):* Summit, backslope, shoulder

*Landform position (three-dimensional):* Side slope, crest, nose 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:* 9.0 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 capacity:* Low (about 3.4 inches)

### **Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 7s

*Hydrologic Soil Group:* B

*Ecological site:* F144AY034CT - Well Drained Till Uplands

*Hydric soil rating:* No

### **Minor Components**

#### **Scituate, extremely stony**

*Percent of map unit:* 6 percent

*Landform:* Ground moraines, drumlins, hills

*Landform position (two-dimensional):* Foothills, backslope

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear, convex

*Across-slope shape:* Convex

*Hydric soil rating:* No

#### **Charlton, extremely stony**

*Percent of map unit:* 5 percent

*Landform:* Hills, ground moraines, ridges

*Landform position (two-dimensional):* Backslope

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear, convex

*Across-slope shape:* Convex

*Hydric soil rating:* No

#### **Montauk, extremely stony**

*Percent of map unit:* 5 percent

*Landform:* Hills, ground moraines, recessional moraines, drumlins

*Landform position (two-dimensional):* Backslope

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear, convex

*Across-slope shape:* Convex

*Hydric soil rating:* No

#### **Hollis, extremely stony**

*Percent of map unit:* 4 percent

*Landform:* Hills, ridges

*Landform position (two-dimensional):* Backslope, shoulder, summit

*Landform position (three-dimensional):* Crest, side slope, nose slope

*Down-slope shape:* Convex  
*Across-slope shape:* Linear, convex  
*Hydric soil rating:* No

## 600—Pits, gravel

### Map Unit Setting

*National map unit symbol:* vjq2  
*Frost-free period:* 125 to 165 days  
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Pits:* 100 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Pits

#### Setting

*Parent material:* Loose sandy and gravelly glaciofluvial deposits

## 651—Udorthents, smoothed

### Map Unit Setting

*National map unit symbol:* vjwk  
*Elevation:* 0 to 3,000 feet  
*Mean annual precipitation:* 45 to 54 inches  
*Mean annual air temperature:* 43 to 54 degrees F  
*Frost-free period:* 145 to 240 days  
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Udorthents and similar soils:* 80 percent  
*Minor components:* 20 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Udorthents

#### Setting

*Parent material:* Excavated and filled land loamy and/or excavated and filled land sandy and gravelly

#### Typical profile

*H1 - 0 to 6 inches:* variable  
*H2 - 6 to 60 inches:* variable

#### Properties and qualities

*Slope:* 0 to 3 percent

*Depth to restrictive feature:* More than 80 inches

*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to very high (0.06 to 20.00 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

#### **Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 6s

*Hydrologic Soil Group:* A

*Hydric soil rating:* Unranked

#### **Minor Components**

##### **Urban land**

*Percent of map unit:* 10 percent

*Hydric soil rating:* Unranked

##### **Beaches**

*Percent of map unit:* 8 percent

*Hydric soil rating:* Unranked

##### **Dumps**

*Percent of map unit:* 2 percent

*Hydric soil rating:* Unranked

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# **Glossary**

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Many of the terms relating to landforms, geology, and geomorphology are defined in more detail in the following National Soil Survey Handbook link: "[National Soil Survey Handbook](#)."

## **ABC soil**

A soil having an A, a B, and a C horizon.

## **Ablation till**

Loose, relatively permeable earthy material deposited during the downwasting of nearly static glacial ice, either contained within or accumulated on the surface of the glacier.

## **AC soil**

A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

## **Aeration, soil**

The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

## **Aggregate, soil**

Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

## **Alkali (sodic) soil**

A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

## **Alluvial cone**

A semiconical type of alluvial fan having very steep slopes. It is higher, narrower, and steeper than a fan and is composed of coarser and thicker layers of material deposited by a combination of alluvial episodes and (to a much lesser degree) landslides (debris flow). The coarsest materials tend to be concentrated at the apex of the cone.

### **Alluvial fan**

A low, outspread mass of loose materials and/or rock material, commonly with gentle slopes. It is shaped like an open fan or a segment of a cone. The material was deposited by a stream at the place where it issues from a narrow mountain valley or upland valley or where a tributary stream is near or at its junction with the main stream. The fan is steepest near its apex, which points upstream, and slopes gently and convexly outward (downstream) with a gradual decrease in gradient.

### **Alluvium**

Unconsolidated material, such as gravel, sand, silt, clay, and various mixtures of these, deposited on land by running water.

### **Alpha,alpha-dipyridyl**

A compound that when dissolved in ammonium acetate is used to detect the presence of reduced iron (Fe II) in the soil. A positive reaction implies reducing conditions and the likely presence of redoximorphic features.

### **Animal unit month (AUM)**

The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

### **Aquic conditions**

Current soil wetness characterized by saturation, reduction, and redoximorphic features.

### **Argillic horizon**

A subsoil horizon characterized by an accumulation of illuvial clay.

### **Arroyo**

The flat-floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in unconsolidated material. It is usually dry but can be transformed into a temporary watercourse or short-lived torrent after heavy rain within the watershed.

### **Aspect**

The direction toward which a slope faces. Also called slope aspect.

### **Association, soil**

A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

### **Available water capacity (available moisture capacity)**

The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

*Very low:* 0 to 3

*Low:* 3 to 6

*Moderate:* 6 to 9

*High:* 9 to 12

*Very high:* More than 12

### **Backslope**

The position that forms the steepest and generally linear, middle portion of a hillslope. In profile, backslopes are commonly bounded by a convex shoulder above and a concave footslope below.

### **Backswamp**

A flood-plain landform. Extensive, marshy or swampy, depressed areas of flood plains between natural levees and valley sides or terraces.

### **Badland**

A landscape that is intricately dissected and characterized by a very fine drainage network with high drainage densities and short, steep slopes and narrow interfluves. Badlands develop on surfaces that have little or no vegetative cover overlying unconsolidated or poorly cemented materials (clays, silts, or sandstones) with, in some cases, soluble minerals, such as gypsum or halite.

### **Bajada**

A broad, gently inclined alluvial piedmont slope extending from the base of a mountain range out into a basin and formed by the lateral coalescence of a series of alluvial fans. Typically, it has a broadly undulating transverse profile, parallel to the mountain front, resulting from the convexities of component fans. The term is generally restricted to constructional slopes of intermontane basins.

### **Basal area**

The area of a cross section of a tree, generally referring to the section at breast height and measured outside the bark. It is a measure of stand density, commonly expressed in square feet.

### **Base saturation**

The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

### **Base slope (geomorphology)**

A geomorphic component of hills consisting of the concave to linear (perpendicular to the contour) slope that, regardless of the lateral shape, forms an apron or wedge at the bottom of a hillside dominated by colluvium and slope-wash sediments (for example, slope alluvium).

### **Bedding plane**

A planar or nearly planar bedding surface that visibly separates each successive layer of stratified sediment or rock (of the same or different lithology)

from the preceding or following layer; a plane of deposition. It commonly marks a change in the circumstances of deposition and may show a parting, a color difference, a change in particle size, or various combinations of these. The term is commonly applied to any bedding surface, even one that is conspicuously bent or deformed by folding.

### **Bedding system**

A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

### **Bedrock**

The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

### **Bedrock-controlled topography**

A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

### **Bench terrace**

A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

### **Bisequum**

Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

### **Blowout (map symbol)**

A saucer-, cup-, or trough-shaped depression formed by wind erosion on a preexisting dune or other sand deposit, especially in an area of shifting sand or loose soil or where protective vegetation is disturbed or destroyed. The adjoining accumulation of sand derived from the depression, where recognizable, is commonly included. Blowouts are commonly small.

### **Borrow pit (map symbol)**

An open excavation from which soil and underlying material have been removed, usually for construction purposes.

### **Bottom land**

An informal term loosely applied to various portions of a flood plain.

### **Boulders**

Rock fragments larger than 2 feet (60 centimeters) in diameter.

### **Breaks**

A landscape or tract of steep, rough or broken land dissected by ravines and gullies and marking a sudden change in topography.

### **Breast height**

An average height of 4.5 feet above the ground surface; the point on a tree where diameter measurements are ordinarily taken.

### **Brush management**

Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

### **Butte**

An isolated, generally flat-topped hill or mountain with relatively steep slopes and talus or precipitous cliffs and characterized by summit width that is less than the height of bounding escarpments; commonly topped by a caprock of resistant material and representing an erosion remnant carved from flat-lying rocks.

### **Cable yarding**

A method of moving felled trees to a nearby central area for transport to a processing facility. Most cable yarding systems involve use of a drum, a pole, and wire cables in an arrangement similar to that of a rod and reel used for fishing. To reduce friction and soil disturbance, felled trees generally are reeled in while one end is lifted or the entire log is suspended.

### **Calcareous soil**

A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

### **Caliche**

A general term for a prominent zone of secondary carbonate accumulation in surficial materials in warm, subhumid to arid areas. Caliche is formed by both geologic and pedologic processes. Finely crystalline calcium carbonate forms a nearly continuous surface-coating and void-filling medium in geologic (parent) materials. Cementation ranges from weak in nonindurated forms to very strong in indurated forms. Other minerals (e.g., carbonates, silicate, and sulfate) may occur as accessory cements. Most petrocalcic horizons and some calcic horizons are caliche.

### **California bearing ratio (CBR)**

The load-supporting capacity of a soil as compared to that of standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

### **Canopy**

The leafy crown of trees or shrubs. (See Crown.)

### **Canyon**

A long, deep, narrow valley with high, precipitous walls in an area of high local relief.

### **Capillary water**

Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

### **Catena**

A sequence, or “chain,” of soils on a landscape that formed in similar kinds of parent material and under similar climatic conditions but that have different characteristics as a result of differences in relief and drainage.

### **Cation**

An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

### **Cation-exchange capacity**

The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

### **Catsteps**

See Terracettes.

### **Cement rock**

Shaly limestone used in the manufacture of cement.

### **Channery soil material**

Soil material that has, by volume, 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches (15 centimeters) along the longest axis. A single piece is called a channer.

### **Chemical treatment**

Control of unwanted vegetation through the use of chemicals.

### **Chiseling**

Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

### **Cirque**

A steep-walled, semicircular or crescent-shaped, half-bowl-like recess or hollow, commonly situated at the head of a glaciated mountain valley or high on the side of a mountain. It was produced by the erosive activity of a mountain glacier. It commonly contains a small round lake (tarn).

## **Clay**

As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

## **Clay depletions**

See Redoximorphic features.

## **Clay film**

A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

## **Clay spot (map symbol)**

A spot where the surface texture is silty clay or clay in areas where the surface layer of the soils in the surrounding map unit is sandy loam, loam, silt loam, or coarser.

## **Claypan**

A dense, compact subsoil layer that contains much more clay than the overlying materials, from which it is separated by a sharply defined boundary. The layer restricts the downward movement of water through the soil. A claypan is commonly hard when dry and plastic and sticky when wet.

## **Climax plant community**

The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

## **Coarse textured soil**

Sand or loamy sand.

## **Cobble (or cobblestone)**

A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

## **Cobbly soil material**

Material that has 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.

## **COLE (coefficient of linear extensibility)**

See Linear extensibility.

## **Colluvium**

Unconsolidated, unsorted earth material being transported or deposited on side slopes and/or at the base of slopes by mass movement (e.g., direct gravitational action) and by local, unconcentrated runoff.

### **Complex slope**

Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

### **Complex, soil**

A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

### **Concretions**

See Redoximorphic features.

### **Conglomerate**

A coarse grained, clastic sedimentary rock composed of rounded or subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer textured material. Conglomerate is the consolidated equivalent of gravel.

### **Conservation cropping system**

Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the effects of the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

### **Conservation tillage**

A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

### **Consistence, soil**

Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the "Soil Survey Manual."

### **Contour stripcropping**

Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

### **Control section**

The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

**Coprogenous earth (sedimentary peat)**

A type of limnic layer composed predominantly of fecal material derived from aquatic animals.

**Corrosion (geomorphology)**

A process of erosion whereby rocks and soil are removed or worn away by natural chemical processes, especially by the solvent action of running water, but also by other reactions, such as hydrolysis, hydration, carbonation, and oxidation.

**Corrosion (soil survey interpretations)**

Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

**Cover crop**

A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

**Crop residue management**

Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

**Cropping system**

Growing crops according to a planned system of rotation and management practices.

**Cross-slope farming**

Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

**Crown**

The upper part of a tree or shrub, including the living branches and their foliage.

**Cryoturbate**

A mass of soil or other unconsolidated earthy material moved or disturbed by frost action. It is typically coarser than the underlying material.

**Cuesta**

An asymmetric ridge capped by resistant rock layers of slight or moderate dip (commonly less than 15 percent slopes); a type of homoclinal produced by differential erosion of interbedded resistant and weak rocks. A cuesta has a long, gentle slope on one side (dip slope) that roughly parallels the inclined beds; on the other side, it has a relatively short and steep or clifflike slope (scarp) that cuts through the tilted rocks.

### **Culmination of the mean annual increment (CMAI)**

The average annual increase per acre in the volume of a stand. Computed by dividing the total volume of the stand by its age. As the stand increases in age, the mean annual increment continues to increase until mortality begins to reduce the rate of increase. The point where the stand reaches its maximum annual rate of growth is called the culmination of the mean annual increment.

### **Cutbanks cave**

The walls of excavations tend to cave in or slough.

### **Decreasers**

The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

### **Deferred grazing**

Postponing grazing or resting grazing land for a prescribed period.

### **Delta**

A body of alluvium having a surface that is fan shaped and nearly flat; deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

### **Dense layer**

A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

### **Depression, closed (map symbol)**

A shallow, saucer-shaped area that is slightly lower on the landscape than the surrounding area and that does not have a natural outlet for surface drainage.

### **Depth, soil**

Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

### **Desert pavement**

A natural, residual concentration or layer of wind-polished, closely packed gravel, boulders, and other rock fragments mantling a desert surface. It forms where wind action and sheetwash have removed all smaller particles or where rock fragments have migrated upward through sediments to the surface. It typically protects the finer grained underlying material from further erosion.

### **Diatomaceous earth**

A geologic deposit of fine, grayish siliceous material composed chiefly or entirely of the remains of diatoms.

**Dip slope**

A slope of the land surface, roughly determined by and approximately conforming to the dip of the underlying bedrock.

**Diversion (or diversion terrace)**

A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

**Divided-slope farming**

A form of field stripcropping in which crops are grown in a systematic arrangement of two strips, or bands, across the slope to reduce the hazard of water erosion. One strip is in a close-growing crop that provides protection from erosion, and the other strip is in a crop that provides less protection from erosion. This practice is used where slopes are not long enough to permit a full stripcropping pattern to be used.

**Drainage class (natural)**

Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained*. These classes are defined in the “Soil Survey Manual.”

**Drainage, surface**

Runoff, or surface flow of water, from an area.

**Drainageway**

A general term for a course or channel along which water moves in draining an area. A term restricted to relatively small, linear depressions that at some time move concentrated water and either do not have a defined channel or have only a small defined channel.

**Draw**

A small stream valley that generally is shallower and more open than a ravine or gulch and that has a broader bottom. The present stream channel may appear inadequate to have cut the drainageway that it occupies.

**Drift**

A general term applied to all mineral material (clay, silt, sand, gravel, and boulders) transported by a glacier and deposited directly by or from the ice or transported by running water emanating from a glacier. Drift includes unstratified material (till) that forms moraines and stratified deposits that form outwash plains, eskers, kames, varves, and glaciofluvial sediments. The term is generally applied to Pleistocene glacial deposits in areas that no longer contain glaciers.

**Drumlin**

A low, smooth, elongated oval hill, mound, or ridge of compact till that has a core of bedrock or drift. It commonly has a blunt nose facing the direction from which the ice approached and a gentler slope tapering in the other direction. The longer axis is parallel to the general direction of glacier flow. Drumlins are products of streamline (laminar) flow of glaciers, which molded the subglacial floor through a combination of erosion and deposition.

**Duff**

A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

**Dune**

A low mound, ridge, bank, or hill of loose, windblown granular material (generally sand), either barren and capable of movement from place to place or covered and stabilized with vegetation but retaining its characteristic shape.

**Earthy fill**

See Mine spoil.

**Ecological site**

An area where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. An ecological site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other ecological sites in kind and/or proportion of species or in total production.

**Eluviation**

The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

**Endosaturation**

A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

**Eolian deposit**

Sand-, silt-, or clay-sized clastic material transported and deposited primarily by wind, commonly in the form of a dune or a sheet of sand or loess.

**Ephemeral stream**

A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

### **Episaturation**

A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

### **Erosion**

The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

#### **Erosion (accelerated)**

Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

#### **Erosion (geologic)**

Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

#### **Erosion pavement**

A surficial lag concentration or layer of gravel and other rock fragments that remains on the soil surface after sheet or rill erosion or wind has removed the finer soil particles and that tends to protect the underlying soil from further erosion.

#### **Erosion surface**

A land surface shaped by the action of erosion, especially by running water.

### **Escarpment**

A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Most commonly applied to cliffs produced by differential erosion. Synonym: scarp.

#### **Escarpment, bedrock (map symbol)**

A relatively continuous and steep slope or cliff, produced by erosion or faulting, that breaks the general continuity of more gently sloping land surfaces. Exposed material is hard or soft bedrock.

#### **Escarpment, nonbedrock (map symbol)**

A relatively continuous and steep slope or cliff, generally produced by erosion but in some places produced by faulting, that breaks the continuity of more gently sloping land surfaces. Exposed earthy material is nonsoil or very shallow soil.

### **Esker**

A long, narrow, sinuous, steep-sided ridge of stratified sand and gravel deposited as the bed of a stream flowing in an ice tunnel within or below the ice (subglacial) or between ice walls on top of the ice of a wasting glacier and left

behind as high ground when the ice melted. Eskers range in length from less than a kilometer to more than 160 kilometers and in height from 3 to 30 meters.

**Extrusive rock**

Igneous rock derived from deep-seated molten matter (magma) deposited and cooled on the earth's surface.

**Fallow**

Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

**Fan remnant**

A general term for landforms that are the remaining parts of older fan landforms, such as alluvial fans, that have been either dissected or partially buried.

**Fertility, soil**

The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

**Fibric soil material (peat)**

The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

**Field moisture capacity**

The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity*, *normal moisture capacity*, or *capillary capacity*.

**Fill slope**

A sloping surface consisting of excavated soil material from a road cut. It commonly is on the downhill side of the road.

**Fine textured soil**

Sandy clay, silty clay, or clay.

**Firebreak**

An area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of firefighters and equipment. Designated roads also serve as firebreaks.

**First bottom**

An obsolete, informal term loosely applied to the lowest flood-plain steps that are subject to regular flooding.

**Flaggy soil material**

Material that has, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has more than 60 percent flagstones.

**Flagstone**

A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

**Flood plain**

The nearly level plain that borders a stream and is subject to flooding unless protected artificially.

**Flood-plain landforms**

A variety of constructional and erosional features produced by stream channel migration and flooding. Examples include backswamps, flood-plain splays, meanders, meander belts, meander scrolls, oxbow lakes, and natural levees.

**Flood-plain splay**

A fan-shaped deposit or other outspread deposit formed where an overloaded stream breaks through a levee (natural or artificial) and deposits its material (commonly coarse grained) on the flood plain.

**Flood-plain step**

An essentially flat, terrace-like alluvial surface within a valley that is frequently covered by floodwater from the present stream; any approximately horizontal surface still actively modified by fluvial scour and/or deposition. May occur individually or as a series of steps.

**Fluvial**

Of or pertaining to rivers or streams; produced by stream or river action.

**Foothills**

A region of steeply sloping hills that fringes a mountain range or high-plateau escarpment. The hills have relief of as much as 1,000 feet (300 meters).

**Footslope**

The concave surface at the base of a hillslope. A footslope is a transition zone between upslope sites of erosion and transport (shoulders and backslopes) and downslope sites of deposition (toeslopes).

**Forb**

Any herbaceous plant not a grass or a sedge.

**Forest cover**

All trees and other woody plants (underbrush) covering the ground in a forest.

**Forest type**

A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

**Fragipan**

A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

**Genesis, soil**

The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

**Gilgai**

Commonly, a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of clayey soils that shrink and swell considerably with changes in moisture content.

**Glaciofluvial deposits**

Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur in the form of outwash plains, valley trains, deltas, kames, eskers, and kame terraces.

**Glaciolacustrine deposits**

Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are bedded or laminated.

**Gleyed soil**

Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

**Graded stripcropping**

Growing crops in strips that grade toward a protected waterway.

**Grassed waterway**

A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

### **Gravel**

Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

### **Gravel pit (map symbol)**

An open excavation from which soil and underlying material have been removed and used, without crushing, as a source of sand or gravel.

### **Gravelly soil material**

Material that has 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

### **Gravelly spot (map symbol)**

A spot where the surface layer has more than 35 percent, by volume, rock fragments that are mostly less than 3 inches in diameter in an area that has less than 15 percent rock fragments.

### **Green manure crop (agronomy)**

A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

### **Ground water**

Water filling all the unblocked pores of the material below the water table.

### **Gully (map symbol)**

A small, steep-sided channel caused by erosion and cut in unconsolidated materials by concentrated but intermittent flow of water. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage whereas a rill is of lesser depth and can be smoothed over by ordinary tillage.

### **Hard bedrock**

Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

### **Hard to reclaim**

Reclamation is difficult after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

### **Hardpan**

A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

**Head slope (geomorphology)**

A geomorphic component of hills consisting of a laterally concave area of a hillside, especially at the head of a drainageway. The overland waterflow is converging.

**Hemic soil material (mucky peat)**

Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

**High-residue crops**

Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

**Hill**

A generic term for an elevated area of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline. Slopes are generally more than 15 percent. The distinction between a hill and a mountain is arbitrary and may depend on local usage.

**Hillslope**

A generic term for the steeper part of a hill between its summit and the drainage line, valley flat, or depression floor at the base of a hill.

**Horizon, soil**

A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the "Soil Survey Manual." The major horizons of mineral soil are as follows:

*O horizon*: An organic layer of fresh and decaying plant residue.

*L horizon*: A layer of organic and mineral limnic materials, including coprogenous earth (sedimentary peat), diatomaceous earth, and marl.

*A horizon*: The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

*E horizon*: The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

*B horizon*: The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

*C horizon*: The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

*Cr horizon*: Soft, consolidated bedrock beneath the soil.

*R layer*: Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

*M layer*: A root-limiting subsoil layer consisting of nearly continuous, horizontally oriented, human-manufactured materials.

*W layer*: A layer of water within or beneath the soil.

## **Humus**

The well decomposed, more or less stable part of the organic matter in mineral soils.

## **Hydrologic soil groups**

Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties include depth to a seasonal high water table, the infiltration rate, and depth to a layer that significantly restricts the downward movement of water. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

## **Igneous rock**

Rock that was formed by cooling and solidification of magma and that has not been changed appreciably by weathering since its formation. Major varieties include plutonic and volcanic rock (e.g., andesite, basalt, and granite).

## **Illuviation**

The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

### **Impervious soil**

A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

### **Increasers**

Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

### **Infiltration**

The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

### **Infiltration capacity**

The maximum rate at which water can infiltrate into a soil under a given set of conditions.

### **Infiltration rate**

The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

### **Intake rate**

The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

*Very low:* Less than 0.2

*Low:* 0.2 to 0.4

*Moderately low:* 0.4 to 0.75

*Moderate:* 0.75 to 1.25

*Moderately high:* 1.25 to 1.75

*High:* 1.75 to 2.5

*Very high:* More than 2.5

### **Interfluve**

A landform composed of the relatively undissected upland or ridge between two adjacent valleys containing streams flowing in the same general direction. An elevated area between two drainageways that sheds water to those drainageways.

### **Interfluve (geomorphology)**

A geomorphic component of hills consisting of the uppermost, comparatively level or gently sloping area of a hill; shoulders of backwearing hillslopes can narrow the upland or can merge, resulting in a strongly convex shape.

### **Intermittent stream**

A stream, or reach of a stream, that does not flow year-round but that is commonly dry for 3 or more months out of 12 and whose channel is generally below the local water table. It flows only during wet periods or when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

### **Invaders**

On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

### **Iron depletions**

See Redoximorphic features.

### **Irrigation**

Application of water to soils to assist in production of crops. Methods of irrigation are:

*Basin:* Water is applied rapidly to nearly level plains surrounded by levees or dikes.

*Border:* Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

*Controlled flooding:* Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

*Corrugation:* Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

*Drip (or trickle):* Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

*Furrow:* Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

*Sprinkler:* Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

*Subirrigation:* Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

*Wild flooding:* Water, released at high points, is allowed to flow onto an area without controlled distribution.

### **Kame**

A low mound, knob, hummock, or short irregular ridge composed of stratified sand and gravel deposited by a subglacial stream as a fan or delta at the margin of a melting glacier; by a supraglacial stream in a low place or hole on the surface of the glacier; or as a ponded deposit on the surface or at the margin of stagnant ice.

**Karst (topography)**

A kind of topography that formed in limestone, gypsum, or other soluble rocks by dissolution and that is characterized by closed depressions, sinkholes, caves, and underground drainage.

**Knoll**

A small, low, rounded hill rising above adjacent landforms.

**Ksat**

See Saturated hydraulic conductivity.

**Lacustrine deposit**

Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

**Lake plain**

A nearly level surface marking the floor of an extinct lake filled by well sorted, generally fine textured, stratified deposits, commonly containing varves.

**Lake terrace**

A narrow shelf, partly cut and partly built, produced along a lakeshore in front of a scarp line of low cliffs and later exposed when the water level falls.

**Landfill (map symbol)**

An area of accumulated waste products of human habitation, either above or below natural ground level.

**Landslide**

A general, encompassing term for most types of mass movement landforms and processes involving the downslope transport and outward deposition of soil and rock materials caused by gravitational forces; the movement may or may not involve saturated materials. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

**Large stones**

Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

**Lava flow (map symbol)**

A solidified, commonly lobate body of rock formed through lateral, surface outpouring of molten lava from a vent or fissure.

**Leaching**

The removal of soluble material from soil or other material by percolating water.

### **Levee (map symbol)**

An embankment that confines or controls water, especially one built along the banks of a river to prevent overflow onto lowlands.

### **Linear extensibility**

Refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. Linear extensibility is used to determine the shrink-swell potential of soils. It is an expression of the volume change between the water content of the clod at  $1/3$ - or  $1/10$ -bar tension (33kPa or 10kPa tension) and oven dryness. Volume change is influenced by the amount and type of clay minerals in the soil. The volume change is the percent change for the whole soil. If it is expressed as a fraction, the resulting value is COLE, coefficient of linear extensibility.

### **Liquid limit**

The moisture content at which the soil passes from a plastic to a liquid state.

### **Loam**

Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

### **Loess**

Material transported and deposited by wind and consisting dominantly of silt-sized particles.

### **Low strength**

The soil is not strong enough to support loads.

### **Low-residue crops**

Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

### **Marl**

An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal proportions; formed primarily under freshwater lacustrine conditions but also formed in more saline environments.

### **Marsh or swamp (map symbol)**

A water-saturated, very poorly drained area that is intermittently or permanently covered by water. Sedges, cattails, and rushes are the dominant vegetation in marshes, and trees or shrubs are the dominant vegetation in swamps. Not used in map units where the named soils are poorly drained or very poorly drained.

### **Mass movement**

A generic term for the dislodgment and downslope transport of soil and rock material as a unit under direct gravitational stress.

### **Masses**

See Redoximorphic features.

### **Meander belt**

The zone within which migration of a meandering channel occurs; the flood-plain area included between two imaginary lines drawn tangential to the outer bends of active channel loops.

### **Meander scar**

A crescent-shaped, concave or linear mark on the face of a bluff or valley wall, produced by the lateral erosion of a meandering stream that impinged upon and undercut the bluff.

### **Meander scroll**

One of a series of long, parallel, close-fitting, crescent-shaped ridges and troughs formed along the inner bank of a stream meander as the channel migrated laterally down-valley and toward the outer bank.

### **Mechanical treatment**

Use of mechanical equipment for seeding, brush management, and other management practices.

### **Medium textured soil**

Very fine sandy loam, loam, silt loam, or silt.

### **Mesa**

A broad, nearly flat topped and commonly isolated landmass bounded by steep slopes or precipitous cliffs and capped by layers of resistant, nearly horizontal rocky material. The summit width is characteristically greater than the height of the bounding escarpments.

### **Metamorphic rock**

Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement at depth in the earth's crust.

Nearly all such rocks are crystalline.

### **Mine or quarry (map symbol)**

An open excavation from which soil and underlying material have been removed and in which bedrock is exposed. Also denotes surface openings to underground mines.

### **Mine spoil**

An accumulation of displaced earthy material, rock, or other waste material removed during mining or excavation. Also called earthy fill.

### **Mineral soil**

Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

**Minimum tillage**

Only the tillage essential to crop production and prevention of soil damage.

**Miscellaneous area**

A kind of map unit that has little or no natural soil and supports little or no vegetation.

**Miscellaneous water (map symbol)**

Small, constructed bodies of water that are used for industrial, sanitary, or mining applications and that contain water most of the year.

**Moderately coarse textured soil**

Coarse sandy loam, sandy loam, or fine sandy loam.

**Moderately fine textured soil**

Clay loam, sandy clay loam, or silty clay loam.

**Mollie epipedon**

A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

**Moraine**

In terms of glacial geology, a mound, ridge, or other topographically distinct accumulation of unsorted, unstratified drift, predominantly till, deposited primarily by the direct action of glacial ice in a variety of landforms. Also, a general term for a landform composed mainly of till (except for kame moraines, which are composed mainly of stratified outwash) that has been deposited by a glacier. Some types of moraines are disintegration, end, ground, kame, lateral, recessional, and terminal.

**Morphology, soil**

The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

**Mottling, soil**

Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few, common, and many*; size—*fine, medium, and coarse*; and contrast—*faint, distinct, and prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

**Mountain**

A generic term for an elevated area of the land surface, rising more than 1,000 feet (300 meters) above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides. A mountain can

occur as a single, isolated mass or in a group forming a chain or range. Mountains are formed primarily by tectonic activity and/or volcanic action but can also be formed by differential erosion.

### **Muck**

Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

### **Mucky peat**

See Hemic soil material.

### **Mudstone**

A blocky or massive, fine grained sedimentary rock in which the proportions of clay and silt are approximately equal. Also, a general term for such material as clay, silt, claystone, siltstone, shale, and argillite and that should be used only when the amounts of clay and silt are not known or cannot be precisely identified.

### **Munsell notation**

A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

### **Natric horizon**

A special kind of argillic horizon that contains enough exchangeable sodium to have an adverse effect on the physical condition of the subsoil.

### **Neutral soil**

A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

### **Nodules**

See Redoximorphic features.

### **Nose slope (geomorphology)**

A geomorphic component of hills consisting of the projecting end (laterally convex area) of a hillside. The overland waterflow is predominantly divergent. Nose slopes consist dominantly of colluvium and slope-wash sediments (for example, slope alluvium).

### **Nutrient, plant**

Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

### **Organic matter**

Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

*Very low:* Less than 0.5 percent  
*Low:* 0.5 to 1.0 percent  
*Moderately low:* 1.0 to 2.0 percent  
*Moderate:* 2.0 to 4.0 percent  
*High:* 4.0 to 8.0 percent  
*Very high:* More than 8.0 percent

### **Outwash**

Stratified and sorted sediments (chiefly sand and gravel) removed or “washed out” from a glacier by meltwater streams and deposited in front of or beyond the end moraine or the margin of a glacier. The coarser material is deposited nearer to the ice.

### **Outwash plain**

An extensive lowland area of coarse textured glaciofluvial material. An outwash plain is commonly smooth; where pitted, it generally is low in relief.

### **Paleoterrace**

An erosional remnant of a terrace that retains the surface form and alluvial deposits of its origin but was not emplaced by, and commonly does not grade to, a present-day stream or drainage network.

### **Pan**

A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan*, *fragipan*, *claypan*, *plowpan*, and *traffic pan*.

### **Parent material**

The unconsolidated organic and mineral material in which soil forms.

### **Peat**

Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

### **Ped**

An individual natural soil aggregate, such as a granule, a prism, or a block.

### **Pedisediment**

A layer of sediment, eroded from the shoulder and backslope of an erosional slope, that lies on and is being (or was) transported across a gently sloping erosional surface at the foot of a receding hill or mountain slope.

### **Pedon**

The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

**Percolation**

The movement of water through the soil.

**Perennial water (map symbol)**

Small, natural or constructed lakes, ponds, or pits that contain water most of the year.

**Permafrost**

Ground, soil, or rock that remains at or below 0 degrees C for at least 2 years. It is defined on the basis of temperature and is not necessarily frozen.

**pH value**

A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

**Phase, soil**

A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

**Piping**

Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

**Pitting**

Pits caused by melting around ice. They form on the soil after plant cover is removed.

**Plastic limit**

The moisture content at which a soil changes from semisolid to plastic.

**Plasticity index**

The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

**Plateau (geomorphology)**

A comparatively flat area of great extent and elevation; specifically, an extensive land region that is considerably elevated (more than 100 meters) above the adjacent lower lying terrain, is commonly limited on at least one side by an abrupt descent, and has a flat or nearly level surface. A comparatively large part of a plateau surface is near summit level.

**Playa**

The generally dry and nearly level lake plain that occupies the lowest parts of closed depressions, such as those on intermontane basin floors. Temporary flooding occurs primarily in response to precipitation and runoff. Playa deposits are fine grained and may or may not have a high water table and saline conditions.

**Plinthite**

The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other diluents. It commonly appears as red mottles, usually in platy, polygonal, or reticulate patterns. Plinthite changes irreversibly to an ironstone hardpan or to irregular aggregates on repeated wetting and drying, especially if it is exposed also to heat from the sun. In a moist soil, plinthite can be cut with a spade. It is a form of laterite.

**Plowpan**

A compacted layer formed in the soil directly below the plowed layer.

**Ponding**

Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

**Poorly graded**

Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

**Pore linings**

See Redoximorphic features.

**Potential native plant community**

See Climax plant community.

**Potential rooting depth (effective rooting depth)**

Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

**Prescribed burning**

Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

**Productivity, soil**

The capability of a soil for producing a specified plant or sequence of plants under specific management.

**Profile, soil**

A vertical section of the soil extending through all its horizons and into the parent material.

**Proper grazing use**

Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This practice increases the vigor and reproduction capacity of the key plants and

promotes the accumulation of litter and mulch necessary to conserve soil and water.

### **Rangeland**

Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

### **Reaction, soil**

A measure of acidity or alkalinity of a soil, expressed as pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

*Ultra acid:* Less than 3.5  
*Extremely acid:* 3.5 to 4.4  
*Very strongly acid:* 4.5 to 5.0  
*Strongly acid:* 5.1 to 5.5  
*Moderately acid:* 5.6 to 6.0  
*Slightly acid:* 6.1 to 6.5  
*Neutral:* 6.6 to 7.3  
*Slightly alkaline:* 7.4 to 7.8  
*Moderately alkaline:* 7.9 to 8.4  
*Strongly alkaline:* 8.5 to 9.0  
*Very strongly alkaline:* 9.1 and higher

### **Red beds**

Sedimentary strata that are mainly red and are made up largely of sandstone and shale.

### **Redoximorphic concentrations**

See Redoximorphic features.

### **Redoximorphic depletions**

See Redoximorphic features.

### **Redoximorphic features**

Redoximorphic features are associated with wetness and result from alternating periods of reduction and oxidation of iron and manganese compounds in the soil. Reduction occurs during saturation with water, and oxidation occurs when the soil is not saturated. Characteristic color patterns are created by these processes. The reduced iron and manganese ions may be removed from a soil if vertical or lateral fluxes of water occur, in which case there is no iron or manganese precipitation in that soil. Wherever the iron and manganese are oxidized and precipitated, they form either soft masses or hard concretions or nodules. Movement of iron and manganese as a result of redoximorphic processes in a soil may result in redoximorphic features that are defined as follows:

1. Redoximorphic concentrations.—These are zones of apparent accumulation of iron-manganese oxides, including:
  - A. Nodules and concretions, which are cemented bodies that can be removed from the soil intact. Concretions are distinguished from nodules on the basis of internal organization. A concretion typically has concentric layers that are visible to the naked eye. Nodules do not have visible organized internal structure; *and*
  - B. Masses, which are noncemented concentrations of substances within the soil matrix; *and*
  - C. Pore linings, i.e., zones of accumulation along pores that may be either coatings on pore surfaces or impregnations from the matrix adjacent to the pores.
2. Redoximorphic depletions.—These are zones of low chroma (chromas less than those in the matrix) where either iron-manganese oxides alone or both iron-manganese oxides and clay have been stripped out, including:
  - A. Iron depletions, i.e., zones that contain low amounts of iron and manganese oxides but have a clay content similar to that of the adjacent matrix; *and*
  - B. Clay depletions, i.e., zones that contain low amounts of iron, manganese, and clay (often referred to as silt coatings or skeletans).
3. Reduced matrix.—This is a soil matrix that has low chroma *in situ* but undergoes a change in hue or chroma within 30 minutes after the soil material has been exposed to air.

### **Reduced matrix**

See Redoximorphic features.

### **Regolith**

All unconsolidated earth materials above the solid bedrock. It includes material weathered in place from all kinds of bedrock and alluvial, glacial, eolian, lacustrine, and pyroclastic deposits.

### **Relief**

The relative difference in elevation between the upland summits and the lowlands or valleys of a given region.

### **Residuum (residual soil material)**

Unconsolidated, weathered or partly weathered mineral material that accumulated as bedrock disintegrated in place.

### **Rill**

A very small, steep-sided channel resulting from erosion and cut in unconsolidated materials by concentrated but intermittent flow of water. A rill generally is not an obstacle to wheeled vehicles and is shallow enough to be smoothed over by ordinary tillage.

**Riser**

The vertical or steep side slope (e.g., escarpment) of terraces, flood-plain steps, or other stepped landforms; commonly a recurring part of a series of natural, steplike landforms, such as successive stream terraces.

**Road cut**

A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

**Rock fragments**

Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

**Rock outcrop (map symbol)**

An exposure of bedrock at the surface of the earth. Not used where the named soils of the surrounding map unit are shallow over bedrock or where "Rock outcrop" is a named component of the map unit.

**Root zone**

The part of the soil that can be penetrated by plant roots.

**Runoff**

The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

**Saline soil**

A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

**Saline spot (map symbol)**

An area where the surface layer has an electrical conductivity of 8 mmhos/cm more than the surface layer of the named soils in the surrounding map unit. The surface layer of the surrounding soils has an electrical conductivity of 2 mmhos/cm or less.

**Sand**

As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

**Sandstone**

Sedimentary rock containing dominantly sand-sized particles.

### **Sandy spot (map symbol)**

A spot where the surface layer is loamy fine sand or coarser in areas where the surface layer of the named soils in the surrounding map unit is very fine sandy loam or finer.

### **Sapric soil material (muck)**

The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

### **Saturated hydraulic conductivity (Ksat)**

The ease with which pores of a saturated soil transmit water. Formally, the proportionality coefficient that expresses the relationship of the rate of water movement to hydraulic gradient in Darcy's Law, a law that describes the rate of water movement through porous media. Commonly abbreviated as "Ksat."

Terms describing saturated hydraulic conductivity are:

*Very high:* 100 or more micrometers per second (14.17 or more inches per hour)

*High:* 10 to 100 micrometers per second (1.417 to 14.17 inches per hour)

*Moderately high:* 1 to 10 micrometers per second (0.1417 inch to 1.417 inches per hour)

*Moderately low:* 0.1 to 1 micrometer per second (0.01417 to 0.1417 inch per hour)

*Low:* 0.01 to 0.1 micrometer per second (0.001417 to 0.01417 inch per hour)

*Very low:* Less than 0.01 micrometer per second (less than 0.001417 inch per hour).

To convert inches per hour to micrometers per second, multiply inches per hour by 7.0572. To convert micrometers per second to inches per hour, multiply micrometers per second by 0.1417.

### **Saturation**

Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

### **Scarification**

The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

### **Sedimentary rock**

A consolidated deposit of clastic particles, chemical precipitates, or organic remains accumulated at or near the surface of the earth under normal low temperature and pressure conditions. Sedimentary rocks include consolidated equivalents of alluvium, colluvium, drift, and eolian, lacustrine, and marine deposits. Examples are sandstone, siltstone, mudstone, claystone, shale, conglomerate, limestone, dolomite, and coal.

**Sequum**

A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

**Series, soil**

A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

**Severely eroded spot (map symbol)**

An area where, on the average, 75 percent or more of the original surface layer has been lost because of accelerated erosion. Not used in map units in which "severely eroded," "very severely eroded," or "gullied" is part of the map unit name.

**Shale**

Sedimentary rock that formed by the hardening of a deposit of clay, silty clay, or silty clay loam and that has a tendency to split into thin layers.

**Sheet erosion**

The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

**Short, steep slope (map symbol)**

A narrow area of soil having slopes that are at least two slope classes steeper than the slope class of the surrounding map unit.

**Shoulder**

The convex, erosional surface near the top of a hillslope. A shoulder is a transition from summit to backslope.

**Shrink-swell**

The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

**Shrub-coppice dune**

A small, streamlined dune that forms around brush and clump vegetation.

**Side slope (geomorphology)**

A geomorphic component of hills consisting of a laterally planar area of a hillside. The overland waterflow is predominantly parallel. Side slopes are dominantly colluvium and slope-wash sediments.

**Silica**

A combination of silicon and oxygen. The mineral form is called quartz.

### **Silica-sesquioxide ratio**

The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

### **Silt**

As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

### **Siltstone**

An indurated silt having the texture and composition of shale but lacking its fine lamination or fissility; a massive mudstone in which silt predominates over clay.

### **Similar soils**

Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

### **Sinkhole (map symbol)**

A closed, circular or elliptical depression, commonly funnel shaped, characterized by subsurface drainage and formed either by dissolution of the surface of underlying bedrock (e.g., limestone, gypsum, or salt) or by collapse of underlying caves within bedrock. Complexes of sinkholes in carbonate-rock terrain are the main components of karst topography.

### **Site index**

A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

### **Slickensides (pedogenic)**

Grooved, striated, and/or glossy (shiny) slip faces on structural peds, such as wedges; produced by shrink-swell processes, most commonly in soils that have a high content of expansive clays.

### **Slide or slip (map symbol)**

A prominent landform scar or ridge caused by fairly recent mass movement or descent of earthy material resulting from failure of earth or rock under shear stress along one or several surfaces.

### **Slope**

The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

### **Slope alluvium**

Sediment gradually transported down the slopes of mountains or hills primarily by nonchannel alluvial processes (i.e., slope-wash processes) and characterized by particle sorting. Lateral particle sorting is evident on long slopes. In a profile sequence, sediments may be distinguished by differences in size and/or specific gravity of rock fragments and may be separated by stone lines. Burnished pedes and sorting of rounded or subrounded pebbles or cobbles distinguish these materials from unsorted colluvial deposits.

### **Slow refill**

The slow filling of ponds, resulting from restricted water transmission in the soil.

### **Slow water movement**

Restricted downward movement of water through the soil. See Saturated hydraulic conductivity.

### **Sodic (alkali) soil**

A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

### **Sodic spot (map symbol)**

An area where the surface layer has a sodium adsorption ratio that is at least 10 more than that of the surface layer of the named soils in the surrounding map unit. The surface layer of the surrounding soils has a sodium adsorption ratio of 5 or less.

### **Sodicity**

The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of  $\text{Na}^+$  to  $\text{Ca}^{++} + \text{Mg}^{++}$ . The degrees of sodicity and their respective ratios are:

*Slight:* Less than 13:1

*Moderate:* 13-30:1

*Strong:* More than 30:1

### **Sodium adsorption ratio (SAR)**

A measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration.

### **Soft bedrock**

Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

## **Soil**

A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief and by the passage of time.

## **Soil separates**

Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

*Very coarse sand:* 2.0 to 1.0  
*Coarse sand:* 1.0 to 0.5  
*Medium sand:* 0.5 to 0.25  
*Fine sand:* 0.25 to 0.10  
*Very fine sand:* 0.10 to 0.05  
*Silt:* 0.05 to 0.002  
*Clay:* Less than 0.002

## **Solum**

The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

## **Spoil area (map symbol)**

A pile of earthy materials, either smoothed or uneven, resulting from human activity.

## **Stone line**

In a vertical cross section, a line formed by scattered fragments or a discrete layer of angular and subangular rock fragments (commonly a gravel- or cobble-sized lag concentration) that formerly was draped across a topographic surface and was later buried by additional sediments. A stone line generally caps material that was subject to weathering, soil formation, and erosion before burial. Many stone lines seem to be buried erosion pavements, originally formed by sheet and rill erosion across the land surface.

## **Stones**

Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

## **Stony**

Refers to a soil containing stones in numbers that interfere with or prevent tillage.

### **Stony spot (map symbol)**

A spot where 0.01 to 0.1 percent of the soil surface is covered by rock fragments that are more than 10 inches in diameter in areas where the surrounding soil has no surface stones.

### **Strath terrace**

A type of stream terrace; formed as an erosional surface cut on bedrock and thinly mantled with stream deposits (alluvium).

### **Stream terrace**

One of a series of platforms in a stream valley, flanking and more or less parallel to the stream channel, originally formed near the level of the stream; represents the remnants of an abandoned flood plain, stream bed, or valley floor produced during a former state of fluvial erosion or deposition.

### **Stripcropping**

Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind erosion and water erosion.

### **Structure, soil**

The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are:

*Platy*: Flat and laminated

*Prismatic*: Vertically elongated and having flat tops

*Columnar*: Vertically elongated and having rounded tops

*Angular blocky*: Having faces that intersect at sharp angles (planes)

*Subangular blocky*: Having subrounded and planar faces (no sharp angles)

*Granular*: Small structural units with curved or very irregular faces

Structureless soil horizons are defined as follows:

*Single grained*: Entirely noncoherent (each grain by itself), as in loose sand

*Massive*: Occurring as a coherent mass

### **Stubble mulch**

Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

### **Subsoil**

Technically, the B horizon; roughly, the part of the solum below plow depth.

### **Subsoiling**

Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

**Substratum**

The part of the soil below the solum.

**Subsurface layer**

Any surface soil horizon (A, E, AB, or EB) below the surface layer.

**Summer fallow**

The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

**Summit**

The topographically highest position of a hillslope. It has a nearly level (planar or only slightly convex) surface.

**Surface layer**

The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

**Surface soil**

The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

**Talus**

Rock fragments of any size or shape (commonly coarse and angular) derived from and lying at the base of a cliff or very steep rock slope. The accumulated mass of such loose broken rock formed chiefly by falling, rolling, or sliding.

**Taxadjuncts**

Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior. Soils are recognized as taxadjuncts only when one or more of their characteristics are slightly outside the range defined for the family of the series for which the soils are named.

**Terminal moraine**

An end moraine that marks the farthest advance of a glacier. It typically has the form of a massive arcuate or concentric ridge, or complex of ridges, and is underlain by till and other types of drift.

**Terrace (conservation)**

An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field

generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

### **Terrace (geomorphology)**

A steplike surface, bordering a valley floor or shoreline, that represents the former position of a flood plain, lake, or seashore. The term is usually applied both to the relatively flat summit surface (tread) that was cut or built by stream or wave action and to the steeper descending slope (scarp or riser) that has graded to a lower base level of erosion.

### **Terracettes**

Small, irregular steplike forms on steep hillslopes, especially in pasture, formed by creep or erosion of surficial materials that may be induced or enhanced by trampling of livestock, such as sheep or cattle.

### **Texture, soil**

The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying “coarse,” “fine,” or “very fine.”

### **Thin layer**

Otherwise suitable soil material that is too thin for the specified use.

### **Till**

Dominantly unsorted and nonstratified drift, generally unconsolidated and deposited directly by a glacier without subsequent reworking by meltwater, and consisting of a heterogeneous mixture of clay, silt, sand, gravel, stones, and boulders; rock fragments of various lithologies are embedded within a finer matrix that can range from clay to sandy loam.

### **Till plain**

An extensive area of level to gently undulating soils underlain predominantly by till and bounded at the distal end by subordinate recessional or end moraines.

### **Tilth, soil**

The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

### **Toeslope**

The gently inclined surface at the base of a hillslope. Toeslopes in profile are commonly gentle and linear and are constructional surfaces forming the lower part of a hillslope continuum that grades to valley or closed-depression floors.

### **Topsoil**

The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

### **Trace elements**

Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

### **Tread**

The flat to gently sloping, topmost, laterally extensive slope of terraces, floodplain steps, or other stepped landforms; commonly a recurring part of a series of natural steplike landforms, such as successive stream terraces.

### **Tuff**

A generic term for any consolidated or cemented deposit that is 50 percent or more volcanic ash.

### **Upland**

An informal, general term for the higher ground of a region, in contrast with a low-lying adjacent area, such as a valley or plain, or for land at a higher elevation than the flood plain or low stream terrace; land above the footslope zone of the hillslope continuum.

### **Valley fill**

The unconsolidated sediment deposited by any agent (water, wind, ice, or mass wasting) so as to fill or partly fill a valley.

### **Variegation**

Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

### **Varve**

A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

### **Very stony spot (map symbol)**

A spot where 0.1 to 3.0 percent of the soil surface is covered by rock fragments that are more than 10 inches in diameter in areas where the surface of the surrounding soil is covered by less than 0.01 percent stones.

### **Water bars**

Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

**Weathering**

All physical disintegration, chemical decomposition, and biologically induced changes in rocks or other deposits at or near the earth's surface by atmospheric or biologic agents or by circulating surface waters but involving essentially no transport of the altered material.

**Well graded**

Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

**Wet spot (map symbol)**

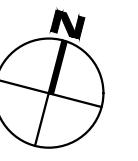
A somewhat poorly drained to very poorly drained area that is at least two drainage classes wetter than the named soils in the surrounding map unit.

**Wilting point (or permanent wilting point)**

The moisture content of soil, on an oven-dry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

**Windthrow**

The uprooting and tipping over of trees by the wind.



NORTH



**OWNER:**  
NABIL BOGHOS  
1630 Osgood Street #1210  
North Andover, MA 01845

A scale bar diagram for a map. It features a horizontal line with tick marks. The first tick mark is labeled '0'. The second tick mark is labeled '20'. The third tick mark is labeled '50'. The fourth tick mark is labeled '100'. The distance between the '0' and '20' marks is divided into four equal segments by three internal tick marks. The distance between the '20' and '50' marks is divided into three equal segments by two internal tick marks. The distance between the '50' and '100' marks is divided into five equal segments by four internal tick marks. Below the scale bar, the text 'SCALE: 1" = 20'' is centered.

SCALE: 1" = 20'

# 33 DANTON DRIVE

## PROJECT INFO

# TEST PIT LOCATIONS

**QUIET NAME**

SHT NO:

DR BY: IEH

CLIK BY: 66

CHK BY: SS

PROJ NO: 2020-041

DATE:10/30/2020

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SCALE: AS SHOWN

Digitized by srujanika@gmail.com



Commonwealth of Massachusetts  
City/Town of Methuen

## Form 11 - Soil Suitability Assessment for On-Site Stormwater Disposal

### A. Facility Information

Owner Name  
35 Danton Drive  
Street Address  
Methuen  
City

MA  
State

412-131-6A  
Map/Lot #  
01844  
Zip Code

### B. Site Information

1. (Check one)  New Construction  Upgrade  Repair

2. Soil Survey Available?  Yes  No If yes: NRCS  
Source 651  
Soil Map Unit

Udorthents

Soil Name

Soil Limitations

Soil Parent material

Landform

3. Surficial Geological Report Available?  Yes  No If yes:

Year Published/Source Map Unit

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:

7. Current Water Resource Conditions (USGS): 10/16/2020  
Month/Day/ Year Range:  Above Normal  Normal  Below Normal

8. Other references reviewed:



Commonwealth of Massachusetts  
City/Town of

STORMWATER

## 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: 1 Hole # 10/22/2020 Date 9 Time 65° SUNNY Weather 42.7283 Latitude -71.2123 Longitude  
1. Land Use DEVELOPED - INDUSTRIAL (e.g., woodland, agricultural field, vacant lot, etc.) Vegetation GRASS Surface Stones (e.g., cobbles, stones, boulders, etc.) -

FLAT 0-3  
Slope (%)

Description of Location: GRASS AREA @ SW CORNER OF LOT  
2. Soil Parent Material: HILL Landform BACKSLOPE Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body 300 feet Drainage Way 400 feet Wetlands 300 feet  
Property Line 50 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	A	Sandy Loam	10YR 3/2						MASSIVE	FIRM	TOPSOIL
8-30	B	Sandy Loam	10YR 3/3						MASSIVE	FIRM	
30-114"	C	FINE SAND	10YR 7/2	-	-	-	15		MASSIVE	V.FIRM	

Additional Notes:

PIT = 9.5' DEEP, -3.5 TO TOP OF PERCH HOLE (12" x 18" D)  
5 min/in



Commonwealth of Massachusetts  
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Stormwater Disposal

**C. On-Site Review** (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: 2 Hole #: 10/22/2020 Date 9:30 Time 65° SW Weather 42.43 Latitude -71.2136 Longitude: 0-3 Land Use: DEVELOPED - INDUSTRIAL (e.g., woodland, agricultural field, vacant lot, etc.) Vegetation: — Surface Stones (e.g., cobbles, stones, boulders, etc.): — Slope (%): —

1. Land Use: Developed - Industrial (e.g., woodland, agricultural field, vacant lot, etc.)

Description of Location: GRASS AREA @ EDGE OF PAVEMENT

2. Soil Parent Material: lava back slope  
Landform Position on Landscape (SU SH BS FS TS)

3. Distances from: Open Water Body _____ feet Drainage Way _____ feet Wetlands _____ feet

Property Line feet Drinking Water Well feet Other feet

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

#### Additional Notes:

Same AS TP 1 , DID NOT PERL TEST



Commonwealth of Massachusetts  
City/Town of Methuen

## Form 11 - Soil Suitability Assessment for On-Site Stormwater Disposal

### D. Determination of High Groundwater Elevation

1. Method Used:

<input type="checkbox"/> Depth observed standing water in observation hole	Obs. Hole # _____ _____ inches	Obs. Hole # _____ _____ inches
<input type="checkbox"/> Depth weeping from side of observation hole	_____ inches	_____ inches
<input type="checkbox"/> Depth to soil redoximorphic features (mottles)	_____ inches	_____ inches
<input type="checkbox"/> 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: 114+ 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)?

c. If no, at what depth was impervious material observed?

Upper boundary: _____ inches  
Upper boundary: _____ inches  
Lower boundary: _____ inches  
Lower boundary: _____ inches



Commonwealth of Massachusetts  
City/Town of

## Form 11 - Soil Suitability Assessment for On-Site Stormwater 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.

Signature of Soil Evaluator

Ryan Boucher 14350

Typed or Printed Name of Soil Evaluator / License #

Name of Approving Authority Witness

10/29/2020

Date

7/1/2022

Expiration Date of License

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 Lows



Commonwealth of Massachusetts  
City/Town of Methuen

## Form 11 - Soil Suitability Assessment for On-Site Stormwater Disposal

### A. Facility Information

Owner Name  
35 Danton Drive  
Street Address  
Methuen  
City

MA  
State

412-131-6A  
Map/Lot #  
01844  
Zip Code

### B. Site Information

1. (Check one)  New Construction  Upgrade  Repair

2. Soil Survey Available?  Yes  No If yes: NRCS  
Source 651  
Soil Map Unit

Udorthents

Soil Name

Soil Limitations

Soil Parent material

Landform

3. Surficial Geological Report Available?  Yes  No If yes:

Year Published/Source Map Unit

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:

7. Current Water Resource Conditions (USGS): 10/16/2020  
Month/Day/ Year Range:  Above Normal  Normal  Below Normal

8. Other references reviewed:





Commonwealth of Massachusetts  
City/Town of

## Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

*Storm Water*

### C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: 4 Hole # 10/22/2020 Date 65° Sun Time 42.7276 Latitude -71.2428 Longitude:

1. Land Use: Developed - Industrial (e.g., woodland, agricultural field, vacant lot, etc.) Vegetation Surface Stones (e.g., cobbles, stones, boulders, etc.)

0-3

Slope (%)

Description of Location:

2. Soil Parent Material: _____ Landform _____ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body 300 feet Drainage Way 300 feet Wetlands 300 feet

Property Line 100 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			
0-12	SANDY LOAM	LOAM	10YR 4/3								TOPSOIL
12-24	SANDY LOAM	LOAM	4/3								FINE-MED SAND (SANDY)
24-38	FINE-MED SAND	2 1/2 YR 6/3									FINE-MED SAND, TP 1-3 SANDY AS TP 1-3, WET
38-90+ 0	FINE SANDY LOAM	10YR 3/2	38" ↑ 5YR 6/3 ↳ REDOX	5YR 6/3 1/2" LAYER AROUND HOLE IN SANDY LAYER (VARIATED SOIL)							NOT GREASY, NO ODORE LOW PERME

Additional Notes:

Hole = 7.5' DEEP, REDOX FROM PERCHED STORMWATER P - 38"  
↳ VARIATED SOIL, NOT ESTHW



Commonwealth of Massachusetts  
City/Town of Methuen

## Form 11 - Soil Suitability Assessment for On-Site Stormwater Disposal

### D. Determination of High Groundwater Elevation

1. Method Used:

<input type="checkbox"/> Depth observed standing water in observation hole	Obs. Hole # _____ _____ inches	Obs. Hole # _____ _____ inches
<input type="checkbox"/> Depth weeping from side of observation hole	_____ inches	_____ inches
<input type="checkbox"/> Depth to soil redoximorphic features (mottles)	_____ inches	_____ inches
<input type="checkbox"/> 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: 90+ 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)?

c. If no, at what depth was impervious material observed?

Upper boundary: _____ inches  
Upper boundary: _____ inches  
Lower boundary: _____ inches  
Lower boundary: _____ inches



Commonwealth of Massachusetts  
City/Town of

## Form 11 - Soil Suitability Assessment for On-Site Stormwater 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.

Signature of Soil Evaluator

Ryan Boucher 14350

Typed or Printed Name of Soil Evaluator / License #

Name of Approving Authority Witness

10/29/2020

Date

7/1/2022

Expiration Date of License

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 Lows



Commonwealth of Massachusetts  
City/Town of Methuen

## Form 11 - Soil Suitability Assessment for On-Site Stormwater Disposal

### A. Facility Information

Owner Name  
35 Danton Drive  
Street Address  
Methuen  
City

MA  
State

412-131-6A  
Map/Lot #  
01844  
Zip Code

### B. Site Information

1. (Check one)  New Construction  Upgrade  Repair

2. Soil Survey Available?  Yes  No If yes: NRCS  
Source 651  
Soil Map Unit

Udorthents

Soil Name

Soil Limitations

Soil Parent material

Landform

3. Surficial Geological Report Available?  Yes  No If yes:

Year Published/Source Map Unit

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:

7. Current Water Resource Conditions (USGS): 10/16/2020  
Month/Day/ Year Range:  Above Normal  Normal  Below Normal

8. Other references reviewed:





Commonwealth of Massachusetts  
City/Town of

## Form 11 - Soil Suitability Assessment for On-Site Stormwater Disposal

### C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: 4 Hole # 10/22/2020 Date 65° Sun Time Weather 42.7276 Latitude -71.2120 Longitude

1. Land Use: INDUSTRIAL (e.g., woodland, agricultural field, vacant lot, etc.) Vegetation Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)

Description of Location: PAVED AREA

2. Soil Parent Material: _____ Landform _____ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body 500 feet Drainage Way _____ feet Wetlands 150 feet  
Property Line 75 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			
0-3	Asphalt										
3-24		Fine Sandy Loam	10/4 4/4								
24-62+		Fine/ Mud Sandy	10/4 6/2								
62-84	O										
84-102+		Dark Brown Sandy Loam									

Additional Notes:

$$\text{Perc} = \frac{1}{2} \text{ in } 37 \text{ min} = 0.8 \text{ " / hr}$$



Commonwealth of Massachusetts  
City/Town of Methuen

## Form 11 - Soil Suitability Assessment for On-Site Stormwater Disposal

### D. Determination of High Groundwater Elevation

1. Method Used:

<input type="checkbox"/> Depth observed standing water in observation hole	Obs. Hole # _____ _____ inches	Obs. Hole # _____ _____ inches
<input type="checkbox"/> Depth weeping from side of observation hole	_____ inches	_____ inches
<input type="checkbox"/> Depth to soil redoximorphic features (mottles)	_____ inches	_____ inches
<input type="checkbox"/> 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: 64+ 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)?

c. If no, at what depth was impervious material observed?

Upper boundary: _____ inches  
Upper boundary: _____ inches  
Lower boundary: _____ inches  
Lower boundary: _____ inches



Commonwealth of Massachusetts  
City/Town of

## Form 11 - Soil Suitability Assessment for On-Site Stormwater 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.

Signature of Soil Evaluator

Ryan Boucher 14350

Typed or Printed Name of Soil Evaluator / License #

Name of Approving Authority Witness

10/29/2020

Date

7/1/2022

Expiration Date of License

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 Lows



Commonwealth of Massachusetts  
City/Town of Methuen

## Form 11 - Soil Suitability Assessment for On-Site Stormwater Disposal

### A. Facility Information

Owner Name  
35 Danton Drive  
Street Address  
Methuen  
City

MA  
State

412-131-6A  
Map/Lot #  
01844  
Zip Code

### B. Site Information

1. (Check one)  New Construction  Upgrade  Repair

2. Soil Survey Available?  Yes  No If yes: NRCS  
Source 651  
Soil Map Unit

Udorthents  
Soil Name Soil Limitations

Soil Parent material Landform

3. Surficial Geological Report Available?  Yes  No If yes: Year Published/Source Map Unit

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: Wetland Type

7. Current Water Resource Conditions (USGS): 10/16/2020  
Month/Day/ Year Range:  Above Normal  Normal  Below Normal

8. Other references reviewed: _____  
_____



Commonwealth of Massachusetts  
City/Town of

## Form 11 - Soil Suitability Assessment for On-Site Stormwater Disposal

### C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: 7 Hole # 10/22/2020 Date Time 65° Sun Weather 42.7273 Latitude 71.2120 Longitude  
Slope (%): 0-3

1. Land Use INDUSTRIAL (e.g., woodland, agricultural field, vacant lot, etc.) Vegetation Surface Stones (e.g., cobbles, stones, boulders, etc.)

Description of Location: Parking lot

2. Soil Parent Material: _____ Landform Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body 500 feet Drainage Way 500 feet Wetlands 150 feet  
Property Line 75 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			
<u>0-3</u>	<u>ASPHALT</u>										
<u>3-24</u>	<u>Fine/Loamy</u> <u>Shady lawn</u>	<u>10yr</u>	<u>3/2</u>				<u>Trace</u>				
<u>24-53</u>	<u>Fine/Loamy</u> <u>Snow</u>	<u>10yr</u>	<u>7/3</u>				<u>Trace</u>				<u>WET</u>
<u>53-72+ 0</u>		<u>10yr</u>	<u>2/1</u>								<u>WET</u>

Additional Notes:



Commonwealth of Massachusetts  
City/Town of

## Form 11 - Soil Suitability Assessment for On-Site Stormwater Disposal

### C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: 8 Hole #: 10/22/2020 Date Time 65° Sun Weather Latitude 42.7272 -71.2119 Longitude

1. Land Use: INDUSTRIAL (e.g., woodland, agricultural field, vacant lot, etc.) Vegetation Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)

Description of Location: Parking Lot

2. Soil Parent Material: _____ Landform Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body _____ feet Drainage Way _____ feet Wetlands _____ feet

Property Line _____ 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			
0-3	Asphalt										
3-35	<del>2-3 FT SOIL 6/3</del>	<del>FINE SOIL 5/2</del>									Some Silt
35-70+	<del>FINE SOIL 5/2</del>	<del>10yr 5/2</del>									Some Silt (stony)
6-3	Asphalt										
3-35	FILL										
35-41	O										
41-80+	Bw	MED SOIL	10yr 0/4				TRACE	5%			

Additional Notes:

Perc < 2 min/in.



Commonwealth of Massachusetts  
City/Town of Methuen

## Form 11 - Soil Suitability Assessment for On-Site Stormwater Disposal

### D. Determination of High Groundwater Elevation

1. Method Used:

<input type="checkbox"/> Depth observed standing water in observation hole	Obs. Hole # _____ _____ inches	Obs. Hole # _____ _____ inches
<input type="checkbox"/> Depth weeping from side of observation hole	_____ inches	_____ inches
<input type="checkbox"/> Depth to soil redoximorphic features (mottles)	_____ inches	_____ inches
<input type="checkbox"/> 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: 80+ 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)?

c. If no, at what depth was impervious material observed?

Upper boundary: _____ inches  
Upper boundary: _____ inches  
Lower boundary: _____ inches  
Lower boundary: _____ inches



Commonwealth of Massachusetts  
City/Town of

## Form 11 - Soil Suitability Assessment for On-Site Stormwater 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.

Signature of Soil Evaluator

Ryan Boucher 14350

Typed or Printed Name of Soil Evaluator / License #

Name of Approving Authority Witness

10/29/2020

Date

7/1/2022

Expiration Date of License

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 Lows



Commonwealth of Massachusetts  
City/Town of Methuen

## Form 11 - Soil Suitability Assessment for On-Site Stormwater Disposal

### A. Facility Information

Owner Name  
35 Danton Drive  
Street Address  
Methuen  
City

MA  
State

412-131-6A  
Map/Lot #  
01844  
Zip Code

### B. Site Information

1. (Check one)  New Construction  Upgrade  Repair

2. Soil Survey Available?  Yes  No If yes: NRCS  
Source 651  
Soil Map Unit

Udorthents  
Soil Name Soil Limitations

Soil Parent material Landform

3. Surficial Geological Report Available?  Yes  No If yes: Year Published/Source Map Unit

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: Wetland Type

7. Current Water Resource Conditions (USGS): 10/16/2020  
Month/Day/ Year Range:  Above Normal  Normal  Below Normal

8. Other references reviewed: _____  
_____



Commonwealth of Massachusetts

City/Town of

*Stormwater*

## 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: 9 Hole # 10/22/2020 Date 65° SW Time Weather 42.7277 Latitude -71.2122 Longitude: 0-3 Slope (%)

1. Land Use INDUSTRIAL (e.g., woodland, agricultural field, vacant lot, etc.) Vegetation Surface Stones (e.g., cobbles, stones, boulders, etc.)

Description of Location: Grass Area @ Edge of Parcival Lot

2. Soil Parent Material:

Landform

Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body 500 feet Drainage Way 500 feet Wetlands 150 feet  
Property Line 85 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			
0-12	Topsoil										
12-62		FINZ/MED SAND	10YR 6/3				15				Some Stain

Additional Notes:



Commonwealth of Massachusetts  
City/Town of Methuen

## Form 11 - Soil Suitability Assessment for On-Site Stormwater Disposal

### D. Determination of High Groundwater Elevation

1. Method Used:

<input type="checkbox"/> Depth observed standing water in observation hole	Obs. Hole # _____ _____ inches	Obs. Hole # _____ _____ inches
<input type="checkbox"/> Depth weeping from side of observation hole	_____ inches	_____ inches
<input type="checkbox"/> Depth to soil redoximorphic features (mottles)	_____ inches	_____ inches
<input type="checkbox"/> 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: 62+ 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)?

c. If no, at what depth was impervious material observed?

Upper boundary: _____ inches  
Upper boundary: _____ inches  
Lower boundary: _____ inches  
Lower boundary: _____ inches



Commonwealth of Massachusetts  
City/Town of

## Form 11 - Soil Suitability Assessment for On-Site Stormwater 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.

Signature of Soil Evaluator

Ryan Boucher 14350

Typed or Printed Name of Soil Evaluator / License #

Name of Approving Authority Witness

10/29/2020

Date

7/1/2022

Expiration Date of License

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.

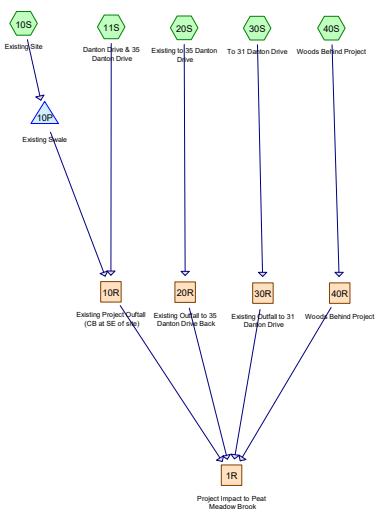
**Field Diagrams:** Use this area for field diagrams:

See Lows

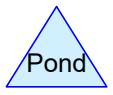
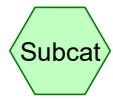
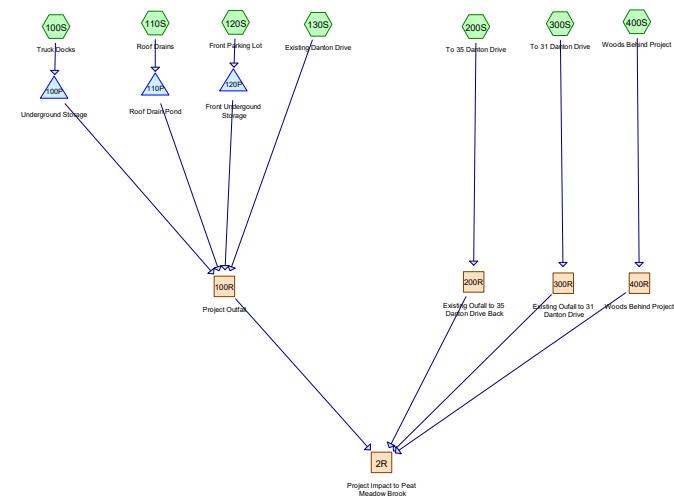
## Appendix G

# EXISTING AND PROPOSED HYDROLOGY

Existing Analysis



Proposed Analysis



### Routing Diagram for 2020-041

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Page 2

**Area Listing (all nodes)**

Area (acres)	CN	Description (subcatchment-numbers)
0.499	49	50-75% Grass cover, Fair, HSG A (110S)
2.797	39	>75% Grass cover, Good, HSG A (10S, 20S, 30S, 120S, 130S, 200S, 300S)
0.074	96	Gravel surface, HSG B (10S)
1.930	98	Paved parking, HSG A (11S, 100S, 120S, 130S, 200S)
1.601	98	Paved parking, HSG B (10S, 20S, 30S)
1.380	98	Roofs, HSG A (100S, 110S, 120S)
0.118	98	Water Surface, HSG A (110S)
0.494	36	Woods, Fair, HSG A (40S, 400S)
<b>8.893</b>	<b>73</b>	<b>TOTAL AREA</b>

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Page 3

**Notes Listing (all nodes)**

Line#	Node Number	Notes
1	Project	Rainfall events imported from "NRCS-Rain.txt" for 4148 MA Lawrence Essex County

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

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

<b>Subcatchment 10S: Existing Site</b>	Runoff Area=133,926 sf 43.18% Impervious Runoff Depth=0.62" Flow Length=555' Tc=11.5 min CN=66 Runoff=1.40 cfs 0.158 af
<b>Subcatchment 11S: Danton Drive &amp; 35</b>	Runoff Area=20,671 sf 100.00% Impervious Runoff Depth=2.92" Flow Length=353' Tc=9.9 min CN=98 Runoff=1.17 cfs 0.115 af
<b>Subcatchment 20S: Existing to 35 Danton</b>	Runoff Area=20,048 sf 52.50% Impervious Runoff Depth=0.80" Tc=6.0 min CN=70 Runoff=0.38 cfs 0.031 af
<b>Subcatchment 30S: To 31 Danton Drive</b>	Runoff Area=6,694 sf 21.05% Impervious Runoff Depth=0.14" Tc=6.0 min CN=51 Runoff=0.00 cfs 0.002 af
<b>Subcatchment 40S: Woods Behind Project</b>	Runoff Area=11,909 sf 0.00% Impervious Runoff Depth=0.00" Tc=6.0 min CN=36 Runoff=0.00 cfs 0.000 af
<b>Subcatchment 100S: Truck Docks</b>	Runoff Area=37,477 sf 100.00% Impervious Runoff Depth=2.92" Tc=6.0 min CN=98 Runoff=2.44 cfs 0.209 af
<b>Subcatchment 110S: Roof Drains</b>	Runoff Area=56,969 sf 61.84% Impervious Runoff Depth=1.30" Tc=6.0 min CN=79 Runoff=1.89 cfs 0.142 af
<b>Subcatchment 120S: Front Parking Lot</b>	Runoff Area=40,262 sf 65.68% Impervious Runoff Depth=1.24" Tc=0.0 min CN=78 Runoff=1.50 cfs 0.095 af
<b>Subcatchment 130S: Existing Danton Drive</b>	Runoff Area=30,390 sf 69.20% Impervious Runoff Depth=1.36" Tc=9.9 min CN=80 Runoff=0.91 cfs 0.079 af
<b>Subcatchment 200S: To 35 Danton Drive</b>	Runoff Area=15,734 sf 53.50% Impervious Runoff Depth=0.85" Tc=0.0 min CN=71 Runoff=0.41 cfs 0.026 af
<b>Subcatchment 300S: To 31 Danton Drive</b>	Runoff Area=3,690 sf 0.00% Impervious Runoff Depth=0.00" Tc=0.0 min CN=39 Runoff=0.00 cfs 0.000 af
<b>Subcatchment 400S: Woods Behind Project</b>	Runoff Area=9,614 sf 0.00% Impervious Runoff Depth=0.00" Tc=0.0 min CN=36 Runoff=0.00 cfs 0.000 af
<b>Reach 1R: Project Impact to Peat Meadow Brook</b>	Inflow=3.32 cfs 0.291 af Outflow=3.32 cfs 0.291 af
<b>Reach 2R: Project Impact to Peat Meadow Brook</b>	Inflow=1.05 cfs 0.105 af Outflow=1.05 cfs 0.105 af
<b>Reach 10R: Existing Project Outfall (CB at SE of site)</b>	Inflow=3.08 cfs 0.258 af Outflow=3.08 cfs 0.258 af
<b>Reach 20R: Existing Outfall to 35 Danton Drive Back</b>	Inflow=0.38 cfs 0.031 af Outflow=0.38 cfs 0.031 af

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**NRCC 24-hr D 2-Year Rainfall=3.15"**

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Page 5

**Reach 30R: Existing Outfall to 31 Danton Drive**

Inflow=0.00 cfs 0.002 af  
Outflow=0.00 cfs 0.002 af

**Reach 40R: Woods Behind Project**

Inflow=0.00 cfs 0.000 af  
Outflow=0.00 cfs 0.000 af

**Reach 100R: Project Outfall**

Inflow=0.91 cfs 0.079 af  
Outflow=0.91 cfs 0.079 af

**Reach 200R: Existing Outfall to 35 Danton Drive Back**

Inflow=0.41 cfs 0.026 af  
Outflow=0.41 cfs 0.026 af

**Reach 300R: Existing Outfall to 31 Danton Drive**

Inflow=0.00 cfs 0.000 af  
Outflow=0.00 cfs 0.000 af

**Reach 400R: Woods Behind Project**

Inflow=0.00 cfs 0.000 af  
Outflow=0.00 cfs 0.000 af

**Pond 10P: Existing Swale**

Peak Elev=4.20' Storage=689 cf Inflow=1.40 cfs 0.158 af  
Outflow=2.03 cfs 0.143 af

**Pond 100P: Underground Storage**

Peak Elev=111.63' Storage=1,920 cf Inflow=2.44 cfs 0.209 af

Discarded=0.36 cfs 0.209 af Primary=0.00 cfs 0.000 af Outflow=0.36 cfs 0.209 af

**Pond 110P: Roof Drain Pond**

Peak Elev=117.07' Storage=2,203 cf Inflow=1.89 cfs 0.142 af  
Discarded=0.18 cfs 0.142 af Primary=0.00 cfs 0.000 af Outflow=0.18 cfs 0.142 af

**Pond 120P: Front Undergound Storage**

Peak Elev=115.07' Storage=1,718 cf Inflow=1.50 cfs 0.095 af  
Discarded=0.07 cfs 0.095 af Primary=0.00 cfs 0.000 af Outflow=0.07 cfs 0.095 af

**Total Runoff Area = 8.893 ac Runoff Volume = 0.857 af Average Runoff Depth = 1.16"**  
**43.46% Pervious = 3.865 ac 56.54% Impervious = 5.028 ac**

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NRCC 24-hr D 2-Year Rainfall=3.15"

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Page 6

**Summary for Subcatchment 10S: Existing Site**

Runoff = 1.40 cfs @ 12.21 hrs, Volume= 0.158 af, Depth= 0.62"

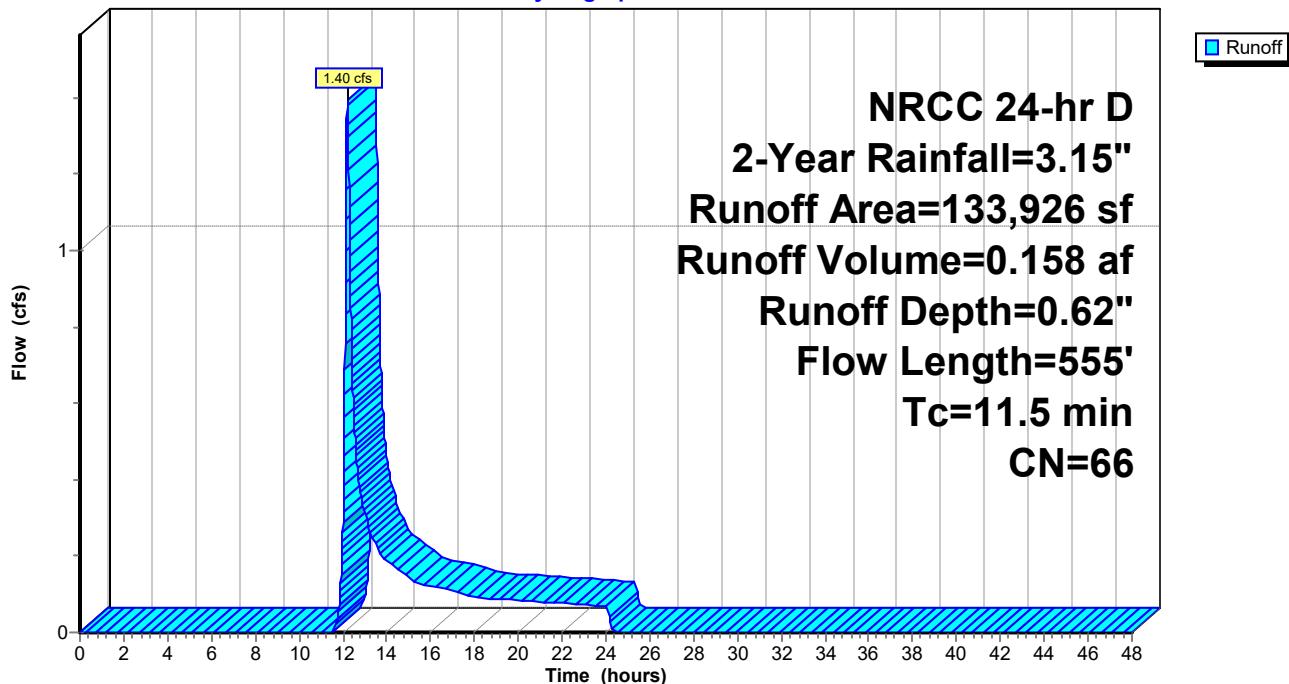
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
72,863	39	>75% Grass cover, Good, HSG A
57,826	98	Paved parking, HSG B
3,237	96	Gravel surface, HSG B
133,926	66	Weighted Average
76,100		56.82% Pervious Area
57,826		43.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	20	0.0050	0.05		<b>Sheet Flow, Woodland Sheet Flow</b> Grass: Dense n= 0.240 P2= 3.15"
1.1	164	0.0145	2.44		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
2.9	155	0.0158	0.88		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.5	148	0.0225	4.68	46.78	<b>Channel Flow, X-Sec and Perimeter</b> Area= 10.0 sf Perim= 13.0' r= 0.77' n= 0.040 Earth, cobble bottom, clean sides
0.1	68	0.0558	13.14	157.70	<b>Channel Flow, X-Section and Perimeter</b> Area= 12.0 sf Perim= 8.0' r= 1.50' n= 0.035 Earth, dense weeds
11.5	555	Total			

## Subcatchment 10S: Existing Site

Hydrograph



**Summary for Subcatchment 11S: Danton Drive & 35 Danton Drive**

Runoff = 1.17 cfs @ 12.17 hrs, Volume= 0.115 af, Depth= 2.92"

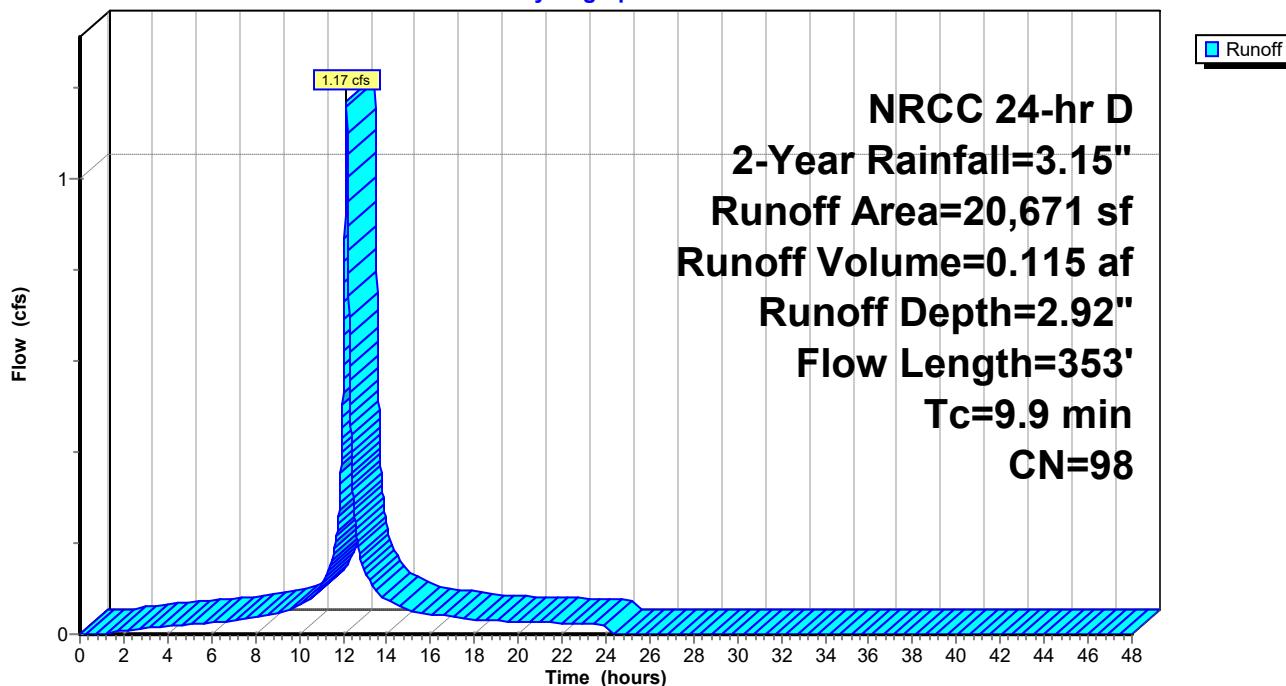
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
20,671	98	Paved parking, HSG A
20,671		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	10	0.0200	0.86		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 3.15"
6.0	178	0.0050	0.49		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.5	42	0.0050	1.44		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
2.7	81	0.0050	0.49		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.5	42	0.0050	1.44		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
9.9	353				Total

**Subcatchment 11S: Danton Drive & 35 Danton Drive**

Hydrograph



### Summary for Subcatchment 20S: Existing to 35 Danton Drive

Runoff = 0.38 cfs @ 12.14 hrs, Volume= 0.031 af, Depth= 0.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 2-Year Rainfall=3.15"

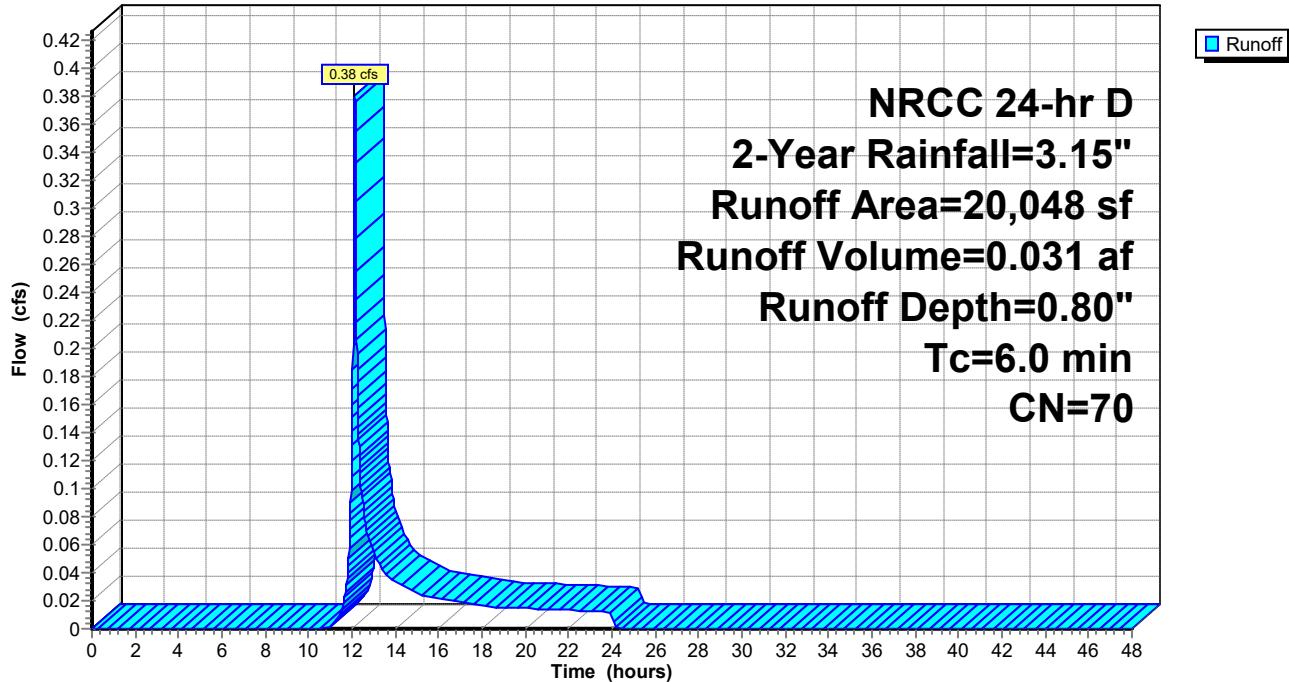
Area (sf)	CN	Description
10,526	98	Paved parking, HSG B
9,522	39	>75% Grass cover, Good, HSG A
20,048	70	Weighted Average
9,522		47.50% Pervious Area
10,526		52.50% Impervious Area

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

### Subcatchment 20S: Existing to 35 Danton Drive

Hydrograph



### Summary for Subcatchment 30S: To 31 Danton Drive

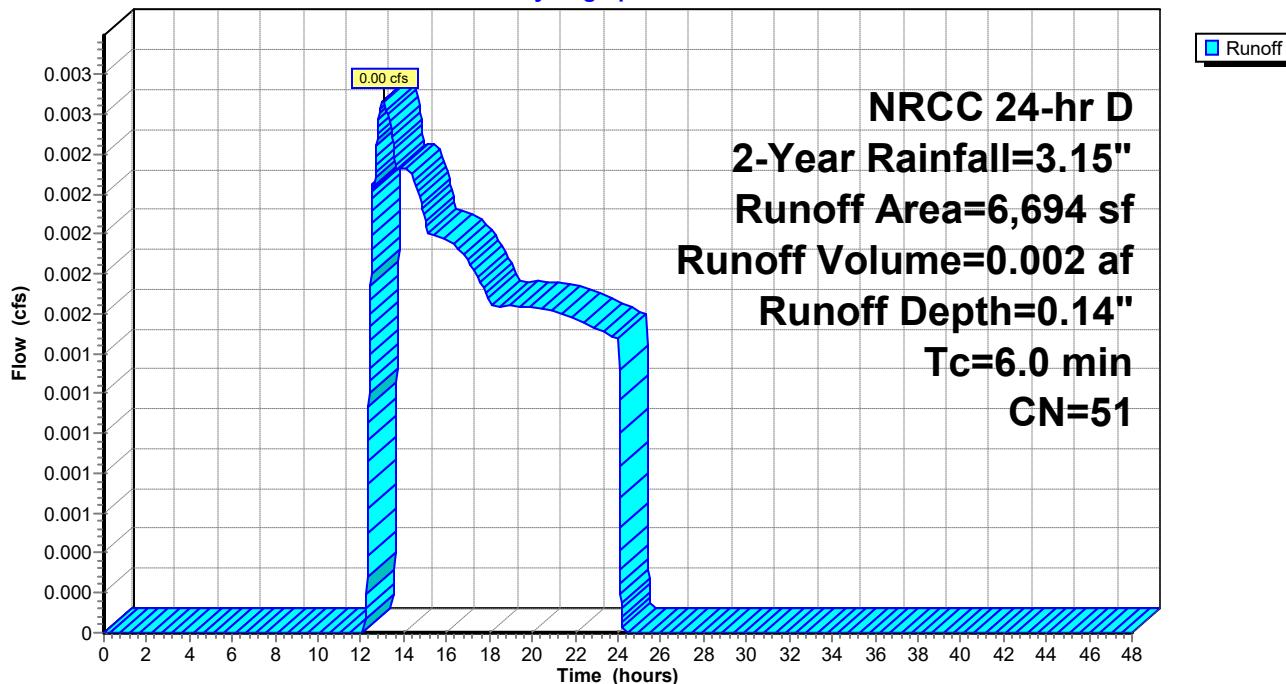
Runoff = 0.00 cfs @ 13.04 hrs, Volume= 0.002 af, Depth= 0.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description		
1,409	98	Paved parking, HSG B		
5,285	39	>75% Grass cover, Good, HSG A		
6,694	51	Weighted Average		
5,285		78.95% Pervious Area		
1,409		21.05% Impervious Area		
Tc (min)	Length (feet)	Slope (ft/ft) Velocity (ft/sec) Capacity (cfs) Description		
6.0				Direct Entry,

### Subcatchment 30S: To 31 Danton Drive

Hydrograph



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Page 11

**Summary for Subcatchment 40S: Woods Behind Project**

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

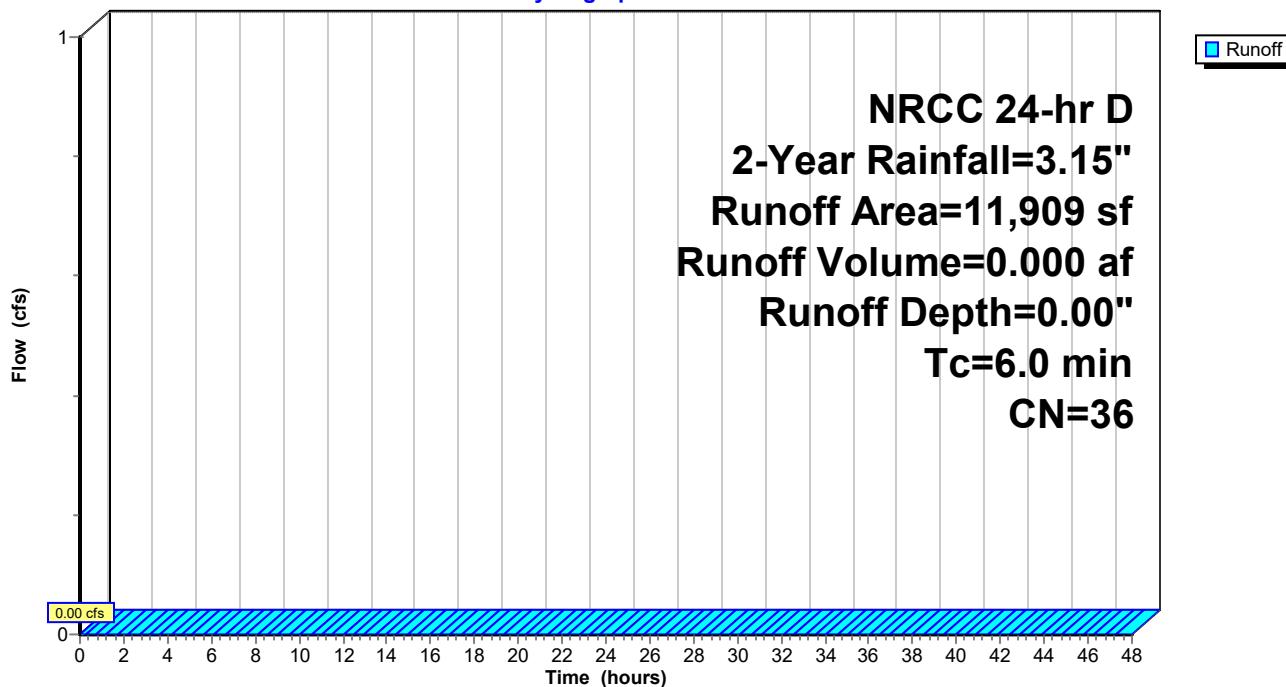
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
11,909	36	Woods, Fair, HSG A
11,909		100.00% Pervious Area

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

**Subcatchment 40S: Woods Behind Project**

Hydrograph



### Summary for Subcatchment 100S: Truck Docks

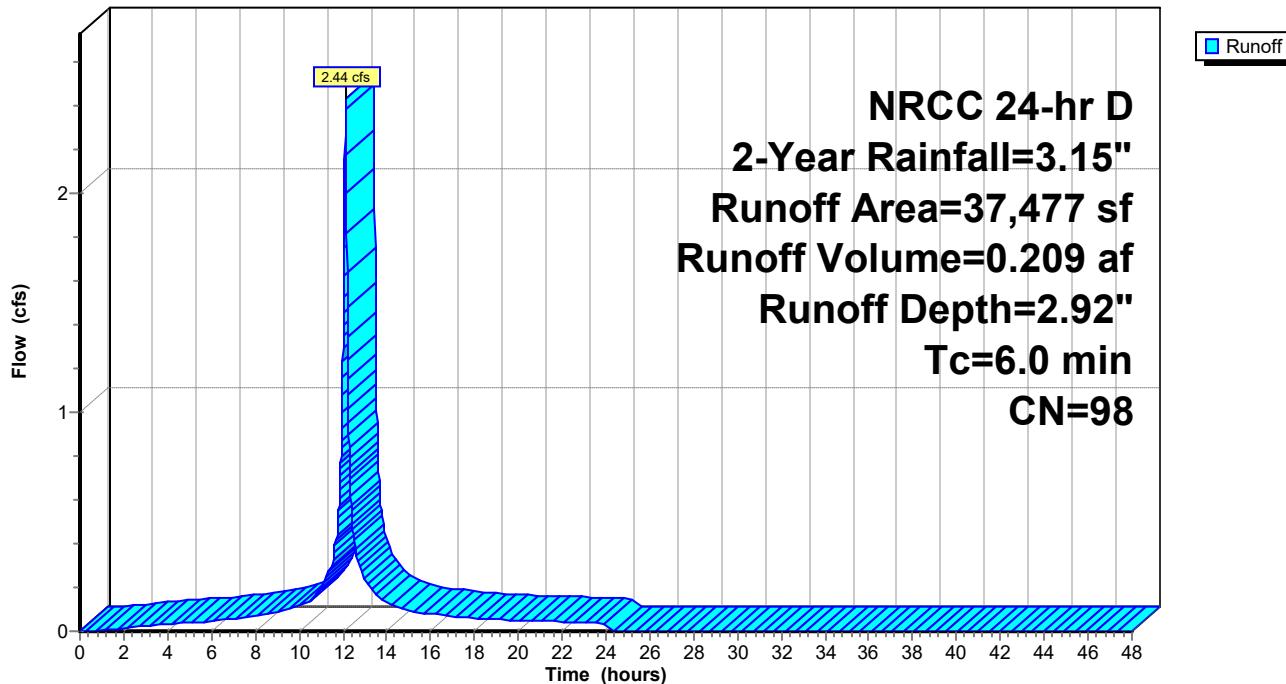
Runoff = 2.44 cfs @ 12.13 hrs, Volume= 0.209 af, Depth= 2.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description			
22,482	98	Paved parking, HSG A			
14,995	98	Roofs, HSG A			
37,477	98	Weighted Average			
37,477		100.00% Impervious Area			
Tc	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
				6.0	Direct Entry, 6

### Subcatchment 100S: Truck Docks

Hydrograph



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NRCC 24-hr D 2-Year Rainfall=3.15"

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Page 13**Summary for Subcatchment 110S: Roof Drains**

Runoff = 1.89 cfs @ 12.13 hrs, Volume= 0.142 af, Depth= 1.30"

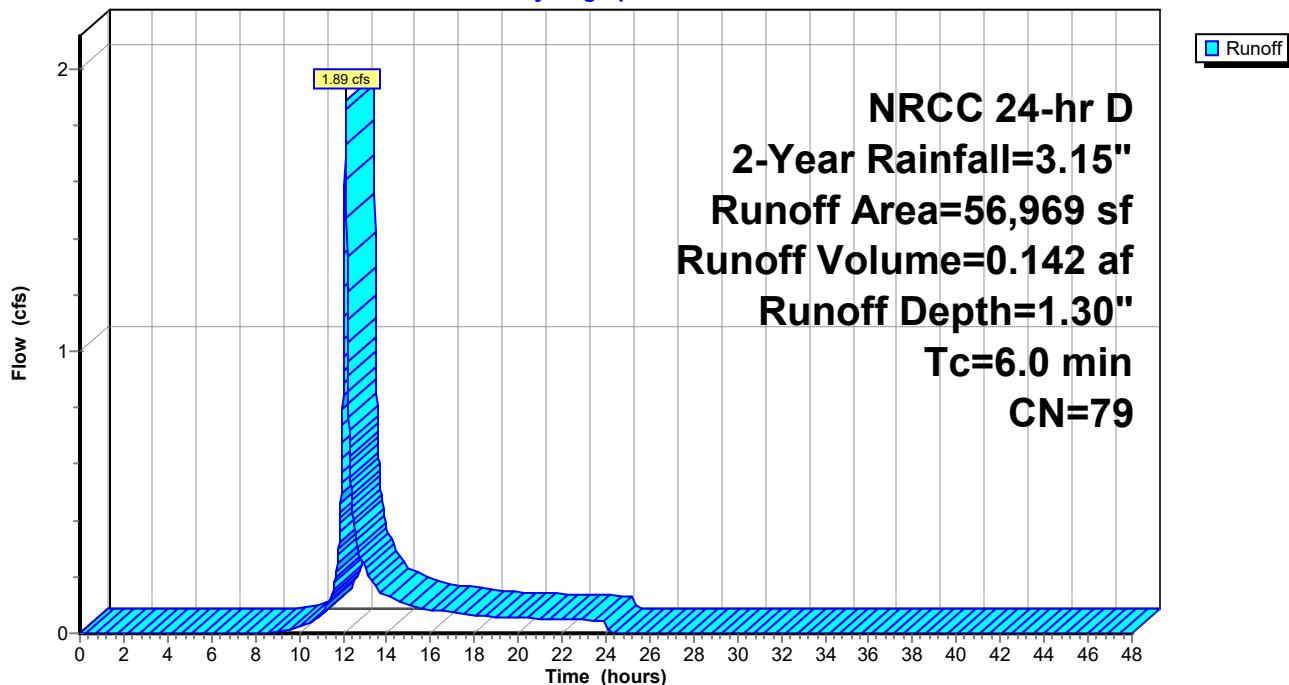
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
30,102	98	Roofs, HSG A
21,741	49	50-75% Grass cover, Fair, HSG A
5,126	98	Water Surface, HSG A
56,969	79	Weighted Average
21,741		38.16% Pervious Area
35,228		61.84% Impervious Area

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

**Subcatchment 110S: Roof Drains**

Hydrograph



**Summary for Subcatchment 120S: Front Parking Lot**

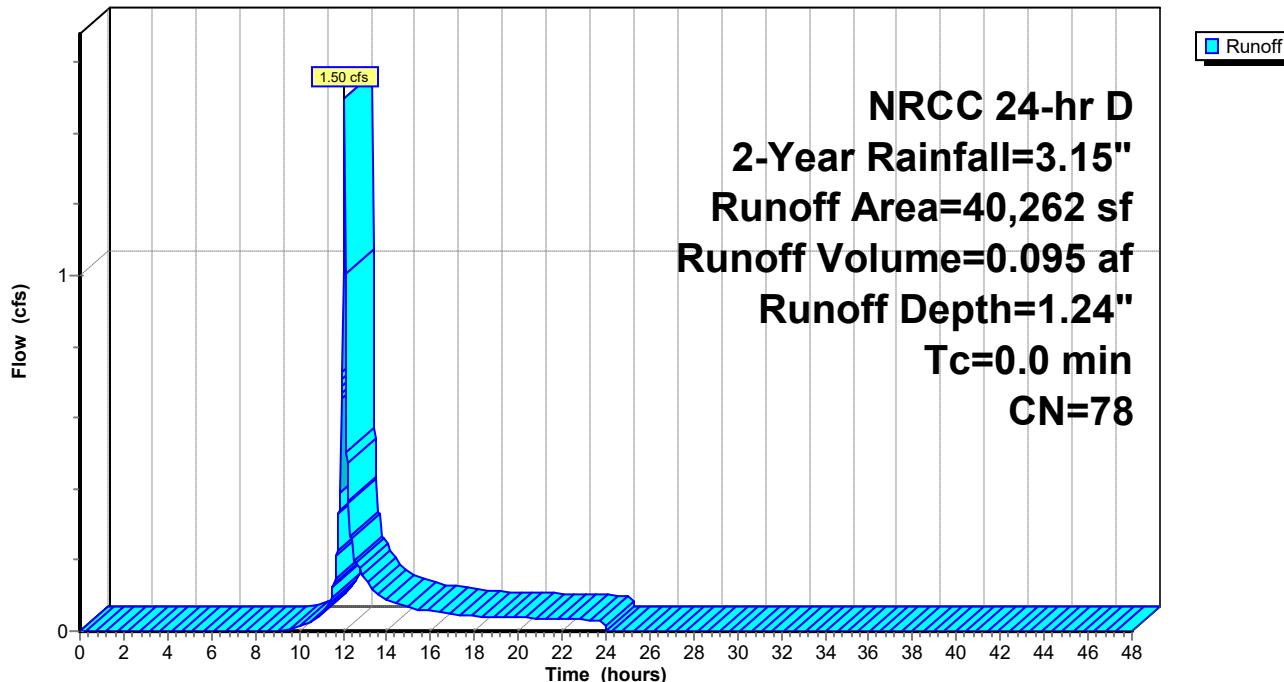
Runoff = 1.50 cfs @ 12.09 hrs, Volume= 0.095 af, Depth= 1.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
11,451	98	Paved parking, HSG A
14,995	98	Roofs, HSG A
13,816	39	>75% Grass cover, Good, HSG A
40,262	78	Weighted Average
13,816		34.32% Pervious Area
26,446		65.68% Impervious Area

**Subcatchment 120S: Front Parking Lot**

Hydrograph



### Summary for Subcatchment 130S: Existing Danton Drive

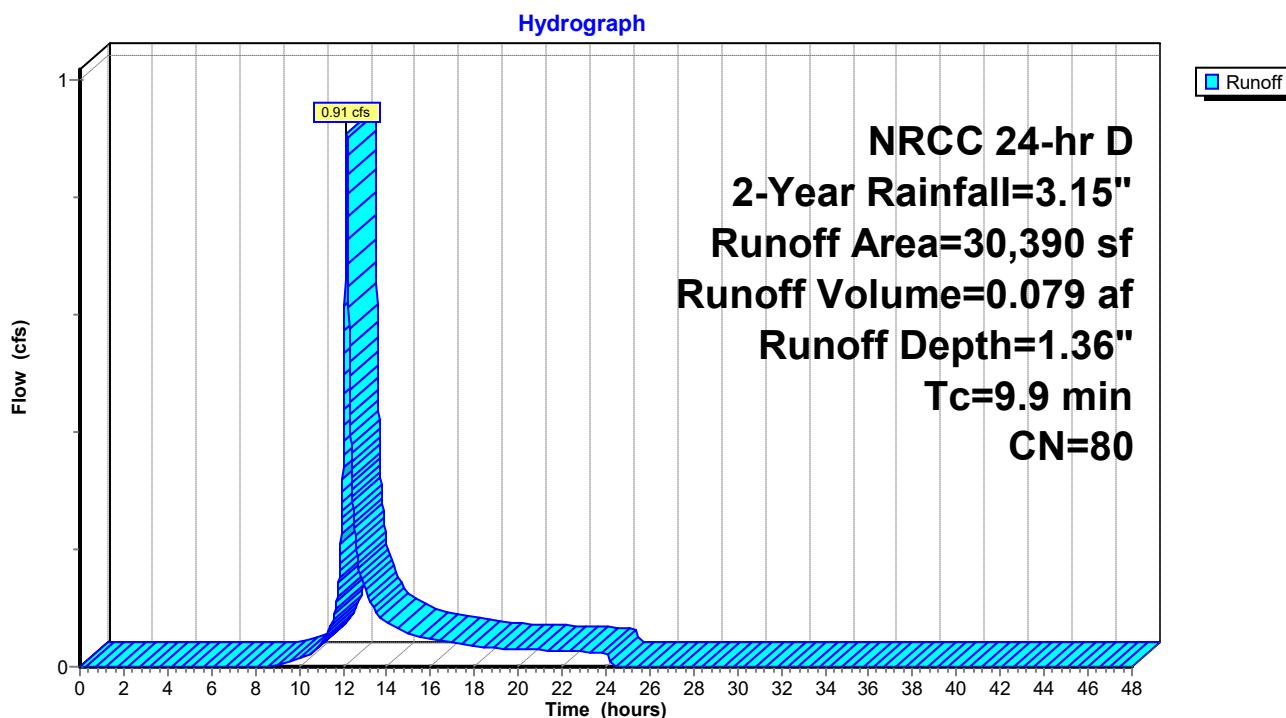
Runoff = 0.91 cfs @ 12.18 hrs, Volume= 0.079 af, Depth= 1.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
21,029	98	Paved parking, HSG A
9,361	39	>75% Grass cover, Good, HSG A

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

### Subcatchment 130S: Existing Danton Drive



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Page 16

**Summary for Subcatchment 200S: To 35 Danton Drive**

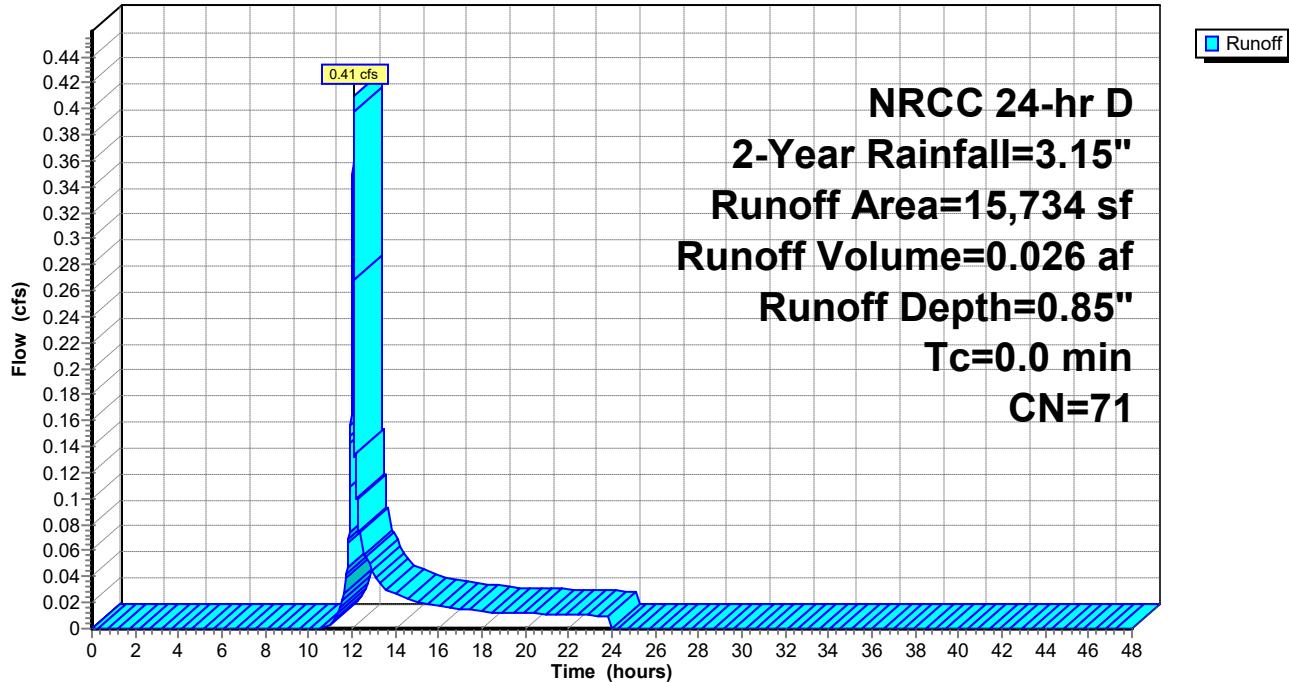
Runoff = 0.41 cfs @ 12.09 hrs, Volume= 0.026 af, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
7,316	39	>75% Grass cover, Good, HSG A
8,418	98	Paved parking, HSG A
15,734	71	Weighted Average
7,316		46.50% Pervious Area
8,418		53.50% Impervious Area

**Subcatchment 200S: To 35 Danton Drive**

Hydrograph



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NRCC 24-hr D 2-Year Rainfall=3.15"

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Page 17

**Summary for Subcatchment 300S: To 31 Danton Drive**

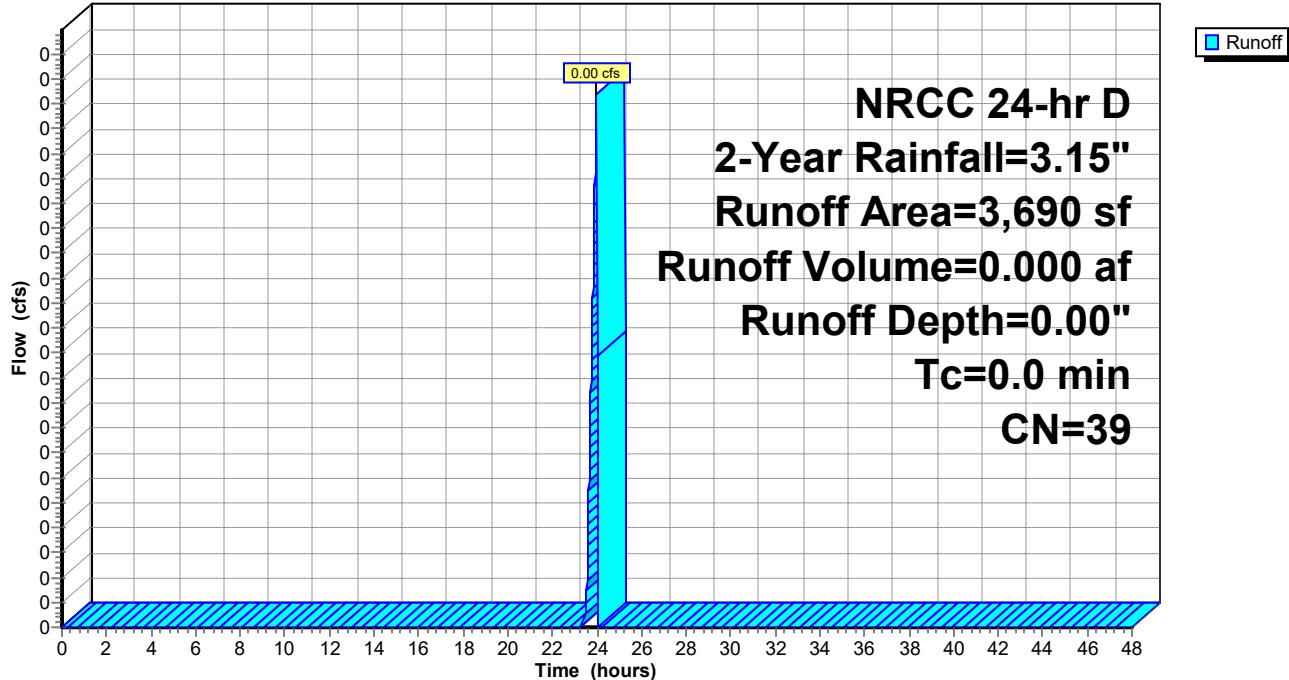
Runoff = 0.00 cfs @ 23.99 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
3,690	39	>75% Grass cover, Good, HSG A
3,690		100.00% Pervious Area

**Subcatchment 300S: To 31 Danton Drive**

Hydrograph



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NRCC 24-hr D 2-Year Rainfall=3.15"

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Page 18

**Summary for Subcatchment 400S: Woods Behind Project**

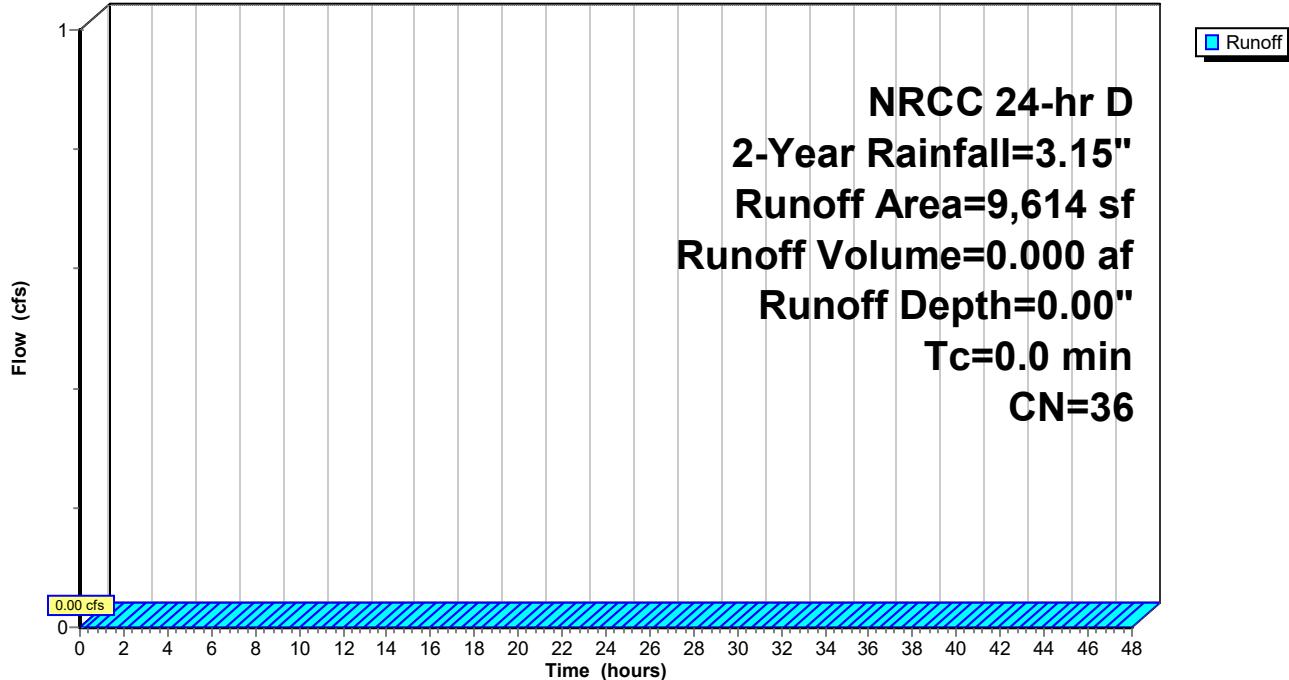
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
9,614	36	Woods, Fair, HSG A
9,614		100.00% Pervious Area

**Subcatchment 400S: Woods Behind Project**

Hydrograph



### Summary for Reach 1R: Project Impact to Peat Meadow Brook

Inflow Area = 4.436 ac, 46.80% Impervious, Inflow Depth = 0.79" for 2-Year event

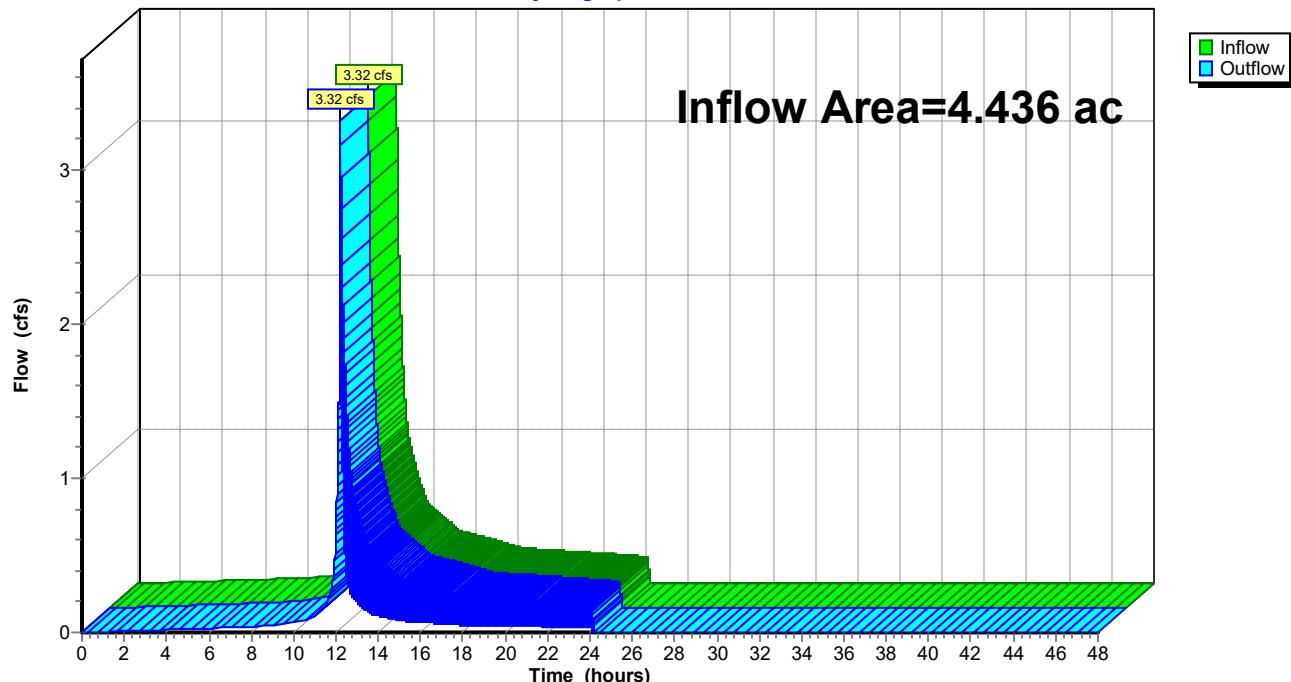
Inflow = 3.32 cfs @ 12.21 hrs, Volume= 0.291 af

Outflow = 3.32 cfs @ 12.21 hrs, Volume= 0.291 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 1R: Project Impact to Peat Meadow Brook

Hydrograph



### Summary for Reach 2R: Project Impact to Peat Meadow Brook

Inflow Area = 4.457 ac, 66.24% Impervious, Inflow Depth = 0.28" for 2-Year event

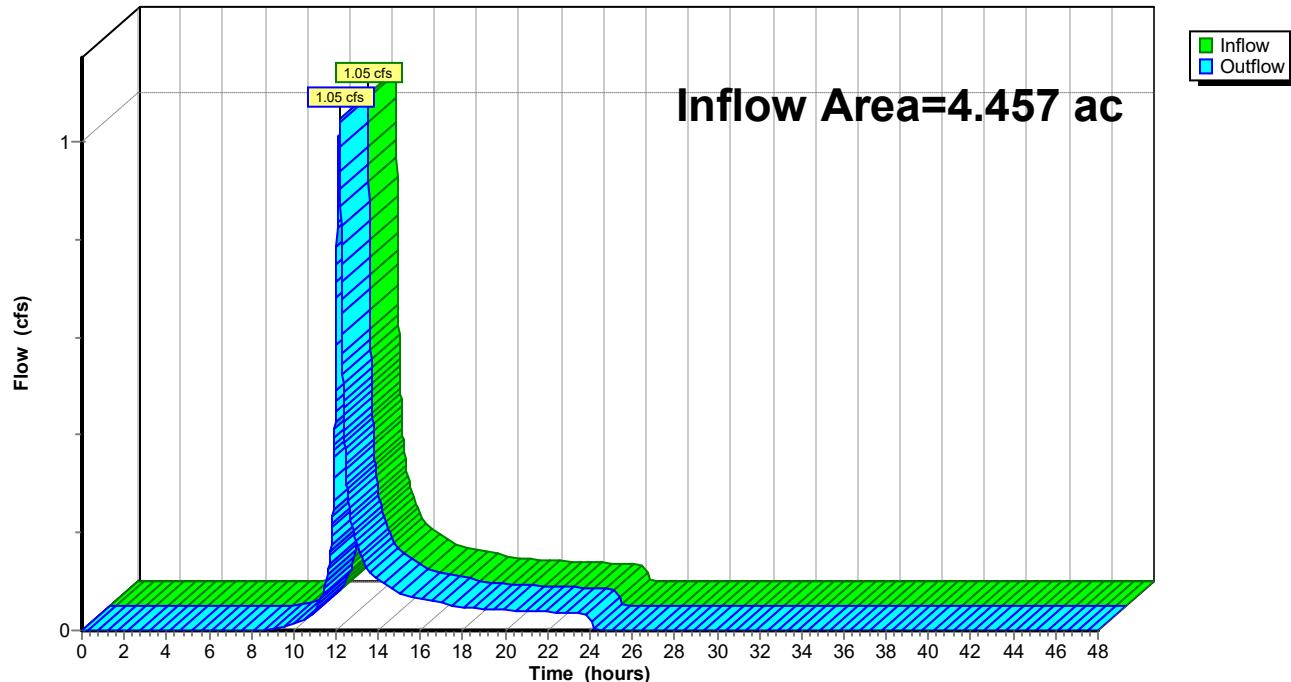
Inflow = 1.05 cfs @ 12.18 hrs, Volume= 0.105 af

Outflow = 1.05 cfs @ 12.18 hrs, Volume= 0.105 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 2R: Project Impact to Peat Meadow Brook

Hydrograph



### Summary for Reach 10R: Existing Project Oufall (CB at SE of site)

Inflow Area = 3.549 ac, 50.78% Impervious, Inflow Depth = 0.87" for 2-Year event

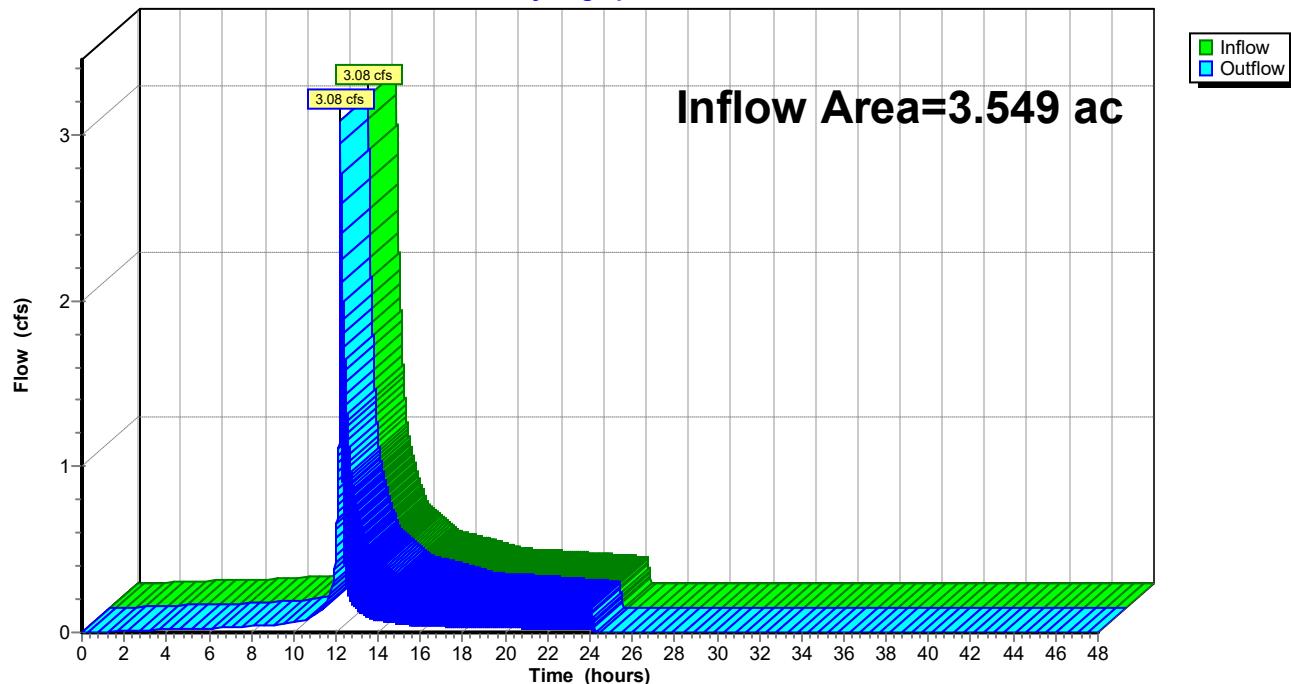
Inflow = 3.08 cfs @ 12.21 hrs, Volume= 0.258 af

Outflow = 3.08 cfs @ 12.21 hrs, Volume= 0.258 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 10R: Existing Project Oufall (CB at SE of site)

Hydrograph



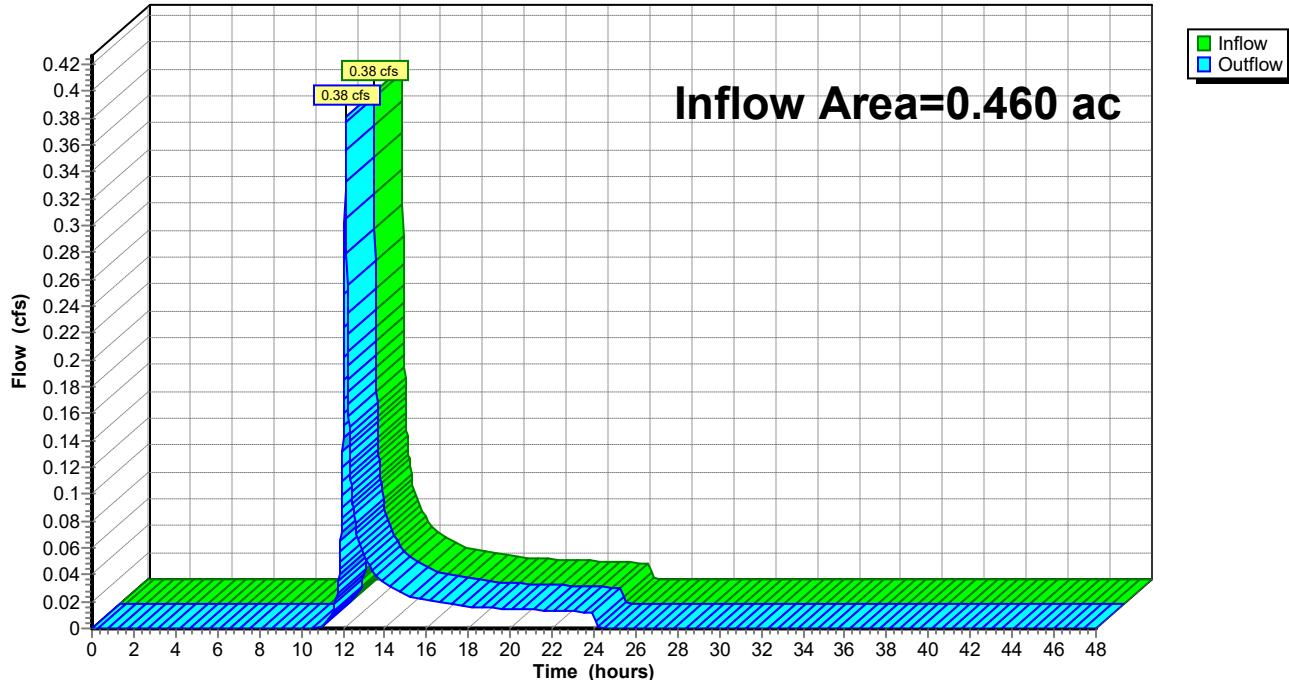
### Summary for Reach 20R: Existing Outfall to 35 Danton Drive Back

Inflow Area = 0.460 ac, 52.50% Impervious, Inflow Depth = 0.80" for 2-Year event  
 Inflow = 0.38 cfs @ 12.14 hrs, Volume= 0.031 af  
 Outflow = 0.38 cfs @ 12.14 hrs, Volume= 0.031 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 20R: Existing Outfall to 35 Danton Drive Back

Hydrograph



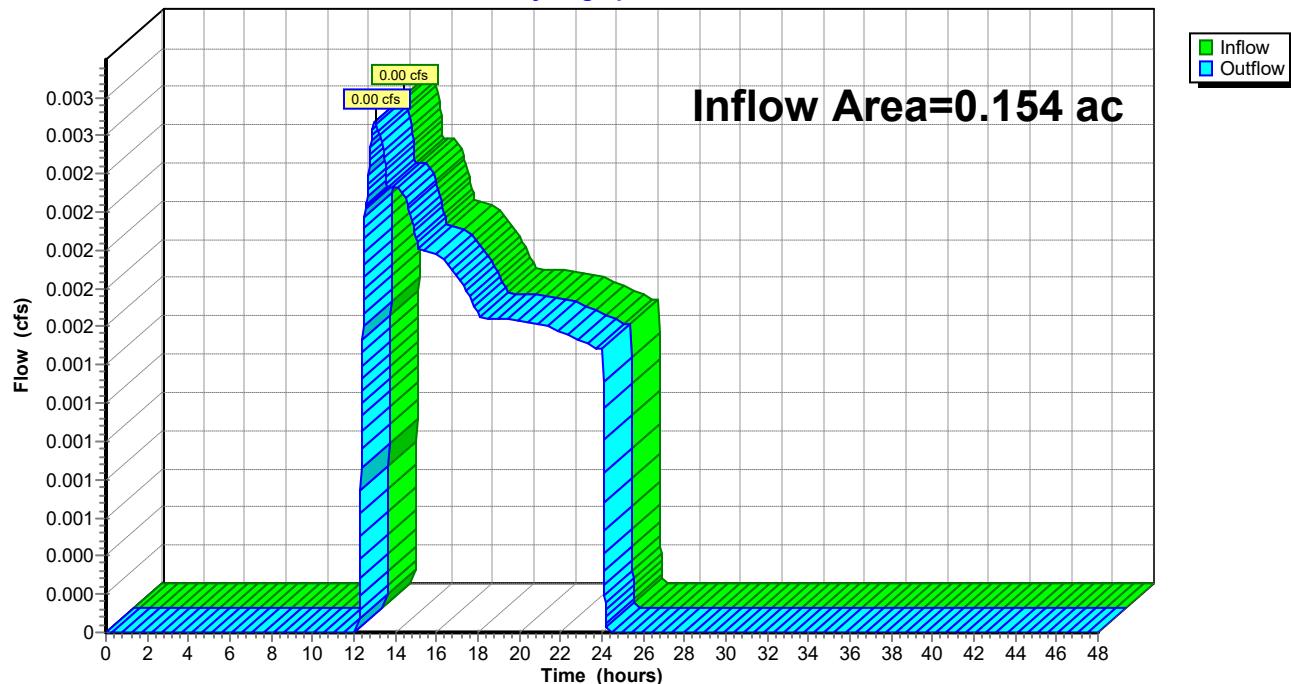
### Summary for Reach 30R: Existing Outfall to 31 Danton Drive

Inflow Area = 0.154 ac, 21.05% Impervious, Inflow Depth = 0.14" for 2-Year event  
 Inflow = 0.00 cfs @ 13.04 hrs, Volume= 0.002 af  
 Outflow = 0.00 cfs @ 13.04 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 30R: Existing Outfall to 31 Danton Drive

Hydrograph



### Summary for Reach 40R: Woods Behind Project

Inflow Area = 0.273 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-Year event

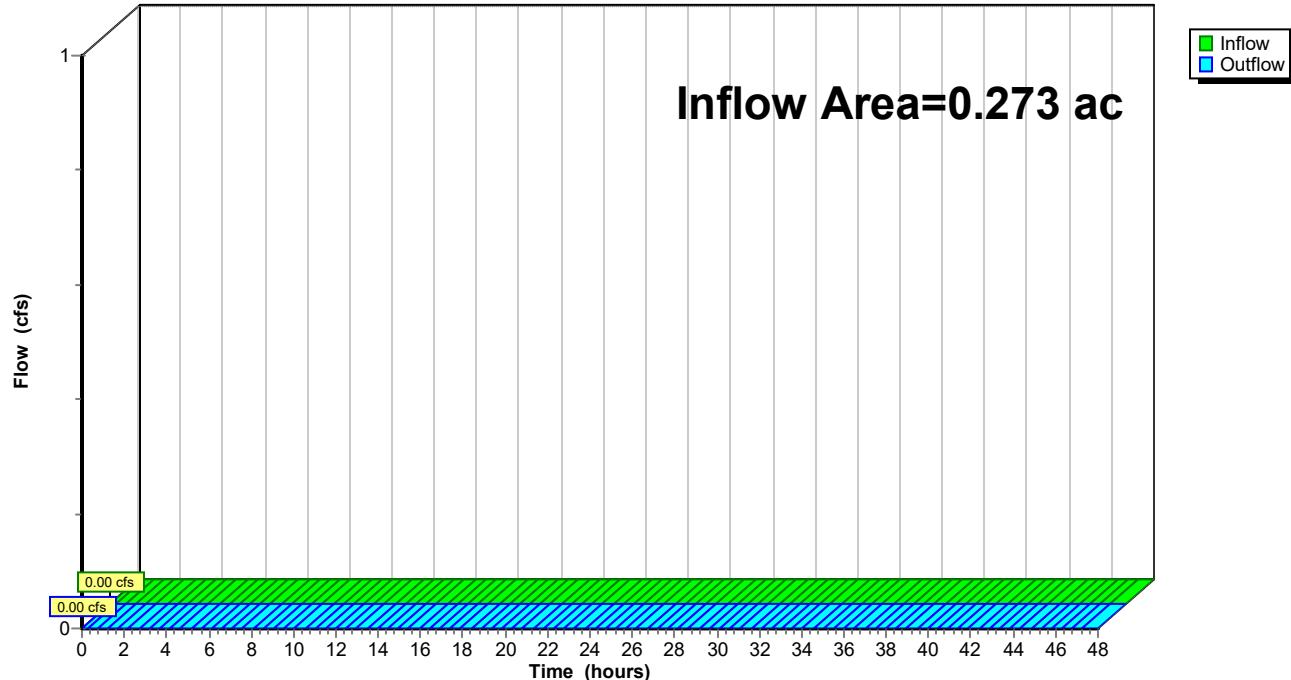
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 40R: Woods Behind Project

Hydrograph



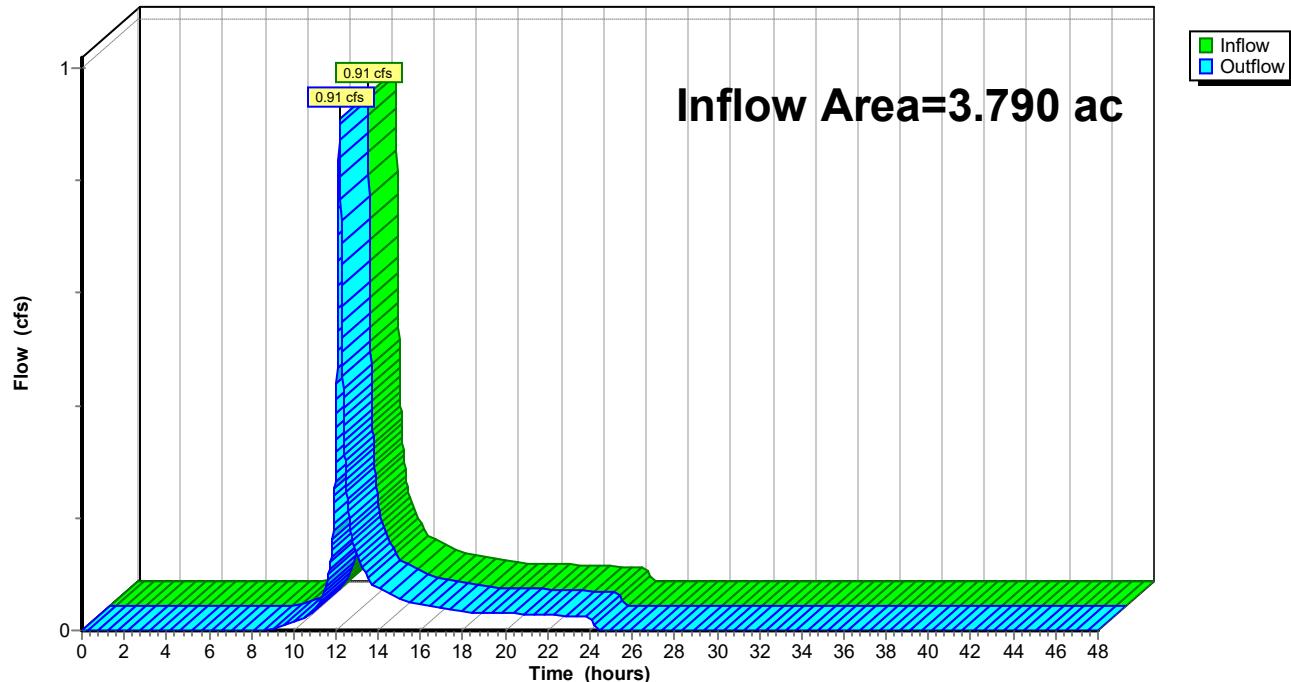
### Summary for Reach 100R: Project Outfall

Inflow Area = 3.790 ac, 72.79% Impervious, Inflow Depth = 0.25" for 2-Year event  
Inflow = 0.91 cfs @ 12.18 hrs, Volume= 0.079 af  
Outflow = 0.91 cfs @ 12.18 hrs, Volume= 0.079 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 100R: Project Outfall

Hydrograph



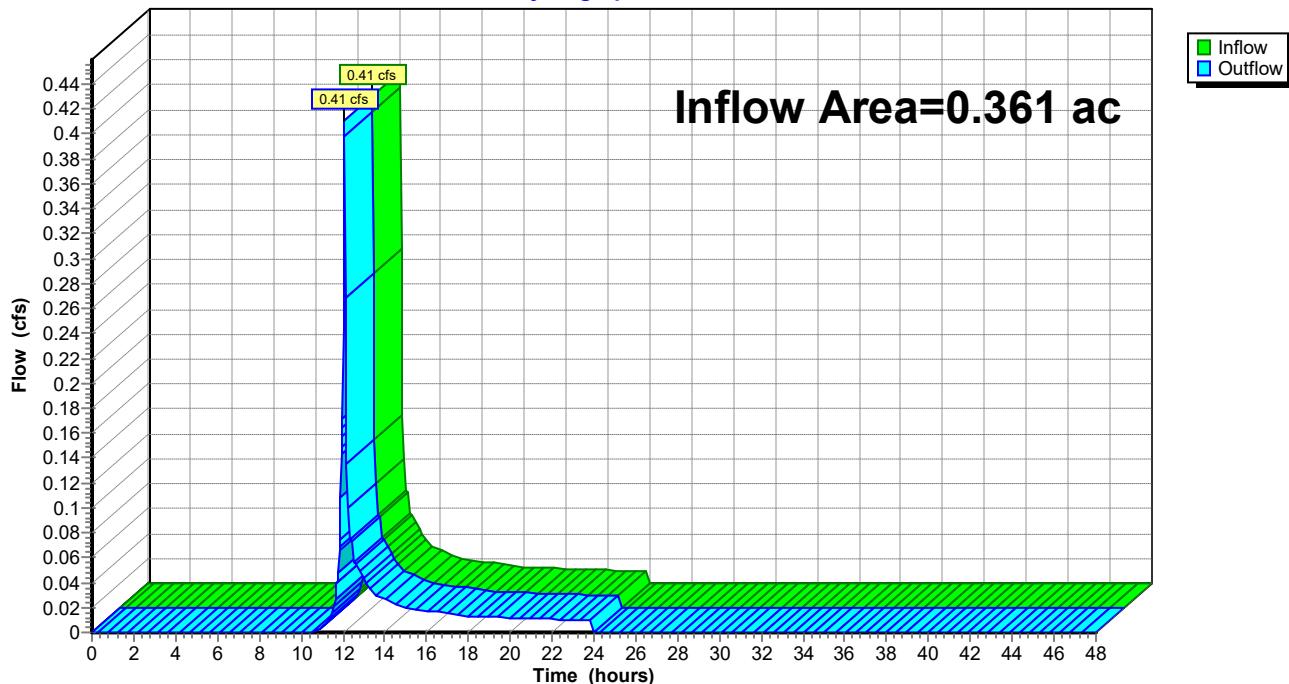
### Summary for Reach 200R: Existing Oufall to 35 Danton Drive Back

Inflow Area = 0.361 ac, 53.50% Impervious, Inflow Depth = 0.85" for 2-Year event  
 Inflow = 0.41 cfs @ 12.09 hrs, Volume= 0.026 af  
 Outflow = 0.41 cfs @ 12.09 hrs, Volume= 0.026 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 200R: Existing Oufall to 35 Danton Drive Back

Hydrograph



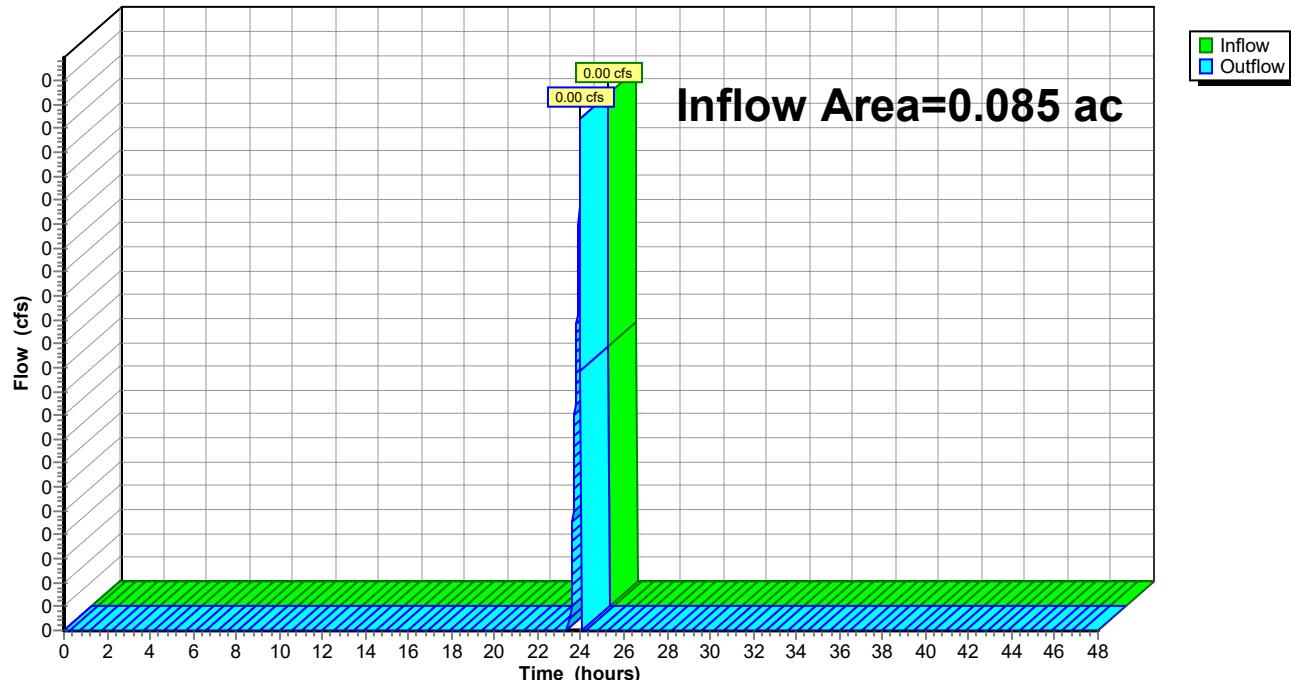
**Summary for Reach 300R: Existing Oufall to 31 Danton Drive**

Inflow Area = 0.085 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-Year event

Inflow = 0.00 cfs @ 23.99 hrs, Volume= 0.000 af

Outflow = 0.00 cfs @ 23.99 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

**Reach 300R: Existing Oufall to 31 Danton Drive****Hydrograph**

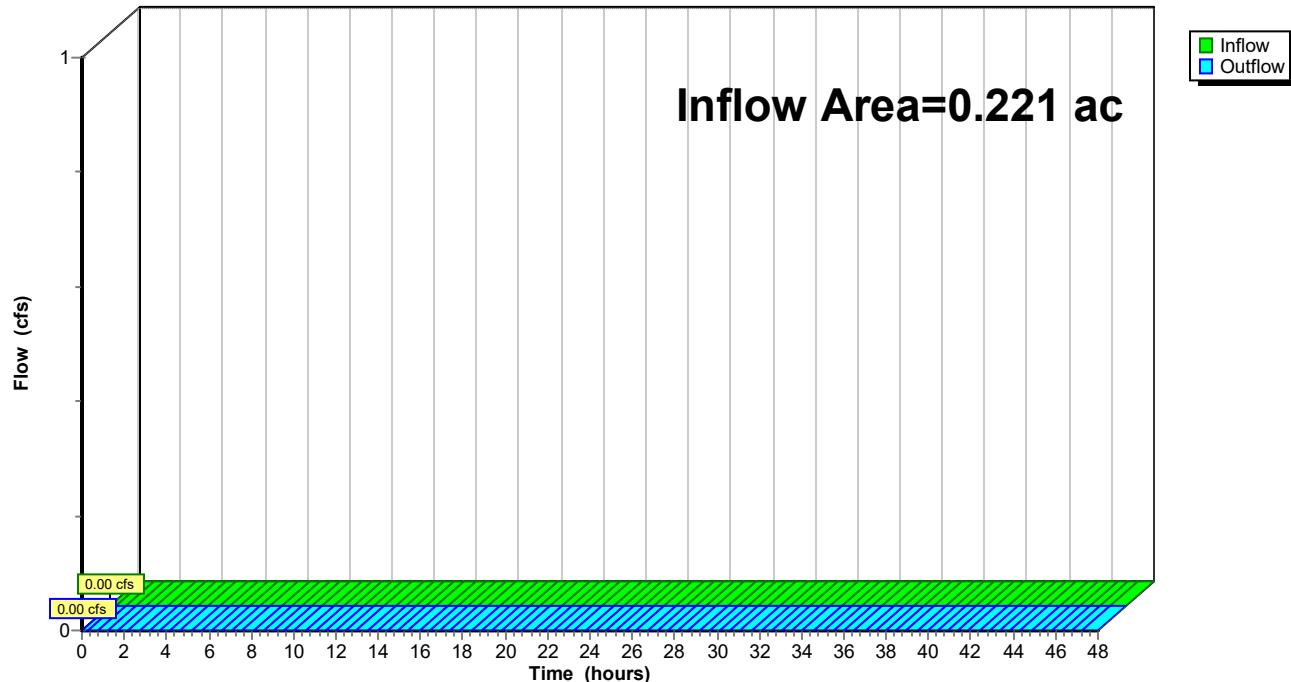
### Summary for Reach 400R: Woods Behind Project

Inflow Area = 0.221 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-Year event  
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af  
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 400R: Woods Behind Project

Hydrograph



### Summary for Pond 10P: Existing Swale

Inflow Area = 3.075 ac, 43.18% Impervious, Inflow Depth = 0.62" for 2-Year event  
 Inflow = 1.40 cfs @ 12.21 hrs, Volume= 0.158 af  
 Outflow = 2.03 cfs @ 12.21 hrs, Volume= 0.143 af, Atten= 0%, Lag= 0.2 min  
 Primary = 2.03 cfs @ 12.21 hrs, Volume= 0.143 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
 Peak Elev= 4.20' @ 12.21 hrs Surf.Area= 0 sf Storage= 689 cf

Plug-Flow detention time= 70.8 min calculated for 0.143 af (90% of inflow)  
 Center-of-Mass det. time= 23.5 min ( 961.0 - 937.6 )

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	690 cf	<b>Custom Stage Data</b> Listed below

Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
0.20	4
0.40	14
0.60	28
0.80	45
1.00	66
1.20	91
1.40	121
1.60	157
1.80	200
2.00	248
2.20	305
2.40	371
2.60	447
2.80	555
3.00	635
3.20	657
3.40	660
3.60	674
3.80	684
4.00	687
4.20	689
5.00	690

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	<b>Special &amp; User-Defined</b> Elev. (feet) 0.00 4.20 4.21 Disch. (cfs) 0.000 0.000 5,000.000

**Primary OutFlow** Max=2.03 cfs @ 12.21 hrs HW=4.20' (Free Discharge)  
 ↑=Special & User-Defined (Custom Controls 2.03 cfs)

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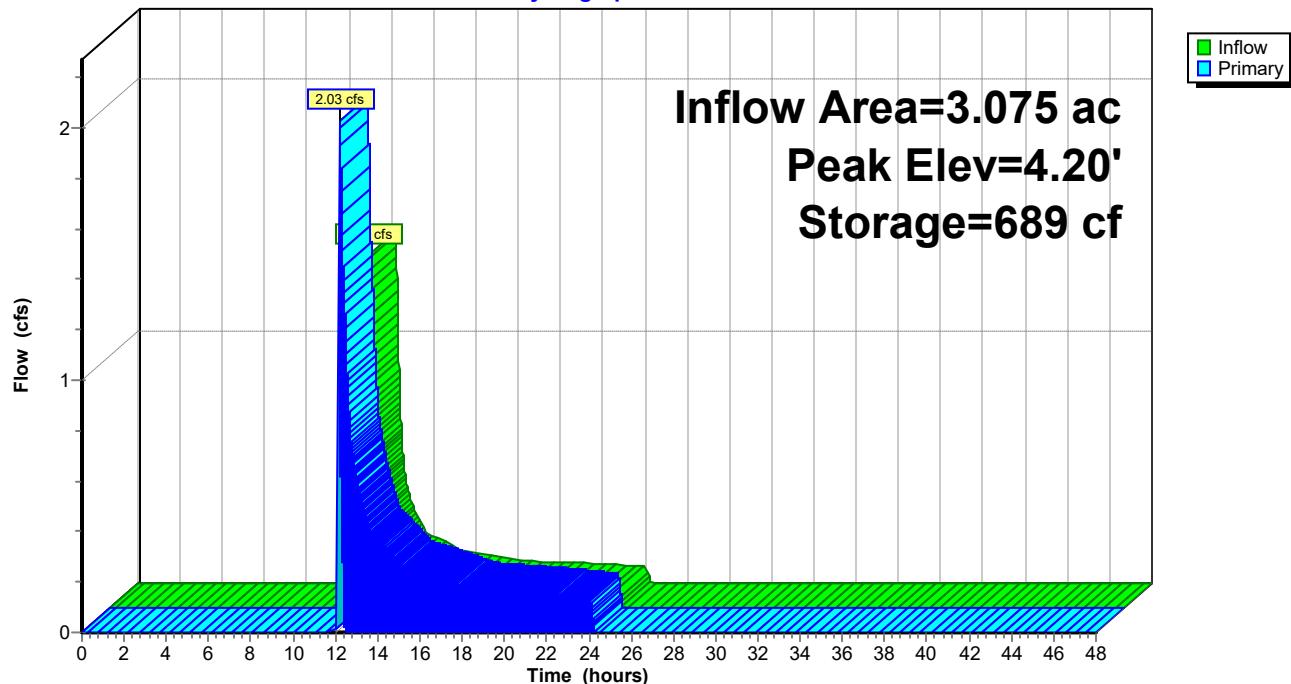
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Page 30

### Pond 10P: Existing Swale

Hydrograph



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Page 31

**Summary for Pond 100P: Underground Storage**

Inflow Area = 0.860 ac, 100.00% Impervious, Inflow Depth = 2.92" for 2-Year event  
 Inflow = 2.44 cfs @ 12.13 hrs, Volume= 0.209 af  
 Outflow = 0.36 cfs @ 11.60 hrs, Volume= 0.209 af, Atten= 85%, Lag= 0.0 min  
 Discarded = 0.36 cfs @ 11.60 hrs, Volume= 0.209 af  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
 Peak Elev= 111.63' @ 12.60 hrs Surf.Area= 1,866 sf Storage= 1,920 cf

Plug-Flow detention time= 26.8 min calculated for 0.209 af (100% of inflow)  
 Center-of-Mass det. time= 26.8 min ( 787.7 - 760.8 )

Volume	Invert	Avail.Storage	Storage Description
#1A	110.00'	2,627 cf	<b>30.25'W x 61.70'L x 5.75'H Field A</b> 10,732 cf Overall - 4,165 cf Embedded = 6,567 cf x 40.0% Voids
#2A	110.75'	4,165 cf	<b>Cultec R-902HD x 64 Inside #1</b> Effective Size= 69.8" W x 48.0" H => 17.65 sf x 3.67' L = 64.7 cf Overall Size= 78.0" W x 48.0" H x 4.10' L with 0.44' Overlap 64 Chambers in 4 Rows Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf
6,792 cf			Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	110.00'	<b>8.270 in/hr Exfiltration over Surface area</b>
#2	Primary	115.40'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)
#3	Primary	112.50'	<b>4.0" Vert. Orifice/Grate</b> C= 0.600

**Discarded OutFlow** Max=0.36 cfs @ 11.60 hrs HW=110.03' (Free Discharge)  
 ↑ 1=Exfiltration (Exfiltration Controls 0.36 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=110.00' (Free Discharge)  
 ↑ 2=Sharp-Crested Rectangular Weir ( Controls 0.00 cfs)  
 3=Orifice/Grate ( Controls 0.00 cfs)

## Pond 100P: Underground Storage - Chamber Wizard Field A

**Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)**

Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf

Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap

Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

16 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 59.70' Row Length +12.0" End Stone x 2 = 61.70' Base Length

4 Rows x 78.0" Wide + 9.0" Spacing x 3 + 12.0" Side Stone x 2 = 30.25' Base Width

9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

64 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 4 Rows = 4,165.1 cf Chamber Storage

10,731.9 cf Field - 4,165.1 cf Chambers = 6,566.8 cf Stone x 40.0% Voids = 2,626.7 cf Stone Storage

Chamber Storage + Stone Storage = 6,791.8 cf = 0.156 af

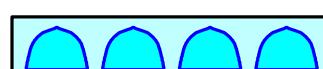
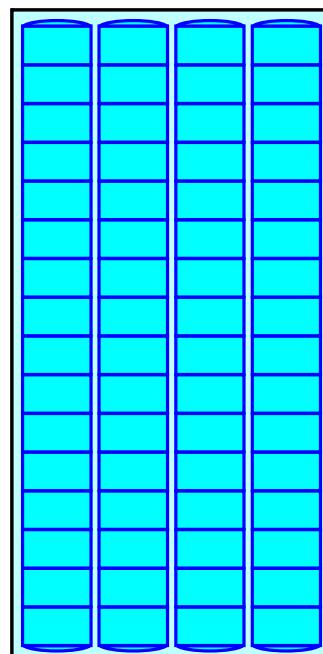
Overall Storage Efficiency = 63.3%

Overall System Size = 61.70' x 30.25' x 5.75'

64 Chambers

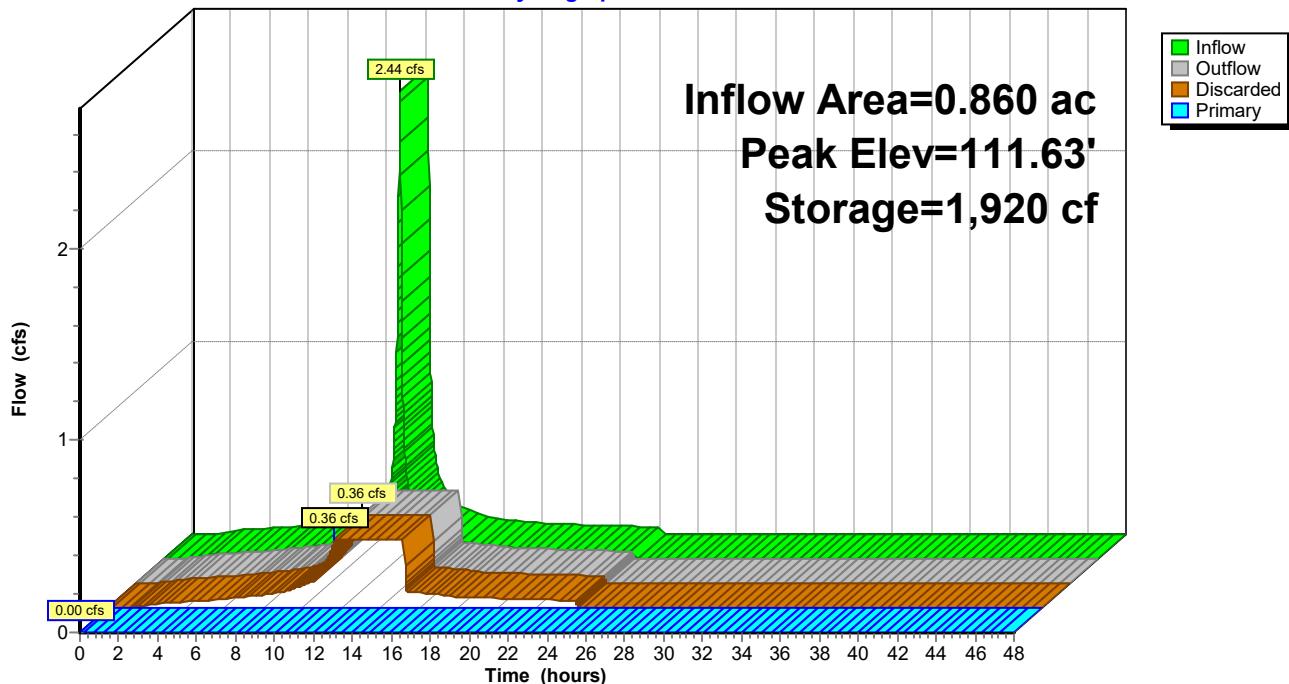
397.5 cy Field

243.2 cy Stone



**Pond 100P: Underground Storage**

Hydrograph



### Summary for Pond 110P: Roof Drain Pond

Inflow Area = 1.308 ac, 61.84% Impervious, Inflow Depth = 1.30" for 2-Year event  
 Inflow = 1.89 cfs @ 12.13 hrs, Volume= 0.142 af  
 Outflow = 0.18 cfs @ 13.39 hrs, Volume= 0.142 af, Atten= 91%, Lag= 75.5 min  
 Discarded = 0.18 cfs @ 13.39 hrs, Volume= 0.142 af  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
 Peak Elev= 117.07' @ 13.39 hrs Surf.Area= 3,159 sf Storage= 2,203 cf

Plug-Flow detention time= 139.6 min calculated for 0.142 af (100% of inflow)  
 Center-of-Mass det. time= 139.6 min ( 1,015.3 - 875.7 )

Volume	Invert	Avail.Storage	Storage Description
#1	116.00'	6,072 cf	3.00'W x 330.00'L x 2.00'H Prismatoid Z=3.0

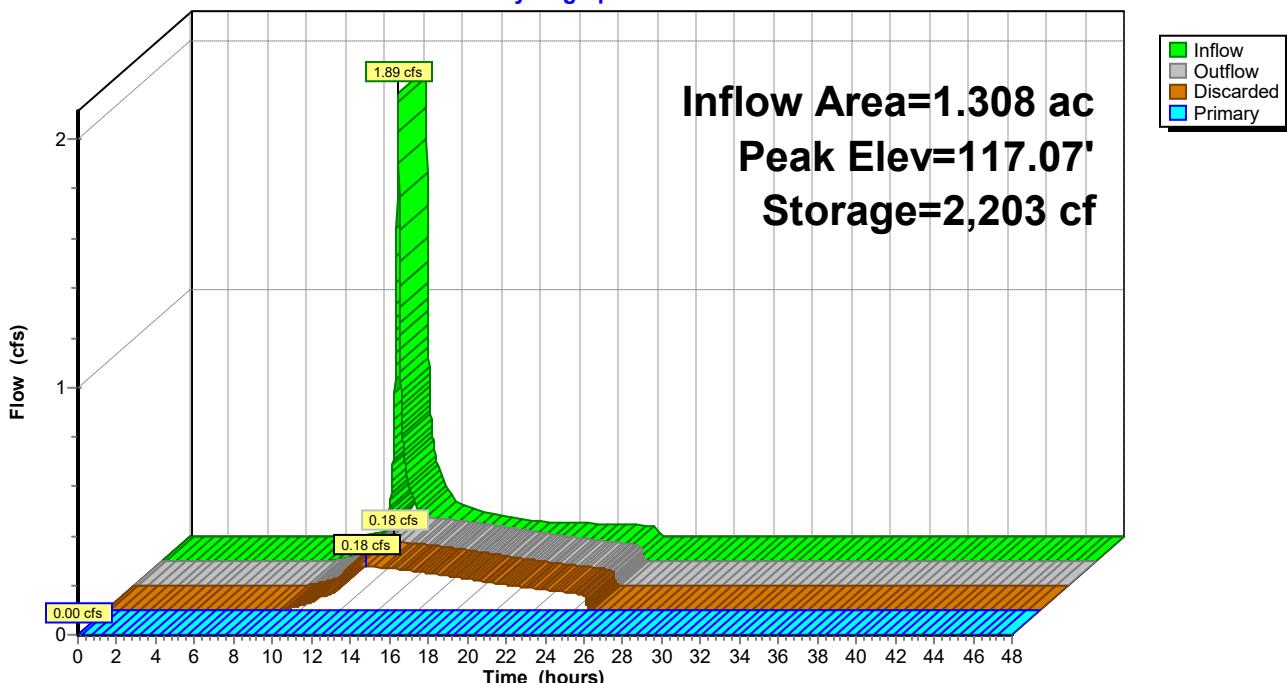
Device	Routing	Invert	Outlet Devices
#1	Discarded	116.00'	2.410 in/hr Exfiltration over Surface area
#2	Primary	117.20'	4.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)

**Discarded OutFlow** Max=0.18 cfs @ 13.39 hrs HW=117.07' (Free Discharge)  
 ↗ 1=Exfiltration (Exfiltration Controls 0.18 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=116.00' (Free Discharge)  
 ↗ 2=Sharp-Crested Rectangular Weir (Controls 0.00 cfs)

### Pond 110P: Roof Drain Pond

Hydrograph



## Summary for Pond 120P: Front Undergound Storage

Inflow Area = 0.924 ac, 65.68% Impervious, Inflow Depth = 1.24" for 2-Year event  
 Inflow = 1.50 cfs @ 12.09 hrs, Volume= 0.095 af  
 Outflow = 0.07 cfs @ 11.36 hrs, Volume= 0.095 af, Atten= 95%, Lag= 0.0 min  
 Discarded = 0.07 cfs @ 11.36 hrs, Volume= 0.095 af  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
 Peak Elev= 115.07' @ 14.80 hrs Surf.Area= 1,250 sf Storage= 1,718 cf

Plug-Flow detention time= 261.8 min calculated for 0.095 af (100% of inflow)  
 Center-of-Mass det. time= 261.8 min ( 1,136.0 - 874.2 )

Volume	Invert	Avail.Storage	Storage Description
#1A	113.00'	1,782 cf	<b>23.00'W x 54.37'L x 5.75'H Field A</b> 7,190 cf Overall - 2,735 cf Embedded = 4,455 cf x 40.0% Voids
#2A	113.75'	2,735 cf	<b>Cultec R-902HD x 42 Inside #1</b> Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 42 Chambers in 3 Rows Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf
4,517 cf			Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	115.60'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)
#2	Discarded	113.00'	<b>2.410 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.07 cfs @ 11.36 hrs HW=113.06' (Free Discharge)  
 ↑ 2=Exfiltration (Exfiltration Controls 0.07 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=113.00' (Free Discharge)  
 ↑ 1=Sharp-Crested Rectangular Weir ( Controls 0.00 cfs)

## Pond 120P: Front Undergound Storage - Chamber Wizard Field A

**Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)**

Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf

Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap

Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

14 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 52.37' Row Length +12.0" End Stone x 2 = 54.37'  
Base Length

3 Rows x 78.0" Wide + 9.0" Spacing x 2 + 12.0" Side Stone x 2 = 23.00' Base Width

9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

42 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 3 Rows = 2,735.4 cf Chamber Storage

7,190.0 cf Field - 2,735.4 cf Chambers = 4,454.6 cf Stone x 40.0% Voids = 1,781.8 cf Stone Storage

Chamber Storage + Stone Storage = 4,517.3 cf = 0.104 af

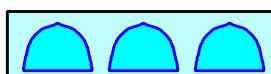
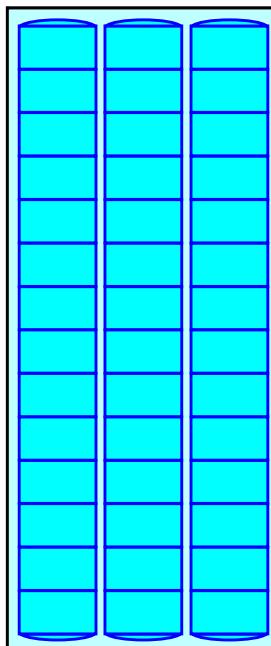
Overall Storage Efficiency = 62.8%

Overall System Size = 54.37' x 23.00' x 5.75'

42 Chambers

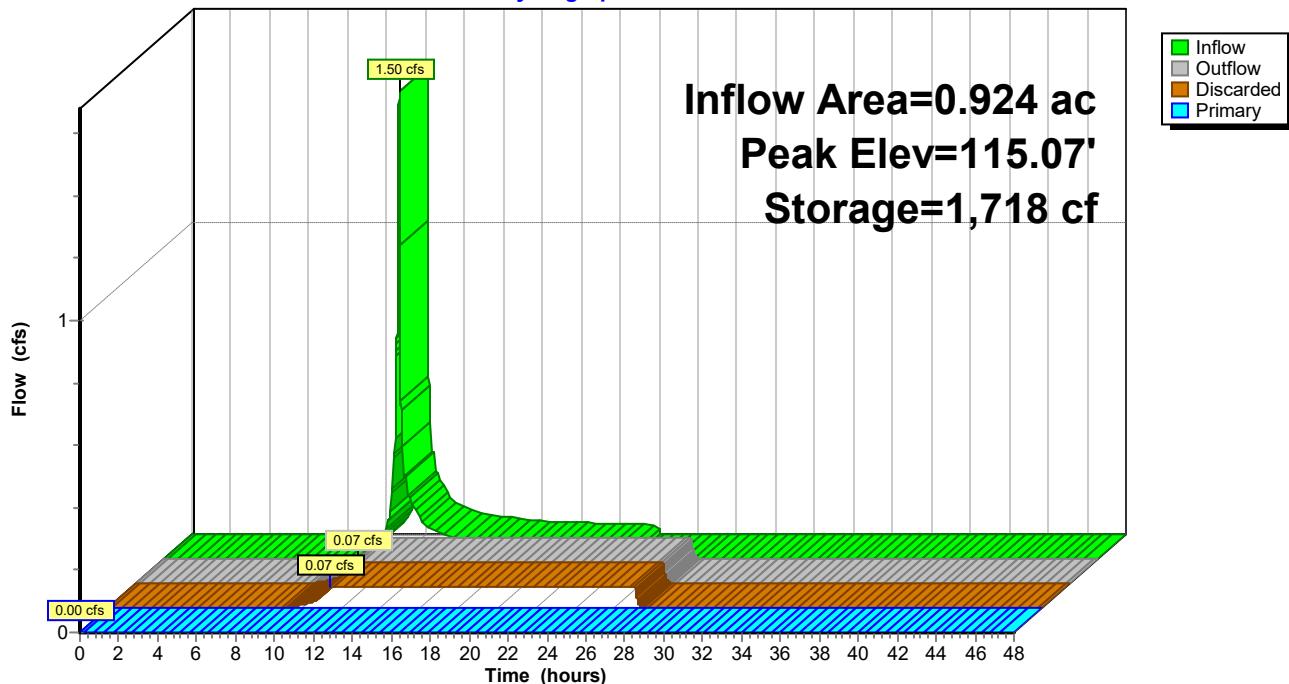
266.3 cy Field

165.0 cy Stone



**Pond 120P: Front Undergound Storage**

Hydrograph



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

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

<b>Subcatchment 10S: Existing Site</b>	Runoff Area=133,926 sf 43.18% Impervious Runoff Depth=1.61" Flow Length=555' Tc=11.5 min CN=66 Runoff=4.30 cfs 0.413 af
<b>Subcatchment 11S: Danton Drive &amp; 35</b>	Runoff Area=20,671 sf 100.00% Impervious Runoff Depth=4.59" Flow Length=353' Tc=9.9 min CN=98 Runoff=1.81 cfs 0.182 af
<b>Subcatchment 20S: Existing to 35 Danton</b>	Runoff Area=20,048 sf 52.50% Impervious Runoff Depth=1.91" Tc=6.0 min CN=70 Runoff=0.98 cfs 0.073 af
<b>Subcatchment 30S: To 31 Danton Drive</b>	Runoff Area=6,694 sf 21.05% Impervious Runoff Depth=0.68" Tc=6.0 min CN=51 Runoff=0.08 cfs 0.009 af
<b>Subcatchment 40S: Woods Behind Project</b>	Runoff Area=11,909 sf 0.00% Impervious Runoff Depth=0.09" Tc=6.0 min CN=36 Runoff=0.00 cfs 0.002 af
<b>Subcatchment 100S: Truck Docks</b>	Runoff Area=37,477 sf 100.00% Impervious Runoff Depth=4.59" Tc=6.0 min CN=98 Runoff=3.76 cfs 0.329 af
<b>Subcatchment 110S: Roof Drains</b>	Runoff Area=56,969 sf 61.84% Impervious Runoff Depth=2.66" Tc=6.0 min CN=79 Runoff=3.87 cfs 0.289 af
<b>Subcatchment 120S: Front Parking Lot</b>	Runoff Area=40,262 sf 65.68% Impervious Runoff Depth=2.57" Tc=0.0 min CN=78 Runoff=3.06 cfs 0.198 af
<b>Subcatchment 130S: Existing Danton Drive</b>	Runoff Area=30,390 sf 69.20% Impervious Runoff Depth=2.75" Tc=9.9 min CN=80 Runoff=1.83 cfs 0.160 af
<b>Subcatchment 200S: To 35 Danton Drive</b>	Runoff Area=15,734 sf 53.50% Impervious Runoff Depth=1.99" Tc=0.0 min CN=71 Runoff=0.94 cfs 0.060 af
<b>Subcatchment 300S: To 31 Danton Drive</b>	Runoff Area=3,690 sf 0.00% Impervious Runoff Depth=0.17" Tc=0.0 min CN=39 Runoff=0.00 cfs 0.001 af
<b>Subcatchment 400S: Woods Behind Project</b>	Runoff Area=9,614 sf 0.00% Impervious Runoff Depth=0.09" Tc=0.0 min CN=36 Runoff=0.00 cfs 0.002 af
<b>Reach 1R: Project Impact to Peat Meadow Brook</b>	Inflow=7.05 cfs 0.663 af Outflow=7.05 cfs 0.663 af
<b>Reach 2R: Project Impact to Peat Meadow Brook</b>	Inflow=4.38 cfs 0.370 af Outflow=4.38 cfs 0.370 af
<b>Reach 10R: Existing Project Outfall (CB at SE of site)</b>	Inflow=6.24 cfs 0.579 af Outflow=6.24 cfs 0.579 af
<b>Reach 20R: Existing Outfall to 35 Danton Drive Back</b>	Inflow=0.98 cfs 0.073 af Outflow=0.98 cfs 0.073 af

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NRCC 24-hr D 10-Year Rainfall=4.83"

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Page 39

**Reach 30R: Existing Outfall to 31 Danton Drive**

Inflow=0.08 cfs 0.009 af  
Outflow=0.08 cfs 0.009 af

**Reach 40R: Woods Behind Project**

Inflow=0.00 cfs 0.002 af  
Outflow=0.00 cfs 0.002 af

**Reach 100R: Project Outfall**

Inflow=4.07 cfs 0.307 af  
Outflow=4.07 cfs 0.307 af

**Reach 200R: Existing Outfall to 35 Danton Drive Back**

Inflow=0.94 cfs 0.060 af  
Outflow=0.94 cfs 0.060 af

**Reach 300R: Existing Outfall to 31 Danton Drive**

Inflow=0.00 cfs 0.001 af  
Outflow=0.00 cfs 0.001 af

**Reach 400R: Woods Behind Project**

Inflow=0.00 cfs 0.002 af  
Outflow=0.00 cfs 0.002 af

**Pond 10P: Existing Swale**

Peak Elev=4.20' Storage=689 cf Inflow=4.30 cfs 0.413 af  
Outflow=4.49 cfs 0.398 af

**Pond 100P: Underground Storage**

Peak Elev=112.80' Storage=3,671 cf Inflow=3.76 cfs 0.329 af

Discarded=0.36 cfs 0.319 af Primary=0.16 cfs 0.010 af Outflow=0.51 cfs 0.329 af

**Pond 110P: Roof Drain Pond**

Peak Elev=117.44' Storage=3,527 cf Inflow=3.87 cfs 0.289 af

Discarded=0.22 cfs 0.215 af Primary=1.51 cfs 0.074 af Outflow=1.73 cfs 0.289 af

**Pond 120P: Front Undergound Storage**

Peak Elev=115.82' Storage=2,457 cf Inflow=3.06 cfs 0.198 af

Discarded=0.07 cfs 0.135 af Primary=1.37 cfs 0.063 af Outflow=1.44 cfs 0.198 af

**Total Runoff Area = 8.893 ac Runoff Volume = 1.718 af Average Runoff Depth = 2.32"**  
**43.46% Pervious = 3.865 ac 56.54% Impervious = 5.028 ac**

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NRCC 24-hr D 10-Year Rainfall=4.83"

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Page 40

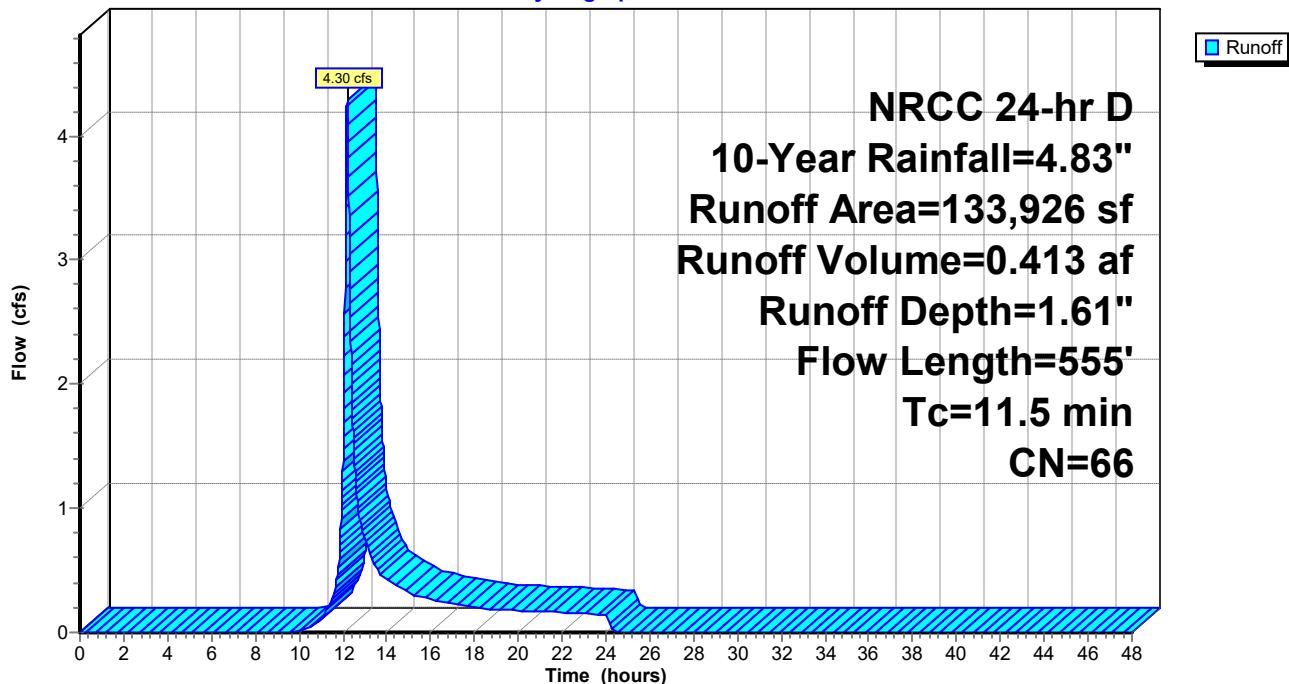
**Summary for Subcatchment 10S: Existing Site**

Runoff = 4.30 cfs @ 12.20 hrs, Volume= 0.413 af, Depth= 1.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
72,863	39	>75% Grass cover, Good, HSG A
57,826	98	Paved parking, HSG B
3,237	96	Gravel surface, HSG B
133,926	66	Weighted Average
76,100		56.82% Pervious Area
57,826		43.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	20	0.0050	0.05		<b>Sheet Flow, Woodland Sheet Flow</b> Grass: Dense n= 0.240 P2= 3.15"
1.1	164	0.0145	2.44		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
2.9	155	0.0158	0.88		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.5	148	0.0225	4.68	46.78	<b>Channel Flow, X-Sec and Perimeter</b> Area= 10.0 sf Perim= 13.0' r= 0.77' n= 0.040 Earth, cobble bottom, clean sides
0.1	68	0.0558	13.14	157.70	<b>Channel Flow, X-Section and Perimeter</b> Area= 12.0 sf Perim= 8.0' r= 1.50' n= 0.035 Earth, dense weeds
11.5	555	Total			

**Subcatchment 10S: Existing Site****Hydrograph**

### Summary for Subcatchment 11S: Danton Drive & 35 Danton Drive

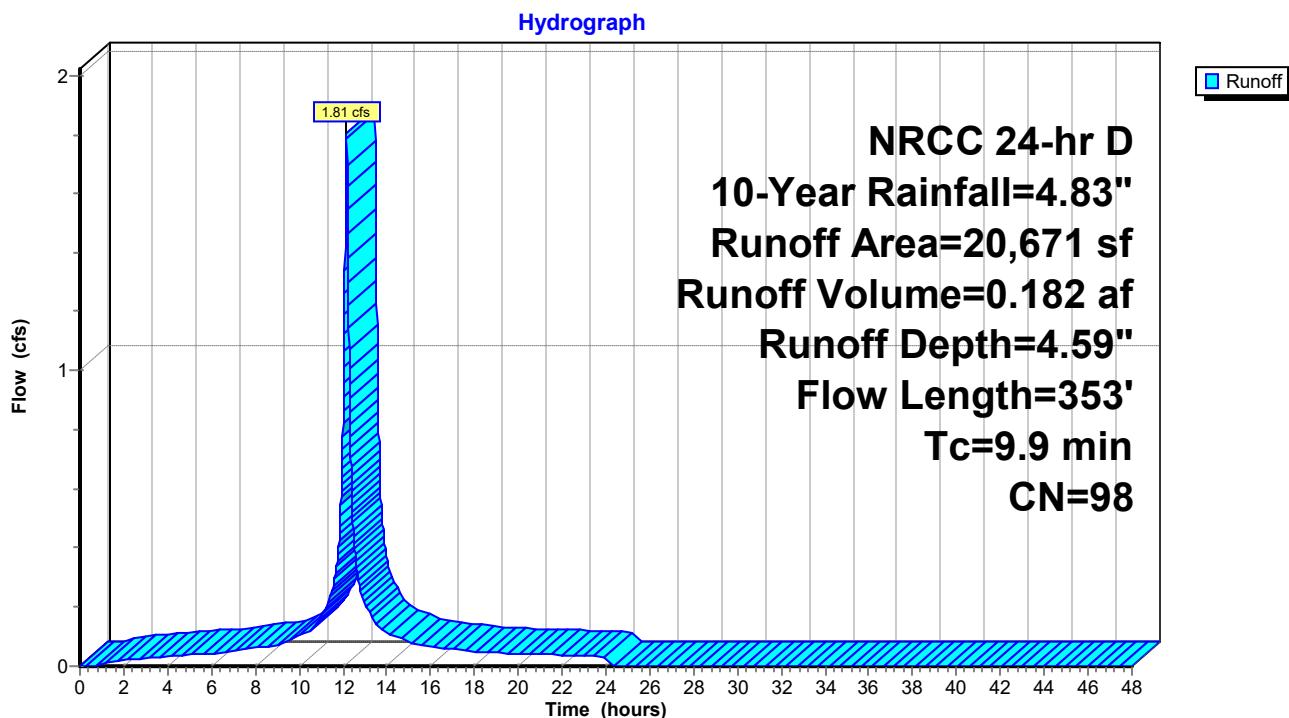
Runoff = 1.81 cfs @ 12.17 hrs, Volume= 0.182 af, Depth= 4.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
20,671	98	Paved parking, HSG A
20,671		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	10	0.0200	0.86		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 3.15"
6.0	178	0.0050	0.49		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.5	42	0.0050	1.44		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
2.7	81	0.0050	0.49		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.5	42	0.0050	1.44		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
9.9	353				Total

### Subcatchment 11S: Danton Drive & 35 Danton Drive



### Summary for Subcatchment 20S: Existing to 35 Danton Drive

Runoff = 0.98 cfs @ 12.13 hrs, Volume= 0.073 af, Depth= 1.91"

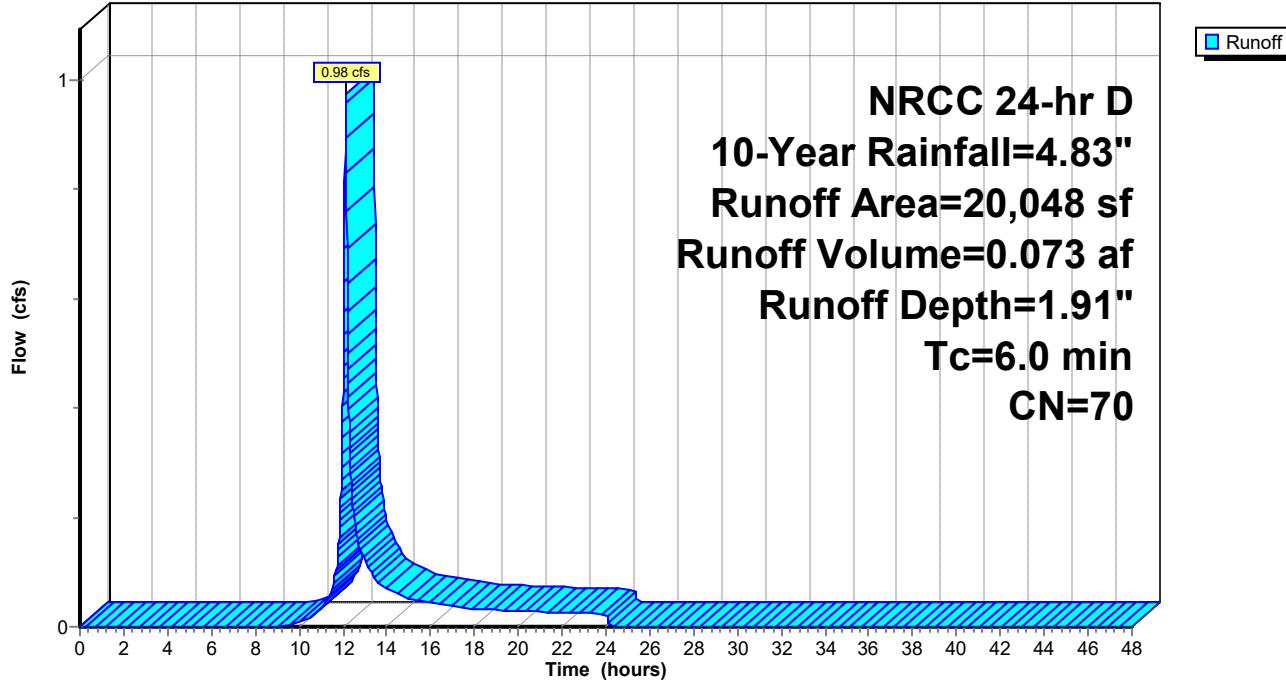
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
10,526	98	Paved parking, HSG B
9,522	39	>75% Grass cover, Good, HSG A
20,048	70	Weighted Average
9,522		47.50% Pervious Area
10,526		52.50% Impervious Area

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

### Subcatchment 20S: Existing to 35 Danton Drive

Hydrograph



### Summary for Subcatchment 30S: To 31 Danton Drive

Runoff = 0.08 cfs @ 12.15 hrs, Volume= 0.009 af, Depth= 0.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 10-Year Rainfall=4.83"

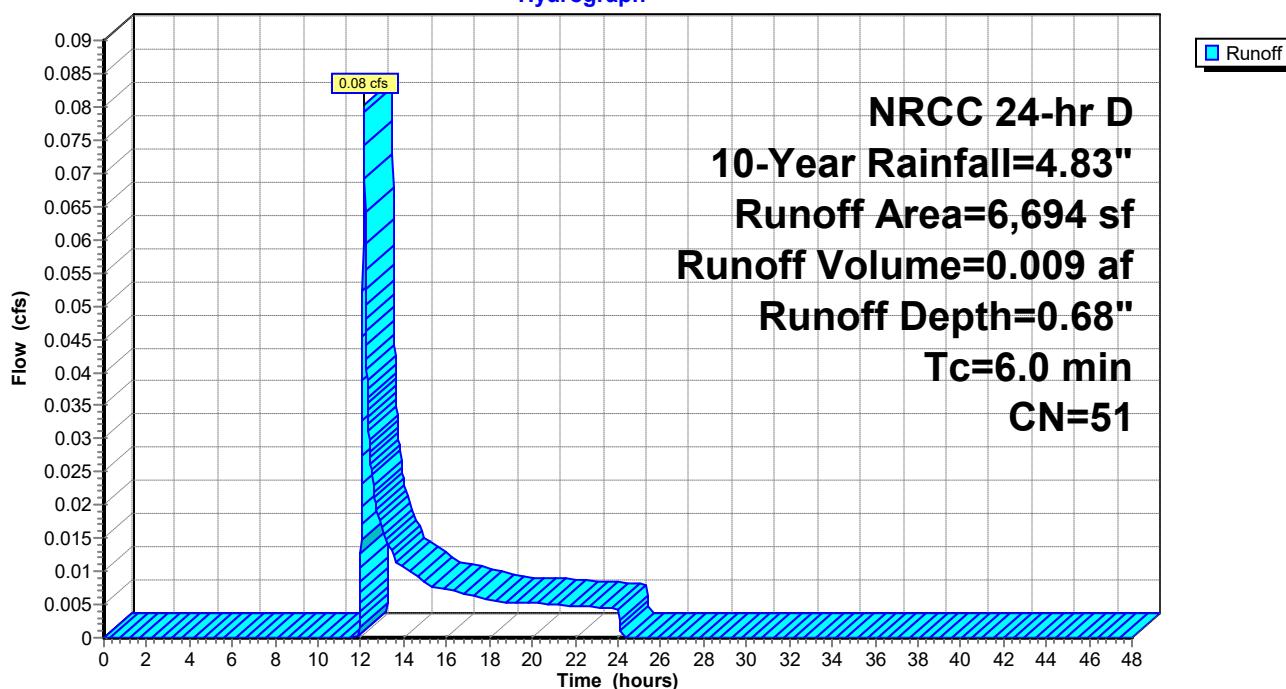
Area (sf)	CN	Description
1,409	98	Paved parking, HSG B
5,285	39	>75% Grass cover, Good, HSG A
6,694	51	Weighted Average
5,285		78.95% Pervious Area
1,409		21.05% Impervious Area

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

### Subcatchment 30S: To 31 Danton Drive

Hydrograph



**2020-041**

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NRCC 24-hr D 10-Year Rainfall=4.83"

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Page 45

### Summary for Subcatchment 40S: Woods Behind Project

Runoff = 0.00 cfs @ 22.23 hrs, Volume= 0.002 af, Depth= 0.09"

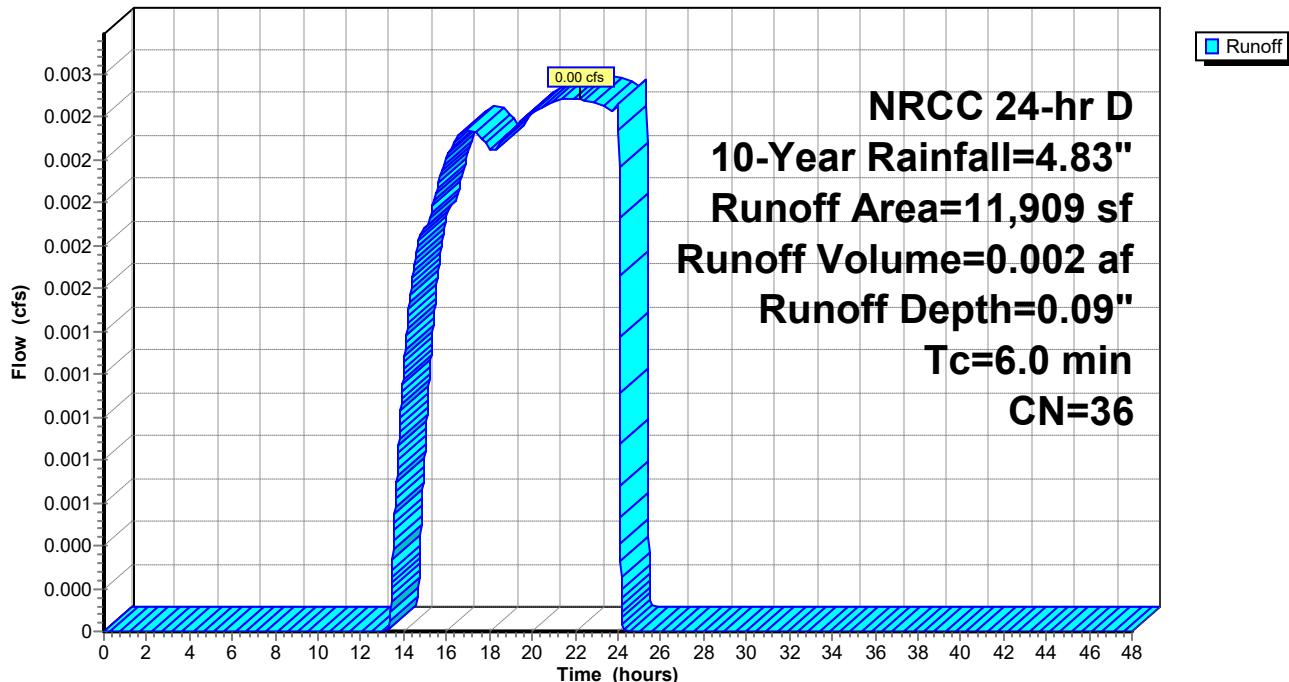
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
11,909	36	Woods, Fair, HSG A
11,909		100.00% Pervious Area

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

### Subcatchment 40S: Woods Behind Project

Hydrograph



### Summary for Subcatchment 100S: Truck Docks

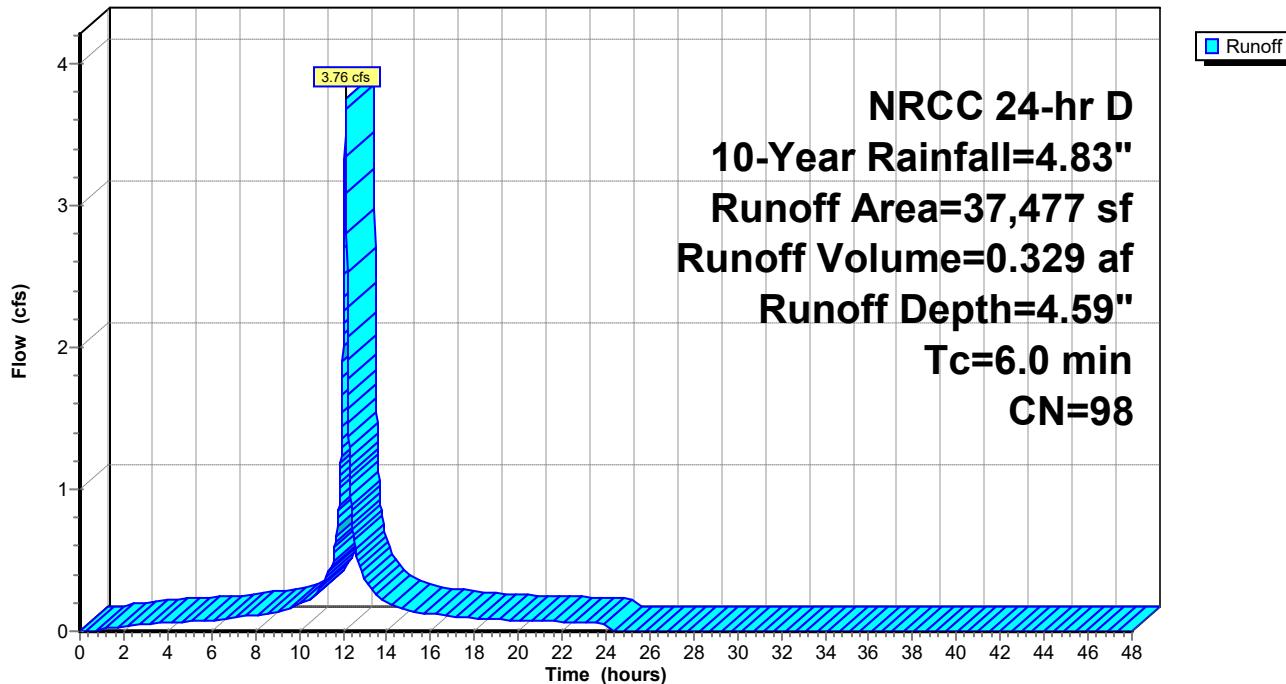
Runoff = 3.76 cfs @ 12.13 hrs, Volume= 0.329 af, Depth= 4.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description			
22,482	98	Paved parking, HSG A			
14,995	98	Roofs, HSG A			
37,477	98	Weighted Average			
37,477		100.00% Impervious Area			
Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
6.0					Direct Entry, 6

### Subcatchment 100S: Truck Docks

Hydrograph



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NRCC 24-hr D 10-Year Rainfall=4.83"

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Page 47

### Summary for Subcatchment 110S: Roof Drains

Runoff = 3.87 cfs @ 12.13 hrs, Volume= 0.289 af, Depth= 2.66"

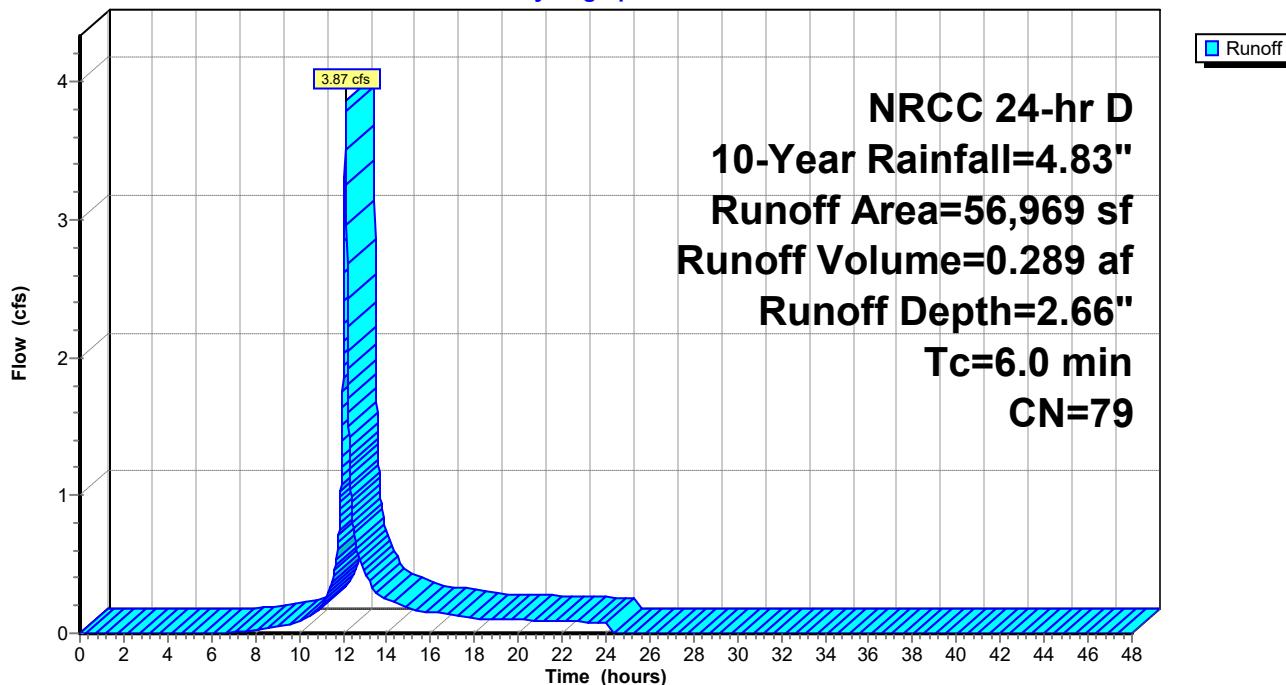
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
30,102	98	Roofs, HSG A
21,741	49	50-75% Grass cover, Fair, HSG A
5,126	98	Water Surface, HSG A
56,969	79	Weighted Average
21,741		38.16% Pervious Area
35,228		61.84% Impervious Area

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

### Subcatchment 110S: Roof Drains

Hydrograph



### Summary for Subcatchment 120S: Front Parking Lot

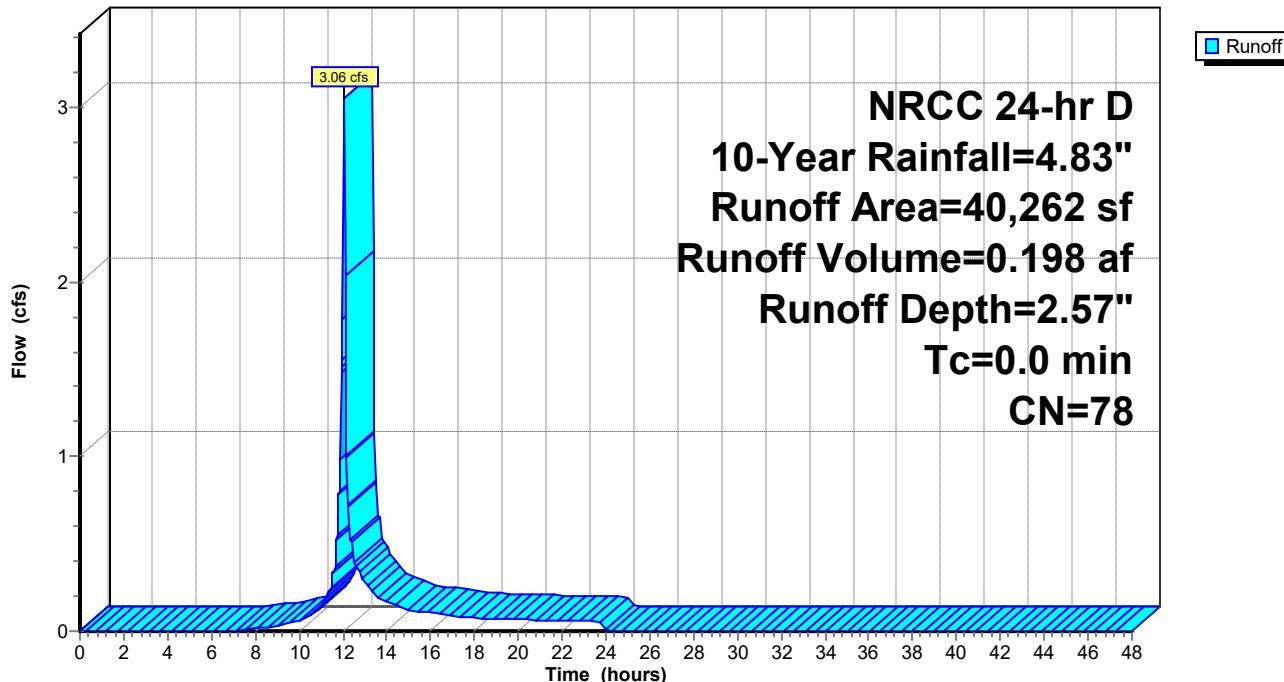
Runoff = 3.06 cfs @ 12.09 hrs, Volume= 0.198 af, Depth= 2.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
11,451	98	Paved parking, HSG A
14,995	98	Roofs, HSG A
13,816	39	>75% Grass cover, Good, HSG A
40,262	78	Weighted Average
13,816		34.32% Pervious Area
26,446		65.68% Impervious Area

### Subcatchment 120S: Front Parking Lot

Hydrograph



### Summary for Subcatchment 130S: Existing Danton Drive

Runoff = 1.83 cfs @ 12.17 hrs, Volume= 0.160 af, Depth= 2.75"

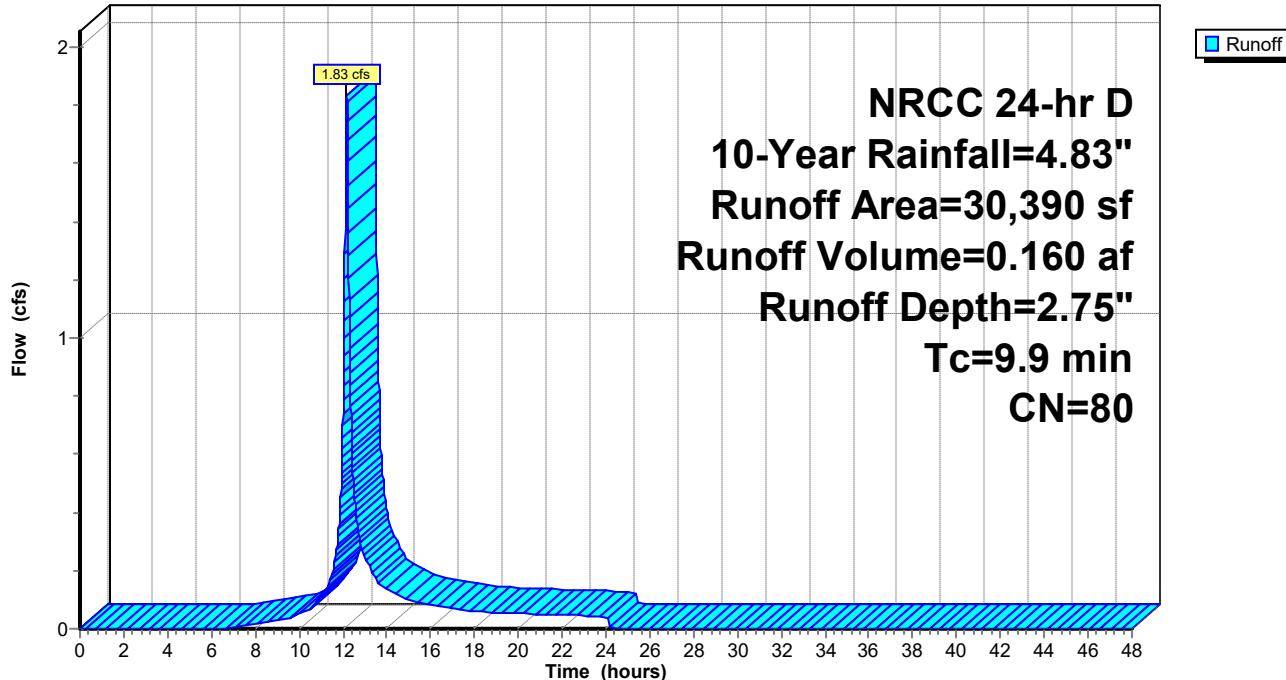
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
21,029	98	Paved parking, HSG A
9,361	39	>75% Grass cover, Good, HSG A
30,390	80	Weighted Average
9,361		30.80% Pervious Area
21,029		69.20% Impervious Area

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

### Subcatchment 130S: Existing Danton Drive

Hydrograph



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NRCC 24-hr D 10-Year Rainfall=4.83"

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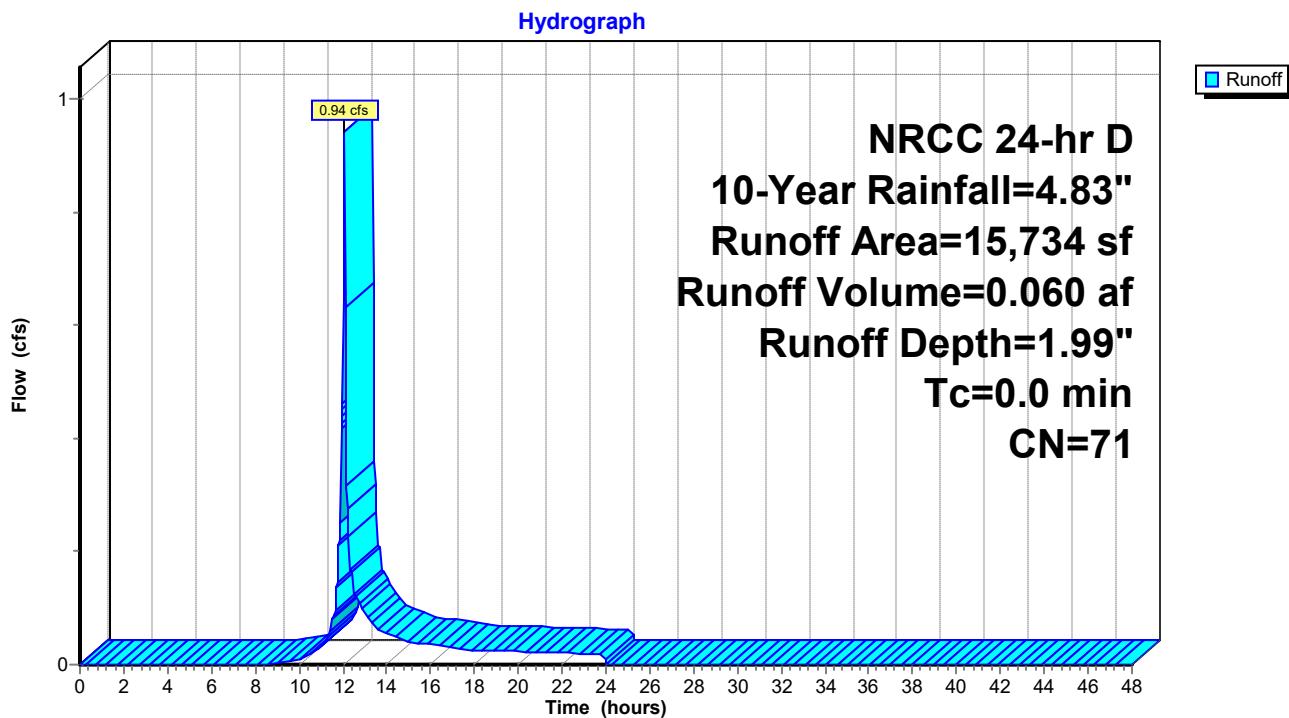
Page 50

**Summary for Subcatchment 200S: To 35 Danton Drive**

Runoff = 0.94 cfs @ 12.09 hrs, Volume= 0.060 af, Depth= 1.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
7,316	39	>75% Grass cover, Good, HSG A
8,418	98	Paved parking, HSG A
15,734	71	Weighted Average
7,316		46.50% Pervious Area
8,418		53.50% Impervious Area

**Subcatchment 200S: To 35 Danton Drive**

### Summary for Subcatchment 300S: To 31 Danton Drive

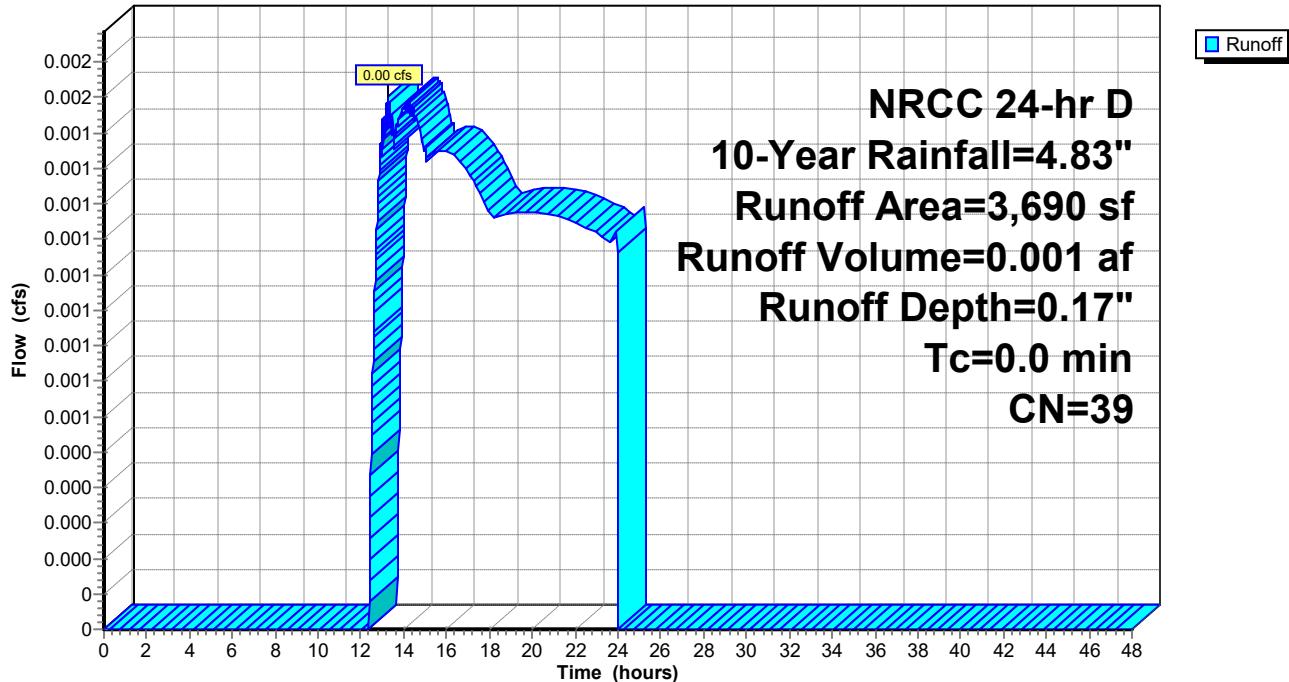
Runoff = 0.00 cfs @ 13.29 hrs, Volume= 0.001 af, Depth= 0.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
3,690	39	>75% Grass cover, Good, HSG A
3,690		100.00% Pervious Area

### Subcatchment 300S: To 31 Danton Drive

Hydrograph



### Summary for Subcatchment 400S: Woods Behind Project

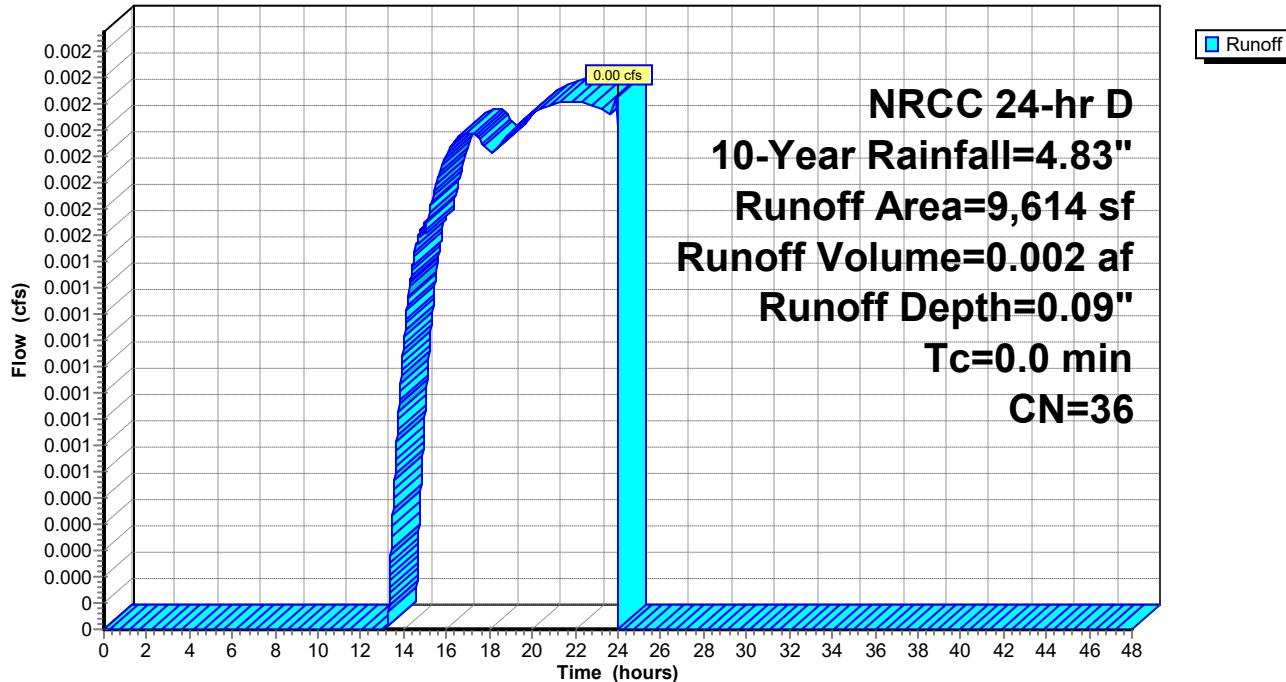
Runoff = 0.00 cfs @ 23.99 hrs, Volume= 0.002 af, Depth= 0.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
9,614	36	Woods, Fair, HSG A
9,614		100.00% Pervious Area

### Subcatchment 400S: Woods Behind Project

Hydrograph



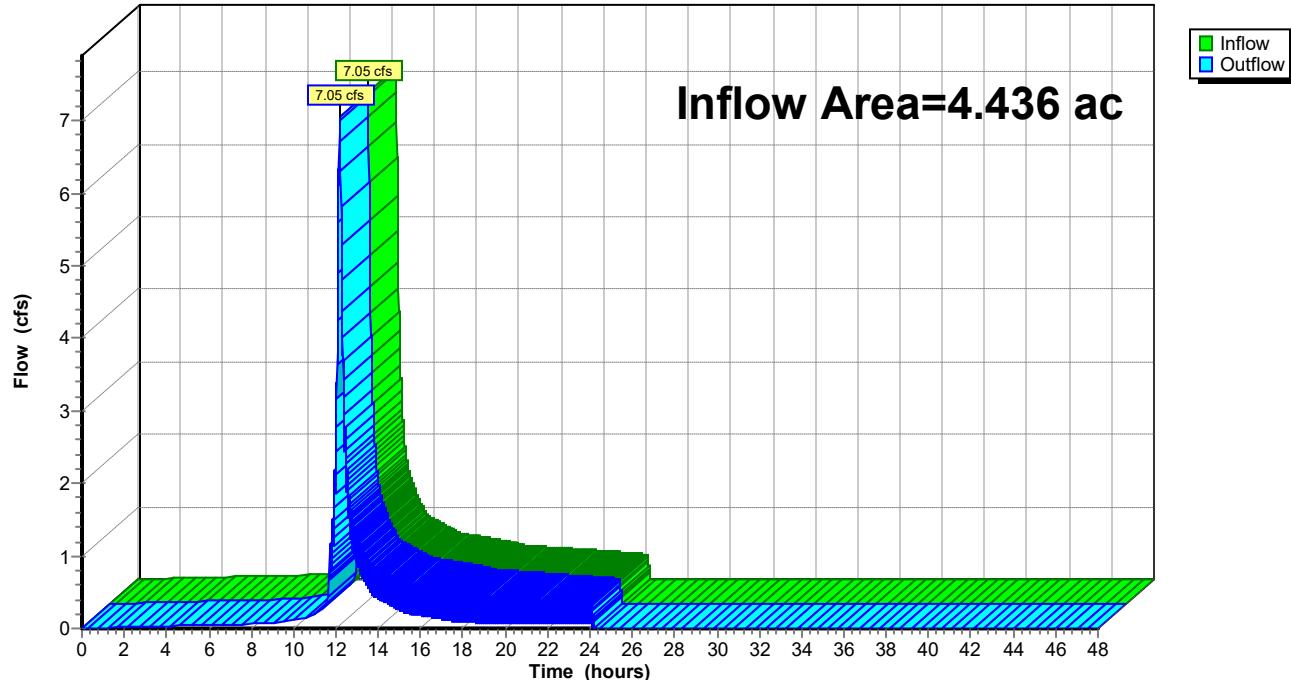
### Summary for Reach 1R: Project Impact to Peat Meadow Brook

Inflow Area = 4.436 ac, 46.80% Impervious, Inflow Depth = 1.79" for 10-Year event  
 Inflow = 7.05 cfs @ 12.17 hrs, Volume= 0.663 af  
 Outflow = 7.05 cfs @ 12.17 hrs, Volume= 0.663 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 1R: Project Impact to Peat Meadow Brook

Hydrograph



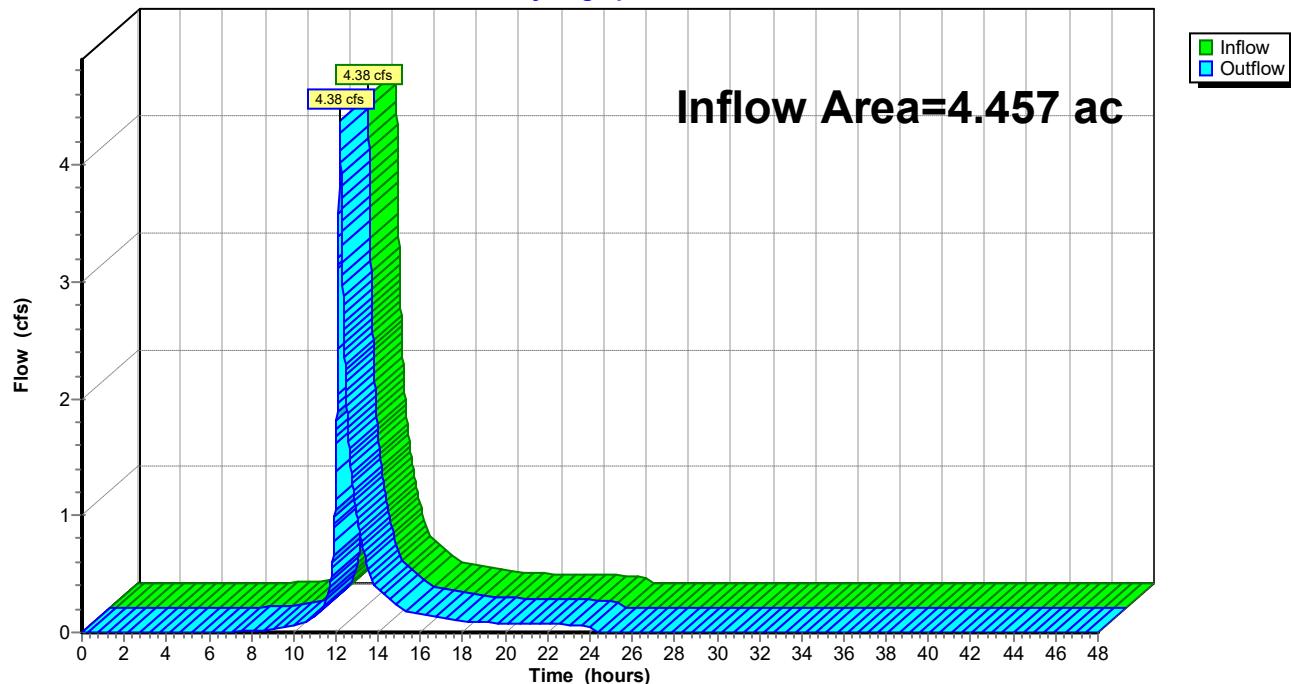
## Summary for Reach 2R: Project Impact to Peat Meadow Brook

Inflow Area = 4.457 ac, 66.24% Impervious, Inflow Depth = 1.00" for 10-Year event  
 Inflow = 4.38 cfs @ 12.19 hrs, Volume= 0.370 af  
 Outflow = 4.38 cfs @ 12.19 hrs, Volume= 0.370 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 2R: Project Impact to Peat Meadow Brook

Hydrograph



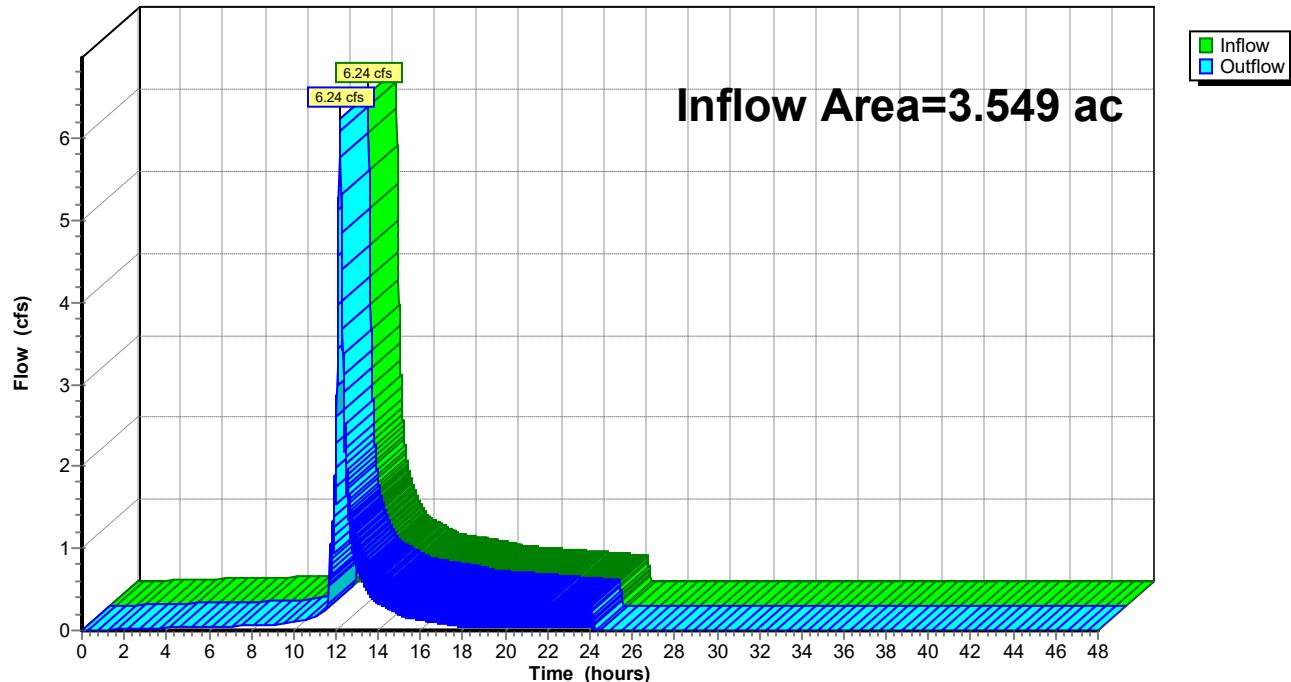
### Summary for Reach 10R: Existing Project Oufall (CB at SE of site)

Inflow Area = 3.549 ac, 50.78% Impervious, Inflow Depth = 1.96" for 10-Year event  
 Inflow = 6.24 cfs @ 12.19 hrs, Volume= 0.579 af  
 Outflow = 6.24 cfs @ 12.19 hrs, Volume= 0.579 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 10R: Existing Project Oufall (CB at SE of site)

Hydrograph



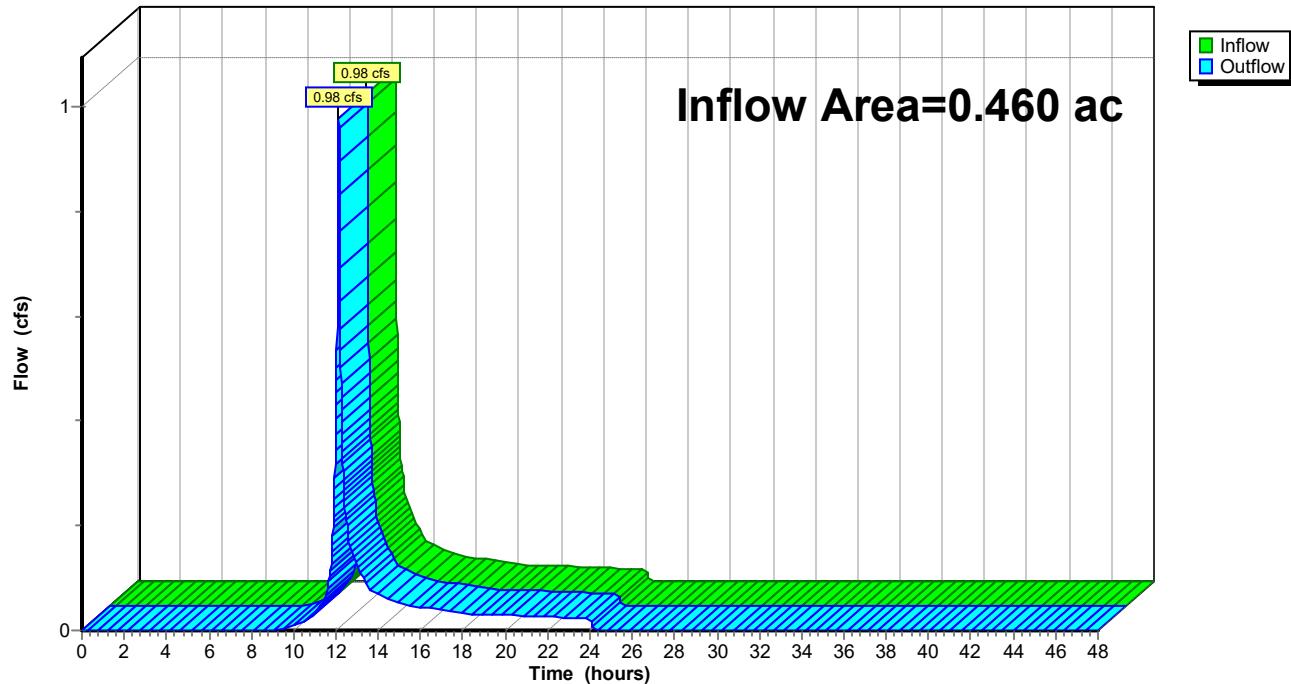
### Summary for Reach 20R: Existing Outfall to 35 Danton Drive Back

Inflow Area = 0.460 ac, 52.50% Impervious, Inflow Depth = 1.91" for 10-Year event  
 Inflow = 0.98 cfs @ 12.13 hrs, Volume= 0.073 af  
 Outflow = 0.98 cfs @ 12.13 hrs, Volume= 0.073 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 20R: Existing Outfall to 35 Danton Drive Back

Hydrograph



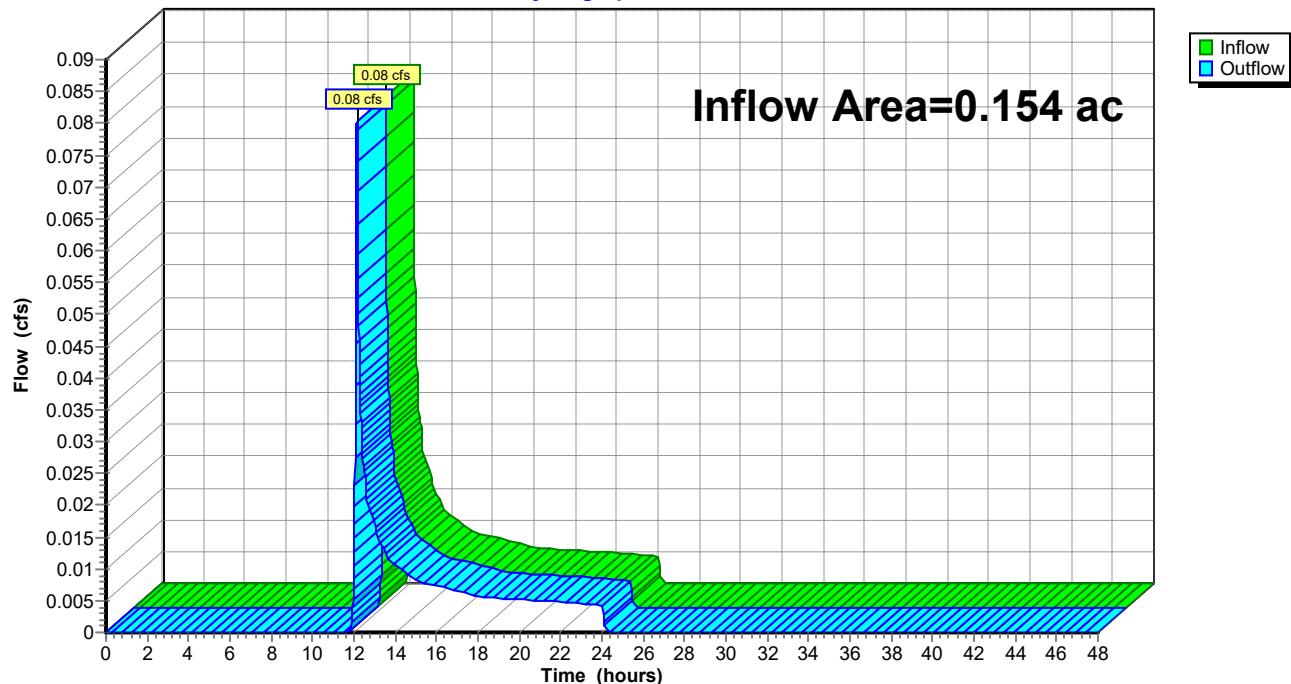
### Summary for Reach 30R: Existing Outfall to 31 Danton Drive

Inflow Area = 0.154 ac, 21.05% Impervious, Inflow Depth = 0.68" for 10-Year event  
 Inflow = 0.08 cfs @ 12.15 hrs, Volume= 0.009 af  
 Outflow = 0.08 cfs @ 12.15 hrs, Volume= 0.009 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 30R: Existing Outfall to 31 Danton Drive

Hydrograph



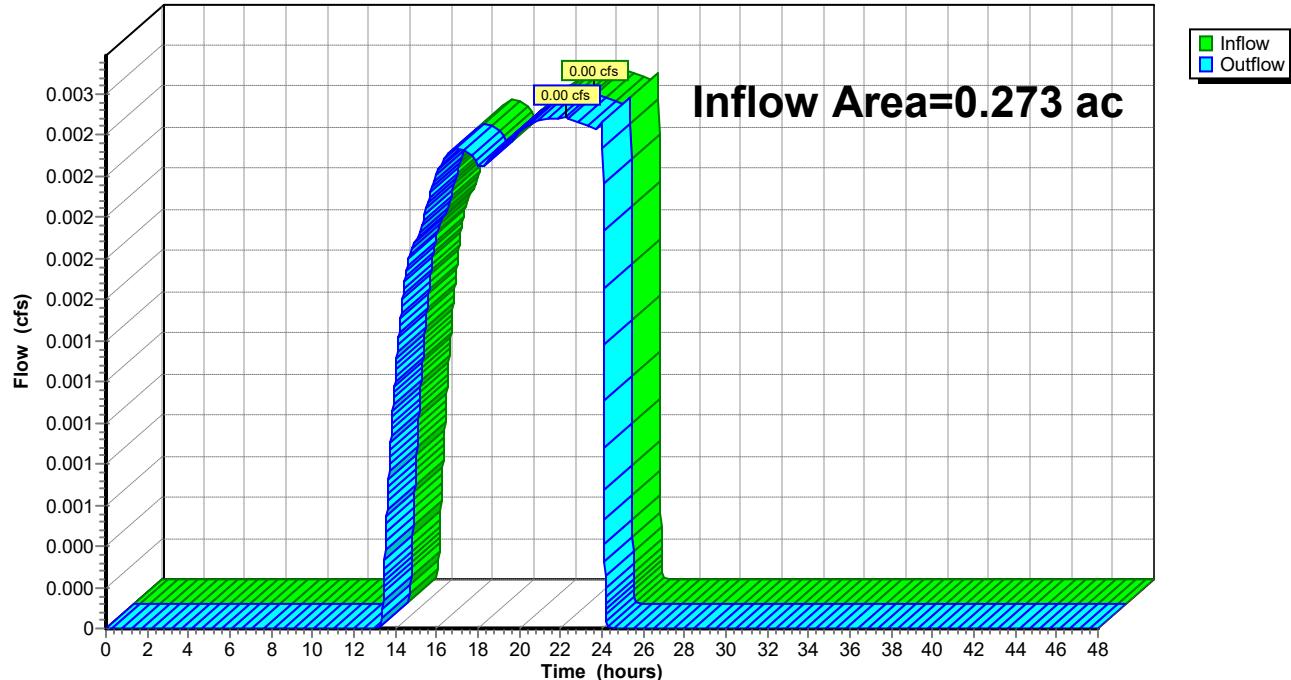
### Summary for Reach 40R: Woods Behind Project

Inflow Area = 0.273 ac, 0.00% Impervious, Inflow Depth = 0.09" for 10-Year event  
 Inflow = 0.00 cfs @ 22.23 hrs, Volume= 0.002 af  
 Outflow = 0.00 cfs @ 22.23 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 40R: Woods Behind Project

Hydrograph



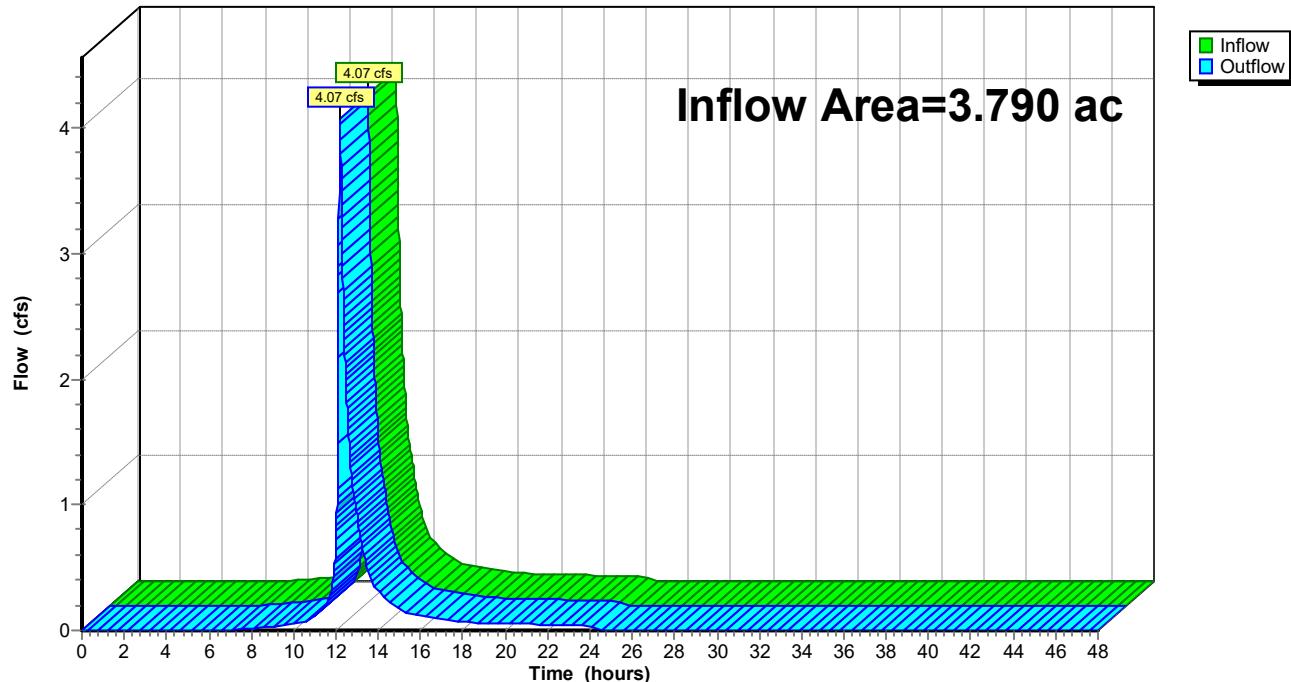
### Summary for Reach 100R: Project Outfall

Inflow Area = 3.790 ac, 72.79% Impervious, Inflow Depth = 0.97" for 10-Year event  
Inflow = 4.07 cfs @ 12.20 hrs, Volume= 0.307 af  
Outflow = 4.07 cfs @ 12.20 hrs, Volume= 0.307 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 100R: Project Outfall

Hydrograph



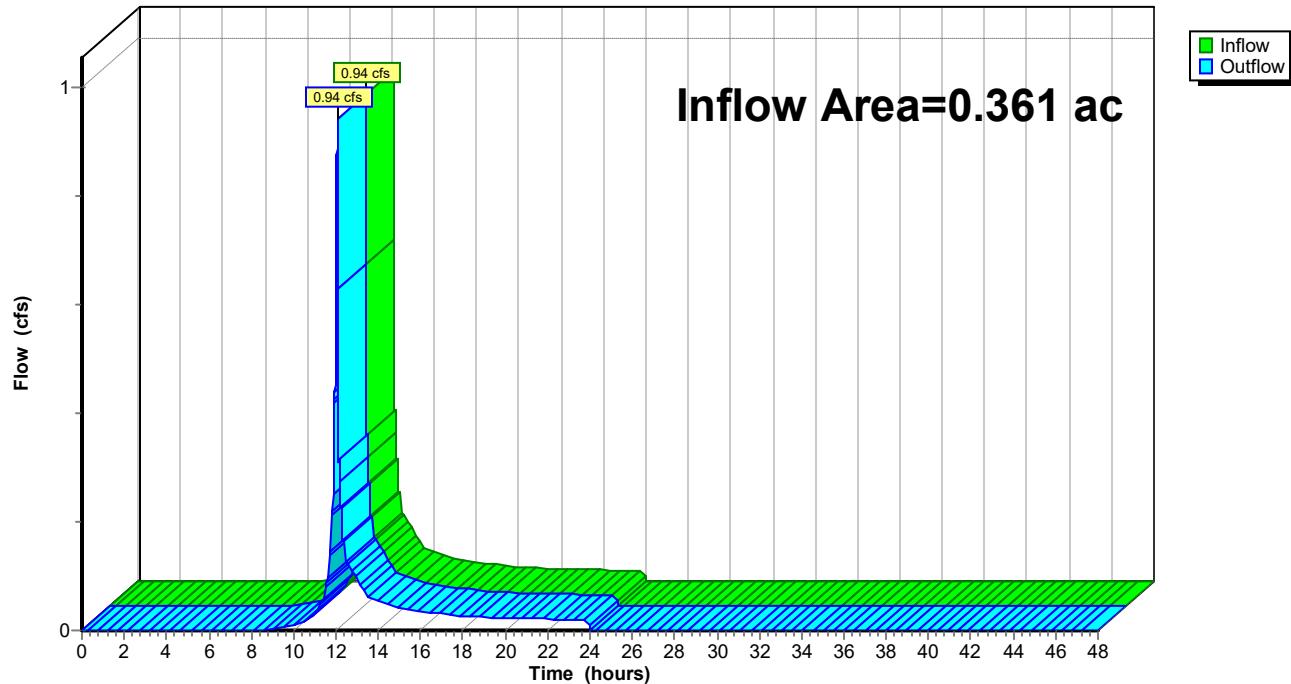
### Summary for Reach 200R: Existing Oufall to 35 Danton Drive Back

Inflow Area = 0.361 ac, 53.50% Impervious, Inflow Depth = 1.99" for 10-Year event  
 Inflow = 0.94 cfs @ 12.09 hrs, Volume= 0.060 af  
 Outflow = 0.94 cfs @ 12.09 hrs, Volume= 0.060 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 200R: Existing Oufall to 35 Danton Drive Back

Hydrograph



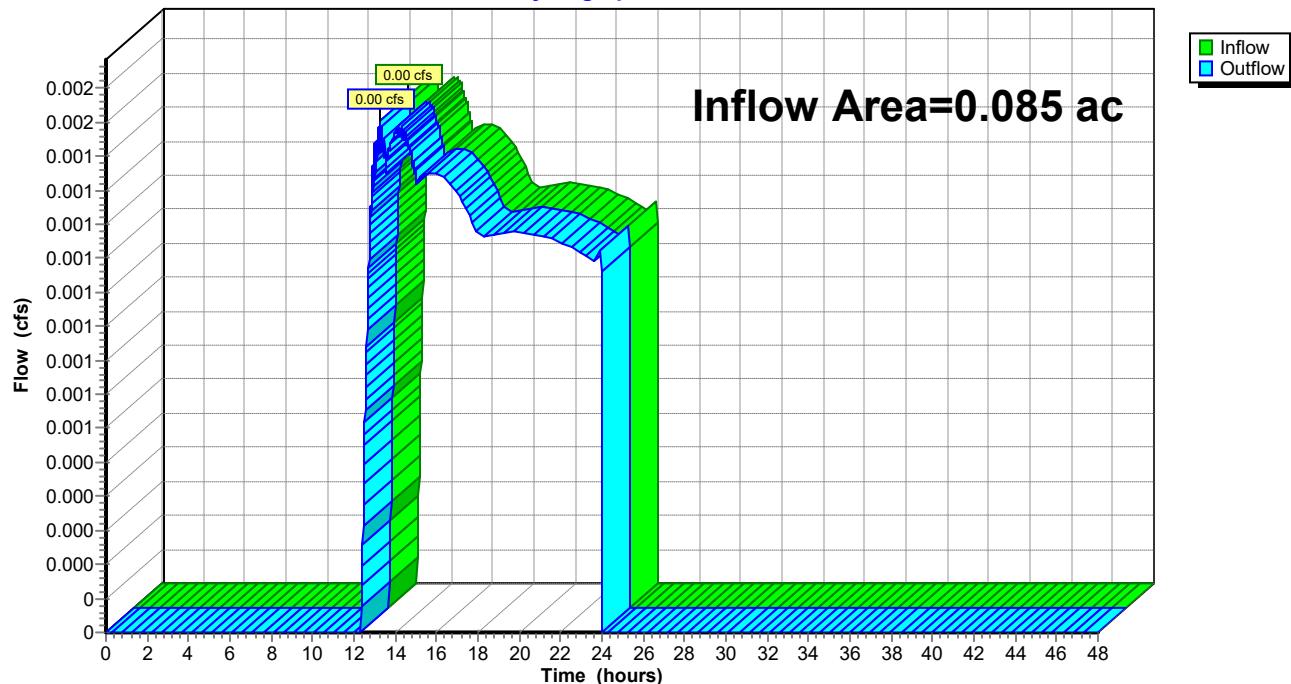
### Summary for Reach 300R: Existing Oufall to 31 Danton Drive

Inflow Area = 0.085 ac, 0.00% Impervious, Inflow Depth = 0.17" for 10-Year event  
 Inflow = 0.00 cfs @ 13.29 hrs, Volume= 0.001 af  
 Outflow = 0.00 cfs @ 13.29 hrs, Volume= 0.001 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 300R: Existing Oufall to 31 Danton Drive

Hydrograph



## Summary for Reach 400R: Woods Behind Project

Inflow Area = 0.221 ac, 0.00% Impervious, Inflow Depth = 0.09" for 10-Year event

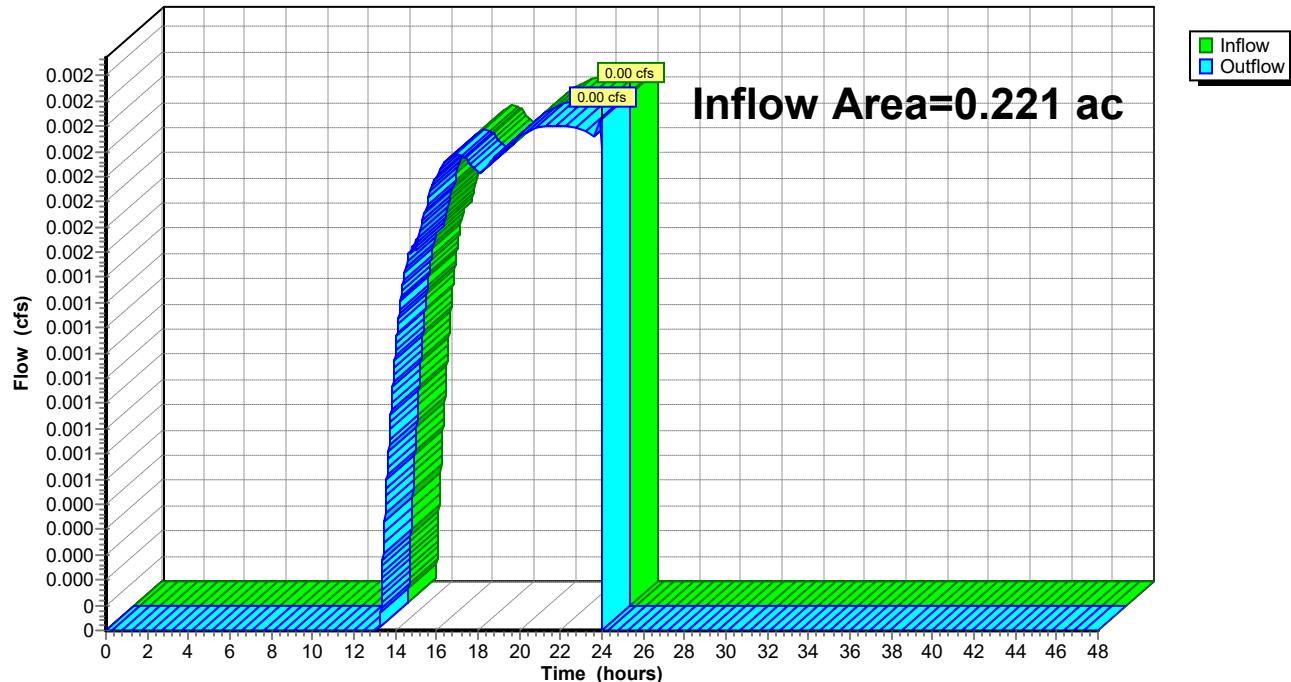
Inflow = 0.00 cfs @ 23.99 hrs, Volume= 0.002 af

Outflow = 0.00 cfs @ 23.99 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 400R: Woods Behind Project

Hydrograph



### Summary for Pond 10P: Existing Swale

Inflow Area = 3.075 ac, 43.18% Impervious, Inflow Depth = 1.61" for 10-Year event  
 Inflow = 4.30 cfs @ 12.20 hrs, Volume= 0.413 af  
 Outflow = 4.49 cfs @ 12.19 hrs, Volume= 0.398 af, Atten= 0%, Lag= 0.0 min  
 Primary = 4.49 cfs @ 12.19 hrs, Volume= 0.398 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
 Peak Elev= 4.20' @ 12.19 hrs Surf.Area= 0 sf Storage= 689 cf

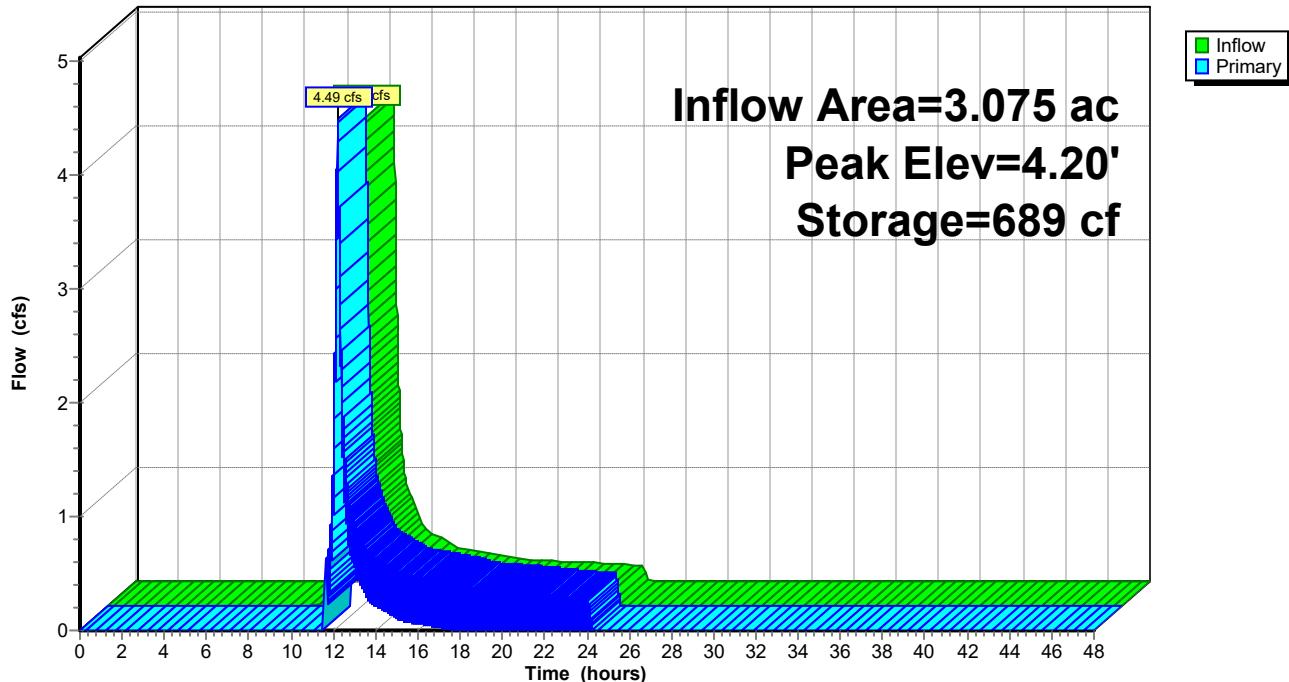
Plug-Flow detention time= 29.3 min calculated for 0.398 af (96% of inflow)  
 Center-of-Mass det. time= 9.0 min ( 906.7 - 897.7 )

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	690 cf	<b>Custom Stage Data</b> Listed below

Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
0.20	4
0.40	14
0.60	28
0.80	45
1.00	66
1.20	91
1.40	121
1.60	157
1.80	200
2.00	248
2.20	305
2.40	371
2.60	447
2.80	555
3.00	635
3.20	657
3.40	660
3.60	674
3.80	684
4.00	687
4.20	689
5.00	690

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	<b>Special &amp; User-Defined</b> Elev. (feet) 0.00 4.20 4.21 Disch. (cfs) 0.000 0.000 5,000.000

**Primary OutFlow** Max=4.47 cfs @ 12.19 hrs HW=4.20' (Free Discharge)  
 ↑=Special & User-Defined (Custom Controls 4.47 cfs)

**Pond 10P: Existing Swale****Hydrograph**

### Summary for Pond 100P: Underground Storage

Inflow Area = 0.860 ac, 100.00% Impervious, Inflow Depth = 4.59" for 10-Year event  
 Inflow = 3.76 cfs @ 12.13 hrs, Volume= 0.329 af  
 Outflow = 0.51 cfs @ 12.63 hrs, Volume= 0.329 af, Atten= 86%, Lag= 30.2 min  
 Discarded = 0.36 cfs @ 11.17 hrs, Volume= 0.319 af  
 Primary = 0.16 cfs @ 12.63 hrs, Volume= 0.010 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
 Peak Elev= 112.80' @ 12.63 hrs Surf.Area= 1,866 sf Storage= 3,671 cf

Plug-Flow detention time= 55.7 min calculated for 0.329 af (100% of inflow)  
 Center-of-Mass det. time= 55.7 min ( 806.9 - 751.2 )

Volume	Invert	Avail.Storage	Storage Description
#1A	110.00'	2,627 cf	<b>30.25'W x 61.70'L x 5.75'H Field A</b> 10,732 cf Overall - 4,165 cf Embedded = 6,567 cf x 40.0% Voids
#2A	110.75'	4,165 cf	<b>Cultec R-902HD</b> x 64 Inside #1 Effective Size= 69.8" W x 48.0" H => 17.65 sf x 3.67' L = 64.7 cf Overall Size= 78.0" W x 48.0" H x 4.10' L with 0.44' Overlap 64 Chambers in 4 Rows Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf
6,792 cf			Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	110.00'	<b>8.270 in/hr Exfiltration over Surface area</b>
#2	Primary	115.40'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)
#3	Primary	112.50'	<b>4.0" Vert. Orifice/Grate</b> C= 0.600

**Discarded OutFlow** Max=0.36 cfs @ 11.17 hrs HW=110.03' (Free Discharge)  
 ↑ 1=Exfiltration (Exfiltration Controls 0.36 cfs)

**Primary OutFlow** Max=0.16 cfs @ 12.63 hrs HW=112.80' (Free Discharge)  
 ↑ 2=Sharp-Crested Rectangular Weir ( Controls 0.00 cfs)  
 3=Orifice/Grate (Orifice Controls 0.16 cfs @ 1.88 fps)

## Pond 100P: Underground Storage - Chamber Wizard Field A

**Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)**

Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf

Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap

Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

16 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 59.70' Row Length +12.0" End Stone x 2 = 61.70' Base Length

4 Rows x 78.0" Wide + 9.0" Spacing x 3 + 12.0" Side Stone x 2 = 30.25' Base Width

9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

64 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 4 Rows = 4,165.1 cf Chamber Storage

10,731.9 cf Field - 4,165.1 cf Chambers = 6,566.8 cf Stone x 40.0% Voids = 2,626.7 cf Stone Storage

Chamber Storage + Stone Storage = 6,791.8 cf = 0.156 af

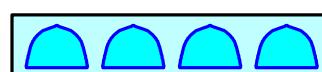
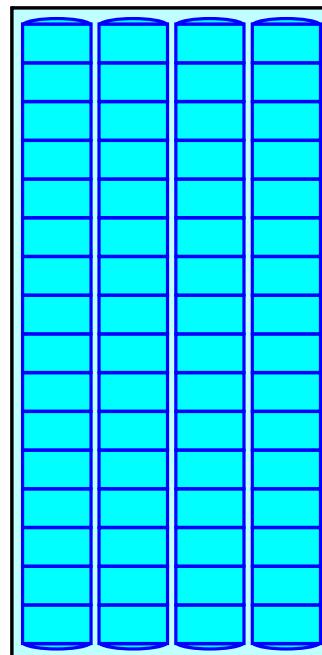
Overall Storage Efficiency = 63.3%

Overall System Size = 61.70' x 30.25' x 5.75'

64 Chambers

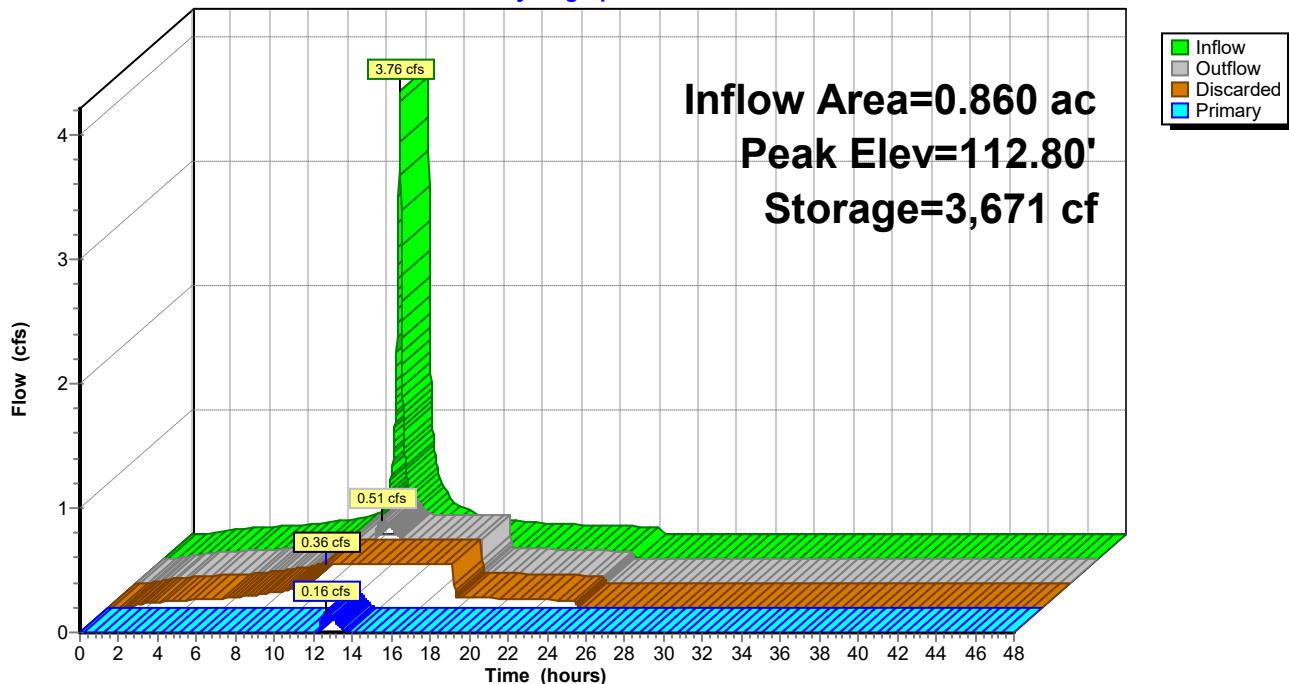
397.5 cy Field

243.2 cy Stone



**Pond 100P: Underground Storage**

Hydrograph



### Summary for Pond 110P: Roof Drain Pond

Inflow Area = 1.308 ac, 61.84% Impervious, Inflow Depth = 2.66" for 10-Year event  
 Inflow = 3.87 cfs @ 12.13 hrs, Volume= 0.289 af  
 Outflow = 1.73 cfs @ 12.25 hrs, Volume= 0.289 af, Atten= 55%, Lag= 7.0 min  
 Discarded = 0.22 cfs @ 12.25 hrs, Volume= 0.215 af  
 Primary = 1.51 cfs @ 12.25 hrs, Volume= 0.074 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
 Peak Elev= 117.44' @ 12.25 hrs Surf.Area= 3,939 sf Storage= 3,527 cf

Plug-Flow detention time= 130.9 min calculated for 0.289 af (100% of inflow)  
 Center-of-Mass det. time= 131.0 min ( 980.0 - 849.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	116.00'	6,072 cf	3.00'W x 330.00'L x 2.00'H Prismatoid Z=3.0

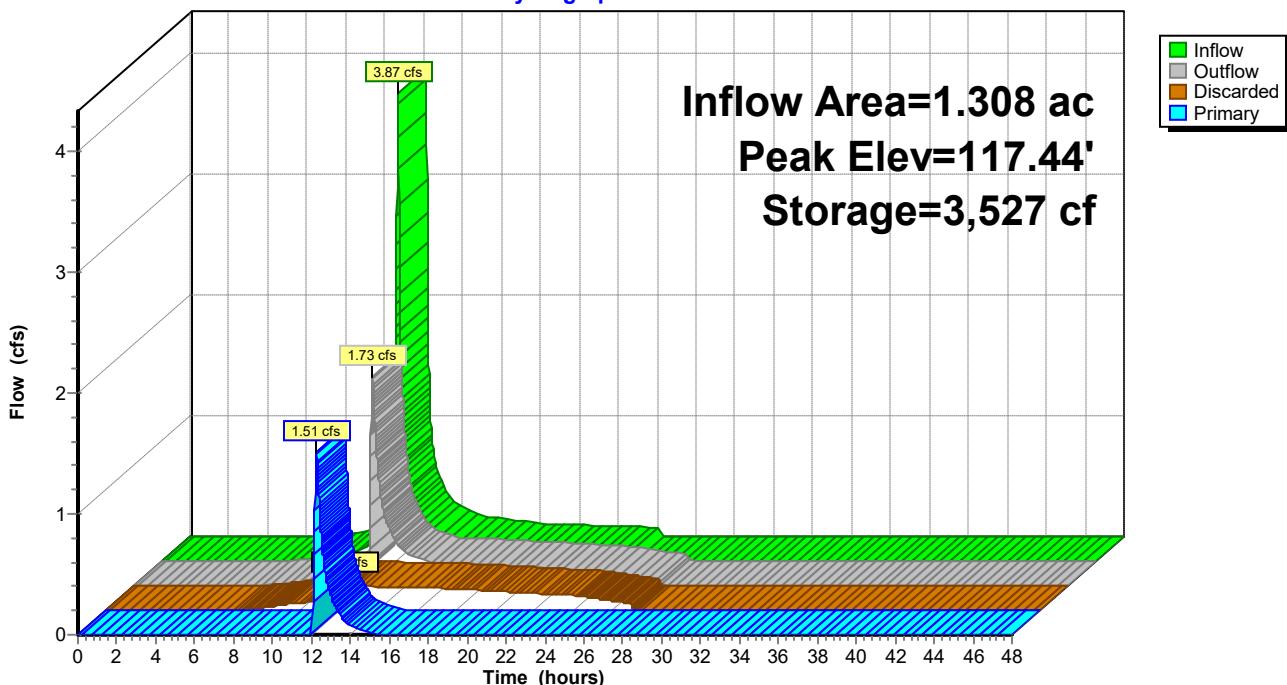
Device	Routing	Invert	Outlet Devices
#1	Discarded	116.00'	2.410 in/hr Exfiltration over Surface area
#2	Primary	117.20'	4.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)

**Discarded OutFlow** Max=0.22 cfs @ 12.25 hrs HW=117.44' (Free Discharge)  
 ↗ 1=Exfiltration (Exfiltration Controls 0.22 cfs)

**Primary OutFlow** Max=1.50 cfs @ 12.25 hrs HW=117.44' (Free Discharge)  
 ↗ 2=Sharp-Crested Rectangular Weir (Weir Controls 1.50 cfs @ 1.60 fps)

### Pond 110P: Roof Drain Pond

Hydrograph



### Summary for Pond 120P: Front Undergound Storage

Inflow Area = 0.924 ac, 65.68% Impervious, Inflow Depth = 2.57" for 10-Year event  
 Inflow = 3.06 cfs @ 12.09 hrs, Volume= 0.198 af  
 Outflow = 1.44 cfs @ 12.11 hrs, Volume= 0.198 af, Atten= 53%, Lag= 1.0 min  
 Discarded = 0.07 cfs @ 10.32 hrs, Volume= 0.135 af  
 Primary = 1.37 cfs @ 12.11 hrs, Volume= 0.063 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
 Peak Elev= 115.82' @ 12.11 hrs Surf.Area= 1,250 sf Storage= 2,457 cf

Plug-Flow detention time= 252.4 min calculated for 0.198 af (100% of inflow)  
 Center-of-Mass det. time= 252.4 min ( 1,099.3 - 846.9 )

Volume	Invert	Avail.Storage	Storage Description
#1A	113.00'	1,782 cf	<b>23.00'W x 54.37'L x 5.75'H Field A</b> 7,190 cf Overall - 2,735 cf Embedded = 4,455 cf x 40.0% Voids
#2A	113.75'	2,735 cf	<b>Cultec R-902HD x 42 Inside #1</b> Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 42 Chambers in 3 Rows Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf
4,517 cf			Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	115.60'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)
#2	Discarded	113.00'	<b>2.410 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.07 cfs @ 10.32 hrs HW=113.06' (Free Discharge)  
 ↑ 2=Exfiltration (Exfiltration Controls 0.07 cfs)

**Primary OutFlow** Max=1.35 cfs @ 12.11 hrs HW=115.82' (Free Discharge)  
 ↑ 1=Sharp-Crested Rectangular Weir (Weir Controls 1.35 cfs @ 1.54 fps)

## Pond 120P: Front Undergound Storage - Chamber Wizard Field A

**Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)**

Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf

Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap

Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

14 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 52.37' Row Length +12.0" End Stone x 2 = 54.37'  
Base Length

3 Rows x 78.0" Wide + 9.0" Spacing x 2 + 12.0" Side Stone x 2 = 23.00' Base Width

9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

42 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 3 Rows = 2,735.4 cf Chamber Storage

7,190.0 cf Field - 2,735.4 cf Chambers = 4,454.6 cf Stone x 40.0% Voids = 1,781.8 cf Stone Storage

Chamber Storage + Stone Storage = 4,517.3 cf = 0.104 af

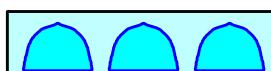
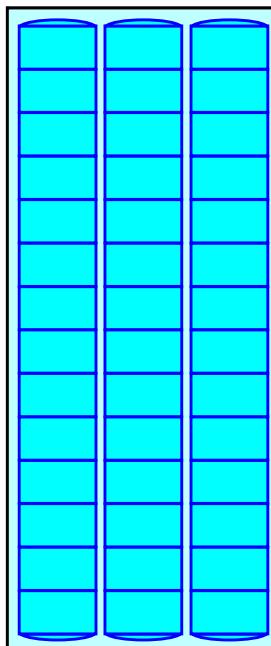
Overall Storage Efficiency = 62.8%

Overall System Size = 54.37' x 23.00' x 5.75'

42 Chambers

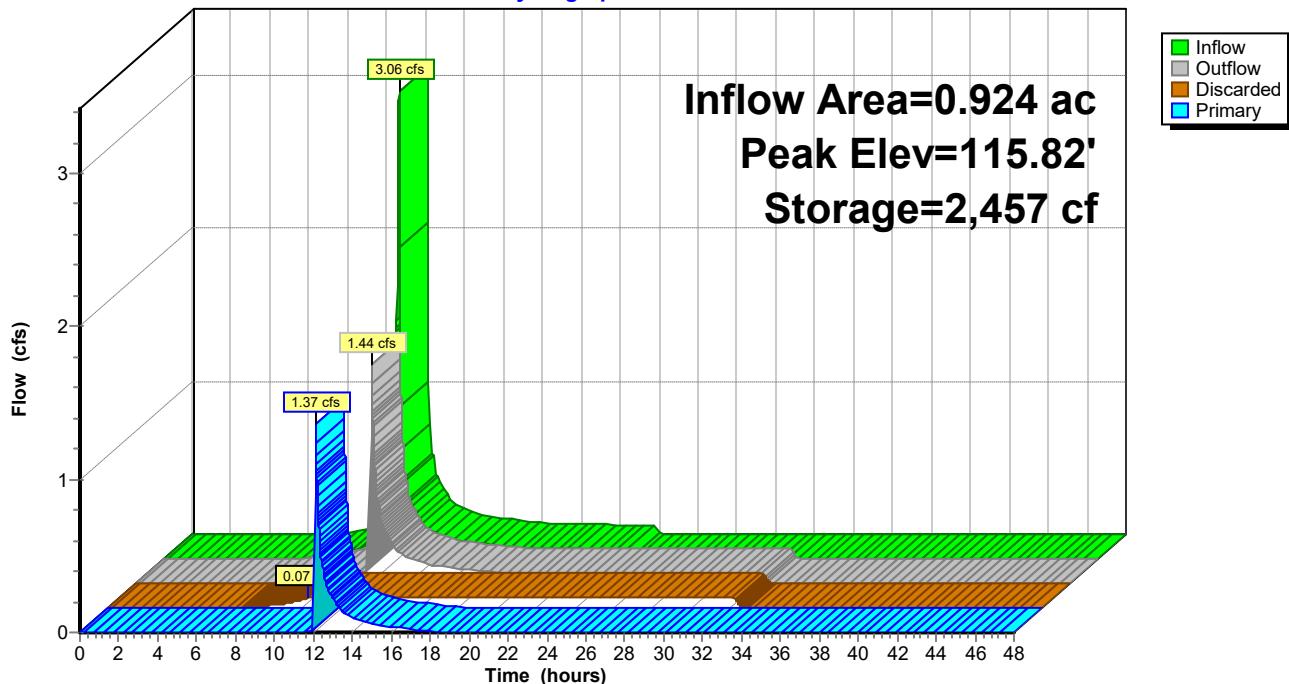
266.3 cy Field

165.0 cy Stone



**Pond 120P: Front Undergound Storage**

Hydrograph



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>Subcatchment 10S: Existing Site</b>	Runoff Area=133,926 sf 43.18% Impervious Runoff Depth=4.79" Flow Length=555' Tc=11.5 min CN=66 Runoff=13.24 cfs 1.227 af
<b>Subcatchment 11S: Danton Drive &amp; 35</b>	Runoff Area=20,671 sf 100.00% Impervious Runoff Depth=8.70" Flow Length=353' Tc=9.9 min CN=98 Runoff=3.36 cfs 0.344 af
<b>Subcatchment 20S: Existing to 35 Danton</b>	Runoff Area=20,048 sf 52.50% Impervious Runoff Depth=5.28" Tc=6.0 min CN=70 Runoff=2.70 cfs 0.203 af
<b>Subcatchment 30S: To 31 Danton Drive</b>	Runoff Area=6,694 sf 21.05% Impervious Runoff Depth=2.96" Tc=6.0 min CN=51 Runoff=0.50 cfs 0.038 af
<b>Subcatchment 40S: Woods Behind Project</b>	Runoff Area=11,909 sf 0.00% Impervious Runoff Depth=1.25" Tc=6.0 min CN=36 Runoff=0.27 cfs 0.029 af
<b>Subcatchment 100S: Truck Docks</b>	Runoff Area=37,477 sf 100.00% Impervious Runoff Depth=8.70" Tc=6.0 min CN=98 Runoff=6.99 cfs 0.624 af
<b>Subcatchment 110S: Roof Drains</b>	Runoff Area=56,969 sf 61.84% Impervious Runoff Depth=6.39" Tc=6.0 min CN=79 Runoff=9.01 cfs 0.696 af
<b>Subcatchment 120S: Front Parking Lot</b>	Runoff Area=40,262 sf 65.68% Impervious Runoff Depth=6.27" Tc=0.0 min CN=78 Runoff=7.07 cfs 0.483 af
<b>Subcatchment 130S: Existing Danton Drive</b>	Runoff Area=30,390 sf 69.20% Impervious Runoff Depth=6.51" Tc=9.9 min CN=80 Runoff=4.23 cfs 0.379 af
<b>Subcatchment 200S: To 35 Danton Drive</b>	Runoff Area=15,734 sf 53.50% Impervious Runoff Depth=5.41" Tc=0.0 min CN=71 Runoff=2.47 cfs 0.163 af
<b>Subcatchment 300S: To 31 Danton Drive</b>	Runoff Area=3,690 sf 0.00% Impervious Runoff Depth=1.57" Tc=0.0 min CN=39 Runoff=0.16 cfs 0.011 af
<b>Subcatchment 400S: Woods Behind Project</b>	Runoff Area=9,614 sf 0.00% Impervious Runoff Depth=1.25" Tc=0.0 min CN=36 Runoff=0.31 cfs 0.023 af
<b>Reach 1R: Project Impact to Peat Meadow Brook</b>	Inflow=19.23 cfs 1.825 af Outflow=19.23 cfs 1.825 af
<b>Reach 2R: Project Impact to Peat Meadow Brook</b>	Inflow=17.92 cfs 1.435 af Outflow=17.92 cfs 1.435 af
<b>Reach 10R: Existing Project Outfall (CB at SE of site)</b>	Inflow=16.52 cfs 1.555 af Outflow=16.52 cfs 1.555 af
<b>Reach 20R: Existing Outfall to 35 Danton Drive Back</b>	Inflow=2.70 cfs 0.203 af Outflow=2.70 cfs 0.203 af

**Reach 30R: Existing Outfall to 31 Danton Drive**

Inflow=0.50 cfs 0.038 af  
Outflow=0.50 cfs 0.038 af

**Reach 40R: Woods Behind Project**

Inflow=0.27 cfs 0.029 af  
Outflow=0.27 cfs 0.029 af

**Reach 100R: Project Outfall**

Inflow=15.11 cfs 1.238 af  
Outflow=15.11 cfs 1.238 af

**Reach 200R: Existing Outfall to 35 Danton Drive Back**

Inflow=2.47 cfs 0.163 af  
Outflow=2.47 cfs 0.163 af

**Reach 300R: Existing Outfall to 31 Danton Drive**

Inflow=0.16 cfs 0.011 af  
Outflow=0.16 cfs 0.011 af

**Reach 400R: Woods Behind Project**

Inflow=0.31 cfs 0.023 af  
Outflow=0.31 cfs 0.023 af

**Pond 10P: Existing Swale**

Peak Elev=4.20' Storage=689 cf Inflow=13.24 cfs 1.227 af  
Outflow=13.25 cfs 1.211 af

**Pond 100P: Underground Storage**

Peak Elev=115.71' Storage=6,760 cf Inflow=6.99 cfs 0.624 af

Discarded=0.36 cfs 0.473 af Primary=2.93 cfs 0.151 af Outflow=3.28 cfs 0.624 af

**Pond 110P: Roof Drain Pond**

Peak Elev=117.86' Storage=5,366 cf Inflow=9.01 cfs 0.696 af

Discarded=0.27 cfs 0.315 af Primary=6.75 cfs 0.382 af Outflow=7.02 cfs 0.696 af

**Pond 120P: Front Undergound Storage**

Peak Elev=116.27' Storage=2,879 cf Inflow=7.07 cfs 0.483 af

Discarded=0.07 cfs 0.156 af Primary=6.98 cfs 0.326 af Outflow=7.05 cfs 0.483 af

**Total Runoff Area = 8.893 ac Runoff Volume = 4.218 af Average Runoff Depth = 5.69"**  
**43.46% Pervious = 3.865 ac 56.54% Impervious = 5.028 ac**

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Page 74

**Summary for Subcatchment 10S: Existing Site**

Runoff = 13.24 cfs @ 12.19 hrs, Volume= 1.227 af, Depth= 4.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
72,863	39	>75% Grass cover, Good, HSG A
57,826	98	Paved parking, HSG B
3,237	96	Gravel surface, HSG B
133,926	66	Weighted Average
76,100		56.82% Pervious Area
57,826		43.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	20	0.0050	0.05		<b>Sheet Flow, Woodland Sheet Flow</b> Grass: Dense n= 0.240 P2= 3.15"
1.1	164	0.0145	2.44		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
2.9	155	0.0158	0.88		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.5	148	0.0225	4.68	46.78	<b>Channel Flow, X-Sec and Perimeter</b> Area= 10.0 sf Perim= 13.0' r= 0.77' n= 0.040 Earth, cobble bottom, clean sides
0.1	68	0.0558	13.14	157.70	<b>Channel Flow, X-Section and Perimeter</b> Area= 12.0 sf Perim= 8.0' r= 1.50' n= 0.035 Earth, dense weeds
11.5	555	Total			

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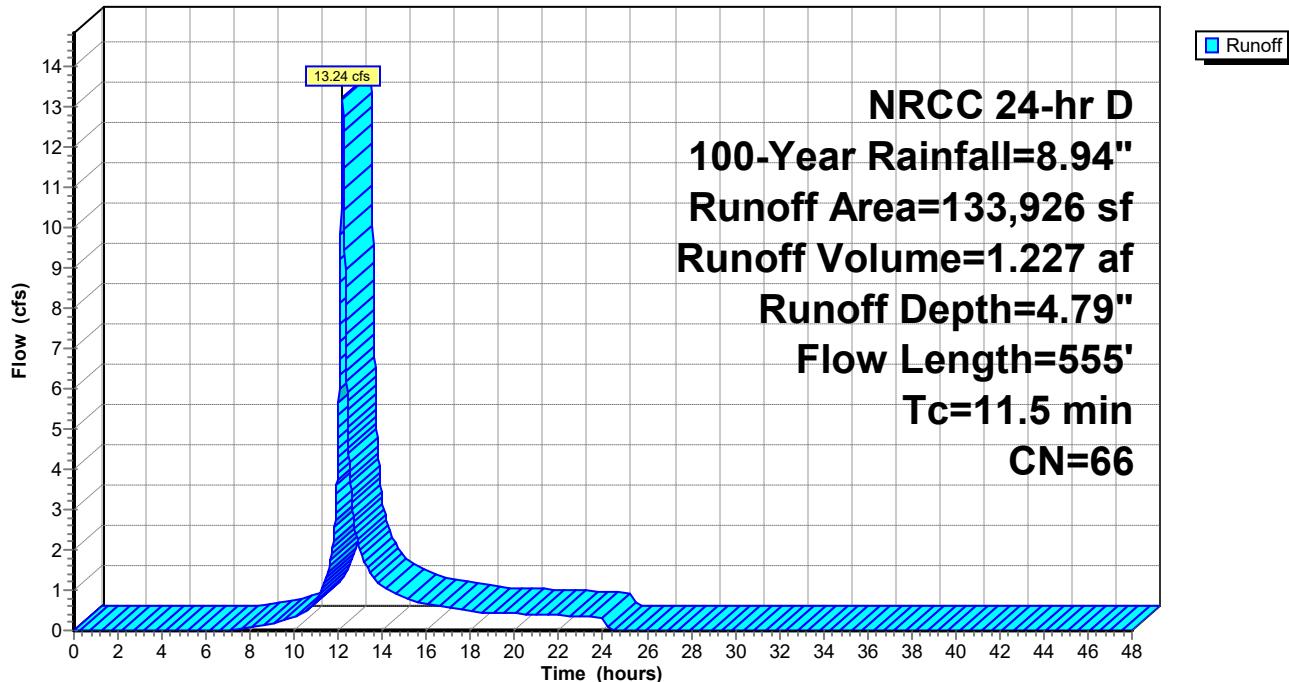
NRCC 24-hr D 100-Year Rainfall=8.94"

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Page 75

### Subcatchment 10S: Existing Site

Hydrograph



**Summary for Subcatchment 11S: Danton Drive & 35 Danton Drive**

Runoff = 3.36 cfs @ 12.17 hrs, Volume= 0.344 af, Depth= 8.70"

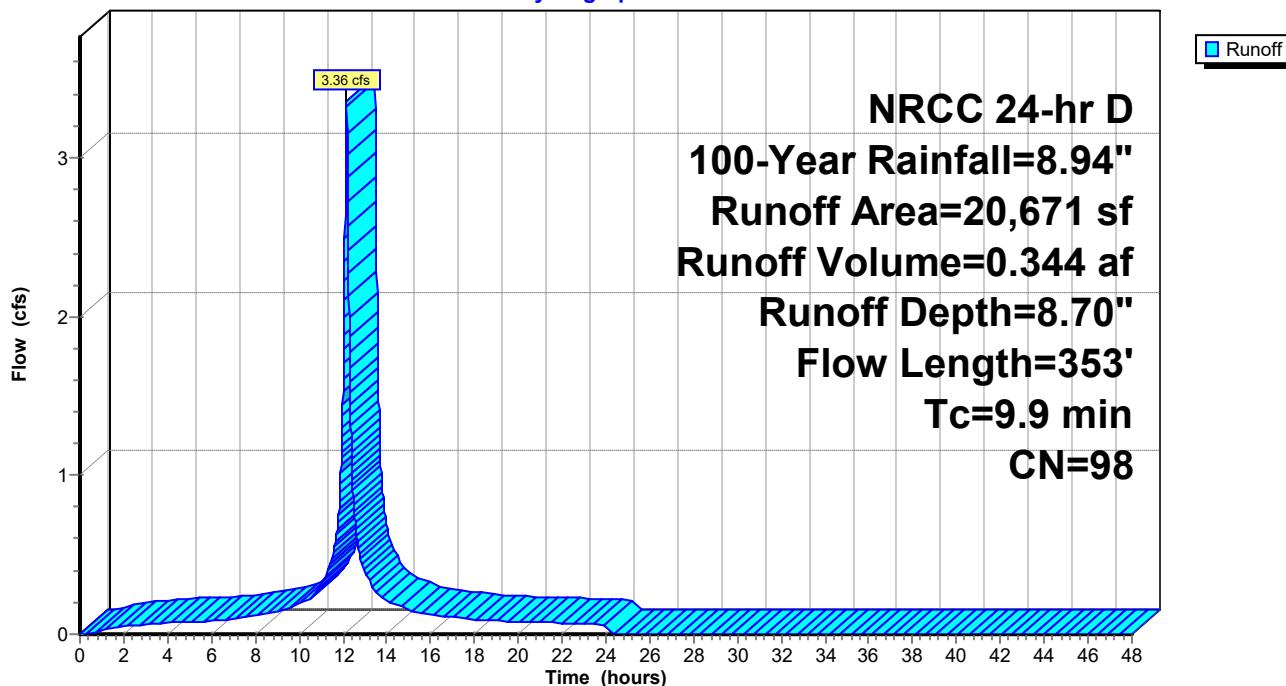
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
20,671	98	Paved parking, HSG A
20,671		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	10	0.0200	0.86		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 3.15"
6.0	178	0.0050	0.49		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.5	42	0.0050	1.44		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
2.7	81	0.0050	0.49		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.5	42	0.0050	1.44		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
9.9	353				Total

**Subcatchment 11S: Danton Drive & 35 Danton Drive**

Hydrograph



### Summary for Subcatchment 20S: Existing to 35 Danton Drive

Runoff = 2.70 cfs @ 12.13 hrs, Volume= 0.203 af, Depth= 5.28"

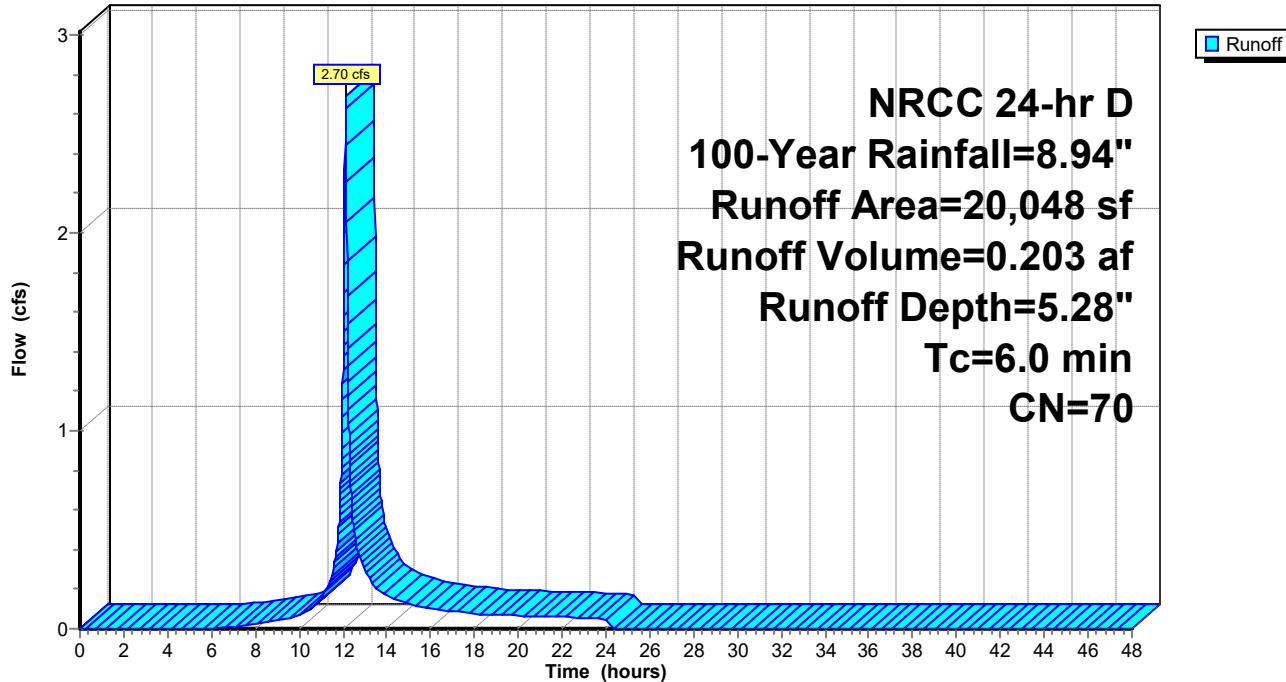
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
10,526	98	Paved parking, HSG B
9,522	39	>75% Grass cover, Good, HSG A
20,048	70	Weighted Average
9,522		47.50% Pervious Area
10,526		52.50% Impervious Area

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

### Subcatchment 20S: Existing to 35 Danton Drive

Hydrograph



### Summary for Subcatchment 30S: To 31 Danton Drive

Runoff = 0.50 cfs @ 12.14 hrs, Volume= 0.038 af, Depth= 2.96"

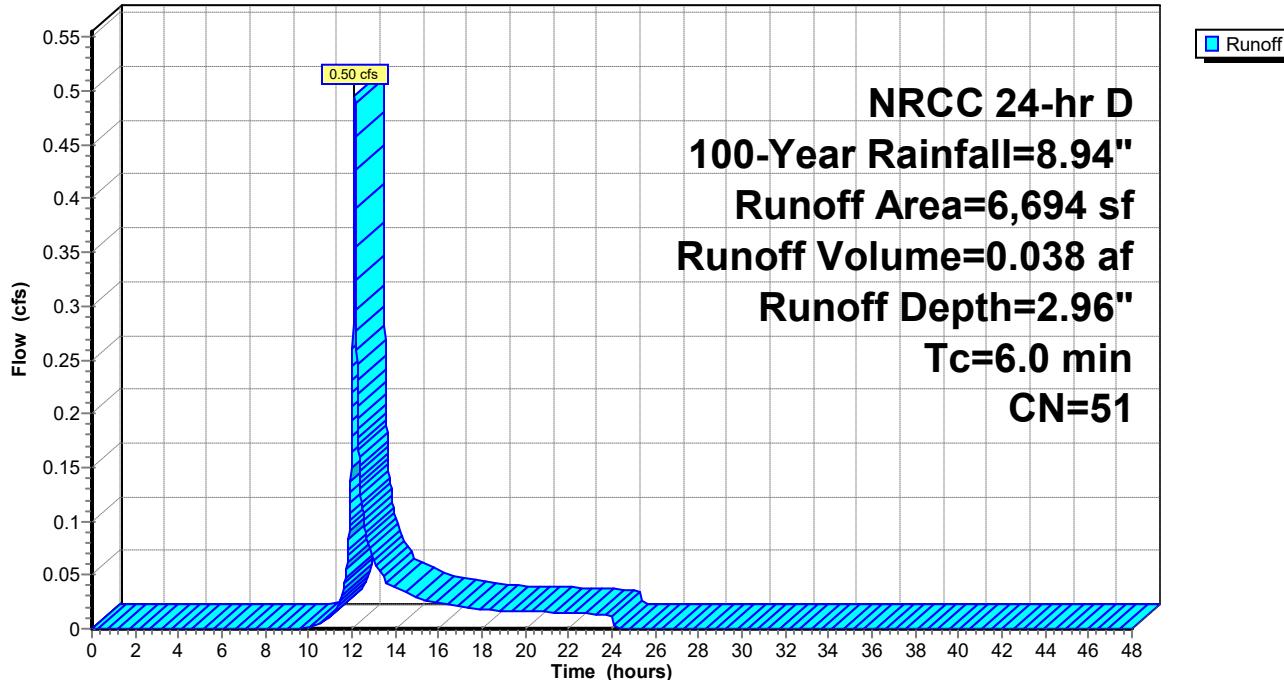
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
1,409	98	Paved parking, HSG B
5,285	39	>75% Grass cover, Good, HSG A
6,694	51	Weighted Average
5,285		78.95% Pervious Area
1,409		21.05% Impervious Area

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

### Subcatchment 30S: To 31 Danton Drive

Hydrograph



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NRCC 24-hr D 100-Year Rainfall=8.94"

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Page 79

### Summary for Subcatchment 40S: Woods Behind Project

Runoff = 0.27 cfs @ 12.15 hrs, Volume= 0.029 af, Depth= 1.25"

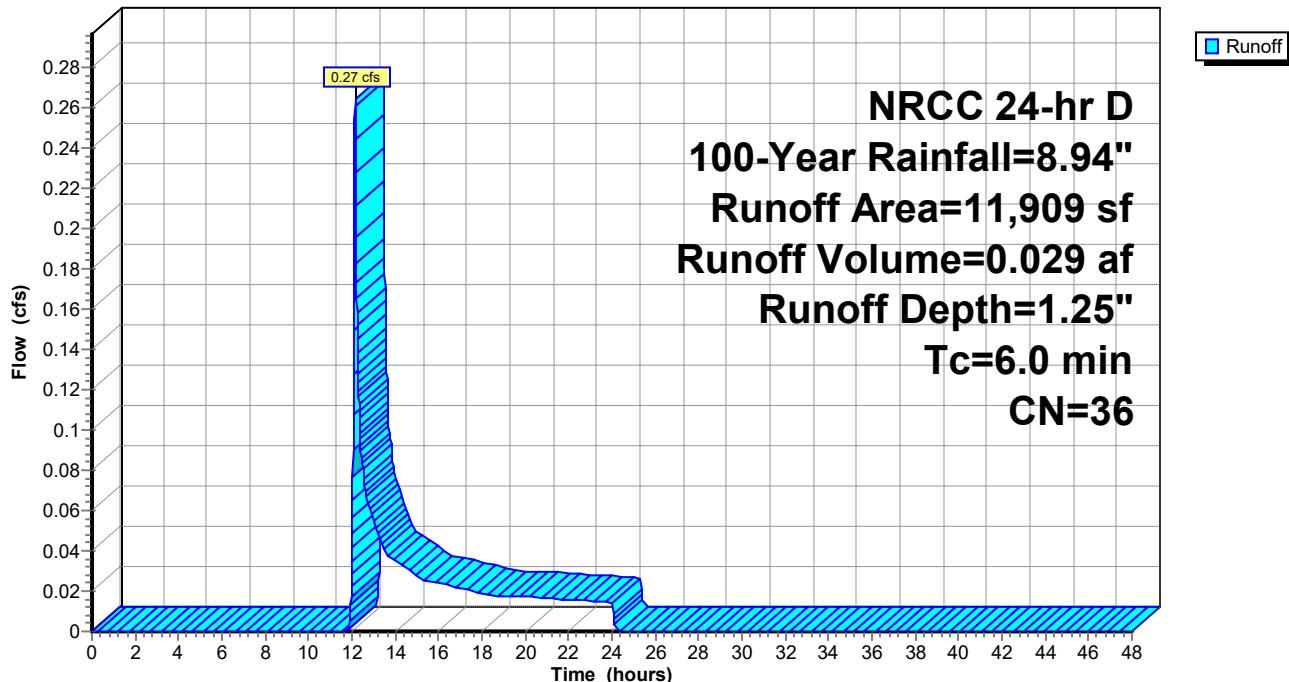
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
11,909	36	Woods, Fair, HSG A
11,909		100.00% Pervious Area

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

### Subcatchment 40S: Woods Behind Project

Hydrograph



### Summary for Subcatchment 100S: Truck Docks

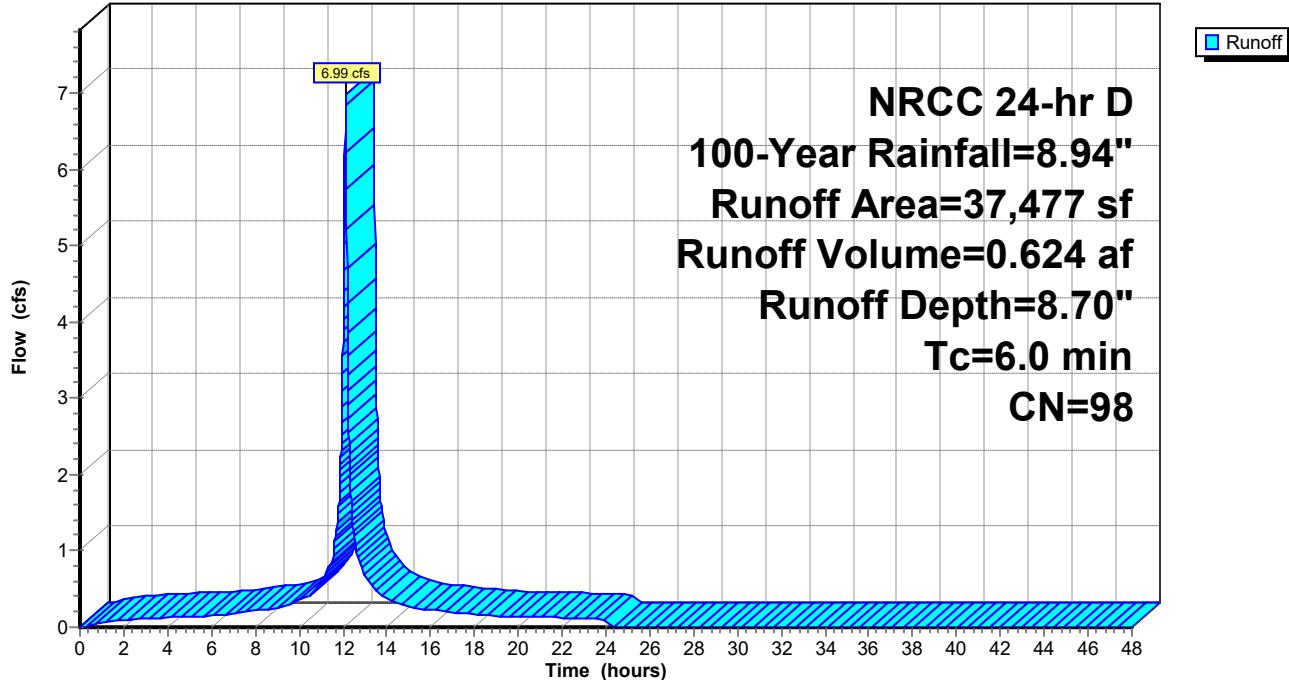
Runoff = 6.99 cfs @ 12.13 hrs, Volume= 0.624 af, Depth= 8.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description			
22,482	98	Paved parking, HSG A			
14,995	98	Roofs, HSG A			
37,477	98	Weighted Average			
37,477		100.00% Impervious Area			
Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
6.0					Direct Entry, 6

### Subcatchment 100S: Truck Docks

Hydrograph



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Page 81

### Summary for Subcatchment 110S: Roof Drains

Runoff = 9.01 cfs @ 12.13 hrs, Volume= 0.696 af, Depth= 6.39"

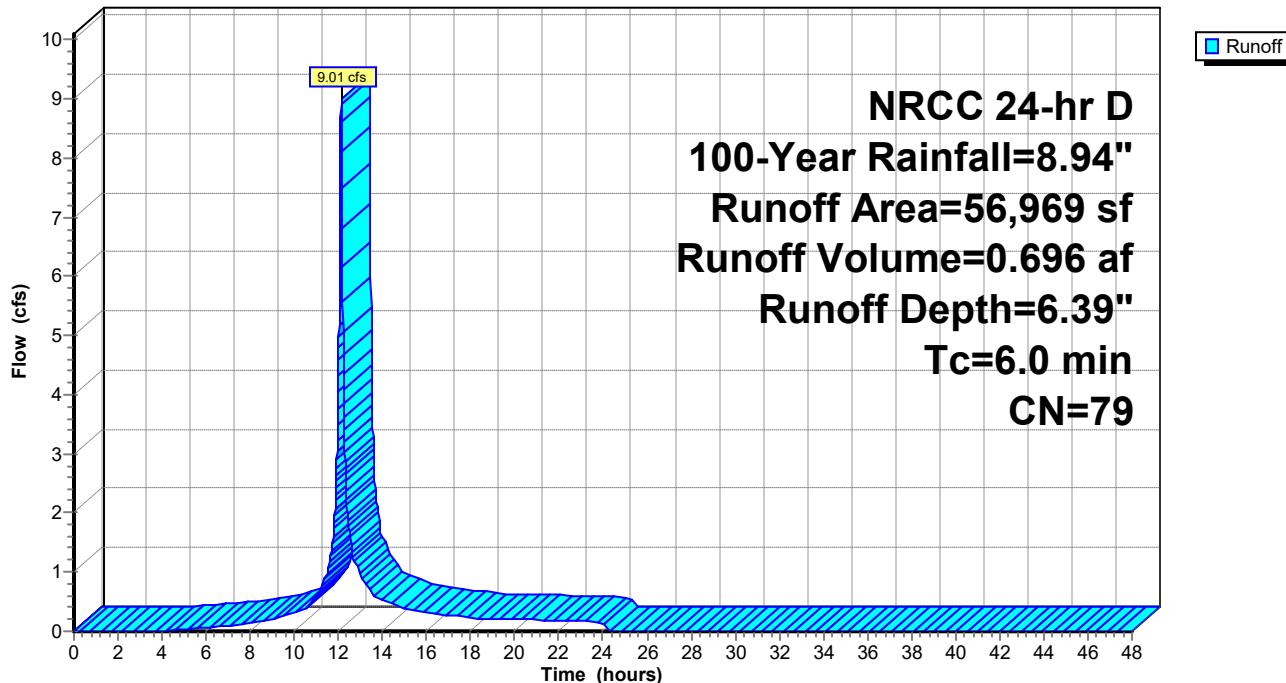
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
30,102	98	Roofs, HSG A
21,741	49	50-75% Grass cover, Fair, HSG A
5,126	98	Water Surface, HSG A
56,969	79	Weighted Average
21,741		38.16% Pervious Area
35,228		61.84% Impervious Area

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

### Subcatchment 110S: Roof Drains

Hydrograph



### Summary for Subcatchment 120S: Front Parking Lot

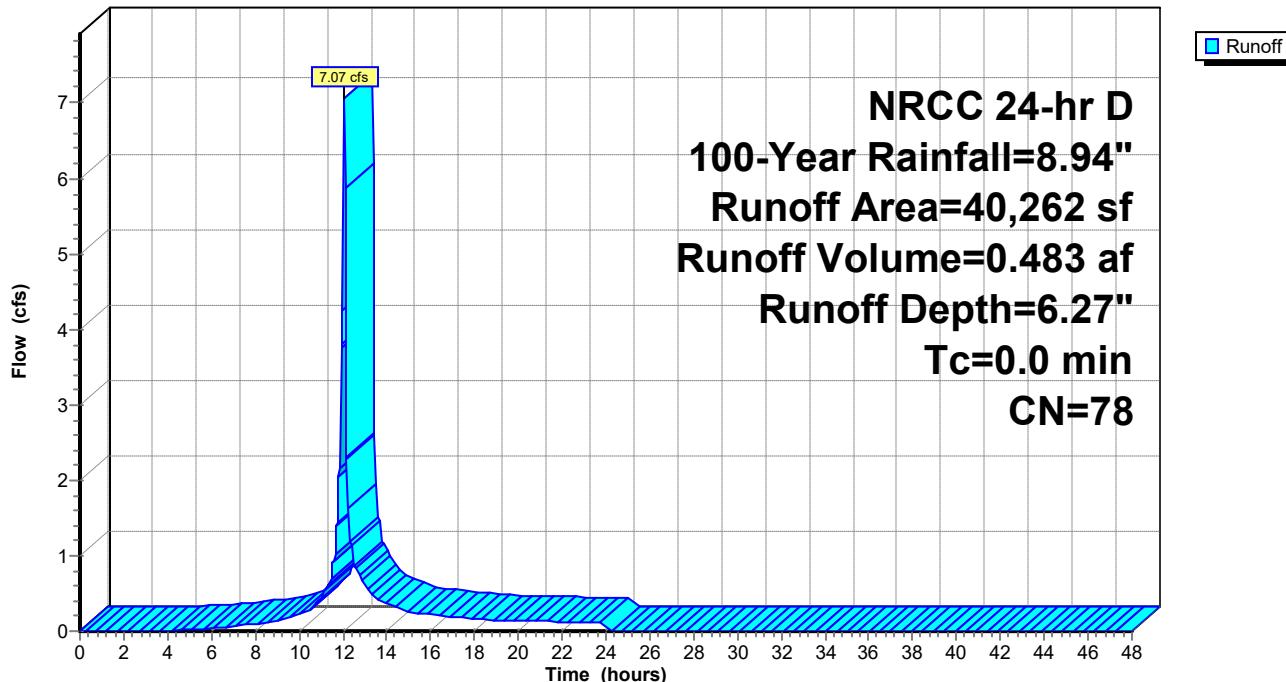
Runoff = 7.07 cfs @ 12.09 hrs, Volume= 0.483 af, Depth= 6.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
11,451	98	Paved parking, HSG A
14,995	98	Roofs, HSG A
13,816	39	>75% Grass cover, Good, HSG A
40,262	78	Weighted Average
13,816		34.32% Pervious Area
26,446		65.68% Impervious Area

### Subcatchment 120S: Front Parking Lot

Hydrograph



### Summary for Subcatchment 130S: Existing Danton Drive

Runoff = 4.23 cfs @ 12.17 hrs, Volume= 0.379 af, Depth= 6.51"

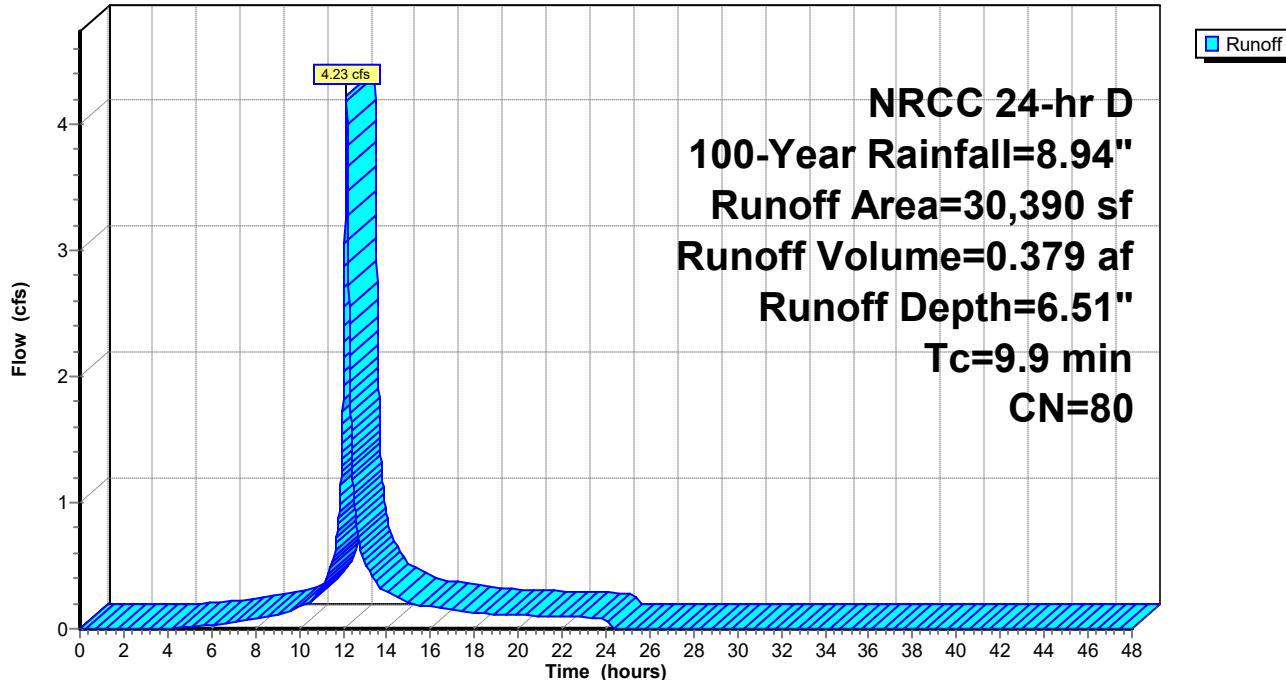
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
21,029	98	Paved parking, HSG A
9,361	39	>75% Grass cover, Good, HSG A
30,390	80	Weighted Average
9,361		30.80% Pervious Area
21,029		69.20% Impervious Area

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

### Subcatchment 130S: Existing Danton Drive

Hydrograph



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NRCC 24-hr D 100-Year Rainfall=8.94"

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Page 84

### Summary for Subcatchment 200S: To 35 Danton Drive

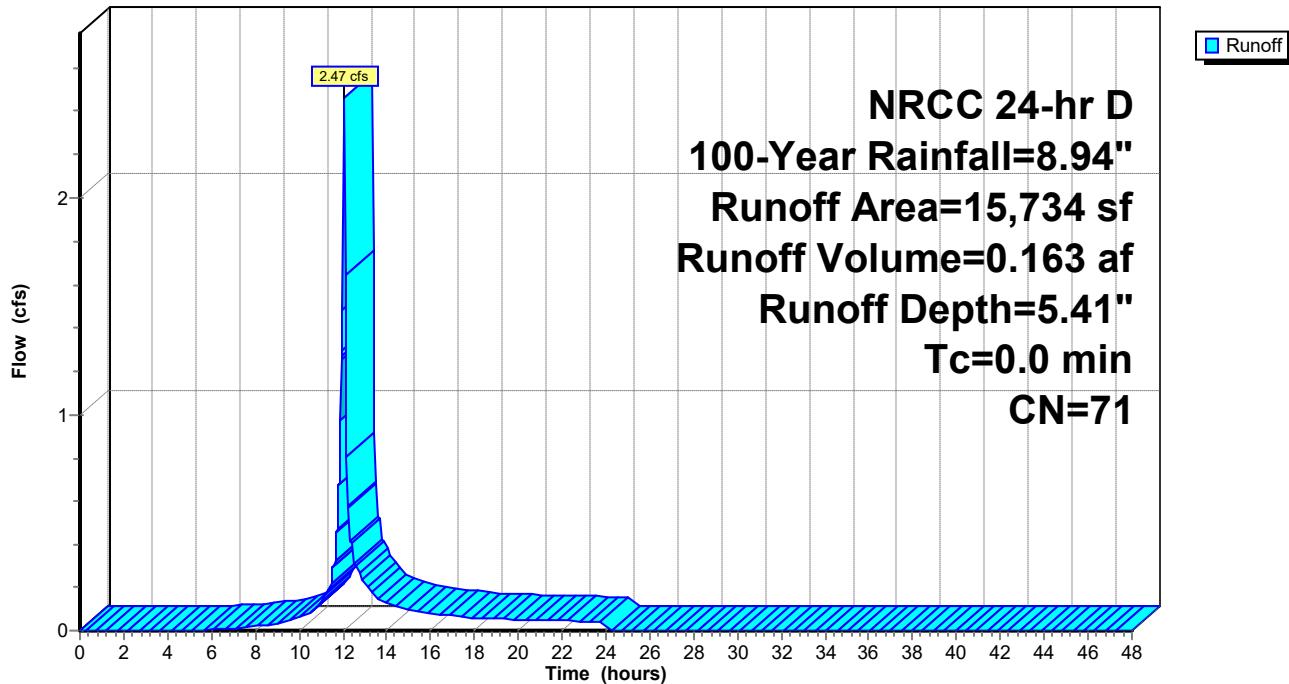
Runoff = 2.47 cfs @ 12.09 hrs, Volume= 0.163 af, Depth= 5.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
7,316	39	>75% Grass cover, Good, HSG A
8,418	98	Paved parking, HSG A
15,734	71	Weighted Average
7,316		46.50% Pervious Area
8,418		53.50% Impervious Area

### Subcatchment 200S: To 35 Danton Drive

Hydrograph



### Summary for Subcatchment 300S: To 31 Danton Drive

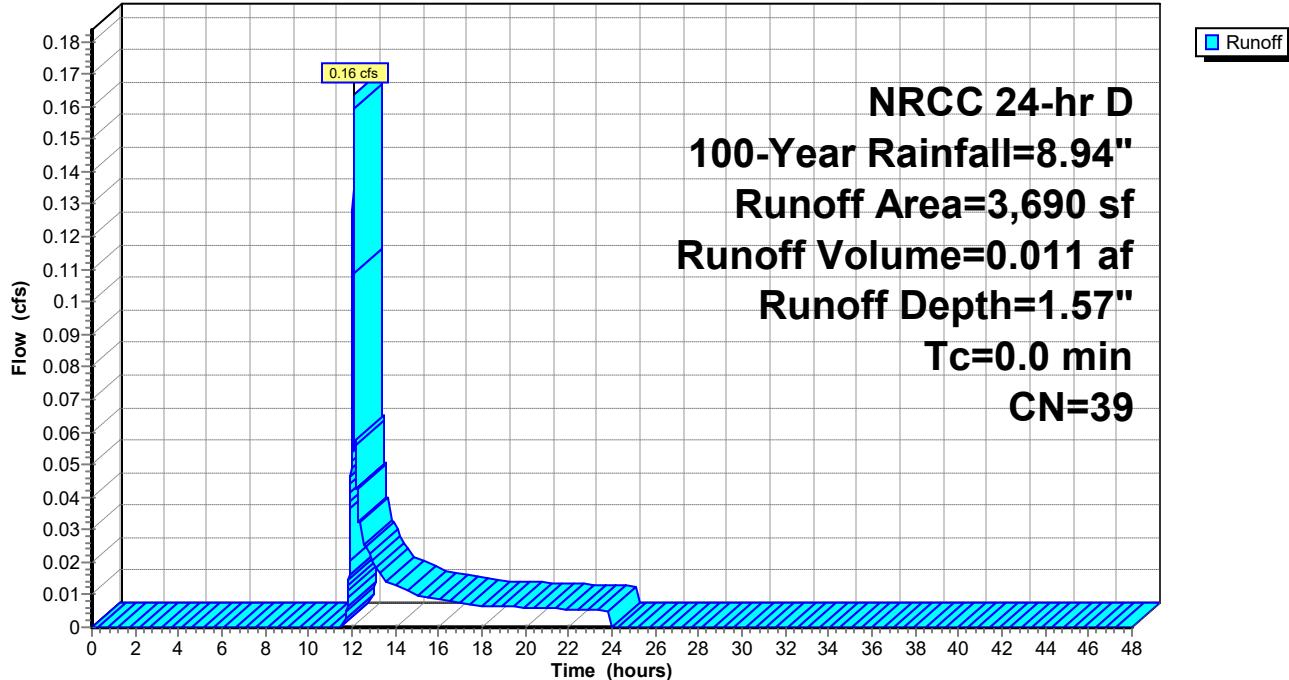
Runoff = 0.16 cfs @ 12.09 hrs, Volume= 0.011 af, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
3,690	39	>75% Grass cover, Good, HSG A
3,690		100.00% Pervious Area

### Subcatchment 300S: To 31 Danton Drive

Hydrograph



### Summary for Subcatchment 400S: Woods Behind Project

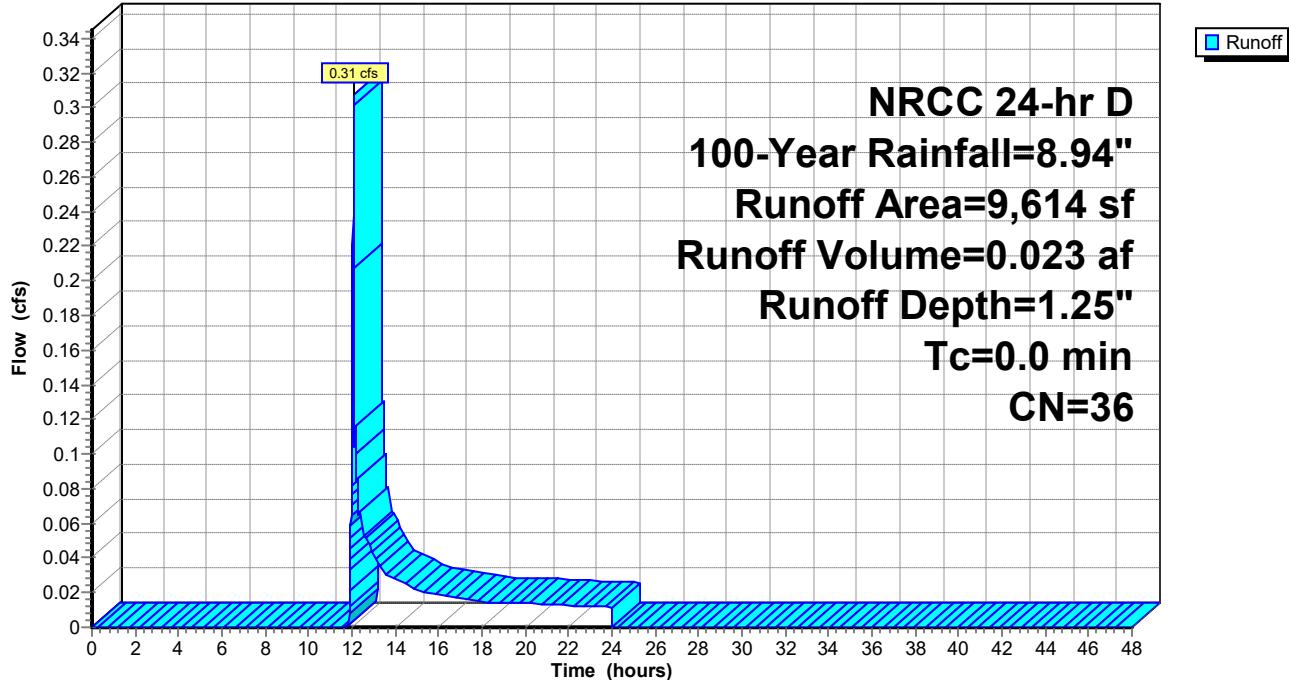
Runoff = 0.31 cfs @ 12.09 hrs, Volume= 0.023 af, Depth= 1.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
9,614	36	Woods, Fair, HSG A
9,614		100.00% Pervious Area

### Subcatchment 400S: Woods Behind Project

Hydrograph



## Summary for Reach 1R: Project Impact to Peat Meadow Brook

Inflow Area = 4.436 ac, 46.80% Impervious, Inflow Depth = 4.94" for 100-Year event

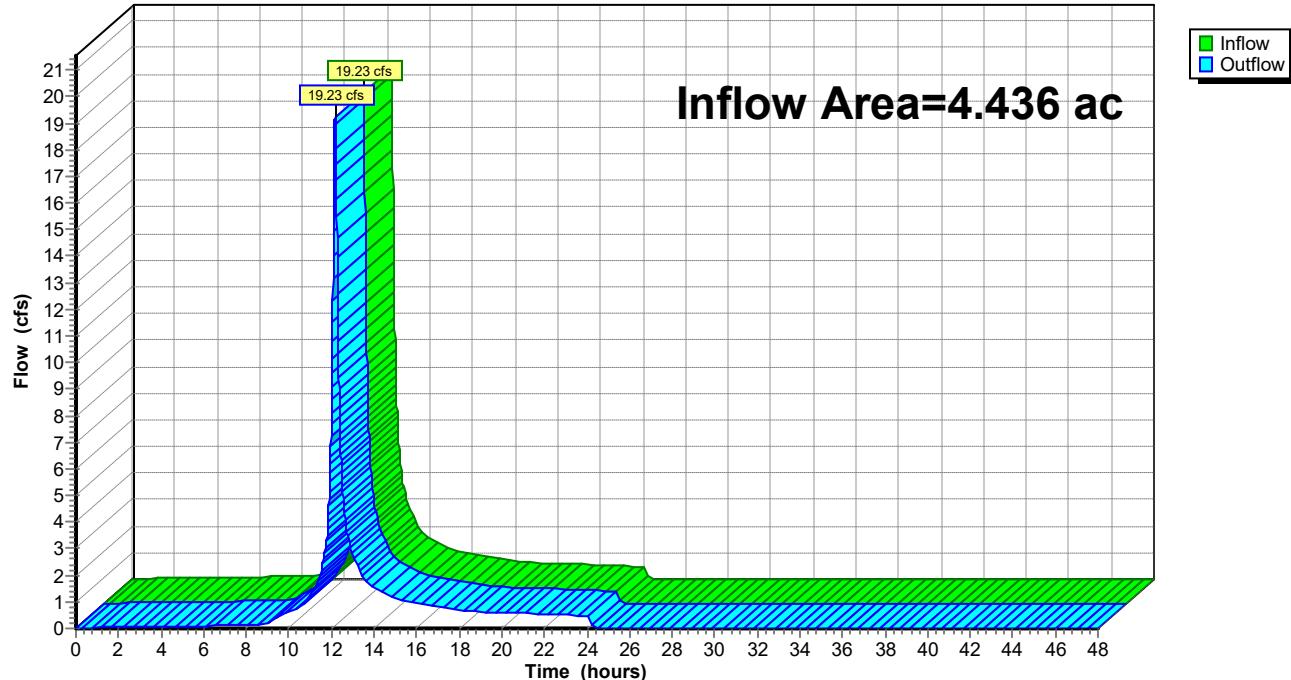
Inflow = 19.23 cfs @ 12.17 hrs, Volume= 1.825 af

Outflow = 19.23 cfs @ 12.17 hrs, Volume= 1.825 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 1R: Project Impact to Peat Meadow Brook

Hydrograph



## Summary for Reach 2R: Project Impact to Peat Meadow Brook

Inflow Area = 4.457 ac, 66.24% Impervious, Inflow Depth = 3.86" for 100-Year event

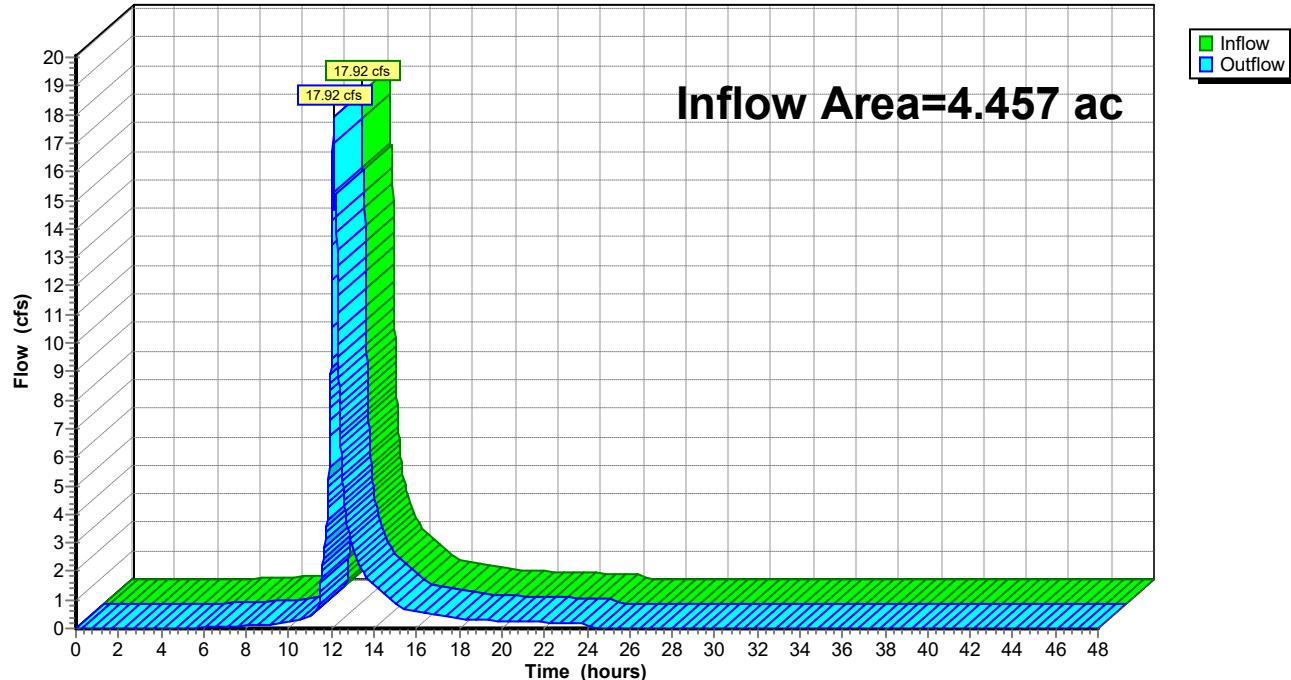
Inflow = 17.92 cfs @ 12.09 hrs, Volume= 1.435 af

Outflow = 17.92 cfs @ 12.09 hrs, Volume= 1.435 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 2R: Project Impact to Peat Meadow Brook

Hydrograph



### Summary for Reach 10R: Existing Project Oufall (CB at SE of site)

Inflow Area = 3.549 ac, 50.78% Impervious, Inflow Depth = 5.26" for 100-Year event

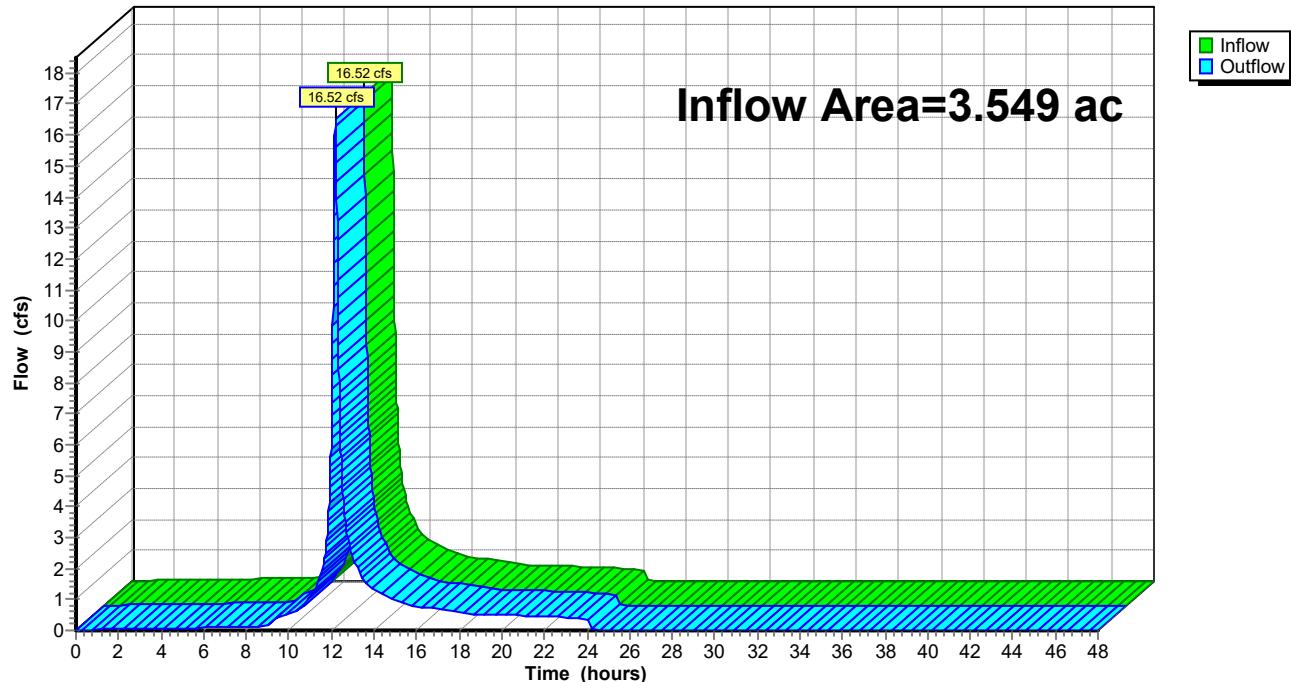
Inflow = 16.52 cfs @ 12.19 hrs, Volume= 1.555 af

Outflow = 16.52 cfs @ 12.19 hrs, Volume= 1.555 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 10R: Existing Project Oufall (CB at SE of site)

Hydrograph



**Summary for Reach 20R: Existing Outfall to 35 Danton Drive Back**

Inflow Area = 0.460 ac, 52.50% Impervious, Inflow Depth = 5.28" for 100-Year event

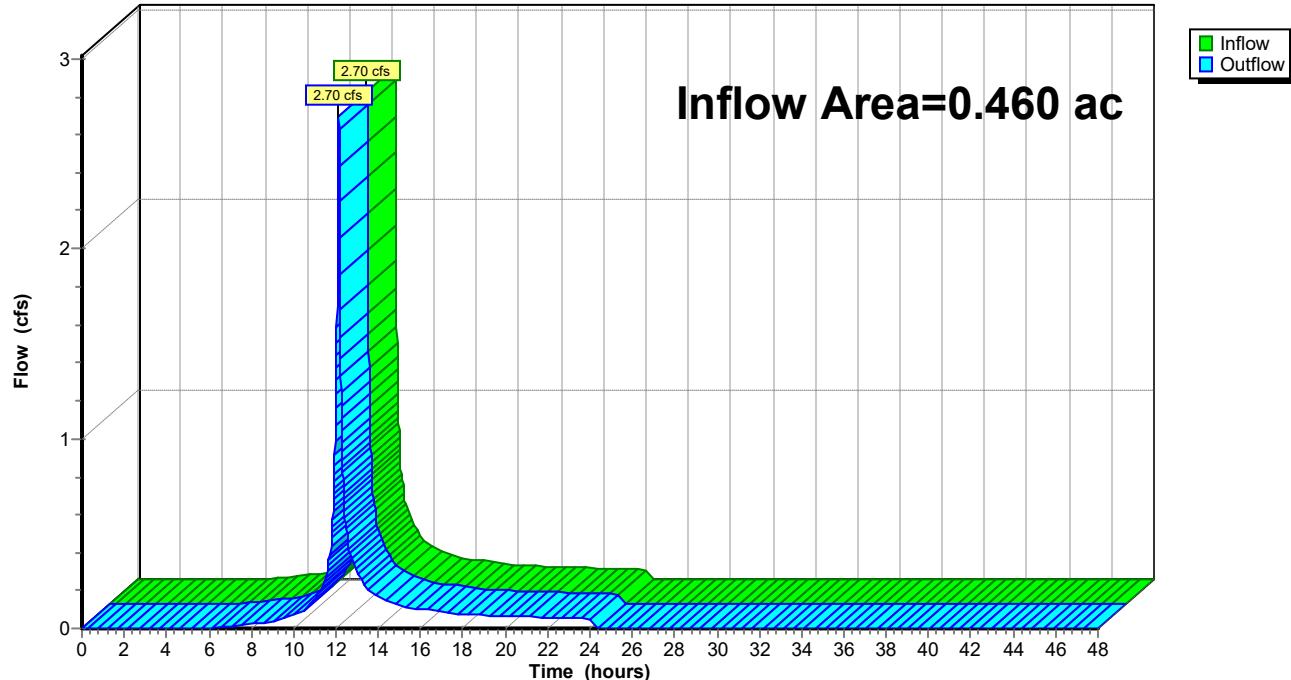
Inflow = 2.70 cfs @ 12.13 hrs, Volume= 0.203 af

Outflow = 2.70 cfs @ 12.13 hrs, Volume= 0.203 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

**Reach 20R: Existing Outfall to 35 Danton Drive Back**

Hydrograph



### Summary for Reach 30R: Existing Outfall to 31 Danton Drive

Inflow Area = 0.154 ac, 21.05% Impervious, Inflow Depth = 2.96" for 100-Year event

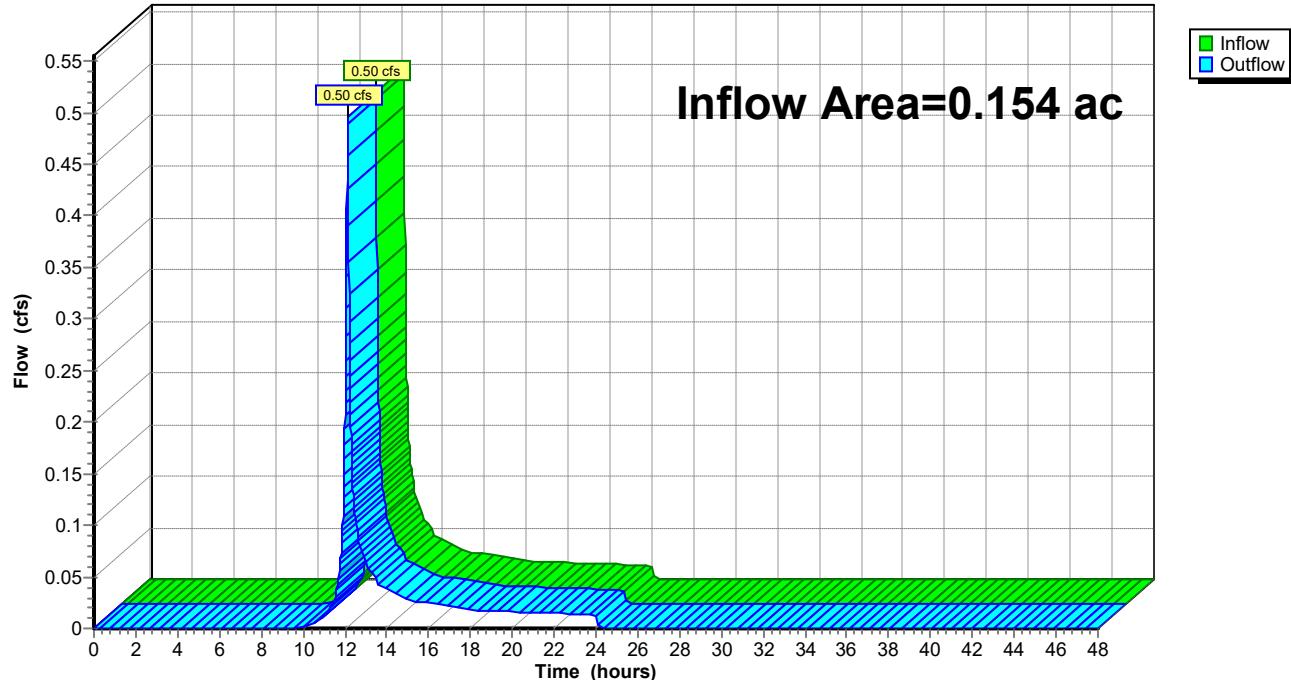
Inflow = 0.50 cfs @ 12.14 hrs, Volume= 0.038 af

Outflow = 0.50 cfs @ 12.14 hrs, Volume= 0.038 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 30R: Existing Outfall to 31 Danton Drive

Hydrograph



### Summary for Reach 40R: Woods Behind Project

Inflow Area = 0.273 ac, 0.00% Impervious, Inflow Depth = 1.25" for 100-Year event

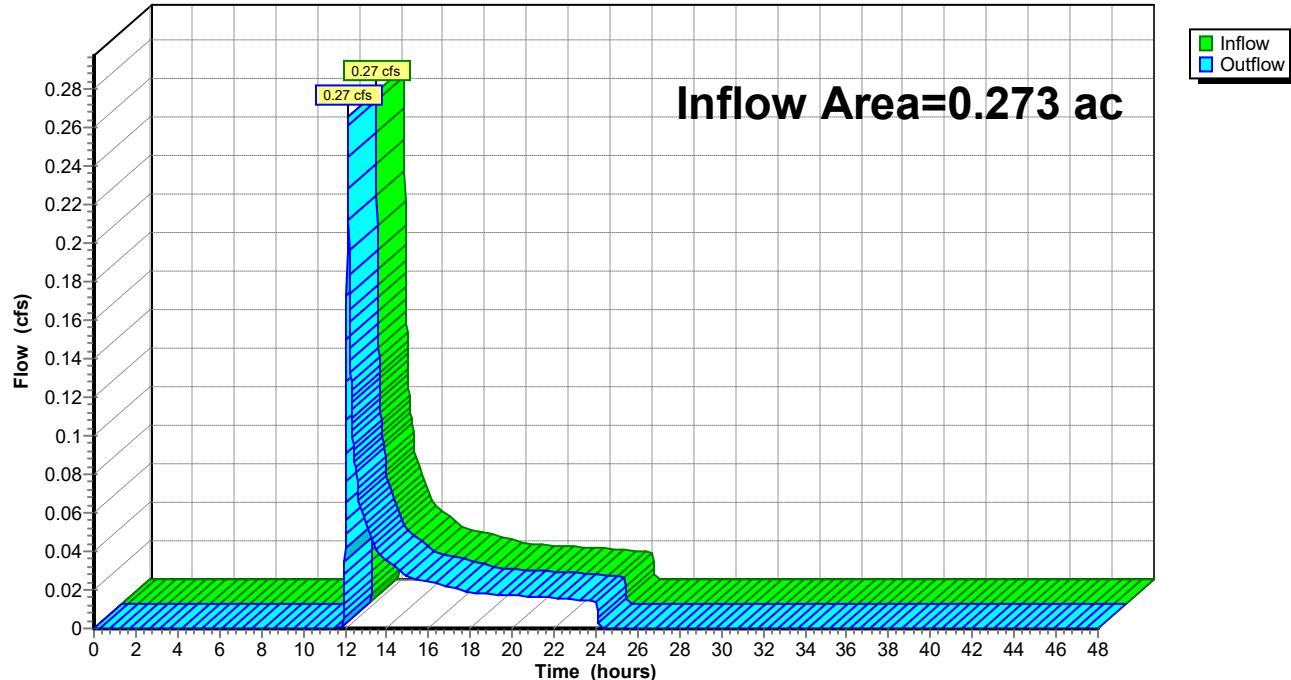
Inflow = 0.27 cfs @ 12.15 hrs, Volume= 0.029 af

Outflow = 0.27 cfs @ 12.15 hrs, Volume= 0.029 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 40R: Woods Behind Project

Hydrograph



### Summary for Reach 100R: Project Outfall

Inflow Area = 3.790 ac, 72.79% Impervious, Inflow Depth = 3.92" for 100-Year event

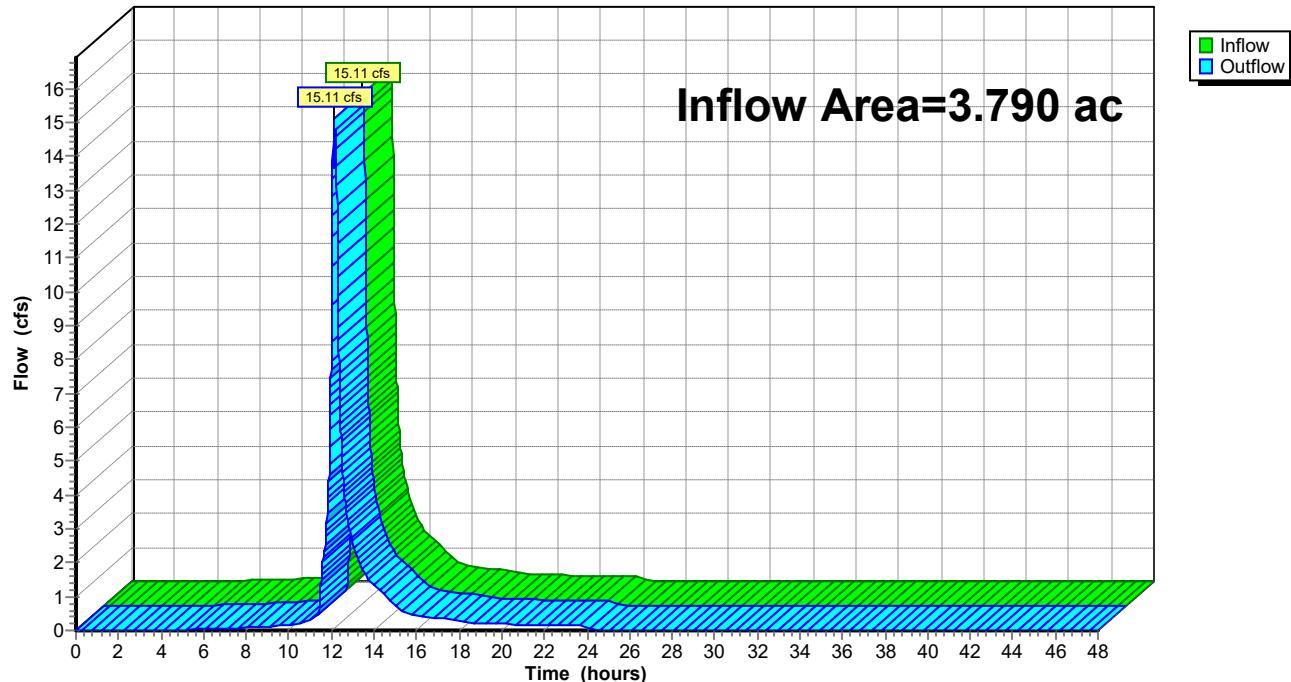
Inflow = 15.11 cfs @ 12.10 hrs, Volume= 1.238 af

Outflow = 15.11 cfs @ 12.10 hrs, Volume= 1.238 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 100R: Project Outfall

Hydrograph



### Summary for Reach 200R: Existing Oufall to 35 Danton Drive Back

Inflow Area = 0.361 ac, 53.50% Impervious, Inflow Depth = 5.41" for 100-Year event

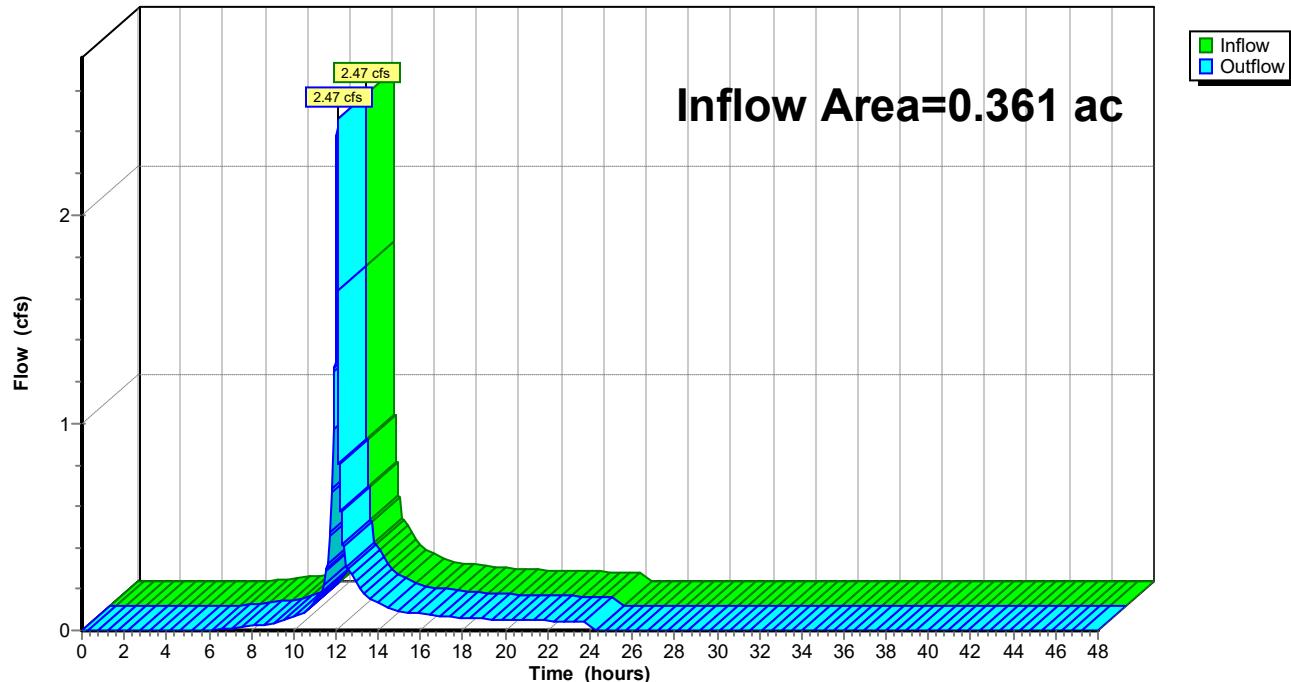
Inflow = 2.47 cfs @ 12.09 hrs, Volume= 0.163 af

Outflow = 2.47 cfs @ 12.09 hrs, Volume= 0.163 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 200R: Existing Oufall to 35 Danton Drive Back

Hydrograph



### Summary for Reach 300R: Existing Oufall to 31 Danton Drive

Inflow Area = 0.085 ac, 0.00% Impervious, Inflow Depth = 1.57" for 100-Year event

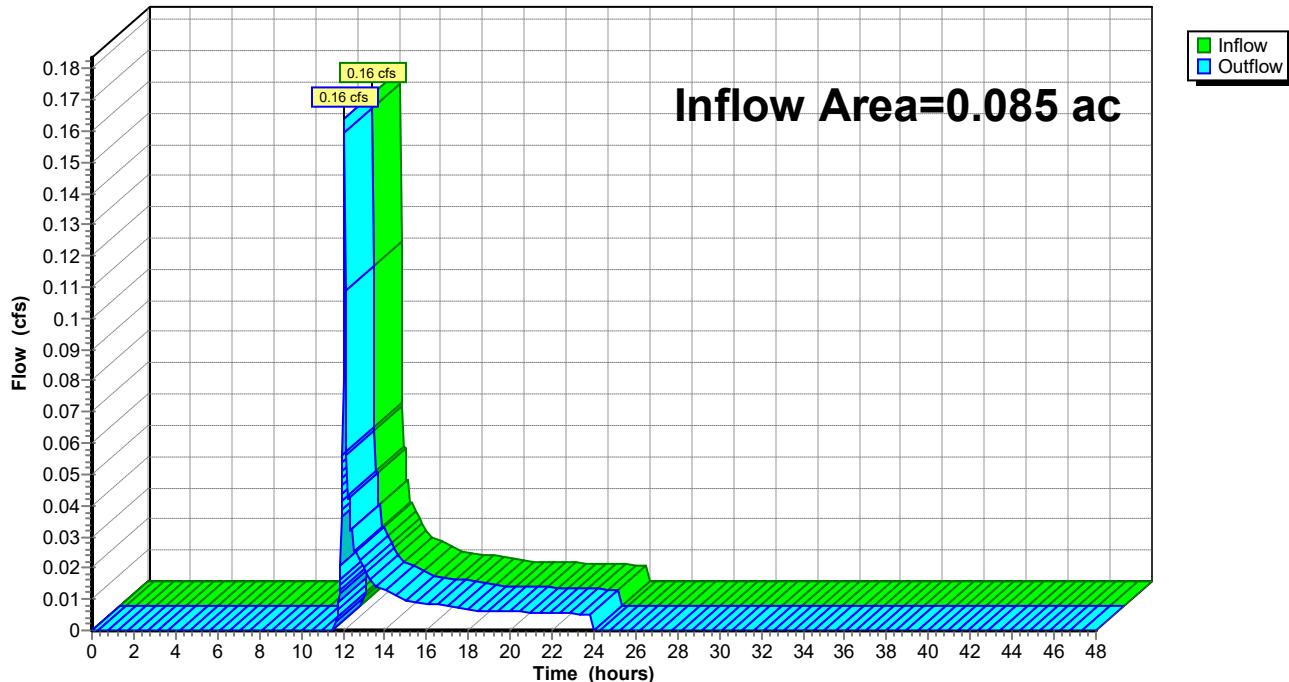
Inflow = 0.16 cfs @ 12.09 hrs, Volume= 0.011 af

Outflow = 0.16 cfs @ 12.09 hrs, Volume= 0.011 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 300R: Existing Oufall to 31 Danton Drive

Hydrograph



## Summary for Reach 400R: Woods Behind Project

Inflow Area = 0.221 ac, 0.00% Impervious, Inflow Depth = 1.25" for 100-Year event

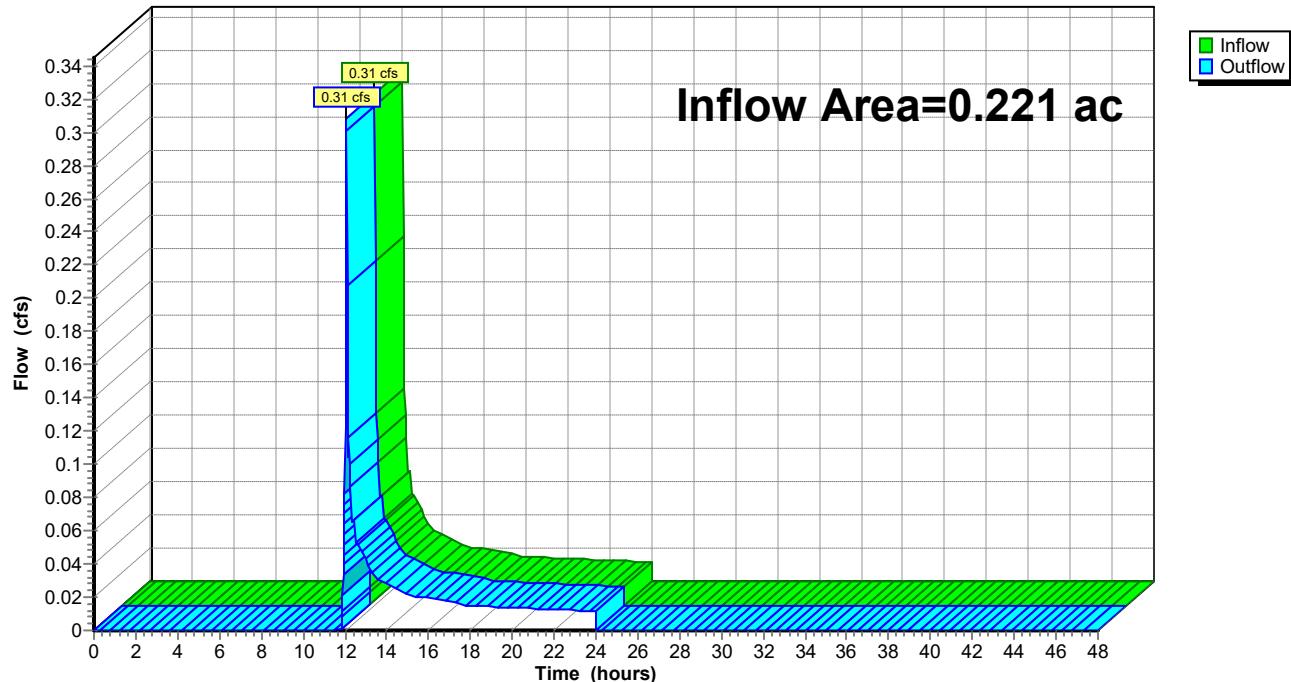
Inflow = 0.31 cfs @ 12.09 hrs, Volume= 0.023 af

Outflow = 0.31 cfs @ 12.09 hrs, Volume= 0.023 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

### Reach 400R: Woods Behind Project

Hydrograph



### Summary for Pond 10P: Existing Swale

Inflow Area = 3.075 ac, 43.18% Impervious, Inflow Depth = 4.79" for 100-Year event  
 Inflow = 13.24 cfs @ 12.19 hrs, Volume= 1.227 af  
 Outflow = 13.25 cfs @ 12.19 hrs, Volume= 1.211 af, Atten= 0%, Lag= 0.0 min  
 Primary = 13.25 cfs @ 12.19 hrs, Volume= 1.211 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
 Peak Elev= 4.20' @ 12.19 hrs Surf.Area= 0 sf Storage= 689 cf

Plug-Flow detention time= 12.1 min calculated for 1.211 af (99% of inflow)  
 Center-of-Mass det. time= 4.6 min ( 861.4 - 856.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	690 cf	<b>Custom Stage Data</b> Listed below

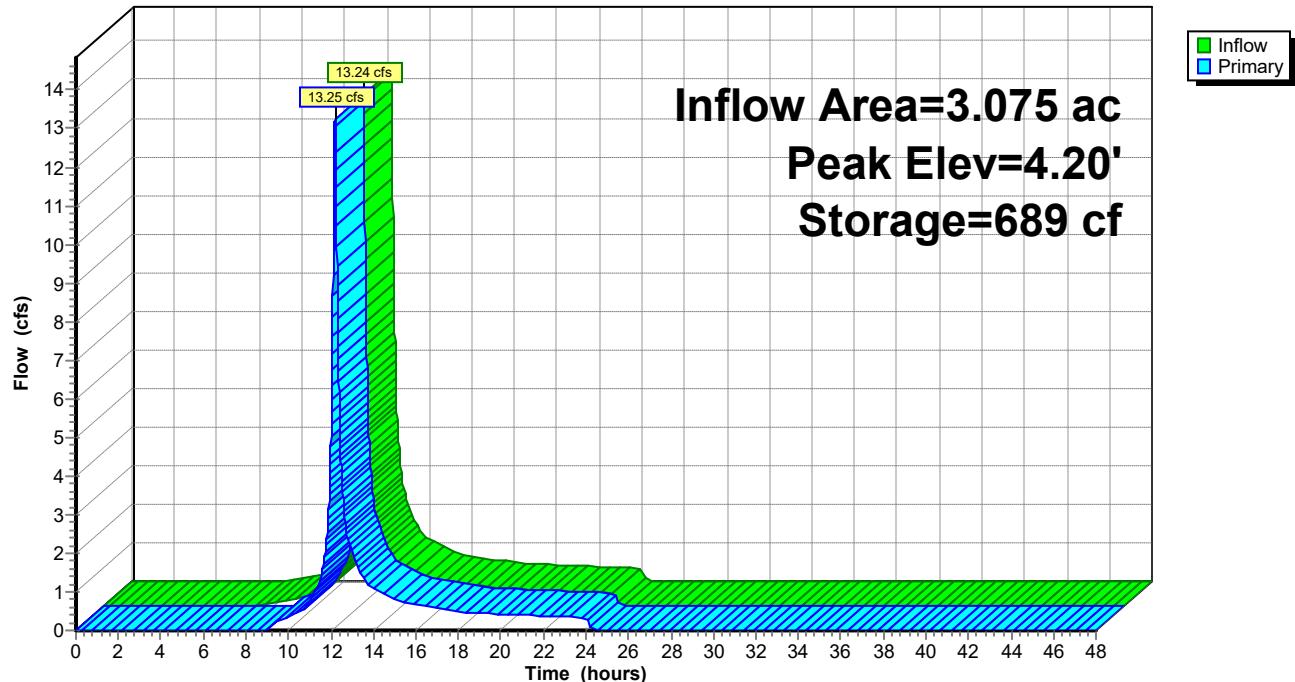
Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
0.20	4
0.40	14
0.60	28
0.80	45
1.00	66
1.20	91
1.40	121
1.60	157
1.80	200
2.00	248
2.20	305
2.40	371
2.60	447
2.80	555
3.00	635
3.20	657
3.40	660
3.60	674
3.80	684
4.00	687
4.20	689
5.00	690

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	<b>Special &amp; User-Defined</b> Elev. (feet) 0.00 4.20 4.21 Disch. (cfs) 0.000 0.000 5,000.000

**Primary OutFlow** Max=13.24 cfs @ 12.19 hrs HW=4.20' (Free Discharge)  
 ↑=Special & User-Defined (Custom Controls 13.24 cfs)

**Pond 10P: Existing Swale**

Hydrograph



**2020-041****NRCC 24-hr D 100-Year Rainfall=8.94"**

Prepared by Microsoft

Printed 10/31/2020

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Page 99

**Summary for Pond 100P: Underground Storage**

Inflow Area = 0.860 ac, 100.00% Impervious, Inflow Depth = 8.70" for 100-Year event  
 Inflow = 6.99 cfs @ 12.13 hrs, Volume= 0.624 af  
 Outflow = 3.28 cfs @ 12.23 hrs, Volume= 0.624 af, Atten= 53%, Lag= 6.2 min  
 Discarded = 0.36 cfs @ 10.03 hrs, Volume= 0.473 af  
 Primary = 2.93 cfs @ 12.23 hrs, Volume= 0.151 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
 Peak Elev= 115.71' @ 12.23 hrs Surf.Area= 1,866 sf Storage= 6,760 cf

Plug-Flow detention time= 62.9 min calculated for 0.624 af (100% of inflow)  
 Center-of-Mass det. time= 62.9 min ( 804.1 - 741.2 )

Volume	Invert	Avail.Storage	Storage Description
#1A	110.00'	2,627 cf	<b>30.25'W x 61.70'L x 5.75'H Field A</b> 10,732 cf Overall - 4,165 cf Embedded = 6,567 cf x 40.0% Voids
#2A	110.75'	4,165 cf	<b>Cultec R-902HD x 64 Inside #1</b> Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 64 Chambers in 4 Rows Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf
6,792 cf			Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	110.00'	<b>8.270 in/hr Exfiltration over Surface area</b>
#2	Primary	115.40'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)
#3	Primary	112.50'	<b>4.0" Vert. Orifice/Grate</b> C= 0.600

**Discarded OutFlow** Max=0.36 cfs @ 10.03 hrs HW=110.03' (Free Discharge)  
 ↑ 1=Exfiltration (Exfiltration Controls 0.36 cfs)

**Primary OutFlow** Max=2.91 cfs @ 12.23 hrs HW=115.71' (Free Discharge)  
 ↑ 2=Sharp-Crested Rectangular Weir (Weir Controls 2.18 cfs @ 1.81 fps)  
 3=Orifice/Grate (Orifice Controls 0.73 cfs @ 8.39 fps)

## Pond 100P: Underground Storage - Chamber Wizard Field A

**Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)**

Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf

Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap

Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

16 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 59.70' Row Length +12.0" End Stone x 2 = 61.70' Base Length

4 Rows x 78.0" Wide + 9.0" Spacing x 3 + 12.0" Side Stone x 2 = 30.25' Base Width

9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

64 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 4 Rows = 4,165.1 cf Chamber Storage

10,731.9 cf Field - 4,165.1 cf Chambers = 6,566.8 cf Stone x 40.0% Voids = 2,626.7 cf Stone Storage

Chamber Storage + Stone Storage = 6,791.8 cf = 0.156 af

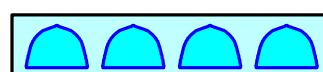
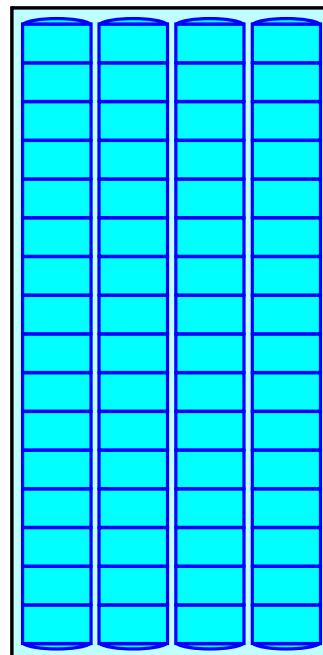
Overall Storage Efficiency = 63.3%

Overall System Size = 61.70' x 30.25' x 5.75'

64 Chambers

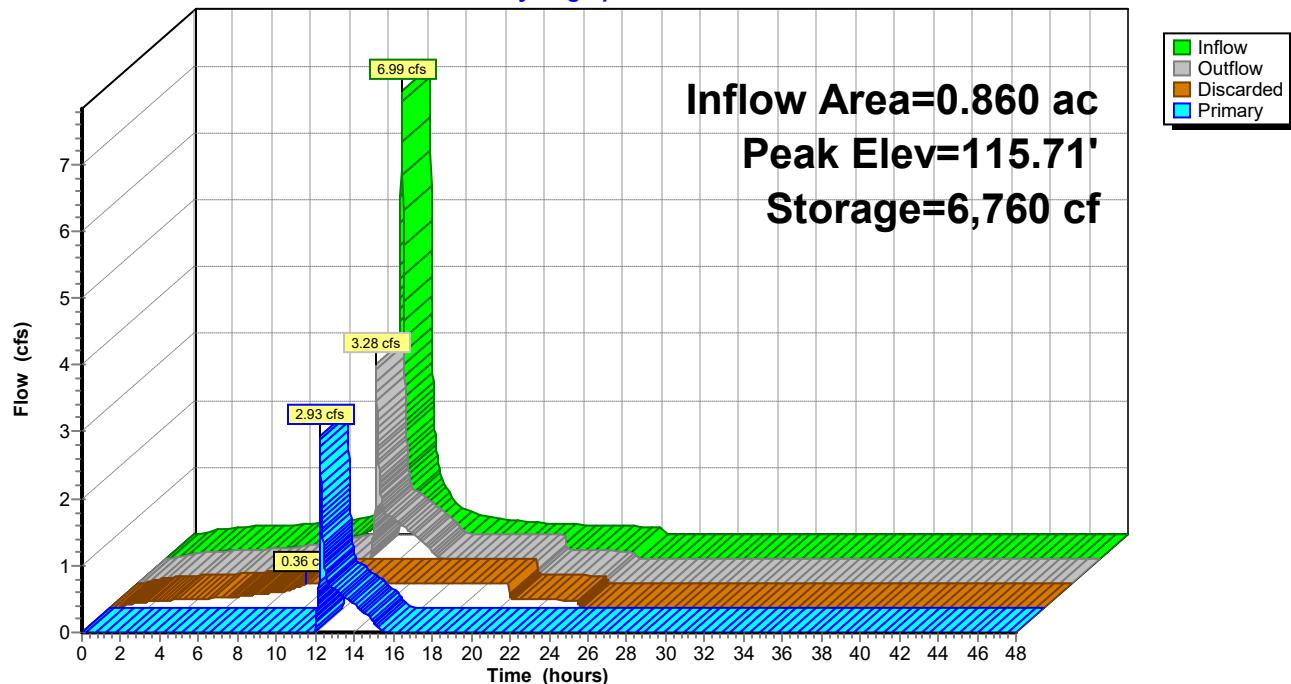
397.5 cy Field

243.2 cy Stone



**Pond 100P: Underground Storage**

Hydrograph



### Summary for Pond 110P: Roof Drain Pond

Inflow Area = 1.308 ac, 61.84% Impervious, Inflow Depth = 6.39" for 100-Year event  
 Inflow = 9.01 cfs @ 12.13 hrs, Volume= 0.696 af  
 Outflow = 7.02 cfs @ 12.18 hrs, Volume= 0.696 af, Atten= 22%, Lag= 2.8 min  
 Discarded = 0.27 cfs @ 12.18 hrs, Volume= 0.315 af  
 Primary = 6.75 cfs @ 12.18 hrs, Volume= 0.382 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
 Peak Elev= 117.86' @ 12.18 hrs Surf.Area= 4,827 sf Storage= 5,366 cf

Plug-Flow detention time= 90.6 min calculated for 0.696 af (100% of inflow)  
 Center-of-Mass det. time= 90.7 min ( 907.3 - 816.6 )

Volume	Invert	Avail.Storage	Storage Description
#1	116.00'	6,072 cf	3.00'W x 330.00'L x 2.00'H Prismatoid Z=3.0

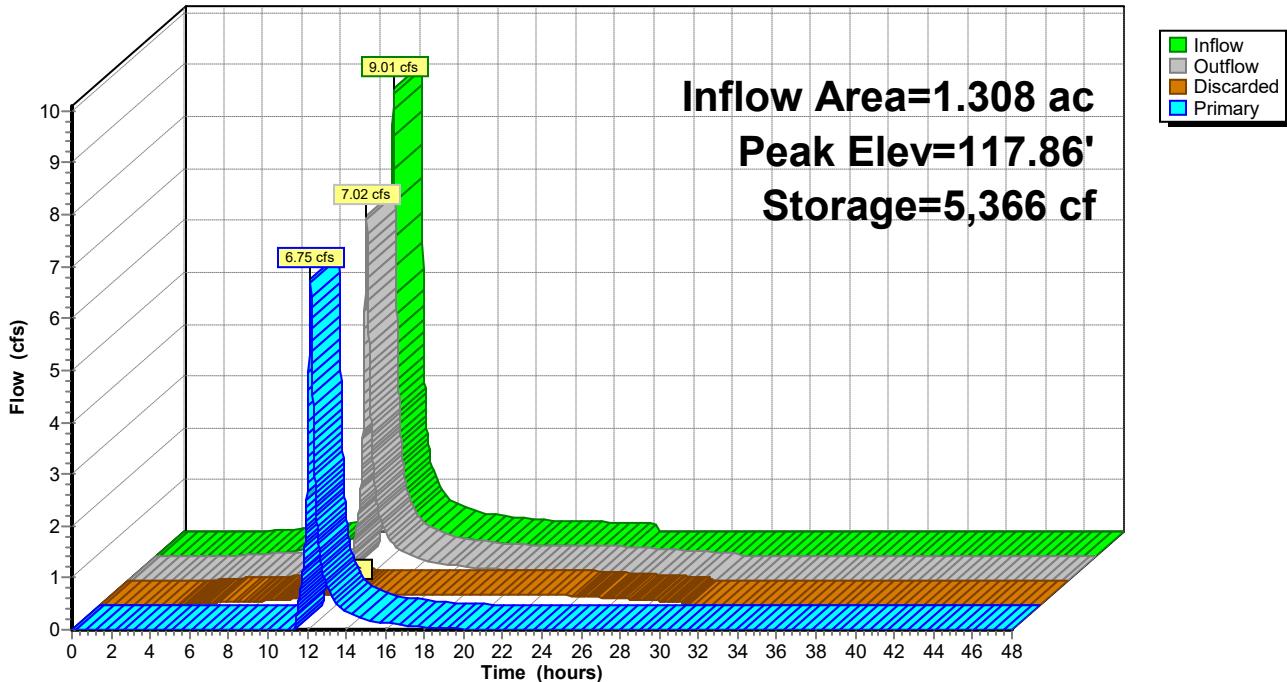
Device	Routing	Invert	Outlet Devices
#1	Discarded	116.00'	2.410 in/hr Exfiltration over Surface area
#2	Primary	117.20'	4.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)

**Discarded OutFlow** Max=0.27 cfs @ 12.18 hrs HW=117.86' (Free Discharge)  
 ↗ 1=Exfiltration (Exfiltration Controls 0.27 cfs)

**Primary OutFlow** Max=6.75 cfs @ 12.18 hrs HW=117.86' (Free Discharge)  
 ↗ 2=Sharp-Crested Rectangular Weir (Weir Controls 6.75 cfs @ 2.65 fps)

### Pond 110P: Roof Drain Pond

Hydrograph



## Summary for Pond 120P: Front Undergound Storage

Inflow Area = 0.924 ac, 65.68% Impervious, Inflow Depth = 6.27" for 100-Year event  
 Inflow = 7.07 cfs @ 12.09 hrs, Volume= 0.483 af  
 Outflow = 7.05 cfs @ 12.09 hrs, Volume= 0.483 af, Atten= 0%, Lag= 0.0 min  
 Discarded = 0.07 cfs @ 7.36 hrs, Volume= 0.156 af  
 Primary = 6.98 cfs @ 12.09 hrs, Volume= 0.326 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
 Peak Elev= 116.27' @ 12.09 hrs Surf.Area= 1,250 sf Storage= 2,879 cf

Plug-Flow detention time= 118.0 min calculated for 0.483 af (100% of inflow)  
 Center-of-Mass det. time= 118.1 min ( 932.0 - 813.9 )

Volume	Invert	Avail.Storage	Storage Description
#1A	113.00'	1,782 cf	<b>23.00'W x 54.37'L x 5.75'H Field A</b> 7,190 cf Overall - 2,735 cf Embedded = 4,455 cf x 40.0% Voids
#2A	113.75'	2,735 cf	<b>Cultec R-902HD x 42 Inside #1</b> Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 42 Chambers in 3 Rows Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf
4,517 cf			Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	115.60'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)
#2	Discarded	113.00'	<b>2.410 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.07 cfs @ 7.36 hrs HW=113.06' (Free Discharge)  
 ↑ 2=Exfiltration (Exfiltration Controls 0.07 cfs)

**Primary OutFlow** Max=6.91 cfs @ 12.09 hrs HW=116.27' (Free Discharge)  
 ↑ 1=Sharp-Crested Rectangular Weir (Weir Controls 6.91 cfs @ 2.67 fps)

## Pond 120P: Front Undergound Storage - Chamber Wizard Field A

**Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)**

Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf

Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap

Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

14 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 52.37' Row Length +12.0" End Stone x 2 = 54.37' Base Length

3 Rows x 78.0" Wide + 9.0" Spacing x 2 + 12.0" Side Stone x 2 = 23.00' Base Width

9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

42 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 3 Rows = 2,735.4 cf Chamber Storage

7,190.0 cf Field - 2,735.4 cf Chambers = 4,454.6 cf Stone x 40.0% Voids = 1,781.8 cf Stone Storage

Chamber Storage + Stone Storage = 4,517.3 cf = 0.104 af

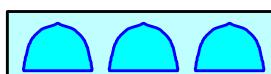
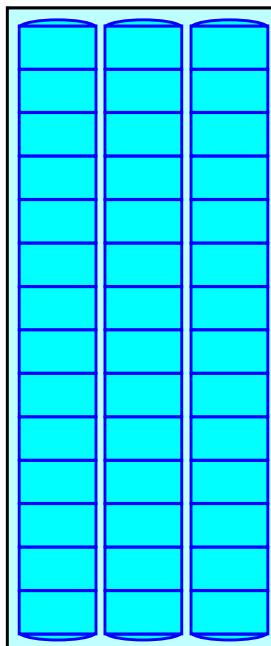
Overall Storage Efficiency = 62.8%

Overall System Size = 54.37' x 23.00' x 5.75'

42 Chambers

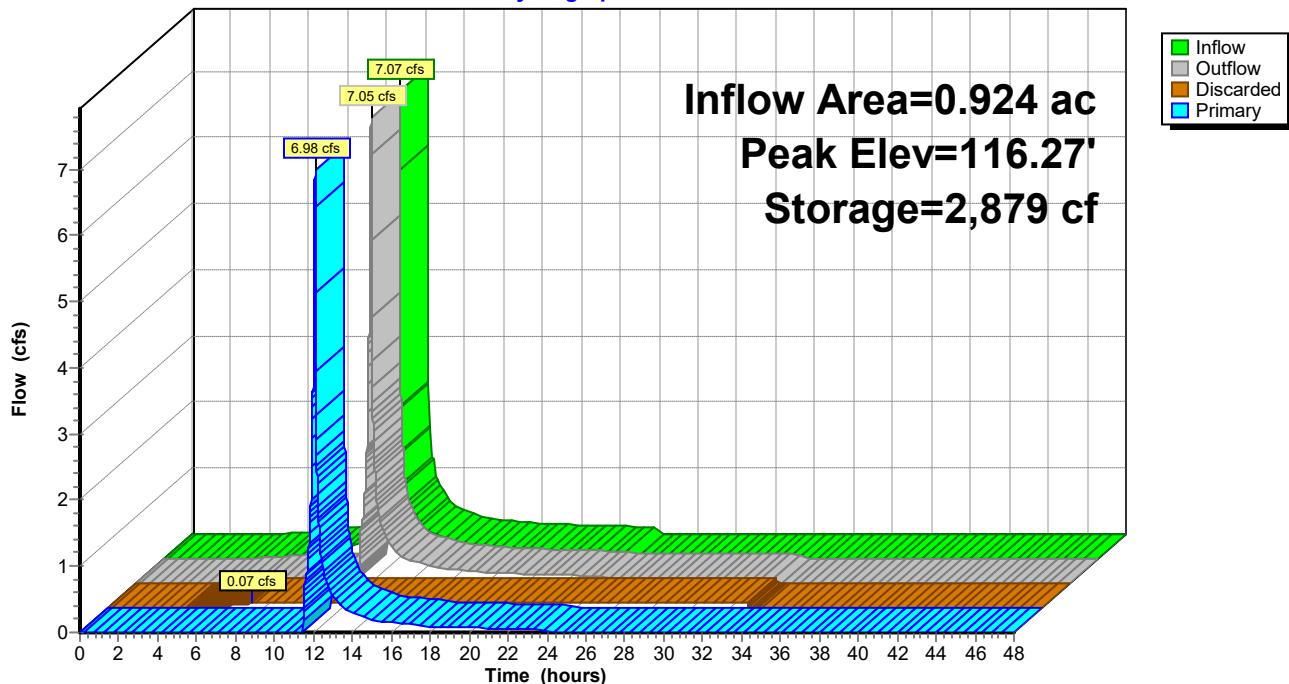
266.3 cy Field

165.0 cy Stone



**Pond 120P: Front Undergound Storage**

Hydrograph



## Appendix H

# WATER QUALITY CALCULATIONS

## INSTRUCTIONS:

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Non-automated: Mar. 4, 2008

TSS Removal  
Calculation Worksheet

Location: 33 Danton Drive - Underground Facilities

A BMP ¹	B TSS Removal Rate ¹	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
Contech Unit	0.25	0.75	0.19	0.56
Infiltration Trench	0.80	0.56	0.45	0.11
	0.00	0.11	0.00	0.11
	0.00	0.11	0.00	0.11

Total TSS Removal =

89%

Separate Form Needs to  
be Completed for Each  
Outlet or BMP Train

Project: 33 Danton Drive  
 Prepared By: JEH  
 Date: 11/2/2020

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

33 Danton Drive - 2020-041  
100S - Recharge Calculations

Paved Parking (sf)	37,477.0
Total Impervious (sf)	37,477.0

F= ¹	0.60
Rv=	1,873.9 cf

Total Volume Provided= 3,227.0 cf

Notes:

1. 0.60 inches of runoff taken from Massachusetts Stormwater Handbook for Type A soils

100S - Water Quality Calculations

Paved Parking (sf)	37,477.0
Total Impervious (sf)	37,477.0

F= ¹	1.00
Rv=	3,123.1 cf

Total Volume Provided= 3,227.0 cf

Notes:

1. 1.00 inches of runoff taken from Massachusetts Stormwater Handbook for High Potential Pollutant Loads

33 Danton Drive - 2020-041  
110S - Recharge Calculations

Roofs (sf)	30,102.0
Total Impervious (sf)	30,102.0

$F=^1$	0.60
$Rv=$	1,505.1 cf

Total Volume Provided= 2,647.0 cf

Notes:

1. 0.60 inches of runoff taken from Massachusetts Stormwater Handbook for Type A soils

110S - Water Quality Calculations

Roofs (sf)	30,102.0
Total Impervious (sf)	30,102.0

$F=^1$	1.00
$Rv=$	2,508.5 cf

Total Volume Provided= 2,647.0 cf

Notes:

1. 1.00 inches of runoff taken from Massachusetts Stormwater Handbook for High Potential Pollutant Loads

33 Danton Drive - 2020-041  
120S - Recharge Calculations

Paved Parking (sf)	11,451.0
Roofs (sf)	14,995.0
Total Impervious (sf)	26,446.0

F=	1	0.60
Rv=		1,322.3 cf

Total Volume Provided= 2,242.0 cf

Notes:

1. 0.60 inches of runoff taken from Massachusetts Stormwater Handbook for Type A soils

120S - Water Quality Calculations

Paved Parking (sf)	11,451.0
Roofs (sf)	14,995.0
Total Impervious (sf)	26,446.0

F=	1	1.00
Rv=		2,203.8 cf

Total Volume Provided= 2,242.0 cf

Notes:

1. 1.00 inches of runoff taken from Massachusetts Stormwater Handbook for High Potential Pollutant Loads

## Appendix I

# OPERATION & MAINTENANCE PLAN

# Operation & Maintenance Plan (Permanent BMPs)

FOR

## 33 Danton Drive

Date: November, 2020

Owner/Operator: Nabil Boghos  
1630 Osgood Street #1210  
North Andover, MA 01845

### **Inspection and Maintenance Schedule**

Facility personnel will inspect the stormwater management system on a routine basis not less than once per month for the first six (6) months of operation and annually thereafter. Refer to plans for landscaped area locations. Inspection and maintenance shall be performed as follows:

#### **1. Landscaped Areas:**

Landscaped areas shall be inspected and maintained on a regular basis. Areas that may be subject to erosion will be stabilized and reseeded immediately. Inspect soil and repair eroded areas monthly. Re-plant void areas as needed. Remove litter and debris monthly. Remove and replace dead vegetation twice per year in spring and fall. Replace soil media if ponding is witnessed more than 48 hours after rainfall event.

#### **2. Roof Drains:**

*Inspections:* The downspout inlets on the roof of the building will need periodic maintenance to ensure proper function. The required interval for this maintenance will vary by season; however, downspout inlets should be inspected for debris before the rainy season. When trees and other deciduous vegetation shed leaves that drop into the gutters, this will inhibit the flow of water and possibly clog downspouts. The leaves and/or debris must be removed in order for the system to work as designed.

*Maintenance:* Debris, such as leaves and trash, shall be removed by hand. Sediments shall be swept and collected or vacuumed.

#### **3. Deep Sump Catch Basins:**

Inspection: Inspect the catch basin after precipitation events at a minimum of four times per year to ensure proper drainage. Inspection should preferably occur during extended precipitation events, high-intensity rainfall, and/or rain-on-snow events. If standing water shows on the surface of the catch basin, cleaning of porous pavers is recommended.

Cleaning: When the depth of the sediment reaches halfway to the top of the catch basin, the catch basin requires cleaning. Sediment should be removed from the catch basin. With care not to damage the catch basin hood or allowing sediment to follow the outfall.

#### **4. Infiltration Chambers:**

Inspections: During first year visually inspect after each major storm (>1.5") and again 72 hours later to verify exfiltration is occurring as designed. Note if water remains in basin after 72 hours. After first year visually inspect twice per year. Infiltration Systems shall be inspected for accumulation of silt, sediment, standing water, or debris on an annual basis. Debris and sediment shall be removed.

Inspection & Maintenance procedure is as follows: The inspection port is a 24" manhole cover with a frame. Removing the manhole cover will provide access to the Chamber below. From the surface, through this access, the sediment may be measured at this location. A stadia rod may be used to measure the depth of sediment, if any, in this row. If the depth of sediment is in excess of 3 inches (76 mm), then this row should be cleaned with high pressure water through a culvert cleaning nozzle. This would be carried out through an upstream structure. CCTV inspection of this row can be deployed through this access port to determine if any sediment has accumulated in the inlet row.

#### **5. CDS Unit – Particle Separator**

Inspection and Maintenance of the CDS unit shall follow the manufcature's guidelines attached to this manual.

## Stormwater System Inspection Report

General Information			
Location: <b>33 Danton Drive</b>			
Date of Inspection		Start/End Time	
Inspector's Name(s)			
Inspector's Title(s)			
Inspector's Contact Information			
Purpose of Inspection			
Weather Information			
Has it rained since the last inspection? <input type="checkbox"/> Yes <input type="checkbox"/> No			
Weather at time of this inspection?			

### Site-Specific Stormwater Devices

	Description	Installed and Operating Properly?	Corrective Action Needed	Date for Corrective Action/Responsible Person
1		<input type="checkbox"/> Yes <input type="checkbox"/> No		
2		<input type="checkbox"/> Yes <input type="checkbox"/> No		
3		<input type="checkbox"/> Yes <input type="checkbox"/> No		
4		<input type="checkbox"/> Yes <input type="checkbox"/> No		
5		<input type="checkbox"/> Yes <input type="checkbox"/> No		
6		<input type="checkbox"/> Yes <input type="checkbox"/> No		
7		<input type="checkbox"/> Yes <input type="checkbox"/> No		
8		<input type="checkbox"/> Yes <input type="checkbox"/> No		

Overall Site Issues

	Description		Corrective Action	Date for Corrective Action/Responsible Person
1	Are all slopes properly stabilized?	<input type="checkbox"/> Yes <input type="checkbox"/> No		
2	Are natural resource areas (e.g., streams, wetlands, etc.) being subjected to erosion?	<input type="checkbox"/> Yes <input type="checkbox"/> No		
3	Are discharge points free of sediment deposits?	<input type="checkbox"/> Yes <input type="checkbox"/> No		

**Certification Statement:**

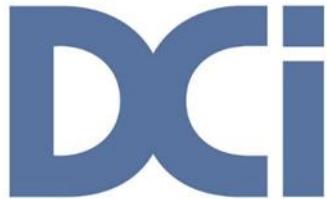
"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Print name:

Signature:

Date:

## TRAFFIC MEMORANDUM



Design Consultants, Inc.

Civil Engineering  
Transportation/Traffic  
Water/Wastewater  
Geotechnical  
Land Surveying  
Environmental  
Planning

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## MEMORANDUM

DCI JOB NO. 2020-041

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**TO:** City of Methuen Planning Division  
City of Methuen  
41 Pleasant Street, Room 217  
Methuen, MA 01844

**FROM:** Wayne Keefner, P.E., PTOE  
Design Consultants, Inc.

**SUBJECT:** **Trip Generation Comparison Memo**  
33 Danton Drive

**DATE:** November 3, 2020

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The purpose of this memorandum is to compare the vehicle-trip generation calculations that were presented by The Engineering Corp, Inc. (TEC) for 35 Danton Drive with the vehicle-trip generation calculations presented by Design Consultants, Inc. (DCI) for 33 Danton Drive and the potential impact at the intersection of Pelham Street at Aegean Drive and Danton Drive. TEC issued a Functional Design Report in May 2016 for the MassWorks Grant project at the intersection of Pelham Street/Aegean Drive/Danton Drive. The MassWorks Grant included implementing a fully actuated traffic signal and striping improvements at the previously existing unsignalized intersection. As part of the future analysis for the intersection, TEC calculated the number of vehicle-trips that the site at 35 Danton Drive could potentially generate, using an approximate maximum square footage of 225,000 square feet. The current proposal for 33 Danton Drive is approximately 60,200 square feet of manufacturing space. The following sections will demonstrate that the expected vehicle-trips from 33 Danton Drive are significantly lower than the previously estimated vehicle-trips and that the site at 33 Danton Drive will not have a detrimental impact on the intersection of Pelham Street at Danton Drive and Aegean Drive.

## Trip Generation Calculations and Comparison

As part of the Functional Design Report, TEC calculated vehicle-trips utilizing average trip generation rates and the fitted curve equation for Land Use Code (LUC) 140 – Manufacturing. This resulted in an estimate of 164 vehicle-trips during the Weekday AM peak hour, 164 vehicle-trips during the Weekday PM peak hour, and 852 vehicle-trips during a typical Weekday. These vehicle-trips represent a the “potential expansion” of the site at 35 Danton Drive. To date, there has been no expansion at the site, therefore zero (0) of these potential vehicle-trips have been added to the intersection. The detailed calculations from TEC are attached in the Appendix.

DCI vehicle-trip estimates were calculated using the *Trip Generation Manual (10th Edition)* published by the *Institute of Transportation Engineers (ITE)* in 2017, the most recent version. The 10th Edition includes the same manufacturing land use as the 9th Edition, Land Use Code 140 - Manufacturing. The proposed facility will occupy 60,200 square feet of space. Based on the ITE trip generation rates and fitted curve equation, it is expected that the Project will generate approximately 37 vehicle-trips during the Weekday AM peak hour, 40 vehicle-trips during the Weekday PM peak hour, and 350 vehicle-trips during a typical Weekday. The pages from the ITE *Trip Generation Manual (10th Edition)* used for these calculations is attached in the Appendix.

**Table 1: Vehicle-Trip Generation Calculations per ITE *Trip Generation Manual, 9th Edition (TEC)***

Land Use Code: 140		Manufacturing	
		Weekday AM Peak Hour	Weekday PM Peak Hour
Size per 1,000 Square Feet	225.000	225.000	225.000
ITE Trip Generation Rate (Peak Hrs) / Fitted Curve Equation (Daily)	0.73	0.73	T = 3.88(X) - 20.70
<b>Total Trips</b>	<b>164</b>	<b>164</b>	<b>852</b>
Entering%	78%	36%	50%
Exiting%	22%	64%	50%
Entering Trips	128	59	426
Exiting Trips	36	105	426

**Table 2: Vehicle-Trip Generation Calculations per ITE *Trip Generation Manual, 10th Edition (DCI)***

Land Use Code: 140		Manufacturing	
		Weekday AM Peak Hour	Weekday PM Peak Hour
Size per 1,000 Square Feet	60.200	60.200	60.200
ITE Trip Generation Rate (Peak Hrs) / Fitted Curve Equation (Daily)	0.62	0.67	T = 3.16(X) + 160.04
<b>Total Trips</b>	<b>37</b>	<b>40</b>	<b>350</b>
Entering%	77%	31%	50%
Exiting%	23%	69%	50%
Entering Trips	28	12	175
Exiting Trips	9	28	175

Based on the respective trip generation calculations, it is expected that there will be approximately 127 fewer vehicle-trips generated during the Weekday AM peak hour, 124 fewer vehicle-trips generated during the Weekday PM peak hour, and 502 fewer vehicle-trips during a typical Weekday added to the traffic network than estimated by TEC.

### Site-Specific Turning Movement Volumes and Comparison

TEC estimated the vehicle-trip distribution percentages using the traffic data collected along Pelham Street, Danton Drive, and Aegean Drive by Automatic Traffic Recorders (ATRs). The corresponding vehicle-trips from the potential expansion of 35 Danton Drive site were then distributed through the intersection using the calculated percentages. Figure 1 shows the site-specific turning movement volumes based on TEC's trip generation. For consistency, DCI utilized the same vehicle-trip distribution percentages to distribute the estimated vehicle-trips through the intersection. Figure 2 shows the expected site-specific turning movement volumes based on the estimate vehicle-trip generation calculated by DCI.

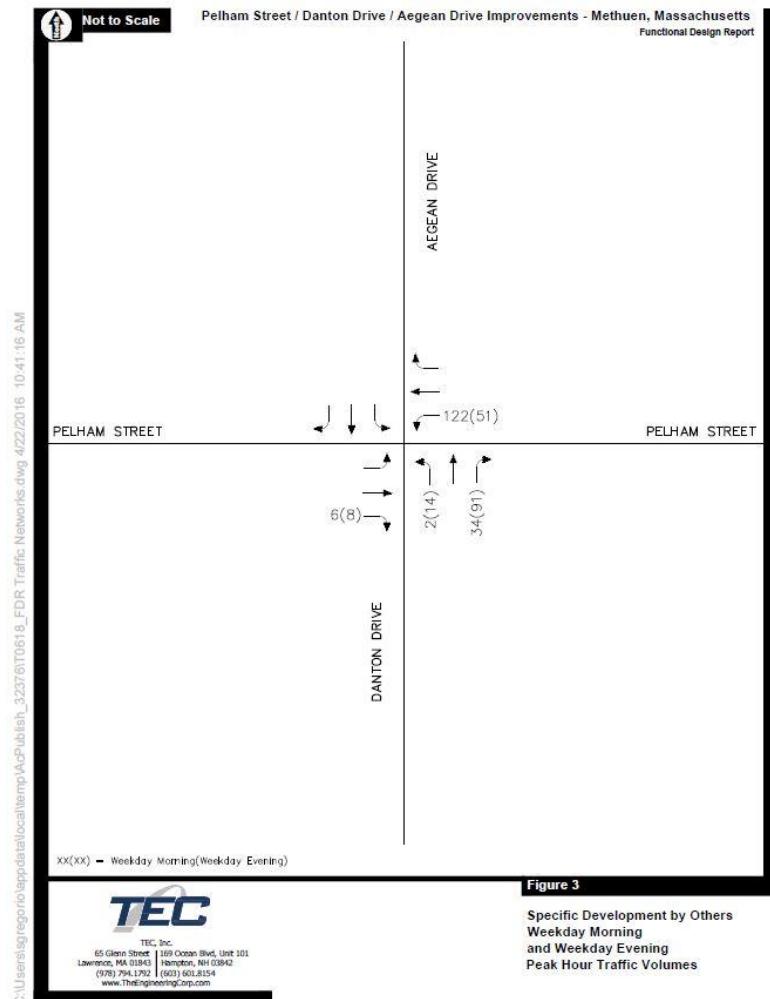
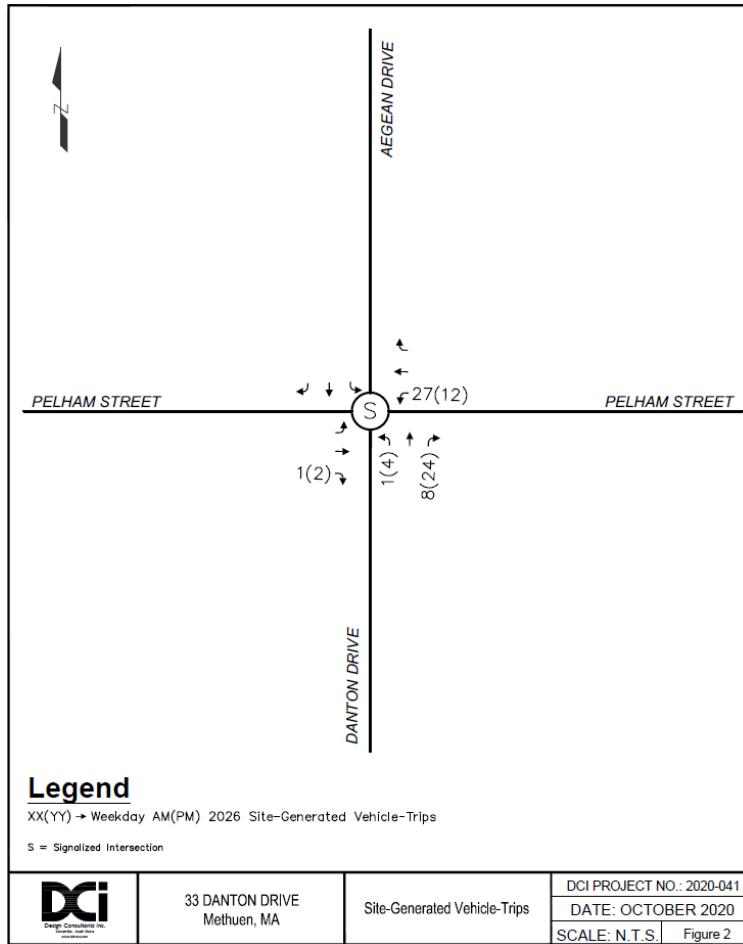


Figure 1: Site-Specific Turning Movement Volumes (TEC)



*Figure 2: Site-Specific Turning Movement Volumes (DCI)*

As shown in Figure 2, the proposed 33 Danton Drive development is expected to generate fewer vehicle-trips at the intersection than previously estimated for 35 Danton Drive in the Functional Design Report. The reduction in vehicle-trips for each movement is summarized below. The decrease in site-specific turning-movement volumes is attributed to there being less square footage at the 33 Danton Drive site than estimated for the “potential expansion” of the 35 Danton Drive site.

#### Weekday AM Peak Hour

- 50% reduction in left-turn volumes from Danton Drive
- 76% reduction in right-turn volumes from Danton Drive
- 83% reduction in right-turn volumes from Pelham Street eastbound
- 78% reduction in left-turn volumes from Pelham Street westbound

#### Weekday PM Peak Hour

- 71% reduction in left-turn volumes from Danton Drive
- 74% reduction in right-turn volumes from Danton Drive
- 75% reduction in right-turn volumes from Pelham Street eastbound
- 76% reduction in left-turn volumes from Pelham Street westbound

## Conclusions

DCI prepared this memorandum in order to compare the vehicle-trip generation calculations that were estimated by TEC in the May 2016 Functional Design Report with the vehicle-trip generation calculations estimated by Design Consultants, Inc. (DCI). Signal and striping improvements were proposed and implemented for the intersection of Pelham Street at Danton Drive and Aegean Drive. In the May 2016 Functional Design Report, trip generation calculations were estimated for the “potential expansion” of the 35 Danton Drive site, approximately 225,000 square feet. The signal timings designed for the fully actuated traffic signal installed at the study intersection were designed to accommodate the site-generated vehicle-trips expected from potential expansion. The current proposed manufacturing development at 33 Danton Drive will have approximately 60,200 square feet of space. The expected site-generated vehicle-trips proposed at the intersection are now significantly less than previously estimated. Therefore, the signalized intersection of Pelham Street at Danton Drive and Aegean Drive will have the capacity to accommodate the vehicle-trips from the current proposed 33 Danton Drive development.

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# **APPENDIX**

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**TRIP GENERATION**

## ***TRIP GENERATION - TEC***

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## Site-Generated Trip Assessment

Project: T0618 - 192 Pelham Street Off-Site Improvements - Methuen, MA  
Date: January 29, 2016  
Analyst: TEC, Inc. / Douglas S. Halpert, E.I.T.  
Source: Institute of Transportation Engineers - Trip Generation , 9th Edition

### Institute of Transportation Engineers (ITE) Land Use Code (LUC) 140 - Manufacturing

Average Vehicle Trips Ends vs: 1,000 Sq. Feet Gross Floor Area  
Independent Variable (X): 225.000

#### AVERAGE WEEKDAY DAILY

$T = 3.88 * (X) - 20.70$   
 $T = 3.88 * 225.000 - (20.70)$   
 $T = \boxed{852}$  vehicle trips  
with 50% ( 426 vpd) entering and 50% ( 426 vpd) exiting.

#### WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$T = 0.730 * (X)$   
 $T = 0.730 * 225.000$   
 $T = \boxed{164}$  vehicle trips  
with 78% ( 128 vph) entering and 22% ( 36 vph) exiting.

#### WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$T = 0.730 * (X)$   
 $T = 0.730 * 225.000$   
 $T = \boxed{164}$  vehicle trips  
with 36% ( 59 vph) entering and 64% ( 105 vph) exiting.

#### SATURDAY DAILY

$T = 1.49 * (X)$   
 $T = 1.49 * 225.000$   
 $T = \boxed{336}$  vehicle trips  
with 50% ( 168 vpd) entering and 50% ( 168 vpd) exiting.

#### SATURDAY MIDDAY PEAK HOUR OF GENERATOR

$T = 0.28 * (X)$   
 $T = 0.28 * 225.000$   
 $T = \boxed{63}$  vehicle trips  
with 50% ( ##### vph) entering and 50% ( ##### vph) exiting.

## ***TRIP GENERATION - DCI***

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## **Land Use: 140 Manufacturing**

### **Description**

A manufacturing facility is an area where the primary activity is the conversion of raw materials or parts into finished products. Size and type of activity may vary substantially from one facility to another. In addition to the actual production of goods, manufacturing facilities generally also have office, warehouse, research, and associated functions. General light industrial (Land Use 110) and industrial park (Land Use 130) are related uses.

### **Additional Data**

Time-of-day distribution data for this land use are presented in Appendix A. For the 17 general urban/suburban sites with data, the overall highest vehicle volumes during the AM and PM on a weekday were counted between 6:30 and 7:30 a.m. and 3:00 and 4:00 p.m., respectively.

The sites were surveyed in the 1980s, the 1990s, the 2000s, and the 2010s in Alberta (CAN), California, Minnesota, New Jersey, New York, Oregon, Pennsylvania, South Dakota, Texas, Vermont, and Washington.

### **Source Numbers**

177, 184, 241, 357, 384, 418, 443, 583, 598, 611, 728, 747, 875, 940, 969

## Manufacturing (140)

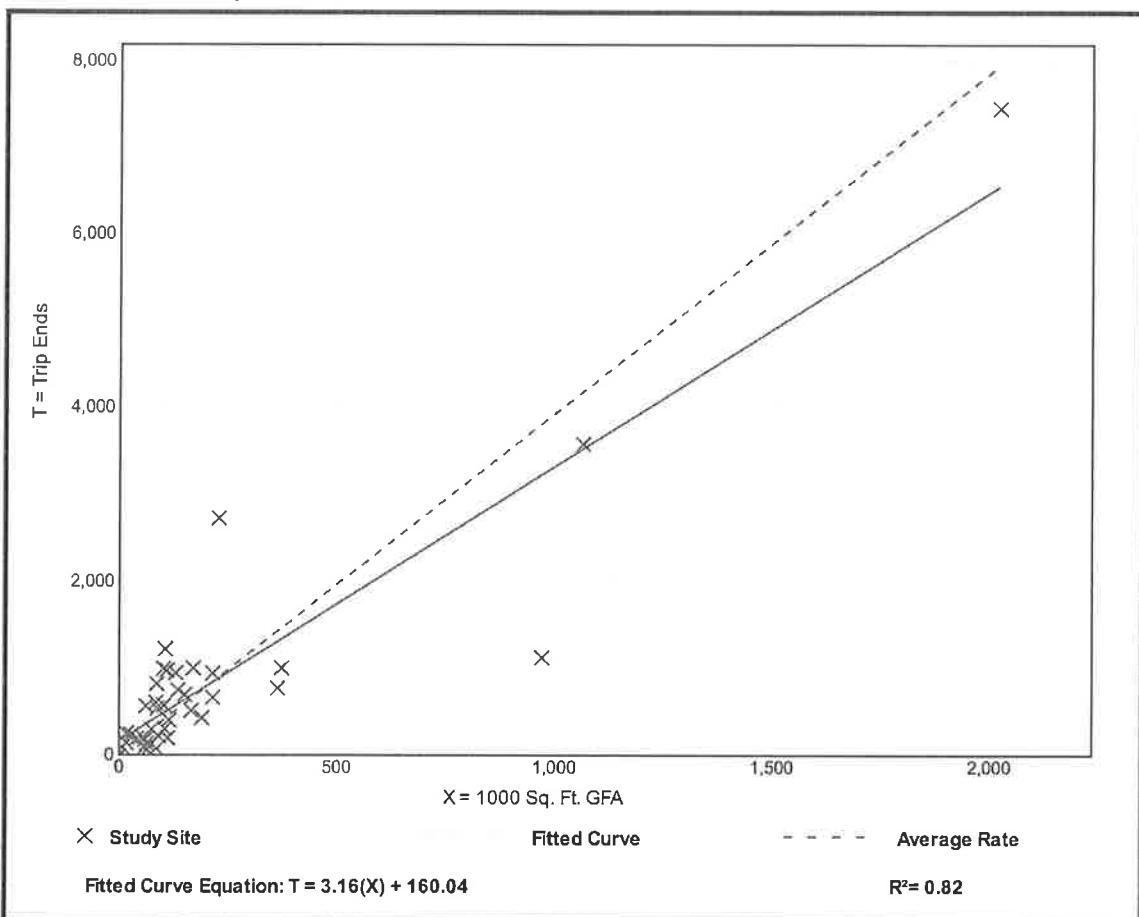
Vehicle Trip Ends vs: 1000 Sq. Ft. GFA  
On a: Weekday

Setting/Location: General Urban/Suburban  
Number of Studies: 39  
1000 Sq. Ft. GFA: 209  
Directional Distribution: 50% entering, 50% exiting

### Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
3.93	0.83 - 49.50	2.62

### Data Plot and Equation



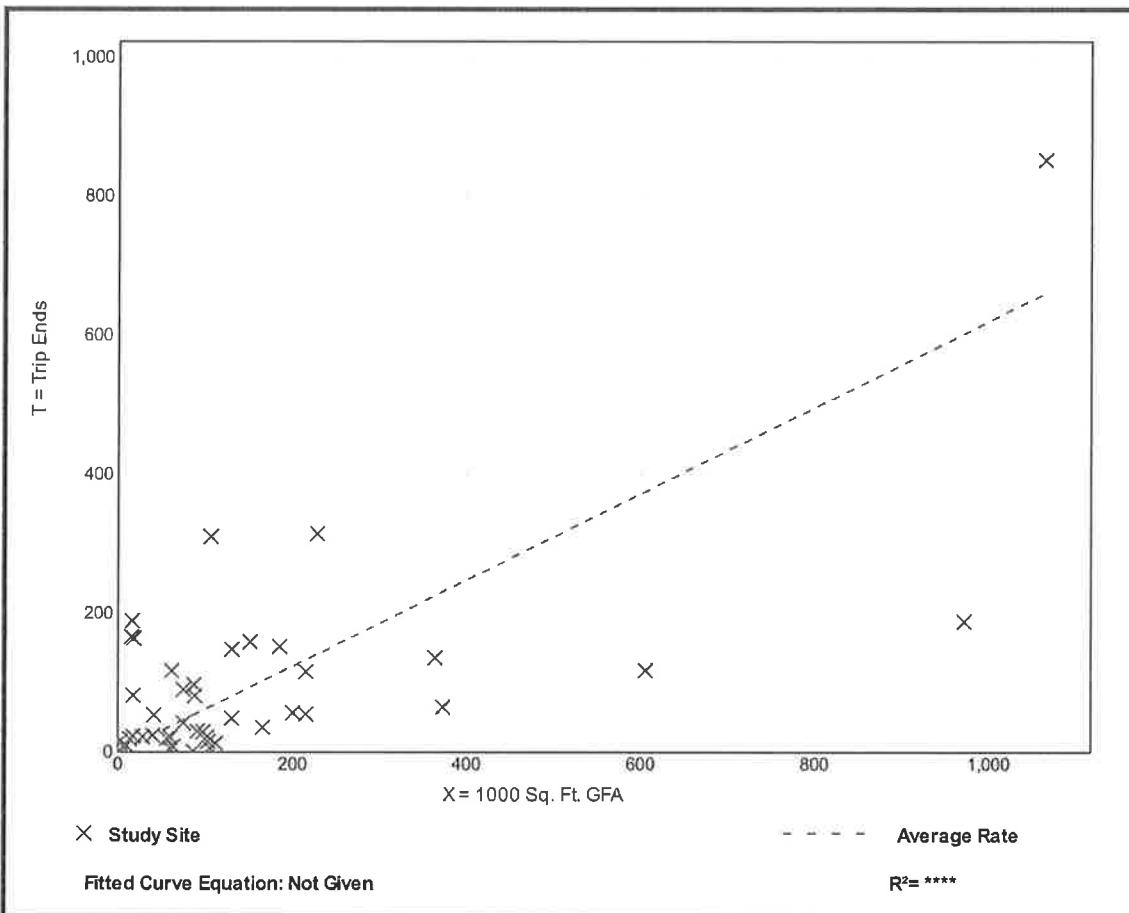
## Manufacturing (140)

**Vehicle Trip Ends vs:** 1000 Sq. Ft. GFA  
**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:** 45  
1000 Sq. Ft. GFA: 149  
**Directional Distribution:** 77% entering, 23% exiting

### Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
0.62	0.01 - 11.93	1.03

### Data Plot and Equation



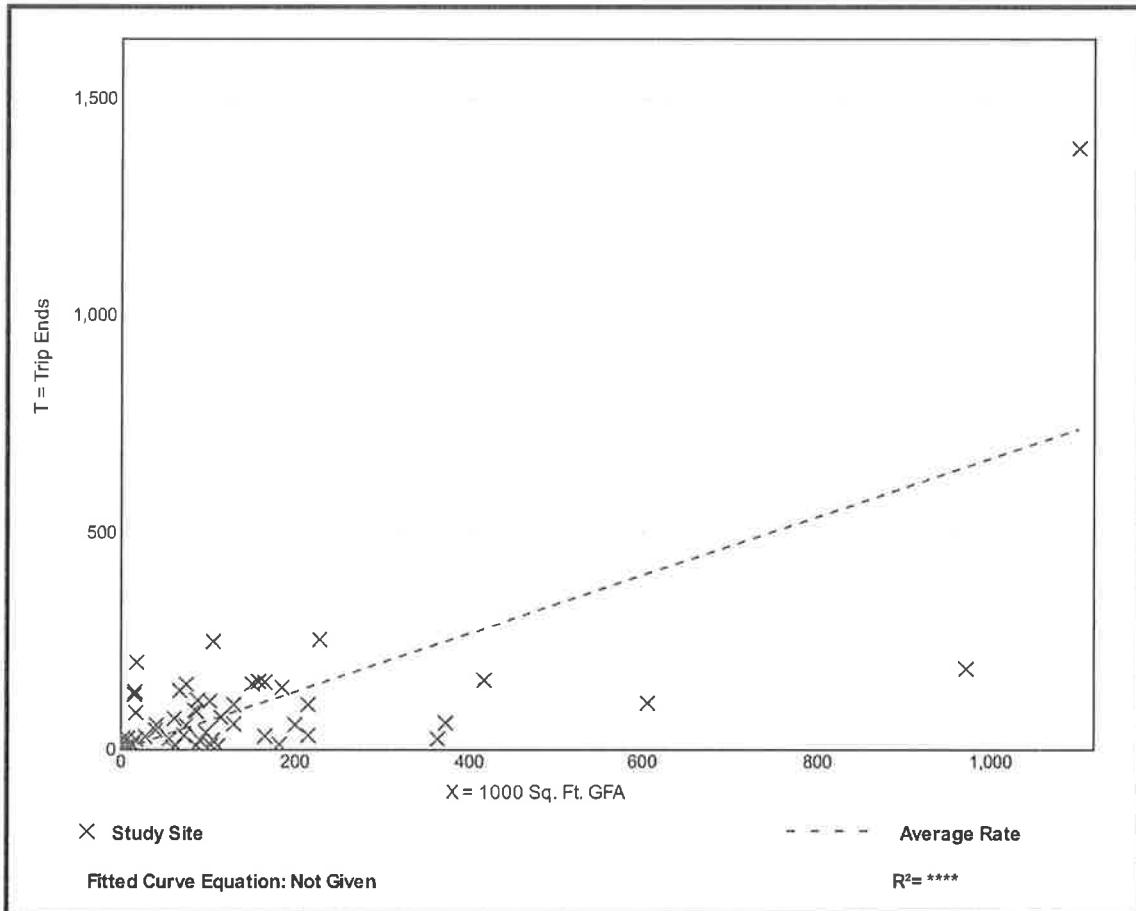
## Manufacturing (140)

**Vehicle Trip Ends vs:** 1000 Sq. Ft. GFA  
**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:** 52  
1000 Sq. Ft. GFA: 152  
**Directional Distribution:** 31% entering, 69% exiting

### Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
0.67	0.07 - 11.37	0.94

### Data Plot and Equation



## **Certified List of Abutters, Address Labels, Certificate of Mailing & Proof of payment to Eagle Tribune**



*Patriot Properties*

## Methuen

10/15/2020

### Abutters List

4:12:18PM

**Filter Used:** DataProperty.AccountNumber in  
(25613,25602,25597,25603,15944,25601,101509,25604,25605,25606,25607,25608,25609,25610,25611,25612,25614,25615,25616,25617,25618,25619,25620,25621,25624,25625,25..)

***Subject Parcel ID:***

***Subject Property Location:***

ParcelID	Location	Owner	Co-Owner	Mailing Address	City	State	Zip
412-131-5D	35 DANTON DR	192 PELHAM ST LLC	C/O JESSICA`S BRICK OVEN	35 DANTON DR	METHUEN	MA	01844-1513
412-131-6A	31 DANTON DR D1B1	FMX REALTY LLC		485 S UNION ST	LAWRENCE	MA	01843
412-131-6AA	33 DANTON DR	33 DANTON DRIVE LLC		35 DANTON DR	METHUEN	MA	01844
412-132-10	(VP) SPENCER ST	METHUEN CITY OF	C/O TREASURER/TAX COLLE	41 PLEASANT ST STE 103	METHUEN	MA	01844-3174
412-132-18	(VP) SPENCER ST	GAGNON JOSEPH J L	C/O MICHELE GAGNON AIT	2226 SE LINDEN LN	GRANTS PASS	OR	97527-5293
412-132-19	(VP) SPENCER ST	METHUEN CITY OF	C/O TREASURER/TAX COLLE	41 PLEASANT ST STE 103	METHUEN	MA	01844-3174
412-132-22	(VP) SPENCER ST	METHUEN TOWN OF	C/O TREASURER/TAX COLLE	41 PLEASANT ST STE 103	METHUEN	MA	01844-3174
412-132-4	12 SPENCER ST	CO IRVIN	NOU ERICA	12 SPENCER ST	METHUEN	MA	01844
412-132-4A	14 SPENCER ST	SYRNIOTIS ANGELO S	SYRNIOTIS MARIA	14 SPENCER ST	METHUEN	MA	01844
412-132-6	58 SPENCER ST	HEANEY TINA	HEANEY GARY	58 SPENCER ST	METHUEN	MA	01844
412-132-7	60 SPENCER ST	GRIER CHRISTOPHER		60 SPENCER ST	METHUEN	MA	01844-1433
412-132-9	(VP) SPENCER ST	WHITTAKER THOMAS R		12 PROVIDENCE HILL RD	SALEM	NH	03079-1832

Parcel Count: **12**

***End of Report***

35 DANTON DR 412-131-5D

LUC: 400

192 PELHAM ST LLC

C/O JESSICA'S BRICK OVEN, INC.

35 DANTON DR

METHUEN, MA 01844-1513

60 SPENCER ST 412-132-7

LUC: 101

GRIER CHRISTOPHER

60 SPENCER ST

METHUEN, MA 01844-1433

31 DANTON DR D1B1 412-131-6A

LUC: 401

FMX REALTY LLC

485 S UNION ST

LAWRENCE, MA 01843

(VP) SPENCER ST 412-132-9

LUC: 132

WHITTAKER THOMAS R

12 PROVIDENCE HILL RD

SALEM, NH 03079-1832

33 DANTON DR 412-131-6AA

LUC: 403

33 DANTON DRIVE LLC

35 DANTON DR

METHUEN, MA 01844

(VP) SPENCER ST 412-132-10

LUC: 936

METHUEN CITY OF

C/O TREASURER/TAX COLLECTOR

41 PLEASANT ST STE 103

METHUEN, MA 01844-3174

(VP) SPENCER ST 412-132-18

LUC: 132

GAGNON JOSEPH J L

C/O MICHELE GAGNON AITCHISON

2226 SE LINDEN LN

GRANTS PASS, OR 97527-5293

(VP) SPENCER ST 412-132-19

LUC: 936

METHUEN CITY OF

C/O TREASURER/TAX COLLECTOR

41 PLEASANT ST STE 103

METHUEN, MA 01844-3174

(VP) SPENCER ST 412-132-22

LUC: 936

METHUEN TOWN OF

C/O TREASURER/TAX COLLECTOR

41 PLEASANT ST STE 103

METHUEN, MA 01844-3174

12 SPENCER ST 412-132-4

LUC: 101

CO IRVIN

NOU ERICA

12 SPENCER ST

METHUEN, MA 01844

14 SPENCER ST 412-132-4A

LUC: 101

SYRNIOTIS ANGELO S

SYRNIOTIS MARIA

14 SPENCER ST

METHUEN, MA 01844

58 SPENCER ST 412-132-6

LUC: 101

HEANEY TINA

HEANEY GARY

58 SPENCER ST

METHUEN, MA 01844