ALLEN & MAJOR
ASSOCIATES, INC.

RESIDENTIAL DEVELOPMENT
159 TEMPLE STREET
NASHUA, NEW HAMPSHIRE

STORMWATER MANAGEMENT PLAN

DATE PREPARED
May 30, 2019
Revised
June 5, 2019
October 18, 2019

APPLICANT:
ZJBV Properties, LLC c/o Joseph's Equipment
300 Gay Street
Manchester, New Hampshire 03103

PREPARED BY:
Allen & Major Associates, Inc.
400 Harvey Road
Manchester, New Hampshire 03103

A&M PROJECT NO.: 2596-01

STORMWATER MANAGEMENT PLAN

RESIDENTIAL DEVELOPMENT
159 TEMPLE STREET – NASHUA, NH

APPLICANT:

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300 GAY STREET
MANCHESTER, NEW HAMPSHIRE 03103

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ALLEN & MAJOR ASSOCIATES, INC.
400 HARVEY ROAD
MANCHESTER, NH 03103

A&M PROJECT #2596-01

Table of Contents

SECTION 1.0

PROJECT OVERVIEW

1.0 OVERVIEW

1.1 EXECUTIVE SUMMARY

The purpose of this drainage report is to provide a detailed review of the stormwater runoff, both quality and quantity, as it pertains to the existing and proposed developed conditions. This report will show by means of narrative, calculations and exhibits that appropriate best management practices have been implemented into the design to mitigate the impacts from the proposed development. This report and following tables demonstrate that there is no increase in total peak rate of runoff and discharge volume from the site for all design storm events.

ANALYSIS POINT #1 (Flow to Municipal)			
	2-Year	10-Year	50-Year
Existing Flow (CFS)	3.45	5.30	8.07
Proposed Flow (CFS)	0.00	0.47	2.97
Change (CFS)	**-3.45**	**-4.83**	**-5.10**
Existing Volume (CF)	11,512	18,109	28,112
Proposed Volume (CF)	27	1,408	12,077
Change (CF)	**-11,485**	**-16,701**	**-16,035**

ANALYSIS POINT #2 (Flow to Tracks)			
	2-Year	10-Year	50-Year
Existing Flow (CFS)	5.30	9.27	15.26
Proposed Flow (CFS)	0.00	0.00	3.98
Change (CFS)	**-5.30**	**-9.27**	**-11.28**
Existing Volume (CF)	16,559	29,207	49,179
Proposed Volume (CF)	0	0	2,857
Change (CF)	**-16,559**	**-29,207**	**-46,322**

TOTAL			
	2-Year	10-Year	50-Year
Existing Flow (CFS)	8.75	14.57	23.33
Proposed Flow (CFS)	0.00	0.47	6.95
Change (CFS)	**-8.75**	**-14.10**	**-16.38**
Existing Volume (CF)	28,071	47,316	77,291
Proposed Volume (CF)	27	1,408	14,934
Change (CF)	**-28,044**	**-45,908**	**-62,357**

1.2 SITE LOCATION AND DESCRIPTION

The overall project site is comprised of two parcels totaling approximately 4 acres. The parcels are listed on the City of Nashua Assessors Map 39, as lots 31 and 38, and have an address of 159 Temple Street. The property is accessed from existing curb cuts on Temple Street and Bridge Street. The proposed development is to be accessed from the existing curb cuts and one additional curb cut along Temple Street.

The existing parcels are developed and currently are used for construction storage and material stockpile. The site is primarily all pavement with three buildings to be razed. The site is surrounded by existing multi-family dwellings to the west, overgrown decommissioned train tracks the east, and an auto shop to the north. The existing tract of land is relatively flat with elevations ranging from 119 to 121 throughout the subject parcel.

The proposed development consists of the construction of two connected multi-family buildings and associated parking. The buildings will total 168 dwelling units with 252 parking spaces proposed. Building 2 is proposed to have ground floor parking, and Building 1 is proposed to have amenity space within the ground floor.

The underlying soils have been mapped by the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS), and include:

Ur	Urban Land	-
UdA	Udipsamments, nearly level	A
WnC	Windsor- Urban land complex, 3 to 15 percent slopes	A

Additional soil information is provided within NRCS Soil Report within the appendix of this report. Based upon the NRCS soil report the project site is classified as Ur (Urban Land). A site-specific soil survey was performed by TES Environmental Consultants, L.L.C, on April 24, 2019 to determine the on-site soil classification. It was determined that the on-site soils are excessively draining and consistent with the surrounding soils found within the NRCS Soil Report. The saturated hydraulic conductivity (Ksat) rate of the surrounding soils was used for the infiltration rate on-site. The average Ksat value of the Wnc and Uda soils is 95.9 micrometers per second. This value was converted to 13.6 inches per hour, and divided by a factor of safety of 2 to achieve the design infiltration rate of 6.79 ≈ 6.5 inches per hour. The site-specific soil survey was used for determining the Hydrologic Soil Group for the development. Please see section 6.5 for the Hydrologic Soil Plans used for the drainage design. The TES Environmental Consultants survey classified the onsite soil as the following:

Symbol	Soil Taxonomic Name	Hydrologic Soil Group
400B/ abaaa	Udorthents, sandy, 0-8% slopes	A
400B/hbhaa	Udorthents, sandy, 0-8% slopes	A

A stormwater analysis has been performed for two project site situations. The first analysis consists of the existing site conditions and the second consists of the proposed site conditions. There are two study points at the project boundaries which the stormwater flows were analyzed. One study point is the contributing flow to the municipal system, and the second study point is the flow directed towards the tracks along the eastern property line. The study points and contributing watersheds are further outlined in the accompanying text and calculations.

Site Data for Stormwater Modeling

The proposed project will disturb approximately 165,000 sf. This disturbance includes the construction of buildings, concrete areas, pavement area, and parking, and stormwater installations.

The proposed watershed is comprised of approximately 127,741+/ square feet of impervious (a decrease of 18,760 sf +/- from the pre-development conditions), including gravel drive, gravel parking, roofs and concrete. Rainfall data used for modeling the stormwater runoff was derived from the "Extreme Precipitation Tables" from the Northeast Regional Climate Center at Cornell University. The storm events were broken down for the 2, 10, and 50-year storms.

1.3 EXISTING SITE CONDITIONS

Stormwater runoff exits the site to two different study point locations. In order to exhibit no increase in runoff to these points, stormwater runoff flows were analyzed at two specific "Study Points." The included Pre-Development Watershed Plan (WS-1) outlines the boundaries and contributing watershed for the Study Points.

1. Study Point 1: This study point examines the contributing flow to the municipal combined sewer system. The contributing sub catchments E-1 and E-4 are primarily pavement ground cover. The stormwater which flows to this study point will enter the municipal combined sewer system via an existing drain inlet located adjacent to Union Street which flows west towards Armory Street.

2. Study Point 2: This study point is located along the eastern property line. This study point analyzes the contributing flows to the existing train tracks along this entire property line. Existing sub catchments E-2 and E-3 direct flow towards this study point. These sub catchments have primarily paved and compacted gravel ground cover.

Analysis Point	Pre-Development						
	Inflow area (sf)	2yr Storm		10yr Storm		50yr Storm	
		Flow (cfs)	Volume (cf)	Flow (cfs)	Volume (cf)	Flow (cfs)	Volume (cf)
SP1	53,537	3.45	11,512	5.30	18,109	8.07	28,112
SP2	111,778	5.30	16,559	9.27	29,207	15.26	49,179
TOTAL=	**165,315**	**8.8**	**28,071**	**14.6**	**47,316**	**23.3**	**77,291**

1.4 PROPOSED SITE CONDITIONS

The project proposes to construct a multi-family residential development with associated parking. The site development will include two buildings which are connected above the first story. The generated stormwater runoff has been designed to be controlled using a combination of structural and non-structural best management practices (BMPs). The non-structural installation consists of a bioretention system along the entire eastern property line. The structural installation consists of a perforated corrugated metal pipe underground infiltration system. The majority of flow will run through the treatment process and into the underground infiltration system, overflow only will be directed to the municipal system (study point 1). The majority of flow to the train tracks (study point 2) will first be collected within the bioretention system and treated within the media filter prior to infiltration.

1. Study Point 1: This study point examines the contributing flow to the municipal combined sewer system. The majority of the stormwater flows to this study point will first be conveyed to the perforated pipe underground infiltration system. The stormwater flow collected within the catch basins will first be adequately pre-treated using CDS hydrodynamic separators, and a Jellyfish filtration water quality device. These devices have been incorporated into the design to meet the New Hampshire Stormwater Manual regulations for flow-through devices, which shall be required as the site has an existing infiltration rate greater than 10 inches per hour. The contributing roof runoff will be connected directly to the infiltration system as this stormwater is considered uncontaminated. This underground infiltration system has been designed to infiltrate the water quality volume required for an infiltration practice (Env-Wq 1508.05). A summary of the post development stormwater flow can be found within the following table. A summary of the reduction in total peak rate of runoff and discharge volume to this Study Point can be found in the beginning of this section.

2. Study Point 2: This study point is located along the eastern property line. This study point analyzes the contributing flows to the existing train tracks along this entire property line. The proposed contributing flow to this study point consists of flow from the parking bays to the east of building 2. These parking bays are designed to sheet flow directly into the bioretention system along the entire eastern property line. This system has been designed to exceed the water quality volume (Env-Wq 1508.06). The stormwater will be treated by the installation of the recommended filter media prior to infiltration.

A hydrologic study of the site was conducted in order to determine the impact of the proposed development on the existing stormwater runoff. The study determined the rates and volume of runoff at these study points discussed have decreased. The included Post Watershed Plan (WS-2) outlines the boundaries and contributing watershed for the Study Points.

Analysis Point	Post-Development						
	Inflow area (sf)	2yr Storm		10yr Storm		50yr Storm	
		Flow (cfs)	Volume (cf)	Flow (cfs)	Volume (cf)	Flow (cfs)	Volume (cf)
SP1	126,225	0.00	27	0.47	1,408	2.97	12,077
SP2	39,090	0.00	0	0.00	0	3.98	2,857
TOTAL=	**165,315**	**0.0**	**27**	**0.5**	**1,408**	**7.0**	**14,934**

SECTION 2.0

DISCUSSION

2.0 DISCUSSION

2.1 METHODOLOGY

The peak discharge rates were determined using techniques and data found in the following:

1. Urban Hydrology for Small Watersheds – Technical Release 55 by the United States Department of Agriculture Soils Conservation Service, June 1986. Runoff curve numbers and 24-hour precipitation values were obtained from this reference.

2. HydroCAD© Storm water Modeling System by HydroCAD Software Solutions LLC, version 10.00-24. The HydroCAD program was used to generate the runoff hydrographs for the watershed areas, to determine discharge/stage/storage characteristics for the infiltration basin, to perform drainage routing and to combine the results of the runoff hydrographs.

3. Soil Survey of Rockingham County, New Hampshire by the United States Department of Agriculture, Natural Resources Conservation Services (NRCS). Soil types and boundaries were obtained from this reference.

2.2 PEAK DISCHARGE RATES

The storm water runoff analysis of the existing and proposed conditions includes an estimation of the peak discharge rate from various rainfall events. Peak discharge rates were developed using TR-55 Urban Hydrology for Small Watersheds, developed by the U.S. Department of Commerce, Engineering Division and the HydroCAD 10.00-24 computer program. Further, the analysis has been prepared in accordance with the NH Stormwater Management Manual and standard engineering practices. The peak discharge rate has been estimated for each watershed during the 2, 10, and 50-year storm events.

The stormwater runoff model shows that the proposed site design results in no increase to the total rate of runoff during all storm events. This is accomplished by the construction of an underground infiltration system and the installation of a bioretention system. The table in *Section 1.1 Executive Summary* provides a summary of the estimated peak discharge rates for each study point during each of the design storm events. The HydroCAD worksheets are included in the Existing and Proposed Drainage Calculations section of this report.

2.3 PERFORMANCE STANDARDS

Stormwater performance standards have been implemented as part of the overall stormwater management plan for the proposed development. The goal of these standards is to improve water quality and protect the waters of New Hampshire from adverse impacts due to development. The performance standards are met by implementing appropriate Best Management Practices (BMPs). BMPs were designed in accordance with the NH Stormwater Management Manual and Env.Wq. 1500.

BMPs implemented in the design include:

- Parking area and street sweeping
- Catch Basins
- Flow through water quality structures
- Subsurface Infiltration System
- Bioretention System
- Specific maintenance schedule

Water Quality Volume (WQV)

The Water Quality Volume (WQV) is the amount of stormwater runoff from a rainfall event that should be captured and treated to remove the majority of stormwater pollutants on an average annual basis. The recommended WQV is the volume of runoff associated with the first one-inch of rainfall, which is equivalent to capturing and treating the runoff from the 90th percentile of all rainfall.

The WQV has been calculated for the proposed site development and adequate treatment is proposed within the Infiltration System. Refer to Appendix Section 6.2 for *NHDES BMP Worksheets* for specific requirements.

Water Quality Flow (WQF)

The Water Quality Flow (WQF) is used to determine a flow rate associated with the WQV, for sizing flow-based treatment and pre-treatment practices.

The WQF has been calculated for the treatment train for the proposed work. Refer to Appendix Section 6.2 for *NHDES BMP Worksheets* for specific requirements.

Groundwater Recharge Volume (GRV)

The purpose of the groundwater recharge volume criterion is to protect groundwater resources by minimizing the loss of annual pre-development groundwater recharge as a result of the proposed development.
The required Groundwater Recharge Volume (GRV) should be based on the site soils and the following equation:

GRV = (AI)(Rd)

Where:
AI = the total effective area of impervious surfaces that will exist on the site after development
Rd = the groundwater recharge depth based on the USDA/NRCS hydrologic soil group, as follows:

2.93	ac	Area of HSG C soil or impervious cover that was replaced by impervious cover	0.40"
0.4	inches	Rd = weighted groundwater recharge depth	
1.17	ac-in	GRV = AI * Rd	
4,251	cf	GRV conversion (ac-in x 43,560 sf/ac x 1ft/12")	

Recharge required = 4,251 ft^3

<u>Provided</u>

Recharge Provided = 8,470 (Infiltration #1) + 2,526 (Bioretention) = 10,996 ft^3
See stage storage plots within the calculation pages in the appendix of this report

2.4 EXPLANATION OF DRAINAGE SYSTEM

References:

1. **New Hampshire Stormwater Management Manual, Volumes 2 & 3, December 2008 and Stormwater Management and Erosion and Sediment Control Handbook for Urban and Developing Areas In New Hampshire**
2. **SCS - TR55** *(Second Ed., 1986) - for runoff curve numbers.*

Runoff for treatment train #1 is collected on-site using catch basins and is then directed to a CDS hydrodynamic separation device. It then flows to a Storm filter Jellyfish device for filtration. This combination will meet the requirement for the New Hampshire Stormwater Manual flow-through devices. After pre-treatment the stormwater flows to an underground perforated corrugated metal pipe infiltration system. Runoff for treatment train #2 sheet flow directly into the proposed bioretention system. The stormwater will be treated by the installation of the recommended filter media prior to infiltration.

The 2, 10, & 50-year storm events were analyzed for pre versus post development conditions (see Drainage Summary). See complete results in the Appendix.

Pipes:

All pipes have been sized to accommodate the 25-year design storm frequency. A maximum velocity of 12.0 fps and a minimum cleaning velocity of 2.0 fps were held for pipes. The calculations herein also show all pertinent pipe data, including flow depths, discharge rates, sizes, and slopes.

The structures are indicated on the plans with their respective data, including horizontal locations and elevations of rims and inverts in and out. Construction details for the structures are shown on the details sheets of the Site Plans.

Infiltration System:

The proposed subsurface Infiltration system was sized to detain and infiltrate enough volume to reduce rates for the 2, 10, & 50-year storm events such that there is no increase in the peak rate of runoff at the Study Point. The proposed system is designed to infiltrate the water quality volume. The proposed infiltration system will consist of 60" CMP piping within crushed stone.

Bioretention System:

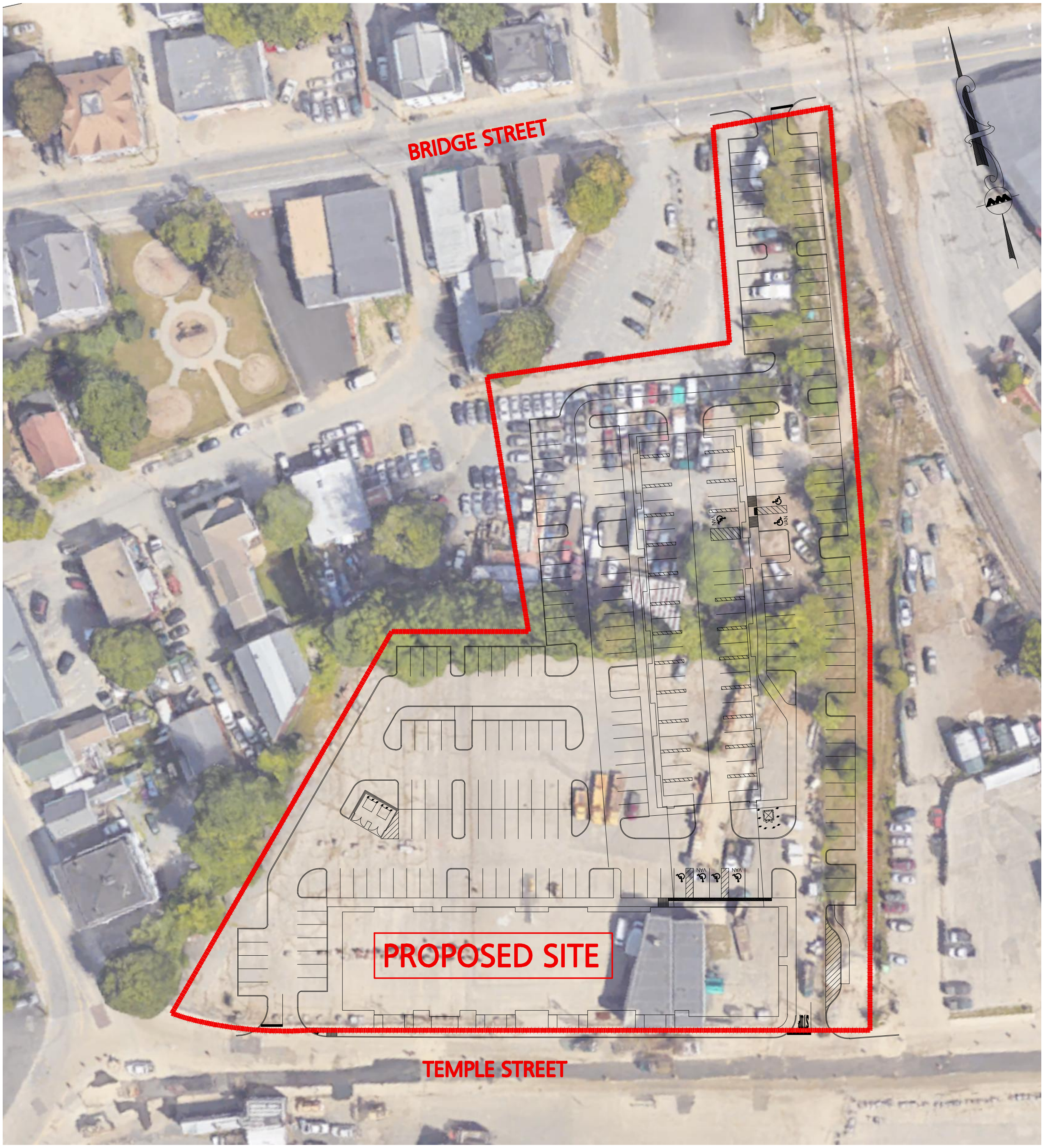
The proposed bioretention system was sized to the NHDES Groundwater Recharge Volume as required by Env-Wq 1504-12. The bioretention system is located along the entire eastern property line. Stormwater runoff from the parking bays to the east of building 2 will sheet flow into the bioretention system. The bioretention system will consist of depression topped with a minimum of 3" of mulch, and a 24" thick layer of filter media, as described in Env-WQ 1508.07 (k) (4).

Water Quality Structures:

The water quality structures consist of a combination of Contech CDS hydrodynamic separation devices and Contech Jellyfish stormwater quality units, which feature high flow pretreatment and membrane filtration. The Jellyfish unit has been sized to meet the water quality flow (WQF) requirement of the AOT permit. These devices are proposed to meet the New Hampshire Stormwater Manual requirements for flow-through devices. These pre-treatment devices are required because the site has an existing infiltration rate higher than 10 inches per hour. Details and elevations of the water quality units are provided within the Site Plan.

SECTION 3.0

FIGURES



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PREPARED BY:

ALLEN & MAJOR ASSOCIATES, INC.

civil & structural engineering ◆ land surveying
environmental consulting ◆ landscape architecture
www.allenmajor.com
400 HARVEY ROAD
MANCHESTER, NH 03103
TEL: (603) 627-5500 FAX: (603) 627-5501
WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

PROJECT:

RESIDENTIAL DEVELOPMENT
159 TEMPLE STREET
NASHUA, NH

AERIAL IMAGE

PROJECT NO.	2596-01	DATE:	05-30-19
SCALE:	1" = 100'	SHEET REF:	-
DESIGNED BY:	ARM	CHECKED BY:	MAM

APPLICANT/OWNER: ZJBV PROPERTIES, LLC c/o JOSEPH'S EQUIPMENT

FIGURE No.

FIG - 1

NOTE:
NASHUA NORTH QUADRANGLE, NEW HAMPSHIRE
PRODUCED BY THE UNITED STATE GEOLOGICAL SURVEY

PREPARED BY:
ALLEN & MAJOR ASSOCIATES, INC.
civil & structural engineering ◆ land surveying
environmental consulting ◆ landscape architecture
www.allenmajor.com
400 HARVEY ROAD
MANCHESTER, NH 03103
TEL: (603) 627-5500 FAX: (603) 627-5501
WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

PROJECT:
RESIDENTIAL DEVELOPMENT
159 TEMPLE STREET
NASHUA, NH

USGS QUAD SITE LOCATION

PROJECT NO.	2596-01	DATE:	05-30-19
SCALE:	1" = 2,000'	SHEET REF:	-
DESIGNED BY:	ARM	CHECKED BY:	MAM

APPLICANT/OWNER: ZJBV PROPERTIES, LLC c/o JOSEPH'S EQUIPMENT

FIGURE No.
FIG - 2

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Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Om	Occum fine sandy loam, high bottom	0.1	0.2%
UdA	Udipsamments, nearly level	0.6	1.1%
Ur	Urban land	52.3	93.0%
W	Water (less than 40 acres)	1.5	2.7%
WnC	Windsor-Urban land complex, 3 to 15 percent slopes	1.6	2.9%
Totals for Area of Interest		**56.2**	**100.0%**

NRCS SOIL SURVEY – MERRIMACK COUNTY, NEW HAMPSHIRE

PREPARED BY:

ALLEN & MAJOR ASSOCIATES, INC.
civil & structural engineering ◆ land surveying
environmental consulting ◆ landscape architecture
www.allenmajor.com
400 HARVEY ROAD
MANCHESTER, NH 03103
TEL: (603) 627-5500 FAX: (603) 627-5501
WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

PROJECT:

RESIDENTIAL DEVELOPMENT
159 TEMPLE STREET
NASHUA, NH

NRCS SOILS SURVEY MAP

PROJECT NO.	2596-01	DATE:	05-30-19
SCALE:	1" = 300'	SHEET REF:	-
DESIGNED BY:	ARM	CHECKED BY:	MAM

APPLICANT/OWNER: ZJBV PROPERTIES, LLC c/o JOSEPH'S EQUIPMENT

FIGURE No.

FIG - 3

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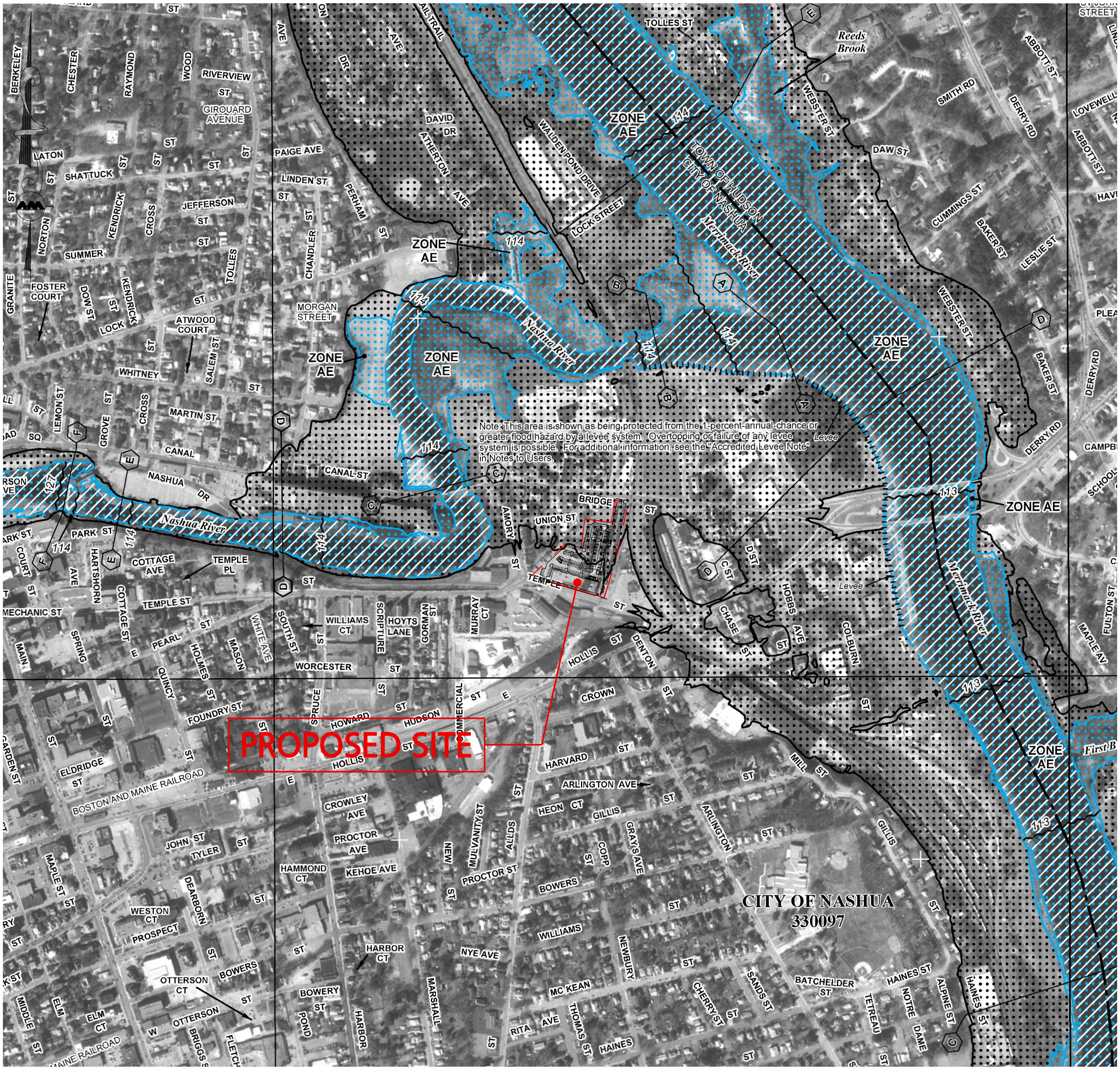

NOTES:

1. THE SITE IS LOCATED WITHIN ZONE X – AREAS DETERMINED TO BE OUTSIDE OF THE 0.2 % ANNUAL CHANCE FLOODPLAIN. ALSO A PORTION OF THE SITE IS LOCATED WITHIN AREA WITH REDUCED FLOOD RISK DUE TO LEVEE ZONE X.

2. FEMA FIRM MAP HILLSBOROUGH COUNTY, NEW HAMPSHIRE #33011C0514E, PANEL 514 OF 701

PREPARED BY:
ALLEN & MAJOR ASSOCIATES, INC.
civil & structural engineering ◆ land surveying
environmental consulting ◆ landscape architecture
w w w . a l l e n m a j o r . c o m
400 HARVEY ROAD
MANCHESTER, NH 03103
TEL: (603) 627-5500 FAX: (603) 627-5501
WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

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FEMA FIRM MAP			
PROJECT NO.	2596-01	DATE:	05-30-19
SCALE:	1" = 1,000'	SHEET REF:	-
DESIGNED BY:	ARM	CHECKED BY:	MAM

APPLICANT/OWNER: ZJBV PROPERTIES, LLC c/o JOSEPH'S EQUIPMENT

FIGURE No.
FIG - 4

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SECTION 4.0

PRE-DEVELOPMENT DRAINAGE CALCULATIONS

TYPE III, 2, 10, & 50YR STORM EVENT

Routing Diagram for Existing Conditions
Prepared by Allen & Major Associates, Inc., Printed 10/1/2019
HydroCAD® 10.00-24 s/n 02881 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
16,269	96	Gravel surface, HSG A (E-2, E-3)
124,994	98	Paved parking, HSG A (E-1, E-2, E-3, E-4)
5,239	98	Roofs, HSG A (E-2, E-3)
18,813	36	Woods, Fair, HSG A (E-1, E-2, E-3, E-4)
165,315	**91**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
165,315	HSG A	E-1, E-2, E-3, E-4
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
165,315		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
16,269	0	0	0	0	16,269	Gravel surface	E-2, E-3
124,994	0	0	0	0	124,994	Paved parking	E-1, E-2, E-3, E-4
5,239	0	0	0	0	5,239	Roofs	E-2, E-3
18,813	0	0	0	0	18,813	Woods, Fair	E-1, E-2, E-3, E-4
165,315	**0**	**0**	**0**	**0**	**165,315**	**TOTAL AREA**	

Summary for Subcatchment E-1: Subcat E-1

[49] Hint: Tc<2dt may require smaller dt

Runoff = 2.54 cfs @ 12.07 hrs, Volume= 8,525 cf, Depth= 2.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=2.95"

Area (sf)	CN	Description
38,815	98	Paved parking, HSG A
401	36	Woods, Fair, HSG A
39,216	97	Weighted Average
401		1.02% Pervious Area
38,815		98.98% Impervious Area

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

Summary for Subcatchment E-2: Subcat E-2

[49] Hint: Tc<2dt may require smaller dt

Runoff = 2.56 cfs @ 12.07 hrs, Volume= 8,027 cf, Depth= 2.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=2.95"

Area (sf)	CN	Description
1,812	96	Gravel surface, HSG A
38,204	98	Paved parking, HSG A
1,252	98	Roofs, HSG A
4,301	36	Woods, Fair, HSG A
45,569	92	Weighted Average
6,113		13.41% Pervious Area
39,456		86.59% Impervious Area

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

Summary for Subcatchment E-3: Subcat E-3

[49] Hint: Tc<2dt may require smaller dt

Runoff = 2.76 cfs @ 12.08 hrs, Volume= 8,532 cf, Depth= 1.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=2.95"

Area (sf)	CN	Description
14,457	96	Gravel surface, HSG A
34,222	98	Paved parking, HSG A
3,987	98	Roofs, HSG A
13,543	36	Woods, Fair, HSG A
66,209	85	Weighted Average
28,000		42.29% Pervious Area
38,210		57.71% Impervious Area

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

Summary for Subcatchment E-4: Subcat E-4

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.91 cfs @ 12.07 hrs, Volume= 2,987 cf, Depth= 2.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=2.95"

Area (sf)	CN	Description
13,753	98	Paved parking, HSG A
568	36	Woods, Fair, HSG A
14,321	96	Weighted Average
568		3.97% Pervious Area
13,753		96.03% Impervious Area

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

Summary for Reach SP1: Flow to Municipal

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 53,537 sf, 98.19% Impervious, Inflow Depth = 2.58" for 2-Year event
Inflow = 3.45 cfs @ 12.07 hrs, Volume= 11,512 cf
Outflow = 3.45 cfs @ 12.07 hrs, Volume= 11,512 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach SP2: Flow to Tracks

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 111,778 sf, 69.48% Impervious, Inflow Depth = 1.78" for 2-Year event
Inflow = 5.30 cfs @ 12.08 hrs, Volume= 16,559 cf
Outflow = 5.30 cfs @ 12.08 hrs, Volume= 16,559 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Subcatchment E-1: Subcat E-1

[49] Hint: Tc<2dt may require smaller dt

Runoff = 3.90 cfs @ 12.07 hrs, Volume= 13,364 cf, Depth= 4.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.44"

Area (sf)	CN	Description
38,815	98	Paved parking, HSG A
401	36	Woods, Fair, HSG A
39,216	97	Weighted Average
401		1.02% Pervious Area
38,815		98.98% Impervious Area

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

Summary for Subcatchment E-2: Subcat E-2

[49] Hint: Tc<2dt may require smaller dt

Runoff = 4.18 cfs @ 12.07 hrs, Volume= 13,457 cf, Depth= 3.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.44"

Area (sf)	CN	Description
1,812	96	Gravel surface, HSG A
38,204	98	Paved parking, HSG A
1,252	98	Roofs, HSG A
4,301	36	Woods, Fair, HSG A
45,569	92	Weighted Average
6,113		13.41% Pervious Area
39,456		86.59% Impervious Area

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

Summary for Subcatchment E-3: Subcat E-3

[49] Hint: Tc<2dt may require smaller dt

Runoff = 5.09 cfs @ 12.07 hrs, Volume= 15,750 cf, Depth= 2.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.44"

Area (sf)	CN	Description
14,457	96	Gravel surface, HSG A
34,222	98	Paved parking, HSG A
3,987	98	Roofs, HSG A
13,543	36	Woods, Fair, HSG A
66,209	85	Weighted Average
28,000		42.29% Pervious Area
38,210		57.71% Impervious Area

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

Summary for Subcatchment E-4: Subcat E-4

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.41 cfs @ 12.07 hrs, Volume= 4,745 cf, Depth= 3.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.44"

Area (sf)	CN	Description
13,753	98	Paved parking, HSG A
568	36	Woods, Fair, HSG A
14,321	96	Weighted Average
568		3.97% Pervious Area
13,753		96.03% Impervious Area

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

Summary for Reach SP1: Flow to Municipal

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 53,537 sf, 98.19% Impervious, Inflow Depth = 4.06" for 10-Year event
Inflow = 5.30 cfs @ 12.07 hrs, Volume= 18,109 cf
Outflow = 5.30 cfs @ 12.07 hrs, Volume= 18,109 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach SP2: Flow to Tracks

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 111,778 sf, 69.48% Impervious, Inflow Depth = 3.14" for 10-Year event
Inflow = 9.27 cfs @ 12.07 hrs, Volume= 29,207 cf
Outflow = 9.27 cfs @ 12.07 hrs, Volume= 29,207 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Subcatchment E-1: Subcat E-1

[49] Hint: Tc<2dt may require smaller dt

Runoff = 5.92 cfs @ 12.07 hrs, Volume= 20,695 cf, Depth= 6.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.69"

Area (sf)	CN	Description
38,815	98	Paved parking, HSG A
401	36	Woods, Fair, HSG A
39,216	97	Weighted Average
401		1.02% Pervious Area
38,815		98.98% Impervious Area

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

Summary for Subcatchment E-2: Subcat E-2

[49] Hint: Tc<2dt may require smaller dt

Runoff = 6.60 cfs @ 12.07 hrs, Volume= 21,831 cf, Depth= 5.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.69"

Area (sf)	CN	Description
1,812	96	Gravel surface, HSG A
38,204	98	Paved parking, HSG A
1,252	98	Roofs, HSG A
4,301	36	Woods, Fair, HSG A
45,569	92	Weighted Average
6,113		13.41% Pervious Area
39,456		86.59% Impervious Area

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

Summary for Subcatchment E-3: Subcat E-3

[49] Hint: Tc<2dt may require smaller dt

Runoff = 8.66 cfs @ 12.07 hrs, Volume= 27,348 cf, Depth= 4.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.69"

Area (sf)	CN	Description
14,457	96	Gravel surface, HSG A
34,222	98	Paved parking, HSG A
3,987	98	Roofs, HSG A
13,543	36	Woods, Fair, HSG A
66,209	85	Weighted Average
28,000		42.29% Pervious Area
38,210		57.71% Impervious Area

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

Summary for Subcatchment E-4: Subcat E-4

[49] Hint: Tc<2dt may require smaller dt

Runoff = 2.15 cfs @ 12.07 hrs, Volume= 7,417 cf, Depth= 6.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.69"

Area (sf)	CN	Description
13,753	98	Paved parking, HSG A
568	36	Woods, Fair, HSG A
14,321	96	Weighted Average
568		3.97% Pervious Area
13,753		96.03% Impervious Area

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

Summary for Reach SP1: Flow to Municipal

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 53,537 sf, 98.19% Impervious, Inflow Depth = 6.30" for 50-Year event
Inflow = 8.07 cfs @ 12.07 hrs, Volume= 28,112 cf
Outflow = 8.07 cfs @ 12.07 hrs, Volume= 28,112 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach SP2: Flow to Tracks

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 111,778 sf, 69.48% Impervious, Inflow Depth = 5.28" for 50-Year event
Inflow = 15.26 cfs @ 12.07 hrs, Volume= 49,179 cf
Outflow = 15.26 cfs @ 12.07 hrs, Volume= 49,179 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Subcatchment E-1: Subcat E-1

[49] Hint: Tc<2dt may require smaller dt

Runoff = 7.09 cfs @ 12.07 hrs, Volume= 24,936 cf, Depth= 7.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.99"

Area (sf)	CN	Description
38,815	98	Paved parking, HSG A
401	36	Woods, Fair, HSG A
39,216	97	Weighted Average
401		1.02% Pervious Area
38,815		98.98% Impervious Area

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

Summary for Subcatchment E-2: Subcat E-2

[49] Hint: Tc<2dt may require smaller dt

Runoff = 7.99 cfs @ 12.07 hrs, Volume= 26,709 cf, Depth= 7.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.99"

Area (sf)	CN	Description
1,812	96	Gravel surface, HSG A
38,204	98	Paved parking, HSG A
1,252	98	Roofs, HSG A
4,301	36	Woods, Fair, HSG A
45,569	92	Weighted Average
6,113		13.41% Pervious Area
39,456		86.59% Impervious Area

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

Summary for Subcatchment E-3: Subcat E-3

[49] Hint: Tc<2dt may require smaller dt

Runoff = 10.72 cfs @ 12.07 hrs, Volume= 34,228 cf, Depth= 6.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.99"

Area (sf)	CN	Description
14,457	96	Gravel surface, HSG A
34,222	98	Paved parking, HSG A
3,987	98	Roofs, HSG A
13,543	36	Woods, Fair, HSG A
66,209	85	Weighted Average
28,000		42.29% Pervious Area
38,210		57.71% Impervious Area

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

Summary for Subcatchment E-4: Subcat E-4

[49] Hint: Tc<2dt may require smaller dt

Runoff = 2.58 cfs @ 12.07 hrs, Volume= 8,964 cf, Depth= 7.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.99"

Area (sf)	CN	Description
13,753	98	Paved parking, HSG A
568	36	Woods, Fair, HSG A
14,321	96	Weighted Average
568		3.97% Pervious Area
13,753		96.03% Impervious Area

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

Summary for Reach SP1: Flow to Municipal

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 53,537 sf, 98.19% Impervious, Inflow Depth = 7.60" for 100-Year event
Inflow = 9.66 cfs @ 12.07 hrs, Volume= 33,900 cf
Outflow = 9.66 cfs @ 12.07 hrs, Volume= 33,900 cf, Atten= 0%, Lag= 0.0 min

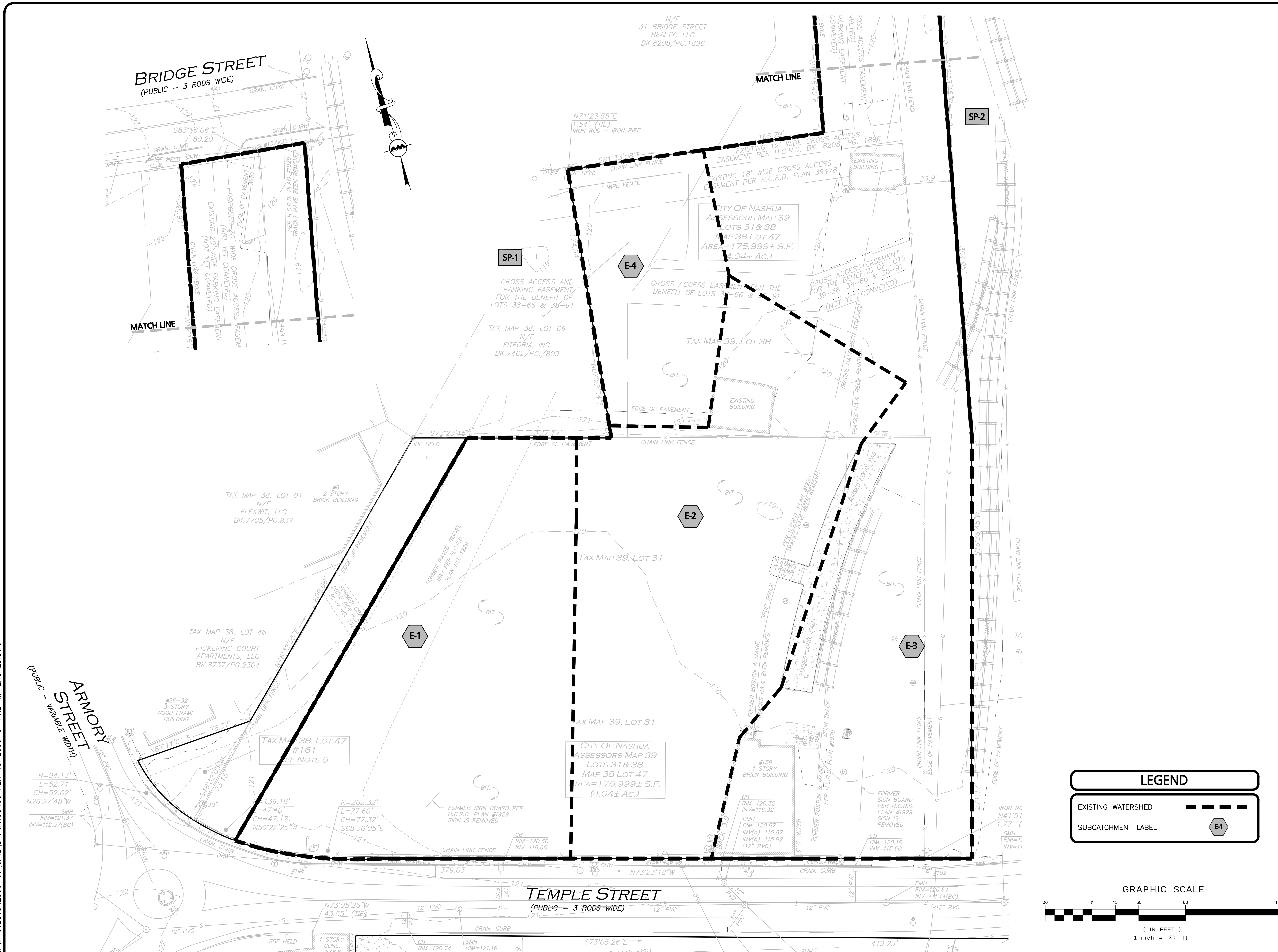
Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach SP2: Flow to Tracks

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 111,778 sf, 69.48% Impervious, Inflow Depth = 6.54" for 100-Year event
Inflow = 18.71 cfs @ 12.07 hrs, Volume= 60,937 cf
Outflow = 18.71 cfs @ 12.07 hrs, Volume= 60,937 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs



APPROVED - NASHUA CITY PLANNING BOARD

CHAIRMAN DATE

SECRETARY DATE

DATE OF APPROVAL

MARKET SQUARE ARCHITECTS

104 Congress St., STE 203
Portsmouth, NH 03801
PH: 603.501.0202

REV	DATE	DESCRIPTION

APPLICANT\OWNER:
ZJBV PROPERTIES, LLC
c/o JOSEPH'S EQUIPMENT
300 GAY STREET
MANCHESTER, NH 03103

PROJECT:
RESIDENTIAL DEVELOPMENT
159 TEMPLE STREET
NASHUA, NH

PROJECT NO. 2596-01	DATE: MAY 30, 2019
SCALE: 1" = ##'	DWG.: C-2596-01_Pre-Watershed
DESIGNED BY: AM	CHECKED BY: MM

PREPARED BY:

ALLEN & MAJOR ASSOCIATES, INC.
civil & structural engineering ♦ land surveying
environmental consulting ♦ landscape architecture
www.allenmajor.com
400 HARVEY ROAD
MANCHESTER, NH 03103
TEL: (603) 627-5500
FAX: (603) 627-5501

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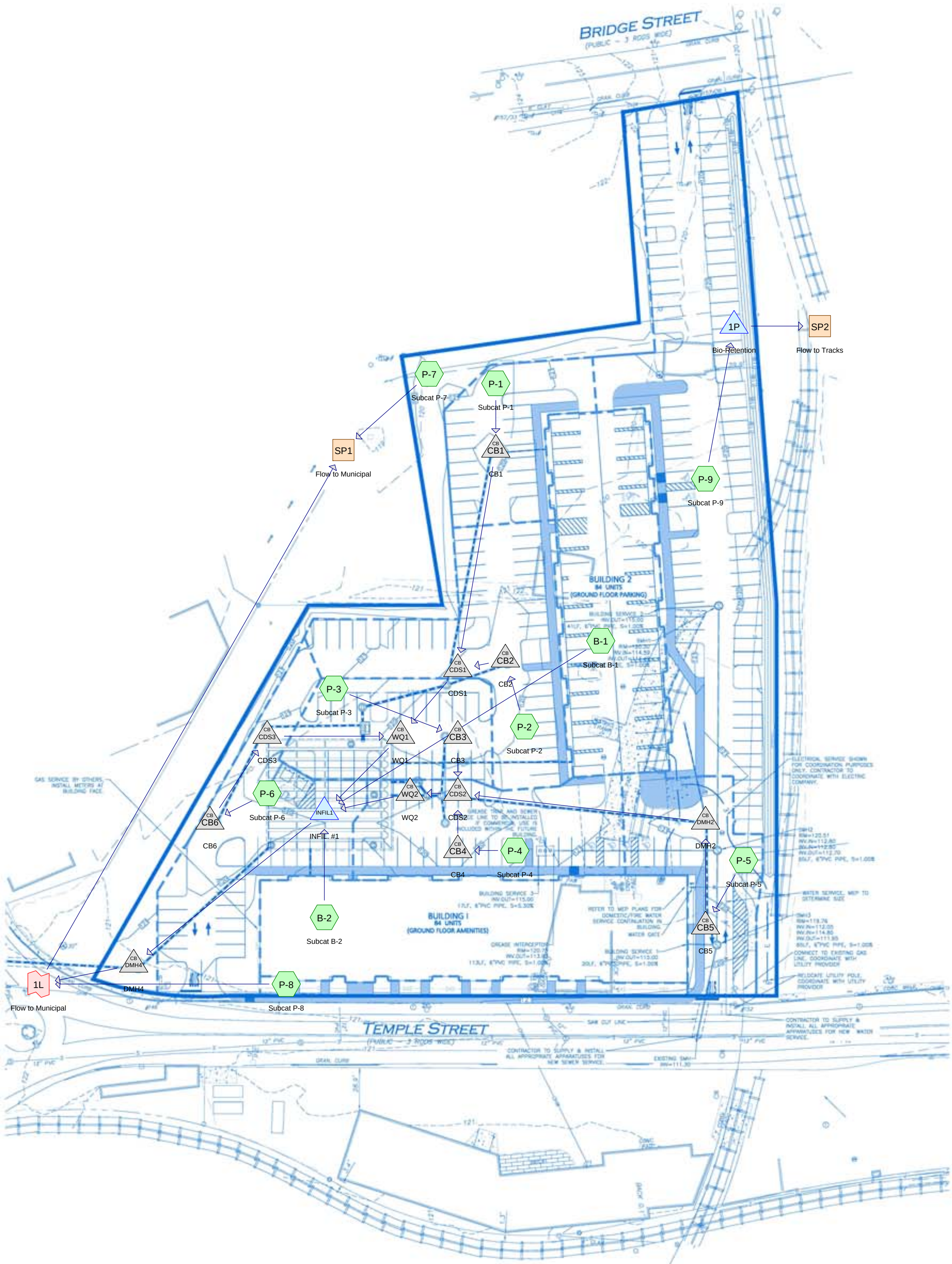
DRAWING TITLE:
PRE-DEVELOPMENT WATERSHED PLAN

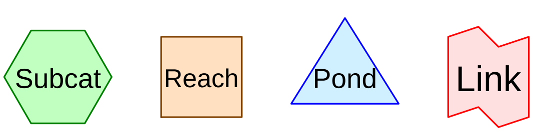
SHEET No.
WS-1

SECTION 5.0

POST-DEVELOPMENT DRAINAGE CALCULATIONS

TYPE III, 2, 10, & 50YR STORM EVENT





Routing Diagram for Proposed Conditions

Prepared by Allen & Major Associates Inc. , Printed 8/21/2019

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Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
37,579	39	>75% Grass cover, Good, HSG A (P-1, P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9)
106,745	98	Paved parking, HSG A (B-1, P-1, P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9)
20,991	98	Roofs, HSG A (B-2)
165,316	**85**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
165,316	HSG A	B-1, B-2, P-1, P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
165,316		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
37,579	0	0	0	0	37,579	>75% Grass cover, Good	P-1, P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9
106,745	0	0	0	0	106,745	Paved parking	B-1, P-1, P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9
20,991	0	0	0	0	20,991	Roofs	B-2
165,316	**0**	**0**	**0**	**0**	**165,316**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	CB1	116.92	115.62	163.0	0.0080	0.013	12.0	0.0	0.0
2	CB2	116.06	115.61	45.0	0.0100	0.013	12.0	0.0	0.0
3	CB3	115.05	114.64	41.0	0.0100	0.013	12.0	0.0	0.0
4	CB4	114.79	114.60	19.0	0.0100	0.013	12.0	0.0	0.0
5	CB5	116.79	116.21	72.0	0.0081	0.013	12.0	0.0	0.0
6	CB6	116.30	115.96	64.0	0.0053	0.013	12.0	0.0	0.0
7	CDS1	115.51	115.03	60.0	0.0080	0.013	12.0	0.0	0.0
8	CDS2	114.54	114.46	10.0	0.0080	0.013	12.0	0.0	0.0
9	CDS3	115.37	114.84	68.0	0.0078	0.013	12.0	0.0	0.0
10	DMH2	116.12	114.64	184.0	0.0080	0.013	12.0	0.0	0.0
11	DMH4	113.46	112.40	101.0	0.0105	0.013	12.0	0.0	0.0
12	INFIL1	114.80	113.56	124.0	0.0100	0.005	12.0	0.0	0.0
13	WQ1	114.74	114.67	8.0	0.0087	0.013	24.0	0.0	0.0
14	WQ2	114.17	114.03	18.0	0.0078	0.013	24.0	0.0	0.0

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment B-1: Subcat B-1 Runoff Area=17,679 sf 100.00% Impervious Runoff Depth=2.72"
Tc=5.0 min CN=98 Runoff=1.17 cfs 4,005 cf

Subcatchment B-2: Subcat B-2 Runoff Area=20,991 sf 100.00% Impervious Runoff Depth=2.72"
Tc=5.0 min CN=98 Runoff=1.39 cfs 4,755 cf

Subcatchment P-1: Subcat P-1 Runoff Area=8,538 sf 85.40% Impervious Runoff Depth=1.85"
Tc=5.0 min CN=89 Runoff=0.42 cfs 1,320 cf

Subcatchment P-2: Subcat P-2 Runoff Area=15,604 sf 89.69% Impervious Runoff Depth=2.11"
Tc=5.0 min CN=92 Runoff=0.88 cfs 2,749 cf

Subcatchment P-3: Subcat P-3 Runoff Area=9,350 sf 76.88% Impervious Runoff Depth=1.48"
Tc=5.0 min CN=84 Runoff=0.37 cfs 1,149 cf

Subcatchment P-4: Subcat P-4 Runoff Area=12,212 sf 85.18% Impervious Runoff Depth=1.85"
Tc=5.0 min CN=89 Runoff=0.61 cfs 1,887 cf

Subcatchment P-5: Subcat P-5 Runoff Area=9,880 sf 81.63% Impervious Runoff Depth=1.70"
Tc=5.0 min CN=87 Runoff=0.45 cfs 1,396 cf

Subcatchment P-6: Subcat P-6 Runoff Area=16,022 sf 84.15% Impervious Runoff Depth=1.85"
Tc=5.0 min CN=89 Runoff=0.80 cfs 2,476 cf

Subcatchment P-7: Subcat P-7 Runoff Area=12,690 sf 0.38% Impervious Runoff Depth=0.00"
Tc=5.0 min CN=39 Runoff=0.00 cfs 0 cf

Subcatchment P-8: Subcat P-8 Runoff Area=3,261 sf 20.98% Impervious Runoff Depth=0.10"
Tc=5.0 min CN=51 Runoff=0.00 cfs 27 cf

Subcatchment P-9: Subcat P-9 Runoff Area=39,090 sf 71.40% Impervious Runoff Depth=1.28"
Tc=5.0 min CN=81 Runoff=1.33 cfs 4,154 cf

Reach SP1: Flow to Municipal Inflow=0.00 cfs 27 cf
Outflow=0.00 cfs 27 cf

Reach SP2: Flow to Tracks Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

Pond 1P: Bio-Retention Peak Elev=118.20' Storage=1,030 cf Inflow=1.33 cfs 4,154 cf
Discarded=0.41 cfs 4,154 cf Primary=0.00 cfs 0 cf Outflow=0.41 cfs 4,154 cf

Pond CB1: CB1 Peak Elev=117.29' Inflow=0.42 cfs 1,320 cf
12.0" Round Culvert n=0.013 L=163.0' S=0.0080 '/' Outflow=0.42 cfs 1,320 cf

Pond CB2: CB2 Peak Elev=116.61' Inflow=0.88 cfs 2,749 cf
12.0" Round Culvert n=0.013 L=45.0' S=0.0100 '/' Outflow=0.88 cfs 2,749 cf

Pond CB3: CB3 Peak Elev=115.39' Inflow=0.37 cfs 1,149 cf
12.0" Round Culvert n=0.013 L=41.0' S=0.0100 '/' Outflow=0.37 cfs 1,149 cf

Pond CB4: CB4 Peak Elev=115.24' Inflow=0.61 cfs 1,887 cf
12.0" Round Culvert n=0.013 L=19.0' S=0.0100 '/' Outflow=0.61 cfs 1,887 cf

Pond CB5: CB5 Peak Elev=117.17' Inflow=0.45 cfs 1,396 cf
12.0" Round Culvert n=0.013 L=72.0' S=0.0081 '/' Outflow=0.45 cfs 1,396 cf

Pond CB6: CB6 Peak Elev=116.84' Inflow=0.80 cfs 2,476 cf
12.0" Round Culvert n=0.013 L=64.0' S=0.0053 '/' Outflow=0.80 cfs 2,476 cf

Pond CDS1: CDS1 Peak Elev=116.20' Inflow=1.30 cfs 4,068 cf
12.0" Round Culvert n=0.013 L=60.0' S=0.0080 '/' Outflow=1.30 cfs 4,068 cf

Pond CDS2: CDS2 Peak Elev=115.34' Inflow=1.43 cfs 4,433 cf
12.0" Round Culvert n=0.013 L=10.0' S=0.0080 '/' Outflow=1.43 cfs 4,433 cf

Pond CDS3: CDS3 Peak Elev=115.89' Inflow=0.80 cfs 2,476 cf
12.0" Round Culvert n=0.013 L=68.0' S=0.0078 '/' Outflow=0.80 cfs 2,476 cf

Pond DMH2: DMH2 Peak Elev=116.50' Inflow=0.45 cfs 1,396 cf
12.0" Round Culvert n=0.013 L=184.0' S=0.0080 '/' Outflow=0.45 cfs 1,396 cf

Pond DMH4: DMH4 Peak Elev=113.46' Inflow=0.00 cfs 0 cf
12.0" Round Culvert n=0.013 L=101.0' S=0.0105 '/' Outflow=0.00 cfs 0 cf

Pond INFIL1: INFIL. #1 Peak Elev=114.21' Storage=5,362 cf Inflow=6.09 cfs 19,738 cf
Discarded=1.07 cfs 19,738 cf Primary=0.00 cfs 0 cf Outflow=1.07 cfs 19,738 cf

Pond WQ1: WQ1 Peak Elev=115.50' Inflow=2.10 cfs 6,545 cf
24.0" Round Culvert n=0.013 L=8.0' S=0.0087 '/' Outflow=2.10 cfs 6,545 cf

Pond WQ2: WQ2 Peak Elev=114.76' Inflow=1.43 cfs 4,433 cf
24.0" Round Culvert n=0.013 L=18.0' S=0.0078 '/' Outflow=1.43 cfs 4,433 cf

Link 1L: Flow to Municipal Inflow=0.00 cfs 27 cf
Primary=0.00 cfs 27 cf

Total Runoff Area = 165,316 sf Runoff Volume = 23,919 cf Average Runoff Depth = 1.74"
22.73% Pervious = 37,579 sf 77.27% Impervious = 127,737 sf

Summary for Subcatchment B-1: Subcat B-1

Runoff = 1.17 cfs @ 12.07 hrs, Volume= 4,005 cf, Depth= 2.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=2.95"

Area (sf)	CN	Description
17,679	98	Paved parking, HSG A
17,679		100.00% Impervious Area

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

Summary for Subcatchment B-2: Subcat B-2

Runoff = 1.39 cfs @ 12.07 hrs, Volume= 4,755 cf, Depth= 2.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=2.95"

Area (sf)	CN	Description
20,991	98	Roofs, HSG A
20,991		100.00% Impervious Area

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

Summary for Subcatchment P-1: Subcat P-1

Runoff = 0.42 cfs @ 12.08 hrs, Volume= 1,320 cf, Depth= 1.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=2.95"

Area (sf)	CN	Description
1,246	39	>75% Grass cover, Good, HSG A
7,292	98	Paved parking, HSG A
8,538	89	Weighted Average
1,246		14.60% Pervious Area
7,292		85.40% Impervious Area

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

Summary for Subcatchment P-2: Subcat P-2

Runoff = 0.88 cfs @ 12.07 hrs, Volume= 2,749 cf, Depth= 2.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=2.95"

Area (sf)	CN	Description
1,609	39	>75% Grass cover, Good, HSG A
13,995	98	Paved parking, HSG A
15,604	92	Weighted Average
1,609		10.31% Pervious Area
13,995		89.69% Impervious Area

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

Summary for Subcatchment P-3: Subcat P-3

Runoff = 0.37 cfs @ 12.08 hrs, Volume= 1,149 cf, Depth= 1.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=2.95"

Area (sf)	CN	Description
2,162	39	>75% Grass cover, Good, HSG A
7,188	98	Paved parking, HSG A
9,350	84	Weighted Average
2,162		23.12% Pervious Area
7,188		76.88% Impervious Area

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

Summary for Subcatchment P-4: Subcat P-4

Runoff = 0.61 cfs @ 12.08 hrs, Volume= 1,887 cf, Depth= 1.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=2.95"

Area (sf)	CN	Description
1,809	39	>75% Grass cover, Good, HSG A
10,403	98	Paved parking, HSG A
12,212	89	Weighted Average
1,809		14.82% Pervious Area
10,403		85.18% Impervious Area

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

Summary for Subcatchment P-5: Subcat P-5

Runoff = 0.45 cfs @ 12.08 hrs, Volume= 1,396 cf, Depth= 1.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=2.95"

Area (sf)	CN	Description
1,815	39	>75% Grass cover, Good, HSG A
8,064	98	Paved parking, HSG A
9,880	87	Weighted Average
1,815		18.37% Pervious Area
8,064		81.63% Impervious Area

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

Summary for Subcatchment P-6: Subcat P-6

Runoff = 0.80 cfs @ 12.08 hrs, Volume= 2,476 cf, Depth= 1.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=2.95"

Area (sf)	CN	Description
2,540	39	>75% Grass cover, Good, HSG A
13,482	98	Paved parking, HSG A
16,022	89	Weighted Average
2,540		15.85% Pervious Area
13,482		84.15% Impervious Area

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

Summary for Subcatchment P-7: Subcat P-7

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=2.95"

Area (sf)	CN	Description
12,642	39	>75% Grass cover, Good, HSG A
48	98	Paved parking, HSG A
12,690	39	Weighted Average
12,642		99.62% Pervious Area
48		0.38% Impervious Area

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

Summary for Subcatchment P-8: Subcat P-8

Runoff = 0.00 cfs @ 13.66 hrs, Volume= 27 cf, Depth= 0.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=2.95"

Area (sf)	CN	Description
2,576	39	>75% Grass cover, Good, HSG A
684	98	Paved parking, HSG A
3,261	51	Weighted Average
2,576		79.02% Pervious Area
684		20.98% Impervious Area

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

Summary for Subcatchment P-9: Subcat P-9

Runoff = 1.33 cfs @ 12.08 hrs, Volume= 4,154 cf, Depth= 1.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=2.95"

Area (sf)	CN	Description
11,179	39	>75% Grass cover, Good, HSG A
27,911	98	Paved parking, HSG A
39,090	81	Weighted Average
11,179		28.60% Pervious Area
27,911		71.40% Impervious Area

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

Summary for Reach SP1: Flow to Municipal

Inflow Area = 126,225 sf, 79.09% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 13.66 hrs, Volume= 27 cf
Outflow = 0.00 cfs @ 13.66 hrs, Volume= 27 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach SP2: Flow to Tracks

Inflow Area = 39,090 sf, 71.40% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Bio-Retention

Inflow Area = 39,090 sf, 71.40% Impervious, Inflow Depth = 1.28" for 2-Year event
Inflow = 1.33 cfs @ 12.08 hrs, Volume= 4,154 cf
Outflow = 0.41 cfs @ 12.44 hrs, Volume= 4,154 cf, Atten= 69%, Lag= 21.2 min
Discarded = 0.41 cfs @ 12.44 hrs, Volume= 4,154 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 118.20' @ 12.44 hrs Surf.Area= 2,442 sf Storage= 1,030 cf

Plug-Flow detention time= 27.1 min calculated for 4,151 cf (100% of inflow)
Center-of-Mass det. time= 27.1 min (869.8 - 842.7)

Volume	Invert	Avail.Storage	Storage Description
#1	118.00'	9,401 cf	**Pond Storage (Conic)**Listed below (Recalc)
#2	115.50'	788 cf	**FIlter Media (Conic)**Listed below (Recalc) 2,625 cf Overall x 30.0% Voids
		10,188 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
118.00	1,050	0	0	1,050
119.00	3,253	2,050	2,050	3,259
119.50	4,346	1,893	3,944	4,357
120.00	19,250	5,457	9,401	19,262

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
115.50	1,050	0	0	1,050
118.00	1,050	2,625	2,625	1,337

Device	Routing	Invert	Outlet Devices
#1	Discarded	115.50'	**6.500 in/hr Exfiltration over Wetted area**
#2	Primary	118.90'	**10.0' long x 0.5' breadth Broad-Crested Rectangular Weir X 3.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.41 cfs @ 12.44 hrs HW=118.20' (Free Discharge)
└—**1=Exfiltration** (Exfiltration Controls 0.41 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=115.50' (Free Discharge)
└—**2=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Summary for Pond CB1: CB1

Inflow Area = 8,538 sf, 85.40% Impervious, Inflow Depth = 1.85" for 2-Year event
Inflow = 0.42 cfs @ 12.08 hrs, Volume= 1,320 cf
Outflow = 0.42 cfs @ 12.08 hrs, Volume= 1,320 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.42 cfs @ 12.08 hrs, Volume= 1,320 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 117.29' @ 12.08 hrs
Flood Elev= 119.72'

Device	Routing	Invert	Outlet Devices
#1	Primary	116.92'	**12.0" Round Culvert** L= 163.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 116.92' / 115.62' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.41 cfs @ 12.08 hrs HW=117.28' (Free Discharge)
└—**1=Culvert** (Inlet Controls 0.41 cfs @ 1.61 fps)

Summary for Pond CB2: CB2

Inflow Area = 15,604 sf, 89.69% Impervious, Inflow Depth = 2.11" for 2-Year event
Inflow = 0.88 cfs @ 12.07 hrs, Volume= 2,749 cf
Outflow = 0.88 cfs @ 12.07 hrs, Volume= 2,749 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.88 cfs @ 12.07 hrs, Volume= 2,749 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 116.61' @ 12.07 hrs
Flood Elev= 119.43'

Device	Routing	Invert	Outlet Devices
#1	Primary	116.06'	**12.0" Round Culvert** L= 45.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 116.06' / 115.61' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.84 cfs @ 12.07 hrs HW=116.60' (Free Discharge)
└—**1=Culvert** (Inlet Controls 0.84 cfs @ 1.97 fps)

Summary for Pond CB3: CB3

Inflow Area = 9,350 sf, 76.88% Impervious, Inflow Depth = 1.48" for 2-Year event
Inflow = 0.37 cfs @ 12.08 hrs, Volume= 1,149 cf
Outflow = 0.37 cfs @ 12.08 hrs, Volume= 1,149 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.37 cfs @ 12.08 hrs, Volume= 1,149 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 115.39' @ 12.08 hrs
Flood Elev= 119.33'

Device	Routing	Invert	Outlet Devices
#1	Primary	115.05'	**12.0" Round Culvert** L= 41.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 115.05' / 114.64' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.36 cfs @ 12.08 hrs HW=115.38' (Free Discharge)
└—**1=Culvert** (Inlet Controls 0.36 cfs @ 1.56 fps)

Summary for Pond CB4: CB4

Inflow Area = 12,212 sf, 85.18% Impervious, Inflow Depth = 1.85" for 2-Year event
Inflow = 0.61 cfs @ 12.08 hrs, Volume= 1,887 cf
Outflow = 0.61 cfs @ 12.08 hrs, Volume= 1,887 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.61 cfs @ 12.08 hrs, Volume= 1,887 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 115.24' @ 12.08 hrs
Flood Elev= 119.29'

Device	Routing	Invert	Outlet Devices
#1	Primary	114.79'	**12.0" Round Culvert** L= 19.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 114.79' / 114.60' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.59 cfs @ 12.08 hrs HW=115.23' (Free Discharge)
1=Culvert (Inlet Controls 0.59 cfs @ 1.78 fps)

Summary for Pond CB5: CB5

Inflow Area = 9,880 sf, 81.63% Impervious, Inflow Depth = 1.70" for 2-Year event
Inflow = 0.45 cfs @ 12.08 hrs, Volume= 1,396 cf
Outflow = 0.45 cfs @ 12.08 hrs, Volume= 1,396 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.45 cfs @ 12.08 hrs, Volume= 1,396 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 117.17' @ 12.08 hrs
Flood Elev= 119.59'

Device	Routing	Invert	Outlet Devices
#1	Primary	116.79'	**12.0" Round Culvert** L= 72.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 116.79' / 116.21' S= 0.0081 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.44 cfs @ 12.08 hrs HW=117.16' (Free Discharge)
1=Culvert (Inlet Controls 0.44 cfs @ 1.64 fps)

Summary for Pond CB6: CB6

Inflow Area = 16,022 sf, 84.15% Impervious, Inflow Depth = 1.85" for 2-Year event
Inflow = 0.80 cfs @ 12.08 hrs, Volume= 2,476 cf
Outflow = 0.80 cfs @ 12.08 hrs, Volume= 2,476 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.80 cfs @ 12.08 hrs, Volume= 2,476 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 116.84' @ 12.08 hrs
Flood Elev= 119.02'

Device	Routing	Invert	Outlet Devices
#1	Primary	116.30'	**12.0" Round Culvert** L= 64.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 116.30' / 115.96' S= 0.0053 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.77 cfs @ 12.08 hrs HW=116.83' (Free Discharge)
1=Culvert (Barrel Controls 0.77 cfs @ 2.64 fps)

Summary for Pond CDS1: CDS1

Inflow Area = 24,142 sf, 88.17% Impervious, Inflow Depth = 2.02" for 2-Year event
Inflow = 1.30 cfs @ 12.07 hrs, Volume= 4,068 cf
Outflow = 1.30 cfs @ 12.07 hrs, Volume= 4,068 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.30 cfs @ 12.07 hrs, Volume= 4,068 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Peak Elev= 116.20' @ 12.07 hrs
Flood Elev= 120.34'

Device	Routing	Invert	Outlet Devices
#1	Primary	115.51'	**12.0" Round Culvert** L= 60.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 115.51' / 115.03' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.25 cfs @ 12.07 hrs HW=116.19' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.25 cfs @ 2.21 fps)

Summary for Pond CDS2: CDS2

Inflow Area = 31,442 sf, 81.60% Impervious, Inflow Depth = 1.69" for 2-Year event
Inflow = 1.43 cfs @ 12.08 hrs, Volume= 4,433 cf
Outflow = 1.43 cfs @ 12.08 hrs, Volume= 4,433 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.43 cfs @ 12.08 hrs, Volume= 4,433 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 115.34' @ 12.08 hrs
Flood Elev= 119.33'

Device	Routing	Invert	Outlet Devices
#1	Primary	114.54'	**12.0" Round Culvert** L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 114.54' / 114.46' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.38 cfs @ 12.08 hrs HW=115.33' (Free Discharge)
└─**1=Culvert** (Barrel Controls 1.38 cfs @ 2.86 fps)

Summary for Pond CDS3: CDS3

Inflow Area = 16,022 sf, 84.15% Impervious, Inflow Depth = 1.85" for 2-Year event
Inflow = 0.80 cfs @ 12.08 hrs, Volume= 2,476 cf
Outflow = 0.80 cfs @ 12.08 hrs, Volume= 2,476 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.80 cfs @ 12.08 hrs, Volume= 2,476 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 115.89' @ 12.08 hrs
Flood Elev= 120.73'

Device	Routing	Invert	Outlet Devices
#1	Primary	115.37'	**12.0" Round Culvert** L= 68.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 115.37' / 114.84' S= 0.0078 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.77 cfs @ 12.08 hrs HW=115.88' (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.77 cfs @ 1.92 fps)

Summary for Pond DMH2: DMH2

Inflow Area = 9,880 sf, 81.63% Impervious, Inflow Depth = 1.70" for 2-Year event
Inflow = 0.45 cfs @ 12.08 hrs, Volume= 1,396 cf
Outflow = 0.45 cfs @ 12.08 hrs, Volume= 1,396 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.45 cfs @ 12.08 hrs, Volume= 1,396 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 116.50' @ 12.08 hrs
Flood Elev= 120.60'

Device	Routing	Invert	Outlet Devices
#1	Primary	116.12'	**12.0" Round Culvert** L= 184.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 116.12' / 114.64' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.44 cfs @ 12.08 hrs HW=116.49' (Free Discharge)
↑**1=Culvert** (Inlet Controls 0.44 cfs @ 1.64 fps)

Summary for Pond DMH4: DMH4

Inflow Area = 110,275 sf, 89.86% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 113.46' @ 0.00 hrs
Flood Elev= 121.58'

Device	Routing	Invert	Outlet Devices
#1	Primary	113.46'	**12.0" Round Culvert** L= 101.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 113.46' / 112.40' S= 0.0105 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=113.46' (Free Discharge)
↑**1=Culvert** (Controls 0.00 cfs)

Summary for Pond INFIL1: INFIL. #1

Inflow Area = 110,275 sf, 89.86% Impervious, Inflow Depth = 2.15" for 2-Year event
Inflow = 6.09 cfs @ 12.07 hrs, Volume= 19,738 cf
Outflow = 1.07 cfs @ 12.53 hrs, Volume= 19,738 cf, Atten= 82%, Lag= 27.7 min
Discarded = 1.07 cfs @ 12.53 hrs, Volume= 19,738 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 114.21' @ 12.53 hrs Surf.Area= 6,699 sf Storage= 5,362 cf
Flood Elev= 118.00' Surf.Area= 6,699 sf Storage= 24,649 cf

Plug-Flow detention time= 30.5 min calculated for 19,724 cf (100% of inflow)
Center-of-Mass det. time= 30.4 min (818.7 - 788.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	113.00'	5,897 cf	**77.00'W x 87.00'L x 5.00'H Field A** 33,495 cf Overall - 18,751 cf Embedded = 14,744 cf x 40.0% Voids
#2A	113.00'	18,751 cf	**CMP Round 60** x 44 Inside #1 Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf Overall Size= 60.0"W x 60.0"H x 20.00'L 44 Chambers in 11 Rows 75.00' Header x 19.63 sf x 1 = 1,472.6 cf Inside
		24,649 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	114.80'	**12.0" Round Culvert** L= 124.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 114.80' / 113.56' S= 0.0100 '/' Cc= 0.900 n= 0.005, Flow Area= 0.79 sf
#2	Discarded	113.00'	**6.500 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=1.07 cfs @ 12.53 hrs HW=114.21' (Free Discharge)
↑**2=Exfiltration** (Exfiltration Controls 1.07 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=113.00' (Free Discharge)
↑**1=Culvert** (Controls 0.00 cfs)

Summary for Pond WQ1: WQ1

Inflow Area = 40,164 sf, 86.57% Impervious, Inflow Depth = 1.96" for 2-Year event
Inflow = 2.10 cfs @ 12.07 hrs, Volume= 6,545 cf
Outflow = 2.10 cfs @ 12.07 hrs, Volume= 6,545 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.10 cfs @ 12.07 hrs, Volume= 6,545 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 115.50' @ 12.07 hrs
Flood Elev= 119.94'

Device	Routing	Invert	Outlet Devices
#1	Primary	114.74'	**24.0" Round Culvert** L= 8.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 114.74' / 114.67' S= 0.0087 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=2.02 cfs @ 12.07 hrs HW=115.49' (Free Discharge)
1=Culvert (Barrel Controls 2.02 cfs @ 2.82 fps)

Summary for Pond WQ2: WQ2

Inflow Area = 31,442 sf, 81.60% Impervious, Inflow Depth = 1.69" for 2-Year event
Inflow = 1.43 cfs @ 12.08 hrs, Volume= 4,433 cf
Outflow = 1.43 cfs @ 12.08 hrs, Volume= 4,433 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.43 cfs @ 12.08 hrs, Volume= 4,433 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 114.76' @ 12.08 hrs
Flood Elev= 119.89'

Device	Routing	Invert	Outlet Devices
#1	Primary	114.17'	**24.0" Round Culvert** L= 18.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 114.17' / 114.03' S= 0.0078 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=1.38 cfs @ 12.08 hrs HW=114.75' (Free Discharge)
1=Culvert (Barrel Controls 1.38 cfs @ 2.74 fps)

Summary for Link 1L: Flow to Municipal

Inflow Area = 113,536 sf, 87.88% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 13.66 hrs, Volume= 27 cf
Primary = 0.00 cfs @ 13.66 hrs, Volume= 27 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment B-1: Subcat B-1	Runoff Area=17,679 sf 100.00% Impervious Runoff Depth=4.20" Tc=5.0 min CN=98 Runoff=1.77 cfs 6,194 cf
Subcatchment B-2: Subcat B-2	Runoff Area=20,991 sf 100.00% Impervious Runoff Depth=4.20" Tc=5.0 min CN=98 Runoff=2.10 cfs 7,354 cf
Subcatchment P-1: Subcat P-1	Runoff Area=8,538 sf 85.40% Impervious Runoff Depth=3.24" Tc=5.0 min CN=89 Runoff=0.73 cfs 2,304 cf
Subcatchment P-2: Subcat P-2	Runoff Area=15,604 sf 89.69% Impervious Runoff Depth=3.54" Tc=5.0 min CN=92 Runoff=1.43 cfs 4,608 cf
Subcatchment P-3: Subcat P-3	Runoff Area=9,350 sf 76.88% Impervious Runoff Depth=2.76" Tc=5.0 min CN=84 Runoff=0.69 cfs 2,153 cf
Subcatchment P-4: Subcat P-4	Runoff Area=12,212 sf 85.18% Impervious Runoff Depth=3.24" Tc=5.0 min CN=89 Runoff=1.05 cfs 3,295 cf
Subcatchment P-5: Subcat P-5	Runoff Area=9,880 sf 81.63% Impervious Runoff Depth=3.04" Tc=5.0 min CN=87 Runoff=0.80 cfs 2,505 cf
Subcatchment P-6: Subcat P-6	Runoff Area=16,022 sf 84.15% Impervious Runoff Depth=3.24" Tc=5.0 min CN=89 Runoff=1.37 cfs 4,324 cf
Subcatchment P-7: Subcat P-7	Runoff Area=12,690 sf 0.38% Impervious Runoff Depth=0.10" Tc=5.0 min CN=39 Runoff=0.00 cfs 107 cf
Subcatchment P-8: Subcat P-8	Runoff Area=3,261 sf 20.98% Impervious Runoff Depth=0.52" Tc=5.0 min CN=51 Runoff=0.02 cfs 142 cf
Subcatchment P-9: Subcat P-9	Runoff Area=39,090 sf 71.40% Impervious Runoff Depth=2.50" Tc=5.0 min CN=81 Runoff=2.63 cfs 8,132 cf
Reach SP1: Flow to Municipal	Inflow=0.47 cfs 1,408 cf Outflow=0.47 cfs 1,408 cf
Reach SP2: Flow to Tracks	Inflow=0.00 cfs 0 cf Outflow=0.00 cfs 0 cf
Pond 1P: Bio-Retention	Peak Elev=118.87' Storage=2,428 cf Inflow=2.63 cfs 8,132 cf Discarded=0.64 cfs 8,132 cf Primary=0.00 cfs 0 cf Outflow=0.64 cfs 8,132 cf
Pond CB1: CB1	Peak Elev=117.42' Inflow=0.73 cfs 2,304 cf 12.0" Round Culvert n=0.013 L=163.0' S=0.0080 '/' Outflow=0.73 cfs 2,304 cf
Pond CB2: CB2	Peak Elev=116.80' Inflow=1.43 cfs 4,608 cf 12.0" Round Culvert n=0.013 L=45.0' S=0.0100 '/' Outflow=1.43 cfs 4,608 cf
Pond CB3: CB3	Peak Elev=115.53' Inflow=0.69 cfs 2,153 cf 12.0" Round Culvert n=0.013 L=41.0' S=0.0100 '/' Outflow=0.69 cfs 2,153 cf
Pond CB4: CB4	Peak Elev=115.41' Inflow=1.05 cfs 3,295 cf 12.0" Round Culvert n=0.013 L=19.0' S=0.0100 '/' Outflow=1.05 cfs 3,295 cf
Pond CB5: CB5	Peak Elev=117.31' Inflow=0.80 cfs 2,505 cf 12.0" Round Culvert n=0.013 L=72.0' S=0.0081 '/' Outflow=0.80 cfs 2,505 cf
Pond CB6: CB6	Peak Elev=117.05' Inflow=1.37 cfs 4,324 cf 12.0" Round Culvert n=0.013 L=64.0' S=0.0053 '/' Outflow=1.37 cfs 4,324 cf
Pond CDS1: CDS1	Peak Elev=116.52' Inflow=2.16 cfs 6,912 cf 12.0" Round Culvert n=0.013 L=60.0' S=0.0080 '/' Outflow=2.16 cfs 6,912 cf

Pond CDS2: CDS2
Peak Elev=115.75' Inflow=2.55 cfs 7,953 cf
12.0" Round Culvert n=0.013 L=10.0' S=0.0080 '/' Outflow=2.55 cfs 7,953 cf

Pond CDS3: CDS3
Peak Elev=116.09' Inflow=1.37 cfs 4,324 cf
12.0" Round Culvert n=0.013 L=68.0' S=0.0078 '/' Outflow=1.37 cfs 4,324 cf

Pond DMH2: DMH2
Peak Elev=116.64' Inflow=0.80 cfs 2,505 cf
12.0" Round Culvert n=0.013 L=184.0' S=0.0080 '/' Outflow=0.80 cfs 2,505 cf

Pond DMH4: DMH4
Peak Elev=113.84' Inflow=0.46 cfs 1,159 cf
12.0" Round Culvert n=0.013 L=101.0' S=0.0105 '/' Outflow=0.46 cfs 1,159 cf

Pond INFIL1: INFIL. #1
Peak Elev=115.18' Storage=10,573 cf Inflow=9.96 cfs 32,737 cf
Discarded=1.12 cfs 31,578 cf Primary=0.46 cfs 1,159 cf Outflow=1.58 cfs 32,737 cf

Pond WQ1: WQ1
Peak Elev=115.76' Inflow=3.54 cfs 11,236 cf
24.0" Round Culvert n=0.013 L=8.0' S=0.0087 '/' Outflow=3.54 cfs 11,236 cf

Pond WQ2: WQ2
Peak Elev=114.99' Inflow=2.55 cfs 7,953 cf
24.0" Round Culvert n=0.013 L=18.0' S=0.0078 '/' Outflow=2.55 cfs 7,953 cf

Link 1L: Flow to Municipal
Inflow=0.47 cfs 1,301 cf
Primary=0.47 cfs 1,301 cf

Total Runoff Area = 165,316 sf Runoff Volume = 41,118 cf Average Runoff Depth = 2.98"
22.73% Pervious = 37,579 sf 77.27% Impervious = 127,737 sf

Summary for Subcatchment B-1: Subcat B-1

Runoff = 1.77 cfs @ 12.07 hrs, Volume= 6,194 cf, Depth= 4.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.44"

Area (sf)	CN	Description
17,679	98	Paved parking, HSG A
17,679		100.00% Impervious Area

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

Summary for Subcatchment B-2: Subcat B-2

Runoff = 2.10 cfs @ 12.07 hrs, Volume= 7,354 cf, Depth= 4.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.44"

Area (sf)	CN	Description
20,991	98	Roofs, HSG A
20,991		100.00% Impervious Area

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

Summary for Subcatchment P-1: Subcat P-1

Runoff = 0.73 cfs @ 12.07 hrs, Volume= 2,304 cf, Depth= 3.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.44"

Area (sf)	CN	Description
1,246	39	>75% Grass cover, Good, HSG A
7,292	98	Paved parking, HSG A
8,538	89	Weighted Average
1,246		14.60% Pervious Area
7,292		85.40% Impervious Area

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

Summary for Subcatchment P-2: Subcat P-2

Runoff = 1.43 cfs @ 12.07 hrs, Volume= 4,608 cf, Depth= 3.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.44"

Area (sf)	CN	Description
1,609	39	>75% Grass cover, Good, HSG A
13,995	98	Paved parking, HSG A
15,604	92	Weighted Average
1,609		10.31% Pervious Area
13,995		89.69% Impervious Area

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

Summary for Subcatchment P-3: Subcat P-3

Runoff = 0.69 cfs @ 12.08 hrs, Volume= 2,153 cf, Depth= 2.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.44"

Area (sf)	CN	Description
2,162	39	>75% Grass cover, Good, HSG A
7,188	98	Paved parking, HSG A
9,350	84	Weighted Average
2,162		23.12% Pervious Area
7,188		76.88% Impervious Area

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

Summary for Subcatchment P-4: Subcat P-4

Runoff = 1.05 cfs @ 12.07 hrs, Volume= 3,295 cf, Depth= 3.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.44"

Area (sf)	CN	Description
1,809	39	>75% Grass cover, Good, HSG A
10,403	98	Paved parking, HSG A
12,212	89	Weighted Average
1,809		14.82% Pervious Area
10,403		85.18% Impervious Area

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

Summary for Subcatchment P-5: Subcat P-5

Runoff = 0.80 cfs @ 12.07 hrs, Volume= 2,505 cf, Depth= 3.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.44"

Area (sf)	CN	Description
1,815	39	>75% Grass cover, Good, HSG A
8,064	98	Paved parking, HSG A
9,880	87	Weighted Average
1,815		18.37% Pervious Area
8,064		81.63% Impervious Area

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

Summary for Subcatchment P-6: Subcat P-6

Runoff = 1.37 cfs @ 12.07 hrs, Volume= 4,324 cf, Depth= 3.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.44"

Area (sf)	CN	Description
2,540	39	>75% Grass cover, Good, HSG A
13,482	98	Paved parking, HSG A
16,022	89	Weighted Average
2,540		15.85% Pervious Area
13,482		84.15% Impervious Area

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

Summary for Subcatchment P-7: Subcat P-7

Runoff = 0.00 cfs @ 14.77 hrs, Volume= 107 cf, Depth= 0.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.44"

Area (sf)	CN	Description
12,642	39	>75% Grass cover, Good, HSG A
48	98	Paved parking, HSG A
12,690	39	Weighted Average
12,642		99.62% Pervious Area
48		0.38% Impervious Area

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

Summary for Subcatchment P-8: Subcat P-8

Runoff = 0.02 cfs @ 12.12 hrs, Volume= 142 cf, Depth= 0.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.44"

Area (sf)	CN	Description
2,576	39	>75% Grass cover, Good, HSG A
684	98	Paved parking, HSG A
3,261	51	Weighted Average
2,576		79.02% Pervious Area
684		20.98% Impervious Area

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

Summary for Subcatchment P-9: Subcat P-9

Runoff = 2.63 cfs @ 12.08 hrs, Volume= 8,132 cf, Depth= 2.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.44"

Area (sf)	CN	Description
11,179	39	>75% Grass cover, Good, HSG A
27,911	98	Paved parking, HSG A
39,090	81	Weighted Average
11,179		28.60% Pervious Area
27,911		71.40% Impervious Area

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

Summary for Reach SP1: Flow to Municipal

Inflow Area = 126,225 sf, 79.09% Impervious, Inflow Depth = 0.13" for 10-Year event
Inflow = 0.47 cfs @ 12.55 hrs, Volume= 1,408 cf
Outflow = 0.47 cfs @ 12.55 hrs, Volume= 1,408 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach SP2: Flow to Tracks

Inflow Area = 39,090 sf, 71.40% Impervious, Inflow Depth = 0.00" for 10-Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Bio-Retention

Inflow Area = 39,090 sf, 71.40% Impervious, Inflow Depth = 2.50" for 10-Year event
Inflow = 2.63 cfs @ 12.08 hrs, Volume= 8,132 cf
Outflow = 0.64 cfs @ 12.48 hrs, Volume= 8,132 cf, Atten= 76%, Lag= 24.1 min
Discarded = 0.64 cfs @ 12.48 hrs, Volume= 8,132 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 118.87' @ 12.48 hrs Surf.Area= 3,939 sf Storage= 2,428 cf

Plug-Flow detention time= 38.0 min calculated for 8,126 cf (100% of inflow)
Center-of-Mass det. time= 38.0 min (861.2 - 823.3)

Volume	Invert	Avail.Storage	Storage Description
#1	118.00'	9,401 cf	**Pond Storage (Conic)**Listed below (Recalc)
#2	115.50'	788 cf	**FIlter Media (Conic)**Listed below (Recalc) 2,625 cf Overall x 30.0% Voids
		10,188 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
118.00	1,050	0	0	1,050
119.00	3,253	2,050	2,050	3,259
119.50	4,346	1,893	3,944	4,357
120.00	19,250	5,457	9,401	19,262

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
115.50	1,050	0	0	1,050
118.00	1,050	2,625	2,625	1,337

Device	Routing	Invert	Outlet Devices
#1	Discarded	115.50'	**6.500 in/hr Exfiltration over Wetted area**
#2	Primary	118.90'	**10.0' long x 0.5' breadth Broad-Crested Rectangular Weir X 3.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.64 cfs @ 12.48 hrs HW=118.87' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.64 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=115.50' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond CB1: CB1

Inflow Area =	8,538 sf, 85.40% Impervious,	Inflow Depth = 3.24"	for 10-Year event
Inflow =	0.73 cfs @ 12.07 hrs,	Volume=	2,304 cf
Outflow =	0.73 cfs @ 12.07 hrs,	Volume=	2,304 cf, Atten= 0%, Lag= 0.0 min
Primary =	0.73 cfs @ 12.07 hrs,	Volume=	2,304 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 117.42' @ 12.07 hrs
Flood Elev= 119.72'

Device	Routing	Invert	Outlet Devices
#1	Primary	116.92'	**12.0" Round Culvert** L= 163.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 116.92' / 115.62' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.70 cfs @ 12.07 hrs HW=117.40' (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.70 cfs @ 1.87 fps)

Summary for Pond CB2: CB2

Inflow Area =	15,604 sf, 89.69% Impervious,	Inflow Depth = 3.54"	for 10-Year event
Inflow =	1.43 cfs @ 12.07 hrs,	Volume=	4,608 cf
Outflow =	1.43 cfs @ 12.07 hrs,	Volume=	4,608 cf, Atten= 0%, Lag= 0.0 min
Primary =	1.43 cfs @ 12.07 hrs,	Volume=	4,608 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 116.80' @ 12.07 hrs
Flood Elev= 119.43'

Device	Routing	Invert	Outlet Devices
#1	Primary	116.06'	**12.0" Round Culvert** L= 45.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 116.06' / 115.61' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.38 cfs @ 12.07 hrs HW=116.78' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.38 cfs @ 2.28 fps)

Summary for Pond CB3: CB3

Inflow Area =	9,350 sf, 76.88% Impervious,	Inflow Depth = 2.76"	for 10-Year event
Inflow =	0.69 cfs @ 12.08 hrs,	Volume=	2,153 cf
Outflow =	0.69 cfs @ 12.08 hrs,	Volume=	2,153 cf, Atten= 0%, Lag= 0.0 min
Primary =	0.69 cfs @ 12.08 hrs,	Volume=	2,153 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 115.53' @ 12.08 hrs
Flood Elev= 119.33'

Device	Routing	Invert	Outlet Devices
#1	Primary	115.05'	**12.0" Round Culvert** L= 41.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 115.05' / 114.64' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.67 cfs @ 12.08 hrs HW=115.52' (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.67 cfs @ 1.84 fps)

Summary for Pond CB4: CB4

Inflow Area = 12,212 sf, 85.18% Impervious, Inflow Depth = 3.24" for 10-Year event
Inflow = 1.05 cfs @ 12.07 hrs, Volume= 3,295 cf
Outflow = 1.05 cfs @ 12.07 hrs, Volume= 3,295 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.05 cfs @ 12.07 hrs, Volume= 3,295 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 115.41' @ 12.07 hrs
Flood Elev= 119.29'

Device	Routing	Invert	Outlet Devices
#1	Primary	114.79'	**12.0" Round Culvert** L= 19.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 114.79' / 114.60' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.01 cfs @ 12.07 hrs HW=115.39' (Free Discharge)
└─**1=Culvert** (Barrel Controls 1.01 cfs @ 2.93 fps)

Summary for Pond CB5: CB5

Inflow Area = 9,880 sf, 81.63% Impervious, Inflow Depth = 3.04" for 10-Year event
Inflow = 0.80 cfs @ 12.07 hrs, Volume= 2,505 cf
Outflow = 0.80 cfs @ 12.07 hrs, Volume= 2,505 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.80 cfs @ 12.07 hrs, Volume= 2,505 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 117.31' @ 12.07 hrs
Flood Elev= 119.59'

Device	Routing	Invert	Outlet Devices
#1	Primary	116.79'	**12.0" Round Culvert** L= 72.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 116.79' / 116.21' S= 0.0081 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.77 cfs @ 12.07 hrs HW=117.30' (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.77 cfs @ 1.92 fps)

Summary for Pond CB6: CB6

Inflow Area = 16,022 sf, 84.15% Impervious, Inflow Depth = 3.24" for 10-Year event
Inflow = 1.37 cfs @ 12.07 hrs, Volume= 4,324 cf
Outflow = 1.37 cfs @ 12.07 hrs, Volume= 4,324 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.37 cfs @ 12.07 hrs, Volume= 4,324 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 117.05' @ 12.07 hrs
Flood Elev= 119.02'

Device	Routing	Invert	Outlet Devices
#1	Primary	116.30'	**12.0" Round Culvert** L= 64.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 116.30' / 115.96' S= 0.0053 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.32 cfs @ 12.07 hrs HW=117.03' (Free Discharge)
└─**1=Culvert** (Barrel Controls 1.32 cfs @ 2.99 fps)

Summary for Pond CDS1: CDS1

Inflow Area = 24,142 sf, 88.17% Impervious, Inflow Depth = 3.44" for 10-Year event
Inflow = 2.16 cfs @ 12.07 hrs, Volume= 6,912 cf
Outflow = 2.16 cfs @ 12.07 hrs, Volume= 6,912 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.16 cfs @ 12.07 hrs, Volume= 6,912 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Peak Elev= 116.52' @ 12.07 hrs
Flood Elev= 120.34'

Device	Routing	Invert	Outlet Devices
#1	Primary	115.51'	**12.0" Round Culvert** L= 60.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 115.51' / 115.03' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.09 cfs @ 12.07 hrs HW=116.49' (Free Discharge)
└─**1=Culvert** (Inlet Controls 2.09 cfs @ 2.66 fps)

Summary for Pond CDS2: CDS2

Inflow Area = 31,442 sf, 81.60% Impervious, Inflow Depth = 3.04" for 10-Year event
Inflow = 2.55 cfs @ 12.07 hrs, Volume= 7,953 cf
Outflow = 2.55 cfs @ 12.07 hrs, Volume= 7,953 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.55 cfs @ 12.07 hrs, Volume= 7,953 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 115.75' @ 12.07 hrs
Flood Elev= 119.33'

Device	Routing	Invert	Outlet Devices
#1	Primary	114.54'	**12.0" Round Culvert** L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 114.54' / 114.46' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.46 cfs @ 12.07 hrs HW=115.72' (Free Discharge)
└─**1=Culvert** (Inlet Controls 2.46 cfs @ 3.13 fps)

Summary for Pond CDS3: CDS3

Inflow Area = 16,022 sf, 84.15% Impervious, Inflow Depth = 3.24" for 10-Year event
Inflow = 1.37 cfs @ 12.07 hrs, Volume= 4,324 cf
Outflow = 1.37 cfs @ 12.07 hrs, Volume= 4,324 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.37 cfs @ 12.07 hrs, Volume= 4,324 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 116.09' @ 12.07 hrs
Flood Elev= 120.73'

Device	Routing	Invert	Outlet Devices
#1	Primary	115.37'	**12.0" Round Culvert** L= 68.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 115.37' / 114.84' S= 0.0078 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.32 cfs @ 12.07 hrs HW=116.07' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.32 cfs @ 2.25 fps)

Summary for Pond DMH2: DMH2

Inflow Area = 9,880 sf, 81.63% Impervious, Inflow Depth = 3.04" for 10-Year event
Inflow = 0.80 cfs @ 12.07 hrs, Volume= 2,505 cf
Outflow = 0.80 cfs @ 12.07 hrs, Volume= 2,505 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.80 cfs @ 12.07 hrs, Volume= 2,505 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 116.64' @ 12.07 hrs
Flood Elev= 120.60'

Device	Routing	Invert	Outlet Devices
#1	Primary	116.12'	**12.0" Round Culvert** L= 184.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 116.12' / 114.64' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.77 cfs @ 12.07 hrs HW=116.63' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.77 cfs @ 1.92 fps)

Summary for Pond DMH4: DMH4

Inflow Area = 110,275 sf, 89.86% Impervious, Inflow Depth = 0.13" for 10-Year event
Inflow = 0.46 cfs @ 12.55 hrs, Volume= 1,159 cf
Outflow = 0.46 cfs @ 12.55 hrs, Volume= 1,159 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.46 cfs @ 12.55 hrs, Volume= 1,159 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 113.84' @ 12.55 hrs
Flood Elev= 121.58'

Device	Routing	Invert	Outlet Devices
#1	Primary	113.46'	**12.0" Round Culvert** L= 101.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 113.46' / 112.40' S= 0.0105 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.46 cfs @ 12.55 hrs HW=113.84' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.46 cfs @ 1.66 fps)

Summary for Pond INFIL1: INFIL. #1

Inflow Area = 110,275 sf, 89.86% Impervious, Inflow Depth = 3.56" for 10-Year event
Inflow = 9.96 cfs @ 12.07 hrs, Volume= 32,737 cf
Outflow = 1.58 cfs @ 12.55 hrs, Volume= 32,737 cf, Atten= 84%, Lag= 28.9 min
Discarded = 1.12 cfs @ 12.55 hrs, Volume= 31,578 cf
Primary = 0.46 cfs @ 12.55 hrs, Volume= 1,159 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 115.18' @ 12.55 hrs Surf.Area= 6,699 sf Storage= 10,573 cf
Flood Elev= 118.00' Surf.Area= 6,699 sf Storage= 24,649 cf

Plug-Flow detention time= 60.9 min calculated for 32,714 cf (100% of inflow)
Center-of-Mass det. time= 60.8 min (838.4 - 777.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	113.00'	5,897 cf	**77.00'W x 87.00'L x 5.00'H Field A** 33,495 cf Overall - 18,751 cf Embedded = 14,744 cf x 40.0% Voids
#2A	113.00'	18,751 cf	**CMP Round 60** x 44 Inside #1 Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf Overall Size= 60.0"W x 60.0"H x 20.00'L 44 Chambers in 11 Rows 75.00' Header x 19.63 sf x 1 = 1,472.6 cf Inside
		24,649 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	114.80'	**12.0" Round Culvert** L= 124.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 114.80' / 113.56' S= 0.0100 '/' Cc= 0.900 n= 0.005, Flow Area= 0.79 sf
#2	Discarded	113.00'	**6.500 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=1.12 cfs @ 12.55 hrs HW=115.18' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 1.12 cfs)

Primary OutFlow Max=0.46 cfs @ 12.55 hrs HW=115.18' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.46 cfs @ 1.66 fps)

Summary for Pond WQ1: WQ1

Inflow Area =	40,164 sf,	86.57% Impervious,	Inflow Depth = 3.36"	for 10-Year event
Inflow =	3.54 cfs @	12.07 hrs, Volume=	11,236 cf	
Outflow =	3.54 cfs @	12.07 hrs, Volume=	11,236 cf,	Atten= 0%, Lag= 0.0 min
Primary =	3.54 cfs @	12.07 hrs, Volume=	11,236 cf	

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 115.76' @ 12.07 hrs
Flood Elev= 119.94'

Device	Routing	Invert	Outlet Devices
#1	Primary	114.74'	**24.0" Round Culvert** L= 8.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 114.74' / 114.67' S= 0.0087 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=3.41 cfs @ 12.07 hrs HW=115.74' (Free Discharge)
└**1=Culvert** (Barrel Controls 3.41 cfs @ 3.18 fps)

Summary for Pond WQ2: WQ2

Inflow Area =	31,442 sf,	81.60% Impervious,	Inflow Depth = 3.04"	for 10-Year event
Inflow =	2.55 cfs @	12.07 hrs, Volume=	7,953 cf	
Outflow =	2.55 cfs @	12.07 hrs, Volume=	7,953 cf,	Atten= 0%, Lag= 0.0 min
Primary =	2.55 cfs @	12.07 hrs, Volume=	7,953 cf	

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 114.99' @ 12.07 hrs
Flood Elev= 119.89'

Device	Routing	Invert	Outlet Devices
#1	Primary	114.17'	**24.0" Round Culvert** L= 18.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 114.17' / 114.03' S= 0.0078 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=2.45 cfs @ 12.07 hrs HW=114.97' (Free Discharge)
└**1=Culvert** (Barrel Controls 2.45 cfs @ 3.10 fps)

Summary for Link 1L: Flow to Municipal

Inflow Area =	113,536 sf,	87.88% Impervious,	Inflow Depth = 0.14"	for 10-Year event
Inflow =	0.47 cfs @	12.55 hrs, Volume=	1,301 cf	
Primary =	0.47 cfs @	12.55 hrs, Volume=	1,301 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment B-1: Subcat B-1	Runoff Area=17,679 sf 100.00% Impervious Runoff Depth=6.45" Tc=5.0 min CN=98 Runoff=2.68 cfs 9,504 cf
Subcatchment B-2: Subcat B-2	Runoff Area=20,991 sf 100.00% Impervious Runoff Depth=6.45" Tc=5.0 min CN=98 Runoff=3.18 cfs 11,285 cf
Subcatchment P-1: Subcat P-1	Runoff Area=8,538 sf 85.40% Impervious Runoff Depth=5.41" Tc=5.0 min CN=89 Runoff=1.19 cfs 3,846 cf
Subcatchment P-2: Subcat P-2	Runoff Area=15,604 sf 89.69% Impervious Runoff Depth=5.75" Tc=5.0 min CN=92 Runoff=2.26 cfs 7,475 cf
Subcatchment P-3: Subcat P-3	Runoff Area=9,350 sf 76.88% Impervious Runoff Depth=4.85" Tc=5.0 min CN=84 Runoff=1.20 cfs 3,776 cf
Subcatchment P-4: Subcat P-4	Runoff Area=12,212 sf 85.18% Impervious Runoff Depth=5.41" Tc=5.0 min CN=89 Runoff=1.70 cfs 5,501 cf
Subcatchment P-5: Subcat P-5	Runoff Area=9,880 sf 81.63% Impervious Runoff Depth=5.18" Tc=5.0 min CN=87 Runoff=1.34 cfs 4,265 cf
Subcatchment P-6: Subcat P-6	Runoff Area=16,022 sf 84.15% Impervious Runoff Depth=5.41" Tc=5.0 min CN=89 Runoff=2.23 cfs 7,218 cf
Subcatchment P-7: Subcat P-7	Runoff Area=12,690 sf 0.38% Impervious Runoff Depth=0.66" Tc=5.0 min CN=39 Runoff=0.09 cfs 699 cf
Subcatchment P-8: Subcat P-8	Runoff Area=3,261 sf 20.98% Impervious Runoff Depth=1.58" Tc=5.0 min CN=51 Runoff=0.12 cfs 430 cf
Subcatchment P-9: Subcat P-9	Runoff Area=39,090 sf 71.40% Impervious Runoff Depth=4.52" Tc=5.0 min CN=81 Runoff=4.73 cfs 14,716 cf
Reach SP1: Flow to Municipal	Inflow=2.97 cfs 12,077 cf Outflow=2.97 cfs 12,077 cf
Reach SP2: Flow to Tracks	Inflow=3.98 cfs 2,857 cf Outflow=3.98 cfs 2,857 cf
Pond 1P: Bio-Retention	Peak Elev=119.03' Storage=2,950 cf Inflow=4.73 cfs 14,716 cf Discarded=0.70 cfs 11,859 cf Primary=3.98 cfs 2,857 cf Outflow=4.68 cfs 14,716 cf
Pond CB1: CB1	Peak Elev=117.58' Inflow=1.19 cfs 3,846 cf 12.0" Round Culvert n=0.013 L=163.0' S=0.0080 '/' Outflow=1.19 cfs 3,846 cf
Pond CB2: CB2	Peak Elev=117.13' Inflow=2.26 cfs 7,475 cf 12.0" Round Culvert n=0.013 L=45.0' S=0.0100 '/' Outflow=2.26 cfs 7,475 cf
Pond CB3: CB3	Peak Elev=115.71' Inflow=1.20 cfs 3,776 cf 12.0" Round Culvert n=0.013 L=41.0' S=0.0100 '/' Outflow=1.20 cfs 3,776 cf
Pond CB4: CB4	Peak Elev=115.63' Inflow=1.70 cfs 5,501 cf 12.0" Round Culvert n=0.013 L=19.0' S=0.0100 '/' Outflow=1.70 cfs 5,501 cf
Pond CB5: CB5	Peak Elev=117.50' Inflow=1.34 cfs 4,265 cf 12.0" Round Culvert n=0.013 L=72.0' S=0.0081 '/' Outflow=1.34 cfs 4,265 cf
Pond CB6: CB6	Peak Elev=117.35' Inflow=2.23 cfs 7,218 cf 12.0" Round Culvert n=0.013 L=64.0' S=0.0053 '/' Outflow=2.23 cfs 7,218 cf
Pond CDS1: CDS1	Peak Elev=117.33' Inflow=3.45 cfs 11,322 cf 12.0" Round Culvert n=0.013 L=60.0' S=0.0080 '/' Outflow=3.45 cfs 11,322 cf

Pond CDS2: CDS2
Peak Elev=117.04' Inflow=4.24 cfs 13,542 cf
12.0" Round Culvert n=0.013 L=10.0' S=0.0080 '/' Outflow=4.24 cfs 13,542 cf

Pond CDS3: CDS3
Peak Elev=116.42' Inflow=2.23 cfs 7,218 cf
12.0" Round Culvert n=0.013 L=68.0' S=0.0078 '/' Outflow=2.23 cfs 7,218 cf

Pond DMH2: DMH2
Peak Elev=116.83' Inflow=1.34 cfs 4,265 cf
12.0" Round Culvert n=0.013 L=184.0' S=0.0080 '/' Outflow=1.34 cfs 4,265 cf

Pond DMH4: DMH4
Peak Elev=114.87' Inflow=2.84 cfs 10,949 cf
12.0" Round Culvert n=0.013 L=101.0' S=0.0105 '/' Outflow=2.84 cfs 10,949 cf

Pond INFIL1: INFIL. #1
Peak Elev=116.21' Storage=16,206 cf Inflow=15.79 cfs 52,870 cf
Discarded=1.17 cfs 41,921 cf Primary=2.84 cfs 10,949 cf Outflow=4.01 cfs 52,870 cf

Pond WQ1: WQ1
Peak Elev=116.08' Inflow=5.69 cfs 18,539 cf
24.0" Round Culvert n=0.013 L=8.0' S=0.0087 '/' Outflow=5.69 cfs 18,539 cf

Pond WQ2: WQ2
Peak Elev=115.26' Inflow=4.24 cfs 13,542 cf
24.0" Round Culvert n=0.013 L=18.0' S=0.0078 '/' Outflow=4.24 cfs 13,542 cf

Link 1L: Flow to Municipal
Inflow=2.89 cfs 11,378 cf
Primary=2.89 cfs 11,378 cf

Total Runoff Area = 165,316 sf Runoff Volume = 68,714 cf Average Runoff Depth = 4.99"
22.73% Pervious = 37,579 sf 77.27% Impervious = 127,737 sf

Summary for Subcatchment B-1: Subcat B-1

Runoff = 2.68 cfs @ 12.07 hrs, Volume= 9,504 cf, Depth= 6.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.69"

Area (sf)	CN	Description
17,679	98	Paved parking, HSG A
17,679		100.00% Impervious Area

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

Summary for Subcatchment B-2: Subcat B-2

Runoff = 3.18 cfs @ 12.07 hrs, Volume= 11,285 cf, Depth= 6.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.69"

Area (sf)	CN	Description
20,991	98	Roofs, HSG A
20,991		100.00% Impervious Area

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

Summary for Subcatchment P-1: Subcat P-1

Runoff = 1.19 cfs @ 12.07 hrs, Volume= 3,846 cf, Depth= 5.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.69"

Area (sf)	CN	Description
1,246	39	>75% Grass cover, Good, HSG A
7,292	98	Paved parking, HSG A
8,538	89	Weighted Average
1,246		14.60% Pervious Area
7,292		85.40% Impervious Area

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

Summary for Subcatchment P-2: Subcat P-2

Runoff = 2.26 cfs @ 12.07 hrs, Volume= 7,475 cf, Depth= 5.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.69"

Area (sf)	CN	Description
1,609	39	>75% Grass cover, Good, HSG A
13,995	98	Paved parking, HSG A
15,604	92	Weighted Average
1,609		10.31% Pervious Area
13,995		89.69% Impervious Area

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

Summary for Subcatchment P-3: Subcat P-3

Runoff = 1.20 cfs @ 12.07 hrs, Volume= 3,776 cf, Depth= 4.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.69"

Area (sf)	CN	Description
2,162	39	>75% Grass cover, Good, HSG A
7,188	98	Paved parking, HSG A
9,350	84	Weighted Average
2,162		23.12% Pervious Area
7,188		76.88% Impervious Area

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

Summary for Subcatchment P-4: Subcat P-4

Runoff = 1.70 cfs @ 12.07 hrs, Volume= 5,501 cf, Depth= 5.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.69"

Area (sf)	CN	Description
1,809	39	>75% Grass cover, Good, HSG A
10,403	98	Paved parking, HSG A
12,212	89	Weighted Average
1,809		14.82% Pervious Area
10,403		85.18% Impervious Area

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

Summary for Subcatchment P-5: Subcat P-5

Runoff = 1.34 cfs @ 12.07 hrs, Volume= 4,265 cf, Depth= 5.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.69"

Area (sf)	CN	Description
1,815	39	>75% Grass cover, Good, HSG A
8,064	98	Paved parking, HSG A
9,880	87	Weighted Average
1,815		18.37% Pervious Area
8,064		81.63% Impervious Area

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

Summary for Subcatchment P-6: Subcat P-6

Runoff = 2.23 cfs @ 12.07 hrs, Volume= 7,218 cf, Depth= 5.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.69"

Area (sf)	CN	Description
2,540	39	>75% Grass cover, Good, HSG A
13,482	98	Paved parking, HSG A
16,022	89	Weighted Average
2,540		15.85% Pervious Area
13,482		84.15% Impervious Area

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

Summary for Subcatchment P-7: Subcat P-7

Runoff = 0.09 cfs @ 12.15 hrs, Volume= 699 cf, Depth= 0.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.69"

Area (sf)	CN	Description
12,642	39	>75% Grass cover, Good, HSG A
48	98	Paved parking, HSG A
12,690	39	Weighted Average
12,642		99.62% Pervious Area
48		0.38% Impervious Area

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

Summary for Subcatchment P-8: Subcat P-8

Runoff = 0.12 cfs @ 12.09 hrs, Volume= 430 cf, Depth= 1.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.69"

Area (sf)	CN	Description
2,576	39	>75% Grass cover, Good, HSG A
684	98	Paved parking, HSG A
3,261	51	Weighted Average
2,576		79.02% Pervious Area
684		20.98% Impervious Area

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

Summary for Subcatchment P-9: Subcat P-9

Runoff = 4.73 cfs @ 12.07 hrs, Volume= 14,716 cf, Depth= 4.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.69"

Area (sf)	CN	Description
11,179	39	>75% Grass cover, Good, HSG A
27,911	98	Paved parking, HSG A
39,090	81	Weighted Average
11,179		28.60% Pervious Area
27,911		71.40% Impervious Area

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

Summary for Reach SP1: Flow to Municipal

Inflow Area = 126,225 sf, 79.09% Impervious, Inflow Depth = 1.15" for 50-Year event
Inflow = 2.97 cfs @ 12.42 hrs, Volume= 12,077 cf
Outflow = 2.97 cfs @ 12.42 hrs, Volume= 12,077 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach SP2: Flow to Tracks

Inflow Area = 39,090 sf, 71.40% Impervious, Inflow Depth = 0.88" for 50-Year event
Inflow = 3.98 cfs @ 12.12 hrs, Volume= 2,857 cf
Outflow = 3.98 cfs @ 12.12 hrs, Volume= 2,857 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Bio-Retention

Inflow Area = 39,090 sf, 71.40% Impervious, Inflow Depth = 4.52" for 50-Year event
Inflow = 4.73 cfs @ 12.07 hrs, Volume= 14,716 cf
Outflow = 4.68 cfs @ 12.12 hrs, Volume= 14,716 cf, Atten= 1%, Lag= 2.7 min
Discarded = 0.70 cfs @ 12.12 hrs, Volume= 11,859 cf
Primary = 3.98 cfs @ 12.12 hrs, Volume= 2,857 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 119.03' @ 12.12 hrs Surf.Area= 4,372 sf Storage= 2,950 cf

Plug-Flow detention time= 33.4 min calculated for 14,706 cf (100% of inflow)
Center-of-Mass det. time= 33.3 min (839.7 - 806.3)

Volume	Invert	Avail.Storage	Storage Description
#1	118.00'	9,401 cf	**Pond Storage (Conic)**Listed below (Recalc)
#2	115.50'	788 cf	**FIlter Media (Conic)**Listed below (Recalc) 2,625 cf Overall x 30.0% Voids
		10,188 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
118.00	1,050	0	0	1,050
119.00	3,253	2,050	2,050	3,259
119.50	4,346	1,893	3,944	4,357
120.00	19,250	5,457	9,401	19,262

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
115.50	1,050	0	0	1,050
118.00	1,050	2,625	2,625	1,337

Device	Routing	Invert	Outlet Devices
#1	Discarded	115.50'	**6.500 in/hr Exfiltration over Wetted area**
#2	Primary	118.90'	**10.0' long x 0.5' breadth Broad-Crested Rectangular Weir X 3.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.70 cfs @ 12.12 hrs HW=119.02' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.70 cfs)

Primary OutFlow Max=3.47 cfs @ 12.12 hrs HW=119.02' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 3.47 cfs @ 0.97 fps)

Summary for Pond CB1: CB1

Inflow Area = 8,538 sf, 85.40% Impervious, Inflow Depth = 5.41" for 50-Year event
Inflow = 1.19 cfs @ 12.07 hrs, Volume= 3,846 cf
Outflow = 1.19 cfs @ 12.07 hrs, Volume= 3,846 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.19 cfs @ 12.07 hrs, Volume= 3,846 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 117.58' @ 12.07 hrs
Flood Elev= 119.72'

Device	Routing	Invert	Outlet Devices
#1	Primary	116.92'	**12.0" Round Culvert** L= 163.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 116.92' / 115.62' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.15 cfs @ 12.07 hrs HW=117.56' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.15 cfs @ 2.15 fps)

Summary for Pond CB2: CB2

Inflow Area = 15,604 sf, 89.69% Impervious, Inflow Depth = 5.75" for 50-Year event
Inflow = 2.26 cfs @ 12.07 hrs, Volume= 7,475 cf
Outflow = 2.26 cfs @ 12.07 hrs, Volume= 7,475 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.26 cfs @ 12.07 hrs, Volume= 7,475 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 117.13' @ 12.07 hrs
Flood Elev= 119.43'

Device	Routing	Invert	Outlet Devices
#1	Primary	116.06'	**12.0" Round Culvert** L= 45.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 116.06' / 115.61' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.18 cfs @ 12.07 hrs HW=117.09' (Free Discharge)
└─**1=Culvert** (Inlet Controls 2.18 cfs @ 2.77 fps)

Summary for Pond CB3: CB3

Inflow Area = 9,350 sf, 76.88% Impervious, Inflow Depth = 4.85" for 50-Year event
Inflow = 1.20 cfs @ 12.07 hrs, Volume= 3,776 cf
Outflow = 1.20 cfs @ 12.07 hrs, Volume= 3,776 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.20 cfs @ 12.07 hrs, Volume= 3,776 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 115.71' @ 12.07 hrs
Flood Elev= 119.33'

Device	Routing	Invert	Outlet Devices
#1	Primary	115.05'	**12.0" Round Culvert** L= 41.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 115.05' / 114.64' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.16 cfs @ 12.07 hrs HW=115.69' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.16 cfs @ 2.16 fps)

Summary for Pond CB4: CB4

Inflow Area = 12,212 sf, 85.18% Impervious, Inflow Depth = 5.41" for 50-Year event
Inflow = 1.70 cfs @ 12.07 hrs, Volume= 5,501 cf
Outflow = 1.70 cfs @ 12.07 hrs, Volume= 5,501 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.70 cfs @ 12.07 hrs, Volume= 5,501 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 115.63' @ 12.07 hrs
Flood Elev= 119.29'

Device	Routing	Invert	Outlet Devices
#1	Primary	114.79'	**12.0" Round Culvert** L= 19.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 114.79' / 114.60' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.64 cfs @ 12.07 hrs HW=115.61' (Free Discharge)
└─**1=Culvert** (Barrel Controls 1.64 cfs @ 3.25 fps)

Summary for Pond CB5: CB5

Inflow Area = 9,880 sf, 81.63% Impervious, Inflow Depth = 5.18" for 50-Year event
Inflow = 1.34 cfs @ 12.07 hrs, Volume= 4,265 cf
Outflow = 1.34 cfs @ 12.07 hrs, Volume= 4,265 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.34 cfs @ 12.07 hrs, Volume= 4,265 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 117.50' @ 12.07 hrs
Flood Elev= 119.59'

Device	Routing	Invert	Outlet Devices
#1	Primary	116.79'	**12.0" Round Culvert** L= 72.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 116.79' / 116.21' S= 0.0081 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.29 cfs @ 12.07 hrs HW=117.48' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.29 cfs @ 2.23 fps)

Summary for Pond CB6: CB6

Inflow Area = 16,022 sf, 84.15% Impervious, Inflow Depth = 5.41" for 50-Year event
Inflow = 2.23 cfs @ 12.07 hrs, Volume= 7,218 cf
Outflow = 2.23 cfs @ 12.07 hrs, Volume= 7,218 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.23 cfs @ 12.07 hrs, Volume= 7,218 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 117.35' @ 12.07 hrs
Flood Elev= 119.02'

Device	Routing	Invert	Outlet Devices
#1	Primary	116.30'	**12.0" Round Culvert** L= 64.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 116.30' / 115.96' S= 0.0053 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.15 cfs @ 12.07 hrs HW=117.32' (Free Discharge)
└─**1=Culvert** (Barrel Controls 2.15 cfs @ 3.33 fps)

Summary for Pond CDS1: CDS1

Inflow Area = 24,142 sf, 88.17% Impervious, Inflow Depth = 5.63" for 50-Year event
Inflow = 3.45 cfs @ 12.07 hrs, Volume= 11,322 cf
Outflow = 3.45 cfs @ 12.07 hrs, Volume= 11,322 cf, Atten= 0%, Lag= 0.0 min
Primary = 3.45 cfs @ 12.07 hrs, Volume= 11,322 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Peak Elev= 117.33' @ 12.07 hrs
Flood Elev= 120.34'

Device	Routing	Invert	Outlet Devices
#1	Primary	115.51'	**12.0" Round Culvert** L= 60.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 115.51' / 115.03' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=3.32 cfs @ 12.07 hrs HW=117.25' (Free Discharge)
└─**1=Culvert** (Inlet Controls 3.32 cfs @ 4.23 fps)

Summary for Pond CDS2: CDS2

Inflow Area = 31,442 sf, 81.60% Impervious, Inflow Depth = 5.17" for 50-Year event
Inflow = 4.24 cfs @ 12.07 hrs, Volume= 13,542 cf
Outflow = 4.24 cfs @ 12.07 hrs, Volume= 13,542 cf, Atten= 0%, Lag= 0.0 min
Primary = 4.24 cfs @ 12.07 hrs, Volume= 13,542 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 117.04' @ 12.07 hrs
Flood Elev= 119.33'

Device	Routing	Invert	Outlet Devices
#1	Primary	114.54'	**12.0" Round Culvert** L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 114.54' / 114.46' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=4.08 cfs @ 12.07 hrs HW=116.91' (Free Discharge)
└─**1=Culvert** (Inlet Controls 4.08 cfs @ 5.20 fps)

Summary for Pond CDS3: CDS3

Inflow Area = 16,022 sf, 84.15% Impervious, Inflow Depth = 5.41" for 50-Year event
Inflow = 2.23 cfs @ 12.07 hrs, Volume= 7,218 cf
Outflow = 2.23 cfs @ 12.07 hrs, Volume= 7,218 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.23 cfs @ 12.07 hrs, Volume= 7,218 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 116.42' @ 12.07 hrs
Flood Elev= 120.73'

Device	Routing	Invert	Outlet Devices
#1	Primary	115.37'	**12.0" Round Culvert** L= 68.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 115.37' / 114.84' S= 0.0078 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.15 cfs @ 12.07 hrs HW=116.39' (Free Discharge)
└─**1=Culvert** (Inlet Controls 2.15 cfs @ 2.74 fps)

Summary for Pond DMH2: DMH2

Inflow Area = 9,880 sf, 81.63% Impervious, Inflow Depth = 5.18" for 50-Year event
Inflow = 1.34 cfs @ 12.07 hrs, Volume= 4,265 cf
Outflow = 1.34 cfs @ 12.07 hrs, Volume= 4,265 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.34 cfs @ 12.07 hrs, Volume= 4,265 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 116.83' @ 12.07 hrs
Flood Elev= 120.60'

Device	Routing	Invert	Outlet Devices
#1	Primary	116.12'	**12.0" Round Culvert** L= 184.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 116.12' / 114.64' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.29 cfs @ 12.07 hrs HW=116.81' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.29 cfs @ 2.23 fps)

Summary for Pond DMH4: DMH4

Inflow Area = 110,275 sf, 89.86% Impervious, Inflow Depth = 1.19" for 50-Year event
Inflow = 2.84 cfs @ 12.44 hrs, Volume= 10,949 cf
Outflow = 2.84 cfs @ 12.44 hrs, Volume= 10,949 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.84 cfs @ 12.44 hrs, Volume= 10,949 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 114.87' @ 12.44 hrs
Flood Elev= 121.58'

Device	Routing	Invert	Outlet Devices
#1	Primary	113.46'	**12.0" Round Culvert** L= 101.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 113.46' / 112.40' S= 0.0105 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.84 cfs @ 12.44 hrs HW=114.86' (Free Discharge)
└─**1=Culvert** (Inlet Controls 2.84 cfs @ 3.61 fps)

Summary for Pond INFIL1: INFIL. #1

Inflow Area = 110,275 sf, 89.86% Impervious, Inflow Depth = 5.75" for 50-Year event
Inflow = 15.79 cfs @ 12.07 hrs, Volume= 52,870 cf
Outflow = 4.01 cfs @ 12.44 hrs, Volume= 52,870 cf, Atten= 75%, Lag= 21.9 min
Discarded = 1.17 cfs @ 12.44 hrs, Volume= 41,921 cf
Primary = 2.84 cfs @ 12.44 hrs, Volume= 10,949 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 116.21' @ 12.44 hrs Surf.Area= 6,699 sf Storage= 16,206 cf
Flood Elev= 118.00' Surf.Area= 6,699 sf Storage= 24,649 cf

Plug-Flow detention time= 59.6 min calculated for 52,833 cf (100% of inflow)
Center-of-Mass det. time= 59.6 min (827.2 - 767.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	113.00'	5,897 cf	**77.00'W x 87.00'L x 5.00'H Field A** 33,495 cf Overall - 18,751 cf Embedded = 14,744 cf x 40.0% Voids
#2A	113.00'	18,751 cf	**CMP Round 60** x 44 Inside #1 Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf Overall Size= 60.0"W x 60.0"H x 20.00'L 44 Chambers in 11 Rows 75.00' Header x 19.63 sf x 1 = 1,472.6 cf Inside
		24,649 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	114.80'	**12.0" Round Culvert** L= 124.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 114.80' / 113.56' S= 0.0100 '/' Cc= 0.900 n= 0.005, Flow Area= 0.79 sf
#2	Discarded	113.00'	**6.500 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=1.17 cfs @ 12.44 hrs HW=116.20' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 1.17 cfs)

Primary OutFlow Max=2.84 cfs @ 12.44 hrs HW=116.20' (Free Discharge)
└─**1=Culvert** (Inlet Controls 2.84 cfs @ 3.61 fps)

Summary for Pond WQ1: WQ1

Inflow Area = 40,164 sf, 86.57% Impervious, Inflow Depth = 5.54" for 50-Year event
Inflow = 5.69 cfs @ 12.07 hrs, Volume= 18,539 cf
Outflow = 5.69 cfs @ 12.07 hrs, Volume= 18,539 cf, Atten= 0%, Lag= 0.0 min
Primary = 5.69 cfs @ 12.07 hrs, Volume= 18,539 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 116.08' @ 12.07 hrs
Flood Elev= 119.94'

Device	Routing	Invert	Outlet Devices
#1	Primary	114.74'	**24.0" Round Culvert** L= 8.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 114.74' / 114.67' S= 0.0087 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=5.48 cfs @ 12.07 hrs HW=116.05' (Free Discharge)
└**1=Culvert** (Barrel Controls 5.48 cfs @ 3.57 fps)

Summary for Pond WQ2: WQ2

Inflow Area = 31,442 sf, 81.60% Impervious, Inflow Depth = 5.17" for 50-Year event
Inflow = 4.24 cfs @ 12.07 hrs, Volume= 13,542 cf
Outflow = 4.24 cfs @ 12.07 hrs, Volume= 13,542 cf, Atten= 0%, Lag= 0.0 min
Primary = 4.24 cfs @ 12.07 hrs, Volume= 13,542 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 115.26' @ 12.07 hrs
Flood Elev= 119.89'

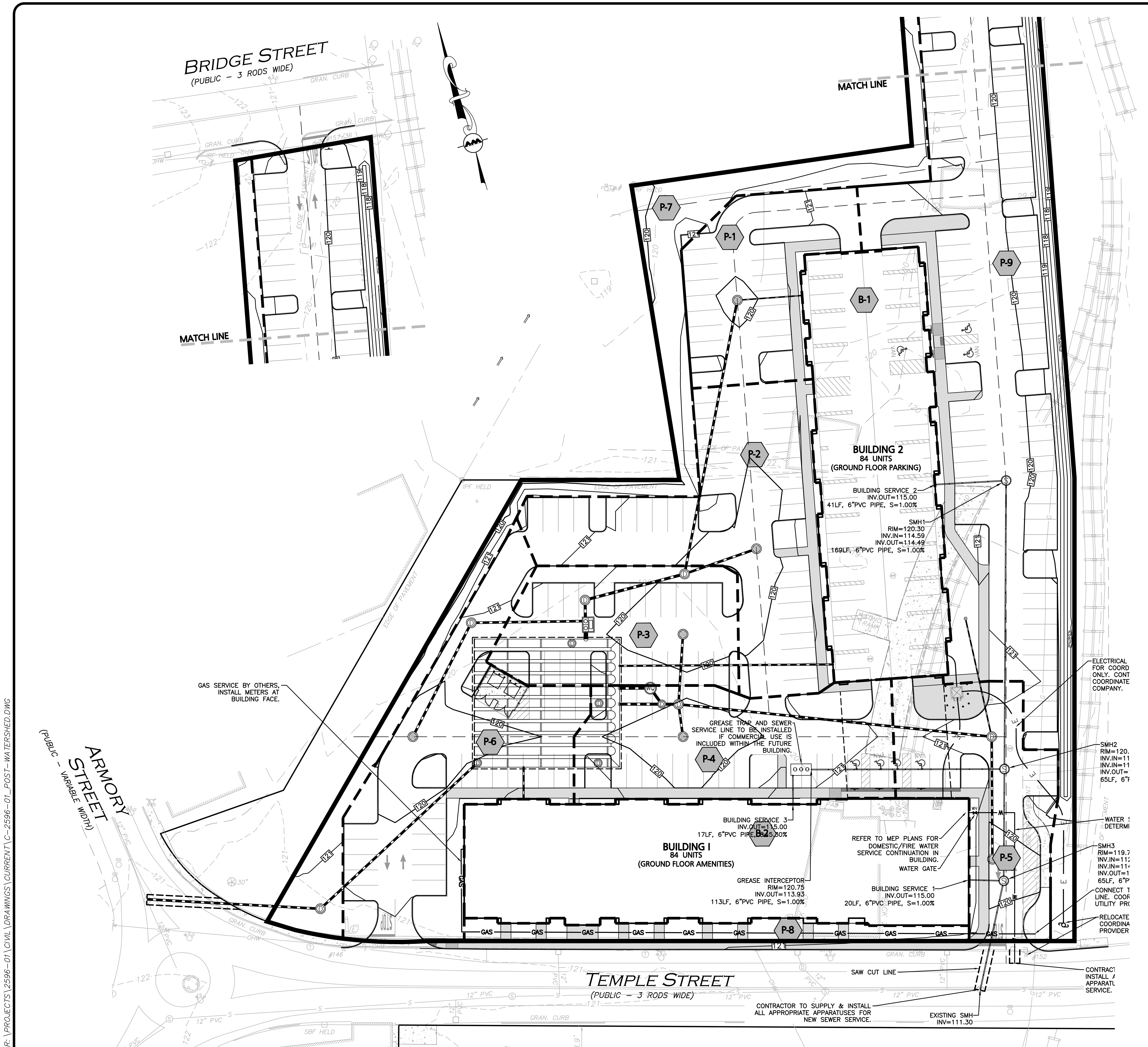
Device	Routing	Invert	Outlet Devices
#1	Primary	114.17'	**24.0" Round Culvert** L= 18.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 114.17' / 114.03' S= 0.0078 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=4.08 cfs @ 12.07 hrs HW=115.24' (Free Discharge)
└**1=Culvert** (Barrel Controls 4.08 cfs @ 3.47 fps)

Summary for Link 1L: Flow to Municipal

Inflow Area = 113,536 sf, 87.88% Impervious, Inflow Depth = 1.20" for 50-Year event
Inflow = 2.89 cfs @ 12.43 hrs, Volume= 11,378 cf
Primary = 2.89 cfs @ 12.43 hrs, Volume= 11,378 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs



LEGEND

EXISTING WATERSHED	
PROPOSED WATERSHED	
SUBCATCHMENT LABEL	P-1
SUBCATCHMENT BOUNDARY	
FLOW DIRECTION	

GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)
1 inch = 30 ft.

APPROVED - NASHUA CITY PLANNING BOARD

CHAIRMAN DATE

SECRETARY DATE

DATE OF APPROVAL

MARKET SQUARE ARCHITECTS
104 Congress St., STE 203
Portsmouth, NH 03801
PH: 603.501.0202

REV	DATE	DESCRIPTION

APPLICANT\OWNER:
ZJBV PROPERTIES, LLC
c/o JOSEPH'S EQUIPMENT
300 GAY STREET
MANCHESTER, NH 03103

PROJECT:

RESIDENTIAL DEVELOPMENT
159 TEMPLE STREET
NASHUA, NH

PROJECT NO.	2596-01	DATE:	MAY 30, 2019
SCALE:	1" = 30'	DWG.:	C-2596-01_Post-Watershed
DESIGNED BY:	AM	CHECKED BY:	MM

PREPARED BY:

ALLEN & MAJOR ASSOCIATES, INC.
civil & structural engineering ◆ land surveying
environmental consulting ◆ landscape architecture
www.allenmajor.com
400 HARVEY ROAD
MANCHESTER, NH 03103
TEL: (603) 627-5500
FAX: (603) 627-5501
WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

DRAWING TITLE:	SHEET No.
POST-DEVELOPMENT WATERSHED PLAN	WS-2

APPENDIX 6.1

OPERATION AND MAINTENANCE

6.1 OPERATION AND MAINTENANCE PLAN

General Information

Allen & Major Associates, Inc. has prepared the following Operation and Maintenance Plan for the residential development located at 159 Temple Street, Nashua, NH. The plan is broken down into the following major sections. The first section gives general information about ownership and responsibility (General Information). The next section describes the erosion and sediment control measures used during construction (Construction Period). The next section describes the erosion and sediment control measures used during construction (Construction Period). The third section describes the long-term pollution prevention measures (Long Term Pollution Prevention Plan). The last section describes the maintenance requirements for the stormwater management practices. (Maintenance Plan).

Contact Information

Stormwater Management System Owner: ZJBV Properties, LLC
300 Gay Street
Manchester, NH 03103
603-641-8608

Notification Procedures for Change of Responsibility for O&M

The Stormwater Management System (SMS) for this project is owned by ZJBV Properties, LLC. The owner shall be legally responsible for the long-term operation and maintenance of this SMS as outlined in this Operation and Maintenance (O&M) Plan. Should ownership of the SMS change, the owner will continue to be responsible until the succeeding owner shall notify the City that the succeeding owner has assumed such responsibility. Upon subsequent transfers, the responsibility shall continue to be that of transferring owner until the transferee owner notifies the City of Nashua of its assumption of responsibility.

In the event the SMS will serve multiple lots/owners, such as the subdivision of the existing parcel, the owner(s) shall establish an association or other legally enforceable arrangements under which the association or a single party shall have legal responsibility for the operation and maintenance of the entire SMS.

Construction Period

1. Contact the City of Nashua Engineering Department at least two (2) weeks prior to start of construction.

2. Install the, tubular sediment barrier, catch basin filters, and construction fencing as shown on the Site Preparation Plan, and the Erosion Control Plan. (See Sheets C-101 & C-105 of the site plan set)

3. Site access shall be achieved only from the designated construction entrances.

4. All erosion control measures shall be inspected weekly and after all rainfall events, and shall be maintained, repaired or replaced as required or at the direction of the owner's engineer, or the City's Engineer.

5. Sediment accumulation up-gradient of tubular sediment barrier greater than 6" in depth shall be removed and disposed of in accordance with all applicable regulations.

6. If it appears that sediment is exiting the site, catch basin filters shall be installed in all catch basins adjacent to the site. Sediment accumulation on all adjacent catch basin inlets shall be removed and the catch basin filters shall be replaced if torn or damaged.

7. The contractor shall comply with the General and Alteration of Terrain notes listed on the Erosion Control Plan. (C-105)

Post-Development Activities

1. Upon completion of all terrain alteration activities that direct stormwater to a particular practice, the responsible party shall initiate the O&M activities.

2. Paved Areas – Paved areas should be swept as part of the routine site maintenance. Pavement sweeping is an excellent source control for sedimentation to the existing drainage system and is typically performed in the spring of each year following the snow melt.

3. Paved Areas – Salt for de-icing on the paved areas during the winter months shall be limited to the minimum amount practicable. Sand containing the minimum amount of calcium chloride (or approved equivalent) needed for handling may be applied as part of the routine winter maintenance activities.

4. All sediments removed from site drainage facilities shall be disposed of properly, and in accordance with applicable local and state regulations.

5. All vegetated areas on the site shall be stabilized and maintained to control erosion. Any disturbed areas shall be re-seeded as soon as practicable.

6. Work within any drainage structures shall performed in accordance with the latest OSHA regulations, and only by individuals with appropriate OSHA certification.

7. Maintenance Responsibilities - All post-construction maintenance activities shall be documented and kept on file and made available to the proper City and State authorities upon request.

8. If ownership of the property is transferred, the new owner(s) shall become the responsible party.

Long Term Pollution Prevention Plan

The Long Term Pollution Prevention Plan (LTPPP) has been prepared and incorporated as part of the Operation and Maintenance of the Stormwater Management System. The purpose of the LTPPP is to identify potential sources of pollution that may affect the quality of stormwater discharges, and to describe the implementation of practices to reduce the pollutants in stormwater discharges. The following items describe the source control and proper procedures for the LTPPP.

Housekeeping
The proposed site development has been designed to maintain a high level of water quality treatment for all stormwater discharge and groundwater. An Operation and Maintenance (O&M) plan has been prepared and is included in this section of the report. The Owner (or its designee) is responsible for adherence to the O&M plan in a strict and complete manner.

Storing of Materials and Waste Products
There are no proposed exterior (un-covered) storage areas. The trash and waste program for the site includes a dedicated space adjacent to the building for waste & recyclables, which will be placed in covered dumpsters inside of a fenced enclosure.

Vehicle Washing
Outdoor vehicle washing has the potential to result in high loads of nutrients, metals, and hydrocarbons during dry weather conditions, as the detergent-rich water used to wash the grime off the vehicle enters the stormwater drainage system. The proposed site redevelopment does not have accommodations for outdoor car washing.

Maintenance of Lawns, Gardens and other Landscaped Areas
It should be recognized that this is a general guideline towards achieving high quality and well groomed landscaped areas. The grounds staff / landscape contractor must recognize the shortcomings of a general maintenance plan such as this, and modify and/or augment it based on weekly, monthly, and yearly observations. In order to ensure the highest quality conditions, the staff must also recognize and appreciate the need to be aware of the constantly changing conditions of the landscaping and be able to respond to them on a proactive basis. No trash or landscape debris (including lawn clippings) shall be stored or dumped within the landscaped or naturalized areas. Information regarding the removal of invasive species can be found in the appendix of this report.

Fertilizer

Maintenance practices should be aimed at reducing environmental, mechanical and pest stresses to promote healthy and vigorous growth. When necessary, pest outbreaks should be treated with the most sensitive control measures available. Synthetic chemical controls should be used only as a last resort to organic and biological control methods. Fertilizer, synthetic chemical controls and pest management applications (when necessary) shall be performed only by licensed applicators in accordance with the manufacturer's label instructions when environmental conditions are conducive to controlled product application.

Only slow-release organic fertilizers should be used in the landscaped areas to limit the amount of nutrients that could enter downstream resource areas. Fertilization of developed areas on site will be performed within manufacturers labeling instructions and shall not exceed an NPK ratio of 1:1:1 (i.e. Triple 10 fertilizer mix), considered a low nitrogen mixture. Additionally, the fertilizer will include a slow release element.

Suggested Aeration Program

In-season aeration of lawn areas is good cultural practice, and is recommended whenever feasible. It should be accomplished with a solid thin tine aeration method to reduce disruption to the use of the area. The depth of solid tine aeration is similar to core type, but should be performed when the soil is somewhat drier for a greater overall effect.

Depending on the intensity of use, it can be expected that all landscaped lawn areas will need aeration to reduce compaction at least once per year. The first operation should occur in late May following the spring season. Methods of reducing compaction will vary based on the nature of the compaction. Compaction on newly established landscaped areas is generally limited to the top 2-3" and can be alleviated using hollow core or thin tine aeration methods.

Landscape Maintenance Program Practices:

Lawn	▪ Mow a minimum of once a week in spring, to a height of 2” to 2 1/2” high. Mowing should be frequent enough so that no more than 1/3 of grass blade is removed at each mowing. The top growth supports the roots; the shorter the grass is cut, the less the roots will grow. Short cutting also dries out the soil and encourages weeds to germinate. ▪ Mow approximately once every two weeks from July 1st to August 15th depending on lawn growth. ▪ Mow on a ten-day cycle in fall, when growth is stimulated by cooler nights and increased moisture. ▪ Do not remove grass clippings after mowing. ▪ Keep mower blades sharp to prevent ragged cuts on grass leaves, which cause a brownish appearance and increase the chance for disease to enter a leaf.
Shrubs	▪ Mulch not more than 3” depth with shredded pine or fir bark. ▪ Hand prune annually, immediately after blooming, to remove 1/3 of the above-ground biomass (older stems). Stem removals to occur within 6” of the ground to open up shrub and maintain two-year wood (the blooming wood). ▪ Fertilize with ½ lb. slow-release fertilizer (see above section on Fertilizer) every second year. ▪ Hand prune evergreen shrubs only as needed to remove dead and damaged wood and to maintain the naturalistic form of the shrub. Never mechanically shear evergreen shrubs.
Trees	▪ Provide aftercare for new tree plantings for the first three years. ▪ Do not fertilize trees, it artificially stimulates them (unless tree health warrants). ▪ Water once a week for the first year; twice a month the second, once a month the third year. ▪ Prune trees on a four-year cycle.

Management of Deicing Chemicals and Snow
Snow shall only be stockpiled on site within the snow storage areas depicted on the Layout & Materials Plan. If the stockpiles of snow do not fit within the designated areas, then snow will be disposed off-site. It will be the responsibility of the snow removal contractor to properly dispose of transported snow according NHDES. It will be the responsibility of the snow removal contractor to follow these guidelines and all applicable laws and regulations.

The owner (or its designee) will be responsible for the clearing of the sidewalk and building entrances. The Owner may be required to use a de-icing agent such as potassium chloride to maintain a safe walking surface; however, these are to be used at the minimum amount practicable. The de-icing agent for the walkways and building entrances will be kept within the storage rooms located within the buildings. De-icing agents will not be stored outside. Additional information can be found in the Salt Minimization Plan, in the appendix of this report.

Maintenance Plan

Documentation
Maintenance documents shall include a completed maintenance checklist (attached) that will include any applicable notes or other documents as described in this section.

Stormwater Collection System:
The stormwater collection system is a series of inlets located at low points within the limits of the paved and landscape areas. The inlets consist of catch basins and one area drain. All of the stormwater inlets connect to the on-site drainage systems. The onsite drainage system consists of one subsurface infiltration system and one bioretention system which receives runoff only from the parking bays to the east of building 2. All collection devices shall be inspected and maintained annually as noted on the attached maintenance log. The stormwater runoff from the building rooftop is collected using gutters, downspouts and roof drains.

Underground Infiltration
There is one proposed underground infiltration system on-site. The proposed system consists of 60” Aluminized Perforated Corrugated Metal Pipe. Copies of the maintenance requirements are included in the following sections.

Bioretention System
There is one bioretention system proposed along the eastern property line of the site. The bioretention system consists of a shallow depressed area with native plantings and a 2’ thick soil filter which will help to treat and infiltrate stormwater. The bioretention system is designed with an overflow weir which will discharge to overland flow.

Operation and Maintenance Schedule Summary
The following is a summary of the maintenance schedule for each of the stormwater BMPs. Note all anomalies, signs of degradation, or corrective actions on the annual Maintenance Checklist.

BMP	MAINTENANCE ITEM	FREQUENCY
Pavement Sweeping	Perform sweeping. No Sand. Distribute de-icing agents and inspect according to narrative.	Inspect /sweep twice per year (Early spring & late fall)
Catch Basins	Inspect for damage to frame and grate, and hoods. Remove sediment and trash when depth exceeds 50% of the sump.	Inspect yearly, remove sediment as needed.
Bioretention System	Inspect for trash and debris. If system does not drain within 72 hours following a rainfall event, contact a qualified professional to assess the system. Replace dead or diseased vegetation as needed. Remove any invasive species.	Inspect twice yearly and after a rain event of 2.5”+, remove trash and debris as needed.
Infiltration System	Inspect for sediment accumulation. Remove sediment using a jet-vac and in accordance with the manufacturers’ recommendations.	Inspect yearly, remove sediment as needed.
Jellyfish Filters	Inspect structure for damage, debris, oil, and sediment. Inspect cartridge lids, replace missing or damaged cartridges. Remove and rinse filters as needed. Vacuum structure with filters removed.	Inspect following construction, twice during the first year, and a minimum of once per year thereafter
Hydrodynamic Separators (CDS)	Inspect for damage to frames and covers. Remove sediment and trash in accordance with manufacturers’ recommendations.	Inspect yearly, remove trash and sediment as needed.

The Owner or its designee shall keep records of the maintenance of the Stormwater BMPs on a yearly basis. Maintenance documents shall include a completed maintenance checklist.

<u>Supplemental Information:</u>

-Operation and Maintenance Plan Schedule
-Operation and Maintenance Log Forms
-Operation and Maintenance Plan Log Forms (During Construction)
-Jellyfish Filter Maintenance Guide
-CDS Maintenance Guide
-CMP Infiltration Maintenance
-Control of Invasive Plants

OPERATION & MAINTENANCE PLAN SCHEDULE

Party Responsible for O & M Plan: ZJBV Properties, LLC

Project: Temple Street Residential Development

Address: #159 Temple Street, Nashua, NH

Date: ___________

Address: TBD

Main Phone Number: TBD

O&M Main Point of Contact: TBD

Structure or Task	Maintenance Activity	Schedule	Notes	Inspection Performed		Inspection Results
				Date:	By:	
Street Sweeping	Sweep, power broom or vacuum paved areas.	Sweeping should be conducted a minimum of twice a year. • Early fall • Immediately following spring snowmelt to remove sand and other debris.	Since contaminants accumulate within 12 inches of the curb line. Street cleaning operations should concentrate on cleaning curb and gutter lines for maximum pollutant removal efficiency. Other areas can also be swept periodically, probably on a less regular basis.			
Deep Sump Catch Basins	Inspect frames and grates. Empty sumps using a vacuum-truck.	Inspected annually, cleaned as needed when sediment reaches 50% of the sump depth.	Sediment should be removed when accumulated to a depth of 50% of the sump. Sediment and debris shall be removed by a vacuum truck. Disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations			
Infiltration System	Inspect for sediment build-up. Remove sediment using a jet-vac.	Inspected annually, cleaned as needed when sediment reaches a depth of 3”	Sediment should be removed when accumulated to a depth of 3”. Sediment and debris shall be removed by a vacuum truck. Disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations			
Bioretention System	Inspect for trash and debris. Remove as necessary.	Inspect twice annually and following any rainfall event exceeding 2.5” in a 24-hour period, with maintenance or rehabilitation as necessary.	Remove trash and debris during each inspection. Contact a qualified professional if the Bioretention System does not drain completely within 72 hours. Replace dead or diseased vegetation and remove invasive species.			
Jellyfish Filter	Inspect frames, rinse filters, vacuum structure	Inspect annually, repair, rinse, and clean as needed.	Sediment should be removed when accumulated to a depth of 12”. Sediment and debris shall be removed by a vacuum truck. Disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations			
Hydrodynamic Separators (CDS)	Inspect frames and covers. Empty sediment storage chamber using a vacuum truck.	Inspected annually, clean as needed when sediment reaches a depth of 12”.	Sediment should be removed when accumulated to a depth of 12”. Sediment and debris shall be removed by a vacuum truck. Disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations			
Mosquito Control	CB management targeted larvicide treatment to CB's and all storm drains to control mosquitoes in their aquatic stages.		Surveillance is a non-chemical inspection method that involves classification of mosquito breeding sites, larval presents, and survey.			

Notes: 1. This O&M Plan Schedule must be maintained by the owner and remain in onsite office at all times.

2. Owner must keep the past 7 years of maintenance and inspection records on site.

TEMPLE STREET RESIDENTIAL DEVELOPMENT
159 TEMPLE STREET
NASHUA, NH

MAINTENANCE LOG FORM

INSPECTOR:_________________________

DATE MAINTENANCE PERFORMED:____________________________

INSPECTOR'S QUALIFICATIONS:____

____

____

MAINTENANCE LOG

TYPE OF MAINTENANCE PERFORMED	DATE SINCE LAST MAINTENANCE	STAFF MEMBER OR CONTRACTOR WHO PERFORMED MAINTENANCE	CONDITION	ISSUE RESOLVED (YES/NO)

FOLLOW-UP REQUIRED:
____

____

TO BE PERFORMED BY:_____________________ ON OR BEFORE:_________________________

NOTES:
1. Attach copies of maintenance work orders.
2. Owner must keep a minimum of the past 7 years of inspections / operations and maintenance records onsite.

Operation and Maintenance Plan Log During Construction

Project: Residential Development
Address: 159 Temple Street
Nashua, NH

Company Responsible for O&M During Construction: ______________________
Individual responsible for Inspections & Log: ______________________
Erosion Control Inspection Qualifications: ______________________
Address: ______________________
Phone (24 Hour Contact Number): ______________________

Erosion Control Measures	Weekly Inspection Schedule/or After Rainfall	Inspection Performed		Method	Notes/Remarks
		Date	By:		
Temporary Tree Protection				Review temporary tree protection fencing and trunk protection. Verify no machinery or construction materials are stored within the fenced area. Repair any damaged fencing. Document any damage to tree. Contact client's construction representative with any tree trunk or root damage.	
Tubular Sediment Barrier				Sediment accumulation up-gradient of the tubular sediment barrier greater than 6" in depth shall be removed and disposed of in accordance with all applicable regulations	
Catch Basin Filter				When the sediment is exiting the site, and as shown on the plan, silt sacks shall be installed in all catch basins adjacent to the site. Sediment accumulation on all catch basin inlets shall be removed and the silt sack replaced if torn or damaged. Remove silt and replace damage silt sacks at each catch basin.	
Construction Entrance				When silt is accumulating in the construction entrance, then the construction entrance shall be cleaned and stone replaced as necessary.	
Catch Basin				• Grates clear of debris • Inlet and outlet clear of debris • Clear of oil or grease • Flow clear of siltation	
Infiltration System				No discharge of stormwater is allowed to the subsurface infiltration system during construction. The infiltration system shall remain off-line until the final stabilization is complete.	

Note: Operation and maintenance plan log shall be documented by contractor and kept within onsite construction office. Upon request, log and operation and maintenance files shall be made available to the City, State, and Federal authorities.

CONTECH®
ENGINEERED SOLUTIONS

JellyFish® Filter Maintenance Guide

Jellyfish®

Jellyfish®

JELLYFISH® FILTER MANHOLE CONFIGURATIONS
INSPECTION & MAINTENANCE GUIDE

TABLE OF CONTENTS

1.0 Inspection and Maintenance Overview

The primary purpose of the Jellyfish® Filter is to capture and remove pollutants from stormwater runoff. As with any filtration system, these pollutants must be removed to maintain the filter's maximum treatment performance. Regular inspection and maintenance are required to insure proper functioning of the system.

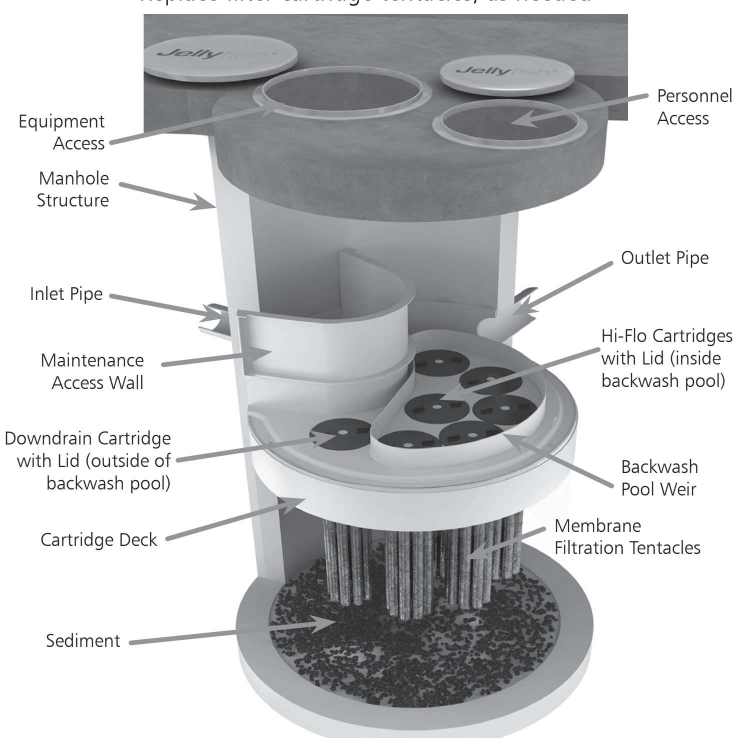
Maintenance frequencies and requirements are site specific and vary depending on pollutant loading. Additional maintenance activities may be required in the event of non-storm event runoff, such as base-flow or seasonal flow, an upstream chemical spill or due to excessive sediment loading from site erosion or extreme runoff events. It is a good practice to inspect the system after major storm events.

Inspection activities are typically conducted from surface observations and include:

- Observe if standing water is present
- Observe if there is any physical damage to the deck or cartridge lids
- Observe the amount of debris in the Maintenance Access Wall (MAW)

Maintenance activities typically include:

- Removal of oil, floatable trash and debris
- Removal of collected sediments
- Rinsing and re-installing the filter cartridges
- Replace filter cartridge tentacles, as needed



Note: Separator Skirt not shown

2.0 Inspection Timing

Inspection of the Jellyfish Filter is key in determining the maintenance requirements for, and to develop a history of the site's pollutant loading characteristics. In general, inspections should be performed at the times indicated below; *or per the approved project stormwater quality documents (if applicable), whichever is more frequent*.

1. Post-construction inspection is required prior to putting the Jellyfish Filter into service. All construction debris or construction-related sediment within the device must be removed, and any damage to system components repaired, before installing the filter cartridges.
2. A minimum of two inspections during the first year of operation to assess the sediment and floatable pollutant accumulation, and to ensure proper functioning of the system.
3. Inspection frequency in subsequent years is based on the inspection and maintenance plan developed in the first year of operation. Minimum frequency should be once per year.
4. Inspection is recommended after each major storm event.
5. Inspection is required immediately after an upstream oil, fuel or other chemical spill.

3.0 Inspection Procedure

The following procedure is recommended when performing inspections:

1. Provide traffic control measures as necessary.
2. Inspect the MAW for floatable pollutants such as trash, debris, and oil sheen.
3. Measure oil and sediment depth in several locations, by lowering a sediment probe through the MAW opening until contact is made with the floor of the structure. Record sediment depth, and presences of any oil layers.
4. Inspect cartridge lids. Missing or damaged cartridge lids to be replaced.
5. Inspect the MAW, cartridge deck, and backwash pool weir, for cracks or broken components. If damaged, repair is required.

3.1 Dry weather inspections

- Inspect the cartridge deck for standing water, and/or sediment on the deck.
- No standing water under normal operating conditions.
- Standing water inside the backwash pool, but not outside the backwash pool indicates that the filter cartridges need to be rinsed.

Inspection Utilitzing Sediment Probe

- Standing water outside the backwash pool may indicate a backwater condition caused by high water elevation in the receiving water body, or possibly a blockage in downstream infrastructure.
- Any appreciable sediment (≥1/16”) accumulated on the deck surface should be removed.

3.2 Wet weather inspections

- Observe the rate and movement of water in the unit. Note the depth of water above deck elevation within the MAW.
- Less than 6 inches, flow should be exiting the cartridge lids of each of the draindown cartridges (i.e. cartridges located outside the backwash pool).
- Greater than 6 inches, flow should be exiting the cartridge lids of each of the draindown cartridges and each of the hi-flo cartridges (i.e. cartridges located inside the backwash pool), and water should be overflowing the backwash pool weir.
- 18 inches or greater and relatively little flow is exiting the cartridge lids and outlet pipe, this condition indicates that the filter cartridges are occluded with sediment and need to be rinsed

4.0 Maintenance Requirements

Required maintenance for the Jellyfish Filter is based upon results of the most recent inspection, historical maintenance records, or the site specific water quality management plan; whichever is more frequent. In general, maintenance requires some combination of the following:

1. Sediment removal for depths reaching 12 inches or greater, or within 3 years of the most recent sediment cleaning, whichever occurs sooner.
2. Floatable trash, debris, and oil removal.
3. Deck cleaned and free from sediment.
4. Filter cartridges rinsed and re-installed as required by the most recent inspection results, or within 12 months of the most recent filter rinsing, whichever occurs sooner.
5. Replace tentacles if rinsing does not restore adequate hydraulic capacity, remove accumulated sediment, or if damaged or missing. It is recommended that tentacles should remain in service no longer than 5 years before replacement.
6. Damaged or missing cartridge deck components must be repaired or replaced as indicated by results of the most recent inspection.
7. The unit must be cleaned out and filter cartridges inspected immediately after an upstream oil, fuel, or chemical spill. Filter cartridge tentacles should be replaced if damaged or compromised by the spill.

5.0 Maintenance Procedure

The following procedures are recommended when maintaining the Jellyfish Filter:

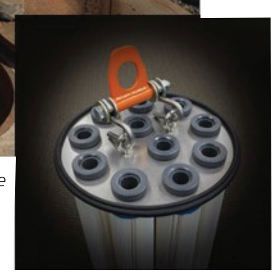
1. Provide traffic control measures as necessary.
2. Open all covers and hatches. Use ventilation equipment as required, according to confined space entry procedures.
3. Caution: Dropping objects onto the cartridge deck may cause damage.
4. Perform Inspection Procedure prior to maintenance activity.
5. To access the cartridge deck for filter cartridge service, descend the ladder and step directly onto the deck. Caution: Do not step onto the maintenance access wall (MAW) or backwash pool weir, as damage may result. Note that the cartridge deck may be slippery.
6. Maximum weight of maintenance crew and equipment on the cartridge deck not to exceed 450 lbs.

5.1 Filter Cartridge Removal

1. Remove a cartridge lid.
2. Remove cartridges from the deck using the lifting loops in the cartridge head plate. Rope or a lifting device (available from Contech) should be used. Caution: Should a snag occur, do not force the cartridge upward as damage to the tentacles may result. Wet cartridges typically weigh between 100 and 125 lbs.
3. Replace and secure the cartridge lid on the exposed empty receptacle as a safety precaution. Contech does not recommend exposing more than one empty cartridge receptacle at a time.

5.2 Filter Cartridge Rinsing

1. Remove all 11 tentacles from the cartridge head plate. Take care not to damage or break the plastic threaded nut or connector.
2. Position tentacles in a container (or over the MAW), with the



Cartridge Removal & Lifting Device

threaded connector (open end) facing down, so rinse water is flushed through the membrane and captured in the container.
3. Using the Jellyfish rinse tool (available from Contech) or a low-pressure garden hose sprayer, direct water spray onto the tentacle membrane, sweeping from top to bottom along the length of the tentacle. Rinse until all sediment is removed from the membrane. Caution: Do not use a high pressure sprayer or focused stream of water on the membrane. Excessive water pressure may damage the membrane.

4. Collected rinse water is typically removed by vacuum hose.
5. Reattach tentacles to cartridge head plate. Reuse O-rings and nuts, ensuring proper placement on each tentacle.

5.3 Cleaning Procedure

1. Perform vacuum cleaning of the Jellyfish Filter only after filter cartridges have been removed from the system. Access the lower chamber for vacuum cleaning only through the maintenance access wall (MAW) opening, being careful not to damage the flexible plastic separator skirt that is attached to the underside of the deck. The separator skirt surrounds the filter cartridge zone, and could be torn if contacted by the wand. Do not lower the vacuum wand through a cartridge receptacle, as damage to the receptacle will result.
2. Vacuum floatable trash, debris, and oil, from the MAW opening. Alternatively, floatable solids may be removed by a net or skimmer.

Tentacle Rinse Using Jellyfish Rinse Tool

3. Pressure wash cartridge deck and receptacles to remove all sediment and debris. Sediment should be rinsed into the sump area. Take care not to flush rinse water into the outlet pipe.
4. Remove water from the sump area. Vacuum or pump equipment should only be introduced through the MAW.
5. Remove the sediment from the bottom of the unit through the MAW opening.

Vacuuming Sump Through MAW

6. For larger diameter Jellyfish Filter manholes (≥8-ft) and vaults without an MAW opening, complete sediment removal may be facilitated by removing a cartridge lid from an empty receptacle and inserting a jetting wand (not a vacuum wand) through the receptacle. Use the sprayer to rinse loosened sediment toward the vacuum hose in the MAW opening, being careful not to damage the receptacle.
7. After the unit is clean, re-fill the lower chamber with water if required by the local jurisdiction, and re-install filter cartridges.
8. Dispose of sediment, floatable trash and debris, oil, spent tentacles, and water according to local regulatory requirements.

5.4 Filter Cartridge Replacement

1. Cartridges should be installed after the deck has been cleaned. It is important that the receptacle surfaces be free from grit and debris.
2. If rinsing is ineffective in removing sediment from the tentacles, or if tentacles are damaged, provisions must be made to replace the spent or damaged tentacles with new tentacles. Contact Contech to order replacement tentacles.
3. Lower filter cartridge to the cartridge deck. Remove cartridge lid from deck and carefully lower the filter cartridge into the receptacle until head plate gasket is seated squarely in receptacle. Caution: Should a snag occur when lowering the cartridge into the receptacle, do not force the cartridge downward; damage may occur.
4. Replace the cartridge lid and check fit before completing rotation to a firm hand-tight attachment.

5.5 Chemical Spills

Caution: If a chemical spill has been captured, do not attempt maintenance. Immediately contact the local hazard response agency and contact Contech.

6.0 Related Maintenance Activities

Jellyfish units are often just one of many structures in a more comprehensive stormwater drainage and treatment system.

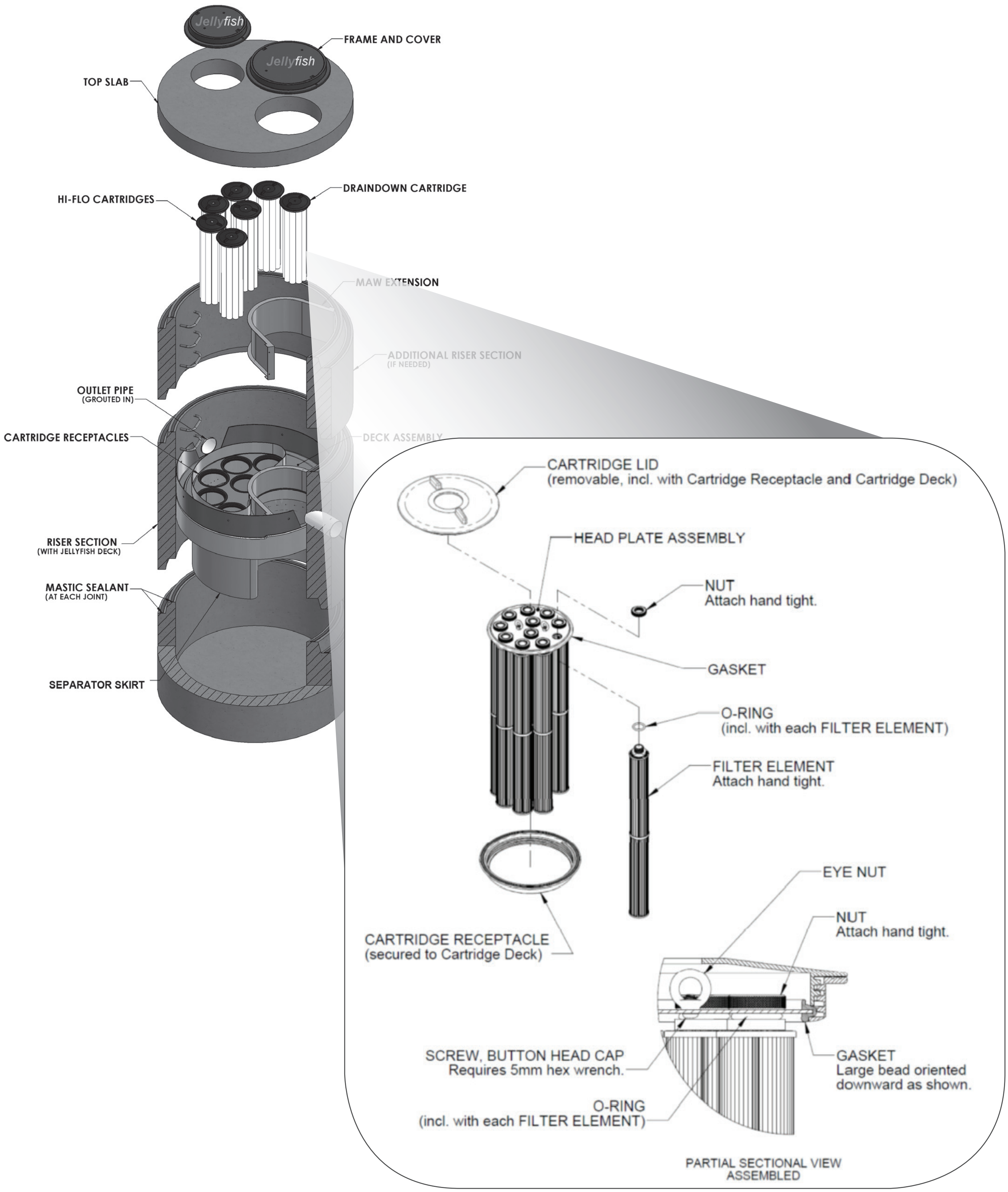
In order for maintenance of the Jellyfish filter to be successful, it is imperative that all other components be properly maintained. The maintenance and repair of upstream facilities should be carried out prior to Jellyfish maintenance activities.

In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil loading, and discharges of inappropriate materials.

7.0 Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in accordance with regulatory protocols. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads. Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. This typically requires coordination with a local landfill for solid waste disposal. For liquid waste disposal a number of options are available including a municipal vacuum truck decant facility, local waste water treatment plant or on-site treatment and discharge.

Jellyfish Filter Components & Filter Cartridge



Jellyfish Filter Inspection and Maintenance Log						
Owner:				Jellyfish Model No:		
Location:				GPS Coordinates:		
Lande Use:	Commercial:		Industrial:		Service Station:	
	Roadway/Highway:		Airport:		Residential:	

Date/Time:						
Inspector:						
Maintenance Contractor:						
Visible Oil Present: (Y/N)						
Oil Quantity Removed:						
Floatable Debris Present: (Y/N)						
Floatable Debris Removed: (Y/N)						
Water Depth in Backwash Pool						
Draindown Cartridges externally rinsed and recommissioned: (Y/N)						
New tentacles put on Cartridges: (Y/N)						
Hi-Flo Cartridges externally rinsed and recommissioned: (Y/N)						
New tentacles put on Hi-Flo Cartridges: (Y/N)						
Sediment Depth Measured: (Y/N)						
Sediment Depth (inches or mm):						
Sediment Removed: (Y/N)						
Cartridge Lids intact: (Y/N)						
Observed Damage:						
Comments:						

Jellyfish®

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800.338.1122
www.ContechES.com

Support

- Drawings and specifications are available at ContechES.com/jellyfish.
- Site-specific design support is available from Contech Engineered Solutions.

CDS® Inspection and Maintenance Guide

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	yd3	m3
CDS2015-4	4	1.2	3.0	0.9	0.5	0.4
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Support

- Drawings and specifications are available at www.contechstormwater.com.
- Site-specific design support is available from our engineers.

CONTECH Construction Products Inc. provides site solutions for the civil engineering industry. CONTECH's portfolio includes bridges, drainage, sanitary sewer, stormwater and earth stabilization products. For information on other CONTECH division offerings, visit contech-cpi.com or call 800.338.1122

CONTECH CONSTRUCTION PRODUCTS INC.
800.925.5240
contechstormwater.com

CDS Inspection & Maintenance Log

CDS Model: ______________________ Location: ______________________

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than eighteen inches the system should be cleaned out. **Note: To avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

CONTECH®
ENGINEERED SOLUTIONS

Inspection & Maintenance Guide for

Corrugated Steel Pipe Underground Infiltration Systems

Safety: Before entering into any storm sewer or underground detention/infiltration system check to make sure all OSHA and local safety regulations and guidelines are observed during the maintenance process. Hard hats, safety glasses, steel-toed boots and any other appropriate personal protective equipment shall be worn at all times.

Frequency: Inspections shall be completed annually.

Inspection Check List:

√ Check quality of parking lot surface.

- Is there evidence of potholes or sinkholes?
- Is there evidence of an unusual amount of silt and soil build-up on the surface?

√ Check for pipe symmetry (uniform curvature).

- Flexible steel pipe is designed to handle minor deflections. Pipe structures deflected more than 7% from design shape, or those that show localized distortions may require further investigation.

√ Check for pipe joint quality.

- Is there evidence of backfill material infiltrating into the pipe structure?

√ Silt Deposition

- If accumulated silt is interfering with the operation of the infiltration system (i.e.: blocking infiltration holes or if silt deposition has significantly reduced the storage capacity of the system) it should be removed. This can be accomplished by the use of a "clam shell" device or vactor truck.

Maintenance:

Underground storm water detention and retention systems should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size or configuration of the system.

<u>Inspection</u>

Inspection is the key to effective maintenance and is easily performed. CONTECH recommends ongoing quarterly inspections of the accumulated sediment. Sediment deposition and transport may vary from year to year and quarterly inspections will help insure that systems are cleaned out at the appropriate time. Inspections should be performed more often in the winter months in climates where sanding operations may lead to rapid accumulations, or in equipment wash-down areas. It is very useful to keep a record of each inspection. A sample inspection log is included for your use.

Systems should be cleaned when inspection reveals that accumulated sediment or trash is clogging the discharge orifice. CONTECH suggests that all systems be designed with an access/inspection manhole situated at or near the inlet and the outlet orifice. Should it be necessary to get inside the system to perform maintenance activities, all appropriate precautions regarding confined space entry and OSHA regulations should be followed.

<u>Cleaning</u>

Maintaining an underground detention or retention system is easiest when there is no flow entering the system. For this reason, it is a good idea to schedule the cleanout during dry weather.

Accumulated sediment and trash can typically be evacuated through the manhole over the outlet orifice. If maintenance is not performed as recommended, sediment and trash may accumulate in front of the outlet orifice. Manhole covers should be securely seated following cleaning activities.

Inspection & Maintenance Log:

__" Diameter System			Location: Anywhere, USA		
Date	**Depth of Sediment**	**Accumulated Trash**	**Maintenance Performed**	**Maintenance Personnel**	Comments
12/01/99	2"	None	Removed Sediment	B. Johnson	Installed
03/01/00	1"	Some	Removed Sediment and Trash	B. Johnson	Swept parking lot
06/01/00	0"	None	None		
09/01/00	0"	Heavy	Removed Trash	S. Riley	
12/01/00	1"	None	Removed Sediment	S. Riley	
4/01/01	0"	None	None	S. Riley	
04/15/01	2"	Some	Removed Sediment and Trash	ACE Environmental Services	

SAMPLE

CONTROL OF INVASIVE PLANTS

During maintenance activities, check for the presence of invasive plants and remove in a safe manner as described on the following pages. They should be controlled as described on the following pages.

Background:

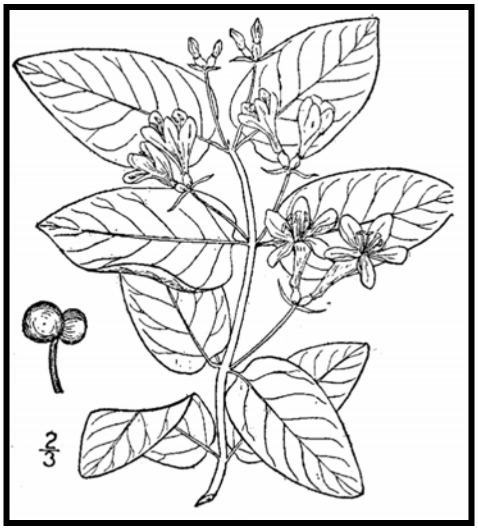
Invasive plants are introduced, alien, or non-native plants, which have been moved by people from their native habitat to a new area. Some exotic plants are imported for human use such as landscaping, erosion control, or food crops. They also can arrive as "hitchhikers" among shipments of other plants, seeds, packing materials, or fresh produce. Some exotic plants become invasive and cause harm by:

- becoming weedy and overgrown;
- killing established shade trees;
- obstructing pipes and drainage systems;
- forming dense beds in water;
- lowering water levels in lakes, streams, and wetlands;
- destroying natural communities;
- promoting erosion on stream banks and hillsides; and
- resisting control except by hazardous chemical.

Methods for Disposing Non-Native Invasive Plants

UNIVERSITY *of* NEW HAMPSHIRE COOPERATIVE EXTENSION

Prepared by the Invasives Species Outreach Group, volunteers interested in helping people control invasive plants. Assistance provided by the Piscataquog Land Conservancy and the NH Invasives Species Committee. Edited by Karen Bennett, Extension Forestry Professor and Specialist.



Tatarian honeysuckle
Lonicera tatarica
USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions.* Vol. 3: 282.

Non-native invasive plants crowd out natives in natural and managed landscapes. They cost taxpayers billions of dollars each year from lost agricultural and forest crops, decreased biodiversity, impacts to natural resources and the environment, and the cost to control and eradicate them.

Invasive plants grow well even in less than desirable conditions such as sandy soils along roadsides, shaded wooded areas, and in wetlands. In ideal conditions, they grow and spread even faster. There are many ways to remove these non-native invasives, but once removed, care is needed to dispose the removed plant material so the plants don't grow where disposed.

Knowing how a particular plant reproduces indicates its method of spread and helps determine the appropriate disposal method. Most are spread by seed and are dispersed by wind, water, animals, or people. Some reproduce by vegetative means from pieces of stems or roots forming new plants. Others spread through both seed and vegetative means.

Because movement and disposal of viable plant parts is restricted (see NH Regulations), viable invasive parts can't be brought to most transfer stations in the state. Check with your transfer station to see if there is an approved, designated area for invasives disposal. This fact sheet gives recommendations for rendering plant parts non-viable.

Control of invasives is beyond the scope of this fact sheet. For information about control visit www.nhinvasives.org or contact your UNH Cooperative Extension office.

New Hampshire Regulations

Prohibited invasive species shall only be disposed of in a manner that renders them nonliving and nonviable. (Agr. 3802.04)

No person shall collect, transport, import, export, move, buy, sell, distribute, propagate or transplant any living and viable portion of any plant species, which includes all of their cultivars and varieties, listed in Table 3800.1 of the New Hampshire prohibited invasive species list. (Agr 3802.01)

How and When to Dispose of Invasives?

To prevent seed from spreading remove invasive plants before seeds are set (produced). Some plants continue to grow, flower and set seed even after pulling or cutting. Seeds can remain viable in the ground for many years. If the plant has flowers or seeds, place the flowers and seeds in a heavy plastic bag "head first" at the weeding site and transport to the disposal site. The following are general descriptions of disposal methods. See the chart for recommendations by species.

Burning: Large woody branches and trunks can be used as firewood or burned in piles. For outside burning, a written fire permit from the local forest fire warden is required unless the ground is covered in snow. Brush larger than 5 inches in diameter can't be burned. Invasive plants with easily airborne seeds like black swallow-wort with mature seed pods (indicated by their brown color) shouldn't be burned as the seeds may disperse by the hot air created by the fire.

Japanese knotweed
Polygonum cuspidatum
USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions*. Vol. 1: 676.

Bagging (solarization): Use this technique with softer-tissue plants. Use heavy black or clear plastic bags (contractor grade), making sure that no parts of the plants poke through. Allow the bags to sit in the sun for several weeks and on dark pavement for the best effect.

Tarping and Drying: Pile material on a sheet of plastic and cover with a tarp, fastening the tarp to the ground and monitoring it for escapes. Let the material dry for several weeks, or until it is clearly nonviable.

Chipping: Use this method for woody plants that don't reproduce vegetatively.

Burying: This is risky, but can be done with watchful diligence. Lay thick plastic in a deep pit before placing the cut up plant material in the hole. Place the material away from the edge of the plastic before covering it with more heavy plastic. Eliminate as much air as possible and toss in soil to weight down the material in the pit. Note that the top of the buried material should be at least three feet underground. Japanese knotweed should be at least 5 feet underground!

Drowning: Fill a large barrel with water and place soft-tissue plants in the water. Check after a few weeks and look for rotted plant material (roots, stems, leaves, flowers). Well-rotted plant material may be composted. A word of caution- seeds may still be viable after using this method. Do this before seeds are set. This method isn't used often. Be prepared for an awful stink!

Composting: Invasive plants can take root in compost. Don't compost any invasives unless you know there is no viable (living) plant material left. Use one of the above techniques (bagging, tarping, drying, chipping, or drowning) to render the plants nonviable before composting. Closely examine the plant before composting and avoid composting seeds.

Be diligent looking for seedlings for *years* in areas where removal and disposal took place.

Suggested Disposal Methods for Non-Native Invasive Plants

This table provides information concerning the disposal of removed invasive plant material. If the infestation is treated with herbicide and left in place, these guidelines don't apply. Don't bring invasives to a local transfer station, unless there is a designated area for their disposal, or they have been rendered non-viable. This listing includes wetland and upland plants from the New Hampshire Prohibited Invasive Species List. The disposal of aquatic plants isn't addressed.

Woody Plants	Method of Reproducing	Methods of Disposal
Norway maple *(Acer platanoides)* European barberry *(Berberis vulgaris)* Japanese barberry *(Berberis thunbergii)* autumn olive *(Elaeagnus umbellata)* burning bush *(Euonymus alatus)* Morrow's honeysuckle *(Lonicera morrowii)* Tatarian honeysuckle *(Lonicera tatarica)* showy bush honeysuckle *(Lonicera x bella)* common buckthorn *(Rhamnus cathartica)* glossy buckthorn *(Frangula alnus)*	**Fruit and Seeds**	**Prior to fruit/seed ripening** Seedlings and small plants ▪ Pull or cut and leave on site with roots exposed. No special care needed. Larger plants ▪ Use as firewood. ▪ Make a brush pile. ▪ Chip. ▪ Burn.
		After fruit/seed is ripe Don't remove from site. ▪ Burn. ▪ Make a covered brush pile. ▪ Chip once all fruit has dropped from branches. ▪ Leave resulting chips on site and monitor.
oriental bittersweet *(Celastrus orbiculatus)* multiflora rose *(Rosa multiflora)*	**Fruits, Seeds, Plant Fragments**	**Prior to fruit/seed ripening** Seedlings and small plants ▪ Pull or cut and leave on site with roots exposed. No special care needed. Larger plants ▪ Make a brush pile. ▪ Burn.
		After fruit/seed is ripe Don't remove from site. ▪ Burn. ▪ Make a covered brush pile. ▪ Chip – only after material has fully dried (1 year) and all fruit has dropped from branches. Leave resulting chips on site and monitor.

Non-Woody Plants	Method of Reproducing	Methods of Disposal
garlic mustard *(Alliaria petiolata)* spotted knapweed *(Centaurea maculosa)* ▪ Sap of related knapweed can cause skin irritation and tumors. Wear gloves when handling. black swallow-wort *(Cynanchum nigrum)* ▪ May cause skin rash. Wear gloves and long sleeves when handling. pale swallow-wort *(Cynanchum rossicum)* giant hogweed *(Heracleum mantegazzianum)* ▪ Can cause major skin rash. Wear gloves and long sleeves when handling. dame's rocket *(Hesperis matronalis)* perennial pepperweed *(Lepidium latifolium)* purple loosestrife *(Lythrum salicaria)* Japanese stilt grass *(Microstegium vimineum)* mile-a-minute weed *(Polygonum perfoliatum)*	**Fruits and Seeds**	**Prior to flowering** Depends on scale of infestation Small infestation ▪ Pull or cut plant and leave on site with roots exposed. Large infestation ▪ Pull or cut plant and pile. (You can pile onto or cover with plastic sheeting). ▪ Monitor. Remove any re-sprouting material. **During and following flowering** Do nothing until the following year or remove flowering heads and bag and let rot. Small infestation ▪ Pull or cut plant and leave on site with roots exposed. Large infestation ▪ Pull or cut plant and pile remaining material. (You can pile onto plastic or cover with plastic sheeting). ▪ Monitor. Remove any re-sprouting material.
common reed (*Phragmites australis*) Japanese knotweed *(Polygonum cuspidatum)* Bohemian knotweed *(Polygonum x bohemicum)*	**Fruits, Seeds, Plant Fragments** Primary means of spread in these species is by plant parts. Although all care should be given to preventing the dispersal of seed during control activities, the presence of seed doesn't materially influence disposal activities.	**Small infestation** ▪ Bag all plant material and let rot. ▪ Never pile and use resulting material as compost. ▪ Burn. **Large infestation** ▪ Remove material to unsuitable habitat (dry, hot and sunny or dry and shaded location) and scatter or pile. ▪ Monitor and remove any sprouting material. ▪ Pile, let dry, and burn.

January 2010

APPENDIX 6.2

NHDES AOT WORKSHEETS

General Calculations - WQV and WQF
(optional worksheet)

This worksheet may be useful when designing a BMP that does not fit into one of the specific worksheets already provided. For example, if proposing a new technology, which is not a stormwater wetland, infiltration practice, etc., then this worksheet may be useful.

Water Quality Volume (WQV)

0.55	ac	A = Area draining to the practice
0.49	ac	A_I = Impervious area draining to the practice
0.88	decimal	I = percent impervious area draining to the practice, in decimal form
0.84	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)
0.46	ac-in	WQV= 1” x Rv x A
1,687	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12”)

Water Quality Flow (WQF)

1	inches	P = amount of rainfall. For WQF in NH, P = 1".
0.84	inches	Q = water quality depth. Q = WQV/A
99	unitless	CN = unit peak discharge curve number. CN =1000/(10+5P+10Q–10*[Q^2 + 1.25*Q*P] $^{0.5}$)
0.2	inches	S = potential maximum retention. S = (1000/CN) - 10
0.030	inches	Ia = initial abstraction. Ia = 0.2S
6.0	minutes	T_c = Time of Concentration
700.0	cfs/mi^2/in	qu is the unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III
0.508	cfs	WQF = q_u x WQV. Conversion: to convert "cfs/mi^2/in * ac-in" to "cfs" multiply by 1mi^2/640ac

Designer's Notes: CDS1

General Calculations - WQV and WQF
(optional worksheet)

This worksheet may be useful when designing a BMP that does not fit into one of the specific worksheets already provided. For example, if proposing a new technology, which is not a stormwater wetland, infiltration practice, etc., then this worksheet may be useful.

Water Quality Volume (WQV)

0.72	ac	A = Area draining to the practice
0.59	ac	A_I = Impervious area draining to the practice
0.82	decimal	I = percent impervious area draining to the practice, in decimal form
0.78	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)
0.57	ac-in	WQV= 1” x Rv x A
2,055	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12”)

Water Quality Flow (WQF)

1	inches	P = amount of rainfall. For WQF in NH, P = 1".
0.78	inches	Q = water quality depth. Q = WQV/A
98	unitless	CN = unit peak discharge curve number. CN =1000/(10+5P+10Q–10*[Q^2 + 1.25*Q*P]$^{0.5}$)
0.2	inches	S = potential maximum retention. S = (1000/CN) - 10
0.042	inches	Ia = initial abstraction. Ia = 0.2S
6.0	minutes	T_c = Time of Concentration
700.0	cfs/mi^2/in	qu is the unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III
0.619	cfs	WQF = q_u x WQV. Conversion: to convert "cfs/mi^2/in * ac-in" to "cfs" multiply by 1mi^2/640ac

Designer's Notes: CDS2

General Calculations - WQV and WQF
(optional worksheet)

This worksheet may be useful when designing a BMP that does not fit into one of the specific worksheets already provided. For example, if proposing a new technology, which is not a stormwater wetland, infiltration practice, etc., then this worksheet may be useful.

Water Quality Volume (WQV)

0.36	ac	A = Area draining to the practice
0.31	ac	A_I = Impervious area draining to the practice
0.86	decimal	I = percent impervious area draining to the practice, in decimal form
0.82	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)
0.30	ac-in	WQV= 1” x Rv x A
1,076	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12”)

Water Quality Flow (WQF)

1	inches	P = amount of rainfall. For WQF in NH, P = 1".
0.82	inches	Q = water quality depth. Q = WQV/A
98	unitless	CN = unit peak discharge curve number. CN =1000/(10+5P+10Q–10*[Q^2 + 1.25*Q*P]$^{0.5}$)
0.2	inches	S = potential maximum retention. S = (1000/CN) - 10
0.033	inches	Ia = initial abstraction. Ia = 0.2S
6.0	minutes	T_c = Time of Concentration
700.0	cfs/mi^2/in	qu is the unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III
0.324	cfs	WQF = q_u x WQV. Conversion: to convert "cfs/mi^2/in * ac-in" to "cfs" multiply by 1mi^2/640ac

Designer's Notes: CDS3

General Calculations - WQV and WQF
(optional worksheet)

This worksheet may be useful when designing a BMP that does not fit into one of the specific worksheets already provided. For example, if proposing a new technology, which is not a stormwater wetland, infiltration practice, etc., then this worksheet may be useful.

Water Quality Volume (WQV)

0.92	ac	A = Area draining to the practice
0.80	ac	A_I = Impervious area draining to the practice
0.86	decimal	I = percent impervious area draining to the practice, in decimal form
0.83	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)
0.76	ac-in	WQV= 1” x Rv x A
2,765	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12”)

Water Quality Flow (WQF)

1	inches	P = amount of rainfall. For WQF in NH, P = 1".
0.83	inches	Q = water quality depth. Q = WQV/A
98	unitless	CN = unit peak discharge curve number. CN =1000/(10+5P+10Q–10*[Q^2 + 1.25*Q*P] $^{0.5}$)
0.2	inches	S = potential maximum retention. S = (1000/CN) - 10
0.033	inches	Ia = initial abstraction. Ia = 0.2S
6.0	minutes	T_c = Time of Concentration
700.0	cfs/mi^2/in	qu is the unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III
0.833	cfs	WQF = q_u x WQV. Conversion: to convert "cfs/mi^2/in * ac-in" to "cfs" multiply by 1mi^2/640ac

Designer's Notes: WQ1

General Calculations - WQV and WQF
(optional worksheet)

This worksheet may be useful when designing a BMP that does not fit into one of the specific worksheets already provided. For example, if proposing a new technology, which is not a stormwater wetland, infiltration practice, etc., then this worksheet may be useful.

Water Quality Volume (WQV)

0.72	ac	A = Area draining to the practice
0.59	ac	A_I = Impervious area draining to the practice
0.82	decimal	I = percent impervious area draining to the practice, in decimal form
0.78	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)
0.57	ac-in	WQV= 1" x Rv x A
2,055	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")

Water Quality Flow (WQF)

1	inches	P = amount of rainfall. For WQF in NH, P = 1".
0.78	inches	Q = water quality depth. Q = WQV/A
98	unitless	CN = unit peak discharge curve number. $CN = 1000/(10+5P+10Q-10*[Q^2 + 1.25*Q*P]^{0.5})$
0.2	inches	S = potential maximum retention. S = (1000/CN) - 10
0.042	inches	Ia = initial abstraction. Ia = 0.2S
6.0	minutes	T_c = Time of Concentration
700.0	$cfs/mi^2/in$	qu is the unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III
0.619	cfs	WQF = q_u x WQV. Conversion: to convert "$cfs/mi^2/in$ * ac-in" to "cfs" multiply by $1mi^2/640ac$

Designer's Notes: WQ2

Groundwater Recharge Volume (GRV) Calculation

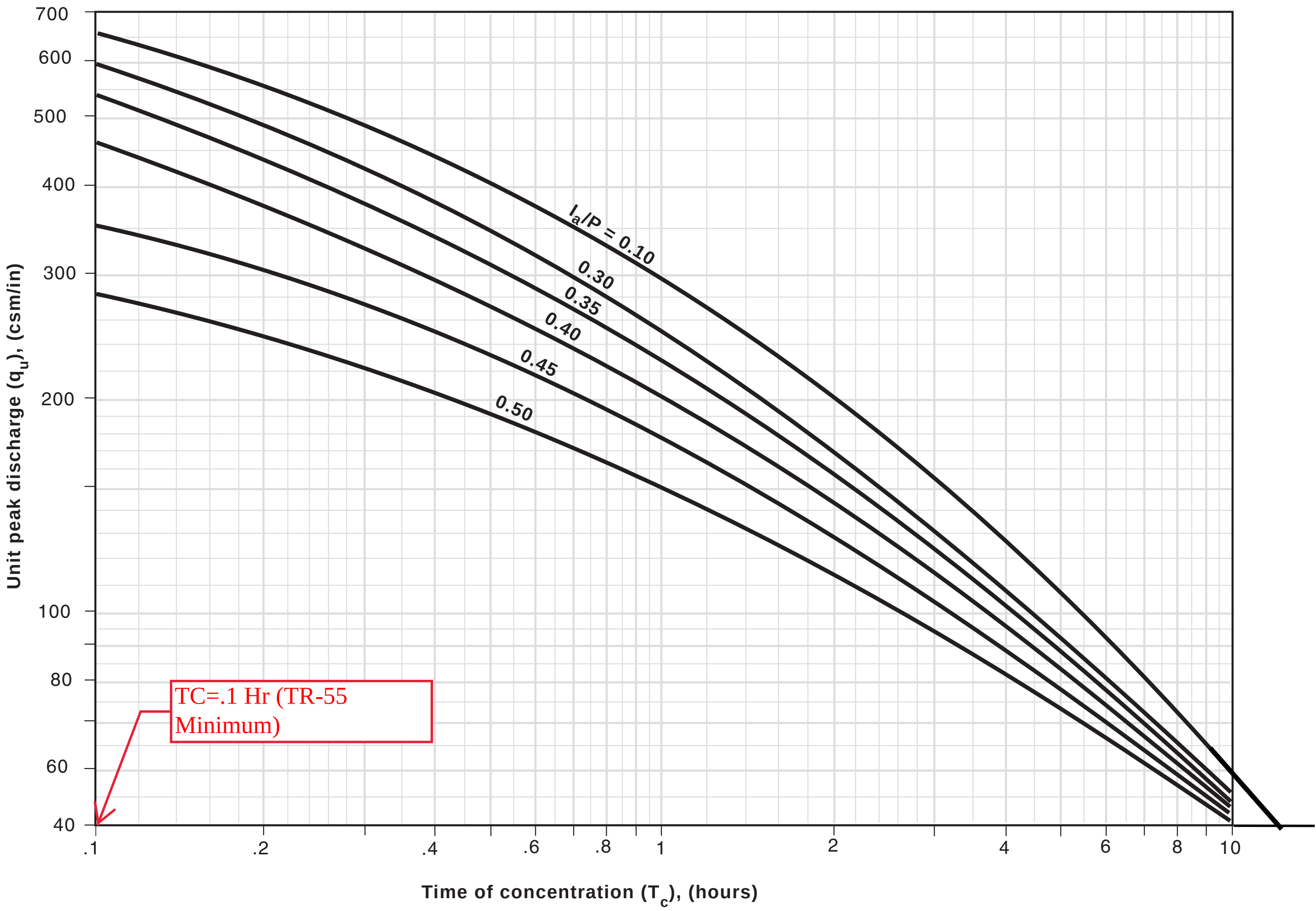
2.93	ac	Area of HSG A soil that was replaced by impervious cover	0.40"
	ac	Area of HSG B soil that was replaced by impervious cover	0.25"
	ac	Area of HSG C soil that was replaced by impervious cover	0.10"
	ac	Area of HSG D soil or impervious cover that was replaced by impervious cover	0.0"
0.40	inches	Rd = weighted groundwater recharge depth	
1.1712	ac-in	GRV = AI * Rd	
4,251	cf	GRV conversion (ac-in x 43,560 sf/ac x 1ft/12”)	

Provide calculations below showing that the project meets the groundwater recharge requirements (Env-Wq 1507.04):

See the stage storage table under the water quality calculations.

Impervious area includes the compacted gravel area. HydroCAD does not show this surface cover as impervious cover.

Exhibit 4-III Unit peal discharge (q_u) for NRCS (SCS) type III rainfall distribution



FILTRATION PRACTICE DESIGN CRITERIA (Env-Wq 1508.06)

Type/Node Name: **Bio-Retention**

Enter the type of filtration practice (e.g., bioretention system) and the node name in the drainage analysis, if applicable

Yes		Have you reviewed the restrictions on unlined systems outlined in Env-Wq 1508.06(b)?	
0.90	ac	A = Area draining to the practice[1]	
0.64	ac	A_I = Impervious area draining to the practice	
0.71	decimal	I = percent impervious area draining to the practice, in decimal form	
0.69	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.62	ac-in	WQV= 1” x Rv x A	
2,256	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12”)	
564	cf	25% x WQV (check calc for sediment forebay volume)	
1,692	cf	75% x WQV (check calc for surface sand filter volume)	
Filter Media		Method of Pretreatment? (not required for clean or roof runoff)	
N/A	cf	V_{SED} = sediment forebay volume, if used for pretreatment	← **≥ 25%WQV**
4,346	sf	A_{SA} = surface area of the practice	
6.50	iph	I_{DESIGN} = design infiltration rate[2]	
No	Yes/No	If I_{DESIGN} is < 0.50 iph, has an underdrain been provided?	
1.0	hours	T_{DRAIN} = drain time = V / (A_{SA} * I_{DESIGN})	← **≤ 72-hrs**
116.50	feet	E_{FC} = elevation of the bottom of the filter course material	
N/A	feet	E_{UD} = invert elevation of the underdrain (UD), if applicable	
115.50	feet	E_{BTM} = elevation of the bottom of the practice (i.e., bottom of the stone reservoir).	
110.00	feet	E_{SHWT} = elevation of SHWT (if none found, enter the lowest elevation of the test pit)	
100.00	feet	E_{ROCK} = elevation of bedrock (if none found, enter the lowest elevation of the test pit)	
#VALUE!	feet	$D_{FC\ to\ UD}$ = depth to UD from the bottom of the filter course[3]	← **≥ 1'**
16.50	feet	$D_{FC\ to\ ROCK}$ = depth to bedrock from the bottom of the filter course[3]	← **≥ 1'**
6.50	feet	$D_{FC\ to\ SHWT}$ = depth to SHWT from the bottom of the filter course[3]	← **≥ 1'**
5.50	feet	$D_{BTM\ to\ SHWT}$ = depth to SHWT from the bottom of the practice[3]	← **≥ 2'**
118.94	ft	Peak elevation of the 10-year storm event (infiltration can be used in analysis)	
119.50	ft	Elevation of the top of the practice	
YES		10 peak elevation ≤ Elevation of the top of the practice	← **yes**

If a surface sand filter is proposed:

YES	ac	Drainage Area check.	← **< 10 ac**
N/A	cf	V = volume of storage[4, 5] (attach a stage-storage table)	← **≥ 75%WQV**
N/A	inches	D_{FC} = filter course thickness	← **18"**
Sheet		Note what sheet in the plan set contains the filter course specification	
N/A	Yes/No	Access grate provided?	← **yes**
N/A		The filter shall not be covered in grass. What is covering the filter?	

If an underground sand filter is proposed:

YES	ac	Drainage Area check.	← **< 10 ac**
N/A	cf	V = volume of storage[4, 5] (attach a stage-storage table)	← **≥ 75%WQV**
N/A	inches	D_{FC} = filter course thickness	← **24"**
Sheet		Note what sheet in the plan set contains the filter course specification	
N/A	Yes/No	Access grate provided?	← **yes**

If a bioretention area is proposed:

YES	ac	Drainage Area no larger than 5 ac?	← yes
2,526	cf	V = volume of storage[4, 5] (attach a stage-storage table)	← $\geq$ WQV
18.0	inches	D_{FC} = filter course thickness	← 18"
Sheet		Note what sheet in the plan set contains the filter course specification	
2.0	:1	Pond side slopes	← $\geq$2:1
Sheet		Note what sheet in the plan set contains the planting plans and surface cover	

If porous pavement is proposed:

N/A		Type of pavement proposed (concrete? Asphalt? Pavers? Etc)	
N/A	acres	A_{SA} = surface area of the pervious pavement	
-	:1	ratio of the contributing area to the pervious surface area	← 5:1
N/A	inches	D_{FC} = filter course thickness	← 12"
Sheet		Note what sheet in the plan set contains the filter course spec.	← 304.1 sand

1. If the practice is a tree box filter, the drainage area shall be < 0.1 acre

2. Rate of the limiting layer (either the filter course or the underlying soil). See Vol. 2 of the NH Stormwater Manual, Ch. 2-4, for guidance on determining the infiltration rate.

3. If not within a GPA or WSIPA: SHWT/Bedrock must be at least 1 foot below the filter course material (or an underdrain must drain the SHWT to at least one foot below the filter course material). If within a GPA or WSIPA: SHWT must be at least two feet below the bottom of the practice OR the filter course material must be at least twice as thick as required and the SHWT must be at least one foot below the filter course material.

4. Volume without depending on infiltration. The storage above the filter media shall not include the volume above the outlet structure, if any.

5. The volume includes the storage above the filter but below the invert of the outlet structure (if any), the filter media voids, and the pretreatment area.

Designer's Notes:

Stage-Area-Storage for Pond 1P: Bio-Retention

Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)
115.50	1,050	0
115.51	1,051	3
115.52	1,052	6
115.53	1,053	9
115.54	1,055	13
115.55	1,056	16
115.56	1,057	19
115.57	1,058	22
115.58	1,059	25
115.59	1,060	28
115.60	1,061	31
115.61	1,063	35
115.62	1,064	38
115.63	1,065	41
115.64	1,066	44
115.65	1,067	47
115.66	1,068	50
115.67	1,070	54
115.68	1,071	57
115.69	1,072	60
115.70	1,073	63
115.71	1,074	66
115.72	1,075	69
115.73	1,076	72
115.74	1,078	76
115.75	1,079	79
115.76	1,080	82
115.77	1,081	85
115.78	1,082	88
115.79	1,083	91
115.80	1,084	94
115.81	1,086	98
115.82	1,087	101
115.83	1,088	104
115.84	1,089	107
115.85	1,090	110
115.86	1,091	113
115.87	1,093	117
115.88	1,094	120
115.89	1,095	123
115.90	1,096	126
115.91	1,097	129
115.92	1,098	132
115.93	1,099	135
115.94	1,101	139
115.95	1,102	142
115.96	1,103	145
115.97	1,104	148
115.98	1,105	151
115.99	1,106	154
116.00	1,107	158
116.01	1,109	161
116.02	1,110	164
116.03	1,111	167
116.04	1,112	170
116.05	1,113	173
116.06	1,114	176
116.07	1,115	180
116.08	1,117	183
116.09	1,118	186
116.10	1,119	189
116.11	1,120	192
116.12	1,121	195
116.13	1,122	198
116.14	1,124	202
116.15	1,125	205
116.16	1,126	208
116.17	1,127	211
116.18	1,128	214
116.19	1,129	217
116.20	1,130	221
116.21	1,132	224
116.22	1,133	227
116.23	1,134	230
116.24	1,135	233
116.25	1,136	236
116.26	1,137	239
116.27	1,138	243
116.28	1,140	246
116.29	1,141	249
116.30	1,142	252
116.31	1,143	255
116.32	1,144	258
116.33	1,145	261
116.34	1,146	265
116.35	1,148	268
116.36	1,149	271
116.37	1,150	274
116.38	1,151	277
116.39	1,152	280
116.40	1,153	284
116.41	1,155	287
116.42	1,156	290
116.43	1,157	293
116.44	1,158	296
116.45	1,159	299
116.46	1,160	302
116.47	1,161	306
116.48	1,163	309
116.49	1,164	312
116.50	1,165	315
116.51	1,166	318
116.52	1,167	321
116.53	1,168	324
116.54	1,169	328
116.55	1,171	331
116.56	1,172	334
116.57	1,173	337
116.58	1,174	340
116.59	1,175	343
116.60	1,176	346
116.61	1,178	350
116.62	1,179	353
116.63	1,180	356
116.64	1,181	359
116.65	1,182	362
116.66	1,183	365
116.67	1,184	369
116.68	1,186	372
116.69	1,187	375
116.70	1,188	378
116.71	1,189	381
116.72	1,190	384
116.73	1,191	387
116.74	1,192	391
116.75	1,194	394
116.76	1,195	397
116.77	1,196	400
116.78	1,197	403
116.79	1,198	406
116.80	1,199	409
116.81	1,200	413
116.82	1,202	416
116.83	1,203	419
116.84	1,204	422
116.85	1,205	425
116.86	1,206	428
116.87	1,207	432
116.88	1,209	435
116.89	1,210	438
116.90	1,211	441
116.91	1,212	444
116.92	1,213	447
116.93	1,214	450
116.94	1,215	454
116.95	1,217	457
116.96	1,218	460
116.97	1,219	463
116.98	1,220	466
116.99	1,221	469
117.00	1,222	473
117.01	1,223	476
117.02	1,225	479
117.03	1,226	482
117.04	1,227	485
117.05	1,228	488
117.06	1,229	491
117.07	1,230	495
117.08	1,231	498
117.09	1,233	501
117.10	1,234	504
117.11	1,235	507
117.12	1,236	510
117.13	1,237	513
117.14	1,238	517
117.15	1,240	520
117.16	1,241	523
117.17	1,242	526
117.18	1,243	529
117.19	1,244	532
117.20	1,245	536
117.21	1,246	539
117.22	1,248	542
117.23	1,249	545
117.24	1,250	548
117.25	1,251	551
117.26	1,252	554
117.27	1,253	558
117.28	1,254	561
117.29	1,256	564
117.30	1,257	567
117.31	1,258	570
117.32	1,259	573
117.33	1,260	576
117.34	1,261	580
117.35	1,263	583
117.36	1,264	586
117.37	1,265	589
117.38	1,266	592
117.39	1,267	595
117.40	1,268	599
117.41	1,269	602
117.42	1,271	605
117.43	1,272	608
117.44	1,273	611
117.45	1,274	614
117.46	1,275	617
117.47	1,276	621
117.48	1,277	624
117.49	1,279	627
117.50	1,280	630
117.51	1,281	633
117.52	1,282	636
117.53	1,283	639
117.54	1,284	643
117.55	1,285	646
117.56	1,287	649
117.57	1,288	652
117.58	1,289	655
117.59	1,290	658

Stage-Area-Storage for Pond 1P: Bio-Retention (continued)

Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)
117.60	1,291	661	118.30	2,922	1,180	119.00	4,596	2,838
117.61	1,292	665	118.31	2,942	1,196	119.01	4,616	2,871
117.62	1,294	668	118.32	2,962	1,212	119.02	4,637	2,903
117.63	1,295	671	118.33	2,982	1,228	119.03	4,657	2,936
117.64	1,296	674	118.34	3,002	1,245	119.04	4,678	2,970
117.65	1,297	677	118.35	3,022	1,261	119.05	4,699	3,003
117.66	1,298	680	118.36	3,042	1,278	119.06	4,719	3,037
117.67	1,299	684	118.37	3,063	1,296	119.07	4,740	3,071
117.68	1,300	687	118.38	3,083	1,313	119.08	4,761	3,105
117.69	1,302	690	118.39	3,104	1,330	119.09	4,782	3,139
117.70	1,303	693	118.40	3,125	1,348	119.10	4,803	3,173
117.71	1,304	696	118.41	3,146	1,366	119.11	4,824	3,208
117.72	1,305	699	118.42	3,167	1,384	119.12	4,845	3,243
117.73	1,306	702	118.43	3,188	1,403	119.13	4,866	3,278
117.74	1,307	706	118.44	3,209	1,421	119.14	4,887	3,313
117.75	1,308	709	118.45	3,231	1,440	119.15	4,909	3,349
117.76	1,310	712	118.46	3,252	1,459	119.16	4,930	3,385
117.77	1,311	715	118.47	3,274	1,478	119.17	4,952	3,421
117.78	1,312	718	118.48	3,296	1,498	119.18	4,973	3,457
117.79	1,313	721	118.49	3,317	1,517	119.19	4,995	3,493
117.80	1,314	724	118.50	3,339	1,537	119.20	5,016	3,530
117.81	1,315	728	118.51	3,362	1,557	119.21	5,038	3,567
117.82	1,316	731	118.52	3,384	1,578	119.22	5,060	3,604
117.83	1,318	734	118.53	3,406	1,598	119.23	5,081	3,641
117.84	1,319	737	118.54	3,429	1,619	119.24	5,103	3,678
117.85	1,320	740	118.55	3,451	1,640	119.25	5,125	3,716
117.86	1,321	743	118.56	3,474	1,661	119.26	5,147	3,754
117.87	1,322	747	118.57	3,497	1,683	119.27	5,169	3,792
117.88	1,323	750	118.58	3,520	1,704	119.28	5,191	3,831
117.89	1,325	753	118.59	3,543	1,726	119.29	5,214	3,869
117.90	1,326	756	118.60	3,566	1,749	119.30	5,236	3,908
117.91	1,327	759	118.61	3,590	1,771	119.31	5,258	3,947
117.92	1,328	762	118.62	3,613	1,794	119.32	5,281	3,986
117.93	1,329	765	118.63	3,637	1,816	119.33	5,303	4,026
117.94	1,330	769	118.64	3,661	1,839	119.34	5,326	4,065
117.95	1,331	772	118.65	3,684	1,863	119.35	5,348	4,105
117.96	1,333	775	118.66	3,708	1,886	119.36	5,371	4,145
117.97	1,334	778	118.67	3,733	1,910	119.37	5,393	4,186
117.98	1,335	781	118.68	3,757	1,934	119.38	5,416	4,226
117.99	1,336	784	118.69	3,781	1,958	119.39	5,439	4,267
118.00	2,387	788	118.70	3,806	1,983	119.40	5,462	4,308
118.01	2,403	798	118.71	3,830	2,008	119.41	5,485	4,349
118.02	2,419	809	118.72	3,855	2,033	119.42	5,508	4,391
118.03	2,436	820	118.73	3,880	2,058	119.43	5,531	4,433
118.04	2,452	831	118.74	3,905	2,084	119.44	5,554	4,474
118.05	2,469	842	118.75	3,930	2,109	119.45	5,577	4,517
118.06	2,485	853	118.76	3,955	2,135	119.46	5,601	4,559
118.07	2,502	865	118.77	3,980	2,162	119.47	5,624	4,602
118.08	2,519	877	118.78	4,006	2,188	119.48	5,647	4,645
118.09	2,536	889	118.79	4,031	2,215	119.49	5,671	4,688
118.10	2,553	[illegible]	[illegible]	4,057	2,242	119.50	5,694	4,731
118.11	2,571	[illegible]	[illegible]	4,083	2,269	119.51	5,888	4,775
118.12	2,588	[illegible]	[illegible]	4,109	2,297	119.52	6,087	4,822
118.13	2,606	938	118.83	4,135	2,324	119.53	6,289	4,870
118.14	2,623	951	118.84	4,161	2,353	119.54	6,496	4,921
118.15	2,641	964	118.85	4,187	2,381	119.55	6,708	4,973
118.16	2,659	977	118.86	4,213	2,409	119.56	6,923	5,028
118.17	2,677	990	118.87	4,240	2,438	119.57	7,142	5,085
118.18	2,695	1,004	118.88	4,267	2,467	119.58	7,366	5,144
118.19	2,713	1,017	118.89	4,293	2,497	119.59	7,594	5,205
118.20	2,732	1,031	118.90	4,320	2,526	119.60	7,827	5,269
118.21	2,750	1,045	118.91	4,347	2,556	119.61	8,063	5,335
118.22	2,769	1,059	118.92	4,374	2,587	119.62	8,304	5,403
118.23	2,787	1,074	118.93	4,402	2,617	119.63	8,549	5,474
118.24	2,806	1,088	118.94	4,429	2,648	119.64	8,799	5,547
118.25	2,825	1,103	118.95	4,457	2,679	119.65	9,052	5,623
118.26	2,844	1,118	118.96	4,484	2,710	119.66	9,310	5,701
118.27	2,864	1,133	118.97	4,512	2,742	119.67	9,572	5,782
118.28	2,883	1,149	118.98	4,540	2,773	119.68	9,838	5,866
118.29	2,902	1,164	118.99	4,568	2,805	119.69	10,109	5,952

Storage area below outlet invert

Stage-Area-Storage for Pond 1P: Bio-Retention (continued)

Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)
119.70	10,384	6,041
119.71	10,663	6,133
119.72	10,946	6,227
119.73	11,233	6,325
119.74	11,525	6,425
119.75	11,821	6,528
119.76	12,121	6,634
119.77	12,426	6,744
119.78	12,734	6,856
119.79	13,047	6,971
119.80	13,365	7,090
119.81	13,686	7,212
119.82	14,012	7,337
119.83	14,342	7,465
119.84	14,676	7,596
119.85	15,014	7,731
119.86	15,357	7,870
119.87	15,704	8,012
119.88	16,055	8,157
119.89	16,410	8,306
119.90	16,770	8,458
119.91	17,134	8,614
119.92	17,502	8,774
119.93	17,874	8,937
119.94	18,251	9,104
119.95	18,632	9,275
119.96	19,017	9,450
119.97	19,406	9,629
119.98	19,800	9,811
119.99	20,197	9,998
120.00	**20,599**	**10,188**

INFILTRATION PRACTICE DESIGN CRITERIA (Env-Wq 1508.05)

Type/Node Name: **Infil #1**

Enter the type of infiltration practice (e.g., trench) and the node name in the drainage analysis, if applicable

Yes		Have you reviewed Env-Wq 1508.05(a) to ensure that infiltration is allowed?	
2.53	ac	A = Area draining to the practice	
2.27	ac	A_I = Impervious area draining to the practice	
0.90	decimal	I = percent impervious area draining to the practice, in decimal form	
0.86	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
2.17	ac-in	WQV= 1" x Rv x A	
7,875	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1,969	cf	25% x WQV (check calc for sediment forebay volume)	
CDS/Filtera		Method of pretreatment? (not required for clean or roof runoff)	
N/A	cf	V_{SED} = sediment forebay volume, if used for pretreatment	← **≥ 25%WQV**
8,470	cf	V = volume[1] (attach a stage-storage table)	← **≥ WQV**
6,699	sf	A_{SA} = surface area of the bottom of the pond	
6.50	iph	I_{DESIGN} = design infiltration rate[2]	
2.3	hours	T_{DRAIN} = drain time = V / (A_{SA} * I_{DESIGN})	← **≤ 72-hrs**
113.00	feet	E_{BTM} = elevation of the bottom of the practice	
110.00	feet	E_{SHWT} = elevation of SHWT (if none found, enter the lowest elevation of the test pit)	
100.00	feet	E_{ROCK} = elevation of bedrock (if none found, enter the lowest elevation of the test pit)	
3.00	feet	D_{SHWT} = separation from SHWT[3]	← **≥ *[3]**
13.0	feet	D_{ROCK} = separation from bedrock[3]	← **≥ *[3]**
NO	ft	D_T = depth of trench, if trench proposed	← **4 - 10 ft**
Yes	Yes/No	If a trench or underground system is proposed, observation well provided	
N/A		If a trench is proposed, material in trench	
Stone		If a basin is proposed, basin floor material	
NO	Yes/No	If a basin is proposed, the perimeter should be curvilinear.	
N/A	:1	If a basin is proposed, pond side slopes	← **≥3:1**
115.38	ft	Peak elevation of the 10-year storm event (infiltration can be used in analysis)	
116.69	ft	Peak elevation of the 50-year storm event (infiltration can be used in analysis)	
118.00	ft	Elevation of the top of the practice (if a basin, this is the elevation of the berm)	
YES		10 peak elevation ≤ Elevation of the top of the trench?	← **yes**
YES		If a basin is proposed, 50-year peak elevation ≤ Elevation of berm?	← **yes**

1. Volume below the lowest invert of the outlet structure and excludes forebay volume
2. See NH Stormwater Manual, Vol.2, Ch.2-4, for guidance on determining the infiltration rate
3. 1' separation if treatment not required; 4' for treatment in GPAs & WSIPAs; & 3' in all other areas.

Designer's Notes:

Stage-Area-Storage for Pond INFIL1: INFIL. #1

Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)
113.00	6,699	0	113.70	6,929	2,833	114.40	7,158	6,330
113.01	6,702	27	113.71	6,932	2,880	114.41	7,161	6,383
113.02	6,706	56	113.72	6,935	2,927	114.42	7,165	6,435
113.03	6,709	86	113.73	6,938	2,974	114.43	7,168	6,488
113.04	6,712	116	113.74	6,942	3,021	114.44	7,171	6,541
113.05	6,715	148	113.75	6,945	3,068	114.45	7,175	6,594
113.06	6,719	186	113.76	6,948	3,115	114.46	7,178	6,646
113.07	6,722	219	113.77	6,952	3,163	114.47	7,181	6,699
113.08	6,725	253	113.78	6,955	3,210	114.48	7,184	6,752
113.09	6,729	287	113.79	6,958	3,258	114.49	7,188	6,805
113.10	6,732	321	113.80	6,961	3,306	114.50	7,191	6,858
113.11	6,735	357	113.81	6,965	3,353	114.51	7,194	6,911
113.12	6,738	392	113.82	6,968	3,401	114.52	7,198	6,964
113.13	6,742	428	113.83	6,971	3,449	114.53	7,201	7,018
113.14	6,745	464	113.84	6,975	3,498	114.54	7,204	7,071
113.15	6,748	500	113.85	6,978	3,546	114.55	7,207	7,124
113.16	6,751	537	113.86	6,981	3,594	114.56	7,211	7,177
113.17	6,755	574	113.87	6,984	3,643	114.57	7,214	7,231
113.18	6,758	611	113.88	6,988	3,691	114.58	7,217	7,284
113.19	6,761	649	113.89	6,991	3,740	114.59	7,221	7,338
113.20	6,765	687	113.90	6,994	3,789	114.60	7,224	7,391
113.21	6,768	725	113.91	6,997	3,838	114.61	7,227	7,445
113.22	6,771	763	113.92	7,001	3,887	114.62	7,230	7,498
113.23	6,774	802	113.93	7,004	3,936	114.63	7,234	7,552
113.24	6,778	841	113.94	7,007	3,985	114.64	7,237	7,606
113.25	6,781	880	113.95	7,011	4,034	114.65	7,240	7,659
113.26	6,784	920	113.96	7,014	4,083	114.66	7,243	7,713
113.27	6,788	959	113.97	7,017	4,133	114.67	7,247	7,767
113.28	6,791	999	113.98	7,020	4,182	114.68	7,250	7,821
113.29	6,794	1,039	113.99	7,024	4,232	114.69	7,253	7,875
113.30	6,797	1,079	114.00	7,027	4,281	114.70	7,257	7,928
113.31	6,801	1,120	114.01	7,030	4,331	114.71	7,260	7,982
113.32	6,804	1,161	114.02	7,034	4,381	114.72	7,263	8,036
113.33	6,807	1,202	114.03	7,037	4,431	114.73	7,266	8,090
113.34	6,811	1,243	114.04	7,040	4,481	114.74	7,270	8,145
113.35	6,814	1,284	114.05	7,043	4,531	114.75	7,273	8,199
113.36	6,817	1,326	114.06	7,047	4,581	114.76	7,276	8,253
113.37	6,820	1,367	114.07	7,050	4,632	114.77	7,280	8,307
113.38	6,824	1,409	114.08	7,053	4,682	114.78	7,283	8,361
113.39	6,827	1,451	114.09	7,057	4,732	114.79	7,286	8,415
113.40	6,830	1,493	114.10	7,060	4,783	114.80	7,289	8,470
113.41	6,833	1,536	114.11	7,063	4,833	114.81	7,293	8,524
113.42	6,837	1,579	114.12	7,066	4,884	114.82	7,296	8,578
113.43	6,840	1,621	114.13	7,070	4,935	114.83	7,299	8,633
113.44	6,843	1,664	114.14	7,073	4,986	114.84	7,303	8,687
113.45	6,847	1,707	114.15	7,076	5,036	114.85	7,306	8,742
113.46	6,850	1,751	114.16	7,079	5,087	114.86	7,309	8,796
113.47	6,853	1,794	114.17	7,083	5,13[illegible]	[illegible]	[illegible]12	8,851
113.48	6,856	1,838	114.18	7,086	5,18[illegible]	[illegible]	[illegible]16	8,905
113.49	6,860	1,881	114.19	7,089	5,24[illegible]	[illegible]	[illegible]19	8,960
113.50	6,863	1,925	114.20	7,093	5,292	[illegible]	[illegible]22	9,014
113.51	6,866	1,969	114.21	7,096	5,343	114.91	7,325	9,069
113.52	6,870	2,014	114.22	7,099	5,395	114.92	7,329	9,124
113.53	6,873	2,058	114.23	7,102	5,446	114.93	7,332	9,178
113.54	6,876	2,102	114.24	7,106	5,497	114.94	7,335	9,233
113.55	6,879	2,147	114.25	7,109	5,549	114.95	7,339	9,288
113.56	6,883	2,192	114.26	7,112	5,601	114.96	7,342	9,342
113.57	6,886	2,237	114.27	7,116	5,652	114.97	7,345	9,397
113.58	6,889	2,282	114.28	7,119	5,704	114.98	7,348	9,452
113.59	6,893	2,327	114.29	7,122	5,756	114.99	7,352	9,507
113.60	6,896	2,372	114.30	7,125	5,808	115.00	7,355	9,562
113.61	6,899	2,418	114.31	7,129	5,860	115.01	7,358	9,617
113.62	6,902	2,464	114.32	7,132	5,912	115.02	7,362	9,672
113.63	6,906	2,509	114.33	7,135	5,964	115.03	7,365	9,726
113.64	6,909	2,555	114.34	7,139	6,016	115.04	7,368	9,781
113.65	6,912	2,601	114.35	7,142	6,068	115.05	7,371	9,836
113.66	6,915	2,647	114.36	7,145	6,121	115.06	7,375	9,891
113.67	6,919	2,694	114.37	7,148	6,173	115.07	7,378	9,946
113.68	6,922	2,740	114.38	7,152	6,225	115.08	7,381	10,001
113.69	6,925	2,786	114.39	7,155	6,278	115.09	7,385	10,056

Storage volume
below invert out

Stage-Area-Storage for Pond INFIL1: INFIL. #1 (continued)

Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)
115.10	7,388	10,111	115.80	7,617	13,986	116.50	7,847	17,791
115.11	7,391	10,167	115.81	7,621	14,041	116.51	7,850	17,844
115.12	7,394	10,222	115.82	7,624	14,096	116.52	7,854	17,897
115.13	7,398	10,277	115.83	7,627	14,151	116.53	7,857	17,950
115.14	7,401	10,332	115.84	7,631	14,207	116.54	7,860	18,002
115.15	7,404	10,387	115.85	7,634	14,262	116.55	7,863	18,055
115.16	7,407	10,442	115.86	7,637	14,317	116.56	7,867	18,108
115.17	7,411	10,497	115.87	7,640	14,372	116.57	7,870	18,161
115.18	7,414	10,553	115.88	7,644	14,427	116.58	7,873	18,213
115.19	7,417	10,608	115.89	7,647	14,482	116.59	7,877	18,266
115.20	7,421	10,663	115.90	7,650	14,537	116.60	7,880	18,319
115.21	7,424	10,718	115.91	7,653	14,592	116.61	7,883	18,371
115.22	7,427	10,774	115.92	7,657	14,647	116.62	7,886	18,424
115.23	7,430	10,829	115.93	7,660	14,702	116.63	7,890	18,476
115.24	7,434	10,884	115.94	7,663	14,757	116.64	7,893	18,528
115.25	7,437	10,939	115.95	7,667	14,812	116.65	7,896	18,581
115.26	7,440	10,995	115.96	7,670	14,867	116.66	7,899	18,633
115.27	7,444	11,050	115.97	7,673	14,922	116.67	7,903	18,685
115.28	7,447	11,105	115.98	7,676	14,977	116.68	7,906	18,737
115.29	7,450	11,161	115.99	7,680	15,032	116.69	7,909	18,789
115.30	7,453	11,216	116.00	7,683	15,087	116.70	7,913	18,841
115.31	7,457	11,271	116.01	7,686	15,142	116.71	7,916	18,893
115.32	7,460	11,327	116.02	7,690	15,197	116.72	7,919	18,945
115.33	7,463	11,382	116.03	7,693	15,252	116.73	7,922	18,996
115.34	7,467	11,438	116.04	7,696	15,306	116.74	7,926	19,048
115.35	7,470	11,493	116.05	7,699	15,361	116.75	7,929	19,100
115.36	7,473	11,548	116.06	7,703	15,416	116.76	7,932	19,151
115.37	7,476	11,604	116.07	7,706	15,471	116.77	7,936	19,203
115.38	7,480	11,659	116.08	7,709	15,525	116.78	7,939	19,254
115.39	7,483	11,715	116.09	7,713	15,580	116.79	7,942	19,306
115.40	7,486	11,770	116.10	7,716	15,635	116.80	7,945	19,357
115.41	7,489	11,825	116.11	7,719	15,689	116.81	7,949	19,408
115.42	7,493	11,881	116.12	7,722	15,744	116.82	7,952	19,459
115.43	7,496	11,936	116.13	7,726	15,798	116.83	7,955	19,510
115.44	7,499	11,992	116.14	7,729	15,853	116.84	7,959	19,561
115.45	7,503	12,047	116.15	7,732	15,907	116.85	7,962	19,612
115.46	7,506	12,103	116.16	7,735	15,962	116.86	7,965	19,663
115.47	7,509	12,158	116.17	7,739	16,016	116.87	7,968	19,714
115.48	7,512	12,214	116.18	7,742	16,070	116.88	7,972	19,765
115.49	7,516	12,269	116.19	7,745	16,125	116.89	7,975	19,815
115.50	7,519	12,324	116.20	7,749	16,179	116.90	7,978	19,866
115.51	7,522	12,380	116.21	7,752	16,233	116.91	7,981	19,917
115.52	7,526	12,435	116.22	7,755	16,288	116.92	7,985	19,967
115.53	7,529	12,491	116.23	7,758	16,342	116.93	7,988	20,017
115.54	7,532	12,546	116.24	7,762	16,396	116.94	7,991	20,068
115.55	7,535	12,602	116.25	7,765	16,450	116.95	7,995	20,118
115.56	7,539	12,657	116.26	7,768	16,504	116.96	7,998	20,168
115.57	7,542	12,713	116.27	7,772	16,558	116.97	8,001	20,218
115.58	7,545	12,768	116.28	7,775	16,612	116.98	8,004	20,268
115.59	7,549	12,823	116.29	7,778	16,666	116.99	8,008	20,318
115.60	7,552	12,879	116.30	7,781	16,720	117.00	8,011	20,367
115.61	7,555	12,934	116.31	7,785	16,774	117.01	8,014	20,417
115.62	7,558	12,990	116.32	7,788	16,828	117.02	8,018	20,467
115.63	7,562	13,045	116.33	7,791	16,882	117.03	8,021	20,516
115.64	7,565	13,100	116.34	7,795	16,936	117.04	8,024	20,566
115.65	7,568	13,156	116.35	7,798	16,990	117.05	8,027	20,615
115.66	7,571	13,211	116.36	7,801	17,043	117.06	8,031	20,664
115.67	7,575	13,267	116.37	7,804	17,097	117.07	8,034	20,713
115.68	7,578	13,322	116.38	7,808	17,151	117.08	8,037	20,762
115.69	7,581	13,377	116.39	7,811	17,204	117.09	8,041	20,811
115.70	7,585	13,433	116.40	7,814	17,258	117.10	8,044	20,860
115.71	7,588	13,488	116.41	7,817	17,311	117.11	8,047	20,909
115.72	7,591	13,543	116.42	7,821	17,365	117.12	8,050	20,957
115.73	7,594	13,599	116.43	7,824	17,418	117.13	8,054	21,006
115.74	7,598	13,654	116.44	7,827	17,471	117.14	8,057	21,055
115.75	7,601	13,709	116.45	7,831	17,525	117.15	8,060	21,103
115.76	7,604	13,765	116.46	7,834	17,578	117.16	8,063	21,151
115.77	7,608	13,820	116.47	7,837	17,631	117.17	8,067	21,199
115.78	7,611	13,875	116.48	7,840	17,684	117.18	8,070	21,247
115.79	7,614	13,930	116.49	7,844	17,738	117.19	8,073	21,295

Stage-Area-Storage for Pond INFIL1: INFIL. #1 (continued)

Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)
117.20	8,077	21,343
117.21	8,080	21,391
117.22	8,083	21,439
117.23	8,086	21,486
117.24	8,090	21,534
117.25	8,093	21,581
117.26	8,096	21,628
117.27	8,100	21,675
117.28	8,103	21,722
117.29	8,106	21,769
117.30	8,109	21,816
117.31	8,113	21,862
117.32	8,116	21,909
117.33	8,119	21,955
117.34	8,123	22,001
117.35	8,126	22,048
117.36	8,129	22,094
117.37	8,132	22,139
117.38	8,136	22,185
117.39	8,139	22,231
117.40	8,142	22,276
117.41	8,145	22,322
117.42	8,149	22,367
117.43	8,152	22,412
117.44	8,155	22,457
117.45	8,159	22,502
117.46	8,162	22,546
117.47	8,165	22,591
117.48	8,168	22,635
117.49	8,172	22,679
117.50	8,175	22,723
117.51	8,178	22,767
117.52	8,182	22,811
117.53	8,185	22,855
117.54	8,188	22,898
117.55	8,191	22,941
117.56	8,195	22,985
117.57	8,198	23,028
117.58	8,201	23,070
117.59	8,205	23,113
117.60	8,208	23,155
117.61	8,211	23,198
117.62	8,214	23,240
117.63	8,218	23,282
117.64	8,221	23,323
117.65	8,224	23,365
117.66	8,227	23,406
117.67	8,231	23,447
117.68	8,234	23,488
117.69	8,237	23,529
117.70	8,241	23,569
117.71	8,244	23,610
117.72	8,247	23,650
117.73	8,250	23,690
117.74	8,254	23,729
117.75	8,257	23,769
117.76	8,260	23,808
117.77	8,264	23,847
117.78	8,267	23,885
117.79	8,270	23,924
117.80	8,273	23,962
117.81	8,277	24,000
117.82	8,280	24,037
117.83	8,283	24,075
117.84	8,287	24,112
117.85	8,290	24,148
117.86	8,293	24,185
117.87	8,296	24,221
117.88	8,300	24,257
117.89	8,303	24,292
117.90	8,306	24,327
117.91	8,309	24,362
117.92	8,313	24,396
117.93	8,316	24,430
117.94	8,319	24,463
117.95	8,323	24,496
117.96	8,326	24,528
117.97	8,329	24,559
117.98	8,332	24,588
117.99	8,336	24,617
118.00	**8,339**	**24,649**

APPENDIX 6.3

WATER QUALITY UNIT SIZING (CONTECH)

CONTECH ENGINEERED SOLUTIONS

Jellyfish Weir Calculation

Date: September 30, 2019

To: Allen & Major

From: David Adams
Sr. Design Engineer
Contech Engineered Solutions

RE: Residential Development 158 – 161 Temple Street, Nashua, NH
Jellyfish Bypass Weir Design Summary

Site Design Data:

- WQS 1:
  - WQ Flow = 0.83 cfs
  - Peak Flow: 5.69 cfs
  - Downstream Pipe: 8LF x 24" HDPE @ 0.875%
  - Model: JFPD0806-5-1

- WQS 2:
  - WQ Flow = 0.62 cfs
  - Downstream Pipe: 18 LF x 15" HDPE @ 0.778%
  - Upstream Pipe: 11 LF x 15" HDPE @ 0.818%
  - Model Offline JFMH6-3-1

Assumptions:

- Free Flow Conditions
- HDPE pipes have smooth interior
- Pipe entry/exit are square edge with headwall

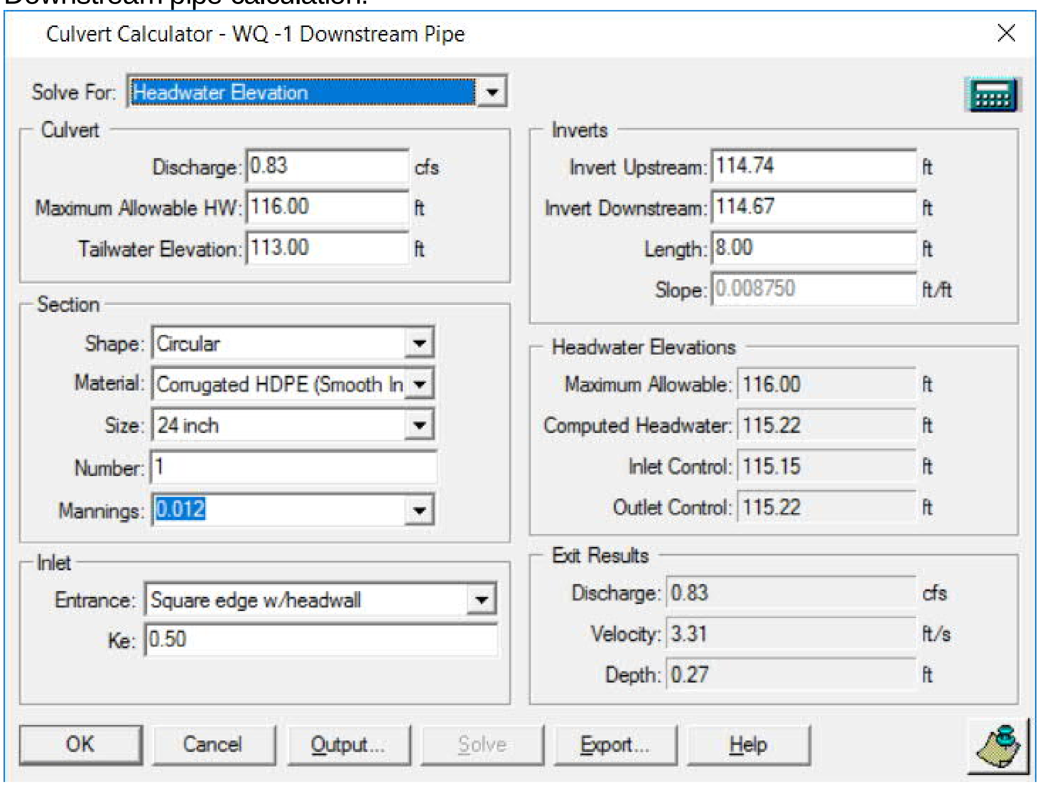
Weir Elevation calculation:

WQS 1:

Downstream pipe headwater elevation during WQ Flow: 115.22 ft
HGL impact of filter: 18" (1.5 ft)
Jellyfish headwater elevation during WQ Flow: 116.72 ft
JFPD Bypass Weir Elevation: 116.72 ft

Bypass Weir Crest Length: 2'-10"
Calculated upstream HGL during peak flow: 117.44 ft

Downstream pipe calculation:

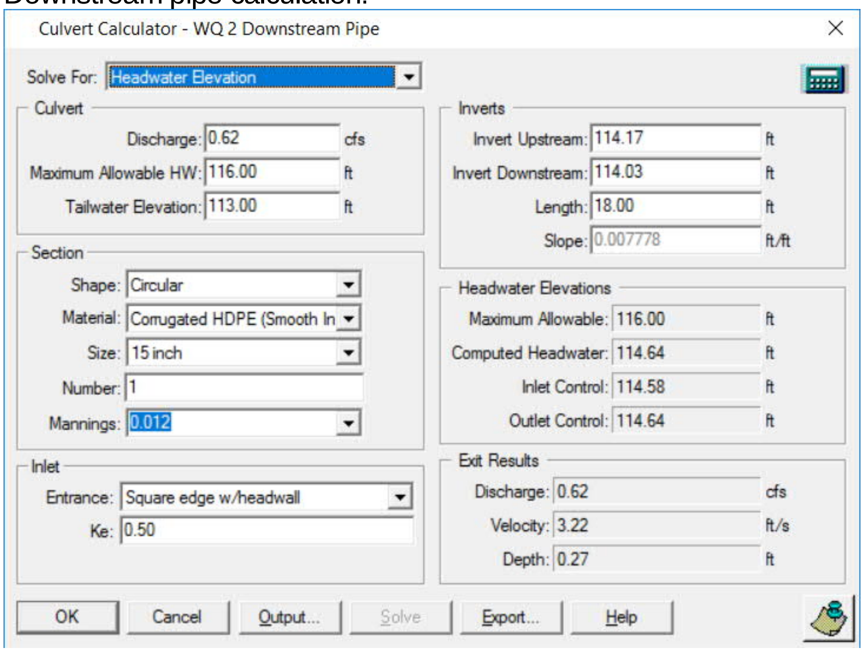


WQS 2:

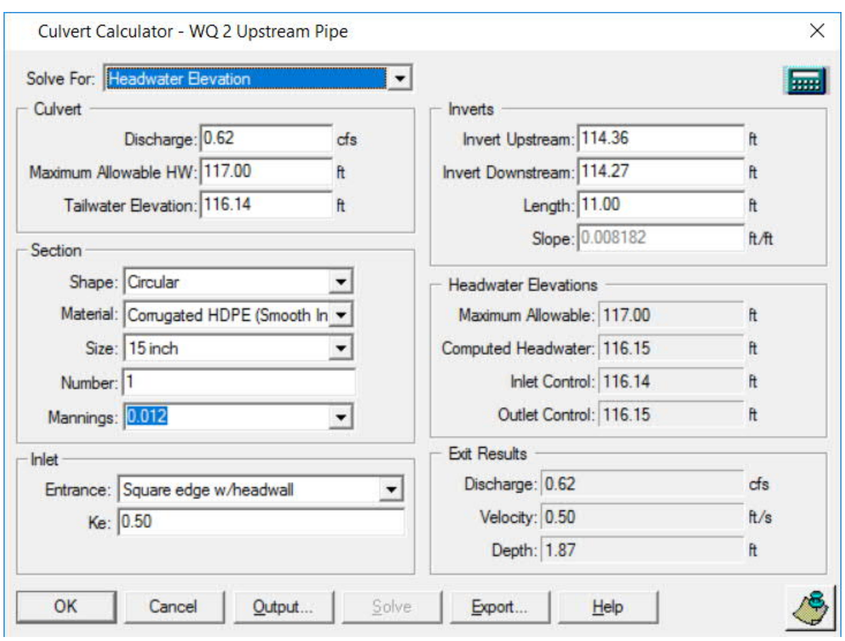
Downstream pipe headwater elevation during WQ Flow: 114.64 ft
HGL impact of filter: 18” (1.5 ft)
Upstream pipe headwater elevation during WQ Flow: 116.15
Upstream Bypass Weir Elevation: 116.15 ft

BP Crest Length: per EOR
Estimated upstream HGL during peak flow: per EOR

Downstream pipe calculation:



Upstream pipe calculation:



71 US Rte 1 Suite F, Scarborough, ME 04074
Toll-free: 866.740.3318 Fax: 866.376.8511

CONTECH ENGINEERED SOLUTIONS

Joshua Stackhouse
Stormwater Consultant

71 US Route One Suite F
Scarborough, ME 04074

Off: 207-885-6112
Mob: 207-219-9110
Email: jstackhouse@conteches.com

Date: October 8, 2019

To: Michael Malynowski, PE – Allen & Major Associates

RE: Residential Development 158-161 Temple Street, Nashua, NH
Jellyfish Bypass Elevation Discrepancies

Dear Michael,

There has been some conflicting information regarding the bypass weir crest length and elevation from Contech on the above project, and I would like to explain why and confirm the correct information.

For system WQS 1 (JFPD0806-5-1), Contech communicated weir lengths of 2'-8" and 2'-10". This was an oversight on our part – some of the Peak Diversion models *do* use a 2'-8" weir length, but this model will be using the 2'-10" length, which was correctly noted on the final design summary from my colleague David Adams on 9/30/19. Along with the weir length, the elevation also changed a few times, and this was the result of internal discussion. When asked for information regarding how this is determined, multiple engineers with advanced knowledge of the product design had different opinions on the correct way to calculate this elevation, and as a result there were conflicting approaches. Each time we looked at the deliverables we were providing, we attempted to update to the current approach by the engineering team.

In the end, the final design approach is to determine the headwater elevation at the outlet pipe from the Jellyfish, and then add in the 18" of operational head required of the system. I have confirmed that this will be the way we design or future projects as well, with the caveat that if there is a tailwater issue, we will need to account for that as well. Ultimately we do intend to provide something similar to the final design summary going forward, and will work with NH DES to make sure the format is something they are comfortable with.

Sincerely,

Joshua Stackhouse

Project:	**Residential Development 158-161 Temple Street**
Location:	**Nashua, NH**
Prepared For:	**Allen Major**

Purpose: To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 1" of runoff from the contributing impervious surface.

Reference: Massachusetts Dept. of Environmental Protection Wetlands Program / United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

Procedure: Determine unit peak discharge using Figure 1 or 2. Figure 2 is in tabular form so is preferred. Using the tc, read the unit peak discharge (qu) from Figure 1 or Table in Figure 2. qu is expressed in the following units: cfs/mi^2/watershed inches (csm/in).

Compute Q Rate using the following equation:

Q = (qu) (A) (WQV)

where:

Q = flow rate associated with first 1" of runoff
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area (in square miles)
WQV = water quality volume in watershed inches (1" in this case)

Structure Name	Impv. (acres)	A (miles^2)	t_c (min)	t_c (hr)	WQV (in)	qu (csm/in.)	Q (cfs)
CDS 1	0.49	0.0007656	6.0	0.100	1.00	774.00	0.59
CDS 2	0.59	0.0009219	6.0	0.100	1.00	774.00	0.71
CDS 3	0.31	0.0004844	6.0	0.100	1.00	774.00	0.37

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

RESIDENTIAL DEVELOPMENT 158-161 TEMPLE STREET
NASHUA, NH

Area	**0.49 ac**	Unit Site Designation	**CDS 1**
Weighted C	**0.9**	Rainfall Station #	**104**
t_c	**6 min**		
CDS Model	**2015-4**	CDS Treatment Capacity	**1.4 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	13.0%	13.0%	0.01	0.01	12.6
0.04	12.2%	25.2%	0.02	0.02	11.8
0.06	11.2%	36.4%	0.03	0.03	10.8
0.08	10.0%	46.4%	0.04	0.04	9.5
0.10	8.2%	54.6%	0.04	0.04	7.8
0.12	5.8%	60.4%	0.05	0.05	5.5
0.14	6.5%	66.9%	0.06	0.06	6.1
0.16	4.6%	71.5%	0.07	0.07	4.3
0.18	3.7%	75.2%	0.08	0.08	3.4
0.20	3.3%	78.5%	0.09	0.09	3.1
0.25	6.7%	85.2%	0.11	0.11	6.1
0.30	3.7%	88.9%	0.13	0.13	3.4
0.35	2.4%	91.3%	0.15	0.15	2.2
0.40	1.8%	93.1%	0.18	0.18	1.6
0.45	1.9%	95.0%	0.20	0.20	1.7
0.50	1.1%	96.1%	0.22	0.22	0.9
0.75	2.6%	98.7%	0.33	0.33	2.1
1.00	0.9%	99.6%	0.44	0.44	0.7
1.50	0.4%	100.0%	0.66	0.66	0.2
2.00	0.0%	100.0%	0.88	0.88	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					93.8
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**87.4%**

1 - Based on 10 years of hourly precipitation data from NCDC 1683, Concord WSO Airport, Merrimack County, NH
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

RESIDENTIAL DEVELOPMENT 158-161 TEMPLE STREET NASHUA, NH

Area	0.59 ac	Unit Site Designation	CDS 2
Weighted C	0.9	Rainfall Station #	104
t_c	6 min		
CDS Model	2015-4	CDS Treatment Capacity	1.4 cfs

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	13.0%	13.0%	0.01	0.01	12.5
0.04	12.2%	25.2%	0.02	0.02	11.8
0.06	11.2%	36.4%	0.03	0.03	10.7
0.08	10.0%	46.4%	0.04	0.04	9.5
0.10	8.2%	54.6%	0.05	0.05	7.8
0.12	5.8%	60.4%	0.06	0.06	5.4
0.14	6.5%	66.9%	0.07	0.07	6.1
0.16	4.6%	71.5%	0.08	0.08	4.3
0.18	3.7%	75.2%	0.10	0.10	3.4
0.20	3.3%	78.5%	0.11	0.11	3.0
0.25	6.7%	85.2%	0.13	0.13	6.1
0.30	3.7%	88.9%	0.16	0.16	3.3
0.35	2.4%	91.3%	0.19	0.19	2.1
0.40	1.8%	93.1%	0.21	0.21	1.6
0.45	1.9%	95.0%	0.24	0.24	1.7
0.50	1.1%	96.1%	0.27	0.27	0.9
0.75	2.6%	98.7%	0.40	0.40	2.0
1.00	0.9%	99.6%	0.53	0.53	0.7
1.50	0.4%	100.0%	0.80	0.80	0.2
2.00	0.0%	100.0%	1.06	1.06	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					93.1
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**86.7%**

1 - Based on 10 years of hourly precipitation data from NCDC 1683, Concord WSO Airport, Merrimack County, NH

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

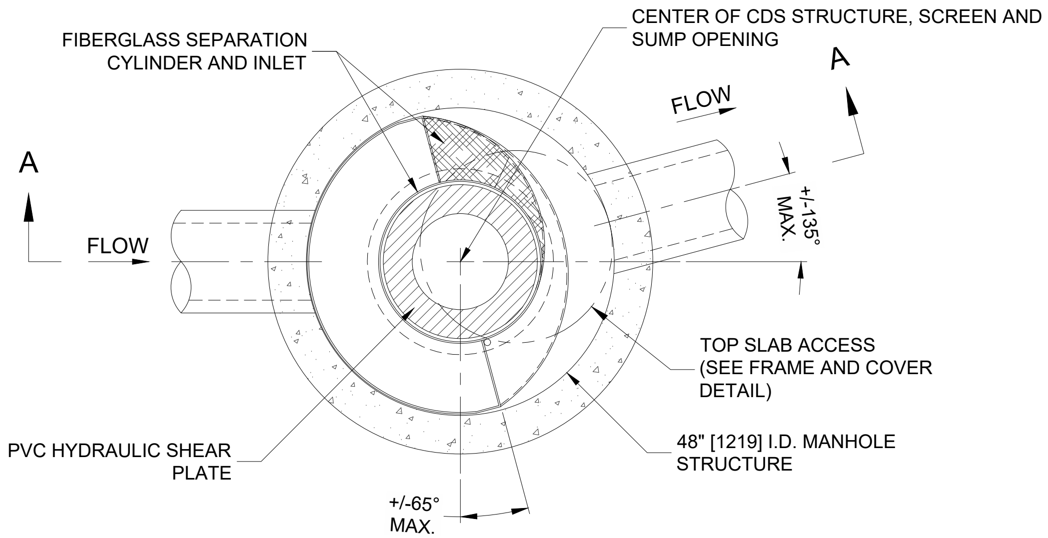
CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

RESIDENTIAL DEVELOPMENT 158-161 TEMPLE STREET
NASHUA, NH

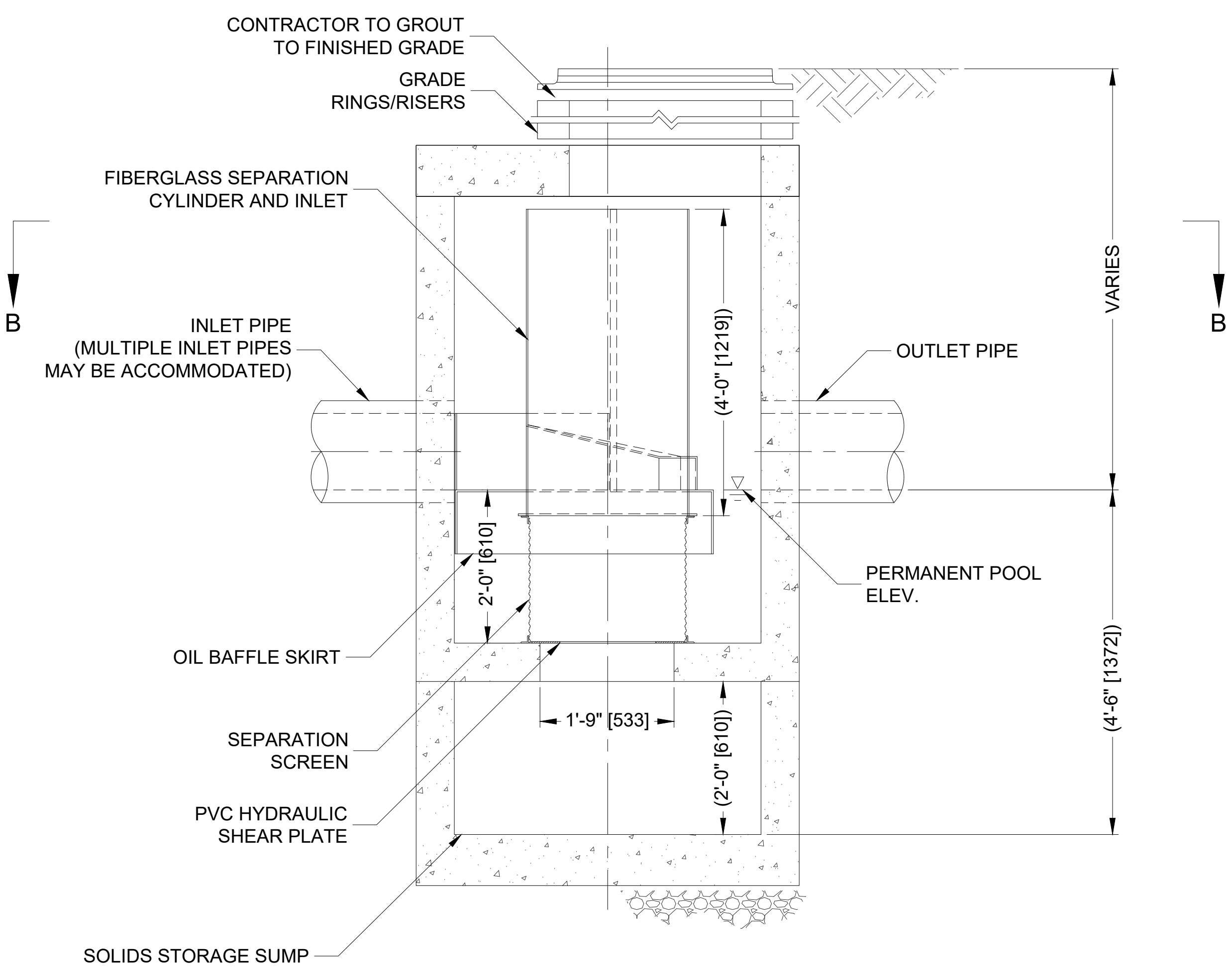
Area	**0.31 ac**	Unit Site Designation	**CDS 3**
Weighted C	**0.9**	Rainfall Station #	**104**
t_c	**6 min**		
CDS Model	**1515-3**	CDS Treatment Capacity	**1.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	13.0%	13.0%	0.01	0.01	12.6
0.04	12.2%	25.2%	0.01	0.01	11.8
0.06	11.2%	36.4%	0.02	0.02	10.8
0.08	10.0%	46.4%	0.02	0.02	9.5
0.10	8.2%	54.6%	0.03	0.03	7.9
0.12	5.8%	60.4%	0.03	0.03	5.5
0.14	6.5%	66.9%	0.04	0.04	6.1
0.16	4.6%	71.5%	0.04	0.04	4.4
0.18	3.7%	75.2%	0.05	0.05	3.4
0.20	3.3%	78.5%	0.06	0.06	3.1
0.25	6.7%	85.2%	0.07	0.07	6.2
0.30	3.7%	88.9%	0.08	0.08	3.4
0.35	2.4%	91.3%	0.10	0.10	2.2
0.40	1.8%	93.1%	0.11	0.11	1.6
0.45	1.9%	95.0%	0.13	0.13	1.7
0.50	1.1%	96.1%	0.14	0.14	0.9
0.75	2.6%	98.7%	0.21	0.21	2.1
1.00	0.9%	99.6%	0.28	0.28	0.7
1.50	0.4%	100.0%	0.42	0.42	0.3
2.00	0.0%	100.0%	0.56	0.56	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					94.2
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**87.7%**

1 - Based on 10 years of hourly precipitation data from NCDC 1683, Concord WSO Airport, Merrimack County, NH
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.



PLAN VIEW B-B
N.T.S.



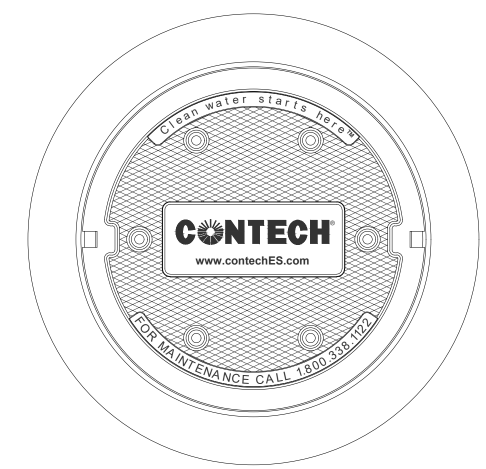
ELEVATION A-A
N.T.S.

CDS2015-4-C DESIGN NOTES

CDS2015-4-C RATED TREATMENT CAPACITY IS 1.4 CFS, OR PER LOCAL REGULATIONS.

THE STANDARD CDS2015-4-C CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

CONFIGURATION DESCRIPTION
GRATED INLET ONLY (NO INLET PIPE)
GRATED INLET WITH INLET PIPE OR PIPES
CURB INLET ONLY (NO INLET PIPE)
CURB INLET WITH INLET PIPE OR PIPES



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS OR L/s)			*
PEAK FLOW RATE (CFS OR L/s)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
SCREEN APERTURE (2400 OR 4700)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST		WIDTH	HEIGHT
		*	*
NOTES/SPECIAL REQUIREMENTS:			

* PER ENGINEER OF RECORD

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 2', AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO..
5. IF REQUIRED, PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.
6. CDS STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C-478 AND AASHTO LOAD FACTOR DESIGN METHOD.

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE.
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT INLET AND OUTLET PIPE(S). MATCH PIPE INVERTS WITH ELEVATIONS SHOWN. ALL PIPE CENTERLINES TO MATCH PIPE OPENING CENTERLINES.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

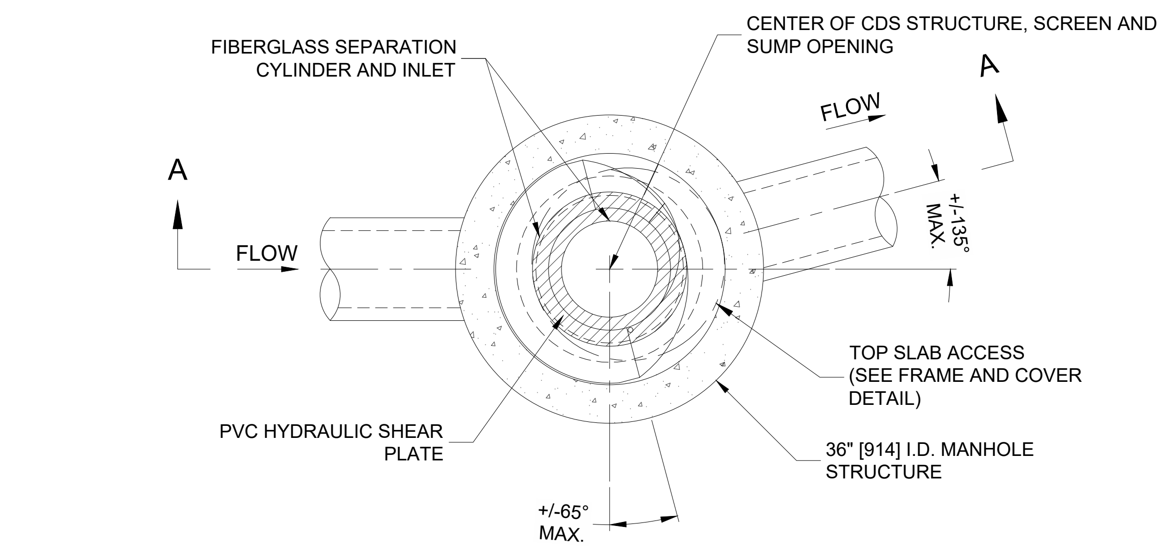
CONTECH® ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CDS2015-4-C
ONLINE CDS
STANDARD DETAIL

CDS1515-3-C DESIGN NOTES

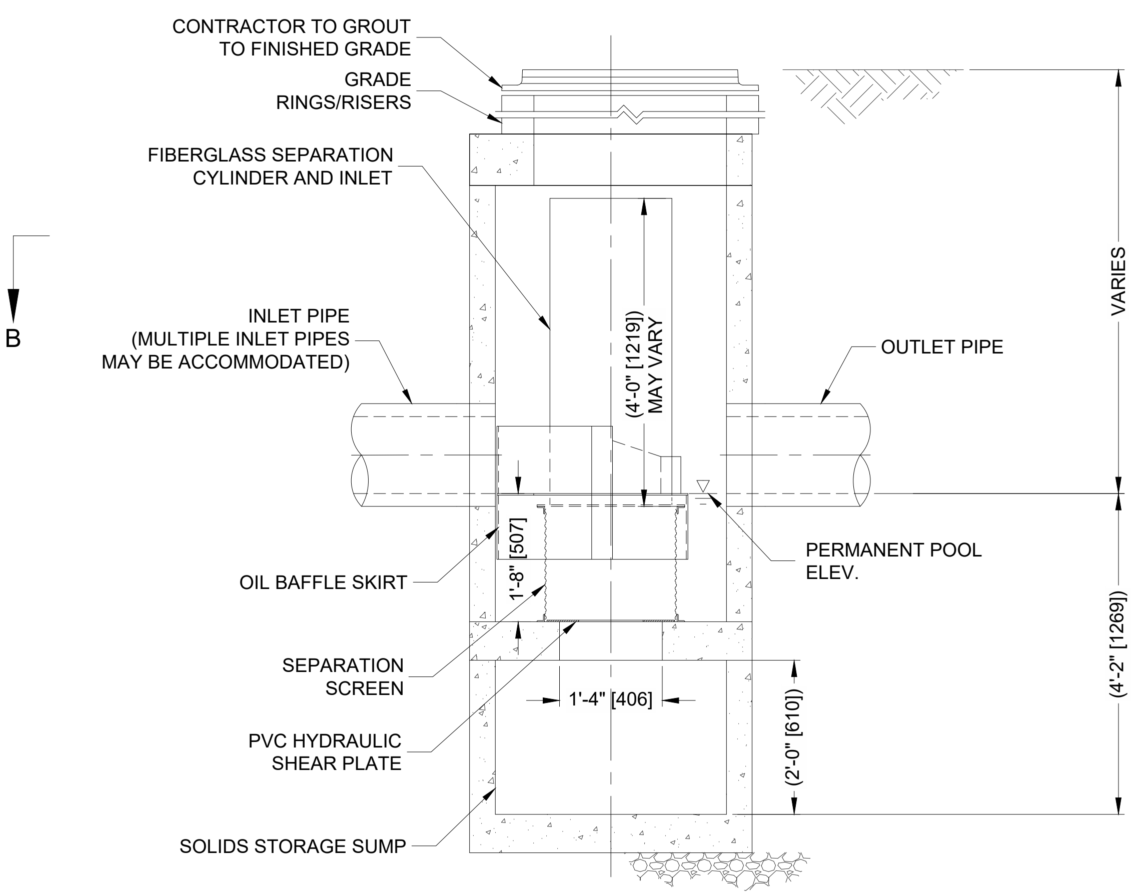
CDS1515-3-C RATED TREATMENT CAPACITY IS 1.0 CFS, OR PER LOCAL REGULATIONS.

THE STANDARD CDS1515-3-C CONFIGURATION IS SHOWN.



PLAN VIEW B-B

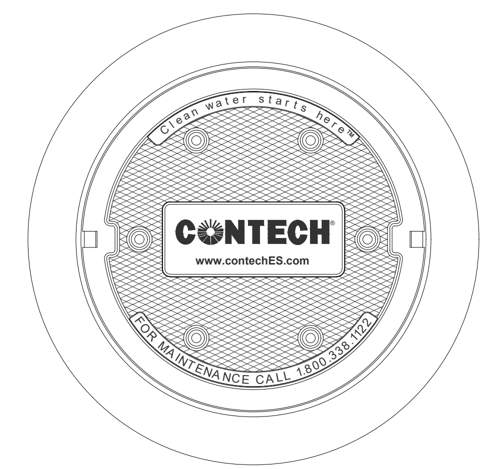
N.T.S.



ELEVATION A-A

N.T.S.

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,788,848; 6,641,720; 6,511,595; 6,581,783; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.



FRAME AND COVER

(DIAMETER VARIES)

N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS OR L/s)			*
PEAK FLOW RATE (CFS OR L/s)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
SCREEN APERTURE (2400 OR 4700)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST		WIDTH	HEIGHT
		*	*
NOTES/SPECIAL REQUIREMENTS:			

* PER ENGINEER OF RECORD

GENERAL NOTES

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 2', AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO..
5. IF REQUIRED, PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.
6. CDS STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C-478 AND AASHTO LOAD FACTOR DESIGN METHOD.

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE.
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT INLET AND OUTLET PIPE(S). MATCH PIPE INVERTS WITH ELEVATIONS SHOWN. ALL PIPE CENTERLINES TO MATCH PIPE OPENING CENTERLINES.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

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CDS1515-3-C
ONLINE CDS
STANDARD DETAIL

Jellyfish Filter Design Summary

158-161 Temple Street: WQU 1

Nashua, NH

Information Provided:

- Total Contributing Drainage Area = 0.92 acres
- Impervious cover = 0.80 acres
- Design Storm = 1.00” Rainfall
- T_c = 6 minutes
- Unit Peak Discharge, qu = 700 cfs/mi^2/in
- Presiding agency = Alteration of Terrain Bureau - NHDES (AoT-NHDES)

Jellyfish Information and Cartridge Data:

The Jellyfish® Filter is an engineered Stormwater quality treatment technology featuring pre-treatment and membrane filtration in a compact stand-alone treatment system that removes a high level and wide variety of Stormwater pollutants. Exceptional pollutant removal is achieved at high treatment flow rates with minimal head loss and low maintenance costs. Each lightweight Jellyfish Filter cartridge contains an extraordinarily large amount of membrane surface area, resulting in superior flow capacity and pollutant removal capacity. The Jellyfish Filter is NJCAT verified in accordance to the TARP Tier II Protocol and New Jersey Tier II Stormwater Test Requirements – Amendments to Tarp Tier II Protocol, with a demonstrated 89% TSS removal efficiency.

- Jellyfish cartridge length = 54 inches (nominal)
- Jellyfish cartridge flowrate (Hi Flo) = 80 gpm
- Jellyfish cartridge flowrate (Drain Down) = 40 gpm
- Jellyfish cartridge headloss = Minimum 18” above outlet

Design Summary:

The Jellyfish for this site was design as a flow-based system, and was sized based on calculating the peak water quality flow rate associated with the design storm. The design storm rainfall depth of 1.00 inch was selected based on NHDES-AoT regulations as of December 2008. Using the NHDES BMP Worksheet, a water quality flow rate of 0.833 cfs was calculated. See the WQF results from the sheet below:

Water Quality Volume (WQV)

0.92	ac	A = Area draining to the practice
0.80	ac	A_I = Impervious area draining to the practice
0.86	decimal	I = percent impervious area draining to the practice, in decimal form
0.83	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)
0.76	ac-in	WQV= 1" x Rv x A
2,765	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")

Water Quality Flow (WQF)

1	inches	P = amount of rainfall. For WQF in NH, P = 1".
0.83	inches	Q = water quality depth. Q = WQV/A
98	unitless	CN = unit peak discharge curve number. CN =1000/(10+5P+10Q–10*[Q^2 + 1.25*Q*P]$^{0.5}$)
0.2	inches	S = potential maximum retention. S = (1000/CN) - 10
0.033	inches	Ia = initial abstraction. Ia = 0.2S
6.0	minutes	T_c = Time of Concentration
700.0	cfs/mi^2/in	qu is the unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III
0.833	cfs	WQF = q_u x WQV. Conversion: to convert "cfs/mi^2/in * ac-in" to "cfs" multiply by 1mi^2/640ac

Fig. 1 –NHDES BMP Worksheet for WQF

Jellyfish Filter Design Summary

The Jellyfish for this site was sized to provide **5 Hi Flo and 1 Drain Down cartridge** in order to meet the water quality flowrate requirement (calculations seen below). In order to house this number of cartridges, Contech Engineered Solutions (Contech) recommends a JF0806-5-1, which is an 8'x6' Precast Vault Jellyfish Filter.

$$\underset{\boldsymbol{Hyd.\ Load}}{\boldsymbol{N_{cartridges}}} = Q_{Treat} \times 449\, {}^{gpm}\!/_{cfs} \le Q_{\underset{(cartridges)}{specific}}$$

$$0.833\, cfs \times 449\, {}^{gpm}\!/_{cfs} \le (x)80\, {}^{gpm}\!/_{ft^2} + (y)40\, {}^{gpm}\!/_{ft^2}$$

$$\underset{\boldsymbol{Hyd.\ Load}}{\boldsymbol{N_{cartridges}}} = [x = 5; y = 1]$$

Hydraulic Loading Requires: (5) Hi Flo, (1) Drain Down Cartridges

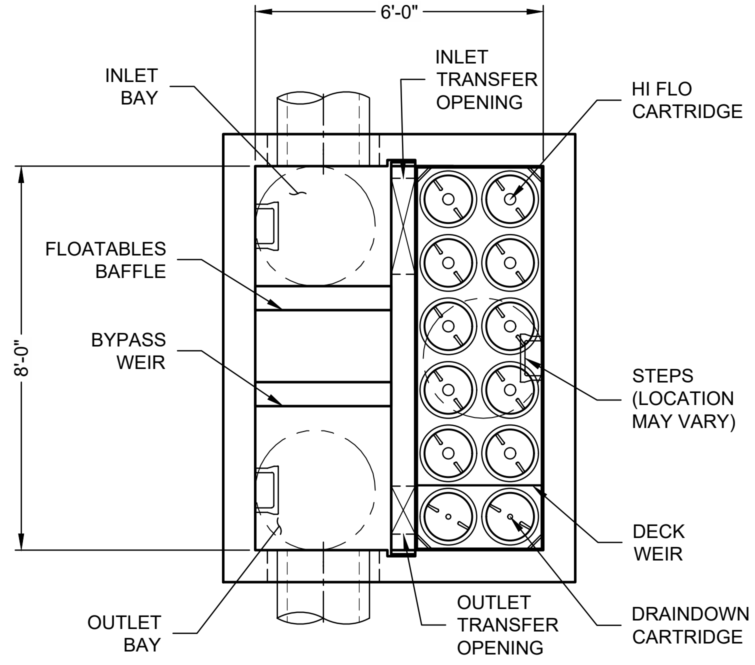
<u>Maintenance:</u>

Contech offers a network of Preferred Service Providers that have the capability to perform all necessary inspections, compliance reporting and cleaning services. Contech recommends inspecting the system annually and maintaining the system at the recommendation of the annual inspection. Full maintenance is typically required every 24-36 months. Please contact Contech's Maintenance Department for all questions regarding maintenance at (503) 258-3157 or visit our website at www.ContechES.com.

Thank you for the opportunity to present this information to you and your client.

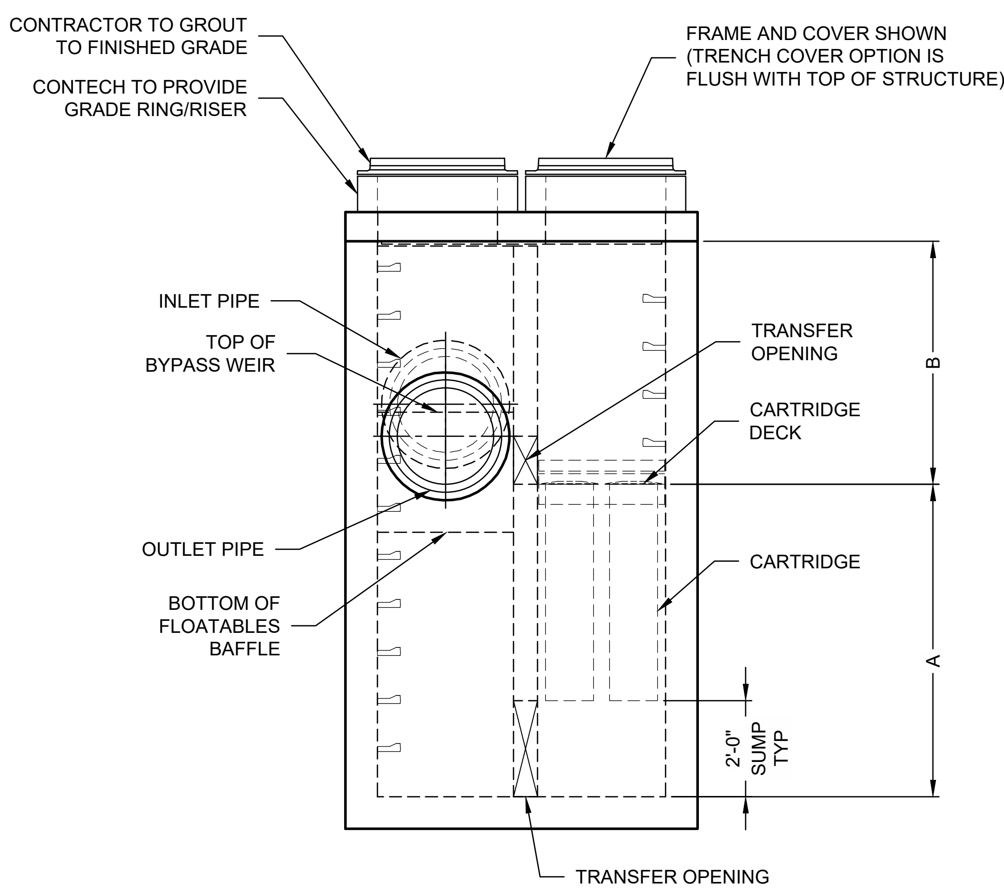
Sincerely,

Pat Valentine PE
Stormwater Design Engineer
Contech Engineered Solutions, LLC.



PLAN VIEW

(TOP SLAB NOT SHOWN FOR CLARITY)



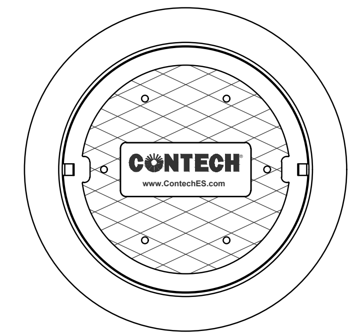
ELEVATION VIEW

JELLYFISH DESIGN NOTES

JELLYFISH TREATMENT CAPACITY IS A FUNCTION OF THE CARTRIDGE LENGTH AND THE NUMBER OF CARTRIDGES. THE STANDARD PEAK DIVERSION STYLE WITH PRECAST TOP SLAB IS SHOWN. ALTERNATE OFFLINE VAULT AND/OR SHALLOW ORIENTATIONS ARE AVAILABLE. PEAK CONVEYANCE CAPACITY TO BE DETERMINED BY ENGINEER OF RECORD

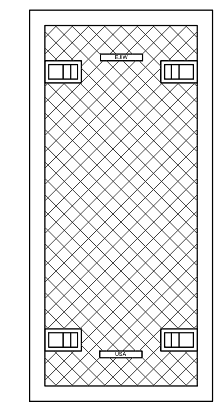
CARTRIDGE SELECTION

CARTRIDGE LENGTH	54"	40"	27"	15"
OUTLET INVERT TO STRUCTURE INVERT (A)	6'-6"	5'-4"	4'-3"	3'-3"
FLOW RATE HI-FLO / DRAINDOWN (CFS) (PER CART)	0.178 / 0.089	0.133 / 0.067	0.089 / 0.045	0.049 / 0.025
MAX. TREATMENT (CFS)	1.96	1.47	0.98	0.54
DECK TO INSIDE TOP (MIN) (B)	5.00	4.00	4.00	4.00



FRAME AND COVER

(DIAMETER VARIES)
N.T.S.



24" TRENCH COVER

(LENGTH VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	*
WATER QUALITY FLOW RATE (cfs)	*
PEAK FLOW RATE (cfs)	*
RETURN PERIOD OF PEAK FLOW (yrs)	*
# OF CARTRIDGES REQUIRED (HF / DD)	*
CARTRIDGE LENGTH	*

PIPE DATA:	I.E.	MAT'L	DIA	SLOPE %	HGL
INLET #1	*	*	*	*	*
INLET #2	*	*	*	*	*
OUTLET	*	*	*	*	*

SEE GENERAL NOTES 6-7 FOR INLET AND OUTLET HYDRAULIC AND SIZING REQUIREMENTS.

RIM ELEVATION	*

ANTI-FLOTATION BALLAST	WIDTH	HEIGHT
	*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES:

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS REPRESENTATIVE. www.ContechES.com
3. JELLYFISH WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. STRUCTURE SHALL MEET AASHTO HS-20 OR PER APPROVING JURISDICTION REQUIREMENTS, WHICHEVER IS MORE STRINGENT, ASSUMING EARTH COVER OF 0' - 10', AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 LOAD RATING AND BE CAST WITH THE CONTECH LOGO.
5. STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C-857, ASTM C-918, AND AASHTO LOAD FACTOR DESIGN METHOD.
6. OUTLET PIPE INVERT IS EQUAL TO THE CARTRIDGE DECK ELEVATION.
7. THE OUTLET PIPE DIAMETER FOR NEW INSTALLATIONS IS RECOMMENDED TO BE ONE PIPE SIZE LARGER THAN THE INLET PIPE AT EQUAL OR GREATER SLOPE.
8. NO PRODUCT SUBSTITUTIONS SHALL BE ACCEPTED UNLESS SUBMITTED 10 DAYS PRIOR TO PROJECT BID DATE, OR AS DIRECTED BY THE ENGINEER OF RECORD.

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STRUCTURE.
C. CONTRACTOR WILL INSTALL AND LEVEL THE STRUCTURE, SEALING THE JOINTS, LINE ENTRY AND EXIT POINTS (NON-SHRINK GROUT WITH APPROVED WATERSTOP OR FLEXIBLE BOOT).
D. CARTRIDGE INSTALLATION, BY CONTECH, SHALL OCCUR ONLY AFTER SITE HAS BEEN STABILIZED AND THE JELLYFISH UNIT IS CLEAN AND FREE OF DEBRIS. CONTACT CONTECH TO COORDINATE CARTRIDGE INSTALLATION WITH SITE STABILIZATION.

Jellyfish® Filter

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING: U.S. PATENT NO. 8,287,726; 8,221,618; US 8,123,935; OTHER INTERNATIONAL PATENTS PENDING

CONTECH®
ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

JELLYFISH JFPD0806
STANDARD DETAIL
PEAK DIVERSION CONFIGURATION

I:\COMMON\CAD\TREATMENT\13 JELLYFISH FILTER\40 STANDARD DRAWINGS\JFPD\DWG\JFPD0806-DTL NEW.DWG 1/29/2018 10:38 AM

CONTECH ENGINEERED SOLUTIONS

Jellyfish Filter Design Summary

158-161 Temple Street: WQU 2

Nashua, NH

Information Provided:

- Total Contributing Drainage Area = 0.72 acres
- Impervious cover = 0.59 acres
- Design Storm = 1.00" Rainfall
- T_c = 6 minutes
- Unit Peak Discharge, qu = 700 cfs/mi^2/in
- Presiding agency = Alteration of Terrain Bureau - NHDES (AoT-NHDES)

Jellyfish Information and Cartridge Data:

The Jellyfish® Filter is an engineered Stormwater quality treatment technology featuring pre-treatment and membrane filtration in a compact stand-alone treatment system that removes a high level and wide variety of Stormwater pollutants. Exceptional pollutant removal is achieved at high treatment flow rates with minimal head loss and low maintenance costs. Each lightweight Jellyfish Filter cartridge contains an extraordinarily large amount of membrane surface area, resulting in superior flow capacity and pollutant removal capacity. The Jellyfish Filter is NJCAT verified in accordance to the TARP Tier II Protocol and New Jersey Tier II Stormwater Test Requirements – Amendments to Tarp Tier II Protocol, with a demonstrated 89% TSS removal efficiency.

- Jellyfish cartridge length = 54 inches (nominal)
- Jellyfish cartridge flowrate (Hi Flo) = 80 gpm
- Jellyfish cartridge flowrate (Drain Down) = 40 gpm
- Jellyfish cartridge headloss = Minimum 18" above outlet

Design Summary:

The Jellyfish for this site was design as a flow-based system, and was sized based on calculating the peak water quality flow rate associated with the design storm. The design storm rainfall depth of 1.00 inch was selected based on NHDES-AoT regulations as of December 2008. Using the NHDES BMP Worksheet, a water quality flow rate of 0.619 cfs was calculated. See the WQF results from the sheet below:

Water Quality Volume (WQV)

0.72	ac	A = Area draining to the practice
0.59	ac	A_I = Impervious area draining to the practice
0.82	decimal	I = percent impervious area draining to the practice, in decimal form
0.78	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)
0.57	ac-in	WQV= 1" x Rv x A
2,055	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")

Water Quality Flow (WQF)

1	inches	P = amount of rainfall. For WQF in NH, P = 1".
0.78	inches	Q = water quality depth. Q = WQV/A
98	unitless	CN = unit peak discharge curve number. CN =1000/(10+5P+10Q–10*[Q^2 + 1.25*Q*P]$^{0.5}$)
0.2	inches	S = potential maximum retention. S = (1000/CN) - 10
0.042	inches	Ia = initial abstraction. Ia = 0.2S
6.0	minutes	T_c = Time of Concentration
700.0	cfs/mi^2/in	qu is the unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III
0.619	cfs	WQF = q_u x WQV. Conversion: to convert "cfs/mi^2/in * ac-in" to "cfs" multiply by 1mi^2/640ac

Fig. 1 –NHDES BMP Worksheet for WQF

Jellyfish Filter Design Summary

The Jellyfish for this site was sized to provide **5 Hi Flo and 1 Drain Down cartridge** in order to meet the water quality flowrate requirement (calculations seen below). In order to house this number of cartridges, Contech Engineered Solutions (Contech) recommends a JF6-3-1, which is an 72" Precast Manhole Jellyfish Filter.

$$\underset{\boldsymbol{Hyd.\ Load}}{\boldsymbol{N_{cartridges}}} = Q_{Treat} \times 449\, {}^{gpm}/_{cfs} \leq Q \underset{(cartridges)}{\ _{specific}}$$

$$0.619\, cfs \times 449\, {}^{gpm}/_{cfs} \leq (x)80\, {}^{gpm}/_{ft^2} + (y)40\, {}^{gpm}/_{ft^2}$$

$$\underset{\boldsymbol{Hyd.\ Load}}{\boldsymbol{N_{cartridges}}} = [x = 3; y = 1]$$

Hydraulic Loading Requires: (3) Hi Flo, (1) Drain Down Cartridges

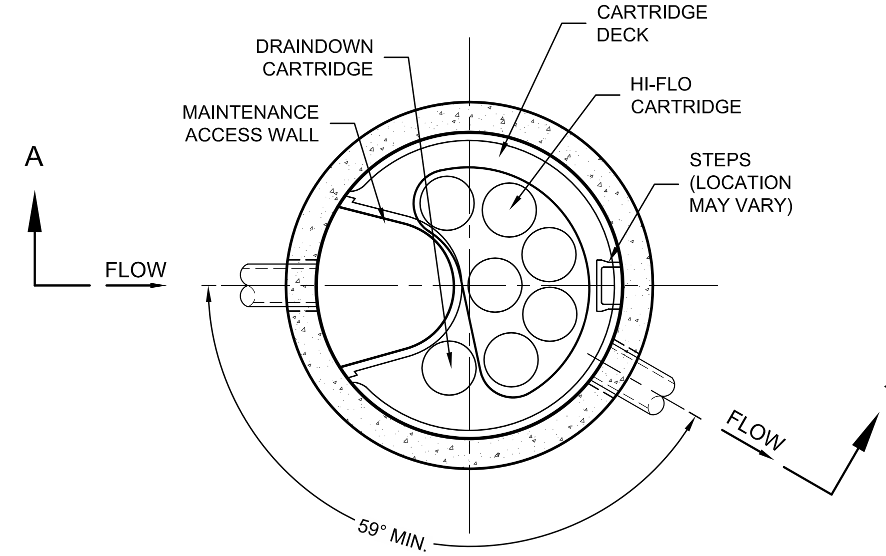
<u>Maintenance:</u>

Contech offers a network of Preferred Service Providers that have the capability to perform all necessary inspections, compliance reporting and cleaning services. Contech recommends inspecting the system annually and maintaining the system at the recommendation of the annual inspection. Full maintenance is typically required every 24-36 months. Please contact Contech's Maintenance Department for all questions regarding maintenance at (503) 258-3157 or visit our website at www.ContechES.com.

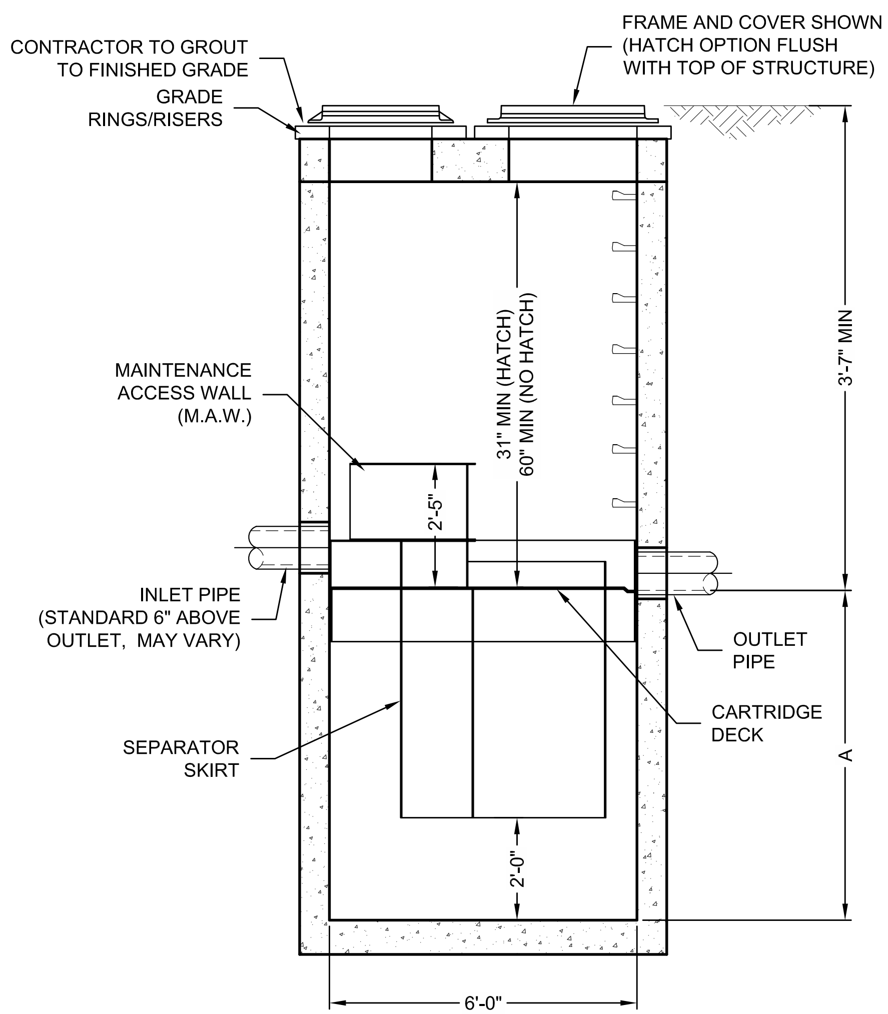
Thank you for the opportunity to present this information to you and your client.

Sincerely,

Pat Valentine PE
Stormwater Design Engineer
Contech Engineered Solutions, LLC.



PLAN VIEW



SECTION A-A

Jellyfish® Filter

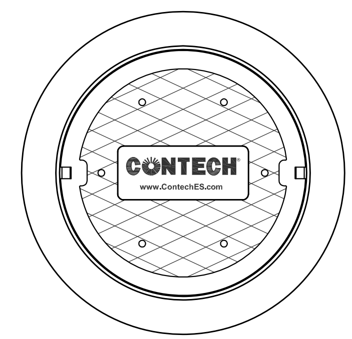
THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENT NO. 8,287,726, 8,221,618 & US 8,123,935; OTHER INTERNATIONAL PATENTS PENDING

JELLYFISH DESIGN NOTES

JELLYFISH TREATMENT CAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. THE STANDARD MANHOLE STYLE IS SHOWN. Ø72" MANHOLE JELLYFISH PEAK TREATMENT CAPACITY IS 1.16 CFS. IF THE SITE CONDITIONS EXCEED 1.16 CFS AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

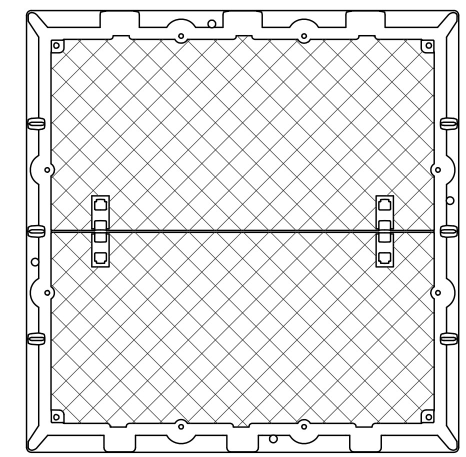
CARTRIDGE SELECTION

CARTRIDGE DEPTH	54"	40"	27"	15"
OUTLET INVERT TO STRUCTURE INVERT (A)	6'-5"	5'-3"	4'-2"	3'-2"
FLOW RATE HIGH-FLO / DRAINDOWN (cfs) (per cart)	0.18 / 0.09	0.13 / 0.065	0.09 / 0.045	0.05 / 0.025
MAX. CARTS HIGH-FLO / DRAINDOWN	6 / 1			



FRAME AND COVER

(DIAMETER VARIES)
N.T.S.



HATCH

(48" x 48" CAST INTO SLAB)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	*
WATER QUALITY FLOW RATE (cfs)	*
PEAK FLOW RATE (cfs)	*
RETURN PERIOD OF PEAK FLOW (yrs)	*
# OF CARTRIDGES REQUIRED (HF / DD)	* / *
CARTRIDGE SIZE	*

PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE #1	*	*	*
INLET PIPE #2	*	*	*
OUTLET PIPE	*	*	*

RIM ELEVATION	*

ANTI-FLOTATION BALLAST	WIDTH	HEIGHT
	*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES:

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS REPRESENTATIVE. www.ContechES.com
3. JELLYFISH WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. STRUCTURE SHALL MEET AASHTO HS-20 OR PER APPROVING JURISDICTION REQUIREMENTS, WHICHEVER IS MORE STRINGENT, ASSUMING EARTH COVER OF 0' - 3', AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 LOAD RATING AND BE CAST WITH THE CONTECH LOGO.
5. STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C-478 AND AASHTO LOAD FACTOR DESIGN METHOD.
6. NO PRODUCT SUBSTITUTIONS SHALL BE ACCEPTED UNLESS SUBMITTED 10 DAYS PRIOR TO PROJECT BID DATE, OR AS DIRECTED BY THE ENGINEER OF RECORD.

INSTALLATION NOTES

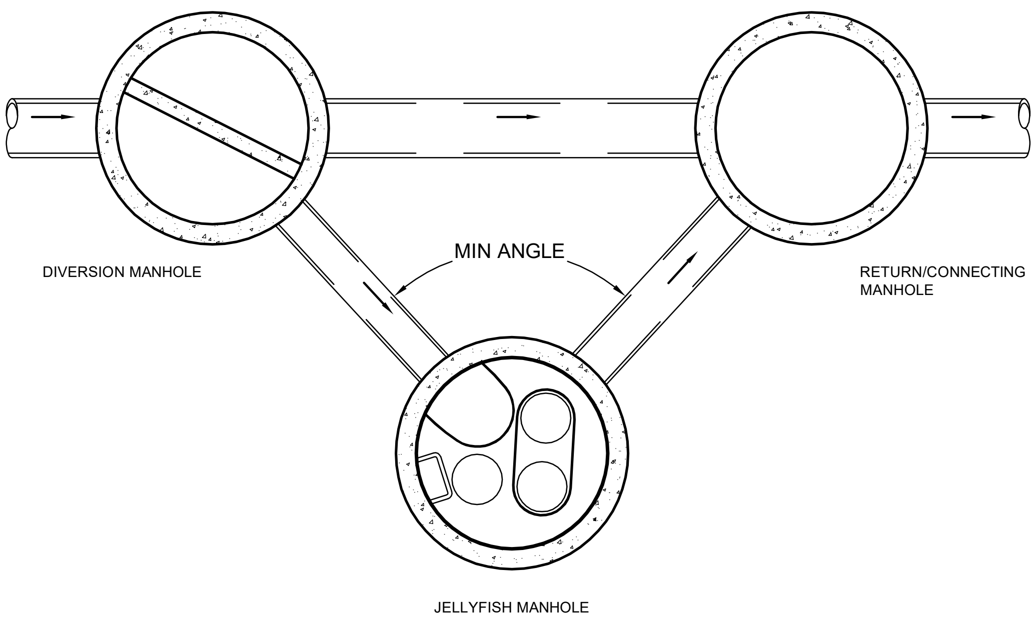
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STRUCTURE (LIFTING CLUTCHES PROVIDED)
C. CONTRACTOR WILL INSTALL AND LEVEL THE STRUCTURE, SEALING THE JOINTS, LINE ENTRY AND EXIT POINTS (NON-SHRINK GROUT WITH APPROVED WATERSTOP OR FLEXIBLE BOOT)
D. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.
E. CARTRIDGE INSTALLATION, BY CONTECH, SHALL OCCUR ONLY AFTER SITE HAS BEEN STABILIZED AND THE JELLYFISH UNIT IS CLEAN AND FREE OF DEBRIS. CONTACT CONTECH TO COORDINATE CARTRIDGE INSTALLATION WITH SITE STABILIZATION AT (866) 740-3318.

CONTECH®
ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

JELLYFISH JF6
STANDARD DETAIL
OFFLINE CONFIGURATION

I:\COMMON\CAD\TREATMENT\13 JELLYFISH FILTER\40 STANDARD DRAWINGS\OFFLINE\DWG\JF6-DTL.DWG 6/26/2015 4:08 PM

FOR INFORMATIONAL PURPOSES ONLY
NOT INTENDED AS A CONSTRUCTION DOCUMENT



PLAN VIEW

Jellyfish® Filter

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENT NO. 8,287,726, 8,221,618 & US 8,123,935; OTHER INTERNATIONAL PATENTS PENDING

CONTECH®
ENGINEERED SOLUTIONS LLC
www.ContechES.com
200 Enterprise Drive, Scarborough, ME 04074
877-907-8676 207-885-9830 207-885-9825 FAX

TYPICAL BYPASS LAYOUT
JELLYFISH® FILTER SYSTEM

DATE:XX/XX/XX	SCALE: NONE	PROJECT No.:TYPJFBYP	SEQ. No.: N/A	DRAWN: ATM	CHECKED: ATM

I:\STORMWATER\COMMOPS\13 JELLYFISH FILTER\40 STANDARD DRAWINGS\JFMH OFFLINE\DWG\JFBYP-LAYOUT.DWG 3/21/2019 2:20 PM

APPENDIX 6.4

TSS WORKSHEETS

ALLEN & MAJOR
ASSOCIATES, INC.

Project No.	2596-01	**Sheet**	1 of 2
Project Description	Residential Development		
	159 Templ Street, Manchester NH		
Calculated By	AM	**Date**	May-19
Checked By		**Date**	

TSS REMOVAL CALULATIONS

The calculations provide the TSS removal rate for the Treatment Train #1 (Infiltration System)

Stormwater Management BMP	TSS Removal rate
Street Sweeping	5 %
Deep Sump Catch Basins	15 %
Hydrodynamic Separators	30 %
Filtration Device (Jellyfish)	60 %
Infiltration System	90 %

Average Annual Load	=	100%	
Street Sweeping	=	5.0	% Removal Rate
		95.0	% TSS Load Remains
TSS Load Remaining	=	95.0	%
Deep Sump Catch Basins	=	15.0	% Removal Rate
		80.8	% TSS Load Remains
TSS Load Remaining	=	80.8	%
Hydrodynamic Separators	=	30.0	% Removal Rate
		56.6	% TSS Load Remains
TSS Load Remaining	=	56.6	%
Filtration Device (Jellyfish)	=	60.0	% Removal Rate
0			
		22.6	% TSS Load Remains
TSS Load Remaining	=	22.6	%
Infiltration System	=	90.0	% Removal Rate
		2.3	% TSS Load Remains

Percentage of TSS Remaining - Initial TSS Load = Final TSS Removal Rate

2.30 - 100.0 = 97.7 %

ALLEN & MAJOR
ASSOCIATES, INC.

Project No.	2596-01	**Sheet**	2 of 2
Project Description	Residential Development		
	159 Templ Street, Manchester NH		
Calculated By	AM	**Date**	May-19
Checked By		**Date**	

TSS REMOVAL CALULATIONS

The calculations provide the TSS removal rate for the Treatment Train #2 (Bioretention System)

Stormwater Management BMP	TSS Removal rate
Street Sweeping	5 %
Deep Sump Catch Basins	15 %
Bioretention System	90 %

Average Annual Load = 100%
Street Sweeping = 5.0 % Removal Rate

95.0 % TSS Load Remains

TSS Load Remaining = 95.0 %
Deep Sump Catch Basins = 15.0 % Removal Rate

80.8 % TSS Load Remains

TSS Load Remaining = 80.8 %
Bioretention System = 90.0 % Removal Rate

8.1 % TSS Load Remains

Percentage of TSS Remaining - Initial TSS Load = Final TSS Removal Rate

8.10 - 100.0 = 91.9 %

APPENDIX 6.5

SITE EVALUATION REPORT AND INFILTRATION CALCULATIONS

Infiltration Feasibility Report

The project proposes two systems that require infiltration to function properly. These systems are identified on the plans as a Bio-retention System, and Infiltration System.

1. Location of the Practice

Bioretention System #1 – this system is located along the eastern property line.

Infiltration System #1 – this system is located on the western side of the development in front of building 1.

2. Existing topography at the location of the practice

The existing topography within the area of the bio-retention system is very flat, as existing elevations along the property line range from 118.9 – 120.0. The location where the infiltration system is proposed is within the existing pavement. The pavement grade is flat with approximately a 0.5% slope.

3. Test pit location

In accordance with Env-Wq 1504.13, NHDES requires that a minimum number of test pits be dug in the location of each system, depending on the size of the proposed system.

The footprint of the infiltration system is 6,700 S.F. and 3 test pits will be dug in the location of the proposed practice. These pits are identified on the plans as TP-101.

4. Seasonal high-water table (SHWT) and bedrock elevations

Based on boring sampling performed groundwater elevation average between 15-17 below grade. Borings were terminated at depths greater than 20 ft. Based on these tests the groundwater and bedrock elevations are suitable for the infiltration design.

5. Profile Description

Test pit were completed on 6/4/2019 by A&M.

TP-1 Date: 6/4/2019 9:00am M. Malynowski, PE

	0 - 3	Pavement	-	
	3 - 10	Gravelly Fill	-	Pavement subbase
	10 - 40	Med/Course Sand	2.5Y 4/4	Several large pieces of cut granite
Ap	40 - 48	Loamy Sand	2.5Y 3/3	
C2	48 - 96	Gravelly Med Sand	10YR 4/6	

Pit Bottom: 96'' Mottles: n/a
Observed Water: n/a Some glaying: n/a
Restrictive n/a Pit elevation: 120.2

Layer:

Seepage: n/a

ESHWT / Restrictive Layer: -

TP-2 Date: 6/4/2019 9:35am M. Malynowski, PE

	0 - 3	Pavement	-	
	3 - 10	Gravelly Fill	-	Pavement subbase
	10 - 35	Med/Course Sand	7.5Y 5/8	Several large pieces of cut granite
Ap	35 - 49	Loamy Sand	2.5Y 3/3	
C2	49 - 105	Gravelly Med Sand	10YR 4/6	

Pit Bottom: 105"

Observed Water: n/a

Restrictive Layer: n/a

Seepage: n/a

Mottles: n/a

Some glaying: n/a

Pit elevation: 120.3

ESHWT / Restrictive Layer: -

TP-3 Date: 6/4/2019 9:55a M. Malynowski, PE

	0 - 3	Pavement	-	
	3 - 19	Gravelly Fill	-	Pavement subbase
	19 - 42	Med/Course Sand	2.5Y 4/4	
Ap	42 - 52	Loamy Sand	2.5Y 3/3	
C2	52 - 94	Gravelly Med Sand	10YR 4/6	

Pit Bottom: 94"

Observed Water: n/a

Restrictive Layer: n/a

Seepage: n/a

Mottles: n/a

Some glaying: n/a

Pit elevation: 120.3

ESHWT / Restrictive Layer: -

6. Summary of field-testing data used to determine the infiltration rate

Based upon the NRCS soil report the project site is classified as Ur (Urban Land). A site-specific soil survey was performed by TES Environmental Consultants, L.L.C, on April 24, 2019 to determine the on-site soil classification. It was determined that the on-site soils are excessively draining and consistent with the surrounding soils found within the NRCS Soil Report. The saturated hydraulic conductivity (Ksat) rate of the surrounding soils was used for the infiltration rate on-site. The average Ksat value of the Wnc and Uda soils is 95.9 micrometers per second. This value was converted to 13.6 inches per hour, and divided by a factor of safety of 2 to achieve the design infiltration rate of 6.79 ≈ 6.5 inches per hour.

APPENDIX 6.6

HYDROLOGIC SOIL PLANS

LEGEND

EX. PROPERTY LINE	
EXISTING 1' CONTOUR	118
EXISTING 5' CONTOUR	120
EXISTING EDGE OF PAVEMENT	
EXISTING EDGE OF GRAVEL	
EXISTING CURB	
HYDROLOGIC SOIL GROUP A	
HYDROLOGIC SOIL GROUP B	
HYDROLOGIC SOIL GROUP C	
HYDROLOGIC SOIL GROUP D	
EXISTING WETLANDS	
OPEN WATER	
IMPERVIOUS COVER	

NOTES:

1. THIS DETAILED SITE–SPECIFIC SOIL MAP, PERFORMED ON 04–24–19 BY THOMAS E. SOKOLOSKI, CERTIFIED SOIL SCIENTIST #063 OF TES ENVIRONMENTAL CONSULTANTS, L.L.C. OF BOW, NEW HAMPSHIRE IN ACCORDANCE WITH THE SITE–SPECIFIC SOIL MAPPING STANDARDS FOR NEW HAMPSHIRE AND VERMONT. SSSNNE SPECIAL PUBLICATION NO. 3, VERSION 4.0, FEBRUARY 2011.

GRAPHIC SCALE

(IN FEET)
1 inch = 30 ft.

APPROVED - NASHUA CITY PLANNING BOARD

CHAIRMAN DATE

SECRETARY DATE

DATE OF APPROVAL

MARKET SQUARE ARCHITECTS
104 Congress St., STE 203
Portsmouth, NH 03801
PH: 603.501.0202

REV	DATE	DESCRIPTION

APPLICANT\OWNER:
ZJBV PROPERTIES, LLC
c/o JOSEPH'S EQUIPMENT
300 GAY STREET
MANCHESTER, NH 03103

PROJECT:

RESIDENTIAL DEVELOPMENT
159 TEMPLE STREET
NASHUA, NH

PROJECT NO.	2596-01	DATE:	MAY 30, 2019
SCALE:	1" = 30'	DWG.:	C-2596-01_Soil Mapping
DESIGNED BY:	AM	CHECKED BY:	MM

PREPARED BY:

ALLEN & MAJOR ASSOCIATES, INC.
civil & structural engineering ◆ land surveying
environmental consulting ◆ landscape architecture
www.allenmajor.com
400 HARVEY ROAD
MANCHESTER, NH 03103
TEL: (603) 627-5500
FAX: (603) 627-5501

WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

DRAWING TITLE:	SHEET No.
PRE-CONSTRUCTION HYDROLOGIC SOIL PLAN	PHSP-1

LEGEND

EX. PROPERTY LINE	
EXISTING 1' CONTOUR	118
EXISTING 5' CONTOUR	120
EXISTING EDGE OF PAVEMENT	
EXISTING EDGE OF GRAVEL	
EXISTING CURB	
HYDROLOGIC SOIL GROUP A	
HYDROLOGIC SOIL GROUP B	
HYDROLOGIC SOIL GROUP C	
HYDROLOGIC SOIL GROUP D	
EXISTING WETLANDS	
OPEN WATER	
IMPERVIOUS COVER	

NOTES:

1. THIS DETAILED SITE–SPECIFIC SOIL MAP, PERFORMED ON 04–24–19 BY THOMAS E. SOKOLOSKI, CERTIFIED SOIL SCIENTIST #063 OF TES ENVIRONMENTAL CONSULTANTS, L.L.C. OF BOW, NEW HAMPSHIRE IN ACCORDANCE WITH THE SITE–SPECIFIC SOIL MAPPING STANDARDS FOR NEW HAMPSHIRE AND VERMONT. SSSNNE SPECIAL PUBLICATION NO. 3, VERSION 4.0, FEBRUARY 2011.

GRAPHIC SCALE

(IN FEET)
1 inch = 30 ft.

APPROVED - NASHUA CITY PLANNING BOARD

CHAIRMAN DATE

SECRETARY DATE

DATE OF APPROVAL

MARKET SQUARE ARCHITECTS
104 Congress St., STE 203
Portsmouth, NH 03801
PH: 603.501.0202

REV	DATE	DESCRIPTION

APPLICANT\OWNER:
ZJBV PROPERTIES, LLC
c/o JOSEPH'S EQUIPMENT
300 GAY STREET
MANCHESTER, NH 03103

PROJECT:

RESIDENTIAL DEVELOPMENT
159 TEMPLE STREET
NASHUA, NH

PROJECT NO.	2596-01	DATE:	MAY 30, 2019
SCALE:	1" = 30'	DWG.:	C-2596-01_Soil Mapping
DESIGNED BY:	AM	CHECKED BY:	MM

PREPARED BY:
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FAX: (603) 627-5501
WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

DRAWING TITLE:	SHEET No.
POST-CONSTRUCTION HYDROLOGIC SOIL PLAN	PHSP-2

<u>APPENDIX 6.7</u>

SITE SPECIFIC SOIL SURVEY REPORT

GEOTECHNICAL ENGINEERING
EVALUATION and RECOMMENDATIONS

Residential Development
158-161 Temple Street
Nashua, New Hampshire

May 30, 2019

Project No. 19.068.NH

PREPARED FOR:
ZJBV Properties
C/O Joseph Equipment Co.
300 Gay Street
Manchester, NH 03103

PREPARED BY:
Miller Engineering & Testing, Inc.

100 Sheffield Road, POB 4776
Manchester, NH 03108-4776

May 30, 2019

Mr. Brian Thibeault
ZJBV Properties LLC
C/O Joseph Equipment Company
300 Gay Street
Manchester, NH 03103

RE: Geotechnical Evaluation Report
Lots 31 & 38 Temple Street
Nashua, NH

Project No. 19.068.NH

Dear Brian:

This report presents the results of a Subsurface Exploration Program and Geotechnical Engineering Evaluation performed for the proposed multi-story residential building project at 158-161 Temple Street (Lots 31 & 38) in Nashua, New Hampshire. The report includes descriptions of the site, subsurface conditions, the proposed project, and our assessment of the impact subsurface conditions might have on design and construction of the proposed two (2), five-story buildings. Details of our subsurface exploration program and geotechnical engineering recommendations are provided in this report.

We appreciate the opportunity to provide geotechnical engineering services to you on this project. If you have any questions or need additional information, please contact us at (603) 668-6016.

Very truly yours,
MILLER ENGINEERING & TESTING, INC.

Frank K. Miller

Frank K. Miller, P.E.
Executive Vice President

STATE OF NEW HAMPSHIRE
FRANK K. MILLER No. 7337
LICENSED
PROFESSIONAL ENGINEER

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The project consists in construction of two (2) five-story buildings at 158-161 Temple Street (Lots 31 & 38) in Nashua, New Hampshire. Proposed Building 1 has an approximate 18,600 SF footprint with frontage on Temple Street; and Building 2, positioned just north of Building 1, has an approximate 15,900 SF footprint The proposed ground level finish floor elevation is 121.5 for both buildings indicating 1 to 2 foot thick fills above existing grade will be required. At the time of our subsurface exploration program, the property was largely paved with bituminous concrete for parking lots, driveways and storage areas. An existing 1-story building was present in the southeastern portion of the property, and a concrete loading dock structure with a railroad spur was evident in the central section of the site.

Following a review of this report, you will find that subsurface conditions are characterized by a wide-spread layer of urban fill material underlain by natural organic layers, glaciofluvial soils, and deeper glacial outwash and till strata. The deep seated glacial till layer would normally be deposited directly upon bedrock. A consistent subsurface profile was found at the exploration locations in the proposed Building 1 and Building 2 footprint areas; however, the thickness and elevations of various layers and strata changes vary somewhat beneath the site. Composition of the urban fill material was somewhat different from location to location, but generally the material has very poor engineering properties and is considered unsuitable beneath the proposed structures.

Our investigation and engineering analyses indicate that the subsurface conditions at the Site are not favorable for design and construction of a conventional shallow foundation system to support the proposed buildings without first removing and replacing any unsuitable urban fill materials and organic soils below the proposed building footprint areas, or insitu ground improvement. The controlling subsurface features for site and foundation design and construction are the occurrence of unsuitable fill and organic materials from the surface to depths between 7 and 12.5 feet below existing surface elevations. These fill materials primarily consist of very loose, black, fine sand and silt intermixed with coal ash and clinkers, and some very loose granular fill zones. The fill layer was frequently underlain by organic soils that we interpret to be buried topsoil and; subsoil layers. The urban fill materials and organic soil layers are considered to be compressible and therefore, will not provide adequate long-term support to a spread footing foundation system without soil improvement (such as could be provided by rammed aggregate piers (RAPs) or by excavating and replacing the unsuitable materials).

Our current scope of services includes geotechnical engineering considerations pertaining to foundation design alternatives; however, considering the high likelihood of contaminated urban fill in the building footprints, an environmental consultant should characterize the fill materials and evaluate potential off-site disposal options and costs.

Details of our subsurface findings, geotechnical evaluation and foundation design recommendations are provided herein.

1.00 INTRODUCTION

The subsurface exploration program at the proposed Temple Street Project consisted in advancement of nine (9) test borings on May 17 and 20, 2019.

The scope of the geotechnical services may be summarized as follows:

1. Perform necessary field investigations through the advancement of test borings at the locations of proposed Building 1 and 2 footprint areas.

2. Evaluate the subsurface conditions and perform geotechnical engineering analyses to develop recommendations for foundation and pavement design and construction.

3. Summarize the exploration program, engineering analyses, and evaluation in the form of a geotechnical engineering report.

Presented herein are descriptions of the project, site, and subsurface conditions encountered during the subsurface exploration program. The specific geotechnical engineering recommendations, formulated based on subsurface conditions, are presented herein. Services with respect to development of plans and specifications, construction quality assurance, environmental engineering, and any other services not specifically outlined herein are not included in our current scope of work. The contents of this report are subject to the limitations in Appendix A.

2.00 SITE AND PROJECT DESCRIPTION

The project consists in construction of two (2) five-story buildings at 158-161 Temple Street (Lots 31 & 38) in Nashua, New Hampshire. Proposed Building 1 has an approximate 18,600 SF footprint with frontage on Temple Street; and Building 2, positioned just north of Building 1, has an approximate 15,900 SF footprint At the time of our subsurface exploration program, the property was largely paved with bituminous concrete for parking lots, driveways and storage areas. An existing 1-story masonry block building was present in the southeastern portion of the property, and a concrete loading dock structure with a railroad spur was evident in the central section of the site. Active and abandoned railroad tracks border the northern and eastern property lines, respectively.

According to the Layout & Materials Plan, prepared by Allen & Major Associates, Inc; and the Schematic Design Plan, prepared by Market Square Architects, proposed buildings 1 and 2 will be structurally connected from the 2nd to the 5th level. The Building 1 ground floor will consist of finished space with a concrete slab-on-grade; and Building 2 will consist of parking area for cars. The proposed ground level finish floor elevation is 121.5 for both buildings indicating 1 to 2 foot thick fills above existing grade will be required. Presumably, both buildings will consist of structural steel framing supported upon a reinforced concrete foundation system.

3.00 SUBSURFACE EXPLORATION PROGRAM

The subsurface exploration program performed for this geotechnical engineering study consisted in the advancement of nine (9) test borings (B-1 through B-9) on May 17 and 20 2019. The exploration locations are depicted in the Subsurface Exploration Location Plan, Figure 1.

3.10 Test Boring Explorations

All test borings were advanced by a drill crew from MET under the supervision of a Geotechnical Engineer. Detailed descriptions of the subsurface conditions are provided on the MET Test Boring Logs presented in Appendix B.

The purpose of the exploration program was to:

- Determine the nature, consistency, and relative density of the soils encountered at the site, and provide detailed descriptions of subsurface strata;
- Determine the thickness and condition of fill and organic layers encountered at the test exploration locations;
- Determine the depth to competent soil and the observed groundwater levels; and
- Determine the depth of "refusal" where encountered at test boring locations.

The test borings were advanced by a drill crew from Miller Engineering & Testing, Inc. using a truck-mounted Diedrich D-50 drill rig turning 2-1/4-inch inside-diameter hollow-stem augers to sampling depths. Samples were taken continuously from the ground surface to a depth of at least 11 feet and then at 5-foot maximum intervals thereafter to termination/refusal depths of the test borings. Samples were obtained using a 1-3/8-inch inside-diameter, split-spoon sampler. Standard Penetration Tests (SPT) were performed at the sampling elevations by driving the split-spoon sampler 18 to 24-inches with a 140-pound hammer falling 30 inches in accordance with ASTM Designation D-1586. The number of blows required to drive the sampler between the 6 and 18-inch increments, termed the N-value, was used to assess the soils relative density and elastic properties.

3.20 Laboratory Testing

Four (4) split-spoon samples were selected at test boring locations from the naturally occurring soil strata for grain size analysis. Results of these tests were used in geotechnical engineering analyses relative to foundation design considerations. Laboratory test results are provided in Appendix C.

4.00 SUBSURFACE CONDITIONS ENCOUNTERED

Results of the test borings indicate that subsurface conditions consist of the following generalized profile from the ground surface downward:

1. Bituminous Pavement Layer
2. Urban Fill Layer
3. Buried Organic Layer
4. Glaciofluvial Layer
5. Glacial Outwash Soil Stratum

Detailed descriptions of the subsurface conditions encountered are provided on the Test Boring Logs in Appendix B. General descriptions of the various strata encountered are presented below. Table 1 below provides a summary of the test boring results.

TABLE 1

Lots 31 & 38 Temple Street Nashua, NH Test Boring Summary

Test Boring No.	Approx Exist Ground Level (ft)	Approx. Proposed FFE (ft)	Approx. Depth/Elev. to Bottom of Unsuitable Fill and Organic Layer (1) (ft)		Approx. Groundwater Elevation (ft)	Approx. Depth/Elev. Test Boring Termination (2) (ft)	
			Depth	**Elev.**	**Elev.**	**Depth**	**Elev.**
B-1	120.5	121.5	7.0	113.5	106.5	31.0	89.5
B-2	120.9	121.5	8.0	112.9	103.9	41.0	79.9
B-3	120.5	121.5	7.5	113.0	106.5	50.2	70.3
B-4	120.0	121.5	8.0	112.0	106.0	26.0	94.0
B-5	120.0	121.5	8.0	112.0	106.0	26.0	94.0
B-6	120.0	121.5	9.0	111.0	106.0	21.0	99.0
B-7	120.0	121.5	8.0	112.0	104.0	21.0	99.0
B-8	120.0	121.5	9.0	111.0	103.0	24.5	95.5
B-9	120.0	121.5	12.5	107.5	--	13.0	107.0

(1) Unsuitable material consists of Fill and Soft/Loose Natural Organic Soils. The Fill materials consist of black, coal ash and clinkers intermixed at some locations with red brick and organic matter. The Natural organic soils consist of "old" topsoil and subsoil layers that were filled over during development of the property.

(2) **Split-spoon refusal could be due to the presence of very dense soils, boulders, or bedrock. Rock core sampling would be required to determine the nature of refusal and quality of bedrock.**

(3) **Test Borings were advanced on May 17 and 20, 2019 Miller Engineering and Testing, Inc. during a design-phase geotechnical engineering investigation.**

Bituminous Pavement Layer

All test borings, except for B-7 and B-9, encountered bituminous pavement at the ground surface. The bituminous layer ranged from 2 to 2.8 inches in thickness.

Urban Fill Layer

All test borings encountered an urban fill layer consisting primarily of very loose, dark brown to black, fine to medium sand, some to little silt, and trace to little gravel intermixed with ash, clinkers, coal, red brick and masonry fragments. Occasional grinding of the auger flights during advancement of some boreholes was noted, indicating the presence of boulders, cobbles, or other hard objects (i.e. possible old foundation remnants) within the fill layer. The urban fill layer, commonly ranging from 7 to 12.5 feet thick at most of the test boring locations, was found to be wide-spread throughout the proposed building areas. The layer was comprised of discrete zones consisting of very loose, fine sand, some silt, little gravel material, which was free of building rubble and ash material. However, all borings encountered some ash and clinker materials at various elevations intermixed with the urban fill layer. Standard Penetration Test (SPT) measurements indicate that the fill layer was loose to medium dense with occasional dense and very loose zones.

Buried Organic Layer

Beneath the urban fill, many of the test borings encountered a very soft organic silt layer (old topsoil and subsoil layers) ranging from 0.5 to 2.5 feet in thickness. The layer appeared to be naturally occurring and was probably buried during the original filling of the property.

Glaciofluvial Soil Stratum

The naturally occurring soil beneath the urban fill and organic layers consisted of a glaciofluvial soil stratum. This layer was comprised of brown, fine to coarse sand with little to trace amounts of gravel and silt material. The layer appeared to be laminated with alternating lenses of finer and coarser sand and silt size particles. Standard Penetration Test measurements in the layer generally ranged from 13 to 25 blows per foot (bpf); however, higher and lower values were occasionally measured. Unbalanced hydrostatic pressure in the borehole likely contributed to the relatively low SPT measurements between 24 and 34 feet at the location of boring B-3.

Glacial Outwash Stratum

A dense, glacial outwash soil stratum consisting of brown, fine to coarse sand with some gravel and silt material was encountered beneath the glaciofluvial soil layer. The glacial outwash soil layer was found 24.0 feet, or deeper below the existing ground surface elevations. Standard Penetration Test measurements in the outwash layer were typically greater than 30 blows per foot.

Groundwater Observations

Groundwater measurements were taken at each test boring location after a brief stabilization period following completion of the drilling. The moisture condition of the split-spoon samples was monitored to provide further indications of the groundwater levels. The groundwater levels beneath the building area were measured between elevations 103.0 (test boring B-8) and 106.5 (test boring B-1), indicating a hydraulic gradient dipping gradually from south to north.

It should be noted that groundwater levels might fluctuate from time to time due to factors such as season, temperature, adjacent structures, and other environmental conditions. Groundwater levels at other times, therefore, may be different from those observed and recorded during this exploration program.

5.00 FOUNDATION SUPPORT EVALUATION

Results of the subsurface exploration program indicate that subsurface conditions are favorable for the design and construction of a spread footing and slab-on-grade foundation system for support of proposed Buildings 1 and 2, after ground improvement using a rammed aggregate pier system or excavation and replacement of unsuitable Fill soils\materials and organic layers. Alternatively, deep foundations (e.g. steel H-piles, concrete filled pipe piles or pressure injected footings) could be constructed transferring loads to the glacial till and bedrock layers to provide adequate foundation support. The deep foundation alternatives involve grade beams, pile caps, and perhaps a structural concrete floor slab; and therefore, are likely more expensive solutions, and are not considered further in this report. In addition, deeper test borings and bedrock core sampling would be needed to fully evaluate an end bearing H-pile foundation system.

The spread footings for the proposed Structure may be supported in a combination of the following conditions:

- Naturally occurring, firm and stable, Glaciofluvial soil deposits;

- Compacted Structural Fill consisting of Select Granular Fill placed on the naturally occurring, firm and stable Glaciofluvial soil; and/or

- Ground Improvement elements such as Rammed Aggregate Piers (e.g. Geopiers, Aggregate Piers) installed through the unsuitable urban fill and organic soil layers into the medium dense to dense naturally-occurring glaciofluvial deposits.

The controlling subsurface features for foundation and site design and construction are as follows:

1. The presence of between about 7 and 12.5 feet of unsuitable urban fill and organic layers consisting of coal ash and clinkers mixed with sand, gravel, organic silt, boulders, and red brick beneath the building footprint area, requiring over-excavation and replacement with compacted Structural Fill or insitu ground improvement. Environmental testing and evaluation were beyond our scope of services; however, a premium fee should be anticipated for off-site disposal of the urban fill material.

2. Unsuitable urban fill and organic layers adjacent to Temple Street and other property boundaries would necessitate relatively deep excavation and installation of temporary earth support systems for perimeter control.

5.10 Dewatering and Subgrade Stabilization Efforts

Groundwater was observed at the exploration locations at depths of about 14 to 16 feet below the existing ground surface. Where deep excavation of unsuitable soils\materials is performed, in areas where RAP's are not utilized, de-watering will be required where the unsuitable materials extend below the groundwater table.

In no case should excavation and the placement and compaction of Structural Fill material occur below the groundwater table. The Site Contractor should implement a dewatering system that will lower the groundwater table at least 12-inches below the excavation level and will allow for the excavation and structural fill/compaction efforts to occur in-the-dry.

At locations where groundwater is encountered during the foundation excavation efforts, the placement of a crushed stone working mat, consisting of 12-inches of ¾-inch crushed stone material completely wrapped in Mirafi 140N Filter Fabric, or equal, may be required to stabilize the naturally occurring sand and silt subgrade soils. The crushed stone working mat should be keyed into the subgrade soils with the effort of at least four (4) passes of a 700-pound vibratory plate compactor, or equivalent effort. A Geotechnical Engineer from MET should assess if the placement of a crushed stone working mat is required to stabilize the subgrade soils.

5.20 Re-Use of On-Site Materials – Structure Areas

The inorganic granular portions of the urban fill layer, excluding ash, coal, clinkers, boulders, metal, organic matter, concrete and brick material may be segregated (if considered feasible by the Contractor) and used as fill beneath the ground floor area in low-lying areas of the site. This material, along with the naturally occurring sand and gravel soils that are excavated during the foundation preparation efforts, could be stockpiled, thoroughly mixed and be re-used as fill above footing bases and below the floor. The buried concrete, brick, and boulder materials encountered in foundation excavation areas, could be crushed on-site and blended with granular soils, to manufacture a suitable material for re-use as Structural Fill.

The stockpiled soil materials that are intended to be re-used within the structure footprint and pavement areas should be protected from excess moisture and frost, as saturated and/or frozen soil materials will not be considered suitable for reuse.
All fill material to be used below and around the proposed structure foundation system and below the pavement areas should be submitted to the MET Geotechnical Laboratory and be subjected to Grain Size Distribution Analyses and Proctor Determinations prior to use. It can then be determined if the fill materials that are intended to be used for the project meet the gradation specifications presented in Table No. 2. A Geotechnical Engineer from MET, should approve all fill material to be used below and around the structure foundation system prior to placement.

6.00 DESIGN RECOMMENDATIONS

Based on results of the subsurface explorations and our geotechnical evaluations, we present the following foundation recommendations for the design of proposed Buildings 1 and 2 at 158-161 Temple Street in Nashua, New Hampshire.

6.10 Insitu Ground Improvement Alternative

Proprietary ground-improvement methods such as Rammed Aggregate Piers (RAP), Grouted Impact Rammed Aggregate Piers (GAP), and Aggregate Piers (AP) (such as designed and installed by Geopier Foundation Company and Hayward Baker) are considered technically viable and economically feasible alternatives capable of sufficiently improving the subsurface urban fill layers in-place to support the proposed construction. RAPs and GAPs both densify the existing fill materials through lateral displacement methods and reinforce the existing urban fill by creating relatively stiff columns through the layer into the naturally occurring medium dense soil stratum. Implementation of this technique will reduce or eliminate potentially contaminated spoils at the ground surface.

We anticipate that 20-inch diameter RAP and/or GAP columns would extend through the full thickness of the urban fill and organic soil layers below the Site and would penetrate into the glaciofluvial soils stratum. The thickness of unsuitable urban fill and organic soils is summarized in Table 1.

With proper site preparation and the use of RAPs or similar ground-improvement techniques, the proposed buildings would be supported on continuous and isolated spread footing foundations with a slab-on-grade ground floor. The foundation system would be proportioned so that post-construction total and differential settlements will be less than 1 inch and ½ inch, respectively, following ground-improvement implementation.

6.20 Excavation and Replacement Alternative

All existing urban fill material, buried organic layers, and all subsurface utilities and structures must be excavated from below the entire building area (footings and slab-on-grade) to expose the underlying, naturally occurring, glaciofluvial soil layer. These materials should be excavated from the zone of stress influence of the building foundation system, which is defined as that area within a 1H:1V slope projecting outward and downward from the bottom outside edge of the perimeter footings to the base of the required excavation. Final excavation to subgrade should be accomplished using an excavator equipped with a flat-edge bucket to reduce subgrade disturbance.

Excavation bases within the naturally occurring glaciofluvial soil layer should be proofrolled in order to densify any naturally occurring loose zones or those, which are created during the excavation process. The proofrolling should consist of a minimum of four (4) passes of a 10-ton vibratory roller, or equivalent effort. Should unstable areas develop during the proofrolling process, due to excess moisture, the vibratory proofrolling efforts should be stopped and static methods should be employed. Footing trench bases should be proofrolled using at least six (6) passes of a 500-pound vibratory plate compactor.

In no case should froze soils remain below the building foundation area. Any frozen materials located within the subgrade soils should be completely removed and replaced structural fill.

6.30 Excavation Perimeter Control

Relatively deep excavations are anticipated to remove urban fill and organic layers adjacent to the property boundaries and streets; therefore, temporary shoring systems should be anticipated during the earthwork operation. The excavation perimeter side-slopes must be constructed in accordance with OSHA 29 CFR Chapter XVII, Subpart P. The excavation slopes must be flattened as needed for safe entry of construction crews and inspectors. The Contractor should select, design, install, and maintain a safe excavation system.

6.40 Structural Fill Placement and Compaction

In areas where fill is required below the proposed building footprint and up to within 8-inches below the bottom of the concrete slab-on-grade, it is recommended that Select Granular Fill material conforming to the gradation specifications in Table 2 or approved on-site materials be used. These materials should be placed in 12-inch maximum loose lifts that are compacted to a minimum of 95 percent of the materials maximum dry density as determined by ASTM Designation D-1557.

The building foundation walls that are not supporting differential earth pressure should be backfilled with Clean Granular Fill conforming to the gradation specifications in Table 1 or inorganic, granular on-site material. These materials should be placed in 12-inch maximum loose lifts and be compacted to a minimum of 95 percent of the materials maximum dry density as determined by ASTM Designation D-1557. Samples of all fill material to be used for the project (on-site material and borrow material) should be submitted to the MET Laboratory prior to placement for evaluation and approval.

6.50 Foundation Systems

A shallow foundation system, consisting of isolated spread footings (under columns) and continuous, strip footings (below interior and exterior load-bearing walls) should be used to support the proposed buildings. The foundation elements should be supported on the naturally occurring medium dense glaciofluvial soils; engineered fill consisting of compacted Select Granular Fill placed on these soils; or RAP improved urban fill material.

Engineering analyses indicate that the foundation elements that will bear on the naturally occurring soils or compacted structural fill should be designed using an allowable net bearing pressure of 4,000 pounds per square foot (2.0 tons per square foot). Foundation elements that will bear on ground improved with RAPs should be designed using an allowable net bearing pressure of 4,000 pounds per square foot (2.0 tons per square foot). The final allowable net bearing pressure will be as determined based on results of settlement analyses by the RAP design engineer.

Spread footings should be a minimum of 3 feet wide. If smaller width footings are to be used, the allowable net bearing pressure should be reduced in direct proportion to the reduction in footing width. Use of this allowable bearing pressure will limit total settlements below footings to less than 1.0 inch. Differential settlement between adjacent footings will be less than 0.5 inch. Settlement would tend to occur as loads are applied; thus most of the settlement will probably occur by the end of construction. Top of interior footings should be embedded at least 6 inches below the bottom of the slab-on-grade elevation.

Lateral forces can be resisted by the shear developed at the base of the footings. Base shear should be calculated using a coefficient of friction of 0.43 for concrete cast directly upon stable, compacted Select Granular Fill.

The design bearing pressure assumes that all exterior footings will be placed at a depth of 4 feet below final exterior grades to provide frost protection for the foundations and to protect them from subfreezing temperatures.

6.60 Slabs-on-Grade

Unless strengthened with RAPs, the urban fill materials and organic soils below building slab areas should be excavated and replaced with compacted Select Granular Fill. A modulus of subgrade reaction (K_V) of 200 psi/inch should be used to proportion the slabs-on-grade. The uppermost 8 inches of material beneath the slabs-on-grade should consist of Base Course Fill that conforms to the gradation specification in Table 2. This material should be placed in one loose lift and should be compacted to a minimum of 95 percent of its maximum dry density, as determined by ASTM D1557.

6.70 Seismic Design Considerations

The proposed ground floor elevations indicate that the buildings will be founded on medium dense silty sand and compacted structural fill soils. These soils are sufficiently dense and the groundwater level is deep enough so as to theoretically preclude seismically induced liquefaction during the design regional seismic event. Accordingly, design provisions for liquefaction are not necessary at this Site.

The New Hampshire State Building Code (2009 International Building Code) requires that all structures be designed to withstand the forces generated by the maximum credible earthquake based on the soil and rock conditions. The soil profile beneath the proposed building constitutes a "stiff soil profile", and we assign the Site a Seismic Site Class of D. The seismic site coefficients for computing the design spectral response acceleration parameters should be:

S_s	S_1	F_a	F_v
0.264	0.080	1.59	2.4

6.80 Groundwater and Foundation Drainage Issues

The groundwater levels beneath the building area were measured between elevations 103.0 (test boring B-8) and 106.5 (test boring B-1), indicating a hydraulic gradient dipping gradually from south to north. Groundwater elevations will probably be lower than the likely foundation excavation levels and deep utilities.

Due to the depth to groundwater below the proposed building footprints, it is our opinion that an underdrainage system is not necessary for the proposed slab-on-grade ground floors, based on geotechnical considerations. We do, however, recommend that the buildings be constructed with foundation perimeter drainage systems.

The perimeter drainage system should consist of 4-inch diameter, rigid PVC SDR35 pipe with perforations of ¼- to ½-inch (openings should be oriented downward). The drain lines should be surrounded by a minimum of 6 inches of ¾-inch crushed stone wrapped in a nonwoven geotextile filter fabric (Mirafi 140N or approved equivalent). The foundation drains should be placed adjacent to the exterior sides of the spread footings at a minimum depth of 4 feet below adjacent exterior grades to protect against frost. Where possible, the foundation drains should be pitched down at a minimum slope of 0.5 percent in the direction of flow. Cleanouts should be provided at every other 90-degree bend in order to provide for future flushing the system as needed.

The foundation drains should be gravity drained to daylight or to a suitable system outlet if feasible or through design of sumps and pumps as required. The final outlet of the drainage systems should be designed by the project Civil Engineer in consideration of all applicable municipal, state, and federal regulations and design stormwater levels within the adjacent stormwater management basin systems. MET can assist the Design Team with foundation drainage systems during the final design phase. Roof downspout drains should not be connected to the foundation drain system. Roof downspouts should be separately tightlined to their discharge outlets.

6.90 Vapor Barrier

An underslab vapor barrier should be installed beneath the concrete slabs-on-grade in order to eliminate potential impacts by water vapor and to protect against transmission of moisture into the floor slab. An underslab vapor barrier will be especially important in areas of the building where the slabs-on-grade will be finished with impermeable surface treatments or floor coverings that may be sensitive to moisture vapors, including tile or carpeting.

The vapor barrier should consist of polyethylene sheeting at least 10-mil thick (Griffolyn Type 65 or approved equal). The sheeting should be overlapped at least one foot at the joints and joined by a manufacturer approved sealant/adhesive. All utility penetrations should be sealed to the vapor barrier in order to render them water tight.

The vapor barrier should be installed within the subslab base course materials as part of a moisture barrier system:

1. 4 inches of compacted Base Course Fill should be placed upon the approved subgrade soils below slab areas.
2. The vapor barrier should be installed on the compacted Base Course Fill, and should be covered with a separate non-woven geotextile filter fabric (Mirafi 140N or equal) that will serve as a cushion between the vapor barrier and the overlying granular materials. An acceptable alternative to the polyethylene sheeting and separate non-woven geotextile fabric is a heavy-duty vapor barrier consisting of a single layer of Griffolyn® Type-65G high-performance, high-density reinforced polyethylene with a non-woven geotextile.
3. An additional 4-inch layer of compacted Base Course Fill, or a 4-inch layer of compacted ¾-inch crushed stone, should then be placed on the vapor barrier/filter fabric to promote

drainage from the bottom of the slab during curing, thereby reducing the effects of differential curing which can be a factor in slab curling.

The project architect and/or structural engineer should confirm the relative location of the vapor retarder and take its placement into account in the design curing specification for the slab-on-grade.

6.100 Foundation and Retaining Walls

Foundation walls, where interior and exterior grades are different, should be designed as retaining walls based on "at-rest" earth pressure conditions. The Site might also be constructed with exterior retaining walls, which should be designed using the “active” earth pressure condition if some rotation or translation is allowable. Retaining walls that cannot rotate or translate (e.g., arch-type walls, retained walls, etc.) should be designed using an earth pressure “at rest” condition. Any fill materials and organic soils below the foundation and retaining walls should be removed and replaced with compacted Select Granular Fill.

For foundation and retaining wall design, the earth pressure diagram can be developed based upon the use of an equivalent fluid weights and the other geotechnical design parameters shown below.

DESIGN PARAMETERS	
ϕ (select granular backfill)	35º
c (select granular backfill)	0 psf
γ (select granular backfill)	135 pcf
Net allowable bearing pressure	4,000 psf
Equivalent fluid weight (active earth pressure condition, unrestrained walls)	36.6 pcf
Equivalent fluid weight (at-rest earth pressure condition, restrained walls)	57.6 pcf
Equivalent fluid weight (passive earth pressure condition, unrestrained walls)	360 pcf (neglect the top 2 feet of soil)
Coefficient of sliding friction (between concrete and natural subgrade soils)	0.43

Concrete gravity, mechanically stabilized earth (MSE), and segmental block retaining walls should be designed in accordance with manufacturers’ specifications and the geotechnical design criteria above. Typically, the internal design of concrete gravity, MSE, and segmental block retaining wall systems is performed as design-build by the general contractor or earthwork contractor and submitted to the design team for review as a shop drawing. Project Specifications should require that a proposed plan, profile, and wall design calculations be submitted as Shop Drawings to be reviewed by the design team prior to commencing construction of the retaining walls. The Geotechnical Engineer should determine the "global" factor of safety of the retaining walls using both static and seismic conditions.

In addition to differential earth pressure, surcharge and hydrostatic pressures (if applicable) should be applied to the foundation walls where appropriate. This uniformly distributed surcharge pressure can be resolved into a force (per linear foot of wall length), which would act at a depth of ½ the wall height below the slab-on-grade.

Retaining walls should be constructed with drainage systems to prevent perched groundwater conditions and hydrostatic pressures from acting against the walls.

The percent vertical load on walls should be based on structural stability analysis. Floor slab and pavement ground pressures should be applied to foundation and retaining walls as applicable. Surcharge forces should be calculated using the following expression:

$$F_S = 0.5 * P * H$$

Where…

F_S = surcharge force

P = live and dead load from the surcharge (psf)

H = height of wall (ft)

Wall designs should achieve wall stability factors of safety of 2.0 (for overturning), 1.5 (for sliding), and 1.5 for overall ("global") stability. If tiered retaining walls are proposed, their design should account for surcharge pressures that would be imposed by the upper walls.

Unrestrained walls should be designed using 100 percent of the passive earth pressure (neglect the uppermost 2 feet of soil). For restrained walls, the passive earth pressure contribution should be neglected.

7.00 BITUMINOUS PAVEMENT GEOTECHNICAL RECOMMENDATIONS

The surface parking lots will consist of bituminous concrete close to existing ground elevations. The following subgrade preparation recommendations are presented for the proposed bituminous pavement areas:

7.10 Subgrade Preparation – Flexible Bituminous Pavement

Based on the results of the test borings, urban fill layers are about 7 to 12.5 feet in thickness below the proposed pavement surface elevations. As previously discussed, the fill material contains variable percentages of organic matter (roots, organic silt), ash, brick, coal fragments, and asphalt remnants. Judging from results of Standard Penetration Tests, the urban fill layer is loose to very loose at many locations, indicating the layer is under-consolidated and likely settling under its own weight. Long-term compression of the urban fill layer will lead to variable ground settlement that could exceed 3 to 6-inches over time. Differential settlement may be reduced using structural geogrid (such as Tensar TriAx Geogrid, or equal) installed beneath the subbase layer and above the urban fill layer, provided that the Owner can tolerate some long-term deflection of the pavement surface, and more frequent than normal maintenance.

To achieve the highest performance and greatest life span of the pavement structure, all existing fill material would be removed from below the proposed pavement areas of the project. These layers would be replaced with controlled compacted fill layers. Alternatively, the strength (modulus) of the urban fill layer could be stiffened inplace using an aggregate pier ground improvement system. A load transfer platform consisting of structural fill layers and geogrid reinforcement would be constructed beneath the pavement to distribute loads to the aggregate piers.

The pavement structure for the proposed project, as presented herein, should provide a serviceable riding surface. However, assuming the selected approach is "limited" removal of the urban fill layer combined with frequent inspection; more than normal maintenance of the pavement surface should be expected during the lifetime of the pavement structure. In fact, shimming and repaving should be expected as part of the maintenance program.

Once the pavement areas of the site have been excavated to the proposed subgrade level, the exposed materials should be compacted with the effort of four (4) passes of a 10-ton vibratory roller, or equivalent effort under the supervision of a Geotechnical Engineer from MET. Any unstable areas within the existing fill subgrade that are identified under the compaction efforts should be completely excavated and replaced with Clean Granular Fill material meeting the grain size distribution requirements established in Table 2. This material should be placed in 12-inch maximum loose lifts and be compacted to at least 95 percent of the materials maximum dry density as determined by ASTM Designation D-1557.

If highly organic and/or a high concentration of debris materials with void spaces between the particles exist at the exposed pavement subbase level, these areas should be completely removed and replaced as directed by the Geotechnical Engineer.

Areas within the pavement subgrade that are determined to be firm and stable under the compaction efforts will be considered suitable to support the required subbase and base course fill materials.

In no case should soils that become frozen during construction remain below the pavement area. Any frozen materials located within the subgrade soils should be completely removed and replaced with Clean Granular Fill material or the pavement structure material as required. Fill material should not be placed upon a frozen subgrade.

The existing urban fill material that is removed as part of the site excavation process might be re-used below the proposed pavement areas. However, organic material and hard objects, including boulders, larger than 8-inches should be removed from the subgrade fill layer.

7.20 Structural Fill Placement and Compaction – Bituminous Pavement

Clean Granular Fill conforming to the gradation specifications in Table 2 or suitable urban fill material should be used below the subbase layer. This material should be placed in 12-inch maximum loose lifts and be compacted to a minimum of 95 percent of the materials maximum dry density as determined by ASTM Designation D-1557.

Due to the high percentage of urban materials within the fill layer (e.g. coal, ash, brick, concrete), the fill materials that are removed during the building over-excavation efforts are not considered suitable for re-use as Clean Granular Fill materials.

7.30 Bituminous Pavement Structure Design

Anticipated traffic loading conditions (EASL's) were not provided to us for the project; however, light traffic loading conditions with minimal, if any, tractor trailer or other truck/bus loading conditions are anticipated during the estimated 20 year design life of the pavement structure. Therefore, MET estimated that the total traffic loading conditions during the 20-year design life of the pavement structure to be less than 50,000 EASL's.

Flexible pavement design procedures, as stipulated in "AASHTO Guide for Design of Pavement Structures – 1993," were used to determine the recommended pavement thickness to support the anticipated loadings. This analysis also considered subgrade strength, environmental effects, and serviceability requirements. The following pavement structure section should provide a serviceable driving surface, with periodic maintenance as required, over a 20-year design life:

Layer Number	Layer Description	Layer Thickness (inches)
1	Bituminous Wearing Course	1.5
2	Bituminous Binder Course	1.5
3	Crushed Gravel NHDOT 304.3	6.0
4	Bank Run Gravel NHDOT 304.2	12.0
5	Clean Granular Fill Material	As necessary

The bituminous pavement structure should be constructed on a subgrade proofrolled in accordance with Sections 6.20 of this Report. Clean Granular Fill should meet the gradation criteria established in Table 2. All fill materials used below pavements should be placed in maximum 12-inch thick loose lifts. Each lift should be compacted to at least 95 percent of the materials maximum dry density as determined by ASTM Designation D-1557.

The Crushed Gravel and Bank Run Gravel materials should meet the gradation specifications established in the latest edition of the NHDOT "Standard Specifications for Road and Bridge Construction," as referenced in the above table. The Crushed Gravel and Gravel materials and all fill materials used below the pavement subbase should be placed in maximum 12-inch thick loose lifts. Each lift should be compacted to at least 95 percent of the material's maximum dry density as determined by ASTM Designation D 1557.

8.00 FINAL DESIGN AND CONSTRUCTION MONITORING

Representative samples of all backfill materials should be submitted to Miller Engineering & Testing, Inc. for testing to establish their optimum water contents and maximum dry densities, and to compare their gradation characteristics with the requirements in Table 2. In this manner, compaction criteria can be developed, which will provide the materials with adequate strength and minimal distortion. Once testing is completed, Miller Engineering & Testing, Inc. can make final recommendations relative to the placement, the compaction, and the control of these fill materials.

It is recommended that a qualified Geotechnical Engineer or his/her representative be retained to provide engineering services during the excavation and foundation construction phases of the project. This will become particularly important relative to the monitoring of ground improvement operations, foundation/pavement excavations, removal and replacement of unsuitable soils, subgrade stabilization, inspection of footing excavations prior to concrete placements, and the placement of engineered fill materials. This would allow for design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction. The adequacy of fill compaction should be determined by field density testing as fill is placed and compacted.

Lastly, it is recommended that this firm be retained to assist in preparation earthwork specifications and to review final design plans. In the event that any changes in the nature, the design, or the locations of the structures are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of the report modified or verified in writing by Miller Engineering & Testing, Inc.

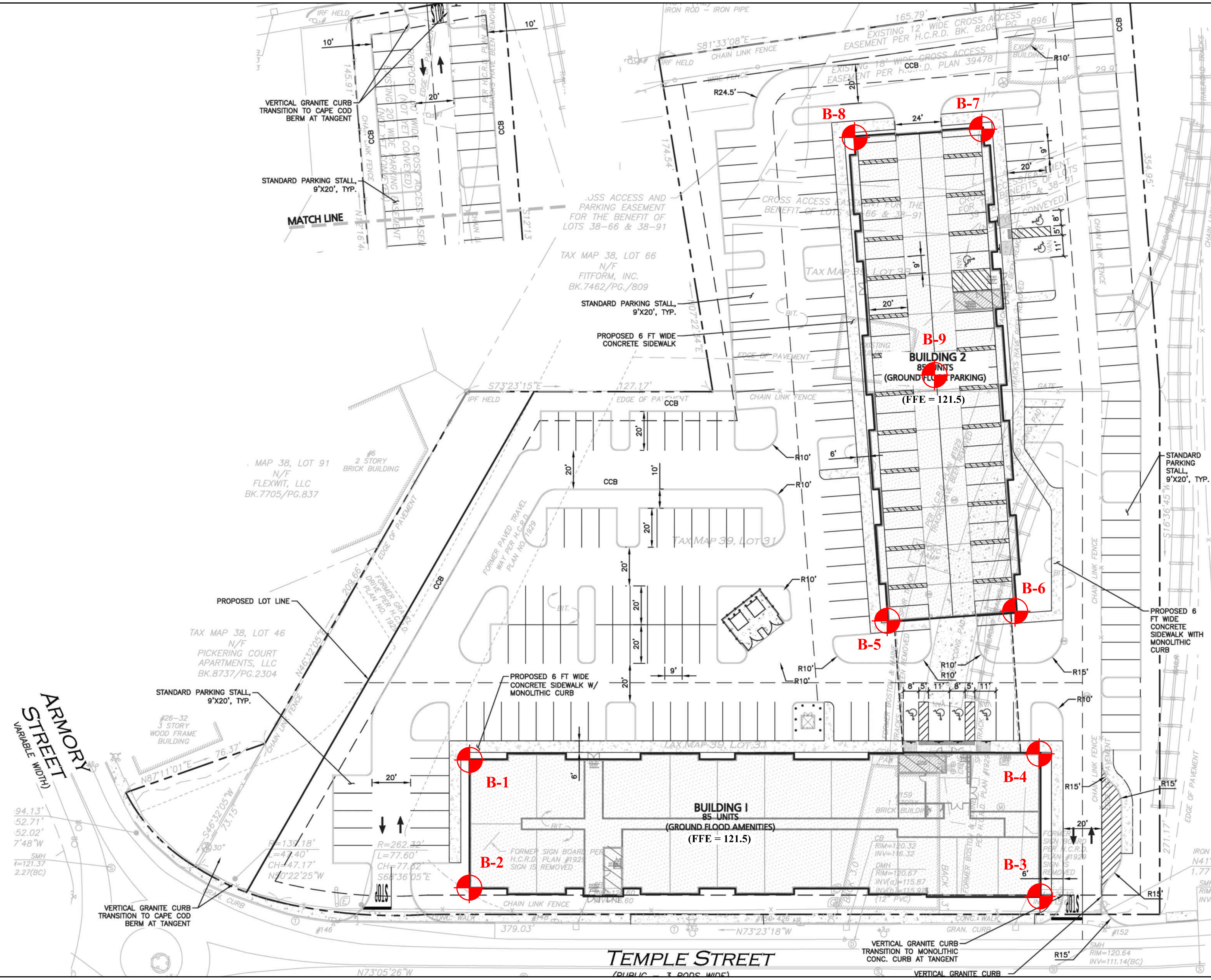
Figure

NOTES

1. This plan is a reproduction of portions of "Layout & Materials Plan, Nashua, NH", (dated March 2019) as prepared by Allen & Major Associates, Inc..
2. A geotechnical engineer from Miller Engineering & Testing, Inc. inspected the test borings.
3. Test boring locations were determined by others and by taping and pacing from known locations.

KEY

Test Borings (drilled by MET 5/17/2019 thru 5/20/2019)



GRAPHIC SCALE

60 0 30 60 120

(IN FEET)

MILLER ENGINEERING & TESTING, INC.
100 SHEFFIELD ROAD - PO BOX 4776
MANCHESTER, NEW HAMPSHIRE 03108
TEL (603) 668-6016 // FAX (603) 668-8641

158-161 Temple Street

Nashua, NH

May 2019

Project No. 19.068.NH

SUBSURFACE EXPLORATION LOCATION PLAN

FIGURE No. 1

Table

TABLE 2

GRADATION SPECIFICATIONS

PERCENTAGE PASSING BY WEIGHT

SIEVE SIZE	SELECT GRANULAR FILL	BASE COURSE FILL	CLEAN GRANULAR FILL
8"	100	100	100
3"	70 - 100	100	70 - 100
½"	40 - 90	40 - 80	40 - 100
No. 4	25 - 80	30 - 70	25 - 100
No. 10	15 - 70	20 - 60	15 - 95
No. 40	5 - 40	10 - 30	10 - 70
No. 200	0 - 12	3 - 10	0 - 15

All borrow fill materials must consist of natural, hard, durable sand and gravel particles. The material must be free of organic material, frozen material, other deleterious matter.

Appendix A

LIMITATIONS

Explorations

1. The analyses, recommendations and designs submitted in this report are based in part upon the data obtained from subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.

2. The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and have been developed by interpretation of widely spaced explorations and samples; actual soil transitions are probably more gradual. For specific information, refer to the boring logs.

3. Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors differing from the time measurements were made.

Review

4. It is recommended that this firm be retained to review final design plans and specifications. In the event that any changes in the nature, design, or location of the structures are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of the report modified or verified in writing by Miller Engineering & Testing, Inc.

Construction

5. It is recommended that this firm be retained to provide soils engineering services during the excavations and foundation construction phases of the work. This is to observe compliance with the design concepts, specifications, or recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

Use of Report

6. This report has been prepared for the exclusive use of **ZJBV Properties LLC for the proposed Residential Development at 158-161 Temple Street in Nashua, NH** in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

7. This soil and foundation engineering report has been prepared for this project by Miller Engineering & Testing, Inc. This report was completed for design purposes and may be limited in its scope to prepare an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to design considerations only.

Appendix B

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.
100 Sheffield Road - Manchester, NH 03103
Ph. (603) 668-6016 - Fax: (603) 668-8641

Project:	Lots 31 & 38 Temple St. Nashua, NH	**Sheet** 1 **of** 1	**Boring No:** B-1
Project No:	19.068.NH	**Location:**	See Plan
Date Start:	05-17-19		
Date End:	05-17-19	**Approx. Surface Elev:**	± 120.5

			GROUNDWATER OBSERVATIONS			
	CASING	**SAMPLER**	**Date**	**Depth**	**Casing At**	**Stabilization Period**
Type	HSA	SS	05-17-19	14'	31'	Upon Completion
Size	2-1/4" ID	1-3/8" ID				
Hammer		140 lbs.				
Fall		30"				

Depth/ Elev.	Cas bl/ft	SAMPLE Sample No.	Depth Range	Pen.	Rec.	BLOWS 0-6"	6-12"	12-18"	18-24"	Strata Change	Sample Description	Notes
0		-	0.0-0.2	2							-: 2" Asphalt	
		S-1	0.5-2.0	18	11		4	7	7		S-1: Dark brown/black, fine to coarse sand, some silt, little gravel (coal ash in sample)(FILL)	
		S-2	2.0-4.0	24	12	6	6	3	3		S-2: Dark brown/black, fine to coarse sand, some silt, little gravel (coal ash in sample)(FILL)	
		S-3	4.0-6.0	24	9	2	5	3	3		S-3: Dark brown/black, fine to coarse sand, some silt, little gravel (coal ash in sample)(FILL)	
6		S-4	6.0-7.0	12	7	2	5				S-4: Brown, fine to medium sand, some silt, little gravel (FILL)	
		S-4A	7.0-8.0	12	7			18	21		S-4A: Brown, fine to coarse sand, some gravel, trace silt	
		S-5	9.0-11.0	24	14	3	10	23	14		S-5: Light brown, fine to coarse sand, some gravel, trace silt	
12												
		S-6	14.0-16.0	24	13	1	11	10	9		S-6: Brown, fine to medium sand, little coarse sand and gravel, trace silt, wet	
18												
		S-7	19.0-21.0	24	15	8	13	8	12		S-7: Brown, fine sand, some silt	
24		S-8	24.0-26.0	24	19	3	9	13	16		S-8: Light brown, fine sand, some silt	
		S-9	29.0-31.0	24	22	3	9	13	16		S-9: Brown, fine sand, some silt	(1)
30												
											BORING TERMINATED AT 31 ft	
36												

Driller: R. Marcoux
Helper: J. Donahue
Inspector: T. Young

COHESIVE CONSISTENCY (Blows/Foot)	COHESIONLESS (Blows/Foot)	PROPORTIONS USED
0-2 VERY SOFT	0-4 VERY LOOSE	TRACE: 0-10%
2-4 SOFT	4-10 LOOSE	LITTLE: 10-20%
4-8 MEDIUM STIFF	10-30 MEDIUM DENSE	SOME: 20-35%
8-15 STIFF	30-50 DENSE	AND: 35-50%
15-30 HARD	50+ VERY DENSE	

NOTES: (1) 1' of blow-in, in augers when trying to sample.

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.
100 Sheffield Road - Manchester, NH 03103
Ph. (603) 668-6016 - Fax: (603) 668-8641

Project:	Lots 31 & 38 Temple St. Nashua, NH	**Sheet**	1 **of** 2
		Boring No:	B-2
Project No:	19.068.NH	**Location:**	See Plan
Date Start:	05-17-19		
Date End:	05-17-19	**Approx. Surface Elev:**	± 120.9

	CASING	SAMPLER	GROUNDWATER OBSERVATIONS			
			Date	**Depth**	**Casing At**	**Stabilization Period**
Type	HSA	SS	05-17-19	17'	41'	Upon Completion
Size	2-1/4" ID	1-3/8" ID				
Hammer		140 lbs.				
Fall		30"				

Depth/ Elev.	Cas bl/ft	Sample No.	Depth Range	Pen.	Rec.	0-6"	6-12"	12-18"	18-24"	Strata Change	Sample Description	Notes
0		-	0.0-0.2	2	7		8	9			-: 2" Asphalt	
		S-1	0.5-1.5	12							S-1: Dark brown/black, fine to coarse sand, some silt, little gravel (coal ash in sample)(FILL)	
		S-1A S-2	1.5-2.0 2.0-3.5	6 18	5 9	7	6	3	8		S-1A: Brown, fine to medium sand, trace silt, trace gravel (FILL) S-2: Brown, fine to medium sand, trace silt, trace gravel (FILL)	
		S-2A S-3	3.5-4.0 4.0-6.0	6 24	2 17	2	2	2	2 3		S-2A: Dark brown, fine sand, some silt, trace gravel (topsoil) S-3: Dark brown, fine sand, some silt, trace gravel (topsoil)	
6		S-4	6.0-8.0	24	19	2	1	2	2		S-4: Brown/Orange, fine sand, some silt (subsoil)	
		S-5	9.0-11.0	24	16	9	22	27	22		S-5: Brown, fine to coarse sand, some gravel, trace silt	
12												
		S-6	14.0-16.0	24	17	2	7	9	12		S-6: Light brown, fine sand, little silt	
18												
		S-7	19.0-21.0	24	16	1	8	9	11		S-7: Brown/Orange (mottled), fine sand, some silt	
24		S-8	24.0-26.0	24	20	1	5	7	10		S-8: Brown/Orange (little mottling), fine sand, some silt	
		S-9	29.0-31.0	24	24	2	6	9	10		S-9: Brown/Orange, fine sand, some silt	
30												
		S-10	34.0-36.0	24	23	4	9	19	23		S-10: Brown/Orange, fine sand, some silt	
36												

Driller: R. Marcoux
Helper: J. Donahue
Inspector: T. Young

COHESIVE CONSISTENCY (Blows/Foot)
0-2 VERY SOFT
2-4 SOFT
4-8 MEDIUM STIFF
8-15 STIFF
15-30 HARD

COHESIONLESS (Blows/Foot)
0-4 VERY LOOSE
4-10 LOOSE
10-30 MEDIUM DENSE
30-50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE: 0-10%
LITTLE: 10-20%
SOME: 20-35%
AND: 35-50%

NOTES:

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL.
WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS.
FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.
100 Sheffield Road - Manchester, NH 03103
Ph. (603) 668-6016 - Fax: (603) 668-8641

Project: Lots 31 & 38 Temple St.
Nashua, NH
Project No.: 19.068.NH
Date Start: 05-17-19
Date End: 05-17-19

Sheet 2 **of** 2
Boring No: B-2
Location: See Plan
Approx. Surface Elev: ± 120.9

	CASING	SAMPLER	GROUNDWATER OBSERVATIONS			
			Date	**Depth**	**Casing At**	**Stabilization Period**
Type	HSA	SS	05-17-19	17'	41'	Upon Completion
Size	2-1/4" ID	1-3/8" ID				
Hammer		140 lbs.				
Fall		30"				

Depth/ Elev.	Cas bl/ft	SAMPLE: Sample No.	SAMPLE: Depth Range	SAMPLE: Pen.	SAMPLE: Rec.	BLOWS: 0-6"	BLOWS: 6-12"	BLOWS: 12-18"	BLOWS: 18-24"	Strata Change	Sample Description	Notes
		S-11	39.0-41.0	24	21	5	14	18	24		S-11: Brown/Orange, fine sand, some silt	
42											BORING TERMINATED AT 41 ft	
48												
54												
60												
66												
72												

Driller: R. Marcoux
Helper: J. Donahue
Inspector: T. Young

COHESIVE CONSISTENCY (Blows/Foot)
0-2 VERY SOFT
2-4 SOFT
4-8 MEDIUM STIFF
8-15 STIFF
15-30 HARD

COHESIONLESS (Blows/Foot)
0-4 VERY LOOSE
4-10 LOOSE
10-30 MEDIUM DENSE
30-50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE: 0-10%
LITTLE: 10-20%
SOME: 20-35%
AND: 35-50%

NOTES:

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL.
WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS.
FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.
100 Sheffield Road - Manchester, NH 03103
Ph. (603) 668-6016 - Fax: (603) 668-8641

Project:	Lots 31 & 38 Temple St.	**Sheet**	1 **of** 2
	Nashua, NH	**Boring No:**	B-3
Project No:	19.068.NH	**Location:**	See Plan
Date Start:	05-20-19		
Date End:	05-20-19	**Approx. Surface Elev:**	± 120.5

			GROUNDWATER OBSERVATIONS			
	CASING	**SAMPLER**	**Date**	**Depth**	**Casing At**	**Stabilization Period**
Type	HSA	SS	05-20-19	14'	50.2'	Upon Completion
Size	2-1/4" ID	1-3/8" ID				
Hammer		140 lbs.				
Fall		30"				

Depth/ Elev.	Cas bl/ft	SAMPLE: Sample No.	Depth Range	Pen.	Rec.	BLOWS: 0-6"	6-12"	12-18"	18-24"	Strata Change	Sample Description	Notes
0		-	0.0-0.2	2	12		3	3	4		-: 2" Asphalt	
		S-1	0.5-2.0	18							S-1: Black, fine to medium sand, some silt, trace gravel (coal ash in sample)(FILL)	
		S-2	2.0-4.0	24	16	3	3	2	2		S-2: Light brown, fine sand, little silt, trace gravel (FILL)	
		S-3	4.0-6.0	24	13	1	1	1/12"			S-3: Light brown/brown, fine sand, little silt, trace gravel (FILL)	
6		S-4	6.0-6.5	6	4	1					S-4: Dark brown, fine sand, some silt (topsoil)	
		S-4A	6.5-7.5	12	9		1	4			S-4A: Brown, fine sand, some silt (subsoil)	
		S-4B	7.5-8.0	6	5				3		S-4B: Brown, fine to coarse sand, some gravel, trace silt	
		S-5	9.0-11.0	24	14	5	9	8	7		S-5: Brown, fine to coarse sand, some gravel, trace silt	
12												
		S-6	14.0-16.0	24	12	3	4	9	11		S-6: Brown, fine to coarse sand, some gravel, trace silt, wet	
18												
		S-7	19.0-20.5	18	12	8	18	12			S-7: Brown to orange, fine to coarse sand, some angular gravel, little silt, wet	
		S-7A	20.5-21.0	6	4				8		S-7A: Gray, fine sand, some silt, wet	
24		S-8	24.0-26.0	24	15	2	3	4	4		S-8: Light brown, fine sand, some silt, wet	
30		S-9	29.0-31.0	24	14	WOR	1	2	5		S-9: Light brown, fine sand, some silt, wet	
		S-10	34.0-36.0	24	19	WOR	2	4	6		S-10: Light brown, fine sand, some silt, wet	
36												

Driller: R. Marcoux
Helper: J. Donahue
Inspector: T. Young

COHESIVE CONSISTENCY (Blows/Foot)	COHESIONLESS (Blows/Foot)	PROPORTIONS USED
0-2 VERY SOFT	0-4 VERY LOOSE	TRACE: 0-10%
2-4 SOFT	4-10 LOOSE	LITTLE: 10-20%
4-8 MEDIUM STIFF	10-30 MEDIUM DENSE	SOME: 20-35%
8-15 STIFF	30-50 DENSE	AND: 35-50%
15-30 HARD	50+ VERY DENSE	

NOTES:

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL.
WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS.
FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.
100 Sheffield Road - Manchester, NH 03103
Ph. (603) 668-6016 - Fax: (603) 668-8641

Project:	Lots 31 & 38 Temple St. Nashua, NH	**Sheet**	2 **of** 2
Project No.:	19.068.NH	**Boring No:**	B-3
Date Start:	05-20-19	**Location:**	See Plan
Date End:	05-20-19	**Approx. Surface Elev:**	± 120.5

	CASING	SAMPLER	GROUNDWATER OBSERVATIONS			
			Date	**Depth**	**Casing At**	**Stabilization Period**
Type	HSA	SS	05-20-19	14'	50.2'	Upon Completion
Size	2-1/4" ID	1-3/8" ID				
Hammer		140 lbs.				
Fall		30"				

Depth/ Elev.	Cas bl/ft	Sample No.	Depth Range	Pen.	Rec.	0-6"	6-12"	12-18"	18-24"	Strata Change	Sample Description	Notes
		S-11	39.0-41.0	24	21	1	5	16	6		S-11: Light brown, fine sand, some silt, wet	
42												
		S-12	44.0-45.3	16	11	9	19	50/4"			S-12: Brown, fine sand, some silt, little gravel	
48												
		S-13	49.0-49.2	2	2	50/2"					S-13: Brown, fine sand, some gravel and silt	
											Split-Spoon Refusal at 50.2"	
											BORING TERMINATED AT 50.2 ft	
54												
60												
66												
72												

Driller: R. Marcoux
Helper: J. Donahue
Inspector: T. Young

COHESIVE CONSISTENCY (Blows/Foot)	COHESIONLESS (Blows/Foot)	PROPORTIONS USED
0-2 VERY SOFT	0-4 VERY LOOSE	TRACE: 0-10%
2-4 SOFT	4-10 LOOSE	LITTLE: 10-20%
4-8 MEDIUM STIFF	10-30 MEDIUM DENSE	SOME: 20-35%
8-15 STIFF	30-50 DENSE	AND: 35-50%
15-30 HARD	50+ VERY DENSE	

NOTES:

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL.
WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS.
FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.
100 Sheffield Road - Manchester, NH 03103
Ph. (603) 668-6016 - Fax: (603) 668-8641

Project:	Lots 31 & 38 Temple St. Nashua, NH	**Sheet**	1 **of** 1
		Boring No:	B-4
Project No:	19.068.NH	**Location:**	See Plan
Date Start:	05-20-19		
Date End:	05-20-19	**Approx. Surface Elev:**	± 120

			GROUNDWATER OBSERVATIONS			
	CASING	**SAMPLER**	**Date**	**Depth**	**Casing At**	**Stabilization Period**
Type	HSA	SS	05-20-19	14'	26'	Upon Completion
Size	2-1/4" ID	1-3/8" ID				
Hammer		140 lbs.				
Fall		30"				

Depth/ Elev.	Cas bl/ft	SAMPLE Sample No.	Depth Range	Pen.	Rec.	BLOWS 0-6"	6-12"	12-18"	18-24"	Strata Change	Sample Description	Notes
0		-	0.0-0.2	2.5							: 2.5" Asphalt	
		S-1	0.5-2.0	18	14		6	5	3		S-1: Brown/dark brown, fine sand, little silt (coal ash in sample)(FILL)	
		S-2	4.0-6.0	24	14	1/12"		1/12"			S-2: Brown/dark brown, fine sand, little silt (coal ash in sample)(FILL)	
6		S-3	6.0-8.0	24	11	2	3	8	6		S-3: Brown, fine to coarse sand, some gravel, trace silt (FILL)	
		S-4	9.0-11.0	24	13	5	7	8	10		S-4: Brown, fine to coarse sand, little gravel, trace silt	
12												
		S-5	14.0-16.0	24	15	4	4	3	3		S-5: Brown, fine to medium sand, trace silt, trace gravel, wet	
18												
24		S-6	24.0-26.0	24	17	3	3	4	2		S-6: Brown, fine sand, some silt, trace gravel, wet	
											BORING TERMINATED AT 26 ft	
30												
36												

Driller: R. Marcoux
Helper: J. Donahue
Inspector: T. Young

COHESIVE CONSISTENCY (Blows/Foot)
0-2 VERY SOFT
2-4 SOFT
4-8 MEDIUM STIFF
8-15 STIFF
15-30 HARD

COHESIONLESS (Blows/Foot)
0-4 VERY LOOSE
4-10 LOOSE
10-30 MEDIUM DENSE
30-50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE: 0-10%
LITTLE: 10-20%
SOME: 20-35%
AND: 35-50%

NOTES:

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL.
WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS.
FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.
100 Sheffield Road - Manchester, NH 03103
Ph. (603) 668-6016 - Fax: (603) 668-8641

Project: Lots 31 & 38 Temple St.
Nashua, NH
Project No: 19.068.NH
Date Start: 05-17-19
Date End: 05-17-19

Sheet 1 **of** 1
Boring No: B-5
Location: See Plan
Approx. Surface Elev: ± 120

	CASING	SAMPLER	GROUNDWATER OBSERVATIONS			
			Date	**Depth**	**Casing At**	**Stabilization Period**
Type	HSA	SS	05-17-19	14'	26'	Upon Completion
Size	2-1/4" ID	1-3/8" ID				
Hammer		140 lbs.				
Fall		30"				

Depth/ Elev.	Cas bl/ft	Sample No.	Depth Range	Pen.	Rec.	Blows 0-6"	Blows 6-12"	Blows 12-18"	Blows 18-24"	Strata Change	Sample Description	Notes
0		-	0.0-0.2	2.5	13		10	9	7		: 2.5" Asphalt	
		S-1	0.5-2.0	18							S-1: Dark brown/black, fine to medium sand, some silt, little gravel (coal ash in sample) (FILL)	
		S-2	2.0-4.0	24	11	4	3	3	3		S-2: Dark brown/black, fine to medium sand, some silt, little gravel (coal ash in sample) (FILL)	
		S-3	4.0-5.3	15	10	2	12	50/3"			S-3: Dark brown/black, fine to medium sand, some silt, little gravel (coal ash in sample) (bottom 3" of sample was fractured rock) (FILL)	
6												
		S-4	7.0-8.0	12	7	1	3				S-4: Dark brown/black, fine to medium sand, some silt, little gravel (coal ash in sample) (FILL)	
		S-4A	8.0-9.0	12	6			6	9		S-4A: Brown, fine to coarse sand, little gravel, trace silt	
		S-5	9.0-11.0	24	16	6	15	21	21		S-5: Brown, fine to coarse sand, little gravel, trace silt	
12												
		S-6	14.0-15.0	12	7	11	13				S-6: Brown, fine to coarse sand, some gravel, trace silt, wet	
		S-6A	15.0-16.0	12	8			11	12		S-6A: Light brown, fine sand, some silt, wet	
18												
		S-7	19.0-21.0	24	16	3	6	5	34		S-7: Light brown, fine sand, some silt, trace gravel, wet	
24		S-8	24.0-26.0	24	17	20	37	31	43		S-8: Brown, fine to coarse sand, some gravel and silt	
											BORING TERMINATED AT 26 ft	
30												
36												

Driller: R. Marcoux
Helper: J. Donahue
Inspector: T. Young

COHESIVE CONSISTENCY (Blows/Foot)
0-2 VERY SOFT
2-4 SOFT
4-8 MEDIUM STIFF
8-15 STIFF
15-30 HARD

COHESIONLESS (Blows/Foot)
0-4 VERY LOOSE
4-10 LOOSE
10-30 MEDIUM DENSE
30-50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE: 0-10%
LITTLE: 10-20%
SOME: 20-35%
AND: 35-50%

NOTES:

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL.
WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS.
FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.
100 Sheffield Road - Manchester, NH 03103
Ph. (603) 668-6016 - Fax: (603) 668-8641

Project:	Lots 31 & 38 Temple St. Nashua, NH	**Sheet**	1 **of** 1
		Boring No:	B-6
Project No:	19.068.NH	**Location:**	See Plan
Date Start:	05-20-19		
Date End:	05-20-19	**Approx. Surface Elev:**	± 120

	CASING	SAMPLER	GROUNDWATER OBSERVATIONS Date	Depth	Casing At	Stabilization Period
Type	HSA	SS	05-20-19	14'	21'	Upon Completion
Size	2-1/4" ID	1-3/8" ID				
Hammer		140 lbs.				
Fall		30"				

Depth/ Elev.	Cas bl/ft	Sample No.	Depth Range	Pen.	Rec.	Blows 0-6"	Blows 6-12"	Blows 12-18"	Blows 18-24"	Strata Change	Sample Description	Notes
0		-	0.0-0.2	2.5	6		4	4			-: 2.5' Asphalt	
		S-1	0.5-1.5	12	6				6		S-1: Black, fine to coarse sand, some silt, little gravel (coal ash in sample) (FILL)	
		S-1A	1.5-2.0	6		3	2	2	2		S-1A: Brown, fine sand, little silt (FILL)	
		S-2	2.0-4.0	24	16						S-2: Brown, fine sand, little silt (FILL)	
		S-3	4.0-5.0	12	10	2	2				S-3: Brown, fine sand, little silt (FILL)	
		S-3A	5.0-6.0	12	6			2	2		S-3A: Brown/Orange, fine sand, some silt, trace fine organic roots (subsoil)	
6		S-4	6.0-8.0	24	21	2	1	2	3		S-4: Brown to light brown, fine sand, little silt (subsoil)	
		S-5	9.0-11.0	24	16	2	4	3	5		S-5: Light brown, fine sand, little silt	
12												
		S-6	14.0-15.0	12	9	8	16				S-6: Brown, fine sand, some silt, wet	(1)
		S-6A	15.0-16.0	12	7			35	34		S-6A: Brown, fine to coarse sand, some gravel, little silt, wet	
18												
		S-7	19.0-21.0	24	14	12	24	18	18		S-7: Brown, fine to coarse sand, some gravel and silt, wet	
											BORING TERMINATED AT 21 ft	
24												
30												
36												

Driller: R. Marcoux
Helper: J. Donahue
Inspector: T. Young

COHESIVE CONSISTENCY (Blows/Foot)
0-2 VERY SOFT
2-4 SOFT
4-8 MEDIUM STIFF
8-15 STIFF
15-30 HARD

COHESIONLESS (Blows/Foot)
0-4 VERY LOOSE
4-10 LOOSE
10-30 MEDIUM DENSE
30-50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE: 0-10%
LITTLE: 10-20%
SOME: 20-35%
AND: 35-50%

NOTES: (1) Change in drilling about 12'.

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL.
WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS.
FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.
100 Sheffield Road - Manchester, NH 03103
Ph. (603) 668-6016 - Fax: (603) 668-8641

Project:	Lots 31 & 38 Temple St. Nashua, NH	**Sheet**	1 **of** 1
		Boring No:	B-7
Project No:	19.068.NH	**Location:**	See Plan
Date Start:	05-20-19		
Date End:	05-20-19	**Approx. Surface Elev:**	± 120

	CASING	SAMPLER	GROUNDWATER OBSERVATIONS Date	Depth	Casing At	Stabilization Period
Type	HSA	SS	05-20-19	16'	21'	Upon Completion
Size	2-1/4" ID	1-3/8" ID				
Hammer		140 lbs.				
Fall		30"				

Depth/ Elev.	Cas bl/ft	SAMPLE Sample No.	Depth Range	Pen.	Rec.	BLOWS 0-6"	6-12"	12-18"	18-24"	Strata Change	Sample Description	Notes
0		S-1	0.0-1.5	18	5	7	5	19			S-1: Brown/Dark brown, fine to coarse sand, some gravel, little silt (FILL)	
		S-1A	1.5-2.0	6	4				7		S-1A: Dark brown, fine sand, some silt (FILL)	
		S-2	2.0-4.0	24	10	1	1	2	3		S-2: Brown/Black, fine to medium sand, some silt, trace gravel (coal ash in sample) (trace fine organic roots in sample) (FILL)	
		S-3	4.0-6.0	24	15	2	3	4	5		S-3: Brown/Black, fine to medium sand, some silt, trace gravel (coal ash and brick in sample)(FILL)	
6		S-4	6.0-8.0	24	12	2	2	3	1		S-4: Brown/Black, fine to medium sand, some silt, trace gravel (coal ash and brick in sample)(FILL)	
		S-5	9.0-11.0	24	15	5	8	6	6		S-5: Light brown, fine sand, trace silt, trace gravel	
12												
		S-6	14.0-15.5	18	11	3	6	8			S-6: Brown, fine sand, some silt	
		S-6A	15.5-16.0	6	3				25		S-6A: Brown, fine to medium sand, some gravel, little silt	(1)
18		S-7	19.0-21.0	24	10	16	19	15	14		S-7: Brown, fine to medium sand, some gravel, little silt	(2)
											BORING TERMINATED AT 21 ft	
24												
30												
36												

Driller: R. Marcoux
Helper: J. Donahue
Inspector: T. Young

COHESIVE CONSISTENCY (Blows/Foot)
0-2 VERY SOFT
2-4 SOFT
4-8 MEDIUM STIFF
8-15 STIFF
15-30 HARD

COHESIONLESS (Blows/Foot)
0-4 VERY LOOSE
4-10 LOOSE
10-30 MEDIUM DENSE
30-50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE: 0-10%
LITTLE: 10-20%
SOME: 20-35%
AND: 35-50%

NOTES: (1) Rock in tip of split-spoon.
(2) Rock in tip of split-spoon.

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL.
WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS.
FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.
100 Sheffield Road - Manchester, NH 03103
Ph. (603) 668-6016 - Fax: (603) 668-8641

Project:	Lots 31 & 38 Temple St. Nashua, NH	**Sheet** 1 **of** 1	**Boring No:** B-8
Project No:	19.068.NH	**Location:**	See Plan
Date Start:	05-20-19		
Date End:	05-20-19	**Approx. Surface Elev:**	± 120

	CASING	SAMPLER	Date	Depth	Casing At	Stabilization Period
			GROUNDWATER OBSERVATIONS			
Type	HSA	SS	05-20-19	17'	24.5'	Upon Completion
Size	2-1/4" ID	1-3/8" ID				
Hammer		140 lbs.				
Fall		30"				

Depth/ Elev.	Cas bl/ft	Sample No.	Depth Range	Pen.	Rec.	0-6"	6-12"	12-18"	18-24"	Strata Change	Sample Description	Notes
0		-	0.0-0.2	2.75	11		6	5	5		-: 2.75" Asphalt	
		S-1	0.5-2.0	18							S-1: Brown/Black, fine to medium sand, some silt, little gravel (coal ash in sample)(FILL)	
		S-2	2.0-4.0	24	20	3	3	3	3		S-2: Gray to orange, fine sand, little silt	
		S-3	4.0-6.0	24	12	4	6	4	7		S-3: Brown/Orange, fine sand, little silt	
6												
		S-4	9.0-10.0	12	8	4	7				S-4: Brown/Orange, fine sand, trace silt	
		S-4A	10.0-11.0	12	9			13	15		S-4A: Brown/Orange, fine sand, some silt	
12												
		S-5	14.0-15.2	14	11	8	17	50/2"			S-5: Gray, fine to medium sand, some silt, little gravel	
18												
		S-6	19.0-21.0	24	15	8	9	18	11		S-6: Gray/Orange, fine to medium sand, some silt, little gravel	
24		S-7	24.0-24.5	6	6	10	25/0"				S-7: Brown, fine to medium sand, little silt, little gravel	(1)
											Split-Spoon Refusal at 24.5'	
											BORING TERMINATED AT 24.5 ft	
30												
36												

Driller: R. Marcoux
Helper: J. Donahue
Inspector: T. Young

COHESIVE CONSISTENCY (Blows/Foot)	COHESIONLESS (Blows/Foot)	PROPORTIONS USED
0-2 VERY SOFT	0-4 VERY LOOSE	TRACE: 0-10%
2-4 SOFT	4-10 LOOSE	LITTLE: 10-20%
4-8 MEDIUM STIFF	10-30 MEDIUM DENSE	SOME: 20-35%
8-15 STIFF	30-50 DENSE	AND: 35-50%
15-30 HARD	50+ VERY DENSE	

NOTES: (1) 18" of blow-in, in augers at time of sampling.

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.
100 Sheffield Road - Manchester, NH 03103
Ph. (603) 668-6016 - Fax: (603) 668-8641

Project: Lots 31 & 38 Temple St. Nashua, NH
Project No: 19.068.NH
Date Start: 05-20-19
Date End: 05-20-19

Sheet 1 **of** 1
Boring No: B-9
Location: See Plan
Approx. Surface Elev: ± 120

	CASING	SAMPLER	GROUNDWATER OBSERVATIONS			
			Date	**Depth**	**Casing At**	**Stabilization Period**
Type	HSA	SS	05-20-19	None	13'	Upon Completion
Size	2-1/4" ID	1-3/8" ID				
Hammer		140 lbs.				
Fall		30"				

Depth/ Elev.	Cas bl/ft	Sample No.	Depth Range	Pen.	Rec.	Blows 0-6"	Blows 6-12"	Blows 12-18"	Blows 18-24"	Strata Change	Sample Description	Notes
0		S-1	0.0-2.0	24	17	3	4	3	2		S-1: Brown/Black, fine to medium sand, some silt, little gravel (coal ash and brick in sample) (FILL)	
		S-2	2.0-4.0	24	5	2	2	2	1		S-2: Brown/Black, fine to medium sand, some silt, little gravel (coal ash in sample)(FILL)	
		S-3	4.0-6.0	24	10	1	1	2	1		S-3: Brown/Black, fine to medium sand, some silt, little gravel (coal ash in sample) (FILL)	
6		S-4	6.0-8.0	24	15	3	3	2	1		S-4: Brown/Black, fine to medium sand, some silt, little gravel (coal ash in sample) (FILL)	
		S-5	9.0-10.5	18	15	2	4	2			S-5: Brown/Black, fine to medium sand, some silt, trace gravel (coal ash and brick in sample) (FILL)	
		S-5A	10.5-11.0	6	4				2		S-5A: Brown/Orange, fine sand, some silt (subsoil)	
12		S-6	11.0-12.5	18	15	1	2	3			S-6: Gray, fine sand, little silt, trace fine organic roots	
		S-6A	12.5-13.0	6	3				12		S-6A: Brown, fine to coarse sand, some gravel, trace silt	
											BORING TERMINATED AT 13 ft	
18												
24												
30												
36												

Driller: R. Marcoux
Helper: J. Donahue
Inspector: T. Young

COHESIVE CONSISTENCY (Blows/Foot)
0-2 VERY SOFT
2-4 SOFT
4-8 MEDIUM STIFF
8-15 STIFF
15-30 HARD

COHESIONLESS (Blows/Foot)
0-4 VERY LOOSE
4-10 LOOSE
10-30 MEDIUM DENSE
30-50 DENSE
50+ VERY DENSE

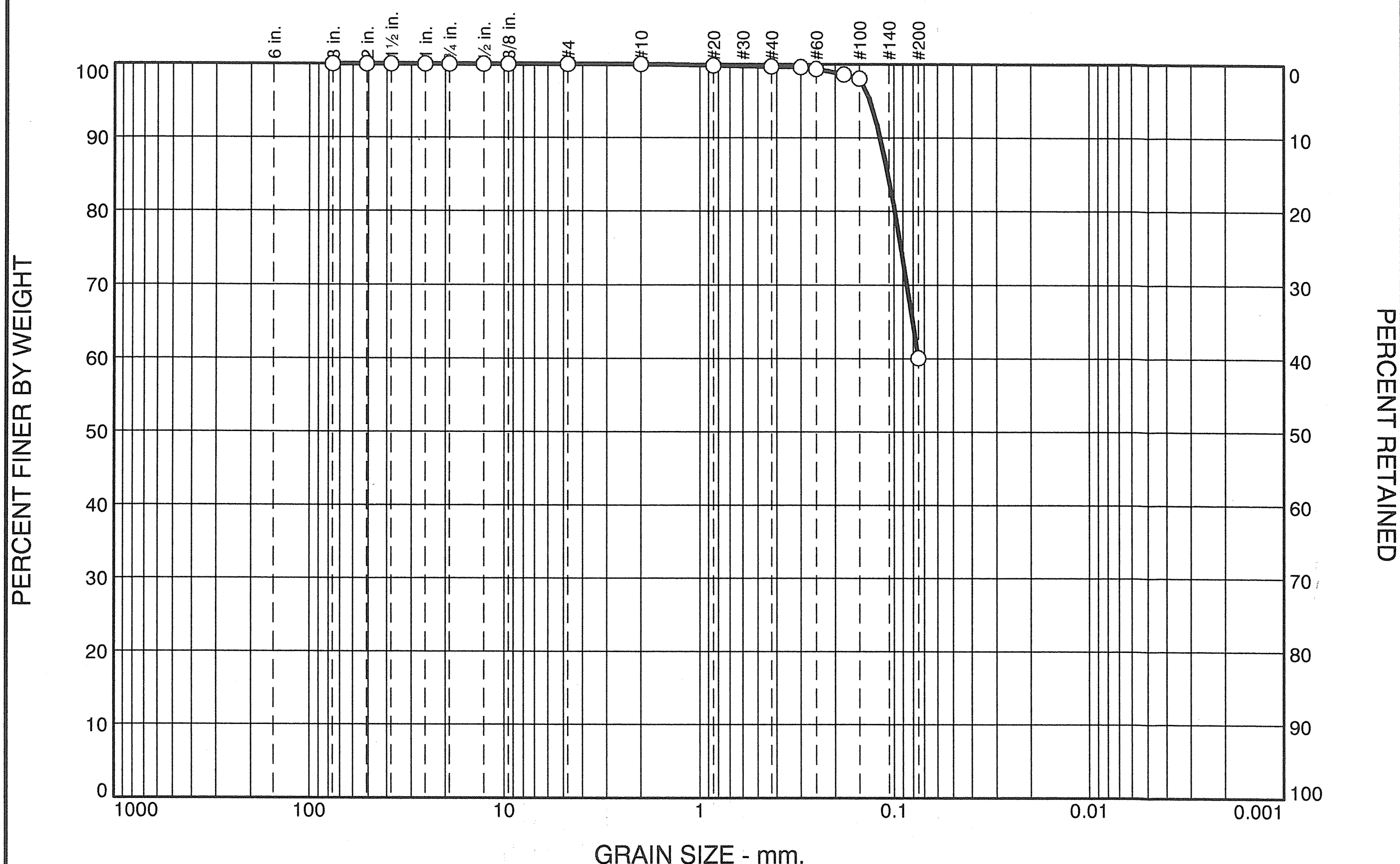
PROPORTIONS USED
TRACE: 0-10%
LITTLE: 10-20%
SOME: 20-35%
AND: 35-50%

NOTES:

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL.
WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS.
FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

Appendix C

GRAINSIZE DISTRIBUTION REPORT - AGGREGATE GRADING



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	0	40	60	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100		
2"	100		
1.5"	100		
1"	100		
.75"	100		
.5"	100		
.375"	100		
#4	100		
#10	100		
#20	100		
#40	100		
#50	100		
#60	99		
#80	99		
#100	98		
#200	60		

* (no specification provided)

Material Description

Brown, fine sand, some silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.1172 D_{85}= 0.1070 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

BORING JAR SAMPLE.

Source of Sample: B-1 **Depth:** 19
Sample Number: S-7

Date: 5-30-19

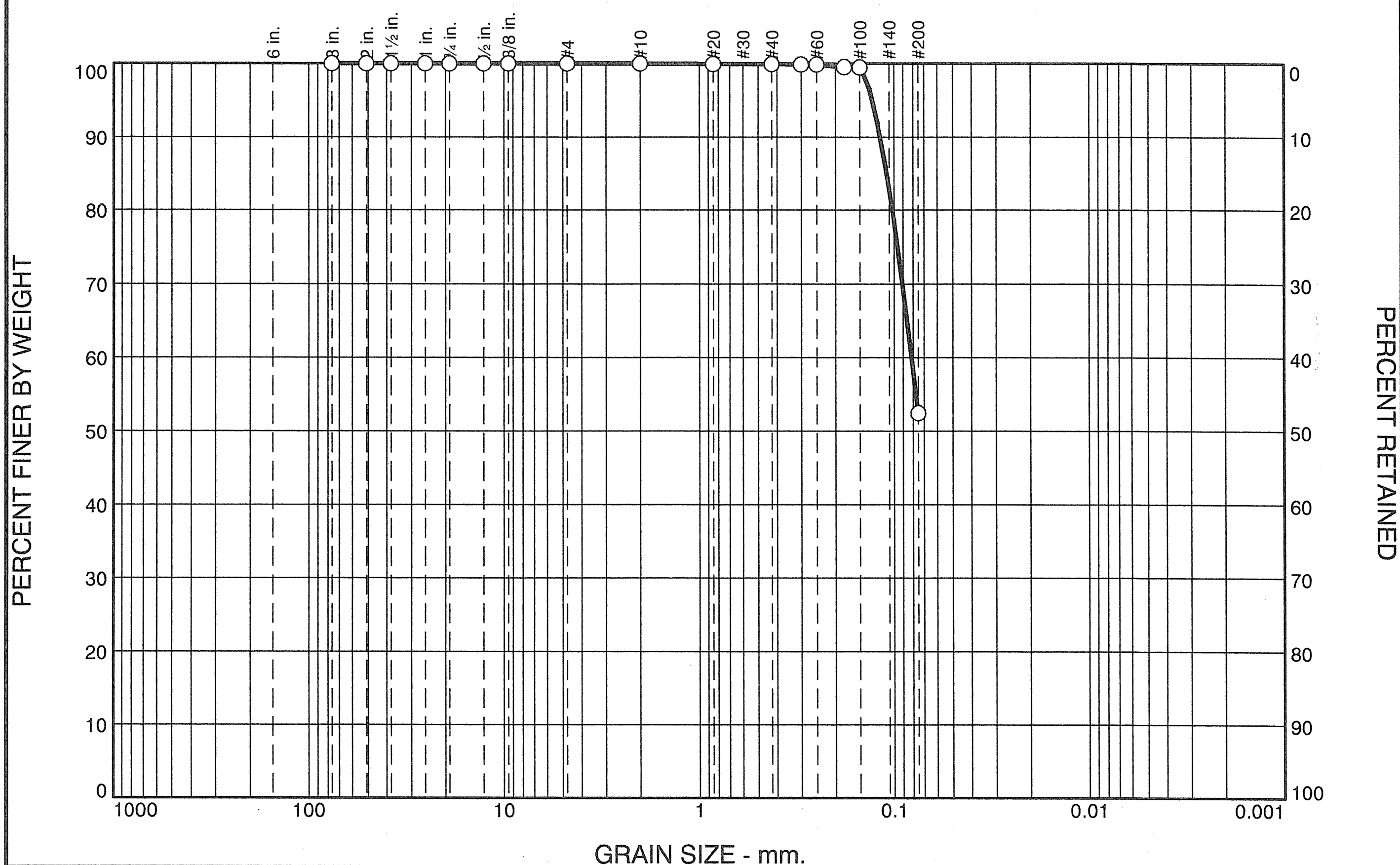
MILLER ENGINEERING & TESTING, INC.

Client: ZJBV Properties LLC
Project: Lots 31 & 38 Temple St.

Project No: 19.068.NH **Figure** L190161A

Tested By: DM/BM

GRAINSIZE DISTRIBUTION REPORT - AGGREGATE GRADING



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	0	48	52	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100		
2"	100		
1.5"	100		
1"	100		
.75"	100		
.5"	100		
.375"	100		
#4	100		
#10	100		
#20	100		
#40	100		
#50	100		
#60	100		
#80	100		
#100	100		
#200	52		

* (no specification provided)

Material Description

Light brown, fine sand, some silt, wet

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.1174 D_{85}= 0.1088 D_{60}= 0.0812
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

BORING JAR SAMPLE

Source of Sample: B-3 **Depth:** 24
Sample Number: S-8

Date: 5-30-19

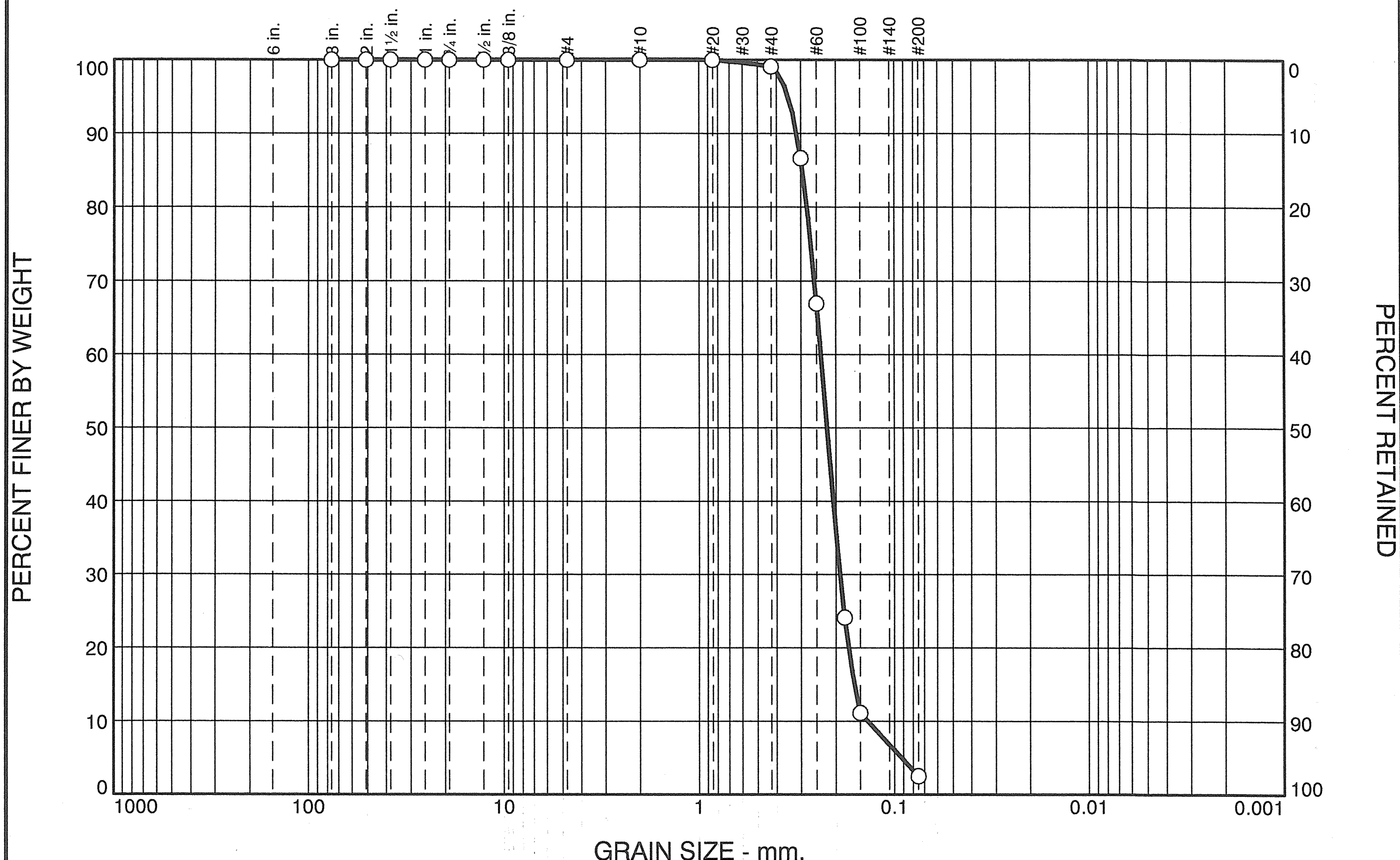
MILLER ENGINEERING & TESTING, INC.

Client: ZJBV Properties LLC
Project: Lots 31 & 38 Temple St.

Project No: 19.068.NH **Figure** L190161B

Tested By: DM/BM

GRAINSIZE DISTRIBUTION REPORT - AGGREGATE GRADING



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	1	96	3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100		
2"	100		
1.5"	100		
1"	100		
.75"	100		
.5"	100		
.375"	100		
#4	100		
#10	100		
#20	100		
#40	99		
#50	87		
#60	67		
#80	24		
#100	11		
#200	2.5		

* (no specification provided)

Material Description

Light brown, fine sand, little silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3143 D_{85}= 0.2942 D_{60}= 0.2374
D_{50}= 0.2210 D_{30}= 0.1900 D_{15}= 0.1606
D_{10}= 0.1367 C_u= 1.74 C_c= 1.11

Classification

USCS= SP AASHTO=

Remarks

BORING JAR SAMPLE.

Source of Sample: B-6 **Depth:** 9
Sample Number: S-5

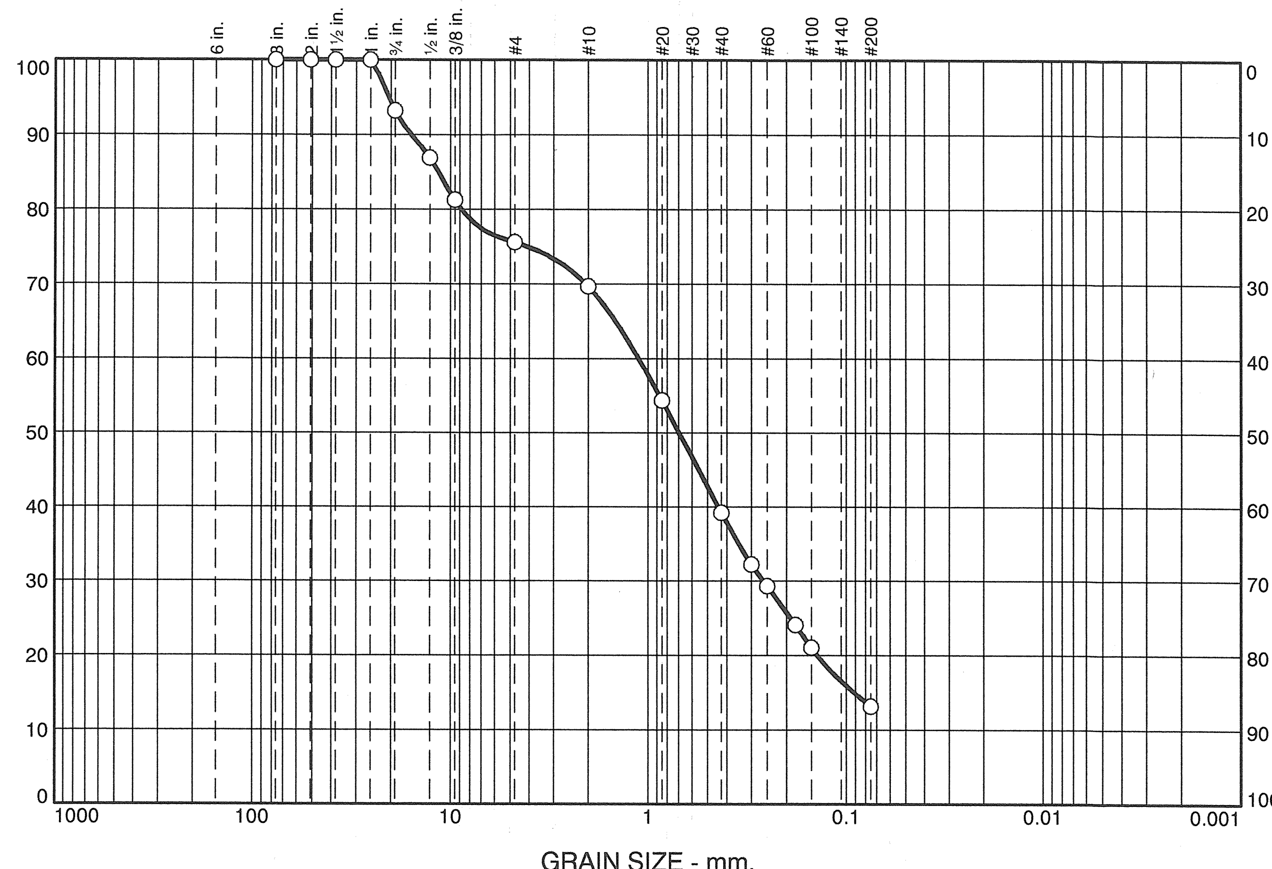
Date: 5-30-19

MILLER ENGINEERING & TESTING, INC.

Client: ZJBV Properties LLC
Project: Lots 31 & 38 Temple St.
Project No: 19.068.NH **Figure** L190161C

Tested By: DM/BM

GRAINSIZE DISTRIBUTION REPORT - AGGREGATE GRADING



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	7	17	6	31	26	13	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100		
2"	100		
1.5"	100		
1"	100		
.75"	93		
.5"	87		
.375"	81		
#4	76		
#10	70		
#20	54		
#40	39		
#50	32		
#60	29		
#80	24		
#100	21		
#200	13		

* (no specification provided)

Material Description

Gray/Orange, fine to medium sand, some silt, little gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 15.7673 D_{85}= 11.4531 D_{60}= 1.1125
D_{50}= 0.6942 D_{30}= 0.2609 D_{15}= 0.0912
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

BORING JAR SAMPLE.

Source of Sample: B-8 **Depth:** 19
Sample Number: S-6

Date: 5-30-19

MILLER ENGINEERING & TESTING, INC.

Client: ZJBV Properties LLC
Project: Lots 31 & 38 Temple St.
Project No: 19.068.NH **Figure** L190161D

Tested By: DM/BM

TES ENVIRONMENTAL CONSULTANTS, L.L.C.

Environmental Planning and Permitting
Soil and Wetlands Investigation

SITE-SPECIFIC SOIL SURVEY REPORT

performed at

158-159 Temple Street
Nashua, New Hampshire

prepared for

Allen & Major Associates, Inc.
250 Commercial Street
Manchester, New Hampshire

TES Project # 19-0046

1494 Route 3A, Unit 1
Bow, NH 03304
(603) 856-8925

tom@tesenviro.comcastbiz.net

STATE OF NEW HAMPSHIRE
THOMAS E. SOKOLOSKI
No. 063
5/4/19
CERTIFIED SOIL SCIENTIST

May 4, 2019

Mr. Michael A. Malynowski, P.E.
Allen & Major Associates, Inc.
400 Harvey Road
Manchester, New Hampshire 03103

RE: Site Specific Soil Map
158-159 Temple Street, Nashua, New Hampshire

Dear Mr. Malynowski:

On April 24, 2019 I performed field work on the above-referenced property for a Site Specific Soil Survey as you requested. This Soil Survey was completed utilizing SSSNNE Special Publication No. 3; Site Specific Soil Mapping Standards for New Hampshire and Vermont, Version 4.0, February 2011. The soil legend used for this soil map conforms to the New Hampshire State-Wide Numerical Soils Legend, Issue #10, January 2011 established and maintained by the Natural Resources Conservation Service.

The purpose of this soil survey was to provide information for an Alteration of Terrain permit application related to planned site redevelopment. Field work for this survey included the examination of numerous soil profiles via hand dug spade pits and soil auger borings taken at intervals sufficient to delineate the boundaries between soil map units. The NRCS Soil Survey of Hillsborough County, New Hampshire (Eastern Part) was reviewed to determine the soils that have been mapped on and in the vicinity of the site, which were entirely Urban Land (Ur), with sandy outwash-derived soils such as Windsor-Urban Land Complex (WnC) and Udipsamments, nearly level (UdA) nearby. No New Hampshire-jurisdictional wetlands were observed on or in the immediate vicinity of the site. Ground control for the soil survey was provided by numerous site development features.

The following report includes a Site Specific Soil Map Key with accompanying Hydrologic Soil Groups and High Intensity Soil Survey codes, as well as soil map unit descriptions. The general surface conditions on the site include asphalt pavement, buildings and altered soils with trees or grasses.

If you have any questions regarding the soils on this site and the accompanying report please contact our office.

Very truly yours,

Thomas E. Sokoloski
New Hampshire Certified Soil Scientist No. 63

STATE OF NEW HAMPSHIRE
THOMAS
E.
SOKOLOSKI
No. 063
5/4/19
CERTIFIED SOIL SCIENTIST

SITE SPECIFIC SOIL MAP UNIT KEY

Symbol*	Map Unit	Slope Class	Drainage Class	HISS Symbol	Hydrologic Soil Group
400B/abaaa	Udorthents, sandy	0-8%	Excessively	161BH	A
400B/hbhaa	Udorthents, sandy	0-8%	Undeterminable	761BH**	A**

* Refer to accompanying report for 5-unit supplemental symbol explanation.

** Assumed based upon adjacent soils without impervious surfaces.

This map product is within the technical standards of the National Cooperative Soil Survey. It is a special purpose product, produced by a certified soil scientist, and is not a product of the USDA Natural Resources Conservation Service. There is a narrative report that accompanies this map and map key. Thomas E. Sokoloski, Certified Soil Scientist #063, of TES Environmental Consultants, L.L.C. in Bow, New Hampshire, performed the site-specific soil mapping on 4/24/2019. This mapping was performed according to the standards of the "Site-Specific Soil Mapping Standards for New Hampshire and Vermont, Version 4.0, January 2011. The Society of Soil Scientists of Northern New England, Special Publication No. 3, publishes these standards.

Supplemental Symbols

The five components of the Disturbed Soil Mapping Unit Supplement are as follows:

Symbol 1: Drainage Class
a-Excessively Well Drained
b-Somewhat Excessively Drained
c-Well Drained
d-Moderately Well Drained
e-Somewhat Poorly Drained
f-Poorly Drained
g-Very Poorly Drained
h-Not Determined

Symbol 2 -: Parent Material (of naturally formed soil only, if present)
a-No natural soil within 60"
b-Glaciofluvial Deposits (outwash/terraces of sand or sand and gravel)
c-Glacial Till Material (active ice)
d-Glaciolacustrine very fine sand and silt deposits (glacial lakes)
e-Loamy/sandy over silt/clay deposits
f-Marine Silt and clay deposits (ocean waters)
g-Alluvial Deposits (floodplains)
h-Organic Materials-Fresh water Bogs, etc
i- Organic Materials-Tidal Marsh

Symbol 3: Restrictive/Impervious Layers
a-None
b-Bouldery surface with more than 15% of the surface covered with boulders
c-Mineral restrictive layer(s) are present in the soil profile less than 40 inches below the soil surface such as hardpan, platy structure or clayey texture with consistence of at least firm, i.e. more than 20 newtons. For other examples of soil characteristics that qualify for restrictive layer, see "Soil Manual for Site evaluations in NH" 2nd Ed., page 3-17, figure 2-14
d-Bedrock in the soil profile 0-20 inches
e-Bedrock in the soil profile 20-60 inches
f-Areas where depth to bedrock is so variable that a single soil type cannot be applied, will be mapped as a complex of soil types
g-Subject to Flooding
h –man-made impervious surface including pavement, concrete, or built-up surfaces (i.e. buildings) with no morphological restrictive layer within control section

Symbol 4 Estimated Ksat* (most restrictive layer excluding symbol 3h above).
a- High
b-Moderate
c-Low
d-Not determined
*See "Guidelines for Ksat Class Placement" in Chapter 3 of the Soil Survey Manual, USDA

Symbol 5: Hydrologic Soil Group*
a-Group A
b-Group B
c-Group C
d-Group D
e-Not determined

*excluding man-made impervious/restrictive layers

SITE SPECIFIC SOIL MAP UNIT DESCRIPTIONS

Map Unit Symbol:	400B/abaaa
Map Unit Name:	Udorthents, sandy
Landscape Settings:	Regraded or filled land surfaces
Surface Features:	Fill material
Drainage Class:	Excessively
Parent Material:	Filled or regraded glacial outwash material with no mineral restrictive features
Complex:	Yes ( ) No (**X**)

Nature of Dissimilar Inclusions, Locations and Estimated Percent:

Additional Notes:

SITE SPECIFIC SOIL MAP UNIT DESCRIPTIONS

Map Unit Symbol:	400B/hbhaa
Map Unit Name:	Udorthents, sandy
Landscape Settings:	Developed, impervious land surfaces (buildings, pavement)
Surface Features:	Buildings and pavement
Drainage Class:	Undeterminable
Parent Material:	Filled or regraded glacial outwash material with no mineral restrictive features
Complex:	Yes ( ) No (**X**)

Nature of Dissimilar Inclusions, Locations and Estimated Percent:

Additional Notes:

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 Hillsborough County, New Hampshire, Eastern Part

May 13, 2019

Preface

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

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

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

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

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

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

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Contents

How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

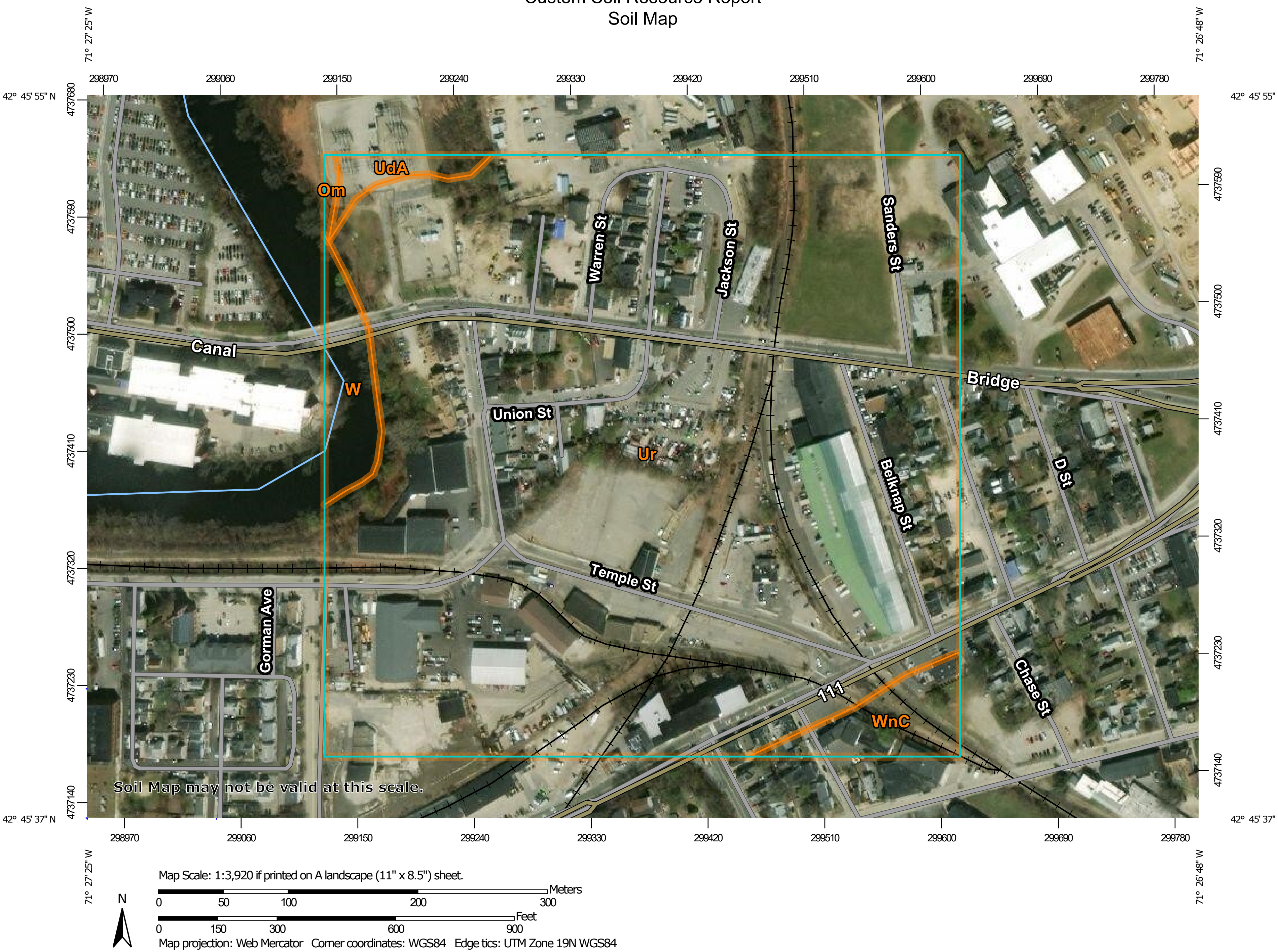
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree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

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

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

Soil Map



71° 27' 25" W
71° 26' 48" W
42° 45' 55" N
42° 45' 37" N
298970
299060
299150
299240
299330
299420
299510
299600
299690
299780
4737680
4737590
4737500
4737410
4737320
4737230
4737140
UdA
Om
W
Ur
WnC
Canal
Bridge
Union St
Warren St
Jackson St
Sanders St
Belknap St
D St
Temple St
Gorman Ave
Chase St
111
Soil Map may not be valid at this scale.
Map Scale: 1:3,920 if printed on A landscape (11" x 8.5") sheet.
Meters
0 50 100 200 300
Feet
0 150 300 600 900
N
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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: Hillsborough County, New Hampshire, Eastern Part
Survey Area Data: Version 20, Sep 7, 2018

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

Date(s) aerial images were photographed: May 22, 2015—Jun 14, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND	MAP INFORMATION
	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
Om	Occum fine sandy loam, high bottom	0.1	0.2%
UdA	Udipsamments, nearly level	0.6	1.1%
Ur	Urban land	52.3	93.0%
W	Water (less than 40 acres)	1.5	2.7%
WnC	Windsor-Urban land complex, 3 to 15 percent slopes	1.6	2.9%
Totals for Area of Interest		**56.2**	**100.0%**

Map Unit Descriptions

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

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

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

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

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

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

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

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

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

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

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

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

Hillsborough County, New Hampshire, Eastern Part

Om—Occum fine sandy loam, high bottom

Map Unit Composition

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

Description of Occum

Setting

Parent material: Sandy and/or coarse-loamy alluvium derived from granite, gneiss or schist

Typical profile

H1 - 0 to 9 inches: fine sandy loam
H2 - 9 to 25 inches: fine sandy loam
H3 - 25 to 60 inches: loamy fine sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Pootatuck

Percent of map unit: 15 percent
Hydric soil rating: No

UdA—Udipsamments, nearly level

Map Unit Setting

National map unit symbol: 9ff9
Elevation: 0 to 1,000 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 45 to 55 degrees F
Frost-free period: 140 to 200 days

Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Udipsamments

Setting

Parent material: Outwash

Typical profile

H - 0 to 60 inches: sand

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.2 inches)

Minor Components

Not soil

Percent of map unit: 10 percent
Hydric soil rating: No

Windsor

Percent of map unit: 5 percent
Hydric soil rating: No

Hinckley

Percent of map unit: 5 percent
Hydric soil rating: No

Ur—Urban land

Map Unit Setting

National map unit symbol: 9ffb
Elevation: 0 to 1,000 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 45 to 55 degrees F
Frost-free period: 140 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 90 percent

Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Windsor

Percent of map unit: 4 percent
Hydric soil rating: No

Hinckley

Percent of map unit: 4 percent
Hydric soil rating: No

Not named

Percent of map unit: 2 percent
Hydric soil rating: No

W—Water (less than 40 acres)

Map Unit Composition

Water < 40: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

WnC—Windsor-Urban land complex, 3 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2svmx
Elevation: 100 to 960 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

Windsor and similar soils: 50 percent
Urban land: 35 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Windsor

Setting

Landform: Outwash plains, outwash terraces, deltas, 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

A - 0 to 3 inches: loamy sand
Bw - 3 to 25 inches: loamy sand
C - 25 to 65 inches: sand

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural 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
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 4.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Hydric soil rating: No

Description of Urban Land

Typical profile

M - 0 to 10 inches: cemented material

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: 0 inches to manufactured layer
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Available water storage in profile: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: Unranked

Minor Components

Hinckley

Percent of map unit: 5 percent
Landform: Deltas, outwash plains, eskers, kames
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Udorthents

Percent of map unit: 5 percent

Landform: Deltas, dunes, outwash plains, outwash terraces
Landform position (three-dimensional): Riser, tread
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Deerfield

Percent of map unit: 5 percent
Landform: Terraces, deltas, outwash plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Physical Properties

Soil Physical Properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

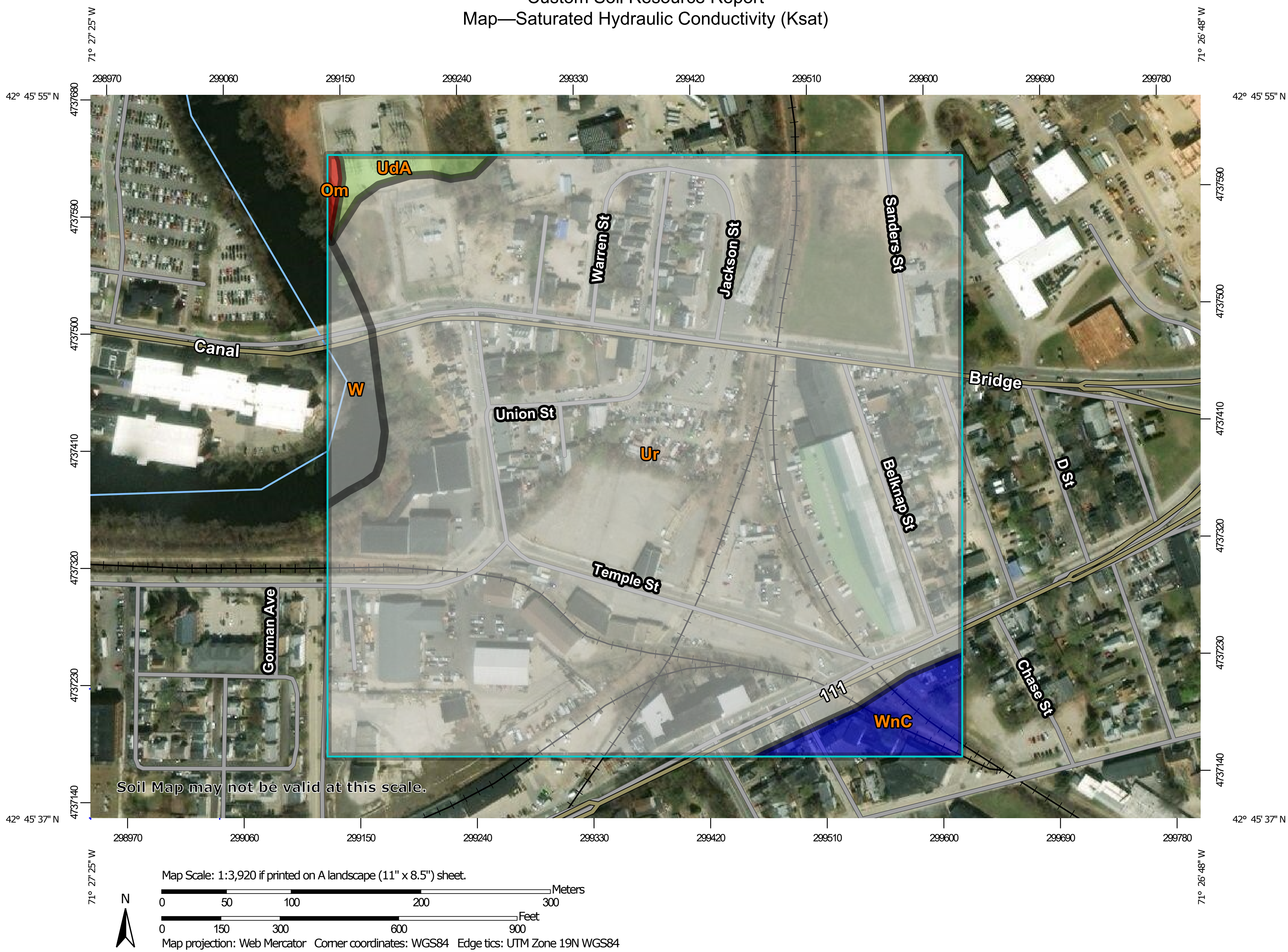
Saturated Hydraulic Conductivity (Ksat)

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity is considered in the design of soil drainage systems and septic tank absorption fields.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

The numeric Ksat values have been grouped according to standard Ksat class limits.

Map—Saturated Hydraulic Conductivity (Ksat)



MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

<= 68.7165

> 68.7165 and <= 91.7222

> 91.7222 and <= 100.0000

Not rated or not available

Soil Rating Lines

<= 68.7165

> 68.7165 and <= 91.7222

> 91.7222 and <= 100.0000

Not rated or not available

Soil Rating Points

<= 68.7165

> 68.7165 and <= 91.7222

> 91.7222 and <= 100.0000

Not rated or not available

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 1:20,000.

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

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

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Soil Survey Area: Hillsborough County, New Hampshire, Eastern Part
Survey Area Data: Version 20, Sep 7, 2018

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

Date(s) aerial images were photographed: May 22, 2015—Jun 14, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND	MAP INFORMATION
	imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Saturated Hydraulic Conductivity (Ksat)

Map unit symbol	Map unit name	Rating (micrometers per second)	Acres in AOI	Percent of AOI
Om	Occum fine sandy loam, high bottom	68.7165	0.1	0.2%
UdA	Udipsamments, nearly level	91.7222	0.6	1.1%
Ur	Urban land		52.3	93.0%
W	Water (less than 40 acres)		1.5	2.7%
WnC	Windsor-Urban land complex, 3 to 15 percent slopes	100.0000	1.6	2.9%
Totals for Area of Interest			**56.2**	**100.0%**

Rating Options—Saturated Hydraulic Conductivity (Ksat)

Units of Measure: micrometers per second

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Fastest

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): Depth Range (Weighted Average)

Top Depth: 12

Bottom Depth: 96

Units of Measure: Inches

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

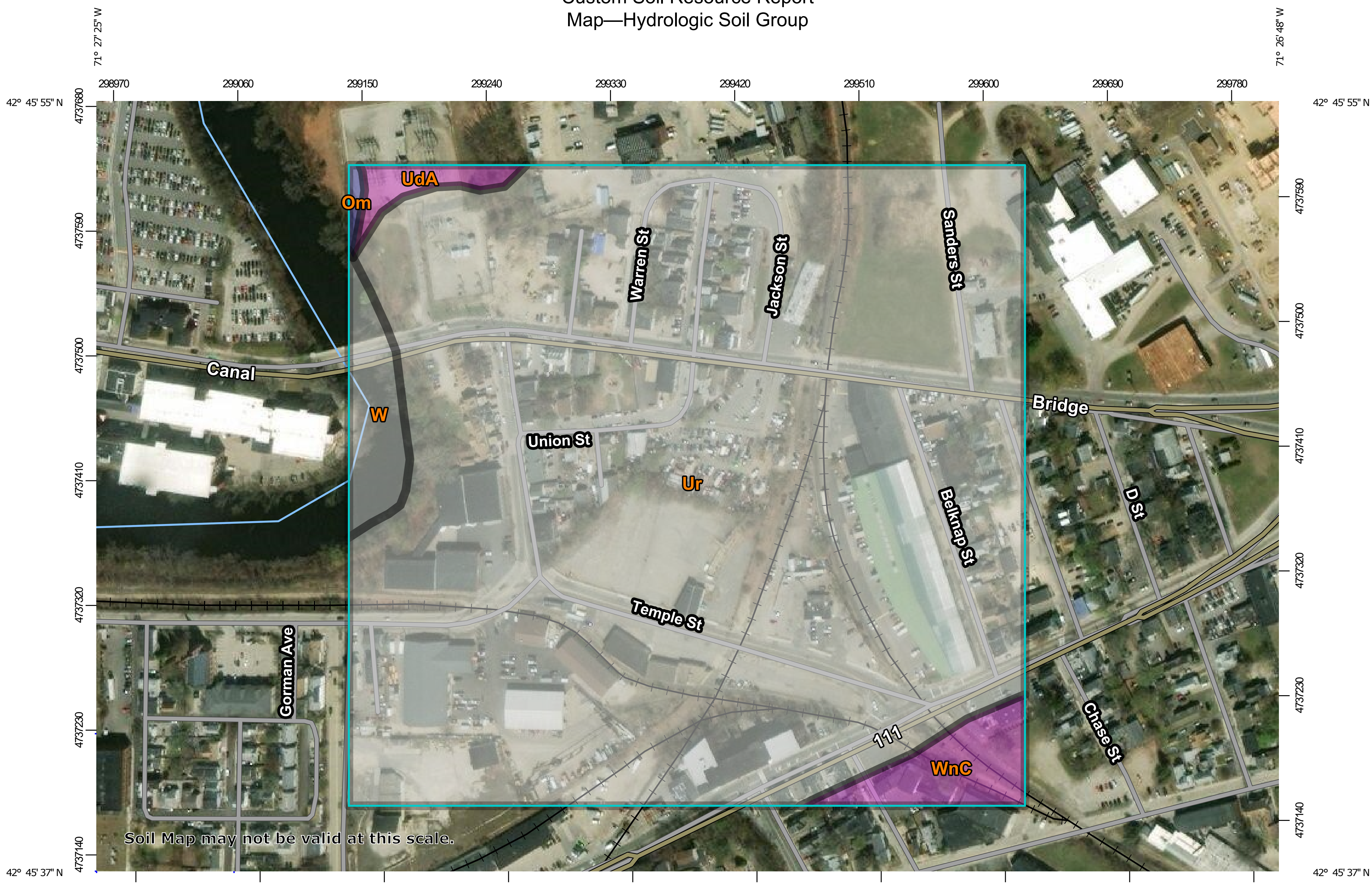
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Custom Soil Resource Report
Map—Hydrologic Soil Group



Map Scale: 1:3,920 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 50, 100, 200, 300

Feet: 0, 150, 300, 600, 900

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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 1:20,000.

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: Hillsborough County, New Hampshire, Eastern Part
Survey Area Data: Version 20, Sep 7, 2018

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

Date(s) aerial images were photographed: May 22, 2015—Jun 14, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND	MAP INFORMATION
	imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Om	Occum fine sandy loam, high bottom	B	0.1	0.2%
UdA	Udipsamments, nearly level	A	0.6	1.1%
Ur	Urban land		52.3	93.0%
W	Water (less than 40 acres)		1.5	2.7%
WnC	Windsor-Urban land complex, 3 to 15 percent slopes	A	1.6	2.9%
Totals for Area of Interest			**56.2**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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APPENDIX 6.8

NATURAL HERITAGE RESPONSE LETTER

Request for NHB Review of "Potential Impacts" from the NHB DataCheck Tool

NHB File Number: NHB19-0941
Data Requested: 3/25/2019

Requested By:

Name: Michael Malynowski
250 Commercial Street,
Manchester, NH 03101
E-mail: mmalynowski@allenmajor.com
Phone: 603-627-5500

Project Location:

Town: Nashua
Tax Map(s)/Lot(s): 39-31, 39-38, 38-47, 39-35

Payment Information. These fields MUST be filled out.

Check Number: ____________________

Name of Account: ____________________

(as printed on the check)

Enclose this completed form with a check in the amount of $25, made out to "Treasurer, State of NH".

Send the check and the completed form to the following address:

DRED - NHB
NHB Reviews
172 Pembroke Road
Concord, NH 03301

New Hampshire Natural Heritage Bureau
NHB DataCheck Results Letter

To: Michael Malynowski, Allen Major Associates
250 Commercial Street
Manchester, NH 03101

From: NH Natural Heritage Bureau

Date: 5/29/2019 (valid for one year from this date)

Re: Review by NH Natural Heritage Bureau of request submitted 3/25/2019

NHB File ID: NHB19-0941 **Applicant:** Michael Malynowski

Location: Nashua
Tax Maps: 39-31, 39-38, 38-47, 39-35

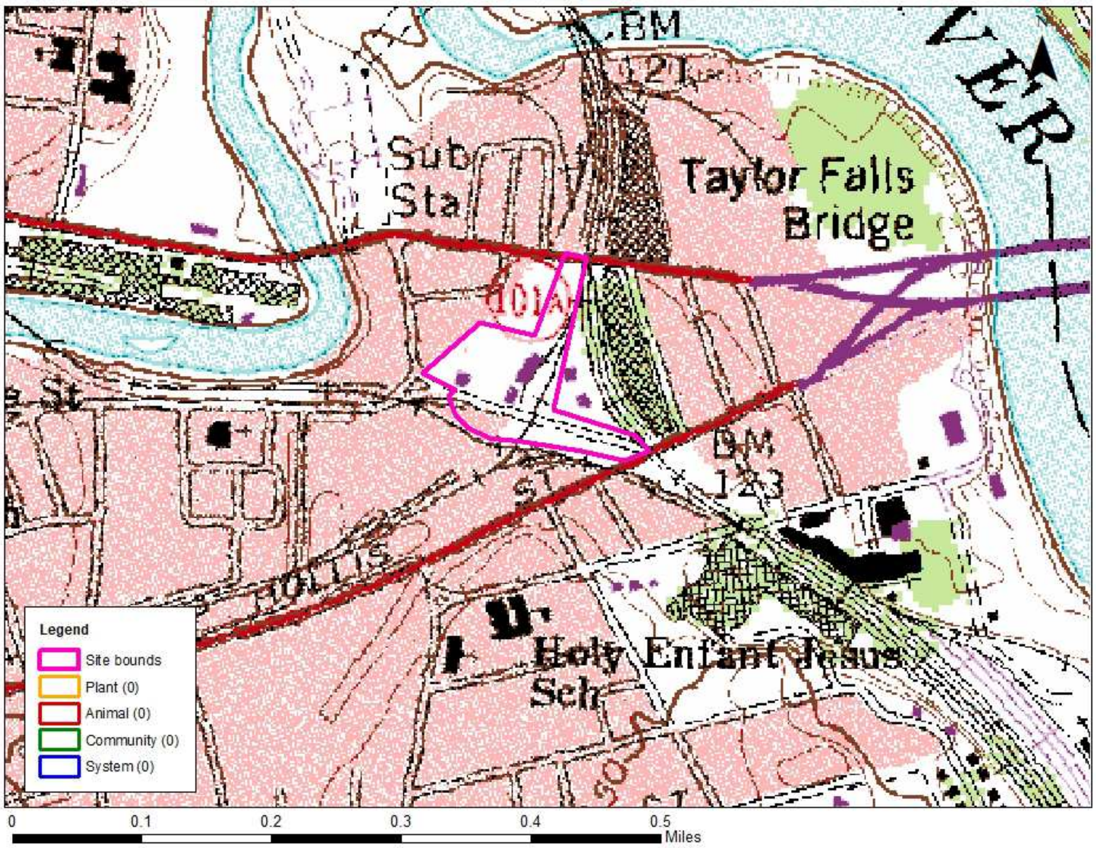
Project Description: Re-develop of parcels 39-31, 39-38, & 38-47 into a residential project consisting of 2 buildings and approximately 170 units with associated parking, utilities and amenities. Parcel 39-35 will be re-purposed to commercial use with existing building and pavement to remain.

The NH Natural Heritage database has been checked by staff of the NH Natural Heritage Bureau and/or the NH Nongame and Endangered Species Program for records of rare species and exemplary natural communities near the area mapped below. The species considered include those listed as Threatened or Endangered by either the state of New Hampshire or the federal government.

It was determined that, although there was a NHB record (e.g., rare wildlife, plant, and/or natural community) present in the vicinity, we do not expect that it will be impacted by the proposed project. This determination was made based on the project information submitted via the NHB Datacheck Tool on 3/25/2019, and cannot be used for any other project.

MAP OF PROJECT BOUNDARIES FOR: **NHB19-0941**

NHB19-0941



APPENDIX 6.9

SURFACE WATER IMPAIRMENT MAPS

AOT Screening Layers

Legend

- Coastal and Great Bay Regi Communities
- Designated Rivers Quarterm Buffer
- Public Water Supply Wells
- Groundwater Classification / GA1
- Groundwater Classification / GA2
- Water Supply Intake Protect Areas
- Wellhead Protection Areas
- Lakes with a Quarter Mile Bu
- All Features
- All Lakes, with a Quarter Mil Buffer
- Outstanding Resource Wate Watersheds
- Surface Waters with Impairn 2016 with Quarter Mile Buffe
- Watersheds with Chloride Impairments 2016

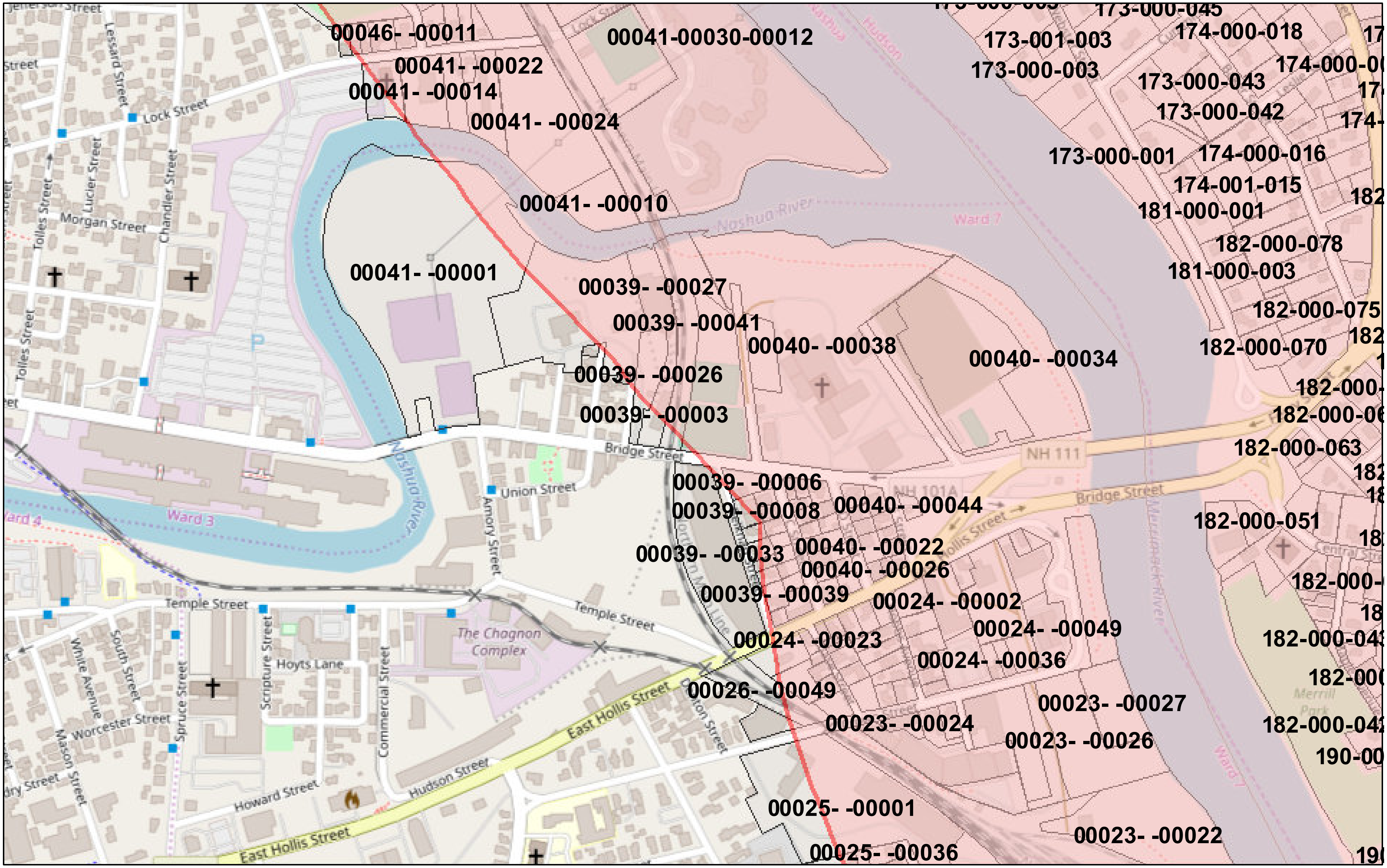
Map Scale

1: 5,000

Map Generated: 5/23/2019

Notes

ArcGIS Web Map



5/23/2019 11:37:10 AM

1:9,028

0 0.075 0.15 0.3 mi

0 0.1 0.2 0.4 km

Designated_Rivers_Web - Designated_Rivers_24k_Buffer_Quartermile

Subject to SWQPA

Designated_Rivers_Web - Parcels_Along_Corridors

Municipalities (borders)

Description

Assessment Unit ID (AUID): NHRIV700040402-09
Assessment Unit Name: NASHUA RIVER
Beach (Y/N?): N
Impairments related to stormwater: Escherichia coli
Metadata

Charts

Select ChartsNo charts to display

- No chart

No chart

Details

- AUID

NHRIV700040402-09 NHRIV700040402-09 N/A

- Shape

N/A

- FID

471 471 N/A

- Waterbodyi

NHRIV700040402-09 NHRIV700040402-09 N/A

- Beach

N N N/A

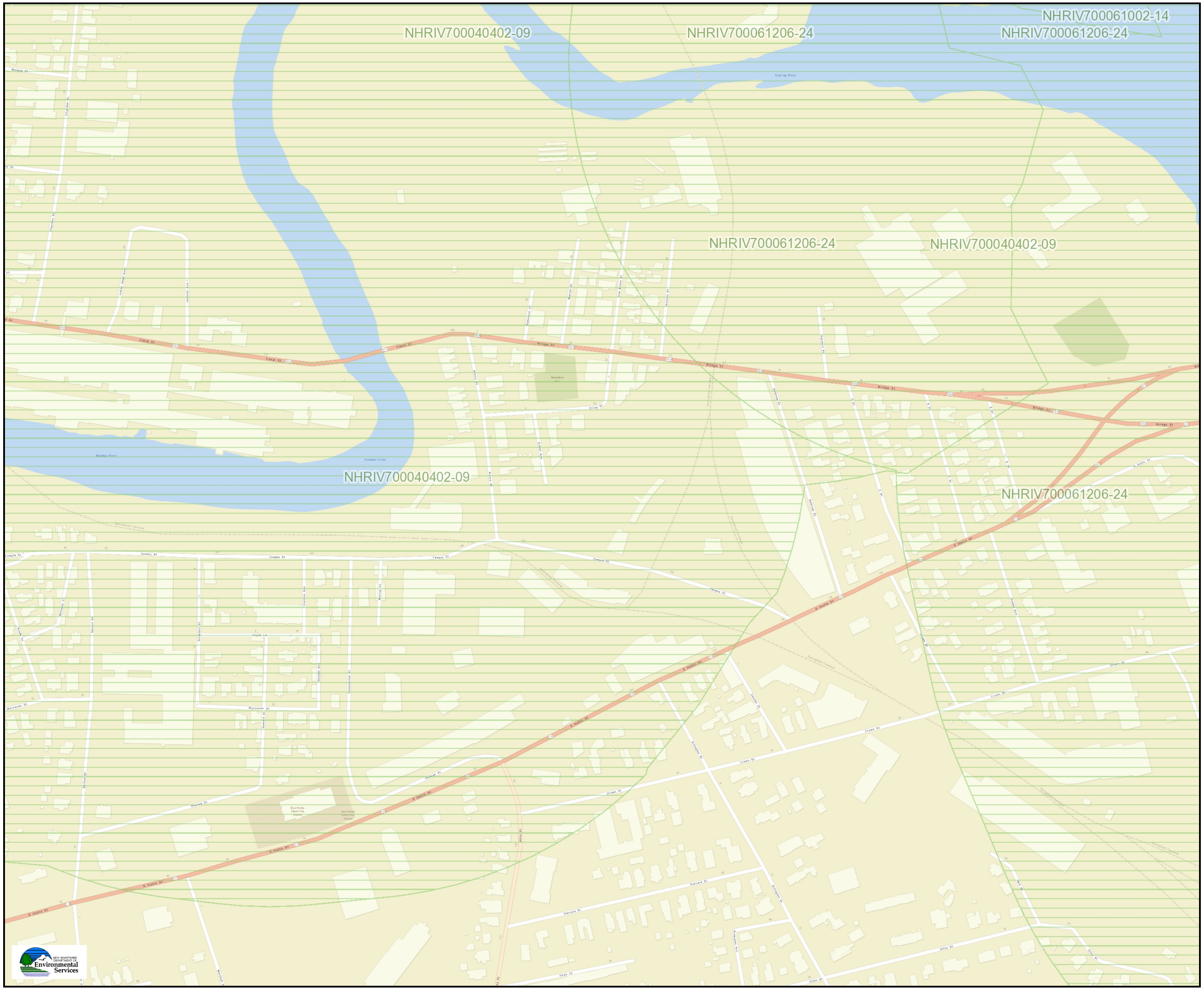
- Waterbodyn

NASHUA RIVER NASHUA RIVER N/A

- Impairment

Escherichia coli

AOT Surface Water Impairments



Legend

Surface Waters with Impairn
2016 with Quarter Mile Buffe

Map Scale

1: 5,000

Map Generated: 5/23/2019

Notes

APPENDIX 6.10

ILLICIT DISCHARGE COMPLIANCE STATEMENT

Illicit Discharge Compliance Statement

Responsibility:

The Owner is responsible for ultimate compliance with all provisions of the New Hampshire Stormwater Management Manual, the USEPA NPDES Construction General Permit and responsible for identifying and eliminating illicit discharges (as defined by the USEPA).

OWNER NAME: ZJBV Properties, LLC c/o Joseph's Equipment ________________________

ADDRESS: 300 Gay Street

Manchester, NH 03103

Tel. Number: ________________________

____

Engineer's Compliance Statement:

To the best of my knowledge, the attached plans, computations and specifications meet the requirements of the New Hampshire Stormwater Management Manual regarding illicit discharges to the stormwater management system and that no detectable illicit discharges exist on the site. All documents and attachments were prepared under my direction and qualified personnel properly gathered and evaluated the information submitted, to the best of my knowledge.

Included with this statement are site plans, drawn to scale, that identify the location of systems for conveying stormwater on the site and show that these systems do not allow the entry of any illicit discharges into the stormwater management system. The plans also show any systems for conveying wastewater and/or groundwater on the site and show that there are no connections between the stormwater and wastewater systems.

For a redevelopment project (if applicable), all actions taken to identify and remove illicit discharges, including without limitation, visual screening, dye or smoke testing, and the removal of any sources of illicit discharges to the stormwater management system are documented and included with this statement.

APPENDIX 6.11

PIPE SIZING CALCULATIONS

ALLEN & MAJOR ASSOCIATES, INC.

DRAINAGE PIPE DESIGN ANALYSIS

A&M Job No.	2596-01
Date:	10/18/2019

Project Location:
159 Temple Street
Nashua NH

Prepared For:
ZJBV Properties

Manning's Formula

$V=1.486/n*R^{\wedge 2/3}*S^{\wedge 1/2}$
Q = V*A
(25-Year storm)

Where: V is the veloctiy in Ft/sec.
n is Mannings coefficient of friction
R is the Hydraulic Radius
S is the slope of the pipe

R=Area/Wetted Perimeter

Where: Area=Pi*(R/12)2
Wetted Perimeter=2*Pi*R/12

PIPE	Q_{design} (cfs)	n	Diameter (inches)	A (ft^2)	Wp (ft)	R (ft)	S (feet/foot)	Q_{full} (cfs)	Q_{full} ³ Q_{design}	V_{full} (ft/s)	Q_d/Q_f	Results Fig. 4-4A	V_{design} (ft/s)	V_{design} ≤ 12 ft/s
CB1	0.97	0.013	12	0.79	3.14	0.25	0.0080	3.19	OK	4.06	0.30	0.85	3.45	OK
CB2	1.86	0.013	12	0.79	3.14	0.25	0.0100	3.56	OK	4.54	0.52	1.00	4.54	OK
CB3	0.96	0.013	12	0.79	3.14	0.25	0.0100	3.56	OK	4.54	0.27	0.83	3.77	OK
CB4	1.39	0.013	12	0.79	3.14	0.25	0.0100	3.56	OK	4.54	0.39	0.91	4.13	OK
CB5	1.08	0.013	12	0.79	3.14	0.25	0.0080	3.19	OK	4.06	0.34	0.88	3.57	OK
CB6	1.82	0.013	12	0.79	3.14	0.25	0.0080	3.19	OK	4.06	0.57	1.03	4.18	OK
DMH1	4.65	0.013	15	1.23	3.93	0.31	0.0080	5.78	OK	4.71	0.80	1.12	5.27	OK
DMH2	1.08	0.013	12	0.79	3.14	0.25	0.0080	3.19	OK	4.06	0.34	0.88	3.57	OK
DMH3	3.42	0.013	15	1.23	3.93	0.31	0.0080	5.78	OK	4.71	0.59	1.04	4.90	OK
DMH4	1.88	0.013	12	0.79	3.14	0.25	0.0100	3.56	OK	4.54	0.53	1.01	4.58	OK
CDS1	2.83	0.013	24	3.14	6.28	0.50	0.0050	16.00	OK	5.09	0.18	0.73	3.72	OK
CDS2	3.42	0.013	15	1.23	3.93	0.31	0.0080	5.78	OK	4.71	0.59	1.04	4.90	OK
CDS3	1.83	0.013	12	0.79	3.14	0.25	0.0080	3.19	OK	4.06	0.57	1.03	4.18	OK
WQ1	4.65	0.013	24	3.14	6.28	0.50	0.0100	22.62	OK	7.20	0.21	0.77	5.54	OK
WQ2	3.42	0.013	15	1.23	3.93	0.31	0.0080	5.78	OK	4.71	0.59	1.04	4.90	OK

APPENDIX 6.12

EXTREME PRECIPITATION TABLES

Extreme Precipitation Tables

Northeast Regional Climate Center

Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Smoothing	Yes
State	New Hampshire
Location	
Longitude	71.452 degrees West
Latitude	42.762 degrees North
Elevation	0 feet
Date/Time	Mon, 22 Apr 2019 11:44:18 -0400

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.27	0.42	0.52	0.68	0.85	1.07	**1yr**	0.74	1.01	1.24	1.56	1.96	2.48	2.72	**1yr**	2.19	2.62	3.04	3.73	4.35	**1yr**
2yr	0.33	0.51	0.64	0.84	1.05	1.32	**2yr**	0.91	1.21	1.53	1.90	2.37	2.95	3.28	**2yr**	2.61	3.15	3.66	4.38	4.98	**2yr**
5yr	0.39	0.61	0.77	1.03	1.32	1.67	**5yr**	1.14	1.52	1.93	2.41	3.00	3.72	4.17	**5yr**	3.29	4.01	4.64	5.50	6.22	**5yr**
10yr	0.44	0.70	0.88	1.20	1.56	1.99	**10yr**	1.34	1.80	2.31	2.90	3.59	4.44	5.00	**10yr**	3.93	4.81	5.55	6.54	7.35	**10yr**
25yr	0.53	0.84	1.06	1.47	1.94	2.51	**25yr**	1.68	2.25	2.92	3.67	4.55	5.60	6.36	**25yr**	4.96	6.12	7.05	8.22	9.19	**25yr**
50yr	0.59	0.95	1.21	1.70	2.30	3.00	**50yr**	1.99	2.66	3.51	4.41	5.46	6.69	7.64	**50yr**	5.92	7.35	8.44	9.77	10.89	**50yr**
100yr	0.68	1.10	1.42	2.01	2.73	3.58	**100yr**	2.36	3.16	4.20	5.27	6.52	7.99	9.18	**100yr**	7.07	8.83	10.12	11.62	12.90	**100yr**
200yr	0.77	1.26	1.63	2.35	3.24	4.28	**200yr**	2.80	3.75	5.03	6.32	7.82	9.54	11.04	**200yr**	8.44	10.61	12.14	13.83	15.28	**200yr**
500yr	0.93	1.53	2.00	2.90	4.07	5.41	**500yr**	3.51	4.70	6.37	8.03	9.92	12.08	14.09	**500yr**	10.69	13.54	15.44	17.42	19.14	**500yr**

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.22	0.34	0.42	0.57	0.70	0.80	**1yr**	0.60	0.78	1.06	1.32	1.67	2.28	2.56	**1yr**	2.02	2.46	2.71	3.02	3.67	**1yr**
2yr	0.32	0.49	0.60	0.81	1.00	1.20	**2yr**	0.86	1.17	1.37	1.79	2.29	2.89	3.20	**2yr**	2.56	3.08	3.57	4.28	4.88	**2yr**
5yr	0.36	0.55	0.69	0.94	1.20	1.42	**5yr**	1.04	1.39	1.63	2.11	2.69	3.49	3.89	**5yr**	3.09	3.74	4.27	5.13	5.81	**5yr**
10yr	0.39	0.61	0.75	1.05	1.36	1.60	**10yr**	1.17	1.57	1.82	2.39	3.04	4.02	4.51	**10yr**	3.56	4.33	4.91	5.87	6.64	**10yr**
25yr	0.45	0.68	0.85	1.21	1.59	1.87	**25yr**	1.38	1.83	2.13	2.81	3.54	4.85	5.51	**25yr**	4.29	5.30	5.89	7.02	7.89	**25yr**
50yr	0.49	0.74	0.92	1.33	1.79	2.12	**50yr**	1.54	2.08	2.40	3.20	3.99	5.62	6.42	**50yr**	4.97	6.17	6.78	8.05	9.01	**50yr**
100yr	0.53	0.80	1.01	1.45	1.99	2.40	**100yr**	1.72	2.34	2.72	3.47	4.50	6.52	7.52	**100yr**	5.77	7.23	7.81	9.23	10.24	**100yr**
200yr	0.58	0.88	1.11	1.61	2.25	2.71	**200yr**	1.94	2.65	3.05	3.92	5.10	7.56	8.83	**200yr**	6.69	8.49	9.00	10.58	11.68	**200yr**
500yr	0.66	0.98	1.27	1.84	2.61	3.21	**500yr**	2.26	3.14	3.59	4.61	6.03	9.22	10.96	**500yr**	8.16	10.54	10.85	12.69	13.89	**500yr**

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.31	0.48	0.58	0.78	0.96	1.13	**1yr**	0.83	1.10	1.28	1.66	2.10	2.62	2.88	**1yr**	2.32	2.77	3.46	4.25	4.77	**1yr**
2yr	0.35	0.55	0.67	0.91	1.12	1.31	**2yr**	0.97	1.28	1.49	1.93	2.47	3.04	3.39	**2yr**	2.69	3.26	3.77	4.49	5.13	**2yr**
5yr	0.44	0.67	0.83	1.14	1.45	1.67	**5yr**	1.26	1.64	1.89	2.43	3.04	4.02	4.52	**5yr**	3.56	4.35	5.00	5.91	6.63	**5yr**
10yr	0.52	0.81	1.00	1.39	1.80	2.04	**10yr**	1.56	2.00	2.31	2.90	3.61	4.98	5.63	**10yr**	4.40	5.41	6.21	7.26	8.09	**10yr**
25yr	0.68	1.03	1.28	1.82	2.40	2.65	**25yr**	2.07	2.59	2.99	3.67	4.50	6.60	7.52	**25yr**	5.84	7.23	8.27	9.54	10.54	**25yr**
50yr	0.82	1.24	1.55	2.22	2.99	3.24	**50yr**	2.58	3.16	3.64	4.40	5.33	8.18	9.35	**50yr**	7.24	8.99	10.27	11.75	12.88	**50yr**
100yr	0.99	1.50	1.88	2.72	3.73	3.95	**100yr**	3.22	3.86	4.43	5.47	6.31	10.13	11.60	**100yr**	8.96	11.16	12.77	14.48	15.76	**100yr**
200yr	1.21	1.82	2.30	3.33	4.65	4.82	**200yr**	4.01	4.71	5.38	6.58	7.47	12.54	14.41	**200yr**	11.10	13.85	15.86	17.85	19.29	**200yr**
500yr	1.57	2.34	3.02	4.38	6.23	6.26	**500yr**	5.38	6.12	6.98	8.42	9.34	16.63	19.13	**500yr**	14.72	18.39	21.15	23.53	25.23	**500yr**

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APPENDIX 6.13

AOT APPLICATION & AOT PERMIT

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

ALTERATION OF TERRAIN PERMIT APPLICATION

Water Division/ Alteration of Terrain Bureau/ Land Resources Management
Check the Status of your Application: www.des.nh.gov/onestop

RSA/ Rule: RSA 485-A:17, Env-Wq 1500

Administrative Use Only	Administrative Use Only	Administrative Use Only	File Number: Check No. Amount: Initials:

1. PROJECT LOCATION			
PROJECT NAME: RESIDENTIAL DEVELOPMENT			
ADDRESS: 159 TEMPLE STREET			
TOWN/CITY: NASHUA	COUNTY: HILLSBOROUGH	STATE: NH	ZIP CODE:03060
TAX MAP: 39	BLOCK:	LOT NUMBER: 31 & 38	UNIT:
LOCATION COORDINATES: 42.45'44.30",-71.27'07.72"	☒ LATITUDE/LONGITUDE ☐ UTM ☐ STATE PLANE		

2. APPLICANT INFORMATION (DESIRED PERMIT HOLDER)		
APPLICANT NAME: ZJBV PROPERTIES, LLC	CONTACT NAME: BRIAN THIBEAULT	
EMAIL: josephequipment@aol.com	FAX:--	PHONE: 603-641-8608
ADDRESS: 300 GAY STREET		
TOWN/CITY: MANCHESTER, NH 03103	STATE: NH	ZIP CODE: 03103

3. PROPERTY OWNER INFORMATION (IF DIFFERENT FROM APPLICANT)		
PROPERTY OWNER:	CONTACT NAME:	
EMAIL:	FAX:	PHONE:
ADDRESS:		
TOWN/CITY:	STATE:	ZIP CODE:

4. AGENT INFORMATION		
ENGINEERING FIRM: ALLEN & MAJOR ASSOCIATES, INC.	CONTACT NAME: MICHAEL MALYNOWSKI, P.E.	
EMAIL: MMALYNOWSKI@ALLENMAJOR.COM	FAX: (603) 627-5501	PHONE: (603) 627-5500
ADDRESS: 400 HARVEY ROAD		
TOWN/CITY: MANCHESTER	STATE: NH	ZIP CODE: 03103

5. PROJECT TYPE				
☐ EXCAVATION	☐ COMMERCIAL	☐ SCHOOL	☐ AGRICULTURAL	☐ LANDFILL
☒ RESIDENTIAL	☐ GOLF COURSE	☐ MUNICIPAL	☐ LAND CONVERSION	☐ OTHER

6. BRIEF PROJECT DESCRIPTION (PLEASE DO NOT REPLY "SEE ATTACHED")

THE PROPOSED PROJECT CONSISTS OF THE DEVELOPMENT OF TWO CONNECTED MULTI-FAMILY RESIDENTAIL BUILDINGS AND ASSOCIATED PARKING.

7. IF APPLICABLE, DESCRIBE ANY WORK STARTED PRIOR TO RECEIVING PERMIT

N/A

8. REQUIRED QUESTIONS (PLEASE DO NOT LEAVE FIELDS BLANK. IF NOT APPLICABLE, STATE "N/A")

A. Date a copy of the *complete* application was sent to the municipality[1]:08/20/2018. **(Attach proof of delivery)**

B. Total area of disturbance: 165,318 square feet

C. Additional impervious cover as a result of the project: - square feet (use the "-" symbol to indicate a net reduction in impervious coverage). Total impervious cover: 127,741 square feet.

D. Total undisturbed cover: 0 square feet

E. Number of lots proposed: 1

F. Total length of roadway: N/A linear feet

G. Select plan type submitted: ☐ Land Conversion ☒ Detailed Development ☐ Excavation, Grading & Reclamation ☐ Steep Slope

H. Name of receiving waters: MUNICIPAL SYSTEM

Using NHDES's Web GIS OneStop program (www2.des.state.nh.us/gis/onestop/), with the Surface Water Impairment layer turned on, list the impairments identified: Escherichia coli (enter "NA" if no pollutants are listed).
For more guidance see: http://des.nh.gov/organization/divisions/water/wmb/tmdl/documents/onestop_gis_wqc_ref_guide.pdf

I. ☐ This project is within ¼ mi of a designated river (**River name:** ___N/A_________________) AND
I have notified the Local River Management Advisory Committee by providing them with a copy of the complete application[1], including all supporting materials, on **Month:** __ **Day:** __ **Year:** ____ **(Attach proof of delivery)**

☒ This project is **not** within ¼ mi of a designated river.

J. Name of species identified by the Natural Heritage Bureau as threatened or endangered or of concern: ______TBD_________________

K. Cut volume N/A____________________________ cubic feet and fill volume N/A____________________ cubic feet within the 100-year floodplain (enter "NA" if not within the floodplain)

L. Is the project within a Water Supply Intake Protection Area (WSIPA)? YES☐ NO☒
Is the project within a Groundwater Protection Area (GPA)? YES☐ NO☒
Are the well setbacks outlined in Env-Wq 1508.02 being met? YES☒ NO☐
Note: Guidance document titled "*Using NHDES's OneStop WebGIS to Locate Protection Areas*" is available online. For more details on the restrictions in these areas, read Chapter 3.1 in Volume 2 of the NH Stormwater Manual.

[1] In accordance with Env-Wq 1503.05 (c)(4), *provide proof* that a completed application form, checklist, plans and all other supporting materials have been sent or delivered to the governing body of each municipality in which the project is proposed. Env-Wq 1503.05 (c)(4) also requires the applicant to provide proof that a completed application form, checklist, plans and all other supporting materials have been sent or delivered to the Local River Advisory Committee, if the project is within 1/4 mile of a designated river.

8. REQUIRED QUESTIONS CONTINUED

M. Is the project a High Load area in accordance with Env-Wq 1502.26? YES☐ NO☒
If yes, specify type of high load land use or activity? _____

N. For each type of approval or permit, check "Yes" if the permit or approval type is required for your project and indicate the permit number / approval date. Indicate "Pending" if the application has been filed, but the permit has not yet been issued. Check "No" to indicate that the permit type is required, but has not yet been filed with the Department. Check "N/A" if the permit or approval type is not required for your project. To determine if other Land Resources Management Permits are required, refer to the Land Resources Management Web Page.

1. Water Supply Approval	☐ Y	☐N	☒N/A	Permit number:	Pending ☐
2. Wetlands Permit	☐ Y	☐N	☒N/A	Permit number:	Pending ☐
3. Shoreland Permit	☐ Y	☐N	☒N/A	Permit number:	Pending ☐
4. Individual Sewerage Disposal	☐ Y	☐N	☒N/A	Permit number:	Pending ☐
5. UIC Registration	☐ Y	☒N	☐N/A	Registration date:	Pending ☒
6. Large/Small Community Well Approval	☐ Y	☐N	☒N/A	Approval letter date:	Pending ☐
7. Large Groundwater Withdrawal Permit	☐ Y	☐N	☒N/A	Permit number:	Pending ☐

9. ADDITIONAL INFORMATION

A. If you have had a pre-application meeting with AoT staff, state his or her name(s):Ridgely Mauck on 05-20-19
Attach a copy of the meeting minutes.

B. Will blasting of bedrock be required? YES☐ NO☒ If yes, estimated quantity of blast rock: _____ cubic yards.
If yes, standard blasting BMP notes must be placed on the plans, available at:
http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-10-12.pdf

If greater than 5,000 cubic yards of blast rock will be generated and there are drinking water supply wells (public or private) within 2,000 feet of blasting activities, a groundwater monitoring program must be developed and submitted to NHDES. Contact the AoT Bureau for additional detail.

C. Indicate if the project will withdraw from, or directly discharge to, any of the following water sources *post-development* and, if "Yes", indicate its purpose*:*

1. Stream or Wetland Purpose:	YES ☐ Withdrawal ☐ Discharge ☐ NO ☐
2. Man-made pond created by impounding a stream or wetland Purpose:	YES ☐ Withdrawal ☐ Discharge ☐ NO ☐
3. Unlined pond dug into the water table Purpose:	YES ☐ Withdrawal ☐ Discharge ☐ NO ☐

10. CHECK ALL APPLICATION ATTACHMENTS THAT APPLY (SUBMIT WITH APPLICATION IN ORDER LISTED)

LOOSE:

☒ Signed application form: des.nh.gov/organization/divisions/water/aot/index.htm (with attached proof(s) of delivery)
☒ Check for the application fee: des.nh.gov/organization/divisions/water/aot/fees.htm
☒ Color copy of a USGS map with the property boundaries outlined (1" = 2,000' scale)
☒ A copy of the pre-application meeting minutes, if you had a pre-application meeting with AoT staff.

BIND IN A REPORT IN THE FOLLOWING ORDER:

☒ Copy of the signed application form & application checklist (des.nh.gov/organization/divisions/water/aot/index.htm)
☒ Copy of the check
☒ Copy of the USGS map with the property boundaries outlined (1" = 2,000' scale)
☒ Narrative of the project with a summary table of the peak discharge rate for the off-site discharge points
☒ Web GIS printout with the "Surface Water Impairments" layer turned on - www2.des.state.nh.us/gis/onestop/
☒ Web GIS printouts with the AoT screening layers turned on - www2.des.state.nh.us/gis/onestop/
☒ NHB letter using DataCheck Tool – www.nhdfl.org/about-forests-and-lands/bureaus/natural-heritage-bureau/
☒ The Web Soil Survey Map with project's watershed outlined – websoilsurvey.nrcs.usda.gov
☒ Aerial photograph (1" = 2,000' scale with the site boundaries outlined)
☒ Photographs representative of the site
☒ Groundwater Recharge Volume calculations (one worksheet for each permit application):
des.nh.gov/organization/divisions/water/aot/documents/bmp_worksh.xls
☒ BMP worksheets (one worksheet for each treatment system):
des.nh.gov/organization/divisions/water/aot/documents/bmp_worksh.xls

10. CHECK ALL APPLICATION ATTACHMENTS THAT APPLY (SUBMIT WITH APPLICATION IN ORDER LISTED)

☒ Drainage analysis, stamped by a professional engineer (see Application Checklist for details)
☒ Riprap apron or other energy dissipation or stability calculations
☒ Site Specific Soil Survey report, stamped and with a certification note prepared by the soil scientist that the survey was done in accordance with the Site Specific Soil Mapping standards, *Site-Specific Soil Mapping Standards for NH & VT, SSSNNE Special Publication No. 3*.
☒ Infiltration Feasibility Report (example online)
☒ Registration and Notification Form for Storm Water Infiltration to Groundwater (UIC Registration-for underground systems only, including drywells and trenches): (http://des.nh.gov/organization/divisions/water/dwgb/dwspp/gw_discharge)
☒ Inspection and maintenance manual with, if applicable, long term maintenance agreements
☒ Source control plan

PLANS:

☒ One set of design plans on 34 - 36” by 22 - 24” white paper (see Application Checklist for details)
☒ Pre & post-development color coded soil plans on 11” x 17” (see Application Checklist for details)
☒ Pre & post-development drainage area plans on 34 - 36” by 22 - 24” white paper (see Application Checklist for details)

100-YEAR FLOODPLAIN REPORT:

☐ All information required in Env-Wq 1503.09, submitted as a separate report.

☐ **REVIEW APPLICATION FOR COMPLETENESS & CONFIRM INFORMATION LISTED ON THE APPLICATION IS INCLUDED WITH SUBMITTAL.**

11. REQUIRED SIGNATURES		
☐ APPLICANT OR ☒ AGENT: Michael Malynowski SIGNATURE	Michael Malynowski PRINT NAME LEGIBLY	06/05/2019 DATE
OWNER OR OWNER’S AGENT (IF DIFFERENT FROM APPLICANT): SIGNATURE	PRINT NAME LEGIBLY	/ / DATE
By initialing here, I understand that in accordance with Env-Wq 1503.20(e), within one week after permit approval, the applicant shall submit a copy of all approved documents to the department in PDF format on a CD.		mam

ATTACHMENT A:
ALTERATION OF TERRAIN PERMIT APPLICATION CHECKLIST

Check the box to indicate the item has been provided or provide an explanation why the item does not apply.

DESIGN PLANS

☐ Plans printed on 34 - 36" by 22 - 24" white paper

☐ PE stamp

☐ Wetland delineation

☐ Temporary erosion control measures

☐ Treatment for all stormwater runoff from impervious surfaces such as roadways (including gravel roadways), parking areas, and non-residential roof runoff. Guidance on treatment BMPs can be found in Volume 2, Chapter 4 of the NH Stormwater Management Manual.

☐ Pre-existing 2-foot contours

☐ Proposed 2-foot contours

☐ Drainage easements protecting the drainage/treatment structures

☐ Compliance with the Wetlands Bureau, RSA 482- A http://des.nh.gov/organization/divisions/water/wetlands/index.htm. Note that artificial detention in wetlands is not allowed.

☐ Compliance with the Comprehensive Shoreland Protection Act, RSA 483-B. http://des.nh.gov/organization/divisions/water/wetlands/cspa

☐ Benches. Benching is needed if you have more than 20 feet change in elevation on a 2:1 slope, 30 feet change in elevation on a 3:1 slope, 40 feet change in elevation on a 4:1 slope.

☐ Check to see if any proposed ponds need state Dam permits. http://des.nh.gov/organization/divisions/water/dam/documents/damdef.pdf

DETAILS

☐ Typical roadway x-section

☐ Detention basin with inverts noted on the outlet structure

☐ Stone berm level spreader

☐ Outlet protection – riprap aprons

☐ A general installation detail for an erosion control blanket

☐ Silt fences or mulch berm

☐ Storm drain inlet protection. Note that since hay bales must be embedded 4 inches into the ground, they are not to be used on hard surfaces such as pavement.

☐ Hay bale barriers

☐ Stone check dams

☐ Gravel construction exit

☐ The treatment BMP's proposed

☐ Any innovative BMP's proposed

CONSTRUCTION SEQUENCE/EROSION CONTROL

☐ Note that the project is to be managed in a manner that meets the requirements and intent of RSA 430:53 and Chapter Agr 3800 relative to invasive species.

☐ Note that perimeter controls shall be installed prior to earth moving operations

☐ Note that ponds and swales shall be installed early on in the construction sequence (before rough grading the site)

☐ Note that all ditches and swales shall be stabilized prior to directing runoff to them

☐ Note that all roadways and parking lots shall be stabilized within 72 hours of achieving finished grade

☐ Note that all cut and fill slopes shall be seeded/loamed within 72 hours of achieving finished grade

☐ Note that all erosion controls shall be inspected weekly AND after every half-inch of rainfall

☐ Note the limits on the open area allowed, see Env-Wq 1505.02 for detailed information

Example note: The smallest practical area shall be disturbed during construction, but in no case shall exceed 5 acres at any one time before disturbed areas are stabilized

☐ Note the definition of the word "stable"

Example note: An area shall be considered stable if one of the following has occurred:

- Base course gravels have been installed in areas to be paved
- A minimum of 85 percent vegetated growth has been established
- A minimum of 3 inches of non-erosive material such stone or riprap has been installed
- Or, erosion control blankets have been properly installed.

☐ Note the limit of time an area may be exposed
Example note: All areas shall be stabilized within 45 days of initial disturbance

☐ Provide temporary and permanent seeding specifications. (Reed canary grass is listed in the Green Book; however, this is a problematic species according to the Wetlands Bureau and therefore should not be specified)

☐ Provide winter construction notes that meet or exceed our standards.

Standard Winter Notes:

- All proposed vegetated areas that do not exhibit a minimum of 85 percent vegetative growth by October 15, or which are disturbed after October 15, shall be stabilized by seeding and installing erosion control blankets on slopes greater than 3:1, and seeding and placing 3 to 4 tons of mulch per acre, secured with anchored netting, elsewhere. The installation of erosion control blankets or mulch and netting shall not occur over accumulated snow or on frozen ground and shall be completed in advance of thaw or spring melt events.

- All ditches or swales which do not exhibit a minimum of 85 percent vegetative growth by October 15, or which are disturbed after October 15, shall be stabilized temporarily with stone or erosion control blankets appropriate for the design flow conditions.

- After November 15, incomplete road or parking surfaces, where work has stopped for the winter season, shall be protected with a minimum of 3 inches of crushed gravel per NHDOT item 304.3.

☐ Note at the end of the construction sequence that "Lot disturbance, other than that shown on the approved plans, shall not commence until after the roadway has the base course to design elevation and the associated drainage is complete and stable". – This note is applicable to single/duplex family subdivisions, when lot development is not part of the permit.

DRAINAGE ANALYSES

Please double-side 8 ½" x 11" sheets where possible but, **do not** reduce the text such that more than one page fits on one side.

☐ PE stamp

☐ Rainfall amount obtained from the Northeast Regional Climate Center- http://precip.eas.cornell.edu/. Include extreme precipitation table as obtained from the above referenced website.

☐ Drainage analyses, in the following order:

- Pre-development analysis: Drainage diagram
- Pre-development analysis: Area Listing and Soil Listing
- Pre-development analysis: Node listing 1-year (if applicable), 2-year, 10-year and 50-year
- Pre-development analysis: Full summary of the 10-year storm
- Post-development analysis: Drainage diagram
- Post-development analysis: Area Listing and Soil Listing
- Post-development analysis: Node listing for the 2-year, 10-year and 50-year
- Post-development analysis: Full summary of the 10-year storm

☐ Review the Area Listing and Soil Listing reports

- Hydrologic soil groups (HSG) match the HSGs on the soil maps provided
- There is the same or less HSG A soil area after development (check for each HSG)
- There is the same or less "woods" cover in the post-development
- Undeveloped land was assumed to be in "good" condition
- The amount of impervious cover in the analyses is correct

Note: A good check is to subtract the total impervious area used in the pre analysis from the total impervious area used in the post-analysis. For residential projects without demolition occurring, a good check is to take this change in impervious area, subtract out the roadway and divide the remaining by the number of houses/units proposed. Do these numbers make sense?

☐ Check the storage input used to model the ponds

☐ Check to see if the artificial berms pass the 50-year storm, i.e., make sure the constructed berms on ponds are not overtopped

☐ Check the outlet structure proposed and make sure it matches that modeled

☐ Check to see if the total areas in the pre and post analyses are same

☐ Confirm the correct NRCS storm type was modeled (Coos, Carroll & Grafton counties are Type II, all others Type III)

PRE AND POST-DEVELOPMENT DRAINAGE AREA PLANS

☐ Plans printed on 34 - 36” by 22 - 24” on white paper

☐ Submit these plans separate from the soil plans

☐ A north arrow

☐ A scale

☐ Labeled subcatchments, reaches and ponds

☐ Tc lines

☐ A clear delineation of the subcatchment boundaries

☐ Roadway station numbers

☐ Culverts and other conveyance structures

PRE AND POST-DEVELOPMENT COLOR-CODED SOIL PLANS

☐ 11” x 17”sheets suitable, as long as it is readable

☐ Submit these plans separate from the drainage area plans

☐ A north arrow

☐ A scale

☐ Name of the soil scientist who performed the survey and date the soil survey took place

☐ 2-foot contours (5-foot contours if application is for a gravel pit) as well as other surveyed features

☐ Delineation of the soil boundaries and wetland boundaries

☐ Delineation of the subcatchment boundaries

☐ Soil series symbols (e.g., 26)

☐ A key or legend which identifies each soil series symbol and its associated soil series name (e.g., 26 = Windsor)

☐ The hydrologic soil group color coding (A = Green, B = yellow, C= orange, D=red, Water=blue, & Impervious = gray)

Please note that excavation projects (e.g., gravel pits) have similar requirements to that above, however the following are common exceptions/additions:

☐ Drainage report is not needed if site does not have off-site flow.

☐ 5 foot contours allowed rather than 2 foot.

☐ No PE stamp needed on the plans

☐ Add a note to the plans that the applicant must submit to the Department of Environmental Services a written update of the project and revised plans documenting the project status every five years from the date of the Alteration of Terrain permit.

☐ Add reclamation notes.

See NRCS publication titled: *Vegetating New Hampshire Sand and Gravel Pits* for a good resource, it is posted online at: http://des.nh.gov/organization/divisions/water/aot/categories/publications .