DRAINAGE REPORT

Proposed Elderly Housing Development | 343 Clintonville Road | North Haven, Connecticut

October 27, 2020 **(Revised December 8, 2020)**
MMI #2709-13

This stormwater drainage report has been prepared in support of a proposed site plan application for the 343 Clintonville Road elderly housing development in the town of North Haven, Connecticut. The applicant proposes to construct two multistory buildings with 120 residential units total as well as an associated clubhouse with outdoor patio.

The ±12.8-acre parcel abuts residential properties to the west, the ACES – Wintergreen Interdistrict Magnet School to the north, and the Tuscan Villa development to the east. The parcel was previously zoned as R40 and has recently been approved to be zoned as Elderly Housing (EH). The parcel is mostly wooded north of Waterman's Brook with farmland to the south of the brook along with a farmhouse with multiple greenhouses. The site is moderately sloped from the southeast corner to the north-northwest.

Access to the new development will be provided by two new entrance drives, one off Clintonville Road to the south and one connecting to the Tuscan Villa development to the east. The new buildings and clubhouse will be served by the public water service located in Clintonville Road. A proposed sanitary sewer lateral will be installed to serve the two buildings and clubhouse and will connect to the existing sewer service running through the middle of the parcel. All other utilities such as electric, telephone, cable, and gas will be provided by the existing services adjacent to the project site and shall be located underground.

Figure 1 – 343 Clintonville Road, North Haven, Connecticut

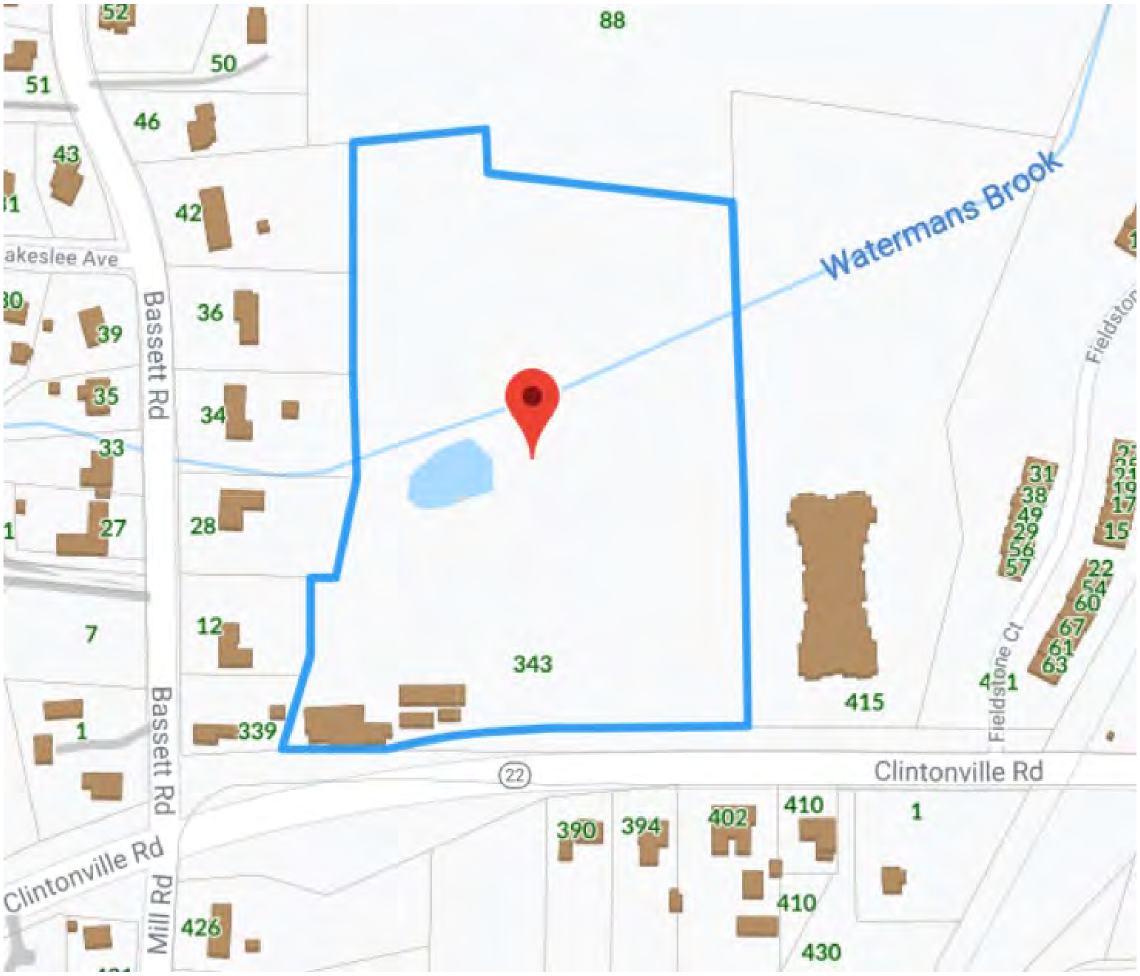

Table 1 – Stormwater Data

Total Parcel Size	12.8 acres
Existing On-Site Impervious Area	0.4 acres
Proposed On-Site Impervious Area	3.1 acres
Soil Types (Hydrologic Soil Group)	"A," "B," and "C"
Existing Land Use	Woods, open space, straight row crops, gravel, bituminous, and building
Proposed Land Use	Woods, open space, gravel, bituminous, and building
Design Storm for Stormwater Management	No increases in peak rates of runoff for the 2-,10-, 25-, 50-, and 100-year storms.
Design Storm for Storm Drainage	25-year storm
Federal Emergency Management Agency Special Flood Hazard Areas	Not applicable
Connecticut Department of Energy & Environmental Protection Aquifer Protection Areas	Not applicable

STORMWATER MANAGEMENT APPROACH

The stormwater management system for this site has been designed utilizing Best Management Practices (BMPs) to provide water quality management while attenuating the proposed peak-flow rates from the development. The design goal is to provide water quality treatment in accordance with the Connecticut Department of Energy & Environmental Protection (CTDEEP) requirements for Water Quality Volume (WQV) and prevent increases in the predevelopment runoff rates from the project site. Existing drainage patterns will be maintained to the maximum extent practicable, and a stormwater treatment train is proposed including several water quality measures such as catch basins with 2-foot sumps, a hydrodynamic separator, riprap energy dissipators, sediment forebays, and retention volume within the proposed stormwater management basin.

The proposed project will include one stormwater management basin that is designed to detain the proposed stormwater peak discharge rates and provide retention storage to address water quality. The detention basin is designated on the plans as Basin 210.

The computer program entitled *Hydraflow Storm Sewers Extension for AutoCAD® Civil 3D® 2019* by Autodesk, Inc., Version 10.5, was used for designing the proposed storm drainage collection system. Storm drainage computations performed include pipe capacity, hydraulic grade line, and gutter flow calculations. The contributing watershed to each individual catch basin inlet was delineated to determine drainage area and land coverage. These values were used to determine the stormwater runoff to each inlet using the Rational Method. The rainfall intensities for the site were obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 10 Precipitation Frequency Data Server (PFDS). The proposed storm drainage system is designed to provide adequate pipe capacity to convey the 25-year storm event.

WATER QUALITY MANAGEMENT

Stormwater runoff from the proposed improvements will be collected by a subsurface pipe and catch basin drainage system. The proposed drainage system will include catch basins with 2-foot sumps to trap sediment and debris. In addition, a proprietary hydrodynamic separator is proposed as part of the main storm drainage system that discharges to Basin 210. The hydrodynamic separator was sized to meet Water Quality Flow (WQF) standards from CTDEEP's *2004 Stormwater Quality Manual*, which is the peak-flow rate associated with the WQV, and sized based on manufacturer's specifications, as recommended in the manual.

The stormwater management basin was sized following recommendations set forth in CTDEEP's *2004 Stormwater Quality Manual*. The manual (Chapter 7) recommends methods for sizing stormwater treatment measures with WQV computations. The WQV addresses the initial stormwater runoff, also commonly referred to as the "first flush" runoff. The WQV provides adequate volume to store the initial 1 inch of runoff, which tends to contain the highest concentrations of potential pollutants. The WQV has been provided within the volume of the proposed stormwater management basin below the first outlet discharge from the outlet control structure. All supporting calculations for the volume provided as well as WQV computations have been included in the Appendix of this report.

A sediment forebay is proposed around the proposed drainage pipe that daylights into the stormwater management basin, which will improve water quality by trapping floatables as well as filtering coarse sediment and other pollutants. Riprap splash pads will dissipate the potential erosive velocity of stormwater entering the basin as well as trap sediment. The sediment forebay will contain the deposited sediment within a small area of the basin and allow for maintenance accessibility.

HYDROLOGIC ANALYSIS

A hydrologic analysis was conducted to analyze the predevelopment and post-development peak-flow rates from the site. Four analysis points consisting of four existing subwatersheds were chosen based on the fact that each area receives stormwater runoff from a portion of the project. Analysis Point A was created to analyze the portion of the site draining toward the western property boundary. Analysis Point B analyzes the portion of the site draining to the existing wetlands north of the proposed site. Analysis Point C analyzes the relatively small area that drains south toward Clintonville Road. Analysis Point D analyzes the portion of the site that drains to the eastern property. The total combined watershed area delineated is approximately 7.7 acres under both existing and proposed conditions.

The method of predicting the surface water runoff rates utilized in this analysis was a computer program entitled *Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2019* by Autodesk, Inc., Version 2020. The *Hydrographs* program is a computer model that utilizes the methodologies set forth in the *Technical Release No. 55* (TR-55) manual and the *Technical Release No. 20* (TR-20) computer model, originally developed by the United States Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS). The *Hydrographs* computer modeling program is primarily used for conducting hydrology studies such as this one.

The *Hydrographs* computer program forecasts the rate of surface water runoff based upon several factors. The input data includes information on land use, hydrologic soil type, vegetation, contributing watershed area, time of concentration, rainfall data, storage volumes, and the hydraulic capacity of structures. The computer model predicts the amount of runoff as a function of time, with the ability to include the attenuation effect due to dams, lakes, large wetlands, floodplains, and the stormwater management basin. The input data for rainfalls with statistical recurrence frequencies of 2, 10, 25, 50, and 100 years was obtained from the NOAA Atlas 14, Volume 10 database. The corresponding rainfall totals are listed below.

Storm Frequency	Rainfall (inches)
2-year	3.48
10-year	5.36
25-year	6.54
50-year	7.41
100-year	8.36

Land use for the site under existing and proposed conditions was determined from field survey and aerial photogrammetry. Land use types used in the analysis included woods, grassed or open space, building, impervious (paved) cover, gravel, and agriculture. Soil types in the watershed were determined from the CTDEEP Geographic Information System (GIS) database of the USDA-NRCS soil survey for New Haven County, Connecticut. For the analysis, the site was determined to contain hydrologic soil types "A," "B," and "C" as classified by USDA-NRCS. The different land uses and soil types were utilized to determine composite runoff Curve Numbers (CN) for each subwatershed. The time of concentration (Tc) was estimated for each subwatershed using the TR-55 methodology that was computed by summing all travel times through the watershed as sheet flow, shallow concentrated flow, and channel flow.

The existing conditions were modeled with the *Hydrographs* program to determine the peak-flow rates for the various storm events at each analysis point. A revised model was developed incorporating the proposed site conditions; the flows obtained with the revised model were then compared to the results of the existing conditions model. Peak-flow rates from the project site were controlled by the storage volume provided within the stormwater basin and the hydraulic capacity of the outlet control structure. Stormwater Management Basin 210 has been designed to provide a minimum of 1 foot of freeboard to the top of the embankment during the 100-year storm event. The following peak rates of runoff were obtained from the *Hydrographs* hydrology results:

Analysis Point A – Western Property Boundary – West					
	Peak Runoff Rate (cubic feet per second)				
Storm Frequency (years)	**2**	**10**	**25**	**50**	**100**
Existing Conditions	0.43	1.74	2.79	3.64	4.61
Proposed Conditions	0.01	0.19	0.59	1.04	1.62

Analysis Point B – Existing Wetland Boundary – North					
	Peak Runoff Rate (cubic feet per second)				
Storm Frequency (years)	**2**	**10**	**25**	**50**	**100**
Existing Conditions	0.52	3.85	7.05	9.76	12.94
Proposed Conditions	0.25	1.58	3.01	4.68	10.65

Detention Basin 210*					
	Water Surface Elevation (feet)				
Storm Frequency (years)	**2**	**10**	**25**	**50**	**100**
Proposed Conditions	58.17	59.33	60.03	60.43	60.71

***Top of basin berm elevation at 62.0 feet**

Analysis Point C – Clintonville Road – Southeast					
	Peak Runoff Rate (cubic feet per second)				
Storm Frequency (years)	**2**	**10**	**25**	**50**	**100**
Existing Conditions	0.00	0.00	0.01	0.02	0.04
Proposed Conditions	0.00	0.04	0.09	0.13	0.18

Analysis Point D – Eastern Property Boundary – East					
	Peak Runoff Rate (cubic feet per second)				
Storm Frequency (years)	**2**	**10**	**25**	**50**	**100**
Existing Conditions	0.00	0.00	0.00	0.00	0.01
Proposed Conditions	0.00	0.00	0.00	0.00	0.01

CONCLUSION

The results of the hydrologic analysis demonstrate that there will be no increases in peak-flow rates from the proposed development at all but one point of analysis. The increase in peak flow for point of analysis C is the result of a proposed sidewalk connecting to the adjacent sidewalk in the right-of-way. This relatively small increase in peak flow to the analysis point is negligible and does not pose any negative downstream impact. The overall decrease in peak flows was achieved for the storm events modeled through a planned stormwater management system with detention provided in the proposed stormwater/water quality basin.

The proposed development will introduce a new stormwater treatment train consisting of several water quality measures such as catch basins with 2-foot sumps, a hydrodynamic separator, riprap energy dissipators, sediment forebay, and retention volume within the proposed stormwater/water quality basin. A hydrodynamic separator will be employed in the main storm drainage system that discharges to the stormwater basin (Basin 210) to enhance sediment removal. Furthermore, the sediment forebay will filter coarse sediment prior to stormwater runoff entering the detention basin. The CTDEEP WQV has been provided within the retention storage in the proposed stormwater/water quality basin.

All supporting documentation and stormwater-related computations are attached to this report along with the *Hydraflow Hydrographs* model results for stormwater management and the *Hydraflow Storm Sewers* model results for the proposed storm drainage system. Illustrative watershed maps for both existing and proposed conditions are also attached to this report.

Attachments

Attachment A – United States Geological Survey Location Map
Attachment B – Natural Resources Conservation Service Hydrologic Soil Group Map
Attachment C – Storm Drainage Computations
Attachment D – Water Quality Computations
Attachment E – Hydrologic Analysis – Input Computations
Attachment F – Hydrologic Analysis – Computer Model Results
Attachment G – Watershed Maps

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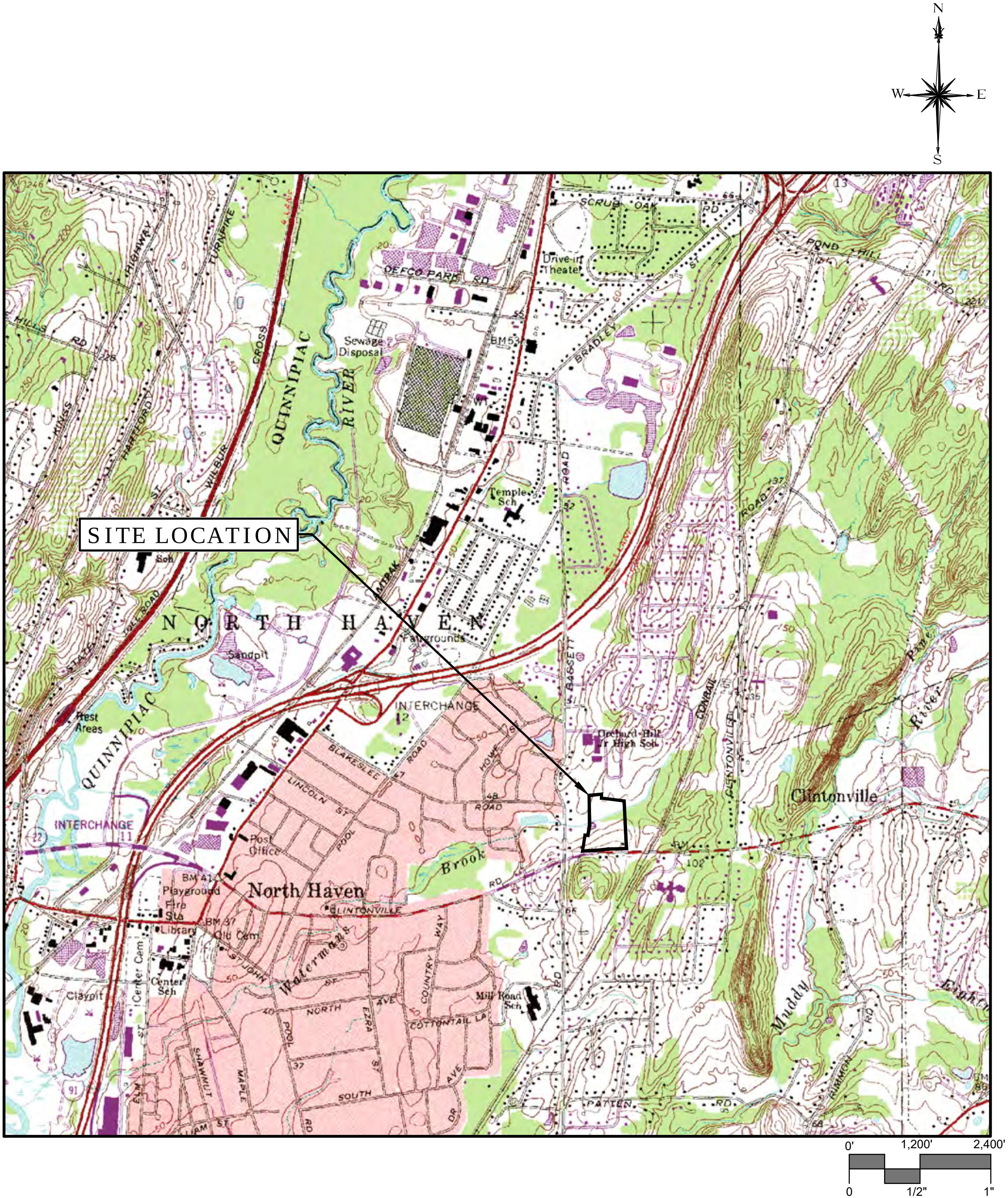
ATTACHMENT A

UNITED STATES GEOLOGICAL SURVEY LOCATION MAP



99 REALTY DRIVE
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USGS QUADRANGLE MAP, QUAD NO. 81

PROPOSED ELDERLY HOUSING DEVELOPMENT

343 CLINTONVILLE ROAD
NORTH HAVEN, CONNECTICUT

PROJECT PHASE:

REV: ---

DATE **OCTOBER 27, 2020**		
SCALE **1"=2,400'**		
PROJ. NO. **2709-13**		
DESIGNED ---	DRAWN KVN	CHECKED ---
DRAWING NAME: **LOC**		

ATTACHMENT B

NATURAL RESOURCES CONSERVATION SERVICE HYDROLOGIC SOIL GROUP MAP

Hydrologic Soil Group—State of Connecticut

Map Scale: 1:2,610 if printed on A portrait (8.5" x 11") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N 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 1:12,000.

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: State of Connecticut
Survey Area Data: Version 20, Jun 9, 2020

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

Date(s) aerial images were photographed: Jun 27, 2014—Jul 22, 2014

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
12	Raypol silt loam	C/D	10.2	28.0%
37C	Manchester gravelly sandy loam, 3 to 15 percent slopes	A	19.6	54.2%
77C	Cheshire-Holyoke complex, 3 to 15 percent slopes, very rocky	B	0.8	2.2%
77D	Cheshire-Holyoke complex, 15 to 35 percent slopes, very rocky	B	2.2	6.0%
308	Udorthents, smoothed	C	3.5	9.6%
Totals for Area of Interest			**36.2**	**100.0%**

Description

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.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

ATTACHMENT C

STORM DRAINAGE COMPUTATIONS

Rational Method Individual Basin Calculations

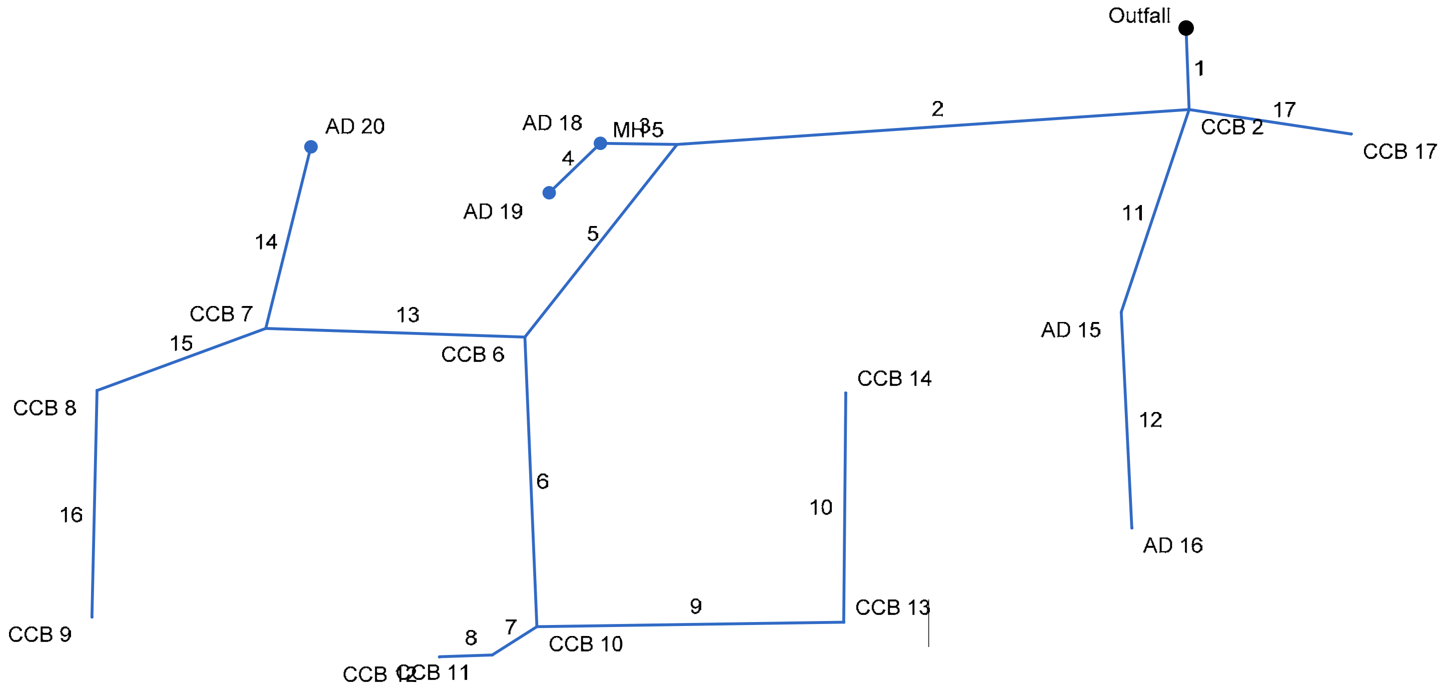
Project: Prop. Elderly Housing Development By: KVN Date: Rev.1/08/21
Location: North Haven, CT (MMI#:2709-13) Checked: Date:

Basin Name	**Impervious Area C=0.9 (sf)**	**Grassed Area C=0.3 (sf)**	**Wooded Area C=0.2 (sf)**	**Total Area (sf)**	**Total Area (ac)**	**Weighted C**	**Tc to Inlet (min)**
System 210							
CCB 2	9,400	6,143	696	16,239	0.37	0.64	10.0
CCB 6	6,316	175	0	6,491	0.15	0.88	5.0
CCB 7	11,000	2,363	0	13,363	0.31	0.79	5.0
CCB 8	13,588	6,735	0	20,323	0.47	0.70	5.0
CCB 9	6,633	9,257	0	15,890	0.36	0.55	10.0
CCB 10	5,926	4,939	0	10,865	0.25	0.63	10.0
CCB 11	1,909	0	0	1,909	0.04	0.90	5.0
CCB 12	1,631	0	0	1,631	0.04	0.90	5.0
CCB 13	5,716	14,015	6463	26,194	0.60	0.41	15.9
CCB 14	6,125	4,390	0	10,515	0.24	0.65	5.0
AD 15	0	3,066	0	3,066	0.07	0.30	5.0
AD 16	0	1,792	0	1,792	0.04	0.30	5.0
CCB 17	991	375	0	1,366	0.03	0.74	5.0
AD 18	1,700	124	0	1,824	0.04	0.86	5.0
AD 19	3,481	607	0	4,088	0.09	0.81	5.0
AD 20	2,592	466	0	3,058	0.07	0.81	5.0

Q = C x I x A, Where:
C = Runoff Coefficient
I = Rainfall Intensity (in/hr) => Tc = 5 min => i= 9.22 in/hr (25-year storm)
A = Area (acres)
Q = Flow (cfs)

	BLD TO CCB 9	BLD TO AD 15	BLD TO AD19
C	0.90	0.90	0.90
I	9.22	9.22	9.22
A	0.54	0.54	0.08
Q	4.48	4.48	0.65

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: System 210.stm	Number of lines: 17	Date: 1/8/2021

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	31.000	87.948	Curb	0.00	0.37	0.64	10.0	56.00	3.23	57.00	24	Cir	0.012	2.04	66.10	FES 1-CCB 2
2	1	194.000	88.144	MH	0.00	0.00	0.00	0.0	57.00	0.93	58.80	24	Cir	0.012	0.78	67.00	CCB 2-MH5
3	2	29.000	4.810	DrGrt	0.00	0.04	0.86	5.0	63.00	3.45	64.00	8	Cir	0.012	1.13	67.00	MH 5-AD 18
4	3	27.000	-45.000	DrGrt	0.65	0.09	0.81	5.0	64.00	1.11	64.30	8	Cir	0.012	1.00	67.20	AD 18-AD19
5	2	93.000	-47.865	Comb	0.00	0.15	0.88	5.0	58.80	0.65	59.40	24	Cir	0.012	1.26	65.50	MH 5-CCB 6
6	5	110.000	-40.603	Comb	0.00	0.25	0.63	10.0	59.80	1.27	61.20	18	Cir	0.012	1.50	69.00	CCB 6-CCB 10
7	6	20.000	59.944	Comb	0.00	0.04	0.90	5.0	65.50	1.00	65.70	12	Cir	0.012	0.84	69.40	CCB 10-CCB 11
8	7	20.000	30.441	Comb	0.00	0.04	0.90	5.0	65.70	1.50	66.00	12	Cir	0.012	1.00	69.30	CCB 11-CCB 12
9	6	116.000	-88.470	Comb	0.00	0.60	0.41	15.9	61.40	1.12	62.70	15	Cir	0.012	1.50	69.00	CCB 10-CCB 13
10	9	87.000	-88.666	Comb	0.00	0.24	0.65	5.0	63.00	0.80	63.70	12	Cir	0.012	1.00	67.20	CCB 13-CCB 14
11	1	81.000	20.485	DrGrt	4.48	0.07	0.30	5.0	57.00	6.42	62.20	12	Cir	0.012	0.62	67.20	CCB 2-AD 15
12	11	82.000	-21.236	DrGrt	0.00	0.04	0.30	5.0	62.20	2.20	64.00	12	Cir	0.012	1.00	67.20	AD 15-AD 16
13	5	98.000	53.681	Comb	0.00	0.31	0.79	5.0	59.40	1.12	60.50	24	Cir	0.012	1.50	64.40	CCB 6-CCB 7
14	13	71.000	102.000	DrGrt	0.00	0.07	0.81	5.0	60.50	3.38	62.90	12	Cir	0.012	1.00	66.00	CCB 7-AD 20
15	13	68.000	-22.149	Comb	0.00	0.47	0.70	5.0	61.00	0.88	61.60	24	Cir	0.012	1.41	64.50	CCB 7-CCB 8
16	15	86.000	-68.461	Comb	4.48	0.36	0.55	10.0	61.80	1.40	63.00	15	Cir	0.012	1.00	66.50	CCB 8-CCB 9
17	1	62.000	-79.383	Comb	0.00	0.03	0.74	5.0	57.00	9.03	62.60	12	Cir	0.012	1.00	66.00	MH 2-CCB 17

Project File: System 210.stm

Number of lines: 17

Date: 1/8/2021

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	31.000	0.37	3.17	0.64	0.24	1.99	10.0	18.8	4.7	18.99	44.01	6.05	24	3.23	56.00	57.00	60.03	60.22	58.00	66.10	FES 1-CCB 2
2	1	194.000	0.00	2.66	0.00	0.00	1.70	0.0	18.0	4.8	13.33	23.60	4.24	24	0.93	57.00	58.80	61.38	61.95	66.10	67.00	CCB 2-MH5
3	2	29.000	0.04	0.13	0.86	0.03	0.11	5.0	5.1	9.1	1.63	2.43	6.22	8	3.45	63.00	64.00	63.40	64.59	67.00	67.00	MH 5-AD 18
4	3	27.000	0.09	0.09	0.81	0.07	0.07	5.0	5.0	9.2	1.32	1.38	4.20	8	1.11	64.00	64.30	64.59	64.84	67.00	67.20	AD 18-AD19
5	2	93.000	0.15	2.53	0.88	0.13	1.59	5.0	17.6	4.9	12.27	19.68	3.91	24	0.65	58.80	59.40	62.17	62.40	67.00	65.50	MH 5-CCB 6
6	5	110.000	0.25	1.17	0.63	0.16	0.63	10.0	16.6	5.1	3.20	12.83	1.81	18	1.27	59.80	61.20	62.70	62.79	65.50	69.00	CCB 6-CCB 10
7	6	20.000	0.04	0.08	0.90	0.04	0.07	5.0	5.2	9.1	0.65	3.86	3.24	12	1.00	65.50	65.70	65.78	66.04	69.00	69.40	CCB 10-CCB 11
8	7	20.000	0.04	0.04	0.90	0.04	0.04	5.0	5.0	9.2	0.33	4.73	1.88	12	1.50	65.70	66.00	66.04	66.24	69.40	69.30	CCB 11-CCB 12
9	6	116.000	0.60	0.84	0.41	0.25	0.40	15.9	15.9	5.2	2.09	7.41	2.74	15	1.12	61.40	62.70	62.86	63.28	69.00	69.00	CCB 10-CCB 13
10	9	87.000	0.24	0.24	0.65	0.16	0.16	5.0	5.0	9.2	1.44	3.46	3.90	12	0.80	63.00	63.70	63.45	64.21	69.00	67.20	CCB 13-CCB 14
11	1	81.000	0.07	0.11	0.30	0.02	0.03	5.0	6.5	8.3	4.75	9.78	6.21	12	6.42	57.00	62.20	61.38	63.10	66.10	67.20	CCB 2-AD 15
12	11	82.000	0.04	0.04	0.30	0.01	0.01	5.0	5.0	9.2	0.11	5.72	0.94	12	2.20	62.20	64.00	63.10	64.14	67.20	67.20	AD 15-AD 16
13	5	98.000	0.31	1.21	0.79	0.24	0.83	5.0	10.7	6.5	9.84	25.96	3.13	24	1.12	59.40	60.50	62.70	62.86	65.50	64.40	CCB 6-CCB 7
14	13	71.000	0.07	0.07	0.81	0.06	0.06	5.0	5.0	9.2	0.52	7.09	1.64	12	3.38	60.50	62.90	63.09	63.20	64.40	66.00	CCB 7-AD 20
15	13	68.000	0.47	0.83	0.70	0.33	0.53	5.0	10.3	6.6	7.96	23.02	2.83	24	0.88	61.00	61.60	63.09	63.11	64.40	64.50	CCB 7-CCB 8
16	15	86.000	0.36	0.36	0.55	0.20	0.20	10.0	10.0	6.7	5.81	8.26	5.19	15	1.40	61.80	63.00	63.33	63.97	64.50	66.50	CCB 8-CCB 9
17	1	62.000	0.03	0.03	0.74	0.02	0.02	5.0	5.0	9.2	0.20	11.59	1.15	12	9.03	57.00	62.60	61.38	62.79	66.10	66.00	MH 2-CCB 17

Project File: System 210.stm

Number of lines: 17

Run Date: 1/8/2021

NOTES:Intensity = 44.23 / (Inlet time + 3.90) ^ 0.72; Return period =Yrs. 25 ; c = cir e = ellip b = box

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp Line No
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	CCB 2	1.58	0.00	1.58	0.00	Curb	4.0	2.74	0.00	0.00	0.00	Sag	2.00	0.050	0.020	0.013	0.29	11.38	0.29	11.38	0.0	Off
2	MH 5	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.0	Off
3	AD 18	0.32	0.00	0.32	0.00	DrGrt	0.0	0.00	0.52	0.83	0.63	Sag	2.00	0.020	0.020	0.013	0.11	12.93	0.11	12.93	0.0	Off
4	AD 19	1.32*	0.00	1.32	0.00	DrGrt	0.0	0.00	0.52	0.83	0.63	Sag	2.00	0.020	0.020	0.013	0.28	30.32	0.28	30.32	0.0	Off
5	CCB 6	1.22	0.00	1.22	0.00	Comb	4.0	2.73	3.12	2.31	1.35	Sag	2.53	0.050	0.020	0.000	0.20	6.05	0.20	6.05	0.0	Off
6	CCB 10	1.05	0.00	1.05	0.00	Comb	4.0	2.73	3.12	2.31	1.35	Sag	2.53	0.031	0.031	0.000	0.20	6.36	0.20	6.36	0.0	Off
7	CCB 11	0.33	0.00	0.33	0.00	Comb	4.0	2.73	0.00	2.31	1.35	0.090	2.53	0.031	0.031	0.013	0.07	2.22	0.00	0.00	0.0	13
8	CCB 12	0.33	0.00	0.33	0.00	Comb	4.0	2.73	0.00	2.31	1.35	0.090	2.53	0.031	0.031	0.013	0.07	2.22	0.00	0.00	0.0	13
9	CCB 13	1.28	0.00	1.28	0.00	Comb	4.0	2.73	3.12	2.31	1.35	Sag	2.53	0.031	0.031	0.000	0.22	7.07	0.22	7.07	0.0	Off
10	CCB 14	1.44	0.00	1.44	0.00	Comb	4.0	2.73	3.12	2.31	1.35	Sag	2.53	0.031	0.031	0.000	0.23	7.56	0.23	7.56	0.0	Off
11	AD 15	4.67*	0.00	4.67	0.00	DrGrt	0.0	0.00	0.52	0.83	0.63	Sag	2.00	0.020	0.020	0.013	2.80	281.76	2.80	281.76	0.0	Off
12	AD 16	0.11	0.00	0.11	0.00	DrGrt	0.0	0.00	0.52	0.83	0.63	Sag	2.00	0.020	0.020	0.000	0.05	7.41	0.05	7.41	0.0	Off
13	CCB 7	2.26	0.00	2.26	0.00	Comb	4.0	2.73	3.12	2.31	1.35	Sag	2.53	0.031	0.031	0.000	0.30	9.80	0.30	9.80	0.0	Off
14	AD 20	0.52	0.00	0.52	0.00	DrGrt	0.0	0.00	0.52	0.83	0.63	Sag	2.00	0.020	0.020	0.013	0.15	17.25	0.15	17.25	0.0	Off
15	CCB 8	3.03	0.00	3.03	0.00	Comb	4.0	2.73	3.12	2.31	1.35	Sag	2.53	0.031	0.031	0.000	0.36	11.68	0.36	11.68	0.0	Off
16	CCB 9	5.81*	0.00	5.81	0.00	Comb	4.0	2.73	3.12	2.31	1.35	Sag	2.53	0.031	0.031	0.000	0.54	17.46	0.54	17.46	0.0	Off
17	CCB 17	0.20	0.00	0.20	0.00	Comb	4.0	2.73	0.00	2.31	1.35	0.020	2.53	0.031	0.031	0.013	0.08	2.46	0.00	0.00	0.0	Off

Project File: System 210.stm

Number of lines: 17

Run Date: 1/8/2021

NOTES: Inlet N-Values = 0.016; Intensity = 44.23 / (Inlet time + 3.90) ^ 0.72; Return period = 25 Yrs. ; * Indicates Known Q added. All curb inlets are throat.

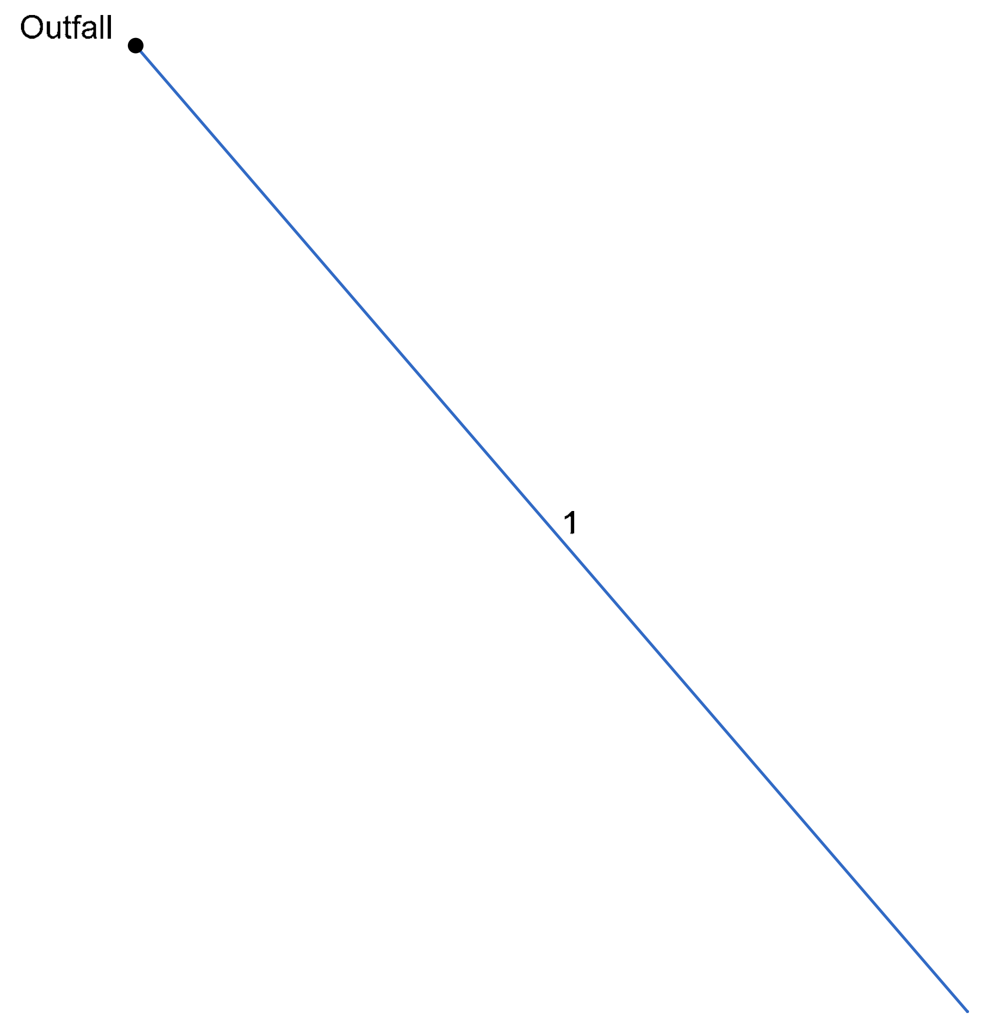
Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	24	18.99	56.00	60.03	2.00	3.14	6.05	0.57	60.60	0.601	31.000	57.00	60.22	2.00	3.14	6.04	0.57	60.78	0.601	0.601	0.186	2.04	1.16
2	24	13.33	57.00	61.38	2.00	3.14	4.25	0.28	61.66	0.296	194.000	58.80	61.95	2.00	3.14	4.24	0.28	62.23	0.296	0.296	0.575	0.78	0.22
3	8	1.63	63.00	63.40	0.40*	0.22	7.46	0.39	63.79	0.000	29.000	64.00	64.59	0.59**	0.33	4.99	0.39	64.98	0.000	0.000	n/a	1.13	n/a
4	8	1.32	64.00	64.59	0.59	0.30	4.04	0.29	64.88	0.000	27.000	64.30	64.84 j	0.54**	0.30	4.35	0.29	65.14	0.000	0.000	n/a	1.00	0.29
5	24	12.27	58.80	62.17	2.00	3.14	3.91	0.24	62.41	0.251	93.000	59.40	62.40	2.00	3.14	3.90	0.24	62.64	0.251	0.251	0.233	1.26	0.30
6	18	3.20	59.80	62.70	1.50	1.77	1.81	0.05	62.75	0.079	110.000	61.20	62.79	1.50	1.77	1.81	0.05	62.84	0.079	0.079	0.087	1.50	0.08
7	12	0.65	65.50	65.78	0.28*	0.18	3.66	0.12	65.90	0.000	20.000	65.70	66.04	0.34**	0.23	2.82	0.12	66.16	0.000	0.000	n/a	0.84	n/a
8	12	0.33	65.70	66.04	0.34	0.14	1.43	0.08	66.12	0.000	20.000	66.00	66.24 j	0.24**	0.14	2.33	0.08	66.32	0.000	0.000	n/a	1.00	n/a
9	15	2.09	61.40	62.86	1.25	0.55	1.70	0.04	62.91	0.089	116.000	62.70	63.28 j	0.58**	0.55	3.78	0.22	63.50	0.474	0.281	n/a	1.50	0.33
10	12	1.44	63.00	63.45	0.45*	0.34	4.20	0.20	63.65	0.000	87.000	63.70	64.21	0.51**	0.40	3.59	0.20	64.41	0.000	0.000	n/a	1.00	0.20
11	12	4.75	57.00	61.38	1.00	0.75	6.05	0.57	61.94	1.518	81.000	62.20	63.10 j	0.90**	0.75	6.37	0.63	63.73	1.333	1.426	n/a	0.62	n/a
12	12	0.11	62.20	63.10	0.90	0.06	0.15	0.05	63.15	0.000	82.000	64.00	64.14 j	0.14**	0.06	1.73	0.05	64.18	0.000	0.000	n/a	1.00	n/a
13	24	9.84	59.40	62.70	2.00	3.14	3.13	0.15	62.85	0.161	98.000	60.50	62.86	2.00	3.14	3.13	0.15	63.01	0.161	0.161	0.158	1.50	0.23
14	12	0.52	60.50	63.09	1.00	0.20	0.67	0.01	63.09	0.018	71.000	62.90	63.20 j	0.30**	0.20	2.61	0.11	63.31	0.467	0.242	0.172	1.00	0.11
15	24	7.96	61.00	63.09	2.00	3.14	2.53	0.10	63.19	0.106	68.000	61.60	63.11	1.51	2.55	3.12	0.15	63.26	0.124	0.115	0.078	1.41	0.21
16	15	5.81	61.80	63.33	1.25	1.03	4.73	0.35	63.67	0.689	86.000	63.00	63.97 j	0.97**	1.03	5.66	0.50	64.47	0.760	0.724	n/a	1.00	0.50
17	12	0.20	57.00	61.38	1.00	0.10	0.26	0.00	61.38	0.003	62.000	62.60	62.79 j	0.19**	0.10	2.04	0.06	62.85	0.500	0.252	n/a	1.00	n/a

Project File: System 210.stm	Number of lines: 17	Run Date: 1/8/2021

Notes: * depth assumed; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: Outlet 210.stm	Number of lines: 1	Date: 12/7/2020

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	71.000	49.384	MH	9.25	0.00	0.00	0.0	55.50	0.70	56.00	18	Cir	0.012	1.00	61.17	FES 210-OCS 210

Project File: Outlet 210.stm	Number of lines: 1	Date: 12/7/2020

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	71.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	9.25	9.55	6.16	18	0.70	55.50	56.00	56.67	57.20	56.55	61.17	FES 210-OCS 21

Project File: Outlet 210.stm

Number of lines: 1

Run Date: 12/7/2020

NOTES:Intensity = 53.32 / (Inlet time + 3.60) ^ 0.71; Return period =Yrs. 100 ; c = cir e = ellip b = box

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	18	9.25	55.50	56.67	1.17	1.48	6.23	0.60	57.28	0.722	71.000	56.00	57.20	1.20	1.52	6.09	0.58	57.78	0.689	0.706	0.501	1.00	0.58

Project File: Outlet 210.stm	Number of lines: 1	Run Date: 12/7/2020

; c = cir e = ellip b = box

Outlet Protection Calculations

Project:	343 Clintonville Road (MMI: 2709-13)	By:	KVN	Date:	01/08/21
Location:	North Haven, Connecticut	Checked:		Date:	
Outlet I.D.	**FES 1**				

*Based on Connecticut DOT Drainage Manual, Section 11.13

Description:

Preformed Scour Hole at FES 1

Design Criteria (25-yr Storm Event):

Q (cfs) =	18.99	R_p (ft)=	2
D (in) =	24	S_p (ft) =	2
V (fps) =	6.05	Tw (ft)=	4.03

Q= Flow rate at discharge point in cubic feet per second (cfs)
D= Outlet pipe diameter (in)
V= Flow velocity at discharge point (ft/s)
R_p= Maximum inside pipe rise (ft)
S_p= inside diametere for circular sections of maximum inside pipe span for non-circular sections (ft)
T_w= Tailwater depth (ft)

Based on **Table 11.13.1,** A *Preformed Scour Hole* is used *One Half Pipe Rise Depression (Type 1)*

Rip Rap Stone Size:

D_{50} Computed (in)	Rip Rap Specification	D_{50} Stone Size Required
0.7	Modified	5 inches

Preformed Scour Hole Dimensions:

F = 0.5(R_p)	=	1 ft
C = 3.0(S_p)+6.0(F)	=	12 ft
B = 2.0(S_p)+6.0(F)	=	10 ft
d (Depth of Stone)	=	12 inches

Level Spreader Design

Level Spreader 210

Broad Crest Elevation (ft)	56.00	
Length (ft)	**20**	
Discharge Coefficient	3.2	
Elevation Increment	0.02	
Q-100 year (cfs)	9.25	(DET 210 Discharge)

Elevation (Feet)	**Weir Discharge (cfs)**	**Area (sf)**	**Velocity (fps)**
56.00	0.00	0.00	0.00
56.02	0.18	0.40	0.45
56.04	0.51	0.80	0.64
56.06	0.94	1.20	0.78
56.08	1.45	1.60	0.91
56.10	2.02	2.00	1.01
56.12	2.66	2.40	1.11
56.14	3.35	2.80	1.20
56.16	4.10	3.20	1.28
56.18	4.89	3.60	1.36
56.20	5.72	4.00	1.43
56.22	6.60	4.40	1.50
56.24	7.52	4.80	1.57
56.26	8.48	5.20	1.63
56.28	9.48	5.60	1.69

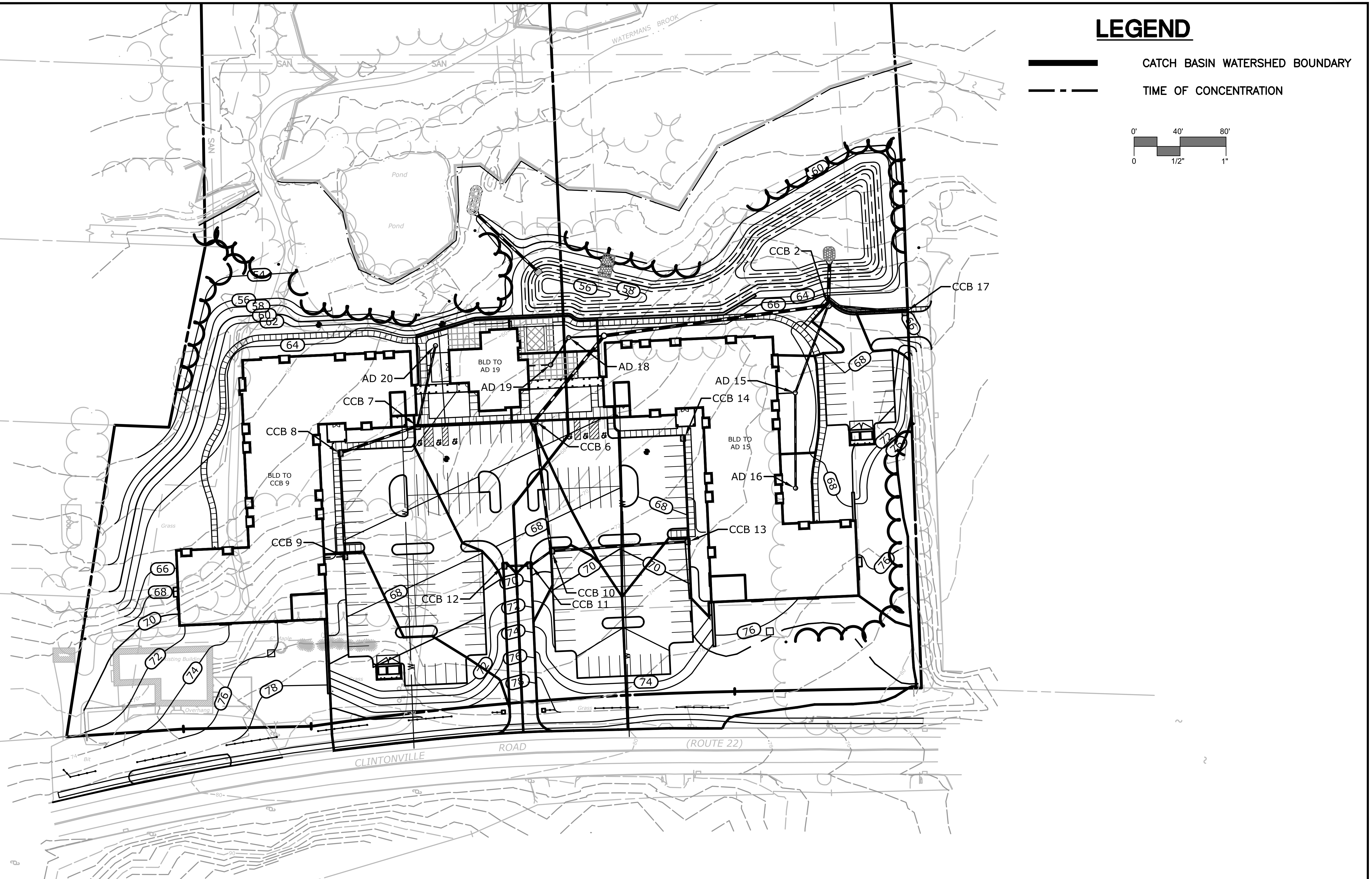
Drawing: C:\USERS\ARONS\APPDATA\LOCAL\TEMP\ACPUBLISH_13196\CB AREAS.DWG Layout Tab:11X17

Plotted by: ARONS On this date: Fri, 2021 January 8 – 10:29am

LEGEND

CATCH BASIN WATERSHED BOUNDARY

TIME OF CONCENTRATION



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REVISIONS

CATCH BASIN AREA MAP

MULTIFAMILY DEVELOPMENT

343 CLINTONVILLE ROAD
NORTH HAVEN, CONNECTICUT

DESIGNED	DRAWN	CHECKED
KVN	KVN	FAB

SCALE: 1"=80'

DATE: JANUARY 8, 2021

PROJECT NO. 2709-13

SHEET NO. CB

ATTACHMENT D

WATER QUALITY COMPUTATIONS

STORMWATER QUALITY CALCULATIONS:
Water Quality Volume

Basin ID	**Total Area (ac.)**	**Impervious Area (ac.)**	**Percent Impervious**	**Volumetric Runoff Coeff., R**	**WQV (ac-ft)**	**Total Volume Required (ac-ft)**	**Total Volume Provided (ac-ft)**
DET 210	5.020	2.984	59%	0.58	0.245	**0.245**	*0.254*

$$\textbf{WQV} = \frac{(1.0 \text{ inches}) \times A \times R}{12}$$

Where: WQV = Water Quality Volume in acre-feet

A = Contributing Area in acres

R = 0.05 + 0.009 (I)

I = Site Imperviousness as percent

STORMWATER QUALITY CALCULATIONS
Total Storage Volume Provided

Detention Basin 110:

Elevation (ft)	Surface Area (ft2)	Volume (ft3)	Volume (ac-ft)	Cumulative Volume (ac-ft)
56.0	4,392	0.0	0.000	**0.000**
57.0	5,850	5,121.0	0.118	**0.118**
57.9	7,384	5,955.3	0.137	**0.254**

The following depicts sizing for the proposed stormwater treatment device (Contech CDS Unit) used to remove total suspended solids and other pollutants prior to discharge into the detention basin. Computations and supportive documentation have been included within the Engineering Report.

CDS Unit (MH 2)

WQF = 2.31 cubic feet per second, cfs

Model: *CDS2025-5* (5’ MH Diameter)

	MILONE AND MACBROOM, INC.	Project	2709-13
	COMPUTATION SHEET	Made By:	KVN
Subject:	Proposed Elderly Housing Development 343 Clintonville Road, North Haven, CT	Date:	12/8/2020
		Chkd by:	
		Date:	

MH 2 (CDS UNIT)

Contributing Basins	Wooded Area (acres)	Grass Area (acres)	Imperv. Area (acres)	Total Area (acres)
Total	0.2	1.35	2.86	4.37

Table 4.1: WQV = (P)(R_v)(A)/12 = 0.233 acre-feet

Where:

I = % of Impervious Cover = 65%

R_v = volumetric runoff coeff. 0.05 + 0.009(I) = 0.639

P = design precipitation (1.0" for water quality storm) = 1 inch

A = site area (acres) = 4.37 acres = 0.0068 $miles^2$

Q = runoff depth (in watershed inches) = [WQV(acrefeet)]*[12(inches/foot)]/drainage area (acres)

Q = 0.639

CN = 1000 / [10+ 5P + 10Q -10(Q^2 + 1.25QP)$^{0.5}$] = 96

Where:

Q = runoff depth (in watershed inches)

t_c = 0.278 hours

Type III Rainfall Distribution:

From Table 4-1, Ia = 0.083 Ia/P = 0.083

(TR-55)

From Exhibit 4-III, q_u = 530 csm/in.

(TR-55)

WQF = (qu)(A)(Q) = 2.31 cfs

2. Compute the time of concentration (t_c) based on the methods described in Chapter 3 of TR-55. A minimum value of 0.167 hours (10 minutes) should be used. For sheet flow, the flow path should not be longer than 300 feet.

3. Using the computed CN, t_c, and drainage area (A) in acres, compute the peak discharge for the water quality storm (i.e., the water quality flow [WQF]), based on the procedures described in Chapter 4 of TR-55.

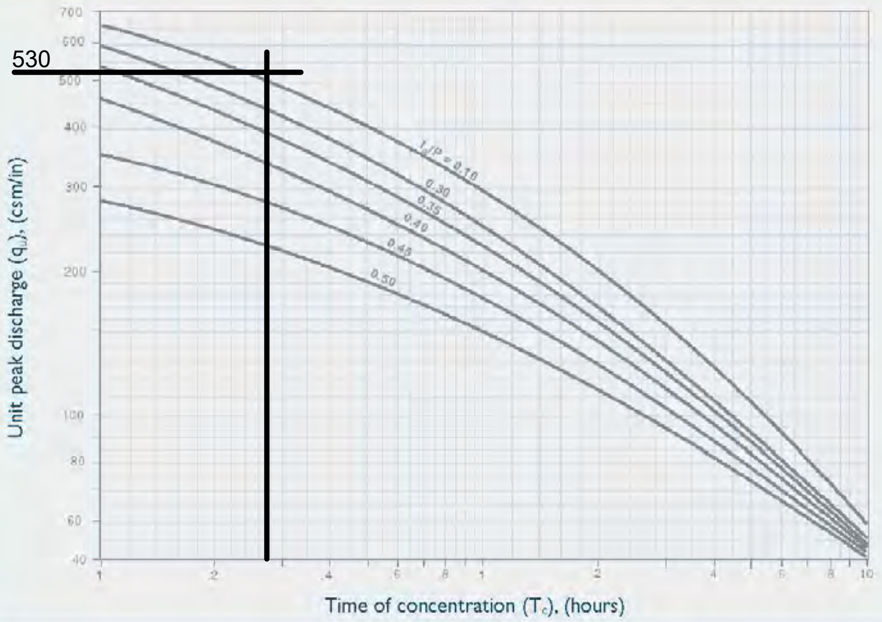
   ○ *Read initial abstraction (I_a) from Table 4-1 in Chapter 4 of TR-55 (reproduced below); compute I_a/P*

Table 4-1 I_a values for runoff curve numbers

Curve number	I_a (in)	Curve number	I_a (in)	Curve number	I_a (in)	Curve number	I_a (in)
40	3.000	55	1.636	70	0.857	85	0.353
41	2.878	56	1.571	71	0.817	86	0.326
42	2.762	57	1.509	72	0.778	87	0.299
43	2.651	58	1.448	73	0.740	88	0.273
44	2.545	59	1.390	74	0.703	89	0.247
45	2.444	60	1.333	75	0.667	90	0.222
46	2.348	61	1.279	76	0.632	91	0.198
47	2.255	62	1.226	77	0.597	92	0.174
48	2.167	63	1.175	78	0.564	93	0.151
49	2.082	64	1.125	79	0.532	94	0.128
50	2.000	65	1.077	80	0.500	95	0.105
51	1.922	66	1.030	81	0.469	96	0.083
52	1.846	67	0.985	82	0.439	97	0.062
53	1.774	68	0.941	83	0.410	98	0.041
54	1.704	69	0.899	84	0.381		

   ○ *Read the unit peak discharge (q_u) from Exhibit 4-III in Chapter 4 of TR-55 (reproduced below) for appropriate t_c*

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



Product Flow Rates

CASCADE

Model	Treatment Rate (cfs)	Sediment Capacity[1] (CF)
CS-4	2.00	19
CS-5	3.50	29
CS-6	5.60	42
CS-8	12.00	75
CS-10	18.00	118

CDS

Model	Treatment Rate[2] (cfs)	Sediment Capacity[1] (CF)
1515-3	1.00	14
2015-4	1.40	25
2015-5	1.40	39
2015-6	1.40	57
2020-5	2.20	39
2020-6	2.20	57
2025-5	3.20	39
2025-6	3.20	57
3020-6	3.90	57
3025-6	5.00	57
3030-6	5.70	57
3035-6	6.50	57
4030-8	7.50	151
4040-8	9.50	151

VORTECHS

Model	Treatment Rate (cfs)	Sediment Capacity[3] (CF)
1000	1.60	16
2000	2.80	32
3000	4.50	49
4000	6.00	65
5000	8.50	86
7000	11.00	108
9000	14.00	130
11000	17.5	151
16000	25	192

STORMCEPTOR STC

Model	Treatment Rate (cfs)	Sediment Capacity[1] (CF)
STC 450i	0.40	46
STC 900	0.89	89
STC 2400	1.58	205
STC 4800	2.47	543
STC 7200	3.56	839
STC 11000	4.94	1086
STC 16000	7.12	1677

[1] *Additional sediment storage capacity available – Check with your local representative for information.*

[2] *Treatment Capacity is based on laboratory testing using OK-110 (average D50 particle size of approximately 100 microns) and a 2400 micron screen.*

[3] *Maintenance recommended when sediment depth has accumulated to within 12-18 inches of the dry weather water surface elevation.*

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It's my job to recommend the best solution to meet permitting requirements.

STORMWATER DESIGN ENGINEER

I work with consultants to design the best approved solution to meet your project's needs.

REGULATORY MANAGER

I understand the local stormwater regulations and what solutions will be approved.

SALES ENGINEER

I make sure our solutions meet the needs of the contractor during construction.

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Removing Pollutants using Hydrodynamic Separation

Utilize high-performance hydrodynamic separation to effectively remove finer sediment, oil and grease, and floating and sinking debris.

CASCADE separator™

CDS®

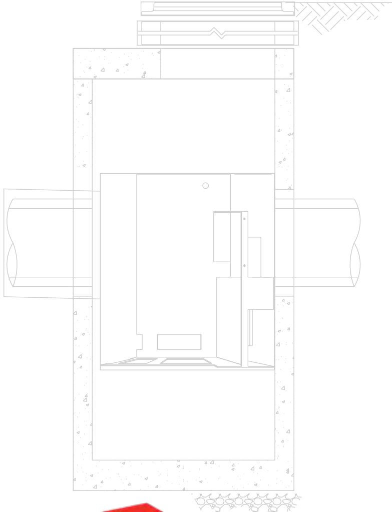
Vortechs®

Stormceptor® STC

HDS systems play a vital role in protecting our waterways by removing high levels of sediment, trash, debris, and hydrocarbons from stormwater runoff.

Frequently used as end-of-pipe solutions, they are also used to provide stormwater quality treatment in places where space is limited.

HDS systems capture and retain a variety of stormwater pollutants and are very easy to maintain. These two key benefits have resulted in new uses for HDS technologies, such as pretreating detention, Low Impact Development, and green infrastructure practices, as well as other land-based stormwater treatment systems.

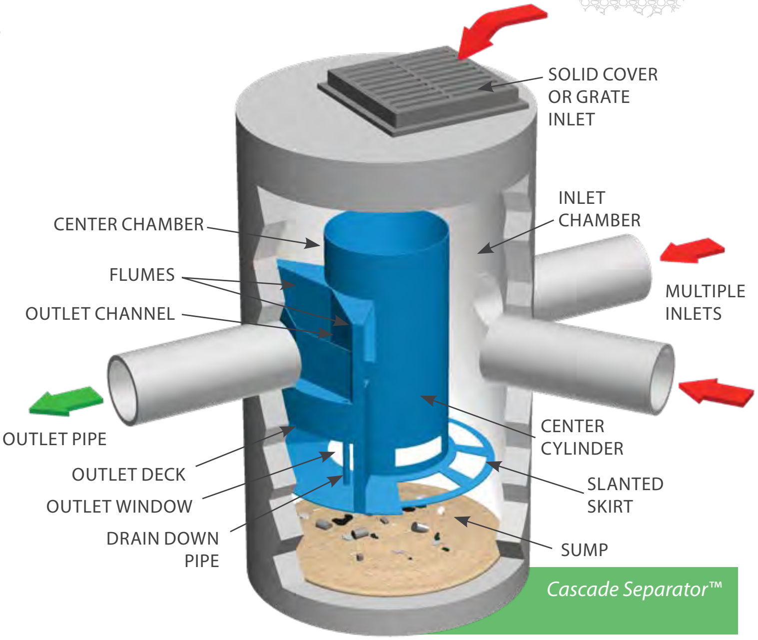


The Cascade Separator™ System

Advanced Sediment Capture Technology ...

The Cascade Separator™ is the newest innovation in stormwater treatment from Contech. The Cascade Separator was developed by Contech's stormwater experts using advanced modeling tools and Contech's industry leading stormwater laboratory.

This innovative hydrodynamic separator excels at sediment capture and retention while also removing hydrocarbons, trash, and debris from stormwater runoff. What makes the Cascade Separator unique is the use of opposing vortices that enhance particle settling and a unique skirt design that allows for sediment transport into the sump while reducing turbulence and resuspension of previously captured material. These two factors allow the Cascade Separator to treat high flow rates in a small footprint, resulting in an efficient and economical solution for any site.



Cascade Separator™

FEATURE	BENEFIT
Unique skirt design & opposing vortices	Superior TSS removal; reduced system size and costs
Inlet area accepts wide range of inlet pipe angles	Design and installation flexibility
Accepts multiple inlet pipes	Eliminates the need for separate junction structure
Grate inlet option	Eliminates the need for a separate grate inlet structure
Internal bypass	Eliminates the need for a separate bypass structure
Clear access to sump and stored pollutants	Fast, easy maintenance

Learn More:
www.ContechES.com/cascade

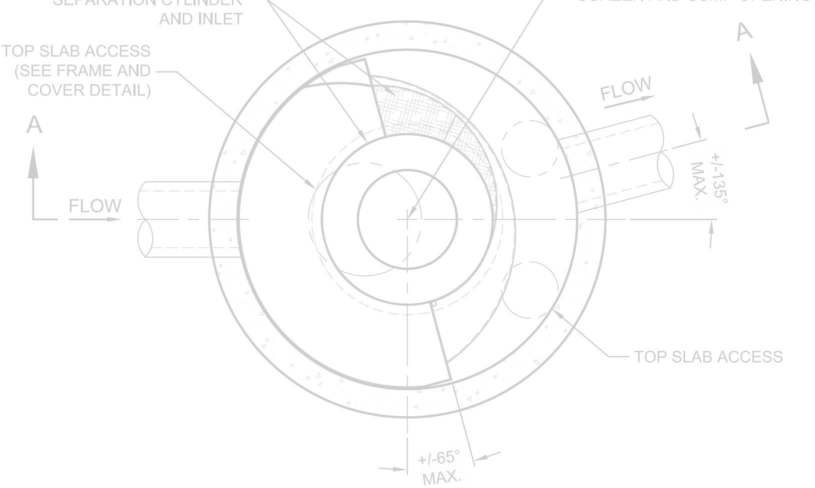
SELECT CASCADE APPROVALS

- New Jersey Department of Environmental Protection Certification (NJDEP)

CASCADE MAINTENANCE

Cascade provides unobstructed access to stored pollutants, making it easy to maintain using a vacuum truck, with no requirement to enter the unit.

Setting new standards in Stormwater Treatment

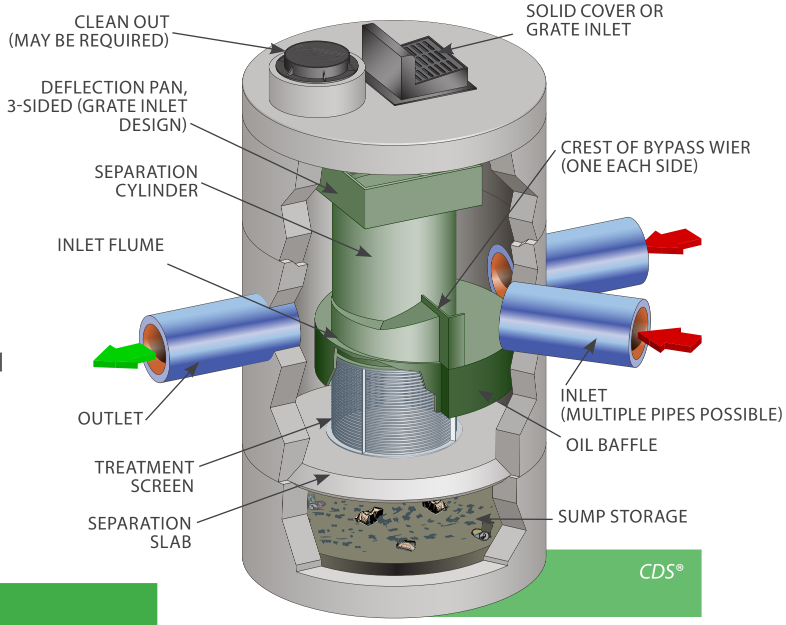


The CDS® System

Superior TSS and Trash Removal ...

The CDS is a hybrid technology that uses a combination of swirl concentration and indirect screening to separate and trap sediment, trash, debris, and hydrocarbons from stormwater runoff.

At the heart of the CDS system is a unique screening technology used to capture and retain sediment. The screen face is louvered so that it is smooth in the downstream direction. The effect created is called "Continuous Deflective Separation." The power of the incoming flow is harnessed to continually shear debris off the screen and to direct trash and sediment toward the center of the separation cylinder. This results in a screen that is self-cleaning and provides 100% removal of floatables and neutrally buoyant material debris 2.4 mm or larger, without blinding.



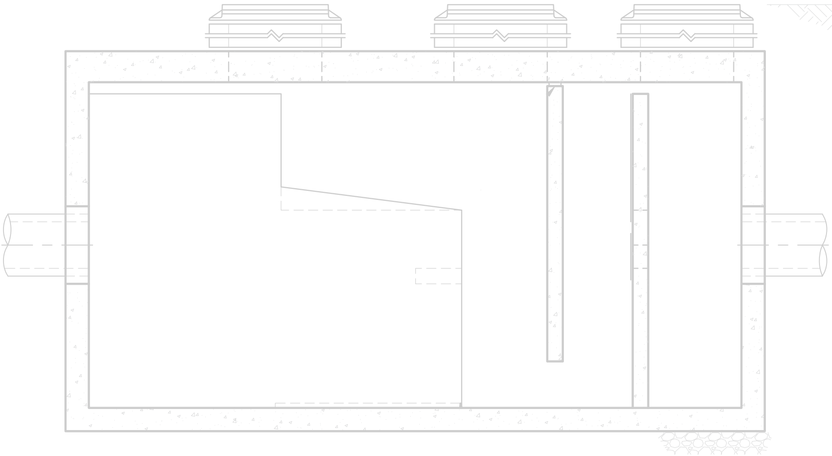
FEATURE	BENEFIT
Unique flow path and isolated storage sump	Excellent TSS capture and retention
Captures and retains 100% of floatables and neutrally buoyant debris 2.4 MM or larger	Superior trash removal
Self-cleaning screen	Ease of maintenance
Inline, offline, multiple inlet pipes, grate inlet, and drop inlet configurations available	Design flexibility
Internal bypass	Eliminates the need for additional structures
Clear access to sump and stored pollutants	Fast, easy maintenance

Learn More:
www.ContechES.com/cds

SELECT CDS APPROVALS

- Washington Department of Ecology (GULD) – Pretreatment
- New Jersey Department of Environmental Protection Certification (NJDEP)
- Canadian Environmental Technology Verification (ETV)
- MASTEP
- Connecticut DOT

The CDS system has been accepted and used extensively in all New England states for over 20 years with thousands of installations.



The Vortechs® System

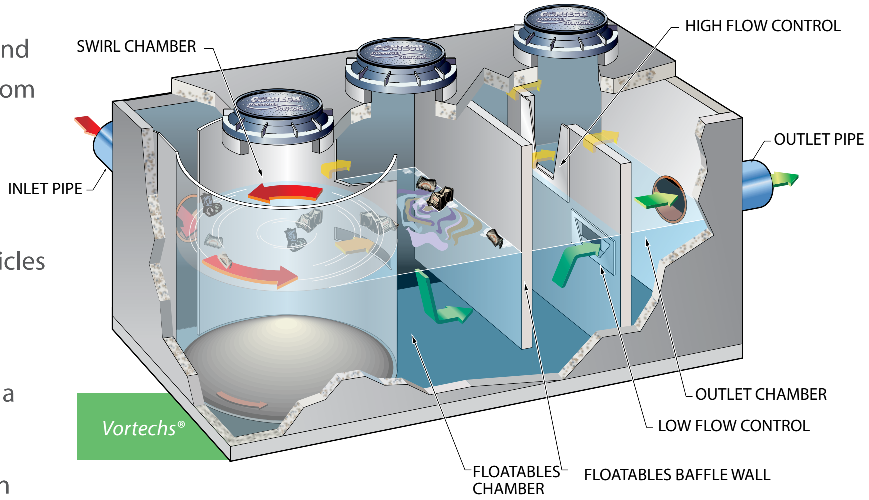
Stormwater Treatment in a Shallow Footprint ....

Vortechs combines swirl concentration and flow controls into a single treatment unit that captures and retains trash, debris, sediment, and hydrocarbons from stormwater runoff.

The Vortechs system's large swirl chamber and flow controls work together to create a low energy environment, ideal for capturing and retaining particles down to 50 microns.

Vortechs is the ideal solution for sites with high groundwater, bedrock, utility conflicts, or sites with a large volume runoff.

The Vortechs System is approved by the Washington Department of Ecology (GULD) - Pretreatment.



Learn More:
www.ContechES.com/vortechs

SELECT VORTECHS APPROVALS

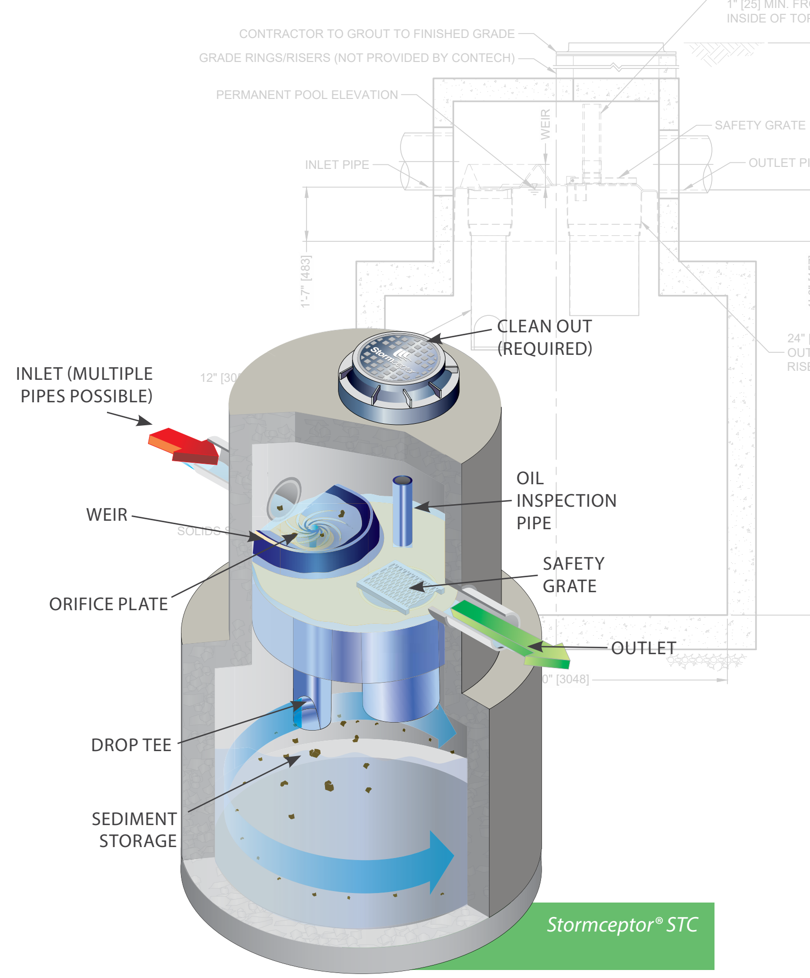
- Washington Department of Ecology (GULD) – Pretreatment
- MASTEP
- Connecticut DOT

FEATURE	BENEFIT
Large swirl chamber	Fine particle removal down to 50 microns
Shallow profile – Typical depth below pipe invert is only 3 feet.	Can be used on sites with high groundwater, bedrock, or utility conflicts
Unobstructed access to stored pollutants	Fast, easy maintenance

The Vortechs System was developed in New England and has been used extensively in the region for over 20 years.

The ideal solution for sites with high groundwater

Stormceptor® STC



Stormceptor STC is the recognized leader in stormwater treatment, offering a range of versatile treatment systems that effectively remove pollutants from stormwater and snowmelt runoff. Stormceptor is flexibly designed to protect waterways from hazardous material spills and stormwater pollution, including suspended sediment, free oils, and other pollutants that attach to particles, no matter how fierce the storm.

Stormceptor's scour prevention technology ensures pollutants are captured and contained during all rainfall events.

Ideal uses

- Sediment (TSS) removal
- Spill control
- Debris and small floatables capture
- Pretreatment for filtration, detention/retention systems, ponds, wetlands, Low Impact Development (LID), green infrastructure, and water-sensitive urban design

Proven performance

With more than 20 years of industry experience, Stormceptor has been performance tested and verified by some of the most stringent technology evaluation programs in North America.

- NJCAT
- Washington Ecology to Washington Department of Ecology (GULD) – Pretreatment
- EN858 Class 2

Learn More:
www.ContechES.com/stormceptor

FEATURE	BENEFIT
Patented scour prevention technology	Superior pollutant removal and retention
Can take the place of a conventional junction or inlet structure	Eliminates the need for additional structures
Minimal drop between inlet and outlet	Site flexibility
Multiple inlets can connect to a single unit	Design flexibility
3rd party tested and verified performance (Sediment & Oil)	Eliminates the need for a separate bypass structure

With over 40,000 units operating worldwide, Stormceptor performs and protects every day, in every storm.

Product Flow Rates

CASCADE

Model	Treatment Rate (cfs)	Sediment Capacity[1] (CF)
CS-4	2.00	19
CS-5	3.50	29
CS-6	5.60	42
CS-8	12.00	75
CS-10	18.00	118

CDS

Model	Treatment Rate[2] (cfs)	Sediment Capacity[1] (CF)
1515-3	1.00	14
2015-4	1.40	25
2015-5	1.40	39
2015-6	1.40	57
2020-5	2.20	39
2020-6	2.20	57
2025-5	3.20	39
2025-6	3.20	57
3020-6	3.90	57
3025-6	5.00	57
3030-6	5.70	57
3035-6	6.50	57
4030-8	7.50	151
4040-8	9.50	151

VORTECHS

Model	Treatment Rate (cfs)	Sediment Capacity[3] (CF)
1000	1.60	16
2000	2.80	32
3000	4.50	49
4000	6.00	65
5000	8.50	86
7000	11.00	108
9000	14.00	130
11000	17.5	151
16000	25	192

STORMCEPTOR STC

Model	Treatment Rate (cfs)	Sediment Capacity[1] (CF)
STC 450i	0.40	46
STC 900	0.89	89
STC 2400	1.58	205
STC 4800	2.47	543
STC 7200	3.56	839
STC 11000	4.94	1086
STC 16000	7.12	1677

1 Additional sediment storage capacity available – Check with your local representative for information.

2 Treatment Capacity is based on laboratory testing using OK-110 (average D50 particle size of approximately 100 microns) and a 2400 micron screen.

3 Maintenance recommended when sediment depth has accumulated to within 12-18 inches of the dry weather water surface elevation.

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Revision 10/19

ATTACHMENT E

HYDROLOGIC ANALYSIS – INPUT COMPUTATIONS

NOAA Atlas 14, Volume 10, Version 3
Location name: North Haven, Connecticut, USA*
Latitude: 41.3925°, Longitude: -72.8368°
Elevation: 70.55 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	**2**	**5**	**10**	**25**	**50**	**100**	**200**	**500**	**1000**
5-min	**0.343** (0.269-0.426)	**0.415** (0.325-0.517)	**0.534** (0.416-0.665)	**0.632** (0.490-0.794)	**0.768** (0.576-1.01)	**0.869** (0.639-1.17)	**0.976** (0.696-1.37)	**1.10** (0.739-1.57)	**1.27** (0.824-1.89)	**1.42** (0.896-2.15)
10-min	**0.486** (0.380-0.603)	**0.588** (0.460-0.732)	**0.756** (0.590-0.943)	**0.895** (0.693-1.12)	**1.09** (0.816-1.43)	**1.23** (0.904-1.66)	**1.38** (0.987-1.94)	**1.56** (1.05-2.23)	**1.80** (1.17-2.68)	**2.01** (1.27-3.04)
15-min	**0.571** (0.448-0.710)	**0.692** (0.542-0.861)	**0.890** (0.694-1.11)	**1.05** (0.817-1.32)	**1.28** (0.960-1.68)	**1.45** (1.07-1.95)	**1.63** (1.16-2.28)	**1.83** (1.23-2.62)	**2.12** (1.38-3.15)	**2.36** (1.49-3.58)
30-min	**0.792** (0.620-0.984)	**0.958** (0.749-1.19)	**1.23** (0.958-1.53)	**1.45** (1.13-1.83)	**1.76** (1.32-2.32)	**2.00** (1.47-2.69)	**2.24** (1.60-3.14)	**2.52** (1.70-3.61)	**2.92** (1.89-4.34)	**3.25** (2.06-4.93)
60-min	**1.01** (0.793-1.26)	**1.22** (0.957-1.52)	**1.57** (1.22-1.96)	**1.85** (1.44-2.33)	**2.25** (1.69-2.96)	**2.54** (1.87-3.42)	**2.85** (2.04-4.00)	**3.21** (2.16-4.59)	**3.72** (2.41-5.52)	**4.14** (2.62-6.28)
2-hr	**1.33** (1.05-1.64)	**1.60** (1.26-1.97)	**2.03** (1.60-2.52)	**2.40** (1.87-2.99)	**2.89** (2.19-3.79)	**3.27** (2.42-4.37)	**3.66** (2.63-5.11)	**4.12** (2.79-5.87)	**4.80** (3.12-7.08)	**5.36** (3.40-8.08)
3-hr	**1.54** (1.22-1.90)	**1.85** (1.47-2.28)	**2.35** (1.86-2.90)	**2.77** (2.17-3.44)	**3.34** (2.54-4.36)	**3.77** (2.80-5.03)	**4.23** (3.05-5.88)	**4.76** (3.23-6.75)	**5.56** (3.62-8.17)	**6.22** (3.96-9.34)
6-hr	**1.96** (1.57-2.39)	**2.35** (1.88-2.87)	**2.99** (2.38-3.67)	**3.52** (2.78-4.35)	**4.26** (3.25-5.51)	**4.80** (3.59-6.37)	**5.38** (3.91-7.45)	**6.07** (4.14-8.55)	**7.11** (4.65-10.4)	**7.98** (5.09-11.9)
12-hr	**2.42** (1.95-2.94)	**2.93** (2.35-3.55)	**3.74** (3.00-4.56)	**4.42** (3.52-5.42)	**5.36** (4.12-6.90)	**6.05** (4.56-7.98)	**6.80** (4.97-9.35)	**7.69** (5.26-10.8)	**9.02** (5.92-13.1)	**10.2** (6.50-15.0)
24-hr	**2.85** (2.31-3.42)	**3.48** (2.82-4.19)	**4.51** (3.64-5.45)	**5.36** (4.30-6.52)	**6.54** (5.07-8.38)	**7.41** (5.63-9.74)	**8.36** (6.17-11.5)	**9.52** (6.54-13.2)	**11.3** (7.43-16.3)	**12.8** (8.23-18.9)
2-day	**3.19** (2.61-3.81)	**3.97** (3.24-4.74)	**5.23** (4.25-6.28)	**6.28** (5.07-7.59)	**7.73** (6.04-9.87)	**8.79** (6.73-11.5)	**9.96** (7.43-13.7)	**11.4** (7.88-15.8)	**13.8** (9.11-19.8)	**15.9** (10.2-23.2)
3-day	**3.46** (2.84-4.12)	**4.32** (3.54-5.14)	**5.71** (4.66-6.82)	**6.86** (5.57-8.25)	**8.46** (6.64-10.8)	**9.62** (7.40-12.6)	**10.9** (8.18-15.0)	**12.6** (8.67-17.3)	**15.2** (10.0-21.7)	**17.5** (11.3-25.5)
4-day	**3.72** (3.06-4.41)	**4.62** (3.80-5.49)	**6.10** (5.00-7.27)	**7.32** (5.96-8.78)	**9.01** (7.10-11.4)	**10.2** (7.90-13.3)	**11.6** (8.72-15.9)	**13.4** (9.24-18.3)	**16.1** (10.7-22.9)	**18.6** (12.0-26.9)
7-day	**4.43** (3.67-5.22)	**5.43** (4.49-6.41)	**7.06** (5.82-8.36)	**8.41** (6.89-10.0)	**10.3** (8.12-12.9)	**11.6** (9.01-15.0)	**13.1** (9.88-17.8)	**15.0** (10.4-20.5)	**18.0** (11.9-25.4)	**20.5** (13.3-29.6)
10-day	**5.14** (4.27-6.03)	**6.19** (5.14-7.27)	**7.90** (6.54-9.33)	**9.32** (7.66-11.1)	**11.3** (8.94-14.1)	**12.7** (9.87-16.3)	**14.3** (10.7-19.2)	**16.2** (11.3-22.0)	**19.2** (12.8-27.0)	**21.7** (14.1-31.1)
20-day	**7.32** (6.14-8.54)	**8.45** (7.08-9.87)	**10.3** (8.59-12.1)	**11.8** (9.80-13.9)	**13.9** (11.1-17.2)	**15.5** (12.0-19.6)	**17.2** (12.9-22.5)	**19.1** (13.4-25.7)	**21.8** (14.6-30.4)	**24.1** (15.6-34.3)
30-day	**9.15** (7.71-10.6)	**10.3** (8.69-12.0)	**12.2** (10.3-14.3)	**13.8** (11.5-16.2)	**16.0** (12.8-19.6)	**17.7** (13.7-22.1)	**19.4** (14.5-25.1)	**21.2** (14.9-28.4)	**23.7** (15.9-32.9)	**25.7** (16.7-36.5)
45-day	**11.4** (9.68-13.2)	**12.6** (10.7-14.6)	**14.6** (12.3-17.0)	**16.3** (13.6-19.0)	**18.5** (14.8-22.5)	**20.3** (15.8-25.1)	**22.0** (16.4-28.2)	**23.7** (16.8-31.6)	**26.0** (17.5-35.9)	**27.7** (18.1-39.1)
60-day	**13.3** (11.3-15.4)	**14.6** (12.4-16.8)	**16.6** (14.0-19.2)	**18.3** (15.3-21.3)	**20.6** (16.5-24.9)	**22.4** (17.5-27.6)	**24.2** (18.0-30.7)	**25.8** (18.3-34.2)	**27.9** (18.8-38.4)	**29.3** (19.2-41.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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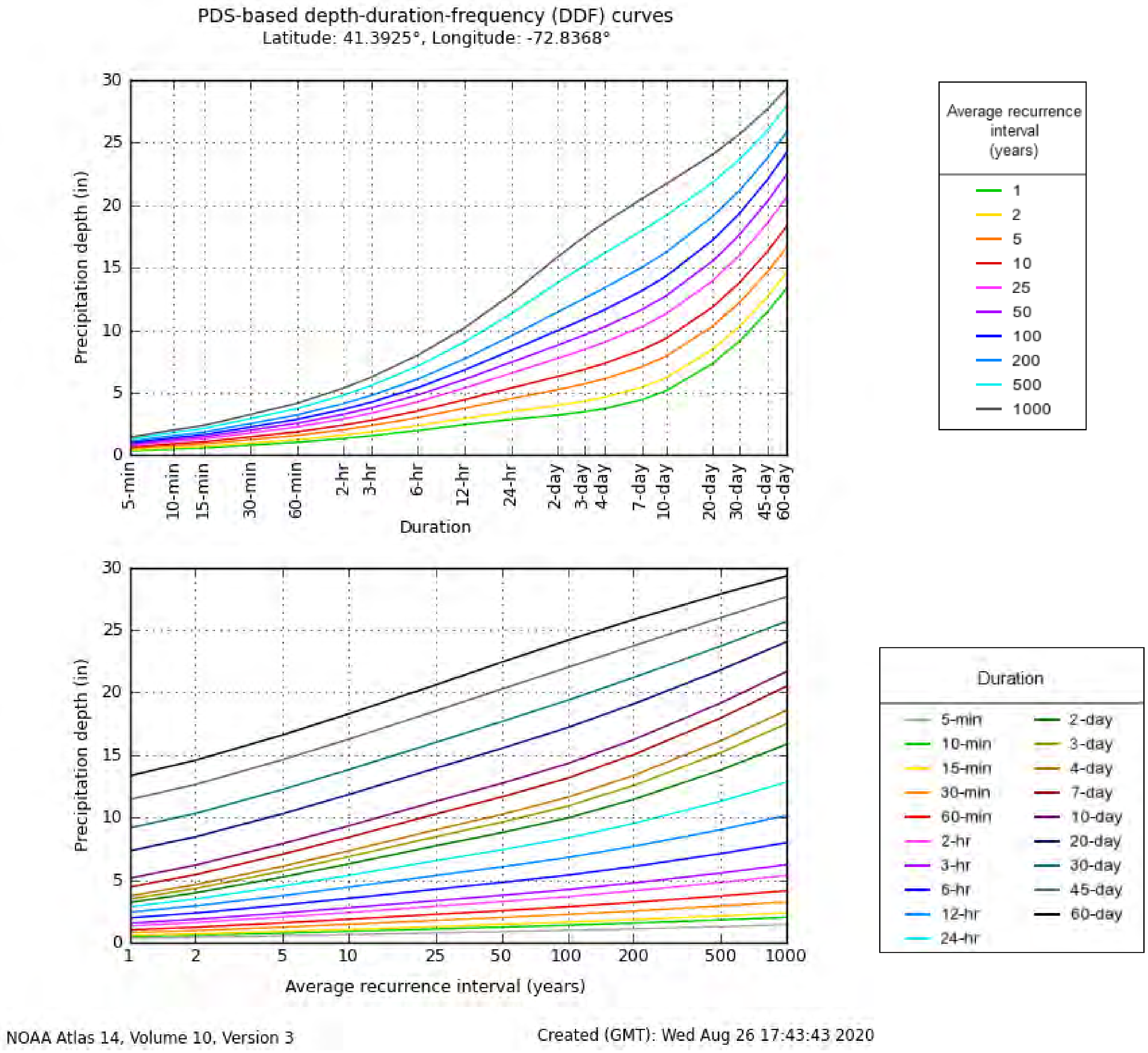
PF graphical



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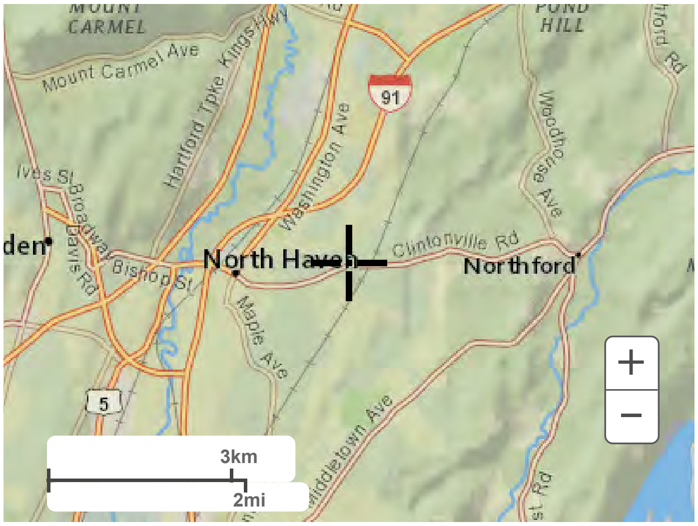
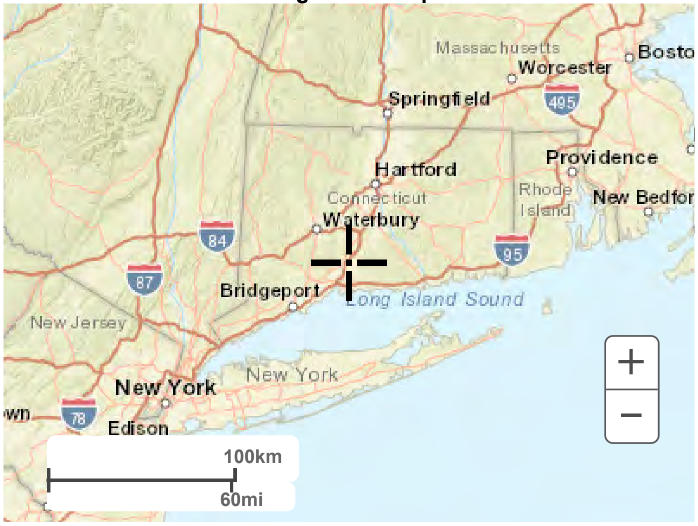
Maps & aerials

Small scale terrain

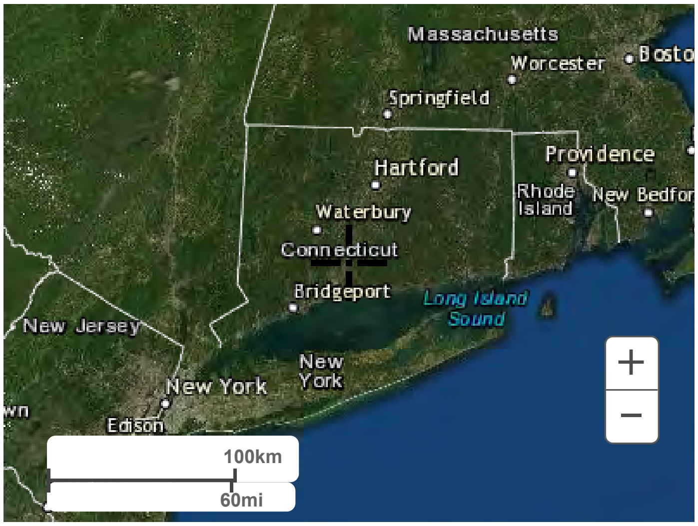


Large scale terrain

Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Worksheet 2: Runoff curve number and runoff

Project: Prop. Elderly Housing Development By: KVN Date: Rev.12/8/2020
Location: North Haven, CT (MMI# 2709-13) Checked: Date:
Circle one: [✓ ***Present***] Developed Watershed: WS 10 - Existing Conditions

1.) Runoff curve number (CN)

Soil Name and Hydrologic Group (appendix A)	**Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)**	**CN Value [1]**			**Area**	**Product of CN x Area**
		Table 2-2	**Figure 2-3**	**Figure 2-4**	[✓ **Acres**] Sq. Ft. %	
A	WOODS (GOOD)	30			0.247	7.42
A	OPEN SPACE (GOOD)	39			0.529	20.64
B	OPEN SPACE (GOOD)	61			0.009	0.57
A	STRAIGHT ROW CROPS (GOOD)	67			0.184	12.31
C	WOODS (GOOD)	70			0.020	1.43
A	GRAVEL	76			0.121	9.20
B	GRAVEL	85			0.007	0.55
N/A	IMPERVIOUS	98			0.198	19.36
N/A	EXISTING BUILDING	98			0.144	14.09
				Totals =	1.459	85.58

(0.00228 sq mi)

[1] Use only one CN value source per line.

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{85.58}{1.46}$$

Use CN = $\boxed{59}$

Worksheet 2: Runoff curve number and runoff

Project: Prop. Elderly Housing Development
By: KVN
Date: Rev.12/8/2020
Location: North Haven, CT (MMI# 2709-13)
Checked:
Date:
Circle one: [✓ ***Present***] Developed
Watershed: WS 20 - Existing Conditions

1.) Runoff curve number (CN)

Soil Name and Hydrologic Group **(appendix A)**	**Cover Description** **(cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)**	**CN Value [1]**			**Area** [✓ **Acres**] Sq. Ft. %	**Product of CN x Area**
		Table 2-2	**Figure 2-3**	**Figure 2-4**		
A	WOODS (GOOD)	30			1.951	58.52
A	OPEN SPACE (GOOD)	39			0.898	35.03
B	OPEN SPACE (GOOD)	61			0.028	1.73
A	STRAIGHT ROW CROPS (GOOD)	67			2.364	158.39
C	WOODS (GOOD)	70			0.450	31.51
C	OPEN SPACE (GOOD)	74			0.215	15.88
A	GRAVEL	76			0.113	8.60
B	GRAVEL	85			0.009	0.79
C	GRAVEL	89			0.021	1.86
N/A	EXISTING BUILDING	98			0.027	2.69
				Totals =	6.077	315.00

(0.00950 sq mi)

[1] Use only one CN value source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{315.00}{6.08}$ Use CN = $\boxed{52}$

Worksheet 2: Runoff curve number and runoff

Project: Prop. Elderly Housing Development By: KVN Date: Rev.12/8/2020
Location: North Haven, CT (MMI# 2709-13) Checked: Date:
Circle one: [✓ Present] Developed Watershed: WS 30 - Existing Conditions

1.) Runoff curve number (CN)

Soil Name and Hydrologic Group (appendix A)	**Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)**	**CN Value [1.]**			**Area** [✓ Acres] Sq. Ft. %	**Product of CN x Area**
		Table 2-2	**Figure 2-3**	**Figure 2-4**		
A	WOODS (GOOD)	30			0.038	1.15
A	OPEN SPACE (GOOD)	39			0.043	1.67
				Totals =	0.081	2.82

(0.00013 sq mi)

[1.] Use only one CN value source per line.

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{2.82}{0.08}$$

Use CN = 35

Worksheet 2: Runoff curve number and runoff

Project: Prop. Elderly Housing Development
By: KVN
Date: Rev.12/8/2020
Location: North Haven, CT (MMI# 2709-13)
Checked:
Date:
Circle one: [✓ Present] Developed
Watershed: WS 40 - Existing Conditions

1.) Runoff curve number (CN)

Soil Name and Hydrologic Group **(appendix A)**	**Cover Description** **(cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)**	**CN Value** [1]			**Area**	**Product of CN x Area**
		Table 2-2	**Figure 2-3**	**Figure 2-4**	[✓ **Acres**] Sq. Ft. %	
A	WOODS (GOOD)	30			0.087	2.61

Totals = 0.087 2.61

(0.00014 sq mi)

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{2.61}{0.09}$ Use CN = $\boxed{30}$

[1] Use only one CN value source per line.

Worksheet 2: Runoff curve number and runoff

Project: Prop. Elderly Housing Development
By: KVN
Date: Rev.12/8/2020
Location: North Haven, CT (MMI# 2709-13)
Checked:
Date:
Circle one: Present [✓ ***Developed***]
Watershed: WS 10 - Proposed Conditions

1.) Runoff curve number (CN)

Soil Name and Hydrologic Group (appendix A)	**Cover Description** (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	**CN Value** [1]			**Area**	**Product of CN x Area**
		Table 2-2	**Figure 2-3**	**Figure 2-4**	[✓ **Acres**] Sq. Ft. %	
A	WOODS (GOOD)	30			0.006	0.18
A	OPEN SPACE (GOOD)	39			1.148	44.79
B	OPEN SPACE (GOOD)	61			0.021	1.31
C	WOODS (GOOD)	70			0.012	0.87
C	OPEN SPACE (GOOD)	74			0.008	0.59
N/A	IMPERVIOUS	98			0.047	4.65
				Totals =	1.244	52.38

(0.00194 sq mi)

[1] Use only one CN value source per line.

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{52.38}{1.24}$$

Use CN = $\boxed{42}$

Worksheet 2: Runoff curve number and runoff

Project: Prop. Elderly Housing Development By: KVN Date: Rev.12/8/2020
Location: North Haven, CT (MMI# 2709-13) Checked: Date:
Circle one: Present [✓ ***Developed***] Watershed: WS 20 - Proposed Conditions

1.) Runoff curve number (CN)

Soil Name and Hydrologic Group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Value [1]			Area [✓ Acres] Sq. Ft. %	Product of CN x Area
		Table 2-2	Figure 2-3	Figure 2-4		
A	WOODS (GOOD)	30			0.178	5.33
A	OPEN SPACE (GOOD)	39			0.459	17.91
C	WOODS (GOOD)	70			0.376	26.29
C	OPEN SPACE (GOOD)	74			0.289	21.40
C	GRAVEL	89			0.021	1.84
N/A	IMPERVIOUS	98			0.030	2.91

[1] Use only one CN value source per line.

Totals = 1.352 75.70

(0.00211 sq mi)

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{75.70}{1.35}$ Use CN = $\boxed{56}$

Worksheet 2: Runoff curve number and runoff

Project: Prop. Elderly Housing Development
By: KVN
Date: Rev.12/8/2020
Location: North Haven, CT (MMI# 2709-13)
Checked:
Date:
Circle one: Present [✓ Developed]
Watershed: WS 21 - Proposed Conditions

1.) Runoff curve number (CN)

Soil Name and Hydrologic Group (appendix A)	**Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)**	**CN Value [1]**			**Area** [✓ **Acres**] Sq. Ft. %	**Product of CN x Area**
		Table 2-2	**Figure 2-3**	**Figure 2-4**		
A	WOODS (GOOD)	30			0.164	4.93
A	OPEN SPACE (GOOD)	39			1.847	72.03
B	OPEN SPACE (GOOD)	61			0.026	1.61
N/A	IMPERVIOUS	98			1.817	178.08
N/A	PROPOSED BUILDING	98			1.167	114.34
				Totals =	5.021	370.98

(0.00785 sq mi)

[1] Use only one CN value source per line.

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{370.98}{5.02}$$

Use CN = $\boxed{74}$

Worksheet 2: Runoff curve number and runoff

Project: Prop. Elderly Housing Development By: KVN Date: Rev.12/8/2020
Location: North Haven, CT (MMI# 2709-13) Checked: Date:
Circle one: Present [✓ Developed] Watershed: WS 30 - Proposed Conditions

1.) Runoff curve number (CN)

Soil Name and Hydrologic Group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Value [1.]			Area	Product of CN x Area
		Table 2-2	Figure 2-3	Figure 2-4	[✓ Acres] Sq. Ft. %	
A	WOODS (GOOD)	30			0.026	0.78
A	OPEN SPACE (GOOD)	39			0.037	1.44
N/A	IMPERVIOUS	98			0.018	1.78

[1.] Use only one CN value source per line.

Totals = 0.081 4.00
(0.00013 sq mi)

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{4.00}{0.08}$ Use CN = 49

Worksheet 2: Runoff curve number and runoff

Project: Prop. Elderly Housing Development By: KVN Date: Rev.12/8/2020
Location: North Haven, CT (MMI# 2709-13) Checked: Date:
Circle one: Present [✓ Developed] Watershed: WS 40 - Proposed Conditions

1.) Runoff curve number (CN)

Soil Name and Hydrologic Group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Value [1.]			Area [✓ Acres] Sq. Ft. %	Product of CN x Area
		Table 2-2	Figure 2-3	Figure 2-4		
A	WOODS (GOOD)	30			0.042	1.27
A	OPEN SPACE (GOOD)	39			0.002	0.07
				Totals =	0.044	1.34

(0.00007 sq mi)

[1.] Use only one CN value source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{1.34}{0.04}$ Use CN = 30

Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Prop. Elderly Housing Development
By: KVN
Date: Rev. 12/8/20
Location: North Haven, CT (MMI# 2709-13)
Checked:
Date:
Circle one: [✓ Present] Developed
Watershed: WS 10 - Existing Conditions
Circle one: [✓ Tc] T_t
Subwatershed:

Sheet flow (applicable to T_c only)

Segment ID		**A-B**	
1. Surface description (Table 3-1)		WOODS	
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400	
3. Flow Length, L (< 300ft)	ft.	100.0	
4. Two-year 24-hr rainfall, P_2	in.	3.48	
5. Land slope, s	ft./ft.	0.140	
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.158	= 0.158

Shallow concentrated flow (assume hyd. radius = depth of flow)

Segment ID		**B-C**				
7. Surface description		GRASS				
8. Manning's roughness coeff., n		0.080				
9. Paved or unpaved		UNPVD				
10. Depth of flow, d (default values: d=.4 unpaved, d=.2 paved)	ft.	0.40				
11. Flow Length, L	ft.	165.0				
12. Watercourse slope, s	ft./ft.	0.040				
13. Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	2.02		#		
14. $T_t = \frac{L}{3600 * V}$	hr.	0.023	+	+	+	= 0.023

Channel flow

Segment ID						
15. Channel Bottom width, b	ft.					
16. Horizontal side slope component, z (z horiz:1 vert)	ft.					
17. Depth of flow, d	ft.					
18. Cross sectional flow area, A (assume trapazoidal)	ft.^{2}					
19. Wetted perimeter, P_w	ft.					
20. Hydraulic Radius, $R = \frac{A}{P_w}$	ft.					
21. Channel slope, s	ft./ft.					
22. Manning's roughness coeff., n						
23. $V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.					
24. Flow length, L	ft.					
25. $T_t = \frac{L}{3600 * V}$	hr.		+	+	+	= 0.000
26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25)	hr.					0.180

Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Prop. Elderly Housing Development
By: KVN
Date: Rev. 12/8/20
Location: North Haven, CT (MMI# 2709-13)
Checked:
Date:
Circle one: [✓ Present] Developed
Watershed: WS 20 - Existing Conditions
Circle one: [✓ T_c] T_t
Subwatershed:

Sheet flow (applicable to T_c only)

	Segment ID	A-B		
1. Surface description (Table 3-1)		WOODS		
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400		
3. Flow Length, L (< 300ft)	ft.	100.0		
4. Two-year 24-hr rainfall, P_2	in.	3.48		
5. Land slope, s	ft./ft.	0.050		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.238	=	0.238

Shallow concentrated flow (assume hyd. radius = depth of flow)

	Segment ID	B-C		C-D		D-E				
7. Surface description		WOODS		GRASS		WOODS				
8. Manning's roughness coeff., n		0.100		0.080		0.100				
9. Paved or unpaved		UNPVD		UNPVD		UNPVD				
10. Depth of flow, d (default values: d=.4 unpaved, d=.2 paved)	ft.	0.40		0.40		0.40				
11. Flow Length, L	ft.	50.0		325.0		95.0				
12. Watercourse slope, s	ft./ft.	0.020		0.045		0.080				
13. Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	1.14		2.14		2.29				
14. $T_t = \frac{L}{3600 * V}$	hr.	0.012	+	0.042	+	0.012	+		=	0.066

+

Channel flow

	Segment ID									
15. Channel Bottom width, b	ft.									
16. Horizontal side slope component, z (z horiz:1 vert)	ft.									
17. Depth of flow, d	ft.									
18. Cross sectional flow area, A (assume trapazoidal)	$ft.^2$									
19. Wetted perimeter, P_w	ft.									
20. Hydraulic Radius, $R = \frac{A}{P_w}$	ft.									
21. Channel slope, s	ft./ft.									
22. Manning's roughness coeff., n										
23. $V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.									
24. Flow length, L	ft.									
25. $T_t = \frac{L}{3600 * V}$	hr.		+		+		+		=	0.000

26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25) hr. 0.304

Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Prop. Elderly Housing Development
By: KVN
Date: Rev. 12/8/20
Location: North Haven, CT (MMI# 2709-13)
Checked:
Date:
Circle one: [✓ Present] Developed
Watershed: WS 30 - Existing Conditions
Circle one: [✓ Tc] T_t
Subwatershed:

Sheet flow (applicable to T_c only)

Segment ID		**A-B**		
1. Surface description (Table 3-1)		WOODS		
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400		
3. Flow Length, L (< 300ft)	ft.	20.0		
4. Two-year 24-hr rainfall, P_2	in.	3.48		
5. Land slope, s	ft./ft.	0.200		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.038	=	0.038

Shallow concentrated flow (assume hyd. radius = depth of flow)

Segment ID		**B-C**								
7. Surface description		GRASS								
8. Manning's roughness coeff., n		0.080								
9. Paved or unpaved		UNPVD								
10. Depth of flow, d (default values: d=.4 unpaved, d=.2 paved)	ft.	0.40								
11. Flow Length, L	ft.	15.0								
12. Watercourse slope, s	ft./ft.	0.250								
13. Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	5.06								
14. $T_t = \frac{L}{3600 * V}$	hr.	0.001	+		+		+		=	0.001

Channel flow

Segment ID										
15. Channel Bottom width, b	ft.									
16. Horizontal side slope component, z (z horiz:1 vert)	ft.									
17. Depth of flow, d	ft.									
18. Cross sectional flow area, A (assume trapazoidal)	$ft.^2$									
19. Wetted perimeter, P_w	ft.									
20. Hydraulic Radius, $R = \frac{A}{P_w}$	ft.									
21. Channel slope, s	ft./ft.									
22. Manning's roughness coeff., n										
23. $V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.									
24. Flow length, L	ft.									
25. $T_t = \frac{L}{3600 * V}$	hr.		+		+		+		=	0.000

26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25) hr. ~~0.039~~

MIN. TC=5MIN

Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Prop. Elderly Housing Development
By: KVN
Date: Rev. 12/8/20
Location: North Haven, CT (MMI# 2709-13)
Checked:
Date:
Circle one: [✓ Present] Developed
Watershed: WS 40 - Existing Conditions
Circle one: [✓ T_c] T_t
Subwatershed:

Sheet flow (applicable to T_c only)

	Segment ID	A-B		
1. Surface description (Table 3-1)		WOODS		
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400		
3. Flow Length, L (< 300ft)	ft.	65.0		
4. Two-year 24-hr rainfall, P_2	in.	3.48		
5. Land slope, s	ft./ft.	0.069		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.148	=	0.148

Shallow concentrated flow (assume hyd. radius = depth of flow)

	Segment ID									
7. Surface description										
8. Manning's roughness coeff., n										
9. Paved or unpaved										
10. Depth of flow, d (default values: d=.4 unpaved, d=.2 paved)	ft.									
11. Flow Length, L	ft.									
12. Watercourse slope, s	ft./ft.									
13. Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.									
14. $T_t = \frac{L}{3600 * V}$	hr.		+		+		+		=	0.000

Channel flow

	Segment ID									
15. Channel Bottom width, b	ft.									
16. Horizontal side slope component, z (z horiz:1 vert)	ft.									
17. Depth of flow, d	ft.									
18. Cross sectional flow area, A (assume trapazoidal)	$ft.^2$									
19. Wetted perimeter, P_w	ft.									
20. Hydraulic Radius, $R = \frac{A}{P_w}$	ft.									
21. Channel slope, s	ft./ft.									
22. Manning's roughness coeff., n										
23. $V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.									
24. Flow length, L	ft.									
25. $T_t = \frac{L}{3600 * V}$	hr.		+		+		+		=	0.000
26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25)	hr.									0.148

Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Prop. Elderly Housing Development
By: KVN
Date: Rev. 12/8/20
Location: North Haven, CT (MMI# 2709-13)
Checked:
Date:
Circle one: Present [✓ Developed]
Watershed: WS 10 - Proposed Conditions
Circle one: [✓ Tc] T_t
Subwatershed:

Sheet flow (applicable to T_c only)

Segment ID		A-B		
1. Surface description (Table 3-1)		GRASS		
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.150		
3. Flow Length, L (< 300ft)	ft.	100.0		
4. Two-year 24-hr rainfall, P_2	in.	3.48		
5. Land slope, s	ft./ft.	0.038		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.121	=	0.121

Shallow concentrated flow (assume hyd. radius = depth of flow)

Segment ID		B-C		C-D		D-E				
7. Surface description		GRASS		GRASS		GRASS				
8. Manning's roughness coeff., n		0.080		0.080		0.080				
9. Paved or unpaved		UNPVD		UNPVD		UNPVD				
10. Depth of flow, d (default values: d=.4 unpaved, d=.2 paved)	ft.	0.40		0.40		0.40				
11. Flow Length, L	ft.	95.0		55.0		70.0				
12. Watercourse slope, s	ft./ft.	0.060		0.180		0.060				
13. Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	2.48		4.29	#	2.48				
14. $T_t = \frac{L}{3600 * V}$	hr.	0.011	+	0.004	+	0.008	+		=	0.022

Channel flow

Segment ID										
15. Channel Bottom width, b	ft.									
16. Horizontal side slope component, z (z horiz:1 vert)	ft.									
17. Depth of flow, d	ft.									
18. Cross sectional flow area, A (assume trapazoidal)	$ft.^2$									
19. Wetted perimeter, P_w	ft.									
20. Hydraulic Radius, $R = \frac{A}{P_w}$	ft.									
21. Channel slope, s	ft./ft.									
22. Manning's roughness coeff., n										
23. $V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.									
24. Flow length, L	ft.									
25. $T_t = \frac{L}{3600 * V}$	hr.		+		+		+		=	0.000
26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25)	hr.									0.143

Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Prop. Elderly Housing Development
By: KVN
Date: Rev. 12/8/20
Location: North Haven, CT (MMI# 2709-13)
Checked:
Date:
Circle one: Present [✓ Developed]
Watershed: WS 20 - Proposed Conditions
Circle one: [✓ Tc] T_t
Subwatershed:

Sheet flow (applicable to T_c only)

Segment ID		**A-B**		
1. Surface description (Table 3-1)		GRASS		
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.150		
3. Flow Length, L (< 300ft)	ft.	55.0		
4. Two-year 24-hr rainfall, P_2	in.	3.48		
5. Land slope, s	ft./ft.	0.027		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.086	=	0.086

Shallow concentrated flow (assume hyd. radius = depth of flow)

Segment ID		**B-C**		**C-D**							
7. Surface description		GRASS		WOOD							
8. Manning's roughness coeff., n		0.080		0.100							
9. Paved or unpaved		UNPVD		UNPVD							
10. Depth of flow, d (default values: d=.4 unpaved, d=.2 paved)	ft.	0.40		0.40							
11. Flow Length, L	ft.	95.0		55.0							
12. Watercourse slope, s	ft./ft.	0.060		0.050							
13. Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	2.48		1.81	#						
14. $T_t = \frac{L}{3600 * V}$	hr.	0.011	+	0.008	+		+		=	0.019	

Channel flow

Segment ID										
15. Channel Bottom width, b	ft.									
16. Horizontal side slope component, z (z horiz:1 vert)	ft.									
17. Depth of flow, d	ft.									
18. Cross sectional flow area, A (assume trapazoidal)	$ft.^2$									
19. Wetted perimeter, P_w	ft.									
20. Hydraulic Radius, $R = \frac{A}{P_w}$	ft.									
21. Channel slope, s	ft./ft.									
22. Manning's roughness coeff., n										
23. $V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.									
24. Flow length, L	ft.									
25. $T_t = \frac{L}{3600 * V}$	hr.		+		+		+		=	0.000
26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25)									hr.	0.105

Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Prop. Elderly Housing Development
By: KVN
Date: Rev. 12/8/20
Location: North Haven, CT (MMI# 2709-13)
Checked:
Date:
Circle one: Present [✓ Developed]
Watershed: WS 21 - Proposed Conditions
Circle one: [✓ Tc] T_t
Subwatershed:

Sheet flow (applicable to T_c only)

Segment ID		A-B		
1. Surface description (Table 3-1)		WOOD		
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400		
3. Flow Length, L (< 300ft)	ft.	70.0		
4. Two-year 24-hr rainfall, P_2	in.	3.48		
5. Land slope, s	ft./ft.	0.060		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.166	=	0.166

Shallow concentrated flow (assume hyd. radius = depth of flow)

Segment ID		B-C		C-D						
7. Surface description		GRASS		BIT						
8. Manning's roughness coeff., n		0.080		0.015						
9. Paved or unpaved		UNPVD		PVD						
10. Depth of flow, d (default values: d=.4 unpaved, d=.2 paved)	ft.	0.40		0.20						
11. Flow Length, L	ft.	160.0		80.0						
12. Watercourse slope, s	ft./ft.	0.030		0.030						
13. Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	1.75		5.88	#					
14. $T_t = \frac{L}{3600 * V}$	hr.	0.025	+	0.004	+		+		=	0.029

Channel flow

Segment ID		D-E		E-F		F-G		G-H		
15. Channel Bottom width, b	ft.	15" HDPE		18" HDPE		24" HDPE		36" HDPE		
16. Horizontal side slope component, z (z horiz:1 vert)	ft.	---		---		---		---		
17. Depth of flow, d	ft.	FULL		FULL		FULL		FULL		
18. Cross sectional flow area, A (assume trapazoidal)	$ft.^2$	1.23		1.77		3.14		7.07		
19. Wetted perimeter, P_w	ft.	3.93		4.71		6.28		9.42		
20. Hydraulic Radius, $R = \frac{A}{P_w}$	ft.	0.31		0.38		0.50		0.75		
21. Channel slope, s	ft./ft.	0.011		0.013		0.007		0.010		
22. Manning's roughness coeff., n		0.012		0.012		0.012		0.012		
23. $V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.	6.06		7.29		6.45		10.25		
24. Flow length, L	ft.	116.0		110.0		340.0		365.0		
25. $T_t = \frac{L}{3600 * V}$	hr.	0.005	+	0.004	+	0.015	+	0.010	=	0.034
26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25)	hr.									0.229

Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Prop. Elderly Housing Development
By: KVN
Date: Rev. 12/8/20
Location: North Haven, CT (MMI# 2709-13)
Checked:
Date:
Circle one: Present [✓ Developed]
Watershed: WS 30 - Proposed Conditions
Circle one: [✓ Tc] T_t
Subwatershed:

Sheet flow (applicable to T_c only)

Segment ID		A-B		
1. Surface description (Table 3-1)		WOODS		
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400		
3. Flow Length, L (< 300ft)	ft.	20.0		
4. Two-year 24-hr rainfall, P_2	in.	3.48		
5. Land slope, s	ft./ft.	0.200		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.038	=	0.038

Shallow concentrated flow (assume hyd. radius = depth of flow)

Segment ID		B-C		C-D		D-E				
7. Surface description		GRASS		BIT		GRASS				
8. Manning's roughness coeff., n		0.030		0.015		0.080				
9. Paved or unpaved		UNPVD		PVD		UNPVD				
10. Depth of flow, d (default values: d=.4 unpaved, d=.2 paved)	ft.	0.40		0.20		0.40				
11. Flow Length, L	ft.	5.0		5.0		5.0				
12. Watercourse slope, s	ft./ft.	0.250		0.025		0.250				
13. Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	13.48		5.37		5.06				
14. $T_t = \frac{L}{3600*V}$	hr.	0.000	+	0.000	+	0.000	+		=	0.001

Channel flow

Segment ID										
15. Channel Bottom width, b	ft.									
16. Horizontal side slope component, z (z horiz:1 vert)	ft.									
17. Depth of flow, d	ft.									
18. Cross sectional flow area, A (assume trapazoidal)	$ft.^2$									
19. Wetted perimeter, P_w	ft.									
20. Hydraulic Radius, $R = \frac{A}{P_w}$	ft.									
21. Channel slope, s	ft./ft.									
22. Manning's roughness coeff., n										
23. $V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.									
24. Flow length, L	ft.									
25. $T_t = \frac{L}{3600*V}$	hr.		+		+		+		=	0.000

26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25) hr. ~~0.038~~

MIN. TC=5MIN

Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Prop. Elderly Housing Development By: KVN Date: Rev. 12/8/20
Location: North Haven, CT (MMI# 2709-13) Checked: Date:
Circle one: Present [✓ Developed] Watershed: WS 40 - Proposed Conditions
Circle one: [✓ Tc] T_t Subwatershed:

Sheet flow (applicable to T_c only)

Segment ID		A-B	
1. Surface description (Table 3-1)		WOODS	
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400	
3. Flow Length, L (< 300ft)	ft.	12.0	
4. Two-year 24-hr rainfall, P_2	in.	3.48	
5. Land slope, s	ft./ft.	0.069	
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.038	= 0.038

Shallow concentrated flow (assume hyd. radius = depth of flow)

Segment ID						
7. Surface description						
8. Manning's roughness coeff., n						
9. Paved or unpaved						
10. Depth of flow, d (default values: d=.4 unpaved, d=.2 paved)	ft.					
11. Flow Length, L	ft.					
12. Watercourse slope, s	ft./ft.					
13. Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.					
14. $T_t = \frac{L}{3600 * V}$	hr.	+	+	+		= 0.000

Channel flow

Segment ID						
15. Channel Bottom width, b	ft.					
16. Horizontal side slope component, z (z horiz:1 vert)	ft.					
17. Depth of flow, d	ft.					
18. Cross sectional flow area, A (assume trapazoidal)	ft.^{2}					
19. Wetted perimeter, P_w	ft.					
20. Hydraulic Radius, $R = \frac{A}{P_w}$	ft.					
21. Channel slope, s	ft./ft.					
22. Manning's roughness coeff., n						
23. $V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.					
24. Flow length, L	ft.					
25. $T_t = \frac{L}{3600 * V}$	hr.	+	+	+		= 0.000

26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25) hr. ~~0.038~~

MIN. TC=5MIN

Pond Report

Pond No. 1 - DET 210

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 56.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	56.00	4,392	0.000	0.000
1.00	57.00	5,850	0.117	0.117
1.90	57.90	7,384	0.136	0.254
2.00	58.00	7,555	0.017	0.271
3.00	59.00	10,570	0.207	0.478
4.00	60.00	12,845	0.268	0.746
5.00	61.00	15,186	0.321	1.067
6.00	62.00	17,608	0.376	1.443

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 18.00	6.00	0.00	0.00
Span (in)	= 18.00	6.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 56.00	57.90	0.00	0.00
Length (ft)	= 71.00	0.00	0.00	0.00
Slope (%)	= 0.70	0.00	0.00	n/a
N-Value	= .012	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.51	0.00	10.00	Inactive
Crest El. (ft)	= 60.50	59.00	61.00	0.00
Weir Coeff.	= 3.33	1.05	2.60	3.33
Weir Type	= 1	45 degV	Rect	Ciplti
Multi-Stage	= Yes	Yes	No	No

Exfil.(in/hr) = 1.000 (by Contour)
TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage acft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0.000	56.00	0.00	0.00	---	---	0.00	---	0.00	---	0.000	---	0.000
1.00	0.117	57.00	0.00	0.00	---	---	0.00	---	0.00	---	0.135	---	0.135
1.90	0.254	57.90	0.00	0.00	---	---	0.00	---	0.00	---	0.171	---	0.171
2.00	0.271	58.00	0.03 ic	0.03 ic	---	---	0.00	---	0.00	---	0.175	---	0.206
3.00	0.478	59.00	0.88 ic	0.87 ic	---	---	0.00	---	0.00	---	0.245	---	1.116
4.00	0.746	60.00	2.37 ic	1.29 ic	---	---	0.00	1.05	0.00	---	0.297	---	2.635
5.00	1.067	61.00	16.92 ic	0.51 ic	---	---	13.12 s	3.29 s	0.00	---	0.352	---	17.27
6.00	1.443	62.00	19.46 ic	0.13 ic	---	---	16.59 s	2.72 s	26.00	---	0.408	---	45.85

ATTACHMENT F

HYDROLOGIC ANALYSIS – COMPUTER MODEL RESULTS

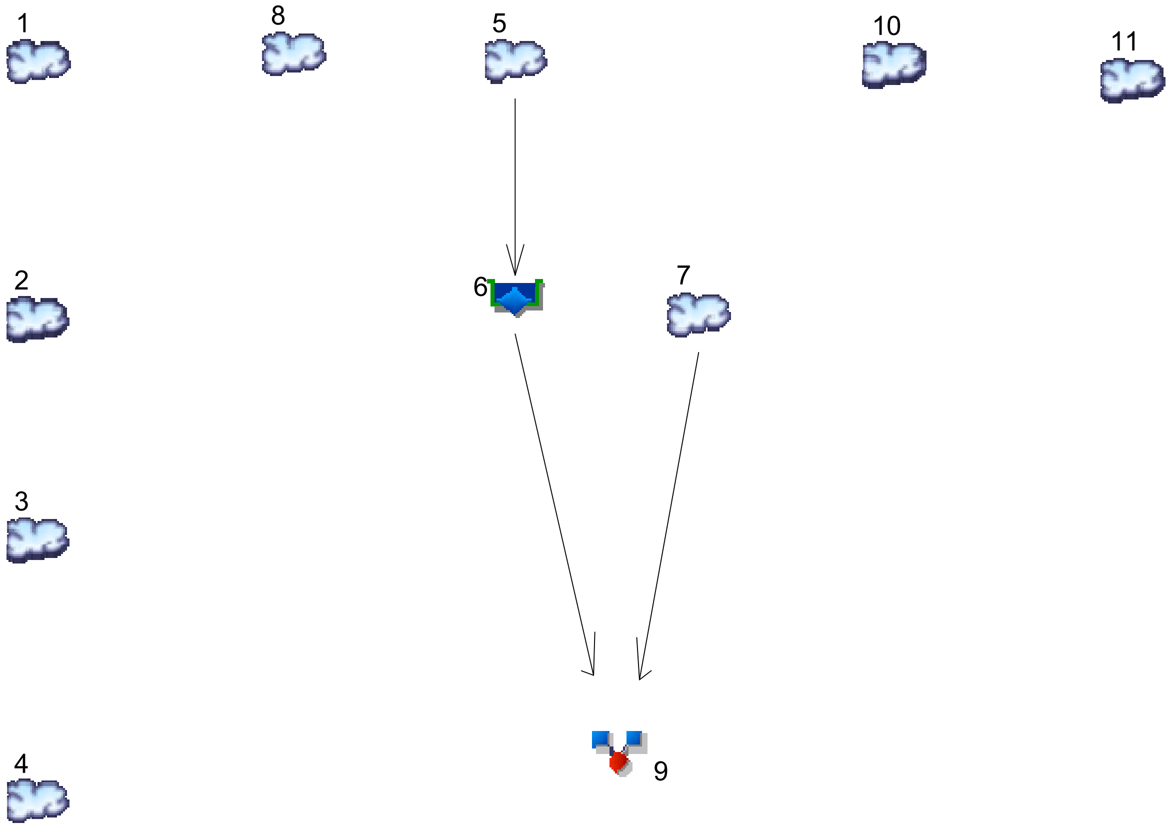
Hydrographs Model Summary of Results

Existing vs. Proposed

Study Area	2yr Storm		10yr Storm		25yr Storm		50yr Storm		100yr Storm	
	Ex	**Pr**	**Ex**	**Pr**	**Ex**	**Pr**	**Ex**	**Pr**	**Ex**	**Pr**
A	0.43	0.01	1.74	0.19	2.79	0.59	3.64	1.04	4.61	1.62
B	0.52	0.25	3.85	1.58	7.05	3.01	9.76	4.68	12.94	10.65
C	0.00	0.00	0.00	0.04	0.01	0.09	0.02	0.13	0.04	0.18
D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01

Study Area:	**Description:**
A	Western Property Boundary
B	Existing Wetlands North of Site
C	Southeastern tract of land that drains to St. Route
D	Eastern Property Boundary

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	EXWS 10 (POA A)
2	SCS Runoff	EXWS 20 (POA B)
3	SCS Runoff	EXWS 30 (POA C)
4	SCS Runoff	EXWS 40 (POA D)
5	SCS Runoff	PRWS 21
6	Reservoir	DET 210
7	SCS Runoff	WS 20
8	SCS Runoff	PRWS 10 (POA A)
9	Combine	POA B
10	SCS Runoff	PRWS 30 (POA C)
11	SCS Runoff	PRWS40 (POA D)

Project: HYDRO 03-Reduced Basin.gpw

Monday, 12 / 7 / 2020

Hydraflow Table of Contents

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	0.427	-------	-------	1.741	2.790	3.637	4.610	EXWS 10 (POA A)
2	SCS Runoff	------	-------	0.518	-------	-------	3.853	7.048	9.759	12.94	EXWS 20 (POA B)
3	SCS Runoff	------	-------	0.000	-------	-------	0.001	0.009	0.020	0.039	EXWS 30 (POA C)
4	SCS Runoff	------	-------	0.000	-------	-------	0.000	0.002	0.004	0.014	EXWS 40 (POA D)
5	SCS Runoff	------	-------	5.426	-------	-------	12.26	16.89	20.39	24.25	PRWS 21
6	Reservoir	5	-------	0.197	-------	-------	1.100	2.423	4.013	9.253	DET 210
7	SCS Runoff	------	-------	0.252	-------	-------	1.464	2.477	3.297	4.245	WS 20
8	SCS Runoff	------	-------	0.006	-------	-------	0.194	0.593	1.037	1.619	PRWS 10 (POA A)
9	Combine	6, 7,	-------	0.252	-------	-------	1.579	3.011	4.683	10.65	POA B
10	SCS Runoff	------	-------	0.003	-------	-------	0.043	0.090	0.131	0.180	PRWS 30 (POA C)
11	SCS Runoff	------	-------	0.000	-------	-------	0.000	0.001	0.002	0.007	PRWS40 (POA D)

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph Description
1	SCS Runoff	0.427	3	735	0.059	------	------	------	EXWS 10 (POA A)
2	SCS Runoff	0.518	3	750	0.128	------	------	------	EXWS 20 (POA B)
3	SCS Runoff	0.000	3	n/a	0.000	------	------	------	EXWS 30 (POA C)
4	SCS Runoff	0.000	3	n/a	0.000	------	------	------	EXWS 40 (POA D)
5	SCS Runoff	5.426	3	729	0.513	------	------	------	PRWS 21
6	Reservoir	0.197	3	927	0.080	5	58.17	0.306	DET 210
7	SCS Runoff	0.252	3	732	0.039	------	------	------	WS 20
8	SCS Runoff	0.006	3	1326	0.003	------	------	------	PRWS 10 (POA A)
9	Combine	0.252	3	732	0.119	6, 7,	------	------	POA B
10	SCS Runoff	0.003	3	747	0.001	------	------	------	PRWS 30 (POA C)
11	SCS Runoff	0.000	3	n/a	0.000	------	------	------	PRWS40 (POA D)

HYDRO 03-Reduced Basin.gpw	Return Period: 2 Year	Monday, 12 / 7 / 2020

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph Description
1	SCS Runoff	1.741	3	732	0.176	------	------	------	EXWS 10 (POA A)
2	SCS Runoff	3.853	3	738	0.506	------	------	------	EXWS 20 (POA B)
3	SCS Runoff	0.001	3	882	0.001	------	------	------	EXWS 30 (POA C)
4	SCS Runoff	0.000	3	1326	0.000	------	------	------	EXWS 40 (POA D)
5	SCS Runoff	12.26	3	729	1.111	------	------	------	PRWS 21
6	Reservoir	1.100	3	804	0.572	5	59.33	0.568	DET 210
7	SCS Runoff	1.464	3	726	0.130	------	------	------	WS 20
8	SCS Runoff	0.194	3	741	0.040	------	------	------	PRWS 10 (POA A)
9	Combine	1.579	3	741	0.702	6, 7,	------	------	POA B
10	SCS Runoff	0.043	3	729	0.005	------	------	------	PRWS 30 (POA C)
11	SCS Runoff	0.000	3	1326	0.000	------	------	------	PRWS40 (POA D)

HYDRO 03-Reduced Basin.gpw	Return Period: 10 Year	Monday, 12 / 7 / 2020

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph Description
1	SCS Runoff	2.790	3	729	0.267	------	------	------	EXWS 10 (POA A)
2	SCS Runoff	7.048	3	735	0.826	------	------	------	EXWS 20 (POA B)
3	SCS Runoff	0.009	3	744	0.002	------	------	------	EXWS 30 (POA C)
4	SCS Runoff	0.002	3	891	0.001	------	------	------	EXWS 40 (POA D)
5	SCS Runoff	16.89	3	729	1.525	------	------	------	PRWS 21
6	Reservoir	2.423	3	768	0.956	5	60.03	0.755	DET 210
7	SCS Runoff	2.477	3	726	0.203	------	------	------	WS 20
8	SCS Runoff	0.593	3	729	0.079	------	------	------	PRWS 10 (POA A)
9	Combine	3.011	3	729	1.160	6, 7,	------	------	POA B
10	SCS Runoff	0.090	3	726	0.008	------	------	------	PRWS 30 (POA C)
11	SCS Runoff	0.001	3	891	0.000	------	------	------	PRWS40 (POA D)

HYDRO 03-Reduced Basin.gpw	Return Period: 25 Year	Monday, 12 / 7 / 2020

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph Description
1	SCS Runoff	3.637	3	729	0.340	------	------	------	EXWS 10 (POA A)
2	SCS Runoff	9.759	3	735	1.093	------	------	------	EXWS 20 (POA B)
3	SCS Runoff	0.020	3	738	0.004	------	------	------	EXWS 30 (POA C)
4	SCS Runoff	0.004	3	750	0.002	------	------	------	EXWS 40 (POA D)
5	SCS Runoff	20.39	3	729	1.842	------	------	------	PRWS 21
6	Reservoir	4.013	3	759	1.256	5	60.43	0.885	DET 210
7	SCS Runoff	3.297	3	726	0.263	------	------	------	WS 20
8	SCS Runoff	1.037	3	729	0.114	------	------	------	PRWS 10 (POA A)
9	Combine	4.683	3	750	1.519	6, 7,	------	------	POA B
10	SCS Runoff	0.131	3	726	0.011	------	------	------	PRWS 30 (POA C)
11	SCS Runoff	0.002	3	750	0.001	------	------	------	PRWS40 (POA D)

Hydrograph Summary Report

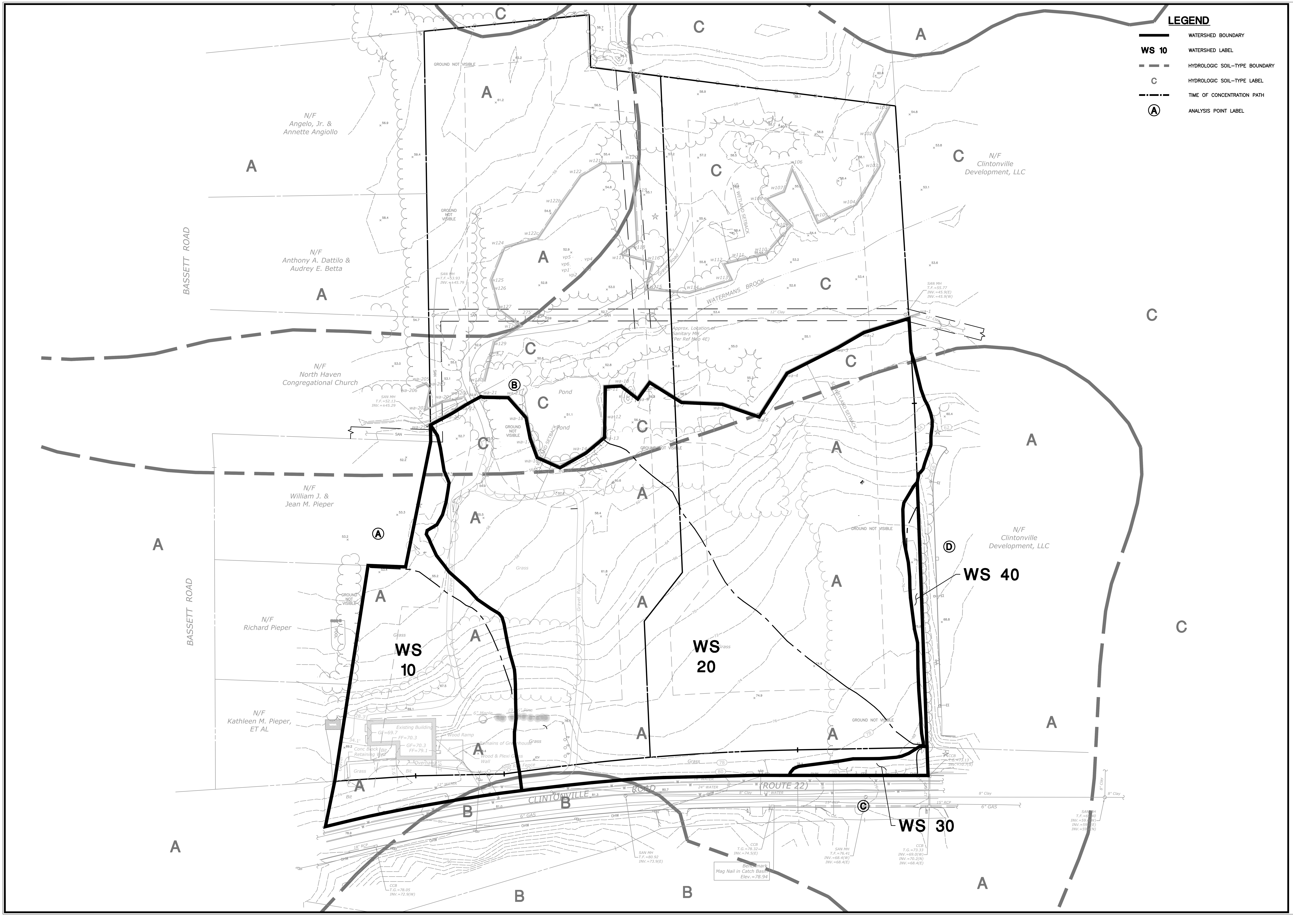
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

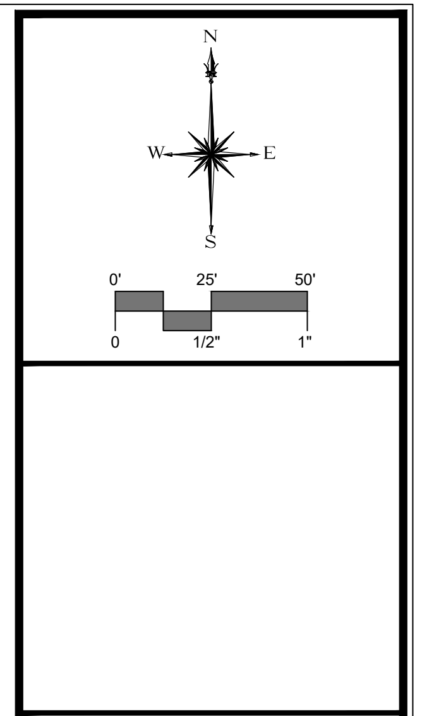
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph Description
1	SCS Runoff	4.610	3	729	0.424	------	------	------	EXWS 10 (POA A)
2	SCS Runoff	12.94	3	735	1.407	------	------	------	EXWS 20 (POA B)
3	SCS Runoff	0.039	3	732	0.006	------	------	------	EXWS 30 (POA C)
4	SCS Runoff	0.014	3	744	0.003	------	------	------	EXWS 40 (POA D)
5	SCS Runoff	24.25	3	729	2.196	------	------	------	PRWS 21
6	Reservoir	9.253	3	750	1.596	5	60.71	0.972	DET 210
7	SCS Runoff	4.245	3	726	0.332	------	------	------	WS 20
8	SCS Runoff	1.619	3	726	0.157	------	------	------	PRWS 10 (POA A)
9	Combine	10.65	3	747	1.928	6, 7,	------	------	POA B
10	SCS Runoff	0.180	3	726	0.015	------	------	------	PRWS 30 (POA C)
11	SCS Runoff	0.007	3	744	0.002	------	------	------	PRWS40 (POA D)

HYDRO 03-Reduced Basin.gpw	Return Period: 100 Year	Monday, 12 / 7 / 2020

ATTACHMENT G

WATERSHED MAPS





MILONE & MACBROOM

99 REALTY DRIVE
CHESHIRE, CT 06410
203.271.1773
WWW.MMINC.COM

DESCRIPTION	DATE	BY
IWWC COMMENTS	12/8/20	KVN

EXISTING WATERSHED MAP

PROPOSED ELDERLY HOUSING DEVELOPMENT

343 CLINTONVILLE ROAD
NORTH HAVEN, CONNECTICUT

DESIGNED	DRAWN	CHECKED
KVN	KVN	FAB

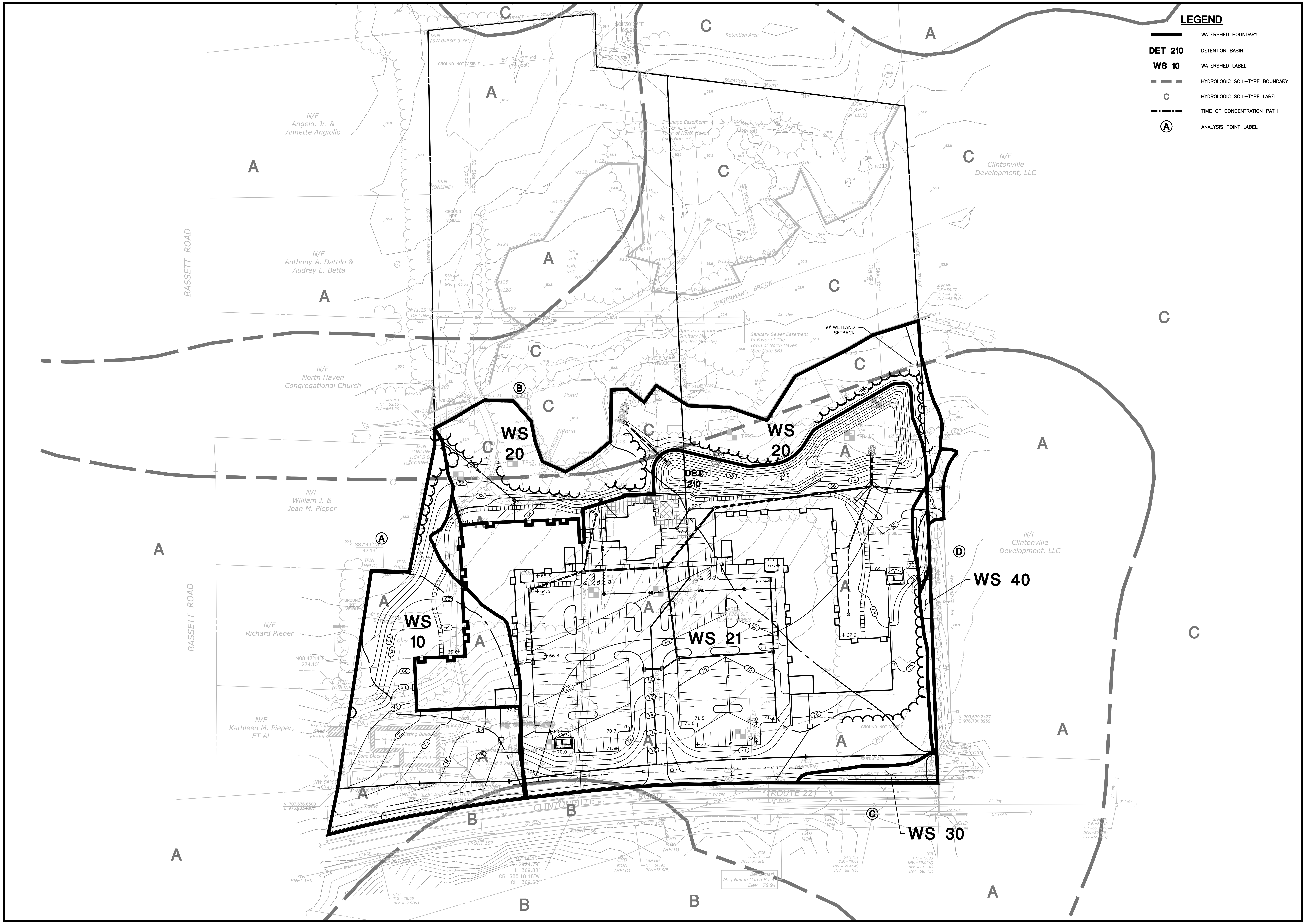
SCALE 1"=50'

DATE OCTOBER 27, 2020

PROJECT NO. 2709-13

SHEET NO. 1 OF 2

SHEET NAME **EXWS**



LEGEND

▬	WATERSHED BOUNDARY
DET 210	DETENTION BASIN
WS 10	WATERSHED LABEL
▬ ▬ ▬	HYDROLOGIC SOIL–TYPE BOUNDARY
C	HYDROLOGIC SOIL–TYPE LABEL
▬ · ▬ · ▬	TIME OF CONCENTRATION PATH
Ⓐ	ANALYSIS POINT LABEL

0' 25' 50'
0 1/2" 1"

MILONE & MACBROOM

99 REALTY DRIVE
CHESHIRE, CT 06410
203.271.1773
WWW.MMINC.COM

DESCRIPTION	DATE	BY
IWWC COMMENTS	12/8/20	KVN

PROPOSED WATERSHED MAP

PROPOSED ELDERLY HOUSING DEVELOPMENT

343 CLINTONVILLE ROAD
NORTH HAVEN, CONNECTICUT

KVN	KVN	FAB
DESIGNED	DRAWN	CHECKED

SCALE 1"=50'

DATE OCTOBER 27, 2020

PROJECT NO. 2709-13

SHEET NO. 2 OF 2

SHEET NAME **PRWS**