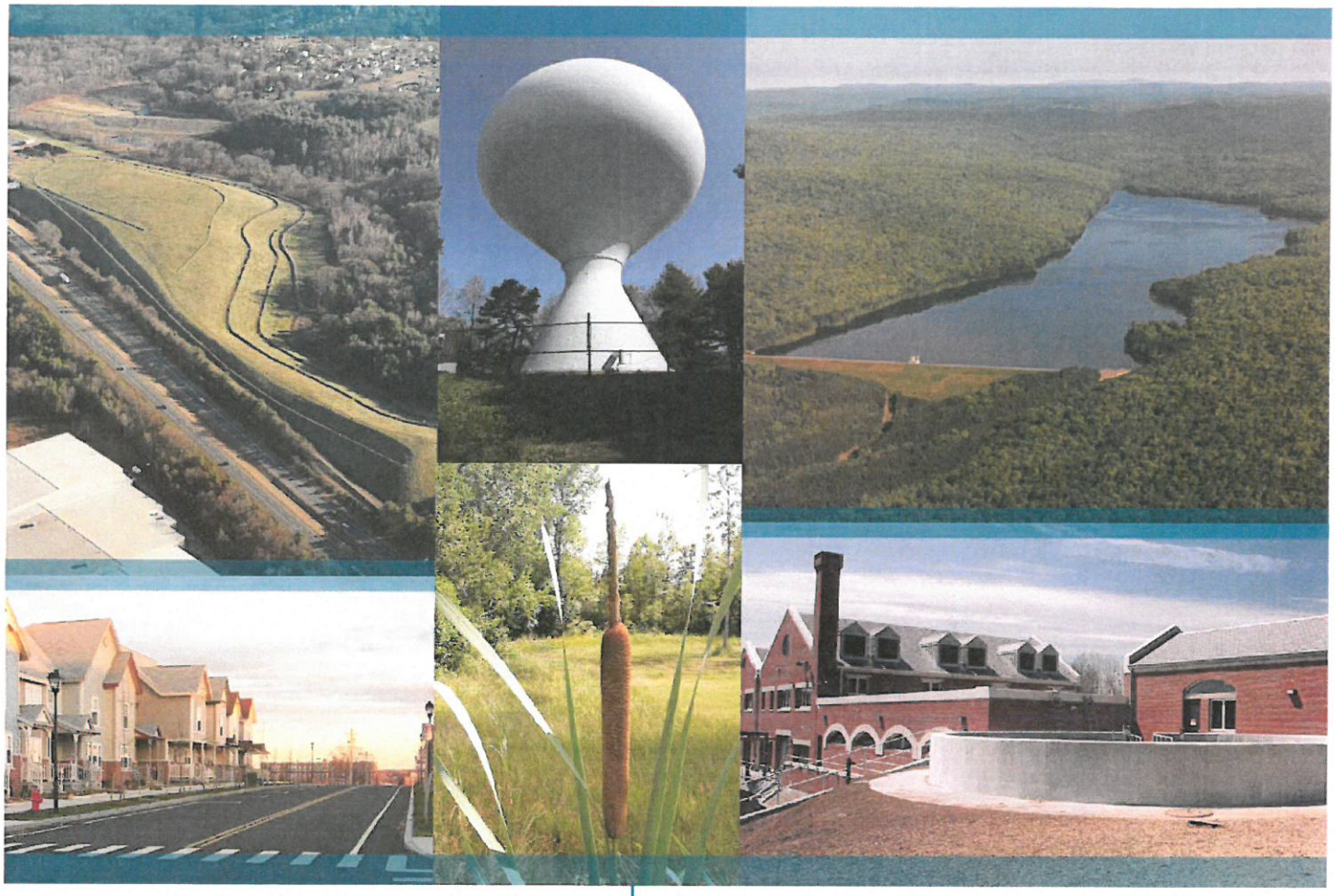

Tighe&Bond

Engineering Report

Prepared For:

Noroton Heights Shopping Center
Darien, CT

November 18, 2016

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Executive Summary

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Section 1
Introduction and Site Conditions

Tighe & Bond has prepared this report in connection with Noroton Heights Shopping Center's proposal to construct a mixed-use development at 346 Heights Road in Darien, Connecticut. Please refer to **Figure 1**, Site Location Map, in **Appendix A** for the location of the site.

Tighe & Bond is familiar with the property, and has reviewed and analyzed available utility information and topography. Drainage calculations and stormwater management plans have been prepared in accordance with the Town of Darien DPW Stormwater Management and Drainage Manual, Connecticut Department of Transportation Drainage Manual 2000, and the Connecticut Department of Energy and Environmental Protection 2004 Stormwater Quality Manual. The drainage calculations include a hydrologic and hydraulic analysis of the existing conditions and the proposed development. More specifically, the calculations include an analysis of the on-site stormwater management measures and their performance in handling peak flow attenuation and suspended solids removal rates. Lastly, the report also includes the proposed soil erosion and sedimentation control measures incorporated during construction and operation and maintenance of the drainage and stormwater management systems.

1.1 Existing Conditions

The site area consists of 3.96 acres, bounded on the west by Hollow Tree Ridge Road, on the east by 310 and 264 Heights Road, residential properties on West Avenue to the north, and Heights Road to the south.

The site is predominantly impervious, consisting of Noroton Heights Shopping Center's four separate buildings and parking lot. The northern section of the property provides an approximately 25' strip of trees and vegetative cover sloping towards the site. The site's stormwater is collected and drained into one of two systems on Heights Road. The majority of the stormwater on the site is drained to the system at the west end of Heights Road (referred to as System 1) while a small amount is drained to the east of the site on Heights Road (referred to as System 2).

System 1 drains to the southwest through a 24" culvert before ultimately discharging to the Noroton River. There are no known flooding issues with this system.

System 2 drains to the east toward Edgarton Street, and southerly to Heights Road and discharges easterly down Heights Road.

See **Appendix C** for the existing watershed map, which includes the two separate systems and design points used in the analysis.

1.2 Proposed Conditions

The proposed site consists of two mixed-use buildings with concrete sidewalks and adjacent parking. The proposed site will also include a retaining wall near the northern boundary of the property to allow the site to be re-graded. New drainage structures will be constructed in the parking lot, along with roof leaders from each of the buildings and

connect to the existing system on Heights Road. All drainage structure inlets proposed on site will drain to System 1 after flowing through three separate detention systems.

Stormwater management will be accommodated on-site. Surface runoff will be collected and conveyed in a series of catch basins and roof leaders and convey stormwater through three separate detention systems located throughout the site. The stormwater collection system will utilize hydrodynamic separators to treat the Water Quality Volume and remove total suspended solids. Closed detention systems, in the form of concrete galleries, will be utilized to reduce peak flow and runoff volumes. Due to the high groundwater levels at the site, infiltration is not proposed from the detention systems.

Section 883(a) of the Zoning Regulations of the Town of Darien requires that the post-development peak stormwater runoff rate be reduced to undeveloped peak runoff rates for this site. "Where an existing residential dwelling or commercial building is proposed to be razed and replaced with a new structure, the basis of existing conditions analysis shall be the site's undeveloped condition if there is no engineered detention system on the existing site." The existing site does not contain an engineered detention system, so the proposed site stormwater management plan includes underground detention systems designed to reduce the post development peak runoff rate below undeveloped (meadow condition) peak runoff rates for the 2, 10, 25 and 50 year storms.

The sanitary sewer from the proposed buildings will discharge to the existing 8" sanitary sewer located in Heights Road. Water services will be provided from the existing main on Heights Road, and gas services from a proposed Eversource gas main to be installed in Heights Road. Electric and Tele-Data services will be provided from existing services located in Hollow Tree Ridge Road.

1.3 Site Soils

According to USGS's Websoil Survey, the site and immediate surrounding area is predominantly made of udorthents-urban land complex soil which is classified hydrologically as a Group B soil. These soils are common in developed areas covered with buildings and pavement. The area north of the site mainly consists of Paxton and Montauk fine sandy loams and is classified as a Group C soil.

Geotechnical evaluation of the site has been prepared by GeoDesign, Inc. in a report titled "Geotechnical Engineering Report Noroton Heights Center 346 Heights Road, Darien CT," February 2015.

A Websoil Survey Report, Geotechnical Recommendations, Test Boring Reports, and a boring location map can be found in **Appendix B** of this report.

Section 2
Stormwater Management

2.1 Existing Site Hydrologic Analysis

The existing conditions hydrologic analysis is comprised of watershed areas and two design analysis points. The first design point is at a manhole south of Heights Road near the western end of the Railroad Station site and the second design point is located at a catch basin at the intersection of Edgerton Street and Heights Road. The watersheds are comprised mostly of the impervious areas of the existing buildings and parking lot on the site, and properties adjacent to the site.

The existing drainage systems in Heights Road that the site drains to consists of two separate systems, separated near a high point in the road immediately west of Wells Fargo Bank. The first system, System 1, drains to a 24" reinforced concrete pipe at shallow slopes flowing south toward the Noroton Heights Train Station. The majority of the site's stormwater is conveyed through System 1 in Heights Road. The second system, System 2, flows east through a 12" reinforced concrete pipe and collects only a small amount of flow from the site.

Impervious and pervious areas, weighted curve numbers, and times of concentration were calculated for each watershed and inputted into a hydraulic model to determine the project's peak flow as part of the comparative hydrology analysis. As per the Town of Darien's requirements, the site was analyzed assuming that the existing site is undeveloped (meadow condition). A curve number value of 65 was utilized for existing site runoff calculations.

A summary of existing watershed areas, curve numbers and times of concentration, existing volumetric hydrographs, and design points are included in **Appendix C** of this report.

2.1.1 Floodplain Management

The Federal Emergency Management Agency's Flood Insurance Rate Map (FIRM) for Fairfield County, effective July 8, 2013 shows the project site is outside of any floodways or floodplains, as shown in **Figure 2** in **Appendix A**. Therefore, no floodplain is identified on this site.

2.2 Proposed Site Hydrologic and Hydraulic Analysis

The proposed conditions hydrologic analysis also includes watershed areas which encompass the site and immediate surrounding area, and the same analysis points as described above. The proposed site is mostly impervious, covered by buildings and associated hardscape. As with the existing site, the northern section of the proposed site will remain wooded and slope towards the site. The new parking lot will be re-graded allowing runoff to be collected by new drainage structures. Stormwater will be treated by site improvements including the stormwater management system.

The proposed stormwater management system will utilize a series of catch basins, roof leaders, hydrodynamic separators, and underground detention. The stormwater

management system will maintain existing drainage patterns while providing low impact development practices and stormwater treatment.

The drainage structures and pipes have been sized to convey the 25-year storm event as per the Town of Darien requirements.

Section 883(a) of the Zoning Regulations of the Town of Darien requires that the post-development peak stormwater runoff rate be reduced to undeveloped (meadow condition) peak runoff rates for this site. "Where an existing residential dwelling or commercial building is proposed to be razed and replaced with a new structure, the basis of existing conditions analysis shall be the site's undeveloped condition if there is no engineered detention system on the existing site." The existing site does not contain an engineered detention system, so the proposed site stormwater management plan includes underground detention systems designed to reduce the post development peak runoff rate below undeveloped (meadow condition) peak runoff rates for the 2, 10, 25 and 50 year storms.

The stormwater management system has been designed to treat the Water Quality Volume (WQV), remove Total Suspended Solids (TSS) and reduce peak flow. There are three water quality structures proposed to treat stormwater before it flows into each of the three underground detention systems. The WQV was calculated for each of the structures using the Connecticut Department of Energy and Environmental Protection 2004 Stormwater Quality Manual. To treat the WQV, the stormwater management system utilized hydrodynamic separators as primary treatment. The hydrodynamic separator has been sized by converting the required WQV to a Water Quality Flow (WQF) in accordance with the 2004 Stormwater Quality Manual. Infiltration is not proposed due to the low permeability soils and the high groundwater levels on the site.

Table 1 below shows the peak discharge from existing to proposed for the 2, 10, 25 and 50-year storm events for each design point.

Table 1
Summary of Stormwater Peak Discharge (cfs)

		Frequency (Years)			
Discharge Location	**Condition**	**2**	**10**	**25**	**50**
Design Point #1	Meadow Conditions	5.68	12.62	15.74	18.98
	Proposed	5.54	10.97	13.27	16.94
	% Reduction	2%	13%	15%	11%
Design Point #2	Existing	12.17	20.26	23.62	26.99
	Proposed	11.77	19.62	22.88	26.15
	% Reduction	3%	6%	3%	3%

The on-site stormwater management system has been designed to mitigate stormwater runoff and the proposed project will not increase peak flow or exacerbate flooding conditions downstream to each of the two design points affected by this development.

The proposed watershed maps, watershed areas, storm sewer calculations, hydrographs, Water Quality Volume and Flow calculations are included in **Appendix D & E** of this report.

2.3 Method of Hydrology and Hydraulic Analysis

The following storm drainage design criteria were used for all pipe systems:

1. Design storm rainfall data was used per Connecticut Department of Transportation Drainage Manual 2000.

2. Detention system is designed for the 2, 10, 25 and 50-year storm events.

3. Piped storm drainage system and the outlets are designed for a 25-year storm event.

4. Minimum time of concentration = 5 minutes.

5. For rational peak flow calculations, runoff coefficients were as follows:

    a. Impervious (Pavement/Roof) areas = 0.90

    b. Wooded areas = 0.50

    c. Landscaped areas = 0.30

6. For hydrograph calculations, SCS Curve Numbers were as follows:

    a. Impervious (Pavement/Roof) areas = 98

    b. Pervious Soils = 69

7. For existing site hydrograph calculations, SCS Curve number of 65 was used for the entire site. Additionally, times of concentrations were calculated assuming the site was undeveloped per Town of Darien requirements.

8. Minimum diameter pipes, excluding roof leaders, underdrains and foundation drains = 12 inches

9. Minimum pipe slope = 1.0 percent

10. The storm water management Plan for the site is designed to treat the Water Quality Volume, remove 80% of Total Suspended Solids and reduce peak flow.

11. Watershed areas delineated using polylines in AutoCAD Civil 3D 2015.

12. Comparative hydrology analyzed using AutoCAD Civil 3D 2015 Hydraflow Hydrographs Extension Version 10.40 by Autodesk software.

13. Storm drainage system analyzed using AutoCAD Civil 3D 2015 Hydraflow Storm Sewers Extension Version 10.40 by Autodesk software.

Runoff computations and storm sewer calculations for existing and proposed conditions are included in **Appendix C, D & E** for review.

2.4 Low Impact Development and Best Management Practices

The stormwater management plan for the proposed site has been designed to remove a high percentage of sediments in accordance with the Connecticut Department of Energy and Environmental Protection Stormwater Quality Manual.

The stormwater management plan for this site uses "Best Management Practices ("BMPs")" to meet or exceed the Connecticut DEEP's goal of 80% removal of total suspended solids and other pollutants as described in Section 2.5.

The BMPs include:

Catch Basins with Sumps: Catch Basins with sumps serve to collect sediment and to prevent discharge of oil and other pollutants into the storm drainage system. All new catch basins will have 24-inch sumps.

Hydrodynamic Separator: Hydrodynamic separators serve as pretreatment and to prevent transport of oils and sediment further downstream prior to connection to the existing storm sewer system. The proposed stormwater management system utilizes Contech Vortechs stormwater quality structures in a bypass configuration prior to discharge into the underground detention system. The Contech Vortechs units have been sized in accordance with the 2004 CTDEEP Stormwater Quality Manual. Sizing calculations are provided in Appendix D.

Underground Detention: Underground detention serves as a secondary treatment practice and to reduce peak flow rates. The detention system will utilize precast 4' x 8' box culverts enclosed in gravel fill with an outlet control structure to reduce peak flows. Infiltration is not proposed due to the low permeability soils and high groundwater levels on the site.

2.5 Stormwater Maintenance and Inspection Schedule

The initial inspection will be made during an intense rainfall to check the adequacy of the yard drains, catch basins, roof leaders, piping, hydrodynamic separator, infiltration system, and outlet.

The following is a checklist of items that will be checked and maintained during scheduled maintenance operations.

Drainage Structures: The Owner will be responsible for cleaning the catch basins, yard drains, manholes, piping, and outlet protection on their property. A Connecticut licensed hauler shall clean the sumps, and legally dispose of removed sand at an off-site location. The road sand may not be reused or stored on-site. As part of the hauling contract, the hauler shall notify the Owner in writing where the material is being disposed.

Each catch basin and yard drain shall be inspected every six months, with one inspection occurring during the month of April. Any debris occurring within one foot from the bottom of each sump shall be removed by Vacuum "Vactor" type of maintenance

equipment. Maintain a log of inspections. Remove organic matter, sand and debris from catch basins as necessary and dispose of legally.

Hydrodynamic Separator: The Contech Vortech units (hydrodynamic separator) will be skimmed and oil and scum removed. In a separate operation, silt, sand and sediment will be removed. Once the structure is cleaned of debris, the chamber will be refilled with clean water to prevent wash through of debris and oil during next storm event.

Underground Detention: The underground detention system will be cleaned of all silt, debris and sediment from the inlet structure, outlet structure and the chamber lengths. The outlet control structure will be inspected and cleaned to make sure nothing is clogging the weir wall orifices or the discharge pipe.

Pavement: Paved areas shall be swept periodically by the Owner to clean trash and other debris. The Owner will sweep paved areas on its property in the spring to remove winter accumulations of road sand.

Perform a visual inspection of paved areas four times per year with one inspection after the last snowfall, but no later than April 1. Sweep accumulated sediment and debris from the paved areas. Clean paved areas as necessary during the remainder of the year.

A Maintenance and Inspection Plan, including forms and checklists, for the proposed project can be found in **Appendix F**.

Section 3
Site Utility Services

3.1 Sanitary Sewer

There is an existing 8" sanitary sewer located east of the site on Heights Road. The project proposes to extend this 8" main approximately 300 linear feet west in Heights Road in order connect the proposed site lateral. An 8" sanitary lateral will be installed from the proposed buildings to the extended sanitary sewer main. 1000-gallon (minimum) grease traps will be installed to intercept grease waste from three of the buildings containing restaurants before it enters the Town's sanitary system.

The on-site sanitary sewer system is sized adequately for the anticipated flow. The total discharge from the development was calculated based on building use and compared to the capacity of one 6" sanitary lateral. It is anticipated that the peak flow for all five buildings will total 0.33 cfs and the capacity of one 6" lateral is 1.149 cfs. This calculation shows that the proposed capacity significantly exceeds the anticipated peak flow.

Please refer to the calculations in **Appendix G**.

3.2 Water Supply

Water service is provided to the site by Aquarion Water Company, which reports a 10" water main in Heights Road. Four new tapping sleeves will be installed on the existing main to service the buildings and fire hydrants for the site.

3.3 Gas, Electric and Tel-Data

Gas and electric service to the site will be provided by Eversource, telephone service will be provided by Frontier and cable television service will be provided by Cablevision. New underground gas will be provided from a new gas main located in Heights Road. Electric and tel-data services will be provided from services located in Hollow Tree Road and it is anticipated that that there is sufficient availability of these services for the site. Details of the connections will be coordinated with the respective utility companies once more detailed information about load requirements for the development have been established.

Section 4
Sedimentation and Erosion Control

4.1 Erosion Control Narrative

1. The proposed development is entitled "Noroton Heights Shopping Center" and is located on Heights Road in Darien, Connecticut.

2. Estimated:

    a. Project Start: Summer 2017

    b. Project Completion: Fall 2019

3. Erosion Control Narrative refers to drawings C8.0.

4. The proposed site development will consist of clearing and grubbing the existing site, demolition of existing buildings, excavation, construction of sedimentation/detention basins, and rough grading of roadways, parking areas, sidewalks and curbing.

5. Conduct a pre-construction meeting with the owner or owner's representative, town engineer, design engineer, site engineer, contractor and site superintendent to establish the limits of construction, construction procedures and material stockpile areas.

6. Field stake the limits of construction.

7. Install all applicable soil and erosion control measures around the perimeter of the site to the extent possible. This will include siltation fence around the project as shown on the plans.

8. Install construction access road and anti-tracking pavement in the areas as shown on the plans. All construction access shall be into the site through the anti-tracking pads.

9. Establish temporary staging area.

10. Install silt sacks and haybale barriers around existing catch basins to remain as indicated on the plans.

11. Install water quality systems and associated drainage network to the maximum extent practicable. Grade the area around the storm drainage system as necessary.

12. Begin rough site grading.

13. Install drainage system to the extent necessary to provide positive drainage.

14. Install sanitary sewer system to extent necessary.

15. Provide silt fence/haybale barrier around soil stockpile area. Provide temporary vegetative cover (defined in erosion control notes) on all exposed surfaces.

16. Pave binder course on roadways.

17. Construct proposed buildings.

18. Construct sidewalks.

19. Establish permanent vegetative cover.

4.2 Erosion Control Notes

1. All sedimentation and erosion control measures shall be constructed in accordance with the standards and specifications of the "2002 Connecticut guidelines for soil erosion and sediment control", Connecticut Department of Energy and Environmental Protection (CTDEEP) bulletin no. 34, and all amendments and addenda thereto.

2. Land disturbance shall be kept to the minimum necessary for construction operations.

3. All erosion control measures shall be installed as shown on the plan and elsewhere as ordered by the engineer or the town.

4. All catch basins shall be protected with a silt sacks, haybale ring, silt fence or block and stone inlet protection throughout the construction period and until all disturbed areas are thoroughly stabilized.

5. Whenever possible, erosion and sediment control measures shall be installed prior to construction. See "erosion control narrative".

6. Additional control measures shall be installed during the construction period as ordered by the engineer.

7. All sedimentation and erosion control measures shall be maintained in effective condition throughout the construction period.

8. Sediment removed shall be disposed of off-site or in a manner as required by the engineer.

9. The construction contractor shall be responsible for construction and maintenance of all control measures throughout the construction period.

10. All disturbed areas to be left exposed for more than 30 days shall be protected with a temporary vegetative cover. Seed these areas with perennial ryegrass at the rate of 40 lbs. per acre (1 lb. per 1,000 sq. ft). Apply soil amendments and mulch as required to establish a uniform stand of vegetation over all disturbed areas.

11. The construction contractor shall utilize approved methods/materials for preventing the blowing and movement of dust from exposed soil surfaces onto adjacent properties and site areas.

12. The construction contractor shall maintain a supply of silt fence/haybales and anti-tracking crushed stone on site for emergency repairs.

13. All drainage structures shall be periodically inspected weekly by the construction contractor and cleaned to prevent the build-up of silt.

14. The construction contractor shall carefully coordinate the placement of erosion control measures with the phasing of construction.

15. Keep all paved roadways clean. Sweep before forecasted storms.

16. Treat all unpaved surfaces with 4" minimum of topsoil prior to final stabilization.

17. Haybale barriers and silt fencing shall be installed along the toe of critical cut and fill slopes.

18. The contractor shall notify the town of Darien's Planning & Zoning staff prior to the installation of erosion controls, cutting of trees, or any excavation.

19. All trucks leaving the site must be covered.

20. Some control measures are permanent. These structures shall be cleaned and replenished at the end of construction. Locations of the permanent control structures are shown on the drainage plans.

21. All sedimentation and erosion controls shall be checked weekly and/or after each rain fall event. Necessary repairs shall be made without delay.

20. Prior to any forecasted rainfall, erosion and sediment controls shall be inspected and repaired as necessary.

21. After all disturbed areas have been stabilized, erosion controls may be removed once authorization to do so has been secured from the town. Disturbed areas shall be seeded and mulched.

4.3 Construction Sequence

1. Flag the limits of construction, right-of-way and tree protection zones.

2. Hold preconstruction meeting. (Remember to Call Before You Dig 1-800-922-4455).

3. Hold tree cutting meeting.

4. Install the construction entrance.

5. Install perimeter erosion and sediment controls and tree protection devices in accordance with the SESC plan.

6. Excavate all stumps located in the building footprint, parking areas and roadway and remove to a disposal site or stockpile area to be chipped. Remaining stumps shall be ground in place.

7. Demolish existing buildings.

8. Make all cuts and fills required. Establish the sub-grade for the topsoil areas, parking and roadway as required and bench the building to a subgrade. Allow a reasonable amount of area around the footprint of the buildings for the construction activities.

9. Begin construction of the buildings.

10. Install all sanitary sewers and drainage facilities starting at the outfall and proceeding upgrade. Install remaining utilities (water, electric, cable, fiber optic, telephone).

11. Prior to installing surface water controls such as temporary diversions and stone dikes, inspect existing conditions to ensure discharge locations are stable. If not stable, review discharge conditions with the design engineer and implement additional stabilization measures prior to installing water surface controls.

12. Prepare sub-base, slopes, parking areas, shoulder areas, and any other area of disturbance for final grading.

13. Install process aggregate in parking areas.

14. Place topsoil where required. Complete the perimeter landscape plantings.

15. Fine grade, rake, seed and mulch to within 2 feet of the curbing.

16. Upon substantial completion of the buildings, complete the balance of site work and stabilization of all other disturbed areas. Install first course of paving.

17. When all other work has been completed, repair and sweep all paved areas for the final course of paving. Inspect the drainage system and clean as needed.

18. Install final course of pavement for parking areas and roadway.

19. After site is stabilized, remove temporary erosion and sediment controls (e.g. geotextile silt fences and haybales).

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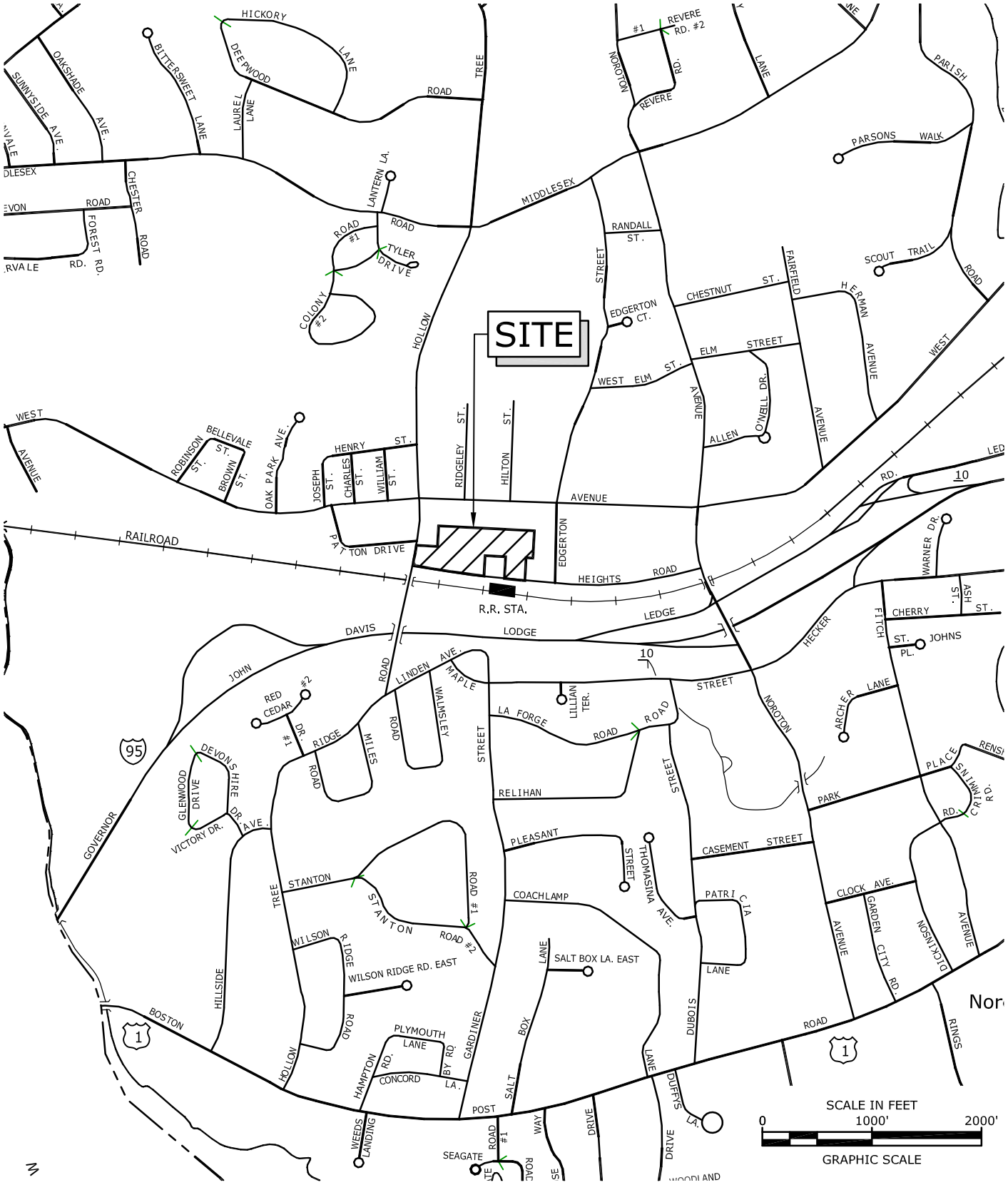
APPENDIX A



NOROTON HEIGHTS SHOPPING CENTER

DARIEN, CT

SITE LOCATION MAP

NORTH

1" = 1000'

FIGURE 1

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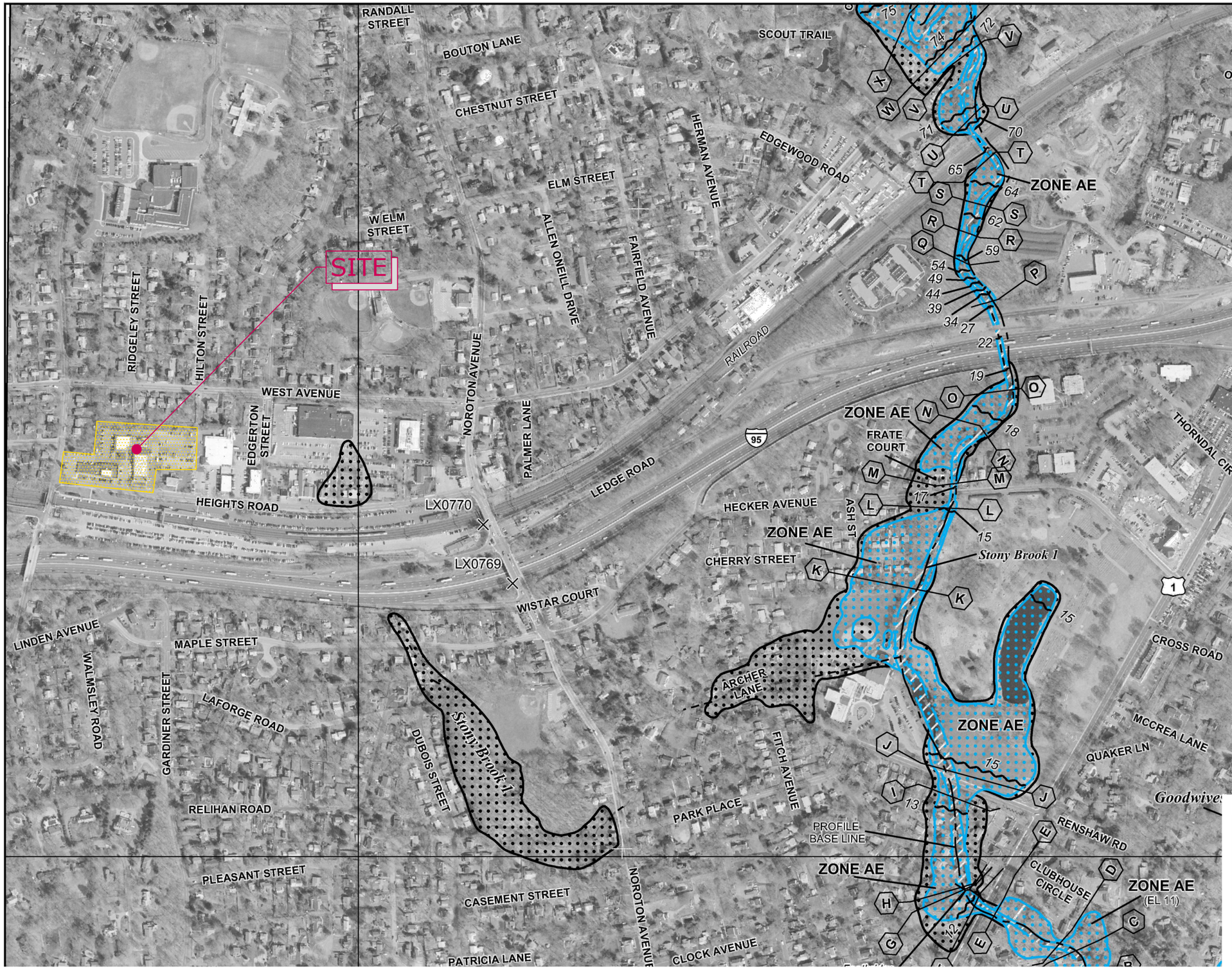
Nov 07, 2016-1:58pm Plotted By: JCB1
Tighe & Bond, Inc. J:\P\P0695 J&G Palmer Mixed Use\Drawing\Sheet\Figure 1 - Site Location.dwg



MAP SCALE 1" = 500'

250 0 500 1000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0528G

FIRM

FLOOD INSURANCE RATE MAP

FAIRFIELD COUNTY, CONNECTICUT

(ALL JURISDICTIONS)

PANEL 528 OF 626

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DARIEN, TOWN OF	090005	0528	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
09001C0528G

MAP REVISED
JULY 8, 2013

Federal Emergency Management Agency

NOROTON HEIGHTS SHOPPING CENTER
DARIEN, CT

FIRM MAP
MAP #09007C0528G

DATE: 09/13/2016	
SCALE: 1:500	
FIGURE 2	

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Sep 13, 2016-12:22pm Plotted By: JCB1
Tighe & Bond, Inc. J:\P\P0695 J&G Palmer Mixed Use\Drawing\Sheet\Figure 1 - FIRM.dwg

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APPENDIX B

Hydrologic Soil Group—State of Connecticut

Map Scale: 1:6,000 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 250 500 1000 1500

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.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
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 14, Sep 22, 2015

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

Date(s) aerial images were photographed: Jul 21, 2014—Aug 27, 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

Hydrologic Soil Group— Summary by Map Unit — State of Connecticut (CT600)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
45B	Woodbridge fine sandy loam, 3 to 8 percent slopes	C/D	0.4	3.0%
84C	Paxton and Montauk fine sandy loams, 8 to 15 percent slopes	C	2.7	20.4%
232B	Haven-Urban land complex, 0 to 8 percent slopes	B	0.2	1.4%
306	Udorthents-Urban land complex	B	9.9	75.1%
Totals for Area of Interest			**13.2**	**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

GEODESIGN INCORPORATED

GEOTECHNICAL | CONSTRUCTION | ENVIRONMENTAL
ENGINEERS and SCIENTISTS

GEOTECHNICAL ENGINEERING REPORT
NOROTON HEIGHTS CENTER
346 HEIGHTS ROAD
DARIEN, CONNECTICUT

Prepared for:

Noroton Heights Shopping Center, Inc.
264 Heights Road
Darien, Connecticut 06820

Prepared by:

Geo**Design,** Inc.
984 Southford Road
Middlebury, Connecticut 06762

File No. 3734-001.00
February 2015

20th Year
GEODESIGN
INCORPORATED

GEOTECHNICAL | CONSTRUCTION | ENVIRONMENTAL
ENGINEERS and SCIENTISTS

February 13, 2015
File No. 3734-001.00

Mr. Gregory J. Palmer
Noroton Heights Shopping Center, Inc.
264 Heights Road
Darien, CT 06820

c/o: Mr. Jim C. Palmer

Via email: jimcpalmer@yahoo.com

Re: Geotechnical Engineering Report
Noroton Heights Center
346 Heights Road
Darien, Connecticut

Geo**Design**, Inc. (Geo**Design)** is pleased to submit this geotechnical engineering report for the proposed Noroton Heights Center in Darien, Connecticut. We appreciate the opportunity to work with you. Please call if you have any questions.

Sincerely,

Geo**Design**, Inc.

Daniel F. LaMesa, P.E.
Project Engineer

Joseph W. Kidd, P.E.
Reviewer

Theodore von Rosenvinge, P.E.
Senior Principal

m:\cl\3734\001\report\report 02.13.15.docx

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1.0 INTRODUCTION

This report provides geotechnical design and construction recommendations for the proposed Noroton Heights Center that will be located at 346 Heights Road in Darien, Connecticut. Refer to Figure 1 (in Appendix 1) for the approximate site location.

1.1 SCOPE OF SERVICES

Our geotechnical engineering services included: reviewing project plans and existing survey data, performing subsurface explorations, characterizing subsurface conditions within the project limits, performing geotechnical engineering analyses, and providing geotechnical design and construction recommendations for the project.

Our services were performed in accordance with our December 8, 2014 proposal, which was based in part on the following documents:

- Noroton Heights Center – Feasibility Study, Town of Darien, Connecticut, Lower Level X-1, prepared by Newman Architects, dated September 8, 2014; and

- Zoning Location and Topographic Survey, 346 Heights Road, Darien, Connecticut, prepared by William W. Seymour and Associates, P.C., dated December 2, 2014.

1.2 PROJECT DATUM

The project vertical datum is based on the NAVD 1988 Datum. Elevations (El.) provided in this report are stated in feet.

1.3 DESIGN METHOD

Our recommendations are based on allowable stress design and the following codes and references:

- The 2003 International Building Code (IBC), 2005 Connecticut Supplement, and 2009, 2011, and 2013 Connecticut Amendment;

- ConnDOT Geotechnical Engineering Manual (2005 Edition);

- ConnDOT Standard Specifications for Roads, Bridges, and Incidental Construction, Form 816 (2004) including 2005 to 2012 supplements;

- AASHTO Guide for the Design of Pavement Structures, 1993; and

- The American Society for Testing and Materials (ASTM).

2.0 BACKGROUND

2.1 EXISTING SITE CONDITIONS

The site is approximately four acres and bounded by Heights Road to the South, Hollow Tree Ridge Road to the West, commercial properties to the East, and residential properties to the North. Refer to Figures 1 and 2 (in Appendix 1) for the site location and site plan. Site topography generally slopes down from north (approximate El. 87) to south (approximate El. 82) with driveways, parking lots, sidewalks and landscaped areas.

There are two commercial buildings that currently occupy the site. The buildings are of slab-on-grade construction (i.e. no basements) and presumably supported on normal shallow foundations.

2.2 PROPOSED CONSTRUCTION

We understand that the existing buildings will be demolished and two new buildings (Building A and Building B) will be constructed in their place. The proposed buildings will have three stories and consist of residential and commercial areas that will include apartments, retail centers, office space, and restaurants. There will also be surrounding surface parking areas and a potential underground parking garage located north of Building B.

Building A will be about 10,500 square feet with a slab-on-grade (i.e. no basement) at about El. 85. Building B will have four separate units ranging in square footage from 4,500 to 7,000 square feet each that will be connected with a plaza and common lower level garage for parking. Building B will also have first floor elevations ranging from approximate El. 84 to 86 with full basements that will have approximate slab elevations of 72 to 74. The top of the proposed underground garage slab will be at approximate El. 75.

It is expected there will be minor (less than 2 to 3 feet) cutting and filling around the proposed buildings, but current grades will largely be unchanged.

3.0 SUBSURFACE DATA

3.1 GENERAL SITE GEOLOGY

Published surficial and bedrock geological data (1:125,000 scale, Surficial Materials Map of Connecticut, Janet Radway Stone, 1992 and Bedrock Geological Map of Connecticut, John Rodgers, 1985) was consulted. The surficial material is mapped as Glacial Till, and is described as a variable mixture of gravel, sand, silt, and clay that is intermix with cobles and boulders. The bedrock is mapped as Granitic Gneiss.

3.2 SUBSURFACE EXPLORATIONS

3.2.1 Test Borings

We performed ten test borings (B-1 through B-10) on January 19 and 20, 2015. The boring locations are depicted on Figure 2 (in Appendix 1). Borings were located in the field by taping/pacing from existing site features. The approximate ground surface elevation at each boring location was estimated from the referenced survey. The locations of the borings and their elevations should be considered approximate. Boring logs are included in Appendix 2.

Borings were made to explore subsurface conditions in the area of the proposed buildings. Hollow-stem-auger drilling methods were used to advance the borings to depths of approximately 15 to 22 feet (approximate El. 72 to 61) below current site grades.

Representative samples were obtained by split barrel sampling procedures in general accordance with ASTM Specification D-1586. The split-barrel sampling procedure utilizes a standard 2-inch O.D. split-barrel sampler that is driven into the bottom of the boring with a 140-pound hammer falling a distance of 30 inches. The number of blows required to advance the sampler the middle 12-inches of a normal 24 inch penetration is recorded as the Standard Penetration Resistance Value (N). The blows (i.e. the "N" values) are indicated on the boring logs at their depth of occurrence and provide an indication of the relative consistency of the material.

3.2.2 Monitoring Well

A one inch diameter groundwater observation well was installed in Boring B-3 to measure stabilized groundwater levels. The well was installed at about 18.5 feet below grade (approximate El. 64).

The well was constructed with a ten foot long 0.01-inch slotted screen and solid riser. The screen was surrounded with filter pack sand and sealed with a bentonite plug. The remaining annulus was backfilled with auger cuttings to the ground surface. A protective cover and concrete collar were installed at the ground surface. Observation well construction is noted on Boring Log B-3 in Appendix 2.

4.0 SUBSURFACE CONDITIONS

4.1 SUBSURFACE PROFILE

Test boring data were generally consistent with the published geological information summarized above except for the presence of Fill. The generalized subsurface profile, as inferred from the subsurface explorations, consists of Asphalt or Topsoil overlying Fill, Glacial

Till, and Inferred Bedrock. An approximate 2.5-foot layer of soft Sandy Silt and Clay with trace amounts of organic material was observed below the Fill in Boring B-2.

The following is a more detailed description of the subsurface materials encountered.

4.1.1 Asphalt and Topsoil

Test borings encountered Asphalt or Topsoil at the ground surface. Asphalt was about 1.5 to 6 inches thick with an underlying 7 to 18 inch sand and gravel base coarse layer. Topsoil was about 3.5 inches thick and generally consisted of dark brown fine to medium sand with little (10 to 20%) silt, trace (0 to 10%) fine gravel, and trace amounts of roots.

4.1.2 Fill

Fill was encountered in all the borings and extended approximately 1 to 5.5 feet (El. 76.5 to 86) below the ground surface. This stratum typically consisted of loose to medium dense, brown, fine to coarse sand with varying amounts of fine to coarse gravel and silt. Trace amounts of roots and brick were also present in the Fill.

Cobbles and possible boulders were inferred in this stratum based on drilling auger "chatter" and refusal. The thickness, character, and consistency of the Fill will vary between exploration locations.

4.1.3 Glacial Till

Glacial Till was encountered below the Fill and generally consisted of loose to very dense, brown/gray, fine to medium sand with some to and (20 to 50%) amounts of silt, trace to little (5 to 20%) amounts of fine to coarse gravel, and trace (0 to 10%) amounts of clay. Cobbles and possible boulders were inferred in this stratum based on drilling auger "chatter." This stratum generally became denser with depth.

4.1.4 Inferred Bedrock

Inferred Bedrock was encountered in Borings B-3 and B-5 at about 18.5 and 20 feet (approximate El. 64 and 67), respectively, below the ground surface. Bedrock depths were inferred based on auger refusal.

4.2 GROUNDWATER

The groundwater level was measured at about 4.3 feet (El. 78.1) below grade in Boring B-3 Observation Well approximately seven days after it was installed. During drilling, groundwater was measured at about 4.4 feet (El. 82.6) below grade in Boring B-7 after the drill hole was left open for approximately 1.8 hours.

Groundwater levels will vary depending on factors such as temperature, season, precipitation, construction activity, and other conditions, which may be different from those at the time of these measurements.

5.0 GEOTECHNICAL RECOMMENDATIONS

We offer the following geotechnical design recommendations based on the subsurface conditions encountered at the site, available project information, and the proposed construction.

5.1 FOUNDATIONS

5.1.1 Foundation Type and Bearing Strata

We recommend supporting the proposed buildings on normal shallow spread footings. The footings should bear below the Fill and Sandy Silt and Clay on undisturbed Glacial Till or on Structural Fill (hereinafter specified as Compacted Granular Fill, CGF) over Glacial Till.

Topsoil, asphalt, Sandy Silt and Clay, and existing Fill are not considered suitable bearing materials, and must be excavated from the building areas during site preparation. When CGF is used beneath the footings (e.g. in filled areas), we recommend that it be placed one foot beyond the edge of the footings and at a one horizontal to one vertical slope away and down from the footings. Crushed Stone can be used in place of CGF in areas below the water table, or for expediency (as it is much easier to compact than CGF).

5.1.2 Footing Levels and Sizes

Exterior footings (and footings in unheated areas) should be constructed at a minimum frost depth of 42-inches below proposed site grades. Interior footings, in heated areas, should be constructed at a minimum depth of 24-inches below proposed top of slab-on-grade level.

The minimum isolated footing size should be 2.5 feet by 2.5 feet, and the minimum wall footing width should be 1.5 feet.

5.1.3 Allowable Bearing Pressures and Estimated Settlements

We recommend a maximum allowable design bearing pressure of two and half tons per square foot for footings bearing on the recommended bearing strata (undisturbed Glacial Till or CGF). The allowable loading can be increased by 1/3 for seismic or wind loading when using allowable stress design.

Based on the recommended bearing strata and anticipated loads, we anticipate that footings will undergo less than one inch of total settlement and less than a half inch of

differential settlement. Settlements will occur as the loads are applied and are expected to be complete at the end of construction.

5.1.4 Drainage

We recommend the use of exterior perimeter footing drains due to the high groundwater table and elevated fines content of site soils. The footing drains should consist of 6-inch diameter perforated PVC pipe, surrounded by 6-inches of Crushed Stone, wrapped in non-woven filter fabric. Cleanouts should be installed in the direction of flow at the beginning of piping runs and consist of 45 degree elbows (90 degree elbows should not be allowed). The drains should be gravity drained to the site drainage system or basement sump pumps.

5.2 BUILDING A SLAB-ON-GRADE

5.2.1 Subgrade

We recommend placing at-grade concrete floor slabs over a minimum ten inch thick base course layer of compacted Sand and Gravel or six-inch layer of compacted Crushed Stone placed on the surface of carefully prepared natural Glacial Till, improved existing Fill (defined herein), or CGF over these materials. Slabs should not be constructed over Sandy Silt and Clay, organics, or other soft soils that could potentially settle over time.

The design subgrade modulus for the recommended subgrade and base course is 250 pounds per cubic inch.

5.2.2 Drainage and Damp-Proofing

Groundwater is estimated to be approximately 7 feet below the proposed top of Building A Slab Level. Damp-proofing of the slab is recommended. Slab damp-proofing must be installed between the slab and base course, and consist of not less than 6-mil polyethylene with joints lapped at least 6-inches. Other approved methods or materials may be considered.

5.3 BUILDING B BASEMENT SLABS

5.3.1 Subgrade

We recommend placing below grade basement slabs over a minimum 12-inch thick base course layer of compacted Crushed Stone placed on the surface of carefully prepared natural Glacial Till or GCF over Glacial Till.

The design subgrade modulus for the recommended subgrade and base course is 300 pounds per cubic inch.

5.3.2 Drainage

Groundwater levels will be above the proposed basement floor elevations unless they are suppressed. We recommend using a "relieved" slab design with an underdrain system. The underdrain system should consist of a network of perforated PVC pipes that are gravity drained to a series of sump pits with pumps. The drains should consist of 4-inch minimum diameter perforated PVC pipe, surrounded by 6-inches of Crushed Stone, and wrapped in non-woven filter fabric. Drain inverts should flat or pitched up to 0.25%, embedded at a minimum depth of 12-inches below bottom of slab, and nominally spaced 25 feet-on-center.

Drainage paths shall be designed to allow all drains to discharge to a sump pit with a series of commercial grade sump pumps. The pumps should be equipped with a mechanism to engage the pumps and maintain the water level at least one foot below the bottom of the slab. The pumps should be duplex, have backup independent power supply (emergency generator), and alarms.

5.3.3 Damp Proofing

As a minimum, slab damp-proofing should be installed between the slab and base course, and consist of not less than 6-mil polyethylene with joints lapped at least 6-inches. Full waterproofing or other approved methods or materials may be considered depending on level of moisture control desired.

5.4 RETAINING WALLS

5.4.1 Backfill and Drainage

We recommend backfilling earth retaining structures with compacted Sand and Gravel and installing footing drains. The drains should consist of 4-inch diameter perforated PVC pipe, surrounded by 6-inches of Crushed Stone, wrapped in non-woven filter fabric. Footing drain inverts should be set flush with or up to 6-inches above bottom of footing level. The drains should be gravity drained to daylight or to the site drainage system.

Weep holes may be installed in place of footing drains where they can discharge to non-paved areas (e.g., grassed areas). In paved areas such as sidewalks, weep holes should be avoided to reduce the potential for ice formation in pedestrian access ways. Where weep holes are appropriate we recommend installing Crushed Stone (minimum diameter of 12 inches), wrapped in non-woven filter fabric at each weep hole location, to prevent movement of wall backfill materials into the weep holes.

5.4.2 Lateral Earth Pressures

Walls that are free to rotate at the top and are not braced should be designed to resist an equivalent active static horizontal fluid earth pressure equal to 37 pcf (based on φ' = 32°, c = 0, Ka = 0.31, and ɣ = 120 pcf). Braced retaining walls should be designed to resist an equivalent at-rest static horizontal fluid earth pressure equal to 57 pcf (based on φ' = 32°, c = 0, Ko = 0.47, and ɣ = 120 pcf). This assumes no unbalanced hydrostatic pressures, seismic forces, or surcharges from traffic loads. We recommend using a traffic surcharge load of 250 psf.

Due to the limited expected wall movement and depth of footings, we do not recommend the use of passive earth pressures against the base of walls.

Based on an assumed Seismic Design Category "C" (or higher), no seismic design forces need be applied to retaining walls.

5.4.3 Coefficient of Friction

We recommend a maximum coefficient of friction of 0.5 between foundations and the recommending bearing strata.

5.4.4 Damp-Proofing

As a minimum damp-proofing should be installed on the exterior surface of the basement walls and extend from the top of the footing to above the ground level. Damp-proofing should consist of a bituminous material, 3 pounds per square yard of acrylic modified cement, or 1/8-inch coat of surface-bonding mortar complying with ASTM C887. Full waterproofing or other approved methods or materials may also be considered depending on level of moisture control desired.

5.5 SEISMIC DESIGN

5.5.1 Site Class

The average Standard Penetration Test "N" value over a 100-foot depth below the proposed buildings is greater than 50. Thus, the site class for the proposed building is "C" (Very Dense Soil and Soft Rock) per the IBC.

We compute S_S for the site as 0.313g, S_1 as 0.067g, SMS as 0.375g, S_{M1} as 0.114g, S_{DS} as 0.250g, S_{D1} as 0.076g, and the peak ground acceleration as 0.10g.

5.5.2 Liquefaction Potential

Based on the standard penetration test results, visual soil classification, and design peak ground acceleration at this locale, the saturated site soils are not susceptible to liquefaction.

5.6 PAVEMENT DESIGN

5.6.1 Subgrade

The Pavement Section (i.e. combined thickness of asphalt, base course, and subbase materials) should be placed on the surface of previously improved existing Fill (defined in Section 8.4).

Based on the visual soil descriptions, the subgrade soils are frost susceptible (U.S. Army Corps of Engineers Group F2 and F3). We recommend a minimum pavement section thickness of 10-inches for this level of frost susceptibility. The recommended minimum pavement section thickness is based on frost design considerations. A thicker pavement section may be necessary based on pavement structural requirements.

5.6.2 Structural Requirements

We performed a pavement analysis in general accordance with AASHTO Design Specifications assuming an equivalent single-axial loading (ESAL) of 2,000,000 and a pavement reliability of 80%. Based on the subsurface conditions at the site and the above assumptions, we recommend the following material thicknesses over the subgrade:

Class 1 Finish Course	Class 4 Binder Course	Processed Aggregate Base Course	Sand and Gravel Subbase
1.5-inches	1.5-inches	6-inches	6-inches

The above pavement section may have to be modified based on the actual ESAL and required reliability.

6.0 MATERIALS RECOMMENDATIONS

6.1 ON-SITE MATERIALS

We do not recommend using the on-site soils for CGF or Sand and Gravel Backfill due to their high fines (i.e. soil partials pass the No. 200 sieve) content.

Too many fines for structural use, but cannot be re-used where structural. 95% beneath structure. 90% - 92% beneath pavement. Must be done during dry season.

6.2 COMPACTED GRANULAR FILL

Compacted Granular Fill (CGF) derived from off-site sources for use as structural fill shall consist of inorganic soil free of clay, loam, ice and snow, tree stumps, roots, and other organic matter; graded within the following limits:

Sieve Size	Percent finer by weight
4-inches	100%
No. 10	30 - 100
No. 40	10 - 90
No. 200	0 - 12

6.3 SAND AND GRAVEL

Sand and Gravel for use as slab base course, pavement subbase, and retaining wall backfill shall consist of hard, durable sand and gravel; free of ice, clay, shale, roots, sod, rubbish, and other organic matter; graded within the following limits:

Sieve Size	Percent finer by weight
2-inches	100%
1/2-inch	50 - 85
No. 4	40 - 75
No. 40	10 - 35
No. 200	0 - 5

6.4 PROCESSED AGGREGATE BASE

Processed Aggregate Base for use as pavement base shall consist of inorganic soil free of clay, loam, ice and snow, tree stumps, roots, and other organic matter; graded within the following limits:

Sieve Size	Percent finer by weight
2 1/2-inches	100%
2-inch	95 - 100
3/4-inch	50 - 75
1/4-inch	25 - 45
No. 40	5 - 20
No. 100	2 - 12

6.5 CRUSHED STONE

Crushed Stone for use around drains or below foundations and slabs shall consist of sound, tough, durable, rock that is graded within the following:

Sieve Size	Percent finer by weight
5/8-inches	100%
1/2-inch	85 - 100
3/8 inch	15 - 45
No. 4	0 - 15
No. 8	0 - 5

6.6 PLACEMENT AND COMPACTION REQUIREMENTS

We recommend a minimum in-place dry density of 95-percent as per ASTM D1557 for material placed below foundations. We recommend a minimum in-place dry density of 92-percent as per ASTM D1557 for material placed below slabs, paved areas, and as backfill against foundations and retaining walls.

Materials should be placed within 2% of their optimum moisture content and compacted in accordance with the following table:

Compaction Method	Maximum Stone Size*	Maximum Loose Lift Thickness		Minimum Number of Passes	
		Below Structures and Pavement	Less Critical Area	Below Structures and Pavement	Less Critical Area
Hand-operated vibratory plate or light roller in confined areas	4"	6"	8"	4	4
Hand-operated vibratory drum rollers weighing at least 1,000# in confined areas	6"	10"	12"	4	4
Light vibratory drum roller					
minimum dynamic force 3,000#/ft drum width	8"	12"	18"	4	4
Medium vibratory drum roller					
minimum dynamic force 5,000#/ft drum width	8"	18"	24"	6	6

* And no more than two-thirds (2/3) loose lift thickness.

7.0 CONSTRUCTION RECOMMENDATIONS

7.1 DEMOLISHING OF EXISTING BUILDINGS

Foundations, slabs, utilities, and remnants of the existing building construction should be removed in their entirety from the proposed building areas and replaced with CGF below proposed foundation and slab areas.

7.2 FOUNDATION EXCAVATION

Based upon proposed lowest slab elevations and code depth for frost protection, the proposed Building B and Underground Garage Footings are expected to bear within the natural Glacial Till. Over excavation and replacement with CGF should be anticipated (e.g., refer to Borings B-1 and B-2 where the Glacial Till is anticipated at about five to eleven feet below top of slab) for proposed Building A Foundations.

We recommend performing a supplemental exploration program of test pits after the existing building demolition to better characterize the extent of the existing Fill and Sandy Silt and Clay. The owner may want to consider constructing a basement level or improving the Fill and Sandy Silt and Clay with rammed aggregate piers if natural Glacial Till is found deeper than 3 to 4 feet below proposed Building A Foundation Levels throughout a significate portion of the building's footprint.

7.3 FOOTING PREPARATION

We recommend the use of smooth edged excavator buckets or clips (not back-bladed) to make the final excavation to help protect the subgrade. The base of footing excavations should be free of water, ice, and loose and frozen soils prior to placing concrete. Should the materials at bearing level become disturbed, the affected materials should be removed prior to placing concrete. Concrete should be placed as soon as possible after excavation and placement of CGF (if needed) so that excessive weathering of bearing materials does not occur. A four inch thick layer of crushed stone may be used to protect footing subgrades that are expected to be open for an extended period of time.

7.4 EXISTING FILL IMPROVEMENT – BELOW PAVEMENTS AND SLABS

We recommend improving the existing Fill by excavating 12-inches of material below bottom of slabs and pavement sections and compacting remaining Fill (if any) with a minimum of four passes with a vibratory drum roller having a minimum dynamic force of 6,500 lbs. per foot of drum width. Areas exhibiting instability shall receive additional compaction and/or be over-excavated and replaced with CGF. This improvement procedure assumes that the existing Fill is above the water table and relatively dry and may have to be modified if the subgrade is too saturated.

Exiting Fill improvement will require careful observation by an experienced geotechnical engineer.

7.5 TEMPORARY EXCAVATIONS

The Fill and natural site soils are classified as OSHA Class "C" soil and can be cut at a maximum one vertical to one and a half horizontal (1V:1.5H) slope up to a maximum excavation depth of 20 feet. These maximum slope and excavation depths assume no surcharge load (i.e. stockpiles, construction equipment, etc.) at the top of the excavations or groundwater seepage.

If excavations cannot be sloped up in accordance with OSHA requirements, a temporary excavation support system will be required. The system should be chosen and installed by the contactor and designed by a Professional Engineer registered in the State of Connecticut.

7.6 TEMPORARY GROUNDWATER CONTROL

We expect that temporary groundwater/storm water control can be accomplished by means of shallow trenches and sumps, and grading the excavation to low points.

8.0 REVIEW OF FINAL DESIGN, PLANS, AND SPECIFICATIONS

When project plans and specifications are available they should be provided to Geo**Design** for review of conformance with our geotechnical recommendations. If any changes are made to the proposed buildings or garage, the recommendations provided in this report will need to be verified by Geo**Design** for applicability.

9.0 CONSTRUCTION QUALITY CONTROL

We recommend that Geo**Design** make field observations of excavations and foundation preparation to monitor compliance with our recommendations and project specifications. Specifically, we recommend field observation of footing subgrades, removal of unsuitable materials, Fill placement and compaction, and existing Fill improvement to monitor compliance with project specifications.

We are available to provide full-time personnel including laboratory and site testing services through completion of construction.

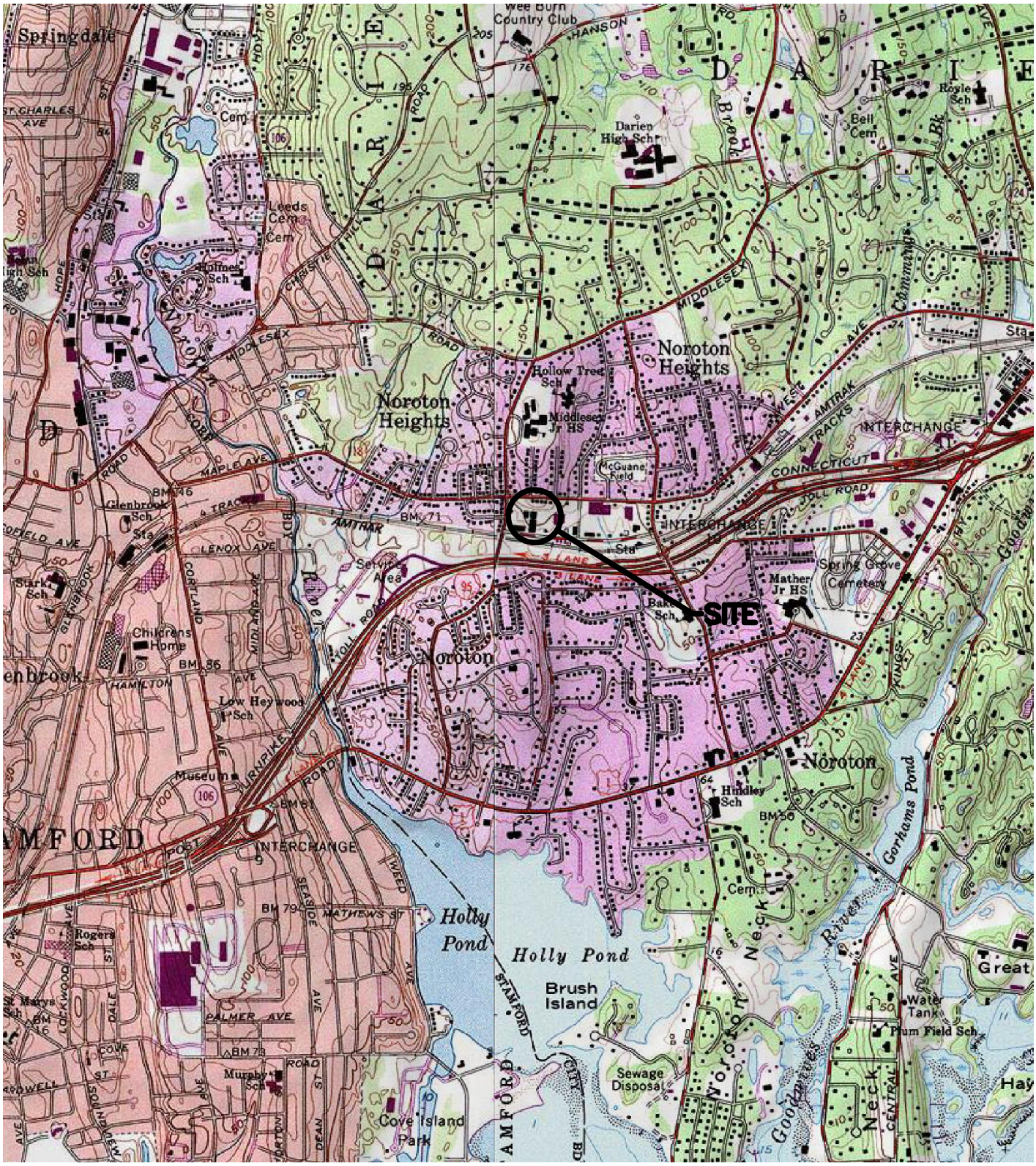
10.0 LIMITATIONS

This report is subject to the limitations included in Appendix 3.

APPENDIX 1

FIGURES

- Figure 1 - Locus Plan
- Figure 2 – Boring Location Plan



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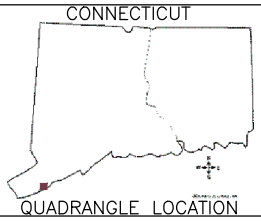


QUADRANGLE LOCATION

SCALE IN FEET

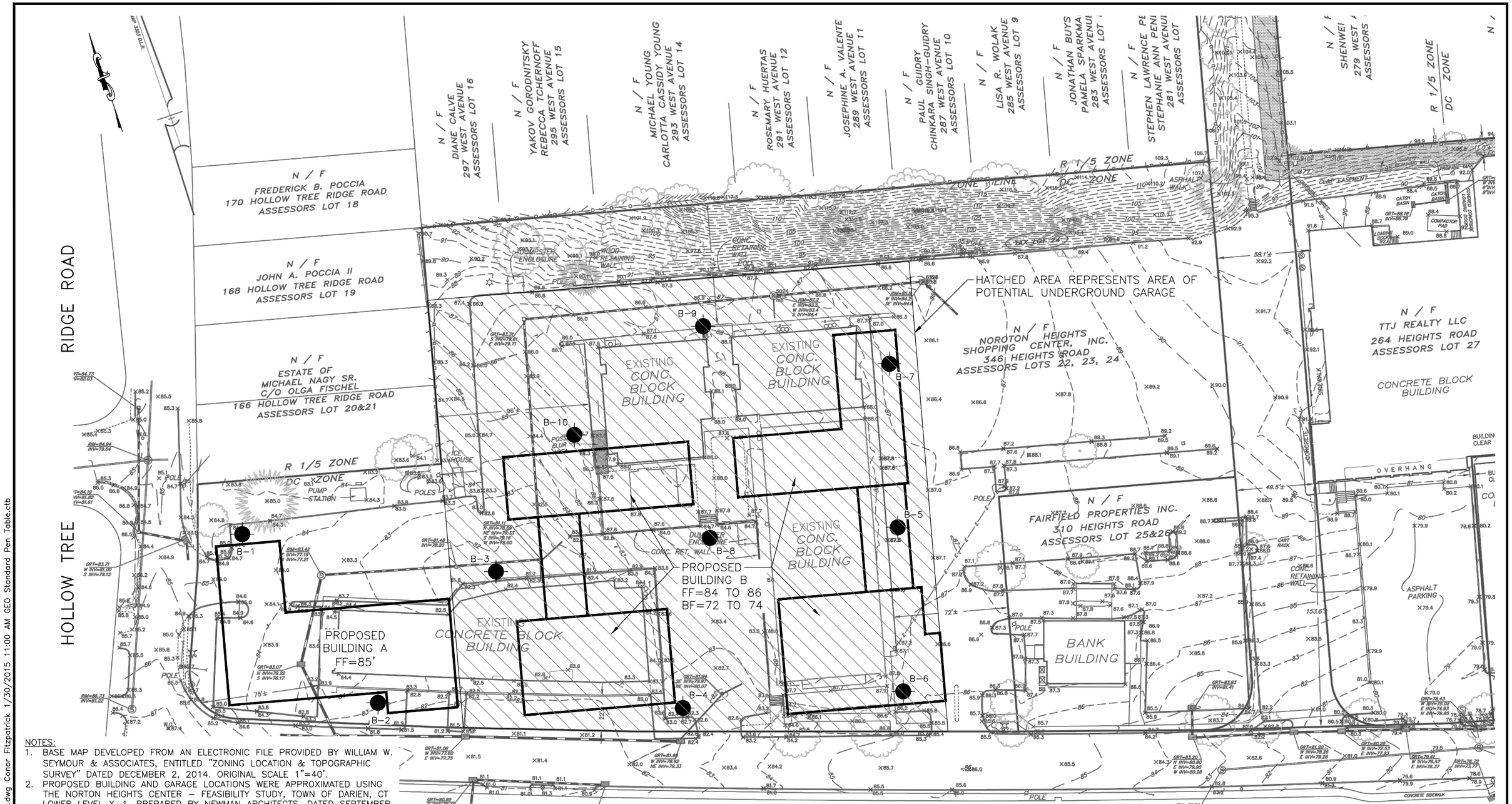
0 1000 2000 4000

346 HEIGHTS ROAD
DARIEN, CT

REFERENCE:
U.S.G.S. 7.5 MINUTE QUADRANGLE: SOUTH NORWALK, CONNECTICUT.
FIGURE WAS CREATED USING TOPO! 2003 SOFTWARE.

PROJECT NO.	3734-001.00
DATE	1/26/15
FIGURE NO.	1

M:\CL\3734\001\CAD\Locus Plan.dwg Conor Fitzpatrick 1/26/2015 2:32 PM GEO Standard Pen Table.ctb



NOTES:

1. BASE MAP DEVELOPED FROM AN ELECTRONIC FILE PROVIDED BY WILLIAM W. SEYMOUR & ASSOCIATES, ENTITLED "ZONING LOCATION & TOPOGRAPHIC SURVEY" DATED DECEMBER 2, 2014. ORIGINAL SCALE 1"=40'.
2. PROPOSED BUILDING AND GARAGE LOCATIONS WERE APPROXIMATED USING THE NORTON HEIGHTS CENTER – FEASIBILITY STUDY, TOWN OF DARIEN, CT LOWER LEVEL X-1, PREPARED BY NEWMAN ARCHITECTS, DATED SEPTEMBER 8, 2014.
3. BORINGS WERE PERFORMED BY SITE, LLC AND OBSERVED AND LOGGED BY GEODESIGN PERSONNEL.
4. THE LOCATIONS OF THE BORINGS WERE DETERMINED BY TAPING AND VISUAL ESTIMATES FROM EXISTING SITE FEATURES. THIS DESIGN SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.

LEGEND

B-1 — TEST BORING NO. AND LOCATION

FF — FIRST FLOOR
BF — BASEMENT FLOOR

DESIGNED BY DFL						
DRAWN BY CPF						
CHECKED BY DFL	NO.	DATE		DRWN	CHKD	APPVD
APPROVED BY TvR	REVISIONS					

SCALE 1" = 60'
60 30 0' 60

GEODESIGN INCORPORATED
Geotechnical | Construction | Environmental Engineers and Scientists
984 SOUTHFORD ROAD • MIDDLEBURY, CONNECTICUT 06762
TELEPHONE: 203.758.8836 • FACSIMILE: 203.758.8842

PROJECT
NORTON HEIGHTS DEVELOPMENT
346 HEIGHTS ROAD
DARIEN, CONNECTICUT

PROJECT NO. 3734-001.00
SCALE AS NOTED
DATE 1/28/15

DWG. TITLE
BORING LOCATION PLAN

FIGURE NO. 2

M:\CL\3734\001\CAD\Boring Location Plan.dwg Conor Fitzpatrick 1/30/2015 11:00 AM GEO Standard Pen Table.ctb

APPENDIX 2

BORING LOGS

- Test Boring B-1
- Test Boring B-2
- Test Boring B-3
- Test Boring B-4
- Test Boring B-5
- Test Boring B-6
- Test Boring B-7
- Test Boring B-8
- Test Boring B-9
- Test Boring B-10

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BORING LOG

Project Name

Noroton Heights Development Project
346 Heights Road
Darien, CT

Boring No.: B-1
Page No.: 1 of 1
File No.: 3734-001.00
Checked By: DFL

Boring Company:	Site, LLC		
Foreman:	John DeAngelis		
GeoDesign Rep.:	Daniel LaMesa		
Date Started:	November 19, 2015	Date Finished:	November 19, 2015
N. Coordinate:		E. Coordinate:	
Ground Surface Elevation (feet):	84.3		
Station:		Offset:	ft

	Casing:	Sampler:
Type:	2.25	SS
I.D.:	2.25 in.	1.38 in.
Hammer Wt.:	N/A	140 lbs
Hammer Fall:	N/A	30 in.
Rig Type:	Truck - CME 75	
Hammer Type:	Automatic - Hydraulic	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
1/19/15	9.0	75.3	Wet sample

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows / 6 inch Interval 0 - 6	6 - 12	12 - 18	18 - 24	Coring Time (min./ft)	Moisture Content (%)
		1	SS	24	10	0.0	20	9	6	3		
		2	SS	24	14	2.0	3	2	2	3		
5		3	SS	24	22	5.0	4	4	4	8		
		4	SS	24	24	7.0	12	17	18	18		
10		5	SS	24	19	10.0	7	12	12	9		
15		6	SS	24	12	15.0	29	53	45	45		
20												
25												
30												

Strata Description (Depth & Elevation (feet))	Symbol	Sample Description (Classification System: Modified Burmister)
3.5" Asphalt (84.0)		
Fill		Medium dense, brown fine to coarse SAND and fine to coarse Gravel, little Silt, trace Roots
4.0		Loose, brown fine to medium SAND and SILT, little fine Gravel, trace Roots
Glacial Till (80.3)		
		Loose, brown fine to medium SAND and SILT, trace fine Gravel, trace Clay
		Dense, brown fine to medium SAND, some Silt, trace fine Gravel
		Medium dense, brown fine to medium SAND and SILT, trace fine Gravel, trace Clay
17.0		Very dense, gray fine to medium SAND, some Silt, trace fine Gravel
Bottom of Exploration at 17.0 ft (67.3)		

Remarks: Inferred cobbles and/or boulder from 12 to 14 feet based on auger chatter.

Notes:
1) Stratification lines represent approximate boundary between material types, transitions may be gradual.
2) Water level readings have been made at times and under conditions stated, fluctuations of groundwater may occur due to other factors than those present at the time measurements were made. AC = After coring; NR = Not Recorded.
3) Abbreviations: A = Auger; C = Core; MC=Macrocore; D = Driven; G = Grab; PS = Piston Sample; SS = Split Spoon; SSL = 3.5 Inch ID Split Spoon; ST = Shelby Tube; V = Vane; WOR/H = Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%

1 - BORING LOG MC 2008-2009 BORING LOGS 3734-001.00.GPJ GEODESIGN STANDARD .GDT 1/30/15

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BORING LOG

Project Name

Noroton Heights Development Project
346 Heights Road
Darien, CT

Boring No.: B-2
Page No.: 1 of 1
File No.: 3734-001.00
Checked By: DFL

Boring Company:	Site, LLC		
Foreman:	John DeAngelis		
GeoDesign Rep.:	Daniel LaMesa		
Date Started:	November 19, 2015	Date Finished:	November 19, 2015
N. Coordinate:		E. Coordinate:	
Ground Surface Elevation (feet):	82		
Station:		Offset:	ft

	Casing:	Sampler:
Type:	2.25	SS
I.D.:	2.25 in.	1.38 in.
Hammer Wt.:	N/A	140 lbs
Hammer Fall:	N/A	30 in.
Rig Type:	Truck - CME 75	
Hammer Type:	Automatic - Hydraulic	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
1/19/15	10.9	71.1	In drill hole after 5 mins

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows / 6 inch Interval 0 - 6	6 - 12	12 - 18	18 - 24	Coring Time (min./ft)	Moisture Content (%)
		1	SS	24	13	0.0	6	6	5	9		
		2	SS	24	9	2.0	16	6	4	4		
5												
		3	SS	24	18	5.0	5	1	1	1		
		4	SS	24	22	7.0	2	2	7	4		
10												
		5	SS	24	20	10.0	4	5	5	4		
15												
		6	SS	24	15	15.0	14	13	8	6		
20												
25												
30												

Strata Description (Depth & Elevation(feet))	Elevation	Sample Description (Classification System: Modified Burmister)
3.5" Topsoil	81.7	
Fill		Medium dense, brown fine to coarse SAND, little Silt, trace fine Gravel
		Medium dense, brown fine to coarse SAND, little Silt, little fine Gravel, trace Roots, trace Bricks
5.5	76.5	Soft, brown/black SILT and CLAY, little fine to medium SAND, trace fine Gravel, trace Organics
Sandy Silt and Clay		
8.0	74.0	Top 12": Medium, brown/black SILT and CLAY, trace fine Sand, trace Roots, trace Organics Bottom 10": Loose, brown fine to medium SAND, some Silt, trace fine Gravel
Glacial Till		Loose, brown fine to medium SAND and SILT, trace fine Gravel, trace Clay
17.0	65.0	Medium dense, brown fine to medium SAND, some SILT, trace fine Gravel
Bottom of Exploration at 17.0 ft		

Remarks

1. Topsoil observed in the split spoon shoe of sample 2.
2. Boring offset about 4 feet due to auger refusal on inferred cobbles and/or boulder.
3. Inferred cobbles and/or boulder from 2 to 5 feet based on auger chatter.

Notes:
1) Stratification lines represent approximate boundary between material types, transitions may be gradual.
2) Water level readings have been made at times and under conditions stated, fluctuations of groundwater may occur due to other factors than those present at the time measurements were made. AC = After coring; NR = Not Recorded.
3) Abbreviations: A = Auger; C = Core; MC=Macrocore; D = Driven; G = Grab; PS = Piston Sample; SS = Split Spoon; SSL = 3.5 Inch ID Split Spoon; ST = Shelby Tube; V = Vane; WOR/H = Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%

1 - BORING LOG MC 2008-2009 BORING LOGS 3734-001.00.GPJ GEODESIGN STANDARD .GDT 1/30/15

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BORING LOG

Project Name

Noroton Heights Development Project
346 Heights Road
Darien, CT

Boring No.: B-3
Page No.: 1 of 1
File No.: 3734-001.00
Checked By: DFL

Boring Company:	Site, LLC		
Foreman:	John DeAngelis		
GeoDesign Rep.:	Hasian Zapata		
Date Started:	November 19, 2015	Date Finished:	November 19, 2015
N. Coordinate:		E. Coordinate:	
Ground Surface Elevation (feet):	82.4		
Station:		Offset:	ft

	Casing:	Sampler:
Type:	2.25	SS
I.D.:	2.25 in.	1.38 in.
Hammer Wt.:	N/A	140 lbs
Hammer Fall:	N/A	30 in.
Rig Type:	Truck - CME 75	
Hammer Type:	Automatic - Hydraulic	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
1/19/15	5.3	77.1	In drill hole after 15 min.
1/20/15	4.1	78.3	In well after 25 hrs.
1/26/15	4.3	78.1	In well after 7 days.

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows / 6 inch Interval 0 - 6	6 - 12	12 - 18	18 - 24	Coring Time (min./ft)	Moisture Content (%)
		1	SS	24	15	0.0	28	11	4	9		
		2	SS	24	19	2.0	18	17	22	10		
5		3	SS	24	17	5.0	9	10	13	13		
10		4	SS	24	24	10.0	20	41	42	33		
15												
20												
25												
30												

Strata Description

Depth & Elevation(feet)

0.9 — 2.5" Asphalt — 82.2
Fill — 81.5
Glacial Till

18.5 — Bottom of Exploration at 18.5 ft — 63.9

Symbol

Sample Description

Classification System: Modified Burmister

Medium dense,
Top 6": gray/brown fine GRAVEL and fine to coarse SAND, trace SIlt
Bottom 7": brown fine to medium SAND and SILT, trace fine Gravel, trace Clay

Dense, brown fine to coarse SAND, some fine to coarse Gravel, little Silt

Medium dense, brown fine to medium SAND and SILT, trace fine to coarse Gravel, trace Clay

Very dense, gray fine to medium SAND and SILT, trace fine to coarse Gravel, trace Clay

Well Log

Remarks

1. Inferred cobbles and/or boulder from 11 to 13 feet based on auger chatter.
2. Inferred Bedrock at 18.5 feet based on auger refusal.
3. 1-in I.D. PVC observation well installed upon completion of boring. Screen set at 18.5 feet, filter pack up to 6 feet, bentonite up to 5 feet, and cutting up to 1 foot with curb box and concrete collar installed.

Notes:
1) Stratification lines represent approximate boundary between material types, transitions may be gradual.
2) Water level readings have been made at times and under conditions stated, fluctuations of groundwater may occur due to other factors than those present at the time measurements were made. AC = After coring; NR = Not Recorded.
3) Abbreviations: A = Auger; C = Core; MC=Macrocore; D = Driven; G = Grab; PS = Piston Sample; SS = Split Spoon; SSL = 3.5 Inch ID Split Spoon; ST = Shelby Tube; V = Vane; WOR/H = Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%

1 - BORING LOG MC 2008-2009 BORING LOGS 3734-001.00.GPJ GEODESIGN STANDARD .GDT 1/30/15

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BORING LOG

Project Name

Noroton Heights Development Project
346 Heights Road
Darien, CT

Boring No.: B-4
Page No.: 1 of 1
File No.: 3734-001.00
Checked By: DFL

Boring Company:	Site, LLC		
Foreman:	John DeAngelis		
GeoDesign Rep.:	Robert Marshall		
Date Started:	November 20, 2015	Date Finished:	November 20, 2015
N. Coordinate:		E. Coordinate:	
Ground Surface Elevation (feet):	83		
Station:		Offset:	ft

	Casing:	Sampler:
Type:	2.25	SS
I.D.:	2.25 in.	1.38 in.
Hammer Wt.:	N/A	140 lbs
Hammer Fall:	N/A	30 in.
Rig Type:	Truck - CME 75	
Hammer Type:	Automatic - Hydraulic	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
1/20/15	13.0	70.0	Wet spoon

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows / 6 inch Interval 0 - 6	6 - 12	12 - 18	18 - 24	Coring Time (min./ft)	Moisture Content (%)
		1	SS	24	14	0.0	14	7	7	30		
		2	SS	24	24	2.0	21	14	19	18		
5		3	SS	24	20	5.0	16	32	19	20		
10		4	SS	24	18	10.0	13	20	31	36		
15		5	SS	24	18	15.0	14	22	33	29		
20		6	SS	24	22	20.0	15	19	26	24		
25												
30												

Strata Description (Depth & Elevation(feet))		Sample Description (Classification System: Modified Burmister)
2" Asphalt	82.8	
Fill 1.5		Medium dense, brown fine to coarse SAND, little fine to coarse Gravel, trace Silt
Glacial Till	81.5	Dense, gray/brown fine to medium SAND, little Silt, little fine to coarse Gravel
		Very dense, gray/brown fine to medium SAND, some Silt, trace fine to coarse Gravel, trace Clay
		Dense, gray/brown fine to medium SAND, some Silt, little fine to coarse Gravel
		Very dense, gray/brown fine SAND, some fine to coarse Gravel, some Silt
		Dense, gray/brown fine SAND, some Silt, little fine to coarse Gravel, trace Clay
22.0		
Bottom of Exploration at 22.0 ft	61.0	

Remarks

Notes:
1) Stratification lines represent approximate boundary between material types, transitions may be gradual.
2) Water level readings have been made at times and under conditions stated, fluctuations of groundwater may occur due to other factors than those present at the time measurements were made. AC = After coring; NR = Not Recorded.
3) Abbreviations: A = Auger; C = Core; MC=Macrocore; D = Driven; G = Grab; PS = Piston Sample; SS = Split Spoon; SSL = 3.5 Inch ID Split Spoon; ST = Shelby Tube; V = Vane; WOR/H = Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%

1 - BORING LOG MC 2008-2009 BORING LOGS 3734-001.00.GPJ GEODESIGN STANDARD .GDT 1/30/15

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Engineers and Scientists
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Telephone: (203) 758-8836 Fax: (203) 758-8842

BORING LOG

Project Name

Noroton Heights Development Project
346 Heights Road
Darien, CT

Boring No.: B-5
Page No.: 1 of 1
File No.: 3734-001.00
Checked By: DFL

Boring Company:	Site, LLC		
Foreman:	John DeAngelis		
GeoDesign Rep.:	Robert Marshall		
Date Started:	November 20, 2015	Date Finished:	November 20, 2015
N. Coordinate:		E. Coordinate:	
Ground Surface Elevation (feet):	87		
Station:		Offset:	ft

	Casing:	Sampler:
Type:	2.25	SS
I.D.:	2.25 in.	1.38 in.
Hammer Wt.:	N/A	140 lbs
Hammer Fall:	N/A	30 in.
Rig Type:	Truck - CME 75	
Hammer Type:	Automatic - Hydraulic	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
1/20/15			None observed

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows / 6 inch Interval 0 - 6	6 - 12	12 - 18	18 - 24	Coring Time (min./ft)	Moisture Content (%)
		1	SS	24	14	0.0	65	9	8	9		
		2	SS	24	24	2.0	22	17	39	32		
5		3	SS	24	12	5.0	20	67/6"	-	-		
10		4	SS	24	10	10.0	39	50/4"	-	-		
15		5	SS	24	9	15.0	34	50/3"	-	-		
20												
25												
30												

Strata Description (Depth & Elevation(feet))	Symbol	Sample Description (Classification System: Modified Burmister)
6" Asphalt		
Fill 86.5		Medium dense, gray fine to coarse SAND and fine to coarse GRAVEL, trace Silt
2.0 Glacial Till 85.0		Dense, gray/brown fine to medium SAND, some Silt, little fine to coarse Gravel
		Vey dense, gray/brown fine to medium SAND, some Silt, little fine to coarse Gravel
		Vey dense, gray/brown fine to medium SAND, some Silt, little fine to coarse Gravel
		Very dense, gray/brown fine to medium SAND, some Silt, little fine to coarse Gravel, trace Clay
19.9 Bottom of Exploration at 19.9 ft 67.1		

Remarks

1. Inferred Bedrock at 19.9 feet based on auger refusal.

Notes:
1) Stratification lines represent approximate boundary between material types, transitions may be gradual.
2) Water level readings have been made at times and under conditions stated, fluctuations of groundwater may occur due to other factors than those present at the time measurements were made. AC = After coring; NR = Not Recorded.
3) Abbreviations: A = Auger; C = Core; MC=Macrocore; D = Driven; G = Grab; PS = Piston Sample; SS = Split Spoon; SSL = 3.5 Inch ID Split Spoon; ST = Shelby Tube; V = Vane; WOR/H = Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%

1 - BORING LOG MC 2008-2009 BORING LOGS 3734-001.00.GPJ GEODESIGN STANDARD .GDT 1/30/15

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Engineers and Scientists
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BORING LOG

Project Name

Noroton Heights Development Project
346 Heights Road
Darien, CT

Boring No.: B-6
Page No.: 1 of 1
File No.: 3734-001.00
Checked By: DFL

Boring Company:	Site, LLC		
Foreman:	John DeAngelis		
GeoDesign Rep.:	Hasian Zapata		
Date Started:	November 19, 2015	Date Finished:	November 19, 2015
N. Coordinate:		E. Coordinate:	
Ground Surface Elevation (feet):	87		
Station:		Offset:	ft

	Casing:	Sampler:
Type:	2.25	SS
I.D.:	2.25 in.	1.38 in.
Hammer Wt.:	N/A	140 lbs
Hammer Fall:	N/A	30 in.
Rig Type:	Truck - CME 75	
Hammer Type:	Automatic - Hydraulic	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
1/19/15			None observed

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows / 6 inch Interval 0 - 6	6 - 12	12 - 18	18 - 24	Coring Time (min./ft)	Moisture Content (%)
		1	SS	24	7	0.0	23	7	6	5		
		2	SS	24	22	2.0	15	11	12	17		
5		3	SS	24	18	5.0	15	14	24	33		
10		4	SS	24	19	10.0	20	25	33	36		
15		5	SS	24	11	15.0	29	50/5"	-	-		
20												
25												
30												

Strata Description (Depth & Elevation(feet))	Symbol	Sample Description (Classification System: Modified Burmister)
3.5" Asphalt (1.0 / 86.7)		
Fill (86.0)		Medium dense, brown fine to coarse SAND and fine to coarse GRAVEL, little Silt
Glacial Till		Medium dense, brown fine to coarse SAND and SILT, trace fine Gravel, trace Clay
		Medium dense, brown fine to medium SAND and SILT, trace fine Gravel, trace Clay
		Dense, gray/brown fine to medium SAND and SILT, little fine to coarse Gravel, trace Clay
(16.0)		Very dense, gray fine to medium SAND and SILT, little fine to coarse Gravel, trace Clay
Bottom of Exploration at 16.0 ft (71.0)		

Remarks

1. Inferred cobbles and/or boulder from 8 to 12 feet and 14 to 16 feet based on auger chatter.
2. Inferred boulder at about 16 feet based on split spoon refusal.

Notes:
1) Stratification lines represent approximate boundary between material types, transitions may be gradual.
2) Water level readings have been made at times and under conditions stated, fluctuations of groundwater may occur due to other factors than those present at the time measurements were made. AC = After coring; NR = Not Recorded.
3) Abbreviations: A = Auger; C = Core; MC=Macrocore; D = Driven; G = Grab; PS = Piston Sample; SS = Split Spoon; SSL = 3.5 Inch ID Split Spoon; ST = Shelby Tube; V = Vane; WOR/H = Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%

1 - BORING LOG MC 2008-2009 BORING LOGS 3734-001.00.GPJ GEODESIGN STANDARD .GDT 1/30/15

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Engineers and Scientists
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BORING LOG

Project Name

Noroton Heights Development Project
346 Heights Road
Darien, CT

Boring No.: B-7
Page No.: 1 of 1
File No.: 3734-001.00
Checked By: DFL

Boring Company:	Site, LLC		
Foreman:	John DeAngelis		
GeoDesign Rep.:	Robert Marshall		
Date Started:	November 20, 2015	Date Finished:	November 20, 2015
N. Coordinate:		E. Coordinate:	
Ground Surface Elevation (feet):	87		
Station:		Offset:	ft

	Casing:	Sampler:
Type:	2.25	SS
I.D.:	2.25 in.	1.38 in.
Hammer Wt.:	N/A	140 lbs
Hammer Fall:	N/A	30 in.
Rig Type:	Truck - CME 75	
Hammer Type:	Automatic - Hydraulic	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
1/20/15	4.4	82.6	In drill hole after 1.8 hrs.

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows / 6 inch Interval 0 - 6	6 - 12	12 - 18	18 - 24	Coring Time (min./ft)	Moisture Content (%)
		1	SS	24	12	0.0	11	2	5	13		
		2	SS	24	20	2.0	13	19	37	29		
5		3	SS	24	11	5.0	26	50/3"	-	-		
10		4	SS	24	9	10.0	28	50/3"	-	-		
15		5	SS	24	3	15.0	50/3"	-	-	-		
20												
25												
30												

Strata Description

Depth & Elevation(feet)

Depth	Description	Elevation
	2" Asphalt	86.8
1.5	Fill	
	Glacial Till	85.5
15.3	Bottom of Exploration at 15.3 ft	71.7

Symbol

Sample Description

Classification System: Modified Burmister

- Medium dense, brown fine to medium SAND, little Silt, little fine to coarse Gravel
- Very dense, gray/brown fine to medium SAND, some Silt, little fine Gravel, trace Clay
- Very dense, gray/brown fine to medium SAND, some Silt, little fine to coarse Gravel
- Very dense, gray fine to medium SAND,, little Silt, trace fine to coarse Gravel
- Very dense, gray/brown fine SAND, some SIlt, trace fine to coarse Gravel, trace Clay

Remarks

Notes:
1) Stratification lines represent approximate boundary between material types, transitions may be gradual.
2) Water level readings have been made at times and under conditions stated, fluctuations of groundwater may occur due to other factors than those present at the time measurements were made. AC = After coring; NR = Not Recorded.
3) Abbreviations: A = Auger; C = Core; MC=Macrocore; D = Driven; G = Grab; PS = Piston Sample; SS = Split Spoon; SSL = 3.5 Inch ID Split Spoon; ST = Shelby Tube; V = Vane; WOR/H = Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%

1 - BORING LOG MC 2008-2009 BORING LOGS 3734-001.00.GPJ GEODESIGN STANDARD .GDT 1/30/15

GEODESIGN INCORPORATED
Geotechnical | Construction | Environmental
Engineers and Scientists
984 Southford Road - Middlebury, CT 06762
Telephone: (203) 758-8836 Fax: (203) 758-8842

BORING LOG

Project Name

Noroton Heights Development Project
346 Heights Road
Darien, CT

Boring No.: B-8
Page No.: 1 of 1
File No.: 3734-001.00
Checked By: DFL

Boring Company:	Site, LLC		
Foreman:	John DeAngelis		
GeoDesign Rep.:	Robert Marshall		
Date Started:	November 20, 2015	Date Finished:	November 20, 2015
N. Coordinate:		E. Coordinate:	
Ground Surface Elevation (feet):	84		
Station:		Offset:	ft

	Casing:	Sampler:
Type:	2.25	SS
I.D.:	2.25 in.	1.38 in.
Hammer Wt.:	N/A	140 lbs
Hammer Fall:	N/A	30 in.
Rig Type:	Truck - CME 75	
Hammer Type:	Automatic - Hydraulic	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
▼ 1/20/15			None observed
▼			
▼			
▼			

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows / 6 inch Interval 0 - 6	6 - 12	12 - 18	18 - 24	Coring Time (min./ft)	Moisture Content (%)
		1	SS	24	16	0.0	6	7	7	15		
		2	SS	24	20	2.0	18	18	18	16		
5		3	SS	24	21	5.0	11	9	29	38		
10		4	SS	24	24	10.0	37	53	44	63		
15		5	SS	24	9	15.0	49	50/3"	-	-		
20												
25												
30												

Strata Description

Depth & Elevation(feet)

1.5" Asphalt 83.9
Fill 83.8
Glacial Till
15.8
Bottom of Exploration at 15.8 ft 68.2

Symbol

Sample Description

Classification System: Modified Burmister

Medium dense,
Top 5": brown/black fine to medium SAND, some fine to coarse Gravel, trace Silt, trace Asphalt
Bottom 8": gray fine to coarse SAND, some fine to coarse Gravel, trace Silt

Dense, gray/brown fine to medium SAND, some Silt, little fine to coarse Gravel

Dense, gray/brown fine to medium SAND, some Silt, little fine to coarse Gravel, trace Clay

Very dense, gray/brown fine to medium SAND, some fine to coarse Gravel, some Silt

Very dense, gray/brown fine to medium SAND, little fine to coarse Gravel, little Silt

Remarks

Notes:
1) Stratification lines represent approximate boundary between material types, transitions may be gradual.
2) Water level readings have been made at times and under conditions stated, fluctuations of groundwater may occur due to other factors than those present at the time measurements were made. AC = After coring; NR = Not Recorded.
3) Abbreviations: A = Auger; C = Core; MC=Macrocore; D = Driven; G = Grab; PS = Piston Sample; SS = Split Spoon; SSL = 3.5 Inch ID Split Spoon; ST = Shelby Tube; V = Vane; WOR/H = Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%

1 - BORING LOG MC 2008-2009 BORING LOGS 3734-001.00.GPJ GEODESIGN STANDARD .GDT 1/30/15

GEODESIGN INCORPORATED
Geotechnical | Construction | Environmental
Engineers and Scientists
984 Southford Road - Middlebury, CT 06762
Telephone: (203) 758-8836 Fax: (203) 758-8842

BORING LOG

Project Name

Noroton Heights Development Project
346 Heights Road
Darien, CT

Boring No.: B-9
Page No.: 1 of 1
File No.: 3734-001.00
Checked By: DFL

Boring Company:	Site, LLC		
Foreman:	John DeAngelis		
GeoDesign Rep.:	Robert Marshall		
Date Started:	November 20, 2015	Date Finished:	November 20, 2015
N. Coordinate:		E. Coordinate:	
Ground Surface Elevation (feet):	87		
Station:		Offset:	ft

	Casing:	Sampler:
Type:	2.25	SS
I.D.:	2.25 in.	1.38 in.
Hammer Wt.:	N/A	140 lbs
Hammer Fall:	N/A	30 in.
Rig Type:	Truck - CME 75	
Hammer Type:	Automatic - Hydraulic	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
1/20/15	6.0	81.0	Wet sample

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows / 6 inch Interval 0 - 6	6 - 12	12 - 18	18 - 24	Coring Time (min./ft)	Moisture Content (%)
		1	SS	24	14	0.0	16	8	7	2		
		2	SS	24	20	2.0	30	33	23	10		
5		3	SS	24	21	5.0	10	12	13	12		
10		4	SS	24	1	10.0	32	50/6"	-	-		
15												
20		5	SS	24	16	20.0	21	26	40	-		
25												
30												

Strata Description

Depth & Elevation(feet)

2" Asphalt 86.8
Fill 86.7
Glacial Till
21.5
Bottom of Exploration at 21.5 ft 65.5

Symbol

Sample Description

Classification System: Modified Burmister

Medium dense,
Top 10": brown fine to coarse Gravel, some fine to coarse Sand, trace Silt
Bottom 2": gray/brown fine to medium SAND, some Silt, trace fine Gravel

Very dense, gray/brown fine to medium SAND, little fine to coarse Gravel, little Silt

Medium dense, gray/brown
Top 10": fine to medium SAND, little Silt, trace fine to coarse Gravel
Bottom 10": fine to medium SAND, some Silt, trace fine to coarse Gravel

Very dense, coarse Gravel (see Note #1)

Very dense, gray/brown SILT, some fine to medium Sand, trace fine to coarse Gravel, trace Clay

Remarks

1. One large piece of gravel jammed in tip of split spoon sample 4

Notes:
1) Stratification lines represent approximate boundary between material types, transitions may be gradual.
2) Water level readings have been made at times and under conditions stated, fluctuations of groundwater may occur due to other factors than those present at the time measurements were made. AC = After coring; NR = Not Recorded.
3) Abbreviations: A = Auger; C = Core; MC=Macrocore; D = Driven; G = Grab; PS = Piston Sample; SS = Split Spoon; SSL = 3.5 Inch ID Split Spoon; ST = Shelby Tube; V = Vane; WOR/H = Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%

1 - BORING LOG MC 2008-2009 BORING LOGS 3734-001.00.GPJ GEODESIGN STANDARD .GDT 1/30/15

GEODESIGN INCORPORATED
Geotechnical | Construction | Environmental
Engineers and Scientists
984 Southford Road - Middlebury, CT 06762
Telephone: (203) 758-8836 Fax: (203) 758-8842

BORING LOG

Project Name

Noroton Heights Development Project
346 Heights Road
Darien, CT

Boring No.: B-10
Page No.: 1 of 1
File No.: 3734-001.00
Checked By: DFL

Boring Company:	Site, LLC		
Foreman:	John DeAngelis		
GeoDesign Rep.:	Robert Marshall		
Date Started:	November 19, 2015	Date Finished:	November 19, 2015
N. Coordinate:		E. Coordinate:	
Ground Surface Elevation (feet):	86		
Station:		Offset:	ft

	Casing:	Sampler:
Type:	2.25	SS
I.D.:	2.25 in.	1.38 in.
Hammer Wt.:	N/A	140 lbs
Hammer Fall:	N/A	30 in.
Rig Type:	Truck - CME 75	
Hammer Type:	Automatic - Hydraulic	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
1/19/15			None observed

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows / 6 inch Interval 0 - 6	6 - 12	12 - 18	18 - 24	Coring Time (min./ft)	Moisture Content (%)
		1	SS	24	15	0.0	22	6	8	6		
		2	SS	24	8	2.0	4	3	2	1		
5												
		3	SS	24	16	5.0	11	19	19	17		
10												
		5	SS	24	18	10.0	34	22	17	24		
15												
		6	SS	24	24	15.0	23	42	42	59		
20												
25												
30												

Strata Description (Depth & Elevation(feet))	Elevation	Sample Description (Classification System: Modified Burmister)
5" Asphalt		
Fill	85.5	Medium dense, brown fine to coarse SAND, some Silt, little fine to coarse Gravel
		Loose, brown/black fine to coarse SAND, some fine to coarse Gravel, some Silt
5.0		
Glacial Till	81.0	Medium dense, gray fine to coarse SAND, some fine to coarse Gravel, little Silt
		Very dense, gray fine to coarse SAND, some fine to coarse Gravel, some Silt, trace Clay
		Very dense, gray fine to coarse SAND, some Silt, little fine to coarse Gravel
17.0		
Bottom of Exploration at 17.0 ft	69.0	

Remarks

1. Inferred cobbles and/or boulder from 5 to 7 feet, 9 to 10 feet, and 12 to 14 feet based on auger chatter.

Notes:
1) Stratification lines represent approximate boundary between material types, transitions may be gradual.
2) Water level readings have been made at times and under conditions stated, fluctuations of groundwater may occur due to other factors than those present at the time measurements were made. AC = After coring; NR = Not Recorded.
3) Abbreviations: A = Auger; C = Core; MC=Macrocore; D = Driven; G = Grab; PS = Piston Sample; SS = Split Spoon; SSL = 3.5 Inch ID Split Spoon; ST = Shelby Tube; V = Vane; WOR/H = Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%

1 - BORING LOG MC 2008-2009 BORING LOGS 3734-001.00.GPJ GEODESIGN STANDARD .GDT 1/30/15

APPENDIX 3

LIMITATIONS

LIMITATIONS

Explorations

1. The analysis and recommendations submitted in this report are based in part upon the data obtained from widely spaced subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to reevaluate the recommendations of this report.

2. The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretations of widely spaced explorations and samples; actual soil transitions are probably more erratic. For specific information, refer to the boring logs.

3. Water level readings have been made in the drill holes and observation well at times and under conditions stated on the logs. These data have been reviewed and interpretations made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature and other factors occurring since the time measurements were made.

Review

4. In the event that any changes in the nature, design or location of the proposed structures are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing by GeoDesign, Inc. It is recommended that this firm be provided the opportunity for a general review of final design and specifications in order that earthwork and geotechnical recommendations may be properly interpreted and implemented in the design and specifications.

Uses of Report

5. This report has been prepared for the exclusive use of the Noroton Heights Shopping Center, Inc. and their design team for specific application to for the proposed Commercial Development in Darien, Connecticut in accordance with generally accepted soil and foundation engineering practices. No other warranty, express or implied, is made.

GEODESIGN
INCORPORATED

GEOTECHNICAL | CONSTRUCTION | ENVIRONMENTAL
ENGINEERS and SCIENTISTS

September 22, 2015
File No. 3734-001.01

Mr. Gregory J. Palmer
Noroton Heights Shopping Center, Inc.
264 Heights Road
Darien, CT 06820

c/o: Mr. Jim C. Palmer

Via email: jimcpalmer@yahoo.com

Re: Geotechnical Data Report
Noroton Heights Center
346 Heights Road
Darien, Connecticut

Dear Mr. Palmer:

Geo**Design**, Inc. (Geo**Design**) is pleased to submit this geotechnical data report for the proposed Noroton Heights Center in Darien, Connecticut. Refer to Figure 1 in Appendix 1 for the site location.

Elevations stated in this report are in feet and based on the Zoning Location and Topographic Survey, 346 Heights Road, Darien, Connecticut, prepared by William W. Seymour and Associates, P.C., dated December 2, 2014.

SCOPE OF SERVICES

Our geotechnical engineering services included: reviewing project plans and existing groundwater data, drilling test borings, installing observation wells, measuring groundwater levels, and performing hydraulic conductivity tests. Our services were provided in accordance with our August 25, 2015 proposal.

TEST BORINGS AND OBSERVATION WELLS

On August 31, 2015, our subcontractor (Site, LLC) drilled three test borings (B-11, B-12, and B-13) and installed observation wells to measure stabilized groundwater levels and perform hydraulic conductivity testing. Boring/well locations are depicted on Figure 2 (Appendix 1) and were located in the field by taping/pacing from existing site features. The approximate ground surface elevation at each location was estimated from the referenced topographic survey. The

locations of the borings/wells and their elevations should be considered approximate. Boring/well logs are included in Appendix 2.

The wells were constructed of two inch diameter solid PVC pipe with five foot 0.01-inch slotted PVC screens. The screens were surrounded with filter pack sand and sealed with a bentonite plug. The remaining annulus was backfilled with auger cuttings to the ground surface. Protective covers and concrete collars were installed at the ground surface. Observation well construction is noted on the boring/well logs.

STABILIZED GROUNDWATER MEASUREMENTS

The following stabilized groundwater levels were measured in the observation wells:

Well Designation	Groundwater Reading Date	Groundwater Depth (feet)	Groundwater Level Elevation (feet)
B-3	1/26/2015	4.3	78.7
B-3	7/30/2015	5.3	77.7
B-3	9/15/2015	6.4	76.6
B-11	9/15/2015	8.0	76.0
B-12	9/15/2015	5.1	79.9
B-13	9/15/2015	0.6	86.4

Groundwater levels will vary depending on factors such as temperature, season, precipitation, construction activity, and other conditions, which may be different from those at the time of these measurements.

HYDRAULIC CONDUCTIVITY TESTING

We performed a hydraulic conductivity (slug) test in the wells recently installed in Borings B-11, B-12, and B-13 and in the well previously installed on January 19, 2015 in Boring B-3. Using the measured raw test data, we estimated the hydraulic conductivity at the test locations using the Bouwer and Rice Slug Test Method. The estimated hydraulic conductivities are summarized in the following table:

Well/Test Location	Hydraulic Conductivity (ft/day)
B-3	0.1
B-11	0.2
B-12	0.1
B-13	0.2

LIMITATIONS

This report is subject to the limitations included in Appendix 3.

Thank you for the opportunity to be of service. Please feel free to call if you have questions.

Sincerely,

Daniel F. LaMesa, P.E.
Project Engineer

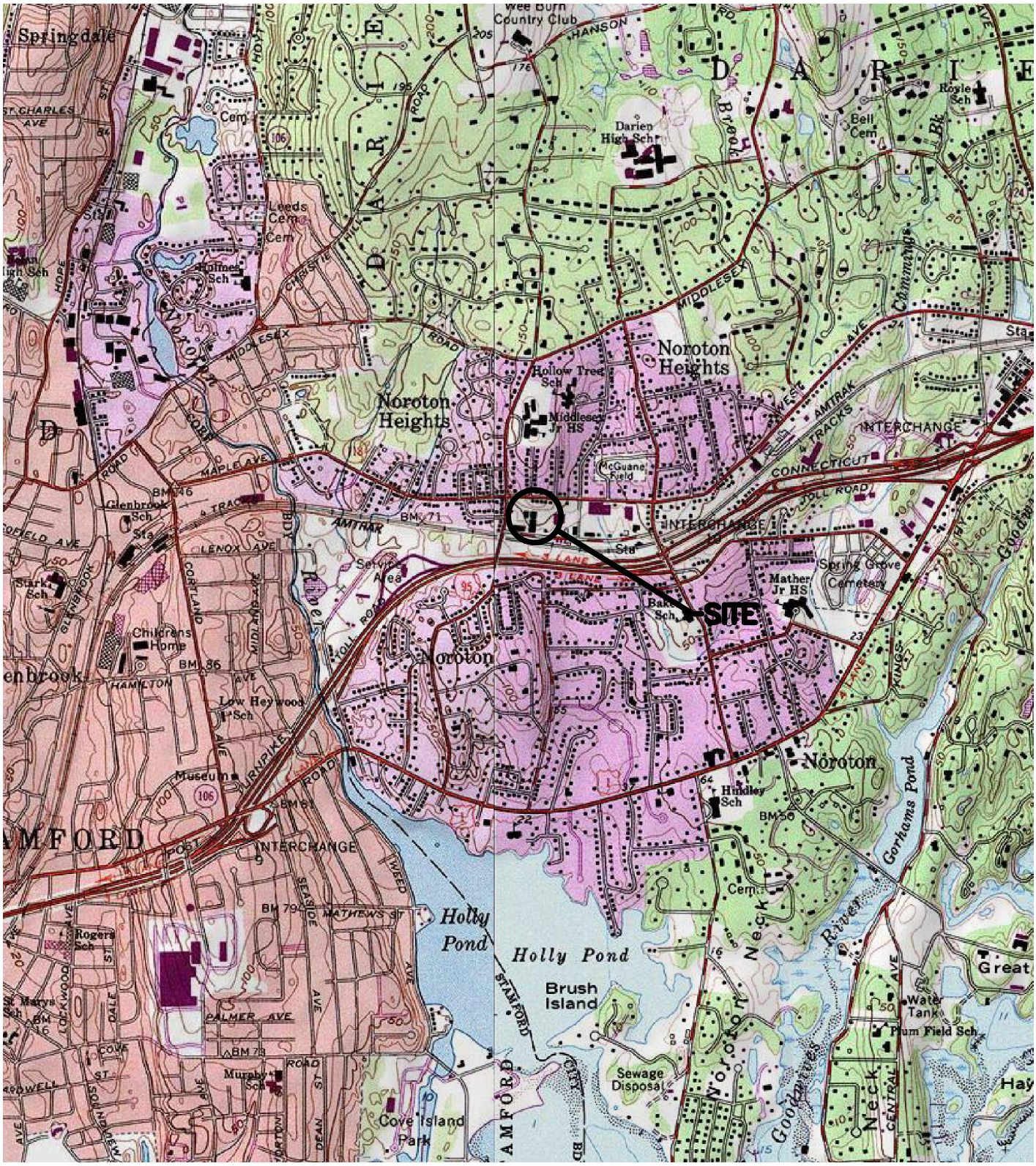
Theodore von Rosenvinge, P.E.
Senior Principal

Attachments: Appendix 1 – Figures
Appendix 2 – Boring/Well Logs
Appendix 3 – Limitations

APPENDIX 1

FIGURES

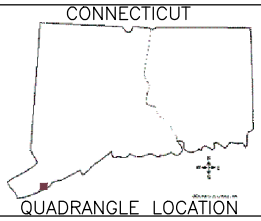
- Figure 1 - Locus Plan
- Figure 2 – Observation Well Location Plan



GEODESIGN INCORPORATED

Geotechnical | Construction | Environmental
Engineers and Scientists
984 SOUTHFORD ROAD • MIDDLEBURY, CONNECTICUT 06762
TELEPHONE: 203.758.8836 • FACSIMILE: 203.758.8842

DRAWN BY: CPF | REVIEWED BY: DFL



QUADRANGLE LOCATION

SCALE IN FEET

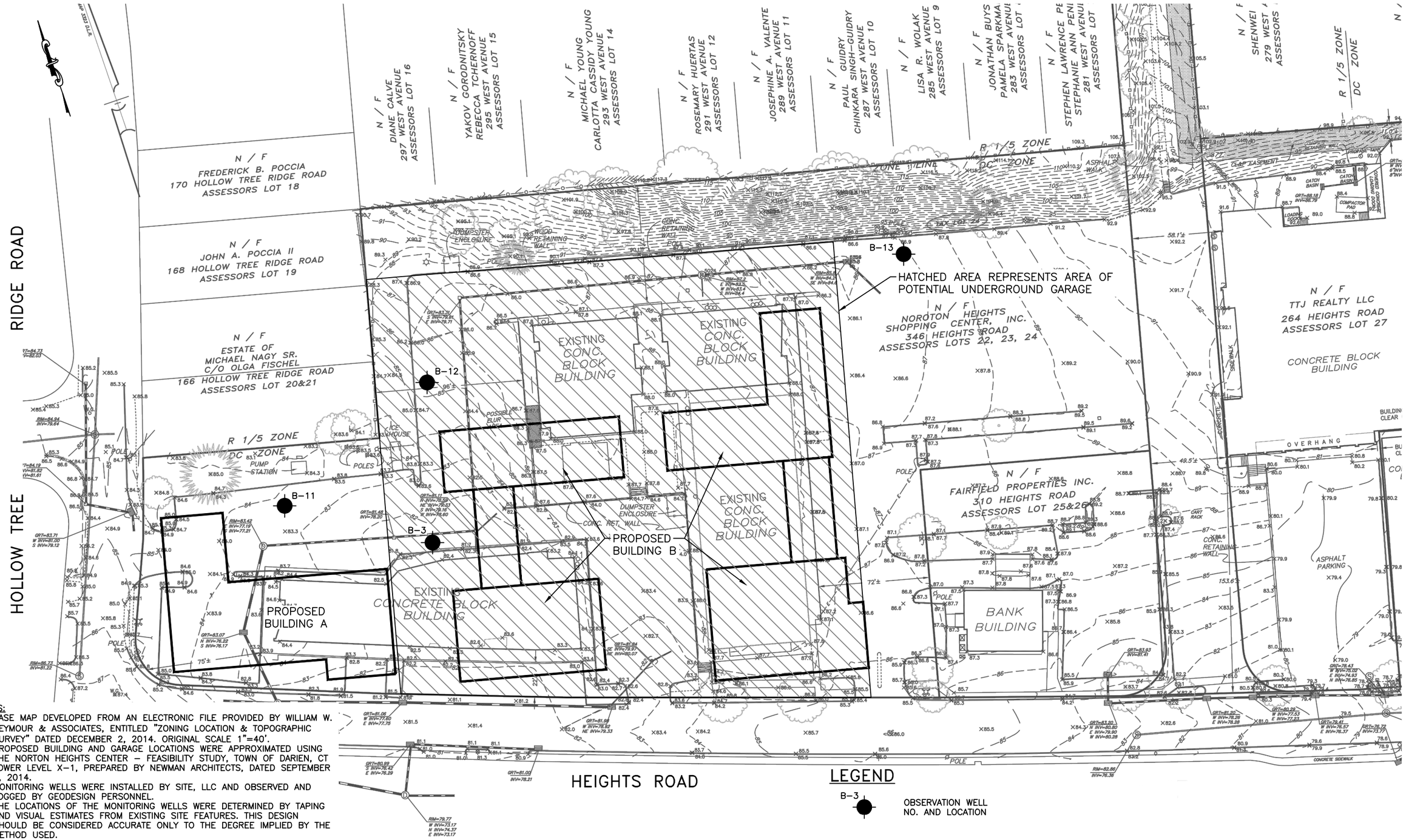
0 1000 2000 4000

346 HEIGHTS ROAD
DARIEN, CT

REFERENCE:
U.S.G.S. 7.5 MINUTE QUADRANGLE: SOUTH NORWALK, CONNECTICUT.
FIGURE WAS CREATED USING TOPO! 2003 SOFTWARE.

PROJECT NO.	3734-001.00
DATE	1/26/15
FIGURE NO.	1

M:\CL\3734\001\CAD\Locus Plan.dwg Conor Fitzpatrick 1/26/2015 2:32 PM GEO Standard Pen Table.ctb



NOTES:

1. BASE MAP DEVELOPED FROM AN ELECTRONIC FILE PROVIDED BY WILLIAM W. SEYMOUR & ASSOCIATES, ENTITLED "ZONING LOCATION & TOPOGRAPHIC SURVEY" DATED DECEMBER 2, 2014. ORIGINAL SCALE 1"=40'.
2. PROPOSED BUILDING AND GARAGE LOCATIONS WERE APPROXIMATED USING THE NORTON HEIGHTS CENTER – FEASIBILITY STUDY, TOWN OF DARIEN, CT LOWER LEVEL X-1, PREPARED BY NEWMAN ARCHITECTS, DATED SEPTEMBER 8, 2014.
3. MONITORING WELLS WERE INSTALLED BY SITE, LLC AND OBSERVED AND LOGGED BY GEODESIGN PERSONNEL.
4. THE LOCATIONS OF THE MONITORING WELLS WERE DETERMINED BY TAPING AND VISUAL ESTIMATES FROM EXISTING SITE FEATURES. THIS DESIGN SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.

DESIGNED BY DFL						
DRAWN BY RJB						
CHECKED BY DFL	NO.	DATE		DRWN	CHKD	APPVD
APPROVED BY TvR	REVISIONS					

SCALE 1" = 60'

60 30 0' 60

GEODESIGN INCORPORATED

Geotechnical | Construction | Environmental Engineers and Scientists

984 SOUTHFORD ROAD • MIDDLEBURY, CONNECTICUT 06762

TELEPHONE: 203.758.8836 • FACSIMILE: 203.758.8842

PROJECT

NORTON HEIGHTS DEVELOPMENT
346 HEIGHTS ROAD
DARIEN, CONNECTICUT

DWG. TITLE

OBSERVATION WELL LOCATION PLAN

PROJECT NO. 3734-001.01

SCALE 1" = 60' DATE 9/22/15

FIGURE NO. 2

M:\CL\3734\001\0.01\CAD\Observation Well Location Plan.dwg Rob Brautigam 9/22/2015 9:31 AM GEO Standard Pen Table.ctb

APPENDIX 2

BORING LOGS

- Test Boring B-3
- Test Boring B-11
- Test Boring B-12
- Test Boring B-13

GEODESIGN INCORPORATED
Geotechnical | Construction | Environmental
Engineers and Scientists
984 Southford Road - Middlebury, CT 06762
Telephone: (203) 758-8836 Fax: (203) 758-8842

BORING LOG

Project Name

Noroton Heights Development Project
346 Heights Road
Darien, CT

Boring No.: B-3
Page No.: 1 of 1
File No.: 3734-001.01
Checked By: DFL

Boring Company:	Site, LLC		
Foreman:	John DeAngelis		
GeoDesign Rep.:	Hasian Zapata		
Date Started:	January 19, 2015	Date Finished:	January 19, 2015
N. Coordinate:		E. Coordinate:	
Ground Surface Elevation (feet):	82.4		
Station:		Offset:	ft

	Casing:	Sampler:
Type:	2.25	SS
I.D.:	2.25 in.	1.38 in.
Hammer Wt.:	N/A	140 lbs
Hammer Fall:	N/A	30 in.
Rig Type:	Truck - CME 75	
Hammer Type:	Automatic - Hydraulic	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
1/20/15	4.1	78.3	In well after 25 hrs.
1/26/15	4.3	78.1	In well after 7 days.
7/30/15	5.3	77.1	In well
9/15/15	6.4	76.0	In well

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows / 6 inch Interval 0 - 6	6 - 12	12 - 18	18 - 24	Coring Time (min./ft)	Moisture Content (%)
		1	SS	24	15	0.0	28	11	4	9		
		2	SS	24	19	2.0	18	17	22	10		
5		3	SS	24	17	5.0	9	10	13	13		
10		4	SS	24	24	10.0	20	41	42	33		
15												
20												
25												
30												

Strata Description

Depth & Elevation(feet)

0.9 — 2.5" Asphalt — 82.2
Fill — 81.5
Glacial Till

18.5 — Bottom of Exploration at 18.5 ft — 63.9

Symbol

Sample Description

Classification System: Modified Burmister

Medium dense,
Top 6": gray/brown fine GRAVEL and fine to coarse SAND, trace SIlt
Bottom 7": brown fine to medium SAND and SILT, trace fine Gravel, trace Clay

Dense, brown fine to coarse SAND, some fine to coarse Gravel, little Silt

Medium dense, brown fine to medium SAND and SILT, trace fine to coarse Gravel, trace Clay

Very dense, gray fine to medium SAND and SILT, trace fine to coarse Gravel, trace Clay

Well Log

Remarks

1. Inferred cobbles and/or boulder from 11 to 13 feet based on auger chatter.
2. Inferred Bedrock at 18.5 feet based on auger refusal.
3. 1-in I.D. PVC observation well installed upon completion of boring. Screen set at 18.5 feet, filter pack up to 6 feet, bentonite up to 5 feet, and cutting up to 1 foot with curb box and concrete collar installed.

Notes:
1) Stratification lines represent approximate boundary between material types, transitions may be gradual.
2) Water level readings have been made at times and under conditions stated, fluctuations of groundwater may occur due to other factors than those present at the time measurements were made. AC = After coring; NR = Not Recorded.
3) Abbreviations: A = Auger; C = Core; MC=Macrocore; D = Driven; G = Grab; PS = Piston Sample; SS = Split Spoon; SSL = 3.5 Inch ID Split Spoon; ST = Shelby Tube; V = Vane; WOR/H = Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%

1 - BORING LOG MC 2008-2009 BORING LOGS 3734-001.01.GPJ GEODESIGN STANDARD .GDT 9/18/15

SITE LLC
Sub-surface Investigations, Technology & Experience

Client: GeoDesign, Inc.
984 Southford Road
Middlebury, CT 06762

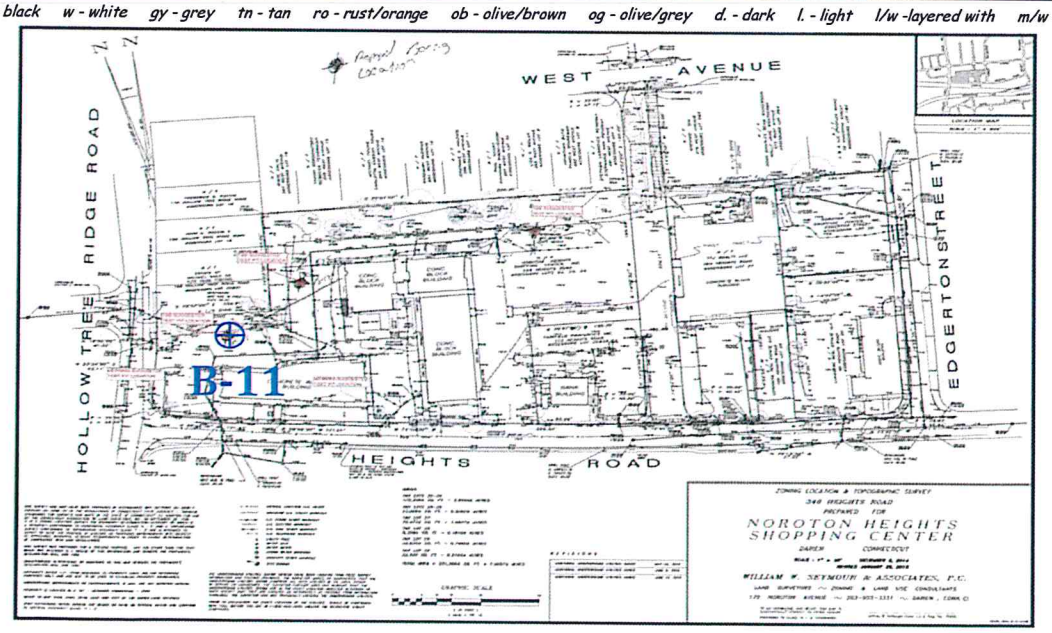
Project: Palmer's Market, Darien, CT
Date: Monday, 31 August 2015
Water: 8'-0" * Estimated
Ground Elev.:
Project Manager: Daniel F. LaMesa, P.E.

(203) 490-4777 63 Lancaster Drive, Beacon Falls, Connecticut 06403 www.site-llc.com

SITElog® Report **B-11**

Depth	Blows per 6"	Moisture	Changes	Color	DESCRIPTION OF FINDINGS	General	No.	Pen.	Rec.
			0.29	bl	ASPHALT (3½" thick)				
			1.92	gy	STONE(c) (Processed)				
			3.00	d.br	SAND, some Organic Silt, little Stone	FILL			
5'				d.br	SAND, some Silt, Gravel				
			6.00						
			6.50	d.br	TOPSOIL	TOPSOIL			
			7.50	ro	SAND & SILT	SUBSOIL			
10'				gy	SAND, some Silt, little Stone, trace Clay				
12' to 14'	11 18 16 18	Moist				TILL	1	24"	18"
15'			15.00						
					End of Exploration @ 15.00				
20'					Set 2" PVC @ 15'-0" w/5' Screen Sand to 8'-0" Bi-Pellets to 6'-0" Backfill to 4" Saw Cut Concrete, Curb Box Threaded Plug, Expandable				
25'									
30'									
35'									

KEY bl - black w - white gy - grey tn - tan ro - rust/orange ob - olive/brown og - olive/grey d. - dark l. - light l/w -layered with m/w -mixed with



Fill
Organics
Subsoil
Silt
Silty Sand
Clay
Sand
Gravel
Cobble
Till
Rock
Water
SPT
Curb Box
Riser
Bentonite
Screen

GPS Coor: 41°04.191N 73°29.916W
Driller Name: J. DeAngelis, III
Helper Name: J. DeAngelis, Jr.
Drill Equip: CME 45/300
Hammer Wgt: 140# CME Auto
Sampler: 2" O.D. Lynac
Casing: 2.25 HSA

DISCLAIMER: Some GPS coord., descriptions and boundaries are not guaranteed.

CPR-9 Rev. 7/95

STATE OF CONNECTICUT
DEPARTMENT OF CONSUMER PROTECTION
REAL ESTATE & PROFESSIONAL TRADES DIVISION

WELL DRILLING COMPLETION REPORT

165 Capitol Avenue, Hartford, Connecticut 06106

Do NOT fill in
STATE WELL NO.
OTHER NO.

OWNER	NAME: Unknown		ADDRESS:	
LOCATION OF WELL	(No. & Street): 346 Heights Road	(Town): Darien	(Lot Number):	
PROPOSED USE OF WELL	☐ DOMESTIC	☐ BUSINESS ESTABLISHMENT	☐ FARM	■ TEST WELL
	☐ PUBLIC SUPPLY	☐ INDUSTRIAL	☐ AIR CONDITIONING	☐ OTHER (Specify)
DRILLING EQUIPMENT	■ ROTARY	☐ COMPRESSED AIR PERCUSSION	☐ CABLE PERCUSSION	☐ OTHER (Specify)

CASING DETAILS	LENGTH (feet)	DIAMETER (inches)	WEIGHT PER FOOT	☐ THREADED ☐ WELDED	DRIVE SHOE ☐ YES ☐ NO	WAS CASING GROUTED? ☐ YES ☐ NO

YIELD TEST	☐ BAILED	☐ PUMPED	☐ COMPRESSED AIR	HOURS	YIELD (GPM)

WATER LEVEL	MEASURE FROM LAND SURFACE - STATIC (Specify feet)	DURING YIELD TEST (feet)	Depth of Completed Well in feet
	8'-0" * Estimated		15'-0"

SCREEN DETAILS	MAKE	LENGTH OPEN TO AQUIFER (feet)
	PVC	

SLOT SIZE	DIAMETER (inches)	IF GRAVEL PACKED:	Diameter of well including gravel pack (inches)	GRAVEL SIZE (inches)	FROM (feet)	TO (feet)
0.01"	2"			#0	10'-0"	15'-0"

DEPTH FROM LAND TO SURFACE FEET TO FEET		FORMATION DESCRIPTION
0'-0"	6'-0"	Fill
6'-0"	6'-6"	Topsoil
6'-6"	7'-6"	Subsoil
7'-6"	15'-0"	Till

Sketch exact location of well with distances, to at least two permanent landmarks

B-11

41°04.191N
73°29.916W

If yield was tested at different depths during drilling, list below

FEET	GALLONS PER MINUTE

DATE WELL COMPLETED	PERMIT NO.	REGISTRATION NO.	DATE OF REPORT	WELL DRILLER (Signature)
31-Aug-2015		WNC.173	1-Sept-2015	John A. DeAngelis, III

AGENCY

SITE LLC
Sub-surface Investigations, Technology & Experience
(203) 490-4777 63 Lancaster Drive, Beacon Falls, Connecticut 06403 www.site-llc.com

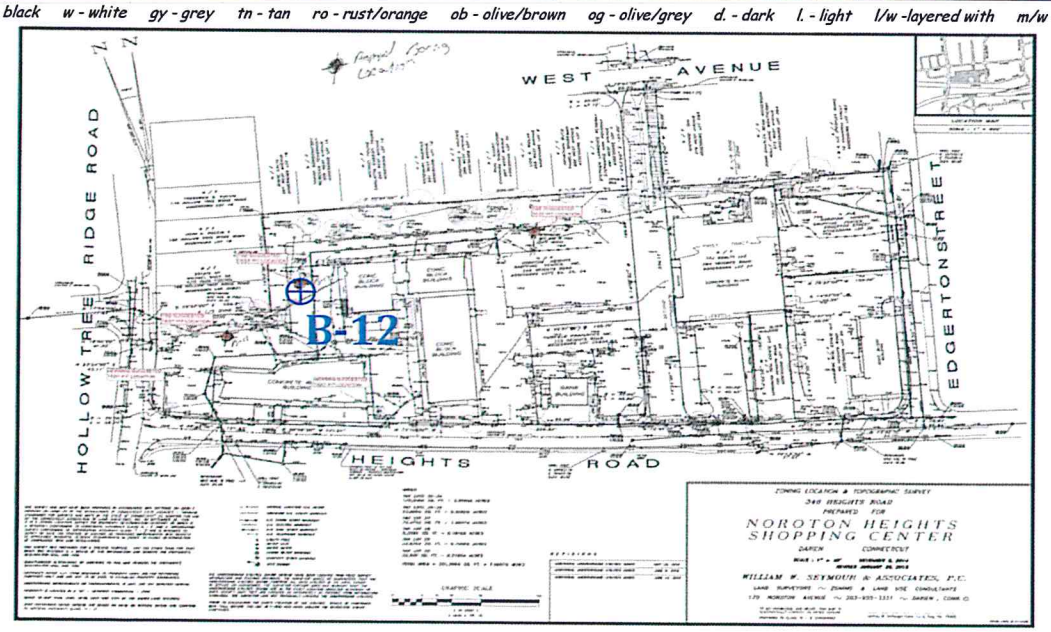
Client: GeoDesign, Inc.
984 Southford Road
Middlebury, CT 06762

Project: Palmer's Market, Darien, CT
Date: Monday, 31 August 2015
Water: 5'-0" * Estimated
Ground Elev.:
Project Manager: Daniel F. LaMesa, P.E.

SITElog® Report **B-12**

Depth	Blows per 6"	Moisture	Changes	Color	DESCRIPTION OF FINDINGS	General	No.	Pen.	Rec.
			0.21	bl	ASPHALT (2½" thick)	FILL			
			1.33	gy	STONE(c) (Processed)				
				ro	SAND, little Stone, Silt				
5'				gy	SAND, some Silt, little Stone, occas. Cobble				
10'						TILL			
12' to 13'	32	98/6"			SAND(f-m), little/some Silt, Stone		1	12"	12"
15'			15.00						
					End of Exploration @ 15.00				
20'					Set 2" PVC @ 15'-0" w/5' Screen Sand to 8'-0" Bi-Pellets to 6'-0" Backfill to 4" Saw Cut Concrete, Curb Box Threaded Plug, Expandable				
25'									
30'									
35'									

KEY bl - black w - white gy - grey tn - tan ro - rust/orange ob - olive/brown og - olive/grey d. - dark l. - light l/w -layered with m/w -mixed with



Fill
Organics
Subsoil
Silt
Silty Sand
Clay
Sand
Gravel
Cobble
Till
Rock
Water
SPT
Curb Box
Riser
Bentonite
Screen

GPS Coor: 41°04.202N 73°29.893W
Driller Name: J. DeAngelis, III
Helper Name: J. DeAngelis, Jr.
Drill Equip: CME 45/300
Hammer Wgt: 140# CME Auto
Sampler: 2" O.D. Lynac
Casing: 2.25 HSA

DISCLAIMER: Some GPS coord., descriptions and boundaries are not guaranteed.

CPR-9 Rev. 7/95

Do NOT fill in
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OTHER NO.

STATE OF CONNECTICUT
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WELL DRILLING COMPLETION REPORT

165 Capitol Avenue, Hartford, Connecticut 06106

OWNER	NAME: Unknown		ADDRESS:	
LOCATION OF WELL	(No. & Street): 346 Heights Road	(Town): Darien	(Lot Number):	
PROPOSED USE OF WELL	☐ DOMESTIC	☐ BUSINESS ESTABLISHMENT	☐ FARM	■ TEST WELL
	☐ PUBLIC SUPPLY	☐ INDUSTRIAL	☐ AIR CONDITIONING	☐ OTHER (Specify)
DRILLING EQUIPMENT	■ ROTARY	☐ COMPRESSED AIR PERCUSSION	☐ CABLE PERCUSSION	☐ OTHER (Specify)

CASING DETAILS	LENGTH (feet)	DIAMETER (inches)	WEIGHT PER FOOT	☐ THREADED ☐ WELDED	DRIVE SHOE ☐ YES ☐ NO	WAS CASING GROUTED? ☐ YES ☐ NO

YIELD TEST	☐ BAILED	☐ PUMPED	☐ COMPRESSED AIR	HOURS	YIELD (GPM)

WATER LEVEL	MEASURE FROM LAND SURFACE - STATIC (Specify feet)	DURING YIELD TEST (feet)	Depth of Completed Well in feet
	5'-0" * Estimated		15'-0"

SCREEN DETAILS	MAKE	LENGTH OPEN TO AQUIFER (feet)
	PVC	

SLOT SIZE	DIAMETER (inches)	IF GRAVEL PACKED	Diameter of well including gravel pack (inches)	GRAVEL SIZE (inches)	FROM (feet)	TO (feet)
0.01"	2"			#0	10'-0"	15'-0"

DEPTH FROM LAND TO SURFACE FEET TO FEET		FORMATION DESCRIPTION
0'-0"	1'-4"	Fill
1'-4"	15'-0"	Till

Sketch exact location of well with distances, to at least two permanent landmarks

B-12

41°04.202N
73°29.893W

If yield was tested at different depths during drilling, list below

FEET	GALLONS PER MINUTE

DATE WELL COMPLETED	PERMIT NO.	REGISTRATION NO.	DATE OF REPORT	WELL DRILLER (Signature)
31-Aug-2015		WNC.173	1-Sept-2015	John A. DeAngelis, III

AGENCY

SITE LLC
Sub-surface Investigations, Technology & Experience

Client: GeoDesign, Inc.
984 Southford Road
Middlebury, CT 06762

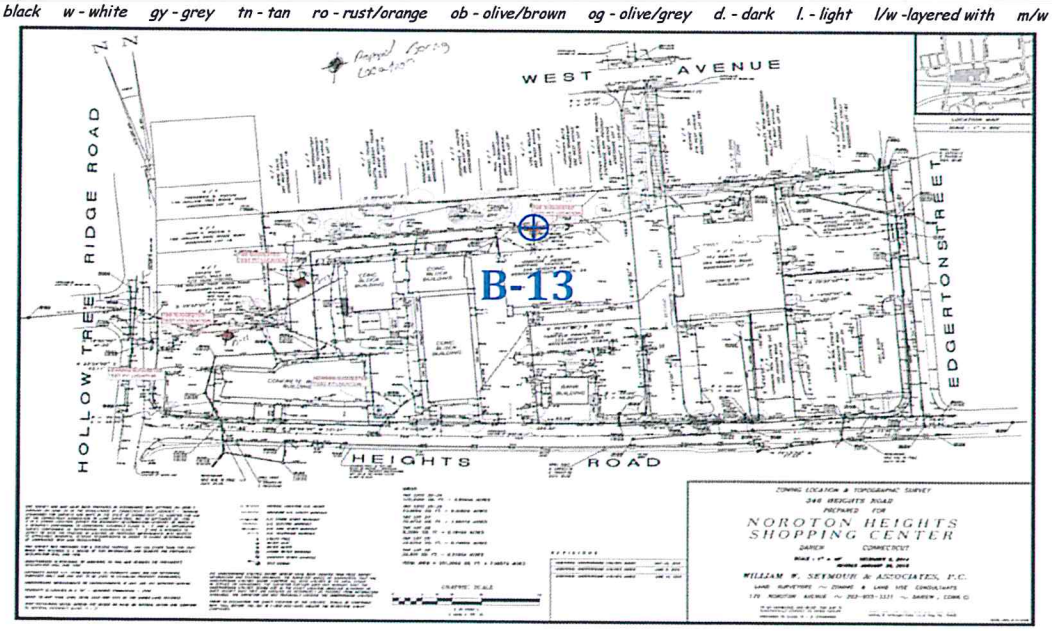
Project: Palmer's Market, Darien, CT
Date: Monday, 31 August 2015
Water: 6'-0" * Estimated
Ground Elev.:
Project Manager: Daniel F. LaMesa, P.E.

(203) 490-4777 63 Lancaster Drive, Beacon Falls, Connecticut 06403 www.site-llc.com

SITElog® Report **B-13**

Depth	Blows per 6"				Moisture	Changes	Color	DESCRIPTION OF FINDINGS	General	No.	Pen.	Rec.
						0.17	bl	ASPHALT (2" thick)	FILL			
						1.25	gy	STONE(c) (Processed)				
							gy	SAND(m-f), some Silt, Stone Fragments				
5'												
10'									TILL			
12' to 14'	17	39	35	35	Damp			SAND(vf-f) & SILT, little Stone		1	24"	22"
15'						15.00						
								End of Exploration @ 15.00				
20'												
25'								Set 2" PVC @ 15'-0" w/5' Screen Sand to 8'-0" Bi-Pellets to 6'-0" Backfill to 4" Saw Cut Concrete, Curb Box Threaded Plug, Expandable				
30'												
35'												

KEY bl - black w - white gy - grey tn - tan ro - rust/orange ob - olive/brown og - olive/grey d. - dark l. - light l/w -layered with m/w -mixed with



Fill
Organics
Subsoil
Silt
Silty Sand
Clay
Sand
Gravel
Cobble
Till
Rock
Water
SPT
Curb Box
Riser
Bentonite
Screen

GPS Coor: 41°04.202N 73°29.825W
Driller Name: J. DeAngelis, III
Helper Name: J. DeAngelis, Jr.
Drill Equip: CME 45/300
Hammer Wgt: 140# CME Auto
Sampler: 2" O.D. Lynac
Casing: 2.25 HSA

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CPR-9 Rev. 7/95

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	☐ PUBLIC SUPPLY	☐ INDUSTRIAL	☐ AIR CONDITIONING	☐ OTHER (Specify)
DRILLING EQUIPMENT	■ ROTARY	☐ COMPRESSED AIR PERCUSSION	☐ CABLE PERCUSSION	☐ OTHER (Specify)

CASING DETAILS	LENGTH (feet)	DIAMETER (inches)	WEIGHT PER FOOT	☐ THREADED ☐ WELDED	DRIVE SHOE ☐ YES ☐ NO	WAS CASING GROUTED? ☐ YES ☐ NO

YIELD TEST	☐ BAILED	☐ PUMPED	☐ COMPRESSED AIR	HOURS	YIELD (GPM)

WATER LEVEL	MEASURE FROM LAND SURFACE - STATIC (Specify feet)	DURING YIELD TEST (feet)	Depth of Completed Well in feet
	6'-0" * Estimated		15'-0"

SCREEN DETAILS	MAKE	LENGTH OPEN TO AQUIFER (feet)
	PVC	

SLOT SIZE	DIAMETER (inches)	IF GRAVEL PACKED	Diameter of well including gravel pack (inches)	GRAVEL SIZE (inches)	FROM (feet)	TO (feet)
0.01"	2"			#0	10'-0"	15'-0"

DEPTH FROM LAND TO SURFACE FEET TO FEET		FORMATION DESCRIPTION
0'-0"	1'-3"	Fill
1'-3"	15'-0"	Till

Sketch exact location of well with distances, to at least two permanent landmarks

B-13

41°04.202N
73°29.825W

If yield was tested at different depths during drilling, list below

FEET	GALLONS PER MINUTE

DATE WELL COMPLETED	PERMIT NO.	REGISTRATION NO	DATE OF REPORT	WELL DRILLER (Signature)
31-Aug-2015		WNC.173	1-Sept-2015	John A. DeAngelis, III

AGENCY

APPENDIX 3

LIMITATIONS

LIMITATIONS

1. Water level readings have been made in observation well at times and under conditions stated in the report. These data have been reviewed and interpretations made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature and other factors occurring since the time measurements were made.

2. The slug tests were performed at four locations at the site and values of hydraulic conductivity were estimated based on interpretations of the test results using the Bouwer and Rice Slug Test Method. The actual hydraulic conductivity may vary at those locations depending on the testing method and interpretation of testing results.

3. This report has been prepared for the exclusive use of the Noroton Heights Shopping Center, Inc. and their design team for specific application to for the proposed Commercial Development in Darien, Connecticut in accordance with generally accepted soil and foundation engineering practices. No other warranty, express or implied, is made.

Tighe&Bond

APPENDIX C

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Existing CN & Tc Calculations**
Prepared By: **TAS** Date: **June 1, 2015**

Designation: **CB-01**
Location: Heights Road - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.100	98	9.8000
Landscaped and Lawns	0.000	69	0.0000
Site	0.000	65	0.0000
	0.100		9.8000

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	205	0.049	1.9

Total Tc = 1.9 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-02**
Location: Heights Road - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.093	98	9.1140
Landscaped and Lawns	0.000	69	0.0000
Site	0.000	65	0.0000
	0.093		9.1140

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	222	0.022	2.8

Total Tc = 2.8 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Existing CN & Tc Calculations**
Prepared By: **TAS** Date: **June 1, 2015**

Designation: **CB-03**
Location: Heights Road - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.188	98	18.4240
Landscaped and Lawns	0.177	69	12.2130
Site	0.000	65	0.0000
	0.365		30.6370

Weighted CN: 84

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	137	0.029	1.7

Total Tc = 1.7 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-04**
Location: Heights Road - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.129	98	12.6420
Landscaped and Lawns	0.000	69	0.0000
Site	0.280	65	18.2000
	0.409		30.8420

Weighted CN: 75

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	179	0.046	1.7

Total Tc = 1.7 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Existing CN & Tc Calculations**
Prepared By: **TAS** Date: **June 1, 2015**

Designation: **CB-05**
Location: Heights Road - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.083	98	8.1340
Landscaped and Lawns	0.000	69	0.0000
Site	0.150	65	9.7500
	0.233		17.8840

Weighted CN: 77

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	165	0.022	2.2

Total Tc = 2.2 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-06**
Location: Site - South

Cover Type	Area, ac	CN	A x CN
Pavement	0.000	98	0.0000
Landscaped and Lawns	0.000	69	0.0000
Site	0.290	65	18.8500
	0.290		18.8500

Weighted CN: 65

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.4	97	0.03	17.5

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment B - C	unpaved	0.03	2.79	105	0.6

Total Tc = 18.2 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Existing CN & Tc Calculations**
Prepared By: **TAS** Date: **June 1, 2015**

Designation: **CB-07**
Location: Site - Roof Leader Conc. Block Building, South

Cover Type	Area, ac	CN	A x CN
Pavement	0.000	98	0.0000
Landscaped and Lawns	0.000	69	0.0000
Site	0.263	65	17.0950
	0.263		17.0950

Weighted CN: 65

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.4	171	0.025	29.7

Total Tc = 29.7 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-08**
Location: Hollow Tree Ridge Road - South

Cover Type	Area, ac	CN	A x CN
Pavement	0.135	98	13.2300
Landscaped and Lawns	0.748	69	51.6120
Site	0.228	65	14.8200
	1.111		79.6620

Weighted CN: 72

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.4	185	0.15	15.5

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment B - C	unpaved	0.015	1.98	193	1.6
Segment C - D	paved	0.036	3.86	41	0.2

Total Tc = 17.3 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Existing CN & Tc Calculations**
Prepared By: **TAS** Date: **June 1, 2015**

Designation: **CB-09**
Location: Hollow Tree Ridge Road - South

Cover Type	Area, ac	CN	A x CN
Pavement	0.137	98	13.4260
Landscaped and Lawns	0.000	69	0.0000
Site	0.000	65	0.0000
	0.137		13.4260

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	195	0.041	2.0

Total Tc = 2.0 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-10**
Location: Hollow Tree Ridge Road - Central

Cover Type	Area, ac	CN	A x CN
Pavement	0.396	98	38.8080
Landscaped and Lawns	0.711	69	49.0590
Site	0.000	65	0.0000
	1.107		87.8670

Weighted CN: 79

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.24	60	0.083	5.3
Segment B - C	0.015	240	0.062	2.0

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment C - D	paved	0.055	4.77	362	1.3

Total Tc = 8.5 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Existing CN & Tc Calculations**
Prepared By: **TAS** Date: **June 1, 2015**

Designation: **CB-11**
Location: Site - Southwest

Cover Type	Area, ac	CN	A x CN
Pavement	0.000	98	0.0000
Landscaped and Lawns	0.000	69	0.0000
Site	0.162	65	10.5300
	0.162		10.5300

Weighted CN: 65

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.4	82	0.024	16.8

Total Tc = 16.8 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-12**
Location: Site - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.000	98	0.0000
Landscaped and Lawns	0.000	69	0.0000
Site	0.232	65	15.0800
	0.232		15.0800

Weighted CN: 65

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.4	156	0.022	29.1

Total Tc = 29.1 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Existing CN & Tc Calculations**
Prepared By: **TAS** Date: **June 1, 2015**

Designation: **CB-13**
Location: Site - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.000	98	0.0000
Landscaped and Lawns	0.000	69	0.0000
Site	0.430	65	27.9500
	0.430		27.9500

Weighted CN: 65

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.4	140	0.043	20.4

Total Tc = 20.4 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-14**
Location: Site - Roof Leader Conc. Block Building, Southwest

Cover Type	Area, ac	CN	A x CN
Pavement	0.000	98	0.0000
Landscaped and Lawns	0.000	69	0.0000
Site	0.121	65	7.8650
	0.121		7.8650

Weighted CN: 65

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.4	90	0.03	16.5

Total Tc = 16.5 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Existing CN & Tc Calculations**
Prepared By: **TAS** Date: **June 1, 2015**

Designation: **CB-15**
Location: Site - Northwest

Cover Type	Area, ac	CN	A x CN
Pavement	0.037	98	3.6260
Landscaped and Lawns	0.239	69	16.4910
Site	0.305	65	19.8250
	0.581		39.9420

Weighted CN: 69

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.24	140	0.1	9.7
Segment B - C	0.4	62	0.37	4.5
Segment C - D	0.4	60	0.067	8.7

Total Tc = 22.8 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-16**
Location: Site - Roof Leader Conc. Block Building, North

Cover Type	Area, ac	CN	A x CN
Pavement	0.000	98	0.0000
Landscaped and Lawns	0.000	69	0.0000
Site	0.093	65	6.0450
	0.093		6.0450

Weighted CN: 65

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.4	50	0.025	11.1

Total Tc = 11.1 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Existing CN & Tc Calculations**
Prepared By: **TAS** Date: **June 1, 2015**

Designation: **CB-17**
Location: Site - North

Cover Type	Area, ac	CN	A x CN
Pavement	0.293	98	28.7140
Landscaped and Lawns	0.474	69	32.7060
Site	1.244	65	80.8600
	2.011		142.2800

Weighted CN: 71

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.24	107	0.075	8.7
Segment B - C	0.4	48	0.583	3.1
Segment C - D	0.4	49	0.031	10.0

Total Tc = 21.8 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-18**
Location: Heights Road / Edgerton Street Intersection - East

Cover Type	Area, ac	CN	A x CN
Pavement	0.127	98	12.4460
Landscaped and Lawns	0.000	69	0.0000
Site	0.000	65	0.0000
	0.127		12.4460

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	300	0.0283	3.2

Total Tc = 3.2 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Existing CN & Tc Calculations**
Prepared By: **TAS** Date: **June 1, 2015**

Designation: **CB-19**
Location: Heights Road / Edgerton Street Intersection - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.119	98	11.6620
Landscaped and Lawns	0.061	69	4.2090
Site	0.000	65	0.0000
	0.180		15.8710

Weighted CN: 88

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.24	16	0.062	2.1
Segment B - C	0.015	147	0.017	2.2

Total Tc = 4.3 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-20**
Location: Heights Road - East

Cover Type	Area, ac	CN	A x CN
Pavement	0.593	98	58.1140
Landscaped and Lawns	0.144	69	9.9360
Site	0.000	65	0.0000
	0.737		68.0500

Weighted CN: 92

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.24	16	0.2	1.3
Segment B - C	0.015	220	0.01	3.8

Total Tc = 5.1 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

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Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Existing CN & Tc Calculations**
Prepared By: **TAS** Date: **June 1, 2015**

Designation: **CB-21**
Location: Site - Southeast

Cover Type	Area, ac	CN	A x CN
Pavement	0.170	98	16.6600
Landscaped and Lawns	0.022	69	1.5180
Site	0.000	65	0.0000
	0.192		18.1780

Weighted CN: 95

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	150	0.035	1.7
Segment B - C	1	0	1	0.0

Total Tc = 1.7 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-22**
Location: Heights Road - Southeast

Cover Type	Area, ac	CN	A x CN
Pavement	0.045	98	4.4100
Landscaped and Lawns	0.000	69	0.0000
Site	0.000	65	0.0000
	0.045		4.4100

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	80	0.031	1.1

Total Tc = 1.1 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

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Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Existing CN & Tc Calculations**
Prepared By: **TAS** Date: **June 1, 2015**

Designation: **CB-23**
Location: Heights Road - Southeast

Cover Type	Area, ac	CN	A x CN
Pavement	0.155	98	15.1900
Landscaped and Lawns	0.000	69	0.0000
Site	0.000	65	0.0000
	0.155		15.1900

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	300	0.025	3.4

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment B - C	paved	0.025	3.21	60	0.3

Total Tc = 3.7 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-24**
Location: Heights Road - East

Cover Type	Area, ac	CN	A x CN
Pavement	0.249	98	24.4020
Landscaped and Lawns	0.020	69	1.3800
Site	0.000	65	0.0000
	0.269		25.7820

Weighted CN: 96

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	161	0.015	2.5

Total Tc = 2.5 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Existing CN & Tc Calculations**
Prepared By: **TAS** Date: **June 1, 2015**

Designation: **CB-25**
Location: Site - Roof Leader Conc. Block Building - East

Cover Type	Area, ac	CN	A x CN
Pavement	0.254	98	24.8920
Landscaped and Lawns	0.000	69	0.0000
Site	0.000	65	0.0000
	0.254		24.8920

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	140	0.02	2.0

Total Tc = 2.0 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-26**
Location: Heights Road - East

Cover Type	Area, ac	CN	A x CN
Pavement	0.129	98	12.6420
Landscaped and Lawns	0.000	69	0.0000
Site	0.000	65	0.0000
	0.129		12.6420

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	155	0.01	2.9

Total Tc = 2.9 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

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Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Existing CN & Tc Calculations**
Prepared By: **TAS** Date: **June 1, 2015**

Designation: **CB-27**
Location: Heights Road - East

Cover Type	Area, ac	CN	A x CN
Pavement	0.166	98	16.2680
Landscaped and Lawns	0.000	69	0.0000
Site	0.000	65	0.0000
	0.166		16.2680

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	190	0.063	1.6

Total Tc = 1.6 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-28**
Location: Heights Road - East

Cover Type	Area, ac	CN	A x CN
Pavement	0.146	98	14.3080
Landscaped and Lawns	0.000	69	0.0000
Site	0.000	65	0.0000
	0.146		14.3080

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	186	0.06	1.6

Total Tc = 1.6 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

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Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Existing CN & Tc Calculations**
Prepared By: **TAS** Date: **June 1, 2015**

Designation: **CB-29**
Location: Heights Road - East

Cover Type	Area, ac	CN	A x CN
Pavement	0.259	98	25.3820
Landscaped and Lawns	0.000	69	0.0000
Site	0.150	65	9.7500
	0.409		35.1320

Weighted CN: 86

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	130	0.015	2.1
Segment B - C	0.4	104	0.014	25.2

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment C - D	paved	0.015	2.49	134	0.9

Total Tc = 28.2 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-30**
Location: Site - South

Cover Type	Area, ac	CN	A x CN
Pavement	0.336	98	32.9280
Landscaped and Lawns	0.000	69	0.0000
Site	0.010	65	0.6500
	0.346		33.5780

Weighted CN: 97

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	192	0.04	2.0

Total Tc = 2.0 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

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Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Existing CN & Tc Calculations**
Prepared By: **TAS** Date: **June 1, 2015**

Designation: **CB-31**
Location: Edgerton Street - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.386	98	37.8280
Landscaped and Lawns	0.275	69	18.9750
Site	0.000	65	0.0000
	0.661		56.8030

Weighted CN: 86

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.24	220	0.081	15.1
Segment B - C	0.24	33	0.167	2.5

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment C - D	paved	0.027	3.34	128	0.6

Total Tc = 18.2 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-32**
Location: Edgerton Street - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.063	98	6.1740
Landscaped and Lawns	0.111	69	7.6590
Site	0.000	65	0.0000
	0.174		13.8330

Weighted CN: 80

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.24	92	0.026	11.8
Segment B - C	0.24	31	0.129	2.6

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment C - D	paved	0.025	3.21	59	0.3

Total Tc = 14.8 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

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Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Existing CN & Tc Calculations**
Prepared By: **TAS** Date: **June 1, 2015**

Designation: **CB-33**
Location: Edgerton Street - East

Cover Type	Area, ac	CN	A x CN
Pavement	0.066	98	6.4680
Landscaped and Lawns	0.000	69	0.0000
Site	0.000	65	0.0000
	0.066		6.4680

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	220	0.045	2.1

Total Tc = 2.1 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-34**
Location: Site - Northeast

Cover Type	Area, ac	CN	A x CN
Pavement	0.068	98	6.6640
Landscaped and Lawns	0.329	69	22.7010
Site	0.000	65	0.0000
	0.397		29.3650

Weighted CN: 74

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.24	240	0.092	15.4
Segment B - C	0.24	30	0.3	1.8

Total Tc = 17.2 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

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Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Existing CN & Tc Calculations**
Prepared By: **TAS** Date: **June 1, 2015**

Designation: **CB-35**
Location: Site - Northeast

Cover Type	Area, ac	CN	A x CN
Pavement	0.543	98	53.2140
Landscaped and Lawns	0.538	69	37.1220
Site	0.000	65	0.0000
	1.081		90.3360

Weighted CN: 84

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.15	198	0.101	8.7

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment C - D	unpaved	0.044	3.38	102	0.5

Total Tc = 9.2 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-36**
Location: Edgerton Street - Northwest

Cover Type	Area, ac	CN	A x CN
Pavement	0.097	98	9.5060
Landscaped and Lawns	0.000	69	0.0000
Site	0.000	65	0.0000
	0.097		9.5060

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	222	0.056	1.9

Total Tc = 1.9 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

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Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Existing CN & Tc Calculations**
Prepared By: **TAS** Date: **June 1, 2015**

Designation: **CB-37**
Location: Edgerton Street - Northwest

Cover Type	Area, ac	CN	A x CN
Pavement	0.154	98	15.0920
Landscaped and Lawns	0.106	69	7.3140
Site	0.000	65	0.0000
	0.260		22.4060

Weighted CN: 86

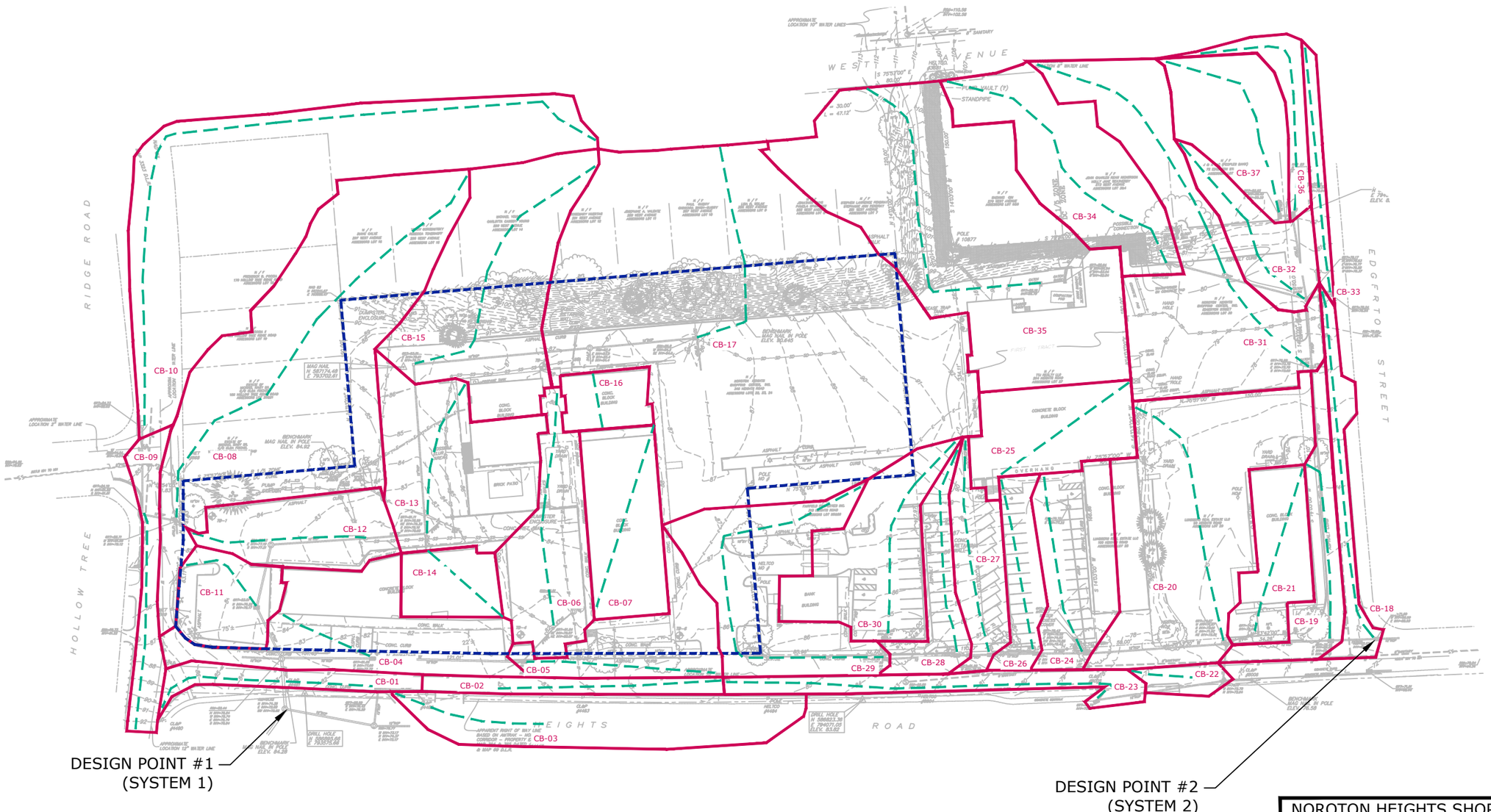
Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.24	127	0.071	10.2
Segment B - C	0.015	64	0.062	0.7

Total Tc = 10.9 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation



LEGEND

SITE LIMIT

WATERSHED BOUNDARY

TIME OF CONCENTRATION FLOW PATH

SCALE IN FEET

0 100' 200'

GRAPHIC SCALE

NOROTON HEIGHTS SHOPPING CENTER
DARIEN, CT

EXISTING WATERSHED MAP

DATE: 09/16/2016
SCALE: 1" = 100'
FIGURE 3

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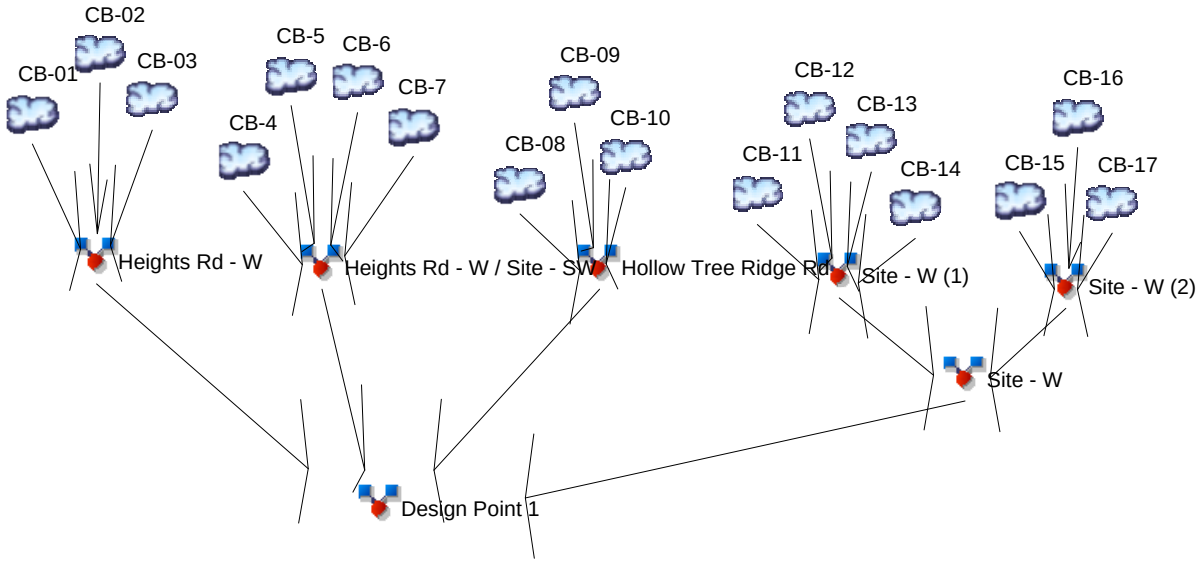
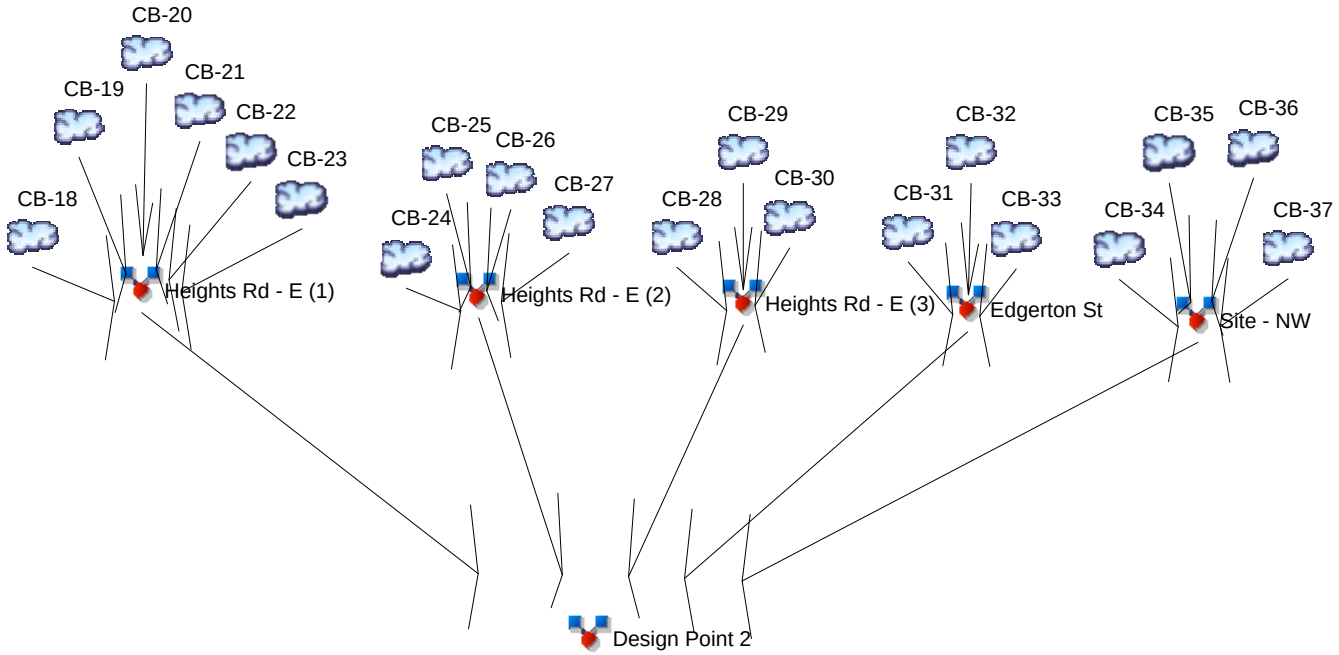
Nov 11, 2016-10:38am Plotted By: JCB1
Tighe & Bond, Inc. J:\P\P0695 J&G Palmer Mixed Use\Calculations\Drainage\2016_9-12 Drainage\EXWM-P0695-05.dwg

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4





Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	------	-------	0.309	-------	-------	0.471	0.538	0.605	0.681	CB-01
2	SCS Runoff	------	-------	0.287	-------	-------	0.438	0.500	0.562	0.633	CB-02
3	SCS Runoff	------	-------	0.734	-------	-------	1.346	1.602	1.859	2.151	CB-03
4	SCS Runoff	------	-------	0.522	-------	-------	1.138	1.410	1.688	2.009	CB-4
5	SCS Runoff	------	-------	0.211	-------	-------	0.443	0.544	0.647	0.766	CB-5
6	SCS Runoff	------	-------	0.093	-------	-------	0.275	0.362	0.455	0.565	CB-6
7	SCS Runoff	------	-------	0.097	-------	-------	0.286	0.378	0.474	0.588	CB-7
8	SCS Runoff	------	-------	0.843	-------	-------	1.987	2.502	3.032	3.652	CB-08
9	SCS Runoff	------	-------	0.423	-------	-------	0.646	0.737	0.829	0.933	CB-09
10	SCS Runoff	------	-------	1.636	-------	-------	3.298	4.013	4.736	5.569	CB-10
11	SCS Runoff	------	-------	0.070	-------	-------	0.209	0.276	0.347	0.430	CB-11
12	SCS Runoff	------	-------	0.086	-------	-------	0.253	0.333	0.418	0.519	CB-12
13	SCS Runoff	------	-------	0.178	-------	-------	0.526	0.694	0.872	1.084	CB-13
14	SCS Runoff	------	-------	0.055	-------	-------	0.166	0.218	0.273	0.339	CB-14
15	SCS Runoff	------	-------	0.337	-------	-------	0.865	1.110	1.366	1.666	CB-15
16	SCS Runoff	------	-------	0.047	-------	-------	0.143	0.188	0.236	0.292	CB-16
17	SCS Runoff	------	-------	1.353	-------	-------	3.270	4.146	5.052	6.113	CB-17
18	SCS Runoff	------	-------	0.392	-------	-------	0.599	0.683	0.768	0.865	CB-18
19	SCS Runoff	------	-------	0.425	-------	-------	0.732	0.858	0.983	1.126	CB-19
20	SCS Runoff	------	-------	1.993	-------	-------	3.239	3.747	4.253	4.828	CB-20
21	SCS Runoff	------	-------	0.562	-------	-------	0.881	1.011	1.141	1.289	CB-21
22	SCS Runoff	------	-------	0.139	-------	-------	0.212	0.242	0.272	0.306	CB-22
23	SCS Runoff	------	-------	0.479	-------	-------	0.731	0.834	0.937	1.055	CB-23
24	SCS Runoff	------	-------	0.805	-------	-------	1.248	1.430	1.610	1.816	CB-24
25	SCS Runoff	------	-------	0.785	-------	-------	1.197	1.367	1.536	1.729	CB-25
26	SCS Runoff	------	-------	0.399	-------	-------	0.608	0.694	0.780	0.878	CB-26
27	SCS Runoff	------	-------	0.513	-------	-------	0.783	0.893	1.004	1.130	CB-27
28	SCS Runoff	------	-------	0.451	-------	-------	0.688	0.786	0.883	0.994	CB-28
29	SCS Runoff	------	-------	0.547	-------	-------	0.976	1.154	1.332	1.535	CB-29
30	SCS Runoff	------	-------	1.054	-------	-------	1.620	1.852	2.083	2.348	CB-30
31	SCS Runoff	------	-------	1.043	-------	-------	1.864	2.205	2.546	2.935	CB-31
32	SCS Runoff	------	-------	0.221	-------	-------	0.438	0.531	0.625	0.733	CB-32
33	SCS Runoff	------	-------	0.204	-------	-------	0.311	0.355	0.399	0.449	CB-33
34	SCS Runoff	------	-------	0.343	-------	-------	0.768	0.956	1.150	1.374	CB-34

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	
35	SCS Runoff	------	-------	2.029	-------	-------	3.734	4.448	5.163	5.979	CB-35
36	SCS Runoff	------	-------	0.300	-------	-------	0.457	0.522	0.587	0.660	CB-36
37	SCS Runoff	------	-------	0.488	-------	-------	0.871	1.030	1.189	1.370	CB-37
38	Combine	1, 2, 3,	-------	1.331	-------	-------	2.256	2.641	3.026	3.465	Heights Rd - W
39	Combine	4, 5, 6,	-------	0.669	-------	-------	1.602	2.027	2.466	2.981	Heights Rd - W / Site - SW
40	Combine	7, 8, 9, 10,	-------	2.595	-------	-------	5.368	6.584	7.825	9.262	Hollow Tree Ridge Rd
41	Combine	11, 12, 13,	-------	0.377	-------	-------	1.118	1.478	1.856	2.306	Site - W (1)
42	Combine	14, 15, 16, 17,	-------	1.731	-------	-------	4.254	5.412	6.610	8.015	Site - W (2)
43	Combine	41, 42	-------	2.104	-------	-------	5.372	6.890	8.466	10.32	Site - W
44	Combine	38, 39, 40,	-------	5.677	-------	-------	12.62	15.74	18.98	22.78	Design Point 1
45	Combine	43 18, 19, 20,	-------	3.991	-------	-------	6.393	7.375	8.355	9.470	Heights Rd - E (1)
46	Combine	21, 22, 23, 24, 25, 26,	-------	2.502	-------	-------	3.837	4.384	4.930	5.554	Heights Rd - E (2)
47	Combine	27, 28, 29, 30,	-------	1.800	-------	-------	2.861	3.300	3.738	4.239	Heights Rd - E (3)
48	Combine	31, 32, 33,	-------	1.356	-------	-------	2.439	2.891	3.343	3.860	Edgerton St
49	Combine	34, 35, 36,	-------	3.002	-------	-------	5.558	6.637	7.723	8.967	Site - NW
50	Combine	37, 45, 46, 47, 48, 49	-------	12.17	-------	-------	20.26	23.62	26.99	30.83	Design Point 2

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.309	2	724	1,044	------	------	------	CB-01
2	SCS Runoff	0.287	2	724	971	------	------	------	CB-02
3	SCS Runoff	0.734	2	724	2,194	------	------	------	CB-03
4	SCS Runoff	0.522	2	724	1,618	------	------	------	CB-4
5	SCS Runoff	0.211	2	738	1,069	------	------	------	CB-5
6	SCS Runoff	0.093	2	754	684	------	------	------	CB-6
7	SCS Runoff	0.097	2	748	620	------	------	------	CB-7
8	SCS Runoff	0.843	2	734	4,002	------	------	------	CB-08
9	SCS Runoff	0.423	2	724	1,430	------	------	------	CB-09
10	SCS Runoff	1.636	2	726	5,675	------	------	------	CB-10
11	SCS Runoff	0.070	2	738	382	------	------	------	CB-11
12	SCS Runoff	0.086	2	748	547	------	------	------	CB-12
13	SCS Runoff	0.178	2	742	1,032	------	------	------	CB-13
14	SCS Runoff	0.055	2	734	278	------	------	------	CB-14
15	SCS Runoff	0.337	2	738	1,796	------	------	------	CB-15
16	SCS Runoff	0.047	2	732	226	------	------	------	CB-16
17	SCS Runoff	1.353	2	738	6,976	------	------	------	CB-17
18	SCS Runoff	0.392	2	724	1,326	------	------	------	CB-18
19	SCS Runoff	0.425	2	724	1,278	------	------	------	CB-19
20	SCS Runoff	1.993	2	724	6,134	------	------	------	CB-20
21	SCS Runoff	0.562	2	724	1,792	------	------	------	CB-21
22	SCS Runoff	0.139	2	724	470	------	------	------	CB-22
23	SCS Runoff	0.479	2	724	1,618	------	------	------	CB-23
24	SCS Runoff	0.805	2	724	2,607	------	------	------	CB-24
25	SCS Runoff	0.785	2	724	2,651	------	------	------	CB-25
26	SCS Runoff	0.399	2	724	1,346	------	------	------	CB-26
27	SCS Runoff	0.513	2	724	1,733	------	------	------	CB-27
28	SCS Runoff	0.451	2	724	1,524	------	------	------	CB-28
29	SCS Runoff	0.547	2	740	2,854	------	------	------	CB-29
30	SCS Runoff	1.054	2	724	3,480	------	------	------	CB-30
31	SCS Runoff	1.043	2	734	4,612	------	------	------	CB-31
32	SCS Runoff	0.221	2	732	911	------	------	------	CB-32
33	SCS Runoff	0.204	2	724	689	------	------	------	CB-33
34	SCS Runoff	0.343	2	734	1,591	------	------	------	CB-34

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
35	SCS Runoff	2.029	2	726	6,931	------	------	------	CB-35
36	SCS Runoff	0.300	2	724	1,012	------	------	------	CB-36
37	SCS Runoff	0.488	2	728	1,871	------	------	------	CB-37
38	Combine	1.331	2	724	4,209	1, 2, 3,	------	------	Heights Rd - W
39	Combine	0.669	2	724	3,990	4, 5, 6,	------	------	Heights Rd - W / Site - SW
40	Combine	2.595	2	726	11,107	7, 8, 9, 10,	------	------	Hollow Tree Ridge Rd
41	Combine	0.377	2	740	2,239	11, 12, 13,	------	------	Site - W (1)
42	Combine	1.731	2	738	8,998	14, 15, 16, 17,	------	------	Site - W (2)
43	Combine	2.104	2	738	11,237	41, 42	------	------	Site - W
44	Combine	5.677	2	726	30,543	38, 39, 40,	------	------	Design Point 1
45	Combine	3.991	2	724	12,618	43 18, 19, 20,	------	------	Heights Rd - E (1)
46	Combine	2.502	2	724	8,337	21, 22, 23, 24, 25, 26,	------	------	Heights Rd - E (2)
47	Combine	1.800	2	724	7,858	27, 28, 29, 30,	------	------	Heights Rd - E (3)
48	Combine	1.356	2	732	6,212	31, 32, 33,	------	------	Edgerton St
49	Combine	3.002	2	726	11,406	34, 35, 36,	------	------	Site - NW
50	Combine	12.17	2	724	46,432	37, 45, 46, 47, 48, 49	------	------	Design Point 2

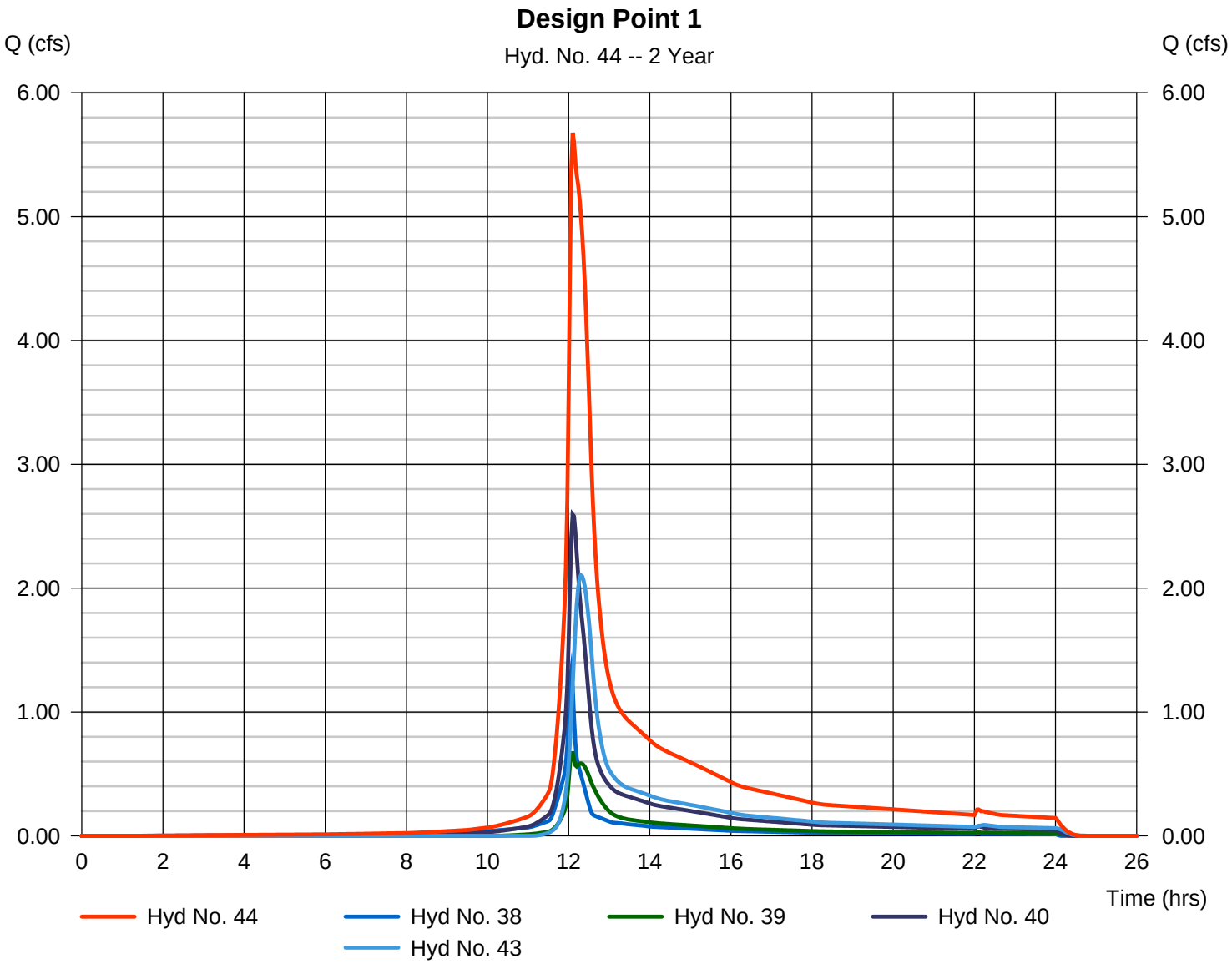
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Thursday, 09 / 15 / 2016

Hyd. No. 44

Design Point 1

Hydrograph type	= Combine	Peak discharge	= 5.677 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 30,543 cuft
Inflow hyds.	= 38, 39, 40, 43	Contrib. drain. area	= 0.000 ac



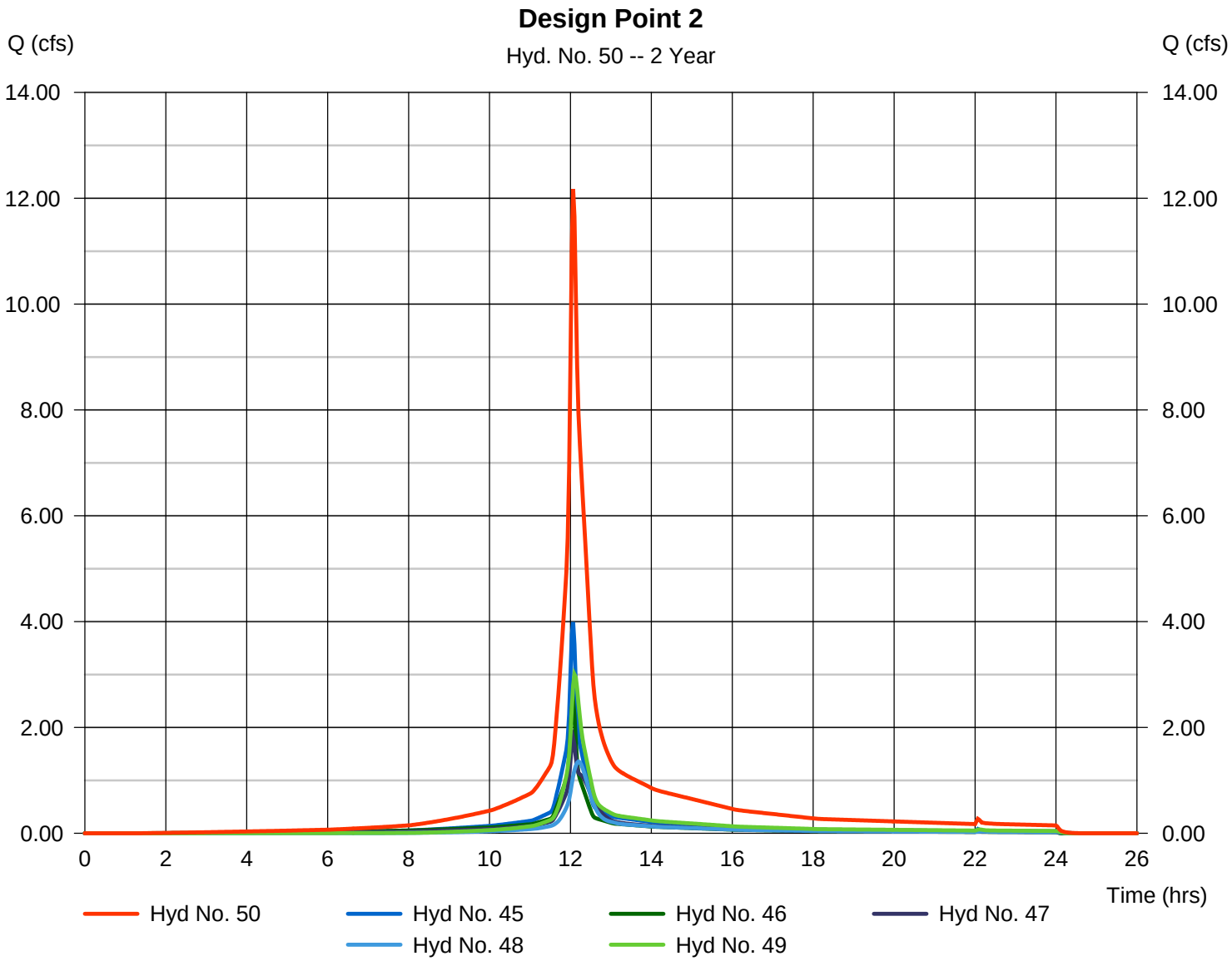
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Thursday, 09 / 15 / 2016

Hyd. No. 50

Design Point 2

Hydrograph type	= Combine	Peak discharge	= 12.17 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 46,432 cuft
Inflow hyds.	= 45, 46, 47, 48, 49	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.471	2	724	1,621	------	------	------	CB-01
2	SCS Runoff	0.438	2	724	1,507	------	------	------	CB-02
3	SCS Runoff	1.346	2	724	4,062	------	------	------	CB-03
4	SCS Runoff	1.138	2	724	3,409	------	------	------	CB-4
5	SCS Runoff	0.443	2	738	2,184	------	------	------	CB-5
6	SCS Runoff	0.275	2	750	1,741	------	------	------	CB-6
7	SCS Runoff	0.286	2	742	1,579	------	------	------	CB-7
8	SCS Runoff	1.987	2	734	8,864	------	------	------	CB-08
9	SCS Runoff	0.646	2	724	2,221	------	------	------	CB-09
10	SCS Runoff	3.298	2	726	11,258	------	------	------	CB-10
11	SCS Runoff	0.209	2	734	972	------	------	------	CB-11
12	SCS Runoff	0.253	2	742	1,393	------	------	------	CB-12
13	SCS Runoff	0.526	2	738	2,627	------	------	------	CB-13
14	SCS Runoff	0.166	2	732	708	------	------	------	CB-14
15	SCS Runoff	0.865	2	736	4,202	------	------	------	CB-15
16	SCS Runoff	0.143	2	730	576	------	------	------	CB-16
17	SCS Runoff	3.270	2	736	15,726	------	------	------	CB-17
18	SCS Runoff	0.599	2	724	2,059	------	------	------	CB-18
19	SCS Runoff	0.732	2	724	2,247	------	------	------	CB-19
20	SCS Runoff	3.239	2	724	10,256	------	------	------	CB-20
21	SCS Runoff	0.881	2	724	2,888	------	------	------	CB-21
22	SCS Runoff	0.212	2	724	729	------	------	------	CB-22
23	SCS Runoff	0.731	2	724	2,512	------	------	------	CB-23
24	SCS Runoff	1.248	2	724	4,149	------	------	------	CB-24
25	SCS Runoff	1.197	2	724	4,117	------	------	------	CB-25
26	SCS Runoff	0.608	2	724	2,091	------	------	------	CB-26
27	SCS Runoff	0.783	2	724	2,691	------	------	------	CB-27
28	SCS Runoff	0.688	2	724	2,367	------	------	------	CB-28
29	SCS Runoff	0.976	2	740	5,147	------	------	------	CB-29
30	SCS Runoff	1.620	2	724	5,472	------	------	------	CB-30
31	SCS Runoff	1.864	2	732	8,319	------	------	------	CB-31
32	SCS Runoff	0.438	2	730	1,782	------	------	------	CB-32
33	SCS Runoff	0.311	2	724	1,070	------	------	------	CB-33
34	SCS Runoff	0.768	2	734	3,407	------	------	------	CB-34

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
35	SCS Runoff	3.734	2	726	12,833	------	------	------	CB-35
36	SCS Runoff	0.457	2	724	1,572	------	------	------	CB-36
37	SCS Runoff	0.871	2	728	3,374	------	------	------	CB-37
38	Combine	2.256	2	724	7,191	1, 2, 3,	------	------	Heights Rd - W
39	Combine	1.602	2	724	8,912	4, 5, 6, 7,	------	------	Heights Rd - W / Site - SW
40	Combine	5.368	2	726	22,343	8, 9, 10,	------	------	Hollow Tree Ridge Rd
41	Combine	1.118	2	736	5,700	11, 12, 13, 14,	------	------	Site - W (1)
42	Combine	4.254	2	736	20,504	15, 16, 17,	------	------	Site - W (2)
43	Combine	5.372	2	736	26,204	41, 42	------	------	Site - W
44	Combine	12.62	2	726	64,649	38, 39, 40, 43	------	------	Design Point 1
45	Combine	6.393	2	724	20,692	18, 19, 20, 21, 22, 23,	------	------	Heights Rd - E (1)
46	Combine	3.837	2	724	13,048	24, 25, 26, 27,	------	------	Heights Rd - E (2)
47	Combine	2.861	2	724	12,986	28, 29, 30,	------	------	Heights Rd - E (3)
48	Combine	2.439	2	732	11,170	31, 32, 33,	------	------	Edgerton St
49	Combine	5.558	2	726	21,187	34, 35, 36, 37,	------	------	Site - NW
50	Combine	20.26	2	724	79,084	45, 46, 47, 48, 49	------	------	Design Point 2

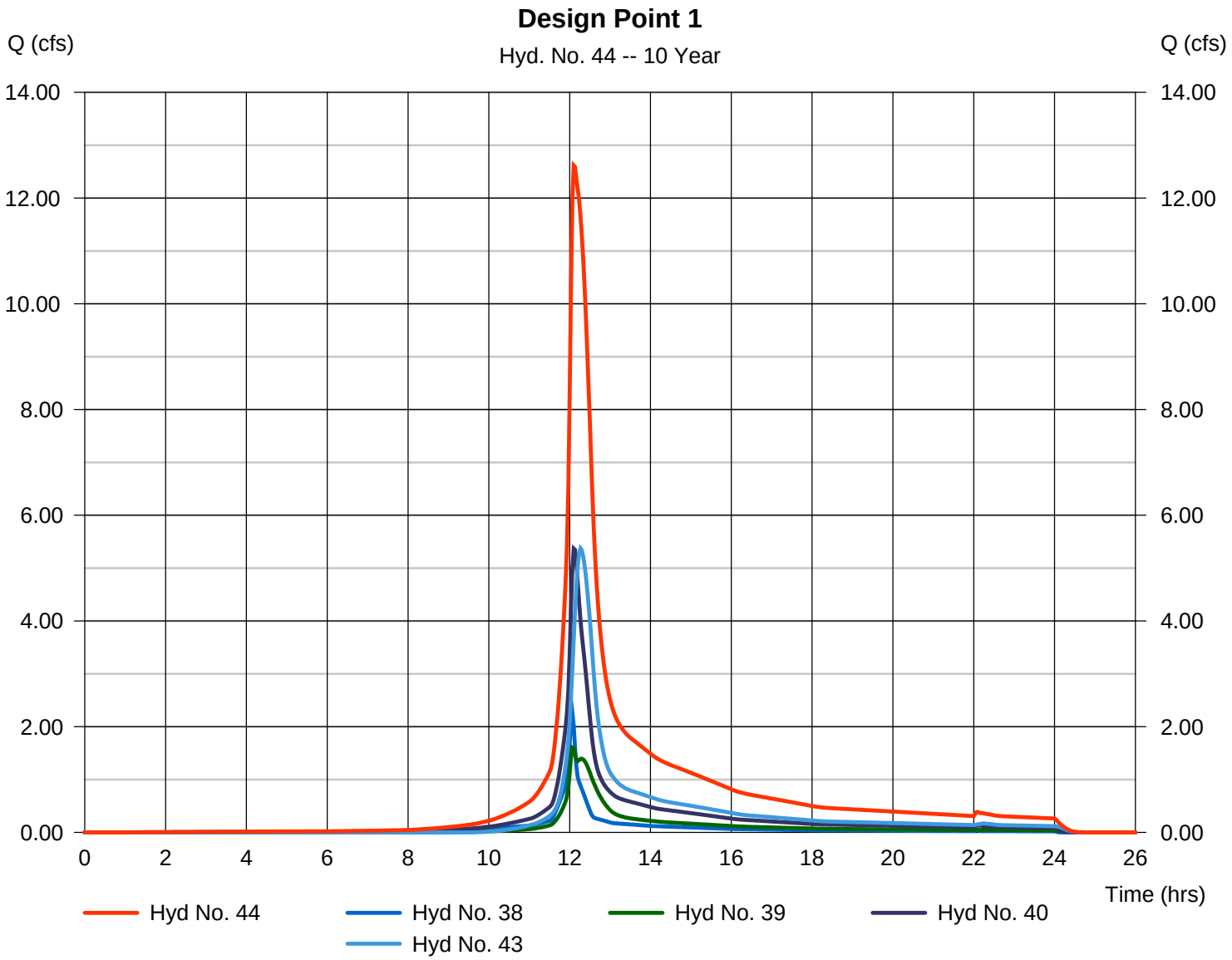
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Thursday, 09 / 15 / 2016

Hyd. No. 44

Design Point 1

Hydrograph type	=	Combine	Peak discharge	=	12.62 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.10 hrs
Time interval	=	2 min	Hyd. volume	=	64,649 cuft
Inflow hyds.	=	38, 39, 40, 43	Contrib. drain. area	=	0.000 ac



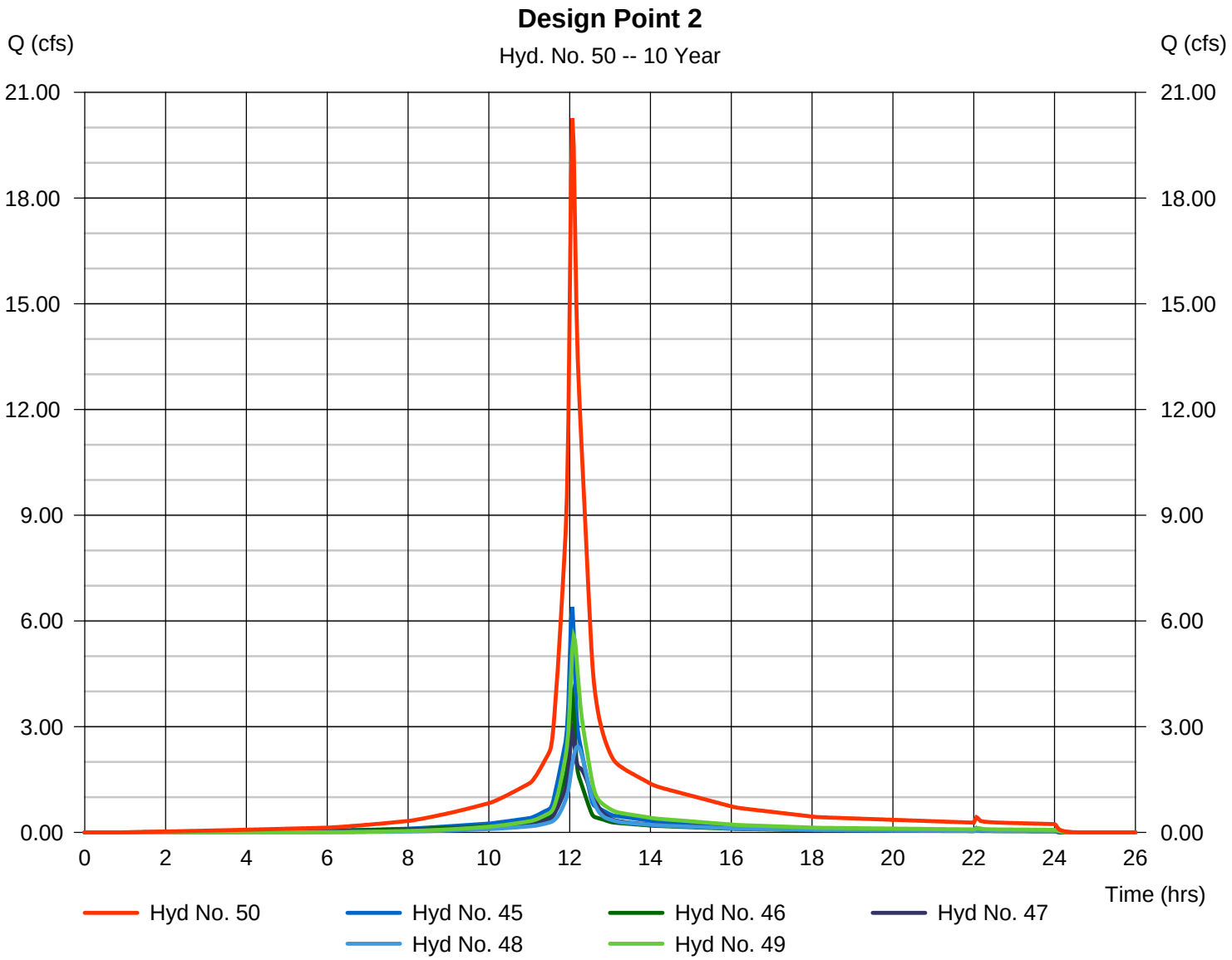
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Thursday, 09 / 15 / 2016

Hyd. No. 50

Design Point 2

Hydrograph type	= Combine	Peak discharge	= 20.26 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 79,084 cuft
Inflow hyds.	= 45, 46, 47, 48, 49	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.538	2	724	1,859	------	------	------	CB-01
2	SCS Runoff	0.500	2	724	1,729	------	------	------	CB-02
3	SCS Runoff	1.602	2	724	4,865	------	------	------	CB-03
4	SCS Runoff	1.410	2	724	4,215	------	------	------	CB-4
5	SCS Runoff	0.544	2	738	2,680	------	------	------	CB-5
6	SCS Runoff	0.362	2	750	2,248	------	------	------	CB-6
7	SCS Runoff	0.378	2	742	2,039	------	------	------	CB-7
8	SCS Runoff	2.502	2	734	11,090	------	------	------	CB-08
9	SCS Runoff	0.737	2	724	2,547	------	------	------	CB-09
10	SCS Runoff	4.013	2	726	13,715	------	------	------	CB-10
11	SCS Runoff	0.276	2	734	1,256	------	------	------	CB-11
12	SCS Runoff	0.333	2	742	1,799	------	------	------	CB-12
13	SCS Runoff	0.694	2	736	3,393	------	------	------	CB-13
14	SCS Runoff	0.218	2	732	915	------	------	------	CB-14
15	SCS Runoff	1.110	2	736	5,325	------	------	------	CB-15
16	SCS Runoff	0.188	2	730	744	------	------	------	CB-16
17	SCS Runoff	4.146	2	736	19,757	------	------	------	CB-17
18	SCS Runoff	0.683	2	724	2,361	------	------	------	CB-18
19	SCS Runoff	0.858	2	724	2,657	------	------	------	CB-19
20	SCS Runoff	3.747	2	724	11,976	------	------	------	CB-20
21	SCS Runoff	1.011	2	724	3,341	------	------	------	CB-21
22	SCS Runoff	0.242	2	724	836	------	------	------	CB-22
23	SCS Runoff	0.834	2	724	2,881	------	------	------	CB-23
24	SCS Runoff	1.430	2	724	4,787	------	------	------	CB-24
25	SCS Runoff	1.367	2	724	4,721	------	------	------	CB-25
26	SCS Runoff	0.694	2	724	2,398	------	------	------	CB-26
27	SCS Runoff	0.893	2	724	3,086	------	------	------	CB-27
28	SCS Runoff	0.786	2	724	2,714	------	------	------	CB-28
29	SCS Runoff	1.154	2	740	6,124	------	------	------	CB-29
30	SCS Runoff	1.852	2	724	6,294	------	------	------	CB-30
31	SCS Runoff	2.205	2	732	9,898	------	------	------	CB-31
32	SCS Runoff	0.531	2	730	2,163	------	------	------	CB-32
33	SCS Runoff	0.355	2	724	1,227	------	------	------	CB-33
34	SCS Runoff	0.956	2	734	4,229	------	------	------	CB-34

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
35	SCS Runoff	4.448	2	726	15,369	------	------	------	CB-35
36	SCS Runoff	0.522	2	724	1,803	------	------	------	CB-36
37	SCS Runoff	1.030	2	728	4,015	------	------	------	CB-37
38	Combine	2.641	2	724	8,452	1, 2, 3,	------	------	Heights Rd - W
39	Combine	2.027	2	724	11,181	4, 5, 6, 7,	------	------	Heights Rd - W / Site - SW
40	Combine	6.584	2	726	27,351	8, 9, 10,	------	------	Hollow Tree Ridge Rd
41	Combine	1.478	2	736	7,362	11, 12, 13, 14,	------	------	Site - W (1)
42	Combine	5.412	2	736	25,825	15, 16, 17,	------	------	Site - W (2)
43	Combine	6.890	2	736	33,187	41, 42	------	------	Site - W
44	Combine	15.74	2	726	80,172	38, 39, 40, 43	------	------	Design Point 1
45	Combine	7.375	2	724	24,052	18, 19, 20, 21, 22, 23,	------	------	Heights Rd - E (1)
46	Combine	4.384	2	724	14,992	24, 25, 26, 27,	------	------	Heights Rd - E (2)
47	Combine	3.300	2	724	15,132	28, 29, 30,	------	------	Heights Rd - E (3)
48	Combine	2.891	2	732	13,287	31, 32, 33,	------	------	Edgerton St
49	Combine	6.637	2	726	25,415	34, 35, 36, 37,	------	------	Site - NW
50	Combine	23.62	2	724	92,878	45, 46, 47, 48, 49	------	------	Design Point 2

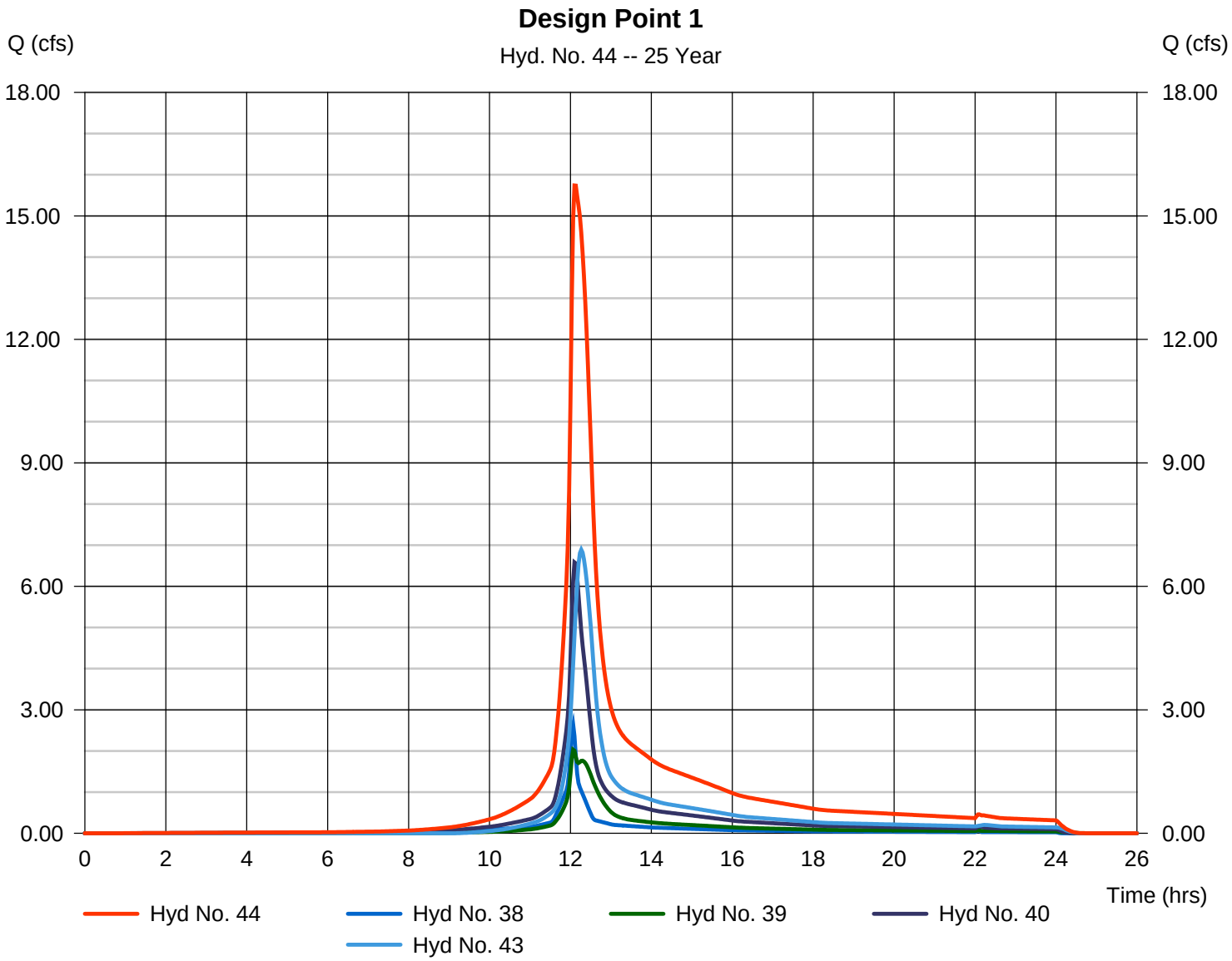
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Thursday, 09 / 15 / 2016

Hyd. No. 44

Design Point 1

Hydrograph type	=	Combine	Peak discharge	=	15.74 cfs
Storm frequency	=	25 yrs	Time to peak	=	12.10 hrs
Time interval	=	2 min	Hyd. volume	=	80,172 cuft
Inflow hyds.	=	38, 39, 40, 43	Contrib. drain. area	=	0.000 ac



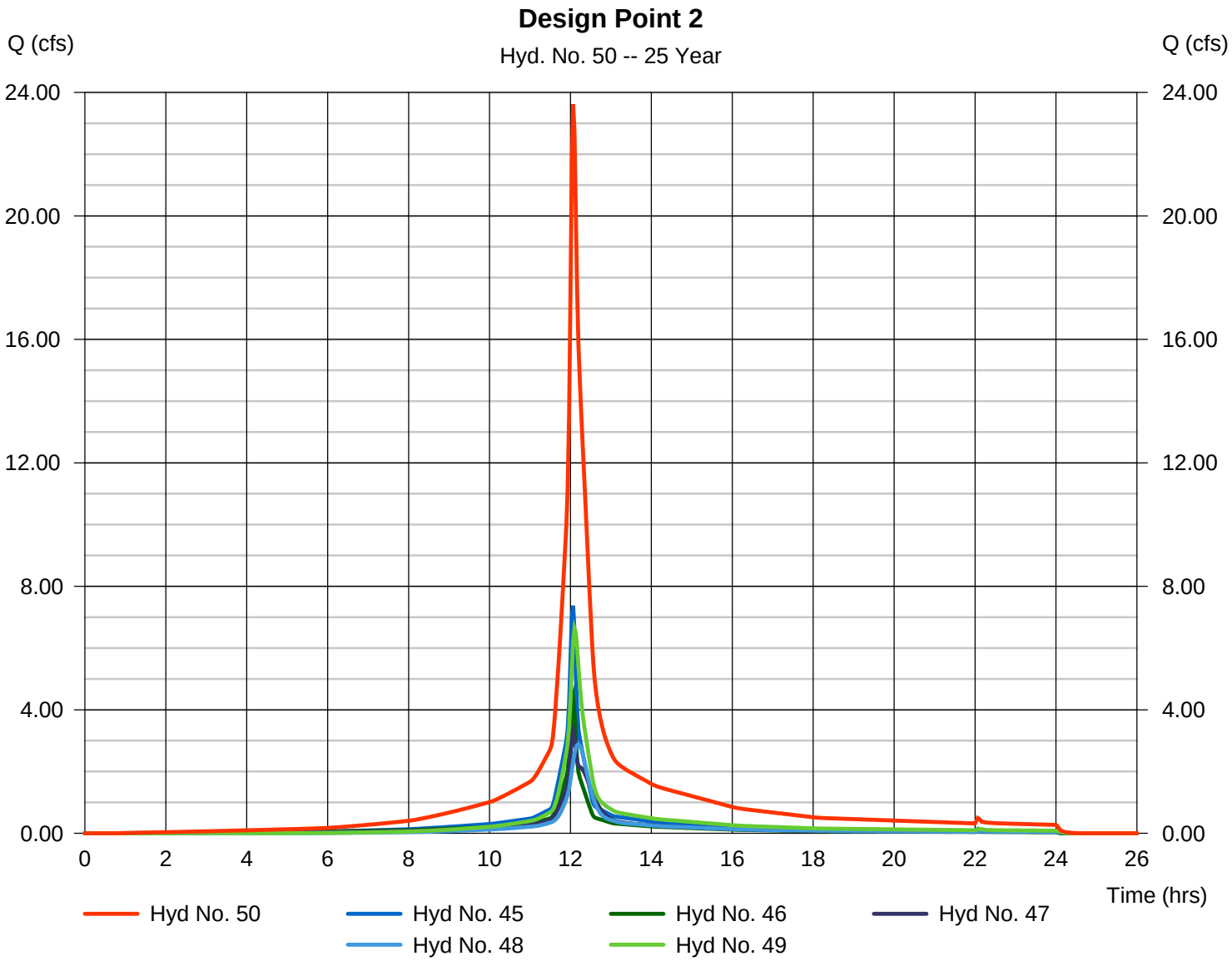
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Thursday, 09 / 15 / 2016

Hyd. No. 50

Design Point 2

Hydrograph type	= Combine	Peak discharge	= 23.62 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 92,878 cuft
Inflow hyds.	= 45, 46, 47, 48, 49	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.605	2	724	2,097	------	------	------	CB-01
2	SCS Runoff	0.562	2	724	1,950	------	------	------	CB-02
3	SCS Runoff	1.859	2	724	5,679	------	------	------	CB-03
4	SCS Runoff	1.688	2	724	5,046	------	------	------	CB-4
5	SCS Runoff	0.647	2	738	3,189	------	------	------	CB-5
6	SCS Runoff	0.455	2	748	2,786	------	------	------	CB-6
7	SCS Runoff	0.474	2	742	2,526	------	------	------	CB-7
8	SCS Runoff	3.032	2	734	13,403	------	------	------	CB-08
9	SCS Runoff	0.829	2	724	2,873	------	------	------	CB-09
10	SCS Runoff	4.736	2	726	16,230	------	------	------	CB-10
11	SCS Runoff	0.347	2	734	1,556	------	------	------	CB-11
12	SCS Runoff	0.418	2	742	2,229	------	------	------	CB-12
13	SCS Runoff	0.872	2	736	4,204	------	------	------	CB-13
14	SCS Runoff	0.273	2	732	1,133	------	------	------	CB-14
15	SCS Runoff	1.366	2	736	6,501	------	------	------	CB-15
16	SCS Runoff	0.236	2	730	921	------	------	------	CB-16
17	SCS Runoff	5.052	2	736	23,957	------	------	------	CB-17
18	SCS Runoff	0.768	2	724	2,663	------	------	------	CB-18
19	SCS Runoff	0.983	2	724	3,070	------	------	------	CB-19
20	SCS Runoff	4.253	2	724	13,702	------	------	------	CB-20
21	SCS Runoff	1.141	2	724	3,796	------	------	------	CB-21
22	SCS Runoff	0.272	2	724	944	------	------	------	CB-22
23	SCS Runoff	0.937	2	724	3,250	------	------	------	CB-23
24	SCS Runoff	1.610	2	724	5,425	------	------	------	CB-24
25	SCS Runoff	1.536	2	724	5,326	------	------	------	CB-25
26	SCS Runoff	0.780	2	724	2,705	------	------	------	CB-26
27	SCS Runoff	1.004	2	724	3,481	------	------	------	CB-27
28	SCS Runoff	0.883	2	724	3,061	------	------	------	CB-28
29	SCS Runoff	1.332	2	740	7,112	------	------	------	CB-29
30	SCS Runoff	2.083	2	724	7,116	------	------	------	CB-30
31	SCS Runoff	2.546	2	732	11,495	------	------	------	CB-31
32	SCS Runoff	0.625	2	730	2,552	------	------	------	CB-32
33	SCS Runoff	0.399	2	724	1,384	------	------	------	CB-33
34	SCS Runoff	1.150	2	734	5,079	------	------	------	CB-34

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
35	SCS Runoff	5.163	2	726	17,941	------	------	------	CB-35
36	SCS Runoff	0.587	2	724	2,034	------	------	------	CB-36
37	SCS Runoff	1.189	2	728	4,663	------	------	------	CB-37
38	Combine	3.026	2	724	9,726	1, 2, 3,	------	------	Heights Rd - W
39	Combine	2.466	2	724	13,548	4, 5, 6,	------	------	Heights Rd - W / Site - SW
40	Combine	7.825	2	726	32,506	7, 8, 9, 10,	------	------	Hollow Tree Ridge Rd
41	Combine	1.856	2	736	9,122	11, 12, 13,	------	------	Site - W (1)
42	Combine	6.610	2	736	31,379	14, 15, 16, 17,	------	------	Site - W (2)
43	Combine	8.466	2	736	40,502	41, 42	------	------	Site - W
44	Combine	18.98	2	728	96,281	38, 39, 40,	------	------	Design Point 1
45	Combine	8.355	2	724	27,424	43 18, 19, 20,	------	------	Heights Rd - E (1)
46	Combine	4.930	2	724	16,936	21, 22, 23, 24, 25, 26,	------	------	Heights Rd - E (2)
47	Combine	3.738	2	724	17,290	27, 28, 29, 30,	------	------	Heights Rd - E (3)
48	Combine	3.343	2	732	15,431	31, 32, 33,	------	------	Edgerton St
49	Combine	7.723	2	726	29,716	34, 35, 36,	------	------	Site - NW
50	Combine	26.99	2	724	106,797	37, 45, 46, 47, 48, 49	------	------	Design Point 2

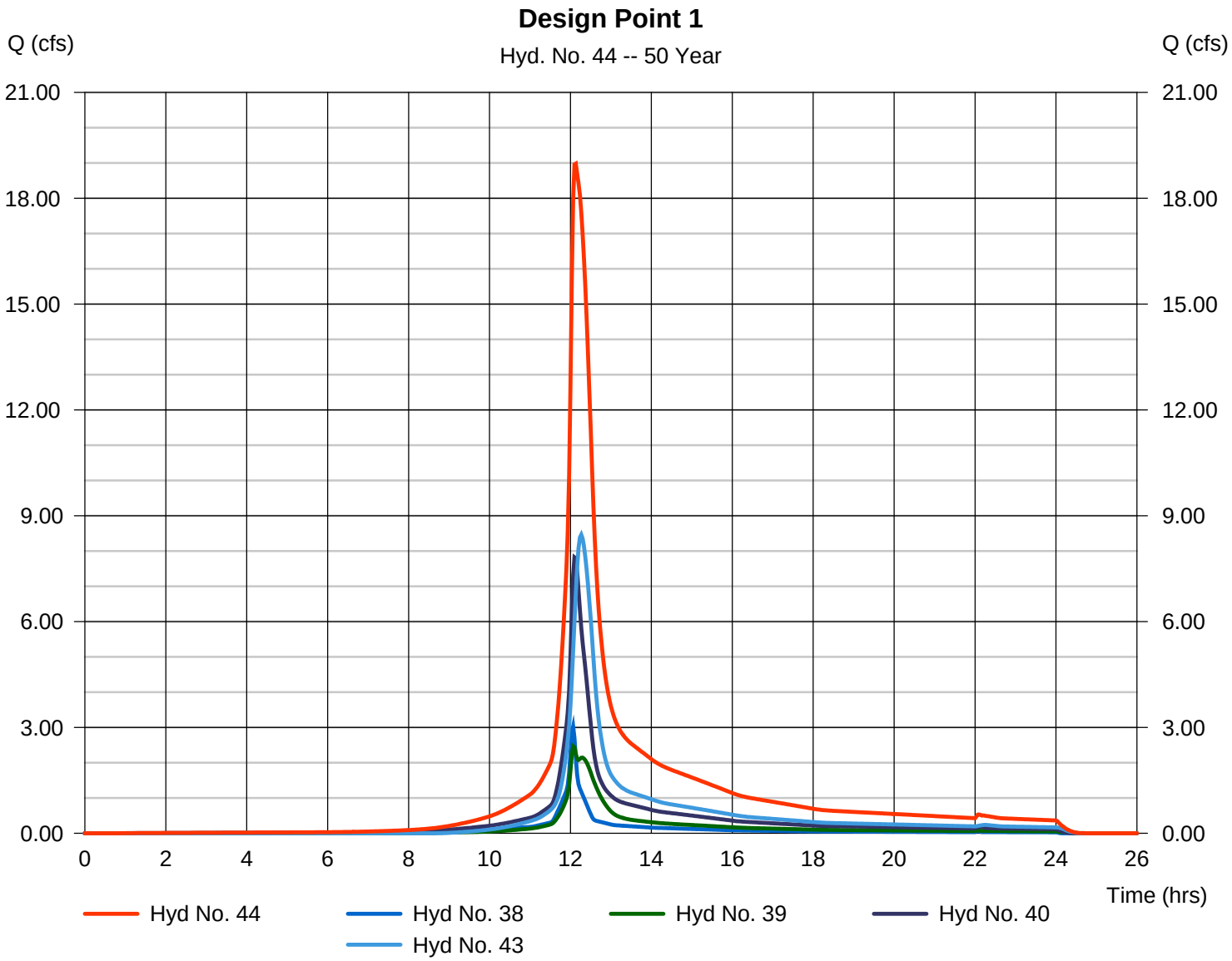
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Thursday, 09 / 15 / 2016

Hyd. No. 44

Design Point 1

Hydrograph type	=	Combine	Peak discharge	=	18.98 cfs
Storm frequency	=	50 yrs	Time to peak	=	12.13 hrs
Time interval	=	2 min	Hyd. volume	=	96,281 cuft
Inflow hyds.	=	38, 39, 40, 43	Contrib. drain. area	=	0.000 ac



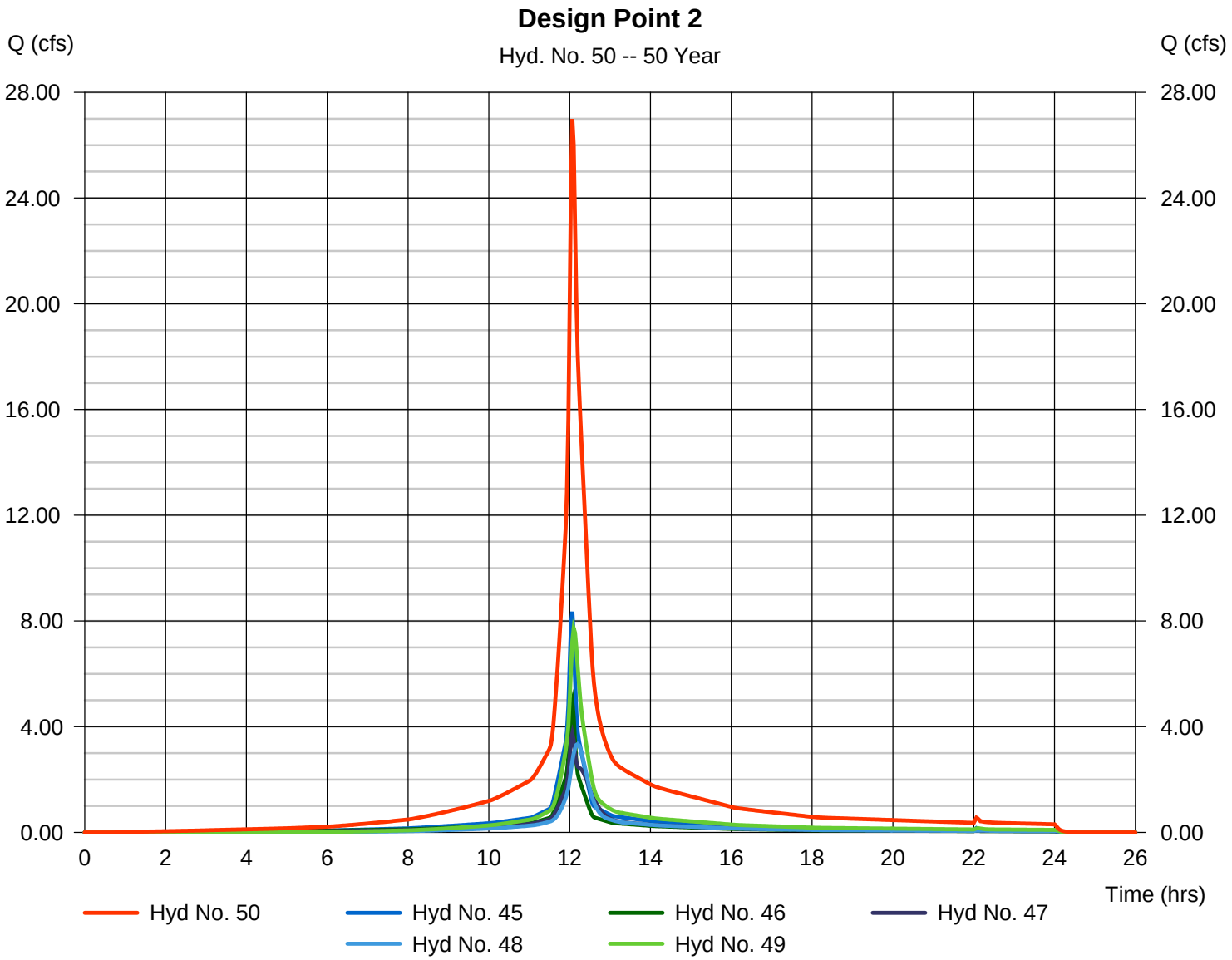
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Thursday, 09 / 15 / 2016

Hyd. No. 50

Design Point 2

Hydrograph type	= Combine	Peak discharge	= 26.99 cfs
Storm frequency	= 50 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 106,797 cuft
Inflow hyds.	= 45, 46, 47, 48, 49	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.681	2	724	2,369	------	------	------	CB-01
2	SCS Runoff	0.633	2	724	2,203	------	------	------	CB-02
3	SCS Runoff	2.151	2	724	6,621	------	------	------	CB-03
4	SCS Runoff	2.009	2	724	6,021	------	------	------	CB-4
5	SCS Runoff	0.766	2	738	3,785	------	------	------	CB-5
6	SCS Runoff	0.565	2	748	3,430	------	------	------	CB-6
7	SCS Runoff	0.588	2	740	3,110	------	------	------	CB-7
8	SCS Runoff	3.652	2	734	16,132	------	------	------	CB-08
9	SCS Runoff	0.933	2	724	3,245	------	------	------	CB-09
10	SCS Runoff	5.569	2	726	19,159	------	------	------	CB-10
11	SCS Runoff	0.430	2	734	1,916	------	------	------	CB-11
12	SCS Runoff	0.519	2	740	2,744	------	------	------	CB-12
13	SCS Runoff	1.084	2	736	5,176	------	------	------	CB-13
14	SCS Runoff	0.339	2	732	1,395	------	------	------	CB-14
15	SCS Runoff	1.666	2	736	7,897	------	------	------	CB-15
16	SCS Runoff	0.292	2	728	1,134	------	------	------	CB-16
17	SCS Runoff	6.113	2	736	28,922	------	------	------	CB-17
18	SCS Runoff	0.865	2	724	3,008	------	------	------	CB-18
19	SCS Runoff	1.126	2	724	3,545	------	------	------	CB-19
20	SCS Runoff	4.828	2	724	15,681	------	------	------	CB-20
21	SCS Runoff	1.289	2	724	4,316	------	------	------	CB-21
22	SCS Runoff	0.306	2	724	1,066	------	------	------	CB-22
23	SCS Runoff	1.055	2	724	3,672	------	------	------	CB-23
24	SCS Runoff	1.816	2	724	6,155	------	------	------	CB-24
25	SCS Runoff	1.729	2	724	6,017	------	------	------	CB-25
26	SCS Runoff	0.878	2	724	3,056	------	------	------	CB-26
27	SCS Runoff	1.130	2	724	3,932	------	------	------	CB-27
28	SCS Runoff	0.994	2	724	3,458	------	------	------	CB-28
29	SCS Runoff	1.535	2	740	8,252	------	------	------	CB-29
30	SCS Runoff	2.348	2	724	8,056	------	------	------	CB-30
31	SCS Runoff	2.935	2	732	13,337	------	------	------	CB-31
32	SCS Runoff	0.733	2	730	3,005	------	------	------	CB-32
33	SCS Runoff	0.449	2	724	1,563	------	------	------	CB-33
34	SCS Runoff	1.374	2	734	6,077	------	------	------	CB-34

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
35	SCS Runoff	5.979	2	726	20,916	------	------	------	CB-35
36	SCS Runoff	0.660	2	724	2,298	------	------	------	CB-36
37	SCS Runoff	1.370	2	728	5,410	------	------	------	CB-37
38	Combine	3.465	2	724	11,193	1, 2, 3,	------	------	Heights Rd - W
39	Combine	2.981	2	724	16,346	4, 5, 6,	------	------	Heights Rd - W / Site - SW
40	Combine	9.262	2	726	38,536	7, 8, 9, 10,	------	------	Hollow Tree Ridge Rd
41	Combine	2.306	2	736	11,231	11, 12, 13,	------	------	Site - W (1)
42	Combine	8.015	2	736	37,953	14, 15, 16, 17,	------	------	Site - W (2)
43	Combine	10.32	2	736	49,184	41, 42	------	------	Site - W
44	Combine	22.78	2	728	115,259	38, 39, 40,	------	------	Design Point 1
45	Combine	9.470	2	724	31,288	43 18, 19, 20,	------	------	Heights Rd - E (1)
46	Combine	5.554	2	724	19,159	21, 22, 23, 24, 25, 26,	------	------	Heights Rd - E (2)
47	Combine	4.239	2	724	19,767	27, 28, 29, 30,	------	------	Heights Rd - E (3)
48	Combine	3.860	2	732	17,905	31, 32, 33,	------	------	Edgerton St
49	Combine	8.967	2	726	34,700	34, 35, 36,	------	------	Site - NW
50	Combine	30.83	2	724	122,820	37, 45, 46, 47, 48, 49	------	------	Design Point 2

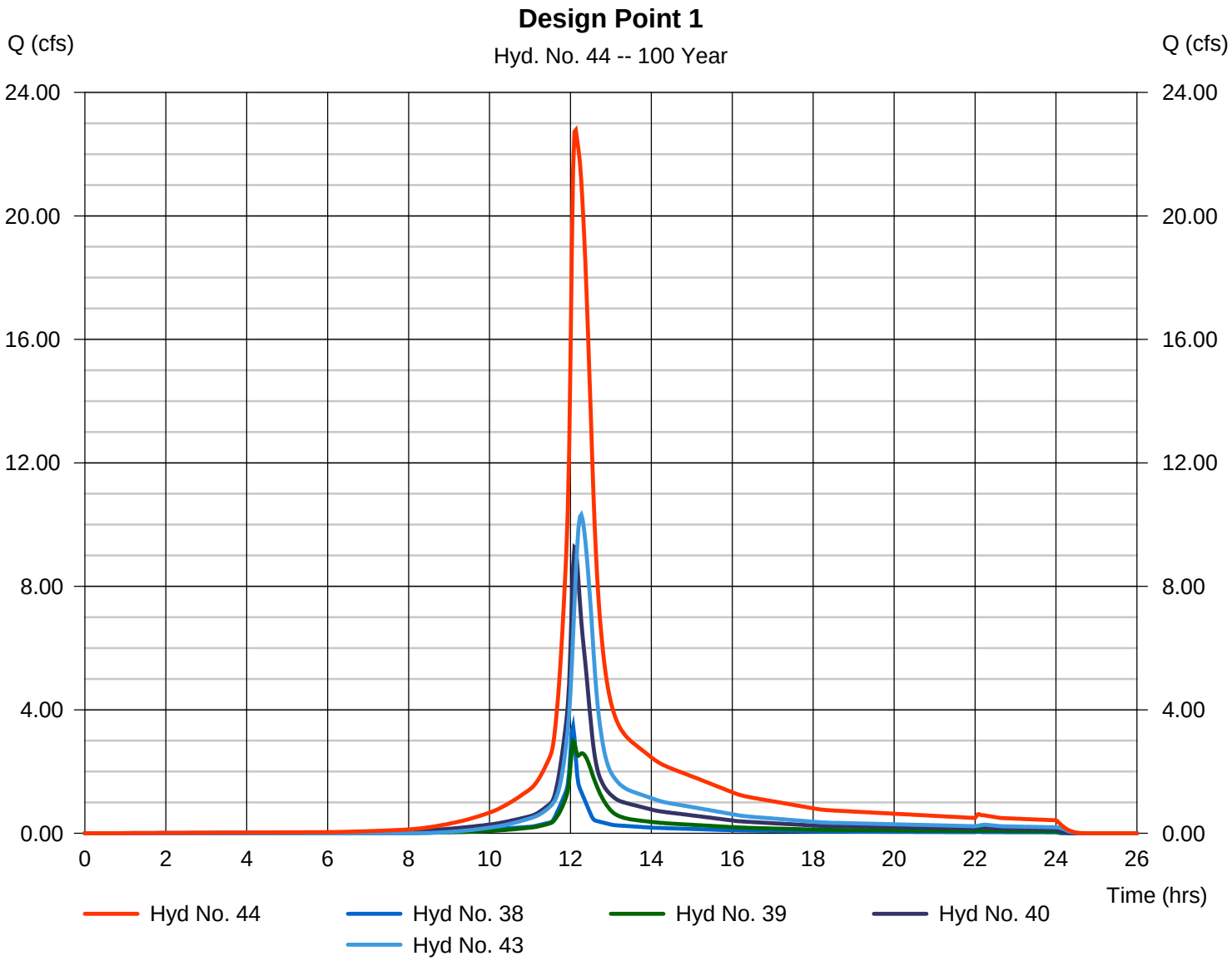
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Thursday, 09 / 15 / 2016

Hyd. No. 44

Design Point 1

Hydrograph type	= Combine	Peak discharge	= 22.78 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 115,259 cuft
Inflow hyds.	= 38, 39, 40, 43	Contrib. drain. area	= 0.000 ac



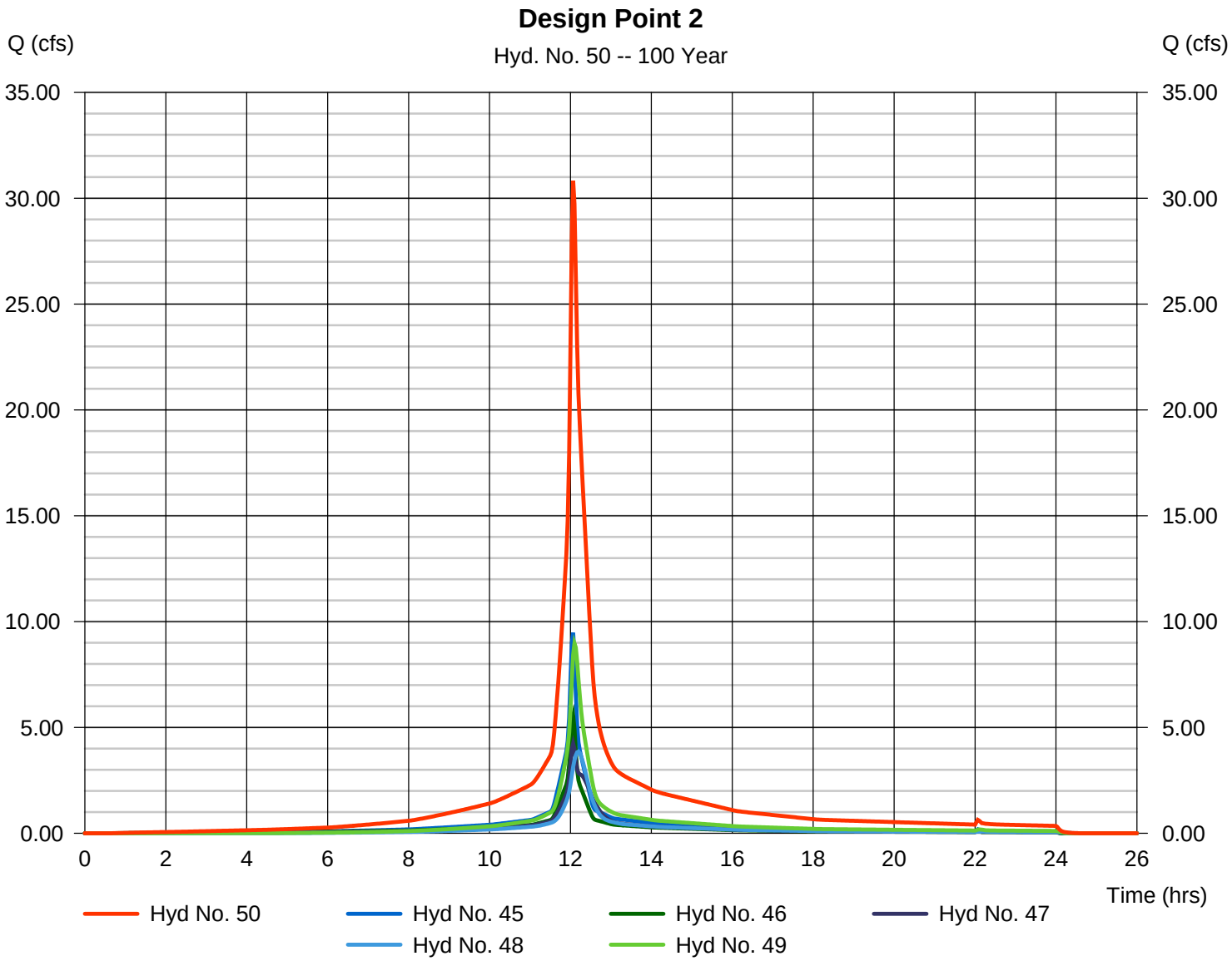
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Thursday, 09 / 15 / 2016

Hyd. No. 50

Design Point 2

Hydrograph type	= Combine	Peak discharge	= 30.83 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 122,820 cuft
Inflow hyds.	= 45, 46, 47, 48, 49	Contrib. drain. area	= 0.000 ac



Tighe&Bond

APPENDIX D

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **CB-01**
Location: Heights Road - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.100	98	9.8000
Landscaped and Lawns	0.000	69	0.0000
	0.100		9.8000

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	205	0.049	1.9

Total Tc = 1.9 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-02**
Location: Heights Road - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.093	98	9.1140
Landscaped and Lawns	0.000	69	0.0000
	0.093		9.1140

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	222	0.022	2.8

Total Tc = 2.8 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **CB-03**
Location: Heights Road - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.188	98	18.4240
Landscaped and Lawns	0.177	69	12.2130
	0.365		30.6370

Weighted CN: 84

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	137	0.029	1.7

Total Tc = 1.7 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-04**
Location: Heights Road - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.403	98	39.4940
Landscaped and Lawns	0.064	69	4.4160
	0.467		43.9100

Weighted CN: 94

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.4	63	0.008	21.1
Segment B - C	0.015	83	0.062	0.8

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment C - D	paved	0.008	1.82	68	0.6

Total Tc = 22.5 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **CB-05**
Location: Heights Road - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.156	98	15.2880
Landscaped and Lawns	0.007	69	0.4830
	0.163		15.7710

Weighted CN: 97

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	171	0.01	3.1

Total Tc = 3.1 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-06**
Location: Hollow Tree Ridge Road - Central

Cover Type	Area, ac	CN	A x CN
Pavement	0.246	98	24.1080
Landscaped and Lawns	0.696	69	48.0240
	0.942		72.1320

Weighted CN: 77

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.4	185	0.15	15.5

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment B - C	unpaved	0.015	1.98	193	1.6
Segment C - D	paved	0.036	3.86	41	0.2

Total Tc = 17.3 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **CB-07**
Location: Hollow Tree Ridge Road - Central

Cover Type	Area, ac	CN	A x CN
Pavement	0.137	98	13.4260
Landscaped and Lawns	0.000	69	0.0000
	0.137		13.4260

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	195	0.041	2.0

Total Tc = 2.0 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-08**
Location: Hollow Tree Ridge Road - Central

Cover Type	Area, ac	CN	A x CN
Pavement	0.396	98	38.8080
Landscaped and Lawns	0.711	69	49.0590
	1.107		87.8670

Weighted CN: 79

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.24	60	0.083	5.3
Segment B - C	0.015	240	0.062	2.0

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment C - D	paved	0.055	4.77	362	1.3

Total Tc = 8.5 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **CB-09**
Location: Site - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.141	98	13.8180
Landscaped and Lawns	0.035	69	2.4150
	0.176		16.2330

Weighted CN: 92

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	75	0.02	1.2

Total Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-09A**
Location: Site - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.141	98	13.8180
Landscaped and Lawns	0.035	69	2.4150
	0.176		16.2330

Weighted CN: 92

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	80	0.02	1.3

Total Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **CB-10**
Location: Site - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.068	98	6.6640
Landscaped and Lawns	0.036	69	2.4840
	0.104		9.1480

Weighted CN: 88

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	135	0.01	2.6

Total Tc = 2.6 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-11**
Location: Site - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.066	98	6.4680
Landscaped and Lawns	0.035	69	2.4150
	0.101		8.8830

Weighted CN: 88

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	136	0.01	2.6

Total Tc = 2.6 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

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Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **CB-12**
Location: Site - Central

Cover Type	Area, ac	CN	A x CN
Pavement	0.054	98	5.2920
Landscaped and Lawns	0.030	69	2.0700
	0.084		7.3620

Weighted CN: 88

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	126	0.015	2.1

Total Tc = 2.1 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-13**
Location: Site - Central

Cover Type	Area, ac	CN	A x CN
Pavement	0.052	98	5.0960
Landscaped and Lawns	0.039	69	2.6910
	0.091		7.7870

Weighted CN: 86

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	100	0.015	1.7

Total Tc = 1.7 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

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Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **CB-14**
Location: Site - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.055	98	5.3900
Landscaped and Lawns	0.023	69	1.5870
	0.078		6.9770

Weighted CN: 89

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	115	0.017	1.8

Total Tc = 1.8 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-15**
Location: Site - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.134	98	13.1320
Landscaped and Lawns	0.090	69	6.2100
	0.224		19.3420

Weighted CN: 86

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.24	90	0.2	5.1
Segment B - C	0.4	30	0.16	3.5

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment C - D	paved	0.025	3.21	115	0.6

Total Tc = 9.3 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

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Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **CB-16**
Location: Site - Northwest

Cover Type	Area, ac	CN	A x CN
Pavement	0.132	98	12.9360
Landscaped and Lawns	0.316	69	21.8040
	0.448		34.7400

Weighted CN: 78

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.24	150	0.07	11.8
Segment B - C	0.4	30	0.25	2.9

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment C - D	paved	0.05	4.55	50	0.2

Total Tc = 14.9 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-17**
Location: Site - Northwest

Cover Type	Area, ac	CN	A x CN
Pavement	0.145	98	14.2100
Landscaped and Lawns	0.132	69	9.1080
	0.277		23.3180

Weighted CN: 84

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.24	110	0.07	9.2
Segment B - C	0.4	32	0.55	2.3

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment C - D	paved	0.035	3.80	82	0.4

Total Tc = 11.8 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

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Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **CB-18A**
Location: Site - North

Cover Type	Area, ac	CN	A x CN
Pavement	0.490	98	48.0200
Landscaped and Lawns	0.719	69	49.6110
	1.209		97.6310

Weighted CN: 81

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.24	110	0.065	9.5
Segment B - C	0.4	40	0.7	2.5

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment C - D	paved	0.09	6.10	45	0.1

Total Tc = 12.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-19A**
Location: Site - North

Cover Type	Area, ac	CN	A x CN
Pavement	0.117	98	11.4660
Landscaped and Lawns	0.034	69	2.3460
	0.151		13.8120

Weighted CN: 91

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	127	0.01	2.4

Total Tc = 2.4 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

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Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **CB-20A**
Location: Site - North

Cover Type	Area, ac	CN	A x CN
Pavement	0.356	98	34.8880
Landscaped and Lawns	0.039	69	2.6910
	0.395		37.5790

Weighted CN: 95

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	271	0.025	3.1

Total Tc = 3.1 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-21A**
Location: Site - Central

Cover Type	Area, ac	CN	A x CN
Pavement	0.277	98	27.1460
Landscaped and Lawns	0.050	69	3.4500
	0.327		30.5960

Weighted CN: 94

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	244	0.02	3.1

Total Tc = 3.1 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

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Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **RF-01**
Location: Site - Southwest

Cover Type	Area, ac	CN	A x CN
Pavement	0.206	98	20.1880
Landscaped and Lawns	0.000	69	0.0000
	0.206		20.1880

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	100	0.01	2.0

Total Tc = 2.0 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **RF-02**
Location: Site - Southwest

Cover Type	Area, ac	CN	A x CN
Pavement	0.124	98	12.1520
Landscaped and Lawns	0.000	69	0.0000
	0.124		12.1520

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	100	0.01	2.0

Total Tc = 2.0 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **RF-03**
Location: South

Cover Type	Area, ac	CN	A x CN
Pavement	0.131	98	12.8380
Landscaped and Lawns	0.000	69	0.0000
	0.131		12.8380

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	100	0.01	2.0

Total Tc = 2.0 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **RF-04**
Location: Site - Northwest

Cover Type	Area, ac	CN	A x CN
Pavement	0.145	98	14.2100
Landscaped and Lawns	0.000	69	0.0000
	0.145		14.2100

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	100	0.01	2.0

Total Tc = 2.0 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

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Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **RF-05**
Location: Site - North

Cover Type	Area, ac	CN	A x CN
Pavement	0.183	98	17.9340
Landscaped and Lawns	0.000	69	0.0000
	0.183		17.9340

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	150	0.01	2.8

Total Tc = 2.8 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **TD-01**
Location: Trench Drain - Loading Dock

Cover Type	Area, ac	CN	A x CN
Pavement	0.023	98	2.2540
Landscaped and Lawns	0.000	69	0.0000
	0.023		2.2540

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	50	0.01	1.2

Total Tc = 1.2 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

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Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **CB-18**
Location: Heights Road / Edgerton Street Intersection - East

Cover Type	Area, ac	CN	A x CN
Pavement	0.127	98	12.4460
Landscaped and Lawns	0.000	69	0.0000
Site	0.000	65	0.0000
	0.127		12.4460

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	300	0.0283	3.2

Total Tc = 3.2 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-19**
Location: Heights Road / Edgerton Street Intersection - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.119	98	11.6620
Landscaped and Lawns	0.061	69	4.2090
Site	0.000	65	0.0000
	0.180		15.8710

Weighted CN: 88

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.24	16	0.062	2.1
Segment B - C	0.015	147	0.017	2.2

Total Tc = 4.3 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

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Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **CB-20**
Location: Heights Road - East

Cover Type	Area, ac	CN	A x CN
Pavement	0.593	98	58.1140
Landscaped and Lawns	0.144	69	9.9360
Site	0.000	65	0.0000
	0.737		68.0500

Weighted CN: 92

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.24	16	0.2	1.3
Segment B - C	0.015	220	0.01	3.8

Total Tc = 5.1 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-21**
Location: Site - Southeast

Cover Type	Area, ac	CN	A x CN
Pavement	0.170	98	16.6600
Landscaped and Lawns	0.022	69	1.5180
Site	0.000	65	0.0000
	0.192		18.1780

Weighted CN: 95

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	150	0.035	1.7
Segment B - C	1	0	1	0.0

Total Tc = 1.7 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

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Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **CB-22**
Location: Heights Road - Southeast

Cover Type	Area, ac	CN	A x CN
Pavement	0.045	98	4.4100
Landscaped and Lawns	0.000	69	0.0000
Site	0.000	65	0.0000
	0.045		4.4100

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	80	0.031	1.1

Total Tc = 1.1 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

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Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **CB-23**
Location: Heights Road - Southeast

Cover Type	Area, ac	CN	A x CN
Pavement	0.155	98	15.1900
Landscaped and Lawns	0.000	69	0.0000
Site	0.000	65	0.0000
	0.155		15.1900

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	300	0.025	3.4

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment B - C	paved	0.025	3.21	60	0.3

Total Tc = 3.7 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-24**
Location: Heights Road - East

Cover Type	Area, ac	CN	A x CN
Pavement	0.249	98	24.4020
Landscaped and Lawns	0.020	69	1.3800
Site	0.000	65	0.0000
	0.269		25.7820

Weighted CN: 96

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	161	0.015	2.5

Total Tc = 2.5 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

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Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **CB-25**
Location: Site - Roof Leader Conc. Block Building - East

Cover Type	Area, ac	CN	A x CN
Pavement	0.254	98	24.8920
Landscaped and Lawns	0.000	69	0.0000
Site	0.000	65	0.0000
	0.254		24.8920

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	140	0.02	2.0

Total Tc = 2.0 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-26**
Location: Heights Road - East

Cover Type	Area, ac	CN	A x CN
Pavement	0.129	98	12.6420
Landscaped and Lawns	0.000	69	0.0000
Site	0.000	65	0.0000
	0.129		12.6420

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	155	0.01	2.9

Total Tc = 2.9 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

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Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **CB-27**
Location: Heights Road - East

Cover Type	Area, ac	CN	A x CN
Pavement	0.166	98	16.2680
Landscaped and Lawns	0.000	69	0.0000
Site	0.000	65	0.0000
	0.166		16.2680

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	190	0.063	1.6

Total Tc = 1.6 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-28**
Location: Heights Road - East

Cover Type	Area, ac	CN	A x CN
Pavement	0.145	98	14.2100
Landscaped and Lawns	0.000	69	0.0000
Site	0.000	65	0.0000
	0.145		14.2100

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	129	0.06	1.2

Total Tc = 1.2 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **CB-29**
Location: Heights Road - East

Cover Type	Area, ac	CN	A x CN
Pavement	0.297	98	29.1060
Landscaped and Lawns	0.000	69	0.0000
Site	0.000	65	0.0000
	0.297		29.1060

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	104	0.015	1.8

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment C - D	paved	0.015	2.49	134	0.9

Total Tc = 2.7 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-30**
Location: Site - South

Cover Type	Area, ac	CN	A x CN
Pavement	0.232	98	22.7360
Landscaped and Lawns	0.000	69	0.0000
Site	0.000	65	0.0000
	0.232		22.7360

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	96	0.04	1.1

Total Tc = 1.1 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **CB-31**
Location: Edgerton Street - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.386	98	37.8280
Landscaped and Lawns	0.275	69	18.9750
Site	0.000	65	0.0000
	0.661		56.8030

Weighted CN: 86

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.24	220	0.081	15.1
Segment B - C	0.24	33	0.167	2.5

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment C - D	paved	0.027	3.34	128	0.6

Total Tc = 18.2 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-32**
Location: Edgerton Street - West

Cover Type	Area, ac	CN	A x CN
Pavement	0.063	98	6.1740
Landscaped and Lawns	0.111	69	7.6590
Site	0.000	65	0.0000
	0.174		13.8330

Weighted CN: 80

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.24	92	0.026	11.8
Segment B - C	0.24	31	0.129	2.6

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment C - D	paved	0.025	3.21	59	0.3

Total Tc = 14.8 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **CB-33**
Location: Edgerton Street - East

Cover Type	Area, ac	CN	A x CN
Pavement	0.066	98	6.4680
Landscaped and Lawns	0.000	69	0.0000
Site	0.000	65	0.0000
	0.066		6.4680

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	220	0.045	2.1

Total Tc = 2.1 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-34**
Location: Site - Northeast

Cover Type	Area, ac	CN	A x CN
Pavement	0.068	98	6.6640
Landscaped and Lawns	0.329	69	22.7010
Site	0.000	65	0.0000
	0.397		29.3650

Weighted CN: 74

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.24	240	0.092	15.4
Segment B - C	0.24	30	0.3	1.8

Total Tc = 17.2 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **CB-35**
Location: Site - Northeast

Cover Type	Area, ac	CN	A x CN
Pavement	0.543	98	53.2140
Landscaped and Lawns	0.538	69	37.1220
Site	0.000	65	0.0000
	1.081		90.3360

Weighted CN: 84

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.15	198	0.101	8.7

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment C - D	unpaved	0.044	3.38	102	0.5

Total Tc = 9.2 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-36**
Location: Edgerton Street - Northwest

Cover Type	Area, ac	CN	A x CN
Pavement	0.097	98	9.5060
Landscaped and Lawns	0.000	69	0.0000
Site	0.000	65	0.0000
	0.097		9.5060

Weighted CN: 98

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	222	0.056	1.9

Total Tc = 1.9 Min.
Min Tc = 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Palmer Mixed Use**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Proposed CN & Tc Calculations**
Prepared By: **JCB** Date: **September 12, 2016**

Designation: **CB-37**
Location: Edgerton Street - Northwest

Cover Type	Area, ac	CN	A x CN
Pavement	0.154	98	15.0920
Landscaped and Lawns	0.106	69	7.3140
Site	0.000	65	0.0000
	0.260		22.4060

Weighted CN: 86

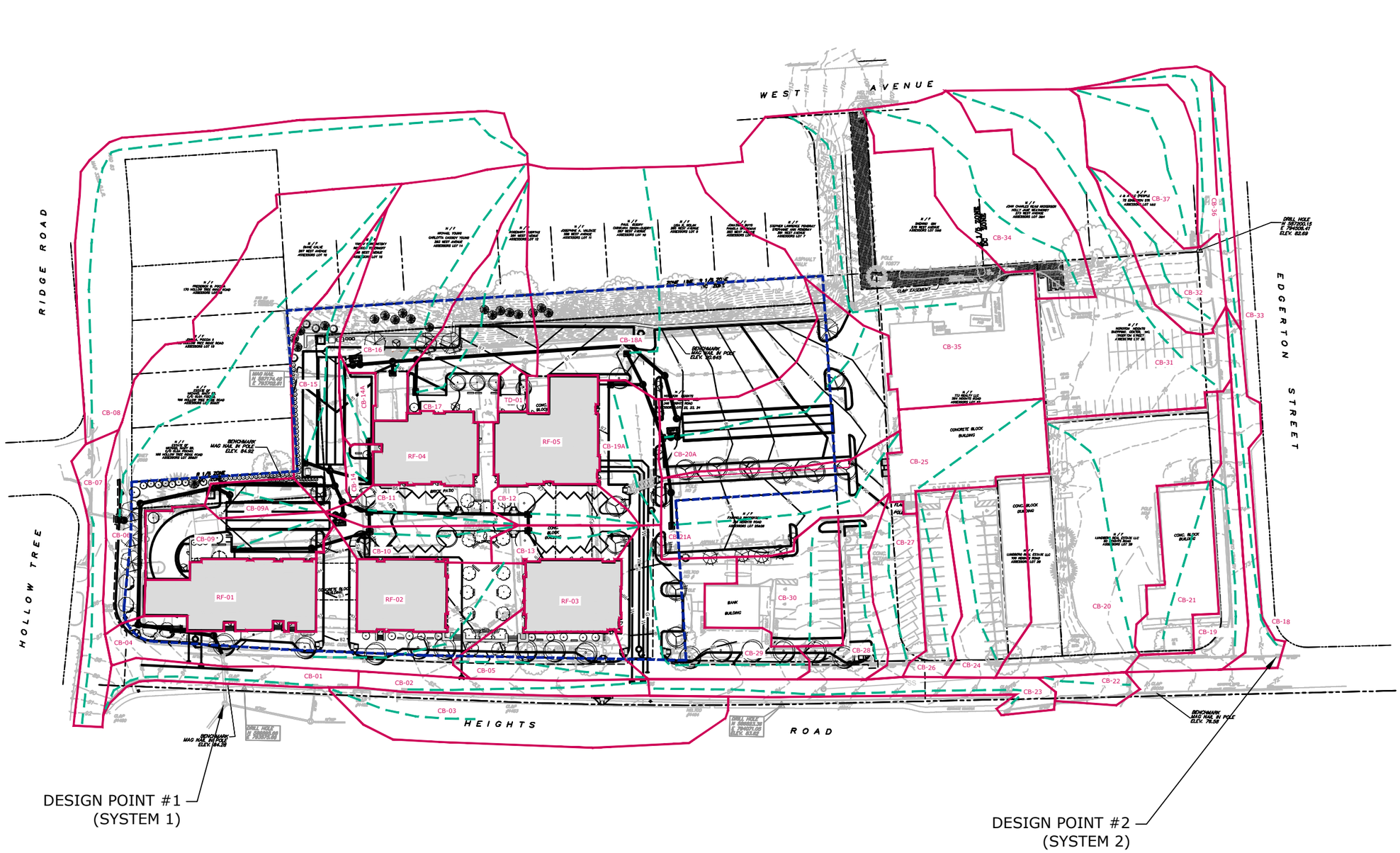
Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.24	127	0.071	10.2
Segment B - C	0.015	64	0.062	0.7

Total Tc = 10.9 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation



LEGEND

- SITE LIMIT
- WATERSHED BOUNDARY
- TIME OF CONCENTRATION FLOW PATH

SCALE IN FEET

0 40' 80'

GRAPHIC SCALE

NOROTON HEIGHTS SHOPPING CENTER
DARIEN, CT

PROPOSED WATERSHED MAP

DATE: 09/16/2016
SCALE: 1" = 100'
FIGURE 4

Tighe&Bond
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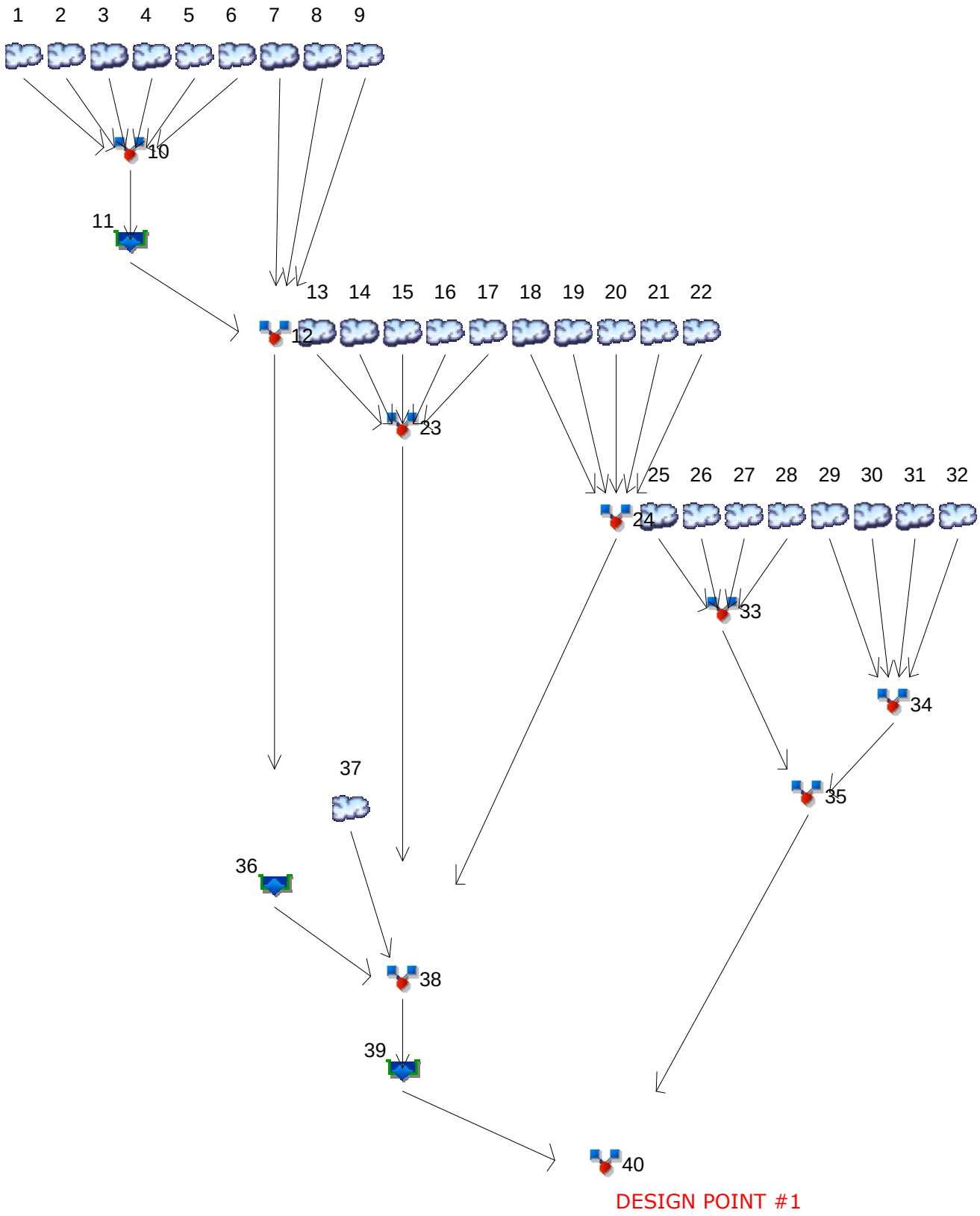
Nov 11, 2016-10:38am Plotted By: JCB1
Tighe & Bond, Inc. J:\P\P0695 J&G Palmer Mixed Use\Calculations\Drainage\2016_9-12 Drainage\PRWM-P0695-05.dwg

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4



Project: Proposed_site with detention.gpw	Thursday, 09 / 15 / 2016

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	------	-------	1.811	-------	-------	3.524	4.254	4.989	-------	CB-18A
2	SCS Runoff	------	-------	0.396	-------	-------	0.652	0.757	0.861	-------	CB-19A
3	SCS Runoff	------	-------	1.157	-------	-------	1.813	2.081	2.347	-------	CB-20A
4	SCS Runoff	------	-------	0.935	-------	-------	1.482	1.705	1.927	-------	CB-21A
5	SCS Runoff	------	-------	0.566	-------	-------	0.863	0.985	1.107	-------	RF-05
6	SCS Runoff	------	-------	0.071	-------	-------	0.108	0.124	0.139	-------	TD-01
7	SCS Runoff	------	-------	0.488	-------	-------	1.020	1.254	1.492	-------	CB-16
8	SCS Runoff	------	-------	0.499	-------	-------	0.905	1.074	1.243	-------	CB-17
9	SCS Runoff	------	-------	0.448	-------	-------	0.684	0.780	0.877	-------	RF-04
10	Combine	1, 2, 3,	-------	4.603	-------	-------	7.868	9.232	10.60	-------	Into DET-01
11	Reservoir	4, 5, 6, 10	-------	0.560	-------	-------	2.188	3.243	5.537	-------	DET-01
12	Combine	7, 8, 9, 11	-------	1.694	-------	-------	3.826	4.803	7.922	-------	Into DET-02
13	SCS Runoff	------	-------	0.476	-------	-------	0.773	0.895	1.016	-------	CB-09
14	SCS Runoff	------	-------	0.246	-------	-------	0.423	0.496	0.568	-------	CB-10
15	SCS Runoff	------	-------	0.239	-------	-------	0.411	0.481	0.552	-------	CB-11
16	SCS Runoff	------	-------	0.198	-------	-------	0.341	0.400	0.459	-------	CB-12
17	SCS Runoff	------	-------	0.199	-------	-------	0.353	0.417	0.481	-------	CB-13
18	SCS Runoff	------	-------	0.191	-------	-------	0.324	0.378	0.433	-------	CB-14
19	SCS Runoff	------	-------	0.458	-------	-------	0.815	0.963	1.111	-------	CB-15
20	SCS Runoff	------	-------	0.637	-------	-------	0.971	1.109	1.246	-------	RF-01
21	SCS Runoff	------	-------	0.383	-------	-------	0.585	0.667	0.750	-------	RF-02
22	SCS Runoff	------	-------	0.405	-------	-------	0.618	0.705	0.792	-------	RF-03
23	Combine	13, 14, 15,	-------	1.357	-------	-------	2.301	2.689	3.075	-------	Comb-1
24	Combine	16, 17, 18, 19, 20,	-------	2.043	-------	-------	3.265	3.769	4.271	-------	Comb-2
25	SCS Runoff	21, 22, ------	-------	0.309	-------	-------	0.471	0.538	0.605	-------	CB-01
26	SCS Runoff	------	-------	0.287	-------	-------	0.438	0.500	0.562	-------	CB-02
27	SCS Runoff	------	-------	0.734	-------	-------	1.346	1.602	1.859	-------	CB-03
28	SCS Runoff	------	-------	0.927	-------	-------	1.474	1.697	1.920	-------	CB-04
29	SCS Runoff	------	-------	0.497	-------	-------	0.763	0.872	0.981	-------	CB-05
30	SCS Runoff	------	-------	0.970	-------	-------	2.030	2.491	2.960	-------	CB-06
31	SCS Runoff	------	-------	0.423	-------	-------	0.646	0.737	0.829	-------	CB-07
32	SCS Runoff	------	-------	1.636	-------	-------	3.298	4.013	4.736	-------	CB-08
33	Combine	25, 26, 27,	-------	1.955	-------	-------	3.264	3.804	4.345	-------	Comb-1
34	Combine	28, 29, 30, 31, 32,	-------	3.167	-------	-------	6.126	7.401	8.693	-------	Comb-2

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	
35	Combine	33, 34	-------	5.072	-------	-------	9.281	11.07	12.88	-------	Offsite
36	Reservoir	12	-------	0.521	-------	-------	2.022	3.161	6.233	-------	DET-02
37	SCS Runoff	------	-------	0.476	-------	-------	0.773	0.895	1.016	-------	CB-09A
38	Combine	23, 24, 36, 37	-------	4.142	-------	-------	6.739	7.803	8.868	-------	Into DET-03
39	Reservoir	38	-------	0.857	-------	-------	2.497	4.008	8.029	-------	DET-03
40	Combine	35, 39	-------	5.540	-------	-------	10.97	13.27	16.94	-------	Design Point 1

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	1.811	2	728	7,006	------	------	------	CB-18A
2	SCS Runoff	0.396	2	724	1,209	------	------	------	CB-19A
3	SCS Runoff	1.157	2	724	3,687	------	------	------	CB-20A
4	SCS Runoff	0.935	2	724	2,939	------	------	------	CB-21A
5	SCS Runoff	0.566	2	724	1,910	------	------	------	RF-05
6	SCS Runoff	0.071	2	724	240	------	------	------	TD-01
7	SCS Runoff	0.488	2	732	2,035	------	------	------	CB-16
8	SCS Runoff	0.499	2	728	1,911	------	------	------	CB-17
9	SCS Runoff	0.448	2	724	1,513	------	------	------	RF-04
10	Combine	4.603	2	724	16,991	1, 2, 3, 4, 5, 6,	------	------	Into DET-01
11	Reservoir	0.560	2	774	16,949	10	82.05	7,946	DET-01
12	Combine	1.694	2	728	22,410	7, 8, 9, 11	------	------	Into DET-02
13	SCS Runoff	0.476	2	724	1,465	------	------	------	CB-09
14	SCS Runoff	0.246	2	724	739	------	------	------	CB-10
15	SCS Runoff	0.239	2	724	717	------	------	------	CB-11
16	SCS Runoff	0.198	2	724	597	------	------	------	CB-12
17	SCS Runoff	0.199	2	724	595	------	------	------	CB-13
18	SCS Runoff	0.191	2	724	577	------	------	------	CB-14
19	SCS Runoff	0.458	2	726	1,563	------	------	------	CB-15
20	SCS Runoff	0.637	2	724	2,150	------	------	------	RF-01
21	SCS Runoff	0.383	2	724	1,294	------	------	------	RF-02
22	SCS Runoff	0.405	2	724	1,367	------	------	------	RF-03
23	Combine	1.357	2	724	4,113	13, 14, 15, 16, 17,	------	------	Comb-1
24	Combine	2.043	2	724	6,952	18, 19, 20, 21, 22,	------	------	Comb-2
25	SCS Runoff	0.309	2	724	1,044	------	------	------	CB-01
26	SCS Runoff	0.287	2	724	971	------	------	------	CB-02
27	SCS Runoff	0.734	2	724	2,194	------	------	------	CB-03
28	SCS Runoff	0.927	2	734	4,557	------	------	------	CB-04
29	SCS Runoff	0.497	2	724	1,640	------	------	------	CB-05
30	SCS Runoff	0.970	2	734	4,390	------	------	------	CB-06
31	SCS Runoff	0.423	2	724	1,430	------	------	------	CB-07
32	SCS Runoff	1.636	2	726	5,675	------	------	------	CB-08
33	Combine	1.955	2	724	8,766	25, 26, 27, 28,	------	------	Comb-1
34	Combine	3.167	2	726	13,134	29, 30, 31, 32,	------	------	Comb-2

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
35	Combine	5.072	2	726	21,900	33, 34	------	------	Offsite
36	Reservoir	0.521	2	954	22,378	12	79.67	5,446	DET-02
37	SCS Runoff	0.476	2	724	1,465	------	------	------	CB-09A
38	Combine	4.142	2	724	34,907	23, 24, 36, 37	------	------	Into DET-03
39	Reservoir	0.857	2	766	34,877	38	79.30	6,470	DET-03
40	Combine	5.540	2	726	56,777	35, 39	------	------	Design Point 1

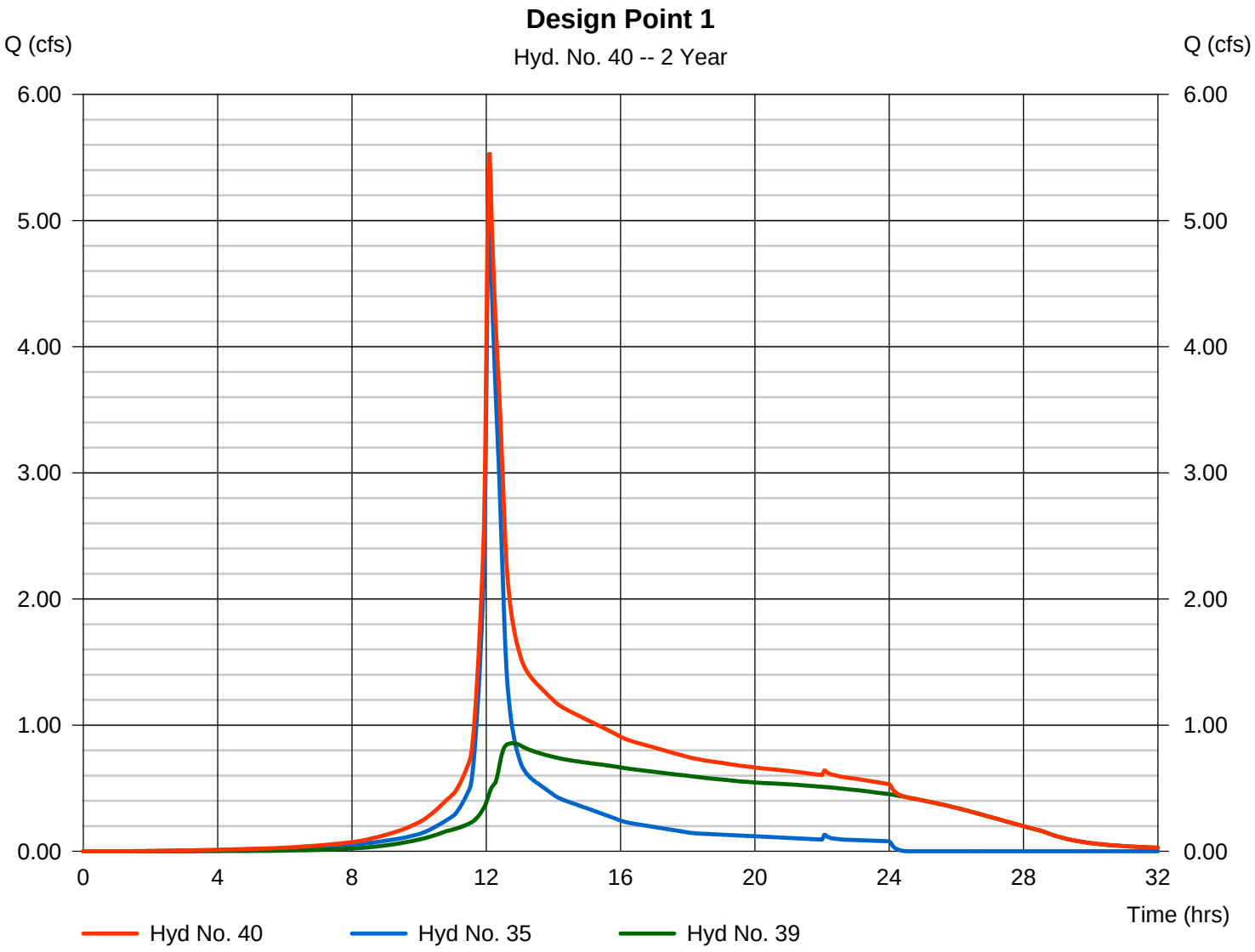
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Thursday, 11 / 10 / 2016

Hyd. No. 40

Design Point 1

Hydrograph type	= Combine	Peak discharge	= 5.540 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 56,777 cuft
Inflow hyds.	= 35, 39	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	3.524	2	728	13,511	------	------	------	CB-18A
2	SCS Runoff	0.652	2	724	2,046	------	------	------	CB-19A
3	SCS Runoff	1.813	2	724	5,941	------	------	------	CB-20A
4	SCS Runoff	1.482	2	724	4,794	------	------	------	CB-21A
5	SCS Runoff	0.863	2	724	2,966	------	------	------	RF-05
6	SCS Runoff	0.108	2	724	373	------	------	------	TD-01
7	SCS Runoff	1.020	2	730	4,159	------	------	------	CB-16
8	SCS Runoff	0.905	2	728	3,492	------	------	------	CB-17
9	SCS Runoff	0.684	2	724	2,350	------	------	------	RF-04
10	Combine	7.868	2	724	29,631	1, 2, 3,	------	------	Into DET-01
11	Reservoir	2.188	2	750	29,589	4, 5, 6, 10	83.17	12,257	DET-01
12	Combine	3.826	2	734	39,591	7, 8, 9, 11	------	------	Into DET-02
13	SCS Runoff	0.773	2	724	2,449	------	------	------	CB-09
14	SCS Runoff	0.423	2	724	1,299	------	------	------	CB-10
15	SCS Runoff	0.411	2	724	1,261	------	------	------	CB-11
16	SCS Runoff	0.341	2	724	1,049	------	------	------	CB-12
17	SCS Runoff	0.353	2	724	1,074	------	------	------	CB-13
18	SCS Runoff	0.324	2	724	1,001	------	------	------	CB-14
19	SCS Runoff	0.815	2	726	2,819	------	------	------	CB-15
20	SCS Runoff	0.971	2	724	3,339	------	------	------	RF-01
21	SCS Runoff	0.585	2	724	2,010	------	------	------	RF-02
22	SCS Runoff	0.618	2	724	2,123	------	------	------	RF-03
23	Combine	2.301	2	724	7,131	13, 14, 15,	------	------	Comb-1
24	Combine	3.265	2	724	11,293	16, 17, 18, 19, 20,	------	------	Comb-2
25	SCS Runoff	0.471	2	724	1,621	21, 22, ------	------	------	CB-01
26	SCS Runoff	0.438	2	724	1,507	------	------	------	CB-02
27	SCS Runoff	1.346	2	724	4,062	------	------	------	CB-03
28	SCS Runoff	1.474	2	734	7,433	------	------	------	CB-04
29	SCS Runoff	0.763	2	724	2,578	------	------	------	CB-05
30	SCS Runoff	2.030	2	734	8,969	------	------	------	CB-06
31	SCS Runoff	0.646	2	724	2,221	------	------	------	CB-07
32	SCS Runoff	3.298	2	726	11,258	------	------	------	CB-08
33	Combine	3.264	2	724	14,624	25, 26, 27,	------	------	Comb-1
34	Combine	6.126	2	726	25,026	28, 29, 30, 31, 32,	------	------	Comb-2

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
35	Combine	9.281	2	726	39,650	33, 34	------	------	Offsite
36	Reservoir	2.022	2	782	39,559	12	80.82	8,786	DET-02
37	SCS Runoff	0.773	2	724	2,449	------	------	------	CB-09A
38	Combine	6.739	2	724	60,433	23, 24, 36, 37	------	------	Into DET-03
39	Reservoir	2.497	2	788	60,402	38	80.49	9,831	DET-03
40	Combine	10.97	2	726	100,052	35, 39	------	------	Design Point 1

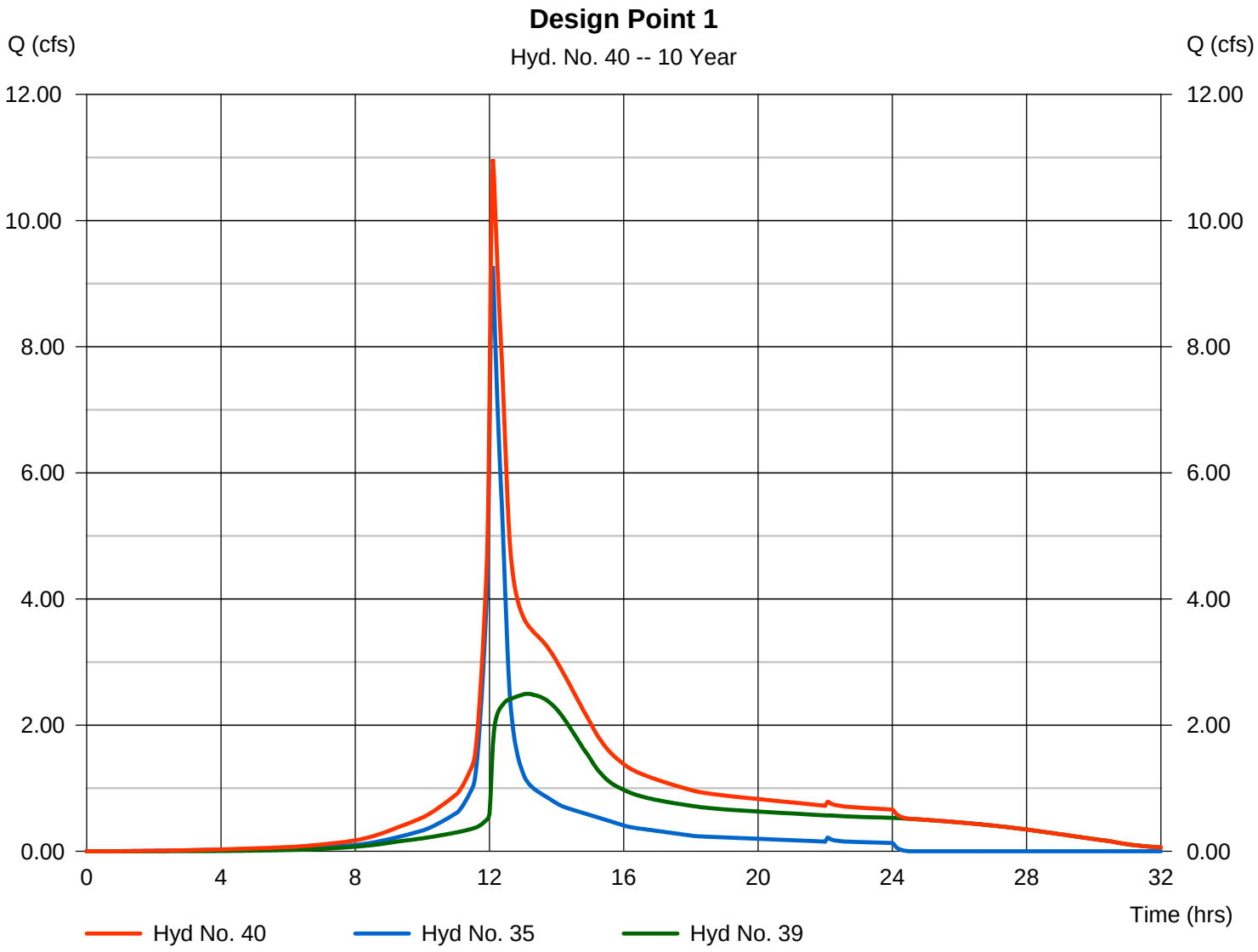
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Thursday, 11 / 10 / 2016

Hyd. No. 40

Design Point 1

Hydrograph type	=	Combine	Peak discharge	=	10.97 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.10 hrs
Time interval	=	2 min	Hyd. volume	=	100,052 cuft
Inflow hyds.	=	35, 39	Contrib. drain. area	=	0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	4.254	2	728	16,345	------	------	------	CB-18A
2	SCS Runoff	0.757	2	724	2,397	------	------	------	CB-19A
3	SCS Runoff	2.081	2	724	6,874	------	------	------	CB-20A
4	SCS Runoff	1.705	2	724	5,564	------	------	------	CB-21A
5	SCS Runoff	0.985	2	724	3,402	------	------	------	RF-05
6	SCS Runoff	0.124	2	724	428	------	------	------	TD-01
7	SCS Runoff	1.254	2	730	5,103	------	------	------	CB-16
8	SCS Runoff	1.074	2	728	4,169	------	------	------	CB-17
9	SCS Runoff	0.780	2	724	2,695	------	------	------	RF-04
10	Combine	9.232	2	724	35,008	1, 2, 3,	------	------	Into DET-01
11	Reservoir	3.243	2	746	34,966	4, 5, 6, 10	83.62	13,998	DET-01
12	Combine	4.803	2	732	46,933	7, 8, 9, 11	------	------	Into DET-02
13	SCS Runoff	0.895	2	724	2,860	------	------	------	CB-09
14	SCS Runoff	0.496	2	724	1,535	------	------	------	CB-10
15	SCS Runoff	0.481	2	724	1,491	------	------	------	CB-11
16	SCS Runoff	0.400	2	724	1,240	------	------	------	CB-12
17	SCS Runoff	0.417	2	724	1,277	------	------	------	CB-13
18	SCS Runoff	0.378	2	724	1,180	------	------	------	CB-14
19	SCS Runoff	0.963	2	726	3,354	------	------	------	CB-15
20	SCS Runoff	1.109	2	724	3,829	------	------	------	RF-01
21	SCS Runoff	0.667	2	724	2,305	------	------	------	RF-02
22	SCS Runoff	0.705	2	724	2,435	------	------	------	RF-03
23	Combine	2.689	2	724	8,403	13, 14, 15,	------	------	Comb-1
24	Combine	3.769	2	724	13,103	16, 17, 18, 19, 20,	------	------	Comb-2
25	SCS Runoff	0.538	2	724	1,859	21, 22, ------	------	------	CB-01
26	SCS Runoff	0.500	2	724	1,729	------	------	------	CB-02
27	SCS Runoff	1.602	2	724	4,865	------	------	------	CB-03
28	SCS Runoff	1.697	2	734	8,627	------	------	------	CB-04
29	SCS Runoff	0.872	2	724	2,965	------	------	------	CB-05
30	SCS Runoff	2.491	2	734	11,006	------	------	------	CB-06
31	SCS Runoff	0.737	2	724	2,547	------	------	------	CB-07
32	SCS Runoff	4.013	2	726	13,715	------	------	------	CB-08
33	Combine	3.804	2	724	17,079	25, 26, 27,	------	------	Comb-1
34	Combine	7.401	2	726	30,232	28, 29, 30, 31, 32,	------	------	Comb-2

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
35	Combine	11.07	2	726	47,311	33, 34	------	------	Offsite
36	Reservoir	3.161	2	758	46,901	12	81.14	9,721	DET-02
37	SCS Runoff	0.895	2	724	2,860	------	------	------	CB-09A
38	Combine	7.803	2	724	71,268	23, 24, 36, 37	------	------	Into DET-03
39	Reservoir	4.008	2	744	71,237	38	80.69	10,399	DET-03
40	Combine	13.27	2	726	118,548	35, 39	------	------	Design Point 1

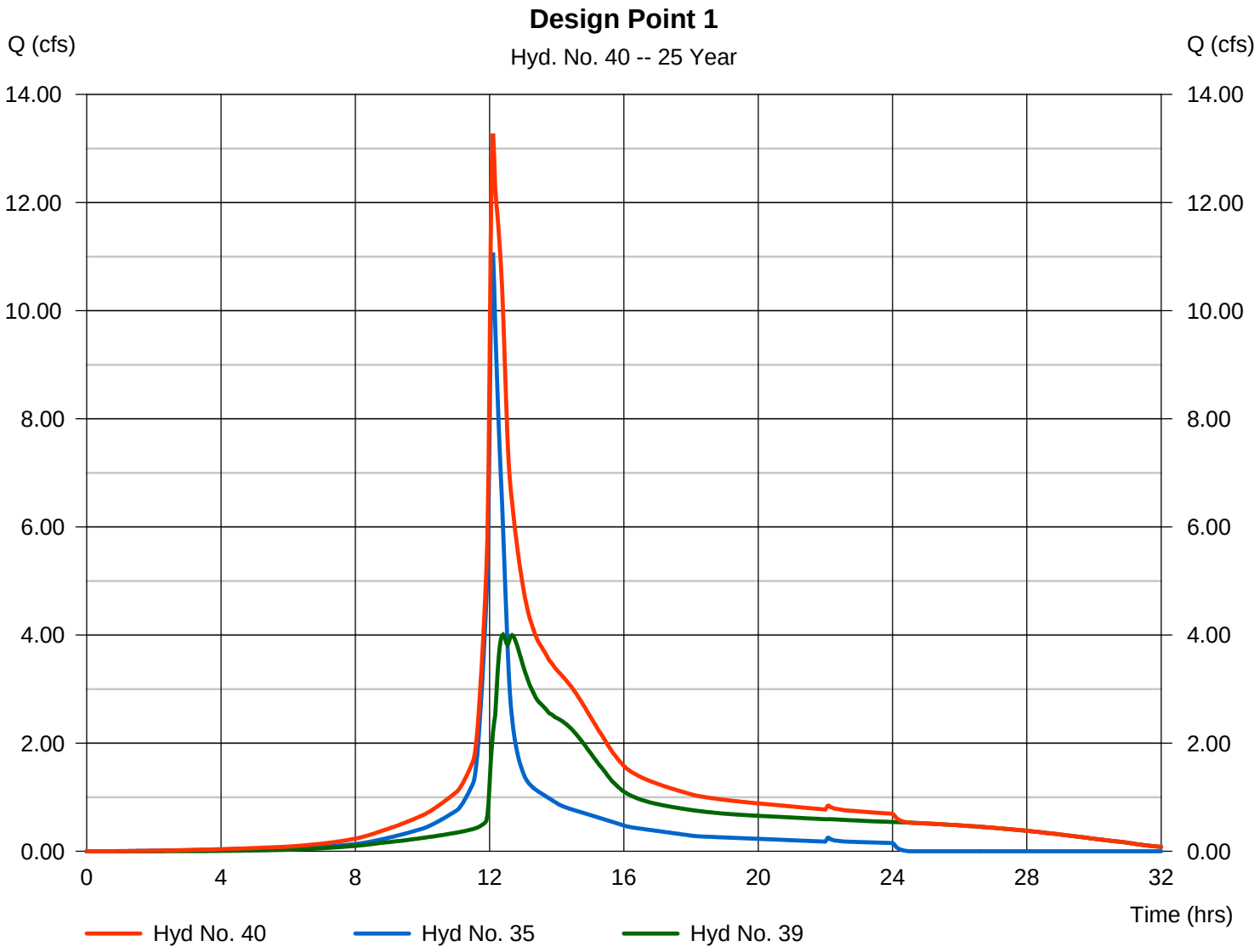
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Thursday, 11 / 10 / 2016

Hyd. No. 40

Design Point 1

Hydrograph type	=	Combine	Peak discharge	=	13.27 cfs
Storm frequency	=	25 yrs	Time to peak	=	12.10 hrs
Time interval	=	2 min	Hyd. volume	=	118,548 cuft
Inflow hyds.	=	35, 39	Contrib. drain. area	=	0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	4.989	2	728	19,235	------	------	------	CB-18A
2	SCS Runoff	0.861	2	724	2,749	------	------	------	CB-19A
3	SCS Runoff	2.347	2	724	7,809	------	------	------	CB-20A
4	SCS Runoff	1.927	2	724	6,335	------	------	------	CB-21A
5	SCS Runoff	1.107	2	724	3,837	------	------	------	RF-05
6	SCS Runoff	0.139	2	724	482	------	------	------	TD-01
7	SCS Runoff	1.492	2	730	6,074	------	------	------	CB-16
8	SCS Runoff	1.243	2	728	4,854	------	------	------	CB-17
9	SCS Runoff	0.877	2	724	3,040	------	------	------	RF-04
10	Combine	10.60	2	724	40,447	1, 2, 3,	------	------	Into DET-01
11	Reservoir	5.537	2	738	40,405	4, 5, 6, 10	83.81	14,753	DET-01
12	Combine	7.922	2	736	54,373	7, 8, 9, 11	------	------	Into DET-02
13	SCS Runoff	1.016	2	724	3,272	------	------	------	CB-09
14	SCS Runoff	0.568	2	724	1,774	------	------	------	CB-10
15	SCS Runoff	0.552	2	724	1,723	------	------	------	CB-11
16	SCS Runoff	0.459	2	724	1,433	------	------	------	CB-12
17	SCS Runoff	0.481	2	724	1,484	------	------	------	CB-13
18	SCS Runoff	0.433	2	724	1,360	------	------	------	CB-14
19	SCS Runoff	1.111	2	726	3,895	------	------	------	CB-15
20	SCS Runoff	1.246	2	724	4,319	------	------	------	RF-01
21	SCS Runoff	0.750	2	724	2,600	------	------	------	RF-02
22	SCS Runoff	0.792	2	724	2,747	------	------	------	RF-03
23	Combine	3.075	2	724	9,685	13, 14, 15,	------	------	Comb-1
24	Combine	4.271	2	724	14,922	16, 17, 18, 19, 20,	------	------	Comb-2
25	SCS Runoff	0.605	2	724	2,097	21, 22, ------	------	------	CB-01
26	SCS Runoff	0.562	2	724	1,950	------	------	------	CB-02
27	SCS Runoff	1.859	2	724	5,679	------	------	------	CB-03
28	SCS Runoff	1.920	2	734	9,823	------	------	------	CB-04
29	SCS Runoff	0.981	2	724	3,352	------	------	------	CB-05
30	SCS Runoff	2.960	2	734	13,099	------	------	------	CB-06
31	SCS Runoff	0.829	2	724	2,873	------	------	------	CB-07
32	SCS Runoff	4.736	2	726	16,230	------	------	------	CB-08
33	Combine	4.345	2	724	19,549	25, 26, 27, 28,	------	------	Comb-1
34	Combine	8.693	2	726	35,553	29, 30, 31, 32,	------	------	Comb-2

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
35	Combine	12.88	2	726	55,103	33, 34	------	------	Offsite
36	Reservoir	6.233	2	746	54,341	12	81.38	10,408	DET-02
37	SCS Runoff	1.016	2	724	3,272	------	------	------	CB-09A
38	Combine	8.868	2	724	82,220	23, 24, 36, 37	------	------	Into DET-03
39	Reservoir	8.029	2	748	82,189	38	80.98	11,196	DET-03
40	Combine	16.94	2	728	137,292	35, 39	------	------	Design Point 1

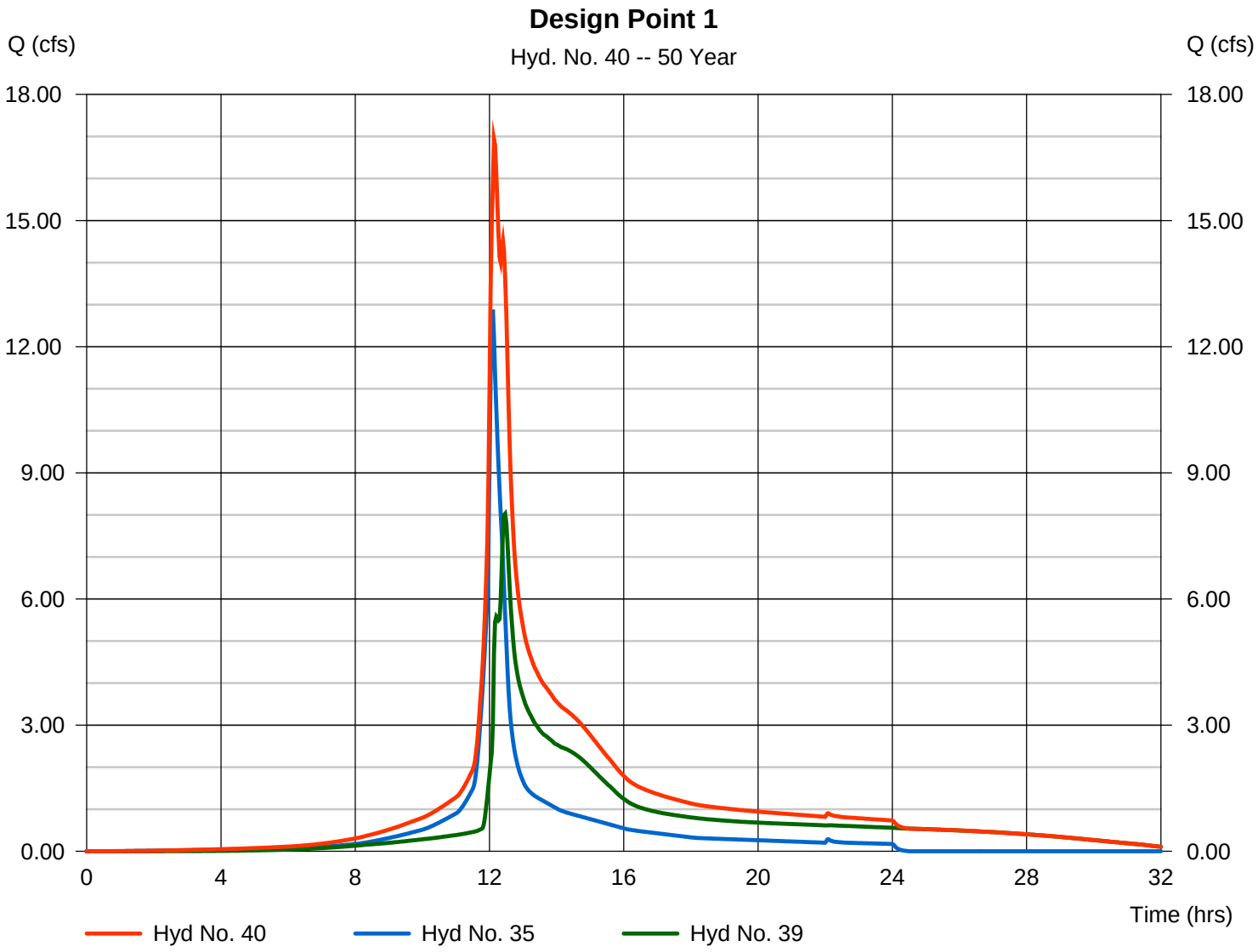
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Thursday, 11 / 10 / 2016

Hyd. No. 40

Design Point 1

Hydrograph type	= Combine	Peak discharge	= 16.94 cfs
Storm frequency	= 50 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 137,292 cuft
Inflow hyds.	= 35, 39	Contrib. drain. area	= 0.000 ac



Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Thursday, 11 / 10 / 2016

Pond No. 1 - DET-01

Pond Data

UG Chambers -Invert elev. = 80.00 ft, Rise x Span = 4.00 x 8.00 ft, Barrel Len = 140.00 ft, No. Barrels = 3, Slope = 0.00%, Headers = Yes

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	80.00	n/a	0	0
0.40	80.40	n/a	1,549	1,549
0.80	80.80	n/a	1,549	3,098
1.20	81.20	n/a	1,549	4,647
1.60	81.60	n/a	1,549	6,196
2.00	82.00	n/a	1,549	7,745
2.40	82.40	n/a	1,549	9,294
2.80	82.80	n/a	1,549	10,843
3.20	83.20	n/a	1,549	12,393
3.60	83.60	n/a	1,549	13,942
4.00	84.00	n/a	1,549	15,491

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 15.00	4.00	8.00	0.00
Span (in)	= 15.00	4.00	8.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 80.00	80.00	82.00	0.00
Length (ft)	= 50.00	0.00	0.00	0.00
Slope (%)	= 1.00	1.00	1.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	Yes	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 5.00	0.00	0.00	0.00
Crest El. (ft)	= 83.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

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 cuft	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	80.00	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.40	1,549	80.40	0.20 ic	0.19 ic	0.00	---	0.00	---	---	---	---	---	0.189
0.80	3,098	80.80	0.31 ic	0.31 ic	0.00	---	0.00	---	---	---	---	---	0.311
1.20	4,647	81.20	0.41 ic	0.40 ic	0.00	---	0.00	---	---	---	---	---	0.401
1.60	6,196	81.60	0.48 ic	0.48 ic	0.00	---	0.00	---	---	---	---	---	0.476
2.00	7,745	82.00	0.56 ic	0.54 ic	0.00	---	0.00	---	---	---	---	---	0.541
2.40	9,294	82.40	1.05 ic	0.58 ic	0.47 ic	---	0.00	---	---	---	---	---	1.054
2.80	10,843	82.80	1.78 ic	0.62 ic	1.15 ic	---	0.00	---	---	---	---	---	1.765
3.20	12,393	83.20	2.22 ic	0.66 ic	1.56 ic	---	0.00	---	---	---	---	---	2.223
3.60	13,942	83.60	3.13 ic	0.69 ic	1.89 ic	---	0.53	---	---	---	---	---	3.107
4.00	15,491	84.00	8.33 oc	0.49 ic	1.95 ic	---	5.89	---	---	---	---	---	8.330

Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Thursday, 11 / 10 / 2016

Pond No. 2 - DET-02

Pond Data

UG Chambers -Invert elev. = 77.80 ft, Rise x Span = 4.00 x 8.00 ft, Barrel Len = 100.00 ft, No. Barrels = 3, Slope = 0.00%, Headers = Yes

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	77.80	n/a	0	0
0.40	78.20	n/a	1,165	1,165
0.80	78.60	n/a	1,165	2,330
1.20	79.00	n/a	1,165	3,495
1.60	79.40	n/a	1,165	4,660
2.00	79.80	n/a	1,165	5,825
2.40	80.20	n/a	1,165	6,990
2.80	80.60	n/a	1,165	8,155
3.20	81.00	n/a	1,165	9,320
3.60	81.40	n/a	1,165	10,485
4.00	81.80	n/a	1,165	11,650

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 15.00	4.00	8.00	0.00
Span (in)	= 15.00	4.00	8.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 77.80	77.80	79.80	0.00
Length (ft)	= 20.00	0.00	0.00	0.00
Slope (%)	= 1.00	1.00	1.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	Yes	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 5.00	0.00	0.00	0.00
Crest El. (ft)	= 81.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

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 cuft	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	77.80	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.40	1,165	78.20	0.20 ic	0.19 ic	0.00	---	0.00	---	---	---	---	---	0.189
0.80	2,330	78.60	0.31 ic	0.31 ic	0.00	---	0.00	---	---	---	---	---	0.311
1.20	3,495	79.00	0.41 ic	0.40 ic	0.00	---	0.00	---	---	---	---	---	0.401
1.60	4,660	79.40	0.48 ic	0.48 ic	0.00	---	0.00	---	---	---	---	---	0.476
2.00	5,825	79.80	0.56 ic	0.54 ic	0.00	---	0.00	---	---	---	---	---	0.541
2.40	6,990	80.20	1.05 ic	0.58 ic	0.47 ic	---	0.00	---	---	---	---	---	1.054
2.80	8,155	80.60	1.78 oc	0.61 ic	1.15 ic	---	0.00	---	---	---	---	---	1.761
3.20	9,320	81.00	2.23 oc	0.65 ic	1.56 ic	---	0.00	---	---	---	---	---	2.214
3.60	10,485	81.40	6.64 oc	0.54 ic	1.89 ic	---	4.21	---	---	---	---	---	6.644
4.00	11,650	81.80	10.35 ic	0.23 ic	0.93 ic	---	9.20 s	---	---	---	---	---	10.35

Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Thursday, 11 / 10 / 2016

Pond No. 3 - DET-03

Pond Data

UG Chambers -Invert elev. = 77.00 ft, Rise x Span = 4.00 x 8.00 ft, Barrel Len = 96.00 ft, No. Barrels = 3, Slope = 0.00%, Headers = Yes

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	77.00	n/a	0	0
0.40	77.40	n/a	1,127	1,127
0.80	77.80	n/a	1,127	2,253
1.20	78.20	n/a	1,127	3,380
1.60	78.60	n/a	1,127	4,506
2.00	79.00	n/a	1,127	5,633
2.40	79.40	n/a	1,127	6,760
2.80	79.80	n/a	1,127	7,886
3.20	80.20	n/a	1,127	9,013
3.60	80.60	n/a	1,127	10,139
4.00	81.00	n/a	1,127	11,266

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 15.00	4.00	8.00	0.00
Span (in)	= 15.00	4.00	8.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 77.00	77.00	79.00	0.00
Length (ft)	= 20.00	0.00	0.00	0.00
Slope (%)	= 1.00	1.00	1.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	Yes	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 5.00	0.00	0.00	0.00
Crest El. (ft)	= 80.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

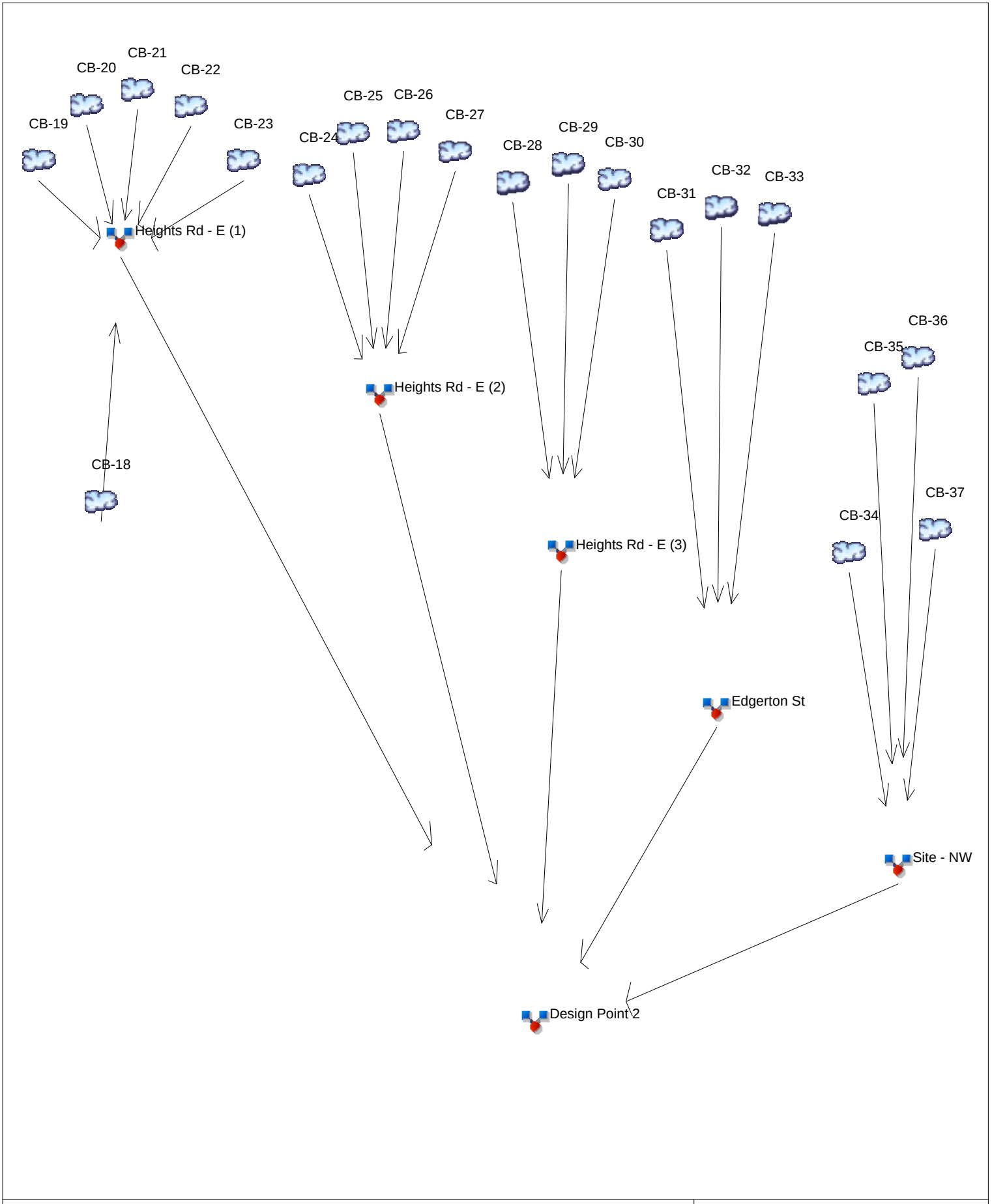
Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	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	77.00	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.40	1,127	77.40	0.20 ic	0.19 ic	0.00	---	0.00	---	---	---	---	---	0.189
0.80	2,253	77.80	0.31 ic	0.31 ic	0.00	---	0.00	---	---	---	---	---	0.311
1.20	3,380	78.20	0.41 ic	0.40 ic	0.00	---	0.00	---	---	---	---	---	0.401
1.60	4,506	78.60	0.48 ic	0.48 ic	0.00	---	0.00	---	---	---	---	---	0.476
2.00	5,633	79.00	0.56 ic	0.54 ic	0.00	---	0.00	---	---	---	---	---	0.541
2.40	6,760	79.40	1.05 ic	0.58 ic	0.47 ic	---	0.00	---	---	---	---	---	1.054
2.80	7,886	79.80	1.78 oc	0.61 ic	1.15 ic	---	0.00	---	---	---	---	---	1.761
3.20	9,013	80.20	2.23 oc	0.65 ic	1.56 ic	---	0.00	---	---	---	---	---	2.214
3.60	10,139	80.60	3.08 oc	0.66 ic	1.89 ic	---	0.53	---	---	---	---	---	3.077
4.00	11,266	81.00	8.35 ic	0.49 ic	1.97 ic	---	5.89	---	---	---	---	---	8.352

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4



Project: Proposed_system 2.gpw	Thursday, 09 / 15 / 2016

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	------	-------	0.392	-------	-------	0.599	0.683	0.768	0.865	CB-18
2	SCS Runoff	------	-------	0.425	-------	-------	0.732	0.858	0.983	1.126	CB-19
3	SCS Runoff	------	-------	1.993	-------	-------	3.239	3.747	4.253	4.828	CB-20
4	SCS Runoff	------	-------	0.562	-------	-------	0.881	1.011	1.141	1.289	CB-21
5	SCS Runoff	------	-------	0.139	-------	-------	0.212	0.242	0.272	0.306	CB-22
6	SCS Runoff	------	-------	0.479	-------	-------	0.731	0.834	0.937	1.055	CB-23
7	SCS Runoff	------	-------	0.805	-------	-------	1.248	1.430	1.610	1.816	CB-24
8	SCS Runoff	------	-------	0.785	-------	-------	1.197	1.367	1.536	1.729	CB-25
9	SCS Runoff	------	-------	0.399	-------	-------	0.608	0.694	0.780	0.878	CB-26
10	SCS Runoff	------	-------	0.513	-------	-------	0.783	0.893	1.004	1.130	CB-27
11	SCS Runoff	------	-------	0.448	-------	-------	0.684	0.780	0.877	0.987	CB-28
12	SCS Runoff	------	-------	0.438	-------	-------	0.782	0.925	1.068	1.231	CB-29
13	SCS Runoff	------	-------	0.717	-------	-------	1.094	1.248	1.403	1.580	CB-30
14	SCS Runoff	------	-------	1.043	-------	-------	1.864	2.205	2.546	2.935	CB-31
15	SCS Runoff	------	-------	0.221	-------	-------	0.438	0.531	0.625	0.733	CB-32
16	SCS Runoff	------	-------	0.204	-------	-------	0.311	0.355	0.399	0.449	CB-33
17	SCS Runoff	------	-------	0.343	-------	-------	0.768	0.956	1.150	1.374	CB-34
18	SCS Runoff	------	-------	2.029	-------	-------	3.734	4.448	5.163	5.979	CB-35
19	SCS Runoff	------	-------	0.300	-------	-------	0.457	0.522	0.587	0.660	CB-36
20	SCS Runoff	------	-------	0.488	-------	-------	0.871	1.030	1.189	1.370	CB-37
21	Combine	1, 2, 3,	-------	3.991	-------	-------	6.393	7.375	8.355	9.470	Heights Rd - E (1)
22	Combine	4, 5, 6, 7, 8, 9,	-------	2.502	-------	-------	3.837	4.384	4.930	5.554	Heights Rd - E (2)
23	Combine	10, 11, 12, 13,	-------	1.401	-------	-------	2.221	2.560	2.899	3.286	Heights Rd - E (3)
24	Combine	14, 15, 16,	-------	1.356	-------	-------	2.439	2.891	3.343	3.860	Edgerton St
25	Combine	17, 18, 19,	-------	3.002	-------	-------	5.558	6.637	7.723	8.967	Site - NW
26	Combine	20, 21, 22, 23, 24, 25	-------	11.77	-------	-------	19.62	22.88	26.15	29.88	Design Point 2

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.392	2	724	1,326	------	------	------	CB-18
2	SCS Runoff	0.425	2	724	1,278	------	------	------	CB-19
3	SCS Runoff	1.993	2	724	6,134	------	------	------	CB-20
4	SCS Runoff	0.562	2	724	1,792	------	------	------	CB-21
5	SCS Runoff	0.139	2	724	470	------	------	------	CB-22
6	SCS Runoff	0.479	2	724	1,618	------	------	------	CB-23
7	SCS Runoff	0.805	2	724	2,607	------	------	------	CB-24
8	SCS Runoff	0.785	2	724	2,651	------	------	------	CB-25
9	SCS Runoff	0.399	2	724	1,346	------	------	------	CB-26
10	SCS Runoff	0.513	2	724	1,733	------	------	------	CB-27
11	SCS Runoff	0.448	2	724	1,513	------	------	------	CB-28
12	SCS Runoff	0.438	2	740	2,289	------	------	------	CB-29
13	SCS Runoff	0.717	2	724	2,422	------	------	------	CB-30
14	SCS Runoff	1.043	2	734	4,612	------	------	------	CB-31
15	SCS Runoff	0.221	2	732	911	------	------	------	CB-32
16	SCS Runoff	0.204	2	724	689	------	------	------	CB-33
17	SCS Runoff	0.343	2	734	1,591	------	------	------	CB-34
18	SCS Runoff	2.029	2	726	6,931	------	------	------	CB-35
19	SCS Runoff	0.300	2	724	1,012	------	------	------	CB-36
20	SCS Runoff	0.488	2	728	1,871	------	------	------	CB-37
21	Combine	3.991	2	724	12,618	1, 2, 3,	------	------	Heights Rd - E (1)
22	Combine	2.502	2	724	8,337	4, 5, 6, 7, 8, 9, 10,	------	------	Heights Rd - E (2)
23	Combine	1.401	2	724	6,224	11, 12, 13,	------	------	Heights Rd - E (3)
24	Combine	1.356	2	732	6,212	14, 15, 16,	------	------	Edgerton St
25	Combine	3.002	2	726	11,406	17, 18, 19, 20,	------	------	Site - NW
26	Combine	11.77	2	724	44,797	21, 22, 23, 24, 25	------	------	Design Point 2

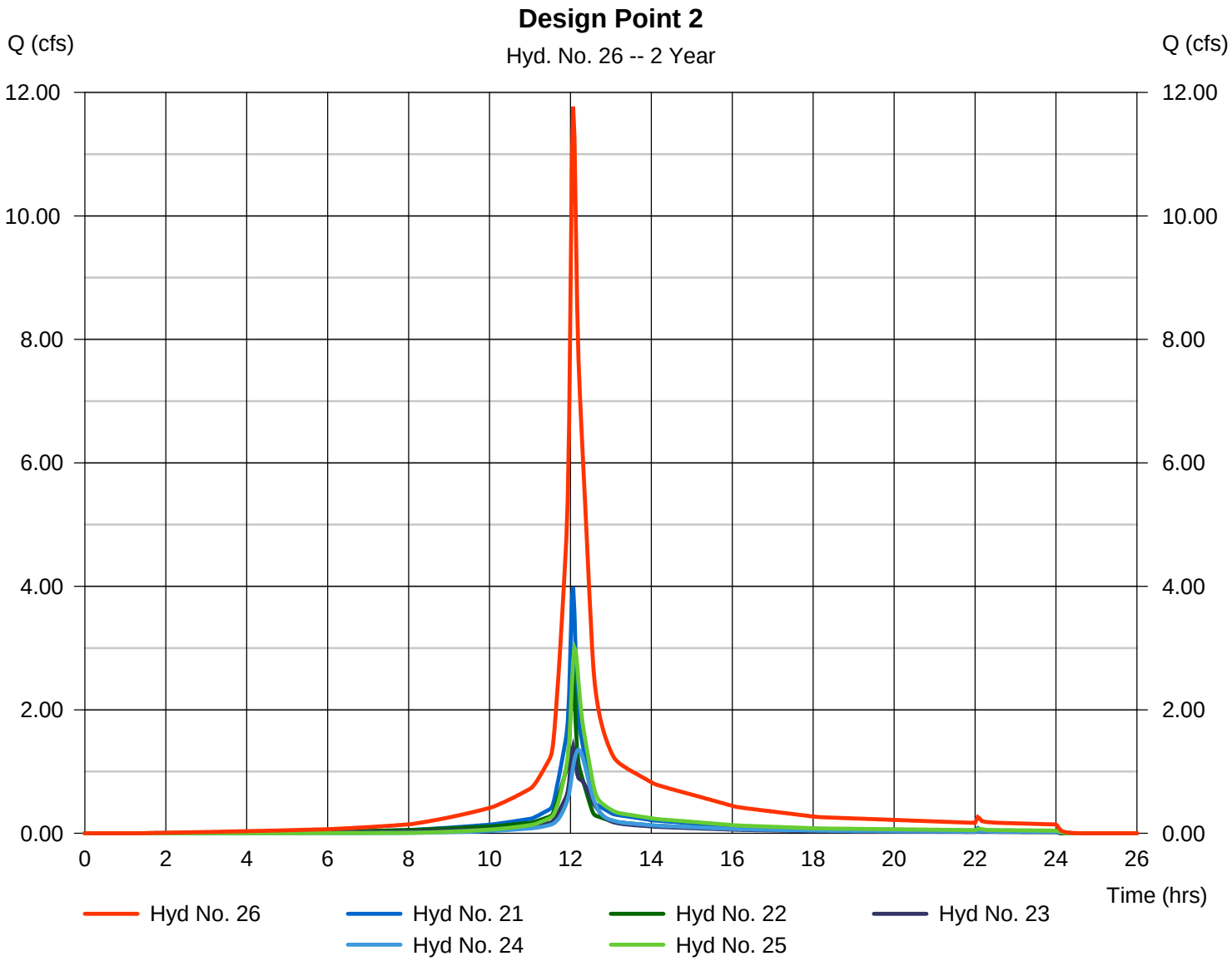
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Thursday, 09 / 15 / 2016

Hyd. No. 26

Design Point 2

Hydrograph type	= Combine	Peak discharge	= 11.77 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 44,797 cuft
Inflow hyds.	= 21, 22, 23, 24, 25	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.599	2	724	2,059	------	------	------	CB-18
2	SCS Runoff	0.732	2	724	2,247	------	------	------	CB-19
3	SCS Runoff	3.239	2	724	10,256	------	------	------	CB-20
4	SCS Runoff	0.881	2	724	2,888	------	------	------	CB-21
5	SCS Runoff	0.212	2	724	729	------	------	------	CB-22
6	SCS Runoff	0.731	2	724	2,512	------	------	------	CB-23
7	SCS Runoff	1.248	2	724	4,149	------	------	------	CB-24
8	SCS Runoff	1.197	2	724	4,117	------	------	------	CB-25
9	SCS Runoff	0.608	2	724	2,091	------	------	------	CB-26
10	SCS Runoff	0.783	2	724	2,691	------	------	------	CB-27
11	SCS Runoff	0.684	2	724	2,350	------	------	------	CB-28
12	SCS Runoff	0.782	2	740	4,128	------	------	------	CB-29
13	SCS Runoff	1.094	2	724	3,761	------	------	------	CB-30
14	SCS Runoff	1.864	2	732	8,319	------	------	------	CB-31
15	SCS Runoff	0.438	2	730	1,782	------	------	------	CB-32
16	SCS Runoff	0.311	2	724	1,070	------	------	------	CB-33
17	SCS Runoff	0.768	2	734	3,407	------	------	------	CB-34
18	SCS Runoff	3.734	2	726	12,833	------	------	------	CB-35
19	SCS Runoff	0.457	2	724	1,572	------	------	------	CB-36
20	SCS Runoff	0.871	2	728	3,374	------	------	------	CB-37
21	Combine	6.393	2	724	20,692	1, 2, 3,	------	------	Heights Rd - E (1)
22	Combine	3.837	2	724	13,048	4, 5, 6, 7, 8, 9, 10,	------	------	Heights Rd - E (2)
23	Combine	2.221	2	724	10,239	11, 12, 13,	------	------	Heights Rd - E (3)
24	Combine	2.439	2	732	11,170	14, 15, 16,	------	------	Edgerton St
25	Combine	5.558	2	726	21,187	17, 18, 19, 20,	------	------	Site - NW
26	Combine	19.62	2	724	76,337	21, 22, 23, 24, 25	------	------	Design Point 2

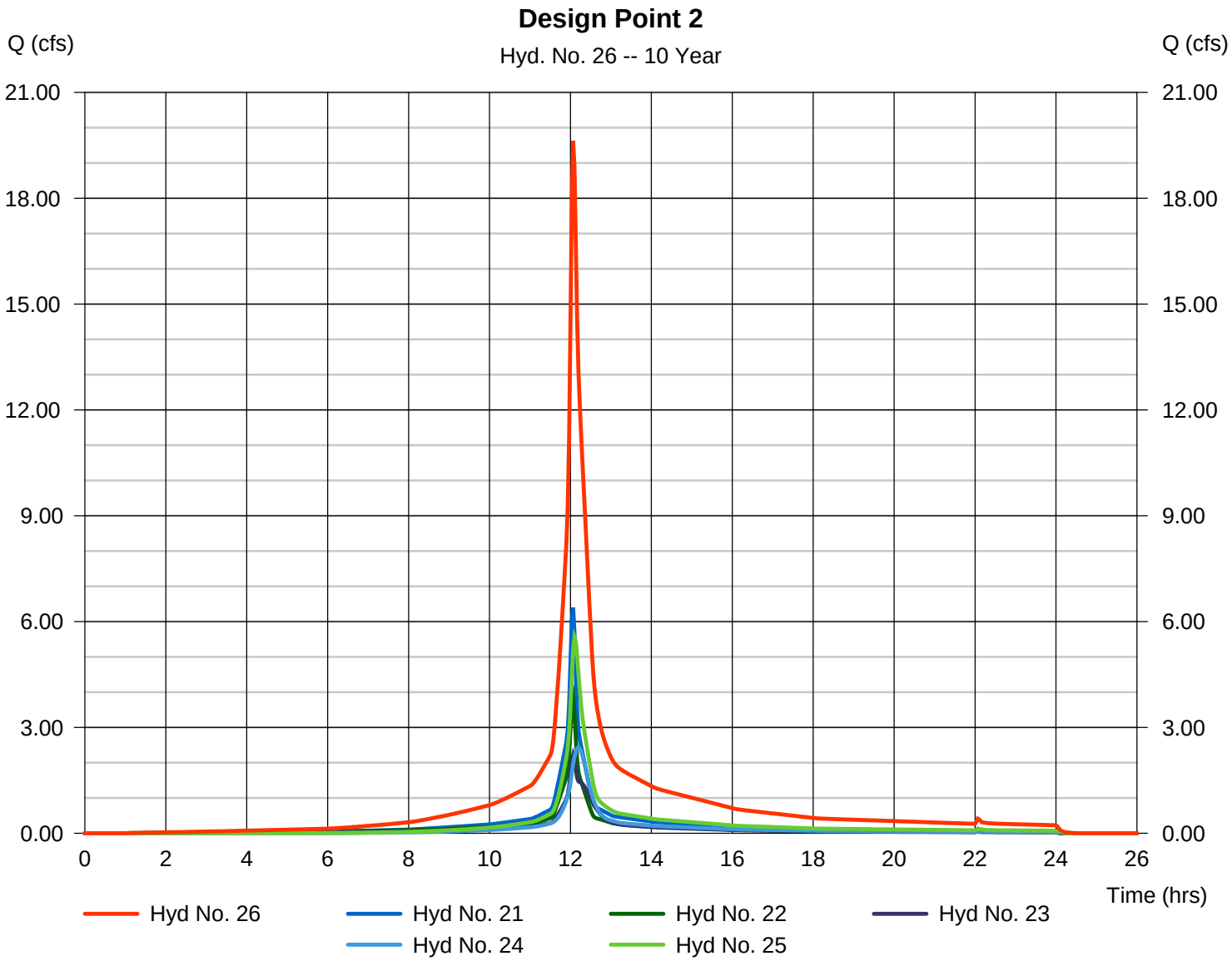
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Thursday, 09 / 15 / 2016

Hyd. No. 26

Design Point 2

Hydrograph type	= Combine	Peak discharge	= 19.62 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 76,337 cuft
Inflow hyds.	= 21, 22, 23, 24, 25	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.683	2	724	2,361	------	------	------	CB-18
2	SCS Runoff	0.858	2	724	2,657	------	------	------	CB-19
3	SCS Runoff	3.747	2	724	11,976	------	------	------	CB-20
4	SCS Runoff	1.011	2	724	3,341	------	------	------	CB-21
5	SCS Runoff	0.242	2	724	836	------	------	------	CB-22
6	SCS Runoff	0.834	2	724	2,881	------	------	------	CB-23
7	SCS Runoff	1.430	2	724	4,787	------	------	------	CB-24
8	SCS Runoff	1.367	2	724	4,721	------	------	------	CB-25
9	SCS Runoff	0.694	2	724	2,398	------	------	------	CB-26
10	SCS Runoff	0.893	2	724	3,086	------	------	------	CB-27
11	SCS Runoff	0.780	2	724	2,695	------	------	------	CB-28
12	SCS Runoff	0.925	2	740	4,911	------	------	------	CB-29
13	SCS Runoff	1.248	2	724	4,313	------	------	------	CB-30
14	SCS Runoff	2.205	2	732	9,898	------	------	------	CB-31
15	SCS Runoff	0.531	2	730	2,163	------	------	------	CB-32
16	SCS Runoff	0.355	2	724	1,227	------	------	------	CB-33
17	SCS Runoff	0.956	2	734	4,229	------	------	------	CB-34
18	SCS Runoff	4.448	2	726	15,369	------	------	------	CB-35
19	SCS Runoff	0.522	2	724	1,803	------	------	------	CB-36
20	SCS Runoff	1.030	2	728	4,015	------	------	------	CB-37
21	Combine	7.375	2	724	24,052	1, 2, 3,	------	------	Heights Rd - E (1)
22	Combine	4.384	2	724	14,992	4, 5, 6, 7, 8, 9, 10,	------	------	Heights Rd - E (2)
23	Combine	2.560	2	724	11,919	11, 12, 13,	------	------	Heights Rd - E (3)
24	Combine	2.891	2	732	13,287	14, 15, 16,	------	------	Edgerton St
25	Combine	6.637	2	726	25,415	17, 18, 19, 20,	------	------	Site - NW
26	Combine	22.88	2	724	89,665	21, 22, 23, 24, 25	------	------	Design Point 2

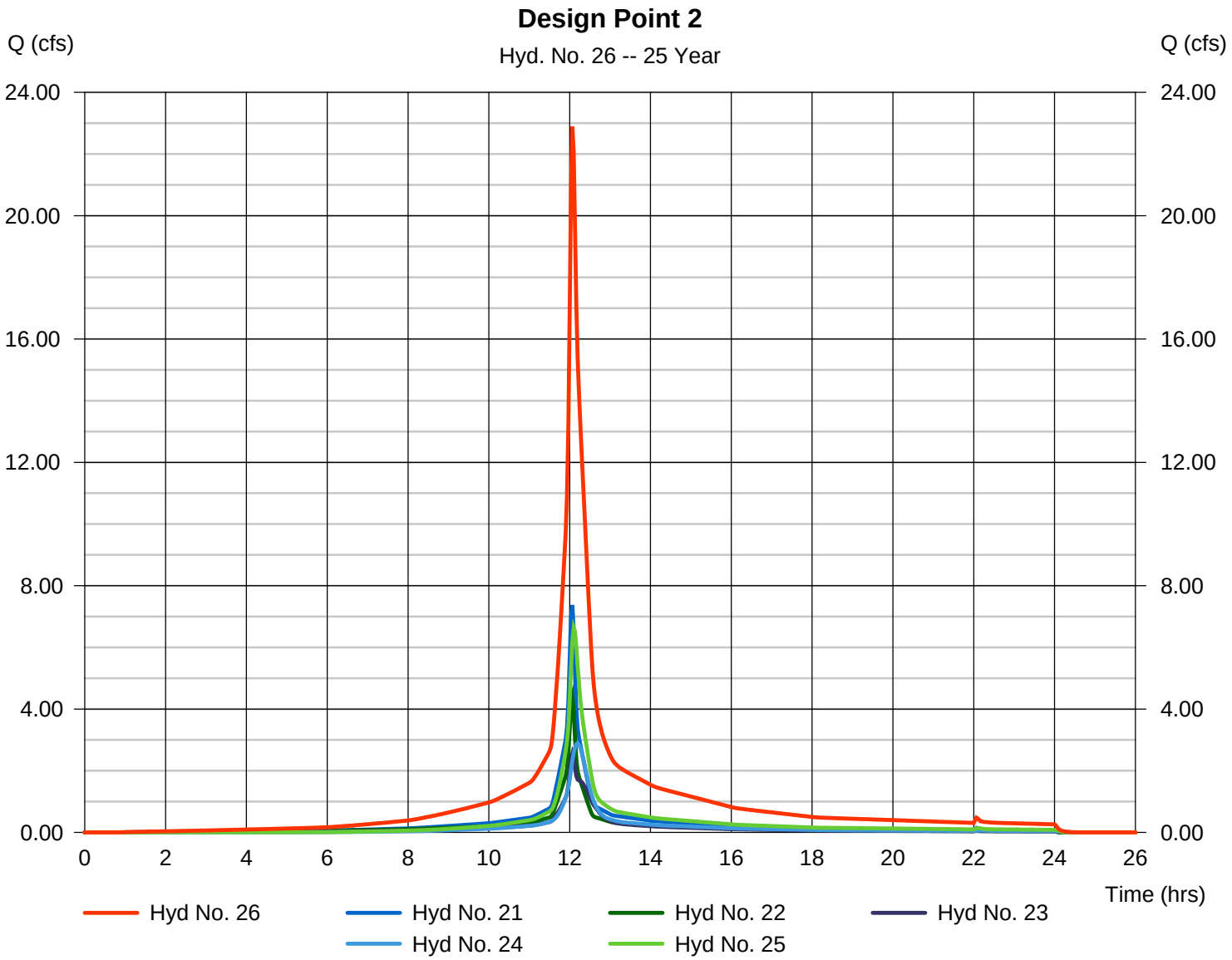
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Thursday, 09 / 15 / 2016

Hyd. No. 26

Design Point 2

Hydrograph type	= Combine	Peak discharge	= 22.88 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 89,665 cuft
Inflow hyds.	= 21, 22, 23, 24, 25	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.768	2	724	2,663	------	------	------	CB-18
2	SCS Runoff	0.983	2	724	3,070	------	------	------	CB-19
3	SCS Runoff	4.253	2	724	13,702	------	------	------	CB-20
4	SCS Runoff	1.141	2	724	3,796	------	------	------	CB-21
5	SCS Runoff	0.272	2	724	944	------	------	------	CB-22
6	SCS Runoff	0.937	2	724	3,250	------	------	------	CB-23
7	SCS Runoff	1.610	2	724	5,425	------	------	------	CB-24
8	SCS Runoff	1.536	2	724	5,326	------	------	------	CB-25
9	SCS Runoff	0.780	2	724	2,705	------	------	------	CB-26
10	SCS Runoff	1.004	2	724	3,481	------	------	------	CB-27
11	SCS Runoff	0.877	2	724	3,040	------	------	------	CB-28
12	SCS Runoff	1.068	2	740	5,704	------	------	------	CB-29
13	SCS Runoff	1.403	2	724	4,865	------	------	------	CB-30
14	SCS Runoff	2.546	2	732	11,495	------	------	------	CB-31
15	SCS Runoff	0.625	2	730	2,552	------	------	------	CB-32
16	SCS Runoff	0.399	2	724	1,384	------	------	------	CB-33
17	SCS Runoff	1.150	2	734	5,079	------	------	------	CB-34
18	SCS Runoff	5.163	2	726	17,941	------	------	------	CB-35
19	SCS Runoff	0.587	2	724	2,034	------	------	------	CB-36
20	SCS Runoff	1.189	2	728	4,663	------	------	------	CB-37
21	Combine	8.355	2	724	27,424	1, 2, 3, 4, 5, 6,	------	------	Heights Rd - E (1)
22	Combine	4.930	2	724	16,936	7, 8, 9, 10,	------	------	Heights Rd - E (2)
23	Combine	2.899	2	724	13,609	11, 12, 13,	------	------	Heights Rd - E (3)
24	Combine	3.343	2	732	15,431	14, 15, 16,	------	------	Edgerton St
25	Combine	7.723	2	726	29,716	17, 18, 19, 20,	------	------	Site - NW
26	Combine	26.15	2	724	103,116	21, 22, 23, 24, 25	------	------	Design Point 2

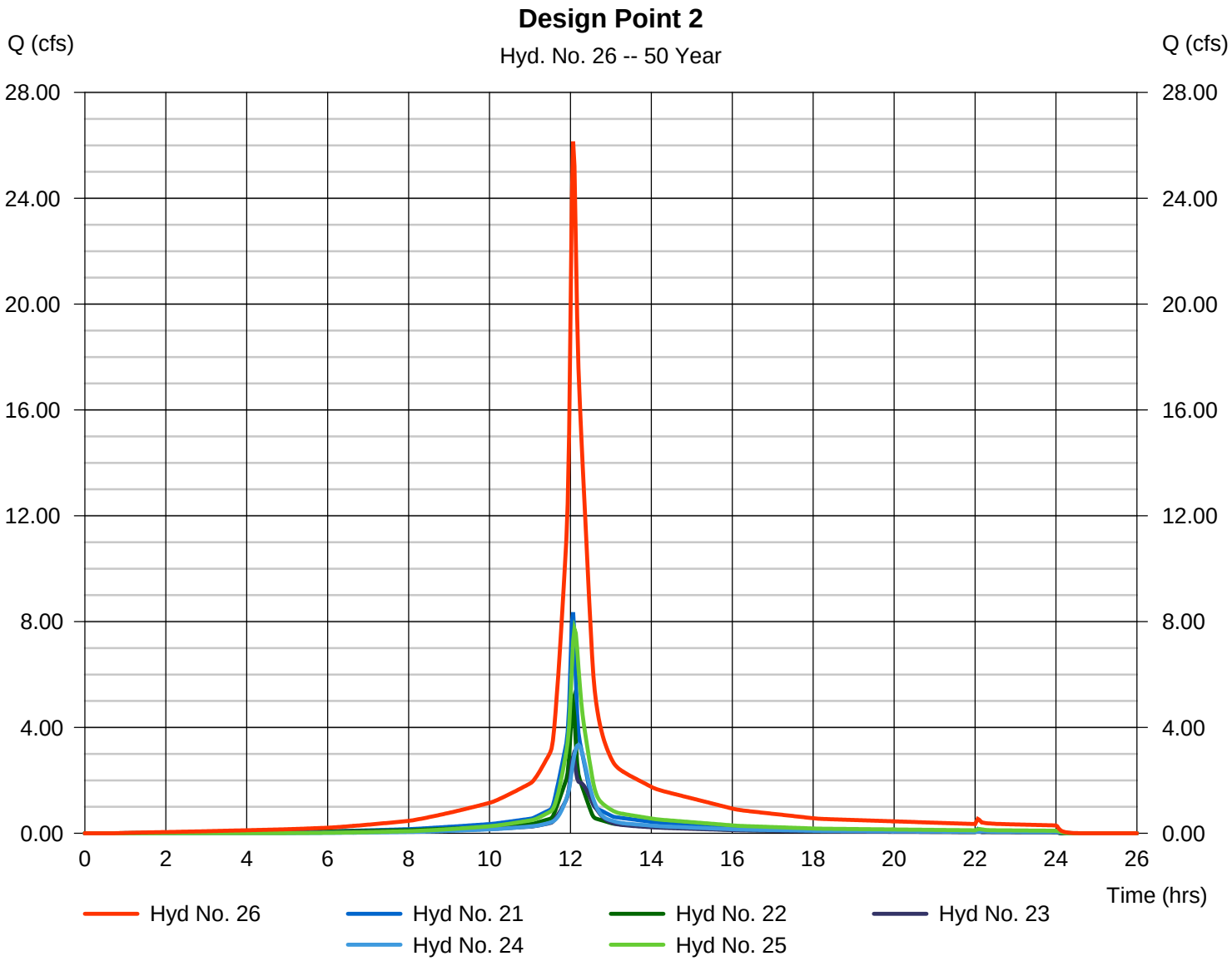
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Thursday, 09 / 15 / 2016

Hyd. No. 26

Design Point 2

Hydrograph type	= Combine	Peak discharge	= 26.15 cfs
Storm frequency	= 50 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 103,116 cuft
Inflow hyds.	= 21, 22, 23, 24, 25	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.865	2	724	3,008	------	------	------	CB-18
2	SCS Runoff	1.126	2	724	3,545	------	------	------	CB-19
3	SCS Runoff	4.828	2	724	15,681	------	------	------	CB-20
4	SCS Runoff	1.289	2	724	4,316	------	------	------	CB-21
5	SCS Runoff	0.306	2	724	1,066	------	------	------	CB-22
6	SCS Runoff	1.055	2	724	3,672	------	------	------	CB-23
7	SCS Runoff	1.816	2	724	6,155	------	------	------	CB-24
8	SCS Runoff	1.729	2	724	6,017	------	------	------	CB-25
9	SCS Runoff	0.878	2	724	3,056	------	------	------	CB-26
10	SCS Runoff	1.130	2	724	3,932	------	------	------	CB-27
11	SCS Runoff	0.987	2	724	3,435	------	------	------	CB-28
12	SCS Runoff	1.231	2	740	6,618	------	------	------	CB-29
13	SCS Runoff	1.580	2	724	5,496	------	------	------	CB-30
14	SCS Runoff	2.935	2	732	13,337	------	------	------	CB-31
15	SCS Runoff	0.733	2	730	3,005	------	------	------	CB-32
16	SCS Runoff	0.449	2	724	1,563	------	------	------	CB-33
17	SCS Runoff	1.374	2	734	6,077	------	------	------	CB-34
18	SCS Runoff	5.979	2	726	20,916	------	------	------	CB-35
19	SCS Runoff	0.660	2	724	2,298	------	------	------	CB-36
20	SCS Runoff	1.370	2	728	5,410	------	------	------	CB-37
21	Combine	9.470	2	724	31,288	1, 2, 3, 4, 5, 6,	------	------	Heights Rd - E (1)
22	Combine	5.554	2	724	19,159	7, 8, 9, 10,	------	------	Heights Rd - E (2)
23	Combine	3.286	2	724	15,548	11, 12, 13,	------	------	Heights Rd - E (3)
24	Combine	3.860	2	732	17,905	14, 15, 16,	------	------	Edgerton St
25	Combine	8.967	2	726	34,700	17, 18, 19, 20,	------	------	Site - NW
26	Combine	29.88	2	724	118,602	21, 22, 23, 24, 25	------	------	Design Point 2

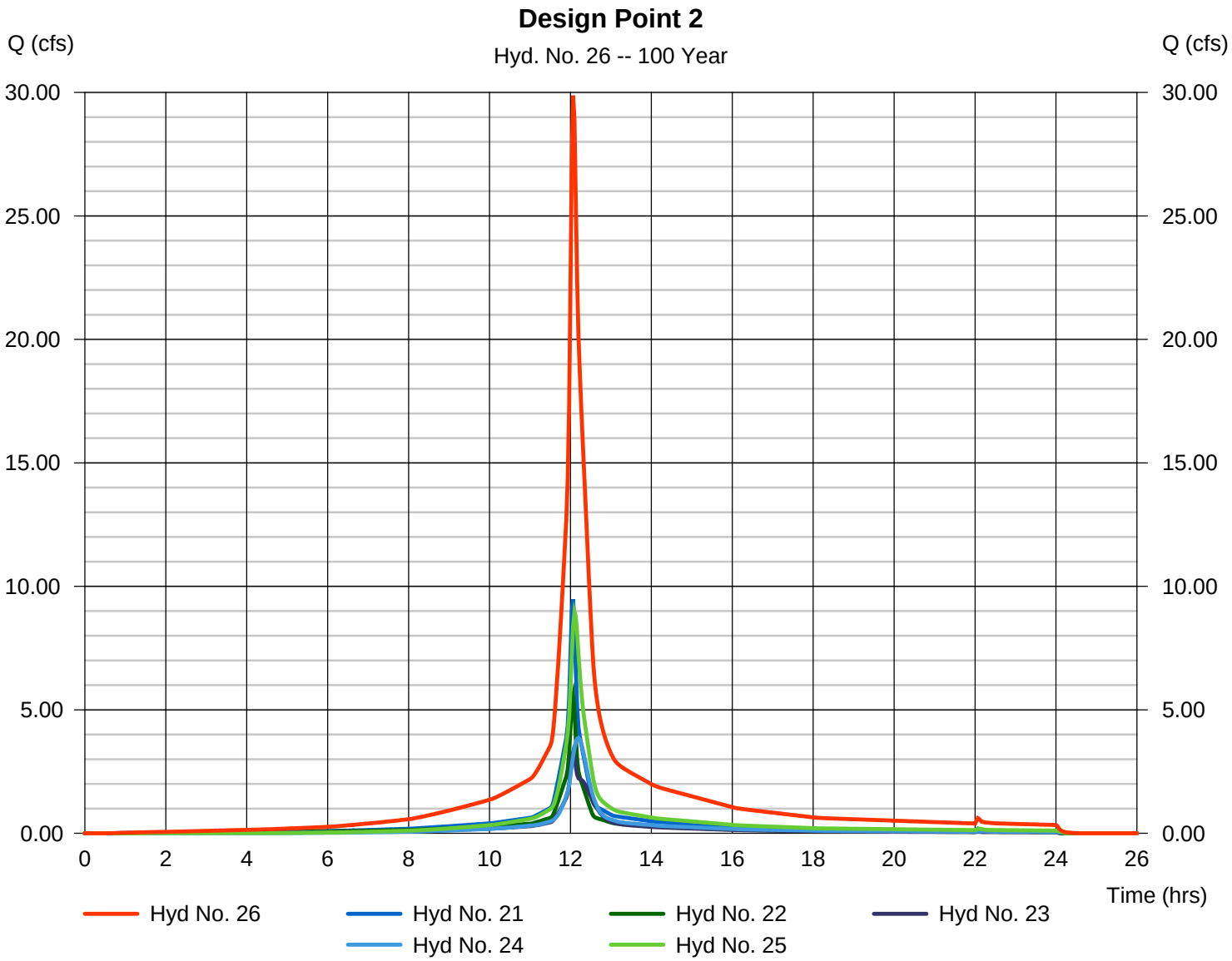
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Thursday, 09 / 15 / 2016

Hyd. No. 26

Design Point 2

Hydrograph type	= Combine	Peak discharge	= 29.88 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 118,602 cuft
Inflow hyds.	= 21, 22, 23, 24, 25	Contrib. drain. area	= 0.000 ac



Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Noroton Heights Shopping Center**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Water Quality Flow**
Prepared By: **JCB** Date: **September 15, 2016**

Required Water Quality Volume (WQv) - WQS 1

Total Area in acres (A)	=	2.369
Impervious Area in acres	=	1.396
Percent of Impervious Area (I)	=	59
Volumetric Runoff Coefficient (R)		

R = 0.05+0.009(I) = 0.580

WQv = (1")(R)(A) / 12 = **0.1146 ac*ft**
= **4991 cf**

Required Water Quality Flow (WQf)

WQv (Ac*ft)	=	0.1146
Drainage Area (Ac)	=	2.369

Q= WQv*12 / DA = **0.580 in**

Runoff Depth in inches (Q)	=	**0.580**	**in**
Design Precipitation in inches (P)	=	**1**	**in**

CN=1000/[10+5*P+10Q-10*(Q²+1.25QP)^1/2] = **95 CN**

From table 4-1 in chapter 4, TR-55

I_a = **0.105 in**
I_a / P = **0.105**

From Exhibit 4-11 in chapter 4, TR-55

q_u = **650 csm/in**

Unit peak discharge in csm/in (q_u)	=	**650**
Area in square miles (A)	=	**0.004**
Runoff Depth in inches (Q)	=	**0.580**

WQF=q_u*A*Q = **1.396 cfs**

Calculated in accordence with the 2004 Connecticut Stormwater Quality Manual Sections 7.4.1 and 7.4.2

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Project Name: **Noroton Heights Shopping Center**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Water Quality Flow**
Prepared By: **JCB** Date: **September 15, 2016**

Required Water Quality Volume (WQv) - WQS 2

Total Area in acres (A)	=	0.870
Impervious Area in acres	=	0.422
Percent of Impervious Area (I)	=	49
Volumetric Runoff Coefficient (R)		

R = 0.05+0.009(I) = 0.487

WQv = (1")(R)(A) / 12 = **0.0353 ac*ft**
= **1537 cf**

Required Water Quality Flow (WQf)

WQv (Ac*ft)	=	0.0353
Drainage Area (Ac)	=	0.870

Q= WQv*12 / DA = **0.487 in**

Runoff Depth in inches (Q)	=	**0.487**	**in**
Design Precipitation in inches (P)	=	**1**	**in**

CN=1000/[10+5*P+10Q-10*(Q²+1.25QP)^1/2] = **94 CN**

From table 4-1 in chapter 4, TR-55

I_a = **0.128 in**
I_a / P = **0.128**

From Exhibit 4-11 in chapter 4, TR-55

q_u = **560 csm/in**

Unit peak discharge in csm/in (q_u)	=	**700**
Area in square miles (A)	=	**0.001**
Runoff Depth in inches (Q)	=	**0.487**

WQF=q_u*A*Q = **0.463 cfs**

Calculated in accordence with the 2004 Connecticut Stormwater Quality Manual Sections 7.4.1 and 7.4.2

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Project Name: **Noroton Heights Shopping Center**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Water Quality Flow**
Prepared By: **JCB** Date: **September 15, 2016**

Required Water Quality Volume (WQv) - WQS 3

Total Area in acres (A)	=	1.394
Impervious Area in acres	=	1.172
Percent of Impervious Area (I)	=	84
Volumetric Runoff Coefficient (R)		

R = 0.05+0.009(I) = 0.807

WQv = (1")(R)(A) / 12 = **0.0937 ac*ft**
= **4082 cf**

Required Water Quality Flow (WQf)

WQv (Ac*ft)	=	0.0937
Drainage Area (Ac)	=	1.394

Q= WQv*12 / DA = **0.807 in**

Runoff Depth in inches (Q)	=	**0.807**	**in**
Design Precipitation in inches (P)	=	**1**	**in**

CN=1000/[10+5*P+10Q-10*(Q²+1.25QP)^1/2] = **98 CN**

From table 4-1 in chapter 4, TR-55

I_a = **0.041 in**
I_a / P = **0.041**

From Exhibit 4-11 in chapter 4, TR-55

q_u = **650 csm/in**

Unit peak discharge in csm/in (q_u)	=	**900**
Area in square miles (A)	=	**0.002**
Runoff Depth in inches (Q)	=	**0.807**

WQF=q_u*A*Q = **1.581 cfs**

Calculated in accordence with the 2004 Connecticut Stormwater Quality Manual Sections 7.4.1 and 7.4.2

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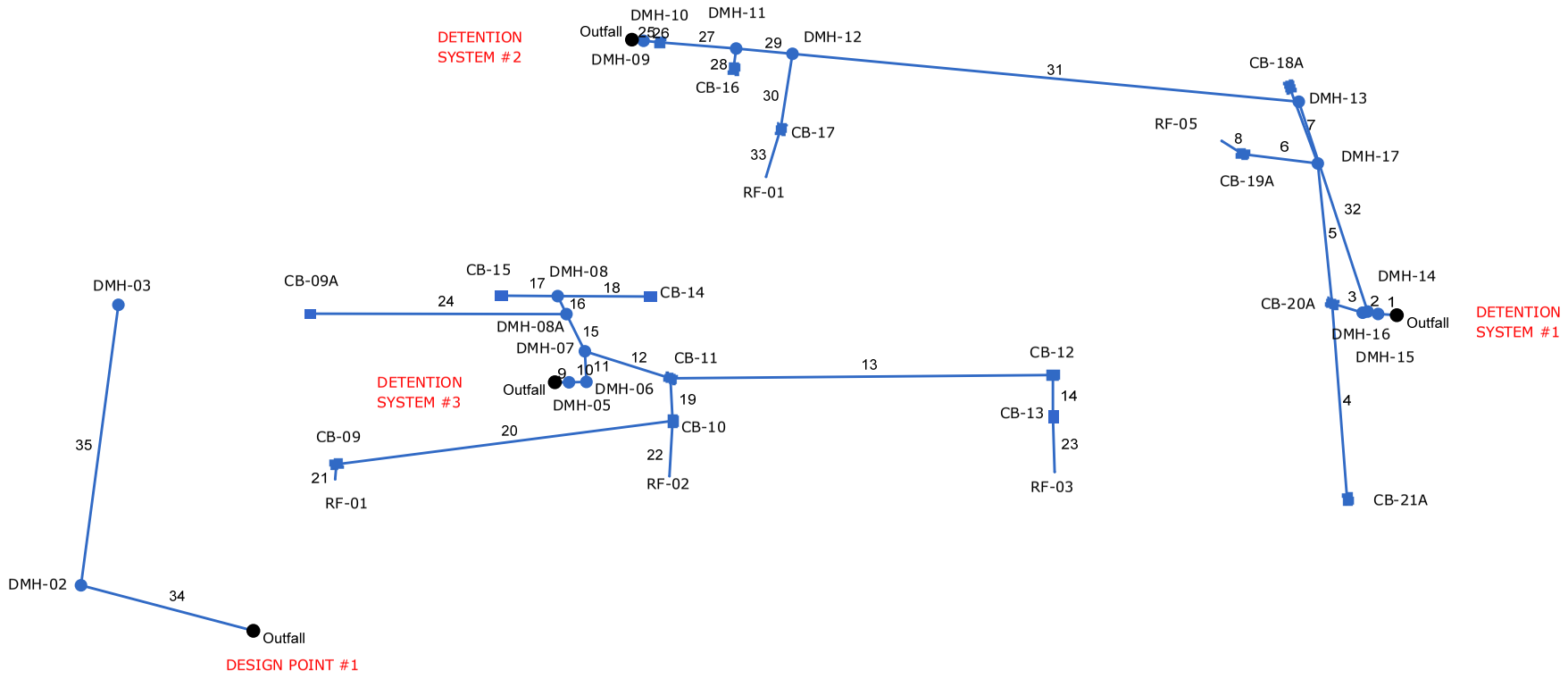
APPENDIX E

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

ONSITE DRAINAGE PLAN



Project File: P0695-proposed storm_jcb.stm	Number of lines: 35	Date: 9/16/2016

Storm Sewers v10.40

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	7.437	0.00	2.34	0.00	0.00	1.60	0.0	12.4	5.1	8.14	0.00	6.82	15	0.00	80.00	80.00	81.12	81.25	87.00	87.00	Pipe - (66)
2	1	6.136	0.00	2.34	0.00	0.00	1.60	0.0	12.4	5.1	8.14	0.00	6.63	15	0.00	80.00	80.00	81.35	81.44	87.00	86.90	Pipe - (65)
3	2	12.785	0.40	2.34	0.84	0.34	1.60	5.0	12.4	5.1	8.15	22.31	6.83	15	10.17	80.00	81.30	81.61	82.42	86.90	86.70	Pipe - (63)
4	3	78.207	0.33	0.33	0.81	0.27	0.27	5.0	5.0	6.7	1.79	7.26	3.08	12	3.54	81.30	84.07	82.42	84.64	86.70	87.60	Pipe - (39)
5	3	56.092	0.00	1.61	0.00	0.00	0.99	0.0	12.1	5.1	5.10	6.60	4.85	15	0.89	81.30	81.80	82.42	82.72	86.70	86.30	Pipe - (02)
6	5	30.081	0.15	0.40	0.76	0.11	0.34	5.0	5.1	6.7	2.26	6.67	3.62	12	2.99	81.80	82.70	82.72	83.34	86.30	86.20	Pipe - (08)
7	5	32.343	1.21	1.21	0.54	0.65	0.65	12.0	12.0	5.2	3.37	4.80	4.79	12	1.55	81.80	82.30	82.72	83.09	86.30	85.80	Pipe - (10)
8	6	10.000	0.25	0.25	0.90	0.23	0.23	5.0	5.0	6.7	1.51	4.73	3.24	12	1.50	82.70	82.85	83.34	83.37	86.20	86.50	
9	End	5.613	0.00	1.55	0.00	0.00	1.17	0.0	9.9	5.5	9.66	0.00	7.87	15	0.00	77.00	77.00	78.24	78.35	84.40	84.40	Pipe - (31)
10	9	6.906	0.00	1.55	0.00	0.00	1.17	0.0	9.9	5.5	9.66	0.00	7.87	15	0.00	77.00	77.00	78.49	78.62	84.40	84.40	Pipe - (30)
11	10	12.255	0.00	1.55	0.00	0.00	1.17	0.0	9.9	5.5	9.67	12.64	7.88	15	3.26	77.00	77.40	79.59	79.82	84.40	84.40	Pipe - (29)
12	11	35.797	0.10	1.07	0.69	0.07	0.86	5.0	6.8	6.2	5.37	11.69	4.38	15	2.79	77.40	78.40	80.78	81.00	84.40	84.90	Pipe - (28)
13	12	152.265	0.08	0.31	0.69	0.06	0.24	5.0	5.5	6.6	1.56	6.56	2.85	12	2.89	78.40	82.80	81.42	83.33	84.90	86.50	Pipe - (27)
14	13	16.634	0.09	0.23	0.64	0.06	0.18	5.0	5.3	6.6	1.21	4.23	3.13	12	1.20	82.80	83.00	83.33	83.46	86.50	86.50	Pipe - (26)
15	11	16.500	0.00	0.48	0.00	0.00	0.31	0.0	9.8	5.6	4.88	7.70	3.98	15	1.21	77.40	77.60	80.78	80.86	84.40	84.65	Pipe - (32)
16	15	8.000	0.00	0.30	0.00	0.00	0.17	0.0	9.8	5.6	4.11	11.33	3.35	15	2.62	77.60	77.81	81.09	81.12	84.65	84.90	Pipe - (32)(2)
17	16	22.698	0.22	0.22	0.51	0.11	0.11	9.3	9.3	5.7	0.64	5.12	2.22	12	1.76	80.80	81.20	81.29	81.53	84.90	84.70	Pipe - (15)
18	16	36.783	0.08	0.08	0.72	0.06	0.06	5.0	5.0	6.7	0.39	4.02	1.71	12	1.09	80.80	81.20	81.29	81.46	84.90	84.70	Pipe - (33)
19	12	17.014	0.10	0.66	0.69	0.07	0.56	5.0	6.6	6.3	3.48	4.18	4.43	12	1.18	78.40	78.60	81.42	81.56	84.90	84.90	Pipe - (34)
20	19	134.950	0.18	0.45	0.78	0.14	0.38	5.9	5.9	6.4	2.46	4.70	3.13	12	1.48	78.60	80.60	82.22	82.77	84.90	84.10	Pipe - (35)
21	20	6.000	0.27	0.27	0.90	0.24	0.24	5.0	5.0	6.7	1.61	4.73	2.05	12	1.50	80.60	80.69	82.99	83.00	84.10	84.50	
22	19	22.000	0.12	0.12	0.90	0.11	0.11	5.0	5.0	6.7	0.71	4.73	0.90	12	1.50	78.60	78.93	82.22	82.23	84.90	85.00	
23	14	22.000	0.14	0.14	0.90	0.13	0.13	5.0	5.0	6.7	0.84	4.73	2.70	12	1.50	83.00	83.33	83.46	83.71	86.50	86.60	
24	15	102.000	0.18	0.18	0.78	0.14	0.14	5.0	5.0	6.7	0.94	5.76	1.20	12	2.23	77.63	79.90	81.09	81.15	84.65	84.20	Pipe - (17)

Project File: P0695-proposed storm_jcb.stm | Number of lines: 35 | Run Date: 11/10/2016

NOTES:Intensity = 101.98 / (Inlet time + 15.80) ^ 0.90; Return period =Yrs. 25 ; c = cir e = ellip b = box

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)	
25	End	4.700	0.00	0.90	0.00	0.00	0.54	0.0	15.1	4.7	5.79	0.00	4.72	15	0.00	77.80	77.80	82.58	82.61	86.20	86.20	Pipe - (24)
26	25	6.572	0.00	0.90	0.00	0.00	0.54	0.0	15.1	4.7	5.79	0.00	4.72	15	0.00	77.80	77.80	82.66	82.71	86.20	86.20	Pipe - (23)
27	26	30.429	0.00	0.90	0.00	0.00	0.54	0.0	15.0	4.7	5.80	8.02	4.73	15	1.31	77.80	78.20	82.76	82.97	86.20	85.80	Pipe - (41)
28	27	8.351	0.45	0.45	0.48	0.22	0.22	14.9	14.9	4.7	1.02	4.22	1.30	12	1.20	82.10	82.20	83.32	83.32	85.80	85.70	Pipe - (43)
29	27	23.000	0.00	0.45	0.00	0.00	0.33	0.0	12.0	5.2	4.93	4.61	4.02	15	0.43	78.20	78.30	83.32	83.43	85.80	86.20	Pipe - (46)
30	29	30.285	0.28	0.45	0.61	0.17	0.33	11.8	11.8	5.2	1.70	4.43	2.17	12	1.32	81.70	82.10	83.68	83.74	86.20	85.60	Pipe - (42)
31	29	202.527	0.00	0.00	0.00	0.00	0.00	0.0	0.6	0.0	3.24	5.38	2.64	15	0.59	78.30	79.50	83.68	84.12	86.20	86.00	Pipe - (46) (1)
32	31	88.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	3.24	5.27	2.64	15	0.57	79.50	80.00	84.22	84.41	86.00	87.00	Pipe - (68)
33	30	20.000	0.17	0.17	0.90	0.16	0.16	5.0	5.0	6.7	1.05	4.73	1.34	12	1.50	82.10	82.40	83.78	83.79	85.60	86.00	
34	End	70.975	0.00	0.00	0.00	0.00	0.00	0.0	0.8	0.0	4.00	7.64	2.26	18	0.45	76.08	76.40	81.07	81.16	83.20	85.50	Pipe - (19)
35	34	112.879	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	4.00	5.86	2.26	18	0.27	76.40	76.70	81.24	81.38	85.50	85.10	Pipe - (18)

Project File: P0695-proposed storm_jcb.stm | Number of lines: 35 | Run Date: 11/10/2016

NOTES:Intensity = 101.98 / (Inlet time + 15.80) ^ 0.90; Return period =Yrs. 25 ; c = cir e = ellip b = box

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APPENDIX F

Noroton Heights Shopping Center

346 Heights Road

Darien, Connecticut

Drainage Maintenance and Inspection Plan

November 11, 2016

The initial inspection will be made during an intense rainfall to check the adequacy of the yard drains, catch basins, roof leaders, piping, hydrodynamic separator, detention system, and system outlet.

The following is a checklist of items that will be checked and maintained during scheduled maintenance operations.

Drainage Structures: The Owner will be responsible for cleaning the catch basins, yard drains, manholes, piping, and outlet protection on their property. A Connecticut licensed hauler shall clean the sumps, and legally dispose of removed sand at an off-site location. The road sand may not be reused or stored on-site. As part of the hauling contract, the hauler shall notify the Owner in writing where the material is being disposed.

Each catch basin and yard drain shall be inspected every six months, with one inspection occurring during the month of April. Any debris occurring within one foot from the bottom of each sump shall be removed by Vacuum "Vactor" type of maintenance equipment. Maintain a log of inspections. Remove organic matter, sand and debris from catch basins as necessary and dispose of legally.

Hydrodynamic Separator: The Contech Vortech units (hydrodynamic separator) will be skimmed and oil and scum removed. In a separate operation, silt, sand and sediment will be removed. Once the structure is cleaned of debris, the chamber will be refilled with clean water to prevent wash through of debris and oil during next storm event.

Underground Detention: The underground detention system will be cleaned of all silt, debris and sediment from the inlet structure, outlet structure and the chamber lengths. The outlet control structure will be inspected and cleaned to make sure nothing is clogging the weir wall orifices or the discharge pipe.

Pavement: Paved areas shall be swept periodically by the Owner to clean trash and other debris. The Owner will sweep paved areas on its property in the spring to remove winter accumulations of road sand.

Perform a visual inspection of paved areas four times per year with one inspection after the last snowfall, but no later than April 1. Sweep accumulated sediment and debris from the paved areas. Clean paved areas as necessary during the remainder of the year.

Drainage Structures Inspection

Each catch basin and yard drain shall be inspected every six months, with one inspection occurring during the month of April. Any debris occurring within one foot from the bottom of each sump shall be removed by Vacuum "Vactor" type of maintenance equipment. Maintain a log of inspections. Remove organic matter, sand and debris from catch basins as necessary and dispose of legally.

Date (MM/DD/YY)	Company/Person	Supervising Team Member	Comments

Underground Detention

The underground Detention system shall be inspected annually and will be cleaned of all silt, debris and sediment from the inlet structure, outlet structure and the chamber lengths. The outlet control structure will be inspected and cleaned to make sure nothing is clogging the discharge pipe.

Date (MM/DD/YY)	Company/Person	Supervising Team Member	Comments

Pavement Inspection

Perform a visual inspection of paved areas four times per year with one inspection after the last snowfall, but no later than April 1. Sweep accumulated sediment and debris from the paved areas. Clean paved areas as necessary during the remainder of the year.

Date (MM/DD/YY)	Company/Person	Supervising Team Member	Comments

Tighe&Bond

APPENDIX G

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **Noroton Heights Shopping Center**
Project Number: **P 0695**
Project Location: **Darien, CT**
Description: **Sanitary Lateral Calculation**
Prepared By: **JCB** Date: **September 15, 2016**

Building Use

		Units	Total Bedrooms
Residential	1 Bedroom	19	19
	2 Bedroom	40	80
			99

	Area (SF)
Retail	24,388
Restaurant	8,667

Average Flow

Building Use	Average Daily Flow	Average Flow
Residential	150 gpd per bedroom	14,850 gpd
Retail	.1 gpd per SF	2,450 gpd
Restaurant	3 gpd per SF	26,000 gpd
		43,300 gpd

Peak Flow

43,300 Gallons per day
5 Peak flow Factor

Peak Flow = 43,300 x 5
Peak Flow = 216,500 gallons per day
Peak Flow = **0.33 cfs**

Sanitary Lateral Capacity

6" PVC lateral

$$\text{Capacity} = \frac{1.49 \times R^{2/3} \times S^{1/2} \times A}{n}$$

R = 0.125
S = 2% = 0.020
A = 0.196
n = 0.009

Capacity = **1.149 cfs**