STORMWATER MANAGEMENT ADDENDUM
MAJOR SITE PLAN
FOR

"STATION PLACE"

Proposed Plate 5
Block 510, Lot 1
Borough of Lawnside
Camden County
New Jersey

"WOODCREST STATION BUSINESS PARK"

Proposed Plate 5 & 6
Block 601, Lot 1
Borough of Lawnside
Camden County
New Jersey

PREPARED FOR

STATION OAK PARTNERS, LLC
50 East Mount Pleasant Avenue
Livingston, New Jersey 07039

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PREPARED BY

Taylor Wiseman & Taylor
ENGINEERS SURVEYORS SCIENTISTS

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Project #17854.1010.00
Project #17854.1013.00
Revised: August 12, 2020
Revised: July 1, 2019
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December 21, 2018

Vladislav Koldomasov
NJ Professional Engineer No. 24GE05529600
Certificate of Authorization No.24GA28032900

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PURPOSE

Per NJDEP's request to incorporate more nonstructural measures on "Station Place" and "Woodcrest Station Business Park" projects, this addendum is presented to provide the engineering information concerning the porous pavement and recharge systems provided and accepted by Mr. Keith Stampfel and Mr. Dhruv Patel of the Department. This addendum is a supplement to the two (2) drainage reports for "Station Place" and Woodcrest Station Business Park" projects. This report will discuss the design of the porous pavement and recharge systems for the water quality storm. These systems were only designed to provide additional areas of recharge to promote groundwater recharge throughout the site, rather than concentrating it in one or two areas. All the required groundwater recharge and water quality volumes are handled within the proposed infiltration/detention basins as designed in the previous reports.

PROJECT HISTORY

Based on the proposal, "Station Place" consists of five (5) apartment buildings (144 units); "Woodcrest Station Business Park" consists of two (2) flex/office buildings. Both projects provide sidewalks, asphalt parking lots, landscaping, lighting, stormwater management systems, and other associated improvements. The stormwater management systems for both project sites will consist of on-site inlets, stormwater sewer system and infiltration/detention basins. Both basins will discharge into an adjacent unmade tributary to Cooper River via proposed controlled outlet structures. The basins with their respective outlet structures are designed such that the development runoff directed into the stormwater management facility for the 2-year, 10-year and 100-year storm will be controlled or detained in order to limit the discharge from the site to 50%, 75% and 80% respectively of the pre-development peak rate of runoff from the same year storm for the corresponding existing drainage area. The stormwater management facilities are also designed to meet water quality and groundwater recharge standards based in the NJDEP Stormwater Management Regulations. These calculations for the stormwater management systems being proposed for the "Station Place" and "Woodcrest Station Business Park" projects can be found in the following reports:

1. Stormwater Management Report for "Woodcrest Station Business Park" dated July 23, 2018, revised August 12, 2020.
2. Stormwater Management Report for "Station Place" dated July 23, 2018, revised July 15, 2019.

Per NJDEP's review of the Freshwater Wetlands and Flood Hazard Area Permit Application, the Department has requested the applicant to incorporate additional non-structural measures such as porous pavement and recharge systems to provide additional groundwater recharge throughout the site. Both projects have incorporated porous pavement and recharge systems throughout the site per the Department's request.

RUNOFF COMPUTATIONS

The soils onsite are mapped by the United States Department of Agriculture (USDA) as Freehold-Downer-Urban land complex. The parent material of Freehold-Downer soils is glauconite bearing loamy eolian deposits and/or glauconite bearing loamy fluviomarine deposits. The landforms consisting with these soils include flats and low hills. The soils are well drained with a seasonal high-water table reported as greater than 80 inches. The reported saturated hydraulic conductivity is moderately high to high.

Based on the NJDEP's Best Management Practices (BMP) manual and N.J.A.C. 7:8 requirements, the Water Quality Design Storm was utilized for the porous pavement and recharge system. As described in the Stormwater Management Rules, the NJDEP stormwater quality design storm has a total rainfall depth of 1.25 inches and a total duration of two hours. Water quality calculations shall take into account the distribution of rain from the water quality design storm, as reflected in the table below:

Water Quality Design Storm Distribution

Time (Minutes)	Cumulative Rainfall (Inches)	Time (Minutes)	Cumulative Rainfall (Inches)
0	0.0000	65	0.8917
5	0.0083	70	0.9917
10	0.0166	75	1.0500
15	0.0250	80	1.0840
20	0.0500	85	1.1170
25	0.0750	90	1.1500
30	0.1000	95	1.1750
35	0.1330	100	1.2000
40	0.1660	105	1.2250
45	0.2000	110	1.2334
50	0.2583	115	1.2417
55	0.3583	120	1.2500
60	0.6250		

Runoff hydrographs for the recharge areas were generated using the Hydraflow Hydrograph Extension for AutoCAD® Civil 3D® 2018 Version 12 program by Autodesk, Inc.

<u>POROUS PAVING</u>

As mentioned above, the stone bed storage will be designed to retain and infiltrate the water quality storm of the contributing drainage area. Runoff from storms greater than the water quality will drain into the proposed storm sewer and discharge to the proposed infiltration/detention basin onsite. The porous pavement will consist of 2.5-inch pervious asphalt with a 2" thickness choker course AASHTO No. 57 followed by AASHTO No. 2 coarse aggregate varying depth for required storage. The tables below show the sections of area and volume storage respectively for each project site.

Porous Pavement @ Station Place

Section	Runoff Volume (cf)	Required Storage Bed Depth (in.)	Provided Storage Bed Depth (in.)	Lowest Stone Encasement Invert (ft.)	TP No. & ESHWT Elevation (ft.)	Design Permeability Rate (in./hr.)	Drain Time (hrs.)
1	266	2.6	6	57.32	* TP#20 – 53.1	0.85	1.22
2	3,382	20.9	21	52.88	** TP#18 – NE @ 49.2	3.87	2.16

* Estimated SHWT obtained from the Soil Conservation Service County Soil Survey Report (Appendix 4)
** ESHWT Not Encountered; Soil Log observed on April 12, 2018.

Porous Pavement @ Woodcrest Station Business Park

Section	Runoff Volume (cf)	Required Storage Bed Depth (in.)	Provided Storage Bed Depth (in.)	Lowest Stone Encasement Invert (ft.)	TP No. & ESHWT Elevation (ft.)	Design Permeability Rate (in./hr.)	Drain Time (hrs.)
1	1,015	12.5	14	69.86	* TP#26 – 64.1	3.21	1.56

* Estimated SHWT obtained from the Soil Conservation Service County Soil Survey Report (Appendix 4)

Runoff volume, required storage bed, and drain time calculations can be found Appendix 1 of this Addendum.

SUBSURFACE STORAGE RECHARGE SYSTEMS

The total drainage areas to the proposed subsurface storage recharge systems are comprised of the garage roof area at "Station Place" and half of each flex/office building roof area at "Woodcrest Station Business Park". The storage recharge systems are designed to only retain and infiltrate the water quality storm of each contributing roof area. Storms above the water quality storm will flow through a weir wall within each recharge outlet structure and drain into the storm sewer system onsite which discharge into the proposed infiltration/detention basins onsite. The subsurface storage recharge system will be constructed with various sizes of perforated HDPE pipes backfilled with ½" to 2" crushed stone providing 40% void ratio. The tables below summarize each system within "Station Place" and "Woodcrest Station Business Park" project site.

Subsurface Storage Recharge Systems @ Station Place

System Number	Number of Rows	Chamber Invert (ft.)	Chamber Size (in.)	Barrel Length (ft.)	Stone Encasement Invert (ft.)	TP No. & ESHWT Elevation (ft.)
1	1	55.00	15	75	54.50	TP#1 – 47.5
2	1	54.70	12	100	54.20	* TP#21 – 52.2
3	1	54.10	12	100	53.60	** TP#18 – NE @ 49.2

* Estimated SHWT obtained from the Soil Conservation Service County Soil Survey Report (Appendix 4)
** ESHWT Not Encountered; Soil Log observed on April 12, 2018.

System Number	Runoff Volume (cf)	System Volume (cf)	WQ Surface Water Elev. (ft.)	Design Permeability Rate (in./hr.)	Drain Time (hrs.)
1	203	216	56.20	10.00	1.08
2	158	171	55.66	1.31	7.24
3	158	171	55.06	1.30	7.29

Subsurface Storage Recharge Systems @ Woodcrest Station Business Park

System Number	Number of Rows	Chamber Invert (ft.)	Chamber Size (in.)	Barrel Length (ft.)	Stone Encasement Invert (ft.)	TP No. & ESHWT Elevation (ft.)
1	3	65.60	30	30	65.10	* TP#27 – 63.1
2	2	64.00	30	75	63.50	* TP#28 – 58.3

* Estimated SHWT obtained from the Soil Conservation Service County Soil Survey Report (Appendix 4)

System Number	Runoff Volume (cf)	System Volume (cf)	WQ Surface Water Elev. (ft.)	Design Permeability Rate (in./hr.)	Drain Time (hrs.)
1	2,614	3,787	67.21	1.07	59.22
2	2,400	3,015	65.94	1.96	17.94

Runoff volume, subsurface storage volume, and drain time calculations can be found Appendix 2 of this Addendum.

SOIL BORINGS AND ASSOCIATED INFORMATION

Taylor Wiseman & Taylor, Blue Bell, PA office performed nine (9) additional soil borings and nine (9) tube permeameter tests in the areas of the proposed porous pavement and recharge systems on December 18th, 2018. The test pits were excavated using a backhoe to determine soil types, depth to estimated seasonal high-water table (ESHWT) if encountered and depth to groundwater (GW) if encountered. The test pits were excavated to depths of roughly eleven feet or until groundwater was encountered. A summary of the findings is shown below:

T.P. Location	Surface Elevation (ft.)	Lowest Elev. of T.P. Excavation (ft.)	Elevation of Test (ft.)	ESHWT Elevation (ft.)	GW Elevation (ft.)	Infiltration Rate (in./hr.)
TP-20	58.1	47.6	54.1	NE	NE	1.71
TP-21	57.2	46.4	51.7	NE	NE	2.63
TP-22	59.2	48.4	52.2	NE	NE	2.61
TP-23	60.0	50.0	52.5	NE	NE	12.5
TP-24	57.5	46.7	53.0	NE	NE	7.74
TP-25	68.6	57.6	62.6	NE	NE	16.5
TP-26	69.1	58.7	63.1	NE	NE	6.41
TP-27	68.1	57.4	64.6	NE	NE	2.14
TP-28	63.3	52.5	58.8	NE	NE	3.92

*(NE) – Not Encountered

Below is a summary of additional soil boring information performed on April 12, 2018 which were used due to their proximity of the proposed porous pavement and recharge systems.

T.P. Location	Surface Elevation (ft.)	Lowest Elev. of T.P. Excavation (ft.)	Elevation of Test (ft.)	ESHWT Elevation (ft.)	GW Elevation (ft.)	Infiltration Rate (in./hr.)
TP-1	55.0	45.7	49.0	47.5	45.7	36.9
TP-18	59.5	49.2	55.3	NE	NE	10.76

*(NE) – Not Encountered

PROJECT SUMMARY

Based on the above analyses, the stormwater management measures designed for this proposed development meet the requirements of the NJDEP Stormwater Management regulations at N.J.A.C.7:8.

APPENDIX 1

POROUS PAVEMENT CALCULATIONS

CALCULATIONS

Taylor Wiseman & Taylor
ENGINEERS / SURVEYORS / SCIENTISTS

BY VAK DATE 12/20/18 POROUS PAVEMENT SECTION 1 SHEET NO. 1 OF 2
CHKD. BY .... DATE .... STATION PLACE JOB NO 17854.1013.00

STEP 1: RUNOFF CALCULATIONS FOR WATER QUALITY DESIGN STORM

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)} = \frac{[1.25 - (0.2 \times 0.204)]^2}{[1.25 + (0.8 \times 0.204)]} = 1.035 \text{ INCHES}$$

P = 1.25 INCHES

$$S = \frac{1{,}000}{CN} - 10 = 0.204$$

CN = 98

VOLUME = Σ DRAINAGE AREA × Q

$$= 3078 \text{ sf} \times 1.035 \text{ INCHES} \times \frac{1 \text{ ft}}{12 \text{ INCHES}} = 265.5 \approx \underline{266 \text{ cf}}$$

STEP 2: STORAGE VOLUME AND DEPTH OF BED SIZING.

$$\text{STORAGE BED DEPTH} = \frac{\text{WATER QUALITY DESIGN STORM RUNOFF VOLUME}}{\text{\% VOIDS} \times \text{STORAGE BED AREA}}$$

$$= \frac{266 \text{ cf}}{0.40(3078 \text{ sf})} \times \frac{12 \text{ INCHES}}{1 \text{ ft}} = \underline{2.6 \text{ INCHES}}.$$

→ 6" PROVIDED

STEP 3: DRAIN TIME CALCULATION.

$$\text{DRAIN TIME} = \frac{\text{WATER QUALITY DESIGN STORM RUNOFF VOLUME}}{\text{SURFACE AREA} \times \text{SUBSOIL DESIGN PERMEABILITY RATE}}$$

$$= \frac{266 \text{ cf}}{\left(3078 \text{ sf} \times 0.85 \frac{\text{INCHES}}{\text{HR}} \times \frac{1 \text{ ft}}{12 \text{ INCHES}}\right)}$$

DRAIN TIME = $\underline{1.22}$ HRS.

CALCULATIONS

Taylor Wiseman & Taylor
ENGINEERS / SURVEYORS / SCIENTISTS

BY: VAK DATE: 12/20/18 POROUS PAVEMENT SECTION 2 SHEET NO. 2 OF 2
CHKD. BY: DATE: STATION PLACE JOB NO. 17824.1013.00

STEP 1: RUNOFF CALCULATIONS FOR WATER QUALITY DESIGN STORM

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)} = \frac{[1.25 - (0.2 \times 0.204)]^2}{[1.25 + (0.8 \times 0.204)]} = 1.035 \text{ INCHES}$$

P = 1.25 INCHES

$$S = \frac{1000}{CN} - 10 = 0.204$$

CN = 98

VOLUME = Σ DRAINAGE AREA × Q

$$= (0.9 \text{ ACRE}) \times 1.035 \text{ INCHES} \times \frac{43,560 \text{ ft}^2}{1 \text{ ACRE}} \times \frac{1 \text{ ft}}{12 \text{ INCHES}}$$

WQ VOLUME = 3,381.3 ≈ 3,382 cf

STEP 2: STORAGE VOLUME AND DEPTH OF BED SIZING

$$\text{STORAGE BED DEPTH} = \frac{\text{WATER QUALITY DESIGN STORM RUNOFF VOLUME}}{\text{\% VOIDS} \times \text{STORAGE BED AREA}}$$

$$= \frac{3,382 \text{ cf}}{0.40(4861 \text{ sf})} \times \frac{12 \text{ INCHES}}{1 \text{ ft}}$$

= 20.9 INCHES → 21 INCHES PROVIDED

STEP 3: DRAIN TIME CALCULATION

$$\text{DRAIN TIME} = \frac{\text{WATER QUALITY DESIGN STORM RUNOFF VOLUME}}{\text{SURFACE AREA} \times \text{SUBSOIL DESIGN PERMEABILITY RATE}}$$

$$= \frac{3,382 \text{ cf}}{\left(4861 \text{ sf} \times 3.87 \frac{\text{INCHES}}{\text{HR}} \times \frac{1 \text{ ft}}{12 \text{ INCHES}}\right)}$$

DRAIN TIME = 2.16 HRS.

CALCULATIONS

Taylor Wiseman & Taylor
ENGINEERS / SURVEYORS / SCIENTISTS

BY: VAK DATE: 1/20/18 — POROUS PAVEMENT SECTION 1 — SHEET NO. 1 OF 1
CHKD. BY: DATE: — WOODCREST STATION BUSINESS PARK — JOB NO. 17854.1010.00

STEP 1: RUNOFF CALCULATIONS FOR WATER QUALITY DESIGN STORM.

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)} = \frac{[1.25 - (0.2 \times 0.204)]^2}{[1.25 + (0.8 \times 0.204)]} = 1.035 \text{ INCHES}$$

P = 1.25 INCHES

$$S = \frac{1000}{CN} - 10 = 0.204$$

CN = 98

$$\text{VOLUME} = \sum \text{DRAINAGE AREA} \times Q$$
$$= (0.27 \text{ ACRE}) \times 1.035 \text{ INCHES} \times \frac{43,560 \text{ ft}^2}{1 \text{ ACRE}} \times \frac{1 \text{ ft}}{12 \text{ INCHES}}$$

WQ VOLUME = 1014.4 ≈ **1,015 cf**

STEP 2: STORAGE VOLUME AND DEPTH OF BED SIZING

$$\text{STORAGE BED DEPTH} = \frac{\text{WATER QUALITY DESIGN STORM RUNOFF VOLUME}}{\text{\% VOIDS} \times \text{STORAGE BED AREA}}$$
$$= \frac{1,015 \text{ cf}}{0.40(2,430 \text{ sf})} \times \frac{12 \text{ INCHES}}{1 \text{ ft}}$$
$$= 12.5 \text{ INCHES} \rightarrow \text{14 INCHES PROVIDED}$$

STEP 3: DRAIN TIME CALCULATION.

$$\text{DRAIN TIME} = \frac{\text{WATER QUALITY DESIGN STORM RUNOFF VOLUME}}{\text{SURFACE AREA} \times \text{SUBSOIL DESIGN PERMEABILITY RATE}}$$
$$= \frac{1015 \text{ cf}}{\left(2,430 \text{ sf} \times 3.21 \frac{\text{INCHES}}{\text{HR}} \times \frac{1 \text{ ft}}{12 \text{ INCHES}}\right)}$$

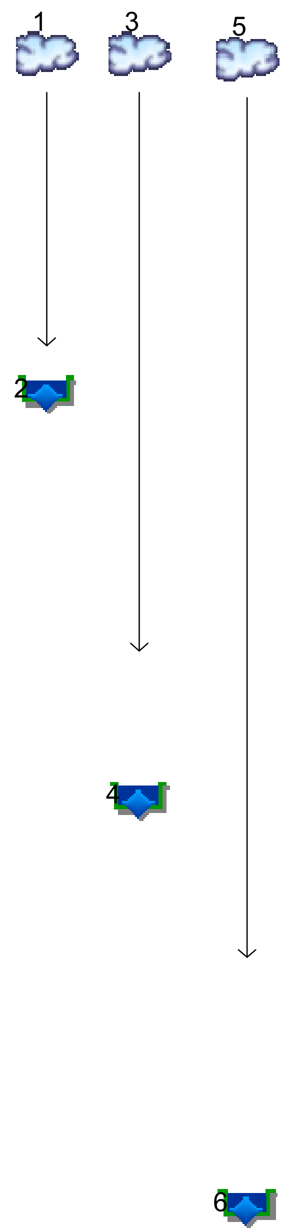
DRAIN TIME = **1.56 HRS**

APPENDIX 2

SUBSURFACE STORAGE RECHARGE SYSTEMS

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12



Legend

Hyd.	Origin	Description
1	SCS Runoff	Roof 1
2	Reservoir	Recharge System #1
3	SCS Runoff	Roof 2
4	Reservoir	Recharge System #2
5	SCS Runoff	Roof 3
6	Reservoir	Recharge System #3

Project: Station Place Recharge System.Rev1.gpw

Friday, 02 / 1 / 2019

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

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	------	0.088	-------	-------	-------	-------	-------	-------	-------	Roof 1
2	Reservoir	1	0.000	-------	-------	-------	-------	-------	-------	-------	Recharge System #1
3	SCS Runoff	------	0.068	-------	-------	-------	-------	-------	-------	-------	Roof 2
4	Reservoir	3	0.000	-------	-------	-------	-------	-------	-------	-------	Recharge System #2
5	SCS Runoff	------	0.068	-------	-------	-------	-------	-------	-------	-------	Roof 3
6	Reservoir	5	0.000	-------	-------	-------	-------	-------	-------	-------	Recharge System #3

Proj. file: Station Place Recharge System.Rev1.gpw

Friday, 02 / 1 / 2019

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

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	0.088	5	70	203	------	------	------	Roof 1
2	Reservoir	0.000	5	n/a	0	1	56.20	203	Recharge System #1
3	SCS Runoff	0.068	5	70	158	------	------	------	Roof 2
4	Reservoir	0.000	5	n/a	0	3	55.66	158	Recharge System #2
5	SCS Runoff	0.068	5	70	158	------	------	------	Roof 3
6	Reservoir	0.000	5	n/a	0	5	55.06	158	Recharge System #3

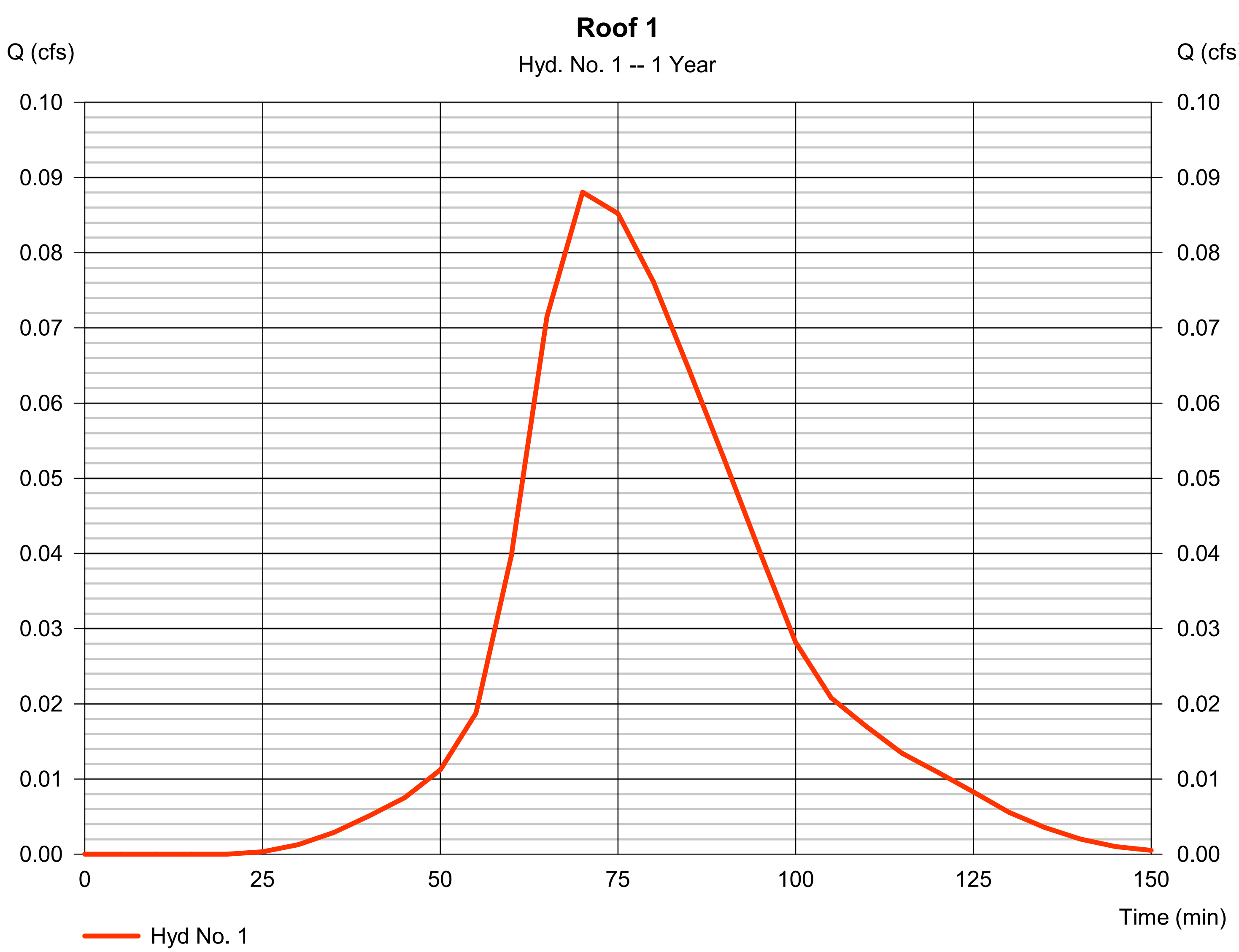
Hydrograph Report

Hyd. No. 1

Roof 1

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.088 cfs
Storm frequency	=	1 yrs	Time to peak	=	70 min
Time interval	=	5 min	Hyd. volume	=	203 cuft
Drainage area	=	0.055 ac	Curve number	=	98*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.00 min
Total precip.	=	1.25 in	Distribution	=	Custom
Storm duration	=	T:\Koldomasov\WQ.cds	Shape factor	=	284

* Composite (Area/CN) = [(0.050 x 98)] / 0.055



Hydrograph Report

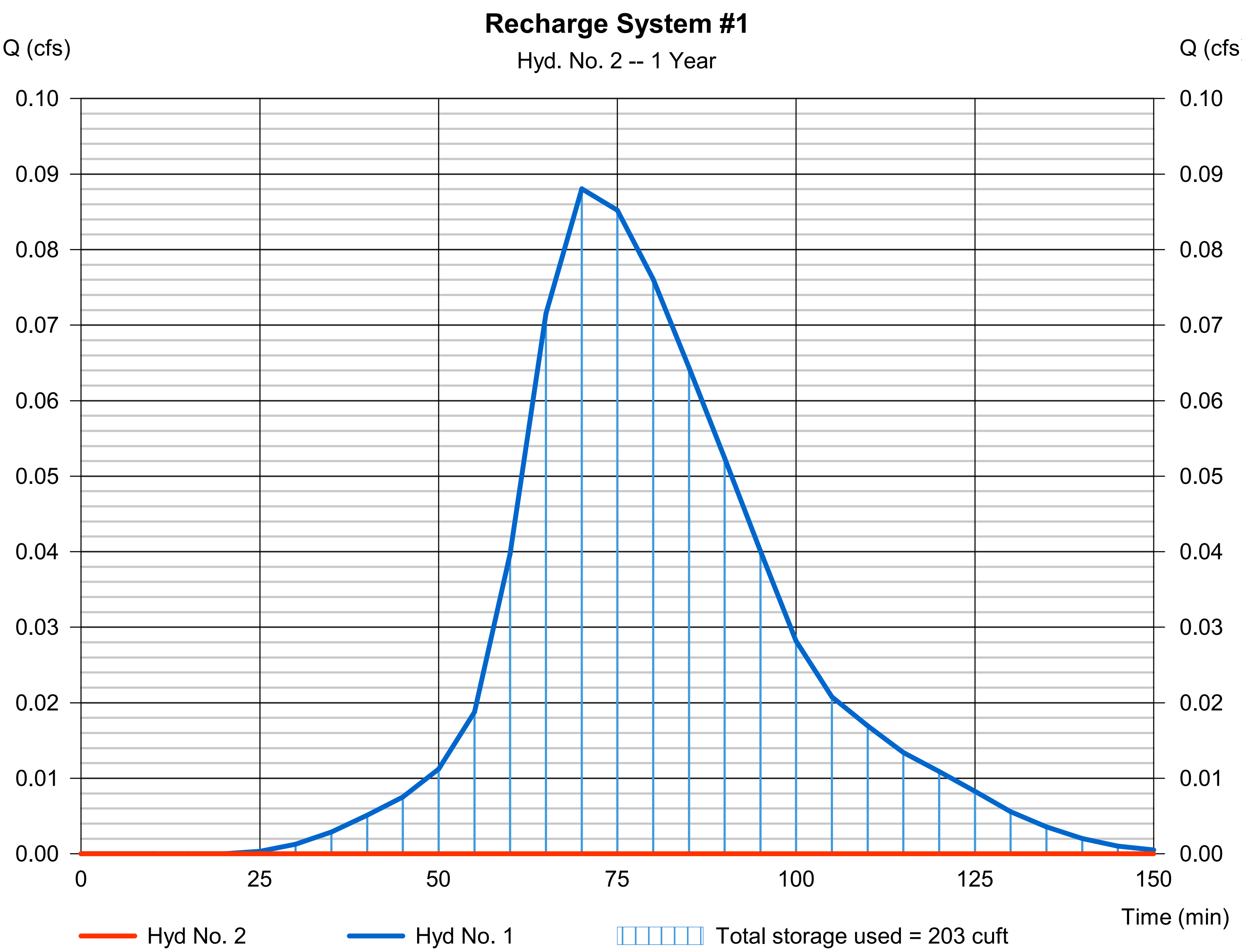
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12 Friday, 02 / 1 / 2019

Hyd. No. 2

Recharge System #1

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 1 yrs	Time to peak	= n/a
Time interval	= 5 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 1 - Roof 1	Max. Elevation	= 56.20 ft
Reservoir name	= Recharge System #1	Max. Storage	= 203 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - Recharge System #1

Pond Data

UG Chambers -Invert elev. = 55.00 ft, Rise x Span = 1.25 x 1.25 ft, Barrel Len = 75.00 ft, No. Barrels = 1, Slope = 0.10%, Headers = No
Encasement -Invert elev. = 54.50 ft, Width = 3.00 ft, Height = 1.75 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	54.50	n/a	0	0
0.18	54.68	n/a	13	13
0.37	54.87	n/a	16	29
0.55	55.05	n/a	17	46
0.73	55.23	n/a	22	68
0.91	55.41	n/a	25	93
1.10	55.60	n/a	26	119
1.28	55.78	n/a	27	146
1.46	55.96	n/a	26	172
1.64	56.14	n/a	24	196
1.83	56.33	n/a	20	216

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 4.00	0.00	0.00	0.00
Crest El. (ft)	= 56.25	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)
TW Elev. (ft) = 0.00

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

Stage / Storage / Discharge Table

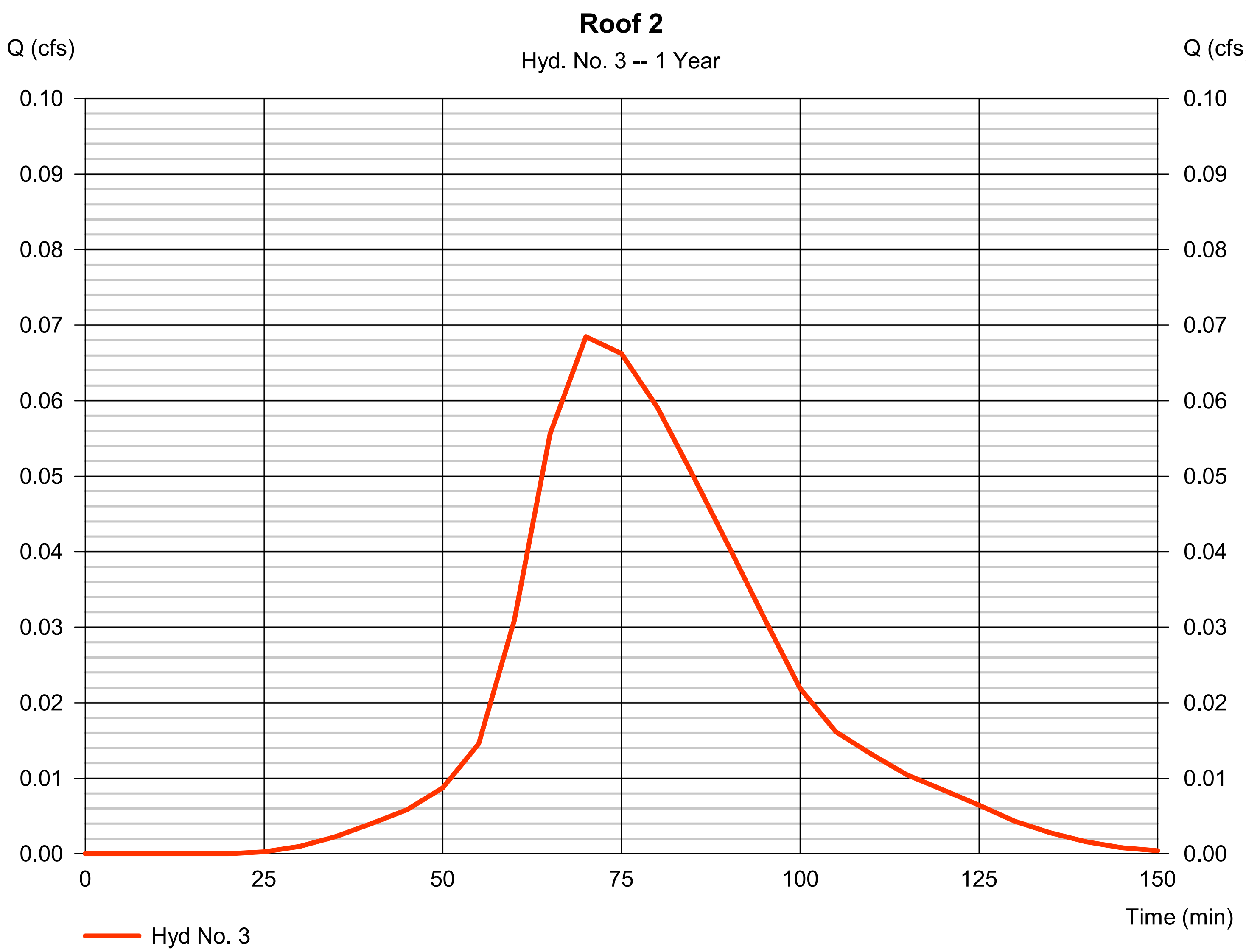
Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	54.50	---	---	---	---	0.00	---	---	---	---	---	0.000
0.18	13	54.68	---	---	---	---	0.00	---	---	---	---	---	0.000
0.37	29	54.87	---	---	---	---	0.00	---	---	---	---	---	0.000
0.55	46	55.05	---	---	---	---	0.00	---	---	---	---	---	0.000
0.73	68	55.23	---	---	---	---	0.00	---	---	---	---	---	0.000
0.91	93	55.41	---	---	---	---	0.00	---	---	---	---	---	0.000
1.10	119	55.60	---	---	---	---	0.00	---	---	---	---	---	0.000
1.28	146	55.78	---	---	---	---	0.00	---	---	---	---	---	0.000
1.46	172	55.96	---	---	---	---	0.00	---	---	---	---	---	0.000
1.64	196	56.14	---	---	---	---	0.00	---	---	---	---	---	0.000
1.83	216	56.33	---	---	---	---	0.27	---	---	---	---	---	0.274

Hydrograph Report

Hyd. No. 3

Roof 2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.068 cfs
Storm frequency	= 1 yrs	Time to peak	= 70 min
Time interval	= 5 min	Hyd. volume	= 158 cuft
Drainage area	= 0.042 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 1.25 in	Distribution	= Custom
Storm duration	= T:\Koldomasov\WQ.cds	Shape factor	= 284



Hydrograph Report

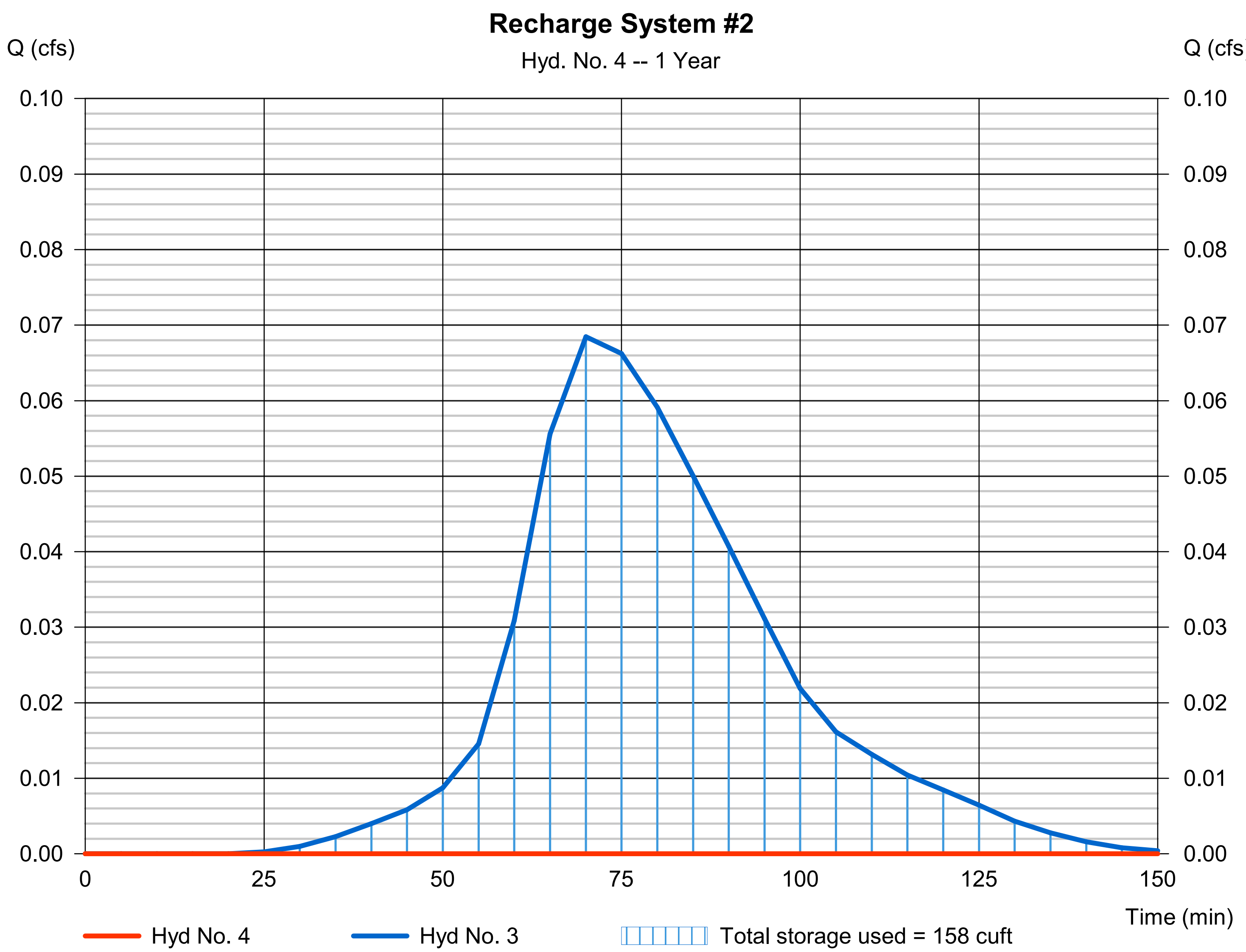
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12 — Friday, 02 / 1 / 2019

Hyd. No. 4

Recharge System #2

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 1 yrs	Time to peak	= n/a
Time interval	= 5 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 3 - Roof 2	Max. Elevation	= 55.66 ft
Reservoir name	= Recharge System 2	Max. Storage	= 158 cuft

Storage Indication method used.



Pond Report

Pond No. 2 - Recharge System 2

Pond Data

UG Chambers -Invert elev. = 54.70 ft, Rise x Span = 1.00 x 1.00 ft, Barrel Len = 100.00 ft, No. Barrels = 1, Slope = 0.10%, Headers = No
Encasement -Invert elev. = 54.20 ft, Width = 2.00 ft, Height = 1.50 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	54.20	n/a	0	0
0.16	54.36	n/a	9	9
0.32	54.52	n/a	13	22
0.48	54.68	n/a	13	34
0.64	54.84	n/a	15	49
0.80	55.00	n/a	20	69
0.96	55.16	n/a	22	91
1.12	55.32	n/a	22	113
1.28	55.48	n/a	22	135
1.44	55.64	n/a	20	155
1.60	55.80	n/a	16	171

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)
TW Elev. (ft) = 0.00

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

Stage / Storage / Discharge Table

Stage ft	Storage 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	54.20	---	---	---	---	---	---	---	---	---	---	0.000
0.16	9	54.36	---	---	---	---	---	---	---	---	---	---	0.000
0.32	22	54.52	---	---	---	---	---	---	---	---	---	---	0.000
0.48	34	54.68	---	---	---	---	---	---	---	---	---	---	0.000
0.64	49	54.84	---	---	---	---	---	---	---	---	---	---	0.000
0.80	69	55.00	---	---	---	---	---	---	---	---	---	---	0.000
0.96	91	55.16	---	---	---	---	---	---	---	---	---	---	0.000
1.12	113	55.32	---	---	---	---	---	---	---	---	---	---	0.000
1.28	135	55.48	---	---	---	---	---	---	---	---	---	---	0.000
1.44	155	55.64	---	---	---	---	---	---	---	---	---	---	0.000
1.60	171	55.80	---	---	---	---	---	---	---	---	---	---	0.000

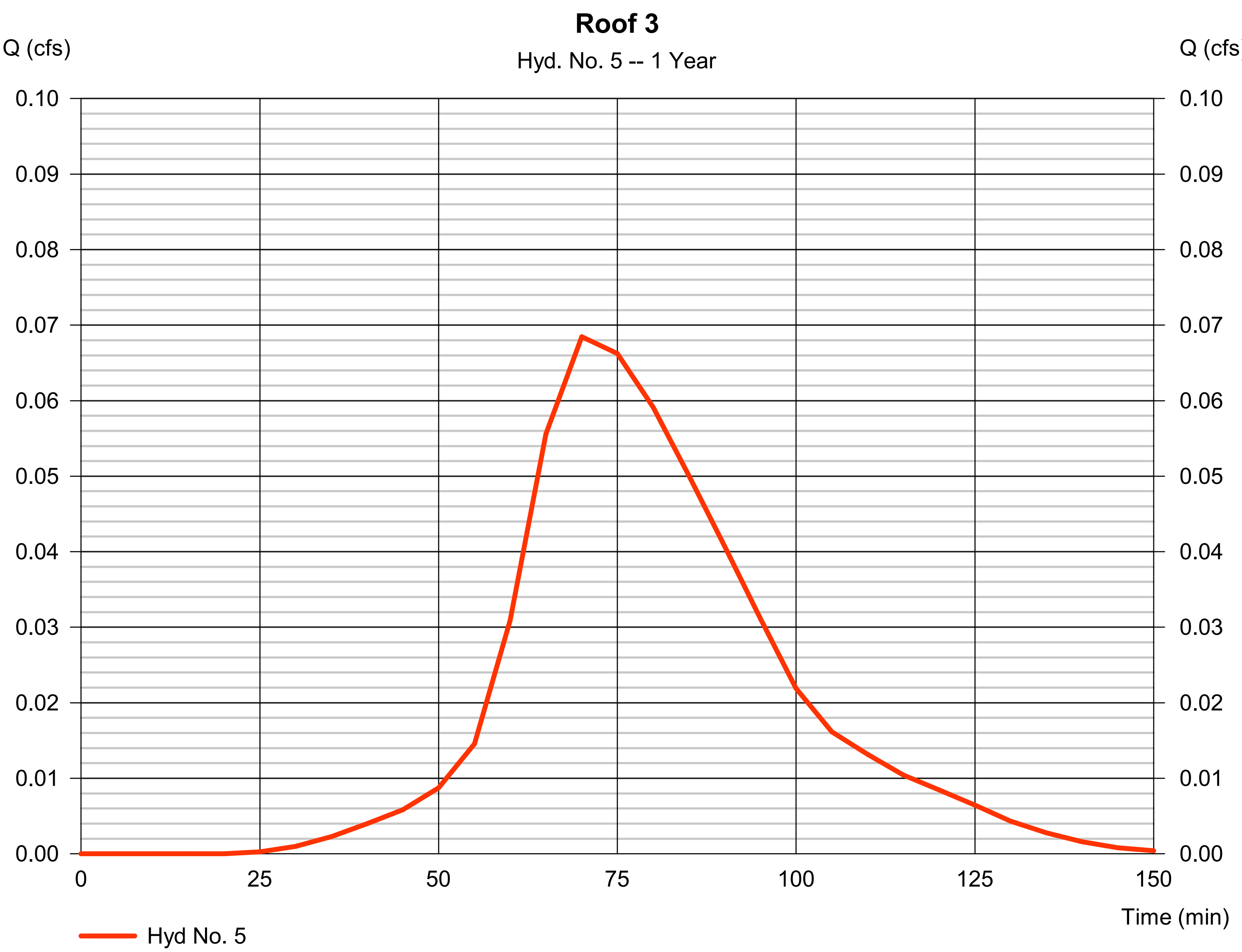
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12 — Friday, 02 / 1 / 2019

Hyd. No. 5

Roof 3

Hydrograph type	= SCS Runoff	Peak discharge	= 0.068 cfs
Storm frequency	= 1 yrs	Time to peak	= 70 min
Time interval	= 5 min	Hyd. volume	= 158 cuft
Drainage area	= 0.042 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 1.25 in	Distribution	= Custom
Storm duration	= T:\Koldomasov\WQ.cds	Shape factor	= 284



Hydrograph Report

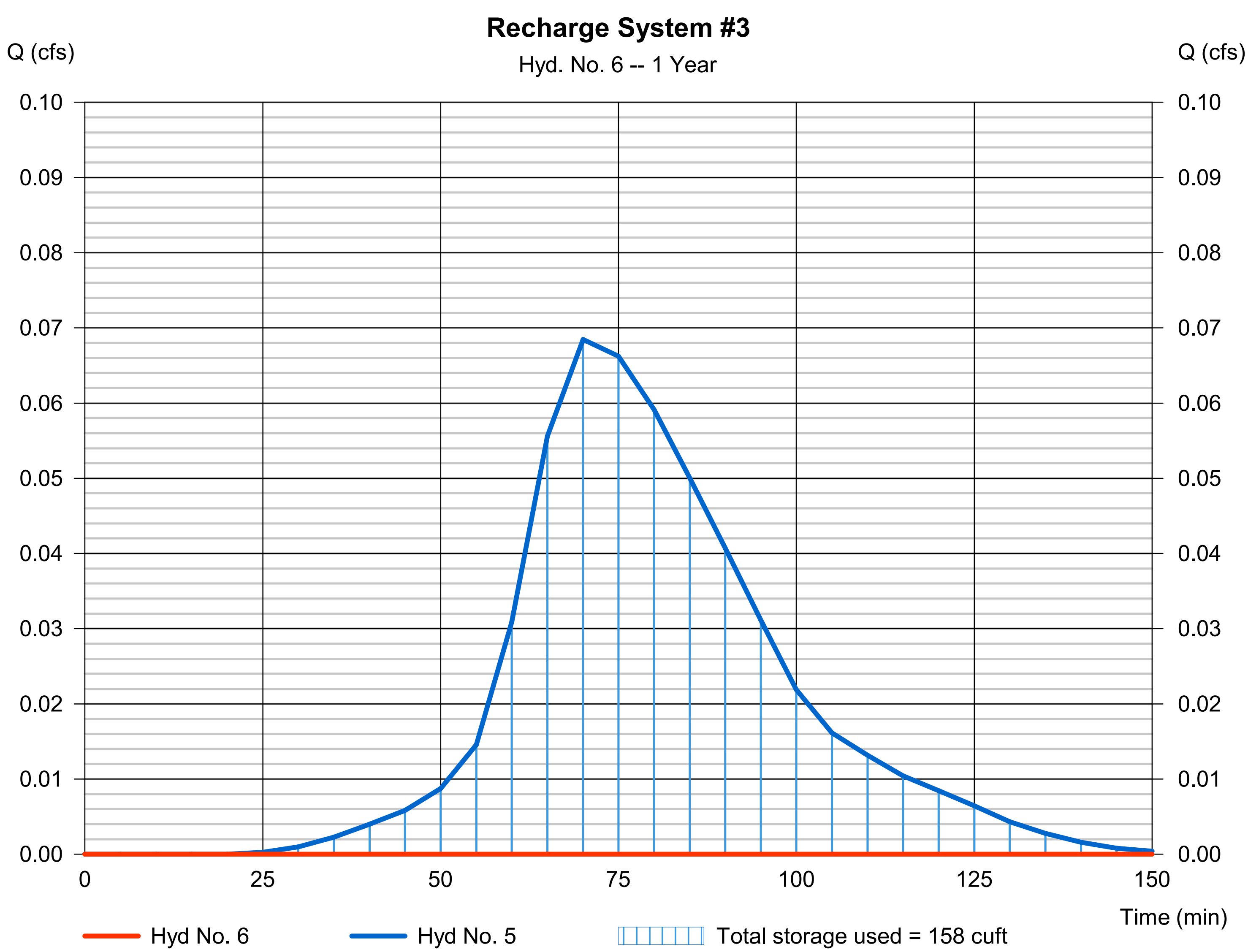
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12 Friday, 02 / 1 / 2019

Hyd. No. 6

Recharge System #3

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 1 yrs	Time to peak	= n/a
Time interval	= 5 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 5 - Roof 3	Max. Elevation	= 55.06 ft
Reservoir name	= Recharge System 3	Max. Storage	= 158 cuft

Storage Indication method used.



Pond Report

Pond No. 3 - Recharge System 3

Pond Data

UG Chambers -Invert elev. = 54.10 ft, Rise x Span = 1.00 x 1.00 ft, Barrel Len = 100.00 ft, No. Barrels = 1, Slope = 0.10%, Headers = No
Encasement -Invert elev. = 53.60 ft, Width = 2.00 ft, Height = 1.50 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	53.60	n/a	0	0
0.16	53.76	n/a	9	9
0.32	53.92	n/a	13	22
0.48	54.08	n/a	13	34
0.64	54.24	n/a	15	49
0.80	54.40	n/a	20	69
0.96	54.56	n/a	22	91
1.12	54.72	n/a	22	113
1.28	54.88	n/a	22	135
1.44	55.04	n/a	20	155
1.60	55.20	n/a	16	171

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .000	.000	.000	n/a
Orifice Coeff.	= 0.00	0.00	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 0.00	0.00	0.00	0.00
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

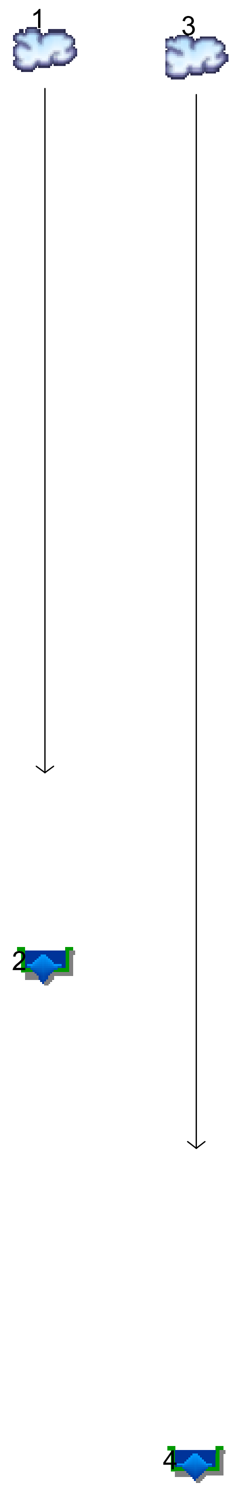
Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

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	53.60	---	---	---	---	---	---	---	---	---	---	0.000
0.16	9	53.76	---	---	---	---	---	---	---	---	---	---	0.000
0.32	22	53.92	---	---	---	---	---	---	---	---	---	---	0.000
0.48	34	54.08	---	---	---	---	---	---	---	---	---	---	0.000
0.64	49	54.24	---	---	---	---	---	---	---	---	---	---	0.000
0.80	69	54.40	---	---	---	---	---	---	---	---	---	---	0.000
0.96	91	54.56	---	---	---	---	---	---	---	---	---	---	0.000
1.12	113	54.72	---	---	---	---	---	---	---	---	---	---	0.000
1.28	135	54.88	---	---	---	---	---	---	---	---	---	---	0.000
1.44	155	55.04	---	---	---	---	---	---	---	---	---	---	0.000
1.60	171	55.20	---	---	---	---	---	---	---	---	---	---	0.000

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12



Legend

Hyd.	Origin	Description
1	SCS Runoff	Roof 1
2	Reservoir	Recharge System #2
3	SCS Runoff	Roof 2
4	Reservoir	Recharge System #3

Project: Woodcrest Station Business Park Recharge System.Rev3.gpw | Monday, 08 / 10 / 2020

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

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	------	1.135	-------	-------	-------	-------	-------	-------	-------	Roof 1
2	Reservoir	1	0.000	-------	-------	-------	-------	-------	-------	-------	Recharge System #2
3	SCS Runoff	------	1.042	-------	-------	-------	-------	-------	-------	-------	Roof 2
4	Reservoir	3	0.000	-------	-------	-------	-------	-------	-------	-------	Recharge System #3

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

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	1.135	5	70	2,614	------	------	------	Roof 1
2	Reservoir	0.000	5	n/a	0	1	67.21	2,614	Recharge System #2
3	SCS Runoff	1.042	5	70	2,400	------	------	------	Roof 2
4	Reservoir	0.000	5	n/a	0	3	65.94	2,400	Recharge System #3

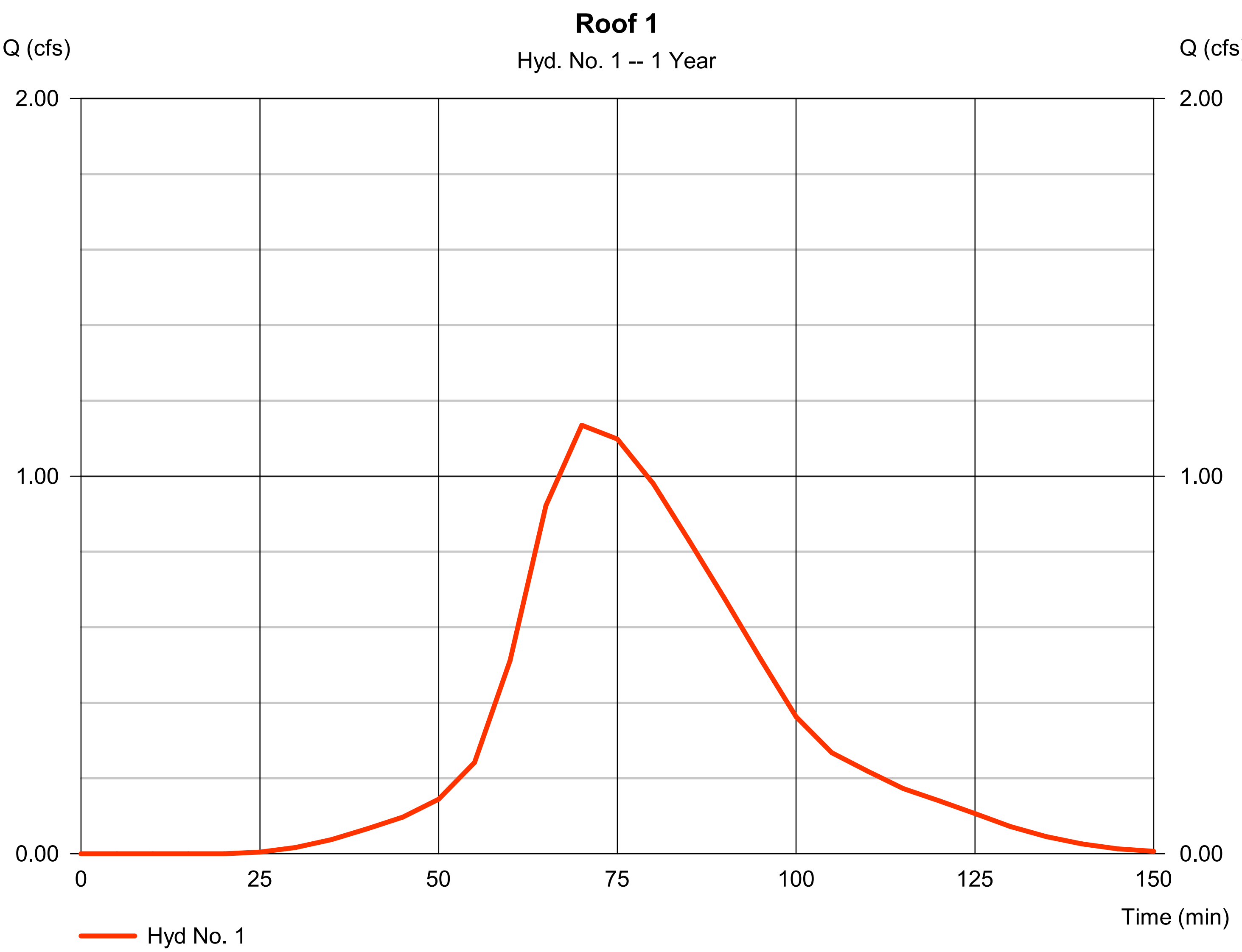
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12 | Monday, 08 / 10 / 2020

Hyd. No. 1

Roof 1

Hydrograph type	= SCS Runoff	Peak discharge	= 1.135 cfs
Storm frequency	= 1 yrs	Time to peak	= 70 min
Time interval	= 5 min	Hyd. volume	= 2,614 cuft
Drainage area	= 0.703 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 1.25 in	Distribution	= Custom
Storm duration	= T:\Koldomasov\WQ.cds	Shape factor	= 284



Hydrograph Report

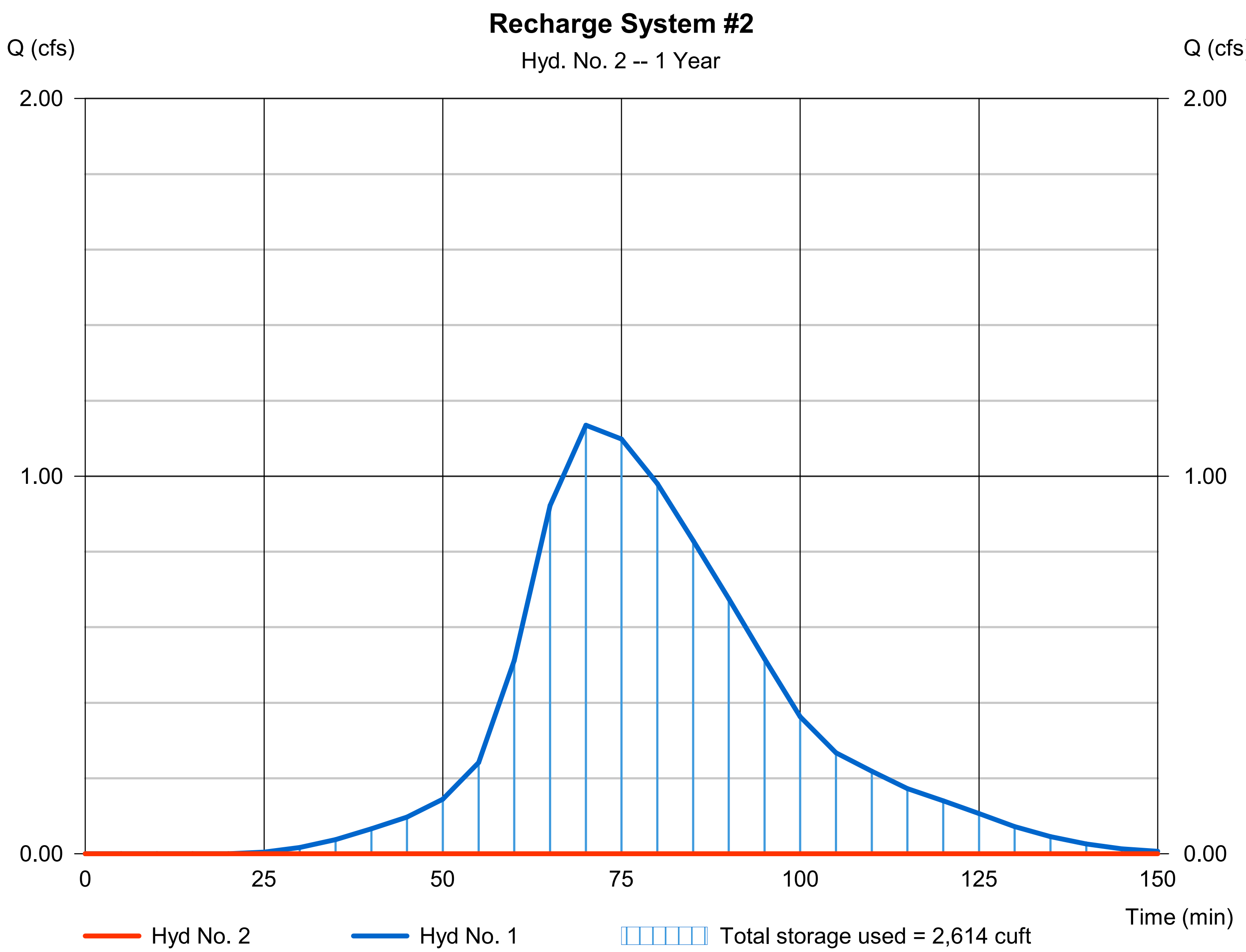
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12 — Monday, 08 / 10 / 2020

Hyd. No. 2

Recharge System #2

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 1 yrs	Time to peak	= n/a
Time interval	= 5 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 1 - Roof 1	Max. Elevation	= 67.21 ft
Reservoir name	= Recharge System 1	Max. Storage	= 2,614 cuft

Storage Indication method used.



Pond No. 2 - Recharge System 1

Pond Data

UG Chambers -Invert elev. = 65.60 ft, Rise x Span = 2.50 x 2.50 ft, Barrel Len = 30.00 ft, No. Barrels = 3, Slope = 0.10%, Headers = Yes
Encasement -Invert elev. = 65.10 ft, Width = 15.00 ft, Height = 3.00 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	65.10	n/a	0	0
0.30	65.40	n/a	311	311
0.61	65.71	n/a	334	645
0.91	66.01	n/a	375	1,019
1.21	66.31	n/a	395	1,414
1.51	66.61	n/a	404	1,818
1.82	66.92	n/a	409	2,227
2.12	67.22	n/a	408	2,635
2.42	67.52	n/a	402	3,036
2.73	67.83	n/a	389	3,426
3.03	68.13	n/a	361	3,787

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .000	.000	.000	n/a
Orifice Coeff.	= 0.00	0.00	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 0.00	0.00	0.00	0.00
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)
TW Elev. (ft) = 0.00

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

Stage / Storage / Discharge Table

Stage ft	Storage 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	65.10	---	---	---	---	---	---	---	---	---	---	0.000
0.30	311	65.40	---	---	---	---	---	---	---	---	---	---	0.000
0.61	645	65.71	---	---	---	---	---	---	---	---	---	---	0.000
0.91	1,019	66.01	---	---	---	---	---	---	---	---	---	---	0.000
1.21	1,414	66.31	---	---	---	---	---	---	---	---	---	---	0.000
1.51	1,818	66.61	---	---	---	---	---	---	---	---	---	---	0.000
1.82	2,227	66.92	---	---	---	---	---	---	---	---	---	---	0.000
2.12	2,635	67.22	---	---	---	---	---	---	---	---	---	---	0.000
2.42	3,036	67.52	---	---	---	---	---	---	---	---	---	---	0.000
2.73	3,426	67.83	---	---	---	---	---	---	---	---	---	---	0.000
3.03	3,787	68.13	---	---	---	---	---	---	---	---	---	---	0.000

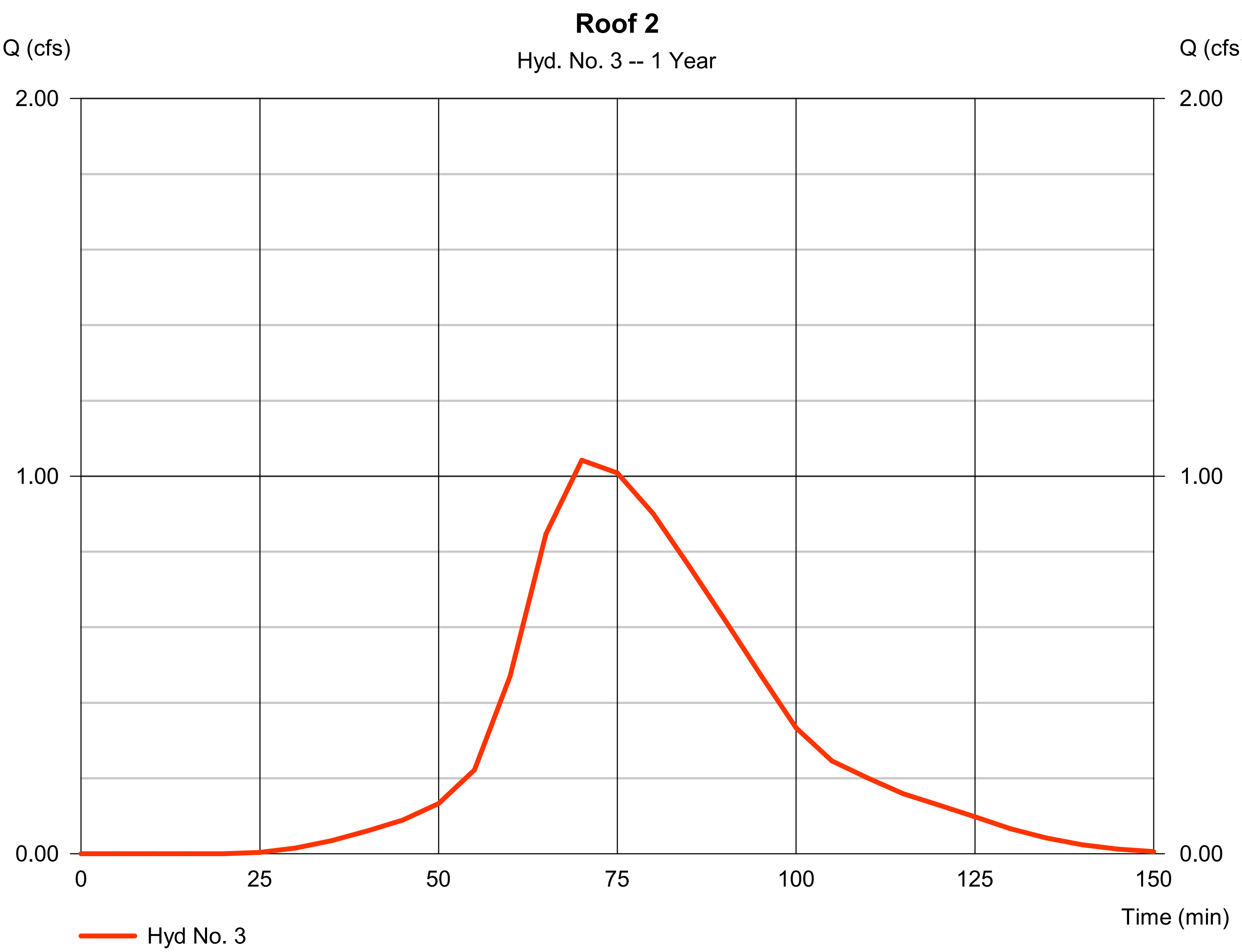
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12 Monday, 08 / 10 / 2020

Hyd. No. 3

Roof 2

Hydrograph type	= SCS Runoff	Peak discharge	= 1.042 cfs
Storm frequency	= 1 yrs	Time to peak	= 70 min
Time interval	= 5 min	Hyd. volume	= 2,400 cuft
Drainage area	= 0.646 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 1.25 in	Distribution	= Custom
Storm duration	= T:\Koldomasov\WQ.cds	Shape factor	= 284



Hydrograph Report

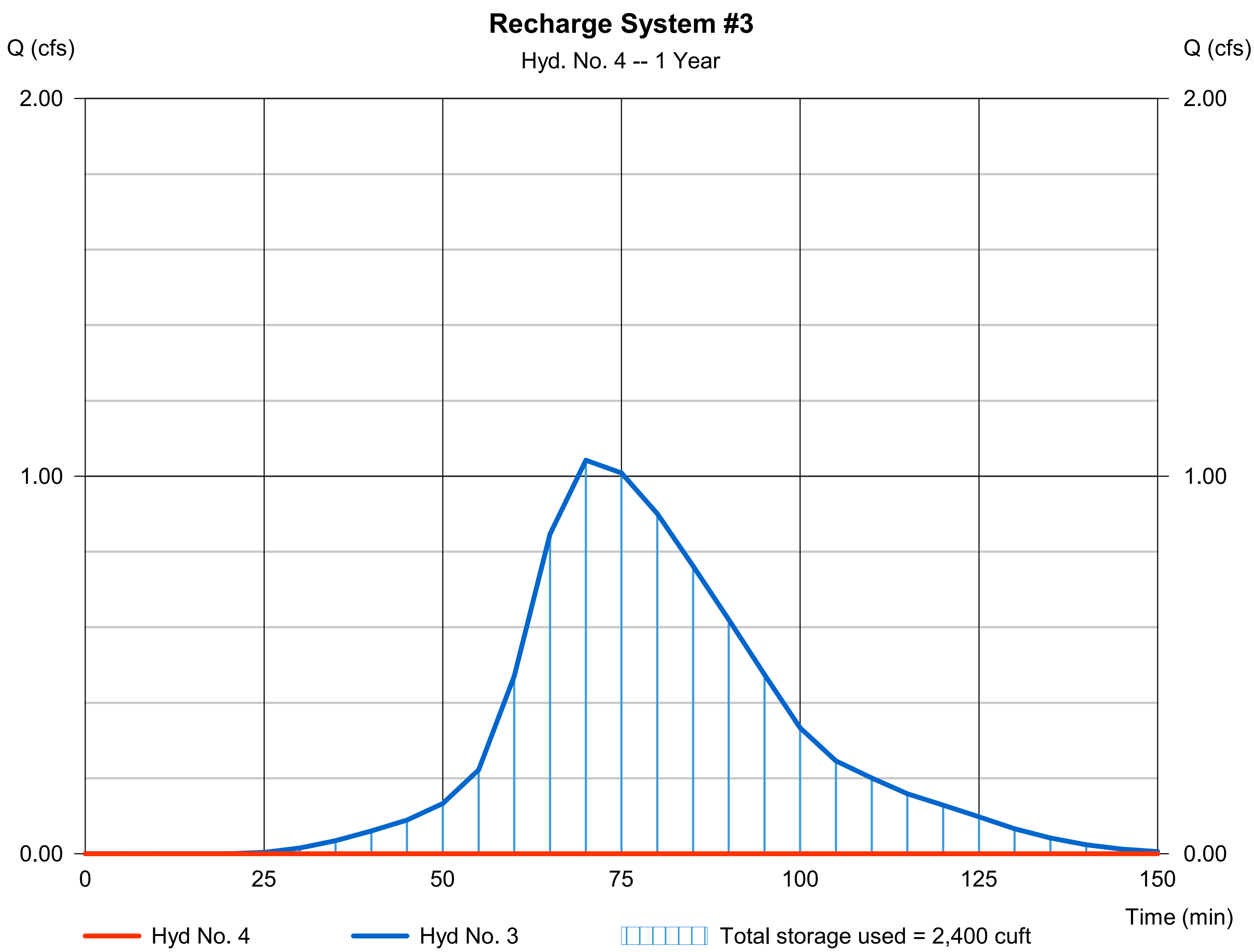
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12 Monday, 08 / 10 / 2020

Hyd. No. 4

Recharge System #3

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 1 yrs	Time to peak	= n/a
Time interval	= 5 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 3 - Roof 2	Max. Elevation	= 65.94 ft
Reservoir name	= Recharge System 2	Max. Storage	= 2,400 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12 Monday, 08 / 10 / 2020

Pond No. 3 - Recharge System 2

Pond Data

UG Chambers -Invert elev. = 64.00 ft, Rise x Span = 2.50 x 2.50 ft, Barrel Len = 75.00 ft, No. Barrels = 2, Slope = 0.10%, Headers = Yes
Encasement -Invert elev. = 63.50 ft, Width = 10.50 ft, Height = 3.00 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	63.50	n/a	0	0
0.31	63.81	n/a	218	218
0.62	64.11	n/a	253	471
0.92	64.42	n/a	298	769
1.23	64.73	n/a	320	1,090
1.54	65.04	n/a	332	1,421
1.85	65.35	n/a	336	1,757
2.15	65.65	n/a	335	2,092
2.46	65.96	n/a	328	2,420
2.77	66.27	n/a	314	2,734
3.08	66.57	n/a	281	3,015

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .000	.000	.000	n/a
Orifice Coeff.	= 0.00	0.00	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 0.00	0.00	0.00	0.00
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)
TW Elev. (ft) = 0.00

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

Stage / Storage / Discharge Table

Stage ft	Storage 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	63.50	---	---	---	---	---	---	---	---	---	---	0.000
0.31	218	63.81	---	---	---	---	---	---	---	---	---	---	0.000
0.62	471	64.11	---	---	---	---	---	---	---	---	---	---	0.000
0.92	769	64.42	---	---	---	---	---	---	---	---	---	---	0.000
1.23	1,090	64.73	---	---	---	---	---	---	---	---	---	---	0.000
1.54	1,421	65.04	---	---	---	---	---	---	---	---	---	---	0.000
1.85	1,757	65.35	---	---	---	---	---	---	---	---	---	---	0.000
2.15	2,092	65.65	---	---	---	---	---	---	---	---	---	---	0.000
2.46	2,420	65.96	---	---	---	---	---	---	---	---	---	---	0.000
2.77	2,734	66.27	---	---	---	---	---	---	---	---	---	---	0.000
3.08	3,015	66.57	---	---	---	---	---	---	---	---	---	---	0.000

CALCULATIONS

Taylor Wiseman & Taylor
ENGINEERS / SURVEYORS / SCIENTISTS

BY: VAK DATE: 8/10/2020 SUBSURFACE STORAGE RECHARGE SYSTEM DRAIN TIME SHEET NO: 1 OF: 1
CHKD. BY: DATE: JOB NO: 17854

STATION PLACE

DRAIN TIME = WATER QUALITY DESIGN STORM RUNOFF VOLUME / SURFACE AREA × SUBSOIL DESIGN PERMEABILITY RATE

SYSTEM 1:

$$\text{DRAIN TIME} = \frac{203\ C.F.}{\left(225\ S.F. \times 10\ \frac{IN}{HR} \times \frac{1\ FT}{12\ IN}\right)} = \underline{1.08\ HRS.}$$

SYSTEM 2:

$$\text{DRAIN TIME} = \frac{158\ C.F.}{\left(200\ S.F. \times 1.31\ \frac{IN}{HR} \times \frac{1\ FT}{12\ IN}\right)} = \underline{7.24\ HRS}$$

SYSTEM 3:

$$\text{DRAIN TIME} = \frac{158\ C.F.}{\left(200\ S.F. \times 1.30\ \frac{IN}{HR} \times \frac{1\ FT}{12\ IN}\right)} = \underline{7.29\ HRS}$$

WOODCREST STATION BUSINESS PARK

SYSTEM 1:

$$\text{DRAIN TIME} = \frac{2,614\ C.F.}{\left(495\ S.F. \times 1.07\ \frac{IN}{HR} \times \frac{1\ FT}{12\ IN}\right)} = \underline{59.22\ HRS}$$

SYSTEM 2:

$$\text{DRAIN TIME} = \frac{2400\ C.F.}{\left(819\ S.F. \times 1.96\ \frac{IN}{HR} \times \frac{1\ FT}{12\ IN}\right)} = \underline{17.94\ HRS}$$

APPENDIX 3

SOIL BORING AND ASSOCIATED INFORMATION

Taylor Wiseman & Taylor
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267-956-1020 phone 267-956-1019 fax
www.taylorwiseman.com

SOIL LOG & PERMEAMETER TESTING RESULTS

Project Name: Lawnside
Test Pit #: TP-1
Location: See Plan
Ground Elevation: 55.0'

Project Number: 17854
Date: April 12, 2018
Soils Described by: J. DiFrank
Test Elevation: 49.0'

Site Information: Block 509, Lot 2 | Borough of Lawnside, Camden County, NJ

SOIL LOG

Bedrock Geology: Belleplain Member (Tkb)
Surficial Geology: Weathered Coastal Plan Formations (Qwcp)

DEPTH (in)	HORIZON	DESCRIPTION (USDA)
0 – 11	A	Root / Organic Layer Dark Brown (7.5 YR 3/2), loamy sand, fine, subangular blocky structure, friable.
11 – 84	B	Strong Brown (7.5 YR 5/8), loamy sand, medium, subangular blocky structure, friable.
84 – 112	C	Red (2.5 YR 4/6), loamy sand, fine, subangular blocky structure, friable w/ weathered rock.

Depth to Seasonal High Water Table: Not Encountered to 112"
Depth to Soil Saturation: Approximately 90"
Depth to Standing Water: Approximately 112"

PERMEAMETER TESTING RESULTS

Methodology Used to Obtain Soil Permeability: Undisturbed, Tube Permeameter Test
Sample Testing Depth: 72 inches
Calculated Soil Permeability Rate: 36.9 inches per hour

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SOIL LOG & PERMEAMETER TESTING RESULTS

Project Name: Lawnside
Test Pit #: TP-18
Location: See Plan
Ground Elevation: 59.5

Project Number: 17854
Date: April 12, 2018
Soils Described by: J. Schmuckler
Test Elevation: 55.3

Site Information: Block 506, Lot 11 | Borough of Lawnside, Camden County, NJ

SOIL LOG

Bedrock Geology: Belleplain Member (Tkb)
Surficial Geology: Weathered Coastal Plan Formations (Qwcp)

DEPTH (in)	HORIZON	DESCRIPTION (USDA)
0 – 8	A	Top Soil, Root Layer
8 – 64	B	Strong Brown (7.5 YR 5/8), loamy sand, medium, subangular blocky structure, friable.
64 – 124	B	Brown Yellow (10 YR 6/6), sandy loam, medium, subangular Blocky structure, friable.

Depth to Seasonal High Water Table: Not Encountered to 124"
Depth to Soil Saturation: Not Encountered to 124"
Depth to Standing Water: Not Encountered to 124"

PERMEAMETER TESTING RESULTS

Methodology Used to Obtain Soil Permeability: Undisturbed, Tube Permeameter Test
Sample Testing Depth: 50 inches
Calculated Soil Permeability Rate: 10.76 inches per hour

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SOIL LOG & PERMEAMETER TESTING RESULTS

Project Name: Lawnside
Test Pit #: TP-20
Location: See Plan
Ground Elevation: 58.1'

Project Number: 17854
Date: December 18, 2018
Soils Described by: J. Schmuckler
Test Elevation: 54.1'

Site Information: Block 506, Lot 11 | Borough of Lawnside, Camden County, NJ

SOIL LOG

Bedrock Geology: Belleplain Member (Tkb)
Surficial Geology: Weathered Coastal Plan Formations (Qwcp)

DEPTH (in)	HORIZON	DESCRIPTION (USDA)
0 – 18	A	Root / Organic Layer Brown (10 YR 4/3), loamy sand, fine, subangular blocky structure, friable.
18 – 64	B	Yellowish Brown (10 YR 5/8), loamy sand, fine, subangular blocky structure, friable.
64 – 126	B	Light Yellowish Brown (10 YR 6/4), loamy sand, fine, subangular blocky structure, friable.

Depth to Seasonal High Water Table:	Not Encountered to 126"
Depth to Soil Saturation:	Not Encountered to 126"
Depth to Standing Water:	Not Encountered to 126"

PERMEAMETER TESTING RESULTS

Methodology Used to Obtain Soil Permeability:	Undisturbed, Tube Permeameter Test
Sample Testing Depth:	48 inches
Calculated Soil Permeability Rate:	1.71 inches per hour

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SOIL LOG & PERMEAMETER TESTING RESULTS

Project Name: Lawnside
Test Pit #: TP-21
Location: See Plan
Ground Elevation: 57.2'

Project Number: 17854
Date: December 18, 2018
Soils Described by: J. Schmuckler
Test Elevation: 51.7'

Site Information: Block 506, Lot 11 | Borough of Lawnside, Camden County, NJ

SOIL LOG

Bedrock Geology: Belleplain Member (Tkb)
Surficial Geology: Weathered Coastal Plan Formations (Qwcp)

DEPTH (in)	HORIZON	DESCRIPTION (USDA)
0 – 18	A	Root / Organic Layer Brown (10 YR 4/3), loamy sand, fine, subangular blocky structure, friable.
18 – 88	B	Yellowish Brown (10 YR 5/8), loamy sand, fine, subangular blocky structure, friable.
88 – 130	B	Yellowish Brown (10 YR 5/6), loamy sand, fine, subangular blocky structure, friable.

Depth to Seasonal High Water Table: Not Encountered to 130"
Depth to Soil Saturation: Not Encountered to 130"
Depth to Standing Water: Not Encountered to 130"

PERMEAMETER TESTING RESULTS

Methodology Used to Obtain Soil Permeability: Undisturbed, Tube Permeameter Test
Sample Testing Depth: 66 inches
Calculated Soil Permeability Rate: 2.63 inches per hour

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SOIL LOG & PERMEAMETER TESTING RESULTS

Project Name: Lawnside
Test Pit #: TP-22
Location: See Plan
Ground Elevation: 59.2'

Project Number: 17854
Date: December 18, 2018
Soils Described by: J. Schmuckler
Test Elevation: 52.2'

Site Information: Block 506, Lot 11 | Borough of Lawnside, Camden County, NJ

SOIL LOG

Bedrock Geology: Belleplain Member (Tkb)
Surficial Geology: Weathered Coastal Plan Formations (Qwcp)

DEPTH (in)	HORIZON	DESCRIPTION (USDA)
0 – 10	A	Root / Organic Layer Brown (10 YR 4/3), loamy sand, fine, subangular blocky structure, friable.
10 – 74	B	Light Yellowish Brown (10 YR 6/4), loamy sand, fine, subangular blocky structure, friable.
74 – 130	B	Yellowish Brown (10 YR 5/6), loamy sand, fine, subangular blocky structure, friable.

Depth to Seasonal High Water Table: Not Encountered to 130"
Depth to Soil Saturation: Not Encountered to 130"
Depth to Standing Water: Not Encountered to 130"

PERMEAMETER TESTING RESULTS

Methodology Used to Obtain Soil Permeability: Undisturbed, Tube Permeameter Test
Sample Testing Depth: 84 inches
Calculated Soil Permeability Rate: 2.61 inches per hour

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SOIL LOG & PERMEAMETER TESTING RESULTS

Project Name: Lawnside
Test Pit #: TP-23
Location: See Plan
Ground Elevation: 60.0'

Project Number: 17854
Date: December 18, 2018
Soils Described by: J. Schmuckler
Test Elevation: 52.5'

Site Information: Block 506, Lot 11 | Borough of Lawnside, Camden County, NJ

SOIL LOG

Bedrock Geology: Belleplain Member (Tkb)
Surficial Geology: Weathered Coastal Plan Formations (Qwcp)

DEPTH (in)	HORIZON	DESCRIPTION (USDA)
0 – 16	A	Root / Organic Layer Brown (10 YR 4/3), loamy sand, fine, subangular blocky structure, friable.
16 – 60	B	Yellowish Brown (10 YR 5/8), loamy sand, fine, subangular blocky structure, friable.
60 – 120	B	Light Yellowish Brown (10 YR 6/4), loamy sand, fine, subangular blocky structure, friable.

Depth to Seasonal High Water Table:	Not Encountered to 120"
Depth to Soil Saturation:	Not Encountered to 120"
Depth to Standing Water:	Not Encountered to 120"

PERMEAMETER TESTING RESULTS

Methodology Used to Obtain Soil Permeability:	Undisturbed, Tube Permeameter Test
Sample Testing Depth:	90 inches
Calculated Soil Permeability Rate:	12.5 inches per hour

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SOIL LOG & PERMEAMETER TESTING RESULTS

Project Name: Lawnside
Test Pit #: TP-24
Location: See Plan
Ground Elevation: 57.5'

Project Number: 17854
Date: December 18, 2018
Soils Described by: J. Schmuckler
Test Elevation: 53.0'

Site Information: Block 506, Lot 11 | Borough of Lawnside, Camden County, NJ

SOIL LOG

Bedrock Geology: Belleplain Member (Tkb)
Surficial Geology: Weathered Coastal Plan Formations (Qwcp)

DEPTH (in)	HORIZON	DESCRIPTION (USDA)
0 – 12	A	Root / Organic Layer Brown (10 YR 4/3), loamy sand, fine, subangular blocky structure, friable.
12 – 78	B	Brownish Yellow (10 YR 6/8), loamy sand, fine, subangular blocky structure, friable.
78 – 130	B	Light Yellowish Brown (10 YR 6/4), loamy sand, fine, subangular blocky structure, friable.

Depth to Seasonal High Water Table: Not Encountered to 130"
Depth to Soil Saturation: Not Encountered to 130"
Depth to Standing Water: Not Encountered to 130"

PERMEAMETER TESTING RESULTS

Methodology Used to Obtain Soil Permeability: Undisturbed, Tube Permeameter Test
Sample Testing Depth: 54 inches
Calculated Soil Permeability Rate: 7.74 inches per hour

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SOIL LOG & PERMEAMETER TESTING RESULTS

Project Name: Lawnside
Test Pit #: TP-25
Location: See Plan
Ground Elevation: 68.6'

Project Number: 17854
Date: December 18, 2018
Soils Described by: J. Schmuckler
Test Elevation: 62.6'

Site Information: Block 506, Lot 11 | Borough of Lawnside, Camden County, NJ

SOIL LOG

Bedrock Geology: Belleplain Member (Tkb)
Surficial Geology: Weathered Coastal Plan Formations (Qwcp)

DEPTH (in)	HORIZON	DESCRIPTION (USDA)
0 – 16	A	Root / Organic Layer Dark Yellowish Brown (10 YR 4/6), loamy sand, fine, subangular blocky structure, friable.
16 – 60	B	Yellow (10 YR 7/6), sand, fine, granular structure, friable.
60 – 132	B	Yellowish Brown (10 YR 5/6), loamy sand, fine, subangular blocky structure, friable.

Depth to Seasonal High Water Table: Not Encountered to 132"
Depth to Soil Saturation: Not Encountered to 132"
Depth to Standing Water: Not Encountered to 132"

PERMEAMETER TESTING RESULTS

Methodology Used to Obtain Soil Permeability: Undisturbed, Tube Permeameter Test
Sample Testing Depth: 72 inches
Calculated Soil Permeability Rate: 16.5 inches per hour

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SOIL LOG & PERMEAMETER TESTING RESULTS

Project Name: Lawnside
Test Pit #: TP-26
Location: See Plan
Ground Elevation: 69.1'

Project Number: 17854
Date: December 18, 2018
Soils Described by: J. Schmuckler
Test Elevation: 63.1'

Site Information: Block 506, Lot 11 | Borough of Lawnside, Camden County, NJ

SOIL LOG

Bedrock Geology: Belleplain Member (Tkb)
Surficial Geology: Weathered Coastal Plan Formations (Qwcp)

DEPTH (in)	HORIZON	DESCRIPTION (USDA)
0 – 8	A	Root / Organic Layer Brown (10 YR 4/3), loamy sand, fine, subangular blocky structure, friable.
8 – 60	B	Yellowish Brown (10 YR 5/8), loamy sand, fine, subangular blocky structure, friable. With band of Yellow (10 YR 7/6), sand, fine, granular structure, friable from 28 – 34".
64 – 125	B	Yellowish Brown (10 YR 5/6), loamy sand, fine, subangular blocky structure, friable.

Depth to Seasonal High Water Table: Not Encountered to 125"
Depth to Soil Saturation: Not Encountered to 125"
Depth to Standing Water: Not Encountered to 125"

PERMEAMETER TESTING RESULTS

Methodology Used to Obtain Soil Permeability: Undisturbed, Tube Permeameter Test
Sample Testing Depth: 72 inches
Calculated Soil Permeability Rate: 6.41 inches per hour

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SOIL LOG & PERMEAMETER TESTING RESULTS

Project Name: Lawnside
Test Pit #: TP-27
Location: See Plan
Ground Elevation: 68.1'

Project Number: 17854
Date: December 18, 2018
Soils Described by: J. Schmuckler
Test Elevation: 64.6'

Site Information: Block 506, Lot 11 | Borough of Lawnside, Camden County, NJ

SOIL LOG

Bedrock Geology: Belleplain Member (Tkb)
Surficial Geology: Weathered Coastal Plan Formations (Qwcp)

DEPTH (in)	HORIZON	DESCRIPTION (USDA)
0 – 8	A	Root / Organic Layer Brown (10 YR 4/3), loamy sand, fine, subangular blocky structure, friable.
8 – 32	B	Yellowish Red (5 YR 5/8) loamy sand, fine, subangular blocky structure, friable.
32 – 128	B	Yellowish Brown (10 YR 5/8), loamy sand, fine, subangular blocky structure, friable.

Depth to Seasonal High Water Table: Not Encountered to 128"
Depth to Soil Saturation: Not Encountered to 128"
Depth to Standing Water: Not Encountered to 128"

PERMEAMETER TESTING RESULTS

Methodology Used to Obtain Soil Permeability: Undisturbed, Tube Permeameter Test
Sample Testing Depth: 42 inches
Calculated Soil Permeability Rate: 2.14 inches per hour

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SOIL LOG & PERMEAMETER TESTING RESULTS

Project Name: Lawnside
Test Pit #: TP-28
Location: See Plan
Ground Elevation: 63.3'

Project Number: 17854
Date: December 18, 2018
Soils Described by: J. Schmuckler
Test Elevation: 58.8'

Site Information: Block 506, Lot 11 | Borough of Lawnside, Camden County, NJ

SOIL LOG

Bedrock Geology: Belleplain Member (Tkb)
Surficial Geology: Weathered Coastal Plan Formations (Qwcp)

DEPTH (in)	HORIZON	DESCRIPTION (USDA)
0 – 8	A	Root / Organic Layer Brown (10 YR 4/3), loamy sand, fine, subangular blocky structure, friable.
8 – 80	B	Yellowish Brown (10 YR 5/6), loamy sand, fine, subangular blocky structure, friable.
80 – 130	B	Yellow (10 YR 7/6), sand, fine, granular structure, friable.

Depth to Seasonal High Water Table: Not Encountered to 130"
Depth to Soil Saturation: Not Encountered to 130"
Depth to Standing Water: Not Encountered to 130"

PERMEAMETER TESTING RESULTS

Methodology Used to Obtain Soil Permeability: Undisturbed, Tube Permeameter Test
Sample Testing Depth: 54 inches
Calculated Soil Permeability Rate: 3.92 inches per hour

APPENDIX 4

SOIL CONSERVATION SERVICE COUNTY SOIL SURVAY REPORT

Series 1961, No. 42

Issued April 1966

SOIL SURVEY

Camden County New Jersey

OUR SOIL * OUR STRENGTH

This is the last report of the 1961 series.

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
NEW JERSEY AGRICULTURAL EXPERIMENT STATION

vegetables and to general farm crops. Most areas have been cleared for farming.

In Camden County, Dragston soils are mapped only in an undifferentiated group, Woodstown and Dragston sandy loams, 0 to 3 percent slopes. The Woodstown soils are described under the Woodstown series.

Fallsington Series

The Fallsington series consists of grayish-colored, poorly drained, moderately coarse textured soils that are generally prominently mottled. They are in the southeastern part of the county in low positions and have slopes of less than 1 percent. Runoff is slow, and some areas are ponded.

The natural vegetation consists of pin, willow, and swamp white oaks and red maple. If seed trees are nearby, idle fields are rapidly seeded to pitch pine. There is generally a dense undergrowth of highbush blueberry, sheep laurel, gallberry, sweet pepperbush, and other shrubs.

A representative profile of Fallsington sandy loam has a dark-gray plow layer about 10 inches thick. The subsoil is grayish-brown sandy loam that is mottled with dark yellowish brown and has slightly more clay than the plow layer. It extends to a depth of about 24 inches. The underlying material is loose, light brownish-gray coarse loamy sand.

The subsoil ranges from sandy loam to sandy clay loam in texture. In places it extends to a depth of 30 to 36 inches. It ranges from gray to yellowish brown in color. In places the substratum has brighter colors. Rounded quartzose pebbles are common in the underlying material. The content ranges from 0 to 5 percent, by volume. Also in some areas the underlying material contains discontinuous lenses of clay, but it was not feasible to map these areas separately.

In their natural state, the Fallsington soils are extremely acid, but some farmed fields have been limed and are now less acid. Also, these soils are almost constantly wet. In winter the water table is near the surface; in summer it is about 2 feet below the surface. The soils are moderately permeable. Generally, tile drains or open ditches can be used to lower the water table. Because of the loose material in the substratum, deep ditches, especially in shallow soils, require careful management to prevent ditchbanks from caving in.

The Fallsington soils occur beside the Pocomoke, Woodstown, and Dragston soils. They are grayer than the Woodstown and Dragston soils. They are not so dark in the surface layer as the Pocomoke soils.

Without drainage, the Fallsington soils are not suitable for any kind of farming. If drained, they are suitable for blueberries and for annual vegetables that can withstand short periods of subsoil saturation. They are also suitable for general crops and pasture. The soils generally cannot be drained well enough to produce high-value perennial crops, such as asparagus, fruit, or alfalfa. They are generally suitable as sites for ponds that are supplied by groundwater.

(Fd) **Fallsington sandy loam.**—A profile of this soil is described for the Fallsington series. Small areas of Pocomoke sandy loam, Dragston sandy loam, and small areas of Fallsington loam are included with this soil in mapping. In some circular depressions, clay layers occur between a depth of 30 and 60 inches from the surface. In these areas groundwater recharge may be slow if groundwater ponds are constructed. (Capability unit IIIw-21; woodland suitability group 4; urban group 9)

Freehold Series

The Freehold series consists of dark grayish-brown, well-drained, sandy soils that are low in glauconite. They occur in high positions in the western part of the county. Their subsoil is dark yellowish brown or brown. The substratum is stratified material that is mostly loamy sand but that also contains thin layers of sandy loam and clayey material. The finer material generally has a reddish color derived from iron coatings. Generally, the soils contain little quartzose gravel.

The natural vegetation consists mostly of red oak, beech, and yellow-poplar.

A typical profile of Freehold soil has a dark grayish-brown fine sandy loam plow layer 9 inches thick; a yellowish-brown fine sandy loam subsurface layer 6 inches thick; a dark yellowish-brown sandy clay loam subsoil 20 inches thick; and underlying layers of mostly stratified loamy sand and sandy loam. The underlying layers range in color from light olive brown to strong brown in places where the sand grains are coated with iron. There are thin ironstone sheets in some lower layers.

The subsoil ranges from fine sandy loam to sandy clay loam in texture. In high positions where oxidation takes place readily, the colors of the subsoil are somewhat redder than those in the typical Freehold soil. The thickness of the solum ranges from 30 to 42 inches. As a rule, Freehold soils contain little gravel (fig. 5).

The Freehold soils naturally are extremely acid, but some farmed fields have been limed and are now less acid. The soils are moderately fertile, moderately permeable, and have a moderate to good water-holding capacity.

Freehold soils occur beside the Holmdel, Shrewsbury, and Collington soils. They lack the mottling common in Holmdel and Shrewsbury soils. They contain less glauconite than Collington soils.

Nearly all the Freehold soils that have favorable slopes have been cleared for farming. They are highly prized for growing fruit, high-value vegetables, and nursery crops, as well as general crops of corn, small grain, hay, and soybeans.

(FfA) **Freehold fine sandy loam, 0 to 2 percent slopes.**—A profile of this soil is described as typical of the Freehold series. Included with this soil in mapping are small areas of Holmdel soils in depressions. These areas may need drainage if crops of high value are to be grown. Also included are areas that contain remnants of more recently deposited material. This material is redder and contains more gravel and less glauconite than normal for Freehold soils, and the sand is generally coarser. The same crops can be grown on this material, but the soil is less fertile and more droughty.

This soil is highly favorable to farming, as there is little erosion hazard and only minor problems of drainage in small areas. The use of cover crops or sod crops is needed to maintain a large amount of organic matter and a porous plow layer.

In places this soil is underlain by clay between a depth of 30 and 60 inches. The clay may cause the layer above to be saturated for brief periods. If this soil is used for a homesite, the clayey layer could cause basement seepage and restrict the use of the soil as a septic field. (Capability unit I–5; woodland suitability group 1; urban group 1)

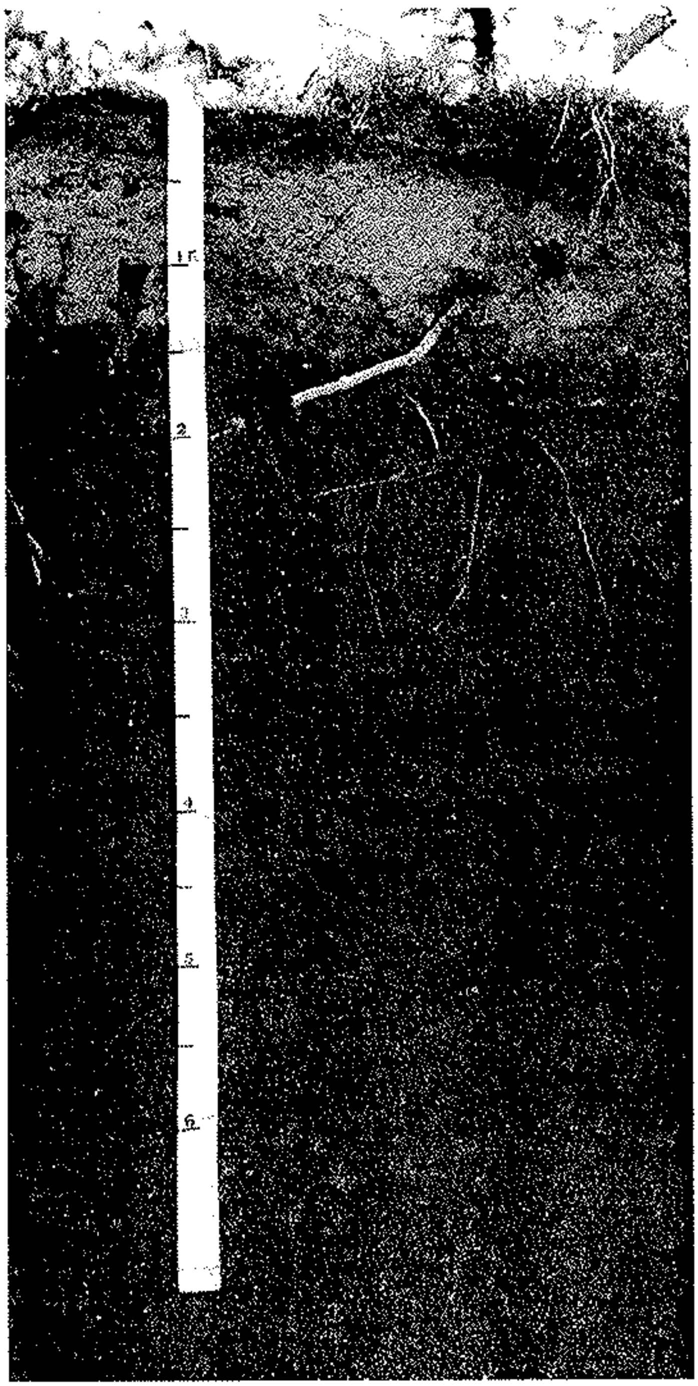


Figure 5.—**A profile of Freehold loamy fine sand showing the loose surface layer.**

(FfB) **Freehold fine sandy loam, 2 to 5 percent slopes.**—Because this soil is more sloping than Freehold fine sandy loam, 0 to 2 percent slopes, runoff is more rapid and organic-matter content is more difficult to maintain. Unless erosion is controlled, it limits crop production. Contour planting, cover crops, and sod crops can be used to reduce the erosion hazard.

This soil is well suited to most urban uses. If underlying clay layers are present, however, they may cause basement seepage and slight problems in septic fields. (Capability unit IIe–5; woodland suitability group 1; urban group 1)

(FfC) **Freehold fine sandy loam, 5 to 10 percent slopes.**—Runoff is rapid on this sloping and strongly sloping soil. If not controlled, erosion is a serious hazard in plowed fields. In some fields erosion has removed part of the surface layer and has cut gullies. Yields of these fields are low, and soil management is more difficult. Contour planting, cover crops, and diversion terraces are practices that help to reduce the erosion hazard in cropped areas. In pasture land and in woodland, however, erosion is not a problem.

If this soil is used for homesites, erosion is a problem in establishing lawns. In some areas sodding may be required. The slope of this soil should be considered in the design of septic fields. (Capability unit IIIe–6; woodland suitability group 1; urban group 4)

(FhB) **Freehold loamy fine sand, 0 to 5 percent slopes.**—The total thickness of the surface and subsurface layers of this soil is about 18 inches. The surface layer is loose and therefore is subject to wind erosion. The subsoil contains considerably more clay than the surface soil. Because of the clay content, the subsoil is moderately permeable and has moderate available moisture holding capacity. This soil generally contains little or no gravel. Some areas that have a surface layer of sand are included with this soil in mapping.

This soil warms readily in spring and is well suited to early crops. Most crops of high value grown on this soil are irrigated. Because most slopes are short, there is little hazard of water erosion. Some erosion control practices may be needed on long slopes. Cover crops, wind stripcrops, and privet windbreaks can be used to reduce wind erosion

If this soil is used for homesites, drought-resistant grasses should be grown in lawns, and water and fertilizer should be regularly applied. (Capability unit IIs–6; woodland suitability group 1; urban group 2)

(FhC) **Freehold loamy fine sand, 5 to 10 percent slopes.**—This soil is like Freehold loamy fine sand, 0 to 5 percent slopes. It has stronger slopes than that soil, runoff is more rapid, and cultivated areas are more likely to have gullies and a thinner surface layer. This soil is more droughty than the less sloping Freehold loamy fine sand. Water erosion is more of a problem on this soil than wind erosion. Contour farming can be used to reduce water erosion.

If this soil is used for homesites, erosion is a problem in establishing a lawn. In some places sodding may be needed. Drought-resistant grasses should be grown, and water and fertilizer should be applied regularly to lawns and landscape plants. The slope should be considered in designing a septic field on this soil. (Capability unit IIIe–6; woodland suitability group 1; urban group 4)

(FnB) **Freehold sand, thick surface variant, 0 to 5 percent slopes.**—The total thickness of the surface and subsurface layers of this soil exceeds 30 inches. These layers are made up of loose sand. Because of the extreme thickness of the sand, this soil has little in common with the other Freehold soils. The sand makes it less fertile and and more droughty than the other Freehold soils. It is also more likely to be eroded by wind. The subsoil, however, contains enough clay to prevent rapid percolation of water and the leaching of added fertilizer. This clayey layer is about 1 foot thick and is underlain by loamy sand.

This soil is best suited to peach trees, apple trees, and grapevines, and other deep-rooted perennial plants. It is too sandy and droughty for pasture.

If this soil is used for homesites, the establishment of lawn grasses and landscape plants is severely limited, as the soil is droughty and infertile. Drought-resistant grasses or warm-climate grasses can be established by using plugs. Deep-rooted landscape plants are needed. Water and fertilizers should be applied frequently. (Capability unit IIIs–7; woodland suitability group 3; urban group 2)

(FsE) **Freehold soils, 15 to 30 percent slopes.**—These soils are chiefly in narrow bands on steep banks adjacent to streams. Nearly all the acreage is forested. Because of steepness and erosion, alternate layers of geologic deposits that have not been greatly altered by the soil-forming processes are exposed at the surface. The deposits are mainly sandy, though in places they are finer textured. Seeps occur if the sand lies over finer material. Runoff is rapid. Because of the erosion hazard, it would be better if these soils were not cleared for farming.

These soils generally occur near streams and have been developed in places as part of a park. (Capability unit VIe–5; woodland suitability group 1; urban group 11)

(FtD) **Freehold and Collington soils, 10 to 15 percent slopes.**—This group is composed mostly of Freehold fine sandy loam and Freehold loamy fine sand, but it also contains Collington soils of the same textures. In places, however, the soils are underlain by clayey deposits that cause seeps. Because the slopes are steep, runoff is rapid.

Small areas have been cleared for farming. The erosion hazard is very high in cultivated fields, and contour planting, hay strips, or diversion terraces are needed. In a few fields gullies have formed. In areas used for pasture and woodland, however, the erosion hazard is only slight. (Capability unit IVe–6; woodland suitability group 1; urban group 11)

(FxB) **Freehold and Downer-Urban land complex, gently sloping**—This mapping unit consists of Freehold and Downer soils in urban areas where it was impractical to map each soil separately. The Freehold soils are more extensive than the Downer soils. The slope ranges from 0 to 5 percent.

The soils in this complex are in urban or suburban use. Most areas are residential, but some are commercial, and some are idle. In the older developed areas where construction was mainly of single units, disturbance of the soil was restricted to the immediate location of the unit. In the newer areas, the disturbance has affected the entire area through stockpiling of surface soil, grading or leveling the area, excavating for foundations, and then replacing the surface soil after construction was finished. (Urban group 1, Freehold and Urban land parts; urban group 2, Downer part)

(FxC) **Freehold and Downer-Urban land complex, sloping.**—Except for stronger slopes, this complex is similar to Freehold and Downer-Urban land complex, gently sloping. The slope ranges from 5 to 15 percent.

Erosion of the soils in this complex is a problem. Also, the septic fields are more difficult to install on these soils than on the less sloping soils, and they do not function so well. (Urban group 4)

(Fy) **Freehold and Downer, clayey substrata,-Urban land complex.**—This unit contains either Freehold or Downer soils; the two seldom occur together in one area. Generally these soils are gently sloping (0 to 5 percent), but some steeper areas are included in mapping.

The Freehold and Downer soils in this unit are similar to the ones described as typical of their respective series, except that they have underlying layers of clay or sandy clay between a depth of 30 and 60 inches. The clayey layers range from 3 to 24 inches in thickness. They reduce the permeability of the substratum and thereby trap water in wet seasons. Thus basement seepage may be a problem for buildings on this unit. Drainage to a depth below 4 feet is needed on land in this unit that is used for a septic field. (Urban group 1, Freehold and Urban land parts; urban group 2, Downer part)

Holmdel Series

The Holmdel series consists of dark grayish-brown, moderately well drained to somewhat poorly drained soils that have a mottled yellowish-brown or light olive-brown subsoil and a stratified substratum. The soils contain a small amount of glauconite. They are on slopes where the water table rises into the subsoil in winter but drops to a depth of 3 feet or more in summer. These soils are in the western part of the county.

The natural vegetation consists mostly of red, scarlet, and white oaks, yellow-poplar, beech, and hickory. In the somewhat poorly drained areas, however, pin oak, willow oak, and sweetgum predominate. The natural shrubs are viburnum and spicebush.

A typical profile of Holmdel soil has a dark grayish-brown, fine sandy loam plow layer 10 inches thick, and a yellowish-brown or light olive-brown, prominently mottled, fine sandy loam subsoil about 24 inches thick. The subsoil is slightly more clayey than the surface layer. Below the subsoil is mostly stratified, olive-colored loamy sand and sandy loam extending to a depth of 60 inches.

In moderately well drained areas, mottling is in the lower part of the subsoil only, but in the somewhat poorly drained areas, it is in the upper part. The subsoil ranges from sandy loam to sandy clay loam in texture, though the sandy loam is more common. In places the subsoil is not so thick as that in the typical profile described. The texture and color of the stratified material varies widely from place to place. Normally, rounded quartzose gravel is not common in Holmdel soils. In places the soils have a pale subsurface layer between the plow layer and the subsoil.

The Holmdel soils naturally are extremely acid, but some farmed fields have been heavily limed and are now less acid. The soils are generally permeable enough to be drained efficiently by tile.

The Holmdel soils occur beside the Freehold, Collington, and Shrewsbury soils. Mottling in the subsoil dis-

TABLE 6.—*Engineering*

Soil type	Sampling site			Depth	Test results				
					Sieve analysis				
					Cumulative percentage passing—				
	Site number	Latitude	Longitude		¾ inch	No. 4 (4.7 mm.)	No. 10 (2 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)
		Degrees, minutes, seconds	*Degrees, minutes, seconds*	*Inches*					
Lakewood sand.	26	39°40′21″	74°53′28″	0 to 4	100	100	98	62	8
				4 to 18	100	94	84	40	6
				18 to 72	100	98	90	51	9
Lakewood sand.	47	39°52′15″	74°57′10″	0 to 16	98	94	91	18	5
				16 to 70	100	98	95	21	3
				70 to 84	100	98	95	21	3
Shrewsbury fine sandy loam.	48	39°51′35″	75°04′30″	0 to 8	100	100	98	83	36
				8 to 68	100	100	100	95	48
				68 to 120	100	100	100	96	38

[1] NL used in this column means nonliquid.
[2] NP used in this column means nonplastic.

TABLE 7.—*Brief description of the soils and*

Map symbol	Soil name [1]	Depth to seasonally high water table	Description of soil	Depth from surface
				Inches
AmA AmB ArA ArB	Aura loamy sand, 0 to 2 percent slopes. Aura loamy sand, 2 to 5 percent slopes. Aura sandy loam, 0 to 2 percent slopes. Aura sandy loam, 2 to 5 percent slopes.	5 to 10 feet.	About 1 to 1½ feet of loamy sand or sandy loam over 1 to 2½ feet of firm sandy clay loam; underlain by stratified sandy loam; contains rounded quartzose gravel up to 2 inches in diameter and from 2 to 20 percent by volume; normally in high positions.	0–15 15–40 40–60
AtB	Aura-Downer loamy sands, 0 to 5 percent slopes.	------------	For data on the Aura soils, see Aura loamy sand and Aura sandy loam; for data on the Downer soils, see Downer loamy sand and Downer sandy loam.	
AvB	Aura-Downer sandy loams, 0 to 5 percent slopes.			
Ax	Aura-Urban land complex (Urban part).	5 to 10 feet.	Urban land consists of variable material that ranges from sandy loam to sandy clay loam; normally in high positions; slope generally ranges from 0 to 5 percent. For data on Aura part, see Aura sandy loam and Aura loamy sand.	0–60
Cm	Colemantown loam.	1 foot.	About 1 foot of highly organic loam over 2 feet of sandy clay; underlain by stratified sandy clay and sandy loam; in very low positions; slope ranges from 0 to 1 percent.	0–10 10–36 36–60
CoA CoB	Collington fine sandy loam, 0 to 2 percent slopes. Collington fine sandy loam, 2 to 5 percent slopes.	5 to 10 feet or more.	About 1 foot of fine sandy loam over 1½ feet of fine sandy clay loam; underlain by stratified loamy sand and sandy loam; in high positions.	0–13 13–32 32–60

See footnotes at end of table.

test data—Continued

Test results—Continued						Classification		
Hydrometer analysis		Liquid limit [1]	Plasticity index [2]	Maximum density	Optimum moisture content	AASHO		Unified [3]
0.05–0.005 mm.	<0.005 mm.					Group	Group index	
Percent	*Percent*	*Percent*	*Percent*	*Lb. per cu. ft.*	*Percent*			
		NL	NP			A–3	0	SP–SM.
		NL	NP			A–1–b	0	SP–SM.
		NL	NP			A–3	0	SP–SM.
		NL	NP			A–1–b	0	SP–SM.
		NL	NP	108	17	A–1–b	0	SP.
		NL	NP	107	17	A–1–b	0	SP.
		NL	NP			A–4	0	SM.
		NL	NP			A–4	3	SM.
		NL	NP			A–4	1	SM.

[3] SCS and BPR have agreed to consider that all soils having plasticity indexes within two points from the A-line are to be given a borderline classification. Examples on borderline classifications obtained by this use are SM–SC and CL–ML.

[4] Howell loam in this test represents the Howell part of the Howell-Urban land complex of soils.

their estimated physical and chemical properties

Classification			Mechanical analysis				Permeability	Available water capacity	Reaction [2]	Shrink-swell potential
			Percentage passing sieve—							
USDA texture	Unified	AASHO	No. 4	No. 10	No. 40	No. 200				
							Inches per hour	*Inches per inch of soil*	*pH*	
Loamy sand or sandy loam.	SP–SM or SM.	A–1, A–2, or A–3.	60–100	50–90	30–70	5–30	0.2–2.0	0.08–0.15	4.0–4.5	Low.
Sandy clay loam	SM or SC	A–2 or A–4	60–100	60–90	30–70	20–40	0.2–0.63	0.12	4.5–5.0	Low to moderate.
Sandy loam	SM or SC	A–2 or A–3	50–90	50–90	30–70	10–30	0.63–2.0	0.08	4.5–5.0	Low.
Sandy loam or sandy clay loam.	SM or SC	A–2	70–90	70–90	40–70	10–30	2.0–6.3	0.12	4.5–5.0	Low.
Loam	ML or OL	A–4	95–100	95–100	80–90	50–60	0.2–0.63	[4] 0.24	4.0–4.5	Low.
Sandy clay	CL or CH	A–7	95–100	95–100	80–90	60–80	0.2–0.63	[4] 0.24	4.5–5.0	Moderate.
Sandy loam and sandy clay.	SM, SC, or ML	A–4	90–100	90–100	70–90	40–70	0.63–2.0	[4] 0.20	4.5–7.0	Low to moderate.
Fine sandy loam.	SM	A–2 or A–4	95–100	95–100	85–95	30–50	0.2–2.0	0.20	4.0–4.5	Low.
Fine sandy clay loam.	SM, SC, or ML.	A–6	95–100	95–100	85–95	35–55	0.2–0.63	0.22	4.5–5.0	Moderate.
Loamy sand and sandy loam.	SP–SM	A–2 or A–4	95–100	95–100	80–90	20–40	0.63–2.0	0.16	4.5–5.0	Low.

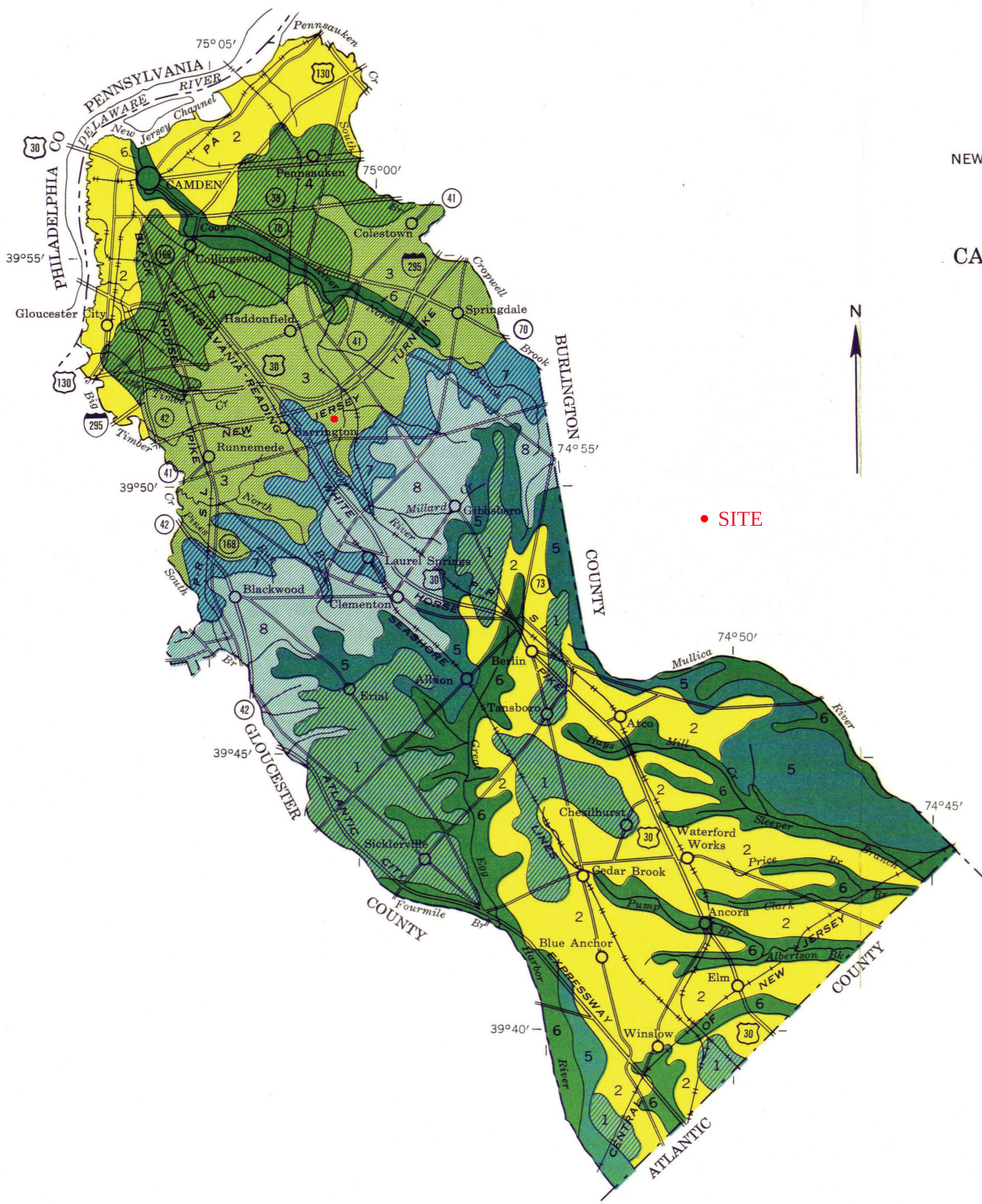
TABLE 7.—*Brief description of the soils and their*

Map symbol	Soil name [1]	Depth to seasonally high water table	Description of soil	Depth from surface
				Inches
DoA DsA DsB DtC DxC	Downer loamy sand, 0 to 5 percent slopes. Downer sandy loam, 0 to 2 percent slopes. Downer sandy loam, 2 to 5 percent slopes. Downer soils, 5 to 10 percent slopes. Downer-Aura complex, 5 to 10 percent slopes (Downer part).	5 to 10 feet.	About 1 to 1½ feet of loamy sand or sandy loam over 1 foot of sandy loam; underlain by stratified, loose loamy sand or sand; in places, contains rounded quartzose gravel up to 2 inches in diameter and 1 to 5 percent by volume; in intermediate positions. For data on the Aura part of Downer-Aura complex, see Aura loamy sand and Aura sandy loam.	0–18 18–30 30–60
DrA	Downer loamy sand, clayey substratum, 0 to 5 percent slopes.	5 to 10 feet.	About 1½ feet of loamy sand over 1 foot of sandy loam; underlain by stratified loamy sand and sandy loam that contain layers of sandy clay; in intermediate positions.	0–16 16–30 30–60
Fd	Fallsington sandy loam.	1 foot.	About 2 feet of sandy loam over stratified loamy sand and sandy loam; in places, contains small amount of rounded quartzose gravel up to 2 inches in diameter; soil is in low positions; slope ranges from 0 to 2 percent; soil originally ponded from late in fall until early in spring.	0–24 24–60
FfA FfB FfC FhB FhC FsE FtD	Freehold fine sandy loam, 0 to 2 percent slopes. Freehold fine sandy loam, 2 to 5 percent slopes. Freehold fine sandy loam, 5 to 10 percent slopes. Freehold loamy fine sand, 0 to 5 percent slopes. Freehold loamy fine sand, 5 to 10 percent slopes. Freehold soils, 15 to 30 percent slozes. Freehold and Collington soils, 10 to 15 percent slopes (Freehold part).	5 to 10 feet or more.	Freehold soils have about 1 or 1½ feet of fine sandy loam or loamy fine sand over loamy sand or sandy loam; underlain by stratified loamy fine sand and sandy loam, weakly cemented with iron in places; in high positions. For data on Collington soil in Freehold and Collington soils, see Collington fine sandy loam.	0–15 15–42 42–60
FnB	Freehold sand, thick surface variant, 0 to 5 percent slopes.	5 to 10 feet or more.	About 2½ feet of loose sand over 1 to 1¼ feet of fine sandy loam; underlain by stratified loamy fine sand and fine sandy loam; in high positions.	0–30 30–40 40–60
FxB FxC	Freehold and Downer-Urban land complex, gently sloping (Urban land part). Freehold and Downer-Urban land complex, sloping (Urban land part).	5 feet or more.	About 5 feet of mixed loamy sand and sandy loam; in high positions; slope ranges from 0 to 5 percent. For data on Freehold part of this complex, see Freehold fine sandy loam and Freehold loamy fine sand. For data on Downer part, see Downer loamy sand and Downer sandy loam.	0–60
Fy	Freehold and Downer, clayey substrata, Urban land complex (Urban land part).	3 feet or more.	About 2 to 3 feet of mixed loamy sand or sandy loam underlain by layers of sandy clay; in high positions. For data on Freehold part of this complex, see Freehold fine sandy loam. For data on Downer part, see Downer loamy sand, clayey substratum.	0–30 30–60
HdA HfA	Holmdel fine sandy loam, 0 to 3 percent slopes. Holmdel loamy fine sand, 0 to 3 percent slopes.	2 to 3 feet.	About 10 inches to 1¼ feet of fine sandy loam or loamy fine sand over 1½ to 2 feet of fine sandy loam or fine sandy clay loam; underlain by stratified fine sandy loam and loamy fine sand; in intermediate positions.	0–10 10–34 34–60

See footnotes at end of table.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NEW JERSEY AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
CAMDEN COUNTY, NEW JERSEY



Scale 1:190,080

1 0 1 2 3 4 Miles

SOIL ASSOCIATIONS

1 Aura-Downer association: Gently sloping gravelly and sandy soils

2 Downer-Woodstown-Dragston association: Gently sloping, grayish-brown sandy soils

3 Freehold-Holmdel-Collington association: Gently to strongly sloping soils from greensand

4 Howell-Urban land association: Gently sloping, brown silty and clayey soils

5 Lakewood-Lakehurst-Lakeland association: Level to steep, gray sandy soils

6 Muck-Alluvial land association: Wet soils mainly along streams

7 Marlton-Kresson association: Gently sloping to steep, olive clay soils

8 Westphalia-Nixonton-Barclay association: Nearly level to steep, fine sandy soils

July 1965

SOIL LEGEND

The first letter in each symbol is the initial of the soil name. A second capital letter, A, B, C, D, or E shows the slope. Most symbols without a slope letter are for nearly level soils, but some are for soils that have considerable range in slope. A final number, 3, in a symbol shows that the soil is severely eroded.

SYMBOL	NAME
AmA	Aura loamy sand, 0 to 2 percent slopes
AmB	Aura loamy sand, 2 to 5 percent slopes
ArA	Aura sandy loam, 0 to 2 percent slopes
ArB	Aura sandy loam, 2 to 5 percent slopes
AtB	Aura-Downer loamy sands, 0 to 5 percent slopes
AvB	Aura-Downer sandy loams, 0 to 5 percent slopes
Ax	Aura-Urban land complex
Ca	Clay pits
Cm	Colemantown loam
CoA	Collington fine sandy loam, 0 to 2 percent slopes
CoB	Collington fine sandy loam, 2 to 5 percent slopes
DoA	Downer loamy sand, 0 to 5 percent slopes
DrA	Downer loamy sand, clayey substratum, 0 to 5 percent slopes
DsA	Downer sandy loam, 0 to 2 percent slopes
DsB	Downer sandy loam, 2 to 5 percent slopes
DtC	Downer soils, 5 to 10 percent slopes
DxC	Downer-Aura complex, 5 to 10 percent slopes
Fd	Fallsington sandy loam
FfA	Freehold fine sandy loam, 0 to 2 percent slopes
FfB	Freehold fine sandy loam, 2 to 5 percent slopes
FfC	Freehold fine sandy loam, 5 to 10 percent slopes
FhB	Freehold loamy fine sand, 0 to 5 percent slopes
FhC	Freehold loamy fine sand, 5 to 10 percent slopes
FnB	Freehold sand, thick surface variant, 0 to 5 percent slopes
FsE	Freehold soils, 15 to 30 percent slopes
FtD	Freehold and Collington soils, 10 to 15 percent slopes
FxB	Freehold and Downer-Urban land complex, gently sloping
FxC	Freehold and Downer-Urban land complex, sloping
Fy	Freehold and Downer, clayey substrata, -Urban land complex
HdA	Holmdel fine sandy loam, 0 to 3 percent slopes
HfA	Holmdel loamy fine sand, 0 to 3 percent slopes
Hm	Holmdel, clayey substratum, -Urban land complex
Hn	Holmdel-Urban land complex
HoB	Howell-Urban land complex, gently sloping
HoC	Howell-Urban land complex, sloping
KmA	Klej loamy sand, 0 to 2 percent slopes
KrA	Kresson sandy loam, 0 to 3 percent slopes
LaA	Lakehurst sand, 0 to 3 percent slopes
LbA	Lakehurst-Lakewood association, 0 to 5 percent slopes
LcB	Lakeland fine sand, firm substratum, 0 to 5 percent slopes
LdA	Lakeland sand, 0 to 5 percent slopes
LeA	Lakeland sand, water table, 0 to 2 percent slopes
LfB	Lakewood fine sand, 0 to 5 percent slopes
LfC	Lakewood fine sand, 5 to 10 percent slopes
LfD	Lakewood fine sand, 10 to 25 percent slopes
LgB	Lakewood sand, 0 to 5 percent slopes
LgC	Lakewood sand, 5 to 10 percent slopes
LhE	Lakewood and Lakeland sands, 10 to 30 percent slopes
Lo	Leon sand
Ls	Leon-St. Johns sands
Lv	Loamy alluvial land
Ma	Made land
McC3	Marlton soils, 5 to 10 percent slopes, severely eroded
Mk	Marlton and Kresson-Urban land complex
MrA	Marlton sandy loam, 0 to 2 percent slopes
MrB	Marlton sandy loam, 2 to 5 percent slopes
MmB	Matawan loamy sand, 0 to 5 percent slopes
MnA	Matawan sandy loam, 0 to 2 percent slopes
MnB	Matawan sandy loam, 2 to 5 percent slopes
Mo	Moderately wet land
Mu	Muck
NbA	Nixonton and Barclay fine sandy loams, 0 to 3 percent slopes
NcA	Nixonton and Barclay loamy fine sands, 0 to 5 percent slopes
Pa	Pasquotank fine sandy loam
Pc	Pasquotank and Weeksville-Urban land complex
Ps	Pocomoke sandy loam
Sa	St. Johns sand
Sc	St. Johns sand, clayey substratum
Sg	Sand and gravel pits
Sv	Sandy alluvial land
Sw	Shrewsbury fine sandy loam
Sx	Shrewsbury-Urban land complex
Tm	Tidal marsh-Made land complex
Um	Urban-Moderately wet land complex
Wd	Weeksville fine sandy loam
WaB	Westphalia fine sandy loam, 0 to 5 percent slopes
WfB	Westphalia loamy fine sand, 0 to 5 percent slopes
WfC	Westphalia loamy fine sand, 5 to 10 percent slopes
WhD	Westphalia soils, 10 to 20 percent slopes
WhD3	Westphalia soils, 10 to 20 percent slopes, severely eroded
Wr	Westphalia and Nixonton-Urban land complex
WsA	Woodstown and Dragston sandy loams, 0 to 3 percent slopes
WtA	Woodstown and Klej loamy sands, 0 to 3 percent slopes
WuA	Woodstown and Klej loamy sands, clayey substrata, 0 to 3 percent slopes

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail, foot
- Railroad
- Ferries
- Ford
- Grade
- R. R. over
- R. R. under
- Tunnel

Buildings
- School
- Church
- Station

Mines and Quarries

Mine dump

Pits, gravel or other

Power lines

Pipe lines

Cemeteries

Dams

Levees

Tanks

Oil wells

BOUNDARIES

- National or state
- County
- Reservation
- Land grant
- Township, civil

DRAINAGE

Streams
- Perennial
- Intermittent, unclass.

Canals and ditches (CANAL, DITCH)

Lakes and ponds
- Perennial
- Intermittent

Wells (flowing)

Springs

Marsh

Wet spot

Drainage end

RELIEF

Escarpments
- Bedrock
- Other

Prominent peaks

Depressions (Large, Small)
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

- Soil boundary and symbol (Dx)
- Gravel
- Stones
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gullies

Soil map constructed 1965 by Cartographic Division, Soil Conservation Service, USDA, from 1957 aerial photographs. Controlled mosaic based on New Jersey plane coordinate system, transverse Mercator projection, 1927 North American datum.