DRAINAGE CALCULATIONS

1075 - 1083 LINDEN AVENUE
LOTS 4, 12, 13 & 14 BLOCK 504
BOROUGH OF RIDGEFIELD
BERGEN COUNTY, NJ

Rev'd February 3, 2022
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SUMMARY & CONCLUSIONS

SUMMARY:

Site Conditions:

The site, located in the Borough of Ridgefield, Bergen County, N.J., is known as 1075-1083 Linden Avenue and designated as Lots 4,12,13 & 14 in Block 504 on the Tax Map of the Borough of Ridgefield. The total tract area and the area of this study encompass 28,450 square feet (0.653ac.). The existing site is currently used as a construction yard for the storage of vehicles and equipment and consists of a mix of gravel, dirt, vegetated and wooded areas. There are no buildings or structures currently on the premises. It is proposed to construct a new 2 story warehouse building with a parking area in the front yard.

Methodology:

The modified rational method was used to analyze drainage of the study area. Soil on site was found to be Boonton-Urban Land Complex from the National Resources Conservation Service Web Soil Survey. This soil has a Hydrologic Soil Group rating of C. Since the development of the site will increase the impervious area by more than 0.25 acres, it will be considered to be a major project. Thus, the storm water runoff has been calculated for the 2, 10 & 100 year storm events in a pre-existing and post developed condition. The retention system has been designed so that the post-project construction peak runoff will be reduced for the 2, 10 & 100 year storms. The retention system has been additionally sized to capture the runoff volume from the roof area and pavement areas that are directly contributing to the system using a 10 year storm with 60 minute duration. Water quality has been addressed by the inclusion of a "BayFilter" manufactured treatment device which will provide the required 80% TSS removal rate for the 1.25 inch 2 hour duration water quality storm.

Summary Table:

Design Storm	Existing Runoff (cfs)	Allowable Runoff (cfs)	Proposed Runoff (cfs)	Required MRM Storage (gallons)	Required Storage Roof & Pavt. (gallons)	Provided Storage Volume (gallons)
2 Year	1.29	0.65	2.17	11,953	NA	26,734
10 Year	1.92	1.44	3.23	12,507	26,119	26,734
100 Year	3.31	2.65	4.60	14,489	NA	26,734

CONCLUSIONS:

The proposed retention system consisting of 36" perforated pipes in a 15' x 87' stone bed will be provide a total capacity of 26,734 gallons, exceeding the minimum required storage volumes as well as providing the required groundwater recharge.

SECTION 1

MODIFIED RATIONAL METHOD

EXISTING CONDITIONS

AREAS

			RUNOFF COEFFICIENT c		(H.S.G.=C)
			100 YR	ADJ. 2,10YR	
GRAVEL DRIVEWAY & PARKING	9,358	SF	0.84	0.67	
WOODED AREA	5,470		0.59	0.47	
OPEN SPACES	13,622		0.51	0.41	
TOTAL	28,450	SF			
=	0.653	AC			

DRAINAGE AREA CHARACTERISTICS

DRAINAGE AREA, A	0.653	AC
MOST DISTANT POINT	200	FT
AVERAGE SLOPE	5%	
TIME OF CONCENTRATION, Tc	10	MIN
RAINFALL INTENSITY, i100	8.0	IN/HR
RAINFALL INTENSITY, i10	5.8	IN/HR
RAINFALL INTENSITY, i2	3.9	IN/HR
100 yr, c (weighted)	0.63	
2-10yr, c (weighted)	0.51	

EXISTING RUNOFF Q = ciA (cfs)

						ALLOWABLE
100 year storm	**Q =**	**3.31**	x	0.80	=	2.65
10 year storm	**Q =**	**1.92**	x	0.75	=	1.44
2 year storm	**Q =**	**1.29**	x	0.50	=	0.65

SECTION 2

PROPOSED CONDITIONS

AREAS

			RUNOFF COEFFICIENT c		(H.S.G.=C)
			100 YR	ADJ. 2,10YR	
BUILDING	11,362	SF	0.99	0.99	
PARKING AREA	9,589		0.99	0.99	
WALKS	270		0.99	0.99	
WOODED AREA	4,492		0.59	0.47	
LANDSCAPED AREAS	2,737		0.51	0.41	
TOTAL	28,450	SF			
=	0.653	AC			

DRAINAGE AREA CHARACTERISTICS

DRAINAGE AREA	0.653	AC
MOST DISTANT POINT	200	FT
AVERAGE SLOPE	5%	
TIME OF CONCENTRATION, Tc	10	MIN
RAINFALL INTENSITY, i100	8.0	IN/HR
RAINFALL INTENSITY, i10	5.8	IN/HR
RAINFALL INTENSITY, i2	3.9	IN/HR
100 yr, c (weighted)	0.88	
2-10yr, c (weighted)	0.85	

PROPOSED PEAK RUNOFF Q = ciA (cfs)

100 year storm	**Q =**	**4.60**
10 year storm	**Q =**	**3.23**
2 year storm	**Q =**	**2.17**

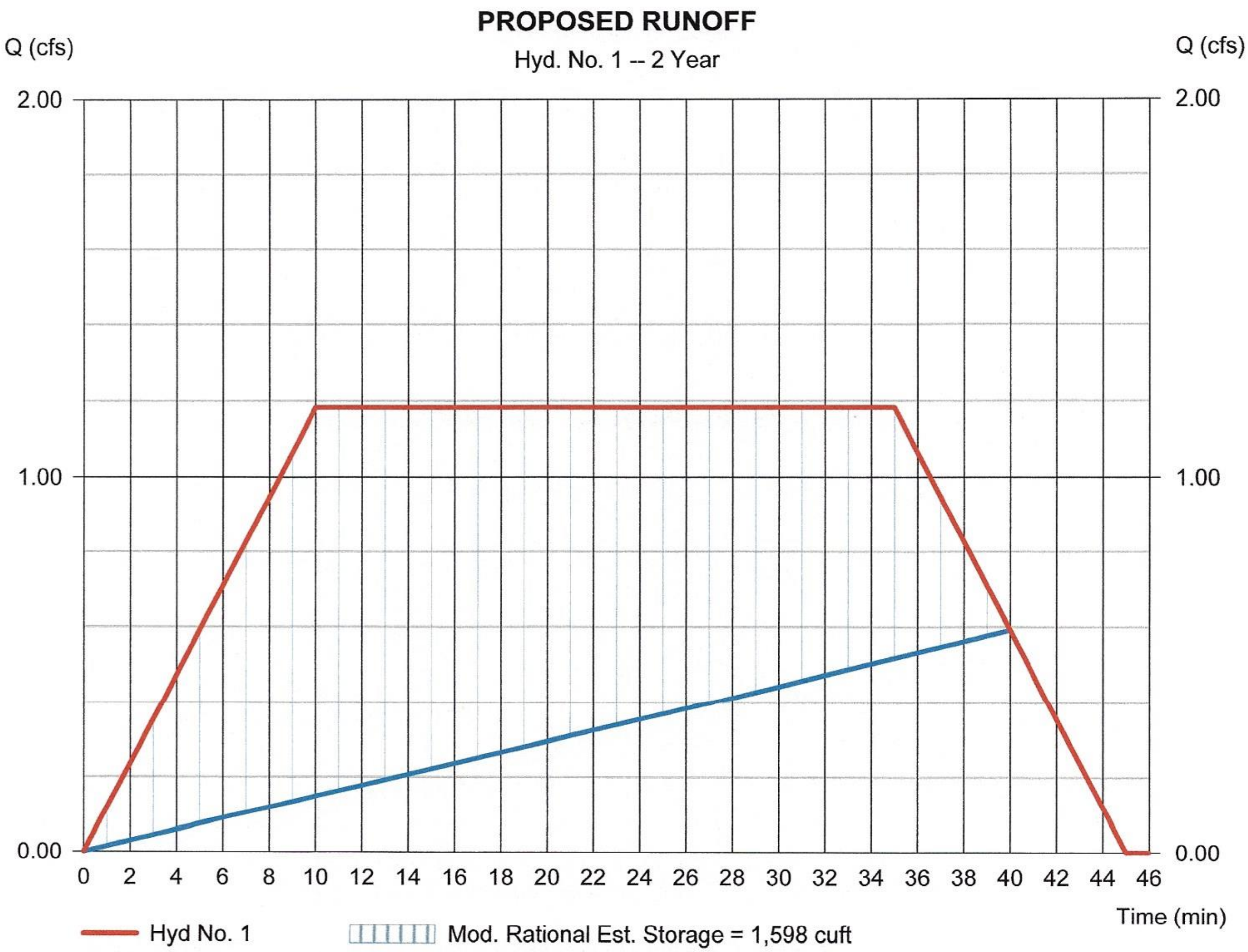
SECTION 3

Hydrograph Report

Hyd. No. 1

PROPOSED RUNOFF

Hydrograph type	= Mod. Rational	Peak discharge	= 1.183 cfs
Storm frequency	= 2 yrs	Time to peak	= 10 min
Time interval	= 1 min	Hyd. volume	= 2,491 cuft
Drainage area	= 0.653 ac	Runoff coeff.	= 0.85
Intensity	= 2.131 in/hr	Tc by User	= 10.00 min
IDF Curve	= Bergen County1.IDF	Storm duration	= 3.5 x Tc
Target Q	=0.650 cfs	Est. Req'd Storage	=1,598 cuft
			= 11,953 gal



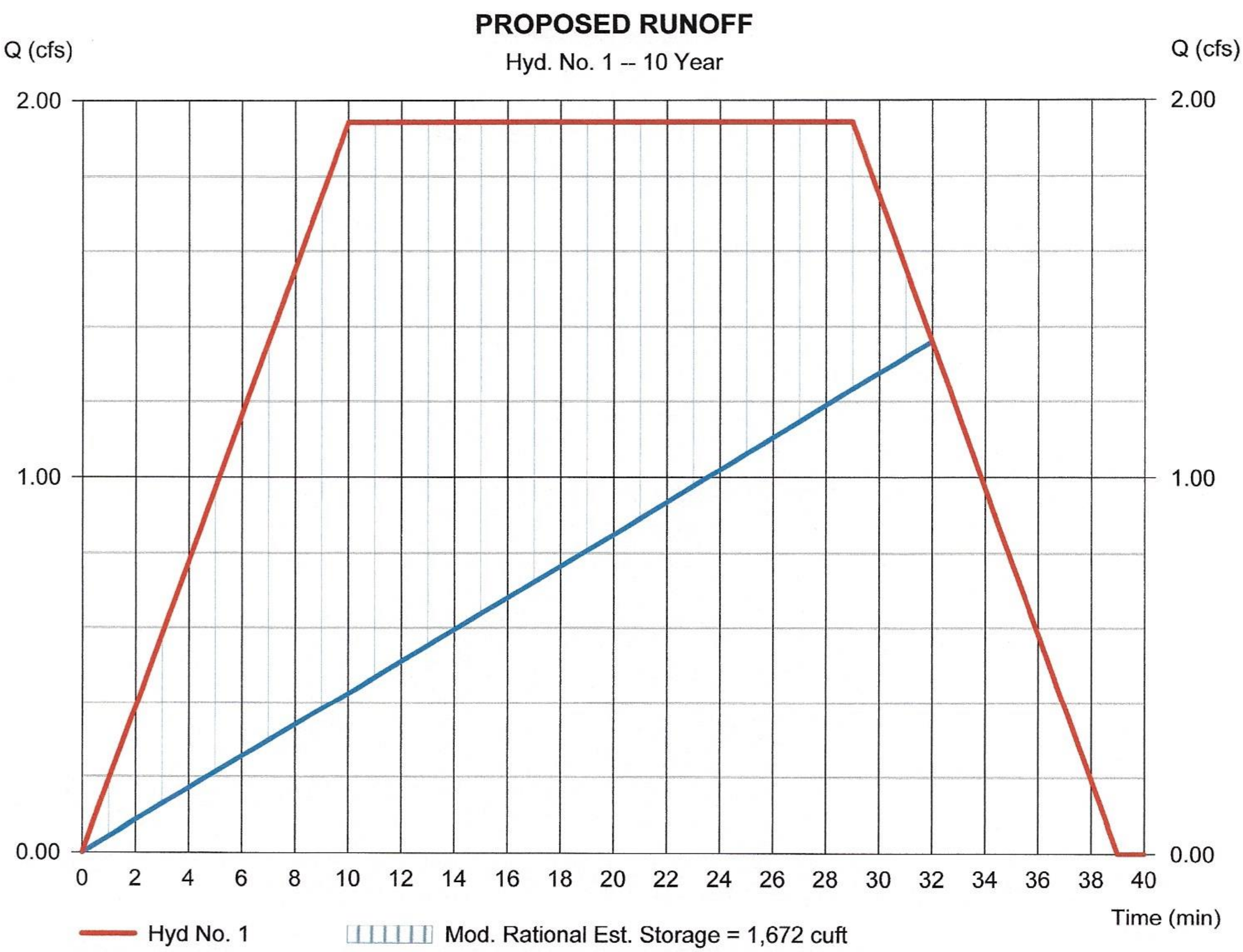
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Thursday, 02 / 3 / 2022

Hyd. No. 1

PROPOSED RUNOFF

Hydrograph type	= Mod. Rational	Peak discharge	= 1.943 cfs
Storm frequency	= 10 yrs	Time to peak	= 10 min
Time interval	= 1 min	Hyd. volume	= 3,393 cuft
Drainage area	= 0.653 ac	Runoff coeff.	= 0.85
Intensity	= 3.501 in/hr	Tc by User	= 10.00 min
IDF Curve	= Bergen County1.IDF	Storm duration	= 2.9 x Tc
Target Q	=1.440 cfs	Est. Req'd Storage	=1,672 cuft
			= 12,507 gal.

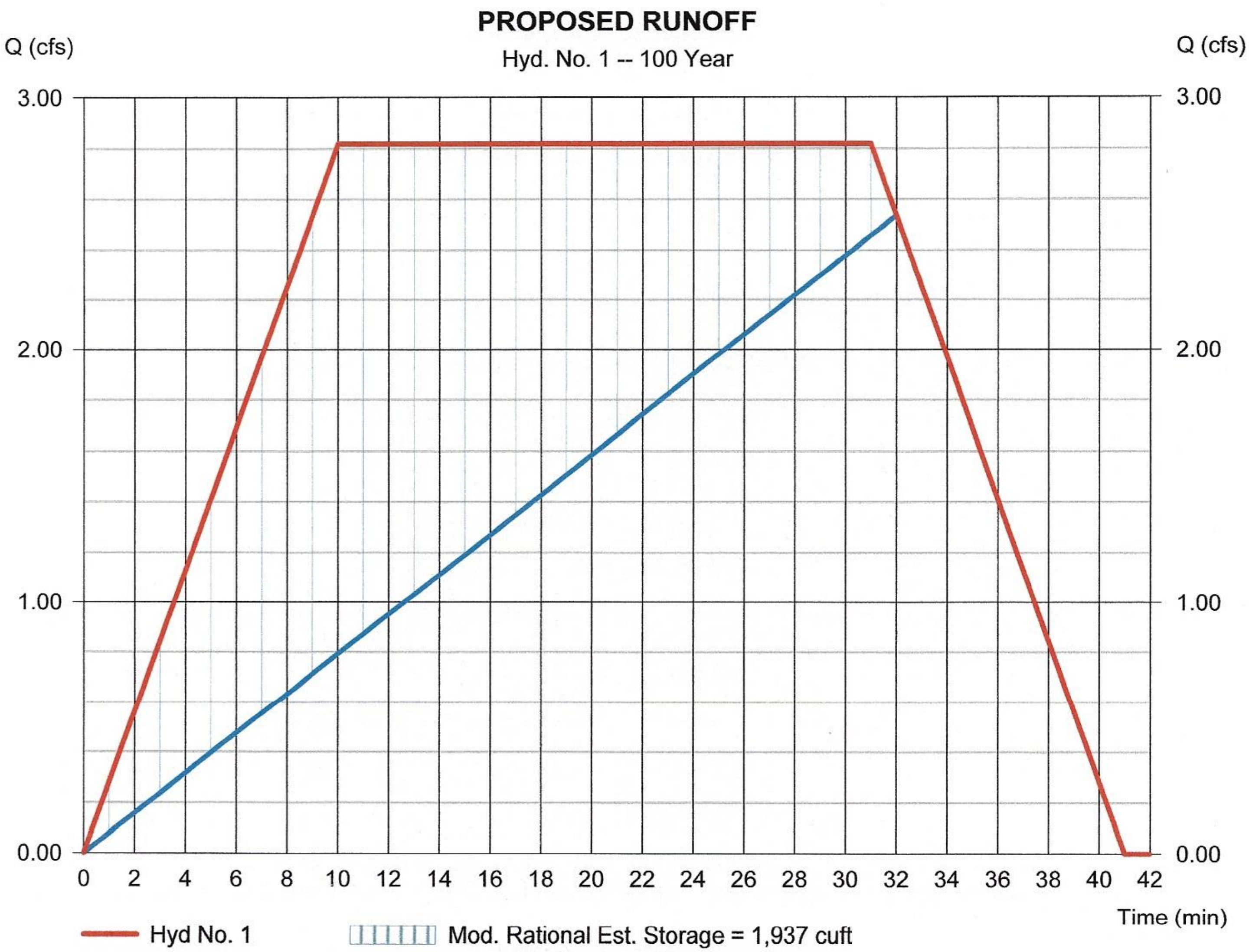


Hydrograph Report

Hyd. No. 1

PROPOSED RUNOFF

Hydrograph type	= Mod. Rational	Peak discharge	= 2.818 cfs
Storm frequency	= 100 yrs	Time to peak	= 10 min
Time interval	= 1 min	Hyd. volume	= 5,259 cuft
Drainage area	= 0.653 ac	Runoff coeff.	= 0.88
Intensity	= 4.904 in/hr	Tc by User	= 10.00 min
IDF Curve	= Bergen County1.IDF	Storm duration	= 3.1 x Tc
Target Q	=2.650 cfs	Est. Req'd Storage	=1,937 cuft
			= 14,489 gal



SECTION 4

REQUIRED STORAGE VOLUME - CONTRIBUTING AREAS TO RETENTION

DESIGN STORM : 10 YEAR -60 MINUTE DURATION

CONTRIBUTING AREAS TO RETENTION SYSTEM

			Runoff Coefficient
BUILDING AREA =	11,362	sf	1.0
PARKING AREA =	9,589		1.0
Rainfall intensity,i =	2.0	in/hr	
RUNOFF VOLUME =	**3492**	cf	
	26119	gal.	

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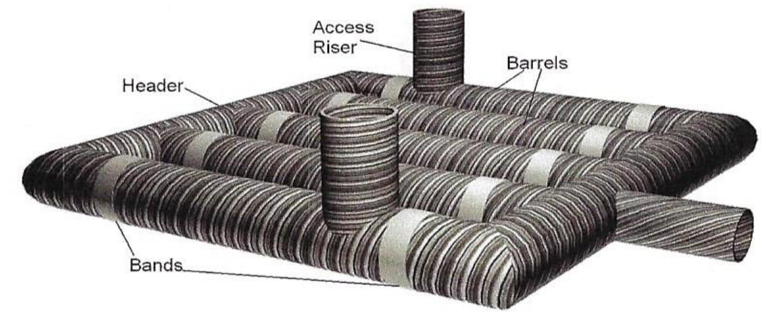


Project Summary

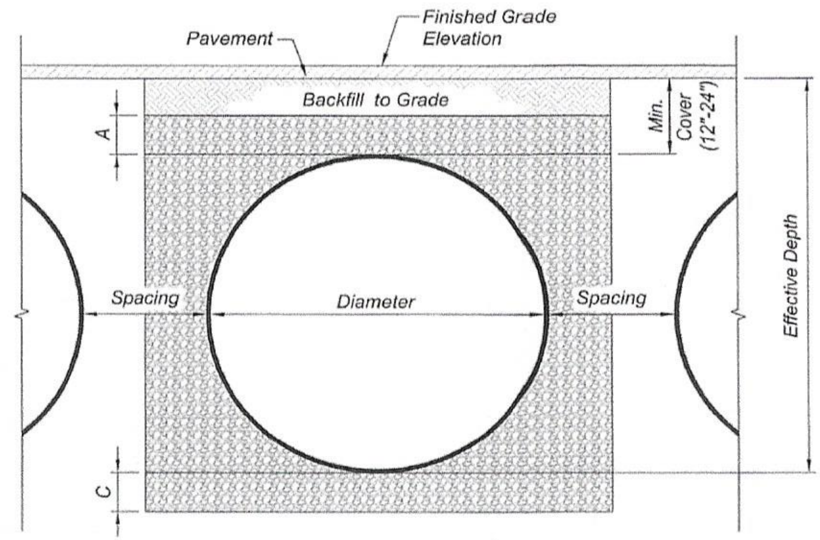
Date:	2/3/2022
Project Name:	1075 Linden Avenue
City / County:	Ridgefield
State:	NJ
Designed By:	MM
Company:	Mark Martins Engineering
Telephone:	

Enter Information in Blue Cells

Corrugated Metal Pipe Calculator

Storage Volume Required (cf):	3,492
Limiting Width (ft):	16.00
Invert Depth Below Asphalt (ft):	7.00
Solid or Perforated Pipe:	Perforated
Shape Or Diameter (in):	36
Number Of Headers:	2
Spacing between Barrels (ft):	1.50
Stone Width Around Perimeter of System (ft):	1.5
Depth A: Porous Stone Above Pipe (in):	6
Depth C: Porous Stone Below Pipe (in):	15
Stone Porosity (0 to 40%):	40

7.07 ft^2 Pipe Area



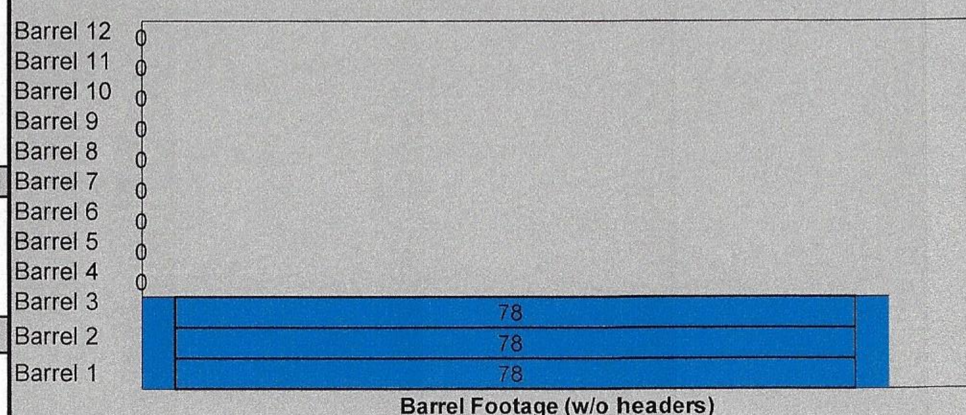
System Sizing

Pipe Storage:	1,824	cf
Porous Stone Storage:	1,750	cf
Total Storage Provided:	3,574	cf
Number of Barrels:	3	barrels
Length per Barrel:	78.0	ft
Length Per Header:	12.0	ft
Rectangular Footprint (W x L):	15. ft x 87. ft	

= 26,734 gal

102.3% Of Required Storage

System Layout



CONTECH Materials

Total CMP Footage:	258	ft
Approximate Total Pieces:	14	pcs
Approximate Coupling Bands:	15	bands
Approximate Truckloads:	2	trucks

Construction Quantities**

Total Excavation:	339	cy
Porous Stone Backfill For Storage:	162	cy stone
Backfill to Grade Excluding Stone:	109	cy fill

***Construction quantities are approximate and should be verified upon final design*

SECTION 5

WATER QUALITY STORM

(1.25" - 2hr)

PAVED AREA TO BAYFILTER = 9,589 SF = 0.220 Ac

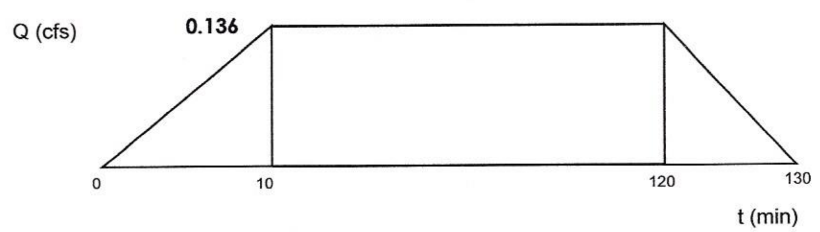
PROPOSED RUNOFF COEFFICIENT

C = 0.99

PROPOSED FLOW

Q = CiA = (0.990) (0.625) (0.220) = **0.136** cfs

CONCLUSION



Storage = 0.136 cf/~~sec~~ x 2 hr x 60 ~~sec~~/~~min~~ x 60 ~~min~~/~~hr~~

= **979 cf**

New Jersey Groundwater Recharge Spreadsheet
Version 2.0
November 2003

Annual Groundwater Recharge Analysis (based on GSR-32)

Select Township ↓	Average Annual P (in)	Climatic Factor
BERGEN CO., RIDGEFIELD BORO	42.9	1.39

Project Name:	1075 Linden Ave, Ridgefield, NJ
Description:	Proposed Warehouse
Analysis Date:	02/03/22

Pre-Developed Conditions

Land Segment	Area (acres)	TR-55 Land Cover	Soil	Annual Recharge (in)	Annual Recharge (cu.ft)
1	0.31272	Open space	Boonton	11.2	12,700
2	0.2148	Gravel, dirt	Boonton	5.1	4,012
3	0.12557	Woods	Boonton	11.7	5,311
4					
5					
6					
7	0				
8	0				
9	0				
10	0				
11	0				
12	0				
13	0				
14	0				
15	0				
Total =	0.7			Total Annual Recharge (in)	Total Annual Recharge (cu-ft)
				9.3	22,022

Post-Developed Conditions

Land Segment	Area (acres)	TR-55 Land Cover	Soil	Annual Recharge (in)	Annual Recharge (cu.ft)
1	0.4872	Impervious areas	Boonton	0.0	-
2	0.06279	Open space	Boonton	11.2	2,550
3	0.1031	Woods	Boonton	11.7	4,360
4					
5	0				
6	0				
7	0				
8	0				
9	0				
10	0				
11	0				
12	0				
13	0				
14	0				
15	0				
Total =	0.7			Total Annual Recharge (in)	Total Annual Recharge (cu.ft)
				2.9	6,910

Annual Recharge Requirements Calculation ↓

% of Pre-Developed Annual Recharge to Preserve =	100%	Total Impervious Area (sq.ft)	21,222
Post-Development Annual Recharge Deficit=	***15,112***	(cubic feet)	

Recharge Efficiency Parameters Calculations (area averages)

RWC=	3.42	(in)	DRWC=	0.00	(in)
ERWC =	1.04	(in)	EDRWC=	0.00	(in)

Procedure to fill the Pre-Development and Post-Development Conditions Tables

For each land segment, first enter the area, then select TR-55 Land Cover, then select Soil. Start from the top of the table and proceed downward. Don't leave blank rows (with A=0) in between your segment entries. Rows with A=0 will not be displayed or used in calculations. For impervious areas outside of standard lots select "Impervious Areas" as the Land Cover. Soil type for impervious areas are only required if an infiltration facility will be built within these areas.

5.2

Project Name	Description	Analysis Date	BMP or LID Type
1075 Linden Ave, Ridgefiel	Proposed Warehouse	02/03/22	Underground Pipe Storage

Recharge BMP Input Parameters

Parameter	Symbol	Value	Unit
BMP Area	ABMP	1305.0	sq.ft
BMP Effective Depth, this is the design variable	dBMP	2.0	in
Upper level of the BMP surface (negative if above ground)	dBMPu	12.0	in
Depth of lower surface of BMP, must be>=dBMPu	dEXC	72.0	in
Post-development Land Segment Location of BMP , Input Zero if Location is distributed or undetermined	SegBMP	1	unitless

Root Zone Water capacity Calculated Parameters

Parameter	Symbol	Value	Unit
Empty Portion of RWC under Post-D Natural Recharge	ERWC	1.02	in
ERWC Modified to consider dEXC	EDRWC	0.00	in
Empty Portion of RWC under Infilt. BMP	RERWC	0.00	in

Recharge Design Parameters

Parameter	Symbol	Value	Unit
Inches of Runoff to capture	Qdesign	0.12	in
Inches of Rainfall to capture	Pdesign	0.18	in
Recharge Provided Avg. over Imp. Area		8.5	in
Runoff Captured Avg. over imp. Area		8.5	in

BMP Calculated Size Parameters

ABMP/Aimp	Aratio	0.06	unitless
BMP Volume	VBMP	212	cu.ft

CALCULATION CHECK MESSAGES

Volume Balance-> Solve Problem to satisfy Annual Recharge
dBMP Check---> OK
dEXC Check---> OK

BMP Location---> OK

Parameters from Annual Recharge Worksheet

Post-D Deficit Recharge (or desired recharge volume)	Vdef	15,112	cu.ft
Post-D Impervious Area (or target Impervious Area)	Aimp	21,222	sq.ft
Root Zone Water Capacity	RWC	3.33	in
RWC Modified to consider dEXC	DRWC	0.00	in
Climatic Factor	C-factor	1.39	no units
Average Annual P	Pavg	42.9	in
Recharge Requirement over Imp. Area	dr	8.5	in

System Performance Calculated Parameters

Annual BMP Recharge Volume		15,107	cu.ft
Avg BMP Recharge Efficiency		100.0%	Represents % Infiltration Recharged
%Rainfall became Runoff		77.3%	%
%Runoff Infiltrated		25.7%	%
%Runoff Recharged		25.7%	%
%Rainfall Recharged		19.9%	%

OTHER NOTES

Pdesign is accurate only after BMP dimensions are updated to make rech volume= deficit volume. The portion of BMP infiltration prior to filling and the area occupied by BMP are ignored in these calculations. Results are sensetive to dBMP, make sure dBMP selected is small enough for BMP to empty in less than 3 days. For land Segment Location of BMP if you select "impervious areas" RWC will be minimal but not zero as determined by the soil type and a shallow root zone for this Land Cover allowing consideration of lateral flow and other losses.

How to solve for different recharge volumes: By default the spreadsheet assigns the values of total deficit recharge volume "Vdef" and total proposed impervious area "Aimp" from the "Annual Recharge" sheet to "Vdef" and "Aimp" on this page. This allows solution for a single BMP to handle the entire recharge requirement assuming the runoff from entire impervious area is available to the BMP.
To solve for a smaller BMP or a LID-IMP to recharge only part of the recharge requirement, set Vdef to your target value and Aimp to impervious area directly connected to your infiltration facility and then solve for ABMP or dBMP. To go back to the default configuration clik the "Default Vdef & Aimp" button.

5.3

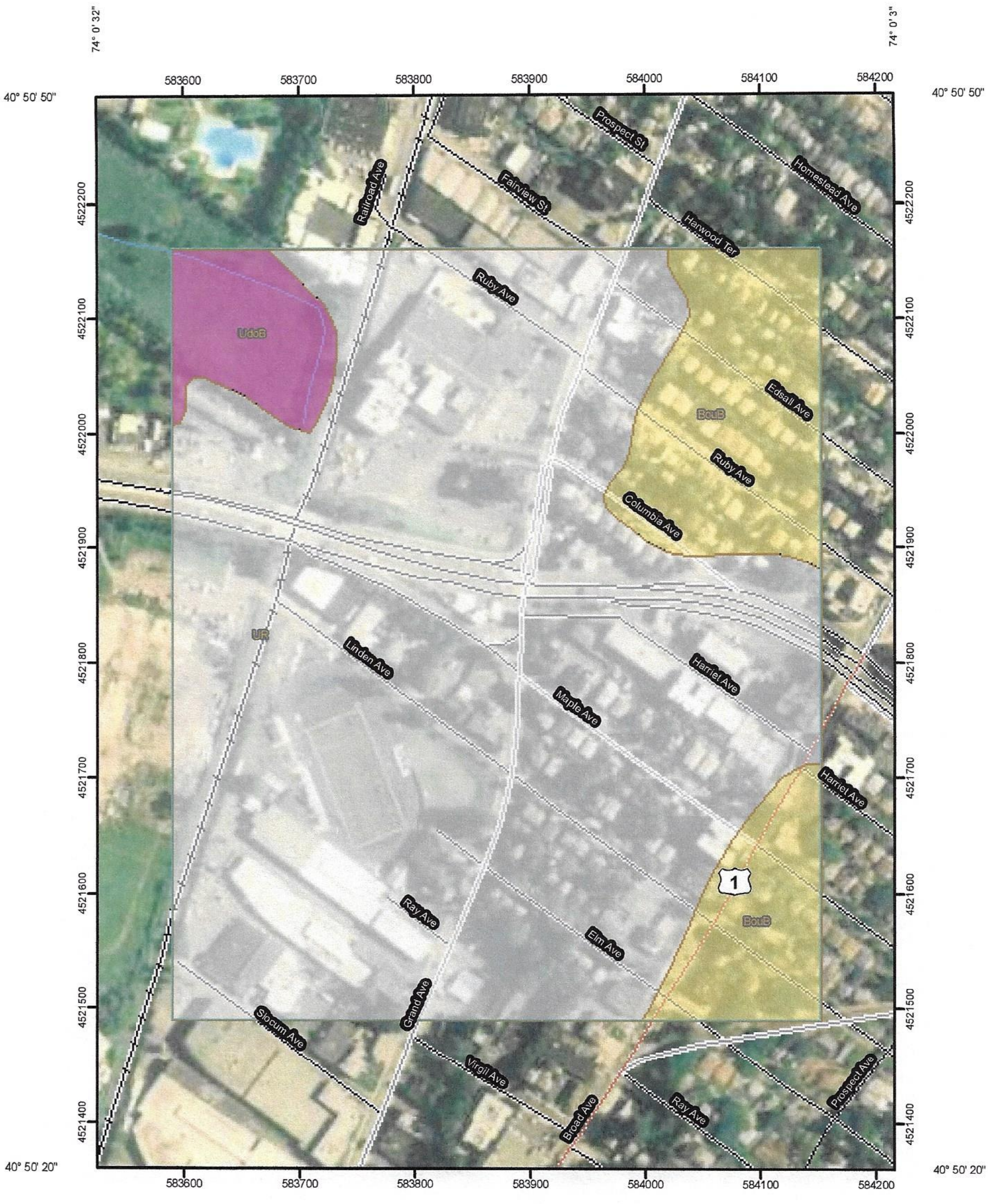
APPENDIX

TABLE 7.1 TYPICAL RUNOFF COEFFICIENTS (C VALUES) FOR 100-YEAR FREQUENCY STORM

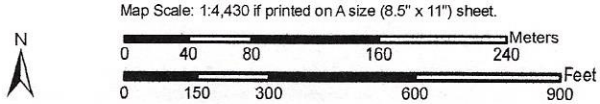
LAND-USE DESCRIPTION	HYDROLOGIC SOIL GROUP			
	A	B	C	D
Cultivated land:				
without conservation treatment	0.49	0.67	0.81	0.88
with conservation treatment	0.27	0.43	0.61	0.67
Pasture or range land:				
poor condition	0.38	0.63	0.78	0.84
good condition	NA	0.25	0.51	0.65
Meadow: good condition	NA	NA	0.44	0.61
Wood or forest land:				
thin stand, poor cover, no mulch	NA	NA	0.59	0.79
good cover	NA	NA	0.45	0.59
Open spaces, lawns, parks, golf courses, cemeteries:				
good condition, grass cover on 75% or more of area	NA	0.25	0.51	0.65
fair condition, grass cover on 50-75% of area	NA	0.45	0.63	0.74
Commercial and business areas (85% impervious)	0.84	0.90	0.93	0.96
Industrial districts (72% impervious)	0.67	0.81	0.88	0.92
Residential:				
Average lot size / Average impervious				
1/8 acre 65%	0.59	0.76	0.86	0.90
1/4 acre 38%	0.25	0.55	0.70	0.80
1/3 acre 30%	NA	0.49	0.67	0.78
1/2 acre 25%	NA	0.45	0.65	0.76
1 acre 20%	NA	0.41	0.63	0.74
Paved parking lots, roofs, driveways, etc.	0.99	0.99	0.99	0.99
Streets and roads:				
paved with curbs and storm sewers	0.99	0.99	0.99	0.99
gravel	0.57	0.76	0.84	0.88
dirt	0.49	0.69	0.80	0.84

NOTE: NA denotes information is not available; design engineers should rely on another authoritative source.

SOURCE: *Technical Manual for Land Use Regulation Program,* Department of Environmental Protection, Bureaus of Inland and Coastal Regulations, Stream Encroachment Permits (Trenton, New Jersey, revised September 1995), p. 12.



Map Scale: 1:4,430 if printed on A size (8.5" x 11") sheet.



Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Bergen County, New Jersey				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
BouB	Boonton-Urban land complex, 0 to 8 percent slopes	C	15.2	16.3%
UdoB	Udorthents, organic substratum, 0 to 8 percent slopes	D	4.3	4.6%
UR	Urban land		73.8	79.1%
Totals for Area of Interest			**93.3**	**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