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DRAINAGE CALCULATIONS

For

Park & Ivy Properties LLC

Block 1709 Lot 7

Allendale

Bergen County

New Jersey

Project #18-110

Revised: 4-15-21

Date: 3-26-21



ALEXANDER J. LAPATKA, PE 28218

DL

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Introduction:

The following calculations are in support of a Site Plan for Park & Ivy Properties LLC located on Lot 7 in Block 1709, Borough of Allendale, Bergen County, New Jersey. A redevelopment of an existing lot is proposed. The construction will include the removal of all existing improvements and redevelop the Site with a new five (5) unit townhouse building and parking lot.

The 0.416 acre site is presently developed with an existing auto repair building, garage and parking lot. There are no existing drainage structures currently on site.

The project proposes to decrease the existing impervious coverage of the site which will decrease the storm water runoff. To further reduce storm water runoff, two (2) seepage Pits are proposed. The seepage pits are sized to retain the volume of the 100 yr. Modified Rational Storm 60 min duration storm neglecting infiltration.

In addition to the proposed seepage pits, a storm drain collection system is proposed. The system will consist of six new lawn inlets, an onsite catch basin and a new inlet and storm MH within Park Avenue. The system will eliminate runoff on to neighboring properties and improve stormwater collection in Park avenue.

A Time of Concentration (Tc) of 10 minutes was used for existing and proposed conditions.

The rainfall intensities were taken from the NOAA Database.

Storm Water Requirements

The project proposes to disturb approximately 0.416 acres. As a result the project is not considered to be a Major Development.

The proposed improvements will decrease the amount impervious coverage on the site and will result in a decrease in runoff and runoff volume. two (2) seepage pits are proposed to be constructed to control the storm water runoff from the proposed building's roof area, increase storm water recharge and reduce runoff from the site. Under proposed conditions there will be a reduction in the rate and volume of runoff for the 2yr, 10yr, 25yr and 100 yr. Modified Rational Method Design storms.

According the Web soil survey, the soils in the area of the site are mapped as Dunellen - Urban Land soils. Dunellen Soils have a Hydrologic Soil Group "A" rating. Hydrologic Soil Group "A" soils are highly permeable soils, that can support retention systems.

A Time of Concentration (Tc) of 10 minutes was used for both existing and proposed conditions.

The rainfall intensities were taken from the NOAA Database.

The proposed drainage design will meet Bergen County Soil Conservation District requirements for Water Quality, Storm Water reductions.

Water Quality

The project proposes a reduction in impervious coverage. Therefore, water quality requirements do not apply to this project.

Storm water Runoff Calculations:

Total Site Area = 0.416 acres

THE RATIONAL METHOD USED IN PEAK RUNOFF CALCULATIONS:

THE MODIFIED RATIONAL METHOD USED IN ROUTING CALCULATIONS:

$$Q = CIA$$

Q = Runoff

C = Flow Coef. (0.3 Pervious Area, 0.9 Bldg's/Conc/Pavers, 0.7 Gravel)

I = Rainfall Intensities Taken from NOAA Database

A = Area

Tc = Time of Concentration

Tc = 10 min.

I₂ = 3.92 in/hr.

I₁₀ = 5.18 in/hr.

I₂₅ = 5.83 in/hr.

I₁₀₀ = 6.76 in/hr.

Existing Conditions:

Site	AREA ACRES	Tc Min	C AVER.	CXA ACRES	Q2 cfs	Q10 cfs	Q25 cfs	Q100 cfs			
Impervious Coverage	0.261	10	0.90	0.235	0.92	1.22	1.37	1.59			
Gravel	0.066	10	0.70	0.046	0.18	0.24	0.27	0.31			
Pervious Coverage	0.089	10	0.30	0.027	0.10	0.14	0.16	0.18			
Total	0.416	10	0.74	0.308	1.21	1.59	1.79	2.08			
Total Runoff =								1.21	1.59	1.79	2.08

Proposed Conditions:

To Retention System	AREA ACRES	Tc Min	C AVER.	CXA ACRES	Q2 cfs	Q10 cfs	Q25 cfs	Q100 cfs			
Impervious Coverage	0.106	10	0.90	0.095	0.37	0.49	0.56	0.64			
Pervious Coverage	0.000	10	0.30	0.000	0.00	0.00	0.00	0.00			
Total	0.106		0.90	0.095	0.37	0.49	0.56	0.64			
Bypass											
Impervious Coverage	0.149	10	0.90	0.134	0.53	0.69	0.78	0.91			
Pervious Coverage	0.161	10	0.30	0.048	0.19	0.25	0.28	0.33			
Total	0.310		0.59	0.182	0.72	0.94	1.06	1.23			
Total Runoff =								0.72	0.94	1.06	1.23

Note: Runoff Volume will be reduced for all storms.

Net Runoff	0.72	0.94	1.06	1.23
Proposed Reduction	41%	41%	41%	41%

Storm Runoff and Volume Summary 2, 10 & 100 year Design Storms.

Exist CxA	0.308	
Prop CxA	0.182	Net leaving Site

NOTE: Calculations assume a zero infiltration rate which is conservative.

Storm Event Year	Td min	I in/hr	Exist Q cfs	Exist Vol cf	Proposed Q cfs	Proposed Vol cf	Reduction Volume cf
2	10	3.90	1.20	720	0.71	427	293
	15	3.22	0.99	892	0.59	529	363
	30	2.19	0.67	1,213	0.40	719	494
	60	1.36	0.42	1,507	0.25	893	614
	120	0.83	0.26	1,839	0.15	1,090	749

Storm Event Year	Td min	I in/hr	Exist Q cfs	Exist Vol cf	Proposed Q cfs	Proposed Vol cf	Reduction Volume cf
10	10	5.15	1.59	951	0.94	564	387
	15	4.28	1.32	1,186	0.78	703	483
	30	3.03	0.93	1,679	0.55	995	684
	60	1.95	0.60	2,161	0.36	1,280	880
	120	1.22	0.38	2,704	0.22	1,602	1,102

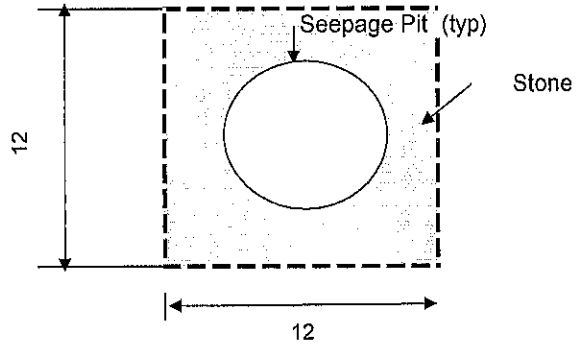
Storm Event Year	Td min	I in/hr	Exist Q cfs	Exist Vol cf	Proposed Q cfs	Proposed Vol cf	Reduction Volume cf
100	10	6.68	2.06	1,234	1.22	731	503
	15	5.58	1.72	1,546	1.02	916	630
	30	4.14	1.27	2,294	0.76	1,359	934
	60	2.81	0.86	3,114	0.51	1,845	1,269
	120	1.85	0.57	4,100	0.34	2,430	1,670

Seepage Pit Design :

Available Volume:

Seep Pit Storage:	$\text{Pi} \cdot \text{r}^2 \times \text{Depth}$	
Inner Dia. =	6 ft.	
Outer Dia. =	7 ft.	
Depth =	6 ft.	
Inside M.H. Storage =	170 cf.	Each
Outside M.H. Storage =	231 cf.	Each
# of Seep. Pits =	1	
Inside Storage =	170 cf.	(Inside)
Outside Vol. =	231 cf.	(Outside)

Retention System Detail (nts)



Plan (nts)

Stone Volume: Length x Width x Depth - (Volume of M.H. + Pipe)

Vol. Occupied By Pit 231 cf.

Stone Bed

Length =	12 ft.
Width =	12 ft.
Depth =	8 ft.
(Minus Pit)	231 cf.
Stone Vol. =	921 cf.

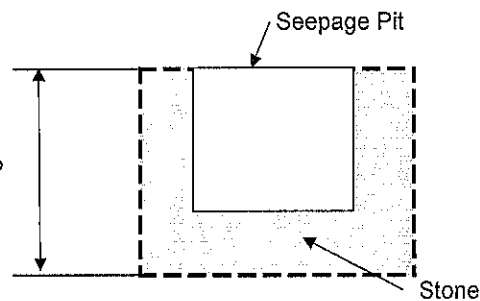
Storage in Stone: 0.4 Voids x Stone Volume

Pit = 170 cf.

Storage in Stone = 368 cf.

Available Storage: M.H. Storage + Pipe + Storage in Stone

Available Storage = 538 cf.



Profile (nts)

Time For System To Drain:

Bed Area =	144	sf
Soil Type =	Dunellen	
Seepage Rate =	6	in/hr *
Seepage Rate =	0.02000	cfs
System Volume =	538	cf **
Time to Drain =	7.5	hrs. < 24 hrs

* Dunellen Soil HSG 'A' - 6" in / Hr Assumed

** Assumes System is full

Required Volume:

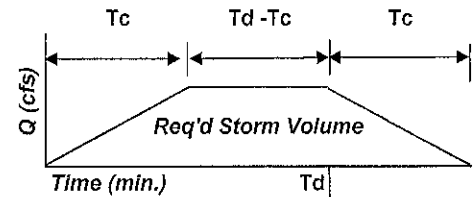
* Area (1/2 Building) =	0.053	ac.
* Tc =	10	min.
* Td =	60	min.
* C =	0.90	
* Rainfall Intensity I ₁₀₀ =	2.81	in/hr (60 Min. Duration)
* Q _{100(Td=60min.)} =	0.13	cfs = C x I ₁₀₀ x A

Volume of storm: Area under Hydrograph = Required Storage

Required Storage = Q₁₀₀ x Td x 60

Required Storage = 483 cf

Required Storage 483 < 538 Available Storage
Design OK!



Hydrograph (nts)

Note: Seepage Rate NOT accounted for in design!



POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerals](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	4.15 (3.77-4.60)	4.97 (4.50-5.48)	5.93 (5.36-6.55)	6.64 (6.00-7.32)	7.51 (6.76-8.29)	8.17 (7.31-9.00)	8.81 (7.84-9.72)	9.42 (8.33-10.4)	10.2 (8.95-11.3)	10.8 (9.35-12.0)
10-min	3.26 (2.96-3.61)	3.92 (3.55-4.33)	4.65 (4.21-5.14)	5.18 (4.69-5.72)	5.83 (5.24-6.43)	6.30 (5.64-6.94)	6.76 (6.01-7.45)	7.19 (6.35-7.94)	7.71 (6.75-8.56)	8.08 (7.01-8.98)
15-min	2.69 (2.44-2.98)	3.22 (2.92-3.56)	3.85 (3.48-4.26)	4.30 (3.88-4.74)	4.86 (4.36-5.36)	5.25 (4.70-5.79)	5.64 (5.02-6.22)	5.99 (5.29-6.62)	6.44 (5.63-7.14)	6.73 (5.84-7.49)
30-min	1.80 (1.64-1.99)	2.19 (1.98-2.42)	2.67 (2.42-2.96)	3.03 (2.74-3.35)	3.49 (3.14-3.85)	3.83 (3.43-4.22)	4.16 (3.70-4.59)	4.48 (3.96-4.95)	4.90 (4.29-5.44)	5.20 (4.51-5.78)
60-min	1.11 (1.01-1.23)	1.35 (1.23-1.50)	1.69 (1.53-1.87)	1.95 (1.76-2.15)	2.29 (2.06-2.52)	2.55 (2.28-2.81)	2.81 (2.50-3.10)	3.08 (2.72-3.40)	3.44 (3.01-3.81)	3.71 (3.22-4.13)
2-hr	0.682 (0.619-0.750)	0.830 (0.754-0.912)	1.05 (0.950-1.15)	1.22 (1.10-1.34)	1.45 (1.31-1.59)	1.64 (1.47-1.80)	1.84 (1.63-2.02)	2.04 (1.80-2.24)	2.33 (2.03-2.56)	2.55 (2.20-2.82)
3-hr	0.510 (0.465-0.560)	0.620 (0.565-0.682)	0.783 (0.713-0.860)	0.911 (0.828-1.00)	1.09 (0.983-1.19)	1.24 (1.11-1.35)	1.38 (1.23-1.52)	1.54 (1.36-1.69)	1.76 (1.53-1.93)	1.93 (1.67-2.13)
6-hr	0.334 (0.306-0.366)	0.404 (0.371-0.444)	0.509 (0.466-0.558)	0.594 (0.541-0.650)	0.713 (0.645-0.779)	0.812 (0.730-0.887)	0.916 (0.817-1.00)	1.03 (0.906-1.12)	1.19 (1.03-1.30)	1.32 (1.13-1.45)
12-hr	0.207 (0.187-0.230)	0.251 (0.228-0.279)	0.318 (0.287-0.352)	0.373 (0.336-0.413)	0.453 (0.404-0.499)	0.520 (0.461-0.573)	0.593 (0.521-0.653)	0.673 (0.584-0.741)	0.789 (0.672-0.870)	0.887 (0.745-0.980)
24-hr	0.117 (0.107-0.128)	0.141 (0.130-0.155)	0.181 (0.166-0.199)	0.215 (0.196-0.236)	0.267 (0.241-0.291)	0.311 (0.279-0.340)	0.360 (0.321-0.394)	0.416 (0.365-0.455)	0.499 (0.431-0.547)	0.570 (0.486-0.628)
2-day	0.069 (0.063-0.075)	0.083 (0.077-0.091)	0.107 (0.098-0.117)	0.126 (0.115-0.138)	0.155 (0.140-0.169)	0.179 (0.161-0.195)	0.206 (0.184-0.225)	0.235 (0.208-0.258)	0.278 (0.242-0.307)	0.315 (0.270-0.349)
3-day	0.048 (0.044-0.053)	0.058 (0.054-0.064)	0.074 (0.068-0.081)	0.088 (0.080-0.095)	0.107 (0.097-0.116)	0.123 (0.112-0.134)	0.141 (0.126-0.153)	0.160 (0.142-0.175)	0.188 (0.165-0.207)	0.212 (0.183-0.234)
4-day	0.038 (0.035-0.041)	0.046 (0.042-0.050)	0.058 (0.054-0.063)	0.068 (0.063-0.074)	0.083 (0.076-0.090)	0.095 (0.087-0.103)	0.108 (0.098-0.118)	0.122 (0.109-0.133)	0.143 (0.126-0.157)	0.161 (0.140-0.177)
7-day	0.026 (0.024-0.028)	0.031 (0.029-0.033)	0.038 (0.036-0.041)	0.044 (0.041-0.048)	0.053 (0.049-0.057)	0.061 (0.056-0.065)	0.069 (0.062-0.074)	0.077 (0.069-0.083)	0.089 (0.079-0.097)	0.099 (0.087-0.108)
10-day	0.021 (0.019-0.022)	0.025 (0.023-0.026)	0.030 (0.028-0.032)	0.035 (0.032-0.037)	0.041 (0.038-0.044)	0.046 (0.043-0.050)	0.052 (0.048-0.056)	0.058 (0.053-0.062)	0.066 (0.059-0.072)	0.073 (0.065-0.079)
20-day	0.014 (0.013-0.015)	0.017 (0.016-0.018)	0.020 (0.019-0.021)	0.022 (0.021-0.024)	0.026 (0.024-0.027)	0.028 (0.026-0.030)	0.031 (0.029-0.033)	0.034 (0.031-0.036)	0.037 (0.034-0.040)	0.040 (0.036-0.043)
30-day	0.012 (0.011-0.012)	0.014 (0.013-0.015)	0.016 (0.015-0.017)	0.018 (0.017-0.019)	0.020 (0.019-0.021)	0.022 (0.020-0.023)	0.024 (0.022-0.025)	0.025 (0.023-0.027)	0.027 (0.025-0.029)	0.029 (0.027-0.031)
45-day	0.010 (0.009-0.010)	0.012 (0.011-0.012)	0.013 (0.013-0.014)	0.015 (0.014-0.015)	0.016 (0.015-0.017)	0.018 (0.017-0.019)	0.019 (0.018-0.020)	0.020 (0.019-0.021)	0.022 (0.020-0.023)	0.023 (0.021-0.024)
60-day	0.009 (0.008-0.009)	0.010 (0.010-0.011)	0.012 (0.011-0.012)	0.013 (0.012-0.014)	0.014 (0.014-0.015)	0.015 (0.014-0.016)	0.016 (0.015-0.017)	0.017 (0.016-0.018)	0.018 (0.017-0.019)	0.019 (0.018-0.020)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

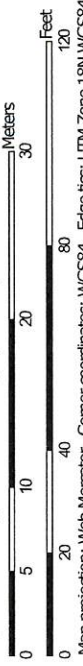
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Hydrologic Soil Group—Bergen County, New Jersey



Soil Map may not be valid at this scale.

Map Scale: 1:434 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
DuuB	Dunellen-Urban land complex, 3 to 8 percent slopes	A	0.5	100.0%
Totals for Area of Interest			0.5	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.

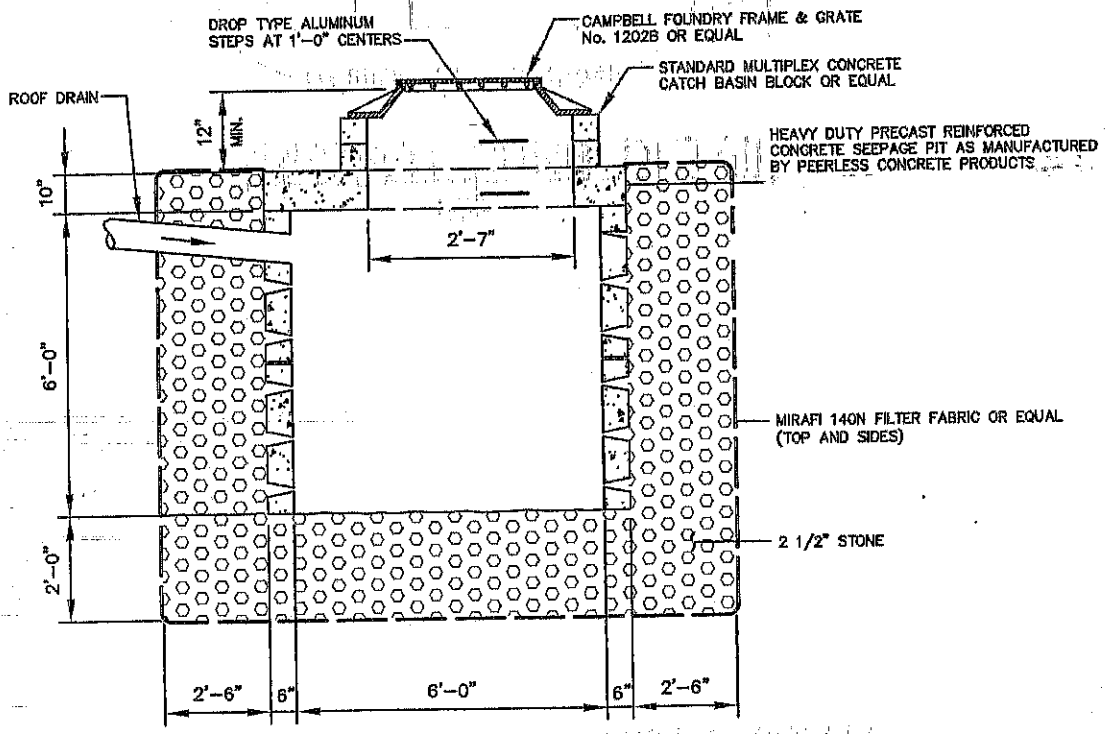
Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

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.

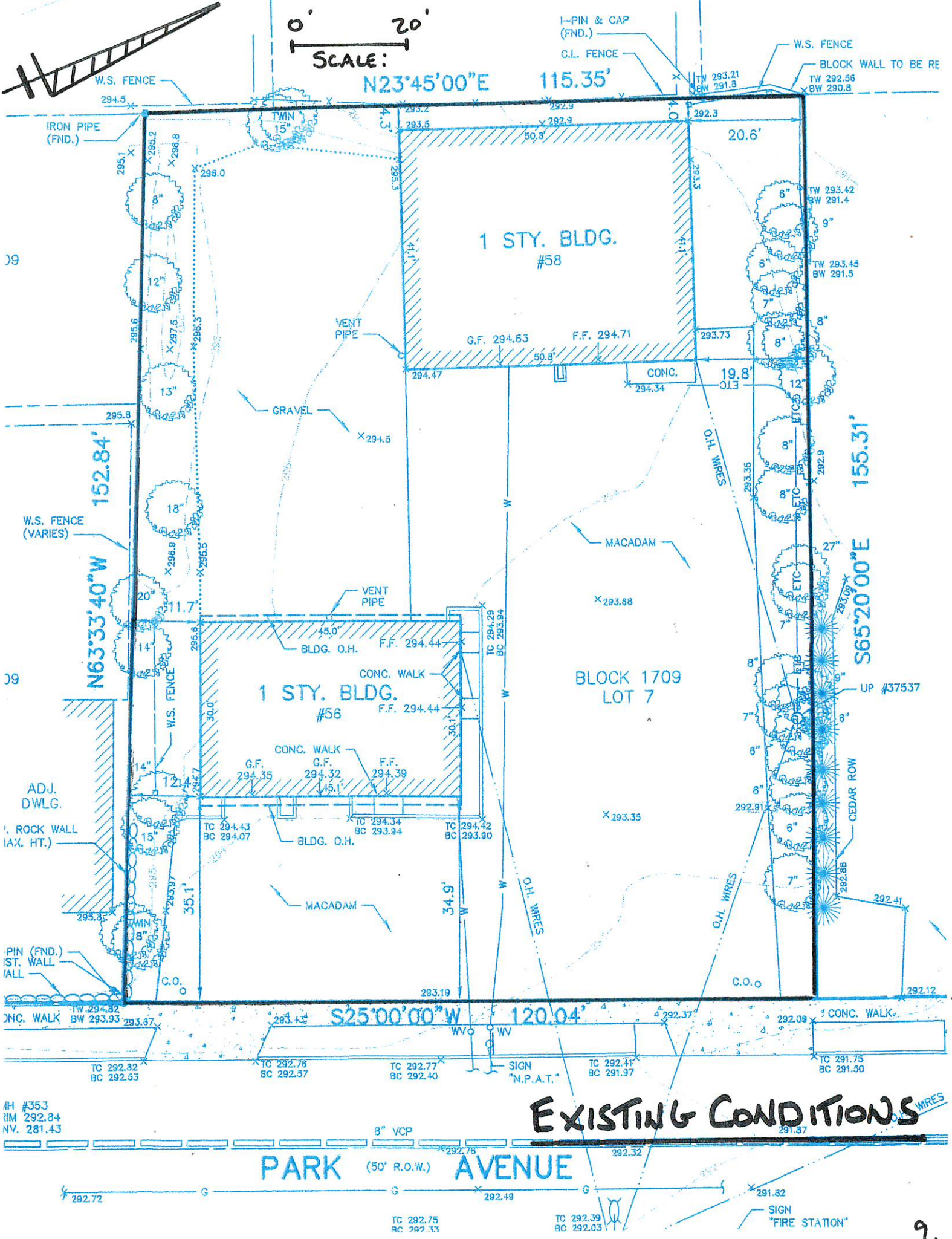
Rating Options

Aggregation Method: Dominant Condition



SEEPAGE PIT DETAIL

NOT TO SCALE



0' 20'
SCALE:

I-PIN & CAP (FND.)
C.L. FENCE
W.S. FENCE
BLOCK WALL TO BE RE

N23°45'00"E

115.35'

1 STY. BLDG.
#58

1 STY. BLDG.
#56

BLOCK 1709
LOT 7

155.31'
S65°20'00"E

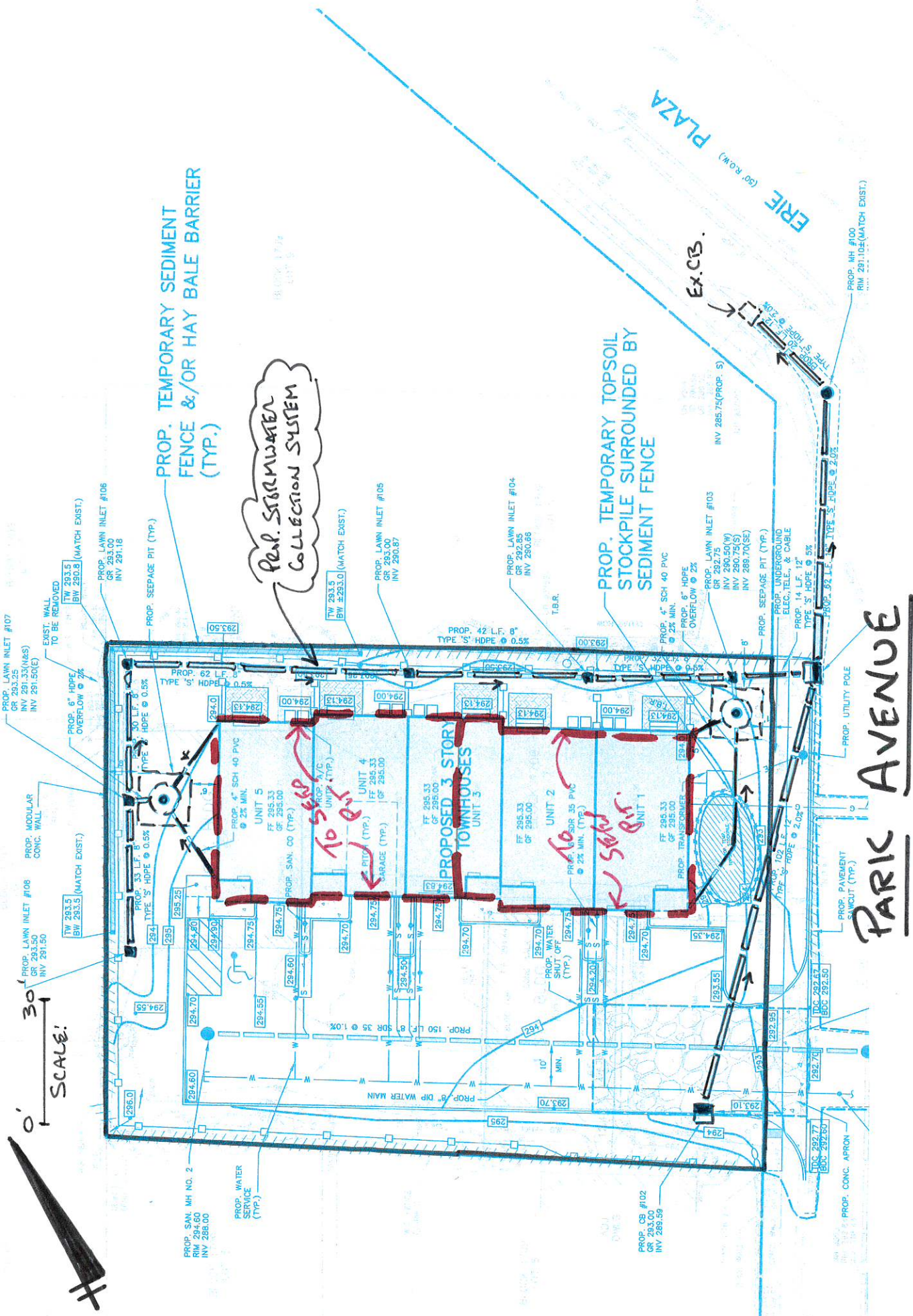
S25°00'00"W 120.04'

PARK AVENUE (50' R.O.W.)

EXISTING CONDITIONS

4H #353
RIM 292.84
NV. 281.43

PROPOSED CONDITIONS DRAINAGE AREA MAP



0' 30' SCALE:

PARK AVENUE

ERIE PLAZA (CON. ROW)