Stormwater Narrative
22 Depot Street
Richmond, Vermont

Project Description

Jameson Partners LLC is proposing an addition to the existing structure at 22 Depot Street. The existing building is currently occupied by the Giffords Mortuary on the first floor and two residential units on the upper level. The project will expand the west side of the building to include two commercial or retail spaces on the lowest level and 4 new residential dwellings on the second and third floors. The project will add 12 new parking spaces at the back of the building to displace the existing parking and provide a space for each unit.

The project will include 0.07 acres of expanded impervious and 0.10 acres of redevelopment impervious.

Stormwater Strategy

The project is below the State of Vermont stormwater jurisdiction for an operational permit. Therefore, the stormwater management design focused on compliance with the Town of Richmond Zoning Regulations Section 6.1.6(c) Drainage. The project is required to maintain the post development peak discharge rates of the 25 year, 24 hour storm below the pre-development peak discharge rates for the same storm event.

The site is mapped by the USDA Natural Resources Conservation Service to include infiltrative soils so we performed a test hole and permeability test. The soil investigation proved the mapping to be correct as shown in the testing results provided on plan sheet WS-Post. The stormwater system has been designed to rely on the deep layer of well drain coarse sand. An underground stormwater infiltration chamber system has been designed to capture and infiltrate the 10 year, 24 hour storm event for the drainage area on the parcel. Plan sheet WS-Post shows the drainage area for watershed WS-P2 that is collected by the practice. This includes the new parking lot behind the building, the re-directed roof runoff from the existing building, and the northeastern half of the new building. By infiltrating the 10 year storm the project will reduce the post development peak runoff for the 25 year storm. The hydrologic modeling for the 25 year storm event, calculations, and plans are attached for review.

Project Name: 22 Depot Street

Discharge Point: 1

Infiltration (4.3.3)

Infiltration Practice # 1

Practice Drainage Area	For Permit Coverage	Not for Permit Coverage	Total to Practice	
1 Total Area (acres)	0.112	0.000	0.112	
2 New Impervious (acres)	0.060	0.000	0.060	
3 Redeveloped Impervious	0.093	0.000	0.093	
	WQ_V for credit	WQ_V not for credit	Total WQ_V	
4 WQ_V to practice	0.0087	0.0000	0.0087	Modified CN for WQ (1.0") storm 99

5	Design Volume for Infiltration (T_V) 0.0000	← Tv value to enter on the Standards Compliance Workbook for this practice
6	Practice Type	◯ Infiltration Basin ◯ Infiltration Trench ◉ Infiltration Chambers ◯ Drywell(s)

Note: If the practice is designed to infiltrate the WQ_V, then $T_V = WQ_V$. Designers may use the Practice Drainage Area Runoff Calculator (second tab) for calculation of practice-specific runoff volumes for other treatment standards. Sizing of the filter bed area/swale bottom need to consider the desired treatment volume (see treatment section). Some design requirements will change based on the size of storm the practice is designed to treat.

* Questions preceded by an asterix (*) may change based on previously entered values

	Feasibility (4.3.3.1)	**Response**	**Attachment location**
7	Has the infiltration rate (fc) of the underlying soil been confirmed to be at least 0.2 inches per hour by the soil testing requirements in Section 4.3.3.2?	◯ Yes ◯ No	
8*	Is the seasonal high groundwater table (SHGWT) separated at least three (3) feet vertically from the bottom of the practice?	◯ Yes ◯ No	
9	Has a groundwater mounding analysis been performed if the practice is designed to infiltrate >1 year storm and the SHGWT <4 feet?	◯ Yes ◯ No	
10	Have the proper setback requirements for groundwater source protection been observed? (Section 4.3.3.1)	◯ Yes ◯ No	
11	Has the practice been placed so that it will not cause intrusion problems for down-gradient structures? (Section 4.3.3.1)	◯ Yes ◯ No	
12	Is the site free from subsurface contamination or prior approval obtained from the Agency? (If approval is required based on prior contamination, include	◯ Yes ◯ No	
13*		◯ Yes ◯ No	

Conveyance (4.3.3.2)	**Response**	**Attachment location**

14	Have the outfalls and the conveyance to the discharge point been designed/protected to avoid erosive velocities?	○ Yes ○ No	
15	Is the practice designed to completely dewater the treatment volume (T_V) within 48 hours after the storm event?	○ Yes ○ No	
16	If the practice is designed to infiltrate <1 year storm and runoff is delivered by the main conveyance system, has it been designed as an off-line practice?	○ Yes ○ No	

Pre-Treatment (4.3.3.3)		**Response**	**Attachment location**
17	Has pretreatment been provided for non-rooftop runoff?	○ Yes ○ No	
18	What type of pretreatment is being used? ☐ Swale ☑ Forebay ☐ Proprietary ☐ Filter Strip ☐ Deep Sump Catch Basins		
19*	Is the infiltration rate (fc) greater than or less than 2 inches per hour?	○ ≤ 2 in/hr ○ > 2 in/hr	
20*	Is the forebay sized to hold at least 50% of the WQv?	○ Yes ○ No	
21*	Is the forebay separated at least three (3) feet from the SHGWT or located over impermeable soils?	○ Yes ○ No	

Treatment (4.3.2.4)		**Response**	**Attachment location**
22	Has direct access been provided to the practice for maintenance and rehabilitation?	○ Yes ○ No	
23*	Has an observation well been installed in every trench, drywell, or subsurface system?	○ Yes ○ No	
24	What is the physical storage volume up to the overflow? **(ac-ft)**		**Enter this on the eNOI**
25	What is the treatment volume provided by the STP? T_V **(ac-ft)**		

Treatment Volume (T_V) for infiltration practices may be calculated using the equations provided as design guidance in Section 4.3.3.5 OR by demonstrating infiltration of the T_V using TR-20 or an approved equavalent.

Landscaping (4.3.2.5)		**Response**	**Attachment location**
26	Does the site plan specify a landscaping plan that ensures dense and vigorous vegetation over the contributing pervious drainage areas and the practice?	○ Yes ○ No	

Attachment location: Indicate the specific location (i.e. appendix, page, plan sheet) where the requisite support documentation has been provided within the application.

Practice Drainage Area Runoff Calculator

Project Name:	22 Depot Street Total WS
Discharge Point:	1
Infiltration Practice #	1

This tool may be used to calculate the required treatment volumes for the area draining to an individual practice where the practices drainage area is only a portion of of the area draining to a discharge point. Where the practice receives runoff from the entire area to a discharge point, this calculator will give the same information as the Standards Compliance Workbook.

Precipitation Data

* Precipitation values shall be obtained from NOAA Atlas 14

Storm	WQ Storm	1 yr, 24 hr	10 yr, 24 hr	100 yr, 24 hr
Precipitation (inches)	1.00	1.98	3.49	5.28

Drainage Area Information

Pre Development Land Use (acres)

	Hydrologic Soil Group				
Landuse	A	B	C	D	Total (acres)
Grass	0.107	0.000	0.000	0.000	0.107
Meadow	0.000	0.000	0.000	0.000	0.000
Woods	0.000	0.000	0.000	0.000	0.000
Pavement, roofs, and other impervious	0.166	0.000	0.000	0.000	0.166
Total	0.273	0.000	0.000	0.000	0.273

Post Development Land Use (acres)

	Hydrologic Soil Group				
Landuse	A	B	C	D	Total (acres)
Grass	0.056	0.000	0.000	0.000	0.056
Meadow	0.000	0.000	0.000	0.000	0.000
Woods	0.000	0.000	0.000	0.000	0.000
Pavement, roofs, and other impervious	0.217	0.000	0.000	0.000	0.217
Total	0.273	0.000	0.000	0.000	0.273

T_V of upstream practices: 0.000 ac-ft T_V credit of this practice: 0.000 ac-ft

Treatment Standard	Required Treatment Volume	Post Development Runoff Volume	Pre-development Runoff Volume	Post Composite CN (to practice)	CN_{Adj} (with T_V practice credit)	Pre Composite CN
Channel Protection (Hydrologic Condition Method)	0.0075	0.0317	0.0243	94	94	90
Overbank Flood	0.0138	0.0589	0.0451	92	92	85
Extreme Flood	0.0203	0.0924	0.0721	89	89	80

Information for Calculating T_C by the Watershed Lag Method

Average Catchment	Hydraulic	Time of Concentration, T_C (min)

	Slope, Y (%)	Length, l (ft)	1 yr	10 yr	100 yr
Pre Development	5.50%	181.00	2.4	3.0	3.4
Post Development, upstream of practice	5.50%	94.00	1.2	1.3	1.5
Post Development, with T_V credit from practice	0.00%	0.00	0.0	0.0	0.0

22 Depot Street, Richmond

25YR Storm Post

25YR Storm Pre
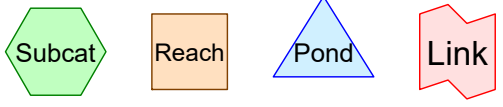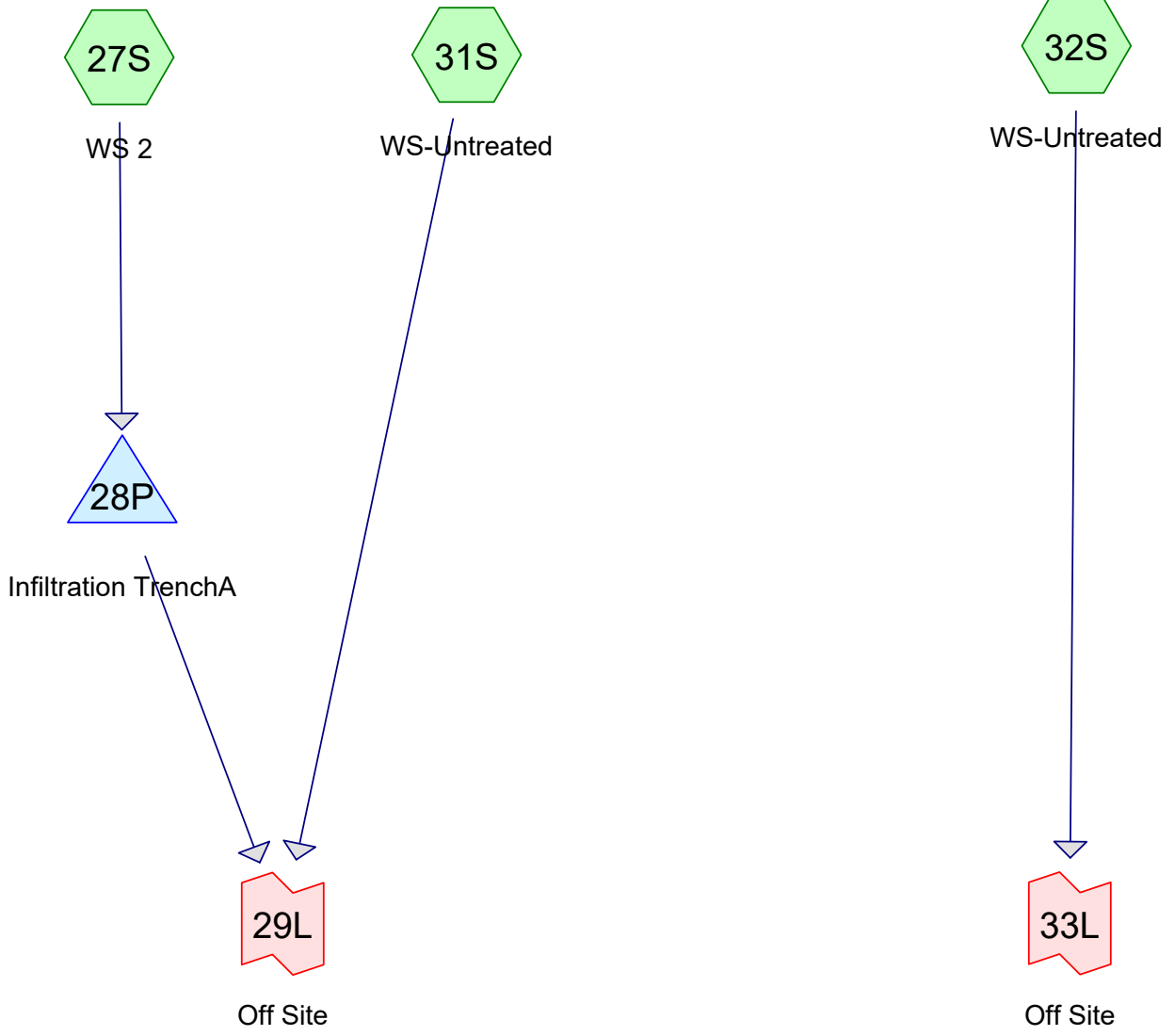
27S
WS 2

31S
WS-Untreated

32S
WS-Untreated

28P

Infiltration TrenchA

29L
Off Site

33L
Off Site

Subcat
Reach
Pond
Link

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.208	95	Worksheet (27S)
0.338	90	Worksheet (31S, 32S)
0.546	**92**	**TOTAL AREA**

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Type II 24-hr 25 Year Rainfall=4.19"
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Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 27S: WS 2　　　　　　　　　Runoff Area=0.208 ac   0.00% Impervious   Runoff Depth=3.62"
Tc=1.1 min   CN=95   Runoff=1.39 cfs 0.063 af

Subcatchment 31S: WS-Untreated　　　　　Runoff Area=0.065 ac   0.00% Impervious   Runoff Depth=3.10"
Tc=1.5 min   CN=90   Runoff=0.39 cfs 0.017 af

Subcatchment 32S: WS-Untreated　　　　　Runoff Area=0.273 ac   0.00% Impervious   Runoff Depth=3.10"
Tc=3.1 min   CN=90   Runoff=1.57 cfs 0.071 af

Pond 28P: Infiltration TrenchA　　　　Peak Elev=329.56' Storage=926 cf   Inflow=1.39 cfs 0.063 af
Discarded=0.07 cfs 0.058 af   Primary=0.95 cfs 0.005 af   Outflow=1.02 cfs 0.063 af

Link 29L: Off Site　　　　　　　　　　　　　　　Inflow=1.22 cfs 0.022 af
Primary=1.22 cfs 0.022 af

Link 33L: Off Site　　　　　　　　　　　　　　　Inflow=1.57 cfs 0.071 af
Primary=1.57 cfs 0.071 af

Total Runoff Area = 0.546 ac   Runoff Volume = 0.150 af   Average Runoff Depth = 3.30"
100.00% Pervious = 0.546 ac   0.00% Impervious = 0.000 ac

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Summary for Subcatchment 27S: WS 2

Runoff   =   1.39 cfs @ 11.91 hrs, Volume=   0.063 af, Depth= 3.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
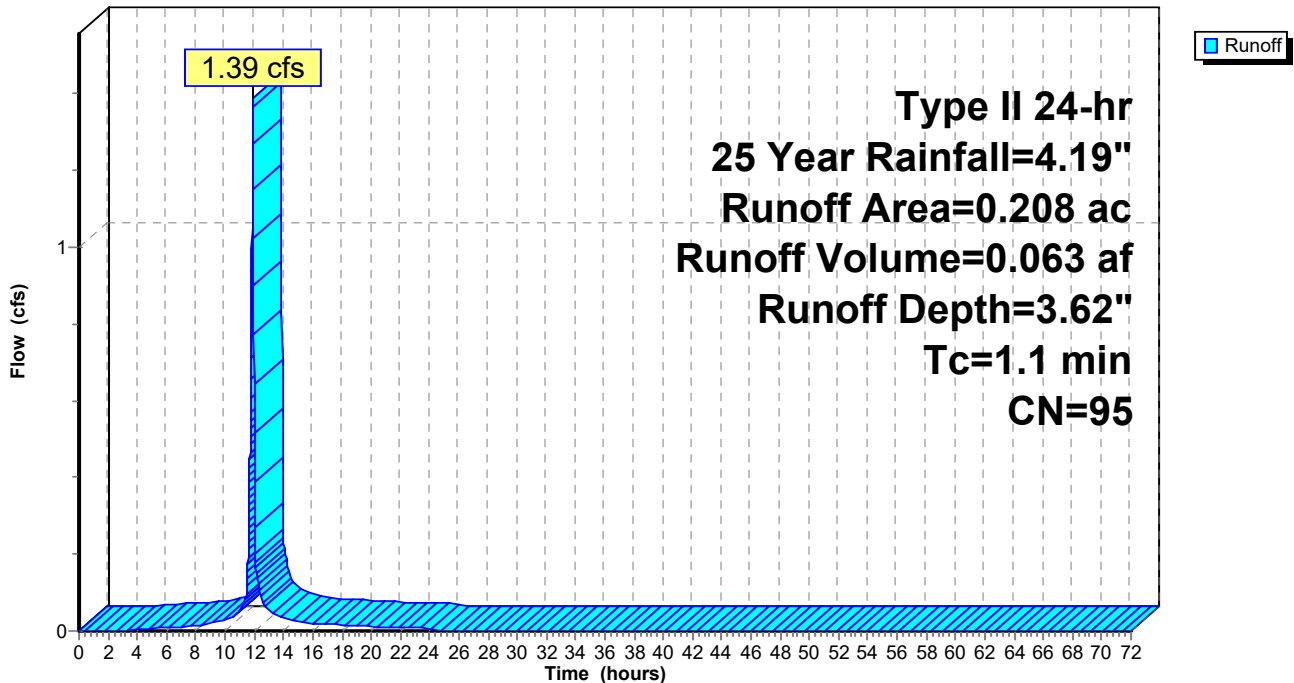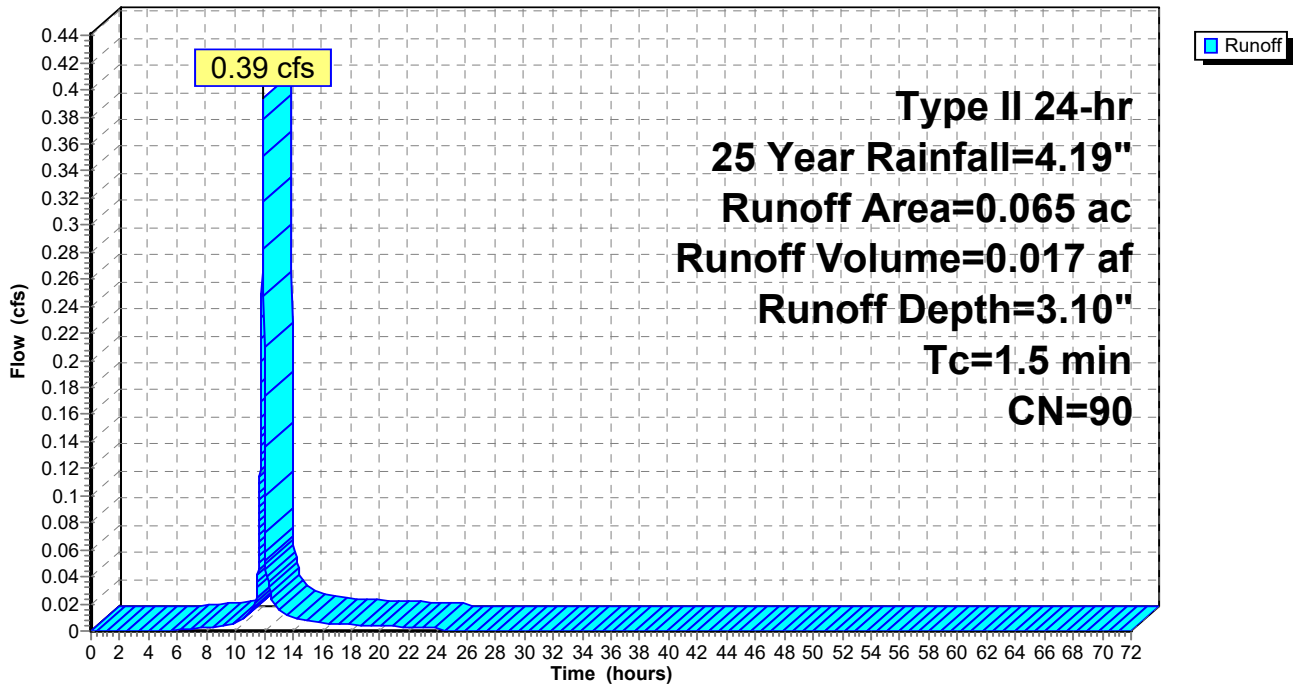Type II 24-hr 25 Year Rainfall=4.19"

	Area (ac)	CN	Description
*	0.208	95	Worksheet
	0.208		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1					**Direct Entry, Worksheet**

Subcatchment 27S: WS 2

Hydrograph

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Type II 24-hr 25 Year Rainfall=4.19"
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Summary for Subcatchment 31S: WS-Untreated

Runoff   =   0.39 cfs @   11.92 hrs, Volume=   0.017 af, Depth= 3.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Year Rainfall=4.19"

	Area (ac)	CN	Description			
*	0.065	90	Worksheet			
	0.065		100.00% Pervious Area			

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5					**Direct Entry, Worksheet**

Subcatchment 31S: WS-Untreated

Summary for Subcatchment 32S: WS-Untreated

Runoff   =   1.57 cfs @   11.94 hrs, Volume=   0.071 af, Depth= 3.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Year Rainfall=4.19"

	Area (ac)	CN	Description
*	0.273	90	Worksheet
	0.273		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1					**Direct Entry, Worksheet**

Subcatchment 32S: WS-Untreated
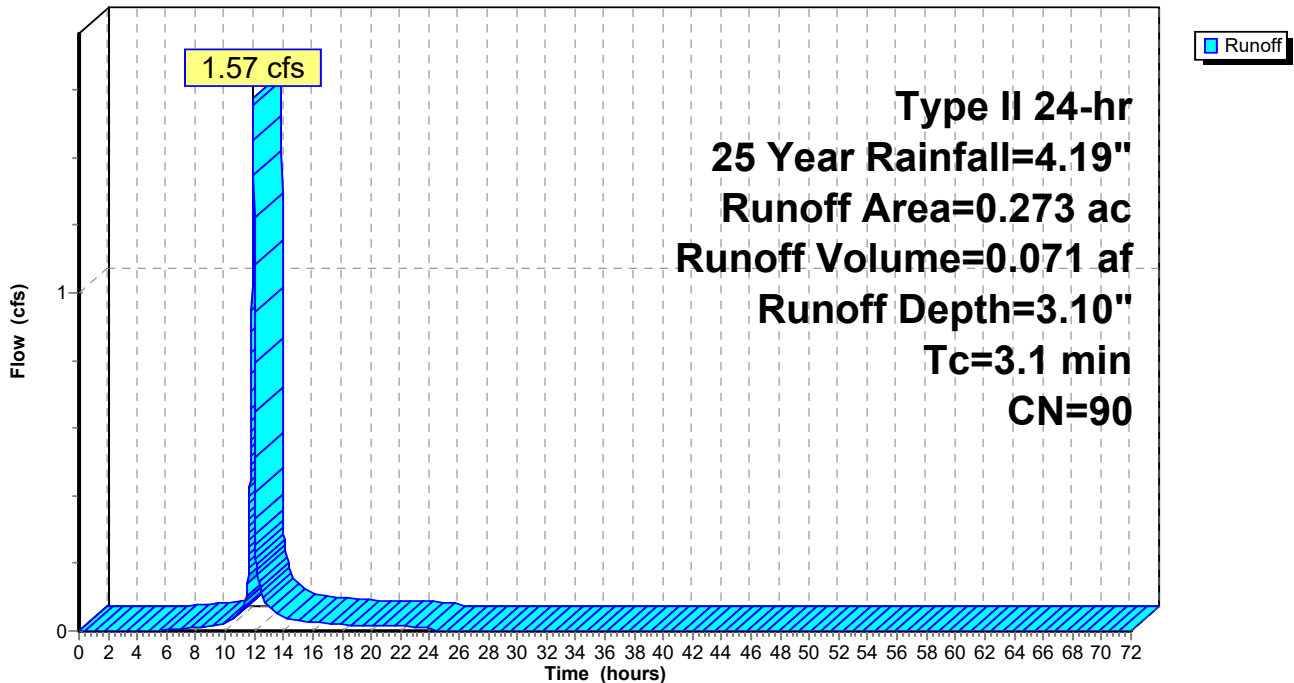
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Summary for Pond 28P: Infiltration TrenchA

Inflow Area =   0.208 ac,   0.00% Impervious, Inflow Depth = 3.62"   for 25 Year event
Inflow   =   1.39 cfs @   11.91 hrs, Volume=   0.063 af
Outflow   =   1.02 cfs @   11.96 hrs, Volume=   0.063 af, Atten= 27%, Lag= 3.1 min
Discarded =   0.07 cfs @   11.25 hrs, Volume=   0.058 af
Primary   =   0.95 cfs @   11.96 hrs, Volume=   0.005 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 329.56' @ 11.96 hrs   Surf.Area= 377 sf   Storage= 926 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 86.3 min (851.3 - 765.0)

5 chambers
Provided

Volume	Invert	Avail.Storage	Storage Description
#1	329.45'	8 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
#2A	323.95'	340 cf	**7.42'W x 40.62'L x 4.75'H Field A**
			1,431 cf Overall - 581 cf Embedded = 850 cf x 40.0% Voids
#3A	324.45'	581 cf	**ADS_StormTech MC-3500 c +Cap** x 5 Inside #2
			Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
			Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
			Cap Storage= +15.6 cf x 2 x 1 rows = 31.2 cf
		929 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
329.45	10	0	0
329.60	100	8	8

Device	Routing	Invert	Outlet Devices
#1	Discarded	323.95'	**10.000 in/hr Exfiltration over Surface area below 323.96'**
#2	Primary	329.45'	**10.0' long x 4.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00
			2.50 3.00 3.50 4.00 4.50 5.00 5.50
			Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66
			2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.07 cfs @ 11.25 hrs HW=324.01'   (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.82 cfs @ 11.96 hrs HW=329.56'   (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 0.82 cfs @ 0.77 fps)

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Pond 28P: Infiltration TrenchA - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 c +Cap (ADS StormTech® MC-3500 c rev 05/12 with Cap storage)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +15.6 cf x 2 x 1 rows = 31.2 cf

5 Chambers/Row x 7.17' Long +1.88' Cap Length x 2 = 39.62' Row Length +6.0" End Stone x 2 = 40.62' Base Length
1 Rows x 77.0" Wide + 6.0" Side Stone x 2 = 7.42' Base Width
6.0" Base + 45.0" Chamber Height + 6.0" Cover = 4.75' Field Height

5 Chambers x 110.0 cf + 15.6 cf Cap Volume x 2 x 1 Rows = 581.0 cf Chamber Storage

1,430.9 cf Field - 581.0 cf Chambers = 849.9 cf Stone x 40.0% Voids = 340.0 cf Stone Storage
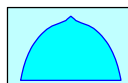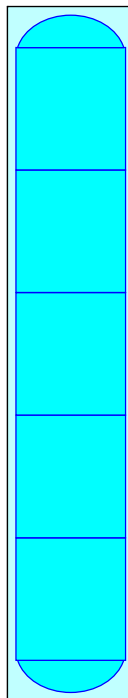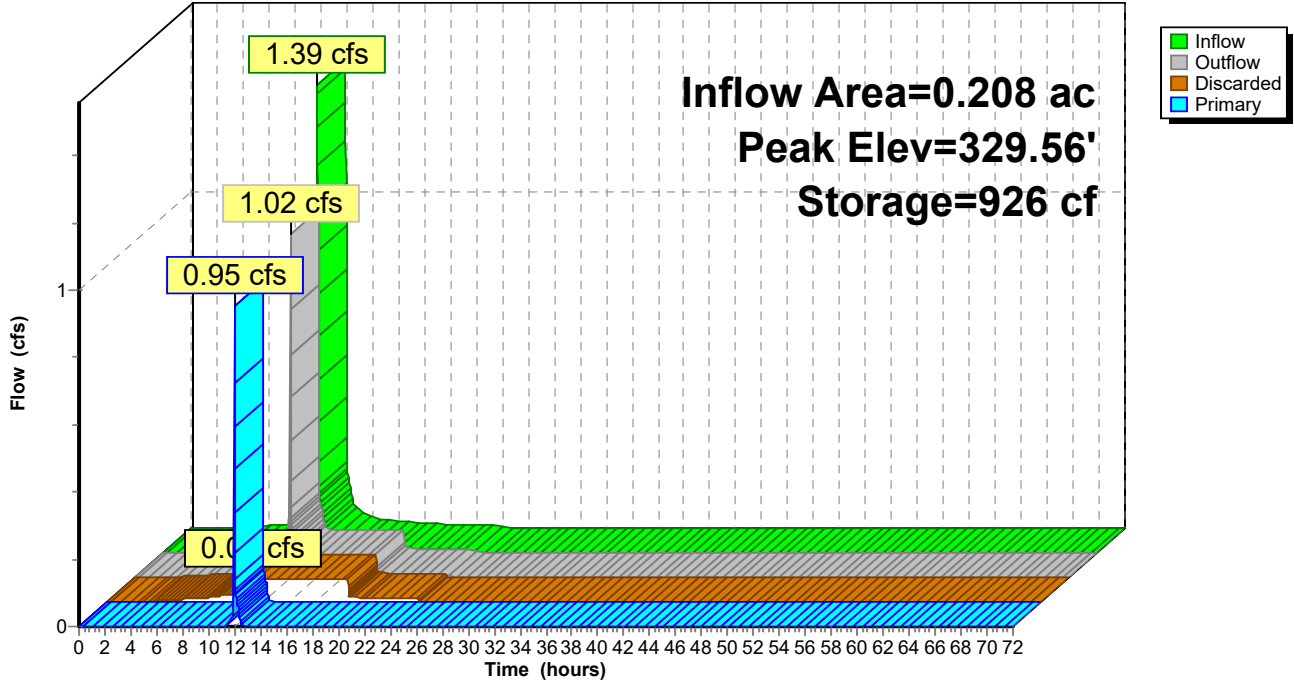
Chamber Storage + Stone Storage = 920.9 cf = 0.021 af
Overall Storage Efficiency = 64.4%

5 Chambers
53.0 cy Field
31.5 cy Stone

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Pond 28P: Infiltration TrenchA

Hydrograph

Inflow Area=0.208 ac
Peak Elev=329.56'
Storage=926 cf

Legend:
- Inflow
- Outflow
- Discarded
- Primary

Flow values: 1.39 cfs, 1.02 cfs, 0.95 cfs, 0.0 cfs

Flow (cfs) vs Time (hours): 0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72

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Type II 24-hr 25 Year Rainfall=4.19"
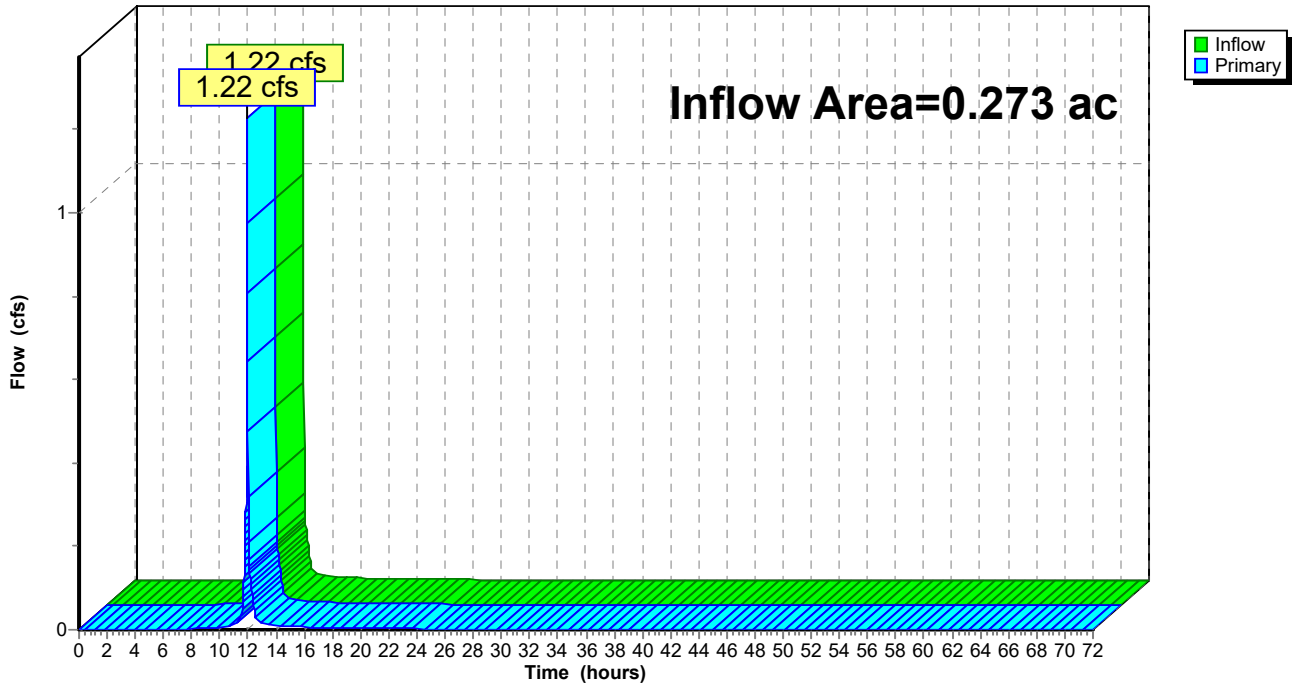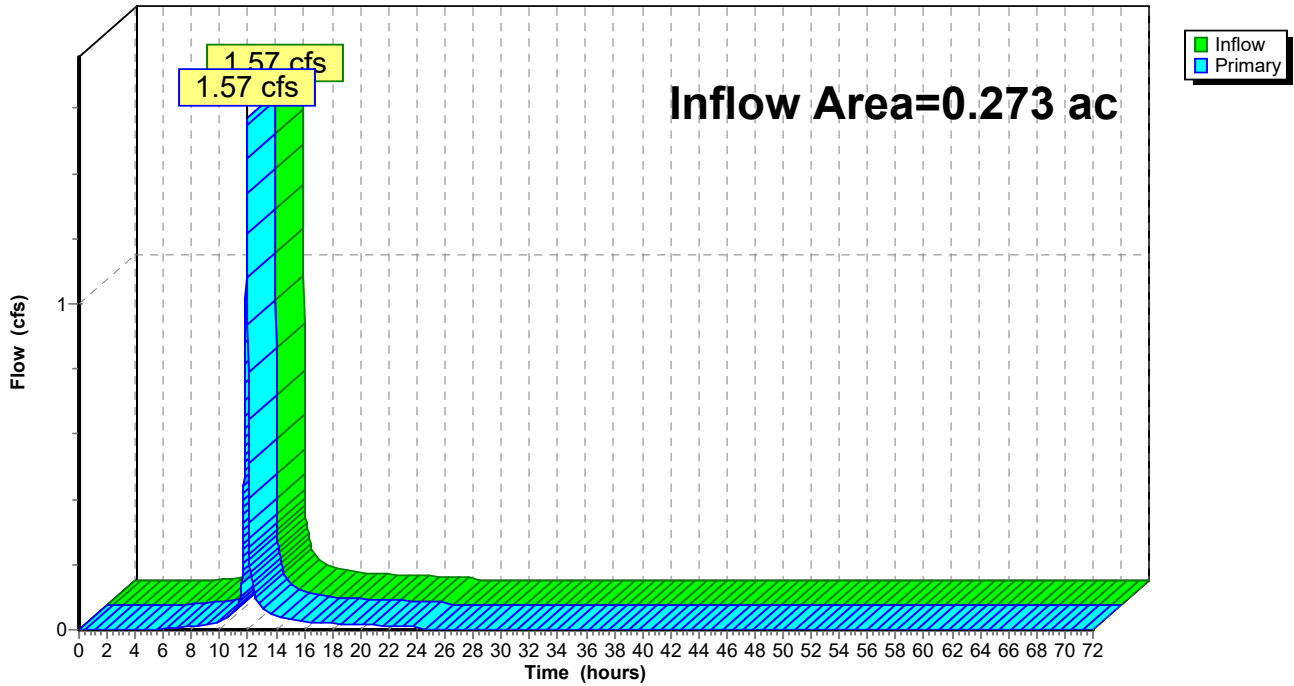Printed 3/20/2023
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Summary for Link 29L: Off Site

Inflow Area =   0.273 ac,   0.00% Impervious, Inflow Depth =   0.96"   for 25 Year event
Inflow   =   1.22 cfs @   11.96 hrs, Volume=   0.022 af
Primary   =   1.22 cfs @   11.96 hrs, Volume=   0.022 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 29L: Off Site

Hydrograph

22 Depot Storm   *Type II 24-hr 25 Year Rainfall=4.19"*
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Summary for Link 33L: Off Site

Inflow Area =   0.273 ac,   0.00% Impervious, Inflow Depth =   3.10"   for 25 Year event
Inflow   =   1.57 cfs @   11.94 hrs, Volume=   0.071 af
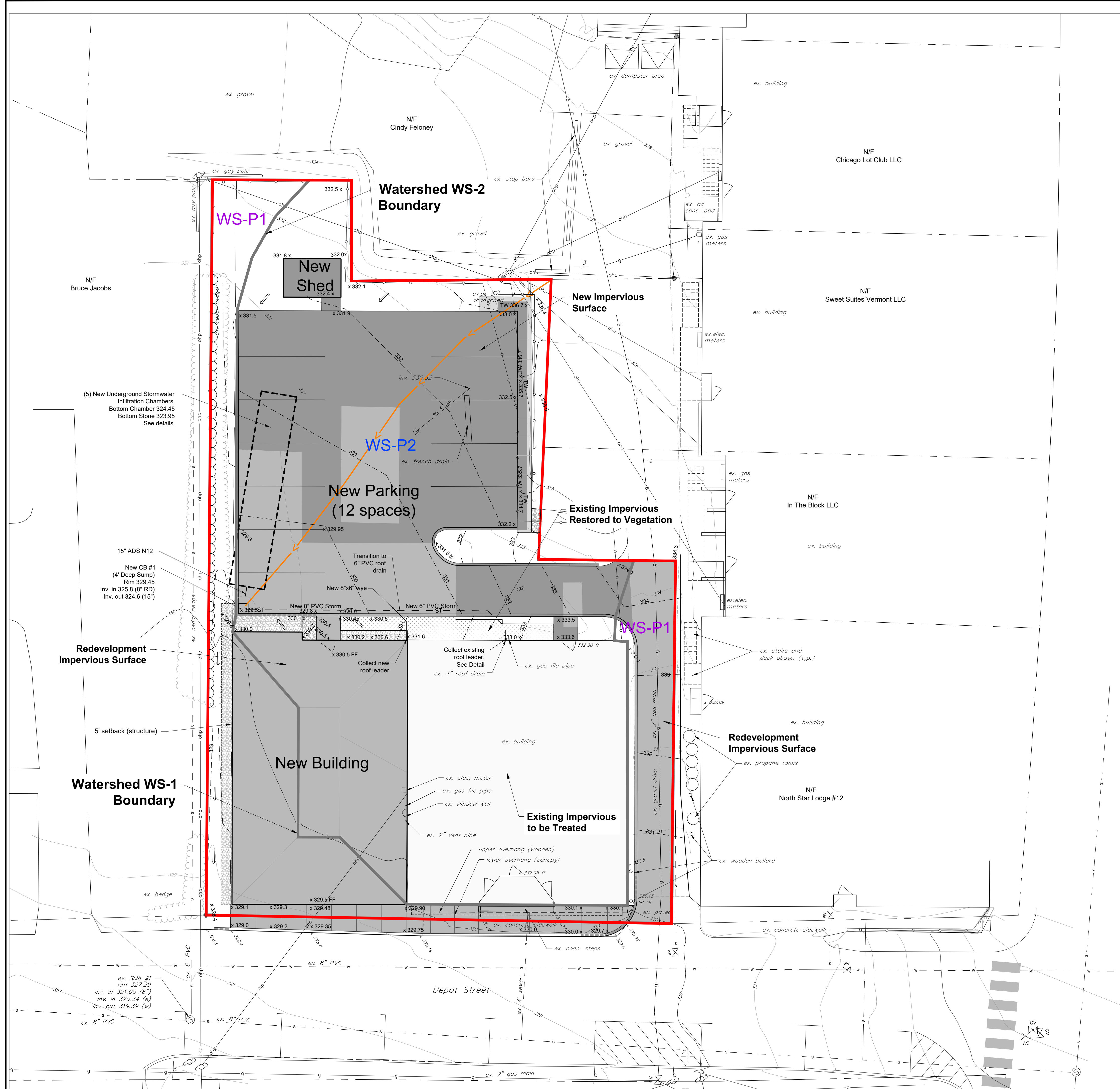Primary   =   1.57 cfs @   11.94 hrs, Volume=   0.071 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 33L: Off Site

INFILTRATION TESTING

Project Name: 22 Depot Street
Testing By: CPG
Date: 3/16/2023
Depth of Test: 36 inches

Infiltration Testing using Borehole Infiltration Test per 2017 VSWMM Section 4.3.2.5
* Alternative pre-soaking procedure per "Oregon State publication" was used

** The lowest rate of the 4 infiltration tests performed at each Test Site
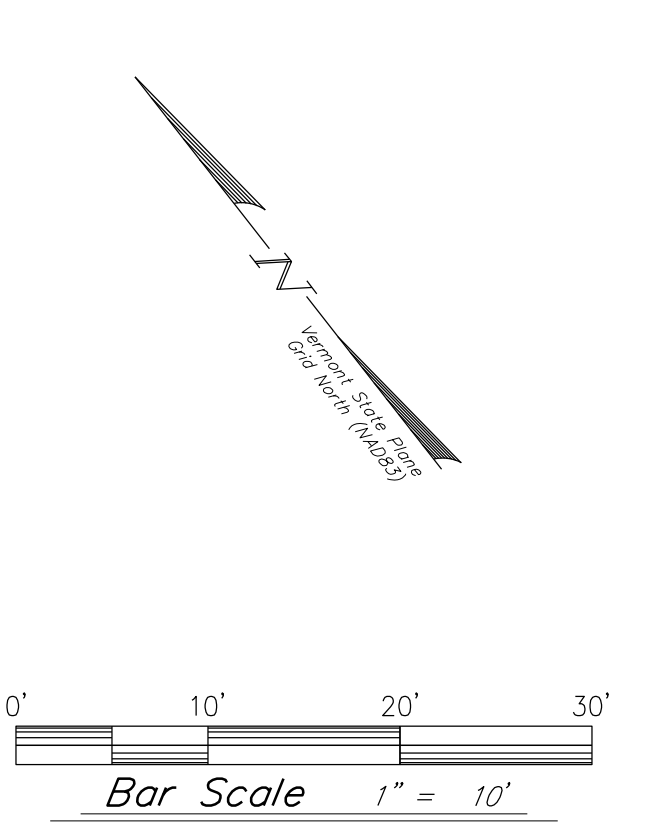***** Using Factor of Safety of 2, Design Rate = Lowest Rate/2**

Test #	Lowest Rate** (in/hr)	Design Rate*** (in/hr)
IT-1	20	10

Impervious Area Legend

▓	NEW Impervious Areas
░	Redevelopment Impervious
░	EXISTING to be Treated
░	Existing Impervious RESTORED to vegetation
▭	Watershed Limit
▭	Site Area Limits
→→→	Post Development TC

Watershed WS-2 Boundary

WS-P1

New Impervious Surface

New Shed

(5) New Underground Stormwater
Infiltration Chambers.
Bottom Chamber 324.45
Bottom Stone 323.95
See details.

WS-P2

New Parking (12 spaces)

Existing Impervious Restored to Vegetation

15" ADS N12

New CB #1
(4' Deep Sump)
Rim 329.45
Inv. in 325.8 (8" RD)
Inv. out 324.6 (15")

Transition to 6" PVC roof drain

New 8"x6" wye

New 8" PVC Storm   New 6" PVC Storm

Redevelopment Impervious Surface

WS-P1

Collect existing roof leader.
See Detail

Collect new roof leader

Redevelopment Impervious Surface

5' setback (structure)

New Building

Watershed WS-1 Boundary

Existing Impervious to be Treated

N/F Cindy Feloney

N/F Bruce Jacobs

N/F Chicago Lot Club LLC

N/F Sweet Suites Vermont LLC

N/F In The Block LLC

N/F North Star Lodge #12

Depot Street

STAMP:

Bar Scale   1" = 10'

Project:

22 Depot Street Mixed Use Addition

Richmond, Vermont

Project No.	22280
Scale	1" = 10'
Drawn by	CPG
Checked by	
Date	04/27/2023

Revisions
No.	Date	Description

Drawing Title

Post Development Watershed Plan

Drawing No.

WS-POST

22280\DWGS\22280 base.dwg

EXISTING
IMPERVIOUS =
7240 SF
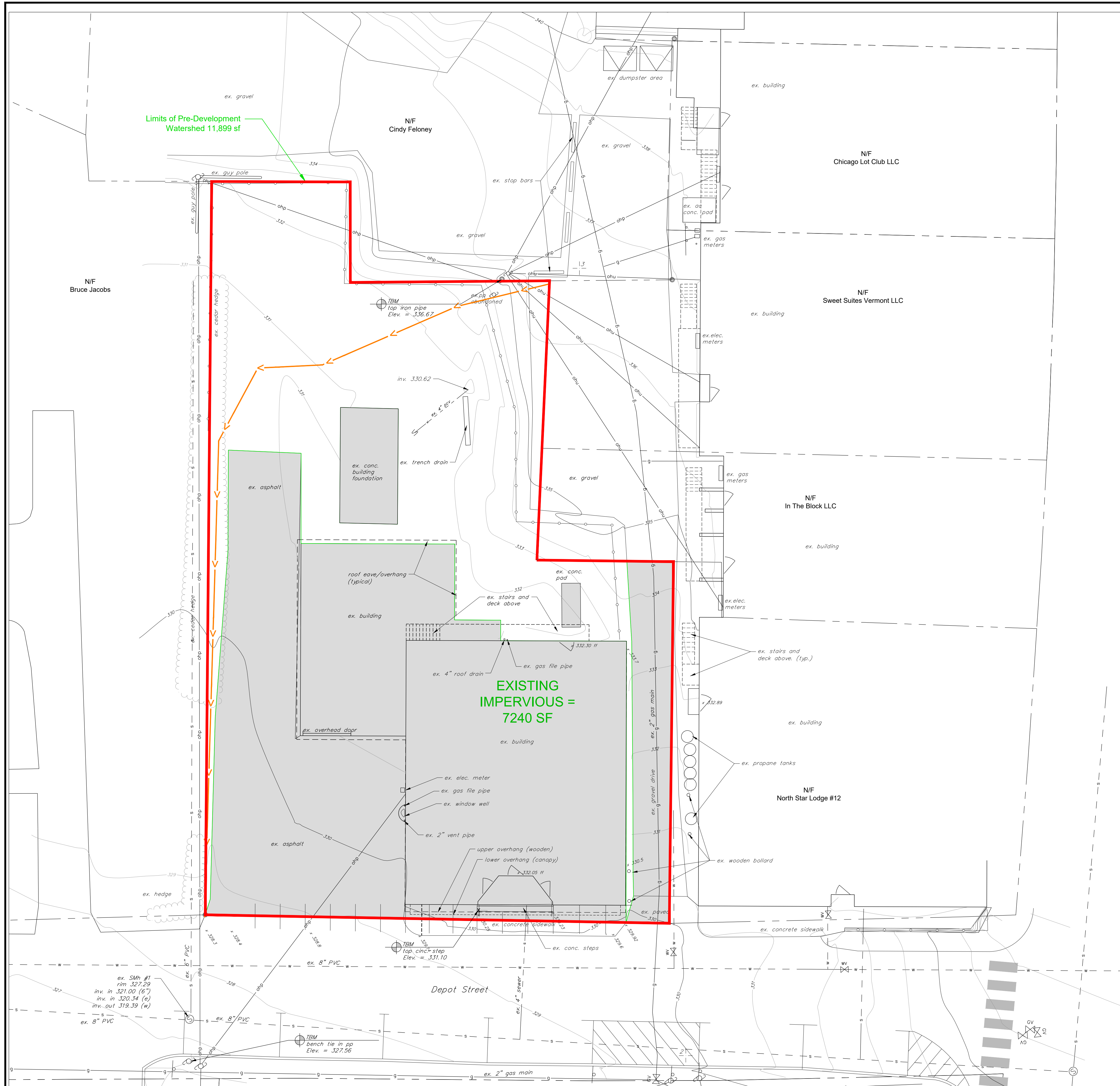
Limits of Pre-Development
Watershed 11,899 sf

N/F
Cindy Feloney

N/F
Bruce Jacobs

N/F
Chicago Lot Club LLC

N/F
Sweet Suites Vermont LLC

N/F
In The Block LLC

N/F
North Star Lodge #12

Depot Street

Legend:
- Existing Impervious
- Pre Development TC
- Watershed Limit
- Site Area Limits

**KREBS &
LANSING**
CONSULTING ENGINEERS

164 Main Street, Suite 201   P: (802) 878-0375
Colchester, Vermont 05446   www.krebsandlansing.com

STAMP:

Bar Scale   1" = 10'
0'   10'   20'   30'

Project:

22 Depot Street
Mixed Use Addition

Richmond, Vermont

Project No.	22280
Scale	1" = 10'
Drawn by	CPG
Checked by	
Date	04/27/2023

Revisions
No. Date   Description

Drawing Title

Pre Development
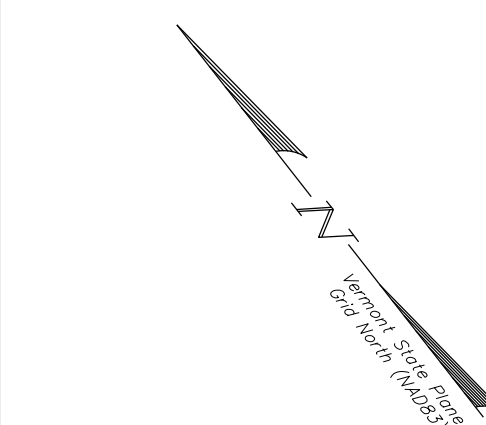Watershed Plan

Drawing No.

WS-PRE

22280\DWGS\22280 base.dwg