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BRADLEY HEIGHTS APARTMENTS

Stormwater Site Plan
Drainage Report

FOR: Timberlane Partners
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JOB NO: 3227

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Section I - Project Overview

Overview:

The project site is located on the south side of 27th Ave SE, east of the intersection with S Meridian. The site address is 202 27th Ave SE. Tax parcel number is 041903-6-006. Parcel area is 7.78 acres. The project is an apartment project with 10 apartment buildings and a recreation building.

Improvements for the project will include the parking lot, storm drainage facilities, sanitary sewer main extension, water main extension, construction of multi-family and recreation buildings, and construction of curb, gutter, and sidewalk along the project frontage.

Project Requirements:

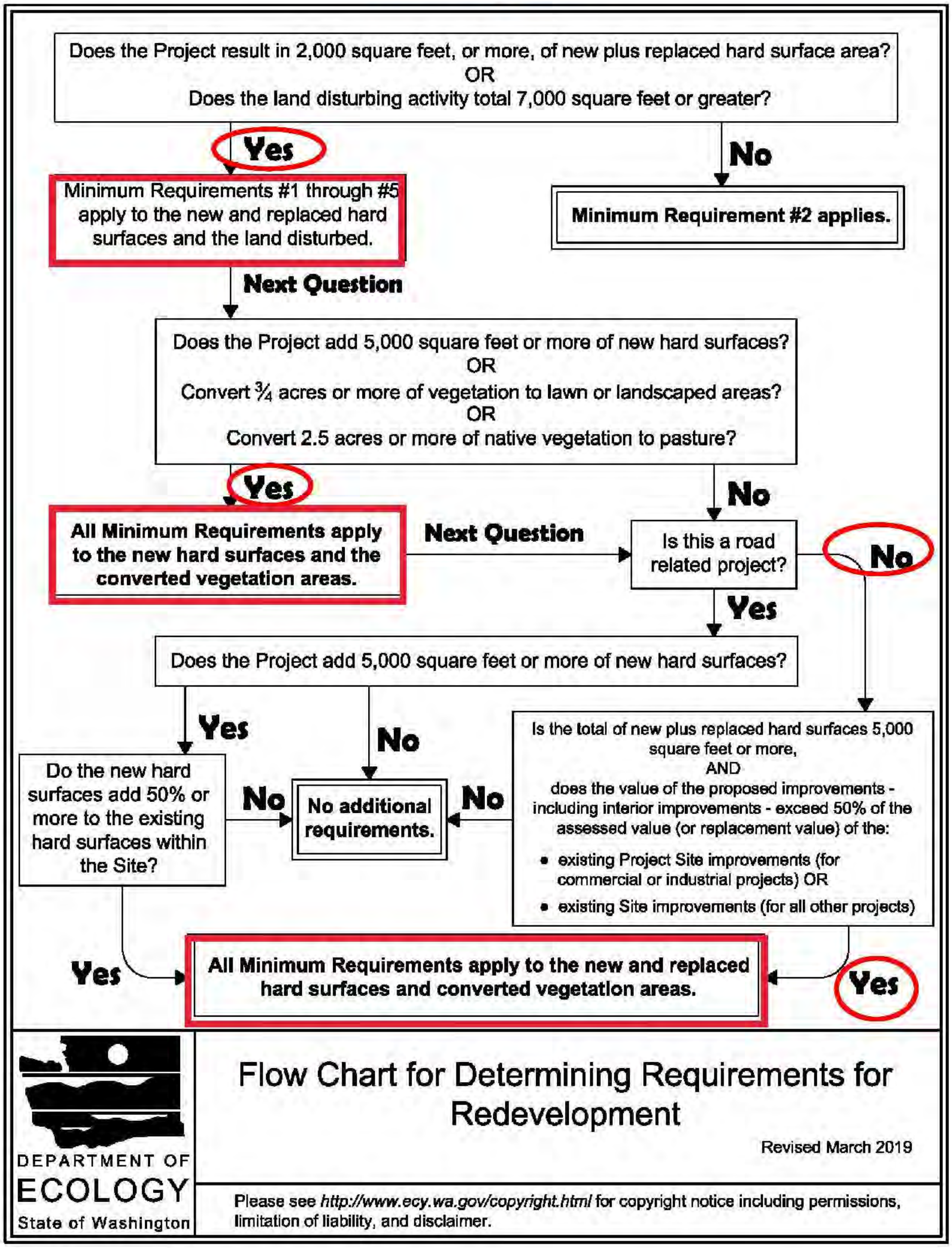
Determination of Applicable Minimum Requirements

8 buildings shown. [STORMWATER REPORT, Page 3/216]

Per PMC 21.10.040 the City of Puyallup has adopted the Washington State Department of Ecology Stormwater Management Manual for Western Washington (SMMWW), with the version in effect being "the most current version approved for city use by the council." The city adopted the 2019 DOE Manual on July 1, 2022, and it is the controlling regulation and is referred to as "the Manual" or "SMMWW" hereinafter.

The project consists of over 270,000 sf of new plus replaced hard surfaces onsite. The existing hard surfaces are 135,105 sf or 40% of the project site and therefore, the project is considered redevelopment. Since the total new plus replaced hard surfaces for the project are greater than 5,000 square feet, and the value of improvements exceed 50% of the assessed value of the existing site improvements, all minimum requirements apply to the new and replaced hard surfaces and converted vegetation areas. Note that all of the existing vegetated areas are already lawn/landscaping so therefore there are no converted vegetation areas. Therefore, the minimum requirements only apply to the new and replaced hard surfaces.

Figure I-3.2: Flow Chart for Determining Requirements for Redevelopment



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Discussion of Minimum Requirements

The Minimum Requirements per Section I-2.5 of the Manual:

Minimum Requirement #1: Preparation of Stormwater Site Plans

The Stormwater Site Plan consists of a report and construction plans. This report and the construction drawings satisfy Minimum Requirement #1.

Minimum Requirement #2: Construction Stormwater Pollution Prevention (SWPPP)

The SWPPP consists of a narrative and drawings. The narrative is addressed in Section V of this report. The civil construction plans include a TESC plan, notes, and details.

Minimum Requirement #3: Source Control of Pollution

A Pollution Source Control Plan has been prepared in conformance with requirements of Volume IV of the Manual and is included with this submittal as a separate document.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls

Currently, drainage from the site sheet flows to the north into 27th Ave SE, then west in the gutter and closed conveyance system. The proposed drainage improvements will connect to this same closed conveyance system to preserve existing drainage systems and outfalls.

Minimum Requirement #5: On-site Stormwater Management

Because the project triggers MR #1-9, and is inside the urban growth area, the project must either meet the Low Impact Development Performance Standard, or use List #2 to determine applicable On-Site Stormwater Management BMPs. This project will use List #2. For each surface the BMP's must be considered in the order listed for that type of surface and use the first BMP that is considered feasible.

Lawn and Landscaped Areas:

- All lawn and landscaped areas will meet the requirements of BMP T5.13, Post Construction Soil Quality and Depth with notes on the plans to this effect.

Roofs:

1. BMP T5.30: Full Dispersion – infeasible due to lack of native vegetation and flowpath length onsite; BMP T5.10A: Downspout Full Infiltration – infeasible based on field tested infiltration rates.
2. Bioretention – infeasible based on field tested infiltration rates
3. BMP T5.10B: Downspout dispersion system – not feasible based on required flowpath lengths
4. BMP T5.10C: Perforated Stub-out connections – will be used for all roof drains.

Other Hard Surfaces:

1. BMP T5.30: Full Dispersion – infeasible due to lack of native vegetation and flowpath length
2. BMP T5.15: Permeable pavement – infeasible based on field tested infiltration rates
3. Bioretention – infeasible based on field tested infiltration rates
4. BMP T5.12: Sheet Flow Dispersion & BMP T5.11: Concentrated Flow Dispersion – infeasible due to lack of flowpath length

Minimum Requirement #6: Runoff Treatment

New plus replaced pollution generating hard surfaces (PGHS) is the parking lot paving. The total area is well over 5,000 square feet and therefore runoff treatment is required. As a multi-family development, enhanced treatment is required. Two methods of enhanced treatment will be used. A Filterra system will be used for the area draining to detention system #1, and a treatment train of wet-vault followed by filter media (StormFilter with ZPG) will be used for the rest of the project.

Minimum Requirement #7: Flow Control

The total new plus replaced hard surface for the project is well over 10,000 sf and therefore flow control is required. Any existing pervious surface to be disturbed is already lawn, and therefore the converted vegetation thresholds are not exceeded, and the minimum requirements do not apply to the pervious areas. To meet this minimum requirement stormwater discharges shall match developed discharge durations to predeveloped durations for the range of predeveloped discharge rates from 50 percent of the 2-year recurrence interval peak flow up to the full 50-year peak flow. Predeveloped condition to be matched shall be forested land cover. Note that the forested land cover only applies to the new and replaced impervious areas since the existing land cover is lawn. Therefore, for the onsite lawn in developed conditions, and offsite tributary areas, the land cover is modeled as in existing conditions, i.e. lawn. See below for hydrologic analysis.

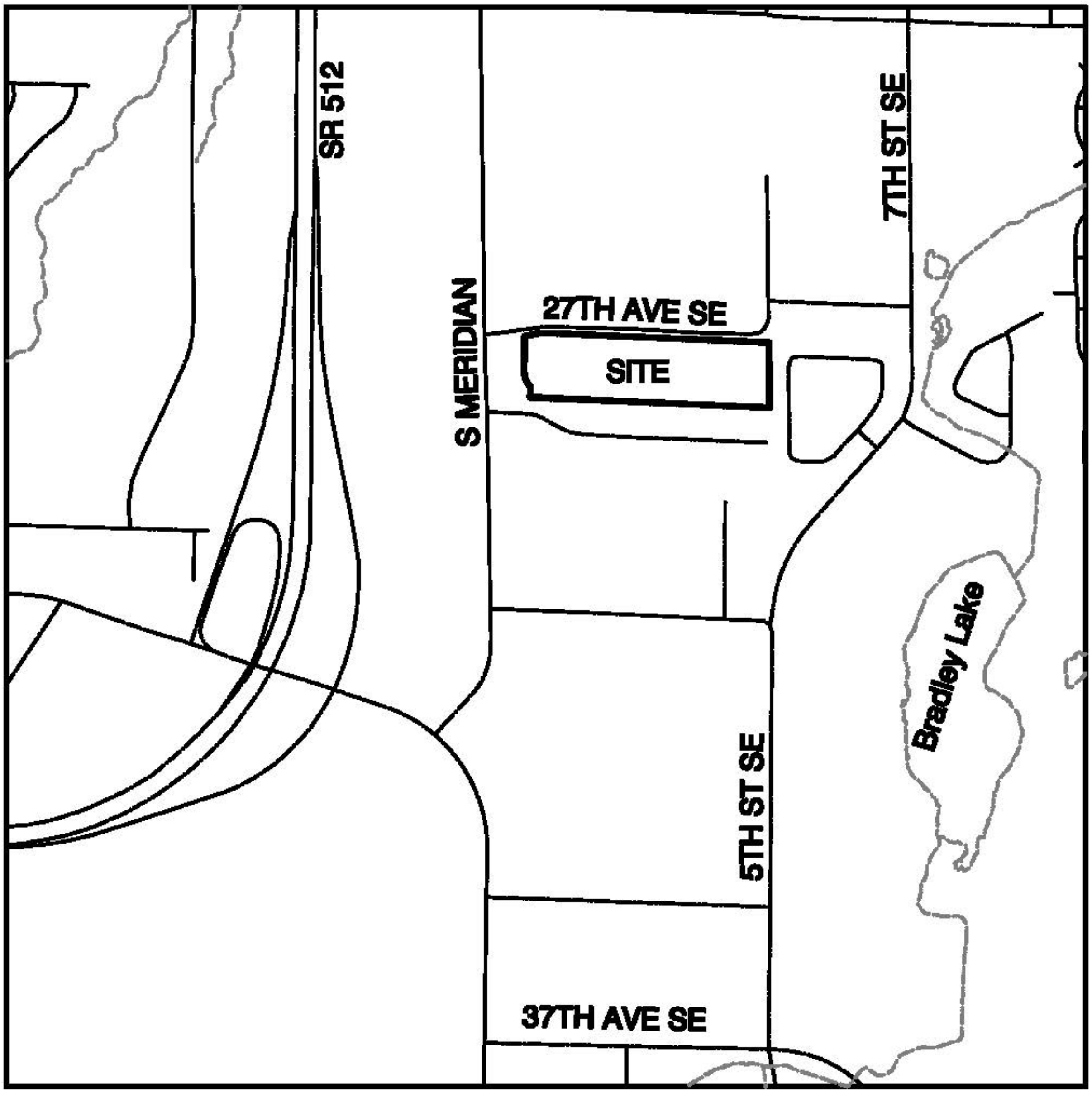
Minimum Requirement #8: Wetlands Protection

There are no wetlands on or near the site.

Minimum Requirement #9: Operation and Maintenance

The stormwater facilities required for this project that require a maintenance plan are: conveyance system, detention vault, flow restrictor, Filterra, and Stormfilter vault. All onsite stormwater facilities will be owned, operated, and maintained by the property owner. An O&M plan is included as a separate document.

Figure 1. Site Location:



VICINITY MAP

Section II – Existing Conditions Summary

Topography:

In existing conditions the site slopes to the northwest, with slopes generally between 5 and 10%. The steepest portion of the site is 14%, with about 10 feet of fall in the west end of the property.

Ground Cover:

The site is developed as a mobile home park. A drive aisle runs through the site with parking areas for each unit. The non-hard surface areas are covered with lawn and landscaping.

Drainage:

There is no defined drainage course onsite. Any surface runoff that does not infiltrate sheet flows northwest into 27th Ave SE.

Soils:

The NRCS Soil Survey of Pierce County indicates the soils on the majority of the site are Everett gravelly sandy loam (13B & 13C). The soils in the northwest corner of the site are mapped as Kitsap silt loam (20B). Based on the soils exploration performed by GeoResources, the soils vary over site, consisting of recessional outwash, glacial till, and glaciolacustrine soils, generally matching the USDA mapping. Groundwater monitoring was performed during the winter of 2021 with peak groundwater reaching elevation 361.0 on the west end of the site and 383.0 on the east end of the site. The field tested infiltration rate was less than 0.1 inch per hour and therefore infiltration of runoff is deemed infeasible.

Floodplain

The project site does not include a floodplain based on latest FIRM and Pierce County flood data.

Section III – Off-Site Analysis

Upstream

Approximately 2.7 acres immediately south of the site drains onto the site. The drainage area is limited by 28th Ave SE and the drainage system that collects any other upstream runoff. The tributary area is similar in topography to the site and is developed with moderate density single-family lots.

Downstream

From the project site, runoff sheet flows north into 27th Ave SE and is collected in the public closed conveyance system consisting of 12-inch pipe along the project frontage. This system flows west, with pipe size increasing to 24-inch right before connecting in the Meridian conveyance system. The Meridian conveyance system is a 24-inch pipe flowing north for approximately 1150 feet to the ¼ mile downstream point. This point is approximately 400 feet north of 23rd Ave SW

Problems

There are no known drainage problems along this downstream route, the road grade is approximately 8% for several hundred feet of fall.

Section IV – Permanent Stormwater Control Plan

Existing Site Hydrology

In existing conditions, any runoff travels northwesterly across the site as sheet flow and is collected along the frontage in the storm system in 27th Ave SE. The areas that must be considered in the hydrologic analysis are the project site itself, the area within the frontage that will be disturbed, and the offsite tributary area.

Drainage Analysis	sf	ac
Project Onsite Area	339103	7.7847
Frontage Area	24768	0.5686
Upstream Trib Area	170871	3.9227
Total	534742	12.2760

Offsite tributary runoff

Because the offsite tributary runoff will not be bypassed, that area is modeled as in existing conditions. Section III-2.4 of the Manual allows this as long as the 100-year peak flow rate from the area not requiring mitigation is less than 50% of the 100-year undetained developed peak flow rate from the area requiring mitigation. The non-mitigation area consists of the 3.92 ac of offsite area shown above plus 1.31 ac of onsite lawn, for a total of 5.23 ac. The offsite tributary area is delineated as:

Upstream Area	sf	ac
Total Area	170871	3.9227
Driveway	20665	0.4744
Shoulder	2181	0.0501
Roof	27737	0.6368
Patio	4128	0.0948
Total Impervious	54711	1.2560
Lawn	116160	2.6667

The total non-mitigation and mitigation required areas are tabulated below. POC 7 is used in the WWHM for this comparison/analysis:

POC 7	Non Mitigation Area		Mitigation Area	
Impervious	sf	acre	sf	acre
Driveway, Flat	20665	0.4744	0	0.0000
Road, Flat	2181	0.0501	125123	2.8724
Roof	27737	0.6368	89477	2.0541
Sidewalk	4128	0.0948	45666	1.0483
Total Impervious	54711	1.2560	260266	5.9749
C, Lawn, Mod	173224	3.9767	46541	1.0684
Total	227935	5.2327	306807	7.0433

The resulting runoff rates are:

```
                Flow Frequency
     Flow(cfs)  Predeveloped  Mitigated
      2 Year   =    0.6887     2.2485
      5 Year   =    1.0639     3.0340
      10 Year  =    1.3676     3.6073
      25 Year  =    1.8213     4.3944
      50 Year  =    2.2144     5.0279
      100 Year =    2.6588     5.7032
```

The predeveloped 100-year runoff rate of the non-mitigated areas is 2.66 cfs, which is 47% of the undetained area to mitigated runoff rate of 5.70 cfs. Since this is less than 50%, the non-mitigated area may be treated as it's existing condition in the hydrologic analysis.

Pre-Developed Hydrology

Because the existing site is developed, the existing lawn area that will remain as lawn does not need to address the minimum requirements, so that only the new and replaced impervious areas are modeled as forest in pre-developed conditions. This will consist of 9,818 sf of new sidewalk in 27th Ave SE and 243,494 sf of new impervious onsite, for a total of 253,312 sf to be modeled as forest. The resulting breakdown of areas for pre-developed conditions are:

Pre-Developed	area	
Cover	sf	acre
C, Forest, Mod	253312	5.8152
C, Lawn, Mod	225467	5.1760
Total Pervious	478779	10.9913
Parking/Road, Flat	22524	0.5171
Sidewalk, Flat	5835	0.1340
Roof	27604	0.6337
Total Imperv	55963	1.2847
Total	534742	12.2760

Based on the USDA soil mapping of the site, the soils are a mix of hydrologic group A and C. However, because the tested infiltration rate shows that infiltration is infeasible, the soils are modeled as hydrologic group C. The slopes are moderate. The project site is within the 42-inch, East rainfall zone and WWHM is run with 15-minute intervals. See Appendix A for WWHM analysis. POC 1 is used for comparison of pre-developed and developed conditions.

The peak runoff rates calculated by WWHM2012 for predeveloped conditions are:

```
      Flow Frequency
   Flow(cfs)  0501 15m
  2 Year   =    0.8550
  5 Year   =    1.3592
  10 Year  =    1.7675
  25 Year  =    2.3761
  50 Year  =    2.9021
  100 Year =    3.4949
```

Developed Site Hydrology

Drainage Basins

Due to topographical constraints, four separate detention facilities will be used to provide flow control. It is not feasible to collect drainage from the frontage or the west edge of the project, so this area is designated as bypass for the flow control analysis. The drainage basin delineations below are for developed conditions. All detention sub-basins are routed to a detention vault module, while the bypass basin is routed directly to POC 1 for proper accounting of developed flow conditions for the flow control requirements.

	Area (ac)				
Cover	Detention #1	Vault #2	Vault #3	Vault #4	Bypass
C, Lawn, Mod	0.5355	0.9018	0.9327	2.1432	0.5319
Impervious					
Parking/Road, Flat	0.3800	0.6511	0.3896	1.9317	0.0444
Sidewalk, Flat	0.1034	0.1916	0.2312	0.2936	0.3233
Roof	0.3275	0.7916	0.3517	1.2201	0.0000
Total Imperv	0.8109	1.6344	0.9724	3.4454	0.3678
Total	1.3464	2.5362	1.9051	5.5886	0.8997

The peak runoff rates calculated by WWHM2012 for developed conditions (prior to detention) are:

```
  Flow Frequency
 Flow(cfs)  0701 15m
2 Year   =    2.7689
5 Year   =    3.8257
10 Year  =    4.6110
25 Year  =    5.7053
50 Year  =    6.5975
100 Year =    7.5584
```

Flow Control

StormTank, an underground detention lattice structure, will be used for detention for area #1 on the west end of the project. Three other detention vaults will be used across the site. Each detention system will have a separate outlet control device. But, all four detention systems are tied to POC 1 to show compliance with flow control requirements. The requirement is that stormwater discharges shall match developed discharge durations to predeveloped durations for the range of predeveloped discharge rates from 50 percent of the 2-year recurrence interval peak flow up to the full 50-year peak flow. The vaults are sized to meet this requirement with no overflow through the standpipe to the 50-year vent. The vaults are configured with a single orifice, and notched standpipe is used for outlet control. Following are the vault configurations:

Provide the actual dimensions of the vaults and use those numbers for modeling. Equivalent areas will not be accepted. From the SWMMWW: performance of wetpools is improved by using large length-to-width ratios.

We are interested in the actual dimensions and true treatment efficiency only. Include the Department of Ecology's wetvault detail in planset and adhere to it. [STORMWATER REPORT, Page 14/216]

Detention Systems				
	StormTank #1	Vault #2	Vault #3	Vault #4
Length (feet)	100	276	280	396
Witch (feet)	20	16.5	16	19
Storage Depth (feet)	2	4.5	6	6
Orifice dia. (in)	1	1.375	0.75	2.125
Notch Height (ft)	0.5	1	1.33	1.42
Notch Width (ft)	0.5	0.5	0.25	0.5
Riser Dia. (in)	12	12	12	12

The WWHM analysis in Appendix A shows that POC 1 meets the flow control requirement. Following are the developed flows, being the combined flows of all detention systems plus bypass, all flow rates are less than pre-developed conditions:

```
     Flow Frequency
  Flow(cfs)  0801 15m
 2 Year   =    0.5154
 5 Year   =    0.7761
 10 Year  =    0.9964
 25 Year  =    1.3381
 50 Year  =    1.6450
 100 Year =    2.0026
```

The stage of detention in the vault:

```
                     Stage Frequency
(feet)          Det #1    Vault #2   Vault #3   Vault #4
 2 Year   =    1.6689     2.2312     2.8998     2.5062
 5 Year   =    1.7988     2.9854     3.9511     3.4759
 10 Year  =    1.8538     3.4534     4.5958     4.1390
 25 Year  =    1.9025     4.0139     5.3577     5.0000
 50 Year  =    1.9289     4.4117     5.8910     5.6579
 100 Year =    1.9492     4.7946     6.3982     6.3298
```

Runoff Treatment

Because the project is multi-family, enhanced treatment of runoff is required. For Basin #1 on the west end of the project, Filterra devices will be used due to lack of depth. Filterra has GULD approval for enhanced treatment. For the other three basins, a treatment train consisting of combined wetvault/detention vault, followed by StormFilter cartridges with ZPG media will be used. Each vault will have a wetvault, with a single StormFilter vault for all three detention vaults.

Filterra

Two Filterra vaults will be used for the west end of the project. Per the DOE GULD for Filterra, the required size of the system is based on a design infiltration rate. For both basic and enhanced treatment, the required infiltration rate is 175 in/hr. The following table shows the drainage basins to both Filterra devices, the resulting treatment flow rates, the required Filterra area, the selected Filterra model with provided area.

	Filterra 1-1		Filterra 1-2	
	POC 2		POC 3	
Cover	Area		Area	
	sf	ac	sf	ac
C, Lawn, Mod	20217	0.4641	3109	0.0714
Paving	8402	0.1929	8152	0.1871
Roof	787	0.0181	0	0.0000
Sidewalk	2763	0.0634	1740	0.0399
Total Imperv	11952	0.2744	9892	0.2271
Treatment Flow (cfs)	0.0248		0.0203	
Q100 (cfs)	0.4065		0.2255	
Fiterra Rate (in/hr)	175			
Required Area (sf)	6.12		5.01	
Filterra Model	FTPD0404		FTPD0404	
Bay Area (sf)	16		16	

Treatment Train

Vaults #2, #3, & #4 will use a treatment train to provide enhanced treatment. The first stage of the treatment train will be wetvaults, incorporated as dead storage beneath the live storage in each of the vaults. The required wetvault volume is calculated as the treatment volume within WWHM. This volume typically would only required a portion of the vault area, but to simplify construction, all cells of all vaults will include dead storage. As a result, the provided treatment volume significantly exceeds the required volume. Therefore, exact ratios of the various cells are not designed to manual standards. The following table shows the required and provided treatment volumes in the wetvaults.

Wetvaults			
	Vault #2	Vault #3	Vault #4
POC	4	5	6
Req'd Treat Volume (ac-ft)	0.2066	0.1359	0.442
Req'd Treat Volume (cf)	8999	5920	19254
Design depth (ft)	4	4	4
Wetcell Area (sf)	1518	2240	2624
# of Cells	3	2	3
Total Design Volume (cf)	18216	17920	31488

The second stage of the treatment train is a StormFilter vault with Stormfilter cartridges with ZPG media. All three vaults will drain to a single vault. For post-detention filters, the design rate is the two year release rate. The flow rate per cartridge is 7.5 gpm.

StormFilter		
	2-year release rate (cfs)	100-year release rate
Vault 2	0.0812	0.5094
Vault 3	0.0278	0.2252
Vault 4	0.1950	0.7385
Total	0.3040	1.4731
Design Rate (gpm)	136.4	
Cartridge flow rate (gpm)	7.5	
Req'd # of cartridges	19	

Conclusions

As explained above, the Minimum Requirements only apply to new and replaced hard surfaces. Drainage from all new and replaced hard surfaces will be routed to detention structures and treatment devices. The analysis shows that the flow control and treatment requirements are met.

Section V – Construction Stormwater Pollution Prevention Plan

Following are the 12 elements of the SWPPP. Where specific BMP’s are prescribed, they are explained as shown on the engineering drawings for the project. Alternate BMP’s may be acceptable in lieu of, or as a supplement to the prescribed BMP’s. Where identified, alternate BMP’s are listed and requirements included.

Element #1 – Mark Clearing Limits

Construction fencing will be used to mark clearing limits, except where boundary fencing already exists.

Element #2 – Establish Construction Access

Construction access or activities occurring on unpaved areas shall be minimized, yet where necessary, access points shall be stabilized to minimize the tracking of sediment onto public roads, and wheel washing, street sweeping, and street cleaning shall be employed to prevent sediment from entering state waters. All wash wastewater shall be controlled on site. A construction access will be installed at each of the three proposed driveway approach locations. The specific BMPs to be used include:

- BMP C105: Stabilized Construction Access

Alternative BMPs:

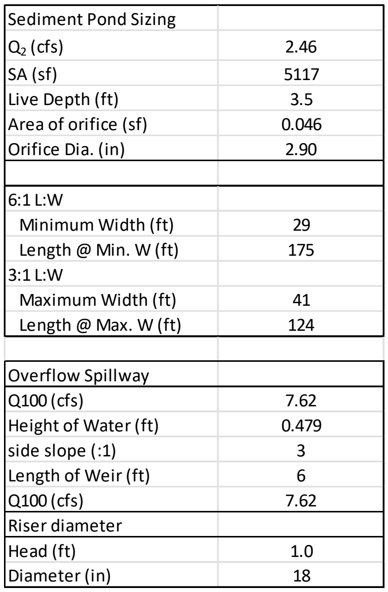
- BMP C106: Wheel Wash
- BMP C107: Construction Road/Parking Area Stabilization

Element #3 – Control Flow Rates

Concentrated runoff shall be collected and conveyed to a sediment pond for detention and release. The required surface area of the sediment pond is based on the 2-year flow rate. The required orifice size is based on the sediment pond surface area. The riser diameter and overflow spillway are based on the 100-year flow rate. The following tables detail the sediment pond sizing requirements.

BMP’s:

- BMP C241: Sediment Pond



Sediment Pond Sizing	
Q_2 (cfs)	2.46
SA (sf)	5117
Live Depth (ft)	3.5
Area of orifice (sf)	0.046
Orifice Dia. (in)	2.90
6:1 L:W	
Minimum Width (ft)	29
Length @ Min. W (ft)	175
3:1 L:W	
Maximum Width (ft)	41
Length @ Max. W (ft)	124
Overflow Spillway	
Q100 (cfs)	7.62
Height of Water (ft)	0.479
side slope (:1)	3
Length of Weir (ft)	6
Q100 (cfs)	7.62
Riser diameter	
Head (ft)	1.0
Diameter (in)	18

Element #4 – Install Sediment Controls

All stormwater runoff from disturbed areas shall pass through an appropriate sediment removal BMP before leaving the construction site or prior to being discharged to an infiltration facility. Interceptor swales will be used to collect runoff from the majority of the site for routing to the sediment pond discussed above in Element #3. Drainage from small areas around the perimeter will flow through silt fence. The specific BMPs to be used for controlling sediment on this project include:

- BMP C200: Interceptor Dike and Swale
- BMP C207: Check Dams
- BMP C233: Silt Fence

Element #5 – Stabilize Soils

Exposed and unworked soils shall be stabilized with the application of effective BMPs to prevent erosion throughout the life of the project. The specific BMPs for soil stabilization that shall be used on this project include:

- BMP C120: Temporary and Permanent Seeding
- BMP C121: Mulching

Exposed areas and soil stockpiles must be stabilized according to the following schedule:

1. From April 1 to October 31 all disturbed areas at final grade and all exposed areas that are scheduled to remain unworked for more than 30 days shall be stabilized within 10 days.
2. From November 1 to March 31 all exposed soils at final grade shall be stabilized immediately using permanent or temporary measures. Exposed soils with an area greater than 5,000 square feet that are scheduled to remain unworked for more than 24 hours and exposed areas of less than 5,000 square feet that will remain unworked for more than seven (7) days shall be stabilized immediately.

All disturbed areas which are not planned to be constructed on within 90 days from time of clearing and grading shall be revegetated with the native vegetation.

In general, cut and fill slopes will be stabilized as soon as possible and soil stockpiles will be temporarily covered with plastic sheeting. All stockpiled soils shall be stabilized from erosion, protected with sediment trapping measures, and where possible, be located away from storm drain inlets, waterways, and drainage channels.

Alternate BMP's:

- BMP C123: Plastic Covering
- BMP C124: Sodding
- BMP C125: Topsoiling

Element #6 – Protect Slopes

The slopes within the clearing limits/area to be disturbed are nearly flat. A retaining wall will be constructed early in the construction process, mitigating the need for any slope protection.

Element #7 – Protect Drain Inlets

All storm drain inlets and culverts made operable during construction shall be protected to prevent unfiltered or untreated water from entering the drainage conveyance system. However, the first priority is to keep all access roads clean of sediment and keep street wash water separate from entering storm drains until treatment can be provided. Storm Drain Inlet Protection (BMP C220) will be implemented for all drainage inlets and culverts that could potentially be impacted by sediment-laden runoff on and near the project site. The following inlet protection measures will be applied on this project:

- BMP C220: Storm Drain Inlet Protection

Element #8 – Stabilize Channels and Outlets

Where site runoff is to be conveyed in channels or discharged to a stream or some other natural drainage point, efforts will be taken to prevent downstream erosion. No surface channels or outlets are proposed for this project.

Element #9 – Control Pollutants

All pollutants, including waste materials and demolition debris, that occur onsite shall be handled and disposed of in a manner that does not cause contamination of stormwater. Good housekeeping and preventative measures will be taken to ensure that the site will be kept clean, well organized, and free of debris. If required, BMPs to be implemented to control specific sources of pollutants are discussed below.

Vehicles, construction equipment, and/or petroleum product storage/dispensing:

- All vehicles, equipment, and petroleum product storage/dispensing areas will be inspected regularly to detect any leaks or spills, and to identify maintenance needs to prevent leaks or spills.
- On-site fueling tanks and petroleum product storage containers shall include secondary containment.
- Spill prevention measures, such as drip pans, will be used when conducting maintenance and repair of vehicles or equipment.
- In order to perform emergency repairs on site, temporary plastic will be placed beneath and, if raining, over the vehicle.
- Contaminated surfaces shall be cleaned immediately following any discharge or spill incident.

Specific construction related BMP’s to be used include:

- Concrete Handling (C151)
- Sawcutting and Surfaceing Pollution Prevention (C152)
- Material Delivery, Storage and Containment (C153)
- Concrete Washout Area (C154)
- Treating and Disposing of High pH Water (C252)

Element #10 – Control Dewatering

Work will commence during the dry season, therefore no dewatering is likely to be required. If groundwater is encountered during construction, the water from all de-watering systems for trenches and foundations may be disposed of in one of the following manners:

> (1) Foundation, vault, and trench de-watering water which have similar characteristics to stormwater runoff at the site shall be discharged into a controlled conveyance system prior to discharge to a sediment trap or sediment pond.
>
> (2) Clean, non-turbid de-watering water, such as well-point ground water, can be discharged to systems tributary to or directly into surface waters of the state, provided the de-watering flow does not cause erosion or flooding of receiving waters. Clean de-watering water should not be routed through stormwater sediment ponds. Other disposal options for clean, non-turbid de-watering water may include:
>
> > (a) Infiltration;
> >
> > (b) Transportation off-site in a vehicle (such as a vacuum flush truck) for legal disposal in a manner that does not pollute state waters;
> >
> > (c) On-site chemical treatment or other suitable treatment technologies approved by the department and Washington State Department of Ecology;
> >
> > (d) Sanitary sewer discharge with local sewer district approval, if there is no other option; and
> >
> > (e) Use of a sedimentation bag with outfall to a ditch or swale for small volumes of localized de-watering water.

Element #11 – Maintain BMPs

All temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to assure continued performance of their intended function. Maintenance and repair shall be conducted in accordance with each particular BMP's specifications. Visual monitoring of the BMPs will be conducted at least once every calendar week and within 24 hours of any rainfall event (typically around 0.5" in 24-hour period) that causes a discharge from the site. If the site becomes inactive, and is temporarily stabilized, the inspection frequency may be reduced to once every month, during the dry season

All temporary erosion and sediment control BMPs shall be removed within 30 days after the final site stabilization is achieved or after the temporary BMPs are no longer needed. The need for TESC measures continuance or removal shall be determined by the designated site CESC lead person with concurrence of the County inspector. Trapped sediment shall be removed or stabilized on site. Disturbed soil resulting from removal of BMPs or vegetation shall be permanently stabilized.

Element #12 – Manage the Project

Erosion and sediment control BMPs for this project have been designed based on the following principles:

- Design the project to fit the existing topography, soils, and drainage patterns.
- Emphasize erosion control rather than sediment control.
- Minimize the extent and duration of the area exposed.
- Keep runoff velocities low.
- Retain sediment on site.
- Thoroughly monitor site and maintain all ESC measures. A Certified Erosion and Sedimentation Control Lead (CESCL) person shall be assigned to the project and will file regular and special inspection reports with the County Planning and Land Services Department.
- Schedule major earthwork during the dry season.

In addition, project management will incorporate the key components listed below:
As this project site is located west of the Cascade Mountain Crest, the project will be managed according to the following key project components:

Phasing of Construction

- The construction project is being phased to the extent practicable in order to prevent soil erosion, and, to the maximum extent possible, the transport of sediment from the site during construction.
- Revegetation of exposed areas and maintenance of that vegetation shall be an integral part of the clearing activities during each phase of construction, per the Scheduling BMP (C 162).

Seasonal Work Limitations

- From October 1 through April 30, clearing, grading, and other soil disturbing activities shall only be permitted if shown to the satisfaction of the local permitting authority that silt-laden runoff will be prevented from leaving the site through a combination of the following:
    - ☐ Site conditions including existing vegetative coverage, slope, soil type, and proximity to receiving waters; and
    - ☐ Limitations on activities and the extent of disturbed areas; and
    - ☐ Proposed erosion and sediment control measures.
- Based on the information provided and/or local weather conditions, the local permitting authority may expand or restrict the seasonal limitation on site disturbance.
- The following activities are exempt from the seasonal clearing and grading limitations:
    - ☐ Routine maintenance and necessary repair of erosion and sediment control BMPs;
    - ☐ Routine maintenance of public facilities or existing utility structures that do not expose the soil or result in the removal of the vegetative cover to soil; and
    - ☐ Activities where there is 100 percent infiltration of surface water runoff within the site in approved and installed erosion and sediment control facilities.

Coordination with Utilities and Other Jurisdictions

- Care has been taken to coordinate with utilities, other construction projects, and the local jurisdiction in preparing this SWPPP and scheduling the construction work.

Inspection and Monitoring

- All BMPs shall be inspected, maintained, and repaired as needed to assure continued performance of their intended function. Site inspections shall be conducted by a person who is knowledgeable in the principles and practices of erosion and sediment control. This person has the necessary skills to:
    - ☐ Assess the site conditions and construction activities that could impact the quality of stormwater, and
    - ☐ Assess the effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges.
- A Certified Erosion and Sediment Control Lead shall be on-site or on-call at all times.
- Whenever inspection and/or monitoring reveals that the BMPs identified in this SWPPP are inadequate, due to the actual discharge of or potential to discharge a significant amount of any pollutant, appropriate BMPs or design changes shall be implemented as soon as possible.

Maintaining an Updated Construction SWPPP

- This SWPPP shall be retained on-site or within reasonable access to the site.
- The SWPPP shall be modified whenever there is a change in the design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the state.
- The SWPPP shall be modified if, during inspections or investigations conducted by the owner/operator, or the applicable local or state regulatory authority, it is determined that the SWPPP is ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site. The SWPPP shall be modified as necessary to include additional or modified BMPs designed to correct problems identified. Revisions to the SWPPP shall be completed within seven (7) days following the inspection.

Specific management related BMP’s to be used include:

- Certified Erosion and Sediment Control Lead (C160)
- Scheduling (C162)

Section VI – Special Reports and Studies

See Geotech report in Appendix B.

Section VII – Other Permits

Required permits include, but are not limited to:

- Building permits will be required for construction of the future buildings.
- Building permits for concrete detention vaults
- Building permits for retaining walls
- Sewer service permits for each building
- Water service permits for each building
- NPDES coverage through DOE

Section VIII – Operation and Maintenance Manual

An Operations and Maintenance Manual is required for the StormTank gallery, Detention/Wetvaults, Filterra, StormFilter vault, and conveyance system. The O&M Manual is included as a separate document.

Section IX – Bond Quantities Worksheet

Any required bond amounts will be calculated when required for permit issuance.

APPENDIX A

WWHM Analysis

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: Bradley Heights 051624

Site Name:	Bradley Heights 1
Site Address:	
City:	Puyallup
Report Date:	5/17/2024
Gage:	42 IN EAST
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2023/01/27
Version:	4.2.19

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year
Low Flow Threshold for POC2:	50 Percent of the 2 Year
High Flow Threshold for POC2:	50 Year
Low Flow Threshold for POC3:	50 Percent of the 2 Year
High Flow Threshold for POC3:	50 Year
Low Flow Threshold for POC4:	50 Percent of the 2 Year
High Flow Threshold for POC4:	50 Year
Low Flow Threshold for POC5:	50 Percent of the 2 Year
High Flow Threshold for POC5:	50 Year
Low Flow Threshold for POC6:	50 Percent of the 2 Year
High Flow Threshold for POC6:	50 Year
Low Flow Threshold for POC7:	50 Percent of the 2 Year
High Flow Threshold for POC7:	50 Year

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	5.8152
C, Lawn, Mod	5.176
Pervious Total	10.9912
Impervious Land Use	acre
ROADS FLAT	0.5171
ROOF TOPS FLAT	0.6337
SIDEWALKS FLAT	0.134
Impervious Total	1.2848
Basin Total	12.276

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	0.7385
Pervious Total	0.7385
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.7385

Basin 3

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	0.2984
Pervious Total	0.2984
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.2984

Basin 4

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	2.5362
Pervious Total	2.5362
Impervious Land Use	acre
Impervious Total	0
Basin Total	2.5362

Basin 5

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	1.9051
Pervious Total	1.9051
Impervious Land Use	acre
Impervious Total	0
Basin Total	1.9051

Basin 6

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	5.5886
Pervious Total	5.5886
Impervious Land Use	acre
Impervious Total	0
Basin Total	5.5886

Basin 7

Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Lawn, Mod	3.9767
Pervious Total	3.9767

Impervious Land Use	acre
ROADS FLAT	0.0501
ROOF TOPS FLAT	0.6368
DRIVEWAYS FLAT	0.4744
SIDEWALKS FLAT	0.0948
Impervious Total	1.2561
Basin Total	5.2328

Mitigated Land Use

Basin 4

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Mod	2.1432
Pervious Total	2.1432
Impervious Land Use	acre
ROADS FLAT	1.9317
ROOF TOPS FLAT	1.2201
SIDEWALKS FLAT	0.2936
Impervious Total	3.4454
Basin Total	5.5886

Basin 5

Bypass:	Yes
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Mod	0.532
Pervious Total	0.532
Impervious Land Use	acre
ROADS FLAT	0.0444
SIDEWALKS FLAT	0.3233
Impervious Total	0.3677
Basin Total	0.8997

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Mod	0.5355
Pervious Total	0.5355
Impervious Land Use	acre
ROADS FLAT	0.38
ROOF TOPS FLAT	0.3275
SIDEWALKS FLAT	0.1034
Impervious Total	0.8109
Basin Total	1.3464

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Mod	0.9018
Pervious Total	0.9018
Impervious Land Use	acre
ROADS FLAT	0.6511
ROOF TOPS FLAT	0.7916
SIDEWALKS FLAT	0.1916
Impervious Total	1.6343
Basin Total	2.5361

Basin 3

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Mod	0.9327
Pervious Total	0.9327
Impervious Land Use	acre
ROADS FLAT	0.3896
ROOF TOPS FLAT	0.3517
SIDEWALKS FLAT	0.2312
Impervious Total	0.9725
Basin Total	1.9052

Filterra 1-1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Mod	0.4641
Pervious Total	0.4641
Impervious Land Use	acre
ROADS FLAT	0.1929
ROOF TOPS FLAT	0.0181
SIDEWALKS FLAT	0.0634
Impervious Total	0.2744
Basin Total	0.7385

Filterra 1-2

Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Lawn, Mod	0.0714
Pervious Total	0.0714
Impervious Land Use	acre
ROADS FLAT	0.1871
SIDEWALKS FLAT	0.0399
Impervious Total	0.227
Basin Total	0.2984

Basin 8

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Mod	1.0684
Pervious Total	1.0684
Impervious Land Use	acre
ROADS FLAT	2.8724
ROOF TOPS FLAT	2.0541
SIDEWALKS FLAT	1.0483
Impervious Total	5.9748
Basin Total	7.0432

Routing Elements

Predeveloped Routing

Mitigated Routing

Vault 4

Width:	19 ft.
Length:	396 ft.
Depth:	7 ft.
Discharge Structure	
Riser Height:	6 ft.
Riser Diameter:	12 in.
Notch Type:	Rectangular
Notch Width:	0.500 ft.
Notch Height:	1.420 ft.
Orifice 1 Diameter:	2.125 in. Elevation:0 ft.
Element Flows To:	
Outlet 1	Outlet 2

Vault Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.172	0.000	0.000	0.000
0.0778	0.172	0.013	0.034	0.000
0.1556	0.172	0.026	0.048	0.000
0.2333	0.172	0.040	0.059	0.000
0.3111	0.172	0.053	0.068	0.000
0.3889	0.172	0.067	0.076	0.000
0.4667	0.172	0.080	0.083	0.000
0.5444	0.172	0.094	0.090	0.000
0.6222	0.172	0.107	0.096	0.000
0.7000	0.172	0.120	0.102	0.000
0.7778	0.172	0.134	0.108	0.000
0.8556	0.172	0.147	0.113	0.000
0.9333	0.172	0.161	0.118	0.000
1.0111	0.172	0.174	0.123	0.000
1.0889	0.172	0.188	0.127	0.000
1.1667	0.172	0.201	0.132	0.000
1.2444	0.172	0.214	0.136	0.000
1.3222	0.172	0.228	0.140	0.000
1.4000	0.172	0.241	0.145	0.000
1.4778	0.172	0.255	0.149	0.000
1.5556	0.172	0.268	0.152	0.000
1.6333	0.172	0.282	0.156	0.000
1.7111	0.172	0.295	0.160	0.000
1.7889	0.172	0.309	0.163	0.000
1.8667	0.172	0.322	0.167	0.000
1.9444	0.172	0.335	0.170	0.000
2.0222	0.172	0.349	0.174	0.000
2.1000	0.172	0.362	0.177	0.000
2.1778	0.172	0.376	0.180	0.000
2.2556	0.172	0.389	0.184	0.000
2.3333	0.172	0.403	0.187	0.000
2.4111	0.172	0.416	0.190	0.000
2.4889	0.172	0.429	0.193	0.000
2.5667	0.172	0.443	0.196	0.000
2.6444	0.172	0.456	0.199	0.000
2.7222	0.172	0.470	0.202	0.000
2.8000	0.172	0.483	0.205	0.000

2.8778	0.172	0.497	0.207	0.000
2.9556	0.172	0.510	0.210	0.000
3.0333	0.172	0.523	0.213	0.000
3.1111	0.172	0.537	0.216	0.000
3.1889	0.172	0.550	0.218	0.000
3.2667	0.172	0.564	0.221	0.000
3.3444	0.172	0.577	0.224	0.000
3.4222	0.172	0.591	0.226	0.000
3.5000	0.172	0.604	0.229	0.000
3.5778	0.172	0.618	0.231	0.000
3.6556	0.172	0.631	0.234	0.000
3.7333	0.172	0.644	0.236	0.000
3.8111	0.172	0.658	0.239	0.000
3.8889	0.172	0.671	0.241	0.000
3.9667	0.172	0.685	0.244	0.000
4.0444	0.172	0.698	0.246	0.000
4.1222	0.172	0.712	0.248	0.000
4.2000	0.172	0.725	0.251	0.000
4.2778	0.172	0.738	0.253	0.000
4.3556	0.172	0.752	0.255	0.000
4.4333	0.172	0.765	0.258	0.000
4.5111	0.172	0.779	0.260	0.000
4.5889	0.172	0.792	0.263	0.000
4.6667	0.172	0.806	0.306	0.000
4.7444	0.172	0.819	0.374	0.000
4.8222	0.172	0.832	0.458	0.000
4.9000	0.172	0.846	0.553	0.000
4.9778	0.172	0.859	0.657	0.000
5.0556	0.172	0.873	0.769	0.000
5.1333	0.172	0.886	0.887	0.000
5.2111	0.172	0.900	1.009	0.000
5.2889	0.172	0.913	1.134	0.000
5.3667	0.172	0.927	1.262	0.000
5.4444	0.172	0.940	1.392	0.000
5.5222	0.172	0.953	1.523	0.000
5.6000	0.172	0.967	1.662	0.000
5.6778	0.172	0.980	1.824	0.000
5.7556	0.172	0.994	1.991	0.000
5.8333	0.172	1.007	2.164	0.000
5.9111	0.172	1.021	2.343	0.000
5.9889	0.172	1.034	3.240	0.000
6.0667	0.172	1.047	3.459	0.000
6.1444	0.172	1.061	3.852	0.000
6.2222	0.172	1.074	4.327	0.000
6.3000	0.172	1.088	4.792	0.000
6.3778	0.172	1.101	5.164	0.000
6.4556	0.172	1.115	5.401	0.000
6.5333	0.172	1.128	5.589	0.000
6.6111	0.172	1.141	5.752	0.000
6.6889	0.172	1.155	5.906	0.000
6.7667	0.172	1.168	6.052	0.000
6.8444	0.172	1.182	6.190	0.000
6.9222	0.172	1.195	6.322	0.000
7.0000	0.172	1.209	6.449	0.000
7.0778	0.172	1.222	6.571	0.000
7.1556	0.000	0.000	6.689	0.000

Vault 1

Width:	20 ft.
Length:	100 ft.
Depth:	3 ft.
Discharge Structure	
Riser Height:	2 ft.
Riser Diameter:	12 in.
Notch Type:	Rectangular
Notch Width:	0.500 ft.
Notch Height:	0.500 ft.
Orifice 1 Diameter:	1.000 in. Elevation:0 ft.

Element Flows To:

Outlet 1	Outlet 2

Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.045	0.000	0.000	0.000
0.0333	0.045	0.001	0.005	0.000
0.0667	0.045	0.003	0.007	0.000
0.1000	0.045	0.004	0.008	0.000
0.1333	0.045	0.006	0.009	0.000
0.1667	0.045	0.007	0.011	0.000
0.2000	0.045	0.009	0.012	0.000
0.2333	0.045	0.010	0.013	0.000
0.2667	0.045	0.012	0.014	0.000
0.3000	0.045	0.013	0.014	0.000
0.3333	0.045	0.015	0.015	0.000
0.3667	0.045	0.016	0.016	0.000
0.4000	0.045	0.018	0.017	0.000
0.4333	0.045	0.019	0.017	0.000
0.4667	0.045	0.021	0.018	0.000
0.5000	0.045	0.023	0.019	0.000
0.5333	0.045	0.024	0.019	0.000
0.5667	0.045	0.026	0.020	0.000
0.6000	0.045	0.027	0.021	0.000
0.6333	0.045	0.029	0.021	0.000
0.6667	0.045	0.030	0.022	0.000
0.7000	0.045	0.032	0.022	0.000
0.7333	0.045	0.033	0.023	0.000
0.7667	0.045	0.035	0.023	0.000
0.8000	0.045	0.036	0.024	0.000
0.8333	0.045	0.038	0.024	0.000
0.8667	0.045	0.039	0.025	0.000
0.9000	0.045	0.041	0.025	0.000
0.9333	0.045	0.042	0.026	0.000
0.9667	0.045	0.044	0.026	0.000
1.0000	0.045	0.045	0.027	0.000
1.0333	0.045	0.047	0.027	0.000
1.0667	0.045	0.049	0.028	0.000
1.1000	0.045	0.050	0.028	0.000
1.1333	0.045	0.052	0.028	0.000
1.1667	0.045	0.053	0.029	0.000
1.2000	0.045	0.055	0.029	0.000
1.2333	0.045	0.056	0.030	0.000
1.2667	0.045	0.058	0.030	0.000

1.3000	0.045	0.059	0.030	0.000
1.3333	0.045	0.061	0.031	0.000
1.3667	0.045	0.062	0.031	0.000
1.4000	0.045	0.064	0.032	0.000
1.4333	0.045	0.065	0.032	0.000
1.4667	0.045	0.067	0.032	0.000
1.5000	0.045	0.068	0.033	0.000
1.5333	0.045	0.070	0.043	0.000
1.5667	0.045	0.071	0.062	0.000
1.6000	0.045	0.073	0.087	0.000
1.6333	0.045	0.075	0.115	0.000
1.6667	0.045	0.076	0.148	0.000
1.7000	0.045	0.078	0.184	0.000
1.7333	0.045	0.079	0.223	0.000
1.7667	0.045	0.081	0.265	0.000
1.8000	0.045	0.082	0.310	0.000
1.8333	0.045	0.084	0.357	0.000
1.8667	0.045	0.085	0.406	0.000
1.9000	0.045	0.087	0.458	0.000
1.9333	0.045	0.088	0.512	0.000
1.9667	0.045	0.090	0.568	0.000
2.0000	0.045	0.091	0.627	0.000
2.0333	0.045	0.093	0.691	0.000
2.0667	0.045	0.094	0.809	0.000
2.1000	0.045	0.096	0.961	0.000
2.1333	0.045	0.097	1.138	0.000
2.1667	0.045	0.099	1.332	0.000
2.2000	0.045	0.101	1.536	0.000
2.2333	0.045	0.102	1.744	0.000
2.2667	0.045	0.104	1.947	0.000
2.3000	0.045	0.105	2.139	0.000
2.3333	0.045	0.107	2.313	0.000
2.3667	0.045	0.108	2.464	0.000
2.4000	0.045	0.110	2.590	0.000
2.4333	0.045	0.111	2.691	0.000
2.4667	0.045	0.113	2.769	0.000
2.5000	0.045	0.114	2.858	0.000
2.5333	0.045	0.116	2.932	0.000
2.5667	0.045	0.117	3.003	0.000
2.6000	0.045	0.119	3.072	0.000
2.6333	0.045	0.120	3.139	0.000
2.6667	0.045	0.122	3.204	0.000
2.7000	0.045	0.124	3.268	0.000
2.7333	0.045	0.125	3.330	0.000
2.7667	0.045	0.127	3.391	0.000
2.8000	0.045	0.128	3.451	0.000
2.8333	0.045	0.130	3.509	0.000
2.8667	0.045	0.131	3.566	0.000
2.9000	0.045	0.133	3.622	0.000
2.9333	0.045	0.134	3.678	0.000
2.9667	0.045	0.136	3.732	0.000
3.0000	0.045	0.137	3.785	0.000
3.0333	0.045	0.139	3.837	0.000
3.0667	0.000	0.000	3.889	0.000

Vault 2

Width:	16.5 ft.
Length:	276 ft.
Depth:	5.5 ft.
Discharge Structure	
Riser Height:	4.5 ft.
Riser Diameter:	12 in.
Notch Type:	Rectangular
Notch Width:	0.500 ft.
Notch Height:	1.000 ft.
Orifice 1 Diameter:	1.375 in. Elevation:0 ft.
Element Flows To:	
Outlet 1	Outlet 2

Vault Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.104	0.000	0.000	0.000
0.0611	0.104	0.006	0.012	0.000
0.1222	0.104	0.012	0.017	0.000
0.1833	0.104	0.019	0.022	0.000
0.2444	0.104	0.025	0.025	0.000
0.3056	0.104	0.031	0.028	0.000
0.3667	0.104	0.038	0.031	0.000
0.4278	0.104	0.044	0.033	0.000
0.4889	0.104	0.051	0.035	0.000
0.5500	0.104	0.057	0.038	0.000
0.6111	0.104	0.063	0.040	0.000
0.6722	0.104	0.070	0.042	0.000
0.7333	0.104	0.076	0.043	0.000
0.7944	0.104	0.083	0.045	0.000
0.8556	0.104	0.089	0.047	0.000
0.9167	0.104	0.095	0.049	0.000
0.9778	0.104	0.102	0.050	0.000
1.0389	0.104	0.108	0.052	0.000
1.1000	0.104	0.115	0.053	0.000
1.1611	0.104	0.121	0.055	0.000
1.2222	0.104	0.127	0.056	0.000
1.2833	0.104	0.134	0.058	0.000
1.3444	0.104	0.140	0.059	0.000
1.4056	0.104	0.146	0.060	0.000
1.4667	0.104	0.153	0.062	0.000
1.5278	0.104	0.159	0.063	0.000
1.5889	0.104	0.166	0.064	0.000
1.6500	0.104	0.172	0.065	0.000
1.7111	0.104	0.178	0.067	0.000
1.7722	0.104	0.185	0.068	0.000
1.8333	0.104	0.191	0.069	0.000
1.8944	0.104	0.198	0.070	0.000
1.9556	0.104	0.204	0.071	0.000
2.0167	0.104	0.210	0.072	0.000
2.0778	0.104	0.217	0.074	0.000
2.1389	0.104	0.223	0.075	0.000
2.2000	0.104	0.230	0.076	0.000
2.2611	0.104	0.236	0.077	0.000
2.3222	0.104	0.242	0.078	0.000

2.3833	0.104	0.249	0.079	0.000
2.4444	0.104	0.255	0.080	0.000
2.5056	0.104	0.261	0.081	0.000
2.5667	0.104	0.268	0.082	0.000
2.6278	0.104	0.274	0.083	0.000
2.6889	0.104	0.281	0.084	0.000
2.7500	0.104	0.287	0.085	0.000
2.8111	0.104	0.293	0.086	0.000
2.8722	0.104	0.300	0.087	0.000
2.9333	0.104	0.306	0.087	0.000
2.9944	0.104	0.313	0.088	0.000
3.0556	0.104	0.319	0.089	0.000
3.1167	0.104	0.325	0.090	0.000
3.1778	0.104	0.332	0.091	0.000
3.2389	0.104	0.338	0.092	0.000
3.3000	0.104	0.345	0.093	0.000
3.3611	0.104	0.351	0.094	0.000
3.4222	0.104	0.357	0.094	0.000
3.4833	0.104	0.364	0.095	0.000
3.5444	0.104	0.370	0.112	0.000
3.6056	0.104	0.376	0.154	0.000
3.6667	0.104	0.383	0.211	0.000
3.7278	0.104	0.389	0.280	0.000
3.7889	0.104	0.396	0.358	0.000
3.8500	0.104	0.402	0.445	0.000
3.9111	0.104	0.408	0.540	0.000
3.9722	0.104	0.415	0.642	0.000
4.0333	0.104	0.421	0.751	0.000
4.0944	0.104	0.428	0.866	0.000
4.1556	0.104	0.434	0.988	0.000
4.2167	0.104	0.440	1.115	0.000
4.2778	0.104	0.447	1.248	0.000
4.3389	0.104	0.453	1.386	0.000
4.4000	0.104	0.460	1.529	0.000
4.4611	0.104	0.466	1.677	0.000
4.5222	0.104	0.472	1.809	0.000
4.5833	0.104	0.479	2.029	0.000
4.6444	0.104	0.485	2.348	0.000
4.7056	0.104	0.491	2.718	0.000
4.7667	0.104	0.498	3.095	0.000
4.8278	0.104	0.504	3.433	0.000
4.8889	0.104	0.511	3.699	0.000
4.9500	0.104	0.517	3.880	0.000
5.0111	0.104	0.523	4.031	0.000
5.0722	0.104	0.530	4.163	0.000
5.1333	0.104	0.536	4.287	0.000
5.1944	0.104	0.543	4.406	0.000
5.2556	0.104	0.549	4.520	0.000
5.3167	0.104	0.555	4.629	0.000
5.3778	0.104	0.562	4.734	0.000
5.4389	0.104	0.568	4.836	0.000
5.5000	0.104	0.575	4.935	0.000
5.5611	0.104	0.581	5.030	0.000
5.6222	0.000	0.000	5.123	0.000

Vault 3

Width: 16 ft.
Length: 280 ft.
Depth: 7 ft.
Discharge Structure
Riser Height: 6 ft.
Riser Diameter: 12 in.
Notch Type: Rectangular
Notch Width: 0.250 ft.
Notch Height: 1.330 ft.
Orifice 1 Diameter: 0.750 in. Elevation:0 ft.
Element Flows To:
Outlet 1 Outlet 2

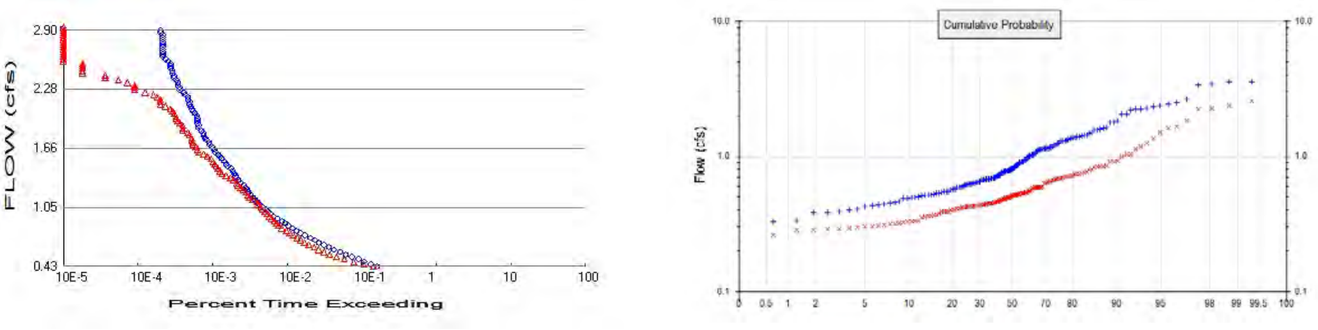
Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.102	0.000	0.000	0.000
0.0778	0.102	0.008	0.004	0.000
0.1556	0.102	0.016	0.006	0.000
0.2333	0.102	0.024	0.007	0.000
0.3111	0.102	0.032	0.008	0.000
0.3889	0.102	0.040	0.009	0.000
0.4667	0.102	0.048	0.010	0.000
0.5444	0.102	0.056	0.011	0.000
0.6222	0.102	0.064	0.012	0.000
0.7000	0.102	0.072	0.012	0.000
0.7778	0.102	0.080	0.013	0.000
0.8556	0.102	0.088	0.014	0.000
0.9333	0.102	0.096	0.014	0.000
1.0111	0.102	0.104	0.015	0.000
1.0889	0.102	0.112	0.015	0.000
1.1667	0.102	0.120	0.016	0.000
1.2444	0.102	0.128	0.017	0.000
1.3222	0.102	0.136	0.017	0.000
1.4000	0.102	0.144	0.018	0.000
1.4778	0.102	0.152	0.018	0.000
1.5556	0.102	0.160	0.019	0.000
1.6333	0.102	0.168	0.019	0.000
1.7111	0.102	0.176	0.020	0.000
1.7889	0.102	0.184	0.020	0.000
1.8667	0.102	0.192	0.020	0.000
1.9444	0.102	0.200	0.021	0.000
2.0222	0.102	0.208	0.021	0.000
2.1000	0.102	0.216	0.022	0.000
2.1778	0.102	0.224	0.022	0.000
2.2556	0.102	0.232	0.022	0.000
2.3333	0.102	0.240	0.023	0.000
2.4111	0.102	0.248	0.023	0.000
2.4889	0.102	0.256	0.024	0.000
2.5667	0.102	0.264	0.024	0.000
2.6444	0.102	0.272	0.024	0.000
2.7222	0.102	0.280	0.025	0.000
2.8000	0.102	0.288	0.025	0.000
2.8778	0.102	0.296	0.025	0.000
2.9556	0.102	0.304	0.026	0.000

3.0333	0.102	0.312	0.026	0.000
3.1111	0.102	0.320	0.026	0.000
3.1889	0.102	0.328	0.027	0.000
3.2667	0.102	0.336	0.027	0.000
3.3444	0.102	0.344	0.027	0.000
3.4222	0.102	0.352	0.028	0.000
3.5000	0.102	0.360	0.028	0.000
3.5778	0.102	0.368	0.028	0.000
3.6556	0.102	0.376	0.029	0.000
3.7333	0.102	0.384	0.029	0.000
3.8111	0.102	0.392	0.029	0.000
3.8889	0.102	0.400	0.030	0.000
3.9667	0.102	0.408	0.030	0.000
4.0444	0.102	0.416	0.030	0.000
4.1222	0.102	0.424	0.031	0.000
4.2000	0.102	0.432	0.031	0.000
4.2778	0.102	0.440	0.031	0.000
4.3556	0.102	0.448	0.031	0.000
4.4333	0.102	0.456	0.032	0.000
4.5111	0.102	0.464	0.032	0.000
4.5889	0.102	0.472	0.032	0.000
4.6667	0.102	0.480	0.033	0.000
4.7444	0.102	0.488	0.049	0.000
4.8222	0.102	0.495	0.081	0.000
4.9000	0.102	0.503	0.121	0.000
4.9778	0.102	0.511	0.167	0.000
5.0556	0.102	0.519	0.218	0.000
5.1333	0.102	0.527	0.272	0.000
5.2111	0.102	0.535	0.330	0.000
5.2889	0.102	0.543	0.390	0.000
5.3667	0.102	0.551	0.452	0.000
5.4444	0.102	0.559	0.515	0.000
5.5222	0.102	0.567	0.579	0.000
5.6000	0.102	0.575	0.643	0.000
5.6778	0.102	0.583	0.710	0.000
5.7556	0.102	0.591	0.789	0.000
5.8333	0.102	0.599	0.872	0.000
5.9111	0.102	0.607	0.958	0.000
5.9889	0.102	0.615	1.046	0.000
6.0667	0.102	0.623	1.241	0.000
6.1444	0.102	0.631	1.632	0.000
6.2222	0.102	0.639	2.105	0.000
6.3000	0.102	0.647	2.569	0.000
6.3778	0.102	0.655	2.939	0.000
6.4556	0.102	0.663	3.174	0.000
6.5333	0.102	0.671	3.360	0.000
6.6111	0.102	0.679	3.523	0.000
6.6889	0.102	0.687	3.675	0.000
6.7667	0.102	0.695	3.819	0.000
6.8444	0.102	0.703	3.955	0.000
6.9222	0.102	0.711	4.086	0.000
7.0000	0.102	0.719	4.211	0.000
7.0778	0.102	0.727	4.332	0.000
7.1556	0.000	0.000	4.448	0.000

Analysis Results

POC 1



+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1

Total Pervious Area:	10.9912
Total Impervious Area:	1.2848

Mitigated Landuse Totals for POC #1

Total Pervious Area:	5.0452
Total Impervious Area:	7.2308

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.855049
5 year	1.359188
10 year	1.767456
25 year	2.376079
50 year	2.902087
100 year	3.494877

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.515355
5 year	0.776099
10 year	0.996419
25 year	1.338135
50 year	1.645032
100 year	2.00258

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1902	0.639	0.579
1903	0.677	0.370
1904	2.040	0.533
1905	0.515	0.525
1906	0.381	0.291
1907	1.270	0.753
1908	0.704	0.421
1909	0.805	0.492
1910	1.294	0.737
1911	1.027	0.452

1912	3.543	1.175
1913	0.673	0.558
1914	3.570	0.841
1915	0.533	0.466
1916	0.895	0.520
1917	0.311	0.300
1918	0.585	0.479
1919	0.549	0.452
1920	0.910	0.434
1921	0.781	0.550
1922	1.426	0.627
1923	0.798	0.525
1924	0.730	0.368
1925	0.461	0.399
1926	0.743	0.535
1927	0.500	0.399
1928	0.650	0.361
1929	1.342	0.716
1930	0.850	0.424
1931	0.623	0.491
1932	0.672	0.480
1933	0.753	0.585
1934	1.780	0.837
1935	0.537	0.437
1936	0.768	0.415
1937	1.385	0.806
1938	0.604	0.477
1939	0.442	0.315
1940	0.913	0.447
1941	0.777	0.327
1942	1.372	0.845
1943	0.857	0.429
1944	1.828	2.270
1945	0.808	0.531
1946	1.016	0.363
1947	0.437	0.438
1948	1.130	0.759
1949	1.137	1.132
1950	0.428	0.329
1951	0.632	0.335
1952	2.626	2.241
1953	2.243	1.501
1954	0.716	0.421
1955	0.403	0.388
1956	0.333	0.245
1957	0.597	0.523
1958	1.585	1.653
1959	1.390	0.988
1960	0.498	0.432
1961	2.325	0.669
1962	0.730	0.520
1963	0.391	0.358
1964	2.359	0.562
1965	1.122	0.702
1966	0.584	0.389
1967	1.304	0.450
1968	0.687	0.535
1969	0.731	0.463

1970	1.148	0.589
1971	1.209	0.828
1972	3.363	0.796
1973	1.251	0.913
1974	1.168	0.592
1975	2.220	1.040
1976	1.785	0.583
1977	0.404	0.283
1978	1.554	0.842
1979	0.977	0.418
1980	1.323	0.492
1981	0.778	0.430
1982	0.561	0.355
1983	1.185	0.736
1984	1.085	0.508
1985	1.570	0.503
1986	0.651	0.539
1987	1.482	1.365
1988	0.619	0.496
1989	0.622	0.482
1990	0.869	0.499
1991	1.119	0.515
1992	1.049	0.511
1993	0.767	0.523
1994	1.120	0.685
1995	0.528	0.323
1996	1.299	1.246
1997	0.677	0.434
1998	1.150	0.663
1999	0.572	0.288
2000	0.810	0.418
2001	0.533	0.332
2002	2.205	0.647
2003	0.830	0.643
2004	1.004	0.596
2005	2.487	0.584
2006	0.616	0.309
2007	1.029	0.716
2008	0.899	0.461
2009	0.569	0.380
2010	0.638	0.651
2011	0.453	0.284
2012	0.759	0.688
2013	0.908	0.403
2014	0.694	0.305
2015	2.042	0.528
2016	0.497	0.302
2017	0.942	0.911
2018	1.505	2.368
2019	2.252	2.556
2020	1.204	0.430
2021	0.955	0.709
2022	1.161	0.414
2023	1.002	0.477
2024	3.400	1.032
2025	0.545	0.505
2026	1.143	0.673
2027	0.693	0.460

2028	0.327	0.296
2029	0.787	0.449
2030	1.354	0.772
2031	0.382	0.315
2032	0.424	0.261
2033	0.485	0.290
2034	0.508	0.509
2035	1.430	1.617
2036	0.777	0.584
2037	0.520	0.392
2038	1.403	0.741
2039	1.095	0.471
2040	0.674	0.425
2041	0.794	0.387
2042	1.441	1.837
2043	0.989	0.657
2044	0.934	0.590
2045	0.671	0.445
2046	0.683	0.692
2047	0.550	0.454
2048	0.520	0.537
2049	0.851	0.644
2050	0.844	0.424
2051	1.640	0.930
2052	0.486	0.538
2053	0.633	0.555
2054	2.441	0.695
2055	0.672	0.319
2056	0.701	0.412
2057	0.450	0.443
2058	0.587	0.449
2059	1.598	0.702

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	3.5705	2.5562
2	3.5426	2.3680
3	3.4003	2.2696
4	3.3632	2.2411
5	2.6259	1.8373
6	2.4870	1.6534
7	2.4413	1.6166
8	2.3587	1.5007
9	2.3250	1.3650
10	2.2525	1.2463
11	2.2430	1.1748
12	2.2203	1.1325
13	2.2049	1.0396
14	2.0418	1.0320
15	2.0399	0.9877
16	1.8276	0.9303
17	1.7849	0.9135
18	1.7799	0.9110
19	1.6402	0.8447
20	1.5984	0.8416
21	1.5849	0.8407
22	1.5702	0.8370

23	1.5543	0.8283
24	1.5051	0.8059
25	1.4823	0.7956
26	1.4411	0.7720
27	1.4297	0.7589
28	1.4259	0.7525
29	1.4031	0.7410
30	1.3900	0.7366
31	1.3846	0.7357
32	1.3722	0.7165
33	1.3543	0.7158
34	1.3423	0.7088
35	1.3230	0.7024
36	1.3038	0.7019
37	1.2989	0.6947
38	1.2939	0.6916
39	1.2697	0.6882
40	1.2512	0.6853
41	1.2085	0.6725
42	1.2042	0.6695
43	1.1847	0.6633
44	1.1678	0.6573
45	1.1610	0.6506
46	1.1501	0.6474
47	1.1480	0.6440
48	1.1426	0.6426
49	1.1366	0.6271
50	1.1300	0.5957
51	1.1220	0.5916
52	1.1198	0.5903
53	1.1189	0.5885
54	1.0950	0.5846
55	1.0852	0.5836
56	1.0492	0.5835
57	1.0287	0.5832
58	1.0266	0.5785
59	1.0156	0.5620
60	1.0042	0.5584
61	1.0024	0.5548
62	0.9891	0.5496
63	0.9765	0.5388
64	0.9546	0.5375
65	0.9418	0.5372
66	0.9340	0.5354
67	0.9133	0.5349
68	0.9104	0.5330
69	0.9077	0.5306
70	0.8993	0.5285
71	0.8955	0.5255
72	0.8690	0.5253
73	0.8570	0.5233
74	0.8506	0.5225
75	0.8497	0.5200
76	0.8445	0.5198
77	0.8302	0.5149
78	0.8101	0.5109
79	0.8079	0.5086
80	0.8054	0.5078

81	0.7975	0.5047
82	0.7943	0.5033
83	0.7872	0.4990
84	0.7807	0.4963
85	0.7785	0.4923
86	0.7769	0.4922
87	0.7768	0.4911
88	0.7683	0.4815
89	0.7665	0.4802
90	0.7593	0.4790
91	0.7534	0.4767
92	0.7432	0.4767
93	0.7313	0.4711
94	0.7298	0.4658
95	0.7297	0.4629
96	0.7158	0.4615
97	0.7041	0.4601
98	0.7009	0.4538
99	0.6941	0.4521
100	0.6930	0.4519
101	0.6866	0.4497
102	0.6833	0.4493
103	0.6774	0.4488
104	0.6766	0.4466
105	0.6736	0.4446
106	0.6728	0.4428
107	0.6719	0.4376
108	0.6719	0.4370
109	0.6715	0.4342
110	0.6511	0.4337
111	0.6502	0.4320
112	0.6387	0.4301
113	0.6379	0.4296
114	0.6335	0.4291
115	0.6321	0.4249
116	0.6226	0.4240
117	0.6217	0.4238
118	0.6189	0.4212
119	0.6164	0.4209
120	0.6045	0.4185
121	0.5970	0.4179
122	0.5867	0.4146
123	0.5853	0.4141
124	0.5841	0.4118
125	0.5716	0.4025
126	0.5692	0.3988
127	0.5607	0.3986
128	0.5503	0.3921
129	0.5486	0.3888
130	0.5452	0.3879
131	0.5368	0.3868
132	0.5334	0.3800
133	0.5331	0.3695
134	0.5277	0.3683
135	0.5202	0.3625
136	0.5201	0.3614
137	0.5152	0.3577
138	0.5078	0.3550

139	0.4997	0.3350
140	0.4977	0.3325
141	0.4968	0.3290
142	0.4860	0.3267
143	0.4852	0.3233
144	0.4611	0.3191
145	0.4528	0.3153
146	0.4496	0.3150
147	0.4419	0.3086
148	0.4368	0.3053
149	0.4279	0.3018
150	0.4242	0.3003
151	0.4043	0.2958
152	0.4033	0.2913
153	0.3914	0.2905
154	0.3819	0.2884
155	0.3815	0.2839
156	0.3332	0.2835
157	0.3271	0.2607
158	0.3106	0.2445

Duration Flows

The Facility PASSED

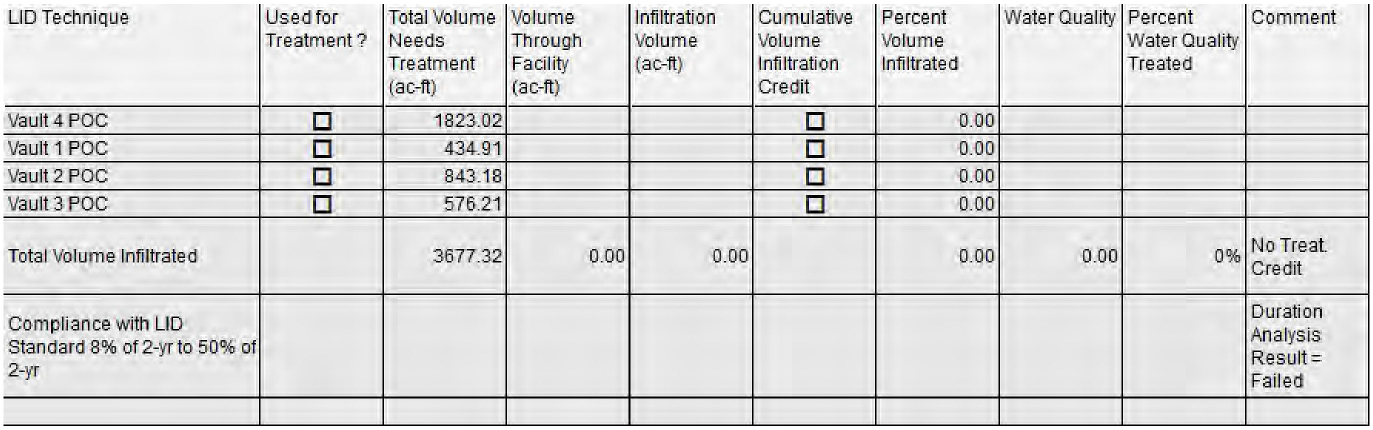
Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.4275	8836	8044	91	Pass
0.4525	7296	5911	81	Pass
0.4775	5989	4375	73	Pass
0.5025	4979	3242	65	Pass
0.5275	4075	2530	62	Pass
0.5525	3384	2055	60	Pass
0.5775	2848	1730	60	Pass
0.6025	2363	1471	62	Pass
0.6275	2009	1268	63	Pass
0.6525	1705	1082	63	Pass
0.6775	1478	941	63	Pass
0.7025	1292	834	64	Pass
0.7275	1131	760	67	Pass
0.7525	964	669	69	Pass
0.7775	838	600	71	Pass
0.8025	740	539	72	Pass
0.8275	652	469	71	Pass
0.8524	572	426	74	Pass
0.8774	526	396	75	Pass
0.9024	472	374	79	Pass
0.9274	410	347	84	Pass
0.9524	365	324	88	Pass
0.9774	331	299	90	Pass
1.0024	308	277	89	Pass
1.0274	286	257	89	Pass
1.0524	257	248	96	Pass
1.0774	236	229	97	Pass
1.1024	221	216	97	Pass
1.1274	206	192	93	Pass
1.1524	191	173	90	Pass
1.1774	180	164	91	Pass
1.2024	167	154	92	Pass
1.2274	162	142	87	Pass
1.2524	155	131	84	Pass
1.2774	146	123	84	Pass
1.3024	135	117	86	Pass
1.3274	123	104	84	Pass
1.3524	116	96	82	Pass
1.3774	112	84	75	Pass
1.4024	108	74	68	Pass
1.4273	103	70	67	Pass
1.4523	97	65	67	Pass
1.4773	88	62	70	Pass
1.5023	84	59	70	Pass
1.5273	80	56	70	Pass
1.5523	73	53	72	Pass
1.5773	69	47	68	Pass
1.6023	66	42	63	Pass
1.6273	61	36	59	Pass
1.6523	58	35	60	Pass
1.6773	54	33	61	Pass
1.7023	51	30	58	Pass
1.7273	50	30	60	Pass

1.7523	46	29	63	Pass
1.7773	44	29	65	Pass
1.8023	42	27	64	Pass
1.8273	41	26	63	Pass
1.8523	39	22	56	Pass
1.8773	36	22	61	Pass
1.9023	36	22	61	Pass
1.9273	35	20	57	Pass
1.9523	35	19	54	Pass
1.9773	35	18	51	Pass
2.0022	34	18	52	Pass
2.0272	32	17	53	Pass
2.0522	30	16	53	Pass
2.0772	29	15	51	Pass
2.1022	28	13	46	Pass
2.1272	27	11	40	Pass
2.1522	27	11	40	Pass
2.1772	26	11	42	Pass
2.2022	26	10	38	Pass
2.2272	24	9	37	Pass
2.2522	23	7	30	Pass
2.2772	20	5	25	Pass
2.3022	20	5	25	Pass
2.3272	19	5	26	Pass
2.3522	19	4	21	Pass
2.3772	18	3	16	Pass
2.4022	17	2	11	Pass
2.4272	17	2	11	Pass
2.4522	16	1	6	Pass
2.4772	16	1	6	Pass
2.5022	15	1	6	Pass
2.5272	15	1	6	Pass
2.5521	15	1	6	Pass
2.5771	14	0	0	Pass
2.6021	13	0	0	Pass
2.6271	12	0	0	Pass
2.6521	12	0	0	Pass
2.6771	12	0	0	Pass
2.7021	12	0	0	Pass
2.7271	12	0	0	Pass
2.7521	12	0	0	Pass
2.7771	12	0	0	Pass
2.8021	12	0	0	Pass
2.8271	12	0	0	Pass
2.8521	12	0	0	Pass
2.8771	11	0	0	Pass
2.9021	11	0	0	Pass

Water Quality

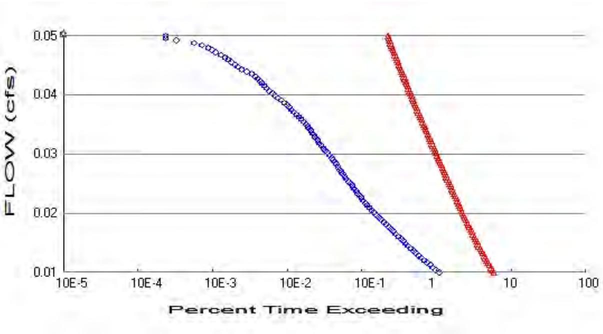
Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 acre-feet
On-line facility target flow: 0 cfs.
Adjusted for 15 min: 0 cfs.
Off-line facility target flow: 0 cfs.
Adjusted for 15 min: 0 cfs.

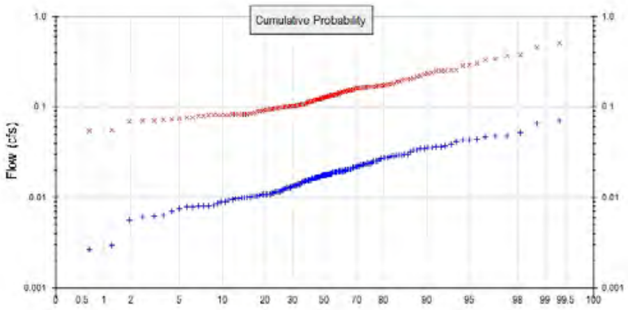
LID Report



LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Vault 4 POC	☐	1823.02			☐	0.00			
Vault 1 POC	☐	434.91			☐	0.00			
Vault 2 POC	☐	843.18			☐	0.00			
Vault 3 POC	☐	576.21			☐	0.00			
Total Volume Infiltrated		3677.32	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

POC 2





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #2
Total Pervious Area: 0.7385
Total Impervious Area: 0

Mitigated Landuse Totals for POC #2
Total Pervious Area: 0.4641
Total Impervious Area: 0.2744

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	**Flow(cfs)**
2 year	0.017796
5 year	0.027748
10 year	0.034114
25 year	0.041738
50 year	0.047081
100 year	0.052135

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	**Flow(cfs)**
2 year	0.126944
5 year	0.184643
10 year	0.229253
25 year	0.293429
50 year	0.347249
100 year	0.406519

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	**Predeveloped**	**Mitigated**
1902	0.017	0.121
1903	0.011	0.137
1904	0.024	0.253
1905	0.009	0.077
1906	0.006	0.077
1907	0.028	0.155
1908	0.020	0.105
1909	0.019	0.109
1910	0.027	0.151
1911	0.018	0.153
1912	0.070	0.370

1913	0.027	0.082
1914	0.007	0.514
1915	0.012	0.082
1916	0.018	0.131
1917	0.006	0.054
1918	0.018	0.103
1919	0.015	0.080
1920	0.018	0.123
1921	0.020	0.099
1922	0.019	0.181
1923	0.016	0.107
1924	0.008	0.149
1925	0.010	0.074
1926	0.017	0.118
1927	0.014	0.103
1928	0.013	0.091
1929	0.028	0.203
1930	0.017	0.162
1931	0.017	0.092
1932	0.013	0.099
1933	0.015	0.101
1934	0.037	0.216
1935	0.017	0.070
1936	0.016	0.121
1937	0.025	0.167
1938	0.015	0.083
1939	0.002	0.087
1940	0.017	0.169
1941	0.011	0.158
1942	0.025	0.177
1943	0.012	0.140
1944	0.029	0.237
1945	0.020	0.142
1946	0.013	0.138
1947	0.009	0.081
1948	0.037	0.125
1949	0.033	0.167
1950	0.011	0.091
1951	0.014	0.135
1952	0.048	0.291
1953	0.044	0.253
1954	0.016	0.104
1955	0.014	0.081
1956	0.008	0.071
1957	0.023	0.096
1958	0.047	0.167
1959	0.030	0.165
1960	0.008	0.091
1961	0.029	0.340
1962	0.017	0.116
1963	0.008	0.072
1964	0.009	0.332
1965	0.033	0.149
1966	0.010	0.094
1967	0.015	0.173
1968	0.016	0.114
1969	0.015	0.108
1970	0.023	0.145

1971	0.035	0.147
1972	0.023	0.456
1973	0.030	0.183
1974	0.018	0.173
1975	0.036	0.252
1976	0.020	0.230
1977	0.010	0.068
1978	0.032	0.179
1979	0.010	0.151
1980	0.019	0.173
1981	0.018	0.126
1982	0.010	0.097
1983	0.029	0.161
1984	0.014	0.156
1985	0.022	0.204
1986	0.018	0.084
1987	0.035	0.164
1988	0.021	0.084
1989	0.019	0.079
1990	0.023	0.114
1991	0.018	0.161
1992	0.022	0.132
1993	0.024	0.133
1994	0.035	0.138
1995	0.009	0.084
1996	0.039	0.136
1997	0.017	0.104
1998	0.019	0.148
1999	0.003	0.115
2000	0.015	0.121
2001	0.008	0.082
2002	0.029	0.258
2003	0.022	0.102
2004	0.019	0.145
2005	0.043	0.283
2006	0.012	0.118
2007	0.013	0.162
2008	0.019	0.133
2009	0.013	0.083
2010	0.011	0.113
2011	0.010	0.097
2012	0.018	0.119
2013	0.011	0.130
2014	0.008	0.102
2015	0.016	0.259
2016	0.006	0.094
2017	0.026	0.169
2018	0.048	0.154
2019	0.052	0.241
2020	0.015	0.160
2021	0.024	0.121
2022	0.010	0.192
2023	0.020	0.200
2024	0.065	0.375
2025	0.018	0.099
2026	0.029	0.177
2027	0.012	0.131
2028	0.010	0.048

2029	0.019	0.106
2030	0.036	0.193
2031	0.011	0.056
2032	0.008	0.085
2033	0.011	0.103
2034	0.011	0.081
2035	0.042	0.161
2036	0.022	0.092
2037	0.006	0.110
2038	0.019	0.172
2039	0.003	0.220
2040	0.011	0.102
2041	0.013	0.131
2042	0.043	0.169
2043	0.020	0.135
2044	0.027	0.124
2045	0.018	0.095
2046	0.021	0.105
2047	0.015	0.100
2048	0.020	0.083
2049	0.018	0.126
2050	0.013	0.122
2051	0.021	0.208
2052	0.012	0.099
2053	0.020	0.085
2054	0.024	0.305
2055	0.010	0.113
2056	0.009	0.139
2057	0.014	0.073
2058	0.017	0.125
2059	0.028	0.206

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	**Predeveloped**	**Mitigated**
1	0.0699	0.5137
2	0.0654	0.4562
3	0.0519	0.3752
4	0.0484	0.3705
5	0.0475	0.3399
6	0.0465	0.3319
7	0.0442	0.3054
8	0.0427	0.2910
9	0.0427	0.2834
10	0.0417	0.2585
11	0.0386	0.2576
12	0.0373	0.2534
13	0.0365	0.2526
14	0.0361	0.2515
15	0.0357	0.2410
16	0.0353	0.2368
17	0.0347	0.2300
18	0.0347	0.2202
19	0.0333	0.2155
20	0.0332	0.2077
21	0.0318	0.2056
22	0.0298	0.2040
23	0.0298	0.2034

24	0.0294	0.1997
25	0.0293	0.1931
26	0.0291	0.1918
27	0.0291	0.1827
28	0.0286	0.1808
29	0.0281	0.1788
30	0.0278	0.1775
31	0.0276	0.1766
32	0.0274	0.1734
33	0.0270	0.1730
34	0.0265	0.1728
35	0.0255	0.1721
36	0.0254	0.1694
37	0.0252	0.1692
38	0.0242	0.1689
39	0.0239	0.1675
40	0.0237	0.1671
41	0.0236	0.1670
42	0.0234	0.1647
43	0.0232	0.1637
44	0.0229	0.1621
45	0.0228	0.1621
46	0.0223	0.1613
47	0.0223	0.1610
48	0.0219	0.1607
49	0.0218	0.1602
50	0.0213	0.1579
51	0.0211	0.1559
52	0.0205	0.1552
53	0.0204	0.1539
54	0.0204	0.1526
55	0.0203	0.1514
56	0.0200	0.1509
57	0.0199	0.1491
58	0.0197	0.1487
59	0.0196	0.1476
60	0.0196	0.1465
61	0.0195	0.1454
62	0.0194	0.1449
63	0.0194	0.1419
64	0.0193	0.1401
65	0.0193	0.1392
66	0.0192	0.1383
67	0.0192	0.1376
68	0.0192	0.1368
69	0.0190	0.1364
70	0.0183	0.1353
71	0.0183	0.1345
72	0.0183	0.1332
73	0.0182	0.1332
74	0.0181	0.1319
75	0.0181	0.1314
76	0.0180	0.1311
77	0.0177	0.1308
78	0.0176	0.1298
79	0.0176	0.1265
80	0.0175	0.1265
81	0.0175	0.1254

82	0.0174	0.1248
83	0.0173	0.1236
84	0.0171	0.1231
85	0.0170	0.1219
86	0.0169	0.1215
87	0.0169	0.1215
88	0.0166	0.1212
89	0.0166	0.1211
90	0.0166	0.1190
91	0.0163	0.1180
92	0.0162	0.1178
93	0.0161	0.1162
94	0.0157	0.1152
95	0.0156	0.1142
96	0.0154	0.1138
97	0.0154	0.1135
98	0.0154	0.1131
99	0.0152	0.1099
100	0.0152	0.1089
101	0.0149	0.1079
102	0.0148	0.1074
103	0.0146	0.1057
104	0.0141	0.1052
105	0.0140	0.1048
106	0.0140	0.1043
107	0.0136	0.1037
108	0.0135	0.1035
109	0.0134	0.1026
110	0.0132	0.1025
111	0.0131	0.1024
112	0.0129	0.1022
113	0.0128	0.1018
114	0.0127	0.1012
115	0.0126	0.1004
116	0.0122	0.0993
117	0.0119	0.0991
118	0.0115	0.0986
119	0.0115	0.0986
120	0.0115	0.0971
121	0.0115	0.0966
122	0.0113	0.0961
123	0.0113	0.0945
124	0.0109	0.0944
125	0.0109	0.0936
126	0.0109	0.0922
127	0.0108	0.0921
128	0.0108	0.0915
129	0.0106	0.0913
130	0.0104	0.0909
131	0.0103	0.0872
132	0.0103	0.0847
133	0.0102	0.0846
134	0.0100	0.0839
135	0.0099	0.0839
136	0.0099	0.0836
137	0.0098	0.0834
138	0.0098	0.0826
139	0.0095	0.0825

140	0.0093	0.0822
141	0.0090	0.0821
142	0.0088	0.0820
143	0.0085	0.0814
144	0.0081	0.0814
145	0.0081	0.0813
146	0.0080	0.0802
147	0.0079	0.0794
148	0.0078	0.0770
149	0.0078	0.0766
150	0.0076	0.0743
151	0.0071	0.0732
152	0.0064	0.0722
153	0.0062	0.0710
154	0.0061	0.0697
155	0.0056	0.0684
156	0.0030	0.0562
157	0.0027	0.0542
158	0.0017	0.0478

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0089	59999	325091	541	Fail
0.0093	54586	310576	568	Fail
0.0097	49650	297114	598	Fail
0.0101	45296	284870	628	Fail
0.0104	41201	272793	662	Fail
0.0108	37816	261934	692	Fail
0.0112	34742	251297	723	Fail
0.0116	31844	241491	758	Fail
0.0120	29240	231962	793	Fail
0.0124	27019	223098	825	Fail
0.0128	24952	214456	859	Fail
0.0131	23047	206257	894	Fail
0.0135	21396	198611	928	Fail
0.0139	19867	191132	962	Fail
0.0143	18482	184152	996	Fail
0.0147	17069	177337	1038	Fail
0.0151	15817	171077	1081	Fail
0.0155	14626	164872	1127	Fail
0.0158	13590	158889	1169	Fail
0.0162	12620	153404	1215	Fail
0.0166	11712	148086	1264	Fail
0.0170	10914	142989	1310	Fail
0.0174	10111	138003	1364	Fail
0.0178	9379	133516	1423	Fail
0.0182	8676	128917	1485	Fail
0.0185	8033	124541	1550	Fail
0.0189	7451	120275	1614	Fail
0.0193	6942	116341	1675	Fail
0.0197	6526	112574	1725	Fail
0.0201	6149	108751	1768	Fail
0.0205	5828	105317	1807	Fail
0.0209	5481	101716	1855	Fail
0.0212	5179	98502	1901	Fail
0.0216	4898	95234	1944	Fail
0.0220	4639	92076	1984	Fail
0.0224	4393	89084	2027	Fail
0.0228	4150	86148	2075	Fail
0.0232	3918	83378	2128	Fail
0.0236	3691	80663	2185	Fail
0.0239	3462	78170	2257	Fail
0.0243	3280	75622	2305	Fail
0.0247	3118	73295	2350	Fail
0.0251	2950	70968	2405	Fail
0.0255	2799	68641	2452	Fail
0.0259	2658	66536	2503	Fail
0.0263	2534	64265	2536	Fail
0.0266	2417	62326	2578	Fail
0.0270	2295	60387	2631	Fail
0.0274	2182	58448	2678	Fail
0.0278	2042	56619	2772	Fail
0.0282	1898	54830	2888	Fail
0.0286	1775	53135	2993	Fail
0.0290	1683	51456	3057	Fail
0.0293	1587	49789	3137	Fail

0.0297	1504	48171	3202	Fail
0.0301	1428	46719	3271	Fail
0.0305	1348	45224	3354	Fail
0.0309	1278	43772	3425	Fail
0.0313	1221	42437	3475	Fail
0.0317	1162	41102	3537	Fail
0.0320	1101	39872	3621	Fail
0.0324	1049	38636	3683	Fail
0.0328	997	37401	3751	Fail
0.0332	921	36226	3933	Fail
0.0336	853	35069	4111	Fail
0.0340	795	33950	4270	Fail
0.0344	739	32886	4450	Fail
0.0347	680	31872	4687	Fail
0.0351	630	30875	4900	Fail
0.0355	589	29950	5084	Fail
0.0359	546	29030	5316	Fail
0.0363	507	28199	5561	Fail
0.0367	461	27301	5922	Fail
0.0371	417	26493	6353	Fail
0.0374	377	25639	6800	Fail
0.0378	354	24858	7022	Fail
0.0382	320	24160	7550	Fail
0.0386	293	23446	8002	Fail
0.0390	271	22753	8395	Fail
0.0394	252	22155	8791	Fail
0.0398	240	21479	8949	Fail
0.0401	225	20858	9270	Fail
0.0405	207	20243	9779	Fail
0.0409	185	19617	10603	Fail
0.0413	158	19002	12026	Fail
0.0417	136	18459	13572	Fail
0.0421	120	17911	14925	Fail
0.0425	111	17390	15666	Fail
0.0428	99	16942	17113	Fail
0.0432	90	16437	18263	Fail
0.0436	81	15978	19725	Fail
0.0440	71	15473	21792	Fail
0.0444	61	15036	24649	Fail
0.0448	55	14642	26621	Fail
0.0452	48	14221	29627	Fail
0.0455	40	13800	34500	Fail
0.0459	31	13379	43158	Fail
0.0463	18	13036	72422	Fail
0.0467	13	12676	97507	Fail
0.0471	13	12332	94861	Fail

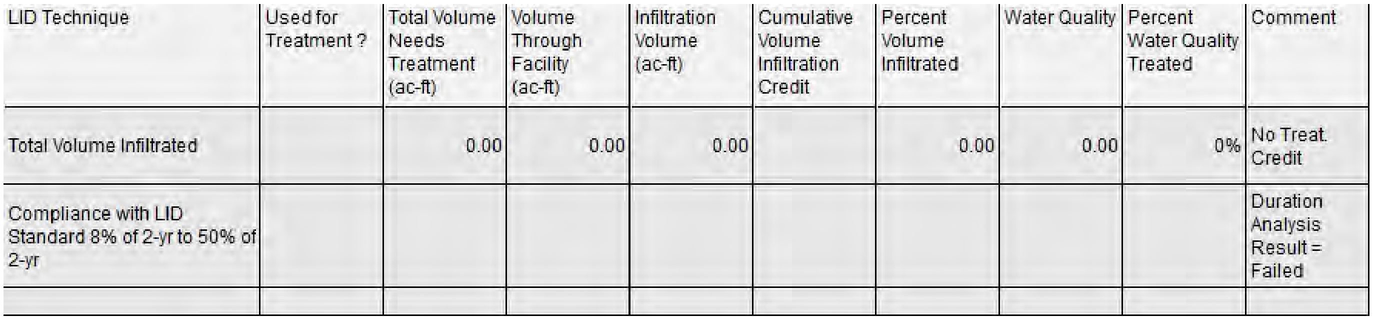
The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #2

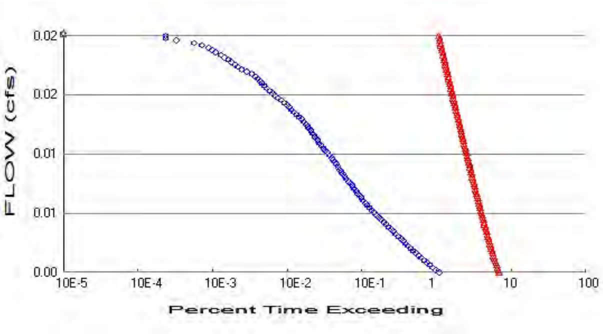
On-line facility volume:	0.0459 acre-feet
On-line facility target flow:	0.0436 cfs.
Adjusted for 15 min:	0.0436 cfs.
Off-line facility target flow:	0.0248 cfs.
Adjusted for 15 min:	0.0248 cfs.

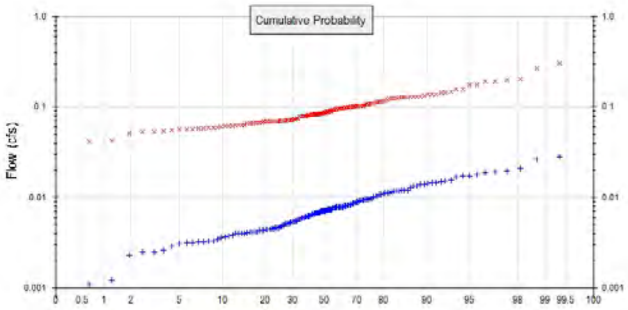
LID Report



LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

POC 3





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #3
Total Pervious Area: 0.2984
Total Impervious Area: 0

Mitigated Landuse Totals for POC #3
Total Pervious Area: 0.0714
Total Impervious Area: 0.227

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #3

Return Period	**Flow(cfs)**
2 year	0.007191
5 year	0.011212
10 year	0.013784
25 year	0.016865
50 year	0.019024
100 year	0.021066

Flow Frequency Return Periods for Mitigated. POC #3

Return Period	**Flow(cfs)**
2 year	0.087163
5 year	0.118366
10 year	0.141248
25 year	0.172791
50 year	0.198269
100 year	0.225501

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #3

Year	**Predeveloped**	**Mitigated**
1902	0.007	0.099
1903	0.004	0.109
1904	0.010	0.139
1905	0.004	0.057
1906	0.002	0.061
1907	0.011	0.091
1908	0.008	0.072
1909	0.008	0.084
1910	0.011	0.085
1911	0.007	0.097
1912	0.028	0.177

1913	0.011	0.066
1914	0.003	0.304
1915	0.005	0.059
1916	0.007	0.105
1917	0.003	0.042
1918	0.007	0.084
1919	0.006	0.055
1920	0.007	0.075
1921	0.008	0.063
1922	0.008	0.102
1923	0.006	0.068
1924	0.003	0.120
1925	0.004	0.053
1926	0.007	0.097
1927	0.006	0.083
1928	0.005	0.062
1929	0.011	0.128
1930	0.007	0.125
1931	0.007	0.064
1932	0.005	0.068
1933	0.006	0.067
1934	0.015	0.118
1935	0.007	0.057
1936	0.006	0.082
1937	0.010	0.104
1938	0.006	0.058
1939	0.001	0.069
1940	0.007	0.128
1941	0.004	0.127
1942	0.010	0.103
1943	0.005	0.096
1944	0.012	0.144
1945	0.008	0.103
1946	0.005	0.085
1947	0.004	0.062
1948	0.015	0.087
1949	0.013	0.130
1950	0.004	0.075
1951	0.006	0.111
1952	0.020	0.144
1953	0.018	0.131
1954	0.007	0.071
1955	0.006	0.065
1956	0.003	0.059
1957	0.009	0.069
1958	0.019	0.093
1959	0.012	0.093
1960	0.003	0.069
1961	0.012	0.205
1962	0.007	0.083
1963	0.003	0.059
1964	0.004	0.193
1965	0.013	0.086
1966	0.004	0.068
1967	0.006	0.102
1968	0.007	0.080
1969	0.006	0.073
1970	0.009	0.086

1971	0.014	0.085
1972	0.009	0.270
1973	0.012	0.148
1974	0.007	0.114
1975	0.015	0.128
1976	0.008	0.131
1977	0.004	0.052
1978	0.013	0.097
1979	0.004	0.097
1980	0.008	0.099
1981	0.007	0.089
1982	0.004	0.070
1983	0.012	0.099
1984	0.006	0.098
1985	0.009	0.116
1986	0.007	0.055
1987	0.014	0.095
1988	0.009	0.057
1989	0.008	0.059
1990	0.009	0.072
1991	0.007	0.102
1992	0.009	0.097
1993	0.010	0.108
1994	0.014	0.081
1995	0.003	0.060
1996	0.016	0.083
1997	0.007	0.072
1998	0.008	0.090
1999	0.001	0.092
2000	0.006	0.082
2001	0.003	0.066
2002	0.012	0.133
2003	0.009	0.070
2004	0.008	0.103
2005	0.017	0.201
2006	0.005	0.091
2007	0.005	0.107
2008	0.008	0.087
2009	0.005	0.063
2010	0.005	0.083
2011	0.004	0.080
2012	0.007	0.083
2013	0.005	0.080
2014	0.003	0.074
2015	0.006	0.140
2016	0.003	0.072
2017	0.010	0.125
2018	0.019	0.082
2019	0.021	0.125
2020	0.006	0.097
2021	0.010	0.079
2022	0.004	0.132
2023	0.008	0.158
2024	0.026	0.193
2025	0.007	0.082
2026	0.012	0.113
2027	0.005	0.101
2028	0.004	0.039

2029	0.008	0.068
2030	0.014	0.140
2031	0.005	0.042
2032	0.003	0.069
2033	0.004	0.086
2034	0.004	0.067
2035	0.017	0.092
2036	0.009	0.068
2037	0.002	0.090
2038	0.008	0.096
2039	0.001	0.176
2040	0.004	0.071
2041	0.005	0.090
2042	0.017	0.100
2043	0.008	0.110
2044	0.011	0.078
2045	0.007	0.064
2046	0.008	0.071
2047	0.006	0.083
2048	0.008	0.068
2049	0.007	0.102
2050	0.005	0.080
2051	0.009	0.118
2052	0.005	0.081
2053	0.008	0.068
2054	0.010	0.158
2055	0.004	0.081
2056	0.004	0.110
2057	0.005	0.053
2058	0.007	0.103
2059	0.011	0.126

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #3

Rank	Predeveloped	Mitigated
1	0.0283	0.3039
2	0.0264	0.2704
3	0.0210	0.2054
4	0.0195	0.2007
5	0.0192	0.1930
6	0.0188	0.1929
7	0.0179	0.1772
8	0.0173	0.1758
9	0.0173	0.1584
10	0.0169	0.1581
11	0.0156	0.1484
12	0.0151	0.1442
13	0.0148	0.1441
14	0.0146	0.1400
15	0.0144	0.1398
16	0.0142	0.1391
17	0.0140	0.1330
18	0.0140	0.1316
19	0.0134	0.1314
20	0.0134	0.1309
21	0.0129	0.1303
22	0.0120	0.1282
23	0.0120	0.1279

24	0.0119	0.1278
25	0.0119	0.1269
26	0.0118	0.1258
27	0.0118	0.1250
28	0.0116	0.1249
29	0.0114	0.1249
30	0.0112	0.1197
31	0.0112	0.1182
32	0.0111	0.1180
33	0.0109	0.1157
34	0.0107	0.1141
35	0.0103	0.1132
36	0.0103	0.1111
37	0.0102	0.1101
38	0.0098	0.1097
39	0.0096	0.1095
40	0.0096	0.1084
41	0.0096	0.1067
42	0.0095	0.1052
43	0.0094	0.1041
44	0.0093	0.1031
45	0.0092	0.1030
46	0.0090	0.1030
47	0.0090	0.1027
48	0.0089	0.1024
49	0.0088	0.1024
50	0.0086	0.1017
51	0.0085	0.1015
52	0.0083	0.1007
53	0.0082	0.0997
54	0.0082	0.0993
55	0.0082	0.0988
56	0.0081	0.0988
57	0.0080	0.0982
58	0.0080	0.0971
59	0.0079	0.0970
60	0.0079	0.0968
61	0.0079	0.0967
62	0.0078	0.0965
63	0.0078	0.0965
64	0.0078	0.0962
65	0.0078	0.0961
66	0.0078	0.0948
67	0.0078	0.0930
68	0.0077	0.0927
69	0.0077	0.0920
70	0.0074	0.0918
71	0.0074	0.0912
72	0.0074	0.0911
73	0.0073	0.0904
74	0.0073	0.0897
75	0.0073	0.0896
76	0.0073	0.0885
77	0.0072	0.0870
78	0.0071	0.0870
79	0.0071	0.0861
80	0.0071	0.0857
81	0.0071	0.0855

82	0.0070	0.0853
83	0.0070	0.0848
84	0.0069	0.0845
85	0.0069	0.0843
86	0.0068	0.0837
87	0.0068	0.0833
88	0.0067	0.0833
89	0.0067	0.0832
90	0.0067	0.0831
91	0.0066	0.0829
92	0.0065	0.0826
93	0.0065	0.0823
94	0.0064	0.0821
95	0.0063	0.0821
96	0.0062	0.0819
97	0.0062	0.0810
98	0.0062	0.0808
99	0.0061	0.0807
100	0.0061	0.0801
101	0.0060	0.0800
102	0.0060	0.0799
103	0.0059	0.0798
104	0.0057	0.0791
105	0.0057	0.0780
106	0.0057	0.0750
107	0.0055	0.0750
108	0.0055	0.0736
109	0.0054	0.0732
110	0.0054	0.0723
111	0.0053	0.0720
112	0.0052	0.0717
113	0.0052	0.0716
114	0.0051	0.0711
115	0.0051	0.0708
116	0.0049	0.0707
117	0.0048	0.0701
118	0.0047	0.0696
119	0.0047	0.0695
120	0.0046	0.0689
121	0.0046	0.0688
122	0.0046	0.0685
123	0.0046	0.0684
124	0.0044	0.0684
125	0.0044	0.0682
126	0.0044	0.0682
127	0.0044	0.0681
128	0.0044	0.0681
129	0.0043	0.0678
130	0.0042	0.0671
131	0.0042	0.0668
132	0.0041	0.0659
133	0.0041	0.0658
134	0.0040	0.0653
135	0.0040	0.0637
136	0.0040	0.0637
137	0.0040	0.0632
138	0.0040	0.0629
139	0.0038	0.0625

140	0.0038	0.0619
141	0.0036	0.0613
142	0.0036	0.0600
143	0.0034	0.0595
144	0.0033	0.0592
145	0.0033	0.0587
146	0.0032	0.0585
147	0.0032	0.0582
148	0.0032	0.0572
149	0.0031	0.0571
150	0.0031	0.0570
151	0.0029	0.0553
152	0.0026	0.0549
153	0.0025	0.0535
154	0.0025	0.0529
155	0.0023	0.0516
156	0.0012	0.0425
157	0.0011	0.0417
158	0.0007	0.0395

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0036	59999	385034	641	Fail
0.0038	54581	375062	687	Fail
0.0039	49645	365478	736	Fail
0.0041	45212	356448	788	Fail
0.0042	41213	348027	844	Fail
0.0044	37772	339551	898	Fail
0.0045	34736	331628	954	Fail
0.0047	31800	323983	1018	Fail
0.0048	29218	316448	1083	Fail
0.0050	26969	309357	1147	Fail
0.0052	24930	302598	1213	Fail
0.0053	23058	296061	1283	Fail
0.0055	21374	289690	1355	Fail
0.0056	19861	283596	1427	Fail
0.0058	18465	277613	1503	Fail
0.0059	17063	271906	1593	Fail
0.0061	15795	266311	1686	Fail
0.0062	14615	260882	1785	Fail
0.0064	13590	255729	1881	Fail
0.0066	12609	250577	1987	Fail
0.0067	11712	245646	2097	Fail
0.0069	10903	240882	2209	Fail
0.0070	10105	236118	2336	Fail
0.0072	9363	231575	2473	Fail
0.0073	8676	227032	2616	Fail
0.0075	8033	222544	2770	Fail
0.0076	7451	218389	2931	Fail
0.0078	6942	214179	3085	Fail
0.0080	6521	210135	3222	Fail
0.0081	6149	206146	3352	Fail
0.0083	5823	202434	3476	Fail
0.0084	5479	198611	3624	Fail
0.0086	5174	194955	3767	Fail
0.0087	4895	191409	3910	Fail
0.0089	4638	187864	4050	Fail
0.0091	4384	184429	4206	Fail
0.0092	4150	180994	4361	Fail
0.0094	3914	177670	4539	Fail
0.0095	3690	174401	4726	Fail
0.0097	3456	171188	4953	Fail
0.0098	3279	168086	5126	Fail
0.0100	3118	165149	5296	Fail
0.0101	2947	162213	5504	Fail
0.0103	2805	159332	5680	Fail
0.0105	2656	156451	5890	Fail
0.0106	2540	153681	6050	Fail
0.0108	2417	150911	6243	Fail
0.0109	2295	148141	6454	Fail
0.0111	2185	145482	6658	Fail
0.0112	2042	142878	6996	Fail
0.0114	1900	140385	7388	Fail
0.0115	1775	137837	7765	Fail
0.0117	1688	135510	8027	Fail
0.0119	1588	133017	8376	Fail

0.0120	1503	130524	8684	Fail
0.0122	1430	128308	8972	Fail
0.0123	1348	125981	9345	Fail
0.0125	1280	123931	9682	Fail
0.0126	1221	121660	9963	Fail
0.0128	1162	119499	10283	Fail
0.0129	1101	117394	10662	Fail
0.0131	1049	115289	10990	Fail
0.0133	1000	113350	11335	Fail
0.0134	922	111411	12083	Fail
0.0136	858	109527	12765	Fail
0.0137	795	107533	13526	Fail
0.0139	739	105594	14288	Fail
0.0140	680	103821	15267	Fail
0.0142	630	101937	16180	Fail
0.0143	591	100220	16957	Fail
0.0145	547	98447	17997	Fail
0.0147	507	96730	19078	Fail
0.0148	461	95067	20621	Fail
0.0150	417	93350	22386	Fail
0.0151	377	91743	24335	Fail
0.0153	354	90137	25462	Fail
0.0154	323	88641	27443	Fail
0.0156	293	87034	29704	Fail
0.0158	271	85483	31543	Fail
0.0159	253	84098	33240	Fail
0.0161	241	82547	34251	Fail
0.0162	225	81162	36072	Fail
0.0164	207	79722	38513	Fail
0.0165	185	78337	42344	Fail
0.0167	158	77007	48738	Fail
0.0168	136	75677	55644	Fail
0.0170	120	74514	62095	Fail
0.0172	111	73129	65881	Fail
0.0173	99	71965	72691	Fail
0.0175	90	70691	78545	Fail
0.0176	80	69417	86771	Fail
0.0178	71	68364	96287	Fail
0.0179	61	67256	110255	Fail
0.0181	55	66093	120169	Fail
0.0182	49	64930	132510	Fail
0.0184	40	63822	159555	Fail
0.0186	31	62714	202303	Fail
0.0187	18	61661	342561	Fail
0.0189	13	60664	466646	Fail
0.0190	13	59611	458546	Fail

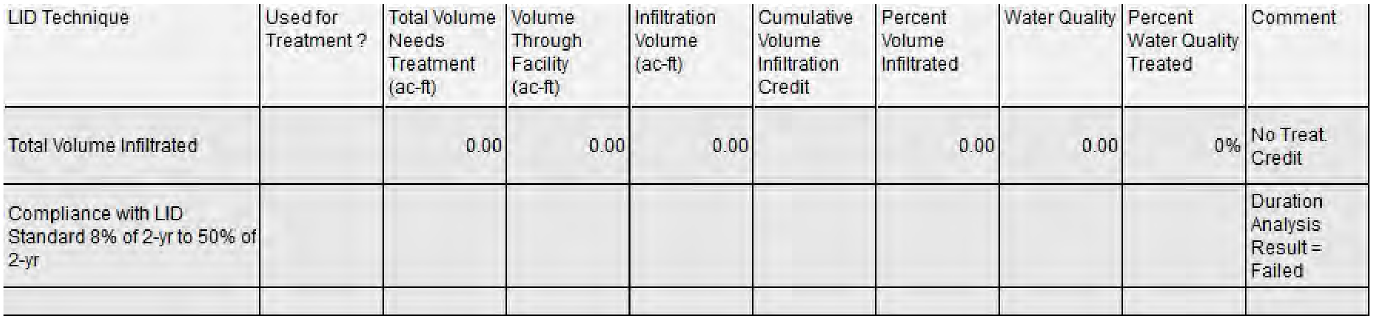
The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #3

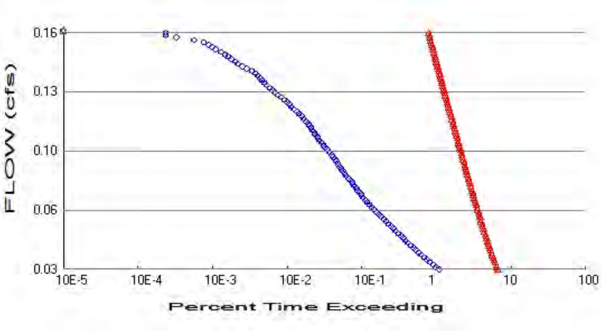
On-line facility volume:	0.027 acre-feet
On-line facility target flow:	0.0352 cfs.
Adjusted for 15 min:	0.0352 cfs.
Off-line facility target flow:	0.0203 cfs.
Adjusted for 15 min:	0.0203 cfs.

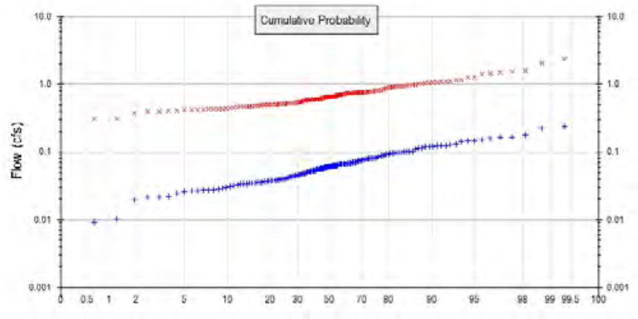
LID Report



LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

POC 4





+ Predeveloped   x Mitigated

Predeveloped Landuse Totals for POC #4
Total Pervious Area: 2.5362
Total Impervious Area: 0

Mitigated Landuse Totals for POC #4
Total Pervious Area: 0.9018
Total Impervious Area: 1.6343

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #4

Return Period	**Flow(cfs)**
2 year	0.061116
5 year	0.095295
10 year	0.117157
25 year	0.143338
50 year	0.161688
100 year	0.179045

Flow Frequency Return Periods for Mitigated. POC #4

Return Period	**Flow(cfs)**
2 year	0.64943
5 year	0.892293
10 year	1.072009
25 year	1.321559
50 year	1.524414
100 year	1.742346

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #4

Year	**Predeveloped**	**Mitigated**
1902	0.059	0.713
1903	0.037	0.793
1904	0.081	1.088
1905	0.033	0.419
1906	0.019	0.444
1907	0.095	0.702
1908	0.067	0.535
1909	0.065	0.608
1910	0.093	0.664
1911	0.060	0.734
1912	0.240	1.432

1913	0.094	0.477
1914	0.024	2.338
1915	0.042	0.433
1916	0.061	0.762
1917	0.021	0.306
1918	0.063	0.604
1919	0.053	0.409
1920	0.062	0.573
1921	0.068	0.478
1922	0.066	0.796
1923	0.054	0.518
1924	0.027	0.866
1925	0.035	0.391
1926	0.060	0.700
1927	0.048	0.601
1928	0.046	0.466
1929	0.095	0.971
1930	0.059	0.911
1931	0.058	0.474
1932	0.043	0.508
1933	0.051	0.502
1934	0.125	0.924
1935	0.057	0.412
1936	0.055	0.614
1937	0.087	0.753
1938	0.052	0.426
1939	0.006	0.500
1940	0.057	0.935
1941	0.037	0.918
1942	0.087	0.794
1943	0.041	0.716
1944	0.098	1.102
1945	0.069	0.759
1946	0.044	0.646
1947	0.031	0.452
1948	0.128	0.645
1949	0.114	0.948
1950	0.037	0.540
1951	0.047	0.800
1952	0.166	1.158
1953	0.152	1.043
1954	0.055	0.531
1955	0.048	0.472
1956	0.027	0.423
1957	0.080	0.513
1958	0.160	0.717
1959	0.102	0.723
1960	0.028	0.504
1961	0.101	1.573
1962	0.057	0.616
1963	0.027	0.429
1964	0.032	1.490
1965	0.114	0.664
1966	0.035	0.501
1967	0.053	0.782
1968	0.056	0.595
1969	0.052	0.547
1970	0.080	0.662

1971	0.119	0.656
1972	0.078	2.080
1973	0.102	1.072
1974	0.060	0.858
1975	0.124	1.022
1976	0.068	1.016
1977	0.034	0.378
1978	0.109	0.759
1979	0.034	0.733
1980	0.066	0.766
1981	0.063	0.653
1982	0.034	0.517
1983	0.101	0.757
1984	0.048	0.745
1985	0.075	0.899
1986	0.062	0.416
1987	0.121	0.704
1988	0.073	0.424
1989	0.067	0.427
1990	0.079	0.548
1991	0.062	0.770
1992	0.077	0.695
1993	0.081	0.783
1994	0.119	0.623
1995	0.029	0.443
1996	0.133	0.635
1997	0.058	0.535
1998	0.066	0.685
1999	0.009	0.667
2000	0.050	0.614
2001	0.026	0.474
2002	0.100	1.057
2003	0.076	0.519
2004	0.066	0.760
2005	0.147	1.477
2006	0.040	0.665
2007	0.044	0.802
2008	0.066	0.655
2009	0.045	0.453
2010	0.039	0.612
2011	0.036	0.575
2012	0.060	0.615
2013	0.039	0.610
2014	0.028	0.530
2015	0.054	1.098
2016	0.022	0.523
2017	0.088	0.918
2018	0.163	0.649
2019	0.178	0.992
2020	0.051	0.741
2021	0.083	0.596
2022	0.035	0.981
2023	0.070	1.149
2024	0.225	1.535
2025	0.062	0.590
2026	0.100	0.856
2027	0.040	0.735
2028	0.034	0.284

2029	0.067	0.514
2030	0.123	1.033
2031	0.039	0.306
2032	0.027	0.495
2033	0.037	0.616
2034	0.037	0.483
2035	0.143	0.712
2036	0.075	0.494
2037	0.021	0.652
2038	0.067	0.750
2039	0.010	1.273
2040	0.037	0.526
2041	0.044	0.669
2042	0.147	0.767
2043	0.070	0.793
2044	0.091	0.579
2045	0.060	0.477
2046	0.071	0.530
2047	0.053	0.597
2048	0.070	0.492
2049	0.063	0.736
2050	0.045	0.601
2051	0.073	0.917
2052	0.040	0.583
2053	0.067	0.494
2054	0.082	1.256
2055	0.034	0.597
2056	0.030	0.799
2057	0.047	0.393
2058	0.058	0.742
2059	0.096	0.907

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #4

Rank	**Predeveloped**	**Mitigated**
1	0.2401	2.3379
2	0.2247	2.0798
3	0.1784	1.5729
4	0.1661	1.5350
5	0.1632	1.4899
6	0.1597	1.4771
7	0.1520	1.4317
8	0.1467	1.2735
9	0.1466	1.2557
10	0.1433	1.1577
11	0.1327	1.1491
12	0.1282	1.1019
13	0.1254	1.0985
14	0.1240	1.0884
15	0.1226	1.0718
16	0.1211	1.0568
17	0.1192	1.0431
18	0.1191	1.0327
19	0.1143	1.0218
20	0.1141	1.0159
21	0.1092	0.9919
22	0.1023	0.9811
23	0.1023	0.9707

24	0.1011	0.9483
25	0.1007	0.9350
26	0.0999	0.9241
27	0.0999	0.9184
28	0.0984	0.9182
29	0.0965	0.9173
30	0.0953	0.9109
31	0.0949	0.9068
32	0.0941	0.8989
33	0.0927	0.8659
34	0.0911	0.8579
35	0.0877	0.8560
36	0.0874	0.8021
37	0.0866	0.8000
38	0.0833	0.7991
39	0.0819	0.7956
40	0.0814	0.7939
41	0.0812	0.7927
42	0.0805	0.7926
43	0.0798	0.7827
44	0.0787	0.7822
45	0.0783	0.7704
46	0.0767	0.7673
47	0.0764	0.7663
48	0.0753	0.7616
49	0.0747	0.7597
50	0.0732	0.7593
51	0.0726	0.7587
52	0.0705	0.7570
53	0.0700	0.7534
54	0.0699	0.7496
55	0.0699	0.7449
56	0.0688	0.7421
57	0.0684	0.7406
58	0.0678	0.7361
59	0.0674	0.7346
60	0.0672	0.7335
61	0.0668	0.7328
62	0.0667	0.7235
63	0.0666	0.7172
64	0.0663	0.7163
65	0.0662	0.7130
66	0.0660	0.7120
67	0.0660	0.7035
68	0.0658	0.7023
69	0.0653	0.6997
70	0.0629	0.6950
71	0.0627	0.6854
72	0.0627	0.6689
73	0.0624	0.6667
74	0.0621	0.6645
75	0.0620	0.6639
76	0.0618	0.6639
77	0.0609	0.6623
78	0.0604	0.6559
79	0.0604	0.6553
80	0.0602	0.6526
81	0.0601	0.6515

82	0.0598	0.6487
83	0.0594	0.6457
84	0.0586	0.6447
85	0.0584	0.6346
86	0.0581	0.6228
87	0.0579	0.6159
88	0.0571	0.6156
89	0.0571	0.6145
90	0.0570	0.6138
91	0.0561	0.6138
92	0.0555	0.6123
93	0.0551	0.6098
94	0.0541	0.6081
95	0.0536	0.6042
96	0.0529	0.6013
97	0.0529	0.6008
98	0.0528	0.5972
99	0.0522	0.5971
100	0.0520	0.5961
101	0.0511	0.5947
102	0.0510	0.5899
103	0.0501	0.5833
104	0.0483	0.5790
105	0.0482	0.5749
106	0.0480	0.5731
107	0.0469	0.5476
108	0.0465	0.5470
109	0.0460	0.5401
110	0.0455	0.5354
111	0.0451	0.5354
112	0.0442	0.5307
113	0.0440	0.5298
114	0.0436	0.5295
115	0.0434	0.5263
116	0.0418	0.5230
117	0.0409	0.5194
118	0.0396	0.5178
119	0.0396	0.5173
120	0.0395	0.5145
121	0.0394	0.5127
122	0.0387	0.5077
123	0.0387	0.5036
124	0.0375	0.5022
125	0.0374	0.5006
126	0.0373	0.5001
127	0.0371	0.4952
128	0.0370	0.4944
129	0.0366	0.4944
130	0.0356	0.4921
131	0.0354	0.4834
132	0.0353	0.4777
133	0.0350	0.4770
134	0.0344	0.4765
135	0.0341	0.4743
136	0.0340	0.4739
137	0.0337	0.4725
138	0.0336	0.4659
139	0.0326	0.4532

140	0.0320	0.4523
141	0.0308	0.4440
142	0.0303	0.4434
143	0.0292	0.4328
144	0.0280	0.4285
145	0.0278	0.4265
146	0.0274	0.4262
147	0.0273	0.4235
148	0.0268	0.4226
149	0.0268	0.4188
150	0.0260	0.4155
151	0.0244	0.4118
152	0.0219	0.4092
153	0.0214	0.3925
154	0.0211	0.3914
155	0.0193	0.3779
156	0.0102	0.3064
157	0.0091	0.3059
158	0.0058	0.2843

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0306	60054	369965	616	Fail
0.0319	54586	358664	657	Fail
0.0332	49672	348415	701	Fail
0.0345	45229	338443	748	Fail
0.0359	41213	329024	798	Fail
0.0372	37767	320049	847	Fail
0.0385	34742	311462	896	Fail
0.0398	31817	303485	953	Fail
0.0412	29224	295673	1011	Fail
0.0425	26986	288360	1068	Fail
0.0438	24930	281103	1127	Fail
0.0451	23058	274178	1189	Fail
0.0465	21374	267530	1251	Fail
0.0478	19867	261214	1314	Fail
0.0491	18465	255065	1381	Fail
0.0504	17069	249026	1458	Fail
0.0518	15784	243209	1540	Fail
0.0531	14615	237613	1625	Fail
0.0544	13595	232129	1707	Fail
0.0557	12609	226810	1798	Fail
0.0570	11717	221713	1892	Fail
0.0584	10903	216672	1987	Fail
0.0597	10111	211907	2095	Fail
0.0610	9363	207254	2213	Fail
0.0623	8676	202711	2336	Fail
0.0637	8033	198279	2468	Fail
0.0650	7451	193958	2603	Fail
0.0663	6942	189858	2734	Fail
0.0676	6521	185814	2849	Fail
0.0690	6149	181825	2956	Fail
0.0703	5823	177836	3054	Fail
0.0716	5481	174069	3175	Fail
0.0729	5174	170357	3292	Fail
0.0743	4895	166811	3407	Fail
0.0756	4639	163266	3519	Fail
0.0769	4385	159886	3646	Fail
0.0782	4150	156507	3771	Fail
0.0796	3915	153127	3911	Fail
0.0809	3690	149859	4061	Fail
0.0822	3457	146812	4246	Fail
0.0835	3280	143765	4383	Fail
0.0849	3118	140828	4516	Fail
0.0862	2947	137892	4679	Fail
0.0875	2799	134956	4821	Fail
0.0888	2655	132186	4978	Fail
0.0902	2534	129471	5109	Fail
0.0915	2416	126867	5251	Fail
0.0928	2295	124264	5414	Fail
0.0941	2183	121660	5573	Fail
0.0955	2040	119167	5841	Fail
0.0968	1898	116785	6153	Fail
0.0981	1773	114513	6458	Fail
0.0994	1683	112186	6665	Fail
0.1008	1589	109915	6917	Fail

0.1021	1506	107754	7154	Fail
0.1034	1429	105483	7381	Fail
0.1047	1348	103378	7668	Fail
0.1061	1279	101383	7926	Fail
0.1074	1224	99278	8110	Fail
0.1087	1162	97117	8357	Fail
0.1100	1101	95178	8644	Fail
0.1114	1050	93295	8885	Fail
0.1127	1001	91522	9143	Fail
0.1140	920	89527	9731	Fail
0.1153	854	87755	10275	Fail
0.1167	796	85982	10801	Fail
0.1180	744	84320	11333	Fail
0.1193	679	82492	12149	Fail
0.1206	631	80885	12818	Fail
0.1220	591	79278	13414	Fail
0.1233	550	77782	14142	Fail
0.1246	507	76120	15013	Fail
0.1259	461	74625	16187	Fail
0.1272	417	73129	17536	Fail
0.1286	377	71744	19030	Fail
0.1299	354	70303	19859	Fail
0.1312	321	68808	21435	Fail
0.1325	293	67533	23048	Fail
0.1339	271	66148	24408	Fail
0.1352	253	64874	25641	Fail
0.1365	241	63545	26367	Fail
0.1378	225	62326	27700	Fail
0.1392	209	61162	29264	Fail
0.1405	186	59999	32257	Fail
0.1418	158	58725	37167	Fail
0.1431	137	57617	42056	Fail
0.1445	120	56509	47090	Fail
0.1458	112	55456	49514	Fail
0.1471	99	54298	54846	Fail
0.1484	90	53262	59180	Fail
0.1498	81	52237	64490	Fail
0.1511	71	51218	72138	Fail
0.1524	61	50104	82137	Fail
0.1537	55	49113	89296	Fail
0.1551	49	48160	98285	Fail
0.1564	42	47218	112423	Fail
0.1577	31	46199	149029	Fail
0.1590	18	45290	251611	Fail
0.1604	13	44470	342076	Fail
0.1617	13	43622	335553	Fail

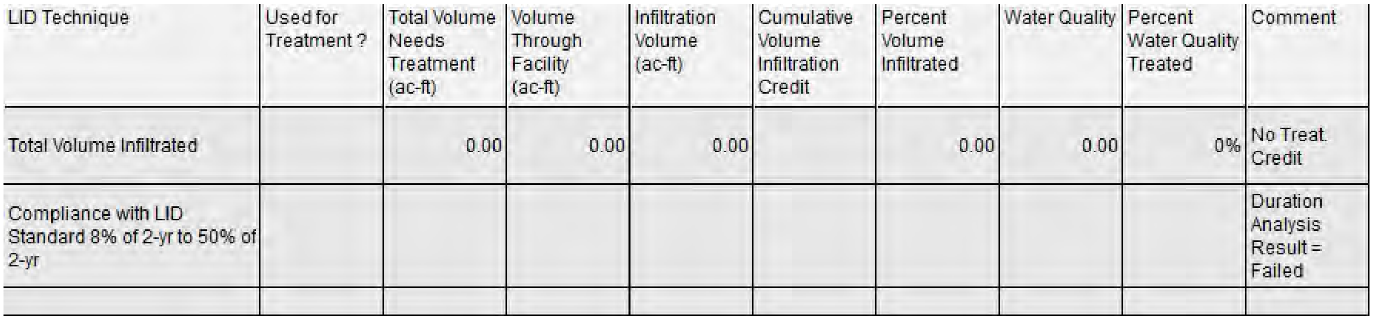
The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #4

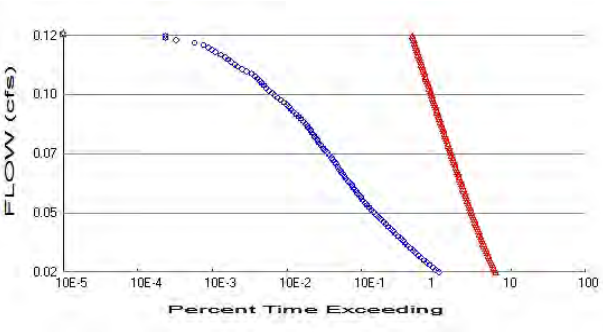
On-line facility volume:	0.2066 acre-feet
On-line facility target flow:	0.253 cfs.
Adjusted for 15 min:	0.253 cfs.
Off-line facility target flow:	0.1457 cfs.
Adjusted for 15 min:	0.1457 cfs.

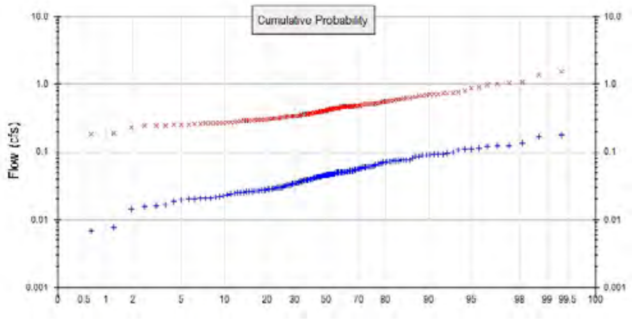
LID Report



LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

POC 5





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #5
Total Pervious Area: 1.9051
Total Impervious Area: 0

Mitigated Landuse Totals for POC #5
Total Pervious Area: 0.9327
Total Impervious Area: 0.9725

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #5

Return Period	**Flow(cfs)**
2 year	0.045908
5 year	0.071582
10 year	0.088004
25 year	0.107671
50 year	0.121454
100 year	0.134492

Flow Frequency Return Periods for Mitigated. POC #5

Return Period	**Flow(cfs)**
2 year	0.409061
5 year	0.574106
10 year	0.698255
25 year	0.872933
50 year	1.016589
100 year	1.172353

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #5

Year	**Predeveloped**	**Mitigated**
1902	0.044	0.426
1903	0.028	0.476
1904	0.061	0.736
1905	0.025	0.258
1906	0.015	0.267
1907	0.072	0.465
1908	0.050	0.338
1909	0.049	0.363
1910	0.070	0.446
1911	0.045	0.474
1912	0.180	1.015

1913	0.071	0.286
1914	0.018	1.545
1915	0.031	0.269
1916	0.046	0.458
1917	0.016	0.185
1918	0.047	0.361
1919	0.040	0.258
1920	0.046	0.375
1921	0.051	0.308
1922	0.050	0.533
1923	0.041	0.334
1924	0.020	0.519
1925	0.027	0.244
1926	0.045	0.417
1927	0.036	0.360
1928	0.035	0.294
1929	0.071	0.629
1930	0.045	0.554
1931	0.044	0.298
1932	0.033	0.320
1933	0.038	0.320
1934	0.094	0.626
1935	0.043	0.246
1936	0.041	0.388
1937	0.066	0.500
1938	0.039	0.265
1939	0.004	0.302
1940	0.043	0.572
1941	0.028	0.551
1942	0.065	0.528
1943	0.031	0.451
1944	0.074	0.721
1945	0.052	0.470
1946	0.033	0.422
1947	0.023	0.276
1948	0.096	0.402
1949	0.086	0.575
1950	0.027	0.322
1951	0.035	0.476
1952	0.125	0.811
1953	0.114	0.720
1954	0.042	0.335
1955	0.036	0.284
1956	0.021	0.252
1957	0.060	0.318
1958	0.120	0.480
1959	0.077	0.485
1960	0.021	0.308
1961	0.076	1.032
1962	0.043	0.383
1963	0.020	0.255
1964	0.024	0.990
1965	0.086	0.443
1966	0.026	0.311
1967	0.040	0.518
1968	0.042	0.372
1969	0.039	0.346
1970	0.060	0.437

1971	0.090	0.436
1972	0.059	1.373
1973	0.077	0.641
1974	0.045	0.548
1975	0.093	0.709
1976	0.051	0.680
1977	0.026	0.231
1978	0.082	0.517
1979	0.025	0.471
1980	0.049	0.512
1981	0.047	0.404
1982	0.026	0.321
1983	0.076	0.494
1984	0.036	0.482
1985	0.057	0.602
1986	0.047	0.265
1987	0.091	0.476
1988	0.055	0.268
1989	0.050	0.254
1990	0.059	0.354
1991	0.047	0.492
1992	0.058	0.414
1993	0.061	0.468
1994	0.089	0.412
1995	0.022	0.276
1996	0.100	0.413
1997	0.044	0.336
1998	0.050	0.449
1999	0.007	0.401
2000	0.038	0.389
2001	0.020	0.282
2002	0.075	0.730
2003	0.057	0.328
2004	0.050	0.470
2005	0.110	0.912
2006	0.030	0.404
2007	0.033	0.512
2008	0.050	0.419
2009	0.034	0.272
2010	0.029	0.378
2011	0.027	0.342
2012	0.045	0.386
2013	0.029	0.398
2014	0.021	0.323
2015	0.040	0.747
2016	0.016	0.319
2017	0.066	0.566
2018	0.123	0.443
2019	0.134	0.685
2020	0.038	0.486
2021	0.063	0.382
2022	0.026	0.618
2023	0.053	0.692
2024	0.169	1.062
2025	0.047	0.351
2026	0.075	0.551
2027	0.030	0.447
2028	0.025	0.169

2029	0.050	0.331
2030	0.092	0.640
2031	0.030	0.188
2032	0.020	0.296
2033	0.028	0.367
2034	0.028	0.288
2035	0.108	0.476
2036	0.056	0.298
2037	0.016	0.388
2038	0.050	0.505
2039	0.008	0.766
2040	0.028	0.331
2041	0.033	0.421
2042	0.110	0.507
2043	0.052	0.474
2044	0.068	0.378
2045	0.045	0.302
2046	0.053	0.335
2047	0.040	0.355
2048	0.053	0.294
2049	0.047	0.442
2050	0.034	0.384
2051	0.055	0.614
2052	0.030	0.347
2053	0.051	0.296
2054	0.062	0.867
2055	0.026	0.372
2056	0.023	0.482
2057	0.035	0.243
2058	0.044	0.442
2059	0.072	0.607

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #5

Rank	**Predeveloped**	**Mitigated**
1	0.1804	1.5447
2	0.1688	1.3732
3	0.1340	1.0622
4	0.1248	1.0320
5	0.1226	1.0148
6	0.1200	0.9901
7	0.1141	0.9119
8	0.1102	0.8670
9	0.1101	0.8112
10	0.1076	0.7659
11	0.0997	0.7475
12	0.0963	0.7361
13	0.0942	0.7304
14	0.0931	0.7213
15	0.0921	0.7198
16	0.0910	0.7093
17	0.0896	0.6923
18	0.0895	0.6846
19	0.0858	0.6798
20	0.0857	0.6413
21	0.0821	0.6395
22	0.0768	0.6288
23	0.0768	0.6264

24	0.0760	0.6182
25	0.0757	0.6139
26	0.0750	0.6070
27	0.0750	0.6021
28	0.0739	0.5748
29	0.0725	0.5718
30	0.0716	0.5657
31	0.0713	0.5536
32	0.0707	0.5512
33	0.0697	0.5510
34	0.0684	0.5476
35	0.0658	0.5333
36	0.0656	0.5284
37	0.0650	0.5194
38	0.0626	0.5179
39	0.0616	0.5166
40	0.0612	0.5121
41	0.0610	0.5121
42	0.0604	0.5073
43	0.0599	0.5046
44	0.0591	0.4998
45	0.0588	0.4937
46	0.0576	0.4924
47	0.0574	0.4861
48	0.0566	0.4852
49	0.0561	0.4823
50	0.0550	0.4818
51	0.0545	0.4798
52	0.0530	0.4764
53	0.0526	0.4763
54	0.0525	0.4763
55	0.0525	0.4762
56	0.0517	0.4745
57	0.0513	0.4737
58	0.0509	0.4713
59	0.0507	0.4701
60	0.0505	0.4701
61	0.0502	0.4680
62	0.0501	0.4651
63	0.0500	0.4577
64	0.0498	0.4513
65	0.0498	0.4491
66	0.0496	0.4470
67	0.0495	0.4456
68	0.0494	0.4430
69	0.0491	0.4428
70	0.0472	0.4419
71	0.0471	0.4416
72	0.0471	0.4374
73	0.0469	0.4364
74	0.0466	0.4261
75	0.0466	0.4221
76	0.0464	0.4215
77	0.0458	0.4193
78	0.0454	0.4168
79	0.0454	0.4136
80	0.0452	0.4133
81	0.0452	0.4125

82	0.0449	0.4044
83	0.0446	0.4036
84	0.0440	0.4022
85	0.0439	0.4009
86	0.0436	0.3976
87	0.0435	0.3886
88	0.0429	0.3884
89	0.0429	0.3882
90	0.0428	0.3857
91	0.0422	0.3843
92	0.0417	0.3826
93	0.0414	0.3818
94	0.0406	0.3778
95	0.0402	0.3775
96	0.0398	0.3751
97	0.0397	0.3721
98	0.0397	0.3715
99	0.0392	0.3665
100	0.0391	0.3633
101	0.0384	0.3609
102	0.0383	0.3597
103	0.0377	0.3555
104	0.0363	0.3536
105	0.0362	0.3511
106	0.0361	0.3472
107	0.0352	0.3458
108	0.0349	0.3422
109	0.0345	0.3380
110	0.0342	0.3361
111	0.0339	0.3353
112	0.0332	0.3351
113	0.0331	0.3340
114	0.0328	0.3309
115	0.0326	0.3306
116	0.0314	0.3276
117	0.0307	0.3228
118	0.0298	0.3216
119	0.0297	0.3208
120	0.0297	0.3203
121	0.0296	0.3200
122	0.0291	0.3186
123	0.0291	0.3178
124	0.0282	0.3109
125	0.0281	0.3084
126	0.0280	0.3076
127	0.0279	0.3019
128	0.0278	0.3017
129	0.0275	0.2981
130	0.0268	0.2976
131	0.0266	0.2965
132	0.0265	0.2963
133	0.0263	0.2938
134	0.0258	0.2938
135	0.0256	0.2879
136	0.0255	0.2865
137	0.0253	0.2837
138	0.0252	0.2821
139	0.0245	0.2760

140	0.0240	0.2759
141	0.0231	0.2715
142	0.0228	0.2691
143	0.0219	0.2677
144	0.0210	0.2668
145	0.0209	0.2647
146	0.0206	0.2646
147	0.0205	0.2580
148	0.0201	0.2577
149	0.0201	0.2553
150	0.0195	0.2539
151	0.0183	0.2516
152	0.0165	0.2456
153	0.0161	0.2438
154	0.0158	0.2428
155	0.0145	0.2311
156	0.0077	0.1883
157	0.0069	0.1848
158	0.0043	0.1693

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0230	59999	350354	583	Fail
0.0239	54619	337944	618	Fail
0.0249	49667	326199	656	Fail
0.0259	45273	315119	696	Fail
0.0269	41207	304593	739	Fail
0.0279	37794	294842	780	Fail
0.0289	34736	285369	821	Fail
0.0299	31822	276394	868	Fail
0.0309	29224	267807	916	Fail
0.0319	26991	259663	962	Fail
0.0329	24930	251962	1010	Fail
0.0339	23058	244649	1061	Fail
0.0349	21374	237503	1111	Fail
0.0359	19867	230633	1160	Fail
0.0369	18471	224096	1213	Fail
0.0379	17069	217780	1275	Fail
0.0389	15789	211686	1340	Fail
0.0399	14620	205924	1408	Fail
0.0409	13590	200218	1473	Fail
0.0419	12615	194622	1542	Fail
0.0429	11712	189193	1615	Fail
0.0438	10908	184152	1688	Fail
0.0448	10105	179110	1772	Fail
0.0458	9368	174457	1862	Fail
0.0468	8676	169803	1957	Fail
0.0478	8044	165316	2055	Fail
0.0488	7451	160883	2159	Fail
0.0498	6942	156784	2258	Fail
0.0508	6521	152629	2340	Fail
0.0518	6149	148640	2417	Fail
0.0528	5823	144817	2486	Fail
0.0538	5481	141050	2573	Fail
0.0548	5174	137449	2656	Fail
0.0558	4895	133903	2735	Fail
0.0568	4639	130635	2816	Fail
0.0578	4386	127366	2903	Fail
0.0588	4150	124153	2991	Fail
0.0598	3915	121050	3091	Fail
0.0608	3690	118003	3197	Fail
0.0618	3457	115012	3326	Fail
0.0628	3279	112075	3417	Fail
0.0637	3120	109305	3503	Fail
0.0647	2947	106591	3616	Fail
0.0657	2799	103987	3715	Fail
0.0667	2655	101328	3816	Fail
0.0677	2534	98835	3900	Fail
0.0687	2415	96286	3986	Fail
0.0697	2295	93904	4091	Fail
0.0707	2182	91522	4194	Fail
0.0717	2042	89306	4373	Fail
0.0727	1898	87145	4591	Fail
0.0737	1773	84929	4790	Fail
0.0747	1683	82879	4924	Fail
0.0757	1586	80885	5099	Fail

0.0767	1503	78891	5248	Fail
0.0777	1429	76951	5384	Fail
0.0787	1348	75123	5572	Fail
0.0797	1278	73240	5730	Fail
0.0807	1220	71411	5853	Fail
0.0817	1162	69639	5993	Fail
0.0827	1099	67921	6180	Fail
0.0836	1048	66370	6333	Fail
0.0846	997	64763	6495	Fail
0.0856	921	63157	6857	Fail
0.0866	853	61550	7215	Fail
0.0876	795	60110	7561	Fail
0.0886	739	58614	7931	Fail
0.0896	679	57229	8428	Fail
0.0906	627	55899	8915	Fail
0.0916	589	54570	9264	Fail
0.0926	545	53284	9776	Fail
0.0936	507	51988	10254	Fail
0.0946	457	50714	11097	Fail
0.0956	417	49473	11864	Fail
0.0966	377	48293	12809	Fail
0.0976	354	47163	13322	Fail
0.0986	320	46021	14381	Fail
0.0996	292	44902	15377	Fail
0.1006	271	43877	16190	Fail
0.1016	253	42764	16902	Fail
0.1025	242	41772	17261	Fail
0.1035	225	40780	18124	Fail
0.1045	207	39778	19216	Fail
0.1055	185	38880	21016	Fail
0.1065	158	37905	23990	Fail
0.1075	137	37041	27037	Fail
0.1085	120	36105	30087	Fail
0.1095	111	35224	31733	Fail
0.1105	99	34371	34718	Fail
0.1115	90	33567	37296	Fail
0.1125	82	32847	40057	Fail
0.1135	72	32005	44451	Fail
0.1145	61	31268	51259	Fail
0.1155	55	30520	55490	Fail
0.1165	49	29761	60736	Fail
0.1175	42	29063	69197	Fail
0.1185	32	28349	88590	Fail
0.1195	18	27717	153983	Fail
0.1205	13	27047	208053	Fail
0.1215	13	26387	202976	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.

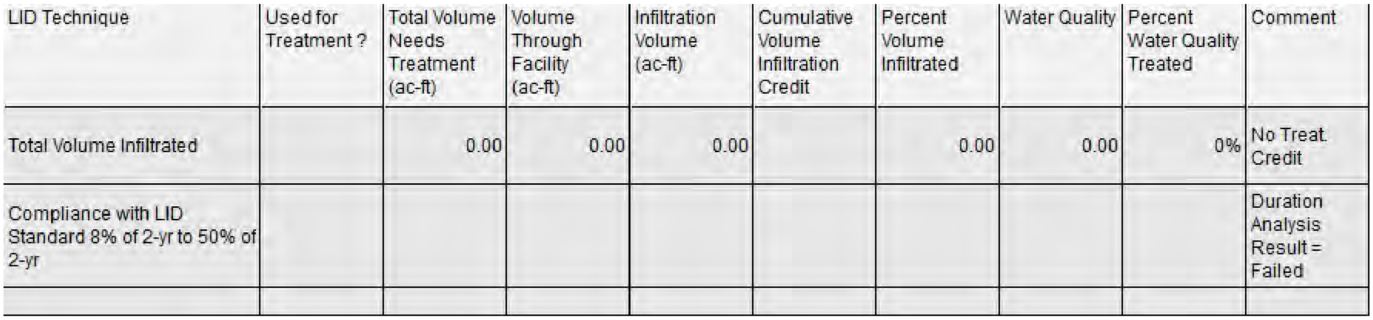
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #5

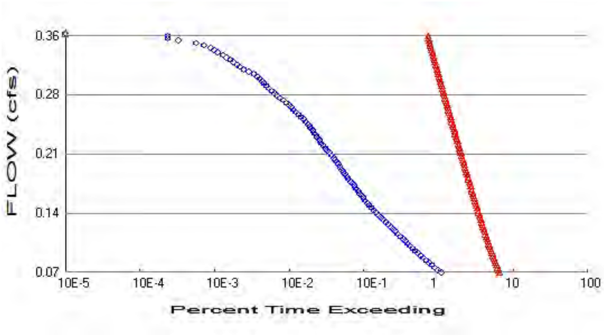
On-line facility volume:	0.1359 acre-feet
On-line facility target flow:	0.1508 cfs.
Adjusted for 15 min:	0.1508 cfs.
Off-line facility target flow:	0.0864 cfs.
Adjusted for 15 min:	0.0864 cfs.

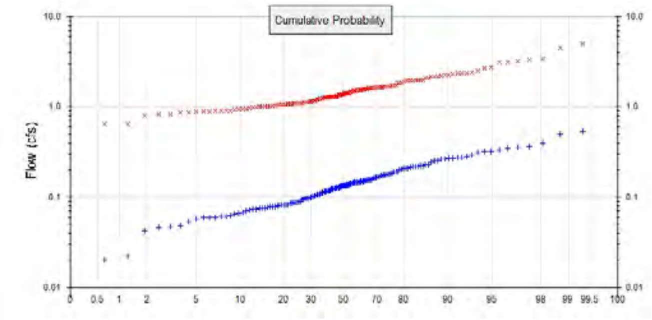
LID Report



LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

POC 6





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #6
Total Pervious Area: 5.5886
Total Impervious Area: 0

Mitigated Landuse Totals for POC #6
Total Pervious Area: 2.1432
Total Impervious Area: 3.4454

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #6

Return Period	**Flow(cfs)**
2 year	0.13467
5 year	0.209985
10 year	0.258158
25 year	0.315851
50 year	0.356285
100 year	0.394531

Flow Frequency Return Periods for Mitigated. POC #6

Return Period	**Flow(cfs)**
2 year	1.383035
5 year	1.907273
10 year	2.296312
25 year	2.837761
50 year	3.278787
100 year	3.753355

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #6

Year	**Predeveloped**	**Mitigated**
1902	0.129	1.504
1903	0.082	1.674
1904	0.179	2.349
1905	0.072	0.888
1906	0.043	0.938
1907	0.210	1.509
1908	0.148	1.141
1909	0.144	1.283
1910	0.204	1.431
1911	0.133	1.569
1912	0.529	3.116

1913	0.207	1.007
1914	0.054	5.022
1915	0.092	0.920
1916	0.134	1.608
1917	0.047	0.645
1918	0.138	1.275
1919	0.117	0.871
1920	0.136	1.229
1921	0.149	1.021
1922	0.145	1.714
1923	0.119	1.107
1924	0.059	1.828
1925	0.078	0.832
1926	0.132	1.475
1927	0.106	1.268
1928	0.101	0.992
1929	0.209	2.078
1930	0.131	1.927
1931	0.128	1.010
1932	0.096	1.081
1933	0.112	1.072
1934	0.276	1.995
1935	0.126	0.868
1936	0.121	1.308
1937	0.193	1.620
1938	0.115	0.903
1939	0.013	1.057
1940	0.126	1.981
1941	0.082	1.939
1942	0.191	1.708
1943	0.090	1.525
1944	0.217	2.363
1945	0.152	1.612
1946	0.097	1.384
1947	0.068	0.958
1948	0.283	1.371
1949	0.251	2.006
1950	0.081	1.139
1951	0.103	1.687
1952	0.366	2.515
1953	0.335	2.260
1954	0.122	1.131
1955	0.107	0.998
1956	0.060	0.891
1957	0.177	1.089
1958	0.352	1.543
1959	0.225	1.559
1960	0.062	1.067
1961	0.223	3.375
1962	0.126	1.308
1963	0.059	0.904
1964	0.070	3.204
1965	0.252	1.429
1966	0.077	1.063
1967	0.116	1.681
1968	0.124	1.265
1969	0.115	1.166
1970	0.176	1.423

1971	0.263	1.411
1972	0.173	4.467
1973	0.225	2.262
1974	0.133	1.831
1975	0.273	2.216
1976	0.151	2.188
1977	0.076	0.801
1978	0.241	1.639
1979	0.074	1.566
1980	0.145	1.650
1981	0.138	1.385
1982	0.075	1.098
1983	0.222	1.622
1984	0.106	1.594
1985	0.166	1.936
1986	0.137	0.887
1987	0.267	1.518
1988	0.160	0.900
1989	0.147	0.899
1990	0.173	1.171
1991	0.137	1.645
1992	0.169	1.465
1993	0.179	1.651
1994	0.262	1.339
1995	0.064	0.942
1996	0.292	1.360
1997	0.129	1.139
1998	0.146	1.470
1999	0.020	1.408
2000	0.110	1.308
2001	0.057	0.999
2002	0.220	2.290
2003	0.168	1.106
2004	0.146	1.613
2005	0.323	3.134
2006	0.087	1.406
2007	0.096	1.712
2008	0.146	1.399
2009	0.099	0.956
2010	0.085	1.299
2011	0.078	1.212
2012	0.133	1.308
2013	0.085	1.307
2014	0.061	1.117
2015	0.118	2.373
2016	0.048	1.107
2017	0.193	1.948
2018	0.360	1.402
2019	0.393	2.149
2020	0.113	1.589
2021	0.183	1.273
2022	0.078	2.089
2023	0.154	2.428
2024	0.495	3.327
2025	0.138	1.244
2026	0.220	1.830
2027	0.087	1.555
2028	0.074	0.599

2029	0.147	1.099
2030	0.270	2.192
2031	0.087	0.650
2032	0.060	1.045
2033	0.082	1.298
2034	0.083	1.019
2035	0.316	1.533
2036	0.165	1.044
2037	0.046	1.374
2038	0.147	1.616
2039	0.023	2.690
2040	0.083	1.120
2041	0.097	1.424
2042	0.323	1.649
2043	0.154	1.673
2044	0.201	1.239
2045	0.132	1.016
2046	0.155	1.129
2047	0.116	1.259
2048	0.154	1.038
2049	0.138	1.554
2050	0.100	1.284
2051	0.161	1.975
2052	0.087	1.230
2053	0.149	1.044
2054	0.181	2.720
2055	0.075	1.269
2056	0.067	1.688
2057	0.102	0.833
2058	0.128	1.565
2059	0.213	1.952

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #6

Rank	Predeveloped	Mitigated
1	0.5292	5.0225
2	0.4951	4.4674
3	0.3931	3.3746
4	0.3661	3.3270
5	0.3595	3.2042
6	0.3520	3.1341
7	0.3348	3.1156
8	0.3233	2.7204
9	0.3231	2.6897
10	0.3157	2.5154
11	0.2924	2.4277
12	0.2825	2.3731
13	0.2764	2.3631
14	0.2731	2.3486
15	0.2703	2.2899
16	0.2669	2.2617
17	0.2627	2.2595
18	0.2624	2.2161
19	0.2518	2.1924
20	0.2515	2.1877
21	0.2407	2.1488
22	0.2254	2.0894
23	0.2254	2.0777

24	0.2228	2.0057
25	0.2219	1.9949
26	0.2201	1.9806
27	0.2201	1.9754
28	0.2167	1.9520
29	0.2126	1.9475
30	0.2100	1.9389
31	0.2091	1.9361
32	0.2074	1.9275
33	0.2044	1.8313
34	0.2007	1.8301
35	0.1931	1.8280
36	0.1926	1.7139
37	0.1908	1.7123
38	0.1835	1.7079
39	0.1806	1.6885
40	0.1795	1.6868
41	0.1789	1.6811
42	0.1773	1.6738
43	0.1757	1.6728
44	0.1733	1.6515
45	0.1726	1.6497
46	0.1690	1.6485
47	0.1684	1.6448
48	0.1660	1.6392
49	0.1647	1.6223
50	0.1614	1.6197
51	0.1599	1.6161
52	0.1554	1.6126
53	0.1543	1.6119
54	0.1540	1.6083
55	0.1539	1.5943
56	0.1517	1.5891
57	0.1506	1.5692
58	0.1494	1.5664
59	0.1486	1.5647
60	0.1480	1.5587
61	0.1473	1.5547
62	0.1470	1.5540
63	0.1467	1.5431
64	0.1462	1.5330
65	0.1460	1.5254
66	0.1455	1.5184
67	0.1453	1.5095
68	0.1449	1.5042
69	0.1439	1.4753
70	0.1385	1.4702
71	0.1382	1.4652
72	0.1381	1.4305
73	0.1375	1.4288
74	0.1368	1.4244
75	0.1366	1.4227
76	0.1362	1.4109
77	0.1343	1.4080
78	0.1332	1.4059
79	0.1331	1.4024
80	0.1326	1.3994
81	0.1325	1.3854

82	0.1317	1.3843
83	0.1308	1.3740
84	0.1291	1.3705
85	0.1287	1.3596
86	0.1280	1.3385
87	0.1276	1.3083
88	0.1258	1.3079
89	0.1258	1.3078
90	0.1257	1.3078
91	0.1237	1.3067
92	0.1222	1.2991
93	0.1215	1.2984
94	0.1192	1.2838
95	0.1181	1.2829
96	0.1166	1.2746
97	0.1165	1.2733
98	0.1163	1.2687
99	0.1149	1.2679
100	0.1147	1.2649
101	0.1125	1.2590
102	0.1123	1.2436
103	0.1105	1.2389
104	0.1065	1.2297
105	0.1063	1.2291
106	0.1058	1.2121
107	0.1032	1.1713
108	0.1025	1.1656
109	0.1013	1.1406
110	0.1002	1.1395
111	0.0995	1.1389
112	0.0974	1.1307
113	0.0970	1.1286
114	0.0961	1.1204
115	0.0955	1.1170
116	0.0921	1.1074
117	0.0900	1.1071
118	0.0874	1.1063
119	0.0872	1.0995
120	0.0871	1.0985
121	0.0868	1.0886
122	0.0853	1.0812
123	0.0853	1.0718
124	0.0826	1.0671
125	0.0825	1.0634
126	0.0822	1.0568
127	0.0818	1.0451
128	0.0816	1.0444
129	0.0806	1.0435
130	0.0785	1.0381
131	0.0781	1.0213
132	0.0777	1.0192
133	0.0771	1.0158
134	0.0757	1.0097
135	0.0752	1.0072
136	0.0749	0.9991
137	0.0741	0.9976
138	0.0740	0.9924
139	0.0719	0.9577

140	0.0704	0.9557
141	0.0679	0.9422
142	0.0668	0.9376
143	0.0644	0.9195
144	0.0617	0.9036
145	0.0612	0.9032
146	0.0604	0.9003
147	0.0601	0.8992
148	0.0591	0.8910
149	0.0590	0.8880
150	0.0573	0.8867
151	0.0537	0.8715
152	0.0483	0.8685
153	0.0471	0.8331
154	0.0464	0.8318
155	0.0426	0.8005
156	0.0225	0.6495
157	0.0201	0.6449
158	0.0127	0.5995

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0673	59999	366032	610	Fail
0.0703	54586	354619	649	Fail
0.0732	49650	343983	692	Fail
0.0761	45224	333789	738	Fail
0.0790	41207	324149	786	Fail
0.0819	37772	315063	834	Fail
0.0848	34736	306476	882	Fail
0.0878	31806	298111	937	Fail
0.0907	29218	290299	993	Fail
0.0936	26969	282765	1048	Fail
0.0965	24925	275452	1105	Fail
0.0994	23047	268416	1164	Fail
0.1024	21401	261879	1223	Fail
0.1053	19894	255508	1284	Fail
0.1082	18504	249192	1346	Fail
0.1111	17069	242987	1423	Fail
0.1140	15806	237115	1500	Fail
0.1170	14631	231519	1582	Fail
0.1199	13612	226035	1660	Fail
0.1228	12637	220772	1747	Fail
0.1257	11712	215342	1838	Fail
0.1286	10908	210522	1929	Fail
0.1315	10122	205647	2031	Fail
0.1345	9379	200994	2143	Fail
0.1374	8687	196451	2261	Fail
0.1403	8033	191908	2388	Fail
0.1432	7451	187697	2519	Fail
0.1461	6947	183542	2642	Fail
0.1491	6526	179332	2747	Fail
0.1520	6161	175343	2846	Fail
0.1549	5828	171576	2943	Fail
0.1578	5480	167753	3061	Fail
0.1607	5175	163986	3168	Fail
0.1637	4898	160496	3276	Fail
0.1666	4644	156895	3378	Fail
0.1695	4397	153460	3490	Fail
0.1724	4150	150080	3616	Fail
0.1753	3915	146756	3748	Fail
0.1782	3692	143709	3892	Fail
0.1812	3461	140662	4064	Fail
0.1841	3282	137560	4191	Fail
0.1870	3118	134457	4312	Fail
0.1899	2947	131577	4464	Fail
0.1928	2799	128862	4603	Fail
0.1958	2658	126092	4743	Fail
0.1987	2536	123433	4867	Fail
0.2016	2418	120884	4999	Fail
0.2045	2295	118225	5151	Fail
0.2074	2183	115732	5301	Fail
0.2104	2042	113294	5548	Fail
0.2133	1899	110912	5840	Fail
0.2162	1777	108585	6110	Fail
0.2191	1683	106258	6313	Fail
0.2220	1586	104042	6560	Fail

0.2249	1504	101882	6774	Fail
0.2279	1430	99777	6977	Fail
0.2308	1348	97561	7237	Fail
0.2337	1278	95455	7469	Fail
0.2366	1220	93461	7660	Fail
0.2395	1162	91577	7880	Fail
0.2425	1101	89694	8146	Fail
0.2454	1049	87810	8370	Fail
0.2483	999	85926	8601	Fail
0.2512	921	84098	9131	Fail
0.2541	854	82325	9639	Fail
0.2570	795	80608	10139	Fail
0.2600	742	79001	10647	Fail
0.2629	680	77395	11381	Fail
0.2658	629	75733	12040	Fail
0.2687	589	74181	12594	Fail
0.2716	546	72630	13302	Fail
0.2746	508	71079	13991	Fail
0.2775	461	69583	15093	Fail
0.2804	417	68143	16341	Fail
0.2833	377	66702	17692	Fail
0.2862	354	65373	18466	Fail
0.2892	321	64043	19951	Fail
0.2921	293	62824	21441	Fail
0.2950	271	61495	22691	Fail
0.2979	252	60220	23896	Fail
0.3008	241	59002	24482	Fail
0.3037	225	57838	25705	Fail
0.3067	207	56675	27379	Fail
0.3096	185	55511	30005	Fail
0.3125	158	54359	34404	Fail
0.3154	136	53284	39179	Fail
0.3183	120	52198	43498	Fail
0.3213	111	51090	46027	Fail
0.3242	99	50038	50543	Fail
0.3271	90	48980	54422	Fail
0.3300	80	47922	59902	Fail
0.3329	71	46958	66138	Fail
0.3359	61	45999	75408	Fail
0.3388	55	45096	81992	Fail
0.3417	49	44193	90189	Fail
0.3446	40	43218	108044	Fail
0.3475	31	42376	136696	Fail
0.3504	18	41617	231205	Fail
0.3534	13	40786	313738	Fail
0.3563	13	39955	307346	Fail

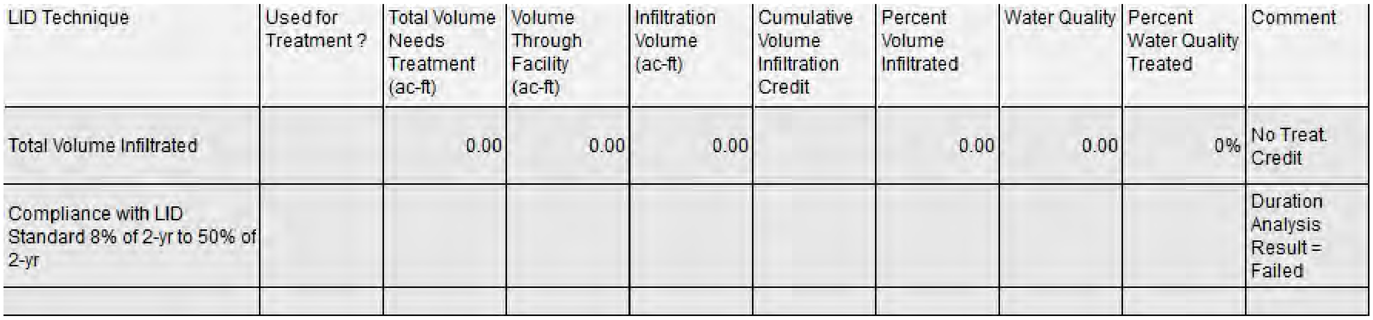
The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #6

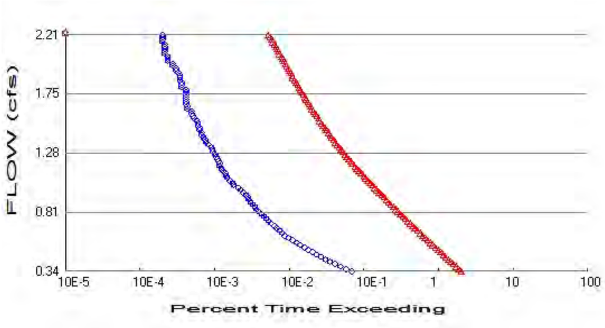
On-line facility volume:	0.442 acre-feet
On-line facility target flow:	0.5333 cfs.
Adjusted for 15 min:	0.5333 cfs.
Off-line facility target flow:	0.3068 cfs.
Adjusted for 15 min:	0.3068 cfs.

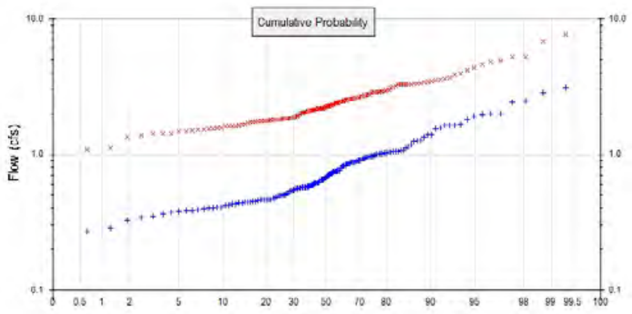
LID Report



LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

POC 7





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #7

Total Pervious Area:	3.9767
Total Impervious Area:	1.2561

Mitigated Landuse Totals for POC #7

Total Pervious Area:	1.0684
Total Impervious Area:	5.9748

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #7

Return Period	**Flow(cfs)**
2 year	0.688733
5 year	1.063896
10 year	1.367647
25 year	1.821267
50 year	2.2144
100 year	2.658794

Flow Frequency Return Periods for Mitigated. POC #7

Return Period	**Flow(cfs)**
2 year	2.248489
5 year	3.034035
10 year	3.607285
25 year	4.39441
50 year	5.027944
100 year	5.703249

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #7

Year	**Predeveloped**	**Mitigated**
1902	0.563	2.596
1903	0.648	2.871
1904	1.570	3.481
1905	0.403	1.483
1906	0.363	1.609
1907	0.931	2.302
1908	0.573	1.848
1909	0.614	2.215
1910	0.930	2.153
1911	0.873	2.472
1912	2.471	4.339

1913	0.404	1.729
1914	3.069	7.683
1915	0.431	1.517
1916	0.716	2.759
1917	0.267	1.117
1918	0.476	2.201
1919	0.435	1.414
1920	0.722	1.904
1921	0.561	1.615
1922	1.108	2.572
1923	0.613	1.747
1924	0.700	3.142
1925	0.391	1.370
1926	0.541	2.555
1927	0.480	2.184
1928	0.495	1.610
1929	1.170	3.261
1930	0.796	3.265
1931	0.496	1.645
1932	0.538	1.756
1933	0.564	1.722
1934	1.344	2.948
1935	0.374	1.503
1936	0.662	2.115
1937	1.020	2.741
1938	0.450	1.516
1939	0.419	1.805
1940	0.847	3.331
1941	0.745	3.331
1942	1.074	2.588
1943	0.759	2.477
1944	1.391	3.659
1945	0.735	2.673
1946	0.810	2.147
1947	0.405	1.615
1948	0.747	2.252
1949	0.816	3.408
1950	0.417	1.973
1951	0.617	2.923
1952	1.904	3.547
1953	1.624	3.255
1954	0.567	1.832
1955	0.384	1.713
1956	0.326	1.544
1957	0.499	1.803
1958	1.056	2.337
1959	1.010	2.337
1960	0.460	1.792
1961	2.005	5.210
1962	0.608	2.159
1963	0.348	1.565
1964	2.003	4.864
1965	0.906	2.163
1966	0.493	1.757
1967	1.036	2.564
1968	0.608	2.072
1969	0.589	1.886
1970	0.868	2.177

1971	0.886	2.139
1972	2.830	6.840
1973	0.876	3.899
1974	0.967	2.928
1975	1.625	3.166
1976	1.405	3.290
1977	0.342	1.347
1978	1.123	2.407
1979	0.856	2.481
1980	1.054	2.486
1981	0.693	2.298
1982	0.505	1.818
1983	0.940	2.524
1984	0.896	2.503
1985	1.248	2.908
1986	0.464	1.421
1987	1.020	2.493
1988	0.461	1.480
1989	0.443	1.559
1990	0.651	1.846
1991	0.961	2.625
1992	0.791	2.540
1993	0.620	2.849
1994	0.826	2.041
1995	0.441	1.554
1996	0.844	2.119
1997	0.557	1.859
1998	0.869	2.274
1999	0.547	2.414
2000	0.665	2.113
2001	0.432	1.732
2002	1.654	3.292
2003	0.588	1.795
2004	0.826	2.675
2005	1.791	5.214
2006	0.578	2.384
2007	0.905	2.737
2008	0.747	2.231
2009	0.439	1.655
2010	0.582	2.163
2011	0.442	2.102
2012	0.638	2.134
2013	0.756	2.034
2014	0.571	1.936
2015	1.622	3.488
2016	0.463	1.871
2017	0.866	3.248
2018	0.971	2.054
2019	1.544	3.096
2020	0.946	2.452
2021	0.704	2.027
2022	1.039	3.394
2023	0.954	4.152
2024	2.413	4.775
2025	0.454	2.156
2026	1.003	2.896
2027	0.646	2.630
2028	0.249	1.039

2029	0.598	1.743
2030	1.001	3.635
2031	0.285	1.086
2032	0.395	1.800
2033	0.474	2.251
2034	0.399	1.766
2035	0.982	2.307
2036	0.529	1.788
2037	0.506	2.378
2038	1.062	2.411
2039	1.046	4.610
2040	0.552	1.824
2041	0.709	2.313
2042	1.010	2.599
2043	0.758	2.882
2044	0.723	2.016
2045	0.519	1.639
2046	0.574	1.822
2047	0.460	2.182
2048	0.386	1.794
2049	0.636	2.671
2050	0.682	2.049
2051	1.269	2.971
2052	0.460	2.132
2053	0.446	1.796
2054	1.959	3.916
2055	0.593	2.113
2056	0.667	2.886
2057	0.378	1.407
2058	0.573	2.712
2059	1.258	3.310

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #7

Rank	Predeveloped	Mitigated
1	3.0693	7.6834
2	2.8295	6.8405
3	2.4714	5.2142
4	2.4135	5.2097
5	2.0053	4.8643
6	2.0033	4.7746
7	1.9587	4.6099
8	1.9039	4.3389
9	1.7910	4.1524
10	1.6539	3.9163
11	1.6248	3.8988
12	1.6238	3.6592
13	1.6221	3.6347
14	1.5702	3.5469
15	1.5442	3.4879
16	1.4052	3.4810
17	1.3910	3.4081
18	1.3443	3.3936
19	1.2692	3.3314
20	1.2579	3.3310
21	1.2478	3.3104
22	1.1704	3.2921
23	1.1234	3.2902

24	1.1076	3.2651
25	1.0742	3.2607
26	1.0617	3.2553
27	1.0557	3.2478
28	1.0541	3.1660
29	1.0463	3.1423
30	1.0388	3.0957
31	1.0362	2.9706
32	1.0203	2.9480
33	1.0196	2.9275
34	1.0101	2.9234
35	1.0098	2.9083
36	1.0027	2.8955
37	1.0010	2.8858
38	0.9825	2.8824
39	0.9714	2.8715
40	0.9672	2.8487
41	0.9610	2.7586
42	0.9544	2.7411
43	0.9459	2.7369
44	0.9405	2.7117
45	0.9311	2.6754
46	0.9296	2.6733
47	0.9056	2.6706
48	0.9047	2.6303
49	0.8964	2.6251
50	0.8863	2.5993
51	0.8764	2.5963
52	0.8726	2.5875
53	0.8688	2.5721
54	0.8684	2.5645
55	0.8662	2.5554
56	0.8556	2.5405
57	0.8465	2.5240
58	0.8441	2.5035
59	0.8259	2.4934
60	0.8258	2.4858
61	0.8157	2.4806
62	0.8101	2.4774
63	0.7962	2.4721
64	0.7907	2.4519
65	0.7586	2.4141
66	0.7581	2.4110
67	0.7565	2.4069
68	0.7471	2.3835
69	0.7467	2.3781
70	0.7448	2.3372
71	0.7349	2.3370
72	0.7231	2.3132
73	0.7224	2.3075
74	0.7159	2.3020
75	0.7087	2.2976
76	0.7040	2.2737
77	0.6999	2.2523
78	0.6930	2.2511
79	0.6816	2.2307
80	0.6666	2.2153
81	0.6650	2.2013

82	0.6619	2.1840
83	0.6507	2.1823
84	0.6478	2.1773
85	0.6461	2.1628
86	0.6383	2.1628
87	0.6357	2.1589
88	0.6204	2.1561
89	0.6171	2.1533
90	0.6138	2.1475
91	0.6126	2.1385
92	0.6082	2.1340
93	0.6078	2.1321
94	0.5979	2.1189
95	0.5935	2.1148
96	0.5888	2.1131
97	0.5877	2.1130
98	0.5824	2.1015
99	0.5783	2.0720
100	0.5742	2.0536
101	0.5727	2.0494
102	0.5725	2.0412
103	0.5705	2.0339
104	0.5675	2.0272
105	0.5637	2.0160
106	0.5631	1.9735
107	0.5607	1.9360
108	0.5567	1.9040
109	0.5518	1.8855
110	0.5467	1.8705
111	0.5414	1.8589
112	0.5381	1.8481
113	0.5290	1.8458
114	0.5185	1.8320
115	0.5064	1.8241
116	0.5052	1.8223
117	0.4992	1.8182
118	0.4963	1.8049
119	0.4955	1.8030
120	0.4929	1.8003
121	0.4800	1.7956
122	0.4756	1.7951
123	0.4739	1.7938
124	0.4642	1.7918
125	0.4632	1.7881
126	0.4613	1.7656
127	0.4602	1.7568
128	0.4599	1.7557
129	0.4597	1.7474
130	0.4540	1.7434
131	0.4503	1.7323
132	0.4463	1.7287
133	0.4426	1.7224
134	0.4425	1.7130
135	0.4405	1.6550
136	0.4390	1.6447
137	0.4349	1.6387
138	0.4320	1.6150
139	0.4311	1.6149

140	0.4188	1.6102
141	0.4170	1.6086
142	0.4046	1.5649
143	0.4036	1.5590
144	0.4032	1.5535
145	0.3989	1.5445
146	0.3955	1.5172
147	0.3909	1.5159
148	0.3863	1.5027
149	0.3843	1.4835
150	0.3783	1.4804
151	0.3740	1.4209
152	0.3627	1.4142
153	0.3476	1.4074
154	0.3419	1.3699
155	0.3255	1.3468
156	0.2851	1.1174
157	0.2675	1.0864
158	0.2490	1.0389

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.3444	3845	112408	2923	Fail
0.3633	3189	103488	3245	Fail
0.3821	2682	95345	3554	Fail
0.4010	2266	87921	3880	Fail
0.4199	1948	81328	4174	Fail
0.4388	1687	74957	4443	Fail
0.4577	1469	69251	4714	Fail
0.4766	1282	63988	4991	Fail
0.4955	1134	59112	5212	Fail
0.5144	1000	54509	5450	Fail
0.5333	885	50282	5681	Fail
0.5521	784	46381	5915	Fail
0.5710	700	42847	6121	Fail
0.5899	608	39839	6552	Fail
0.6088	539	36758	6819	Fail
0.6277	483	33961	7031	Fail
0.6466	444	31445	7082	Fail
0.6655	410	29091	7095	Fail
0.6844	381	26891	7058	Fail
0.7033	352	24897	7073	Fail
0.7222	316	23030	7287	Fail
0.7410	294	21385	7273	Fail
0.7599	270	19917	7376	Fail
0.7788	252	18515	7347	Fail
0.7977	236	17180	7279	Fail
0.8166	213	15922	7475	Fail
0.8355	201	14798	7362	Fail
0.8544	192	13712	7141	Fail
0.8733	179	12714	7102	Fail
0.8922	168	11839	7047	Fail
0.9110	158	11003	6963	Fail
0.9299	155	10282	6633	Fail
0.9488	146	9579	6560	Fail
0.9677	134	8886	6631	Fail
0.9866	124	8310	6701	Fail
1.0055	114	7739	6788	Fail
1.0244	100	7219	7219	Fail
1.0433	96	6753	7034	Fail
1.0622	89	6282	7058	Fail
1.0810	83	5895	7102	Fail
1.0999	80	5513	6891	Fail
1.1188	77	5122	6651	Fail
1.1377	71	4792	6749	Fail
1.1566	68	4455	6551	Fail
1.1755	65	4187	6441	Fail
1.1944	64	3894	6084	Fail
1.2133	62	3687	5946	Fail
1.2322	61	3443	5644	Fail
1.2510	59	3228	5471	Fail
1.2699	56	3068	5478	Fail
1.2888	53	2888	5449	Fail
1.3077	52	2736	5261	Fail
1.3266	50	2580	5160	Fail
1.3455	46	2420	5260	Fail

1.3644	43	2289	5323	Fail
1.3833	41	2170	5292	Fail
1.4022	39	2045	5243	Fail
1.4211	37	1956	5286	Fail
1.4399	37	1865	5040	Fail
1.4588	35	1756	5017	Fail
1.4777	35	1680	4800	Fail
1.4966	33	1570	4757	Fail
1.5155	33	1493	4524	Fail
1.5344	32	1419	4434	Fail
1.5533	29	1363	4700	Fail
1.5722	28	1297	4632	Fail
1.5911	27	1236	4577	Fail
1.6099	27	1171	4337	Fail
1.6288	24	1120	4666	Fail
1.6477	24	1072	4466	Fail
1.6666	23	1024	4452	Fail
1.6855	23	980	4260	Fail
1.7044	23	946	4113	Fail
1.7233	23	903	3926	Fail
1.7422	23	860	3739	Fail
1.7611	23	813	3534	Fail
1.7799	23	778	3382	Fail
1.7988	20	746	3730	Fail
1.8177	20	718	3590	Fail
1.8366	20	686	3430	Fail
1.8555	19	651	3426	Fail
1.8744	19	625	3289	Fail
1.8933	19	604	3178	Fail
1.9122	18	580	3222	Fail
1.9311	17	556	3270	Fail
1.9500	17	533	3135	Fail
1.9688	15	510	3400	Fail
1.9877	15	494	3293	Fail
2.0066	13	474	3646	Fail
2.0255	13	454	3492	Fail
2.0444	13	435	3346	Fail
2.0633	12	410	3416	Fail
2.0822	12	396	3300	Fail
2.1011	12	383	3191	Fail
2.1200	12	366	3050	Fail
2.1388	12	352	2933	Fail
2.1577	11	334	3036	Fail
2.1766	11	321	2918	Fail
2.1955	11	304	2763	Fail
2.2144	11	289	2627	Fail

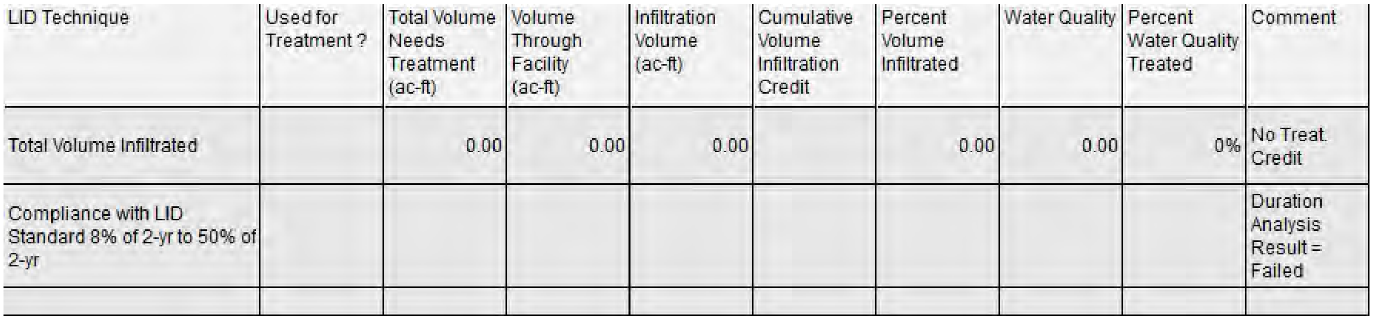
The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #7

On-line facility volume:	0.1632 acre-feet
On-line facility target flow:	0.2127 cfs.
Adjusted for 15 min:	0.2127 cfs.
Off-line facility target flow:	0.123 cfs.
Adjusted for 15 min:	0.123 cfs.

LID Report



LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

POC 8

POC #8 was not reported because POC must exist in both scenarios and both scenarios must have been run.

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

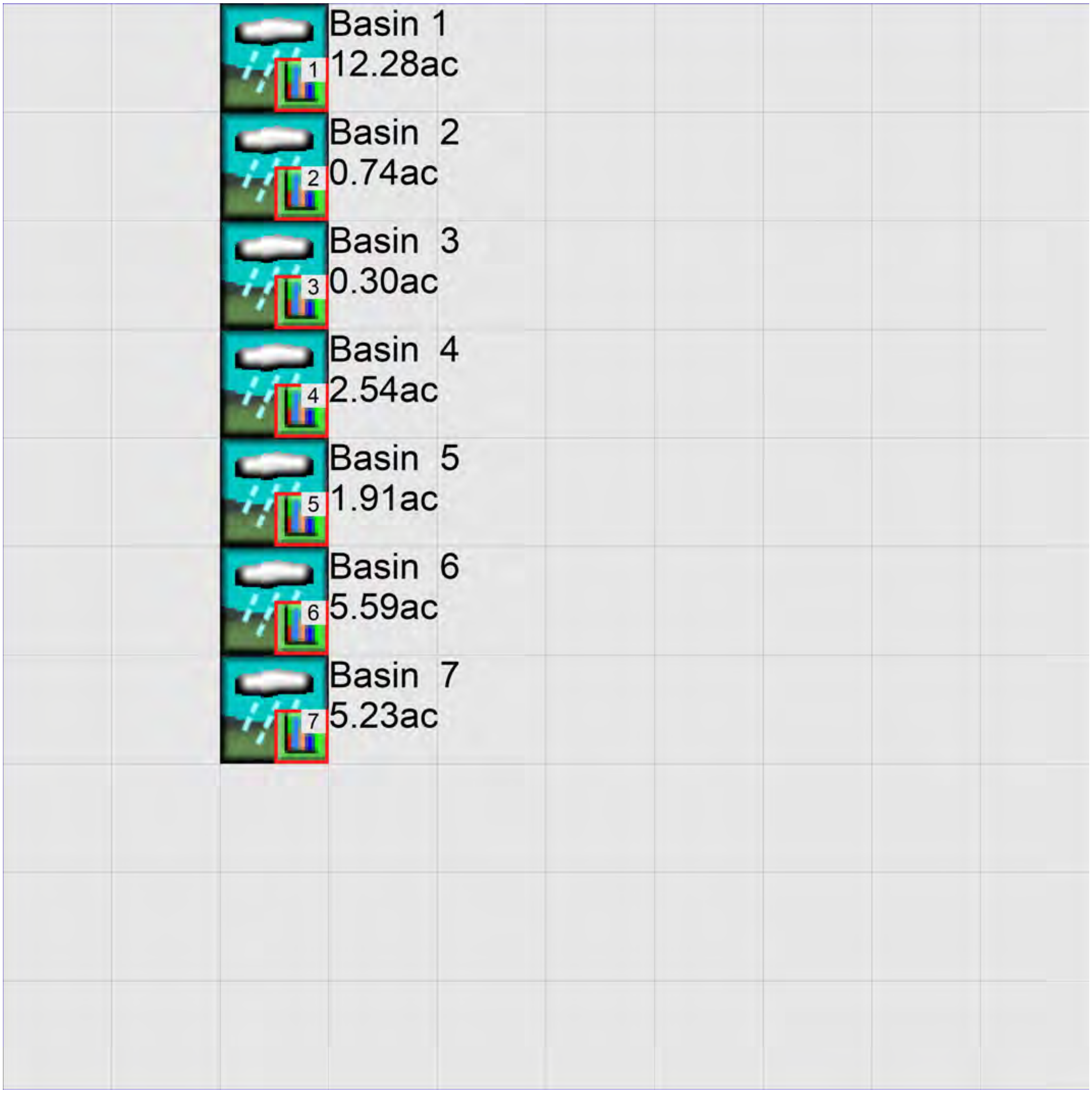
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic

The Filterras are not connected to vault 1 as shown on plans. Basins 2, 3 and 4 mitigated match the area of Basins 4, 5, and 6 in the predeveloped exactly. Clarify the labeling as it is confusing. If Basin 1 is the entire project why is it only 1.35 acres here? What is Basin 8? Where are Basins 6 and 7 in the mitigated? Basin map and all labels should be clear and consistent. Provide descriptions and visual representations of all baisns from the model. [STORMWATER REPORT, Page 133/216]

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM        26   Bradley Heights 051624.wdm
MESSU      25   PreBradley Heights 051624.MES
           27   PreBradley Heights 051624.L61
           28   PreBradley Heights 051624.L62
           30   POCBradley Heights 0516241.dat
           31   POCBradley Heights 0516242.dat
           32   POCBradley Heights 0516243.dat
           33   POCBradley Heights 0516244.dat
           34   POCBradley Heights 0516245.dat
           35   POCBradley Heights 0516246.dat
           36   POCBradley Heights 0516247.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      11
      PERLND      17
      IMPLND       1
      IMPLND       4
      IMPLND       8
      IMPLND       5
      COPY       501
      COPY       502
      COPY       503
      COPY       504
      COPY       505
      COPY       506
      COPY       507
      DISPLY       1
      DISPLY       2
      DISPLY       3
      DISPLY       4
      DISPLY       5
      DISPLY       6
      DISPLY       7
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin 1                    MAX                    1    2   30    9
    2        Basin  2                   MAX                    1    2   31    9
    3        Basin  3                   MAX                    1    2   32    9
    4        Basin  4                   MAX                    1    2   33    9
    5        Basin  5                   MAX                    1    2   34    9
    6        Basin  6                   MAX                    1    2   35    9
    7        Basin  7                   MAX                    1    2   36    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  502         1    1
  503         1    1
```

```
  504         1    1
  505         1    1
  506         1    1
  507         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   11     C, Forest, Mod          1    1    1    1   27    0
   17     C, Lawn, Mod            1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   11         0    0    1    0    0    0    0    0    0    0    0    0
   17         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   11         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   17         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   11         0    0    0    0    0    0    0    0    0    0    0
   17         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   11              0       4.5      0.08       400       0.1       0.5     0.996
   17              0       4.5      0.03       400       0.1       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   11              0         0         2         2         0         0         0
   17              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   11            0.2       0.5      0.35         6       0.5       0.7
   17            0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   11              0         0         0         0       2.5         1         0
```

```
   17              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name-------->   Unit-systems   Printer ***
    # -  #                      User  t-series Engl Metr ***
                                       in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
    4      ROOF TOPS/FLAT         1    1    1   27    0
    8      SIDEWALKS/FLAT         1    1    1   27    0
    5      DRIVEWAYS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
    4         0    0    1    0    0    0
    8         0    0    1    0    0    0
    5         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    4    1    9
    4         0    0    4    0    0    0    1    9
    8         0    0    4    0    0    0    1    9
    5         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
    4         0    0    0    0    0
    8         0    0    0    0    0
    5         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
    4            400      0.01       0.1       0.1
    8            400      0.01       0.1       0.1
    5            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
    4              0         0
    8              0         0
    5              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
    4              0         0
    8              0         0
    5              0         0
  END IWAT-STATE1
```

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin 1***
PERLND  11                      5.8152     COPY   501     12
PERLND  11                      5.8152     COPY   501     13
PERLND  17                       5.176     COPY   501     12
PERLND  17                       5.176     COPY   501     13
IMPLND   1                      0.5171     COPY   501     15
IMPLND   4                      0.6337     COPY   501     15
IMPLND   8                       0.134     COPY   501     15
Basin  2***
PERLND  11                      0.7385     COPY   502     12
PERLND  11                      0.7385     COPY   502     13
Basin  3***
PERLND  11                      0.2984     COPY   503     12
PERLND  11                      0.2984     COPY   503     13
Basin  4***
PERLND  11                      2.5362     COPY   504     12
PERLND  11                      2.5362     COPY   504     13
Basin  5***
PERLND  11                      1.9051     COPY   505     12
PERLND  11                      1.9051     COPY   505     13
Basin  6***
PERLND  11                      5.5886     COPY   506     12
PERLND  11                      5.5886     COPY   506     13
Basin  7***
PERLND  17                      3.9767     COPY   507     12
PERLND  17                      3.9767     COPY   507     13
IMPLND   1                      0.0501     COPY   507     15
IMPLND   4                      0.6368     COPY   507     15
IMPLND   5                      0.4744     COPY   507     15
IMPLND   8                      0.0948     COPY   507     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1
COPY   503 OUTPUT MEAN   1 1   48.4        DISPLY   3     INPUT  TIMSER 1
COPY   504 OUTPUT MEAN   1 1   48.4        DISPLY   4     INPUT  TIMSER 1
COPY   505 OUTPUT MEAN   1 1   48.4        DISPLY   5     INPUT  TIMSER 1
COPY   506 OUTPUT MEAN   1 1   48.4        DISPLY   6     INPUT  TIMSER 1
COPY   507 OUTPUT MEAN   1 1   48.4        DISPLY   7     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                         in  out                             ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY
```

```
  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1               PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1               IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1               PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1               IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    502 FLOW     ENGL      REPL
COPY   503 OUTPUT MEAN   1 1     48.4      WDM    503 FLOW     ENGL      REPL
COPY   504 OUTPUT MEAN   1 1     48.4      WDM    504 FLOW     ENGL      REPL
COPY   505 OUTPUT MEAN   1 1     48.4      WDM    505 FLOW     ENGL      REPL
COPY   506 OUTPUT MEAN   1 1     48.4      WDM    506 FLOW     ENGL      REPL
COPY   507 OUTPUT MEAN   1 1     48.4      WDM    507 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM        26   Bradley Heights 051624.wdm
MESSU      25   MitBradley Heights 051624.MES
           27   MitBradley Heights 051624.L61
           28   MitBradley Heights 051624.L62
           35   POCBradley Heights 0516246.dat
           33   POCBradley Heights 0516244.dat
           34   POCBradley Heights 0516245.dat
           31   POCBradley Heights 0516242.dat
           32   POCBradley Heights 0516243.dat
           36   POCBradley Heights 0516247.dat
           30   POCBradley Heights 0516241.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      17
      IMPLND       1
      IMPLND       4
      IMPLND       8
      RCHRES       1
      RCHRES       2
      RCHRES       3
      RCHRES       4
      COPY       506
      COPY       504
      COPY       505
      COPY       502
      COPY       503
      COPY       507
      COPY         1
      COPY       501
      COPY       601
      DISPLY       6
      DISPLY       4
      DISPLY       5
      DISPLY       2
      DISPLY       3
      DISPLY       7
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    6        Basin 4                     MAX                    1    2   35    9
    4        Basin 2                     MAX                    1    2   33    9
    5        Basin 3                     MAX                    1    2   34    9
    2        Filterra 1-1                MAX                    1    2   31    9
    3        Filterra 1-2                MAX                    1    2   32    9
    7        Basin  8                    MAX                    1    2   36    9
    1        Vault 4                     MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
```

```
    1         1    1
  506         1    1
  504         1    1
  505         1    1
  502         1    1
  503         1    1
  507         1    1
  501         1    1
  601         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   17     C, Lawn, Mod            1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   17         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   17         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   17         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   17              0       4.5      0.03       400       0.1       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   17              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   17            0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   17              0         0         0         0       2.5         1         0
  END PWAT-STATE1
```

```
END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
    4      ROOF TOPS/FLAT         1    1    1   27    0
    8      SIDEWALKS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
    4         0    0    1    0    0    0
    8         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    4    1    9
    4         0    0    4    0    0    0    1    9
    8         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
    4         0    0    0    0    0
    8         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
    4            400      0.01       0.1       0.1
    8            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
    4              0         0
    8              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
    4              0         0
    8              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin 1***
PERLND  17                      0.5355     RCHRES   2      2
PERLND  17                      0.5355     RCHRES   2      3
IMPLND   1                        0.38     RCHRES   2      5
```

```
IMPLND   4                      0.3275     RCHRES   2      5
IMPLND   8                      0.1034     RCHRES   2      5
Basin 4***
PERLND  17                      2.1432     RCHRES   1      2
PERLND  17                      2.1432     RCHRES   1      3
IMPLND   1                      1.9317     RCHRES   1      5
IMPLND   4                      1.2201     RCHRES   1      5
IMPLND   8                      0.2936     RCHRES   1      5
Basin 2***
PERLND  17                      0.9018     RCHRES   3      2
PERLND  17                      0.9018     RCHRES   3      3
IMPLND   1                      0.6511     RCHRES   3      5
IMPLND   4                      0.7916     RCHRES   3      5
IMPLND   8                      0.1916     RCHRES   3      5
Basin 3***
PERLND  17                      0.9327     RCHRES   4      2
PERLND  17                      0.9327     RCHRES   4      3
IMPLND   1                      0.3896     RCHRES   4      5
IMPLND   4                      0.3517     RCHRES   4      5
IMPLND   8                      0.2312     RCHRES   4      5
Basin 4***
PERLND  17                      2.1432     COPY   506     12
PERLND  17                      2.1432     COPY   506     13
IMPLND   1                      1.9317     COPY   506     15
IMPLND   4                      1.2201     COPY   506     15
IMPLND   8                      0.2936     COPY   506     15
Basin 5***
PERLND  17                       0.532     COPY   501     12
PERLND  17                       0.532     COPY   601     12
PERLND  17                       0.532     COPY   501     13
PERLND  17                       0.532     COPY   601     13
IMPLND   1                      0.0444     COPY   501     15
IMPLND   1                      0.0444     COPY   601     15
IMPLND   8                      0.3233     COPY   501     15
IMPLND   8                      0.3233     COPY   601     15
Basin 2***
PERLND  17                      0.9018     COPY   504     12
PERLND  17                      0.9018     COPY   504     13
IMPLND   1                      0.6511     COPY   504     15
IMPLND   4                      0.7916     COPY   504     15
IMPLND   8                      0.1916     COPY   504     15
Basin 3***
PERLND  17                      0.9327     COPY   505     12
PERLND  17                      0.9327     COPY   505     13
IMPLND   1                      0.3896     COPY   505     15
IMPLND   4                      0.3517     COPY   505     15
IMPLND   8                      0.2312     COPY   505     15
Filterra 1-1***
PERLND  17                      0.4641     COPY   502     12
PERLND  17                      0.4641     COPY   502     13
IMPLND   1                      0.1929     COPY   502     15
IMPLND   4                      0.0181     COPY   502     15
IMPLND   8                      0.0634     COPY   502     15
Filterra 1-2***
PERLND  17                      0.0714     COPY   503     12
PERLND  17                      0.0714     COPY   503     13
IMPLND   1                      0.1871     COPY   503     15
IMPLND   8                      0.0399     COPY   503     15
Basin  8***
PERLND  17                      1.0684     COPY   507     12
PERLND  17                      1.0684     COPY   507     13
IMPLND   1                      2.8724     COPY   507     15
IMPLND   4                      2.0541     COPY   507     15
IMPLND   8                      1.0483     COPY   507     15

******Routing******
PERLND  17                      2.1432     COPY     1     12
IMPLND   1                      1.9317     COPY     1     15
IMPLND   4                      1.2201     COPY     1     15
IMPLND   8                      0.2936     COPY     1     15
```

```
PERLND  17                     2.1432     COPY     1     13
PERLND  17                     0.5355     COPY     1     12
IMPLND   1                       0.38     COPY     1     15
IMPLND   4                     0.3275     COPY     1     15
IMPLND   8                     0.1034     COPY     1     15
PERLND  17                     0.5355     COPY     1     13
PERLND  17                     0.9018     COPY     1     12
IMPLND   1                     0.6511     COPY     1     15
IMPLND   4                     0.7916     COPY     1     15
IMPLND   8                     0.1916     COPY     1     15
PERLND  17                     0.9018     COPY     1     13
PERLND  17                     0.9327     COPY     1     12
IMPLND   1                     0.3896     COPY     1     15
IMPLND   4                     0.3517     COPY     1     15
IMPLND   8                     0.2312     COPY     1     15
PERLND  17                     0.9327     COPY     1     13
RCHRES   1                          1     COPY   501     16
RCHRES   2                          1     COPY   501     16
RCHRES   3                          1     COPY   501     16
RCHRES   4                          1     COPY   501     16
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   506 OUTPUT MEAN   1 1   48.4        DISPLY   6     INPUT  TIMSER 1
COPY   504 OUTPUT MEAN   1 1   48.4        DISPLY   4     INPUT  TIMSER 1
COPY   505 OUTPUT MEAN   1 1   48.4        DISPLY   5     INPUT  TIMSER 1
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1
COPY   503 OUTPUT MEAN   1 1   48.4        DISPLY   3     INPUT  TIMSER 1
COPY   507 OUTPUT MEAN   1 1   48.4        DISPLY   7     INPUT  TIMSER 1
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                         in  out                             ***
    1     Vault 4                 1    1    1    1   28    0    1
    2     Vault 1                 1    1    1    1   28    0    1
    3     Vault 2                 1    1    1    1   28    0    1
    4     Vault 3                 1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
    3         1    0    0    0    0    0    0    0    0    0
    4         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
    3         4    0    0    0    0    0    0    0    0    0    1    9
    4         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
```

```
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
    1        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    2        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    3        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    4        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1              1      0.08       0.0       0.0       0.5       0.0
    2              2      0.02       0.0       0.0       0.5       0.0
    3              3      0.05       0.0       0.0       0.5       0.0
    4              4      0.05       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # - # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1           0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2           0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3           0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    4           0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   92    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.172727  0.000000  0.000000
  0.077778  0.172727  0.013434  0.034175
  0.155556  0.172727  0.026869  0.048330
  0.233333  0.172727  0.040303  0.059192
  0.311111  0.172727  0.053737  0.068349
  0.388889  0.172727  0.067172  0.076417
  0.466667  0.172727  0.080606  0.083711
  0.544444  0.172727  0.094040  0.090418
  0.622222  0.172727  0.107475  0.096661
  0.700000  0.172727  0.120909  0.102524
  0.777778  0.172727  0.134343  0.108070
  0.855556  0.172727  0.147778  0.113345
  0.933333  0.172727  0.161212  0.118385
  1.011111  0.172727  0.174646  0.123219
  1.088889  0.172727  0.188081  0.127870
  1.166667  0.172727  0.201515  0.132358
  1.244444  0.172727  0.214949  0.136699
  1.322222  0.172727  0.228384  0.140906
  1.400000  0.172727  0.241818  0.144991
  1.477778  0.172727  0.255253  0.148964
  1.555556  0.172727  0.268687  0.152834
  1.633333  0.172727  0.282121  0.156608
  1.711111  0.172727  0.295556  0.160293
  1.788889  0.172727  0.308990  0.163896
  1.866667  0.172727  0.322424  0.167421
  1.944444  0.172727  0.335859  0.170873
  2.022222  0.172727  0.349293  0.174257
  2.100000  0.172727  0.362727  0.177577
  2.177778  0.172727  0.376162  0.180835
  2.255556  0.172727  0.389596  0.184036
  2.333333  0.172727  0.403030  0.187182
  2.411111  0.172727  0.416465  0.190277
  2.488889  0.172727  0.429899  0.193321
```

```
2.566667  0.172727  0.443333  0.196319
2.644444  0.172727  0.456768  0.199271
2.722222  0.172727  0.470202  0.202180
2.800000  0.172727  0.483636  0.205048
2.877778  0.172727  0.497071  0.207876
2.955556  0.172727  0.510505  0.210667
3.033333  0.172727  0.523939  0.213421
3.111111  0.172727  0.537374  0.216140
3.188889  0.172727  0.550808  0.218825
3.266667  0.172727  0.564242  0.221477
3.344444  0.172727  0.577677  0.224098
3.422222  0.172727  0.591111  0.226689
3.500000  0.172727  0.604545  0.229251
3.577778  0.172727  0.617980  0.231784
3.655556  0.172727  0.631414  0.234290
3.733333  0.172727  0.644848  0.236769
3.811111  0.172727  0.658283  0.239223
3.888889  0.172727  0.671717  0.241651
3.966667  0.172727  0.685152  0.244056
4.044444  0.172727  0.698586  0.246437
4.122222  0.172727  0.712020  0.248795
4.200000  0.172727  0.725455  0.251132
4.277778  0.172727  0.738889  0.253446
4.355556  0.172727  0.752323  0.255740
4.433333  0.172727  0.765758  0.258013
4.511111  0.172727  0.779192  0.260267
4.588889  0.172727  0.792626  0.263894
4.666667  0.172727  0.806061  0.306460
4.744444  0.172727  0.819495  0.374292
4.822222  0.172727  0.832929  0.457964
4.900000  0.172727  0.846364  0.553361
4.977778  0.172727  0.859798  0.657876
5.055556  0.172727  0.873232  0.769621
5.133333  0.172727  0.886667  0.887116
5.211111  0.172727  0.900101  1.009146
5.288889  0.172727  0.913535  1.134678
5.366667  0.172727  0.926970  1.262816
5.444444  0.172727  0.940404  1.392763
5.522222  0.172727  0.953838  1.523802
5.600000  0.172727  0.967273  1.662141
5.677778  0.172727  0.980707  1.824049
5.755556  0.172727  0.994141  1.991713
5.833333  0.172727  1.007576  2.164939
5.911111  0.172727  1.021010  2.343551
5.988889  0.172727  1.034444  3.240711
6.066667  0.172727  1.047879  3.459743
6.144444  0.172727  1.061313  3.852081
6.222222  0.172727  1.074747  4.327384
6.300000  0.172727  1.088182  4.792931
6.377778  0.172727  1.101616  5.164422
6.455556  0.172727  1.115051  5.401260
6.533333  0.172727  1.128485  5.589067
6.611111  0.172727  1.141919  5.752941
6.688889  0.172727  1.155354  5.906782
6.766667  0.172727  1.168788  6.052247
6.844444  0.172727  1.182222  6.190584
6.922222  0.172727  1.195657  6.322755
7.000000  0.172727  1.209091  6.449526
7.077778  0.172727  1.222525  6.571515
END FTABLE  1
FTABLE      2
 92    4
   Depth      Area    Volume  Outflow1 Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
0.000000  0.045914  0.000000  0.000000
0.033333  0.045914  0.001530  0.004954
0.066667  0.045914  0.003061  0.007007
0.100000  0.045914  0.004591  0.008581
0.133333  0.045914  0.006122  0.009909
0.166667  0.045914  0.007652  0.011079
```

```
 0.200000  0.045914  0.009183  0.012136
 0.233333  0.045914  0.010713  0.013108
 0.266667  0.045914  0.012244  0.014013
 0.300000  0.045914  0.013774  0.014863
 0.333333  0.045914  0.015305  0.015667
 0.366667  0.045914  0.016835  0.016432
 0.400000  0.045914  0.018365  0.017163
 0.433333  0.045914  0.019896  0.017864
 0.466667  0.045914  0.021426  0.018538
 0.500000  0.045914  0.022957  0.019189
 0.533333  0.045914  0.024487  0.019818
 0.566667  0.045914  0.026018  0.020428
 0.600000  0.045914  0.027548  0.021020
 0.633333  0.045914  0.029079  0.021596
 0.666667  0.045914  0.030609  0.022157
 0.700000  0.045914  0.032140  0.022704
 0.733333  0.045914  0.033670  0.023239
 0.766667  0.045914  0.035200  0.023761
 0.800000  0.045914  0.036731  0.024272
 0.833333  0.045914  0.038261  0.024772
 0.866667  0.045914  0.039792  0.025263
 0.900000  0.045914  0.041322  0.025744
 0.933333  0.045914  0.042853  0.026217
 0.966667  0.045914  0.044383  0.026681
 1.000000  0.045914  0.045914  0.027137
 1.033333  0.045914  0.047444  0.027585
 1.066667  0.045914  0.048975  0.028027
 1.100000  0.045914  0.050505  0.028461
 1.133333  0.045914  0.052036  0.028889
 1.166667  0.045914  0.053566  0.029311
 1.200000  0.045914  0.055096  0.029727
 1.233333  0.045914  0.056627  0.030137
 1.266667  0.045914  0.058157  0.030541
 1.300000  0.045914  0.059688  0.030941
 1.333333  0.045914  0.061218  0.031335
 1.366667  0.045914  0.062749  0.031724
 1.400000  0.045914  0.064279  0.032109
 1.433333  0.045914  0.065810  0.032489
 1.466667  0.045914  0.067340  0.032864
 1.500000  0.045914  0.068871  0.033236
 1.533333  0.045914  0.070401  0.043736
 1.566667  0.045914  0.071931  0.062626
 1.600000  0.045914  0.073462  0.086978
 1.633333  0.045914  0.074992  0.115744
 1.666667  0.045914  0.076523  0.148322
 1.700000  0.045914  0.078053  0.184304
 1.733333  0.045914  0.079584  0.223391
 1.766667  0.045914  0.081114  0.265350
 1.800000  0.045914  0.082645  0.309995
 1.833333  0.045914  0.084175  0.357173
 1.866667  0.045914  0.085706  0.406752
 1.900000  0.045914  0.087236  0.458621
 1.933333  0.045914  0.088766  0.512682
 1.966667  0.045914  0.090297  0.568848
 2.000000  0.045914  0.091827  0.627044
 2.033333  0.045914  0.093358  0.691902
 2.066667  0.045914  0.094888  0.809912
 2.100000  0.045914  0.096419  0.961512
 2.133333  0.045914  0.097949  1.137965
 2.166667  0.045914  0.099480  1.332042
 2.200000  0.045914  0.101010  1.536593
 2.233333  0.045914  0.102541  1.744256
 2.266667  0.045914  0.104071  1.947602
 2.300000  0.045914  0.105601  2.139493
 2.333333  0.045914  0.107132  2.313586
 2.366667  0.045914  0.108662  2.464945
 2.400000  0.045914  0.110193  2.590741
 2.433333  0.045914  0.111723  2.691034
 2.466667  0.045914  0.113254  2.769612
 2.500000  0.045914  0.114784  2.858698
```

```
2.533333  0.045914  0.116315  2.932023
2.566667  0.045914  0.117845  3.003097
2.600000  0.045914  0.119376  3.072116
2.633333  0.045914  0.120906  3.139249
2.666667  0.045914  0.122436  3.204643
2.700000  0.045914  0.123967  3.268426
2.733333  0.045914  0.125497  3.330713
2.766667  0.045914  0.127028  3.391604
2.800000  0.045914  0.128558  3.451190
2.833333  0.045914  0.130089  3.509550
2.866667  0.045914  0.131619  3.566758
2.900000  0.045914  0.133150  3.622880
2.933333  0.045914  0.134680  3.677975
2.966667  0.045914  0.136211  3.732098
3.000000  0.045914  0.137741  3.785299
3.033333  0.045914  0.139272  3.837623
END FTABLE  2
FTABLE      3
 92    4
   Depth      Area    Volume  Outflow1 Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
0.000000  0.104545  0.000000  0.000000
0.061111  0.104545  0.006389  0.012683
0.122222  0.104545  0.012778  0.017937
0.183333  0.104545  0.019167  0.021968
0.244444  0.104545  0.025556  0.025366
0.305556  0.104545  0.031944  0.028360
0.366667  0.104545  0.038333  0.031067
0.427778  0.104545  0.044722  0.033556
0.488889  0.104545  0.051111  0.035873
0.550000  0.104545  0.057500  0.038049
0.611111  0.104545  0.063889  0.040107
0.672222  0.104545  0.070278  0.042065
0.733333  0.104545  0.076667  0.043935
0.794444  0.104545  0.083056  0.045729
0.855556  0.104545  0.089444  0.047456
0.916667  0.104545  0.095833  0.049121
0.977778  0.104545  0.102222  0.050732
1.038889  0.104545  0.108611  0.052294
1.100000  0.104545  0.115000  0.053810
1.161111  0.104545  0.121389  0.055284
1.222222  0.104545  0.127778  0.056720
1.283333  0.104545  0.134167  0.058121
1.344444  0.104545  0.140556  0.059489
1.405556  0.104545  0.146944  0.060826
1.466667  0.104545  0.153333  0.062134
1.527778  0.104545  0.159722  0.063415
1.588889  0.104545  0.166111  0.064671
1.650000  0.104545  0.172500  0.065903
1.711111  0.104545  0.178889  0.067112
1.772222  0.104545  0.185278  0.068300
1.833333  0.104545  0.191667  0.069468
1.894444  0.104545  0.198056  0.070616
1.955556  0.104545  0.204444  0.071746
2.016667  0.104545  0.210833  0.072859
2.077778  0.104545  0.217222  0.073954
2.138889  0.104545  0.223611  0.075034
2.200000  0.104545  0.230000  0.076098
2.261111  0.104545  0.236389  0.077148
2.322222  0.104545  0.242778  0.078184
2.383333  0.104545  0.249167  0.079206
2.444444  0.104545  0.255556  0.080215
2.505556  0.104545  0.261944  0.081211
2.566667  0.104545  0.268333  0.082196
2.627778  0.104545  0.274722  0.083168
2.688889  0.104545  0.281111  0.084130
2.750000  0.104545  0.287500  0.085081
2.811111  0.104545  0.293889  0.086021
2.872222  0.104545  0.300278  0.086951
2.933333  0.104545  0.306667  0.087871
```

```
2.994444  0.104545  0.313056  0.088781
3.055556  0.104545  0.319444  0.089683
3.116667  0.104545  0.325833  0.090575
3.177778  0.104545  0.332222  0.091459
3.238889  0.104545  0.338611  0.092334
3.300000  0.104545  0.345000  0.093201
3.361111  0.104545  0.351389  0.094060
3.422222  0.104545  0.357778  0.094911
3.483333  0.104545  0.364167  0.095755
3.544444  0.104545  0.370556  0.112192
3.605556  0.104545  0.376944  0.154520
3.666667  0.104545  0.383333  0.211531
3.727778  0.104545  0.389722  0.280059
3.788889  0.104545  0.396111  0.358396
3.850000  0.104545  0.402500  0.445428
3.911111  0.104545  0.408889  0.540352
3.972222  0.104545  0.415278  0.642553
4.033333  0.104545  0.421667  0.751541
4.094444  0.104545  0.428056  0.866915
4.155556  0.104545  0.434444  0.988335
4.216667  0.104545  0.440833  1.115513
4.277778  0.104545  0.447222  1.248197
4.338889  0.104545  0.453611  1.386165
4.400000  0.104545  0.460000  1.529221
4.461111  0.104545  0.466389  1.677190
4.522222  0.104545  0.472778  1.809250
4.583333  0.104545  0.479167  2.029130
4.644444  0.104545  0.485556  2.348211
4.705556  0.104545  0.491944  2.718514
4.766667  0.104545  0.498333  3.095094
4.827778  0.104545  0.504722  3.433699
4.888889  0.104545  0.511111  3.699546
4.950000  0.104545  0.517500  3.880635
5.011111  0.104545  0.523889  4.031585
5.072222  0.104545  0.530278  4.163098
5.133333  0.104545  0.536667  4.287788
5.194444  0.104545  0.543056  4.406624
5.255556  0.104545  0.549444  4.520361
5.316667  0.104545  0.555833  4.629608
5.377778  0.104545  0.562222  4.734860
5.438889  0.104545  0.568611  4.836526
5.500000  0.104545  0.575000  4.934952
5.561111  0.104545  0.581389  5.030430
END FTABLE  3
FTABLE      4
 92   4
   Depth      Area    Volume  Outflow1 Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
0.000000  0.102847  0.000000  0.000000
0.077778  0.102847  0.007999  0.004257
0.155556  0.102847  0.015998  0.006020
0.233333  0.102847  0.023998  0.007373
0.311111  0.102847  0.031997  0.008514
0.388889  0.102847  0.039996  0.009519
0.466667  0.102847  0.047995  0.010428
0.544444  0.102847  0.055994  0.011263
0.622222  0.102847  0.063993  0.012041
0.700000  0.102847  0.071993  0.012771
0.777778  0.102847  0.079992  0.013462
0.855556  0.102847  0.087991  0.014119
0.933333  0.102847  0.095990  0.014747
1.011111  0.102847  0.103989  0.015349
1.088889  0.102847  0.111989  0.015928
1.166667  0.102847  0.119988  0.016487
1.244444  0.102847  0.127987  0.017028
1.322222  0.102847  0.135986  0.017552
1.400000  0.102847  0.143985  0.018061
1.477778  0.102847  0.151984  0.018556
1.555556  0.102847  0.159984  0.019038
1.633333  0.102847  0.167983  0.019508
```

```
1.711111  0.102847  0.175982  0.019967
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1.866667  0.102847  0.191980  0.020855
1.944444  0.102847  0.199980  0.021285
2.022222  0.102847  0.207979  0.021707
2.100000  0.102847  0.215978  0.022120
2.177778  0.102847  0.223977  0.022526
2.255556  0.102847  0.231976  0.022925
2.333333  0.102847  0.239976  0.023317
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2.644444  0.102847  0.271972  0.024823
2.722222  0.102847  0.279971  0.025185
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2.877778  0.102847  0.295970  0.025895
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4.355556  0.102847  0.447954  0.031857
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4.511111  0.102847  0.463953  0.032421
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6.922222  0.102847  0.711927  4.086358
7.000000  0.102847  0.719927  4.211547
7.077778  0.102847  0.727926  4.331963
```

```
  END FTABLE  4
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     6 OUTPUT MEAN   1 1     48.4      WDM    706 FLOW     ENGL      REPL
COPY   506 OUTPUT MEAN   1 1     48.4      WDM    806 FLOW     ENGL      REPL
COPY   606 OUTPUT MEAN   1 1     48.4      WDM    906 FLOW     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
COPY   601 OUTPUT MEAN   1 1     48.4      WDM    901 FLOW     ENGL      REPL
RCHRES   1 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1001 STAG     ENGL      REPL
RCHRES   2 HYDR   RO     1 1        1      WDM   1002 FLOW     ENGL      REPL
RCHRES   2 HYDR   STAGE  1 1        1      WDM   1003 STAG     ENGL      REPL
COPY     4 OUTPUT MEAN   1 1     48.4      WDM    704 FLOW     ENGL      REPL
COPY   504 OUTPUT MEAN   1 1     48.4      WDM    804 FLOW     ENGL      REPL
COPY   604 OUTPUT MEAN   1 1     48.4      WDM    904 FLOW     ENGL      REPL
RCHRES   3 HYDR   RO     1 1        1      WDM   1004 FLOW     ENGL      REPL
RCHRES   3 HYDR   STAGE  1 1        1      WDM   1005 STAG     ENGL      REPL
COPY     5 OUTPUT MEAN   1 1     48.4      WDM    705 FLOW     ENGL      REPL
COPY   505 OUTPUT MEAN   1 1     48.4      WDM    805 FLOW     ENGL      REPL
COPY   605 OUTPUT MEAN   1 1     48.4      WDM    905 FLOW     ENGL      REPL
RCHRES   4 HYDR   RO     1 1        1      WDM   1006 FLOW     ENGL      REPL
RCHRES   4 HYDR   STAGE  1 1        1      WDM   1007 STAG     ENGL      REPL
COPY     2 OUTPUT MEAN   1 1     48.4      WDM    702 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    802 FLOW     ENGL      REPL
COPY   602 OUTPUT MEAN   1 1     48.4      WDM    902 FLOW     ENGL      REPL
COPY     3 OUTPUT MEAN   1 1     48.4      WDM    703 FLOW     ENGL      REPL
COPY   503 OUTPUT MEAN   1 1     48.4      WDM    803 FLOW     ENGL      REPL
COPY   603 OUTPUT MEAN   1 1     48.4      WDM    903 FLOW     ENGL      REPL
COPY     7 OUTPUT MEAN   1 1     48.4      WDM    707 FLOW     ENGL      REPL
COPY   507 OUTPUT MEAN   1 1     48.4      WDM    807 FLOW     ENGL      REPL
COPY   607 OUTPUT MEAN   1 1     48.4      WDM    907 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13
```

```
  MASS-LINK        15
IMPLND     IWATER SURO        0.083333       COPY            INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK        16
RCHRES     ROFLOW                            COPY            INPUT  MEAN
  END MASS-LINK   16


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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APPENDIX B

Geotechnical Report

GEORESOURCES
earth science & geotechnical engineering
5007 Pacific Hwy E., Suite 16 | Fife, WA 98424 | 253.896.1011 | www.georesources.rocks

February 10, 2022

Bradley Heights SS, LLC
1816C 11th avenue
Seattle, WA 98122

Attn: Jorden Mellergaard
(509) 899-0326
jorden@timberlanepartners.com

Geotechnical Engineering Report
Proposed Multi-Family Development
202 – 27th Avenue Southeast
Puyallup, Washington
PN: 0419036006
Doc ID: Timberlane.BradleyHeights.RG

INTRODUCTION

This *geotechnical engineering report* summarizes our site observations, subsurface explorations, laboratory testing and engineering analyses, and provides geotechnical recommendations and design criteria for the proposed multi-story, multi-family residential development to be located at 202 – 27th Avenue Southeast in the City of Puyallup within Pierce County, Washington. The development is proposed to be on one Pierce County tax parcel, numbered 0419036006. The site is currently in use as a trailer park with multiple single-family trailers and access road. The general location of the site is shown on the attached Site Location Map, Figure 1.

Our understanding of the project is based on our discussions with you, a review of the *Conceptual Site Plan* provided to us by Azure Green Consultants (attached as our Figure 2), our subsurface explorations, including those completed during our most recent December 22, 2021 site visit, and our experience in the general area.

We understand that the proposed development will include the construction of 12 multi-family residential structures and one clubhouse building. We anticipate the structures will range from one to three stories and will be supported by conventional spread footings. Additional development will include paved drive lanes and parking areas, a below-grade stormwater facility, and associated typical below grade utilities.

SCOPE

The purpose of our services was to evaluate the surface and subsurface conditions across the site as a basis for providing geotechnical recommendations and design criteria for the proposed development. Specifically, the scope of services for this project will include the following:

1. Reviewed available geological, hydrogeological, and geotechnical literature for the site area;

2. Monitoring the drilling of three hollow-stem auger borings to depths of about 21 feet below existing grades and completed as groundwater observation wells;
3. Describing surface and subsurface conditions, including soil type, and depth to groundwater;
4. Performing one Small Scale (PIT) at a location and elevation determined and approved by the project civil engineer;
5. Providing seismic design parameters, including 2018 IBC site class;
6. Providing geotechnical conclusions and recommendations regarding site grading activities, including site preparation, subgrade preparation, fill placement criteria, suitability of on-site soils for use as structural fill, temporary and permanent cut slopes and drainage and erosion control measures;
7. Providing recommendations for the design and construction of shallow foundations and slabs-on-grade including bearing capacity and subgrade modulus as appropriate;
8. Providing our opinion about the feasibility of onsite infiltration in accordance with the 2012 (with 2014 updates) Department of Ecology Stormwater Management Manual for Western Washington (SWMMWW);
9. Providing recommendations for erosion and sediment control during wet weather grading and construction;
10. Preparing this written *Geotechnical Engineering Report* summarizing our site observations and conclusions, and our geotechnical recommendations and design criteria, along with the supporting data; and,
11. Monitoring groundwater levels on a monthly basis during the prescribed wet season and prepare a written report addendum summarizing the collected data.
12. Provided a design infiltration rate based on in-situ testing, as applicable; and,
13. Updated our preliminary *Geotechnical Engineering Report*, summarized our site observations and conclusions, our geotechnical recommendations and design criteria, along with supporting data.

The above scope of work was summarized in our Proposal for Geotechnical Engineering Services dated December 3, 2021. We received authorization from Mr. David R. Enslow the same day.

SITE CONDITIONS

Surface Conditions

The site is located at 202 – 27th Avenue Southeast in Puyallup, Washington (PN: 0419036006), within an area of existing residential development. The site is generally rectangular in shape, measures approximately 1,115 to 1,130 feet wide (east to west) by 300 feet long (north to south), and encompasses about 7.78 acres. The site is bounded by residential development to the south, east, and west, and by 27th Avenue Southeast to the north.

The site generally slopes gently down from southeast to northwest towards the intersection of 27th Avenue Southeast and South Meridian. The southeastern and south-central portions of the site slope down at approximately 3 to 5 percent, while the north-central and southwestern portions of the site slope down to the northwest at approximately 7 to 10 percent, with localized slopes of approximately 20 to 22 percent located in the southwestern corner of the site. The northwestern corner of the site slopes down to 27th Avenue Southeast at approximately 2 to 4 percent. The total topographic relief across the site is on the order of 48 to 50 feet.

Vegetation across the site generally consists of typical residential landscaping and grass lawn areas with occasional coniferous and deciduous trees along the site perimeter and scattered within the existing lots. No areas of erosion or slope instability were noted at the site at the time of our reconnaissance.

Site Soils

The USDA Natural Resource Conservation Survey (NRCS) Web Soil Survey maps most of the site, including the areas of proposed development, as being underlain by Everett gravelly sandy loam (13B and 13C). An area in the northwestern portion of the site is mapped as being underlain by Kitsap silt loam (20B). An excerpt from the NRCS soils map for the site area is included as Figure 3. These soils are described below.

- Everett very gravelly sandy loam (13B, 13C): The Everett soils are typically derived from sandy and gravelly glacial outwash and form on slopes of 0 to 8 (13B) and 8 to 15 (13C) percent. These soils are listed as having a "slight" (13B) and "moderate," (13C) erosion hazard when exposed, and are included in hydrologic soils group A.

- Kitsap Silt Loam (20B): The Kitsap soils are derived from glaciolacustrine deposits, form on slopes of 2 to 8 percent, are listed as having a "slight to moderate" erosion hazard, and are included in hydrologic soils group C/D.

Site Geology

The draft *Geologic Map of the Puyallup 7.5-minute Quadrangle, Washington* by K. W. Troost (in review) maps the site as being underlain by recessional outwash (Qvsb$_4$) and adjacent to areas mapped as underlain by recessional lacustrine deposits (Qvrl). These glacial soils were deposited during near the end of the Vashon Stade of the Fraser Glaciation, approximately 12,000 to 15,000 years ago. An excerpt of the above reference geologic map is attached as Figure 3. Description of the geologic units is provided below.

- Recessional Outwash (Qvsb$_4$): Recessional outwash deposits typically consist of a poorly sorted, lightly to moderately stratified mixture of sand and gravel that may locally contain silt or clay. Recessional outwash was deposited by meltwater streams issuing from the receding continental ice mass. Accordingly, they are considered normally consolidated and offer moderate strength properties where undisturbed. The potential for stormwater infiltration is generally favorable, depending on grain size.

- Recessional-Lacustrine (Qvrl): Recessional-lacustrine or glaciolacustrine deposits typically consist of a stratified to varved deposit of clay, silt, and sand that was deposited within glacial lakes or other low energy fluvial environments. These deposits are considered normally consolidated and exhibit low to moderate strength and moderate compressibility characteristics where undisturbed. Because of the silty nature of recessional lacustrine soils, the potential for stormwater infiltration is low.

Subsurface Explorations

As part of the scope of work for this study, on January 24, 2020 a GeoResources representative was on site and monitored the drilling of three hollow-stem auger borings to depths of 21 to 21½ feet below existing grades. After termination of drilling, each boring was completed as a groundwater monitoring well in accordance with Washington Department of Ecology Regulations. On December 22, 2021, a GeoResources representative returned to the site and monitored the excavation of two test pits (TP-101 and TP-102) and performed a small-scale pilot infiltration test (PIT) in general accordance with the 2019 Department of Ecology Stormwater Management Manual of Western Washington (2019 SWMMWW) to determine the initial saturated hydraulic conductivity ($K_{sat,\ initial}$) of the subsurface soils at 4 feet below existing grades. The PIT was completed at the location of TP-102. The test pits were excavated by a licensed contractor operating a track mounted excavator working for us.

On March 21, 2018, we monitored the excavation of five test pits to depths of 7½ to 8½ feet below existing grades under a separate scope of work. The work was completed for a different client as a portion of their feasibility period to purchase the property. The test pits are labeled as TP-1 through TP-5 and their locations are approximately shown on the Site and Exploration Plan, Figure 2.

The specific number, locations, and depths of our explorations were selected by GeoResources personnel based on the configuration of the proposed development and were adjusted in the field based on site access limitations. Given the existing development, access limitations were significant. A field representative from our office continuously monitored the test pit explorations, maintained logs of the subsurface conditions encountered, obtained representative soil samples, and observed pertinent site features. The soil densities presented on the test pit logs were based on the difficulty of excavation and our experience. Each test pit was then backfilled with the excavated material and abandoned.

The subsurface explorations excavated as part of this evaluation indicate the subsurface conditions at specific locations only, as actual subsurface conditions can vary across the site. Furthermore, the nature and extent of such variation would not become evident until additional explorations are performed or until construction activities have begun. Based on our experience in the area and extent of prior explorations in the area, it is our opinion that the soils encountered in the explorations are generally representative of the soils at the site. The soils encountered were visually classified in accordance with the Unified Soil Classification System (USCS) and ASTM D: 2488. The USCS is included in Appendix A as Figure A-1. The approximate locations of our explorations are indicated on the attached Site and Exploration Map, Figure 2, while the descriptive logs of our explorations and are included in Appendix A.

Subsurface Conditions

In our opinion, the soils we encountered generally confirmed the mapped stratigraphy at the site and typical conditions for the general site area. In the western portion of the site, we generally encountered tan to light brown massive to laminated silt that was in a soft wet condition which we interpret as glaciolacustrine recessional outwash. In the central portions of the site, we encountered variable surficial conditions ranging from silt, silty sand, and sandy gravel that was in a loose/soft to medium dense/medium stiff, moist to wet condition. We interpret these soils as glaciolacustrine recessional outwash and uncontrolled fill. In the eastern portion of the site, we encountered dense silty sand with gravel that we interpret as glacial till. It appears the surficial soils in the central and western portions of the site were underlain by glacial till at depth.

Given the limitations of our subsurface exploration program because of the developed conditions, we anticipate that additional areas of uncontrolled fill may be present on the site.

Additional subsurface explorations would be required to determine the depths, extents, and composi of uncontrolled fill at the site.

Laboratory Testing

Geotechnical laboratory tests were performed on select samples retrieved from the borings and test pits to estimate index engineering properties of the soils encountered. Laboratory testing included visual soil classification per ASTM D: 2488 and ASTM D: 2487, moisture content determinations per ASTM D: 2216, and grain size analyses per ASTM D: 6913 standard procedures. The results of the laboratory tests are included in Appendix B, and summarized below in Table 1.

TABLE 1:
LABORATORY TEST RESULTS FOR ON-SITE SOILS

Soil Type	Sample	Lab ID Number	Gravel Content (percent)	Sand Content (percent)	Silt/Clay Content (percent)
Poorly graded GRAVEL with silt and sand (GP-GM)	B-1/S-5/12½ft	099117	53.0	36.9	10.1
Well-graded GRAVEL with silt and sand (GW-GM)	B-2/S-4/10ft	099123	55.4	38.5	6.1
SILT (ML)	B-3/S-4/10ft	099129	NA	NA	97.0

NA = Not Applicable

Groundwater Conditions

Groundwater monitoring was completed during the wet season between October 2020 to April 2021 in each of the three monitoring wells installed at the site. Monitoring was completed using downhole pressure transducers that collected daily measurements of water levels in each monitoring well. Additionally, one pressure transducer was installed at the site to provide daily measurements of barometric pressure. Measurements of barometric pressure were used to correct water level measurements for the effects of atmospheric pressure fluctuations.

Our observations indicate a seasonal perched groundwater table develops during the wet season in the western and central portions of the site. A perched groundwater table typically develops when the vertical infiltration of precipitation through a more permeable soil is slowed at depth by a deeper, less permeable soil type, such as glacial till. The groundwater table appears to have a limited thickness and fluctuates relatively rapidly. Total seasonal variation was on the order of 2 to 4 feet. Below, Table 2 summarizes the depths and elevations of groundwater observations for the site. Graphical outputs of wet season groundwater level measurements are included in Appendix C.

TABLE 2:
APPROXIMATE DEPTHS AND ELEVATIONS OF GROUNDWATER ENCOUNTERED IN EXPLORATIONS

Well ID	Depth to Seasonal High Groundwater (feet)	Seasonal High Elevation of Groundwater (feet)	Date Observed
MW-1	17	361	February 23, 21
MW-2	17	383	January 13, 21
MW-3	NE	NE	NA
Notes: NE = Not encountered NA = Not applicable			

ENGINEERING CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our data review, site reconnaissance, subsurface explorations and our experience in the area, it is our opinion that the site is suitable for the proposed multi-family development. Pertinent conclusions and geotechnical recommendations regarding the design and construction of the proposed multi-family development are presented below.

Seismic Design

The site is located in the Puget Sound region of western Washington, which is seismically active. Seismicity in this region is attributed primarily to the interaction between the Pacific, Juan de Fuca and North American plates. The Juan de Fuca plate is subducting beneath the North American plate at the Cascadia Subduction Zone (CSZ). This produces both intercrustal (between plates) and intracrustal (within a plate) earthquakes. In the following sections we discuss the design criteria and potential hazards associated with the regional seismicity.

Seismic Site Class

Based on our observations and the subsurface units mapped at the site, we interpret the structural site conditions to correspond to a seismic Site Class “C” in accordance with the 2018 IBC documents and American Society of Civil Engineers (ASCE) standard 7-16 Chapter 20 Table 20.3-1. This is based on the reviewed range of SPT (Standard Penetration Test) blow counts for the soil types in the site area. These conditions were assumed to be representative for the subsurface conditions for the site.

Design parameters

The U.S. Geological Survey (USGS) completed probabilistic seismic hazard analyses (PSHA) for the entire country in November 1996, which were updated and republished in 2002 and 2008. We used the *ATC Hazard by Location* website to estimate seismic design parameters at the site. Table 4, below, summarizes the recommended design parameters.

TABLE 3:
2018 IBC Parameters for Design of Seismic Structures

Spectral Response Acceleration (SRA) and Site Coefficients	Short Period	1 Second Period
Mapped SRA	$S_s = 1.263$	$S_1 = 0.435$
Site Coefficients (Site Class C)	$F_a = 1.2$	$F_v = 1.5$
Maximum Considered Earthquake SRA	$S_{MS} = 1.516$	$S_{M1} = 0.653$
Design SRA	$S_{DS} = 1.010$	$S_{D1} = 0.435$

Peak Ground Acceleration

The mapped peak ground acceleration (PGA) for this site is 0.5g. To account for site class, the PGA is multiplied by a site amplification factor (F_{PGA}) of 1.2. The resulting site modified peak ground acceleration (PGA_M) is 0.6g. In general, estimating seismic earth pressures (k_h) by the Mononobe-Okabe method or seismic inputs for slope stability analysis are taken as 1/3 to 1/2 of the PGA_M, or 0.2g to 0.3g.

Seismic Hazards

Earthquake-induced geologic hazards may include liquefaction, lateral spreading, slope instability, and ground surface fault rupture. Liquefaction is a phenomenon where there is a reduction or complete loss of soil strength due to an increase in pore water pressure in soils. The increase in pore water pressure is induced by seismic vibrations. Liquefaction primarily affects geologically recent deposits of loose, uniformly graded, fine-grained sands and granular silts that are below the groundwater table. The site is mapped as having a "very low" liquefaction susceptibility by the *Liquefaction Susceptibility Map of Pierce County, Washington* (2004); an excerpt of this map is included as Figure 5. The soils encountered in our explorations consisted of a relatively limited thickness of loose to medium dense silty sand and medium stiff to stiff sandy silt underlain by dense to very dense glacial till. Give the limited perched groundwater table, we anticipate that settlements caused by liquefaction would be limited to less than estimated static settlements.

The ground surface at the project site is gently sloping. Accordingly, it is our opinion the potential for earthquake-induced slope instability on the site is low. No evidence of ground fault rupture was observed in the subsurface explorations or out site reconnaissance. Therefore, in our opinion, the proposed structures should have no greater risk for ground fault rupture than other structures located in the area.

Foundation Support

Based on the encountered subsurface conditions at the locations explored and the preliminary building plans, we recommend that spread footings be founded on the medium dense to very dense native glacial soils, or on structural fill that extends to suitable native soils. Based on our understanding of the proposed locations of the structures, it is our opinion that shallow foundations may be used to support the buildings; however, considerations for uncontrolled fill and loose to medium stiff native soils should be made. We have not been provided with the design loads and have assumed the structures will be lightly loaded based on our experience with similar projects.

Complete Fill Removal

Uncontrolled fill soils and soft silt deposits encountered in the lower, western portion of the site are not a suitable bearing soil for the proposed footings. Any known locations of uncontrolled fill or uncontrolled filled encountered during grading should be removed from the building envelopes of the proposed structures. Soft silt soils in the western portion of the site can likely be mitigated through grading and placement of structural fill.

We recommend that all footing elements be supported by a minimum of 2 feet of properly placed structural fill. In areas where deeper fill removal is required the foundation elements may be deepened to extend to the base of the excavation, or the excavation may be backfilled with structural fill. After removal of the fill materials, the exposed surface should be evaluated prior to placing structural fill.

Spread Footing design

Footings should bear on properly placed and compacted structural fill as discussed in the "Complete Fill Removal" section, above. Removal of unsuitable soils below the footings should extend beyond the foundation edges 1-foot horizontally for every 1-foot of vertical excavation. Loose, soft, or other unsuitable material present at the base of the excavation should be removed prior to placement of structural fill. The soil at the base of the excavations should be protected against disturbance from weather, traffic, or other adverse conditions. The excavation should be backfilled with suitable materials as described in the **"Structural Fill"** section of this report. If Control Density Fill (CDF) is used as backfill, the horizontal extent of the excavation can be limited to 1H:2V on each side of the footing.

We recommend a minimum width of 24 inches for isolated footings and at least 18 inches for continuous wall footings. All footing elements should be embedded at least 18 inches below grade for frost protection. For footing bearing surfaces prepared as described in the "Complete Fill Removal" we recommend using an allowable soil bearing capacity of 2,000 psf (pounds per square foot) for design.nnThese values are for combined dead and long-term live loads. The weight of the footing and any overlying backfill may be neglected. The allowable bearing value may be increased by one-third for transient loads such as those induced by seismic events or wind loads.

Lateral loads may be resisted by friction on the base of footings and floor slabs and as passive pressure on the sides of footings. We recommend that an allowable coefficient of friction of 0.35 be used to calculate friction between the concrete and the underlying structural fill. Passive pressure may be determined using an allowable equivalent fluid density of 300 pcf (pounds per cubic foot). Factors of safety have been applied to these values.

We estimate that settlements of footings designed and constructed as recommended will be less than 1 inch, for the anticipated load conditions, with differential settlements between comparably loaded footings of ½ inch or less. Most of the settlements should occur essentially as loads are being applied; however, disturbance of the foundation subgrade during construction could result in larger settlements than estimated.

Floor Slab Support

We anticipate that the lower level of the structures will consist of a slab-on-grade floor. Slab-on-grade floors should be supported on medium dense native soils or on structural fill prepared as described above. Areas of uncontrolled fill material should be evaluated during grading activity for suitability of structural support. Areas of significant organic debris should be removed.

We recommend that floor slabs be directly underlain by a minimum 4-inch thick pea gravel or washed 5/8-inch crushed rock and should contain less than 5 percent fines. This layer should be placed and compacted to an unyielding condition.

A synthetic vapor retarder is recommended to control moisture migration through the slabs. This is of particular importance where moisture migration through the slab is an issue, such as where adhesives are used to anchor carpet or tile to the slab.

A subgrade modulus of 350 kcf (kips per cubic foot) may be used for floor slab design. We estimate that settlement of the floor slabs designed and constructed as recommended, will be 1/2 inch or less over a span of 50 feet.

Subgrade/Basement Walls

The lateral pressures acting on retaining walls (such as basement or grade separation walls) will depend upon the nature and density of the soil behind the wall as well as the presence or absence of hydrostatic pressure. Below we provide recommended design values and drainage recommendations for retaining walls.

Design Values

For walls backfilled with granular well-drained soil and a level backslope, the design active pressure may be taken as 35 pcf (equivalent fluid density). For walls that are braced or otherwise restrained, the design at-rest pressure may be taken as 55 pcf. For the condition of an inclined back slope, higher lateral pressures would act on the walls. For a 3H:1V (Horizontal to Vertical) slope above the wall, the pressure may be taken as 35 pcf (equivalent fluid density). For walls that are braced or otherwise active pressure may be taken as 48 pcf; for a 2H:1V back slope condition, a wall design pressures of 55 pcf may be assumed If basement walls taller than 6 feet are required, as seismic surcharge of 12H should be included where required by the code. If walls will be constructed with a backslope and will be braced or otherwise restrained against movement, we should be notified so that we can evaluate the anticipated conditions and recommend an appropriate at-rest earth pressure.

Lateral loads may be resisted by friction on the base of footings and as passive pressure on the sides of footings and the buried portion of the wall, as described in the "**Foundation Support**" section of this report.

Wall Drainage

Adequate drainage behind retaining structures is imperative. Positive drainage which controls the development of hydrostatic pressure can be accomplished by placing a zone of drainage behind the walls. Granular drainage material should contain less than 2 percent fines and at least 30 percent retained on the US No. 4 sieve.

A minimum 4 inch diameter perforated or slotted PVC pipe should be placed in the drainage zone along the base and behind the wall to provide an outlet for accumulated water and direct accumulated water to an appropriate discharge location. We recommend that a nonwoven geotextile filter fabric be placed between the soil drainage material and the remaining wall backfill to reduce silt migration into the drainage zone. The infiltration of silt into the drainage zone can, with time, reduce the permeability of the granular material. The filter fabric should be placed such that it fully separates the drainage material and the backfill, and should be extended over the top of the drainage zone.

A soil drainage zone should extend horizontally at least 18 inches from the back of the wall. The drainage zone should also extend from the base of the wall to within 1 foot of the top of the wall. The soil drainage zone should be compacted to approximately 90 percent of the maximum dry density (MDD), as determined in accordance with ASTM D: 1557. Over-compaction should be avoided as this can lead to excessive lateral pressures on the wall. A geocomposite drain mat may also be used instead of free draining soils, provided it is installed in accordance with the manufacturer's instructions.

Below Grade Vaults

The proposed below grade vault should be designed to resist the static and dynamic lateral earth pressures presented in the **"Subgrade/Basement Walls"** section of this report. We recommend the proposed vault be completely waterproofed (exterior of foundation walls and underside of slab) to prevent water intrusion. The walls and floor slabs associated with these structures should be designed to resist the lateral and uplift forces associated with maximum estimated seasonal high groundwater levels. We recommend using a soil unit weight of 130 pcf to calculate vertical forces acting on the vault lid, base extensions, or anti-flotation slabs.

Temporary Excavations

All job site safety issues and precautions are the responsibility of the contractor providing services/work. The following cut/fill slope guidelines are provided for planning purposes only. Temporary cut slopes will likely be necessary during grading operations or utility installation. All excavations at the site associated with confined spaces, such as utility trenches and retaining walls, must be completed in accordance with local, state, or federal requirements including Washington Administrative Code (WAC) and Washington Industrial Safety and Health Administration (WISHA). Excavation, trenching, and shoring is covered under WAC 296-155 Part N.

Based on WAC 296-155-66401, it is our opinion that the glaciolacustrine recessional outwash soils on the site would be classified as Type C soils, while the underlying glacial till would be classified as Type A soils. For temporary excavations of less than 20 feet in depth, the side slopes in Type C soils should be sloped at a maximum inclination of 1½ H:1V or flatter from the toe to top of the slope; while side slopes in Type A soils should be sloped at a maximum inclination of ¾H:1V or flatter from the toe to top of the slope. All exposed slope faces should be covered with a durable reinforced plastic membrane during construction to prevent slope raveling and rutting during periods of precipitation. These guidelines assume that all surface loads are kept at a minimum distance of at least one half the depth of the cut away from the top of the slope and that significant seepage is not present on the slope face. Flatter cut slopes will be necessary where significant raveling or seepage occurs, if construction materials will be stockpiled along the slope crest, or if construction traffic will be routed along the slope crest.

Where it is not feasible to slope the site soils back at these inclinations, shoring will be required. All shoring for the project should incorporate applicable criteria presented in the **"Subgrade/Basement Walls"** section of this report into the design. Settlement of the ground surface can occur behind shoring during excavation. The amount of settlement depends heavily on the type of shoring system, the contractor's workmanship, and soil conditions. Accordingly, we recommend that structures in the vicinity of the planned shoring installation be reviewed with regard to foundation support and tolerance to settlement.

This information is provided solely for the benefit of the owner and other design consultants, and should not be construed to imply that GeoResources, LLC assumes responsibility for job site safety. It is understood that job site safety is the sole responsibility of the project contractor..

Permanent Cut and Fill Slopes

We do not anticipate that permanent cut and fill slopes will be utilized for this project. However, if cut and fill slopes are required, we recommend a maximum slope of 2H:1V (Horizontal:Vertical) for permanent cut and fill slopes. Where 2H:1V slopes are not feasible, retaining structures should be considered. Where retaining structures are greater than 4 feet in height (bottom of footing to top of structure) or have slopes of greater than 15 percent above them, they should be designed by a qualified engineer.

Fill slopes constructed on grades that are steeper than 5H:1V (20 percent) should be "keyed" into the undisturbed native soils by cutting a series of horizontal benches and should be constructed in accordance with Appendix J of the 2018 IBC. The benches should be 1½ times the width of the equipment used for grading and be a maximum of 3 feet in height. Subsurface drainage may be required in areas where significant seepage is encountered during grading. Collected drainage should be directed to an appropriate discharge point.

Site Drainage

All ground surfaces, pavements and sidewalks at the site should be sloped to direct surface water away from the structures and property lines. Surface water runoff should be controlled by a system of curbs, berms, drainage swales, and or catch basins, and conveyed to an appropriate discharge point.

We recommend that footing drains are installed for the residence in accordance with IBC 1805.4.2, and basement walls (if utilized) have a wall drain as describe above. The roof drain should not be connected to the footing drain.

Stormwater Infiltration

In the following sections we provide an opinion regarding the feasibility of infiltration, and construction considerations.

Infiltration Feasibility

Based on our observations, laboratory testing, in-situ infiltration testing, and experience, it is our opinion that the soils at the site will not support on-site infiltration. On December 22, 2021, we completed a small-scale pilot infiltration test (PIT) in the lower, western portion of the site in accordance with method outlined by the current Stormwater Management Manual for Western Washington. The results of our PIT indicated the saturated hydraulic conductivity of the soils was less than 0.1 inches per hour, below the infeasibility threshold for infiltration facilities. Accordingly, we recommend that alternative stormwater management methods are used.

Construction Considerations

To reduce potential clogging of stormwater facilities, they should not be connected to the stormwater runoff system until after construction is complete and the site area is landscaped, paved or otherwise protected. Additional measures may also be taken during construction to minimize the potential of fines contamination of the proposed stormwater facility, such as utilizing an alternative storm water management location during construction. All contractors working on the site (builders and subcontractors) should divert sediment laden stormwater away from proposed infiltration facilities during construction and landscaping activities. No concrete trucks should be washed or cleaned, and washout areas should not be within the vicinity of the proposed infiltration facilities. After construction activities have been completed, periodic sweeping of the paved areas will help extend the life of the stormwater facility.

Pavement Section Design

We understand that several pavement sections may be used for the onsite portion of the development, including hot mix asphalt (HMA) pavement sections in the passenger car parking stalls, passenger car drive lanes, and either HMA or Portland cement concrete (PCC) pavement in emergency vehicle or truck areas.

Pavement Subgrades

Pavement subgrade areas should be prepared by removing any soft or deleterious material down to firm and unyielding soils in accordance with the "**Site Preparation**" section of this report. The prepared subgrade should be evaluated by proof-rolling with a fully-loaded dump truck or equivalent point load equipment. Soft, loose, or wet areas that are identified should be recompacted or removed, as appropriate. Over-excavated areas should be backfilled with compacted structural fill. Where fill is placed, the upper 2 feet of roadway subgrade should have a maximum dry density of at least 95 percent, as determined in accordance with the ASTM D: 1557.

Pavement Sections

Pavement section thicknesses should conform to appropriate minimum sections provided in the most current City of Puyallup *Public Works Engineering & Construction Standards*, Section 100 for roadway design.

Pavement Frost Conditions

Frost-susceptible soil is generally regarded as having greater than 3 percent finer than 0.02 millimeter (mm). Soil with a fines content not exceeding 7 percent passing the No. 200 sieve, based on the minus ¾-inch fraction, can normally be expected to have 3 percent or less finer than 0.02 mm. Based on the soils observed during our construction monitoring, most of the near-surface soils could be considered frost-susceptible. Based on information provided in the WSDOT Pavement Policy, we recommend assuming the frost depth would be about 18 inches. For both rigid and flexible pavements, WSDOT recommends that the total depth of the pavement section be at least 50 percent of the frost depth.

Pavement Materials and Construction

In general, the aggregate base course, HMA, and PCC should be constructed in accordance with the most current City of Puyallup *Public Works Engineering & Construction Standards*, Section 100 for roadway design. Where not covered by Section 100, we recommend defaulting to WSDOT Standard Specifications for Road, Bridge, and Municipal Construction (WSDOT Standard Specifications, 2016). HMA should conform to Section 5-04 in the WSDOT Standard Specifications and the PCC should conform to Section 5-05 of the WSDOT Standard Specifications. We recommend that crushed rock used as CSBC in pavement sections consist of material of approximately the same quality as "crushed surfacing (base course)" (or better) described in Section 9-03.9(3) of the WSDOT Standard Specifications. We further recommend that CSBC material be compacted to at least 95 percent of the MDD based on the modified Proctor procedure (ASTM D;1577).

EARTHWORK RECOMMENDATIONS

Site Preparation

All structural areas on the site to be graded should be stripped of vegetation, organic surface soils, and other deleterious materials including existing structures, foundations or abandoned utility lines. Organic topsoil is not suitable for use as structural fill, but may be used for limited depths in non-structural areas. Stripping depths ranging from 4 to 12 inches should be expected to remove these unsuitable soils. Areas of thicker topsoil or organic debris may be encountered in areas of heavy vegetation or depressions.

Where placement of fill material is required, the stripped/exposed subgrade areas should be compacted to a firm and unyielding surface prior to placement of any fill. Excavations for debris removal should be backfilled with structural fill compacted to the densities described in the "**Structural Fill**" section of this report.

We recommend that a member of our staff evaluate the exposed subgrade conditions after removal of vegetation and topsoil stripping is completed and prior to placement of structural fill. The exposed subgrade soil should be proof-rolled with heavy rubber-tired equipment during dry weather or probed with a 1/2-inch-diameter steel rod during wet weather conditions.

Soft, loose, or otherwise unsuitable areas delineated during proofrolling or probing should be recompacted, if practical, or over-excavated and replaced with structural fill. The depth and extent of overexcavation should be evaluated by our field representative at the time of construction. The areas of old fill material should be evaluated during grading operations to determine if they need mitigation; recompaction or removal.

Structural Fill

All material placed as fill associated with mass grading, as utility trench backfill, under building areas, or under roadways should be placed as structural fill. The structural fill should be placed in horizontal lifts of appropriate thickness to allow adequate and uniform compaction of each lift. Structural fill should be compacted to at least 95 percent of MDD (maximum dry density as determined in accordance with ASTM D: 1557).

The appropriate lift thickness will depend on the structural fill characteristics and compaction equipment used. We recommend that the appropriate lift thickness be evaluated by our field representative during construction. We recommend that our representative be present during site grading activities to observe the work and perform field density tests.

The suitability of material for use as structural fill will depend on the gradation and moisture content of the soil. As the amount of fines (material passing US No. 200 sieve) increases, soil becomes increasingly sensitive to small changes in moisture content and adequate compaction becomes more difficult to achieve. During wet weather, we recommend use of well-graded sand and gravel with less than 5 percent (by weight) passing the US No. 200 sieve based on that fraction passing the 3/4-inch sieve, such as *Gravel Backfill for Walls* (WSDOT 9-03.12(2)). If prolonged dry weather prevails during the earthwork and foundation installation phase of construction, higher fines content (up to 10 to 12 percent) may be acceptable.

Material placed for structural fill should be free of debris, organic matter, trash and cobbles greater than 6-inches in diameter. The moisture content of the fill material should be adjusted as necessary for proper compaction.

Suitability of On-Site Materials as Fill

During dry weather construction, the non-organic, granular on-site soil may be considered for use as structural fill; provided it meets the criteria described above in the "**Structural Fill"** section and can be compacted as recommended. If the soil material is over-optimum in moisture content when excavated, it will be necessary to aerate or dry the soil prior to placement as structural fill. We generally did not observe the site soils to be excessively moist at the time of our subsurface exploration program.

The uncontroleld fill encountered at shallow depths consist of a mixture of sand, silt, and gravel with debris. We do not anticipate that these soils will be suitable for use as structural fill because of their fines content and the presence of debris. The deeper glacial till is generally comparable to "common borrow" material and will be suitable for use as structural fill provided the moisture content is maintained within 2 percent of the optimum moisture level.

We recommend that completed graded-areas be restricted from traffic or protected prior to wet weather conditions. The graded areas may be protected by paving, placing asphalt-treated base, a layer of free-draining material such as pit run sand and gravel or clean crushed rock material containing less than 5 percent fines, or some combination of the above.

Erosion Control

Weathering, erosion and the resulting surficial sloughing and shallow land sliding are natural processes. As noted, no evidence of surficial raveling or sloughing was observed at the site. To manage and reduce the potential for these natural processes, we recommend erosion protection measures will need to be in place prior to grading activity on the site. Erosion hazards can be mitigated by applying Best Management Practices (BMP's) outlined in the current Stormware *Management Manual for Western Washington.* These may include, but are not limited to silt fence per BMP C233, straw wattles per BMP C235, temporary and permanent seeding per BMP C120, and mulch per BMP C121.

Wet Weather and Wet Condition Considerations

In the Puget Sound area, wet weather generally begins about mid-October and continues through about May, although rainy periods could occur at any time of year. Therefore, it is strongly encouraged that earthwork be scheduled during the dry weather months of June through September. Most of the soil at the site contains sufficient fines to produce an unstable mixture when wet. Such soil is highly susceptible to changes in water content and tends to become unstable and impossible to proof-roll and compact if the moisture content exceeds the optimum.

In addition, during wet weather months, the groundwater levels could increase, resulting in seepage into site excavations. Performing earthwork during dry weather would reduce these problems and costs associated with rainwater, construction traffic, and handling of wet soil. However, should wet weather/wet condition earthwork be unavoidable, the following recommendations are provided:

- The ground surface in and surrounding the construction area should be sloped as much as possible to promote runoff of precipitation away from work areas and to prevent ponding of water.
- Work areas or slopes should be covered with plastic when not being worked. The use of sloping, ditching, sumps, dewatering, and other measures should be employed as necessary to permit proper completion of the work.
- Earthwork should be accomplished in small sections to minimize exposure to wet conditions. That is, each section should be small enough so that the removal of unsuitable soils and placement and compaction of clean structural fill could be accomplished on the same day. The size of construction equipment may have to be limited to prevent soil disturbance. It may be necessary to excavate soils with a backhoe, or equivalent, and locate them so that equipment does not pass over the excavated area. Thus, subgrade disturbance caused by equipment traffic would be minimized.
- Fill material should consist of clean, well-graded, sand and gravel, of which not more than 5 percent fines by dry weight passes the No. 200 mesh sieve, based on wet-sieving the fraction passing the ¾-inch mesh sieve. The gravel content should range from between 20 and 50 percent retained on a No. 4 mesh sieve. The fines should be non-plastic.
- No exposed soil should be left uncompacted and exposed to moisture. A smooth-drum vibratory roller, or equivalent, should roll the surface to seal out as much water as possible.
- In-place soil or fill soil that becomes wet and unstable and/or too wet to suitably compact should be removed and replaced with clean, granular soil (see gradation requirements above).
- Excavation and placement of structural fill material should be observed on a full-time basis by a geotechnical engineer (or representative) experienced in wet weather/wet condition earthwork to determine that all work is being accomplished in accordance with the project specifications and our recommendations.
- Grading and earthwork should not be accomplished during periods of heavy, continuous rainfall.

We recommend that the above requirements for wet weather/wet condition earthwork be incorporated into the contract specifications.

LIMITATIONS

We have prepared this report for use by Bradley Heights SS, LLC and other members of the design team, for use in the design of a portion of this project. The data used in preparing this report and this report should be provided to prospective contractors for their bidding or estimating purposes only. Our report, conclusions and interpretations are based on our subsurface explorations, data from others and limited site reconnaissance, and should not be construed as a warranty of the subsurface conditions.

Variations in subsurface conditions are possible between the explorations and may also occur with time. A contingency for unanticipated conditions should be included in the budget and schedule. Sufficient monitoring, testing and consultation should be provided by our firm during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork and foundation installation activities comply with contract plans and specifications.

The scope of our services does not include services related to environmental remediation and construction safety precautions. Our recommendations are not intended to direct the contractor's methods, techniques, sequences or procedures, except as specifically described in our report for consideration in design.

If there are any changes in the loads, grades, locations, configurations or type of facilities to be constructed, the conclusions and recommendations presented in this report may not be fully applicable. If such changes are made, we should be given the opportunity to review our recommendations and provide written modifications or verifications, as appropriate.

◆ ◆ ◆

We have appreciated the opportunity to be of service to you on this project. If you have any questions or comments, please do not hesitate to call at your earliest convenience.

Respectfully submitted,
GeoResources, LLC

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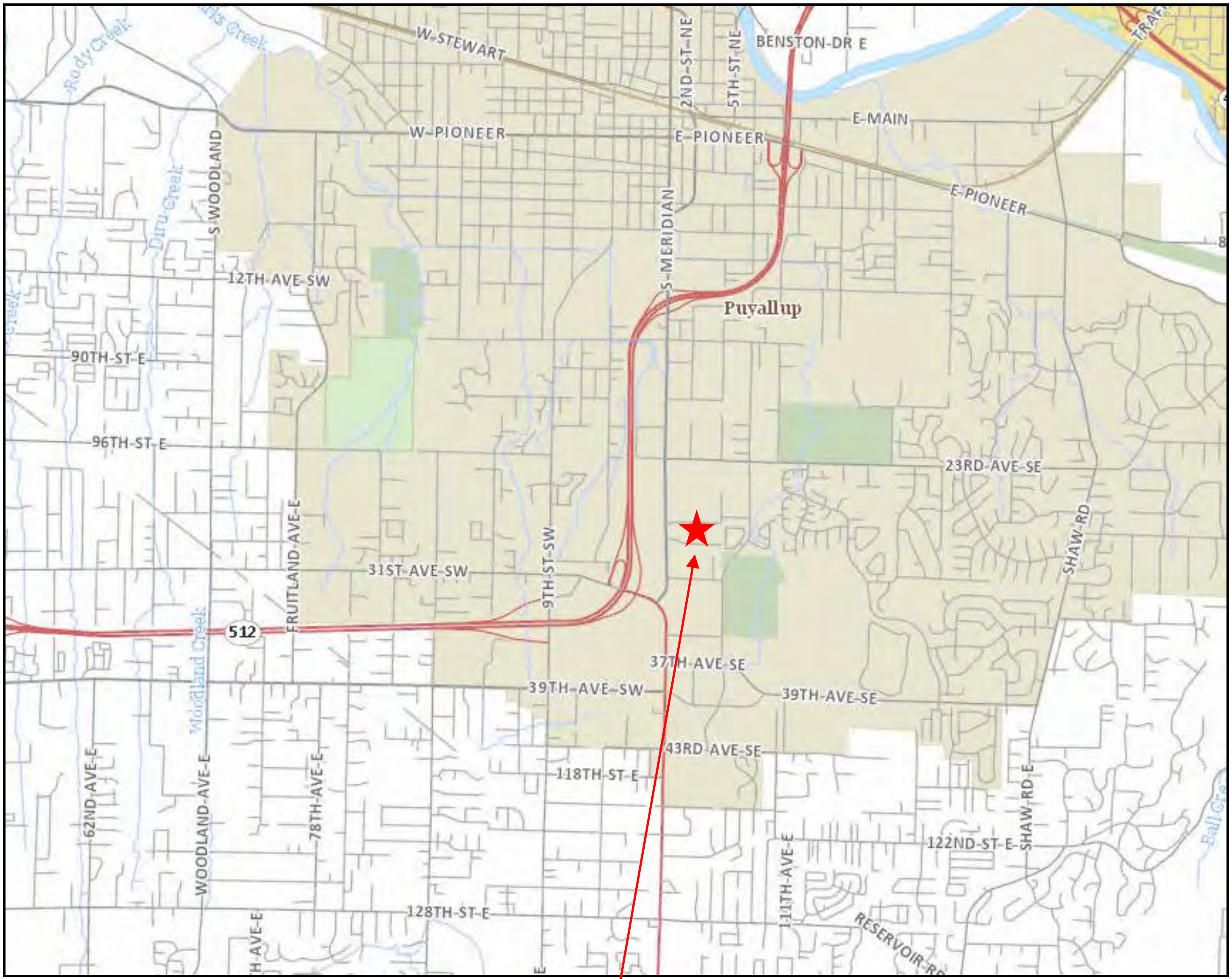
Attachments:	Figure 1: Site Location Map
	Figure 2: Site & Exploration Plan
	Figure 3: NRCS Soils Map
	Figure 4: Geologic Map
	Figure 5: Liquefaction Hazard Map
	Appendix "A" - Subsurface Explorations
	Appendix "B" - Laboratory Test results
	Appendix "C" – Groundwater Monitoring Data



Approximate Site Location

Map created from Pierce County Public GIS (https://matterhornwab.co.pierce.wa.us/publicgis/)

N
W E
S

Not to Scale

GEORESOURCES
earth science & geotechnical engineering
4809 Pacific Hwy. E. | Fife, WA 98424 | 253.896.1011 | www.georesources.rocks

Site Location Map

Proposed Multi-Family Development
202-27th Avenue SE
Pierce County, Washington
PN: 00419036006

DocID: Timberlane.BradleyHeights.F	February 2022	Figure 1

Conceptual site plan provided by Azure Green Consultants

⊕ Number and approximate location of borings (1/24/20)

▦ Number and approximate location of test pits (excavated 3/21/2018 & 12/22/21)

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Site and Exploration Plan

Proposed Multifamily Redevelopment
202 – 27th Ave SE
Puyallup, Washington

Doc:ID: Timberlane.BradleyHeights.F2.1	February 2022	Figure 2

Approximate Site Location

Map created from Web Soil Survey (http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx)

Soil Type	Soil Name	Parent Material	Slopes	Erosion Hazard	Hydrologic Soils Group
13B	Everett very gravelly sandy loam	Sandy and gravelly glacial outwash	0 to 8	Slight	A
13C			8 to 15	Moderate	
20B	Kitsap silt loam	Glaciolacustrine deposits	2 to 8	Slight to moderate	C/D

Not to Scale

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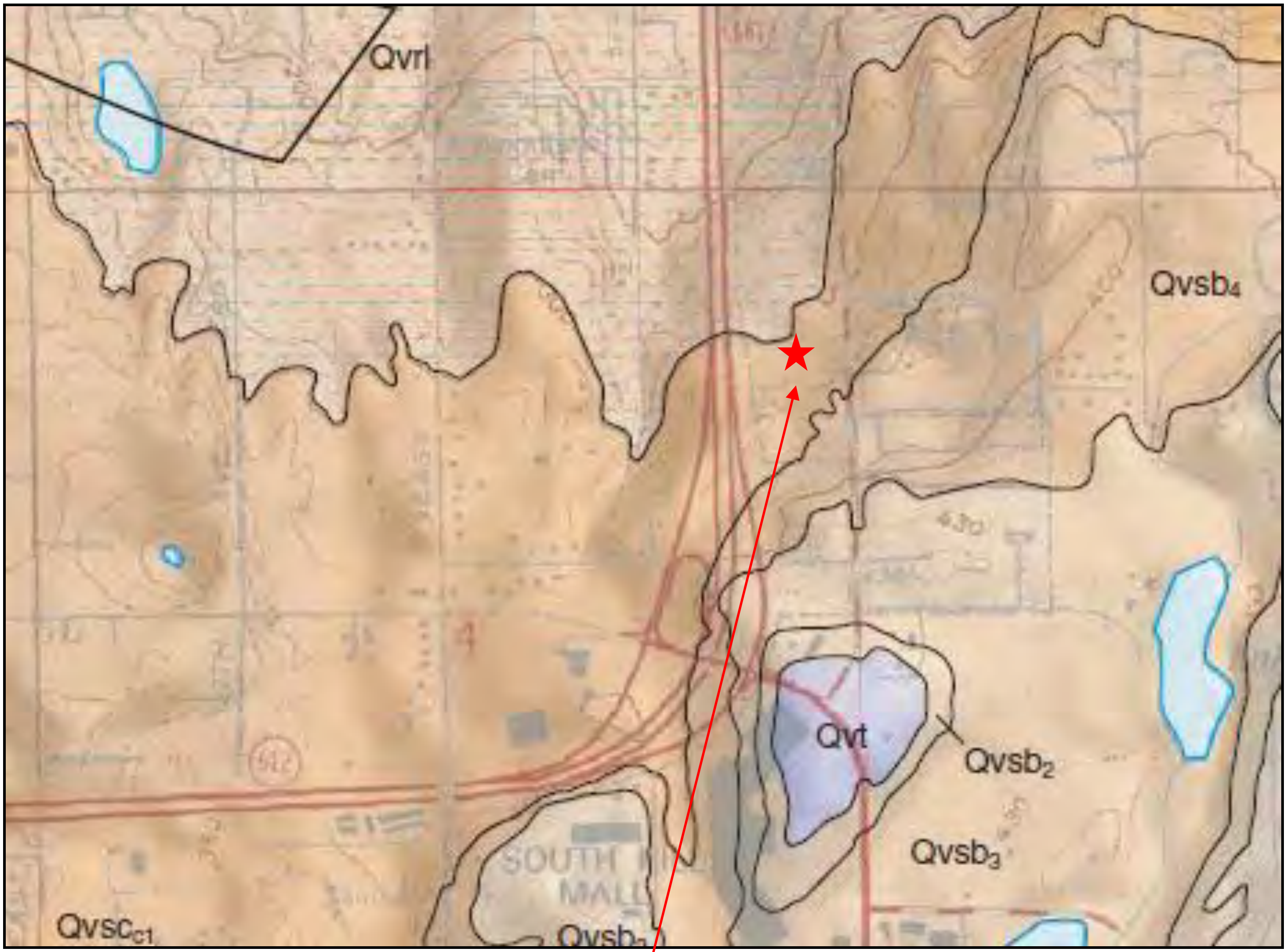
NRCS Soils Map

Proposed Multi-Family Development
202-27th Avenue SE
Pierce County, Washington
PN: 00419036006

DocID: Timberlane.BradleyHeights.F	February 2022	Figure 3



Approximate Site Location

An excerpt from *the draft Geologic Map of the Puyallup 7.5-minute Quadrangle, Washington*, by Troost, K.G.

Qvrl	Recessional Lacustrine Deposits
$Qvsc_{C1}$	Steilacoom gravel-Clover Creek Channel
$Qvsb_4$	Vashon recessional outwash-Bradley Channel

Not to Scale

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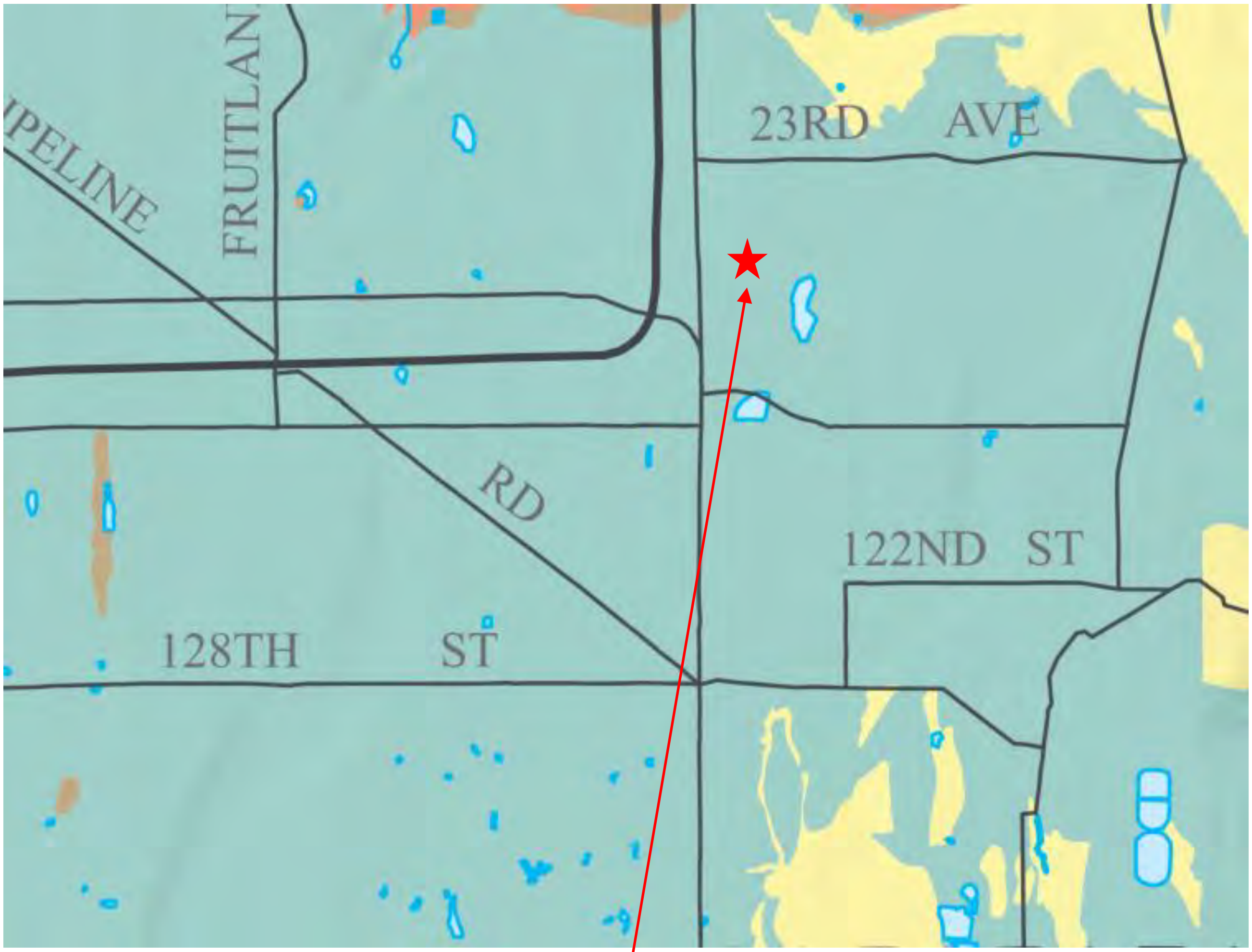
Geologic Map

Proposed Multi-Family Development
202-27th Avenue SE
Pierce County, Washington
PN: 00419036006

DocID: Timberlane.BradleyHeights.F	February 2022	Figure 4



Approximate Site Location

An excerpt from *the Liquefaction Susceptibility Map of Pierce County, Washington* by Palmer et Al. (2004)

🟥 Liquefaction susceptibility: HIGH
🟧 Liquefaction susceptibility: MODERATE to HIGH
🟧 Liquefaction susceptibility: MODERATE
🟨 Liquefaction susceptibility: LOW to MODERATE
🟩 Liquefaction susceptibility: LOW
🟩 Liquefaction susceptibility: VERY LOW to LOW
🟦 Liquefaction susceptibility: VERY LOW
⬜ Bedrock

N
W E
S

Not to Scale

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Geologic Map

Proposed Multi-Family Development
202-27th Avenue SE
Pierce County, Washington
PN: 00419036006

DocID: Timberlane.BradleyHeights.F	February 2022	Figure 4

Appendix A

Subsurface Explorations

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE GRAINED SOILS More than 50% Retained on No. 200 Sieve	GRAVEL More than 50% Of Coarse Fraction Retained on No. 4 Sieve	CLEAN GRAVEL	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND More than 50% Of Coarse Fraction Passes No. 4 Sieve	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY-GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% Passes No. 200 Sieve	SILT AND CLAY Liquid Limit Less than 50	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY Liquid Limit 50 or more	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

1. Field classification is based on visual examination of soil in general accordance with ASTM D2488-90.
2. Soil classification using laboratory tests is based on ASTM D6913.
3. Description of soil density or consistency are based on interpretation of blow count data, visual appearance of soils, and or test data.

SOIL MOISTURE MODIFIERS:

Dry-	Absence of moisture, dry to the touch
Moist-	Damp, but no visible water
Wet-	Visible free water or saturated, usually soil is obtained from below water table

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Unified Soils Classification System

Proposed Multi-Family Development
202-27th Avenue SE
Pierce County, Washington
PN: 00419036006

DocID: Timberlane.BradleyHeights.F | February 2022 | Figure A-1

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LOG OF BORING MW-1

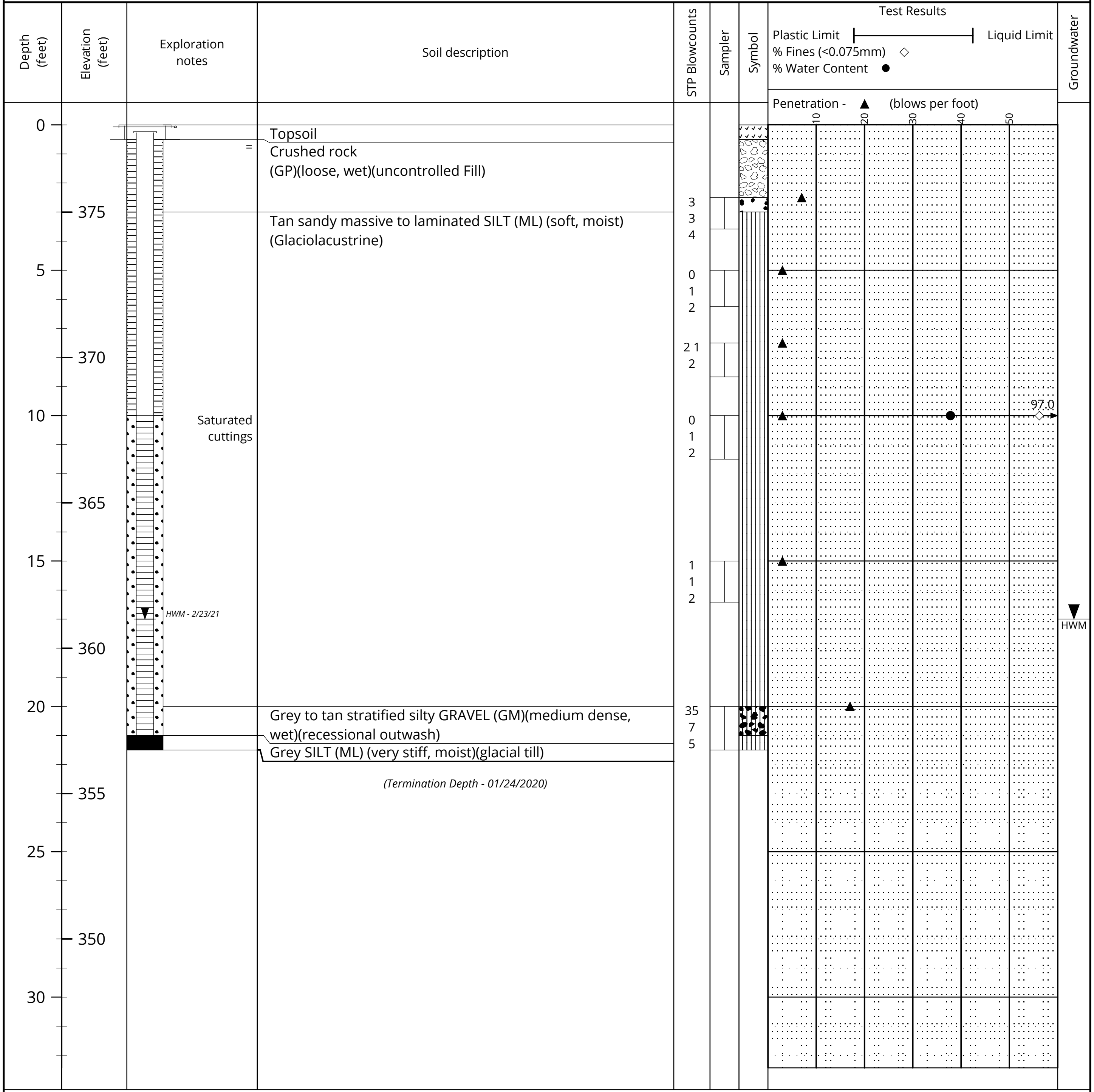
Proposed Multi-Family Development
202 - 27th Avenue Southwest
Puyallup, WA

1. Refer to log key for definition of symbols, abbreviations, and codes
2. USCS disination is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. NE = Not Encountered
5. ATD = At Time of Drilling
6. HWM = Highest Groundwater Level

Notes:

Drilling Company: Holocene
Drilling Method: HSA
Drilling Rig: D-50
Sampler Type: 2-inch OD Split spoon
Hammer Type: Auto
Hammer Weight: 140 lbs

Logged By: EJF
Drilling Date: 01/24/2020
Datum: NAVD 88
Elevation: 378 feet
Termination Depth: 21.5
Latitude:
Longitude:



Depth (feet)	Soil description	STP Blowcounts
0	Topsoil	
	Crushed rock (GP)(loose, wet)(uncontrolled Fill)	3 3 4
3	Tan sandy massive to laminated SILT (ML) (soft, moist) (Glaciolacustrine)	0 1 2
		2 1 2
		0 1 2
		1 1 2
20	Grey to tan stratified silty GRAVEL (GM)(medium dense, wet)(recessional outwash)	35 7 5
	Grey SILT (ML) (very stiff, moist)(glacial till)	

(Termination Depth - 01/24/2020)

■ Paving ▨ Gravel frac ▥ Silty sand ▩ Poorly graded GRAVEL with silt ▩ Silty gravel ▒ Topsoil

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LOG OF BORING MW-2

Proposed Multi-Family Development
202 - 27th Avenue Southwest
Puyallup, WA

1. **Refer to log key for definition of symbols, abbreviations, and codes**
2. **USCS disination is based on visual manual classification and selected lab testing**
3. **Groundwater level, if indicated, is for the date shown and may vary**
4. **NE = Not Encountered**
5. **ATD = At Time of Drilling**
6. **HWM = Highest Groundwater Level**

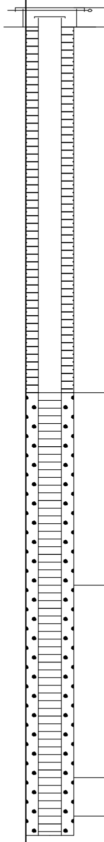
Drilling Company: Holocene
Drilling Method: HSA
Drilling Rig: Track
Sampler Type: Cathead?
Hammer Type:
Hammer Weight: 140 lbs

Logged By: EJF
Drilling Date: 01/24/2020
Datum: NAVD 88
Elevation: 400 feet
Termination Depth: 21
Latitude:
Longitude:

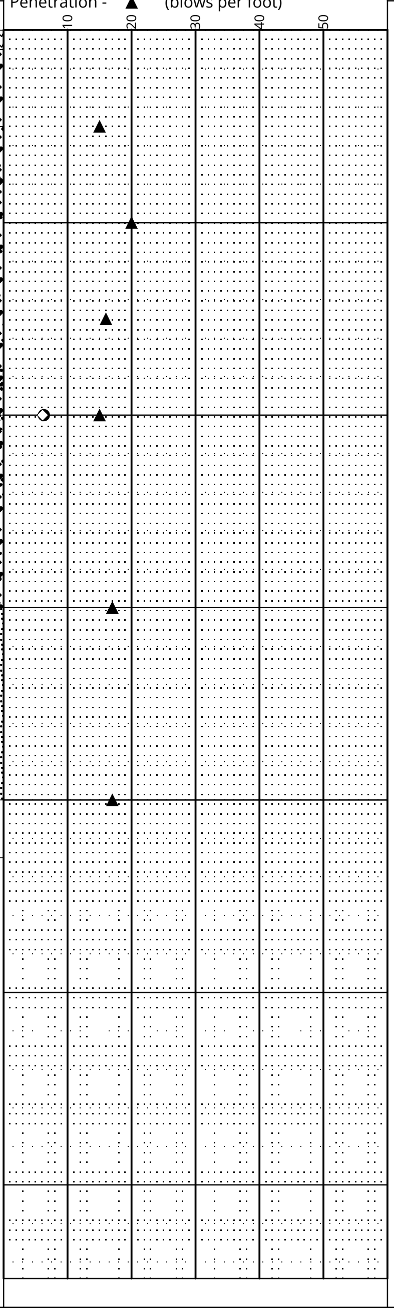
Notes:

Depth (feet)	Elevation (feet)	Soil description	STP Blowcounts
0	400	Topsoil	
		Tan well-graded GRAVEL with silt and sand (GW-GM) (moist to wet, medium dense) (Recessional Outwash)	
			8 9 6
5	395		12 12 8
			13 8 8
10	390	Tan well-graded sandy GRAVEL with silt (GW-GM), lightly stratified (moist, medium dense)	12 5 10
15	385	Tan SAND (SP) (medium dense, moist)(recessional outwash)	11 11 6
20	380	Grey, mottled SILT (ML)(very stiff, moist)(Glacial till)	4 7 10
25	375		
30	370		

(Termination Depth - 01/24/2020)



Test Results
Plastic Limit ├──┤ Liquid Limit
% Fines (<0.075mm) ◇
% Water Content ●
Penetration - ▲ (blows per foot)



■ Paving	▨ Gravel frac	▥ Silty sand	▦ Poorly graded GRAVEL with silt	▦ Silty gravel	▨ Topsoil

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LOG OF BORING MW-3

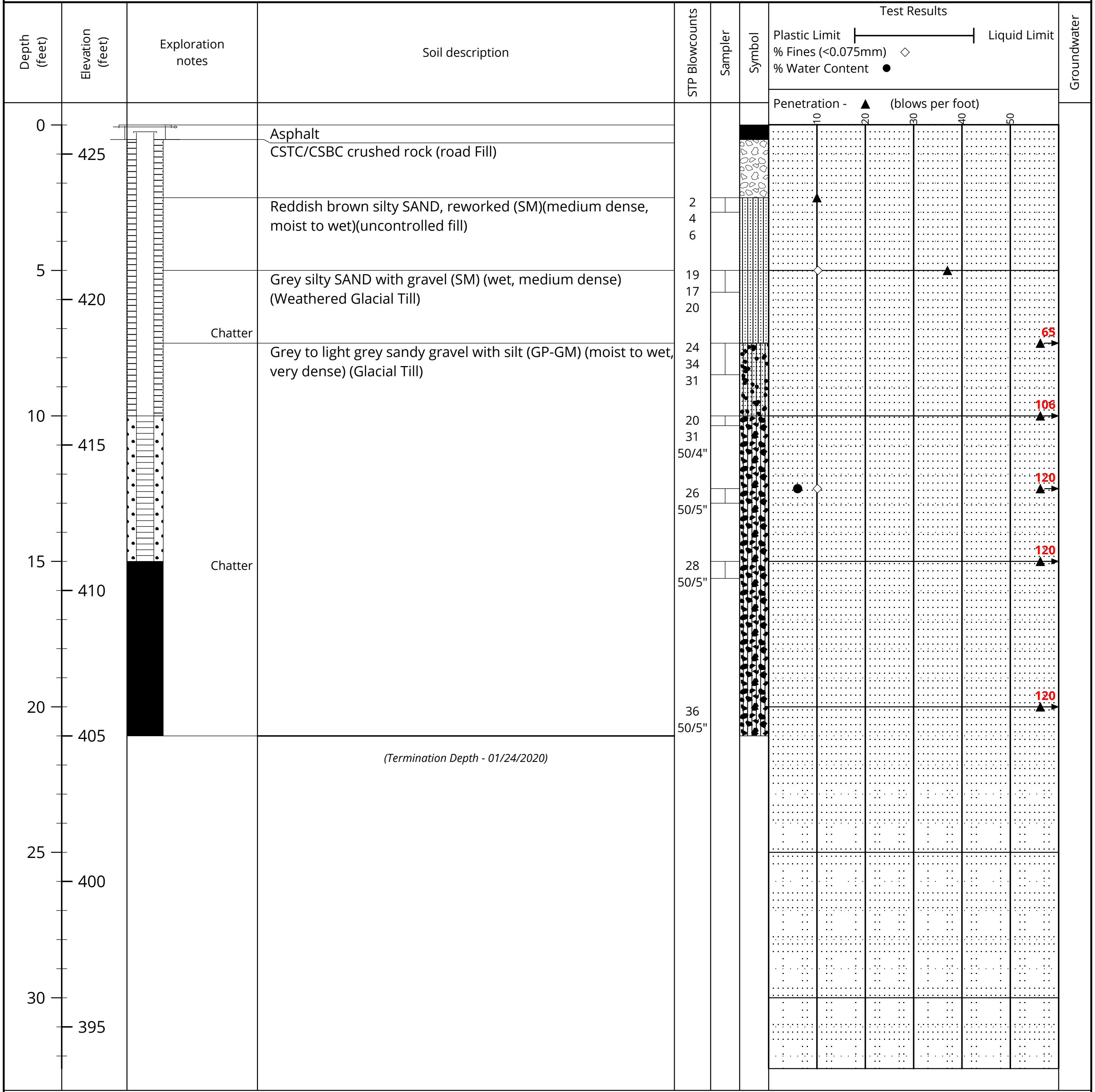
Proposed Multi-Family Development
202 - 27th Avenue Southwest
Puyallup, WA

1. Refer to log key for definition of symbols, abbreviations, and codes
2. USCS disination is based on visual manual classification and selected lab testing
3. Groundwater level, if indicated, is for the date shown and may vary
4. NE = Not Encountered
5. ATD = At Time of Drilling
6. HWM = Highest Groundwater Level

Drilling Company: Holocene
Drilling Method: HSA
Drilling Rig: Track
Sampler Type: Cathead?
Hammer Type:
Hammer Weight: 140 lbs

Logged By: EJF
Drilling Date: 01/24/2020
Datum: NAVD 88
Elevation: 426 feet
Termination Depth: 21
Latitude:
Longitude:

Notes:



Exploration notes	Soil description	STP Blowcounts
	Asphalt	
	CSTC/CSBC crushed rock (road Fill)	
	Reddish brown silty SAND, reworked (SM)(medium dense, moist to wet)(uncontrolled fill)	2 4 6
Chatter	Grey silty SAND with gravel (SM) (wet, medium dense) (Weathered Glacial Till)	19 17 20
	Grey to light grey sandy gravel with silt (GP-GM) (moist to wet, very dense) (Glacial Till)	24 34 31
		20 31 50/4"
		26 50/5"
Chatter		28 50/5"
		36 50/5"

(Termination Depth - 01/24/2020)

■	Paving	▨	Gravel frac	▥	Silty sand	▩	Poorly graded GRAVEL with silt	▩	Silty gravel

Test Pit TP-101

Location: central-western portion of property
Approximate Elevation: 388 feet (NAVD 88)

Depth (ft)	Soil Type	Soil Description
0 - ¼	-	Topsoil
¼ - 1½	SM	Brown silty sand (medium dense, moist) (weathered till)
1½ - 9½	SM	Grey silty sand (dense to very dense, moist) (glacial till)

Terminated at 9½ feet below ground surface.
No caving was observed at time of excavation.
Mottling was observed at 1½ feet below ground surface.

Test Pit TP-102/PIT-1

Location: Northwestern portion of property
Approximate Elevation: 378 feet (NAVD 88)

Depth (ft)	Soil Type	Soil Description
0 - ¼	-	Topsoil
¼ - 6½	ML	Tan to grey silt (medium stiff, moist) (weathered till)

Terminated at 6½ feet below ground surface.
Caving observed from 2 to 6 feet below ground surface.
No mottling or groundwater seepage observed.
Small-scale PIT completed at 4 feet below ground surface.

Logged by: TSS

Excavated on: December 22, 2021

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Test Pit Logs

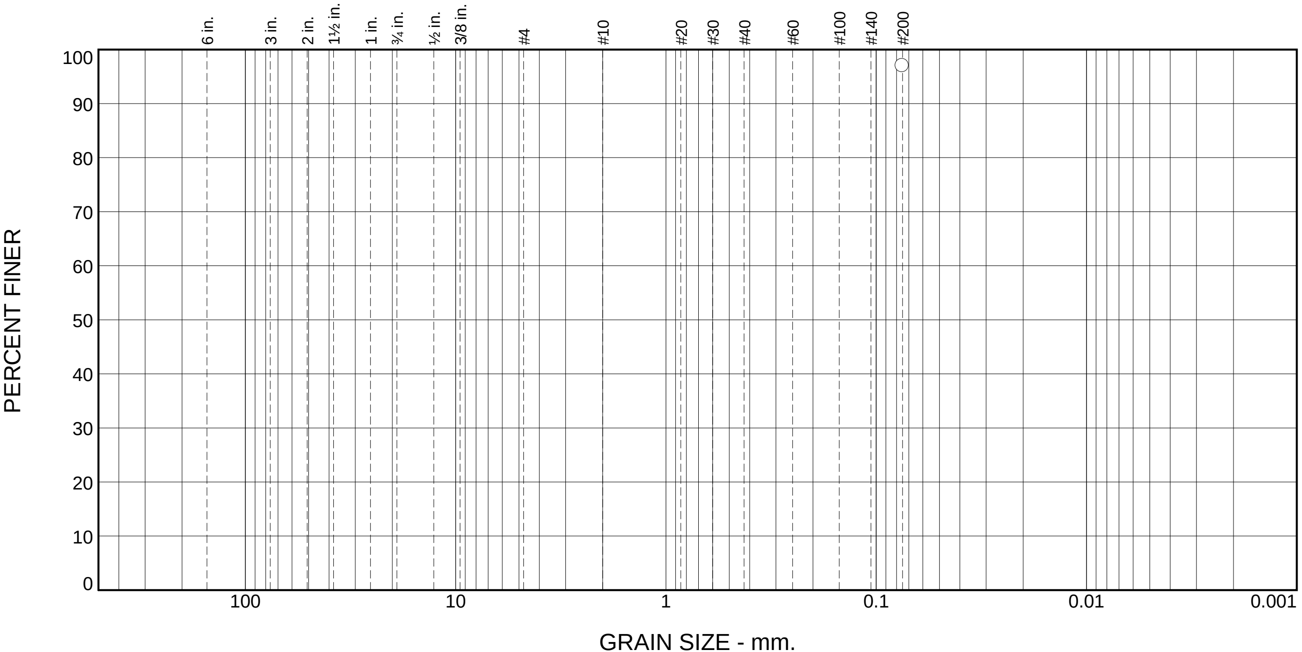
Proposed Multi-Family Development
202-27th Avenue SE
Pierce County, Washington
PN: 00419036006

DocID: Timberlane.BradleyHeights.F | February 2022 | Figure A-5

Appendix B

Laboratory Test Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						97.0	

Test Results (ASTM D 6913 & ASTM C 117)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	97.0		

* (no specification provided)

Material Description

Tan, mottled, SILT (ML), laminated (wet, soft)

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= ML **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}=	D_{85}=	D_{60}=
D_{50}=	D_{30}=	D_{15}=
D_{10}=	C_u=	C_c=

Remarks

Moisture = 37.8%

Date Received: 01/24/2020 **Date Tested:** 02/18/2020

Tested By: EJF

Checked By:

Title:

Source of Sample: MW-1 **Depth:** 10 **Date Sampled:** 01/24/2020

Sample Number: S-4

GeoResources, LLC

Fife, WA

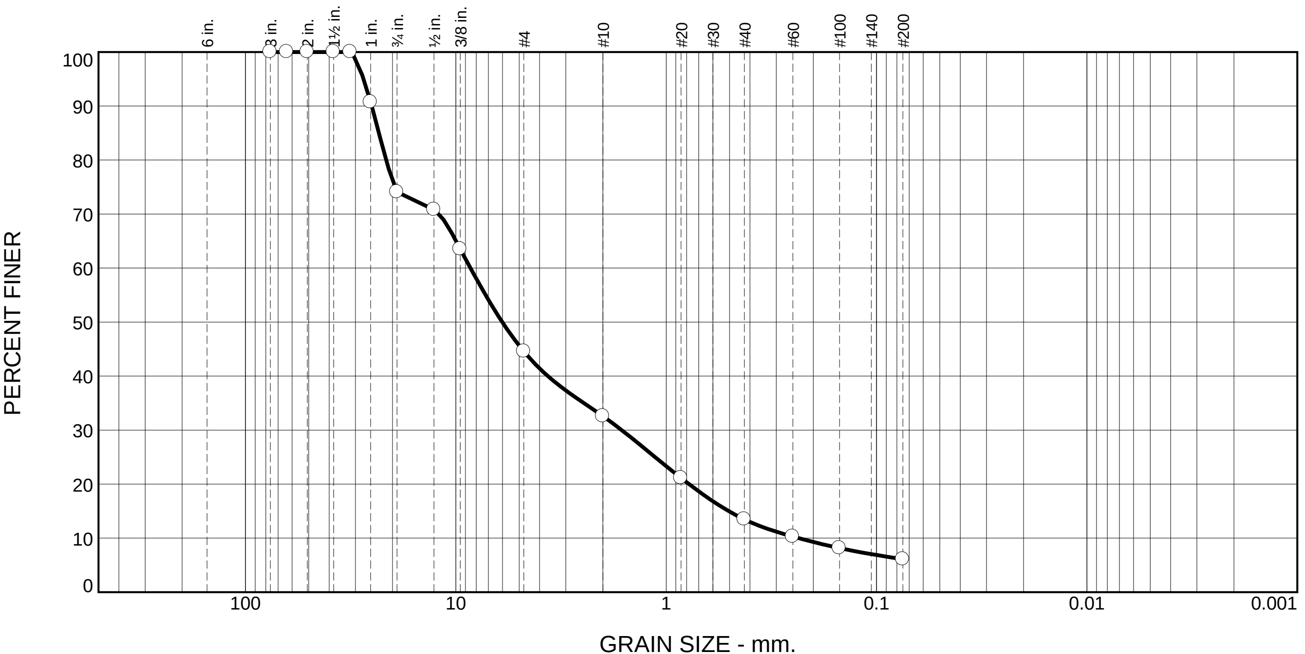
Client: Bradley Heights SS, LLC

Project: Proposed Multi-Family Development

Project No: Timberlane.BradleyHts **Figure** B-3

Tested By: ______________________ **Checked By:** ______________________

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	25.9	29.5	12.0	19.1	7.4	6.1	

Test Results (ASTM D 6913 & ASTM C 117)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3.0	100.0		
2.5	100.0		
2.0	100.0		
1.5	100.0		
1.25	100.0		
1	90.7		
.75	74.1		
.5	70.8		
0.375	63.5		
#4	44.6		
#10	32.6		
#20	21.1		
#40	13.5		
#60	10.3		
#100	8.2		
#200	6.1		

* (no specification provided)

Material Description

Tan well-graded sandy gravel with silt (GW-GM), lightly stratified (wet, medium dense)

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** **PI=**

Classification

USCS (D 2487)= **AASHTO (M 145)=**

Coefficients

D_{90}= 25.1048	D_{85}= 23.2261	D_{60}= 8.5264
D_{50}= 6.0116	D_{30}= 1.6294	D_{15}= 0.5038
D_{10}= 0.2347	C_u= 36.33	C_c= 1.33

Remarks

Moisture = 6.3%

Date Received: 01/24/2020 **Date Tested:** 02/19/2020

Tested By: EJF

Checked By:

Title:

Source of Sample: MW-2 **Depth:** 10 **Date Sampled:** 01/24/2020

Sample Number: S-4

GeoResources, LLC

Fife, WA

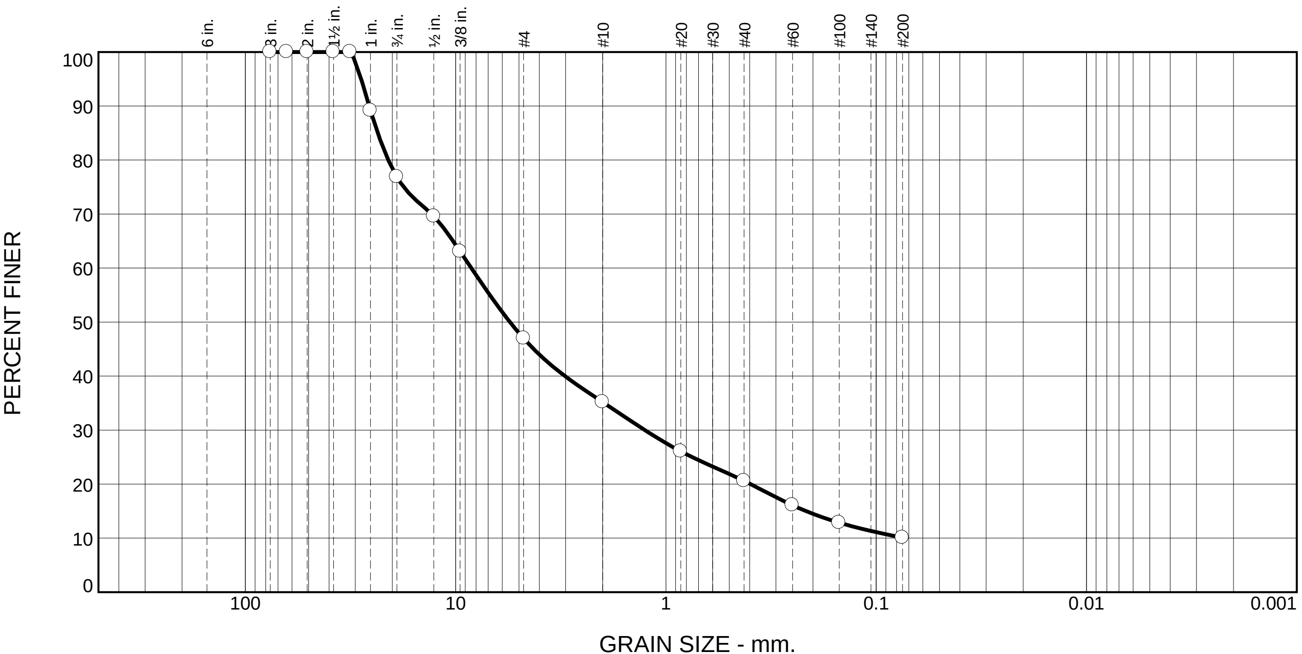
Client: Bradley Heights SS, LLC

Project: Proposed Multi-Family Development

Project No: Timberlane.BradleyHts **Figure** B-2

Tested By: ______________ **Checked By:** ______________

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	23.1	29.9	11.8	14.6	10.5	10.1	

Test Results (ASTM D 6913 & ASTM C 117)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3.0	100.0		
2.5	100.0		
2.0	100.0		
1.5	100.0		
1.25	100.0		
1	89.2		
.75	76.9		
.5	69.6		
0.375	63.1		
#4	47.0		
#10	35.2		
#20	26.1		
#40	20.6		
#60	16.1		
#100	12.9		
#200	10.1		

* (no specification provided)

Material Description

Tan, poorly graded sandy gravel with silt (GP-GM) (moist to wet, dense)

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= GP-GM **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}=	25.7745	D_{85}=	23.4789	D_{60}=	8.4277
D_{50}=	5.5158	D_{30}=	1.2593	D_{15}=	0.2156
D_{10}=		C_u=		C_c=	

Remarks

Moisture = 6.0%

Date Received: 01/24/2020 **Date Tested:** 02/18/2020

Tested By: EJF

Checked By:

Title:

Source of Sample: MW-3 **Depth:** 12.5

Sample Number: S-5

Date Sampled: 01/24/2020

GeoResources, LLC

Fife, WA

Client: Bradley Heights SS, LLC

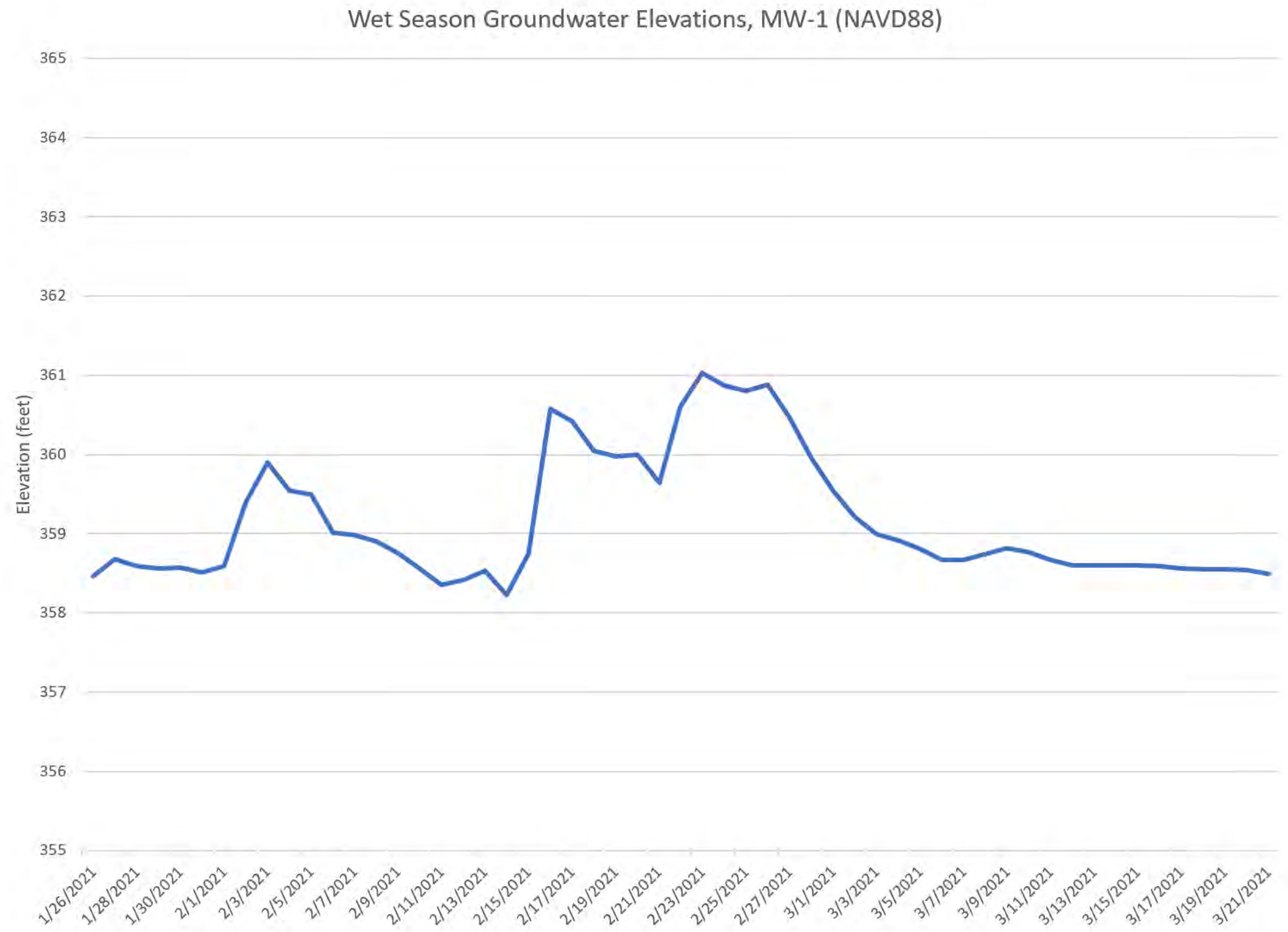
Project: Proposed Multi-Family Development

Project No: Timberlane.BradleyHts **Figure** B-1

Tested By: ______________________ **Checked By:** ______________________

Appendix C

Groundwater Monitoring Data



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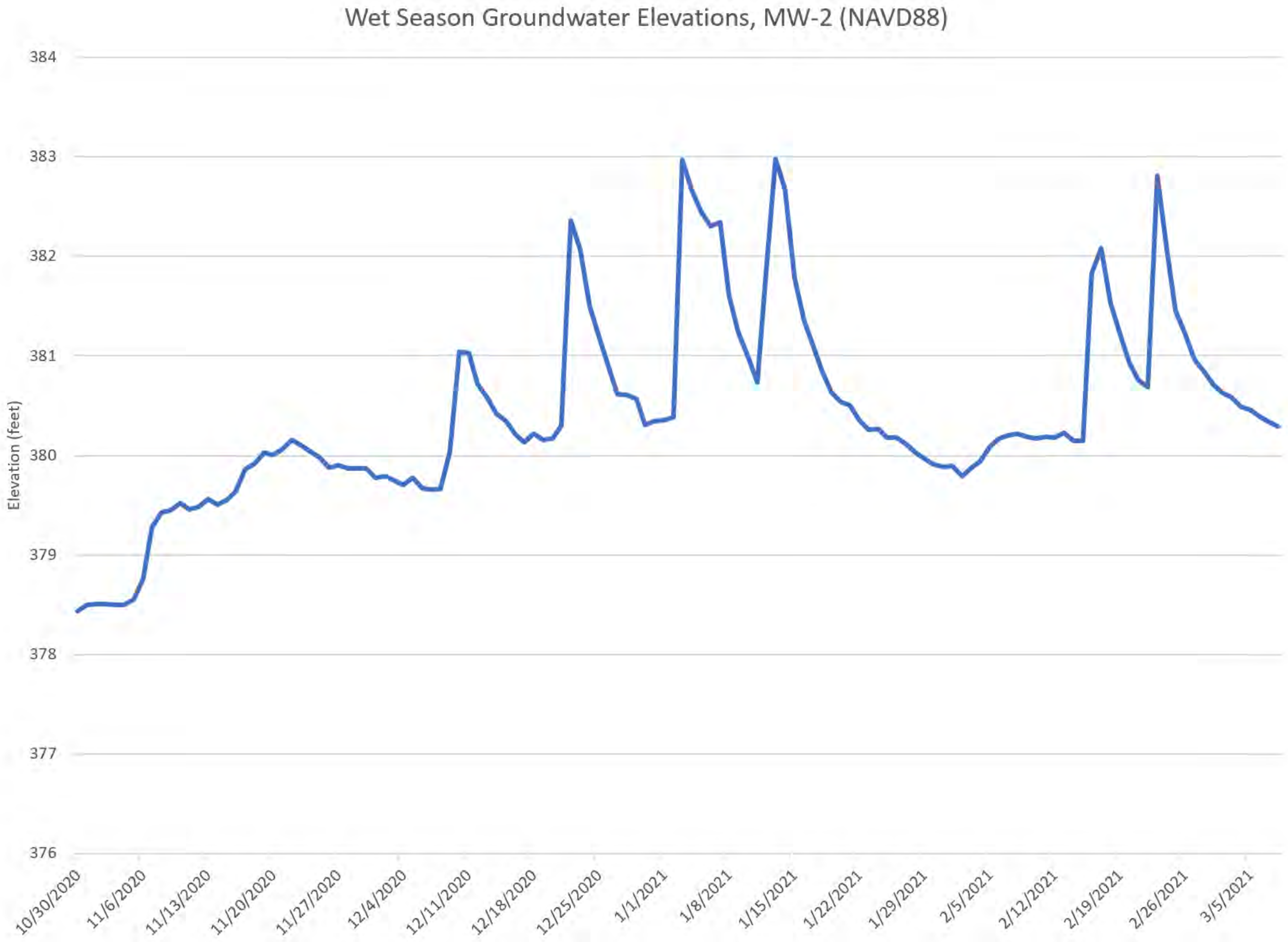
Seasonal Groundwater Levels

Proposed Multi-Family Development
202-27th Avenue SE
Pierce County, Washington
PN: 00419036006

DocID: Timberlane.BradleyHeights.F	February 2022	Figure C-1



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Seasonal Groundwater Levels

Proposed Multi-Family Development
202-27th Avenue SE
Pierce County, Washington
PN: 00419036006

DocID: Timberlane.BradleyHeights.F	February 2022	Figure C-2

APPENDIX C

Filterra GULD

WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

June 2020

GENERAL USE LEVEL DESIGNATION FOR BASIC (TSS), ENHANCED, PHOSPHORUS & OIL TREATMENT

For

CONTECH Engineered Solutions Filterra®

Ecology's Decision:

Based on Contech's submissions, including the Final Technical Evaluation Reports, dated August 2019, March 2014, December 2009, and additional information provided to Ecology dated October 9, 2009, Ecology hereby issues the following use level designations:

1. A General Use Level Designation for Basic, Enhanced, Phosphorus, and Oil Treatment for the Filterra® system constructed with a minimum media thickness of 21 inches (1.75 feet), at the following water quality design hydraulic loading rates:

Treatment	Infiltration Rate (in/hr) for use in Sizing
Basic	175
Phosphorus	100
Oil	50
Enhanced	175

2. The Filterra is not appropriate for oil spill-control purposes.
3. Ecology approves Filterra systems for treatment at the hydraulic loading rates listed above, and sized based on the water quality design flow rate for an off-line system. Calculate the water quality design flow rates using the following procedures:
   - Western Washington: for treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.
   - Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three flow rate based methods described in Chapter 2.7.6 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.
   - Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.

4. This General Use Level Designation has no expiration date, but Ecology may revoke or amend the designation, and is subject to the conditions specified below.

Ecology's Conditions of Use:

Filterra systems shall comply with these conditions shall comply with the following conditions:

1. Design, assemble, install, operate, and maintain the Filterra systems in accordance with applicable Contech Filterra manuals and this Ecology Decision.
2. The minimum size filter surface-area for use in Washington is determined by using the design water quality flow rate (as determined in this Ecology Decision, Item 3, above) and the Infiltration Rate from the table above (use the lowest applicable Infiltration Rate depending on the level of treatment required). Calculate the required area by dividing the water quality design flow rate (cu-ft/sec) by the Infiltration Rate (converted to ft/sec) to obtain required surface area (sq-ft) of the Filterra unit.
3. Each site plan must undergo Contech Filterra review before Ecology can approve the unit for site installation. This will ensure that design parameters including site grading and slope are appropriate for use of a Filterra unit.
4. Filterra media shall conform to the specifications submitted to and approved by Ecology and shall be sourced from Contech Engineered Solutions, LLC with no substitutions.
5. Maintenance includes removing trash, degraded mulch, and accumulated debris from the filter surface and replacing the mulch layer. Use inspections to determine the site-specific maintenance schedules and requirements. Follow maintenance procedures given in the most recent version of the Filterra Operation and Maintenance Manual.
6. Maintenance: The required maintenance interval for stormwater treatment devices is often dependent upon the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured treatment device.
    - Contech designs Filterra systems for a target maintenance interval of 6 months in the Pacific Northwest. Maintenance includes removing and replacing the mulch layer above the media along with accumulated sediment, trash, and captured organic materials therein, evaluating plant health, and pruning the plant if deemed necessary.
    - Conduct maintenance following manufacturer's guidelines.
7. Filterra systems come in standard sizes.
8. Install the Filterra in such a manner that flows exceeding the maximum Filterra operating rate are conveyed around the Filterra mulch and media and will not resuspend captured sediment.
9. Discharges from the Filterra units shall not cause or contribute to water quality standards violations in receiving waters.

Approved Alternate Configurations

Filterra Internal Bypass - Pipe (FTIB-P)

1. The Filterra® Internal Bypass – Pipe allows for piped-in flow from area drains, grated inlets, trench drains, and/or roof drains. Design capture flows and peak flows enter the structure through an internal slotted pipe. Filterra® inverted the slotted pipe to allow design flows to drop through to a series of splash plates that then disperse the design flows over the top surface of the Filterra® planter area. Higher flows continue to bypass the slotted pipe and convey out the structure.
2. To select a FTIB-P unit, the designer must determine the size of the standard unit using the sizing guidance described above.

Filterra Internal Bypass – Curb (FTIB-C)

1. The Filterra® Internal Bypass –Curb model (FTIB-C) incorporates a curb inlet, biofiltration treatment chamber, and internal high flow bypass in one single structure. Filterra® designed the FTIB-C model for use in a “Sag” or “Sump” condition and will accept flows from both directions along a gutter line. An internal flume tray weir component directs treatment flows entering the unit through the curb inlet to the biofiltration treatment chamber. Flows in excess of the water quality treatment flow rise above the flume tray weir and discharge through a standpipe orifice; providing bypass of untreated peak flows. Americast manufactures the FTIB-C model in a variety of sizes and configurations and you may use the unit on a continuous grade when a single structure providing both treatment and high flow bypass is preferred. The FTIB-C model can also incorporate a separate junction box chamber to allow larger diameter discharge pipe connections to the structure.
2. To select a FTIB-C unit, the designer must determine the size of the standard unit using the sizing guidance described above.

Filterra® Shallow

1. The Filterra Shallow provides additional flexibility for design engineers and designers in situations where various elevation constraints prevent application of a standard Filterra configuration. Engineers can design this system up to six inches shallower than any of the previous Filterra unit configurations noted above.
2. Ecology requires that the Filterra Shallow provide a media contact time equivalent to that of the standard unit. This means that with a smaller depth of media, the surface area must increase.
3. To select a Filterra Shallow System unit, the designer must first identify the size of the standard unit using the modeling guidance described above.
4. Once the size of the standard Filterra unit is established using the sizing technique described above, use information from the following table to select the appropriate size Filterra Shallow System unit.

Shallow Unit Basic, Enhanced, Phosphorus, and Oil Treatment Sizing

Standard Depth	Equivalent Shallow Depth
4x4	4x6 or 6x4
4x6 or 6x4	6x6
4x8 or 8x4	6x8 or 8x6
6x6	6x10 or 10x6
6x8 or 8x6	6x12 or 12x6
6x10 or 10x6	13x7

Notes:

1. Shallow Depth Boxes are less than the standard depth of 3.5 feet but no less than 3.0 feet deep (TC to INV).

Applicant: Contech Engineered Solutions, LLC.

Applicant's Address:

11815 NE Glenn Widing Drive
Portland, OR 97220

Application Documents:

- State of Washington Department of Ecology Application for Conditional Use Designation, Americast (September 2006)
- Quality Assurance Project Plan Filterra® Bioretention Filtration System Performance Monitoring, Americast (April 2008)
- Quality Assurance Project Plan Addendum Filterra® Bioretention Filtration System Performance Monitoring, Americast (June 2008)
- Draft Technical Evaluation Report Filterra® Bioretention Filtration System Performance Monitoring, Americast (August 2009)
- Final Technical Evaluation Report Filterra® Bioretention Filtration System Performance Monitoring, Americast (December 2009)
- Technical Evaluation Report Appendices Filterra® Bioretention Filtration System Performance Monitoring, Americast, (August 2009)
- Memorandum to Department of Ecology Dated October 9, 2009 from Americast, Inc. and Herrera Environmental Consultants
- Quality Assurance Project Plan Filterra® Bioretention System Phosphorus treatment and Supplemental Basic and Enhanced Treatment Performance Monitoring, Americast (November 2011)
- Filterra® letter August 24, 2012 regarding sizing for the Filterra® Shallow System.
- University of Virginia Engineering Department Memo by Joanna Crowe Curran, Ph. D dated March 16, 2013 concerning capacity analysis of Filterra® internal weir inlet tray.
- Terraphase Engineering letter to Jodi Mills, P.E. dated April 2, 2013 regarding Terraflume Hydraulic Test, Filterra® Bioretention System and attachments.
- Technical Evaluation Report, Filterra® System Phosphorus Treatment and Supplemental Basic Treatment Performance Monitoring. March 27th, 2014.
- State of Washington Department of Ecology Application for Conditional Use Level Designation, Contech Engineered Solutions (May 2015)

- Quality Assurance Project Plan Filterra® Bioretention System, Contech Engineered Solutions (May 2015)
- Filterra Bioretention System Armco Avenue General Use Level Designation Technical Evaluation Report, Contech Engineered Solutions (August 2019)

Applicant's Use Level Request:

General Level Use Designation for Basic (175 in/hr), Enhanced (175 in/hr), Phosphorus (100 in/hr), and Oil Treatment (50 in/hr).

Applicant's Performance Claims:

Field-testing and laboratory testing show that the Filterra® unit is promising as a stormwater treatment best management practice and can meet Ecology's performance goals for basic, enhanced, phosphorus, and oil treatment.

Findings of Fact:

Field Testing 2015-2019

1. Contech completed field testing of a 4 ft. x 4 ft. Filterra® unit at one site in Hillsboro, Oregon from September 2015 to July 2019. Throughout the monitoring period a total of 24 individual storm events were sampled, of which 23 qualified for TAPE sampling criteria.
2. Contech encountered several unanticipated events and challenges that prevented them from collecting continuous flow and rainfall data. An analysis of the flow data from the sampled events, including both the qualifying and non-qualifying events, demonstrated the system treated over 99 % of the influent flows. Peak flows during these events ranged from 25 % to 250 % of the design flow rate of 29 gallons per minute.
3. Of the 23 TAPE qualified sample events, 13 met requirements for TSS analysis. Influent concentrations ranged from 20.8 mg/L to 83 mg/L, with a mean concentration of 46.3 mg/L. The UCL95 mean effluent concentration was 15.9 mg/L, meeting the 20 mg/L performance goal for Basic Treatment.
4. All 23 TAPE qualified sample events met requirements for dissolved zinc analysis. Influent concentrations range from 0.0384 mg/L to 0.2680 mg/L, with a mean concentration of 0.0807 mg/L. The LCL 95 mean percent removal was 62.9 %, meeting the 60 % performance goal for Enhanced Treatment.
5. Thirteen of the 23 TAPE qualified sample events met requirements for dissolved copper analysis. Influent concentrations ranged from 0.00543 mg/L to 0.01660 mg/L, with a mean concentration of 0.0103 mg/L. The LCL 95 mean percent removal was 41.2 %, meeting the 30 % performance goal for Enhanced Treatment.
6. Total zinc concentrations were analyzed for all 24 sample events. Influent EMCs for total zinc ranged from 0.048 mg/L to 5.290 mg/L with a median of 0.162 mg/L. Corresponding effluent EMCs for total zinc ranged from 0.015 mg/L to 0.067 mg/L with a median of

0.029 mg/L. Total event loadings for the study for total zinc were 316.85 g at the influent and 12.92 g at the effluent sampling location, resulting in a summation of loads removal efficiency of 95.9 %.

7. Total copper concentrations were analyzed for all 24 sample events. Influent EMCs for total copper ranged from 0.003 mg/L to 35.600 mg/L with a median value of 0.043 mg/L. Corresponding effluent EMCs for total copper ranged from 0.002 mg/L to 0.015 mg/L with a median of 0.004 mg/L. Total event loadings for total copper for the study were 1,810.06 g at the influent and 1.90 g at the effluent sampling location, resulting in a summation of loads removal efficiency of 99.9 %.

Field Testing 2013

1. Filterra completed field-testing of a 6.5 ft x 4 ft. unit at one site in Bellingham, Washington. Continuous flow and rainfall data collected from January 1, 2013 through July 23, 2013 indicated that 59 storm events occurred. Water quality data was obtained from 22 storm events. Not all the sampled storms produced information that met TAPE criteria for storm and/or water quality data.
2. The system treated 98.9 % of the total 8-month runoff volume during the testing period. Consequently, the system achieved the goal of treating 91 % of the volume from the site. Stormwater runoff bypassed Filterra treatment during four of the 59 storm events.
3. Of the 22 sampled events, 18 qualified for TSS analysis (influent TSS concentrations ranged from 25 to 138 mg/L). The data were segregated into sample pairs with influent concentration greater than and less than 100 mg/L. The UCL95 mean effluent concentration for the data with influent less than 100 mg/L was 5.2 mg/L, below the 20-mg/L threshold. Although the TAPE guidelines do not require an evaluation of TSS removal efficiency for influent concentrations below 100 mg/L, the mean TSS removal for these samples was 90.1 %. Average removal of influent TSS concentrations greater than 100 mg/L (three events) was 85 %. In addition, the system consistently exhibited TSS removal greater than 80 % at flow rates equivalent to a 100 in/hr infiltration rate and was observed at 150 in/hr.
4. Ten of the 22 sampled events qualified for TP analysis. Americast augmented the dataset using two sample pairs from previous monitoring at the site. Influent TP concentrations ranged from 0.11 to 0.52 mg/L. The mean TP removal for these twelve events was 72.6 %. The LCL95 mean percent removal was 66.0, well above the TAPE requirement of 50 %. Treatment above 50 % was evident at 100 in/hr infiltration rate and as high as 150 in/hr. Consequently, the Filterra test system met the TAPE Phosphorus Treatment goal at 100 in/hr. Influent ortho-P concentrations ranged from 0.005 to 0.012 mg/L; effluent ortho-P concentrations ranged from 0.005 to 0.013 mg/L. The reporting limit/resolution for the ortho-P test method is 0.01 mg/L, therefore the influent and effluent ortho-P concentrations were both at and near non-detect concentrations.

Field Testing 2008-2009

1. Filterra completed field-testing at two sites at the Port of Tacoma. Continuous flow and rainfall data collected during the 2008-2009 monitoring period indicated that 89 storm events occurred. The monitoring obtained water quality data from 27 storm events. Not all the sampled storms produced information that met TAPE criteria for storm and/or water quality data.
2. During the testing at the Port of Tacoma, 98.96 to 99.89 % of the annual influent runoff volume passed through the POT1 and POT2 test systems respectively. Stormwater runoff bypassed the POT1 test system during nine storm events and bypassed the POT2 test system during one storm event. Bypass volumes ranged from 0.13 % to 15.3% of the influent storm volume. Both test systems achieved the 91 % water quality treatment-goal over the 1-year monitoring period.
3. Consultants observed infiltration rates as high as 133 in/hr during the various storms. Filterra did not provide any paired data that identified percent removal of TSS, metals, oil, or phosphorus at an instantaneous observed flow rate.
4. The maximum storm average hydraulic loading rate associated with water quality data is <40 in/hr, with the majority of flow rates < 25 in/hr. The average instantaneous hydraulic loading rate ranged from 8.6 to 53 in/hr.
5. The field data showed a removal rate greater than 80 % for TSS with an influent concentration greater than 20 mg/L at an average instantaneous hydraulic loading rate up to 53 in/hr (average influent concentration of 28.8 mg/L, average effluent concentration of 4.3 mg/L).
6. The field data showed a removal rate generally greater than 54 % for dissolved zinc at an average instantaneous hydraulic loading rate up to 60 in/hr and an average influent concentration of 0.266 mg/L (average effluent concentration of 0.115 mg/L).
7. The field data showed a removal rate generally greater than 40 % for dissolved copper at an average instantaneous hydraulic loading rate up to 35 in/hr and an average influent concentration of 0.0070 mg/L (average effluent concentration of 0.0036 mg/L).
8. The field data showed an average removal rate of 93 % for total petroleum hydrocarbon (TPH) at an average instantaneous hydraulic loading rate up to 53 in/hr and an average influent concentration of 52 mg/L (average effluent concentration of 2.3 mg/L). The data also shows achievement of less than 15 mg/L TPH for grab samples. Filterra provided limited visible sheen data due to access limitations at the outlet monitoring location.
9. The field data showed low percentage removals of total phosphorus at all storm flows at an average influent concentration of 0.189 mg/L (average effluent concentration of 0.171 mg/L). We may relate the relatively poor treatment performance of the Filterra system at this location to influent characteristics for total phosphorus that are unique to the Port of Tacoma site. It appears that the Filterra system will not meet the 50 % removal performance goal when the majority of phosphorus in the runoff is expected to be in the dissolved form.

Laboratory Testing

1. Filterra performed laboratory testing on a scaled down version of the Filterra unit. The lab data showed an average removal from 83-91 % for TSS with influents ranging from 21 to 320 mg/L, 82-84 % for total copper with influents ranging from 0.94 to 2.3 mg/L, and 50-61 % for orthophosphate with influents ranging from 2.46 to 14.37 mg/L.
2. Filterra conducted permeability tests on the soil media.
3. Lab scale testing using Sil-Co-Sil 106 showed removals ranging from 70.1 % to 95.5 % with a median removal of 90.7 %, for influent concentrations ranging from 8.3 to 260 mg/L. Filterra ran these laboratory tests at an infiltration rate of 50 in/hr.
4. Supplemental lab testing conducted in September 2009 using Sil-Co-Sil 106 showed an average removal of 90.6 %. These laboratory tests were run at infiltration rates ranging from 25 to 150 in/hr for influent concentrations ranging from 41.6 to 252.5 mg/L. Regression analysis results indicate that the Filterra system's TSS removal performance is independent of influent concentration in the concentration rage evaluated at hydraulic loading rates of up to 150 in/hr.

Contact Information:

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Ecology web link: http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html

Ecology:
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Water Quality Program
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Date	**Revision**
December 2009	GULD for Basic, Enhanced, and Oil granted, CULD for Phosphorus
September 2011	Extended CULD for Phosphorus Treatment
September 2012	Revised design storm discussion, added Shallow System.
January 2013	Revised format to match Ecology standards, changed Filterra contact information
February 2013	Added FTIB-P system
March 2013	Added FTIB-C system
April 2013	Modified requirements for identifying appropriate size of unit

June 2013	Modified description of FTIB-C alternate configuration
March 2014	GULD awarded for Phosphorus Treatment. GULD updated for a higher flow-rate for Basic Treatment.
June 2014	Revised sizing calculation methods
March 2015	Revised Contact Information
June 2015	CULD for Basic and Enhanced at 100 in/hr infiltration rate
September 2019	GULD for Basic and Enhanced at 175 in/hr infiltration rate
February 2020	Revised sizing language to note sizing based on off-line calculations
June 2020	Added Phosphorus to Filterra Shallow sizing table

APPENDIX D

StormFilter GULD

WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

April 2017

GENERAL USE LEVEL DESIGNATION FOR BASIC (TSS) TREATMENT

For

CONTECH Engineered Solutions
Stormwater Management StormFilter®
With ZPG Media at 1 gpm/sq ft media surface area

Ecology's Decision:

Based on the CONTECH Engineered Solutions' (CONTECH) application submissions, Ecology hereby issues a General Use Level Designation (GULD) for the Stormwater Management StormFilter® (StormFilter):

1. **As a basic stormwater treatment practice for total suspended solids (TSS) removal,**
    - **Using ZPG™ media (zeolite/perlite/granular activated carbon), with the size distribution described below,**
    - **Sized at a hydraulic loading rate of 1 gpm/ft^2 of media surface area, per Table 1, and**
    - **Internal bypassing needs to be consistent with the design guidelines in CONTECH's current product design manual.**

Table 1. StormFilter Design Flow Rates per Cartridge

Effective Cartridge Height (inches)	**12**	**18**	**27**
Cartridge Flow Rate (gpm/cartridge)	**5**	**7.5**	**11.3**

2. **Ecology approves StormFilter systems containing ZPG™ media for treatment at the hydraulic loading rates shown in Table 1, and sized based on the water quality design flow rate for an off-line system when using an external bypass vault or a treatment vault with an internal bypass. Contech designs their StormFilter systems to maintain treatment of the water quality design flow while routing excess flows around the treatment chamber during periods of peak bypass. The water quality design flow rates are calculated using the following procedures:**
    - **Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.**

- **Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.**
- **Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.**

3. This designation has no expiration date, but Ecology may amend or revoke it.

Ecology's Conditions of Use:

The StormFilter with ZPG media shall comply with the following conditions:

1. **Design, install, operate, and maintain the StormFilter with ZPG media in accordance with applicable Contech Engineered Solutions manuals, documents, and the Ecology Decision.**

2. **Install StormFilter systems to bypass flows exceeding the water quality treatment rate. Additionally, high flows will not re-suspend captured sediments. Design StormFilter systems in accordance with the performance goals in Ecology's most recent Stormwater Manual and CONTECH's *Product Design Manual Version 4.1 (April 2006)*, or most current version, unless otherwise specified.**

3. **Owners must follow the design, pretreatment, land use application, and maintenance criteria in CONTECH's Design Manual.**

4. **Pretreatment of TSS and oil and grease may be necessary, and designers shall provide pre-treatment in accordance with the most current versions of the CONTECH's *Product Design Manual (April 2006)* or the applicable Ecology Stormwater Manual. Design pre-treatment using the performance criteria and pretreatment practices provided on Ecology's "Evaluation of Emerging Stormwater Treatment Technologies" website.**

5. **Maintenance: The required maintenance interval for stormwater treatment devices is often dependent upon the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.**
    - **Typically, CONTECH designs StormFilter systems for a target filter media replacement interval of 12 months. Maintenance includes removing accumulated sediment from the vault, and replacing spent cartridges with recharged cartridges.**

- **Indications of the need for maintenance include effluent flow decreasing to below the design flow rate, as indicated by the scumline above the shoulder of the cartridge.**
- **Owners/operators must inspect StormFilter with ZPG media for a minimum of twelve months from the start of post-construction operation to determine site-specific maintenance schedules and requirements. You must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW, the wet season in western Washington is October 1 to April 30. According to SWMMEW, the wet season in eastern Washington is October 1 to June 30). After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.**
- **Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flowrate and/or a decrease in pollutant removal ability.**
- **When inspections are performed, the following findings typically serve as maintenance triggers:**
  - **Accumulated vault sediment depths exceed an average of 2 inches, or**
  - **Accumulated sediment depths on the tops of the cartridges exceed an average of 0.5 inches, or**
  - **Standing water remains in the vault between rain events, or**
  - **Bypass occurs during storms smaller than the design storm.**
- **Note: If excessive floatables (trash and debris) are present, perform a minor maintenance consisting of gross solids removal, not cartridge replacement.**

6. **CONTECH shall maintain readily available reports listed under "Application Documents" (above) as public, as well as the documentation submitted with its previous conditional use designation application. CONTECH shall provide links to this information from its corporate website, and make this information available upon request, at no cost and in a timely manner.**

7. **ZPG™ media used shall conform with the following specifications:**

- **Each cartridge contains a total of approximately 2.6 cubic feet of media. The ZPG™ cartridge consists of an outer layer of perlite that is approximately 1.3 cubic feet in volume and an inner layer, consisting of a mixture of 90% zeolite and 10% granular activated carbon, which is approximately 1.3 cubic feet in volume.**

- **Perlite Media: Perlite media shall be made of natural siliceous volcanic rock free of any debris or foreign matter. The expanded perlite shall**

have a bulk density ranging from 6.5 to 8.5 lbs per cubic foot and particle sizes ranging from 0.09" (#8 mesh) to 0.38" (3/8" mesh).

- **Zeolite Media: Zeolite media shall be made of naturally occurring clinoptilolite. The zeolite media shall have a bulk density ranging from 44 to 50 lbs per cubic foot and particle sizes ranging from 0.13" (#6 mesh) to 0.19" (#4 mesh). Additionally, the cation exchange capacity (CEC) of zeolite shall range from approximately 1.0 to 2.2 meq/g.**

- **Granular Activated Carbon: Granular activated carbon (GAC) shall be made of lignite coal that has been steam-activated. The GAC media shall have a bulk density ranging from 28 to 31 lbs per cubic foot and particle sizes ranging from a 0.09" (#8 mesh) to 0.19" (#4 mesh).**

Approved Alternate Configurations

Peak Diversion StormFilter

1. The Peak Diversion StormFilter allows for off-line bypass within the StormFilter structure. Design capture flows and peak flows enter the inlet bay which contains an internal weir. The internal weir allows design flows to enter the cartridge bay through a transfer hole located at the bottom of the inlet bay while the unit routs higher flows around the cartridge bay.
2. To select the size of the Peak Diversion StormFilter unit, the designer must determine the number of cartridges required and size of the standard StormFilter using the site-specific water quality design flow and the **StormFilter Design Flow Rates per Cartridge** as described above.
3. New owners may not install the Peak Diversion StormFilter at an elevation or in a location where backwatering may occur.

Applicant: Contech Engineered Solutions

Applicant's Address: 11835 NE Glenn Widing Dr.
Portland, OR 97220

Application Documents:

The applicant's master report, titled, "The Stormwater Management StormFilter Basic Treatment Application for General Use Level Designation in Washington", Stormwater Management, Inc., November 1, 2004, includes the following reports:

- (Public) *Evaluation of the Stormwater Management StormFilter Treatment System: Data Validation Report and Summary of the Technical Evaluation Engineering Report (TEER) by Stormwater Management Inc.*, October 29, 2004 Ecology's technology assessment protocol requires the applicant to hire an independent consultant to complete the following work:

1. Complete the data validation report.
2. Prepare a TEER summary, including a testing summary and conclusions compared with the supplier's performance claims.
3. Provide a recommendation of the appropriate technology use level.
4. Work with Ecology to post recommend relevant information on Ecology's website.
5. Provide additional testing recommendations, if needed."
6. This report, authored by Dr. Gary Minton, Ph. D., P.E., Resource Planning Associates, satisfies the Ecology requirement.

- (Public) "Performance of the Stormwater Management StormFilter Relative to the Washington State Department of Ecology Performance Goals for Basic Treatment," is a summary of StormFilter performance that strictly adheres to the criteria listed in the Guidance for Evaluating Emerging Stormwater Treatment Technologies, Technology Assessment Protocol – Ecology (TAPE).
- "Heritage Marketplace Field Evaluation: Stormwater Management StormFilter with ZPG™ Media," is a report showing all of the information collected at Site A as stated in the SMI Quality Assurance Project Plan (QAPP). This document contains detailed information regarding each storm event collected at this site, and it provided a detailed overview of the data and project.
- "Lake Stevens Field Evaluation: Stormwater Management StormFilter with ZPG™ Media," is a report that corresponds to Site E as stated in the SMI QAPP. This document contains detailed information regarding each storm collected at this site, and includes a detailed overview of the data and project.
- (Public) "Evaluation of the Stormwater Management StormFilter for the removal of SIL-CO-SIL 106, a standardized silica product: ZPG™ at 7.5 GPM" is a report that describes laboratory testing at full design flow.
- "Factors Other Than Treatment Performance."
- "State of Washington Installations."
- "Peak Diversion StormFilter" is a technical document demonstrating the Peak Diversion StormFilter system complies with the Stormwater Management Manual for Western Washington Volume V Section 4.5.1.

Above-listed documents noted as "public" are available by contacting CONTECH.

Applicant's Use Level Request:

That Ecology grant a General Use Level Designation for Basic Treatment for the StormFilter using ZPG™ media (zeolite/perlite/granular activated carbon) at a hydraulic loading rate of 1 gpm/ft^2 of media surface area in accordance with Ecology's 2011 *Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE).*

Applicant's Performance Claim:

The combined data from the two field sites reported in the TER (Heritage Marketplace and Lake Stevens) indicate that the performance of a StormFilter system configured for inline bypass with ZPG™ media and a hydraulic loading rate of 1 gpm/ft^2 of media surface area meets Ecology performance goals for Basic Treatment.

Ecology's Recommendations:

Based on the weight of the evidence and using its best professional judgment, Ecology finds that:

- StormFilter, using ZPG™ media and operating at a hydraulic loading rate of no more than 1 gpm/ft^2 of media surface area, is expected to provide effective stormwater treatment achieving Ecology's Basic Treatment (TSS removal) performance goals. Contech demonstrated this is through field and laboratory testing performed in accordance with the approved protocol. StormFilter is deemed satisfactory with respect to factors other than treatment performance (e.g., maintenance; see the protocol's Appendix B for complete list).

Findings of Fact:

- Influent TSS concentrations and particle size distributions were generally within the range of what Ecology considers "typical" for western Washington (silt-to-silt loam).
- Contech sampled thirty-two (32) storm events at two sites for storms from April 2003 to March 2004, of which Contech deemed twenty-two (22) as "qualified" and were therefore included in the data analysis set.
- Statistical analysis of these 22 storm events verifies the data set's adequacy.
- Analyzing all 22 qualifying events, the average influent and effluent concentrations and aggregate pollutant load reduction are 114 mg/L, 25 mg/L, and 82%, respectively.
- Analyzing all 22 qualifying events based on the *estimated average* flow rate during the event (versus the *measured peak* flow rate), and more heavily weighting those events near the design rate (versus events either far above or well below the design rate) does not significantly affect the reported results.
- For the 7 qualifying events with influent TSS concentrations greater than 100 mg/L, the average influent and effluent concentrations and aggregate pollutant load reduction are 241 mg/L, 34 mg/L, and 89%, respectively. If we exclude the 2 of 7 events that exceed the maximum 300 mg/L specified in Ecology's guidelines, the average influent and effluent concentrations and aggregate pollutant load reduction are 158 mg/L, 35 mg/L, and 78%, respectively.
- For the 15 qualifying events with influent TSS concentrations less than 100 mg/L, the average influent and effluent concentrations and aggregate pollutant load reduction are 55 mg/L, 20 mg/L, and 61%, respectively. If the 6 of 15 events that fall below the minimum 33 mg/L TSS specified in Ecology's guidelines are excluded, the average

influent and effluent concentrations and aggregate pollutant load reduction are 78 mg/L, 26 mg/L, and 67%, respectively.

- For the 8 qualifying events with peak discharge exceeding design flow (ranging from 120 to 257% of the design rate), results ranged from 52% to 96% TSS removal, with an average of 72%.
- Due to the characteristics of the hydrographs, the field results generally reflect flows below (ranging between 20 and 60 percent of) the tested facilities' design rate. During these sub-design flow rate periods, some of the cartridges operate at or near their *individual* full design flow rate (generally between 4 and 7.5 GPM for an 18" cartridge effective height) because their float valves have opened. Float valves remain closed on the remaining cartridges, which operate at their base "trickle" rate of 1 to 1.5 GPM.
- Laboratory testing using U.S. Silica's Sil-Co-Sil 106 fine silica product showed an average 87% TSS removal for testing at 7.5 GPM per cartridge (100% design flow rate).
- Other relevant testing at I-5 Lake Union, Greenville Yards (New Jersey), and Ski Run Marina (Lake Tahoe) facilities shows consistent TSS removals in the 75 to 85% range. *Note that the evaluators operated the I-5 Lake Union at 50%, 100%, and 125% of design flow*.
- SMI's application included a satisfactory "Factors other than treatment performance" discussion.

Note: Ecology's 80% TSS removal goal applies to 100 mg/l and greater influent TSS. Below 100 mg/L influent TSS, the goal is 20 mg/L effluent TSS.

Technology Description:

The Stormwater Management StormFilter® (StormFilter), a flow-through stormwater filtration system, improves the quality of stormwater runoff from the urban environment by removing pollutants. The StormFilter can treat runoff from a wide variety of sites including, but not limited to: retail and commercial development, residential streets, urban roadways, freeways, and industrial sites such as shipyards, foundries, etc.

Operation:

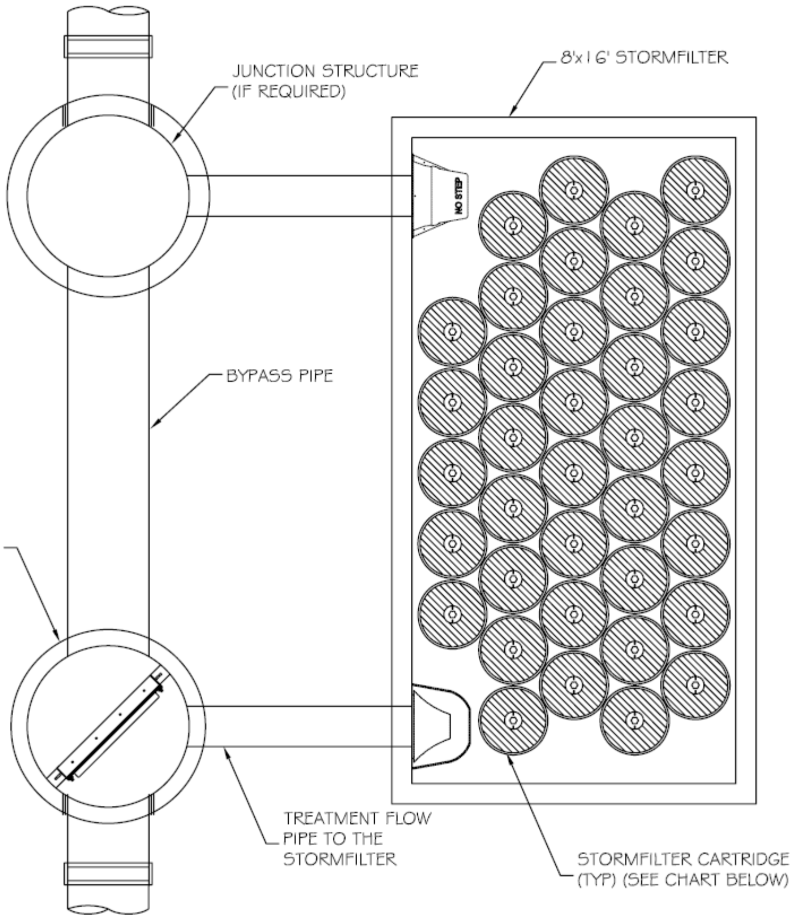
The StormFilter is typically comprised of a vault that houses rechargeable, media-filled, filter cartridges. Various media may be used, but this designation covers only the zeolite-perlite-granulated activated carbon (ZPG™) medium. Stormwater from storm drains percolates through these media-filled cartridges, which trap particulates and may remove pollutants such as dissolved metals, nutrients, and hydrocarbons. During the filtering process, the StormFilter system also removes surface scum and floating oil and grease. Once filtered through the media, the treated stormwater is directed to a collection pipe or discharged to an open channel drainage way.

This document includes a bypass schematic for flow rates exceeding the water quality design flow rate on page 8.

StormFilter Configurations:

Contech offers the StormFilter in multiple configurations: precast, high flow, catch basin, curb inlet, linear, volume, corrugated metal pipe, drywell, and CON/Span form. Most configurations use pre-manufactured units to ease the design and installation process. Systems may be either uncovered or covered underground units.

The typical precast StormFilter unit is composed of three sections: the energy dissipater, the filtration bay, and the outlet sump. As Stormwater enters the inlet of the StormFilter vault through the inlet pipe, piping directs stormwater through the energy dissipater into the filtration bay where treatment will take place. Once in the filtration bay, the stormwater ponds and percolates horizontally through the media contained in the StormFilter cartridges. After passing through the media, the treated water in each cartridge collects in the cartridge's center tube from where piping directs it into the outlet sump by a High Flow Conduit under-drain manifold. The treated water in the outlet sump discharges through the single outlet pipe to a collection pipe or to an open channel drainage way. In some applications where you anticipate heavy grit loads, pretreatment by settling may be necessary.



EFFECTIVE CARTRIDGE HEIGHT	12"	18"	27"
CARTRIDGE FLOW RATE (gpm/cart)	5	7.5	11.3

contechstormwater.com

STORMFILTER WITH STORMGATE
SCHEMATIC DETAIL
PLAN VIEW

DRAWING
1
1/1

DATE: 11/11/05 | SCALE: NONE | FILE NAME: SGMH-SF816-OTIS-SCH | DRAWN: MJW | CHECKED: XXX

Figure 1. Stormwater Management StormFilter Configuration with Bypass

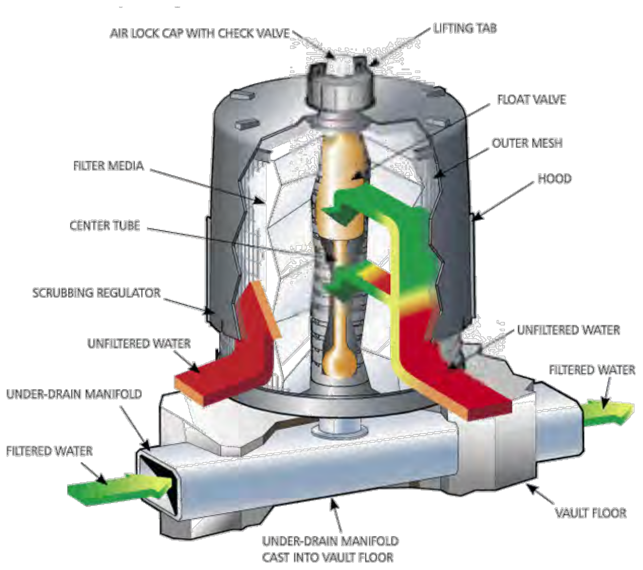


Figure 2. The StormFilter Cartridge

Cartridge Operation:

As the water level in the filtration bay begins to rise, stormwater enters the StormFilter cartridge. Stormwater in the cartridge percolates horizontally through the filter media and passes into the cartridge's center tube, where the float in the cartridge is in a closed (downward) position. As the water level in the filtration bay continues to rise, more water passes through the filter media and into the cartridge's center tube. Water displaces the air in the cartridge and it purges from beneath the filter hood through the one-way check valve located in the cap. Once water fills the center tube there is enough buoyant force on the float to open the float valve and allow the treated water to flow into the under-drain manifold. As the treated water drains, it tries to pull in air behind it. This causes the check valve to close, initiating a siphon that draws polluted water throughout the full surface area and volume of the filter. Thus, water filters through the entire filter cartridge throughout the duration of the storm, regardless of the water surface elevation in the filtration bay. This continues until the water surface elevation drops to the elevation of the scrubbing regulators. At this point, the siphon begins to break and air quickly flows beneath the hood through the scrubbing regulators, causing energetic bubbling between the inner surface of the hood and the outer surface of the filter. This bubbling agitates and cleans the surface of the filter, releasing accumulated sediments on the surface, flushing them from beneath the hood, and allowing them to settle to the vault floor.

Adjustable cartridge flow rate:

Inherent to the design of the StormFilter is the ability to control the individual cartridge flow rate with an orifice-control disc placed at the base of the cartridge. Depending on the treatment requirements and on the pollutant characteristics of the influent stream as specified in the CONTECH *Product Design Manual*, operators may adjust the flow rate through the filter cartridges. By decreasing the flow rate through the filter cartridges, the influent contact time with the media is increased and the water velocity through the system is decreased, thus increasing both the level of treatment and the solids removal efficiencies of the filters, respectively (de Ridder, 2002).

Recommended research and development:

Ecology encourages CONTECH to pursue continuous improvements to the StormFilter. To that end, CONTECH recommends the following actions:

- Determine, through laboratory testing, the relationship between accumulated solids and flow rate through the cartridge containing the ZPG™ media. **Completed 11/05.**
- Determine the system's capabilities to meet Ecology's enhanced, phosphorus, and oil treatment goals.
- Develop easy-to-implement methods of determining that a StormFilter facility requires maintenance (cleaning and filter replacement).

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Ecology Contact:

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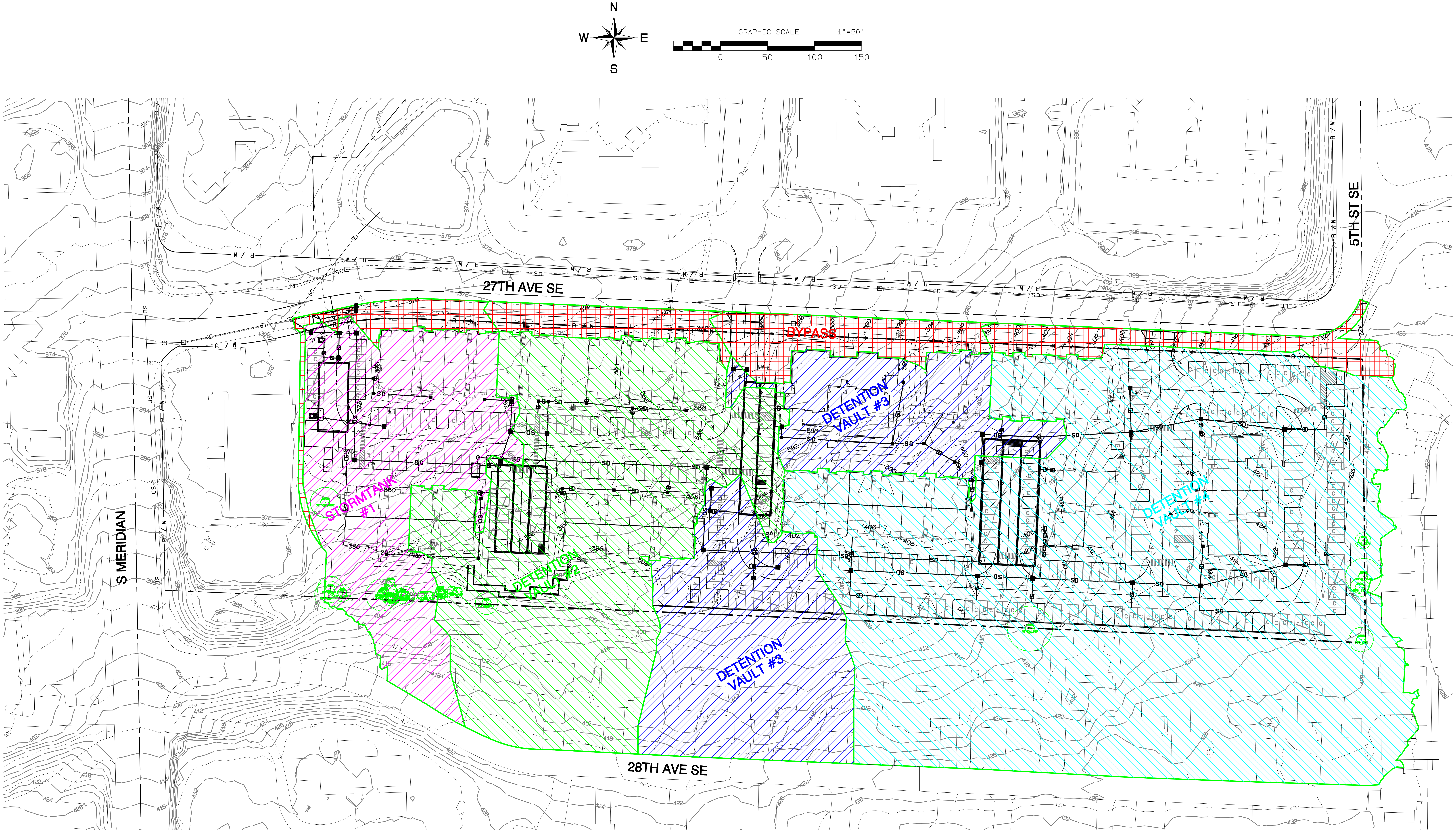
Revision History

Date	**Revision**
Jan 2005	Original Use Level Designation
Dec 2007	Revision
May 2012	Maintenance requirements updated
November 2012	Design Storm and Maintenance requirements updated
January 2013	Updated format to match Ecology standard format
September 2014	Added Peak Diversion StormFilter Alternate Configuration
November 2016	Revised Contech contact information
April 2017	Revised sizing language to note sizing based on Off-line calculations

Bradley Heights - Drainage Report

Section 3, Township 19 N, Range 4 E, Willamette Meridian, Pierce County, Washington



Robert A. Trivitt
5/17/2024
43715

Detention Drainage Basins

Bradley Heights

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JOB NO: 3227
DATE: May 16, 2024
DESIGNED BY: Rob Trivitt
DRAWN BY: Rob Trivitt
CHECKED BY: Paul Green
APPROVED BY: Paul Green

REVISION	DATE
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OF 2

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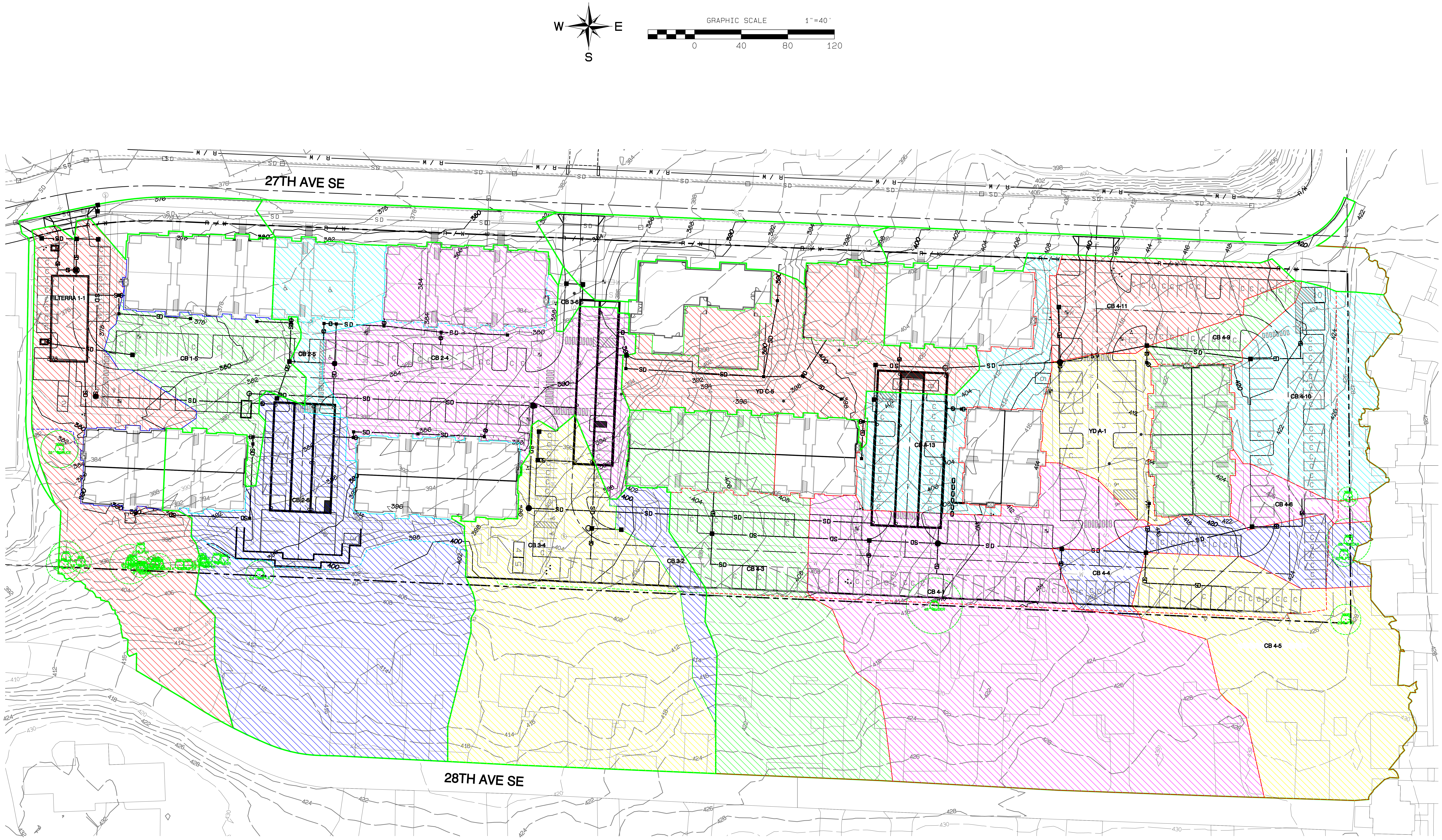
Bradley Heights - Drainage Report

Section 3, Township 19 N, Range 4 E, Willamette Meridian, Pierce County, Washington

Provide basin map that clearly labels and delineates
each basin within the context of the model.
[STORMWATER REPORT, Page 216/216]



5/17/2024
ROBERT A. TRIVITT
43715

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CB Drainage Basins

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DRAWING
D-2
SHEET 2
OF 2

Project Desc.: Bradley Heights Path: F:\Jobs\3227 - Bradley Heights\Tmwin\bradley heights 2024 0517 ENG.pro Plot Date/Time: 5/17/2024/10:26:08AM