BARGHAUSEN

PRELIMINARY TECHNICAL INFORMATION REPORT

1510 Puyallup
Sumner, Washington

4/19/2019

Prepared for:
Duke Realty Limited Partnership
200 Spectrum Center Drive, #200
Irvine, CA 92618

April 19, 2019

Our Job No. 20662

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Preliminary Technical Information Report

1510 Puyallup

Sumner, Washington

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TABLE OF CONTENTS

TABLE OF EXHIBITS

Tab 1.0

1.0 PROJECT OVERVIEW

1.1 Purpose and Scope

The proposed 1510 Puyallup Site project consists of approximately 9.2 acres of land located at 1510 Puyallup Street, north of downtown Sumner. The existing site will be redeveloped with an approximate 183,800 square foot warehouse type building, parking, truck docks, utilities, landscaping, and storm facilities. The existing site is home to Pasquier Panel Products, a wood panel manufacturing facility. More particularly the site is described as a portion of Section 24, Township 20 North, Range 4 East, Willamette Meridian, City of Sumner, and Pierce County, Washington. Please see the vicinity map included as Exhibit A.

This report provides site information and an analysis used to design the stormwater facilities that will provide the detention, water quality, and conveyance for approximately 9.2 acres pursuant to development. A SEPA determination is being applied for with the City of Sumner for this site. The proposed project site is designed to meet the City of Sumner and the 2012 Department of Ecology Stormwater Management Manual for Western Washington requirements.

1.2 Pre-Developed Conditions

The proposed project site consists of 9.2 acres of land located between Puyallup Street and Hubbard Street, just west of Williams Avenue within the City of Sumner. This area includes some of the Hubbard Street right-of-way that is being improved. The existing site is currently a manufacturing facility with existing buildings and pavement on the west and grass and vegetation on the east side.

The pre-developed site generally slopes from south to north. There are existing storm conveyance systems both onsite and in the surrounding right-of-ways.

Drainage from the site flows west in Puyallup Street, eventually discharging to the White Stuck River.

1.3 Post Developed Conditions

The proposal for this project is to construct an approximate 183,800 square foot warehouse type building on the site. The site would also include driveways, utilities, landscaping, parking, truck docks and storm water facilities.

The site will be graded to drain to new catch basins and underground conveyance. The storm system would slope to the northeast and enter a proposed onsite pond and tank detention system for detention. Water quality would be achieved prior to detention with the installation of vault type water quality units between the last catch basin and the detention system. The water quality units are WSDOE GULD approved for Enhanced treatment. Runoff from the proposed ROW improvements would similarly be treated with a water quality unit prior to discharge into the detention system.

Tab 2.0

2.0 EXISTING CONDITIONS SUMMARY

2.1 General Requirements

The proposed project site is designed to meet the detention and water quality requirements of the 2012 DOE Stormwater Management Manual for Western Washington and the requirements of the City of Sumner. This site is considered a "valley" site and as such is designed to meet the 2 and 10 peak discharge rates from the site as allowed by the City of Sumner. Per the City of Sumner requirements, no systems that utilize a pool of water for water quality treatment are allowed.

ANALYSIS OF THE MINIMUM REQUIREMENTS

Minimum Requirement No. 1: Preparation of Stormwater Site Plans.

Response: This report submitted with the construction drawings for this site satisfy this requirement.

Minimum Requirement No. 2: Construction Stormwater Pollution Prevention (SWPP).

Response: See Exhibit H for the SWPPP and for the responses for the 13 elements. This will be prepared during the construction permit application.

Minimum Requirement No. 3: Source Control of Pollution.

Response: Good housekeeping measures will be used to keep the site clean and to reduce the chance that stormwater will come into contact with pollutants.

Minimum Requirement No. 4: Preservation of Natural Drainage Systems and Outfalls.

Response: This site drains to the existing conveyance systems surrounding the site. The drainage will continue to be directed north to the Puyallup Street right-of-way conveyance system to match existing conditions.

Minimum Requirement No. 5: On-site Stormwater Management.

Response: Because this site is not suitable for infiltration and there is not space available for dispersion, LID best management practices are not practical for this site. The runoff from the project site will collected and routed to a detention system on the east side of the site. See Section 4.3 for additional narrative.

Minimum Requirement No. 6: Runoff Treatment.

Response: Runoff from this project site will be routed to a GULD approved water quality unit for enhanced water quality treatment. The proposed units will be located prior to the detention system.

Minimum Requirement No. 7: Flow Control.

Response: Flow control is being provided in the proposed detention pond and tank system located onsite. The detention system will utilize 7.5 feet of live storage and will meet peak discharge rates as required.

Minimum Requirement No. 8: Wetlands Protection.

Response: Not applicable, this site does not drain to a wetland.

Minimum Requirement No. 9: Operation and Maintenance

An Operation and Maintenance Manual will be included as Exhibit I during the construction permit application.

2.2 Drainage Basin

The proposed project is located in the White/Stuck River Basin, which is situated in northern Pierce County. A review of the topographic map and field observations confirm that runoff from the site generally flows west in Puyallup Street towards the White/Stuck River. The White River continues into the Puyallup River and ultimately into Puget Sound.

2.3 Soil Conditions

The existing soil conditions consist of Sultan silt loam, which is considered type C soil, and Briscot loam and Snohomish silty clay loam which are considered type D soils. The existing site is developed on the western portion with grass, shrubs and a few trees on the east side and on the north side of the office building. The site was modeled as flat, type C forest for existing conditions. Per the geotechnical review of the existing conditions, infiltration is not recommended on this site.

Please see Exhibit B SCS soils map.

2.4 Critical / Sensitive Areas

A review of critical and sensitive area maps provided by the City of Sumner show that the site has a high liquefaction potential as shown on the seismic hazard map and within the Volcanic Hazard Zone for a possible lahar flow path. The site is also located within a wellhead protection area for the Central Well. The site does not include wetland, flood hazard or landslide hazard areas. Critical Area Maps are included in Exhibit J.

Tab 3.0

3.0 OFF-SITE ANALYSIS

3.1 Upstream Tributary Area

Because the project site is surrounded by existing development and street right-of-ways, there is no offsite drainage directed to the site.

3.2 Downstream Analysis

Runoff exits the property on the north side where runoff enters the existing underground conveyance system in Puyallup Street. The pipe is a 12" pipe on the eastern side of the project frontage but increases to a 24" pipe on the western side of the project frontage at the intersection with Tacoma Avenue. Runoff continues west in 24" storm pipes approximately 1000 feet where there is a discharge to the White/Stuck River.

The White River then flows west approximately 7,600 feet where it joins the Puyallup River. The Puyallup River continues to Puget Sound.

Please refer to the attached Downstream Drainage Path Map, Exhibit J.

Tab 4.0

4.0 PERMANENT STORMWATER CONTROL PLAN

4.1 Existing Site Hydrology

The project site is developed with a large manufacturing building, a couple of accessory buildings, and a large paved area for parking and loading.

The site slopes from south to north and drains primarily to the existing catch basins onsite and then to the existing conveyance system in Puyallup Street. The site is considered flat till forest for existing conditions. See Exhibit C for the Existing Conditions Basin Map.

4.2 Developed Site Hydrology

Under developed conditions, the existing site will demolished and redeveloped. The proposed project consists of a new warehouse type building, a parking facility for employees and customers, truck loading docks and a maneuvering area. Runoff from approximately 9.2 acres of area, which includes a portion of Hubbard Street, shall be detained and treated as required. See Exhibit D - Developed Conditions Basin Map.

Water quality will occur before discharge to the detention system by installing vault type water quality units between the last catch basin and the detention system. The eastern portion of the roof will drainage directly to the detention system without treatment. Discharge from the site will be to the existing storm pipes in Puyallup Street as it is in existing conditions. The storm drainage proposal conforms to the requirements of the 2012 Department of Ecology Stormwater Management Manual and City of Sumner requirements.

4.3 Performance Standards and Goals

Calculations are shown using Western Washington Hydrology Model (WWHM2012) to size the detention system based on the 2012 DOE Standards and the City of Sumner 'valley' standards. Stormwater developed discharge peak rates shall match pre-developed for the 2-year and 10-year events. The detention system, which provides 7.5 feet of live storage has the volume capacity to detain the developed flows anticipated from this site. Please see the Exhibit E for hydrology calculations.

Since this is an industrial site, enhanced water quality treatment is required.

This development triggers all of the minimum requirements, including Minimum Requirement #5 – Stormwater Management. In order to meet this requirement, List #2 was evaluated for each surface to determine which LID BMPs could be used on this site. See below for feasibility analysis:

- Lawn and Landscape Areas:
    - Post-Construction Soil Quality and Depth (BMP T5.13)
        - This BMP is feasible and will be used onsite.
- Roof Areas:
    - Full Dispersion

        - This site is not proposing to protect at least 65% of the site in native condition or forest to allow full dispersion onsite.

    - Full Infiltration

        - Infiltration is not feasible onsite due to existing soils. Infiltration is also not recommended by the geotechnical engineer.

    - Bio Retention

        - Infiltration is not recommended for this site due to soil type.

    - Downspout Dispersion

        - Site design constraints prevent a 25' vegated flow path.

    - Perforated Stub-Out Connections

        - Perforated stub-out connections are infeasible because pipes will be located under paved areas and because infiltration is not advised.

- Other Hard Surfaces:

    - Full Dispersion

        - This site is not proposing to protect at least 65% of the site in native condition or forest to allow full dispersion onsite.

    - Permeable Pavement

        - Infiltration is not recommended for this site.

    - Bio Retention

        - Infiltration is not recommended for this site.

    - Sheet flow dispersion

        - Infeasible due to site and size constraints.

4.4 Flow Control System

Per the Geotechnical Engineering Report, infiltration is not feasible on the project site.

The detention system proposed is a combination of an open pond in the northeast corner and underground detention tanks in the truck dock. An equalizer pipe will be used between the two systems so they act as one system. The detention system is sized to provide the required volume to match the peak flows as required for the 9.2 acres tributary to it.

The calculations to size the detention system can be seen in Exhibit E Detention Analysis and Design.

4.5 Water Quality System

This project proposes to utilize vault type water quality units to provide enhanced treatment for the proposed improvements. The units have obtained Department of Ecology (DOE) approval for enhanced water quality treatment. Please refer to Exhibit F for water quality calculations and the GULD approval.

Because there are less than 25 truck docks proposed, oil control is not required.

4.6 Conveyance System Analysis and Design

Per City of Sumner Development Standards (section 5.2), conveyance calculations will be performed using SBUH methodology as permitted in the WSDOT Hydraulics Manual. The conveyance system will be designed to convey and contain the 25-year peak flows at a minimum. The conveyance calculations will be included as Exhibit G.

Tab 5.0

5.0 CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN (SWPPP)

An construction stormwater pollution prevention plan (SWPPP) will be prepared and included as Exhibit H during construction permit application.

Tab 6.0

6.0 SPECIAL REPORTS AND STUDIES

The following report has been prepared for this project site:

- Geotechnical Engneering Study by Earth Solutions NW, LLC dated January 30, 2019

Tab 7.0

7.0 Other permits

City of Sumner approval will be required for the following:

- City of Sumner Design Review
- City of Sumner Grade and Fill Permit
- City of Sumner Street Obstruction Notification
- City of Sumner Permits for Utility Extensions
- City of Sumner Commercial Building Permit (Commercial and Industrial Application)
- Washington State Department of Ecology NPDES Permit (Construction Stormwater General Permit)

A Construction Stormwater General Permit will be obtained prior to any soil disturbance onsite and will be maintained throughout construction. Any proposed retaining walls over four feet in height will also need separate building permits. Any fences will also need permits.

Tab 8.0

8.0 OPERATIONS AND MAINTENANCE MANUAL

An Operations and Maintenance Manual will be prepared and included as Exhibit I with the construction permit application.

Tab 9.0

9.0 BOND QUANTITIES

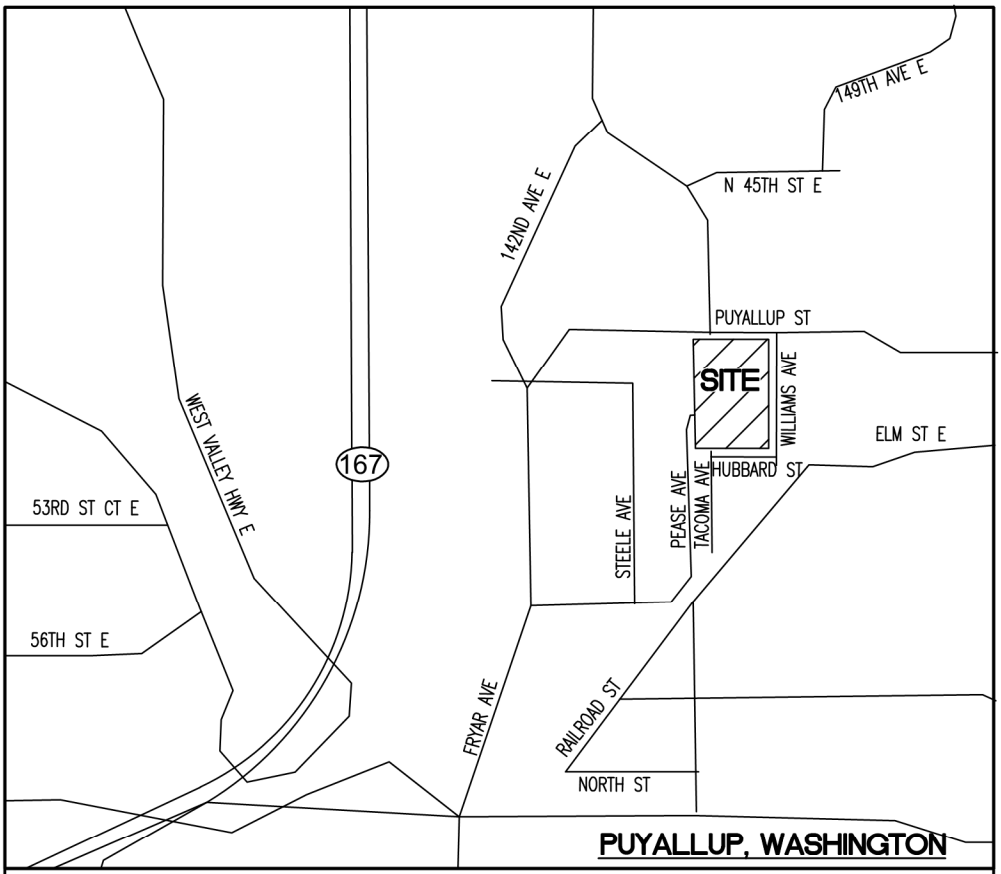
Bond quantities will be prepared and submitted along with final design plans as required by the City.

Tab 10.0

10.0 CONCLUSION

This Preliminary Technical Information Report shows the design for this site to meet all the requirements of the City of Sumner as mentioned in the 2012 Department of Ecology Stormwater Management Manual for Western Washington as modified by the City of Sumner. Therefore, this project should be accepted as proposed.

Exhibit A
Vicinity Map



VICINITY MAP
N.T.S.

Exhibit B
SCS Soils Map

Map Scale: 1:1,620 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Pierce County Area, Washington
Survey Area Data: Version 14, Sep 10, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 8, 2014—Jul 15, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
6A	Briscot loam	1.3	13.0%
39A	Snohomish silty clay loam	1.5	15.7%
42A	Sultan silt loam	7.0	71.3%
Totals for Area of Interest		**9.8**	**100.0%**

III-2.3.2 Runoff Parameters

All storm event hydrograph methods require input of parameters that describe physical drainage basin characteristics. These parameters provide the basis from which the runoff hydrograph is developed. This section describes only the key parameter of curve number that is used to estimate the runoff from the water quality design storm.

Curve Number

The NRCS (formerly SCS) has, for many years, conducted studies of the runoff characteristics for various land types. After gathering and analyzing extensive data, NRCS has developed relationships between land use, soil type, vegetation cover, interception, infiltration, surface storage, and runoff. The relationships have been characterized by a single runoff coefficient called a "curve number." The National Engineering Handbook - Section 4: Hydrology (NEH-4, SCS, August 1972) contains a detailed description of the development and use of the curve number method.

NRCS has developed "curve number" (CN) values based on soil type and land use. They can be found in *Urban Hydrology for Small Watersheds*, Technical Release 55 (TR-55), June 1986, published by the NRCS. The combination of these two factors is called the "soil-cover complex." The soil-cover complexes have been assigned to one of four hydrologic soil groups, according to their runoff characteristics. NRCS has classified over 4,000 soil types into these four soil groups. Table III-2.3.1 Hydrologic Soil Series for Selected Soils in Washington State shows the hydrologic soil group of most soils in the state of Washington and provides a brief description of the four groups. For details on other soil types refer to the NRCS publication mentioned above (TR-55, 1986).

Table III-2.3.1 Hydrologic Soil Series for Selected Soils in Washington State

Soil Type	Hydrologic Soil Group	Soil Type	Hydrologic Soil Group	Soil Type	Hydrologic Soil Group
Agnew	C	Hoogdal	C	Raught	B
Ahl	B	Hoypus	A	Reed	D
Aits	C	Huel	A	Reed, Drained or Protected	C
Alderwood	C	Indianoloa	A	Renton	D
Arents, Alderwood	B	Jonas	B	Republic	B
Arents, Everett	B	Jumpe	B	Riverwash	variable
Ashoe	B	Kalaloch	C	Rober	C
Baldhill	B	Kapowsin	C/D	Salal	C
Barneston	C	Kilchis	C	Salkum	B
Baumgard	B	Kitsap	C	Sammamish	D
Beausite	B	Klaus	C	San Juan	A
Belfast	C	Klone	B	Scamman	D
Bellingham	D	Lates	C	Schneider	B
Bellingham varient	C	Lebam	B	Seattle	D
Boistfort	B	Lummi	D	Sekiu	D
Bow	D	Lynwood	A	Semiahmoo	D
Bristcot	D	Lystair	B	Shalcar	D
Buckley	C	Mal	C	Shano	B
Bunker	B	Manley	B	Shelton	C
Cagey	C	Mashel	B	Si	C
Carlsborg	A	Maytown	C	Sinclair	C
Casey	D	McKenna	D	Skipopa	D
Cassolary	C	McMurray	D	Skykomish	B
Cathcard	B	Melbourne	B	Snahopish	B
Centralia	B	Menzel	B	Snohomish	D
Chehalis	B	Mized Alluvial	variable	Solduc	B

Soil Type	Hydrologic Soil Group	Soil Type	Hydrologic Soil Group	Soil Type	Hydrologic Soil Group
Chesaw	A	Molson	B	Solleks	C
Cinebar	B	Mukilteo	C/D	Spana	D
Calallam	C	Naff	B	Spanaway	A/B
Clayton	B	Nargar	A	Springdale	B
Coastal beaches	variable	National	B	Sulavar	B
Colter	C	Neilton	A	Sultan	C
Custer	D	Newberg	B	Sultan variant	B
Custer, Drained	C	Nisqually	B	Sumas	C
Dabob	C	Nooksak	C	Swantown	D
Datula	C	Norma	C/D	Tacoma	D
Delphi	D	Ogarty	C	Tanwax	D
Dick	A	Olete	C	Tanwax, Drained	C
Dimal	D	Olomount	C	Tealwhit	D
Dupont	D	Olympic	B	Tenino	C
Earlmont	C	Orcas	D	Tisch	D
Edgewick	C	Oridia	D	Tokul	C
Eld	B	Orting	D	Townsend	C
Elwell	B	Oso	C	Trition	D
Esquatzel	B	Ovall	C	Tukwila	D
Everett	A	Pastik	C	Tukey	C
Everson	D	Pheeney	C	Urbana	C
Galvin	D	Phelan	D	Vailton	B
Getchell	A	Pilchuck	C	Verlot	C
Giles	B	Potchub	C	Wapato	D
Godfrey	D	Poulsbo	C	Warden	B
Greenwater	A	Prather	C	Whidbey	C
Grove	C	Puget	D	Wilkeson	B
Harstine	C	Puyallup	B	Winston	A
Hartnit	C	Queets	B	Woodinville	B
Hoh	B	Quilcene	C	Yelm	C
Holo	C	Ragnar	B	Zynbar	B
Hoodsport	C	Rainier	C		

Notes:

Hydrologic Soil Group Classifications, as defined by the Soil Conservation Service:

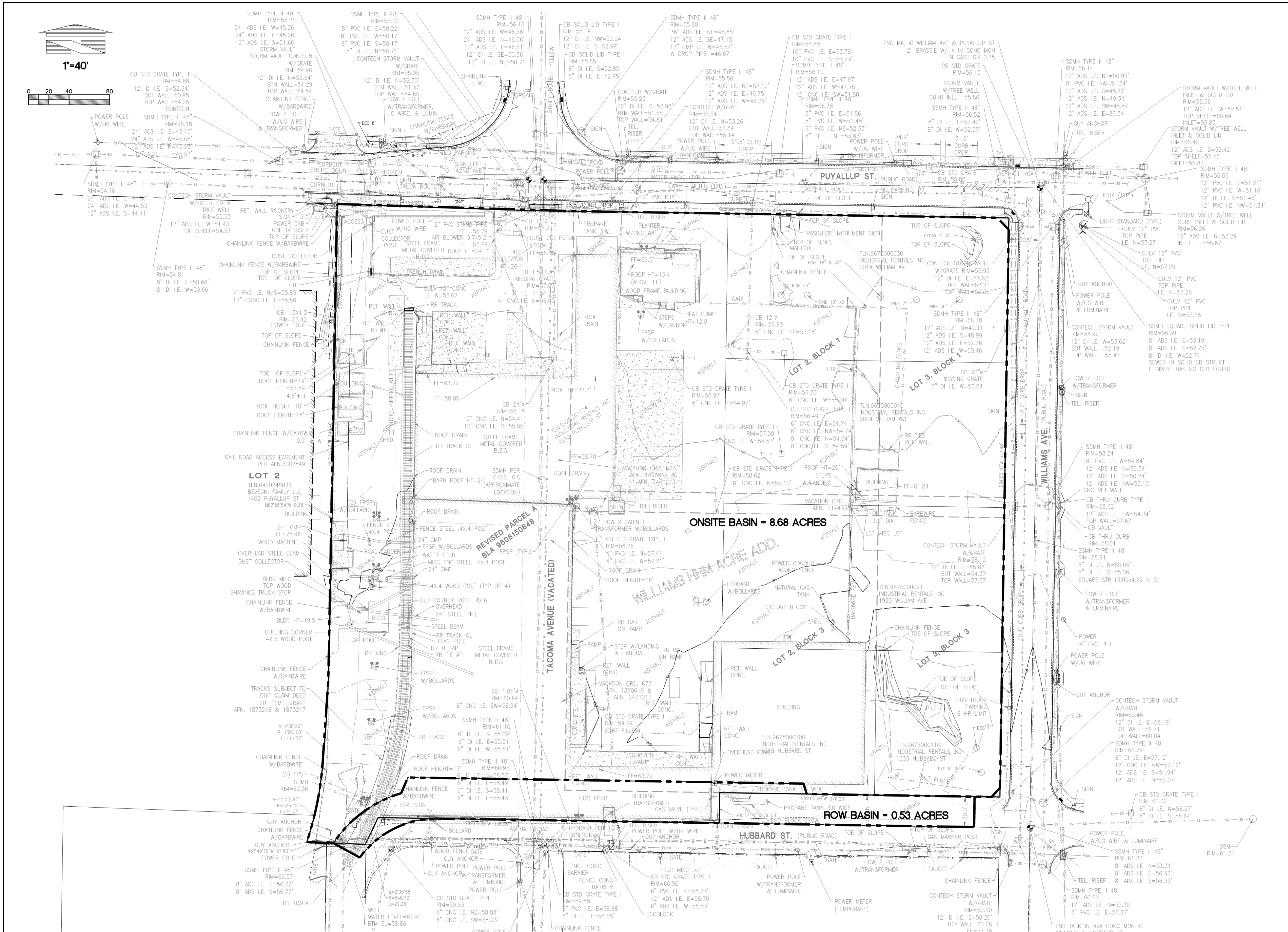
A= (Low runoff potential). Soils having low runoff potential and high infiltration rates, even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels and have a high rate of water transmission (greater than 0.30 in/hr.).

B =(Moderately low runoff potential). Soils having moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.3 in/hr.).

C = (Moderately high runoff potential). Soils having low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine textures. These soils have a low rate of water transmission (0.05-0.15 in/hr.).

D = (High runoff potential). Soils having high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a hardpan

Exhibit C
Existing Conditions
Basin Map



EXISTING CONDITONS MAP

1510 PUYALLUP STREET

For: DUKE REALTY
200 SPECTRUM CENTER DRIVE, SUITE 1600
IRVINE, CA 92618

JASON GUY HUBBELL — STATE OF WASHINGTON — 28950 — REGISTERED PROFESSIONAL ENGINEER
04/18/2019

Designed	KEH
Drawn	RDC
Checked	KEH
Approved	JGH
Date	4/18/19
Scale	Horizontal 1"=40' / Vertical NA

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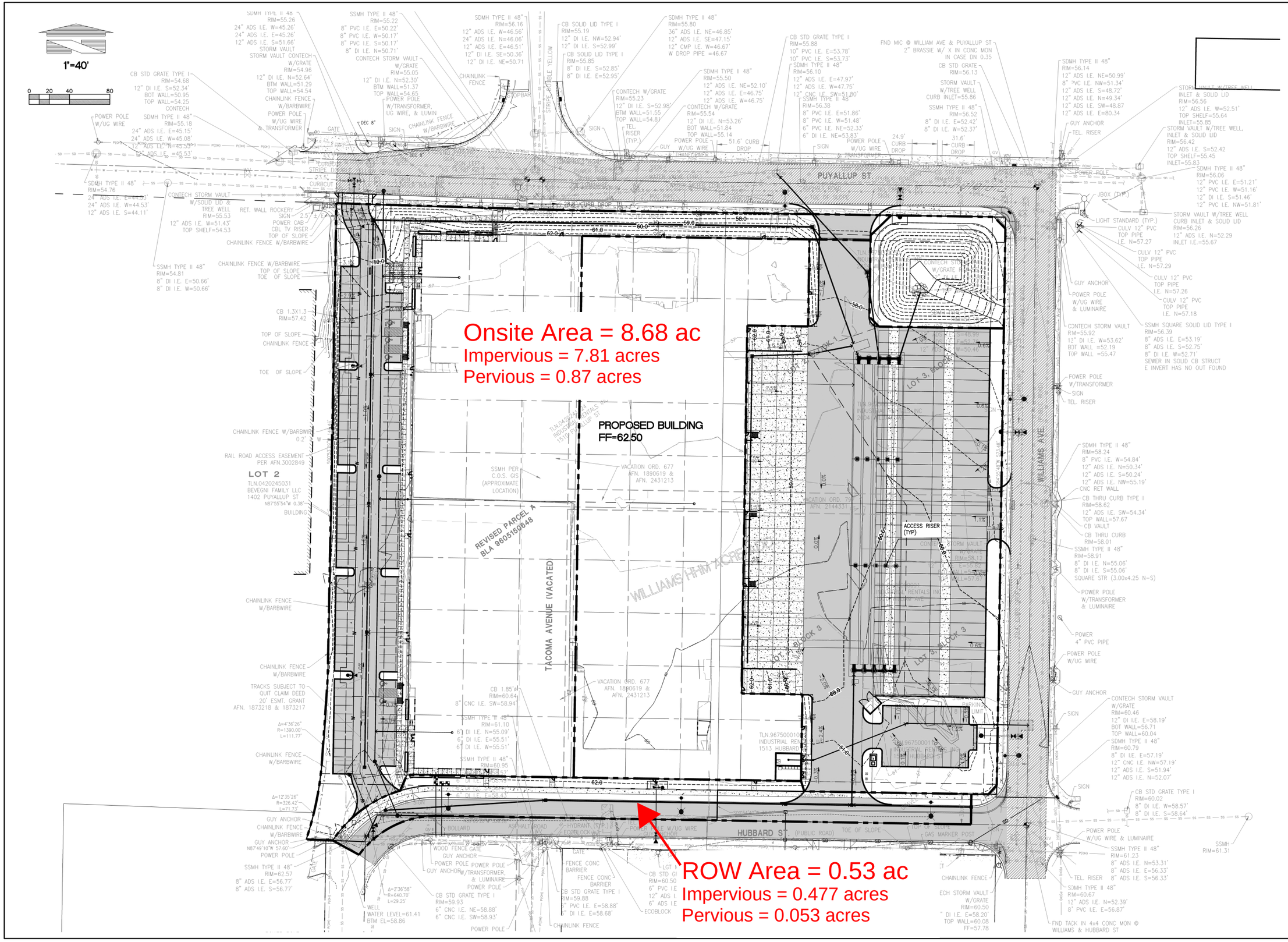
Sheet 1 of 1

Exhibit D
Developed Conditions Basin Map

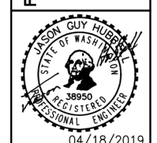


No.	Date	By	Ckd.	Appr.	Revision

Title: DEVELOPED CONDITIONS MAP

1510 PUYALLUP STREET

For: DUKE REALTY
200 SPECTRUM CENTER DRIVE,
SUITE 1600
IRVINE, CA 92618



04/18/2019

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Designed KEH Drawn RDC Checked KEH Approved KEH Date 4/18/19

Barghausen Consulting Engineers, Inc.
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Job Number 20662

Sheet 1 of 1

File:P:\20000s\20662\exhibit\20662-basin map.dwg Date/Time:4/18/2019 11:45 AM Scale:0.388863 HWARRIS Xref: ----

Exhibit E
Detention Analysis and Design

Site Summary

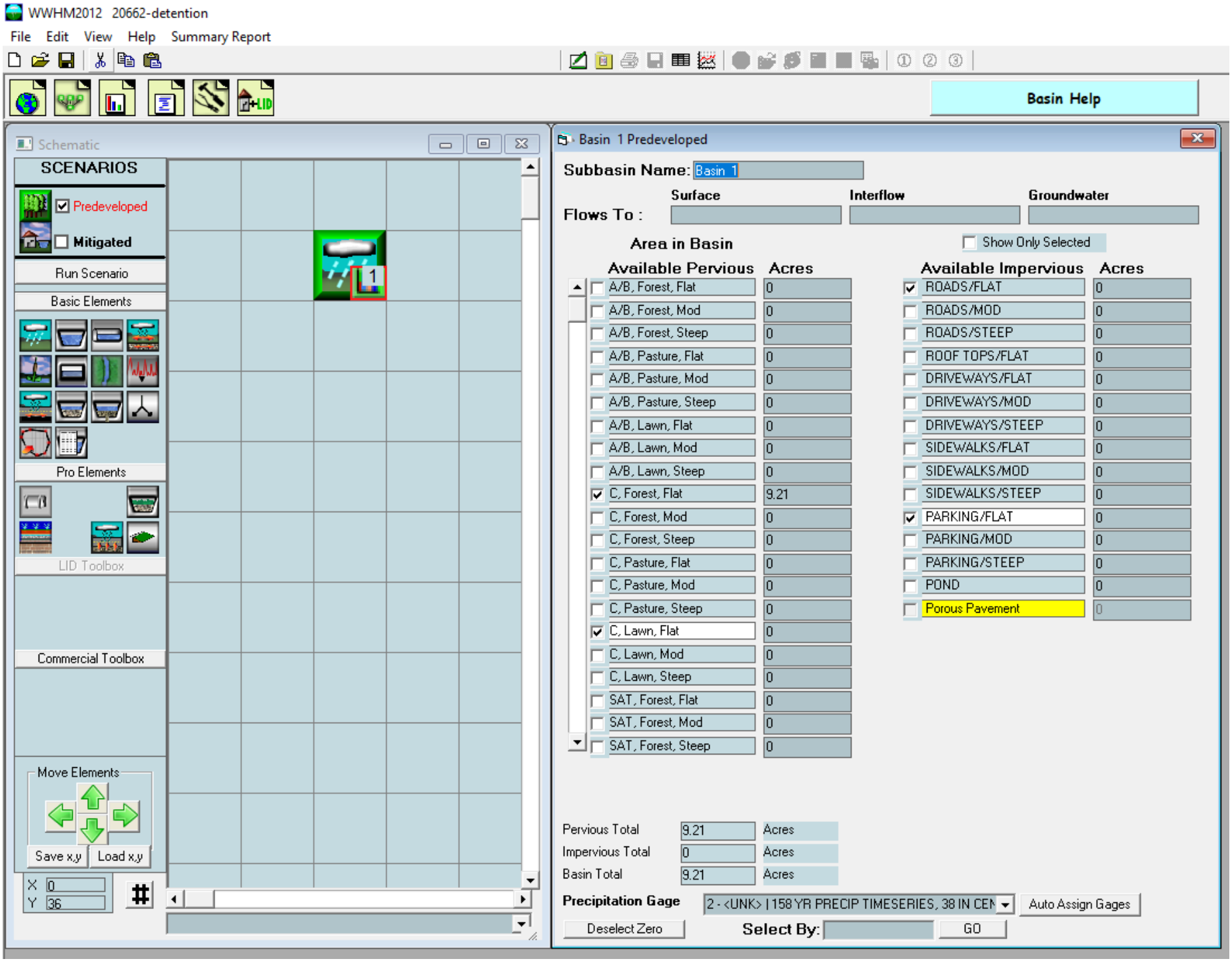
Total Area to detention = 9.21 acres

On-Site Area = 8.68 acres

Impervious flat = 7.81 acres
Landscape flat = 0.87 acre

ROW Area = 0.53 acres

Impervious flat = 0.477 acres
Landscape flat = 0.053 acre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Basin Help
Schematic
SCENARIOS
Predeveloped
Mitigated
Run Scenario
Basic Elements
Pro Elements
LID Toolbox
Commercial Toolbox
Move Elements
Save x,y
Load x,y
X 0
Y 36
Basin 1 Predeveloped
Subbasin Name: Basin 1
Flows To :
Surface
Interflow
Groundwater
Area in Basin
Show Only Selected
Available Pervious
Acres
A/B, Forest, Flat 0
A/B, Forest, Mod 0
A/B, Forest, Steep 0
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ROADS/MOD 0
ROADS/STEEP 0
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DRIVEWAYS/MOD 0
DRIVEWAYS/STEEP 0
SIDEWALKS/FLAT 0
SIDEWALKS/MOD 0
SIDEWALKS/STEEP 0
PARKING/FLAT 0
PARKING/MOD 0
PARKING/STEEP 0
POND 0
Porous Pavement 0
Pervious Total 9.21 Acres
Impervious Total 0 Acres
Basin Total 9.21 Acres
Precipitation Gage
2 - <UNK> | 158 YR PRECIP TIMESERIES, 38 IN CEN
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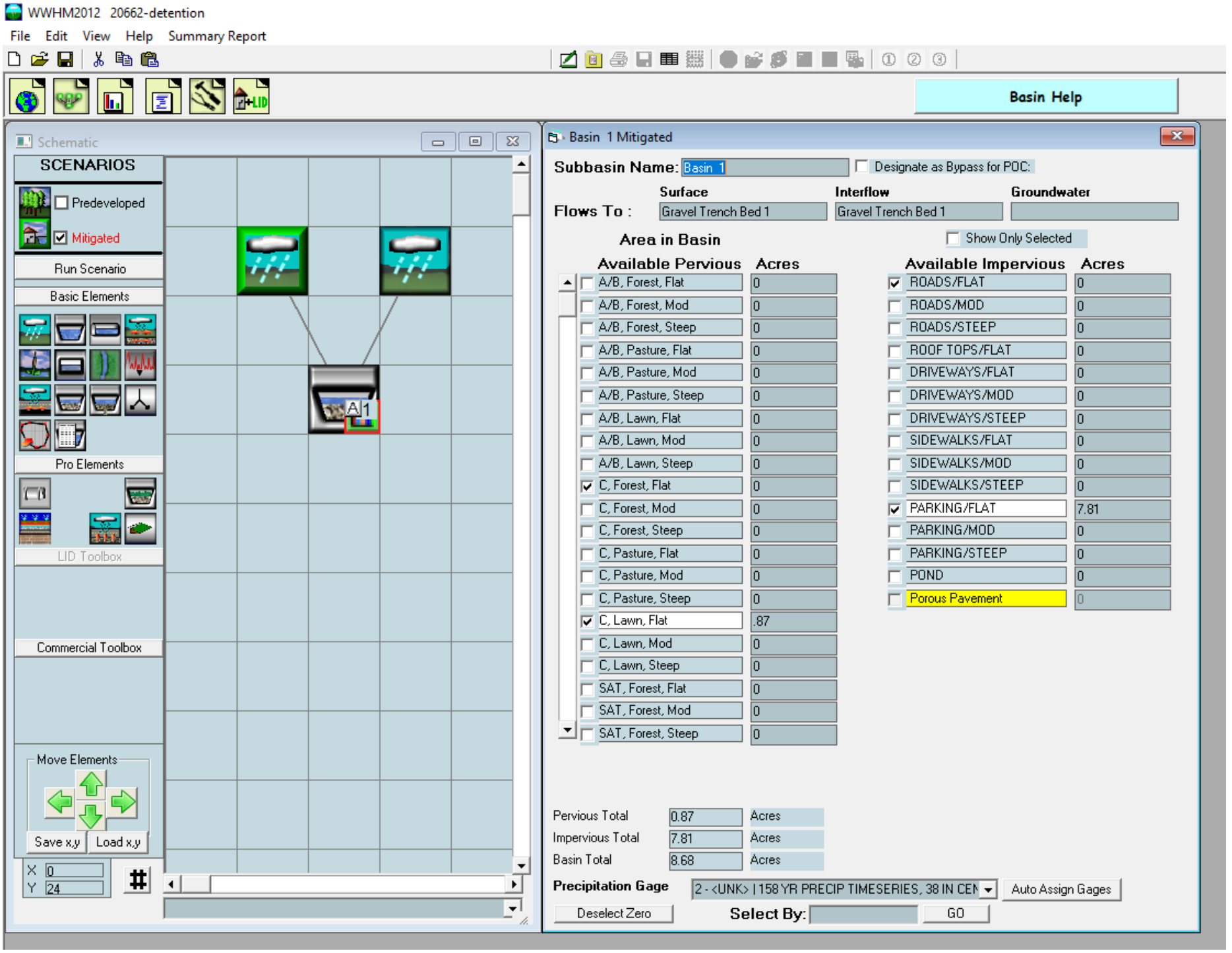
Deselect Zero
Select By:
GO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Predeveloped
Mitigated
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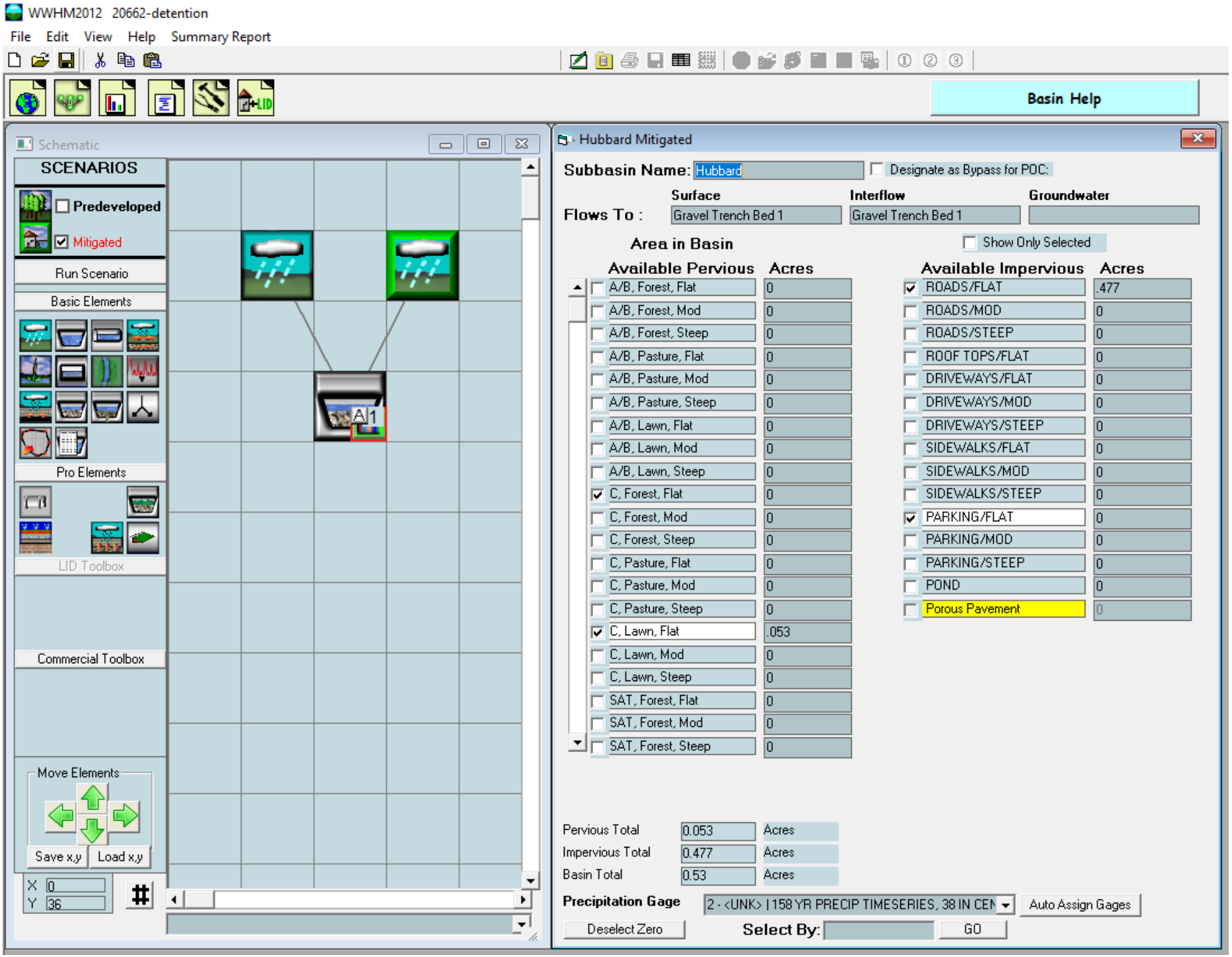
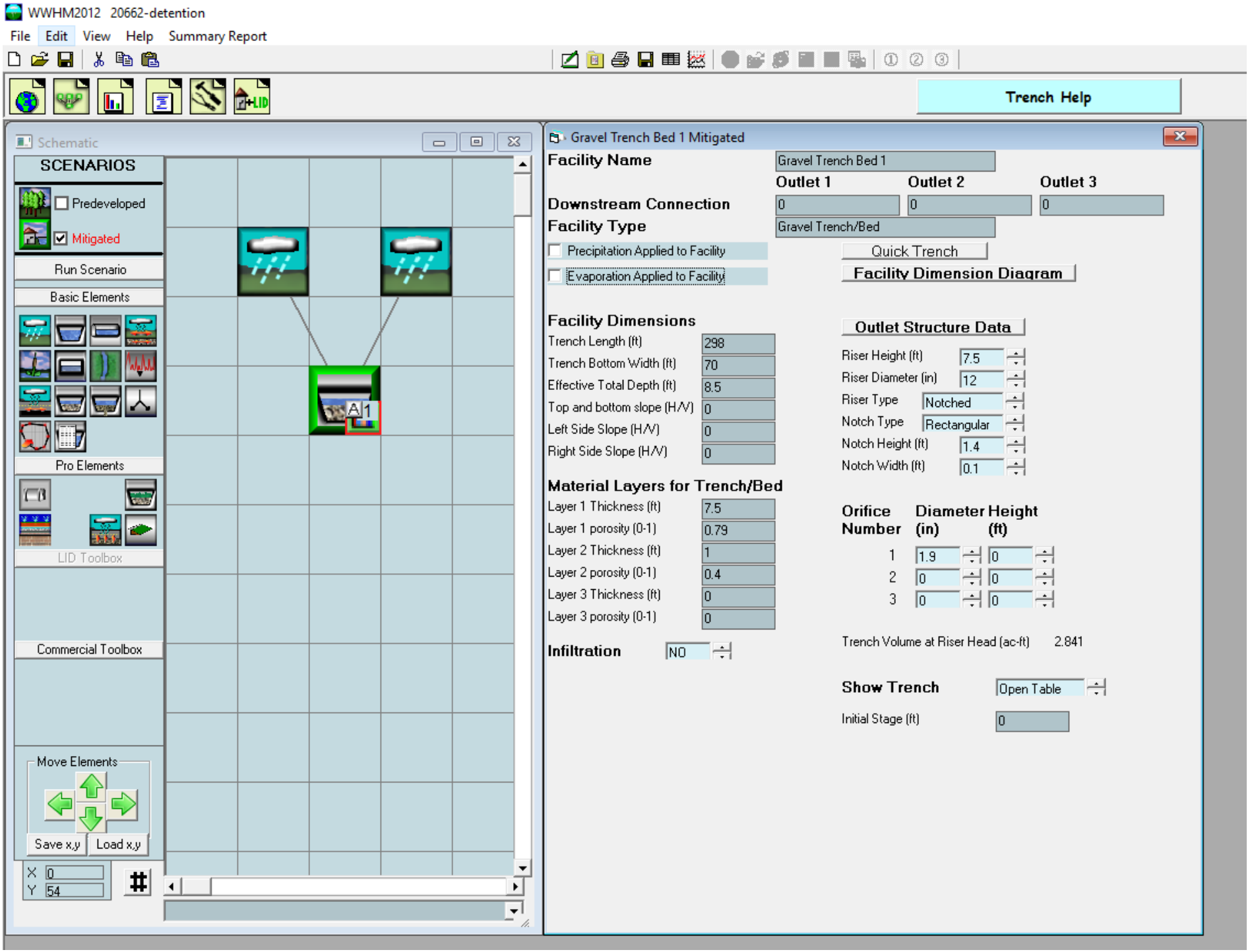
Pro Elements
LID Toolbox
Commercial Toolbox
Move Elements
Save x,y
Load x,y
X 0
Y 24
A1
Basin 1 Mitigated
Subbasin Name: Basin 1
Designate as Bypass for POC:
Flows To :
Surface
Interflow
Groundwater
Gravel Trench Bed 1
Gravel Trench Bed 1
Area in Basin
Show Only Selected
Available Pervious
Acres
A/B, Forest, Flat 0
A/B, Forest, Mod 0
A/B, Forest, Steep 0
A/B, Pasture, Flat 0
A/B, Pasture, Mod 0
A/B, Pasture, Steep 0
A/B, Lawn, Flat 0
A/B, Lawn, Mod 0
A/B, Lawn, Steep 0
C, Forest, Flat 0
C, Forest, Mod 0
C, Forest, Steep 0
C, Pasture, Flat 0
C, Pasture, Mod 0
C, Pasture, Steep 0
C, Lawn, Flat .87
C, Lawn, Mod 0
C, Lawn, Steep 0
SAT, Forest, Flat 0
SAT, Forest, Mod 0
SAT, Forest, Steep 0
Available Impervious
Acres
ROADS/FLAT 0
ROADS/MOD 0
ROADS/STEEP 0
ROOF TOPS/FLAT 0
DRIVEWAYS/FLAT 0
DRIVEWAYS/MOD 0
DRIVEWAYS/STEEP 0
SIDEWALKS/FLAT 0
SIDEWALKS/MOD 0
SIDEWALKS/STEEP 0
PARKING/FLAT 7.81
PARKING/MOD 0
PARKING/STEEP 0
POND 0
Porous Pavement 0
Pervious Total 0.87 Acres
Impervious Total 7.81 Acres
Basin Total 8.68 Acres
Precipitation Gage
2 - <UNK> | 158 YR PRECIP TIMESERIES, 38 IN CEN
Auto Assign Gages
Deselect Zero
Select By:
GO


WWHM2012 20662-detention
File Edit View Help Summary Report
Basin Help
Schematic
SCENARIOS
Predeveloped
Mitigated
Run Scenario
Basic Elements
Pro Elements
LID Toolbox
Commercial Toolbox
Move Elements
Save x,y
Load x,y
X 0
Y 36
A1
Hubbard Mitigated
Subbasin Name: Hubbard
Designate as Bypass for POC:
Flows To :
Surface
Interflow
Groundwater
Gravel Trench Bed 1
Gravel Trench Bed 1
Area in Basin
Show Only Selected
Available Pervious
Acres
A/B, Forest, Flat 0
A/B, Forest, Mod 0
A/B, Forest, Steep 0
A/B, Pasture, Flat 0
A/B, Pasture, Mod 0
A/B, Pasture, Steep 0
A/B, Lawn, Flat 0
A/B, Lawn, Mod 0
A/B, Lawn, Steep 0
C, Forest, Flat 0
C, Forest, Mod 0
C, Forest, Steep 0
C, Pasture, Flat 0
C, Pasture, Mod 0
C, Pasture, Steep 0
C, Lawn, Flat .053
C, Lawn, Mod 0
C, Lawn, Steep 0
SAT, Forest, Flat 0
SAT, Forest, Mod 0
SAT, Forest, Steep 0
Available Impervious
Acres
ROADS/FLAT .477
ROADS/MOD 0
ROADS/STEEP 0
ROOF TOPS/FLAT 0
DRIVEWAYS/FLAT 0
DRIVEWAYS/MOD 0
DRIVEWAYS/STEEP 0
SIDEWALKS/FLAT 0
SIDEWALKS/MOD 0
SIDEWALKS/STEEP 0
PARKING/FLAT 0
PARKING/MOD 0
PARKING/STEEP 0
POND 0
Porous Pavement 0
Pervious Total 0.053 Acres
Impervious Total 0.477 Acres
Basin Total 0.53 Acres
Precipitation Gage
2 - <UNK> | 158 YR PRECIP TIMESERIES, 38 IN CEN
Auto Assign Gages
Deselect Zero
Select By:
GO

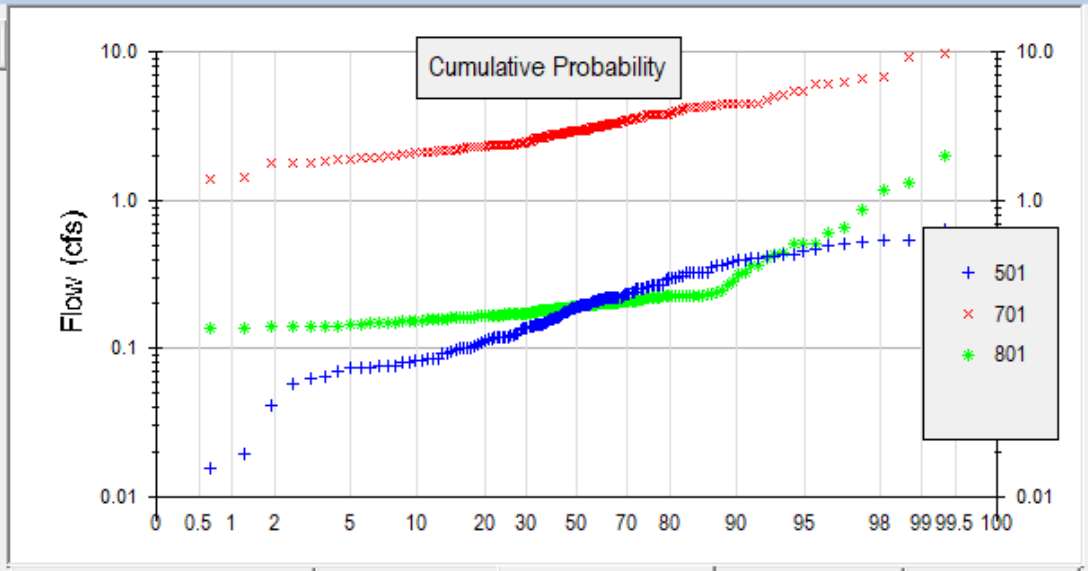

WWHM2012 20662-detention
File Edit View Help Summary Report
Trench Help
Schematic
SCENARIOS
Predeveloped
Mitigated
Run Scenario
Basic Elements
Pro Elements
LID Toolbox
Commercial Toolbox
Move Elements
Save x,y
Load x,y
X 0
Y 54
A1
Gravel Trench Bed 1 Mitigated
Facility Name
Gravel Trench Bed 1
Outlet 1
Outlet 2
Outlet 3
Downstream Connection
0
0
0
Facility Type
Gravel Trench/Bed
Precipitation Applied to Facility
Evaporation Applied to Facility
Quick Trench
Facility Dimension Diagram
Facility Dimensions
Trench Length (ft) 298
Trench Bottom Width (ft) 70
Effective Total Depth (ft) 8.5
Top and bottom slope (H/V) 0
Left Side Slope (H/V) 0
Right Side Slope (H/V) 0
Outlet Structure Data
Riser Height (ft) 7.5
Riser Diameter (in) 12
Riser Type Notched
Notch Type Rectangular
Notch Height (ft) 1.4
Notch Width (ft) 0.1
Material Layers for Trench/Bed
Layer 1 Thickness (ft) 7.5
Layer 1 porosity (0-1) 0.79
Layer 2 Thickness (ft) 1
Layer 2 porosity (0-1) 0.4
Layer 3 Thickness (ft) 0
Layer 3 porosity (0-1) 0
Orifice Number
Diameter (in)
Height (ft)
1 1.9 0
2 0 0
3 0 0
Infiltration NO
Trench Volume at Riser Head (ac-ft) 2.841
Show Trench Open Table
Initial Stage (ft) 0

WWHM2012 20662-detention

File Edit View Help Summary Report

Analysis Help

Analysis



Stream Protection Duration | LID Duration | Flow Frequency | Water Quality | Hydrograph

Wetland Input Volumes | LID Report | Recharge Duration | Recharge Predeveloped | Recharge Mitigated

Analyze datasets Compact WDM Delete Selected Monthly FF

501 POC 1 Predeveloped flow
701 Inflow to POC 1 Mitigated
801 POC 1 Mitigated flow
1000 Trapezoidal Pond 1 ALL OUTLETS Mitigated
1002 Gravel Trench Bed 1 ALL OUTLETS Mitigated

All Datasets | Flow | Stage | Precip | Evap | POC 1

Flood Frequency Method
- (•) Log Pearson Type III 17B
- ( ) Weibull
- ( ) Cunnane
- ( ) Gringorten

Flow Frequency

Flow(cfs)	0501 15m	0701 15m	0801 15m
2 Year =	0.1941	2.9410	0.1936
5 Year =	0.3019	3.9608	0.2823
10 Year =	0.3605	4.7039	0.3598
25 Year =	0.4202	5.7230	0.4835
50 Year =	0.4556	6.5424	0.5974
100 Year =	0.4848	7.4150	0.7329

Annual Peaks

1902	0.1423	3.4360	0.2042
1903	0.1184	3.8105	0.1649
1904	0.1936	4.4684	0.1733
1905	0.0932	1.9479	0.1966
1906	0.0417	2.1637	0.1395
1907	0.2979	2.9697	0.2160
1908	0.2206	2.4073	0.1679
1909	0.2182	2.9324	0.1962
1910	0.3008	2.8301	0.2178
1911	0.1959	3.2010	0.1861
1912	0.6460	5.4843	0.2018
1913	0.3096	2.2737	0.2271
1914	0.0756	9.7507	0.1408
1915	0.1247	1.9770	0.1988
1916	0.1937	3.6604	0.1857
1917	0.0646	1.3811	0.1643
1918	0.2074	2.9284	0.2108
1919	0.1533	1.8160	0.2000
1920	0.1974	2.4397	0.1834
1921	0.2208	2.0860	0.2071
1922	0.2214	3.3111	0.2201
1923	0.1780	2.2800	0.2058
1924	0.0813	4.2347	0.1551
1925	0.1009	1.7857	0.1593
1926	0.1880	3.4452	0.1632
1927	0.1219	2.8094	0.1808
1928	0.1504	2.1107	0.1792
1929	0.3083	4.2271	0.1997

30

SIZE THE EMERGENCY OVERFLOW SPILLWAY

Length = $(Q_{100}/(3.21H^{3/2}))$ - 2.4 H

Let H = 0.5 feet

Q_{100} = 7.41 cfs

SO Length = $(7.41/(3.21(0.5^{3/2}))$ - 2.4 (0.5)

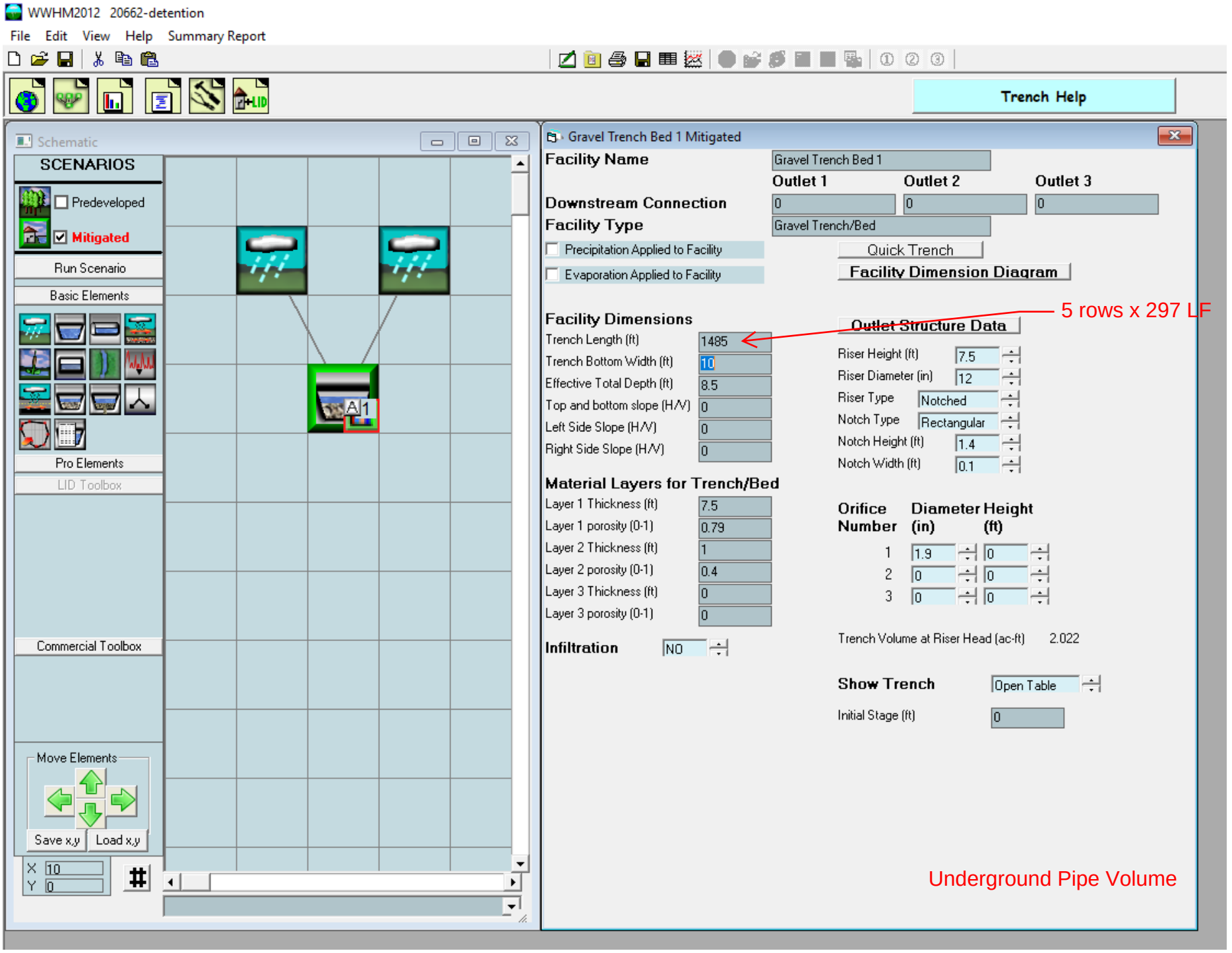
Length = 5.33 feet

Use 6 feet

Open Pond

Elevation	Area Open Pond SF	Volume CF	Sum Volume CF			
48.5	**1585**	**0**	**0**	**Static WS**		
49	1902	871.75	871.75			
50	2623	2262.5	3134.25			
51	3424	3023.5	6157.75			
52	4307	3865.5	10023.25			
53	**5282**	4794.5	14817.75			
54	6351	5816.5	20634.25			
55	7514	6932.5	27566.75			
56	8786	8150	35716.75	**Max. WS**	**0.82**	**ac-ft provided**
57	10142	9464	45180.75		2.84	ac-ft req'd

Open Pond Volume


WWHM2012 20662-detention
File Edit View Help Summary Report
Trench Help
Schematic
SCENARIOS
Predeveloped
Mitigated
Run Scenario
Basic Elements
Pro Elements
LID Toolbox
Commercial Toolbox
Move Elements
Save x,y
Load x,y
X 10
Y 0
A1
Gravel Trench Bed 1 Mitigated
Facility Name
Gravel Trench Bed 1
Outlet 1
Outlet 2
Outlet 3
Downstream Connection
0
0
0
Facility Type
Gravel Trench/Bed
Precipitation Applied to Facility
Evaporation Applied to Facility
Quick Trench
Facility Dimension Diagram
5 rows x 297 LF
Facility Dimensions
Trench Length (ft) 1485
Trench Bottom Width (ft) 10
Effective Total Depth (ft) 8.5
Top and bottom slope (H/V) 0
Left Side Slope (H/V) 0
Right Side Slope (H/V) 0
Outlet Structure Data
Riser Height (ft) 7.5
Riser Diameter (in) 12
Riser Type Notched
Notch Type Rectangular
Notch Height (ft) 1.4
Notch Width (ft) 0.1
Material Layers for Trench/Bed
Layer 1 Thickness (ft) 7.5
Layer 1 porosity (0-1) 0.79
Layer 2 Thickness (ft) 1
Layer 2 porosity (0-1) 0.4
Layer 3 Thickness (ft) 0
Layer 3 porosity (0-1) 0
Orifice Number
Diameter (in)
Height (ft)
1 1.9 0
2 0 0
3 0 0
Infiltration NO
Trench Volume at Riser Head (ac-ft) 2.022
Show Trench Open Table
Initial Stage (ft) 0
Underground Pipe Volume

WWHM2012

PROJECT REPORT

General Model Information

Project Name: 20662-detention
Site Name:
Site Address:
City:
Report Date: 4/18/2019
Gage:
Data Start: 10/01/1901
Data End: 09/30/2059
Timestep: 15 Minute
Precip Scale: 1.000
Version Date: 2018/10/10
Version: 4.2.16

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	9.21
Pervious Total	9.21
Impervious Land Use	acre
Impervious Total	0
Basin Total	9.21

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C, Lawn, Flat	0.87
Pervious Total	0.87

Impervious Land Use	acre
PARKING FLAT	7.81
Impervious Total	7.81
Basin Total	8.68

Element Flows To:

Surface	Interflow	Groundwater
Gravel Trench Bed 1	Gravel Trench Bed 1	

Hubbard

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C, Lawn, Flat	0.053
Pervious Total	0.053

Impervious Land Use	acre
ROADS FLAT	0.477
Impervious Total	0.477
Basin Total	0.53

Element Flows To:

Surface	Interflow	Groundwater
Gravel Trench Bed 1	Gravel Trench Bed 1	

Mitigated Routing

Gravel Trench Bed 1

Bottom Length: 298.00 ft.
Bottom Width: 70.00 ft.
Trench bottom slope 1: 0 To 1
Trench Left side slope 0: 0 To 1
Trench right side slope 2: 0 To 1
Material thickness of first layer: 7.5
Pour Space of material for first layer: 0.79
Material thickness of second layer: 1
Pour Space of material for second layer: 0.4
Material thickness of third layer: 0
Pour Space of material for third layer: 0
Discharge Structure
Riser Height: 7.5 ft.
Riser Diameter: 12 in.
Notch Type: Rectangular
Notch Width: 0.100 ft.
Notch Height: 1.400 ft.
Orifice 1 Diameter: 1.9 in. Elevation:0 ft.
Element Flows To:
Outlet 1 Outlet 2

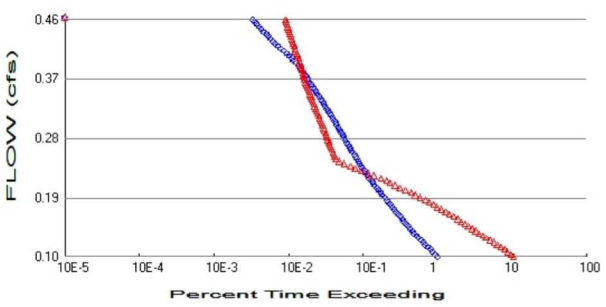
Gravel Trench Bed Hydraulic Table

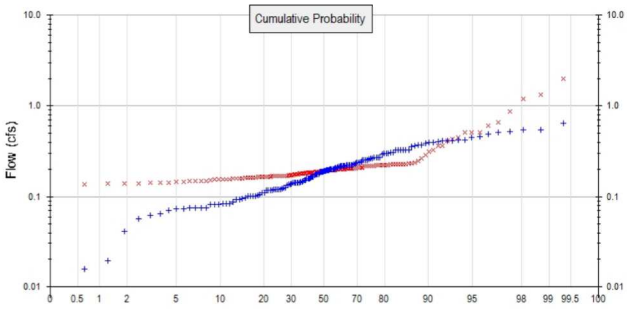
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.478	0.000	0.000	0.000
0.0944	0.478	0.035	0.030	0.000
0.1889	0.478	0.071	0.042	0.000
0.2833	0.478	0.107	0.052	0.000
0.3778	0.478	0.142	0.060	0.000
0.4722	0.478	0.178	0.067	0.000
0.5667	0.478	0.214	0.073	0.000
0.6611	0.478	0.250	0.079	0.000
0.7556	0.478	0.285	0.085	0.000
0.8500	0.478	0.321	0.090	0.000
0.9444	0.478	0.357	0.095	0.000
1.0389	0.478	0.393	0.099	0.000
1.1333	0.478	0.428	0.104	0.000
1.2278	0.478	0.464	0.108	0.000
1.3222	0.478	0.500	0.112	0.000
1.4167	0.478	0.535	0.116	0.000
1.5111	0.478	0.571	0.120	0.000
1.6056	0.478	0.607	0.124	0.000
1.7000	0.478	0.643	0.127	0.000
1.7944	0.478	0.678	0.131	0.000
1.8889	0.478	0.714	0.134	0.000
1.9833	0.478	0.750	0.138	0.000
2.0778	0.478	0.786	0.141	0.000
2.1722	0.478	0.821	0.144	0.000
2.2667	0.478	0.857	0.147	0.000
2.3611	0.478	0.893	0.150	0.000
2.4556	0.478	0.929	0.153	0.000
2.5500	0.478	0.964	0.156	0.000
2.6444	0.478	1.000	0.159	0.000

2.7389	0.478	1.036	0.162	0.000
2.8333	0.478	1.071	0.164	0.000
2.9278	0.478	1.107	0.167	0.000
3.0222	0.478	1.143	0.170	0.000
3.1167	0.478	1.179	0.172	0.000
3.2111	0.478	1.214	0.175	0.000
3.3056	0.478	1.250	0.178	0.000
3.4000	0.478	1.286	0.180	0.000
3.4944	0.478	1.322	0.183	0.000
3.5889	0.478	1.357	0.185	0.000
3.6833	0.478	1.393	0.188	0.000
3.7778	0.478	1.429	0.190	0.000
3.8722	0.478	1.464	0.192	0.000
3.9667	0.478	1.500	0.195	0.000
4.0611	0.478	1.536	0.197	0.000
4.1556	0.478	1.572	0.199	0.000
4.2500	0.478	1.607	0.202	0.000
4.3444	0.478	1.643	0.204	0.000
4.4389	0.478	1.679	0.206	0.000
4.5333	0.478	1.715	0.208	0.000
4.6278	0.478	1.750	0.210	0.000
4.7222	0.478	1.786	0.212	0.000
4.8167	0.478	1.822	0.215	0.000
4.9111	0.478	1.857	0.217	0.000
5.0056	0.478	1.893	0.219	0.000
5.1000	0.478	1.929	0.221	0.000
5.1944	0.478	1.965	0.223	0.000
5.2889	0.478	2.000	0.225	0.000
5.3833	0.478	2.036	0.227	0.000
5.4778	0.478	2.072	0.229	0.000
5.5722	0.478	2.108	0.231	0.000
5.6667	0.478	2.143	0.233	0.000
5.7611	0.478	2.179	0.235	0.000
5.8556	0.478	2.215	0.237	0.000
5.9500	0.478	2.251	0.239	0.000
6.0444	0.478	2.286	0.240	0.000
6.1389	0.478	2.322	0.245	0.000
6.2333	0.478	2.358	0.260	0.000
6.3278	0.478	2.393	0.281	0.000
6.4222	0.478	2.429	0.305	0.000
6.5167	0.478	2.465	0.332	0.000
6.6111	0.478	2.501	0.361	0.000
6.7056	0.478	2.536	0.391	0.000
6.8000	0.478	2.572	0.423	0.000
6.8944	0.478	2.608	0.455	0.000
6.9889	0.478	2.644	0.488	0.000
7.0833	0.478	2.679	0.521	0.000
7.1778	0.478	2.715	0.560	0.000
7.2722	0.478	2.751	0.602	0.000
7.3667	0.478	2.786	0.645	0.000
7.4611	0.478	2.822	0.690	0.000
7.5556	0.478	2.840	0.849	0.000
7.6500	0.478	2.858	1.317	0.000
7.7444	0.478	2.876	1.897	0.000
7.8389	0.478	2.895	2.425	0.000
7.9333	0.478	2.913	2.777	0.000
8.0278	0.478	2.931	3.007	0.000
8.1222	0.478	2.949	3.204	0.000

8.2167	0.478	2.967	3.388	0.000
8.3111	0.478	2.985	3.560	0.000
8.4056	0.478	3.003	3.722	0.000
8.5000	0.478	3.021	3.876	0.000

Analysis Results
POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 9.21
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.923
Total Impervious Area: 8.287

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.19408
5 year	0.301932
10 year	0.360534
25 year	0.420181
50 year	0.455634
100 year	0.484786

Match 2 and 10 year peak flows

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.193632
5 year	0.282287
10 year	0.359824
25 year	0.483465
50 year	0.59735
100 year	0.732885

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1902	0.142	0.204
1903	0.118	0.165
1904	0.194	0.173
1905	0.093	0.197
1906	0.042	0.140
1907	0.298	0.216
1908	0.221	0.168
1909	0.218	0.196
1910	0.301	0.218
1911	0.196	0.186

1912	0.646	0.202
1913	0.310	0.227
1914	0.076	0.141
1915	0.125	0.199
1916	0.194	0.186
1917	0.065	0.164
1918	0.207	0.211
1919	0.153	0.200
1920	0.197	0.183
1921	0.221	0.207
1922	0.221	0.220
1923	0.178	0.206
1924	0.081	0.155
1925	0.101	0.159
1926	0.188	0.163
1927	0.122	0.181
1928	0.150	0.179
1929	0.308	0.200
1930	0.198	0.170
1931	0.183	0.170
1932	0.143	0.176
1933	0.138	0.200
1934	0.406	0.246
1935	0.189	0.224
1936	0.164	0.190
1937	0.262	0.192
1938	0.160	0.195
1939	0.010	0.168
1940	0.177	0.207
1941	0.084	0.142
1942	0.266	0.607
1943	0.137	0.178
1944	0.251	0.328
1945	0.222	0.196
1946	0.120	0.146
1947	0.076	0.175
1948	0.418	0.228
1949	0.358	0.432
1950	0.101	0.160
1951	0.125	0.168
1952	0.544	0.506
1953	0.491	0.516
1954	0.177	0.200
1955	0.145	0.156
1956	0.071	0.137
1957	0.252	0.199
1958	0.525	0.877
1959	0.325	0.448
1960	0.086	0.165
1961	0.327	0.361
1962	0.175	0.182
1963	0.084	0.153
1964	0.092	0.170
1965	0.365	0.238
1966	0.102	0.195
1967	0.157	0.165
1968	0.160	0.206
1969	0.160	0.171

1970	0.250	0.209
1971	0.394	0.365
1972	0.256	0.205
1973	0.326	0.287
1974	0.176	0.210
1975	0.414	0.316
1976	0.219	0.186
1977	0.074	0.142
1978	0.368	0.227
1979	0.101	0.159
1980	0.209	0.188
1981	0.200	0.200
1982	0.082	0.149
1983	0.327	0.229
1984	0.133	0.187
1985	0.217	0.204
1986	0.194	0.195
1987	0.370	0.410
1988	0.235	0.206
1989	0.211	0.181
1990	0.239	0.201
1991	0.187	0.181
1992	0.268	0.221
1993	0.259	0.196
1994	0.389	0.226
1995	0.075	0.184
1996	0.427	0.514
1997	0.164	0.158
1998	0.195	0.182
1999	0.016	0.148
2000	0.148	0.198
2001	0.076	0.137
2002	0.271	0.186
2003	0.236	0.217
2004	0.217	0.197
2005	0.399	0.172
2006	0.121	0.154
2007	0.121	0.189
2008	0.206	0.192
2009	0.141	0.171
2010	0.120	0.224
2011	0.097	0.162
2012	0.141	0.192
2013	0.110	0.154
2014	0.082	0.149
2015	0.157	0.169
2016	0.063	0.169
2017	0.299	0.265
2018	0.544	1.987
2019	0.507	1.189
2020	0.165	0.162
2021	0.269	0.217
2022	0.111	0.162
2023	0.227	0.194
2024	0.426	0.179
2025	0.200	0.204
2026	0.326	0.224
2027	0.117	0.175

2028	0.102	0.147
2029	0.221	0.186
2030	0.410	0.226
2031	0.136	0.160
2032	0.074	0.145
2033	0.119	0.156
2034	0.117	0.188
2035	0.463	1.327
2036	0.240	0.202
2037	0.057	0.164
2038	0.192	0.228
2039	0.019	0.138
2040	0.107	0.171
2041	0.144	0.165
2042	0.450	0.660
2043	0.218	0.225
2044	0.293	0.223
2045	0.200	0.195
2046	0.234	0.225
2047	0.172	0.183
2048	0.223	0.192
2049	0.199	0.204
2050	0.143	0.166
2051	0.208	0.220
2052	0.120	0.193
2053	0.214	0.233
2054	0.272	0.232
2055	0.084	0.141
2056	0.094	0.173
2057	0.147	0.182
2058	0.186	0.185
2059	0.328	0.217

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.6460	1.9871
2	0.5444	1.3268
3	0.5438	1.1891
4	0.5254	0.8769
5	0.5073	0.6600
6	0.4911	0.6072
7	0.4630	0.5156
8	0.4504	0.5143
9	0.4265	0.5065
10	0.4259	0.4481
11	0.4175	0.4324
12	0.4136	0.4101
13	0.4104	0.3655
14	0.4064	0.3607
15	0.3990	0.3284
16	0.3941	0.3164
17	0.3892	0.2873
18	0.3705	0.2655
19	0.3683	0.2463
20	0.3654	0.2385
21	0.3577	0.2333
22	0.3284	0.2321

23	0.3266	0.2292
24	0.3265	0.2285
25	0.3265	0.2280
26	0.3257	0.2273
27	0.3248	0.2271
28	0.3096	0.2257
29	0.3083	0.2255
30	0.3008	0.2249
31	0.2991	0.2248
32	0.2979	0.2244
33	0.2935	0.2239
34	0.2718	0.2238
35	0.2706	0.2226
36	0.2693	0.2211
37	0.2677	0.2201
38	0.2663	0.2201
39	0.2618	0.2178
40	0.2595	0.2174
41	0.2555	0.2170
42	0.2515	0.2167
43	0.2510	0.2160
44	0.2503	0.2108
45	0.2404	0.2099
46	0.2390	0.2089
47	0.2356	0.2071
48	0.2349	0.2067
49	0.2341	0.2061
50	0.2265	0.2058
51	0.2230	0.2055
52	0.2219	0.2048
53	0.2214	0.2044
54	0.2213	0.2043
55	0.2208	0.2042
56	0.2206	0.2039
57	0.2190	0.2018
58	0.2182	0.2018
59	0.2175	0.2014
60	0.2167	0.2001
61	0.2165	0.2000
62	0.2138	0.1999
63	0.2112	0.1998
64	0.2085	0.1997
65	0.2078	0.1993
66	0.2074	0.1988
67	0.2061	0.1978
68	0.2000	0.1967
69	0.1998	0.1966
70	0.1997	0.1965
71	0.1994	0.1962
72	0.1981	0.1955
73	0.1974	0.1951
74	0.1959	0.1950
75	0.1946	0.1947
76	0.1942	0.1946
77	0.1937	0.1938
78	0.1936	0.1931
79	0.1917	0.1922
80	0.1887	0.1921

81	0.1880	0.1921
82	0.1872	0.1917
83	0.1859	0.1896
84	0.1832	0.1887
85	0.1780	0.1881
86	0.1772	0.1877
87	0.1768	0.1872
88	0.1763	0.1861
89	0.1753	0.1861
90	0.1723	0.1857
91	0.1655	0.1857
92	0.1640	0.1856
93	0.1636	0.1855
94	0.1602	0.1838
95	0.1599	0.1834
96	0.1595	0.1826
97	0.1572	0.1823
98	0.1570	0.1819
99	0.1533	0.1819
100	0.1504	0.1812
101	0.1481	0.1810
102	0.1468	0.1808
103	0.1448	0.1792
104	0.1437	0.1788
105	0.1435	0.1780
106	0.1431	0.1757
107	0.1423	0.1755
108	0.1415	0.1751
109	0.1411	0.1733
110	0.1384	0.1727
111	0.1370	0.1722
112	0.1356	0.1715
113	0.1331	0.1706
114	0.1247	0.1706
115	0.1247	0.1703
116	0.1219	0.1699
117	0.1210	0.1696
118	0.1207	0.1692
119	0.1204	0.1692
120	0.1200	0.1681
121	0.1195	0.1679
122	0.1187	0.1678
123	0.1184	0.1658
124	0.1173	0.1651
125	0.1168	0.1649
126	0.1115	0.1646
127	0.1102	0.1645
128	0.1066	0.1643
129	0.1025	0.1636
130	0.1017	0.1632
131	0.1014	0.1624
132	0.1010	0.1622
133	0.1009	0.1618
134	0.0973	0.1602
135	0.0945	0.1598
136	0.0932	0.1593
137	0.0925	0.1586
138	0.0864	0.1584

139	0.0842	0.1559
140	0.0842	0.1557
141	0.0840	0.1551
142	0.0821	0.1542
143	0.0816	0.1537
144	0.0813	0.1533
145	0.0758	0.1490
146	0.0758	0.1490
147	0.0756	0.1477
148	0.0747	0.1474
149	0.0738	0.1464
150	0.0737	0.1454
151	0.0710	0.1424
152	0.0646	0.1421
153	0.0626	0.1410
154	0.0575	0.1408
155	0.0417	0.1395
156	0.0192	0.1383
157	0.0157	0.1374
158	0.0100	0.1367

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0970	54342	575059	1058	Fail
0.1007	50874	531126	1044	Fail
0.1043	46830	475781	1015	Fail
0.1079	44077	437000	991	Fail
0.1115	40681	388912	956	Fail
0.1152	37562	344980	918	Fail
0.1188	35418	314620	888	Fail
0.1224	32819	278000	847	Fail
0.1260	30326	245148	808	Fail
0.1296	28609	223265	780	Fail
0.1333	26542	197226	743	Fail
0.1369	25180	179941	714	Fail
0.1405	23495	159609	679	Fail
0.1441	21966	141438	643	Fail
0.1478	20892	128751	616	Fail
0.1514	19540	113627	581	Fail
0.1550	18581	103211	555	Fail
0.1586	17401	90635	520	Fail
0.1622	16221	78724	485	Fail
0.1659	15346	70802	461	Fail
0.1695	14376	61883	430	Fail
0.1731	13462	54204	402	Fail
0.1767	12825	48819	380	Fail
0.1803	12000	42321	352	Fail
0.1840	11429	37789	330	Fail
0.1876	10676	32371	303	Fail
0.1912	10000	27783	277	Fail
0.1948	9507	24404	256	Fail
0.1985	8925	20393	228	Fail
0.2021	8338	17047	204	Fail
0.2057	7944	14991	188	Fail
0.2093	7490	12692	169	Fail
0.2129	7136	11396	159	Fail
0.2166	6670	9595	143	Fail
0.2202	6282	7728	123	Fail
0.2238	6039	6443	106	Pass
0.2274	5740	5240	91	Pass
0.2311	5442	4312	79	Pass
0.2347	5235	3726	71	Pass
0.2383	4963	3089	62	Pass
0.2419	4753	2657	55	Pass
0.2455	4535	2401	52	Pass
0.2492	4343	2308	53	Pass
0.2528	4193	2252	53	Pass
0.2564	3974	2178	54	Pass
0.2600	3766	2101	55	Pass
0.2637	3609	2043	56	Pass
0.2673	3425	1974	57	Pass
0.2709	3296	1930	58	Pass
0.2745	3146	1874	59	Pass
0.2781	3029	1815	59	Pass
0.2818	2945	1777	60	Pass
0.2854	2823	1727	61	Pass
0.2890	2682	1668	62	Pass

0.2926	2573	1631	63	Pass
0.2963	2459	1586	64	Pass
0.2999	2378	1546	65	Pass
0.3035	2270	1497	65	Pass
0.3071	2143	1444	67	Pass
0.3107	2055	1402	68	Pass
0.3144	1957	1357	69	Pass
0.3180	1885	1317	69	Pass
0.3216	1789	1272	71	Pass
0.3252	1698	1241	73	Pass
0.3289	1631	1214	74	Pass
0.3325	1568	1175	74	Pass
0.3361	1483	1134	76	Pass
0.3397	1423	1112	78	Pass
0.3433	1349	1079	79	Pass
0.3470	1288	1053	81	Pass
0.3506	1224	1020	83	Pass
0.3542	1165	986	84	Pass
0.3578	1114	966	86	Pass
0.3615	1064	930	87	Pass
0.3651	1006	908	90	Pass
0.3687	972	886	91	Pass
0.3723	922	865	93	Pass
0.3759	882	855	96	Pass
0.3796	818	840	102	Pass
0.3832	776	823	106	Pass
0.3868	744	812	109	Pass
0.3904	696	791	113	Fail
0.3941	636	770	121	Fail
0.3977	608	757	124	Fail
0.4013	558	730	130	Fail
0.4049	526	711	135	Fail
0.4085	483	693	143	Fail
0.4122	434	671	154	Fail
0.4158	399	657	164	Fail
0.4194	365	641	175	Fail
0.4230	339	626	184	Fail
0.4267	317	612	193	Fail
0.4303	297	595	200	Fail
0.4339	282	579	205	Fail
0.4375	254	567	223	Fail
0.4411	237	551	232	Fail
0.4448	225	541	240	Fail
0.4484	207	527	254	Fail
0.4520	194	510	262	Fail
0.4556	181	504	278	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 #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
Gravel Trench Bed 1 POC	☐	3178.31			☐	0.00			
Total Volume Infiltrated		3178.31	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

Model Default Modifications

Total of 0 changes have been made.

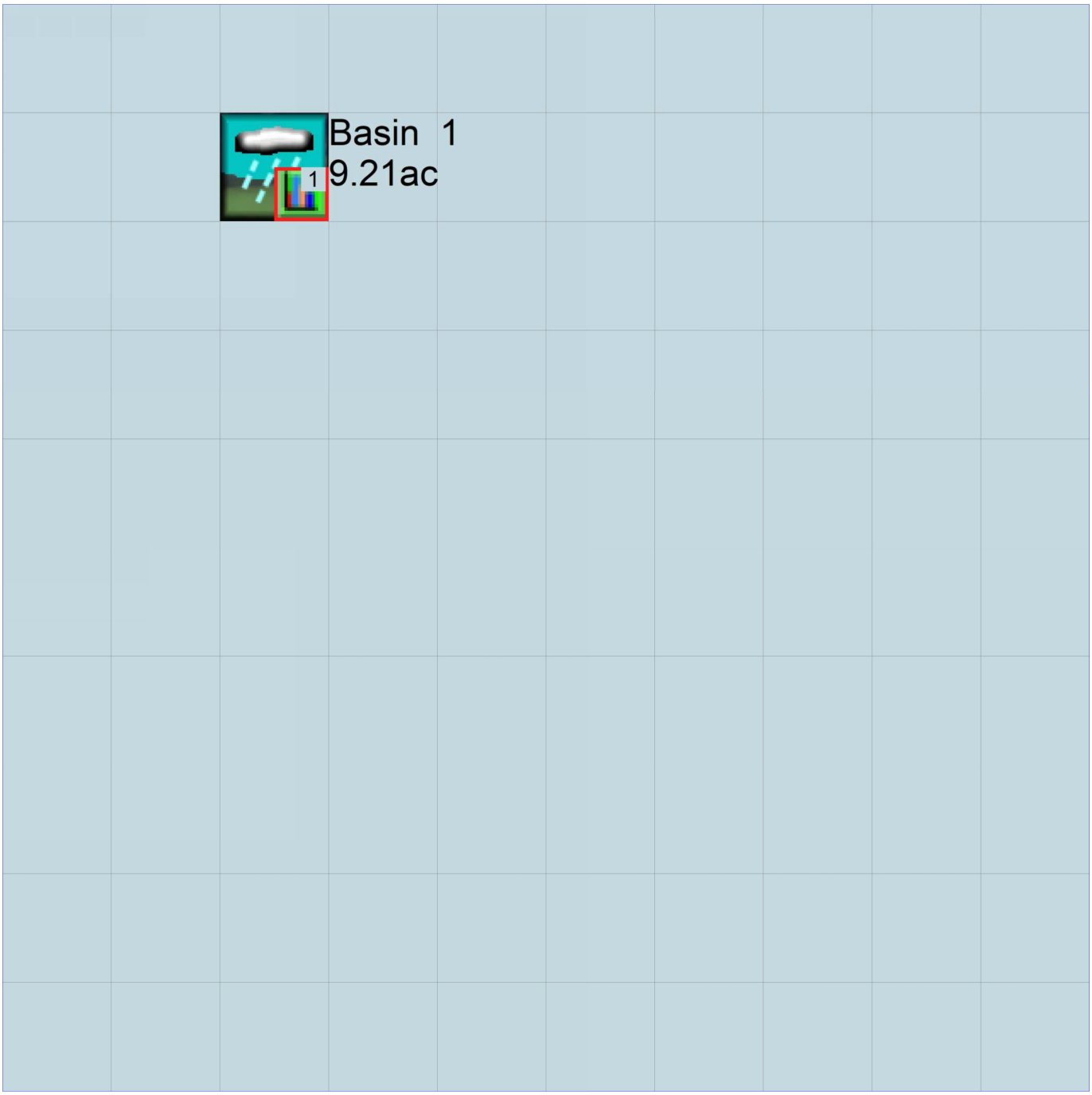
PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic

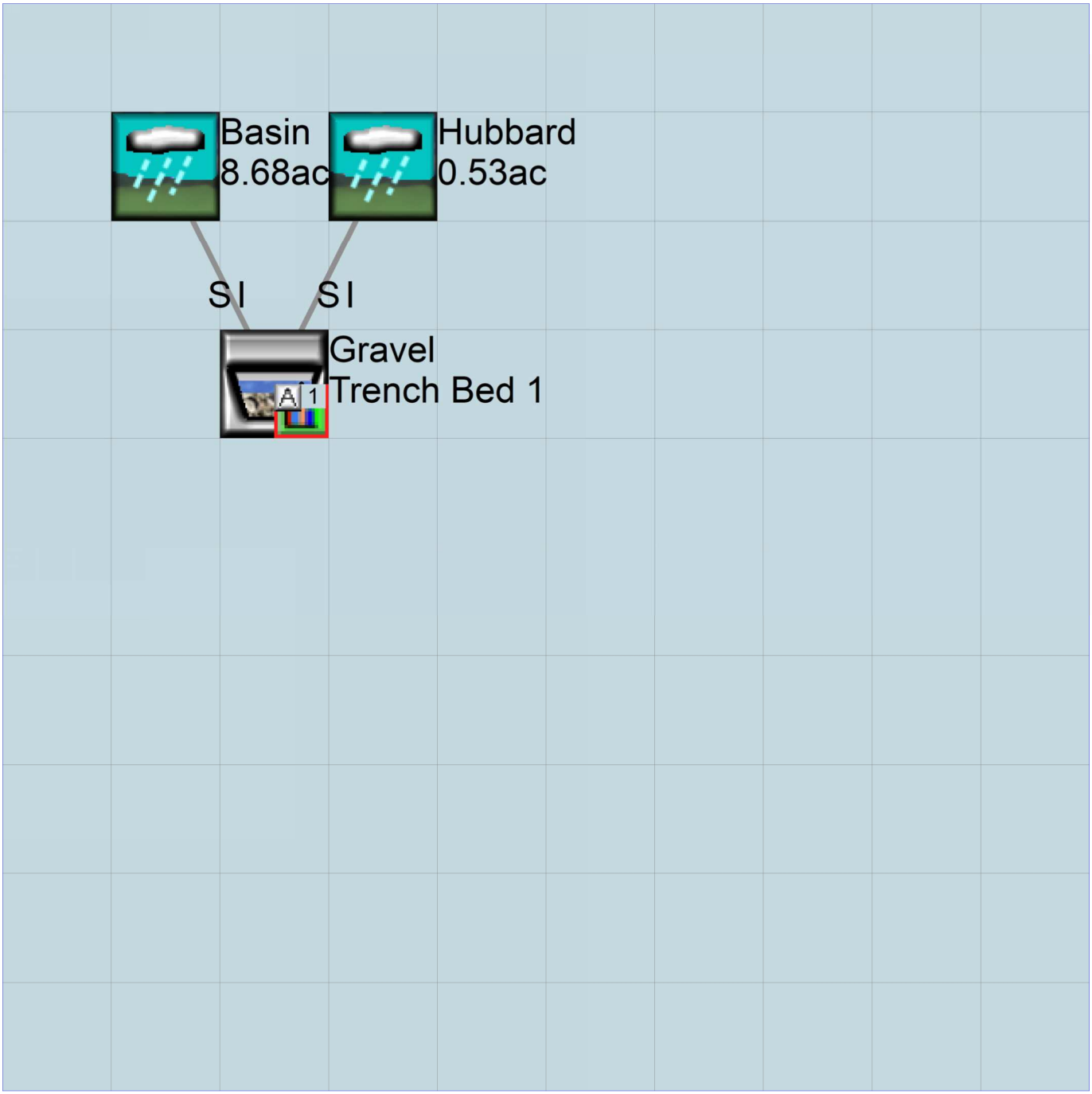
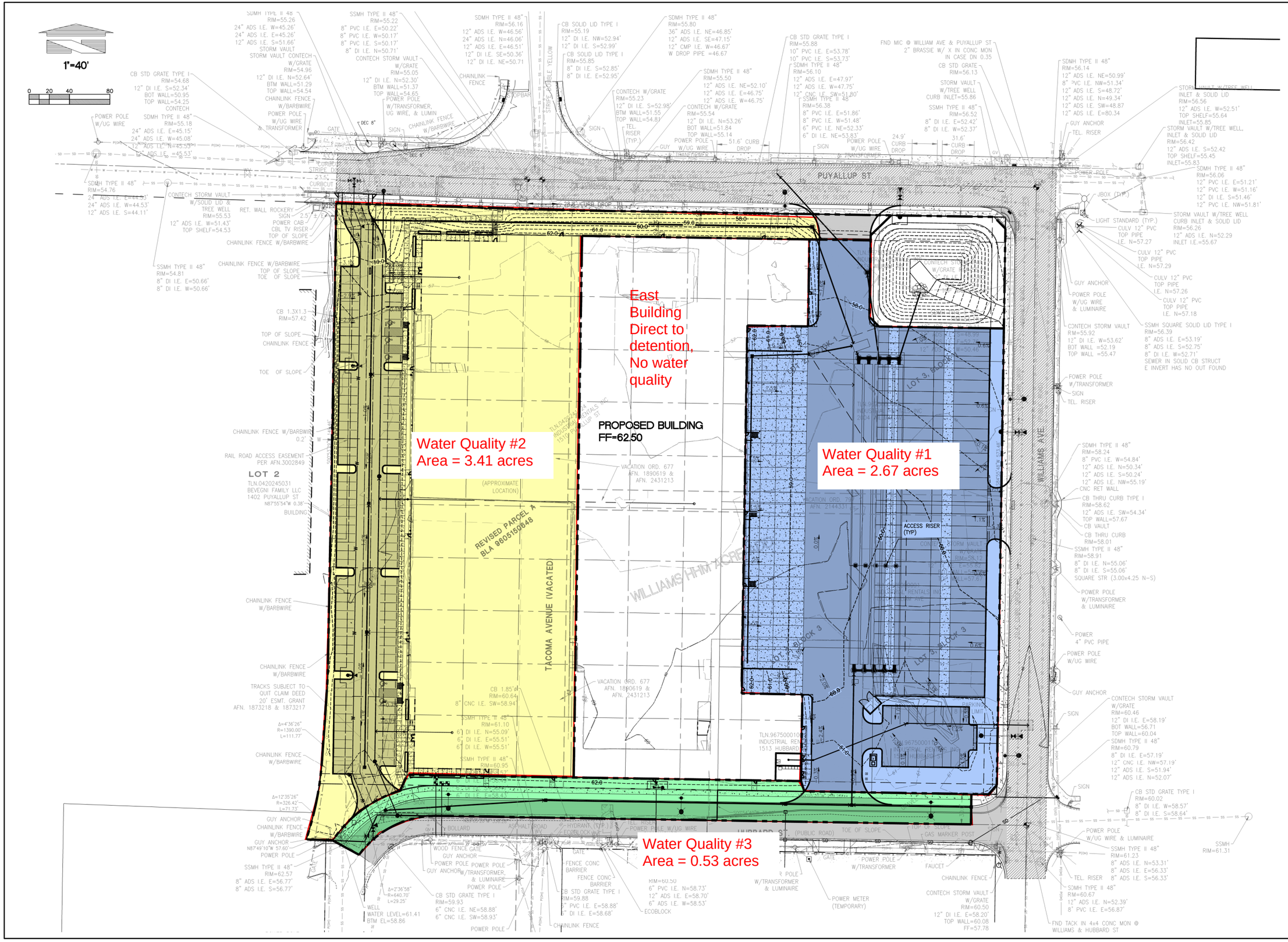


Exhibit F
Water Quality Calculations



No.	Date	By	Ckd.	Appr.	Revision

Title: DEVELOPED CONDITIONS MAP

1510 PUYALLUP STREET

For: DUKE REALTY
200 SPECTRUM CENTER DRIVE, SUITE 1600
IRVINE, CA 92618

JASON GUY HUBBARD — STATE OF WASHINGTON — No. 38950 — REGISTERED PROFESSIONAL ENGINEER
04/18/2019

Scale: Horizontal 1"=40' Vertical NA

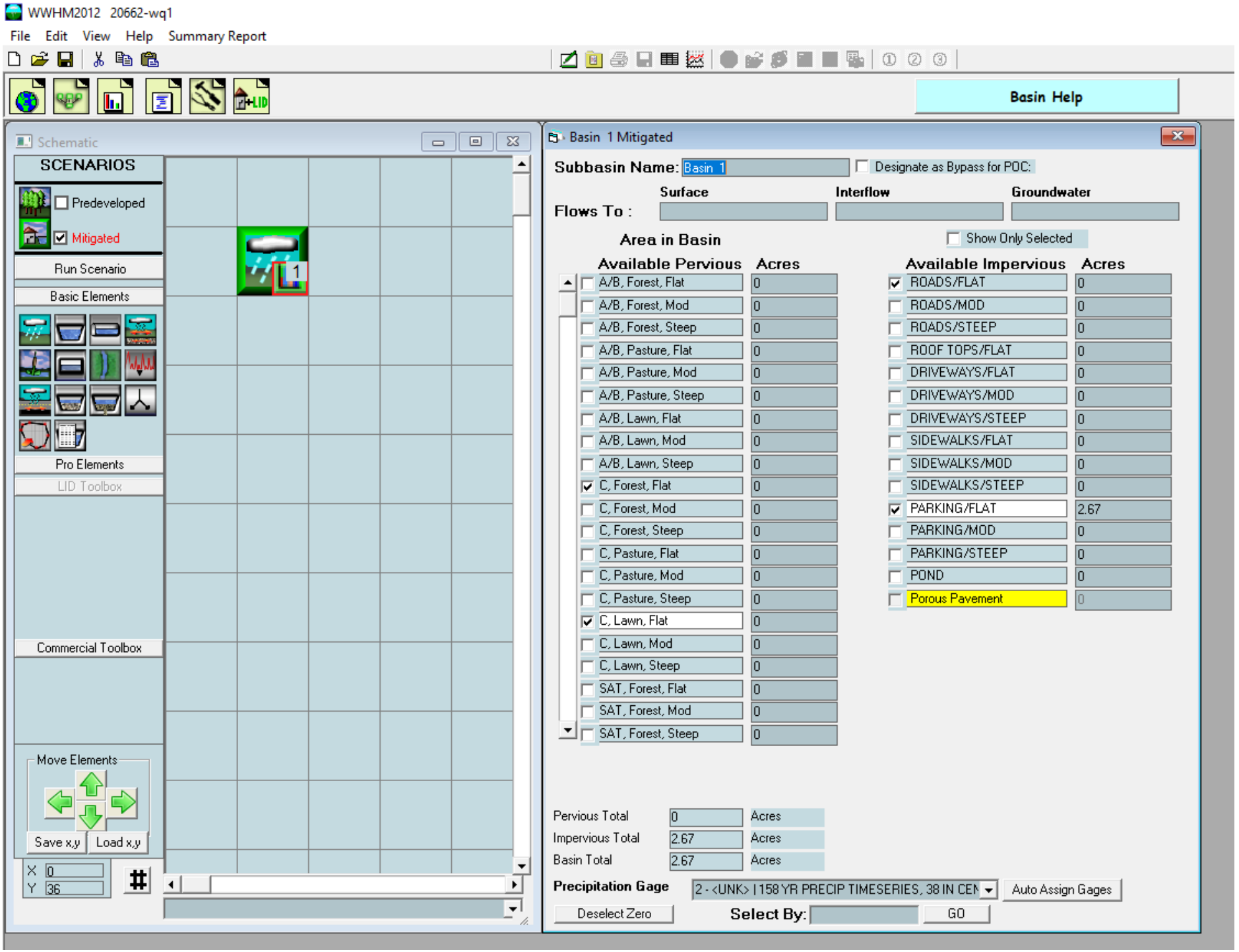
Designed KEH Drawn ROC Checked KEH Approved JGH Date 5/28/19

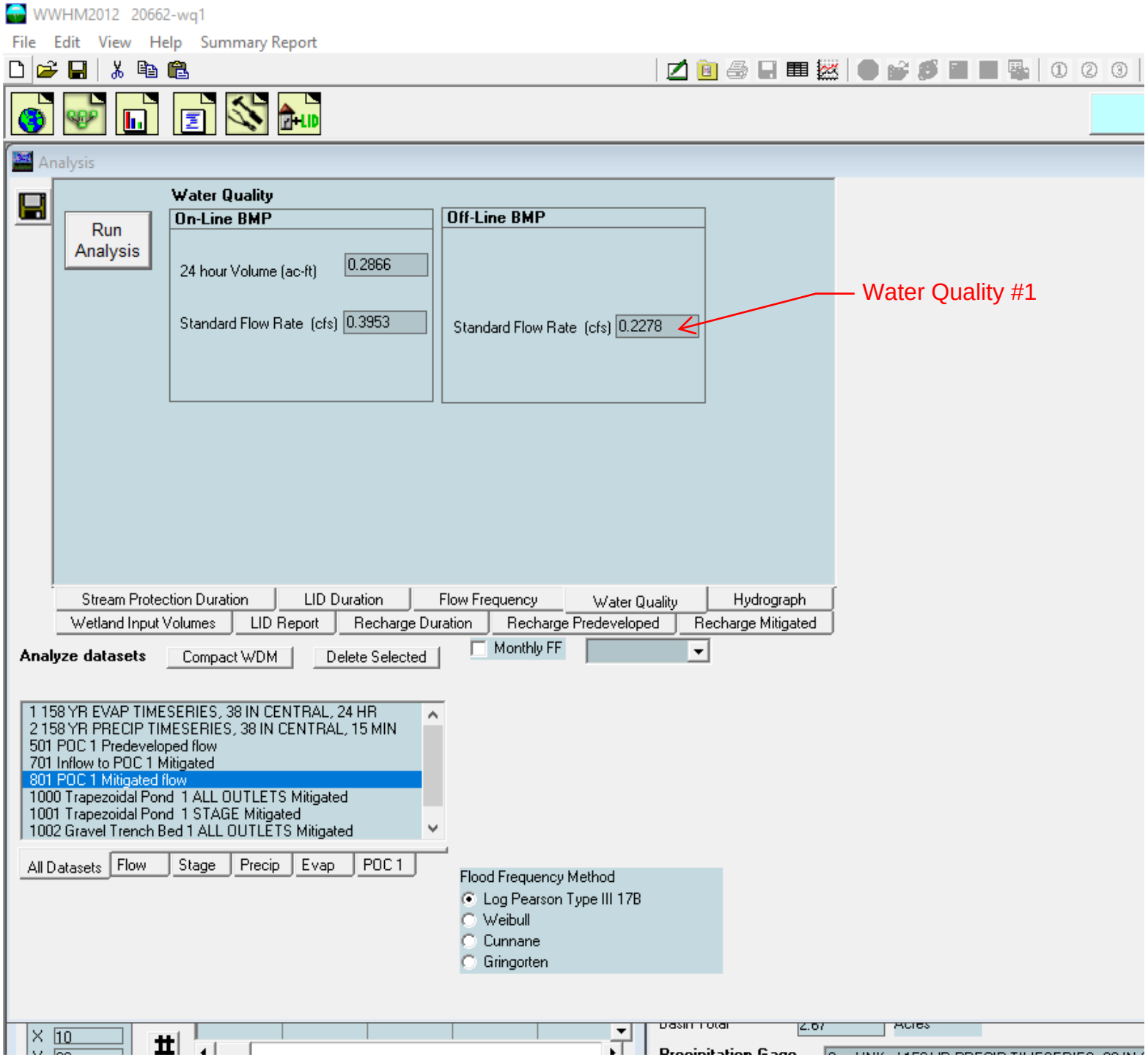
Barghausen Consulting Engineers, Inc.
18215 72nd Avenue South
Kent, WA 98032
425.251.6222
barghausen.com

Job Number 20662

Sheet 1 of 1

File:P:\20000s\20662\exhibit\20662-basin map.dwg Date/Time:4/18/2019 11:45 AM Scale:0.386863 HHARRIS Xref: ----


WWHM2012 20662-wq1
File Edit View Help Summary Report
Basin Help
Schematic
SCENARIOS
Predeveloped
Mitigated
Run Scenario
Basic Elements
Pro Elements
LID Toolbox
Commercial Toolbox
Move Elements
Save x,y
Load x,y
X 0
Y 36
Basin 1 Mitigated
Subbasin Name: Basin 1
Designate as Bypass for POC:
Flows To :
Surface
Interflow
Groundwater
Area in Basin
Show Only Selected
Available Pervious
Acres
A/B, Forest, Flat 0
A/B, Forest, Mod 0
A/B, Forest, Steep 0
A/B, Pasture, Flat 0
A/B, Pasture, Mod 0
A/B, Pasture, Steep 0
A/B, Lawn, Flat 0
A/B, Lawn, Mod 0
A/B, Lawn, Steep 0
C, Forest, Flat 0
C, Forest, Mod 0
C, Forest, Steep 0
C, Pasture, Flat 0
C, Pasture, Mod 0
C, Pasture, Steep 0
C, Lawn, Flat 0
C, Lawn, Mod 0
C, Lawn, Steep 0
SAT, Forest, Flat 0
SAT, Forest, Mod 0
SAT, Forest, Steep 0
Available Impervious
Acres
ROADS/FLAT 0
ROADS/MOD 0
ROADS/STEEP 0
ROOF TOPS/FLAT 0
DRIVEWAYS/FLAT 0
DRIVEWAYS/MOD 0
DRIVEWAYS/STEEP 0
SIDEWALKS/FLAT 0
SIDEWALKS/MOD 0
SIDEWALKS/STEEP 0
PARKING/FLAT 2.67
PARKING/MOD 0
PARKING/STEEP 0
POND 0
Porous Pavement 0
Pervious Total 0 Acres
Impervious Total 2.67 Acres
Basin Total 2.67 Acres
Precipitation Gage
2 - <UNK> | 158 YR PRECIP TIMESERIES, 38 IN CEN
Auto Assign Gages
Deselect Zero
Select By:
GO

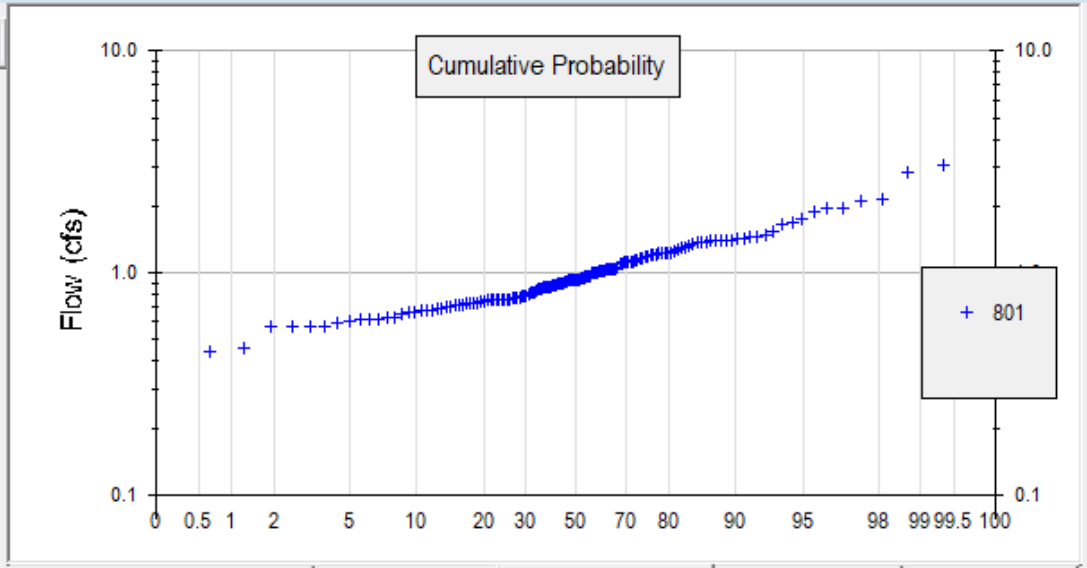

WWHM2012 20662-wq1
File Edit View Help Summary Report
Analysis
Water Quality
Run Analysis
On-Line BMP
24 hour Volume (ac-ft) 0.2866
Standard Flow Rate (cfs) 0.3953
Off-Line BMP
Standard Flow Rate (cfs) 0.2278
Water Quality #1
Stream Protection Duration
LID Duration
Flow Frequency
Water Quality
Hydrograph
Wetland Input Volumes
LID Report
Recharge Duration
Recharge Predeveloped
Recharge Mitigated
Analyze datasets
Compact WDM
Delete Selected
Monthly FF
1 158 YR EVAP TIMESERIES, 38 IN CENTRAL, 24 HR
2 158 YR PRECIP TIMESERIES, 38 IN CENTRAL, 15 MIN
501 POC 1 Predeveloped flow
701 Inflow to POC 1 Mitigated
801 POC 1 Mitigated flow
1000 Trapezoidal Pond 1 ALL OUTLETS Mitigated
1001 Trapezoidal Pond 1 STAGE Mitigated
1002 Gravel Trench Bed 1 ALL OUTLETS Mitigated
All Datasets
Flow
Stage
Precip
Evap
POC 1
Flood Frequency Method
Log Pearson Type III 17B
Weibull
Cunnane
Gringorten

WWHM2012 20662-wq1

File Edit View Help Summary Report

Analysis Help

Analysis



Stream Protection Duration | LID Duration | Flow Frequency | Water Quality | Hydrograph

Wetland Input Volumes | LID Report | Recharge Duration | Recharge Predeveloped | Recharge Mitigated

Analyze datasets Compact WDM Delete Selected Monthly FF

1 158 YR EVAP TIMESERIES, 38 IN CENTRAL, 24 HR
2 158 YR PRECIP TIMESERIES, 38 IN CENTRAL, 15 MIN
501 POC 1 Predeveloped flow
701 Inflow to POC 1 Mitigated
801 POC 1 Mitigated flow
1000 Trapezoidal Pond 1 ALL OUTLETS Mitigated
1001 Trapezoidal Pond 1 STAGE Mitigated
1002 Gravel Trench Bed 1 ALL OUTLETS Mitigated

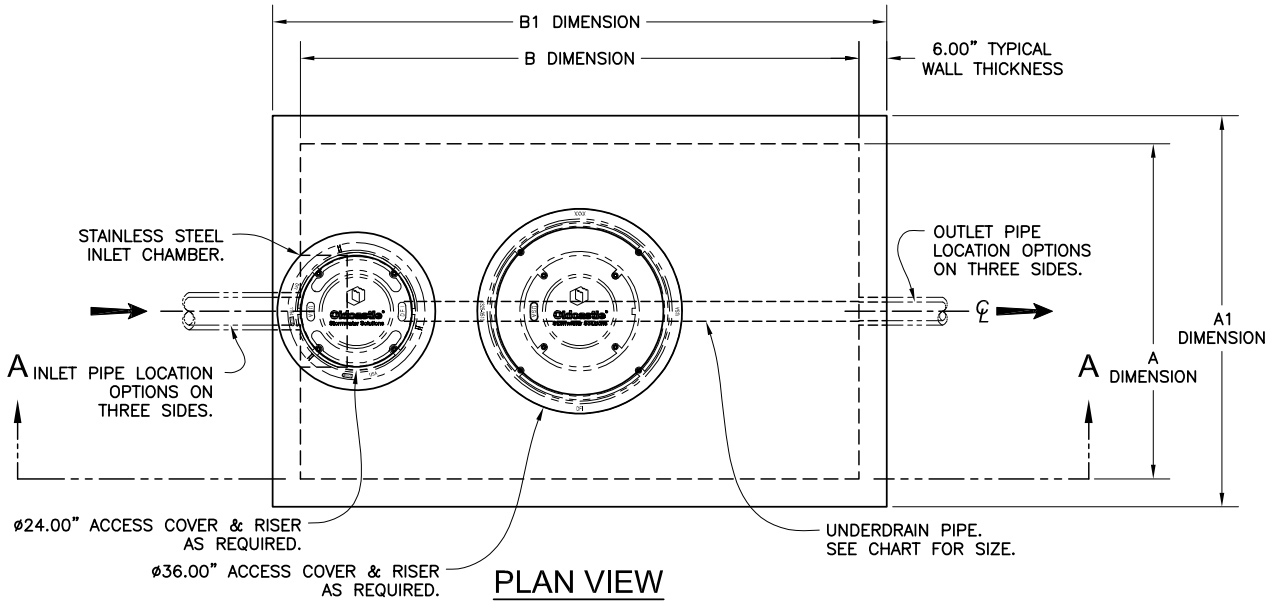
All Datasets | Flow | Stage | Precip | Evap | POC 1

Flood Frequency Method
- (•) Log Pearson Type III 17B
- ( ) Weibull
- ( ) Cunnane
- ( ) Gringorten

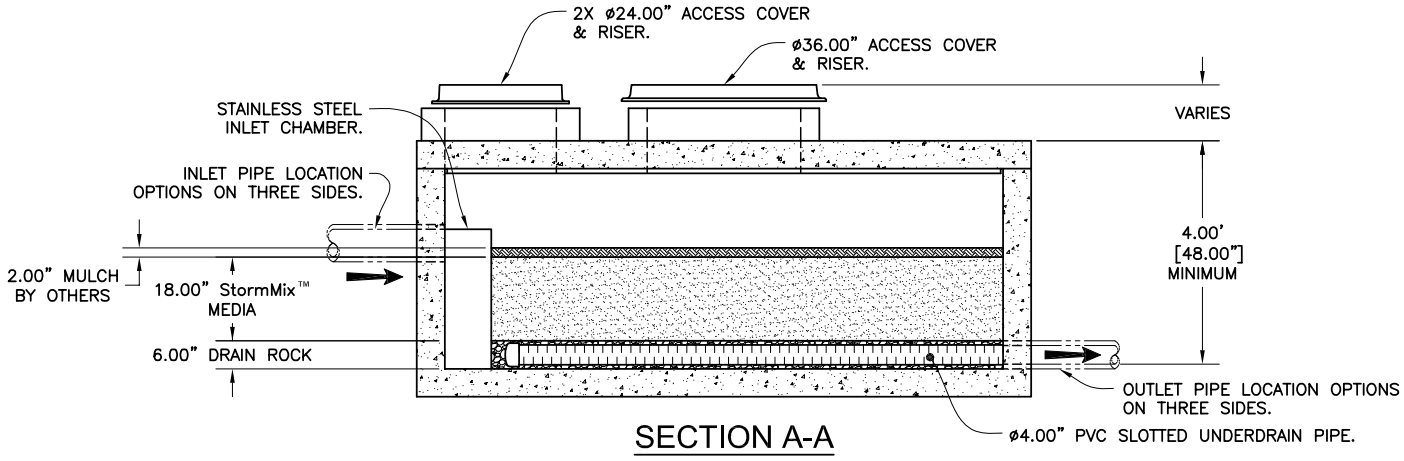
```
Flow Frequency
Flow(cfs)  0801 15m
2 Year   =    0.9357
5 Year   =    1.2560
10 Year  =    1.4888
25 Year  =    1.8075
50 Year  =    2.0632
100 Year =    2.3351

Annual Peaks
 1902          1.1064
 1903          1.2264
 1904          1.3882
 1905          0.6224
 1906          0.6960
 1907          0.9310
 1908          0.7655
 1909          0.9445
 1910          0.9026
 1911          1.0129
 1912          1.6785
 1913          0.7314
 1914          3.0704
 1915          0.6297
 1916          1.1780
 1917          0.4449
 1918          0.9432
 1919          0.5770
 1920          0.7678
 1921          0.6585
 1922          1.0331
 1923          0.7198
 1924          1.3623
 1925          0.5686
 1926          1.1098
 1927          0.9041
 1928          0.6705
 1929          1.3383
```

Basin Total 2.67 Acres



PLAN VIEW



SECTION A-A

MODEL	VAULT SIZE [1] (ID)		VAULT [1] FOOTPRINT (OD)		TREATMENT [2] FLOW CAPACITY (GPM/CFS)
	A DIM	B DIM	A1 DIM	B2 DIM	
BPU-IB-46	4'	4'	5'	5'	25.6 / 0.057
BPU-IB-46	4'	6'	5'	7'	38.4 / 0.860
BPU-IB-48	4'	8'	5'	9'	51.2 / 0.114
BPU-IB-412	4'	12'	5'	13'	76.8 / 0.171
BPU-IB-66	6'	6'	7'	7'	57.6 / 0.128
BPU-IB-68	6'	8'	7'	9'	76.8 / 0.171
BPU-IB-612	6'	12'	7'	13'	115.2 / 0.257
BPU-IB-816	8'	16'	9'	17'	204.8 / 0.456
BPU-IB-818	8'	18'	9'	19'	230.4 / 0.513
BPU-IB-1020	10'	20'	11'	21'	320 / 0.713

WQ #1

[1] All Dimensions Are Nominal.
[2] Based on an WA Ecology GULD Approval for Basic, Enhanced & Phosphorus. At 1.60 gpm/sf Media Surface Area.

US Patents Pending

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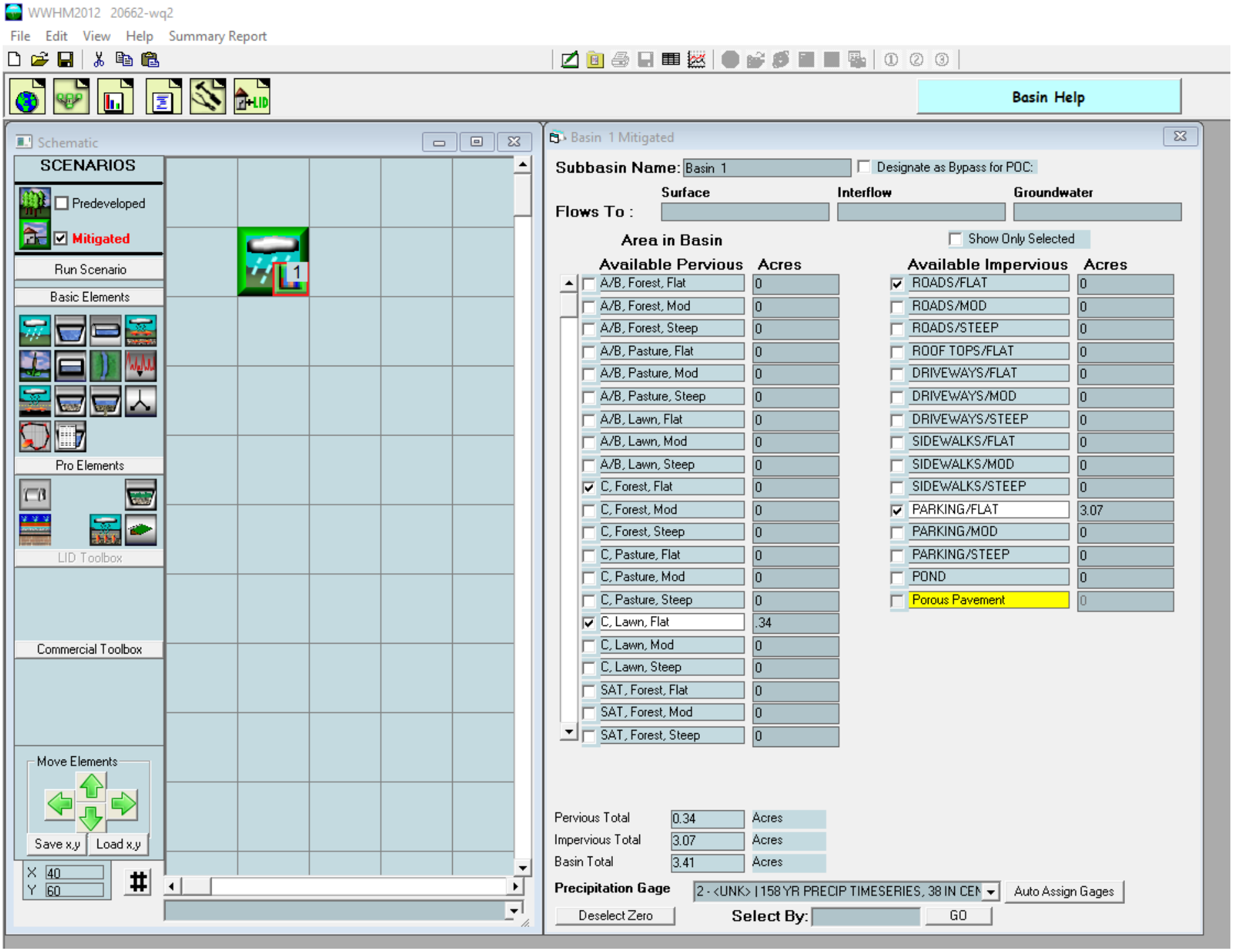
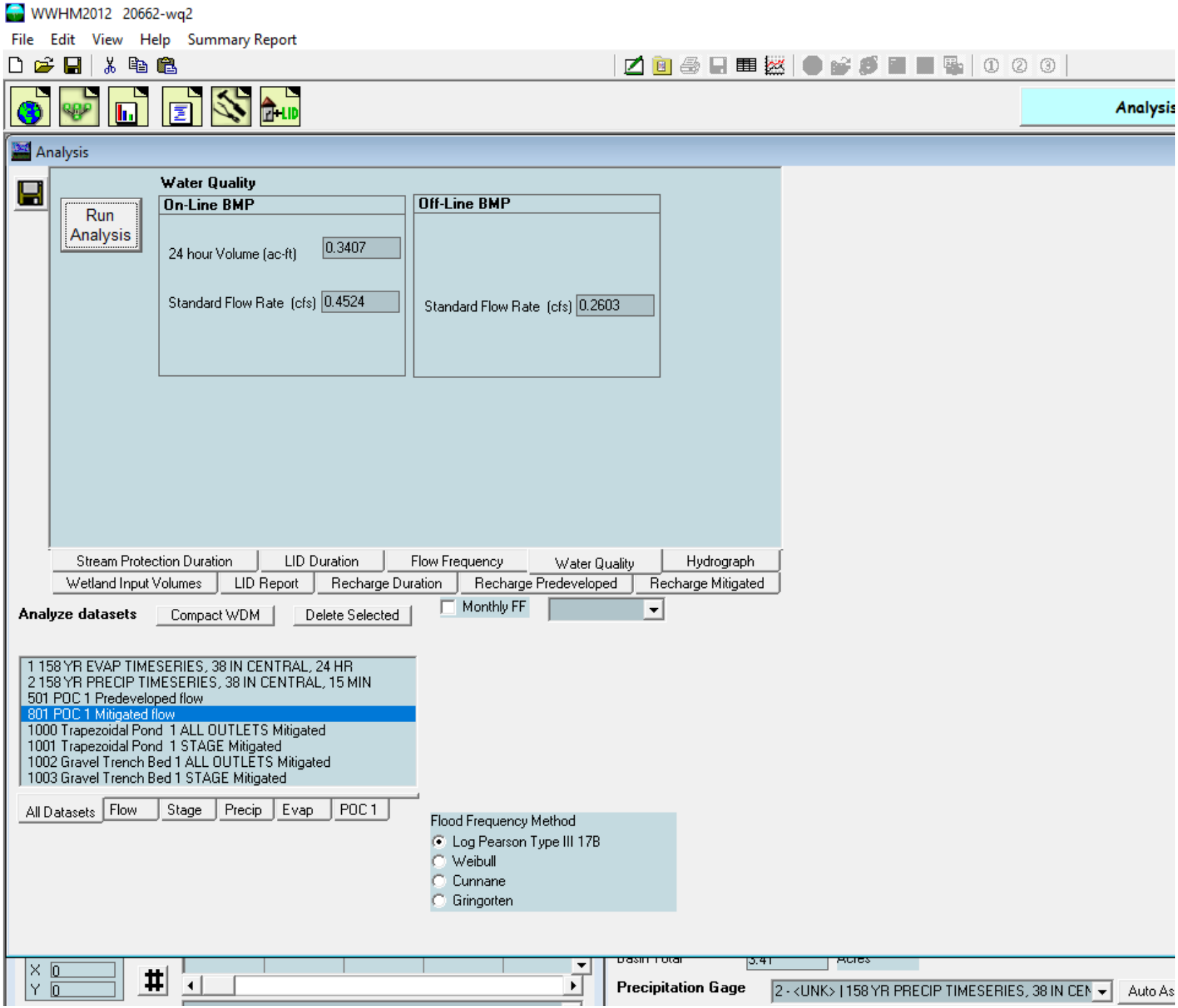
DRAWING NO.	REV	ECO	DATE	
BPU	NR	ECO-0149 NEW	JPR 6/12/18	SHEET 1 OF 2


WWHM2012 20662-wq2
File Edit View Help Summary Report
Basin Help
Schematic
SCENARIOS
Predeveloped
Mitigated
Run Scenario
Basic Elements
Pro Elements
LID Toolbox
Commercial Toolbox
Move Elements
Save x,y
Load x,y
X 40
Y 60
Basin 1 Mitigated
Subbasin Name: Basin 1
Designate as Bypass for POC:
Flows To :
Surface
Interflow
Groundwater
Area in Basin
Show Only Selected
Available Pervious
Acres
A/B, Forest, Flat 0
A/B, Forest, Mod 0
A/B, Forest, Steep 0
A/B, Pasture, Flat 0
A/B, Pasture, Mod 0
A/B, Pasture, Steep 0
A/B, Lawn, Flat 0
A/B, Lawn, Mod 0
A/B, Lawn, Steep 0
C, Forest, Flat 0
C, Forest, Mod 0
C, Forest, Steep 0
C, Pasture, Flat 0
C, Pasture, Mod 0
C, Pasture, Steep 0
C, Lawn, Flat .34
C, Lawn, Mod 0
C, Lawn, Steep 0
SAT, Forest, Flat 0
SAT, Forest, Mod 0
SAT, Forest, Steep 0
Available Impervious
Acres
ROADS/FLAT 0
ROADS/MOD 0
ROADS/STEEP 0
ROOF TOPS/FLAT 0
DRIVEWAYS/FLAT 0
DRIVEWAYS/MOD 0
DRIVEWAYS/STEEP 0
SIDEWALKS/FLAT 0
SIDEWALKS/MOD 0
SIDEWALKS/STEEP 0
PARKING/FLAT 3.07
PARKING/MOD 0
PARKING/STEEP 0
POND 0
Porous Pavement 0
Pervious Total 0.34 Acres
Impervious Total 3.07 Acres
Basin Total 3.41 Acres
Precipitation Gage
2 - <UNK> | 158 YR PRECIP TIMESERIES, 38 IN CEN
Auto Assign Gages
Deselect Zero
Select By:
GO

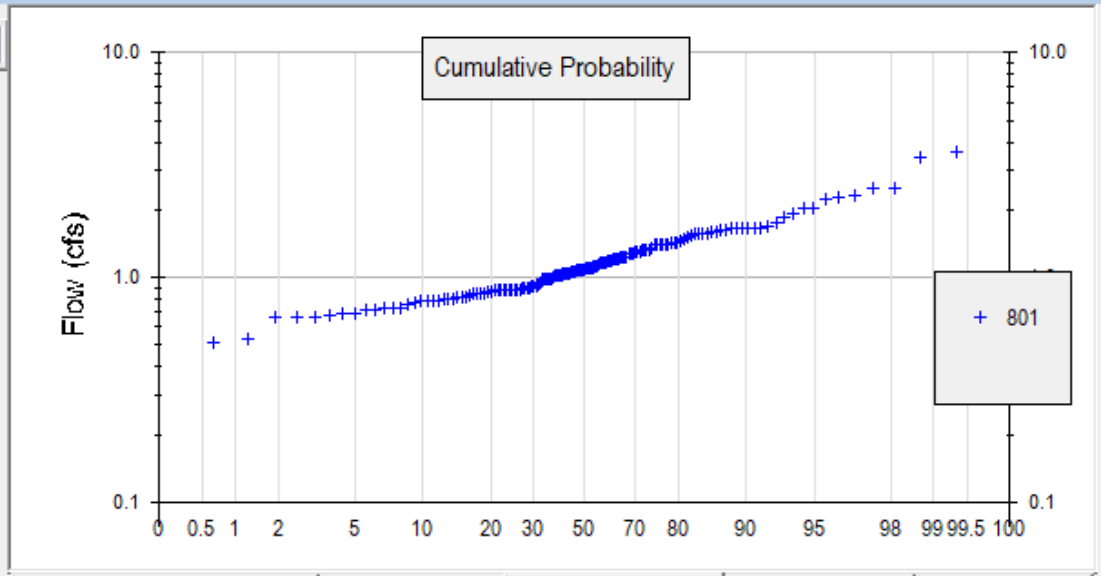

WWHM2012 20662-wq2
File Edit View Help Summary Report
Analysis
Water Quality
On-Line BMP
Off-Line BMP
Run Analysis
24 hour Volume (ac-ft) 0.3407
Standard Flow Rate (cfs) 0.4524
Standard Flow Rate (cfs) 0.2603
Stream Protection Duration
LID Duration
Flow Frequency
Water Quality
Hydrograph
Wetland Input Volumes
LID Report
Recharge Duration
Recharge Predeveloped
Recharge Mitigated
Analyze datasets
Compact WDM
Delete Selected
Monthly FF
1 158 YR EVAP TIMESERIES, 38 IN CENTRAL, 24 HR
2 158 YR PRECIP TIMESERIES, 38 IN CENTRAL, 15 MIN
501 POC 1 Predeveloped flow
801 POC 1 Mitigated flow
1000 Trapezoidal Pond 1 ALL OUTLETS Mitigated
1001 Trapezoidal Pond 1 STAGE Mitigated
1002 Gravel Trench Bed 1 ALL OUTLETS Mitigated
1003 Gravel Trench Bed 1 STAGE Mitigated
All Datasets
Flow
Stage
Precip
Evap
POC 1
Flood Frequency Method
Log Pearson Type III 17B
Weibull
Cunnane
Gringorten
Precipitation Gage
2 - <UNK> | 158 YR PRECIP TIMESERIES, 38 IN CEN
Auto As

WWHM2012 20662-wq2

File Edit View Help Summary Report

Analysis Help

Analysis



Stream Protection Duration | LID Duration | Flow Frequency | Water Quality | Hydrograph

Wetland Input Volumes | LID Report | Recharge Duration | Recharge Predeveloped | Recharge Mitigated

Analyze datasets Compact WDM Delete Selected Monthly FF

1 158 YR EVAP TIMESERIES, 38 IN CENTRAL, 24 HR
2 158 YR PRECIP TIMESERIES, 38 IN CENTRAL, 15 MIN
501 POC 1 Predeveloped flow
801 POC 1 Mitigated flow
1000 Trapezoidal Pond 1 ALL OUTLETS Mitigated
1001 Trapezoidal Pond 1 STAGE Mitigated
1002 Gravel Trench Bed 1 ALL OUTLETS Mitigated
1003 Gravel Trench Bed 1 STAGE Mitigated

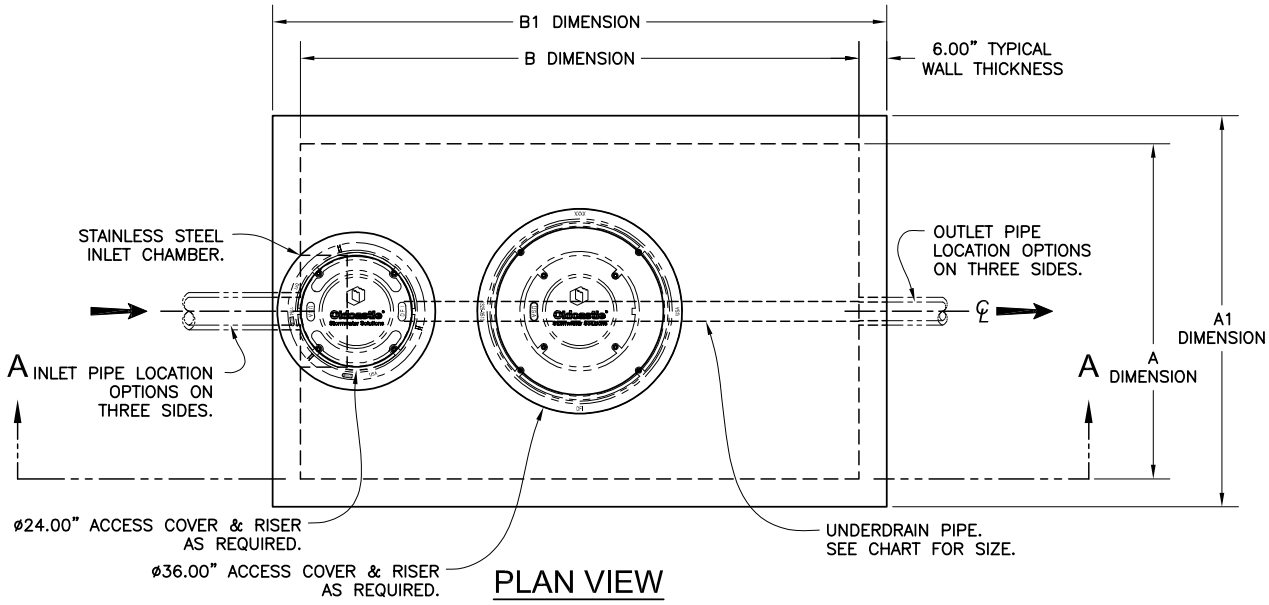
All Datasets | Flow | Stage | Precip | Evap | POC 1

Flood Frequency Method
- (•) Log Pearson Type III 17B
- ( ) Weibull
- ( ) Cunnane
- ( ) Gringorten

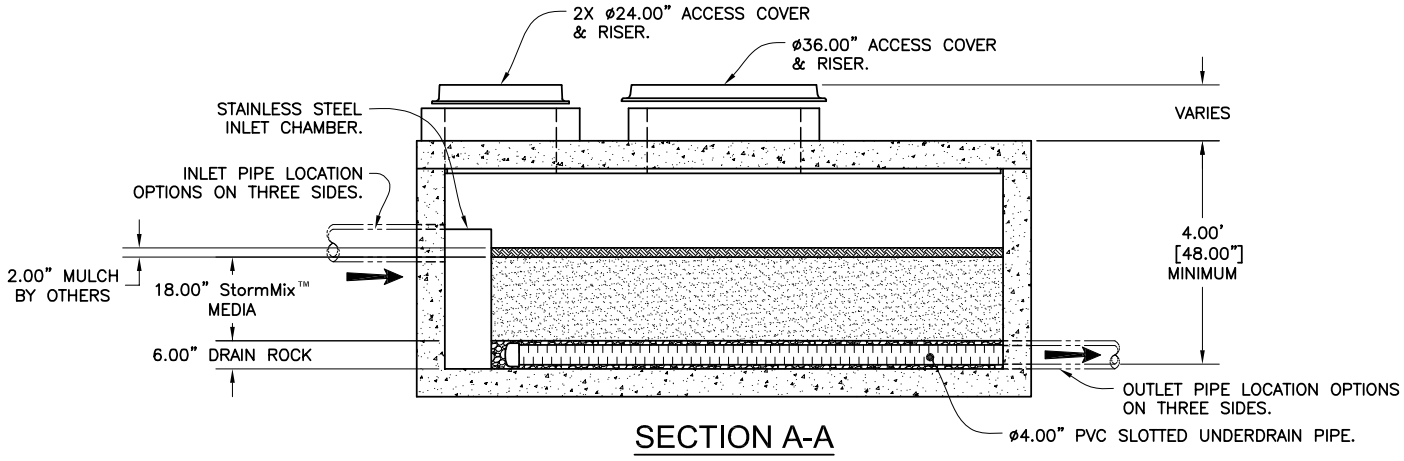
```
Flow Frequency
Flow(cfs)  0801 15m
2 Year   =    1.0894
5 Year   =    1.4672
10 Year  =    1.7424
25 Year  =    2.1199
50 Year  =    2.4234
100 Year =    2.7466

Annual Peaks
 1902          1.2729
 1903          1.4116
 1904          1.6550
 1905          0.7216
 1906          0.8015
 1907          1.1000
 1908          0.8917
 1909          1.0863
 1910          1.0484
 1911          1.1857
 1912          2.0311
 1913          0.8423
 1914          3.6118
 1915          0.7323
 1916          1.3560
 1917          0.5116
 1918          1.0849
 1919          0.6727
 1920          0.9037
 1921          0.7727
 1922          1.2264
 1923          0.8445
 1924          1.5688
 1925          0.6615
 1926          1.2763
 1927          1.0408
 1928          0.7819
 1929          1.5658
```

Basin Total 3.41 Acres



PLAN VIEW



SECTION A-A

MODEL	VAULT SIZE [1] (ID)		VAULT [1] FOOTPRINT (OD)		TREATMENT [2] FLOW CAPACITY (GPM/CFS)
	A DIM	B DIM	A1 DIM	B2 DIM	
BPU-IB-46	4'	4'	5'	5'	25.6 / 0.057
BPU-IB-46	4'	6'	5'	7'	38.4 / 0.860
BPU-IB-48	4'	8'	5'	9'	51.2 / 0.114
BPU-IB-412	4'	12'	5'	13'	76.8 / 0.171
BPU-IB-66	6'	6'	7'	7'	57.6 / 0.128
BPU-IB-68	6'	8'	7'	9'	76.8 / 0.171
BPU-IB-612	6'	12'	7'	13'	115.2 / 0.257
BPU-IB-816	8'	16'	9'	17'	204.8 / 0.456
BPU-IB-818	8'	18'	9'	19'	230.4 / 0.513
BPU-IB-1020	10'	20'	11'	21'	320 / 0.713

WQ #2

[1] All Dimensions Are Nominal.
[2] Based on an WA Ecology GULD Approval for Basic, Enhanced & Phosphorus. At 1.60 gpm/sf Media Surface Area.

US Patents Pending

Bioretention/ Biofiltration

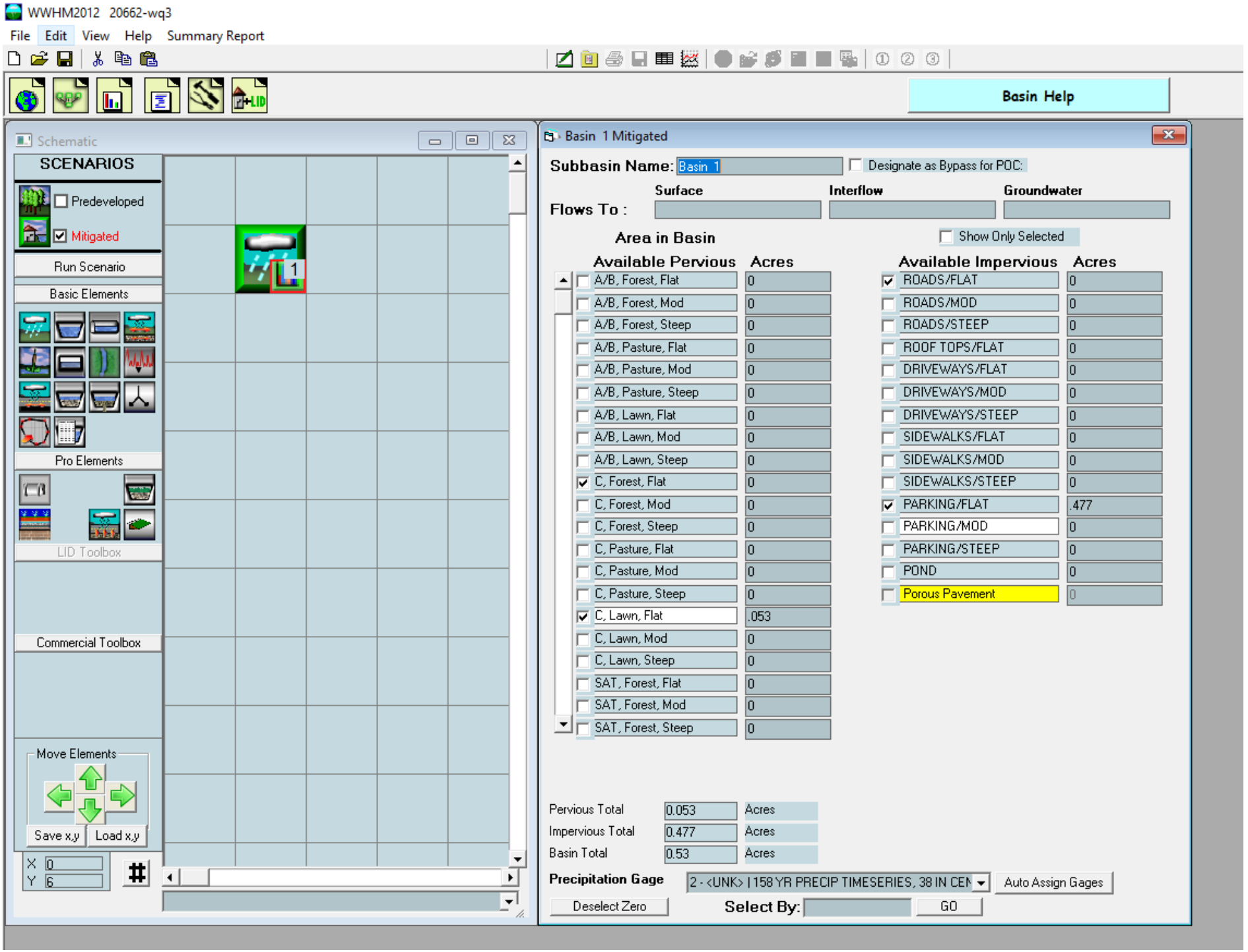
BioPod™ Biofilter Underground

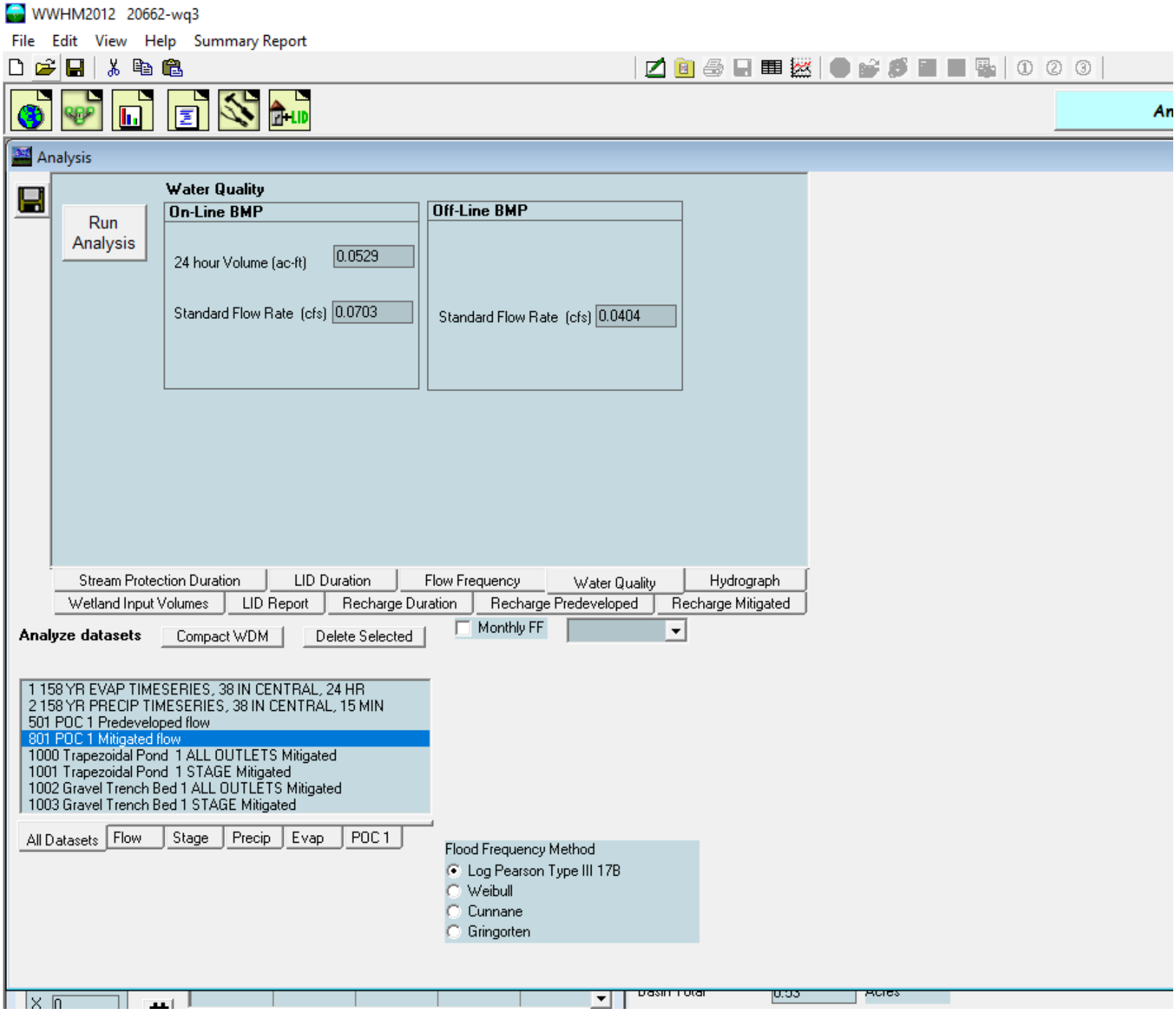
Vault with External Bypass

Oldcastle® INFRASTRUCTURE

Ph: 800.579.8819 | oldcastlestormwater.com

DRAWING NO.	REV	ECO	DATE	
BPU	NR	ECO-0149 NEW	JPR 6/12/18	SHEET 1 OF 2


WWHM2012 20662-wq3
File Edit View Help Summary Report
Basin Help
Schematic
SCENARIOS
Predeveloped
Mitigated
Run Scenario
Basic Elements
Pro Elements
LID Toolbox
Commercial Toolbox
Move Elements
Save x,y
Load x,y
X 0
Y 6
Basin 1 Mitigated
Subbasin Name: Basin 1
Designate as Bypass for POC:
Flows To :
Surface
Interflow
Groundwater
Area in Basin
Show Only Selected
Available Pervious
Acres
A/B, Forest, Flat 0
A/B, Forest, Mod 0
A/B, Forest, Steep 0
A/B, Pasture, Flat 0
A/B, Pasture, Mod 0
A/B, Pasture, Steep 0
A/B, Lawn, Flat 0
A/B, Lawn, Mod 0
A/B, Lawn, Steep 0
C, Forest, Flat 0
C, Forest, Mod 0
C, Forest, Steep 0
C, Pasture, Flat 0
C, Pasture, Mod 0
C, Pasture, Steep 0
C, Lawn, Flat .053
C, Lawn, Mod 0
C, Lawn, Steep 0
SAT, Forest, Flat 0
SAT, Forest, Mod 0
SAT, Forest, Steep 0
Available Impervious
Acres
ROADS/FLAT 0
ROADS/MOD 0
ROADS/STEEP 0
ROOF TOPS/FLAT 0
DRIVEWAYS/FLAT 0
DRIVEWAYS/MOD 0
DRIVEWAYS/STEEP 0
SIDEWALKS/FLAT 0
SIDEWALKS/MOD 0
SIDEWALKS/STEEP 0
PARKING/FLAT .477
PARKING/MOD 0
PARKING/STEEP 0
POND 0
Porous Pavement 0
Pervious Total 0.053 Acres
Impervious Total 0.477 Acres
Basin Total 0.53 Acres
Precipitation Gage
2 - <UNK> | 158 YR PRECIP TIMESERIES, 38 IN CEN
Auto Assign Gages
Deselect Zero
Select By:
GO

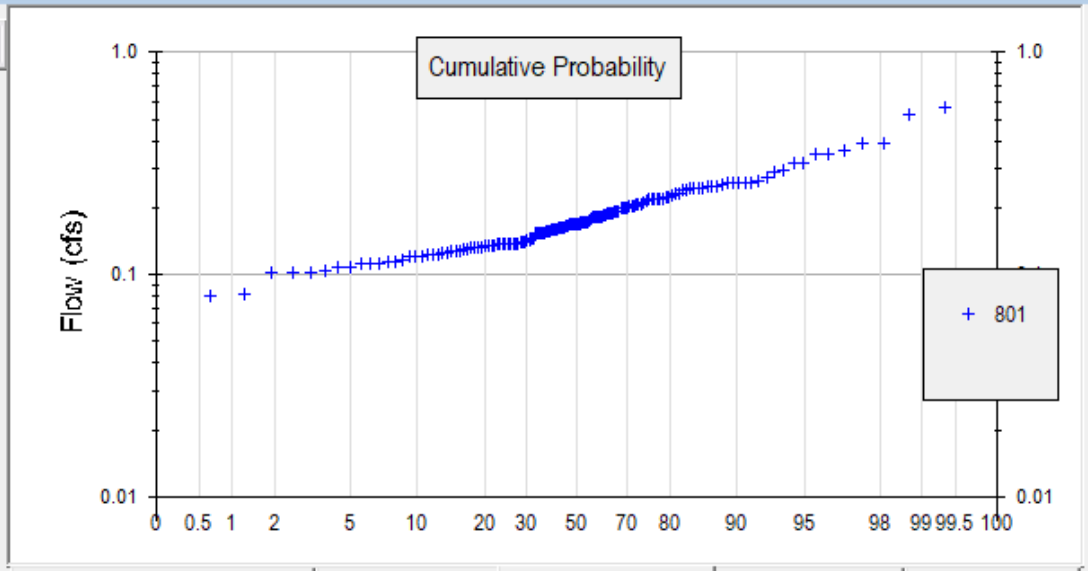

WWHM2012 20662-wq3
File Edit View Help Summary Report
Analysis
Water Quality
Run Analysis
On-Line BMP
24 hour Volume (ac-ft) 0.0529
Standard Flow Rate (cfs) 0.0703
Off-Line BMP
Standard Flow Rate (cfs) 0.0404
Stream Protection Duration
LID Duration
Flow Frequency
Water Quality
Hydrograph
Wetland Input Volumes
LID Report
Recharge Duration
Recharge Predeveloped
Recharge Mitigated
Analyze datasets
Compact WDM
Delete Selected
Monthly FF
1 158 YR EVAP TIMESERIES, 38 IN CENTRAL, 24 HR
2 158 YR PRECIP TIMESERIES, 38 IN CENTRAL, 15 MIN
501 POC 1 Predeveloped flow
801 POC 1 Mitigated flow
1000 Trapezoidal Pond 1 ALL OUTLETS Mitigated
1001 Trapezoidal Pond 1 STAGE Mitigated
1002 Gravel Trench Bed 1 ALL OUTLETS Mitigated
1003 Gravel Trench Bed 1 STAGE Mitigated
All Datasets
Flow
Stage
Precip
Evap
POC 1
Flood Frequency Method
Log Pearson Type III 17B
Weibull
Cunnane
Gringorten

WWHM2012 20662-wq3

File Edit View Help Summary Report

Analysis Help

Analysis



Stream Protection Duration | LID Duration | Flow Frequency | Water Quality | Hydrograph

Wetland Input Volumes | LID Report | Recharge Duration | Recharge Predeveloped | Recharge Mitigated

Analyze datasets Compact WDM Delete Selected Monthly FF

1 158 YR EVAP TIMESERIES, 38 IN CENTRAL, 24 HR
2 158 YR PRECIP TIMESERIES, 38 IN CENTRAL, 15 MIN
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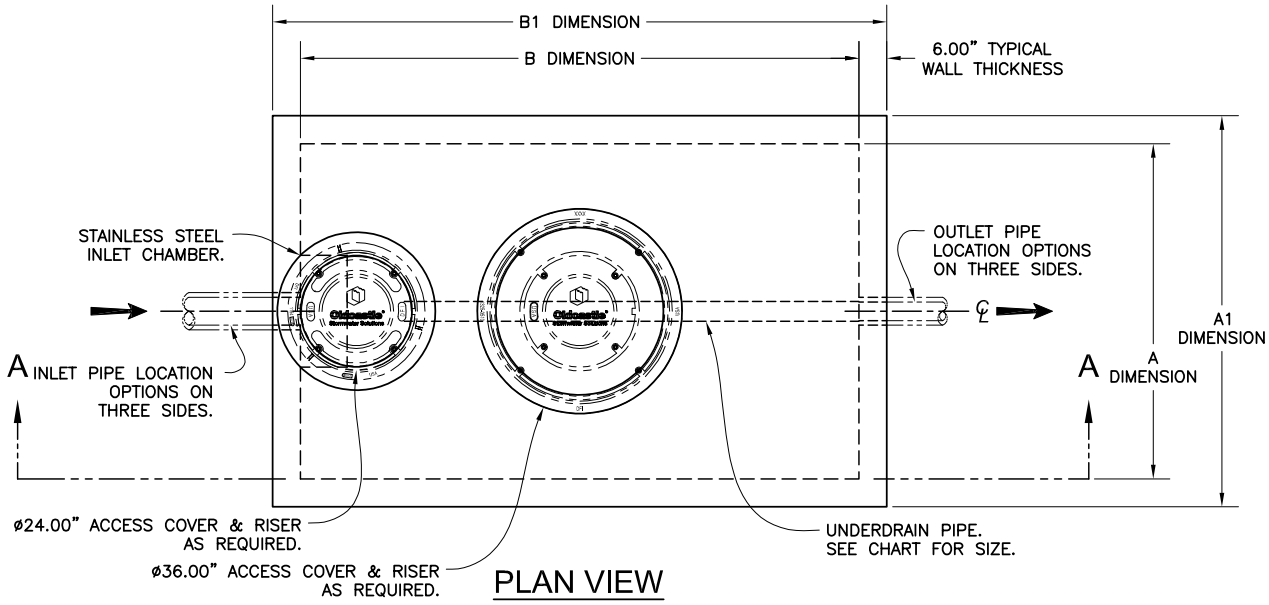
801 POC 1 Mitigated flow
1000 Trapezoidal Pond 1 ALL OUTLETS Mitigated
1001 Trapezoidal Pond 1 STAGE Mitigated
1002 Gravel Trench Bed 1 ALL OUTLETS Mitigated
1003 Gravel Trench Bed 1 STAGE Mitigated

All Datasets | Flow | Stage | Precip | Evap | POC 1

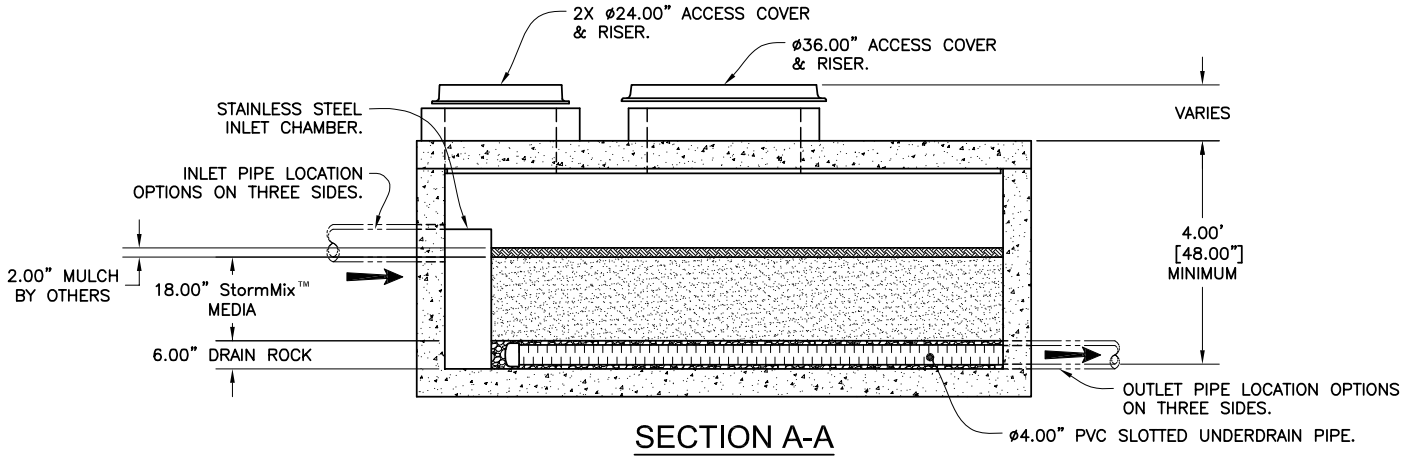
Flood Frequency Method
- (•) Log Pearson Type III 17B
- ( ) Weibull
- ( ) Cunnane
- ( ) Gringorten

```
Flow Frequency
Flow(cfs)  0801 15m
2 Year   =    0.1693
5 Year   =    0.2280
10 Year  =    0.2707
25 Year  =    0.3294
50 Year  =    0.3766
100 Year =    0.4268

Annual Peaks
 1902          0.1978
 1903          0.2193
 1904          0.2572
 1905          0.1121
 1906          0.1245
 1907          0.1709
 1908          0.1386
 1909          0.1688
 1910          0.1629
 1911          0.1842
 1912          0.3156
 1913          0.1309
 1914          0.5612
 1915          0.1138
 1916          0.2107
 1917          0.0795
 1918          0.1686
 1919          0.1045
 1920          0.1404
 1921          0.1201
 1922          0.1906
 1923          0.1312
 1924          0.2437
 1925          0.1028
 1926          0.1983
 1927          0.1617
 1928          0.1215
 1929          0.2433
```



PLAN VIEW



SECTION A-A

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BPU-IB-66	6'	6'	7'	7'	57.6 / 0.128
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BPU-IB-612	6'	12'	7'	13'	115.2 / 0.257
BPU-IB-816	8'	16'	9'	17'	204.8 / 0.456
BPU-IB-818	8'	18'	9'	19'	230.4 / 0.513
BPU-IB-1020	10'	20'	11'	21'	320 / 0.713

WQ #3

[1] All Dimensions Are Nominal.
[2] Based on an WA Ecology GULD Approval for Basic, Enhanced & Phosphorus. At 1.60 gpm/sf Media Surface Area.

US Patents Pending

Bioretention/ Biofiltration

BioPod™ Biofilter Underground

Vault with External Bypass

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DRAWING NO.	REV	ECO	DATE	SHEET
BPU	NR	ECO-0149 NEW	JPR 6/12/18	1 OF 2

WASHINGTON STATE DEPARTMENT OF ECOLOGY

July 2018

GENERAL USE LEVEL DESIGNATION FOR BASIC (TSS), DISSOLVED METALS (ENHANCED), AND PHOSPHORUS TREATMENT

For

Oldcastle Infrastructure, Inc.'s
The BioPod™ Biofilter
(Formerly the TreePod Biofilter)

Ecology's Decision:

Based on Oldcastle Infrastructure, Inc. application submissions for the The BioPod™ Biofilter (BioPod), Ecology hereby issues the following use level designation:

1. **General Use Level Designation (GULD) for Basic, Enhanced, and Phosphorus Treatment:**
   - **Sized at a hydraulic loading rate of 1.6 gallons per minute (gpm) per square foot (sq ft) of media surface area.**

2. **Ecology approves the BioPod at the hydraulic loading rate listed above, to achieve the maximum water quality design flow rate. 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. **The GULD has no expiration date, but may be amended or revoked by Ecology.**

Ecology's Conditions of Use:

The BioPod shall comply with these conditions:

1) **Oldcastle Infrastructure, Inc. shall design, assemble, install, operate, and maintain the BioPod installations in accordance with Oldcastle Infrastructure, Inc.'s applicable manuals and the Ecology Decision.**

2) **BioPod media shall conform to the specifications submitted to and approved by Ecology**

3) **Maintenance: The required inspection/maintenance interval for stormwater treatment devices is often dependent on the efficiency of the device and 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.**

   - **The BioPod is designed for a target maintenance interval of 1 year. Maintenance includes replacing the mulch, assessing plant health, removal of trash, and raking the top few inches of engineered media.**
   - **A BioPod system tested at the Lake Union Ship Canal Test Facility in Seattle, WA required maintenance after 1.5 months, or 6.3% of a water year. Monitoring personnel observed similar maintenance issues with other systems evaluated at the Test Facility. The runoff from the Test Facility may be unusual and maintenance requirements of systems installed at the Test Facility may not be indicative of maintenance requirements for all sites.**
   - **Test results provided to Ecology from a BioPod System evaluated in a lab following New Jersey Department of Environmental Protection Laboratory Protocol for Filtration MTDs have indicated the BioPod System is capable of longer maintenance intervals.**
   - **Owners/operators must inspect BioPod systems for a minimum of twelve months from the start of post-construction operation to determine site-specific inspection/maintenance schedules and requirements. Owners/operators 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 the 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 flow rate and/or a decrease in pollutant removal ability.**

4) **Install the BioPod in such a manner that you bypass flows exceeding the maximum operating rate and you will not resuspend captured sediment.**

5) Discharges from the BioPod shall not cause or contribute to water quality standards violations in receiving waters.

Applicant: Oldcastle Infrastructure, Inc.

Applicant's Address: 360 Sutton Place
Santa Rosa, CA 95407

Application Documents:

Technical Evaluation Report TreePod™ BioFilter System Performance Certification Project, Prepared for Oldcastle, Inc., Prepared by Herrera Environmental Consultants, Inc. February 2018

Technical Memorandum: Response to Board of External Reviewers' Comments on the Technical Evaluation Report for the TreePod™ Biofilter System Performance Certification Project, Oldcastle, Inc. and Herrera Environmental Consultants, Inc., February 2018

Technical Memorandum: Response to Board of External Reviewers' Comments on the Technical Evaluation Report for the TreePod™ Biofilter System Performance Certification Project, Oldcastle, Inc. and Herrera Environmental Consultants, Inc., January 2018

Application for Pilot Use Level Designation, TreePod™ Biofilter – Stormwater Treatment System, Oldcastle Stormwater Solutions, May 2016

Emerging Stormwater Treatment Technologies Application for Certification: The TreePod™ Biofilter, Oldcastle Stormwater Solutions, April 2016

Applicant's Use Level Request:

- General Use Level Designation as a Basic, Enhanced, and Phosphorus Treatment device in accordance with Ecology's *Stormwater Management Manual for Western Washington*

Applicant's Performance Claims:

Based on results from laboratory and field-testing, the applicant claims the BioPod™ Biofilter operating at a hydraulic loading rate of 153 inches per hour is able to remove:

- 80% of Total Suspended Solids (TSS) for influent concentrations greater than 100 mg/L and achieve a 20 mg/L effluent for influent concentrations less than 100 mg/L.
- 60% dissolved zinc for influent concentrations 0.02 to 0.3 mg/L.
- 30% dissolved copper for influent concentrations 0.005 to 0.02 mg/L.
- 50% or greater total phosphorus for influent concentrations 0.1 to 0.5 mg/L.

Ecology's Recommendations:

Ecology finds that:

- Oldcastle Infrastructure, Inc. has shown Ecology, through laboratory and field testing, that the BioPod™ Biofilter is capable of attaining Ecology's Basic, Total Phosphorus, and Enhanced treatment goals.

Findings of Fact:

Field Testing

1. Herrera Environmental Consultants, Inc. conducted monitoring of the BioPod™ Biofilter at the Lake Union Ship Canal Test Facility in Seattle Washington between November 2016 and April 2018. Herrera collected flow-weight composite samples during 14 separate storm events and peak flow grab samples during 3 separate storm events. The system was sized at an infiltration rate of 153 inches per hour or a hydraulic loading rate of 1.6 gpm/ft^2.
2. The D_{50} of the influent PSD ranged from 3 to 292 microns, with an average D_{50} of 28 microns.
3. Influent TSS concentrations ranged from 17 mg/L to 666 mg/L, with a mean concentration of 98 mg/L. For all samples (influent concentrations above and below 100 mg/L) the bootstrap estimate of the lower 95 percent confidence limit (LCL 95) of the mean TSS reduction was 84% and the bootstrap estimate of the upper 95 percent confidence limit (UCL95) of the mean TSS effluent concentration was 8.2 mg/L.
4. Dissolved copper influent concentrations from the 17 events ranged from 9.0 µg/L to 21.1 µg/L. The 21.1 µg/L data point was reduced to 20.0 µg/L, the upper limit to the TAPE allowed influent concentration range, prior to calculating the pollutant removal. A bootstrap estimate of the LCL95 of the mean dissolved copper reduction was 35%.
5. Dissolved zinc influent concentrations from the 17 events ranged from 26.1 µg/L to 43.3 µg/L. A bootstrap estimate of the LCL95 of the mean dissolved zinc reduction was 71%.
6. Total phosphorus influent concentrations from the 17 events ranged from 0.064 mg/L to 1.56 mg/L. All influent data greater than 0.5 mg/L were reduced to 0.5 mg/L, the upper limit to the TAPE allowed influent concentration range, prior to calculating the pollutant removal. A bootstrap estimate of the LCL95 of the mean total phosphorus reduction was 64%.
7. The system experienced rapid sediment loading and needed to be maintained after 1.5 months. Monitoring personnel observed similar sediment loading issues with other systems evaluated at the Test Facility. The runoff from the Test Facility may not be indicative of maintenance requirements for all sites.

Laboratory Testing

1. Good Harbour Laboratories (GHL) conducted laboratory testing at their site in Mississauga, Ontario in October 2017 following the New Jersey Department of Environmental Protection Laboratory Protocol for Filtration MTDs. The testing evaluated a 4-foot by 6-foot standard biofiltration chamber and inlet contour rack with bypass weir. The test sediment used during the testing was custom blended by GHL using various commercially available silica sands, which had an average d_{50} of 69 µm. Based on the lab test results:

a. GHL evaluated removal efficiency over 15 events at a Maximum Treatment Flow Rate (MTFR) of 37.6 gpm, which corresponds to a MTFR to effective filtration treatment area ratio of 1.80 gpm/ft^2. The system, operating at 100% of the MTFR with an average influent concentration of 201.3 mg/L, had an average removal efficiency of 99 percent.
b. GHL evaluated sediment mass loading capacity over an additional 16 events using an influent SSC concentration of 400 mg/L. The first 11 runs were evaluated at 100% of the MTFR. The BioPod began to bypass, so the remaining 5 runs were evaluated at 90% of the MTFR. The total mass of the sediment captured was 245.0 lbs and the cumulative mass removal efficiency was 96.3%.

2. Herrera Environmental Consultants Inc. conducted laboratory testing in September 2014 at the Seattle University Engineering Laboratory. The testing evaluated the flushing characteristics, hydraulic conductivity, and pollutant removal ability of twelve different media blends. Based on this testing, Oldcastle Infrastructure, Inc. selected one media blend, Mix 8, for inclusion in their TAPE evaluation of the BioPod™ Biofilter.
   a. Herrera evaluated Mix 8 in an 8-inch diameter by 36-inch tall polyvinyl chloride (PVC) column. The column contained 18-inches of Mix 8 on top of 6-inches of pea gravel. The BioPod will normally include a 3-inch mulch layer on top of the media layer; however, this was not included in the laboratory testing.
   b. Mix 8 has a hydraulic conductivity of 218 inches per hour; however, evaluation of the pollutant removal ability of the media was based on an infiltration rate of 115 inches per hour. The media was tested at 75%, 100%, and 125% of the infiltration rate. Based on the lab test results:
      - The system was evaluated using natural stormwater. The dissolved copper and dissolved zinc concentrations in the natural stormwater were lower than the TAPE influent standards; therefore, the stormwater was spiked with 66.4 mL of 100 mg/L Cu solution and 113.6 mL of 1,000 mg/L Zn solution.
      - The BioPod removed an average of 81% of TSS, with a mean influent concentration of 48.4 mg/L and a mean effluent concentration of 9.8 mg/L.
      - The BioPod removed an average of 94% of dissolved copper, with a mean influent concentration of 10.6 µg/L and a mean effluent concentration of 0.6 µg/L.
      - The BioPod removed an average of 97% of dissolved zinc, with a mean influent concentration of 117 µg/L and a mean effluent concentration of 4 µg/L.
      - The BioPod removed an average of 97% of total phosphorus, with a mean influent concentration of 2.52 mg/L and a mean effluent concentration of 0.066 mg/L. When total phosphorus influent concentrations were capped at the TAPE upper limit of 0.5 mg/L, calculations showed an average removal of 87%.

Other BioPod Related Issues to be Addressed By the Company:

1. Conduct hydraulic testing to obtain information about maintenance requirements on a site with runoff that is more typical of the Pacific Northwest.

Technology Description: Download at https://oldcastleprecast.com/stormwater/bioretention-biofiltration-applications/bioretention-biofiltration-solutions/

Contact Information:

Applicant: Chris Demarest
Oldcastle Infrastructure, Inc.
(925) 667-7100
Chris.demarest@oldcastle.com

Applicant website: https://oldcastleprecast.com/stormwater/

Ecology web link: https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

Ecology: Douglas C. Howie, P.E.
Department of Ecology
Water Quality Program
(360) 407-6444
douglas.howie@ecy.wa.gov

Revision History

Date	Revision
March 2018	GULD granted for Basic Treatment
March 2018	Provisional GULD granted for Enhanced and Phosphorus Treatment
June 2016	PULD Granted
April 2018	GULD for Basic and Provisional GULD for Enhanced and Phosphorus granted, changed name to BioPod from TreePod
July 2018	GULD for Enhanced and Phosphorus granted

Exhibit G
Conveyance Analysis

Conveyance Calculations will be added at construction permit application

Exhibit H
Storm Water Pollution Prevention Plan

The SWPPP will be added at construction permit application

Exhibit I
Operations and Maintenance Manual

The O & M Manual will be added at construction permit application

Exhibit J
Downstream Drainage Path Map

Downstream Drainage Map

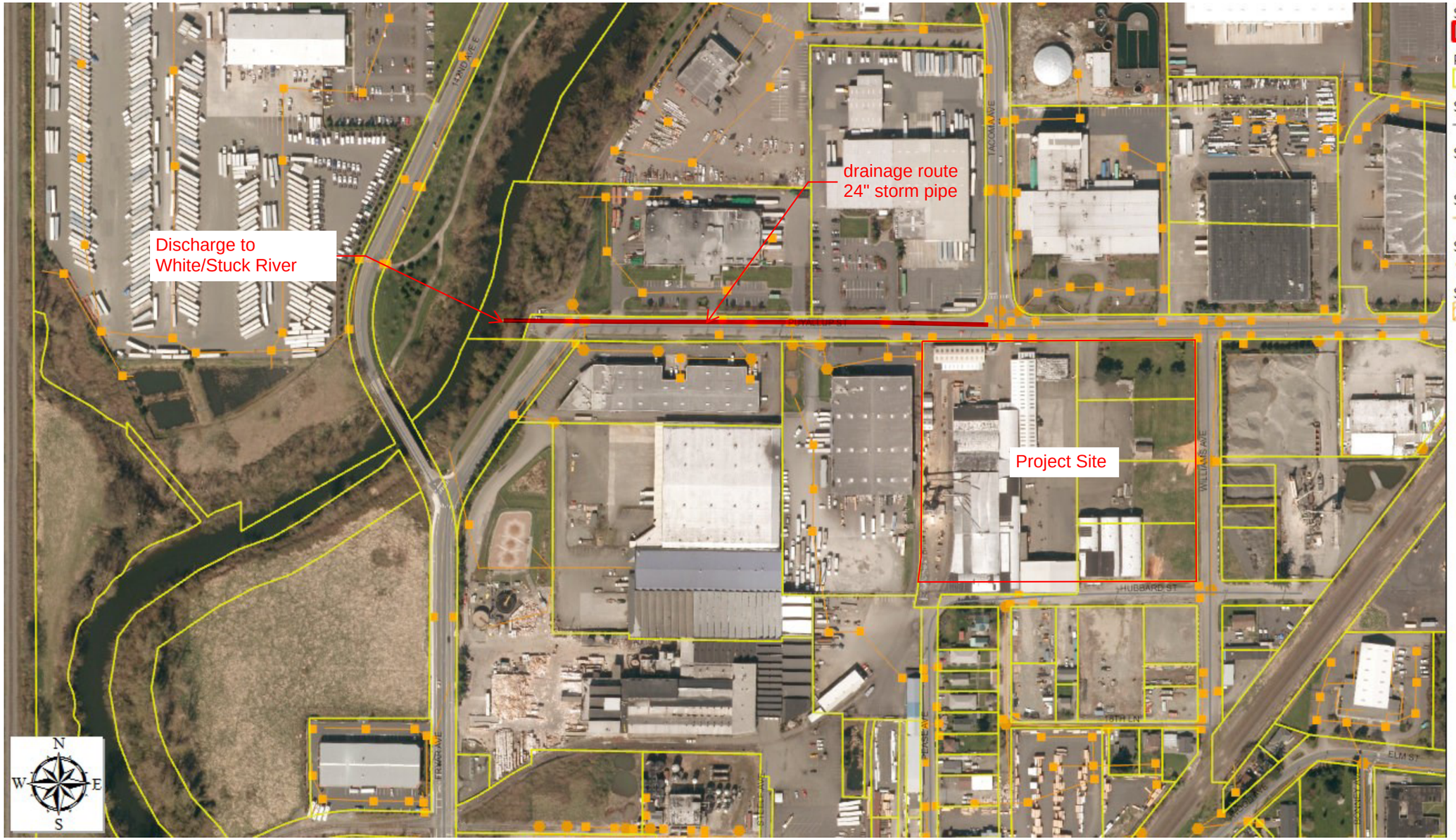

Exhibit K
Critical Area Maps

City of Sumner
Aquifer Recharge Area Map

ADOPTED: 12-15-2003 & 03-16-1992
ORDINANCE NO: 2071 & 1543
PLOTTED ON: 03-10-2016, JAM

SOURCE: City of Sumner Community Development Department, 2016

Critical Areas

DISCLAIMER:
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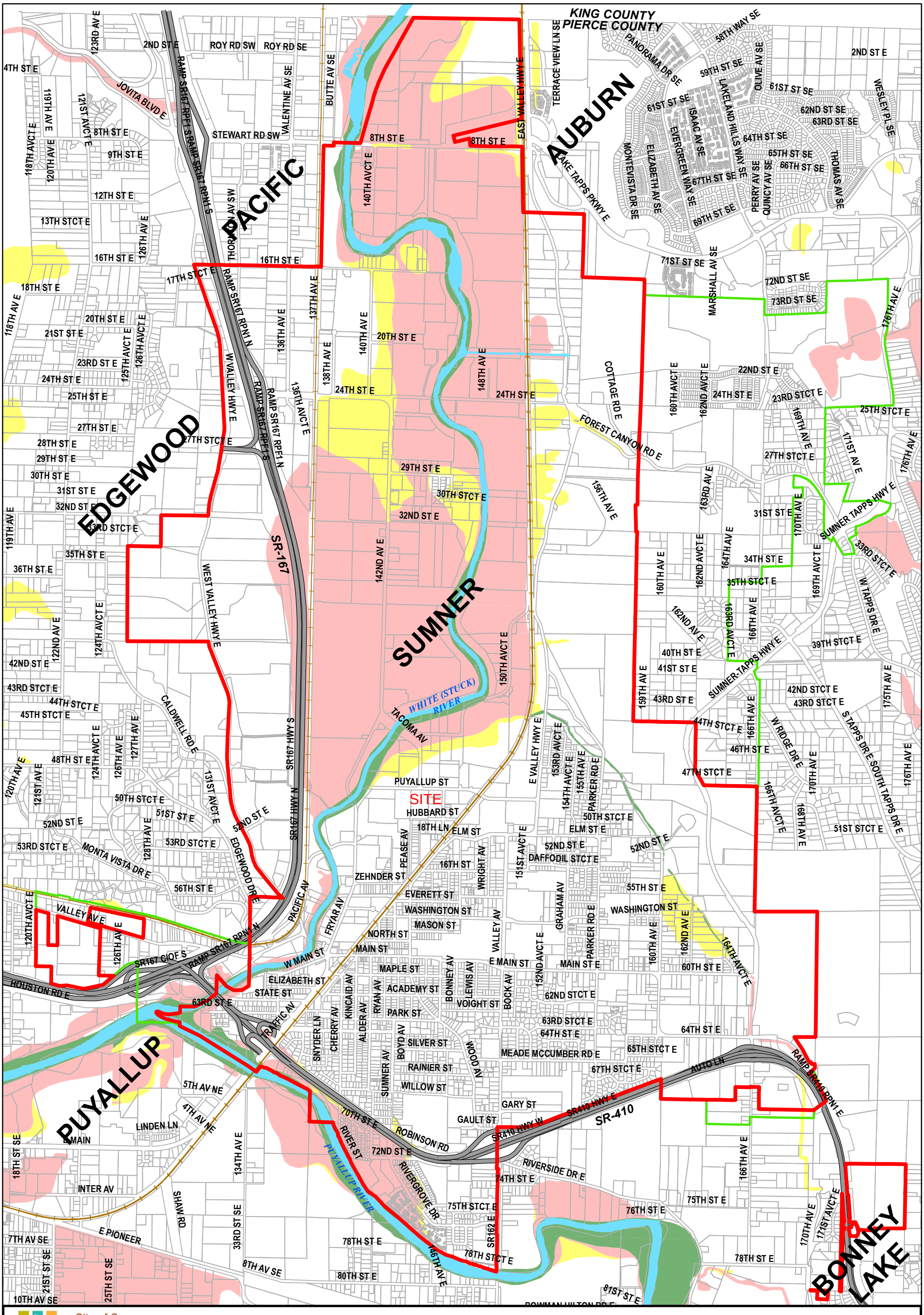
Scale:
0 0.25 0.5 Miles

Legend:
- Sumner City Limits
- Sumner UGA
- Parcels

Aquifer Recharge Areas
- Drastic Zones Rated 180 or Greater

Wellhead Protection Areas:
- 5-Years
- 6-Months
- 1-Year
- 10-Years

Well / Water Source Sites:
- Cemetery Well
- County Springs
- Elhi Springs
- South Well
- Sumner Springs
- Weber Springs
- Dieringer Well
- Central Well



City of Sumner

Flood Hazard Area Map

CITY OF SUMNER WASHINGTON

ADOPTED: 10-19-1987
ORDINANCE NO: 1406
PLOTTED ON: 03-10-2016, JAM

SOURCE: City of Sumner Community Development Department, 2003

N W E S

Critical Areas

DISCLAIMER:
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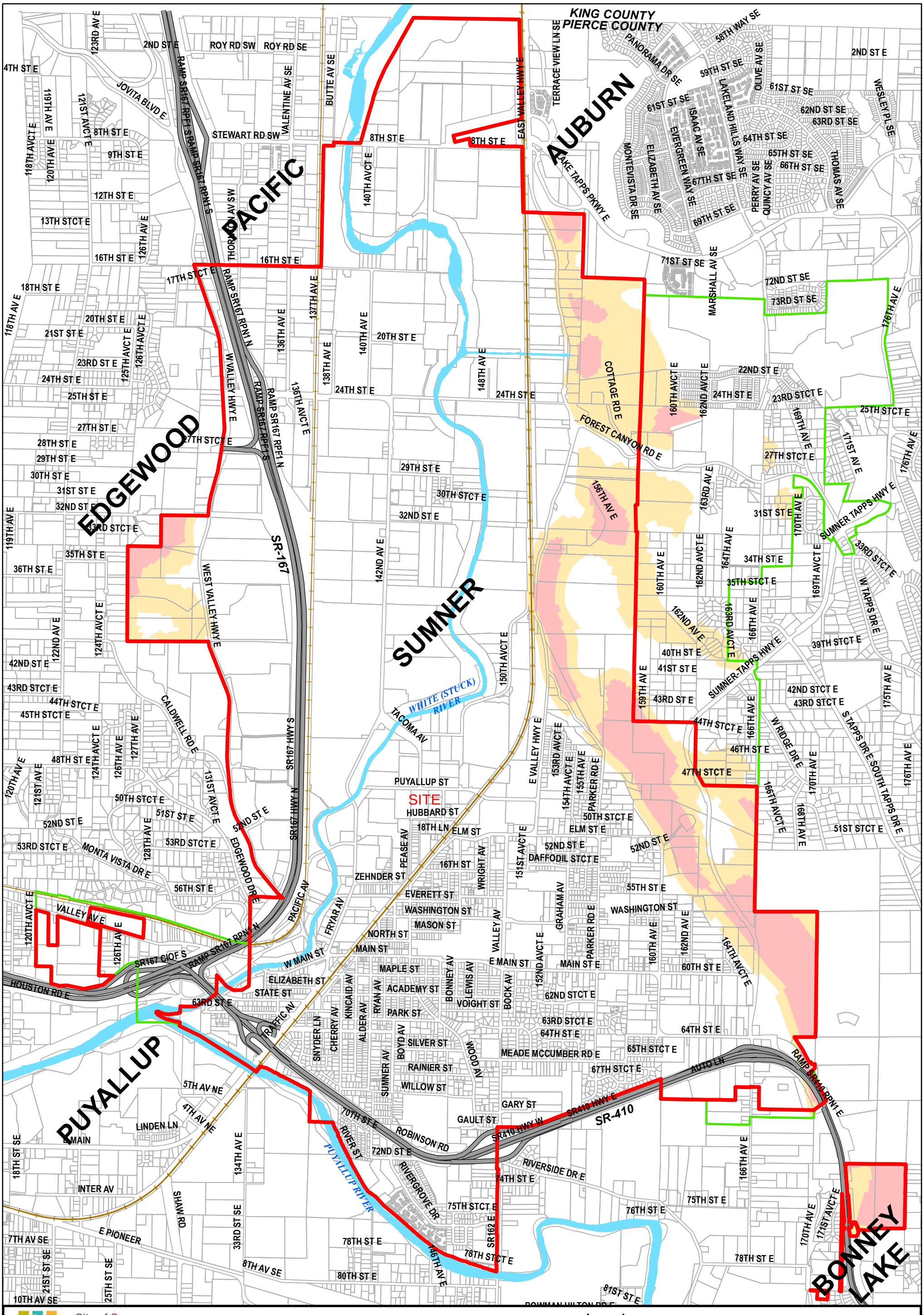
Scale:
0 0.25 0.5 Miles

Legend:

- Sumner City Limits
- Sumner UGA
- Parcels

Flood Hazard Areas (1984 FEMA)

- Floodway
- 100-Year
- 500-Year



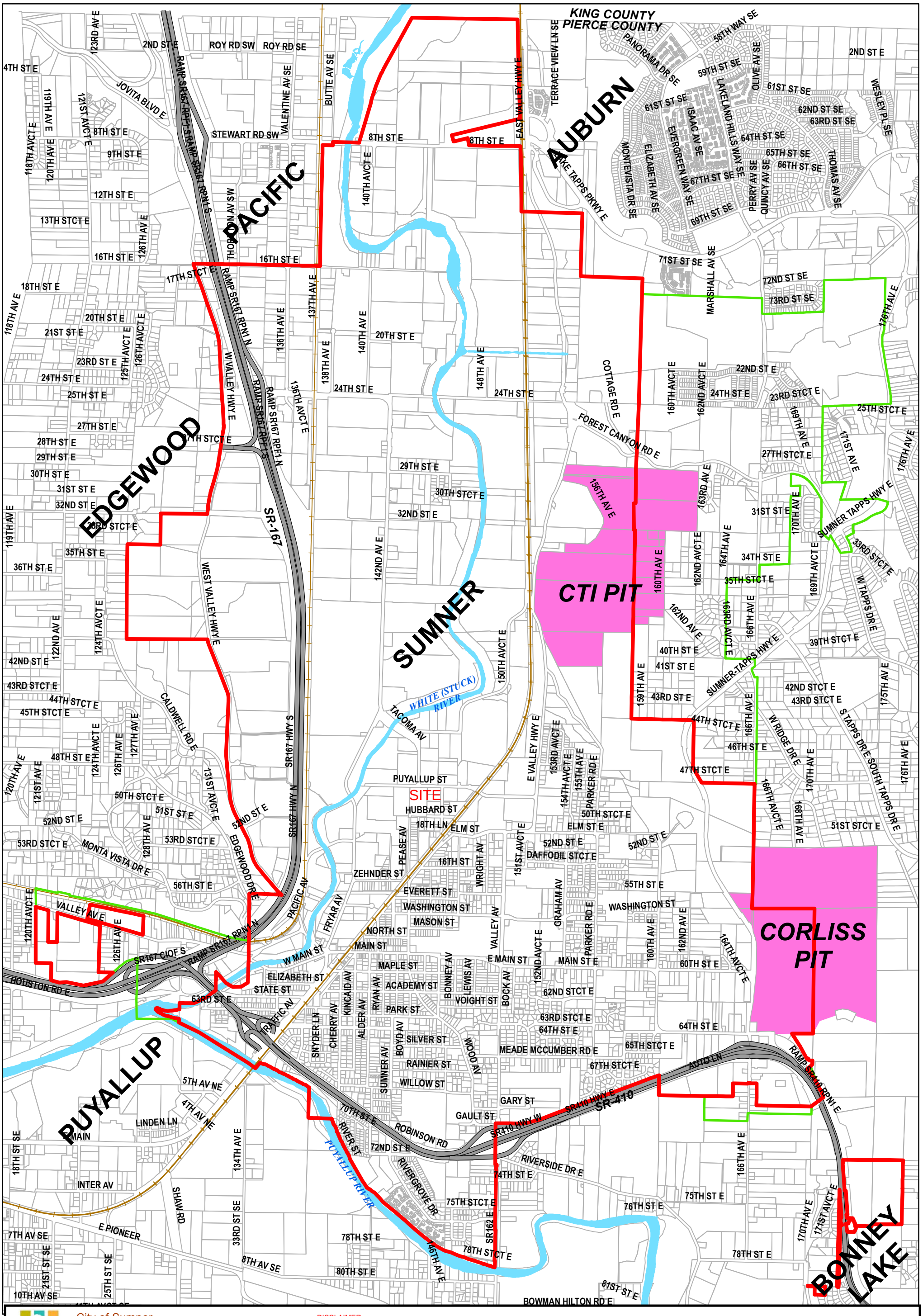
City of Sumner

Landslide & Erosion Hazard Area Map

ADOPTED: 03-16-1992
ORDINANCE NO: 1544
PLOTTED ON: 03-10-2016, JAM

SOURCE: City of Sumner Community Development Department, 2003

Critical Areas



City of Sumner

Mineral Resource Area Map

ADOPTED: 03-16-1992
ORDINANCE NO: 1541
PLOTTED ON: 03-10-2016, JAM

SOURCE: City of Sumner Community Development Department, 2003

Critical Areas

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Scale:
0 0.25 0.5 Miles

Legend:

- Sumner City Limits
- Sumner UGA
- Parcels
- Mineral Resource Area

KING COUNTY
PIERCE COUNTY
AUBURN
PACIFIC
EDGEWOOD
SUMNER
PUYALLUP
BONNEY LAKE
SITE
WHITE (STUCK) RIVER
PUYALLUP RIVER
SR-167
SR-410
SR167 HWY S
SR167 HWY N
SR410 HWY E
SR410 HWY W
E VALLEY HWY E
WEST VALLEY HWY E
RAMP SR167 RPN1 S
RAMP SR167 RPN1 N
RAMP SR167 RPE1 N
SR167 CIOF S
RAMP SR167 RPN1 N
RAMP SR410 RPN1 E
AUTO LN
ROY RD SW
ROY RD SE
STEWART RD SW
JOVITA BLVD E
2ND ST E
4TH ST E
8TH ST E
9TH ST E
12TH ST E
13TH STCT E
16TH ST E
17TH STCT E
18TH ST E
20TH ST E
21ST ST E
23RD ST E
24TH ST E
25TH ST E
27TH ST E
27TH STCT E
28TH ST E
29TH ST E
30TH ST E
30TH STCT E
31ST ST E
32ND ST E
33RD STCT E
35TH ST E
36TH ST E
42ND ST E
43RD STCT E
44TH STCT E
45TH STCT E
48TH ST E
50TH STCT E
51ST ST E
52ND ST E
53RD STCT E
56TH ST E
63RD ST E
64TH ST E
65TH STCT E
67TH STCT E
70TH ST E
72ND ST E
74TH ST E
75TH STCT E
76TH ST E
78TH ST E
78TH STCT E
80TH ST E
81ST ST E
10TH AV SE
7TH AV SE
8TH AV SE
4TH AV NE
5TH AV NE
118TH AV E
119TH AV E
120TH AV E
121ST AV E
123RD AV E
124TH AV E
125TH AV E
126TH AV E
127TH AV E
128TH AV E
131ST AV E
134TH AV E
136TH AV E
137TH AV E
138TH AV E
140TH AV E
142ND AV E
148TH AV E
150TH AV E
156TH AV E
159TH AV E
160TH AV E
162ND AV E
163RD AV E
164TH AV E
166TH AV E
169TH AV E
170TH AV E
171ST AV E
175TH AV E
176TH AV E
118TH AV E
119TH AV E
120TH AV E
121ST AV E
122ND AV E
124TH AV E
125TH AV E
126TH AV E
127TH AV E
128TH AV E
131ST AV E
134TH AV E
136TH AV E
137TH AV E
138TH AV E
140TH AV E
142ND AV E
148TH AV E
150TH AV E
151ST AV E
153RD AV E
154TH AV E
155TH AV E
156TH AV E
159TH AV E
160TH AV E
162ND AV E
163RD AV E
164TH AV E
166TH AV E
169TH AV E
170TH AV E
171ST AV E
175TH AV E
176TH AV E
18TH ST SE
21ST ST SE
25TH ST SE
33RD ST SE
119TH AV E
120TH AV E
122ND AV E
124TH AV E
126TH AV E
134TH AV E
142ND AV E
146TH AV E
150TH AV E
153RD AV E
154TH AV E
155TH AV E
156TH AV E
159TH AV E
160TH AV E
162ND AV E
163RD AV E
164TH AV E
166TH AV E
169TH AV E
170TH AV E
171ST AV E
175TH AV E
176TH AV E
TERRACE VIEW LN SE
PANORAMA DR SE
58TH WAY SE
59TH ST SE
61ST ST SE
62ND ST SE
63RD ST SE
64TH ST SE
65TH ST SE
66TH ST SE
67TH ST SE
69TH ST SE
71ST ST SE
72ND ST SE
73RD ST SE
OLIVE AV SE
LAKELAND HILLS WAY SE
ISAAC AV SE
EVERGREEN WAY SE
ELIZABETH AV SE
MONTEVISTA DR SE
PERRY AV SE
QUINCY AV SE
THOMAS AV SE
WESLEY PL SE
LAKE TAPPS PKWY E
MARSHALL AV SE
COTTAGE RD E
FOREST CANYON RD E
22ND ST E
23RD STCT E
25TH STCT E
27TH STCT E
31ST ST E
33RD STCT E
34TH ST E
35TH STCT E
39TH STCT E
40TH ST E
41ST ST E
42ND STCT E
43RD ST E
43RD STCT E
44TH STCT E
46TH ST E
47TH STCT E
50TH STCT E
51ST STCT E
52ND ST E
53RD STCT E
55TH ST E
56TH ST E
60TH ST E
62ND STCT E
63RD STCT E
64TH ST E
65TH STCT E
67TH STCT E
69TH ST E
70TH ST E
72ND ST E
74TH ST E
75TH STCT E
76TH ST E
78TH ST E
78TH STCT E
80TH ST E
81ST ST E
SUMNER TAPPS HWY E
W TAPPS DR E
S TAPPS DR E SOUTH TAPPS DR E
W RIDGE DR E
SUMNER-TAPPS HWY E
MONTA VISTA DR E
CALDWELL RD E
EDGEWOOD DR E
VALLEY AV E
HOUSTON RD E
TRAFFIC AV
PACIFIC AV
FRYAR AV
SNYDER LN
CHERRY AV
KINCAID AV
ALDER AV
RYAN AV
SUMNER AV
BOYD AV
BONNEY AV
LLEWIS AV
WOOD AV
BOCK AV
VALLEY AV
GRAHAM AV
PEASE AV
WRIGHT AV
PUYALLUP ST
HUBBARD ST
18TH LN
ELM ST
ELM ST E
DAFFODIL STCT E
ZEHNDER ST
EVERETT ST
WASHINGTON ST
MASON ST
NORTH ST
MAIN ST
W MAIN ST
E MAIN ST
MAIN ST E
MAPLE ST
ELIZABETH ST
STATE ST
ACADEMY ST
PARK ST
SILVER ST
RAINIER ST
WILLOW ST
GARY ST
GAULT ST
ROBINSON RD
RIVER ST
RIVERGROVE DR
RIVERSIDE DR E
PARKER RD E
MEADE MCCUMBER RD E
VOIGHT ST
LINDEN LN
MAIN
INTER AV
SHAW RD
E PIONEER
VALLEY AV E
SUMNER CITY LIMITS
SUMNER UGA
PARCELS
HIGH
LOW TO MODERATE
PEAT
VERY LOW
WATER
HIGH DYNAMIC SETTLEMENT HAZARD

City of Sumner

Seismic Hazard Area Map

Critical Areas

CITY OF SUMNER WASHINGTON

ADOPTED: XXX
ORDINANCE NO: XXX
PLOTTED ON: 03-10-2016, JAM

SOURCE: City of Sumner Community Development Department, 2016

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Scale:
0 0.25 0.5 Miles

Legend:
- Sumner City Limits
- Sumner UGA
- Parcels

Liquefacation Hazard Area
- High
- Low to Moderate
- Peat
- Very Low
- Water
- High Dynamic Settlement Hazard

King County

Pierce County

Pacific

Auburn

Edgewood

Puyallup

Unincorporated Pierce County

Bonney Lake

Lake Tapps

8th Street Creek

White (Stuck) River

Sotain Creek

Dieringer Flume

Salmon Creek

Wapato Creek

Puyallup River

Unnamed Creek

SITE

200'

100'

50'

136TH AV E

142ND AV E

160TH AV E

166TH AV E

24TH ST E

64TH ST E

ELM ST E

MAIN ST

MAIN ST E

VALLEY AV

VALLEY AV E

TRAFFIC AV

FOREST CANYON RD E

WEST VALLEY HWY E

EAST VALLEY HWY E

SUMNER-TAPPS HWY E

Union Pacific Railroad

BNSF Railroad

Meeker Southern Railroad

167

410

N

0 0.5 Miles

This map is intended for planning purposes only. The map depicts the approximate location and extent of "shorelines of the state" based on the following elements: the ordinary high water mark (OHWM), a 200 foot buffer of the OHWM, the draft FEMA floodplain, and potentially associated wetlands. The actual extent of the shoreline jurisdiction will require a site-specific evaluation to identify the OHWM, the floodway and any associated wetlands.

CITY OF SUMNER WASHINGTON

City of Sumner

Shoreline Map

ADOPTED: 10-06-2014
ORDINANCE NO: 2497
PLOTTED ON: 03-10-2016, JAM

SOURCE: City of Sumner Community Development Department, 2014

N W E S

Critical Areas

Scale:
0 0.25 0.5 Miles

Legend

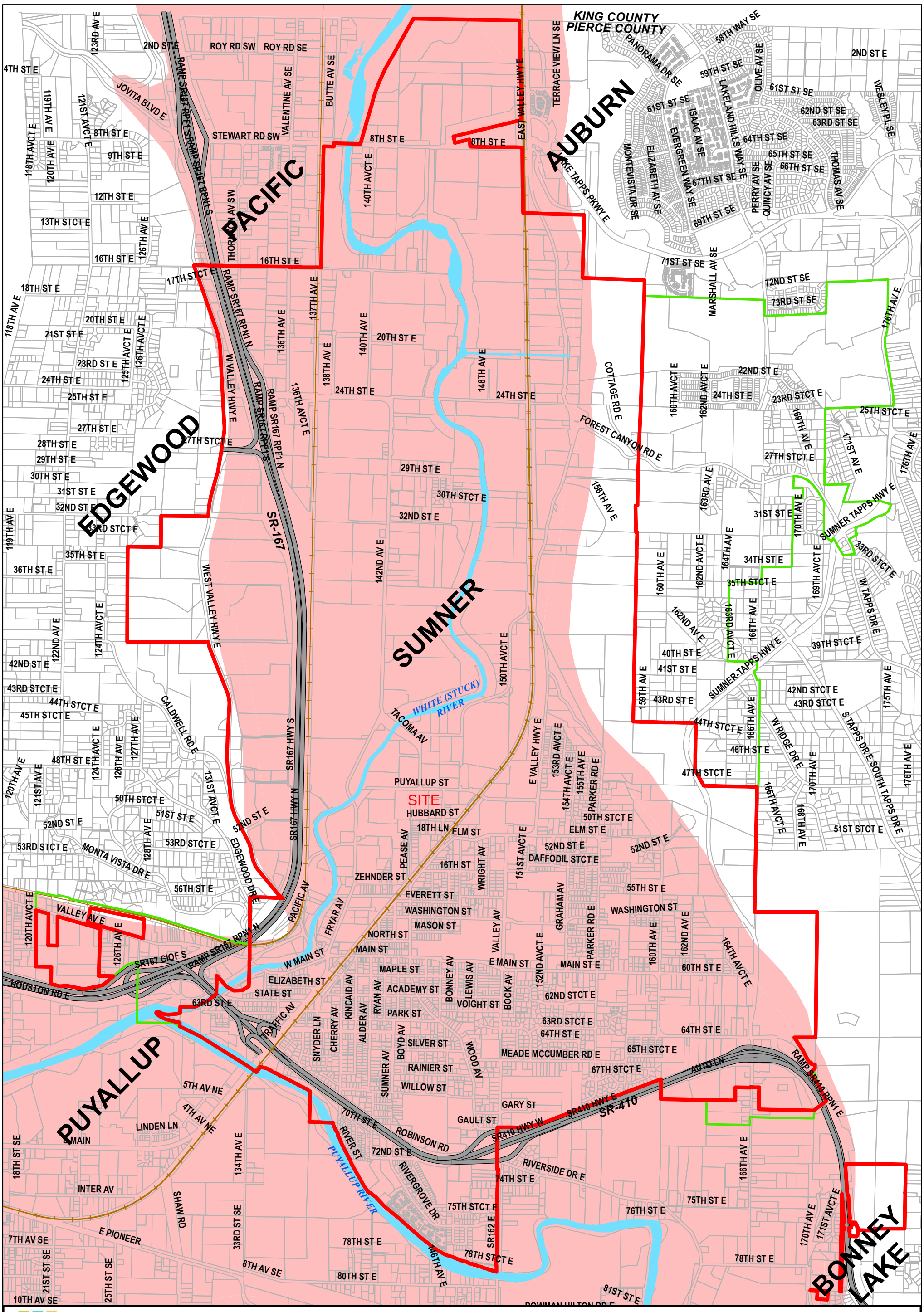
Shoreline Environment Designation

- Natural and Buffers (200 FT)
- Shoreline Residential (100 FT)
- Tapps Reservoir (100 FT)
- Urban (50 FT)
- Urban Conservancy (100/200 FT)

NOTE: All areas waterward of the Ordinary High Water Mark (OHWM) have a Shoreline Environmental Designation of Aquatic.

NOTE: Setback is measured from the OHWM.

- Sumner City Limits
- Sumner UGA
- Proposed Sumner UGA
- Joint Planning Area
- Selected City Owned Property w/in Urban Conservancy
- Waterbodies
- Streams
- Flume (Pipe)
- Railroads
- Shoreline Planning Area Outside of Study Area
- Incorporated Cities



City of Sumner

Volcanic Hazard Area Map

ADOPTED: 04-06-1992
ORDINANCE NO: 1551
PLOTTED ON: 03-10-2016, JAM

SOURCE: City of Sumner Community Development Department, 2003

Critical Areas

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Scale:
0 0.25 0.5 Miles

Legend:

- Sumner City Limits
- Sumner UGA
- Parcels
- Volcanic Hazard Area

City of Sumner
Wetland Inventory Map, 2007

Scale:
0 1000 2000 3000 Feet

N
W E
S

EXHIBIT A

LEGEND:
- Sumner City Limits
- Sumner UGA
- Parcels

Wetlands
- Wetlands, March 2007