BAYAN TRAILS

Olympia, Washington

STORMWATER SITE PLAN

NOVEMBER 2014

REVISED MARCH 2015

PREPARED FOR:

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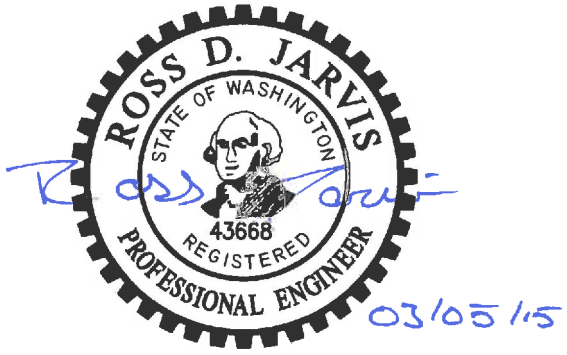
SCJ ALLIANCE
CONSULTING SERVICES

CERTIFICATE OF ENGINEER

PROJECT ENGINEER'S CERTIFICATION: I hereby certify that this Drainage and Erosion Control Plan for the Bayan Trails project has been prepared by me or under my supervision and meets minimum standards of the Drainage Design and Erosion Control Manual for the City of Olympia and normal standards of engineering practice. I hereby acknowledge and agree that the jurisdiction does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities designed by me.



Prepared by Ross Jarvis, PE

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1. PROJECT OVERVIEW

1.1 Site Data

Project Proponent:	Golden Alon Development Company PO Box 1068 Olympia, WA 98507
Parcel Numbers:	11817210100, 11817210200
Total Site Area:	19.52 ac
Zoned:	RM-18
Site Address:	607 and 709 Sleater Kinney Road NE
Required Permits:	Grading, utility, paving, building, etc.
Section, Township, Range:	Section 17, Township 18N, Range 1W, W.M.

1.2 Project Description

The Bayan Trails project is proposed on a partially developed 19.52 acre site. The proposal is to develop 10.55 acres with four senior apartment buildings, one community building, one pool building, ten muti-family townhome style apartments, three on-site roads, and off-site road improvements to Sleater Kinney Road NE. Stormwater, water and sanitary sewer utilities, and parking lots are also proposed along with the buildings and road improvements. The project site is located west of Sleater Kinney Road NE, north and south of existing residential neighborhoods, and east of the Chehalis-Western Trail.

The stormwater runoff from the building roofs will be infiltrated on-site. Since the roofs are considered clean runoff, water quality is not proposed. Stormwater runoff from the parking lots, sidewalks, disturbed pervious areas, and on-site roads will be conveyed to a bioretention cell or modular wetland system and detention vaults, for water quality and flow control requirements respectively, prior to entering the existing wetland or storm drainage system in Sleater Kinney Road NE.

See the aerial map and site map in **Appendix A.** See the Existing and Developed Conditions Exhibits in **Appendix B.** See the soils map in **Appendix D**.

2. EXISTING CONDITIONS SUMMARY

2.1 Site Description

The site is wooded; however, there are currently two single family residences on the site with associated driveways and parking lots. There is a high point near the eastern third of the project site: the site east of the high point slopes to the east at approximately 1.7-percent; the site west of the high point slopes

to the west at approximately 2.4-percent with a steeper slope near the wetland of approximately 12-percent. Currently, stormwater runoff from the eastern side of the project site exits to the east via sheet flow and enters the existing storm drain system in Sleater Kinney Road NE. The storm drain system within Sleater Kinney Road NE conveys stormwater to the north and eventually outlets to Woodard Creek. Currently stormwater runoff from the western side of the project site exits to the west via sheet flow and enters the existing wetland that covers the western half of the property. There is an existing overland path through the neighbor's property to the north that conveys overflow runoff from the wetland and is then piped back to the storm drain system within Sleater Kinney Road NE.

There is not an existing drainage system on-site. The geotechnical report indicates that deeper soils will not allow for infiltration; however, soils near the surface allow for infiltration. Since the deeper soils are not well suited for infiltration, the existing site was modeled in the forested condition with Type C soils per the October 2014 geotechnical report prepared by Landau Associates. Table 2.1 below summarizes the areas used to model the existing conditions of the site. An existing conditions drainage exhibit is included in **Appendix B** of this report.

Table 2.1. Existing Conditions Basin

Basin	PERVIOUS AREA (ACRES)	IMPERVIOUS AREA (ACRES)
East	5.36	0
West	5.17	0
Total	10.53	0

See the Existing Conditions Basin Map in **Appendix B.**

2.2 Soils

A Geotechnical Report was prepared for this site by Landau Associates in October 2014. In general test pits encountered recessional outwash overlying glacial till. Underlying the gravelly sand, coarser and cleaner advanced outwash deposits of sand and gravel soil are present. The recessional outwash generally consists of medium dense silty sand or sand with silt and varying amounts of gravel. The glacial till generally consists of dense to very dense silty sand with varying amounts of gravel. Per Section 3.4 of the geotechnical report, shallow downspout infiltration systems are recommended; however, deeper infiltration systems for the developed site are not recommended. A copy of Landau Associates Geotechnical Report is included in **Appendix D** of this report.

3. OFFSITE ANALYSIS

3.1 Upstream Analysis

The project site is located at a high-point in the area and is not receiving stormwater runoff from upstream sources.

3.2 Downstream Analysis

The stormwater runoff from the building roofs will be infiltrated on-site.

Eastern Runoff

All of the stormwater runoff from the eastern basin will be collected, treated, detained, and released to the existing storm drain system within Sleater Kinney Road NE. Since stormwater runoff from this basin will outlet to it's historic location and will be released at the predeveloped conditions runoff rates, downstream impacts are not anticipated.

Western Runoff

All of the stormwater runoff from the western basin will be collected, treated, detained, and released to the existing wetland to the west. Since stormwater runoff from this basin will outlet to it's historic location and will be released at the predeveloped conditions runoff rates, downstream impacts are not anticipated. There is an existing overland path through the neighbor's property to the north that conveys overflow runoff from the wetland and is then piped back to the storm drain system within Sleater Kinney Road NE. The outlet from the piped conveyance system is approximately 380-feet north of the northern property line and connects to the existing storm drain system within Sleater Kinney Road NE.

See the Off-site Map in **Appendix B**.

4. SUMMARY OF MINIMUM REQUIREMENTS

4.1 Summary of Compliance

The stormwater design complies with all 10 minimum requirements as follows:

Minimum Requirement #1 – Preparation of Stormwater Site Plans – This summary is contained within the stormwater site plan.

Minimum Requirement #2 – Construction Stormwater Pollution Prevention – A pollution prevention plan has been included within the stormwater site plan which describes the 12 required elements. Further, an erosion control plan has been prepared and is part of the engineering plan set.

Minimum Requirement #3 – Source Control of Pollution – The project owner has been made aware of the requirements for source control for pollution prevention. A source control pollution prevention plan will be completed as part of the final construction documents.

Minimum Requirement #4 – Preservation of Natural Drainage Systems and Outfalls – Runoff from the project site currently sheet flows to the west and east. Runoff to the west enters the existing wetland; runoff to the east enters the conveyance system in Sleater Kinney Road NE. Stormwater runoff from the developed site will follow the natural drainage system.

Minimum Requirement #5 – On-site Stormwater Management, including Easements and Setbacks – Stormwater roof runoff will be infiltrated on-site; the remaining surface water runoff will be collected in

catch basins and conveyed to detention systems prior to exiting the site. Disturbed pervious surfaces will receive amended soils that meet the requirements of BMP T5.13. The resulting soil will be conducive to the type of vegetation to be established.

Minimum Requirement #6 – Runoff Treatment – Runoff treatment is provided by various bioretention systems as well as MWS – Linear Modular Wetland systems throughout the site that will provide enhanced water quality treatment.

Minimum Requirement #7 – Flow Control – Roof runoff will be infiltrated on-site; the remaining surface water runoff will be detained and released at the pre-developed rates.

Minimum Requirement #8 – Wetlands Protection – There is an existing wetland located on the western half of this project site. The western detention vault outlets to adispersion trench that iswithin the wetland buffer. Appendix I-D of the DDECM and WWHM2012 has been used to analyze the Wetland Fluctuation. The volume of runoff from the proposed development is within the constraints set forth in Appendix 1-D of the DDECM. See hydro-period calculations using WWHM 2012 within **Appendix C**.

Minimum Requirement #9 – Basin/Watershed Planning – The site will act as its own watershed and will meet the minimum requirements of the DDECM. No additional watershed planning is necessary.

Minimum Requirement #10 – Operation and Maintenance – An operation and maintenance manual will be prepared and provided as part of the final engineering documents for the Bayan Trails project.

5. PERMANENT STORMWATER CONTROL PLAN

5.1 Existing Site Hydrology

The pre-developed site was modeled in the forested condition using hydrologic group C soils. Even though roof infiltration is proposed, the predeveloped conditions were modeled as two basins with the entire area contributing to their respective point of compliance. Sizing calculations were prepared using the Western Washington Hydrology Model version 3 (WWHM v3). Please see the topographical survey and existing conditions exhibit in **Appendix B**. Existing Conditions hydrology calculations can be found in **Appendix C**.

5.2 Developed Site Hydrology

The project site was modeled with two basins where surface runoff drains to separate detention systems. There is a high point near the eastern third of the project site. The western portion drains to the existing wetland and is separated into two sub-basins: West Basin – 1 consists of the northern half of the west basin and West Basin – 2 consists of the southern half of the west basin The eastern portion is separated into two sub-basins: East Basin – 1 and East Basin – 2. East Basin – 1 consists of the northern half of the east basin and East Basin – 2 consists of the southern half of the east basin. Below is a summary of the two basins.

East Basin - 1

This basin includes stormwater runoff from portions of 6th Avenue NE, portions of the parking lot north of Senior Housing Buildings 'A' and 'B', and portions of the landscaped areas and sidewalks within the northern half of the eastern basin. The proposed detention facility has been designed using WWHM v3 per the City of Olympia's 2009 Drainage and Erosion Control Manual.

East Basin - 2

This basin includes stormwater runoff from portions of Road C, portions of the parking lot south of Senior Housing Buildings 'C' and 'D', portions of the drive aisles and parking lots near the multi-family townhome style apartments, and portions of the landscaped areas and sidewalks within the southern half of the eastern basin. The proposed detention facility has been designed using WWHM v3 per the City of Olympia's 2009 Drainage and Erosion Control Manual.

West Basin - 1

This basin includes stormwater runoff from portions of 6th Avenue NE, Road B, portions of the parking lot north of the Senior Housing Buildings, and portions of the landscaped areas and sidewalks within the northern half of the western basin.

West Basin – 2

This basin includes stormwater runoff from portions of Road B, Road C, portions of the parking lot south of the Senior Housing Buildings, portions of the drive aisles and parking lots near the multi-family townhome style apartments, and portions of the landscaped areas and sidewalks within the southern half of the western basin. The proposed detention facility has been designed using WWHM v3 per the City of Olympia's 2009 Drainage and Erosion Control Manual.

Table 5.1 below shows the developed conditions area summary for the Basins.

See **Appendix B** for the developed conditions exhibit and **Appendix E** for the Storm Drainage Plan.

Table 5.1 Bayan Trails Developed Conditions Summary

	West Basin – 1 (Acres)	West Basin – 2 (Acres)	East Basin – 1 (Acres)	East Basin – 2 (Acres)
Pavement (PGIS)	0.41	1.17	0.78	0.52
Sidewalks	0.14	0.46	0.34	0.16
Total Impervious	0.55	1.63	1.12	0.68
Landscape	0.15	0.17	0.50	0.41
Forest	0.31	0.96	1.08	0.36
Total Pervious	0.46	1.13	1.58	0.77
Total Area*	1.01	2.76	2.70	1.45

*Total area does not include roof runoff.

Stormwater Storage

The geotechnical report recommends shallow downspout infiltration systems for stormwater runoff from the proposed roofs. However, deeper infiltration systems for the developed site are not recommended and detention vaults are proposed for the eastern and western basins. The vaults have been sized using WWHM v3.

East Basin - 1

This basin includes stormwater runoff from portions of 6th Avenue NE, portions of the parking lot north of Senior Housing Buildings 'A' and 'B', and portions of the landscaped areas and sidewalks within the northern half of the eastern basin. This detention vault will be cast in place and has the following dimensions: 10,000 square feet surface area; and 3.5-feet deep with 3.0-feet of live storage.

East Basin - 2

This basin includes stormwater runoff from portions of Road C, portions of the parking lot south of Senior Housing Buildings 'C' and 'D', portions of the drive aisles and parking lots near the multi-family townhome style apartments, and portions of the landscaped areas and sidewalks within the southern half of the eastern basin. This bioretention cell has a bottom square area of 1,800 square-feet with the following dimensions: 3:1 side slopes; 1.5-feet depth of bioretention soil mixture; 1.0-feet depth of aggregate; and 4.5-feet overall depth with 4.0-feet of live storage.

West Basin - 1

This basin includes stormwater runoff from portions of 6th Avenue NE, Road B, portions of the parking lot north of the Senior Housing Buildings, and portions of the landscaped areas and sidewalks within the northern half of the western basin.

West Basin - 2

This basin includes stormwater runoff from portions of Road B, Road C, portions of the parking lot south of the Senior Housing Buildings, portions of the drive aisles and parking lots near the multi-family townhome style apartments, and portions of the landscaped areas and sidewalks within the southern half of the western basin. This detention vault has the following dimensions: 6,720 square feet surface area; and 7.0-feet deep with 6.5-feet of live storage.

Roof Runoff

Roof runoff will be tight-lined to on-site infiltration trenches. Per Standard Drawing 5-10A2, the prescriptive method was used for design. An infiltration trench is proposed for Senior Housing buildings 'A', 'B', and the Community building; this is labeled the northern roof basin. An infiltration trench is proposed for Senior Housing buildings 'C', 'D', and the Pool building; this is labeled the southern roof basin. An infiltration trench is proposed for the townhome style apartments and is labeled the northern roof basin; note roof runoff from two townhome style apartments contribute to a single infiltration trench.

North Basin Infiltration Trench

The total roof area within the north basin is 36,034 square feet. Using a Type B hydrologic soil group soil factor, the required trench volume = 0.125 * 36,034 square feet = 4,505 cubic feet (approximately). This correlates to an infiltration trench with the following dimensions: 115' long x 10' wide x 4' deep.

South Basin Infiltration Trench

The total roof area within the south basin is 35,052 square feet. Using a Type B hydrologic soil group soil factor, the required trench volume = 0.125 * 35,052 square feet = 4,385 cubic feet (approximately). This correlates to an infiltration trench with the following dimensions: 110' long x 10' wide x 4' deep.

Townhome Basin Infiltration Trench

The total roof area for two townhomes is 8,640 square feet. Using a Type B hydrologic soil group soil factor, the required trench volume = 0.125 * 8,640 square feet = 1,080 cubic feet (approximately). This correlates to an infiltration trench with the following dimensions: 62' long x 5' wide x 3.5' deep.

5.3 Flow Control System

Flow control has been designed per the WWHM v3 up to the developed conditions 100-year event. See **Appendix C** for flow control calculations.

5.4 Performance Standards and Goals

The project is located east of an existing wetland. The proposed apartments and associated out-buildings are considered commercial buildings; the enhanced treatment menu has been selected for this project. Flow control has been designed per the WWHM v3 up to the developed conditions 100-year event. If the downspout infiltration systems fail, they will overflow to the proposed detention vaults or bioretention cell as a contingency plan.

5.5 Water Quality System

Treatment of stormwater runoff from the site will be provided by various bioretention cells and MWS-Linear Modular Wetland systems throughout the site. As indicated in Volume V Section 3.4 of the 2012 Department of Ecology Stormwater Management Manual for Western Washington (SMMWW), both bioretention cells and MWS-Linear Modular Wetlands are appropriate methods for providing enhanced treatment. The bioretention cells were designed using WWHM v3 and pass at least 91% of the influent runoff through the bioretention soil mixture. The Modular Wetlands were designed using WWHM v3 and pass at least 91% of the influent runoff. Per the SMMWW General Use Level Designation for Enhanced Treatment, the MWS-Linear Modular Wetland Stormwater Treatment System is to be sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sf) of wetland cell surface area. For moderate pollutant loading rates the Prefilters are to be sized at 3.0 gpm/sq of cartridge surface area.

East Basin - 1

The runoff from East basin 1 will be treated by two Modular Wetland systems. The systems will be installed upstream of detention therefore the water quality design flow rate was found using WWHM3, 0.09 cfs.

0.09 cfs * 448 gpm/cfs = 40.32 gpm

1 gpm/sf of media surface area is required; hence 41 square feet of wetland cell surface area is need to provide adequate enhance treatment. Model MWS-L-4-8 has a WetlandMEDIA surface area of 50 sf. Using one for the East Basin 1 downstream of detention, we are able to treat up to 50 gpm of runoff, exceeding the requirement. According to Modular Wetland a pre-filter cartridge has over 25 sf of surface area per cartridge. One pre-filter cartridge will be used which can can pretreat up to 75 gpm.

West Basin - 1

The runoff from West Basin 1 will be treated by one Modular Wetland systems. The water quality design flow rate was found using WWHM3, 0.03 cfs.

0.11 cfs * 448 gpm/cfs = 49.28 gpm

1 gpm/sf of media surface area is required; hence 50 square feet of wetland cell surface area is need to provide adequate enhance treatment. Model MWS-L-4-8 has a WetlandMEDIA surface area of 50 sf. Using one for the West Basin 1 (no detention), we are able to treat up to 50 gpm of runoff, exceeding the requirement. According to Modular Wetland a pre-filter cartridge has over 25 sf of surface area per cartridge. One pre-filter cartridge will be used which can can pretreat up to 75 gpm.

A summary of the water quality calculations along with a bioretention key map and MWS-Linear Modular Wetland details have been included in **Appendix C** of this report.

5.6 Conveyance System Analysis and Design

The West Basin – 2 has the highest contributing area and will have the highest developed conditions 25-year 24-hour flow rate. Per the WWHM3 model, the developed conditions 25-year 24-hour flow rate is 1.84 cfs. The proposed conveyance system consists of 12-inch diameter pipes at a minimum slope of 0.5%. Per the Manning's equation, a 12-inch pipe at 0.5% has a total capacity of 2.99 cfs. Therefore the proposed stormwater pipes will have adequate capacity to handle the stormwater generated by the site.

See the hydraulic calculations in **Appendix C**.

6. CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN

6.1 Objective of the Stormwater Pollution Prevention Plan

The purpose of a Construction Stormwater Pollution Prevention Plan (SWPPP) is to describe the potential for pollution problems on a construction project. The SWPPP also explains and illustrates the measures to be taken on the construction site to control these problems. This SWPPP is prepared according to the guidance of the 2009 City of Olympia Stormwater Manual. The Manual describes

twelve necessary elements of construction stormwater pollution prevention. These twelve elements include: mark clearing limits, establish construction access, control flow rates, install sediment controls, stabilize soils, protect slopes, protect drain inlets, stabilize channels and outlets, control pollutants, control de-watering, maintain BMPs, and manage the project. These elements have been addressed as follows.

6.2 Summary of Elements

The Best Management Practices (BMPs) listed in this report, or their equivalent, are required. Any revisions by the contractor to the BMPs listed in the SWPPP shall be approved by the Engineer in writing. Therefore, if the contractor does not require a BMP or needs to modify a BMP, the contractor shall document the reasons and present the documentation to the Engineer for approval.

ELEMENT #1: MARK CLEARING LIMITS

Prior to beginning land disturbing activities, including clearing and grading, all clearing limits and trees that are to be preserved within the construction area shall be clearly marked, both in the field and on the plans, to prevent damage and offsite impacts. Barrier fences shall be constructed as shown on the Temporary Erosion & Sediment Control Plans and in accordance with BMP C103

The duff layer, native topsoil, and natural vegetation shall be retained in an undisturbed state to the maximum extent practicable.

ELEMENT #2: ESTABLISH CONSTRUCTION ACCESS

A stabilized construction entrance shall be constructed to minimize the tracking of sediment onto any public road. The stabilized construction entrance shall be constructed as shown on the Temporary Erosion & Sediment Control Plans and in accordance with the requirements of BMP C105.

Adjacent roads and paved areas shall be cleaned thoroughly as needed. Sediment shall be removed from roads by shoveling or pickup sweeping and shall be transported to a controlled sediment disposal area.

ELEMENT #3: CONTROL FLOW RATES

Properties downstream from the development site shall be protected from erosion due to any increases in the volume, velocity, and peak flow rate stormwater runoff from the project site. If off-site discharges do occur, sediment traps or temporary sediment ponds in accordance with BMPs C240 and C241 respectively shall be installed prior to the points of discharge.

ELEMENT #4: INSTALL SEDIMENT CONTROLS

Prior to leaving a construction site or prior to discharge into an infiltration facility, stormwater runoff shall pass through an appropriate sediment removal BMP. Silt fence barriers shall be constructed as shown on the erosion control plans and in accordance with BMP C233.

In addition to silt fencing, the following BMPs may be implemented as appropriate:

BMP C230 – Straw Bale Barrier

BMP C231 – Brusher Barrier

BMP C232 – Gravel Filter Berm

BMP C234 – Vegetated Strip

BMP C235 – Straw Wattles

BMP C240 – Sediment Trap

BMP C241 – Temporary Sediment Pond

BMP C250 – Construction Stormwater Chemical Treatment

BMP C251 – Construction Stormwater Filtration

ELEMENT #5: STABILIZE SOILS

All exposed and unworked soils shall be stabilized by application of effective BMPs, which protect the soil from the erosive forces of raindrop impact and flowing water and from wind erosion. From October 1 through April 30, no soils shall remain exposed and unworked for more than 2 days. From May 1 to September 30, no soils shall remain exposed and unworked for more than 7 days. This condition applies to all soils on site, whether at final grade or not. Additionally, except where approved chemical treatment, full dispersion, or infiltration is practiced, clearing, grading, and other soil disturbing activities are prohibited between October 15 and April 1.

In areas where the soils will remain unworked for more than 30 days or have reached final grade, seeding and mulching shall be used in accordance with BMPs C120 and C121. If the slope is 2H:1V or greater with at least 10 feet of vertical relief, nets or blankets shall be used according to BMP C122. Sod shall be used in accordance with BMP C124 for disturbed areas that require immediate vegetative cover. Dust control shall be used as needed to prevent wind transport of dust from disturbed soil surfaces and in accordance with BMP C140.

ELEMENT #6: PROTECT SLOPES

Slopes will be stabilized as indicated in Element #5 above. In addition, the following BMPs may be implemented where appropriate:

BMP C130 – Surface Roughening

BMP C200 – Interceptor Dike and Swale

BMP C205 – Subsurface Drains

BMP C207 – Check Dams

ELEMENT #7: PROTECT DRAIN INLETS

All storm drain inlets made operable during construction as well as existing structures downstream of the project shall be protected so that stormwater runoff shall not enter the conveyance system without

first being filtered or treated to remove sediment. Install catch basin inlet protection as shown on the Temporary Erosion Control Plans and in accordance with BMP C220.

Inlets should be inspected weekly at a minimum and daily during storm events. Inlet protection devices should be cleaned or removed and replaced before six inches of sediment has accumulated.

ELEMENT #8: STABILIZE CHANNELS AND OUTLETS

Stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent to streambanks, slopes and downstream reaches shall be provided at the outlets of all conveyance systems. Install riprap as shown on the erosion control plans and in accordance with BMP C209.

ELEMENT #9: CONTROL POLLUTANTS

All pollutants, including waste materials and demolition debris, that occur on-site during construction shall be handled and disposed of in a manner that does not cause contamination of stormwater.

Cover, containment, and protection from vandalism shall be provided for all chemicals, liquid products, petroleum products, and non-inert wastes present on the site (see Chapter 173-304 WAC for the definition of inert waste). Onsite fueling tanks shall include secondary containment.

Maintenance and repair of heavy equipment and vehicles involving oil changes, hydraulic system drain down, solvent and de-greasing cleaning operations, fuel tank drain down and removal, and other activities which may result in discharge or spillage of pollutants to the ground or into stormwater runoff must be conducted using spill prevention measures, such as drip pans. Contaminated surfaces shall be cleaned immediately following any discharge or spill incident. Spills should be reported to 911. Emergency repairs may be performed on-site using temporary plastic placed beneath and, if raining, over the vehicle.

Application of agricultural chemicals, including fertilizers and pesticides, shall be conducted in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Manufacturers' recommendations shall be followed for application rates and procedures.

Suggested BMPs:

BMP C151 – Concrete Handling

BMP C152 – Sawcutting and Surfacing Pollution Prevention

ELEMENT #10: CONTROL DE-WATERING

Foundation, vault, and trench de-watering water shall be discharged into a controlled conveyance system prior to discharge to a sediment pond. Channels must be stabilized, as specified in Element #8.

Clean, non-turbid de-watering water can be discharged to systems tributary to state surface waters, provided the de-watering flow does not cause erosion or flooding of receiving waters. These clean waters should not be routed through stormwater sediment ponds.

Highly turbid or otherwise contaminated de-watering water, such as from construction equipment operation, clamshell digging, concrete tremie pour, or work inside a cofferdam, shall be handled separately from stormwater at the site. Some disposal options, depending on site constraints, may include: 1) transport off-site in vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters, 2) on-site treatment using chemical treatment or other suitable treatment technologies, 3) sanitary sewer discharge with local sewer district's approval, or 4) use of a sedimentation bag with outfall to a ditch or swale for small volumes of localized dewatering.

ELEMENT #11: MAINTAIN BMPs

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 in accordance with BMP specifications.

Sediment control BMPs shall be inspected weekly or after a runoff-producing storm event during the dry season and daily during the wet season.

Temporary erosion and sediment control BMPs shall be removed within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed. Trapped sediment shall be removed or stabilized on-site. Disturbed soil areas resulting from removal of BMPs or vegetation shall be permanently stabilized.

ELEMENT #12: MANAGE THE PROJECT

Clearing and grading activities for developments shall be permitted only if conducted pursuant to an approved site development plan (e.g., subdivision approval) that establishes permitted areas of clearing, grading, cutting, and filling. These permitted clearing and grading areas and any other areas required to preserve critical or sensitive areas, buffers, native growth protection easements, or tree retention areas as may be required by local jurisdictions, shall be delineated on the site plans and the development site.

Seasonal Work Limitations:

From October 1 through April 30, clearing, grading, and other soil disturbing activities shall be permitted only if shown to the satisfaction of the local permitting authority that silt-laden runoff will be prevented from leaving the construction site. Additionally, except where approved chemical treatment, full dispersion, or infiltration is practiced, clearing, grading, and other soil disturbing activities are prohibited between November 1 and February 28.

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 the soil; and
- Activities where there is one hundred percent infiltration of surface water runoff within the site in approved and installed erosion and sediment control facilities.

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. The person shall have the skills to (1) assess the site conditions and construction activities that could impact stormwater runoff quality, and (2) assess erosion and sediment control measure effectiveness. A Certified Professional in Erosion and Sediment Control shall be on-site or on-call at all times during construction.

Sampling and analysis of the stormwater discharges from the construction site may be necessary to ensure compliance with standards.

Whenever inspection and/or monitoring reveals that the BMPs identified in the construction SWPPP are inadequate, due to the actual discharge of or potential to discharge a significant amount of any pollutant, the construction SWPPP shall be modified, as appropriate, in a timely manner.

Maintaining an Updated Construction SWPPP:

The construction SWPPP shall be retained on-site or within reasonable access to the site. The construction SWPPP shall be updated within 7 days to reflect any significant changes in the design, construction, operation, or maintenance at the construction site that have, or could have, a significant effect on the discharge of pollutants to the waters of the state.

The SWPPP shall be updated within 7 days if during inspections or investigations by site staff or local or state officials, it is determined that the SWPPP is ineffective in controlling pollutants such that applicable discharge or surface water standards violations are apparent.

7. OPERATION AND MAINTENANCE MANUAL

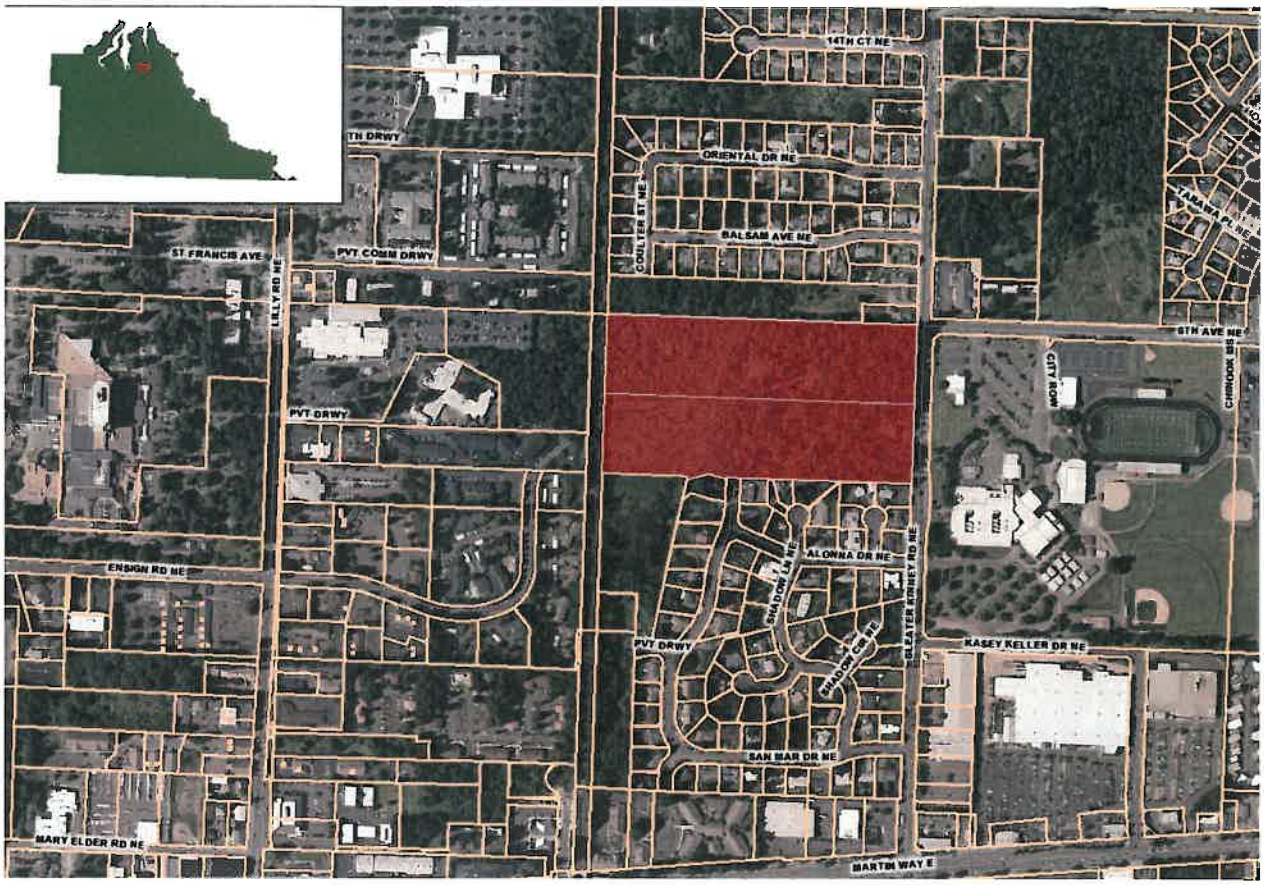
7.1 Overview

An operation and maintenance manual will be prepared and provided as part of the final engineering for the Copper Trails Apartments project.

Appendix A

Aerial Map, Site Map

Aerial Map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ST FRANCIS AVE
LELLY RD NE
PVT COMM DRWY
PVT DRWY
ENSIGN RD NE
ALONNA DR NE
SHADOW LN NE
SHADOW CIR NE
BLAYLOCK ST NE
PVT DRWY
KASEY KELLER DR NE
SAN MAR DR NE
MARY ELDER RD NE
MARTIN WAY E
6TH AVE NE
CHINOOK ST

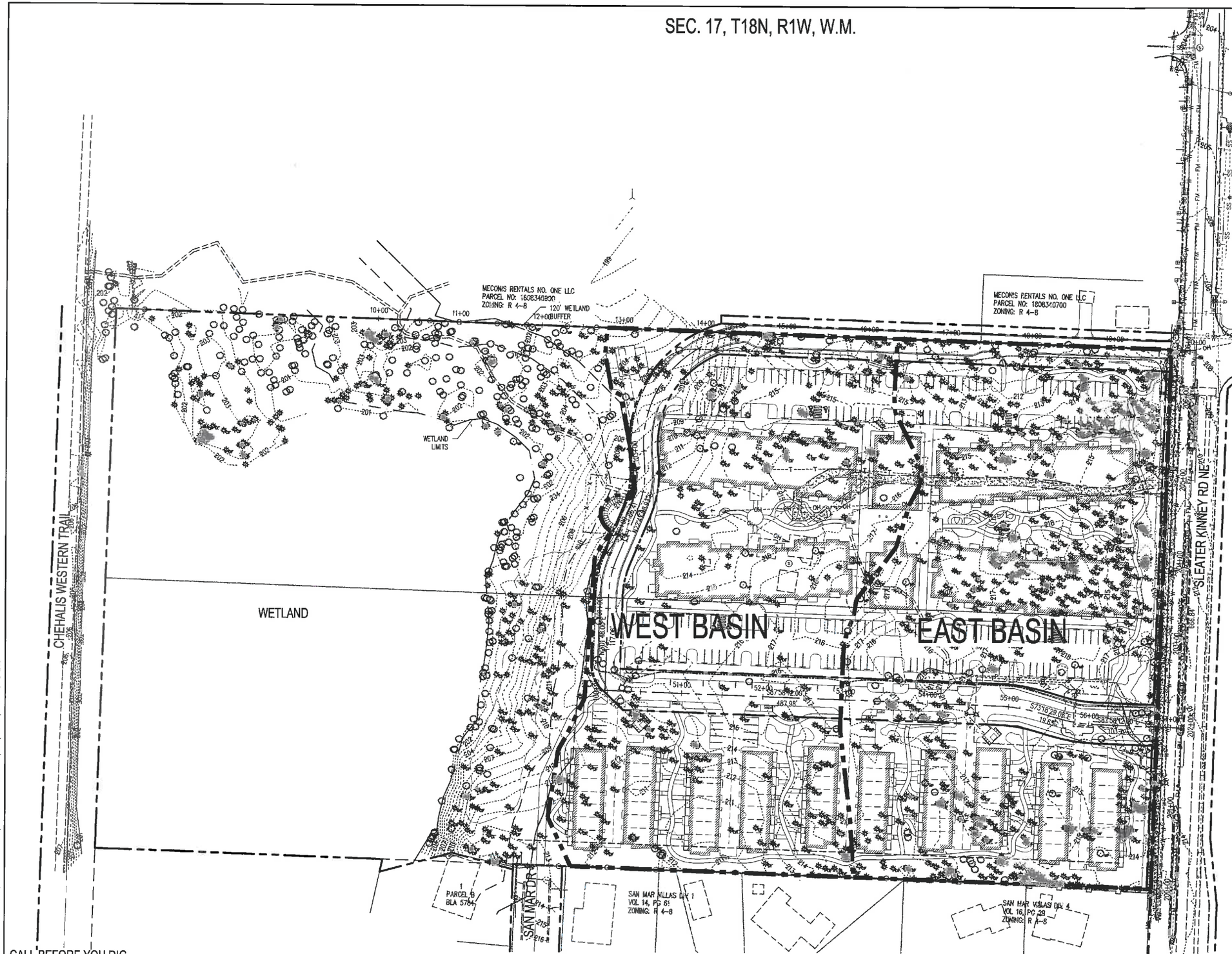
Site Map

Appendix B

Existing Conditions Exhibit, Developed Conditions Exhibit, Topographical Survey, Off-Site Map

EXHIBIT E6

SEC. 17, T18N, R1W, W.M.



EXISTING CONDITIONS:

TOTAL AREA:	850,603 SQUARE FEET (19.52 ACRES)
BUILDABLE AREA:	458,706 SQUARE FEET (10.53 ACRES)
WEST BASIN AREA:	225,391 S.F. (5.17 ACRES)
EAST BASIN AREA:	233,315 S.F. (5.36 ACRES)

CALL BEFORE YOU DIG

THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR THE LOCATION AND PROTECTION OF ALL EXISTING UTILITIES. THE CONTRACTOR SHALL VERIFY ALL UTILITY LOCATIONS PRIOR TO CONSTRUCTION BY CALLING THE UNDERGROUND LOCATE LINE AT (800) 424-5555 A MINIMUM OF 48 HOURS PRIOR TO ANY EXCAVATION.

Mar 03, 2015 - 3:55:50pm - User root
N:\PROJECTS\1541 GOLDEN ALDR DEVELOPMENT\SHEDI BAYAN TRAILS\PHASE 20 - SPR SUBMITTAL\CADD\EXHIBITS\EX BASIN EXHIBIT.DWG

NO.	REVISIONS	DATE	BY
1			

SCJ ALLIANCE
CONSULTING SERVICES
8730 TALLON LANE NE, SUITE 200, LACEY, WASHINGTON 98516
P: 360-352-1465 F: 360-352-1509
SCJALLIANCE.COM

SHEET TITLE: PREDEVELOPED CONDITIONS EXHIBIT

PROJECT NAME: BAYAN TRAILS
OLYMPIA, WASHINGTON

SEAL:

ROSS D. JARVIS
STATE OF WASHINGTON
43668
REGISTERED
PROFESSIONAL ENGINEER

DESIGNER:	R. JARVIS
DRAWN BY:	L HURTADO
APPROVED BY:	R. JARVIS
DATE:	NOVEMBER, 2014
JOB No:	1541.01
DRAWING FILE No:	EX BASIN EXHIBIT
DRAWING No:	EX-01
SHEET No:	2 OF 13

SEC. 17, T18N, R1W, W.M.

EXHIBIT E6

N

0 40 80

SCALE IN FEET

NORTH BASIN ROOF AREAS:
TOTAL AREA: 36,034 SQUARE FEET (0.83 ACRES)

SOUTH BASIN ROOF AREAS:
TOTAL AREA: 35,052 SQUARE FEET (0.80 ACRES)

TOWNHOME ROOF AREAS:
TOTAL AREA: 43,420 SQUARE FEET (1.00 ACRES)

AREA SUMMARY:

TOTAL AREA: *7.92 ACRES
*EXCLUDES ROOF AREA

EAST BASIN – 1
ROADS / PARKING LOT: 0.78 ACRES
CONCRETE SIDEWALKS: 0.34 ACRES
TOTAL IMPERVIOUS: 1.12 ACRES

LANDSCAPING: 0.50 ACRES
FOREST: 1.08 ACRES
TOTAL PERVIOUS: 1.58 ACRES

TOTAL AREA: 2.70 ACRES

EAST BASIN – 2
ROADS / PARKING LOT: 0.52 ACRES
CONCRETE SIDEWALKS: 0.16 ACRES
TOTAL IMPERVIOUS: 0.68 ACRES

LANDSCAPING: 0.41 ACRES
FOREST: 0.36 ACRES
TOTAL PERVIOUS: 0.77 ACRES

TOTAL AREA: 1.45 ACRES

WEST BASIN – 1
ROADS / PARKING LOT: 0.41 ACRES
CONCRETE SIDEWALKS: 0.14 ACRES
TOTAL IMPERVIOUS: 0.55 ACRES

LANDSCAPING: 0.15 ACRES
FOREST: 0.31 ACRES
TOTAL PERVIOUS: 0.46 ACRES

TOTAL AREA: 1.01 ACRES

WEST BASIN – 2
ROADS / PARKING LOT: 1.17 ACRES
CONCRETE SIDEWALKS: 0.46 ACRES
TOTAL IMPERVIOUS: 1.63 ACRES

LANDSCAPING: 0.17 ACRES
FOREST: 0.96 ACRES
TOTAL PERVIOUS: 1.13 ACRES

TOTAL AREA: 2.76 ACRES

CALL BEFORE YOU DIG

THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR THE LOCATION AND PROTECTION OF ALL EXISTING UTILITIES. THE CONTRACTOR SHALL VERIFY ALL UTILITY LOCATIONS PRIOR TO CONSTRUCTION BY CALLING THE UNDERGROUND LOCATE LINE AT (800) 424-5555 A MINIMUM OF 48 HOURS PRIOR TO ANY EXCAVATION.

SCJ ALLIANCE
CONSULTING SERVICES
8730 TALLON LANE NE, SUITE 200, LACEY, WASHINGTON 98516
P: 360-352-1465 F: 360-352-1509
SCJALLIANCE.COM

SHEET TITLE: DEVELOPED CONDITIONS EXHIBIT

PROJECT NAME: BAYAN TRAILS
OLYMPIA, WASHINGTON

SEAL: ROSS D. JARVIS, STATE OF WASHINGTON, 43566, REGISTERED PROFESSIONAL ENGINEER

DESIGNER:	R. JARVIS
DRAWN BY:	L HURTADO
APPROVED BY:	R. JARVIS
DATE:	NOVEMBER, 2014
JOB No:	1541.01
DRAWING FILE No:	DEV BASIN EXHIBIT
DRAWING No:	DEV
SHEET No:	6 OF 13

Mar 05, 2015 8:51:04am - User: rossj
N:\PROJECTS\1541 GOLDEN ALON DEVELOPMENT\1541.01 BAYAN TRAILS\PHASE 20 - SPR SUBMITTAL\CADD\EXHIBITS\DEV BASIN EXHIBIT.DWG

EXHIBIT E6

SHEET NAME: TP-1

SHEET NO. 1 OF 3

PROJECT NAME:
607 AND 709 SLEATER KINNEY RD NE
OLYMPIA, WA 98506
TOPOGRAPHIC SURVEY

CLIENT NAME:
GOLDEN ALON DEVELOPMENT CO. LLC

MTN 2 COAST, LLC
1506 FAIRVIEW ST SE
OLYMPIA, WA 98501
360.239.1497

BLAIR E. PRIGGE — No. 21271 — REGISTERED PROFESSIONAL LAND SURVEYOR

DATE	5/26/2014
SCALE	1" = 30'
M2C PROJECT NO.	14-183
DRAWN	BEP
CHECKED	ELF
APPROVED	BEP

SLEATER KINNEY RD NE

NORTH 1/4 CORNER, SECTION 17, FOUND 2" DOMED BRASS CAP IN MONUMENT CASE

CROSS WALK

STRIPING

CATCH BASIN RIM 211.38 IE 12" PVC N & S 207.93

CATCH BASIN RIM 212.61 IE 12" PVC N & S 209.16

CURB ISLAND HAVE 1' WIDE CONC STRIP ALONG CURB EDGE

CATCH BASIN RIM 213.38 IE 12" PVC N 209.90

CATCH BASIN RIM 207.19 IE 12" PVC N & S 203.82

EASEMENT

329.37'

S 02°01'48" W 658.74'

4' TALL CYCLONE FENCE

MAN GATE

GATE PILAR WITH LIGHT

KEY PAD AND SLIDING GATE.

ORIENTAL GARDEN

HOUSE

DECK

6' TALL BOARD FENCE

6' TALL CYCLONE FENCE

MECONIS RENTALS NO. ONE LLC
PARCEL NO: 1808340700
ZONING: R 4-8

SAN MAR VILLAS DIV 4
VOL 16, PG 29
ZONING: R 4-8

PARCEL A

PARCEL B

GRAVEL DRIVE

TRAIL

ORIENTAL GARDEN

HOUSE

APPROX LOCATION DRAINFIELD

GARAGE

6' TALL CYCLONE FENCE

S 88°02'25" E 775.52

MATCH LINE SEE SHEET TP-2

0' 30' 60'

NOTE

SEE SHEET TP-3 FOR LEGAL DESCRIPTION, LEGEND, DATUM AND SURVEY NOTES.

EXHIBIT E6

MATCH LINE SEE SHEET TP-1

MECONIS RENTALS NO. ONE LLC
PARCEL NO: 18083409000
ZONING: R 4-8

12" CMP
IE 200.48
FLOWS NORTH TO MANHOLE IN BALSAM AVE (150' NORTH OF PROPERTY LINE)

S 88°00'26" E 1290.78'

TOP

CHICKEN COOP

WOOD SHED

GARDEN

6' TALL CYCLONE FENCE

DEBRIS PILE

SAN MAR VILLAS DIV 1
VOL 14, PG 61
ZONING: R 4-8

ASPHALT MAY EXTEND FURTHER NORTH BUT BURIED UNDER NATURAL DEBRIS

SAN MAR DR.

S 01°57'52" W

30'

6.37'

OP

OP

EASEMENT

77.02'

N 24°57'32" W

PARCEL B
BLA 5784

S 75°04'59" W 91.74'

15.81'

N 12°18'53" E

DWF 1 DWF 2 DWF 3 DWF 4 DWF 5 DWF 6 DWF 8 DWF 9 DWF 10 DWF 11 DWF 12 DWF 13 DWF 14 DWF 16 DWF 17 DWF 18 DWF 19 DWF 21 DWF 22 DWF 23 DWF 24 DWF 25 DWF 26 DWF 26 DWF 27 DWF 28 DWF 29 DWF 30 DWF 31 DWF 32 DWF 33 DWF 34 DWF 35

PARCEL A

WETLAND

PARCEL B

M2C

0' 30' 60'

NOTE

SEE SHEET TP-3 FOR LEGAL DESCRIPTION, LEGEND, DATUM AND SURVEY NOTES.

MATCH LINE SEE SHEET TP-3

SHEET NAME: TP-2

SHEET NO 2 OF 3

PROJECT NAME:
607 AND 709 SLEATER KINNEY RD NE
OLYMPIA, WA 98506
TOPOGRAPHIC SURVEY

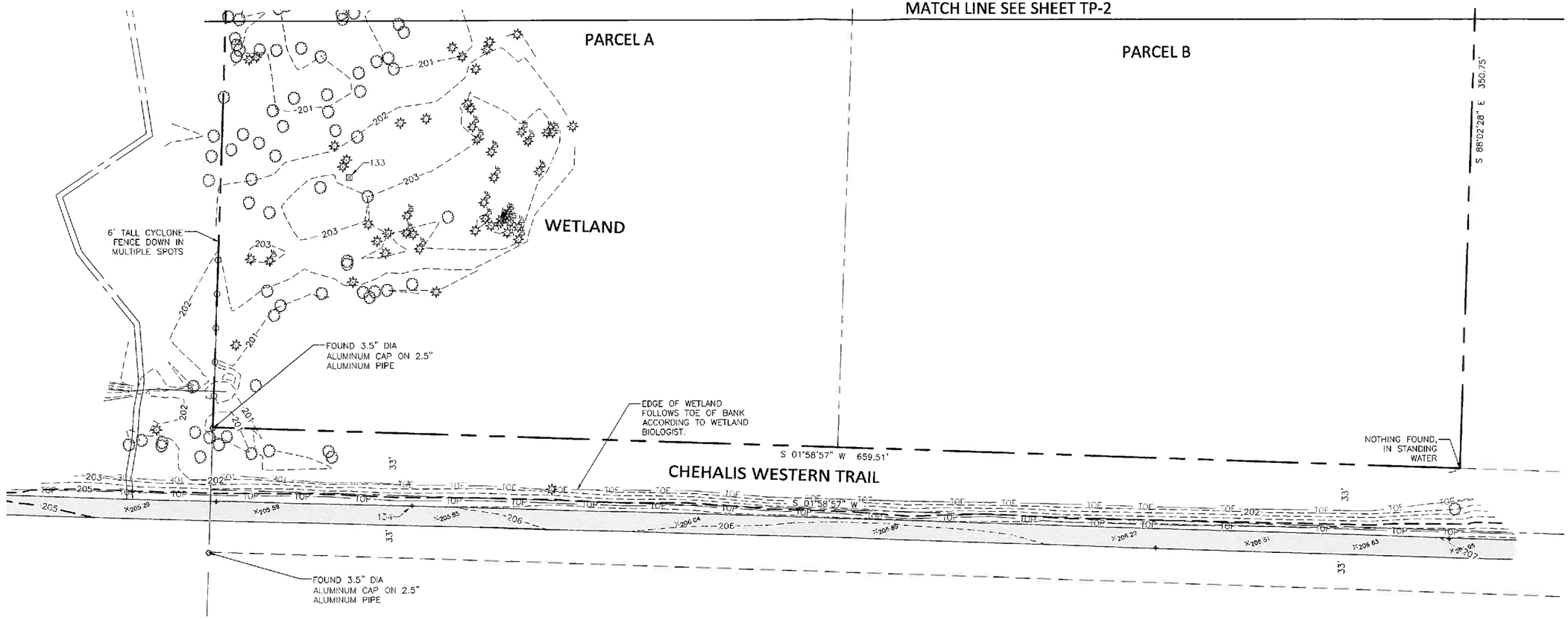
CLIENT NAME:
GOLDEN ALON DEVELOPMENT CO. LLC

MTN 2 COAST LLC
1506 FAIRVIEW ST SE
OLYMPIA, WA 98501
360.239.1497

BLAIR E. PRIGGE 21827 REGISTERED PROFESSIONAL LAND SURVEYOR

DATE	5/26/2014
SCALE	1" = 30'
M2C PROJECT NO:	14-183
DRAWN	BEP
CHECKED	ELF
APPROVED	BEP

EXHIBIT E6



LEGAL DESCRIPTIONS

PARCEL A

THE NORTH QUARTER OF THE NORTHEAST QUARTER OF THE NORTHWEST QUARTER OF SECTION 17, TOWNSHIP 18 NORTH, RANGE 1 WEST, W.M., EXCEPTING THEREFROM THE EAST 30 FEET FOR COUNTY ROAD KNOWN AS SLEATER KINNEY ROAD.

PARCEL B

PARCEL A OF BOUNDARY LINE ADJUSTMENT NO. BLA-5784 AS RECORDED AUGUST 20, 1983 UNDER AUDITORS FILE NO 9308200260.

AREA SUMMARY		
	ACRES	SQ. FT.
PARCEL A WETLANDS	2.852	124232
PARCEL A UPLANDS	6.663	290236
PARCEL B WETLANDS	3.122	135998
PARCEL B UPLANDS	6.391	278373
TOTAL AREA (ACRES)	19.028	828839

M2C

0' 30' 60'

SITE DATA

SITE ADDRESS 607 AND 709 SLEATER KINNEY ROAD NE OLYMPIA, WA 98506

TAX PARCEL NO. 11817210100 AND 11817210200

ZONING: RM-18

SURVEY NOTES

1. SURVEY FIELD WORK COMPLETED MAY 2014.
2. SECTION SUBDIVISION PER ROS AFN 9307130242 AND ROS AFN 9211060188.
3. UNDERGROUND UTILITIES SHOWN PER LOCATE BY APPLIED PROFESSIONAL SERVICES AND REFERRING TO CITY OF OLYMPIA UTILITY SYSTEM MAPS.
4. WETLANDS FLAGGED BY LISA PALAZZI OF SCJ ALLIANCE.

DATUM

1. HORIZONTAL – WASHINGTON STATE PLANE COORDINATES, SOUTH ZONE, NAD 83/91 BASED ON TIES TO THURSTON COUNTY MONUMENTS 7498 AND GP34005-1
2. VERTICAL – NAVD 88 BASED ON CITY OF LACEY BENCH MARK NO 745, WHICH IS ALSO THURSTON COUNTY MONUMENT 7498, NAVD 88 ELEVATION = 207.93

Point Table					
Point #	Northing	Easting	Elevation	Raw	Description
103	635955.71	1058679.86	214.91		MNCC
104	635859.52	1058684.87	215.30		MNHT
105	636084.25	1058678.59	213.31		MNHT
106	635980.96	1058579.76	215.16		MNHT
107	636051.14	1058551.06	212.44		MNCC
108	636068.49	1058434.57	214.85		MNHT
109	635985.44	1058408.69	215.16		MNHT
110	636091.60	1058263.54	214.42		MNCC
111	636150.82	1058071.50	201.65		MNHT
112	635776.68	1058726.77	214.14		MNHT 112
113	635669.21	1058601.30	217.48		MNPK
114	635547.76	1058602.52	215.43		MNHT
115	635731.53	1058478.82	220.56		MNHT
116	635506.92	1058456.43	216.45		MNHT
117	635877.43	1058191.40	212.94		MNHT
118	635739.12	1058174.90	214.60		MNHT
119	636126.63	1057937.36	201.81		MNCC
120	636164.91	1057783.16	203.19		MNHT
121	635902.56	1057965.76	201.77		MNHT
122	635782.60	1057987.53	205.04		MNHT
123	635683.62	1057999.01	209.14		MNHT
124	635670.62	1058103.52	211.95		MNHT
125	635565.48	1058006.68	212.21		MNHT
126	635531.29	1058106.26	211.18		MNHT
129	635572.61	1058230.62	210.61		MNHT
131	635546.51	1058322.15	214.90		MNHT
132	635669.67	1058336.89	216.12		MNHT
133	636107.81	1057619.72	202.60		MNHT
134	636075.42	1057445.83	205.89		MNPK

MNHT HUB AND TACK
MNPK PK NAIL
MNCC REBAR AND CONTROL CAP

HATCHING

GRAVEL

ASPHALT

CONCRETE

LEGEND (SURFACE FEATURES)

- DECIDUOUS TREE
- CONIFER TREE
- MAPLE TREE
- DOUGLAS-FIR TREE
- STUMP
- SHRUB
- BIKE RACK
- MAIL BOX
- STREET SIGN (AS DESCRIBED)
- ALUMINUM CAP
- BRASS CAP
- CONCRETE MONUMENT
- HUB AND TACK
- IRON PIPE
- MAG NAIL
- MONUMENT IN CASE
- PK NAIL
- REBAR AND CAP
- DWF WETLAND FLAG

LINE TYPES

- WOOD FENCE
- CHAIN LINK FENCE
- HOGWIRE FENCE
- GROUND TOE
- GROUND TOP
- GROUND BREAK
- STORM LINE
- SANITARY SEWER LINE
- BURIED TELEPHONE
- OVERHEAD TELEPHONE
- BURIED POWER
- OVERHEAD POWER
- WATER LINE
- NATURAL GAS LINE
- BURIED CABLE TV LINE
- BURIED FIBER OPTIC LINE
- SANITARY FORCED MAIN
- WETLAND LINE
- DITCH LINE
- MAJOR CONTOUR
- MINOR CONTOUR

LEGEND (UTILITIES)

- CABLE MARKER POST
- CABLE RISER/ PEDESTAL
- CABLE VAULT/MANHOLE
- CULVERT
- LUMINAIRE WITH ARM
- LUMINAIRE
- LANDSCAPE/YARD LIGHT
- NATURAL GAS MARKER POST
- NATURAL GAS METER
- PROPANE TANK
- NATURAL GAS VALVE
- POWER CONDUIT
- GUY ANCHOR
- GUY POLE
- POWER JUNCTION BOX
- POWER MARKER POST
- POWER METER
- POWER POLE
- PP WITH DROP LINE
- PP WITH DROP AND LIGHT
- PP WITH DROP, LIGHT AND TRANSFORMER
- PP WITH DROP AND TRANSFORMER
- PP WITH LIGHT AND TRANSFORMER
- PP WITH LIGHT
- PP WITH TRANSFORMER
- POWER TRANSFORMER
- POWER VAULT/ MANHOLE
- SOS CLEANOUT
- SOS MANHOLE
- SOS MARKER POST
- SEPTIC TANK
- STORM CATCH BASIN
- STORM MANHOLE
- STORM CLEANOUT
- STORM ROOF DRAIN
- STORM YARD DRAIN
- STORM MARKER POST
- TELEPHONE CABINET
- TELEPHONE JUNCTION BOX
- TELEPHONE RISER
- TELEPHONE MARKER POST
- TELEPHONE POLE
- TELEPHONE VAULT/MANHOLE
- WATER AIR RELEASE VALVE
- WATER BLOW OFF
- FIRE DEPARTMENT CONNECTION
- HOSE BIB
- IRRIGATION CONTROL VALVE
- WATER MARKER POST
- WATER METER
- WATER POST INDICATOR VALVE
- SPRINKLER HEAD
- WATER VALVE
- WATER FIRE HYDRANT
- WATER VAULT/MANHOLE
- WELL

NE 1/4, NW 1/4, SECTION 17, TOWNSHIP 18 NORTH, RANGE 1 WEST, W.W.

SHEET NAME: TP-3
SHEET NO. 3 OF 3

PROJECT NAME: 607 AND 709 SLEATER KINNEY RD NE OLYMPIA, WA 98506 TOPOGRAPHIC SURVEY

CLIENT NAME: GOLDEN ALON DEVELOPMENT CO. LLC

MTN 2 COAST, INC
1506 FAIRVIEW ST SE
OLYMPIA, WA 98501
360.239.1497

BLAIR E. PRIGGE 29277 REGISTERED PROFESSIONAL LAND SURVEYOR

DATE	5/26/2014
SCALE	1" = 30'
M2C PROJECT NO.	14-183
DRAWN	BEP
CHECKED	ELF
APPROVED	BEP


BALSAM
PIPE FLOW
OVERLAND FLOW
PROJECT SITE
SLEATER KINNEY

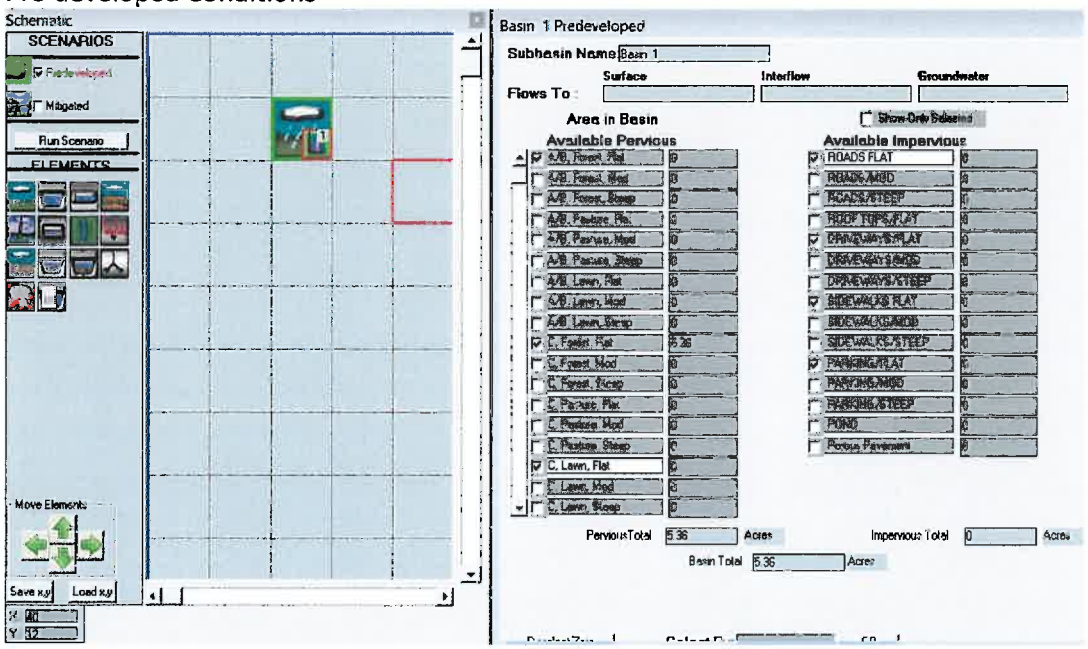
Off-site Map

Appendix C

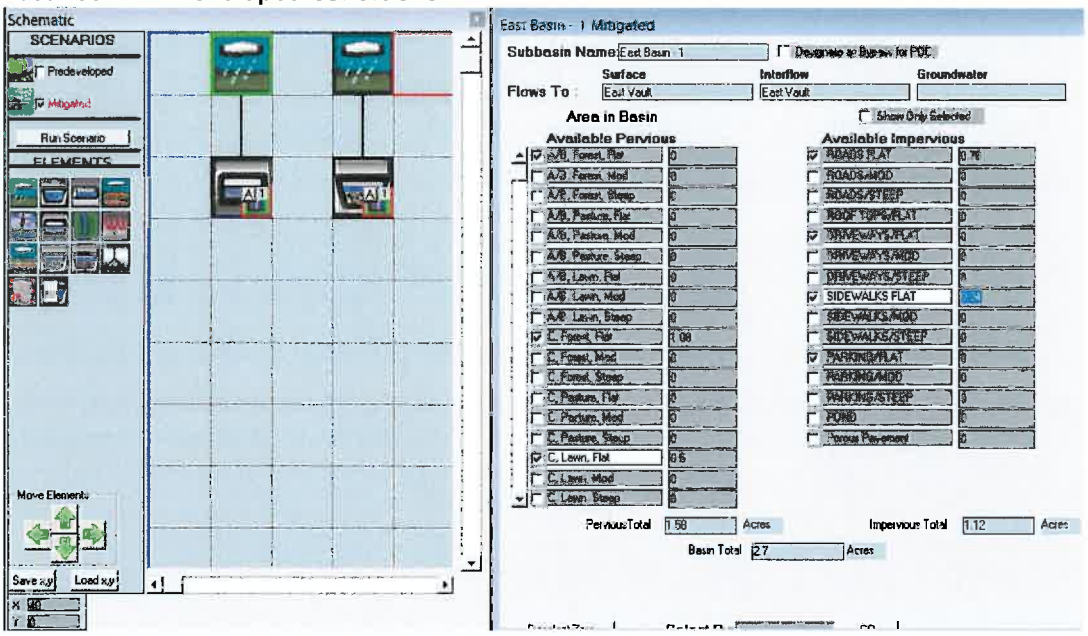
Hydrology & Hydro-period Calculations, Bioretention Key Map, Water Quality Calculations, Hydraulic Calculations

East Basin

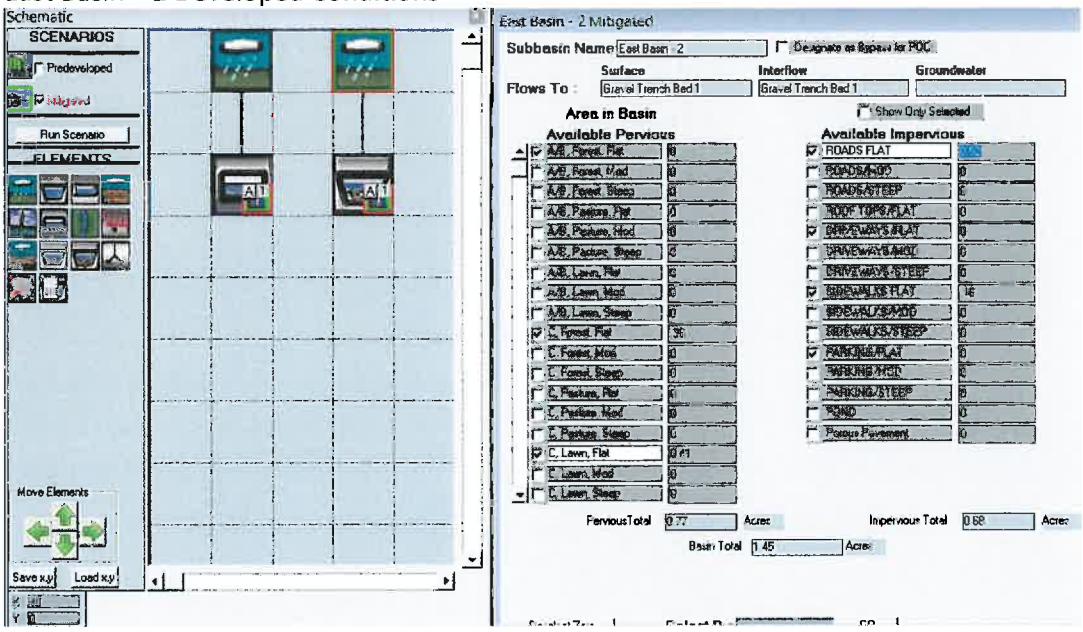
Pre-developed Conditions



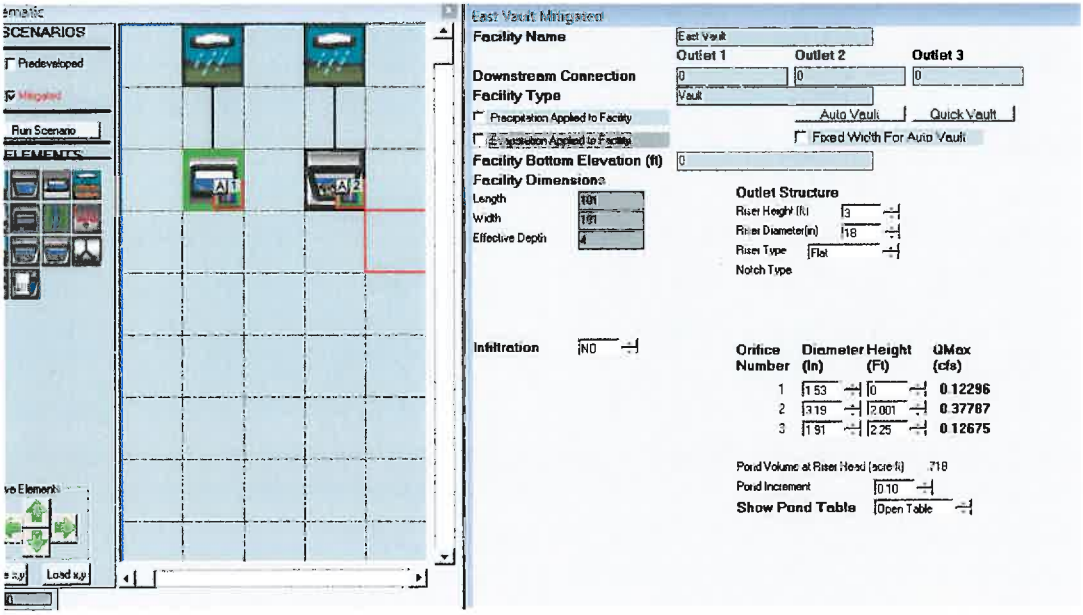
East Basin – 1 Developed Conditions



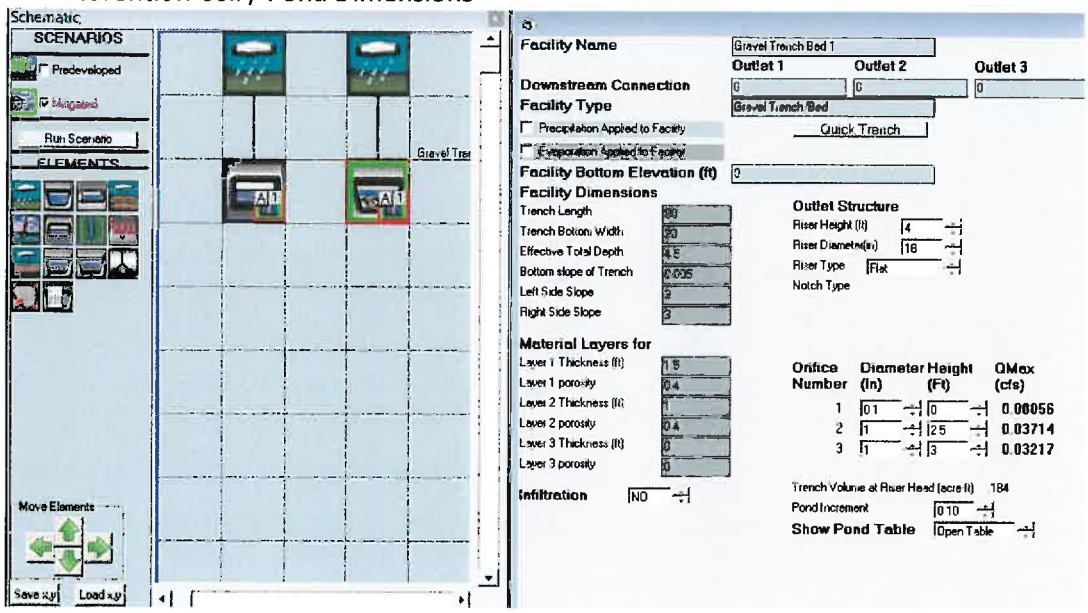
East Basin – 2 Developed Conditions



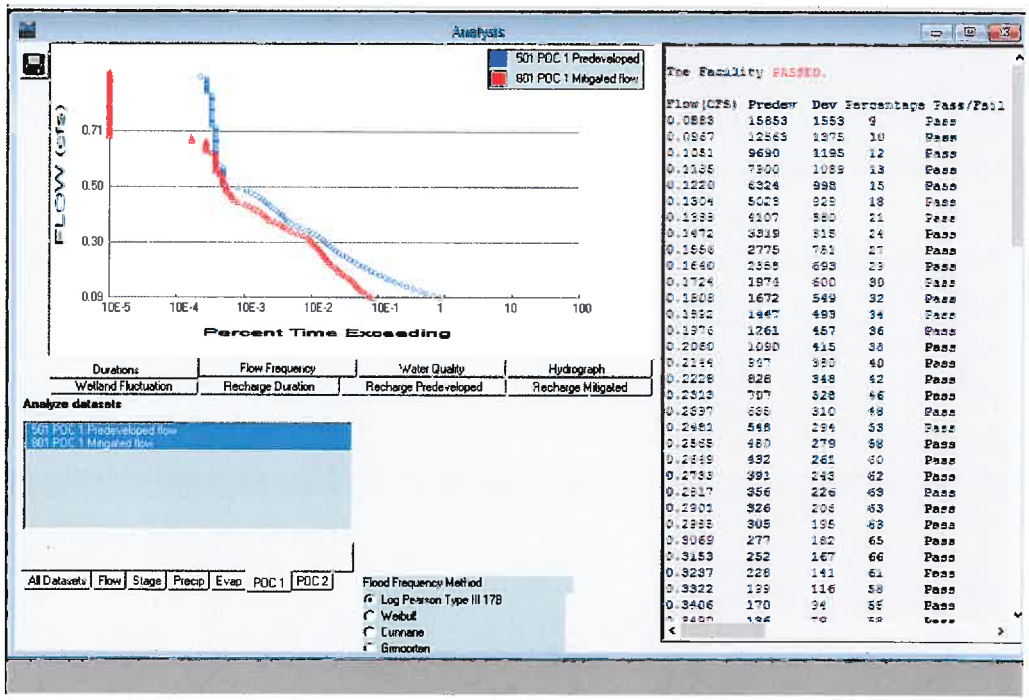
East Vault Dimensions



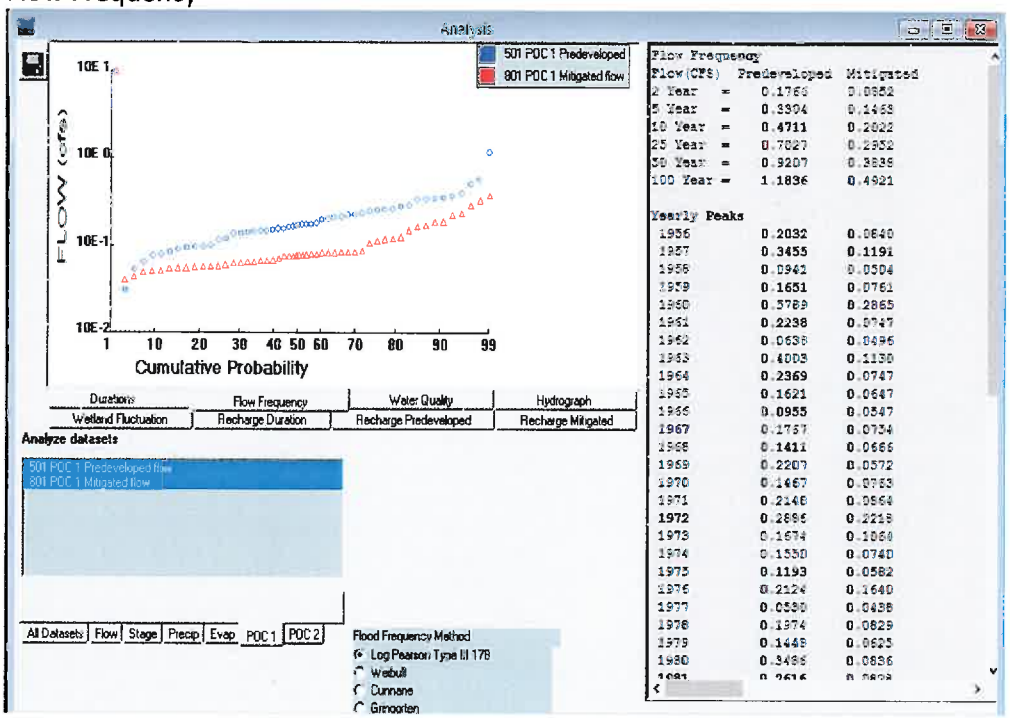
East Biorention Cell / Pond Dimensions



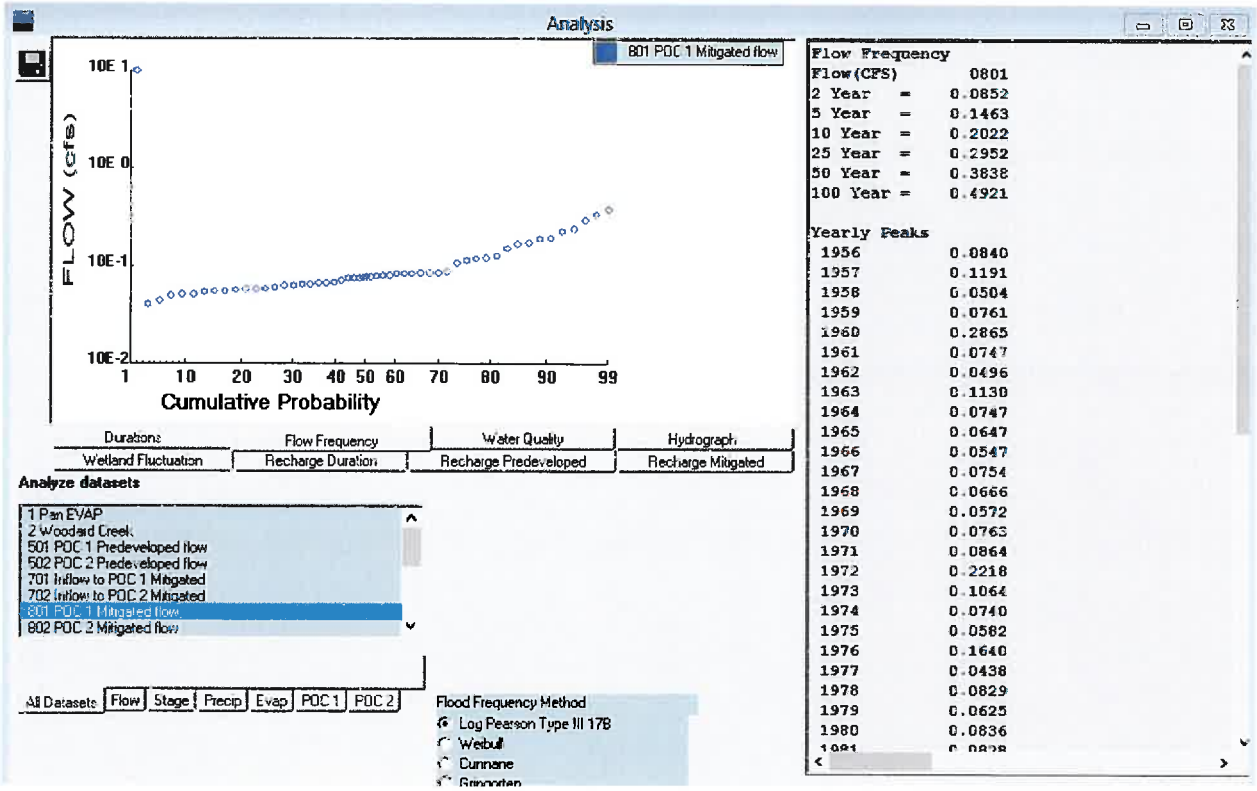
Flow Durations



Flow Frequency



East Basin 1 - Treatment



2-year Q = 0.09 cfs

EXHIBIT E6

Project Name: East Basintreat
Site Address:
City :
Report Date : 3/4/2015
Gage : Woodard Creek
Data Start : 1955/10/01
Data End : 2008/09/30
Precip Scale: 1.00
WWHM3 Version:

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Flat	3.48

Impervious Land Use	Acres

Element Flows To:

Surface	Interflow	Groundwater

Name : East Basin - 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Flat	1.08
C, Lawn, Flat	.5

Impervious Land Use	Acres
ROADS FLAT	0.78
SIDEWALKS FLAT	0.34

Element Flows To:

Surface	Interflow	Groundwater
East Vault,	East Vault,	

Name : East Vault
Width : 101 ft.
Length : 101 ft.
Depth: 4ft.
Discharge Structure
Riser Height: 3 ft.
Riser Diameter: 18 in.
Orifice 1 Diameter: 1.53 in. **Elevation:** 0 ft.
Orifice 1 Diameter: 3.19 in. **Elevation:** 2.001 ft.
Orifice 1 Diameter: 1.91 in. **Elevation:** 2.25 ft.

Element Flows To:

Outlet 1	Outlet 2

Vault Hydraulic Table

Stage(ft)	Area(acr)	Volume(acr-ft)	Dschrg(cfs)	Infilt(cfs)
0.000	0.234	0.000	0.000	0.000
0.044	0.234	0.010	0.013	0.000
0.089	0.234	0.021	0.018	0.000
0.133	**0.234**	**0.031**	**0.022**	**0.000**
0.178	0.234	0.042	0.026	0.000
0.222	0.234	0.052	0.029	0.000
0.267	0.234	0.062	0.032	0.000
0.311	0.234	0.073	0.034	0.000
0.356	0.234	0.083	0.037	0.000
0.400	0.234	0.094	0.039	0.000
0.444	0.234	0.104	0.041	0.000
0.489	0.234	0.114	0.043	0.000
0.533	0.234	0.125	0.045	0.000
0.578	0.234	0.135	0.047	0.000
0.622	0.234	0.146	0.048	0.000
0.667	0.234	0.156	0.050	0.000
0.711	0.234	0.167	0.052	0.000
0.756	0.234	0.177	0.053	0.000
0.800	0.234	0.187	0.055	0.000
0.844	0.234	0.198	0.056	0.000
0.889	0.234	0.208	0.058	0.000
0.933	0.234	0.219	0.059	0.000
0.978	0.234	0.229	0.061	0.000
1.022	0.234	0.239	0.062	0.000
1.067	0.234	0.250	0.063	0.000
1.111	0.234	0.260	0.065	0.000
1.156	0.234	0.271	0.066	0.000
1.200	0.234	0.281	0.067	0.000
1.244	0.234	0.291	0.069	0.000
1.289	0.234	0.302	0.070	0.000
1.333	0.234	0.312	0.071	0.000
1.378	0.234	0.323	0.072	0.000
1.422	0.234	0.333	0.073	0.000
1.467	0.234	0.343	0.074	0.000
1.511	0.234	0.354	0.076	0.000
1.556	0.234	0.364	0.077	0.000
1.600	0.234	0.375	0.078	0.000
1.644	0.234	0.385	0.079	0.000
1.689	0.234	0.396	0.080	0.000
1.733	0.234	0.406	0.081	0.000
1.778	0.234	0.416	0.082	0.000
1.822	0.234	0.427	0.083	0.000
1.867	0.234	0.437	0.084	0.000
1.911	0.234	0.448	0.085	0.000
1.956	0.234	0.458	0.086	0.000
2.000	0.234	0.468	0.087	0.000
2.044	0.234	0.479	0.144	0.000
2.089	0.234	0.489	0.168	0.000
2.133	0.234	0.500	0.187	0.000
2.178	0.234	0.510	0.203	0.000
2.222	0.234	0.520	0.217	0.000
2.267	0.234	0.531	0.243	0.000
2.311	0.234	0.541	0.266	0.000
2.356	0.234	0.552	0.285	0.000
2.400	0.234	0.562	0.301	0.000
2.444	0.234	0.572	0.316	0.000
2.489	0.234	0.583	0.331	0.000
2.533	0.234	0.593	0.344	0.000
2.578	0.234	0.604	0.357	0.000
2.622	0.234	0.614	0.369	0.000
2.667	0.234	0.624	0.380	0.000
2.711	0.234	0.635	0.392	0.000
2.756	0.234	0.645	0.402	0.000
2.800	0.234	0.656	0.413	0.000
2.844	0.234	0.666	0.423	0.000
2.889	0.234	0.677	0.433	0.000

2.933	0.234	0.687	0.443	0.000
2.978	0.234	0.697	0.452	0.000
3.022	0.234	0.708	0.510	0.000
3.067	0.234	0.718	0.722	0.000
3.111	0.234	0.729	1.020	0.000
3.156	0.234	0.739	1.384	0.000
3.200	0.234	0.749	1.803	0.000
3.244	0.234	0.760	2.270	0.000
3.289	0.234	0.770	2.781	0.000
3.333	0.234	0.781	3.332	0.000
3.378	0.234	0.791	3.920	0.000
3.422	0.234	0.801	4.544	0.000
3.467	0.234	0.812	5.201	0.000
3.511	0.234	0.822	5.889	0.000
3.556	0.234	0.833	6.608	0.000
3.600	0.234	0.843	7.355	0.000
3.644	0.234	0.853	8.131	0.000
3.689	0.234	0.864	8.933	0.000
3.733	0.234	0.874	9.761	0.000
3.778	0.234	0.885	10.61	0.000
3.822	0.234	0.895	11.49	0.000
3.867	0.234	0.906	12.39	0.000
3.911	0.234	0.916	13.32	0.000
3.956	0.234	0.926	14.27	0.000
4.000	0.234	0.937	15.24	0.000
4.044	0.234	0.947	16.23	0.000
4.089	0.000	0.000	17.24	0.000

Name : East Basin - 2
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Flat	.36
C, Lawn, Flat	.41

Impervious Land Use	Acres
ROADS FLAT	0.52
SIDEWALKS FLAT	0.16

Element Flows To:

Surface	Interflow	Groundwater
Gravel Trench Bed 1,	Gravel Trench Bed 1,	

Name : Gravel Trench Bed 1
Bottom Length: 90ft.
Bottom Width : 20ft.
Trench bottom slope 1: 0.005 To 1
Trench Left side slope 0: 3 To 1
Trench right side slope 2: 3 To 1
Material thickness of first layer : 1.5
Pour Space of material for first layer : 0.4
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: 4 ft.
Riser Diameter: 18 in.
Orifice 1 Diameter: 0.1 in. **Elevation:** 0 ft.
Orifice 1 Diameter: 1 in. **Elevation:** 2.5 ft.
Orifice 1 Diameter: 1 in. **Elevation:** 3 ft.

Element Flows To:
Outlet 1 **Outlet 2**

EXHIBIT E6

Gravel Trench Bed Hydraulic Table

Stage(ft)	Area(acr)	Volume(acr-ft)	Dschrg(cfs)	Infilt(cfs)
0.000	0.041	0.000	0.000	0.000
0.050	0.042	0.001	0.000	0.000
0.100	0.043	0.002	0.000	0.000
0.150	0.043	0.003	0.000	0.000
0.200	0.044	0.003	0.000	0.000
0.250	0.044	0.004	0.000	0.000
0.300	0.045	0.005	0.000	0.000
0.350	0.046	0.006	0.000	0.000
0.400	0.046	0.007	0.000	0.000
0.450	0.047	0.008	0.000	0.000
0.500	0.048	0.009	0.000	0.000
0.550	0.048	0.010	0.000	0.000
0.600	0.049	0.011	0.000	0.000
0.650	0.049	0.012	0.000	0.000
0.700	0.050	0.013	0.000	0.000
0.750	0.051	0.014	0.000	0.000
0.800	0.051	0.015	0.000	0.000
0.850	0.052	0.016	0.000	0.000
0.900	0.052	0.017	0.000	0.000
0.950	0.053	0.018	0.000	0.000
1.000	0.054	0.019	0.000	0.000
1.050	0.054	0.020	0.000	0.000
1.100	0.055	0.021	0.000	0.000
1.150	0.056	0.022	0.000	0.000
1.200	0.056	0.023	0.000	0.000
1.250	0.057	0.025	0.000	0.000
1.300	0.057	0.026	0.000	0.000
1.350	0.058	0.027	0.000	0.000
1.400	0.059	0.028	0.000	0.000
1.450	0.059	0.029	0.000	0.000
1.500	0.060	0.030	0.000	0.000
1.550	0.061	0.032	0.000	0.000
1.600	0.061	0.033	0.000	0.000
1.650	0.062	0.034	0.000	0.000
1.700	0.062	0.035	0.000	0.000
1.750	0.063	0.037	0.000	0.000
1.800	0.064	0.038	0.000	0.000
1.850	0.064	0.039	0.000	0.000
1.900	0.065	0.040	0.000	0.000
1.950	0.066	0.042	0.000	0.000
2.000	0.066	0.043	0.000	0.000
2.050	0.067	0.044	0.000	0.000
2.100	0.067	0.046	0.000	0.000
2.150	0.068	0.047	0.000	0.000
2.200	0.069	0.048	0.000	0.000
2.250	0.069	0.050	0.000	0.000
2.300	0.070	0.051	0.000	0.000
2.350	0.070	0.053	0.000	0.000
2.400	0.071	0.054	0.000	0.000
2.450	0.072	0.055	0.000	0.000
2.500	0.072	0.057	0.000	0.000
2.550	0.073	0.060	0.006	0.000
2.600	0.074	0.064	0.009	0.000
2.650	0.074	0.068	0.011	0.000
2.700	0.075	0.072	0.012	0.000
2.750	0.075	0.075	0.014	0.000
2.800	0.076	0.079	0.015	0.000
2.850	0.077	0.083	0.016	0.000
2.900	0.077	0.087	0.017	0.000
2.950	0.078	0.091	0.018	0.000
3.000	0.079	0.095	0.019	0.000
3.050	0.079	0.098	0.026	0.000
3.100	0.080	0.102	0.029	0.000

3.150	0.080	0.106	0.032	0.000
3.200	0.081	0.111	0.034	0.000
3.250	0.082	0.115	0.036	0.000
3.300	0.082	0.119	0.038	0.000
3.350	0.083	0.123	0.040	0.000
3.400	0.084	0.127	0.042	0.000
3.450	0.084	0.131	0.044	0.000
3.500	0.085	0.135	0.045	0.000
3.550	0.085	0.140	0.047	0.000
3.600	0.086	0.144	0.048	0.000
3.650	0.087	0.148	0.050	0.000
3.700	0.087	0.153	0.051	0.000
3.750	0.088	0.157	0.053	0.000
3.800	0.088	0.161	0.054	0.000
3.850	0.089	0.166	0.055	0.000
3.900	0.090	0.170	0.057	0.000
3.950	0.090	0.175	0.058	0.000
4.000	0.091	0.179	0.059	0.000
4.050	0.092	0.184	0.223	0.000
4.100	0.092	0.188	0.523	0.000
4.150	0.093	0.193	0.911	0.000
4.200	0.093	0.198	1.370	0.000
4.250	0.094	0.202	1.891	0.000
4.300	0.095	0.207	2.466	0.000
4.350	0.095	0.212	3.092	0.000
4.400	0.096	0.217	3.764	0.000
4.450	0.097	0.221	4.479	0.000
4.500	0.097	0.226	5.235	0.000

Name : Basin 2
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Flat	1.88

Impervious Land Use	Acres

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

ANALYSIS RESULTS

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.176637
5 year	0.3304
10 year	0.471149
25 year	0.702731
50 year	0.920727
100 year	1.183566

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.085223
5 year	0.146295
10 year	0.202248
25 year	0.295155
50 year	0.383768

100 year 0.492124

Yearly Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1957	0.203	0.084
1958	0.345	0.119
1959	0.094	0.050
1960	0.165	0.076
1961	0.579	0.286
1962	0.224	0.075
1963	0.064	0.050
1964	0.400	0.113
1965	0.237	0.075
1966	0.162	0.065
1967	0.096	0.055
1968	0.177	0.075
1969	0.141	0.067
1970	0.221	0.057
1971	0.147	0.076
1972	0.215	0.086
1973	0.289	0.222
1974	0.167	0.106
1975	0.155	0.074
1976	0.119	0.058
1977	0.212	0.164
1978	0.053	0.044
1979	0.197	0.083
1980	0.145	0.062
1981	0.349	0.084
1982	0.262	0.083
1983	0.138	0.079
1984	0.265	0.078
1985	0.172	0.070
1986	0.079	0.054
1987	0.280	0.188
1988	0.258	0.237
1989	0.116	0.066
1990	0.139	0.063
1991	0.354	0.379
1992	0.513	0.701
1993	1.929	0.186
1994	0.099	0.055
1995	0.077	0.056
1996	0.180	0.082
1997	0.250	0.118
1998	1.183	0.080
1999	0.369	0.064
2000	0.151	0.149
2001	0.091	0.060
2002	0.031	0.040
2003	0.173	0.084
2004	0.084	0.051
2005	0.175	0.125
2006	0.096	0.058
2007	0.157	0.067
2008	0.148	0.170
2009	0.344	0.329

Ranked Yearly Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	1.9288	0.7014
2	1.1826	0.3789
3	0.5789	0.3290
4	0.5133	0.2865
5	0.4003	0.2368
6	0.3694	0.2218
7	0.3539	0.1885
8	0.3486	0.1861
9	0.3455	0.1697

10	0.3441	0.1640
11	0.2886	0.1489
12	0.2803	0.1245
13	0.2650	0.1191
14	0.2616	0.1180
15	0.2582	0.1130
16	0.2503	0.1064
17	0.2369	0.0864
18	0.2238	0.0840
19	0.2207	0.0839
20	0.2148	0.0836
21	0.2124	0.0829
22	0.2032	0.0828
23	0.1974	0.0824
24	0.1802	0.0798
25	0.1767	0.0795
26	0.1754	0.0780
27	0.1733	0.0763
28	0.1720	0.0761
29	0.1674	0.0754
30	0.1651	0.0747
31	0.1621	0.0747
32	0.1566	0.0740
33	0.1550	0.0701
34	0.1512	0.0674
35	0.1478	0.0666
36	0.1467	0.0659
37	0.1448	0.0647
38	0.1411	0.0638
39	0.1390	0.0627
40	0.1376	0.0625
41	0.1193	0.0600
42	0.1160	0.0582
43	0.0991	0.0577
44	0.0965	0.0572
45	0.0955	0.0563
46	0.0941	0.0548
47	0.0907	0.0547
48	0.0837	0.0541
49	0.0791	0.0507
50	0.0769	0.0504
51	0.0638	0.0496
52	0.0530	0.0438
53	0.0309	0.0399

POC #1

The Facility PASSED.

Flow(CFS)	Predev	Dev	Percentage	Pass/Fail
0.0883	15853	1553	9	Pass
0.0967	12563	1375	10	Pass
0.1051	9690	1195	12	Pass
0.1135	7900	1089	13	Pass
0.1220	6324	998	15	Pass
0.1304	5023	929	18	Pass
0.1388	4107	880	21	Pass
0.1472	3319	815	24	Pass
0.1556	2775	751	27	Pass
0.1640	2358	693	29	Pass
0.1724	1974	600	30	Pass
0.1808	1672	549	32	Pass
0.1892	1447	493	34	Pass
0.1976	1261	457	36	Pass
0.2060	1090	415	38	Pass
0.2144	947	380	40	Pass
0.2228	828	348	42	Pass
0.2313	707	328	46	Pass
0.2397	635	310	48	Pass
0.2481	548	294	53	Pass
0.2565	480	279	58	Pass

EXHIBIT E6

0.2649	432	261	60	Pass
0.2733	391	243	62	Pass
0.2817	356	226	63	Pass
0.2901	326	206	63	Pass
0.2985	305	195	63	Pass
0.3069	277	182	65	Pass
0.3153	252	167	66	Pass
0.3237	228	141	61	Pass
0.3322	199	116	58	Pass
0.3406	170	94	55	Pass
0.3490	136	79	58	Pass
0.3574	113	71	62	Pass
0.3658	92	63	68	Pass
0.3742	82	53	64	Pass
0.3826	77	44	57	Pass
0.3910	72	40	55	Pass
0.3994	67	37	55	Pass
0.4078	61	34	55	Pass
0.4162	56	30	53	Pass
0.4246	50	26	52	Pass
0.4331	45	22	48	Pass
0.4415	41	19	46	Pass
0.4499	38	15	39	Pass
0.4583	35	13	37	Pass
0.4667	31	12	38	Pass
0.4751	27	12	44	Pass
0.4835	23	11	47	Pass
0.4919	20	10	50	Pass
0.5003	15	10	66	Pass
0.5087	10	10	100	Pass
0.5171	9	9	100	Pass
0.5255	9	9	100	Pass
0.5340	9	9	100	Pass
0.5424	9	9	100	Pass
0.5508	9	8	88	Pass
0.5592	9	8	88	Pass
0.5676	9	7	77	Pass
0.5760	9	7	77	Pass
0.5844	8	7	87	Pass
0.5928	7	7	100	Pass
0.6012	7	7	100	Pass
0.6096	7	7	100	Pass
0.6180	7	7	100	Pass
0.6264	7	7	100	Pass
0.6348	7	6	85	Pass
0.6433	7	5	71	Pass
0.6517	7	5	71	Pass
0.6601	7	5	71	Pass
0.6685	7	5	71	Pass
0.6769	7	5	71	Pass
0.6853	7	3	42	Pass
0.6937	7	3	42	Pass
0.7021	7	0	0	Pass
0.7105	7	0	0	Pass
0.7189	7	0	0	Pass
0.7273	7	0	0	Pass
0.7357	6	0	0	Pass
0.7442	6	0	0	Pass
0.7526	6	0	0	Pass
0.7610	6	0	0	Pass
0.7694	6	0	0	Pass
0.7778	6	0	0	Pass
0.7862	6	0	0	Pass
0.7946	6	0	0	Pass
0.8030	6	0	0	Pass
0.8114	6	0	0	Pass
0.8198	6	0	0	Pass
0.8282	6	0	0	Pass
0.8366	6	0	0	Pass
0.8451	6	0	0	Pass
0.8535	6	0	0	Pass
0.8619	5	0	0	Pass

EXHIBIT E6

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0.8703     5          0        0        Pass
0.8787     5          0        0        Pass
0.8871     5          0        0        Pass
0.8955     5          0        0        Pass
0.9039     5          0        0        Pass
0.9123     5          0        0        Pass
0.9207     4          0        0        Pass
_____________________________________________________________________



_____________________________________________________________________

Water Quality BMP Flow and Volume for POC  1.
On-line facility volume:  0.135 acre-feet
On-line facility target flow:  0.01 cfs.
Adjusted for 15 min:  0.0686  cfs.
Off-line facility target flow:  0.0432 cfs.
Adjusted for 15 min:  0.0432 cfs.
_____________________________________________________________________

Flow Frequency Return Periods for Predeveloped.  POC #2
Return Period          Flow(cfs)
2 year                   0
5 year                   0
10 year                  0
25 year                  0
50 year                  0
100 year                 0

Flow Frequency Return Periods for Mitigated.  POC #2
Return Period          Flow(cfs)
2 year                   0
5 year                   0
10 year                  0
25 year                  0
50 year                  0
100 year                 0
_____________________________________________________________________

Yearly Peaks for Predeveloped and Mitigated.  POC #2
Year         Predeveloped    Mitigated
_____________________________________________________________________

Ranked Yearly Peaks for Predeveloped and Mitigated.  POC #2
Rank     Predeveloped        Mitigated
_____________________________________________________________________

POC #2
The Facility PASSED

The Facility PASSED.

Flow(CFS) Predev   Dev Percentage Pass/Fail
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
0.0000     0         0        0        Pass
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EXHIBIT E6

0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
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0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
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0.0000	0	0	0	Pass
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0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass

0.0000	0	0	0	Pass
0.0000	0	0	0	Pass
0.0000	0	0	0	Pass

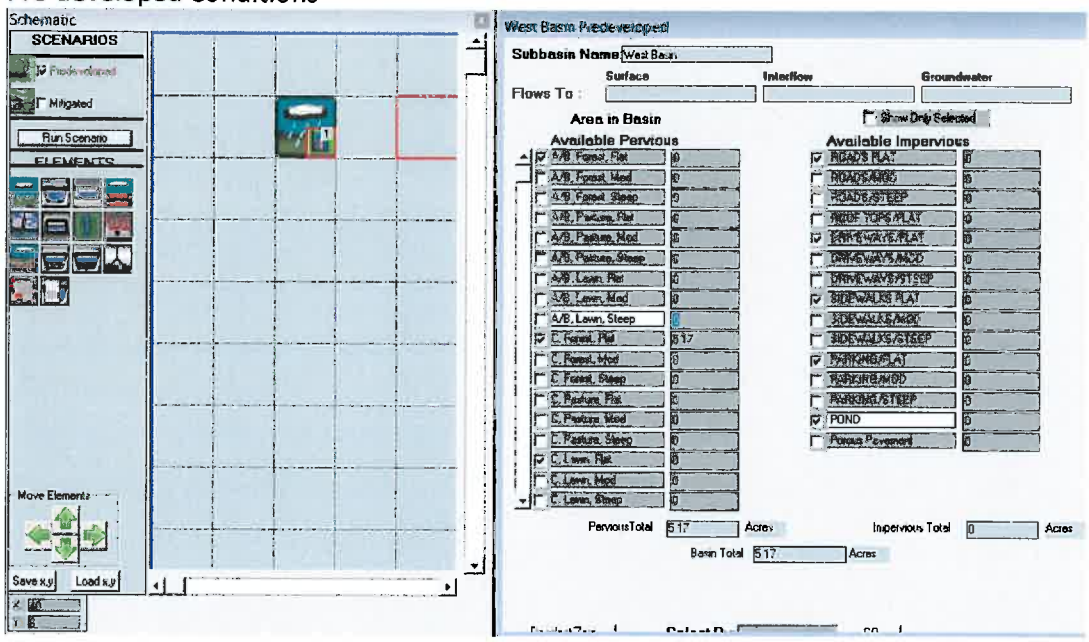
Water Quality BMP Flow and Volume for POC 2.
On-line facility volume: 0 acre-feet
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

Perlnd and Implnd Changes

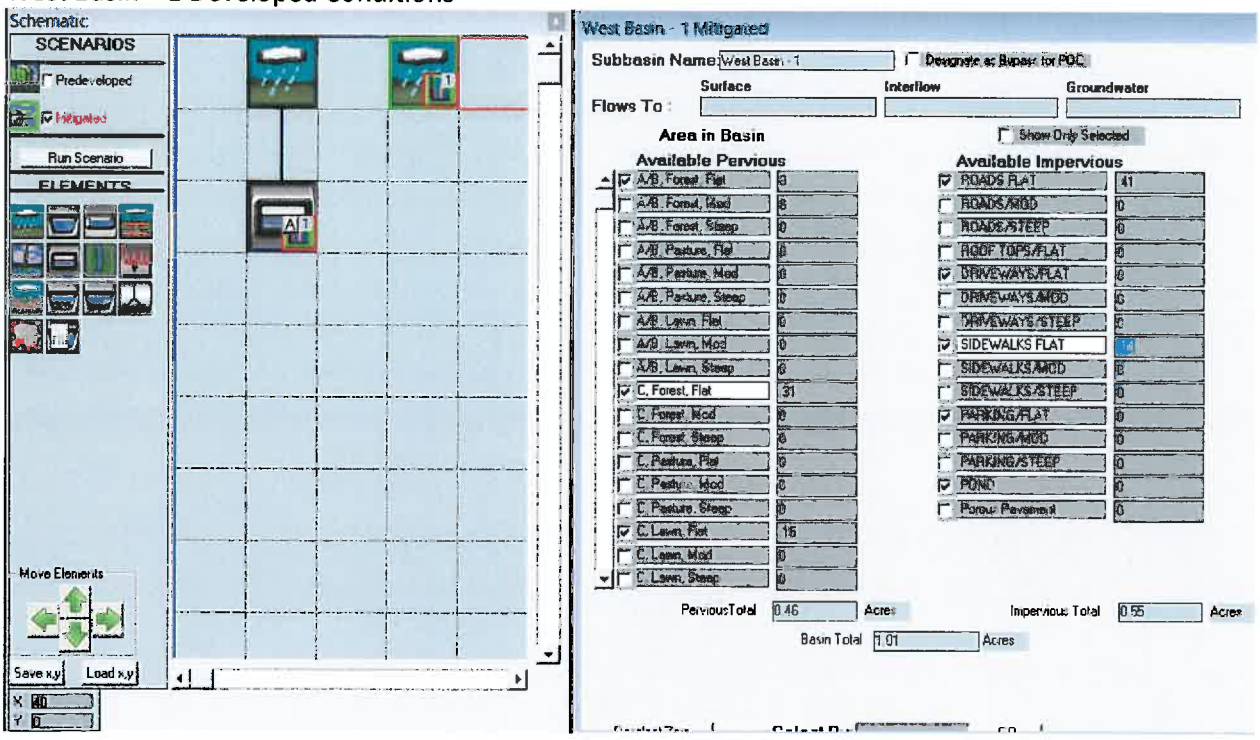
No changes have been made.

West Basin

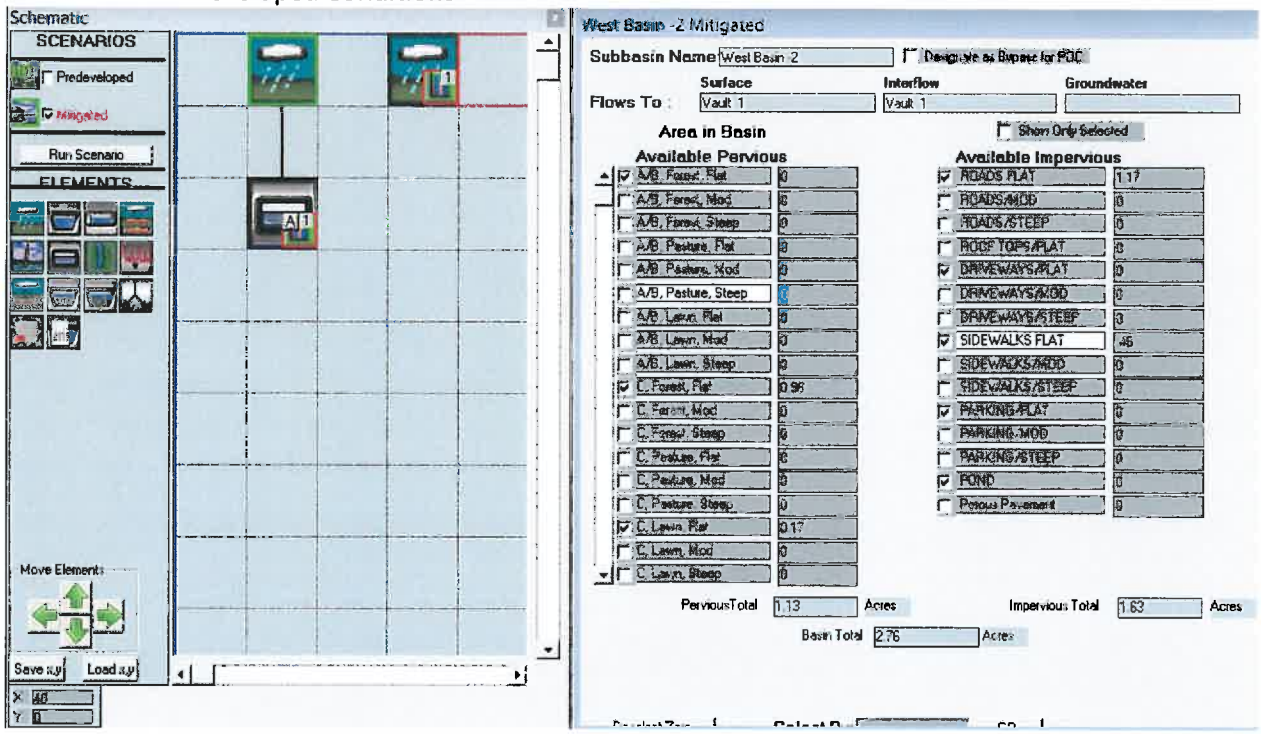
Pre-developed Conditions



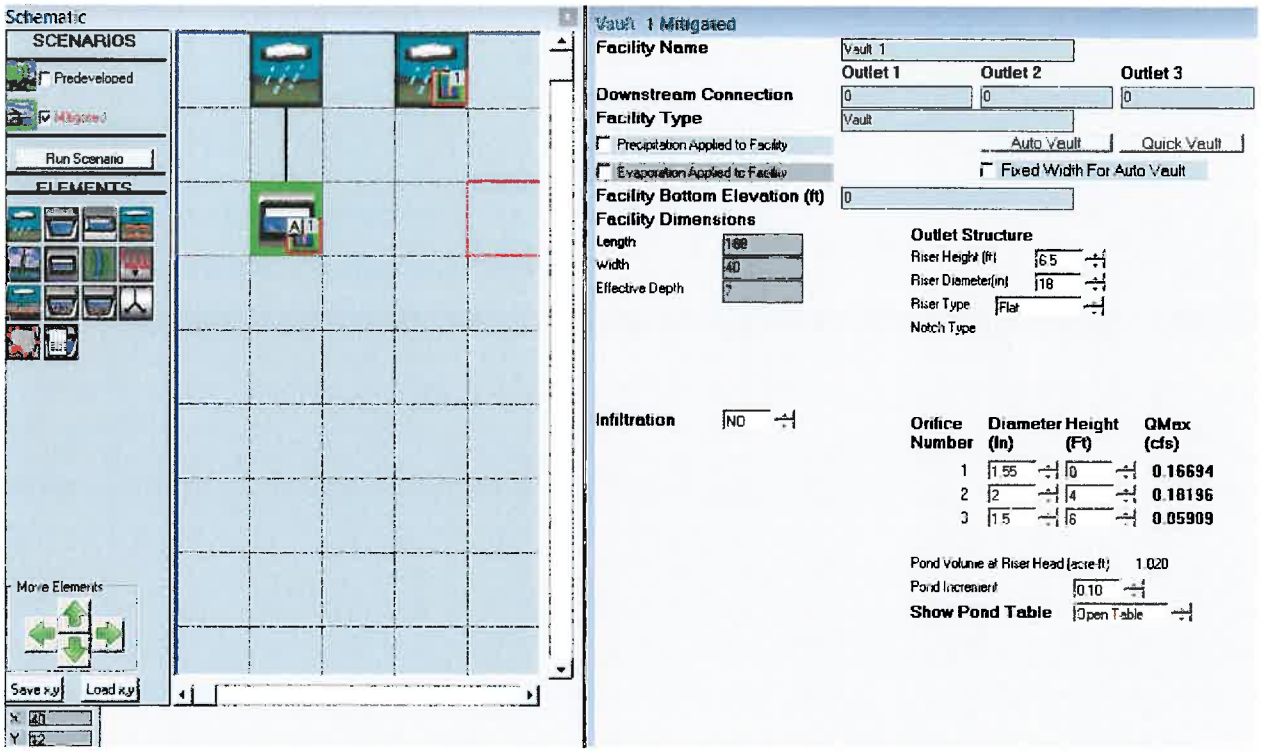
West Basin – 1 Developed Conditions



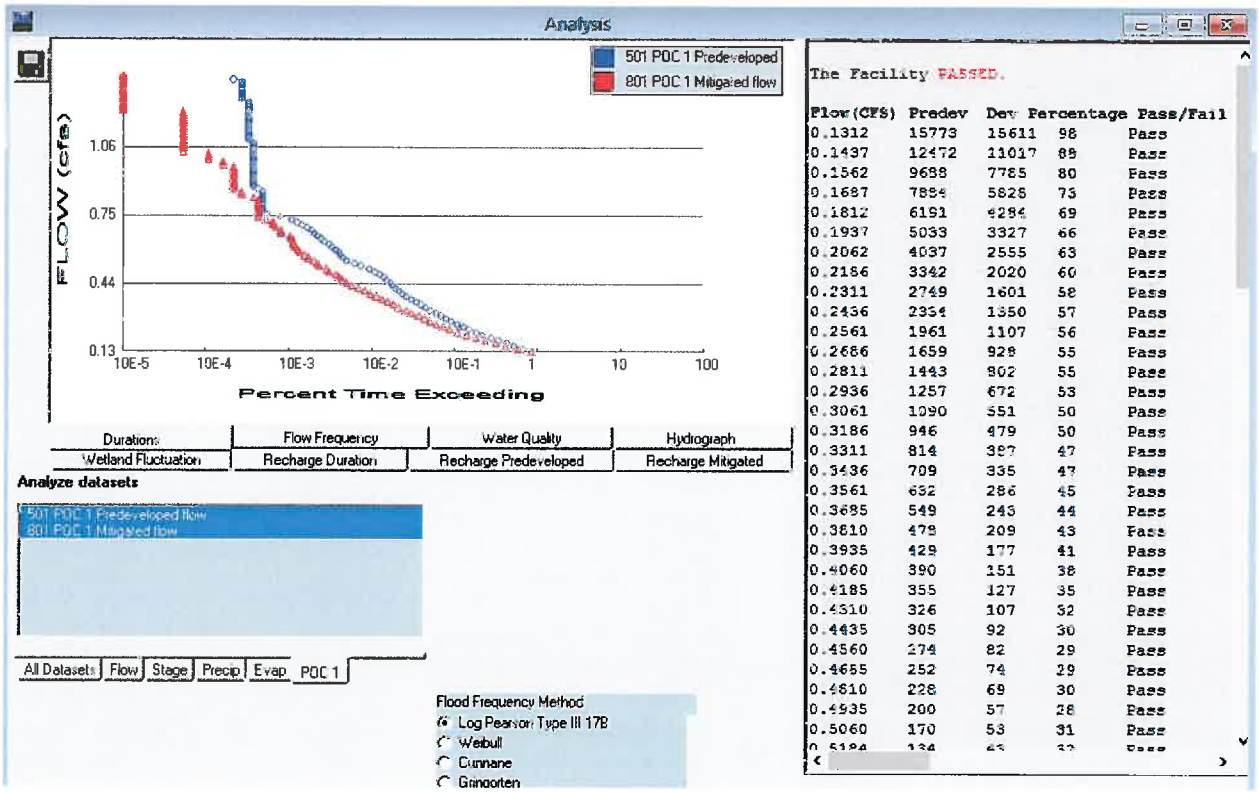
West Basin – 2 Developed Conditions



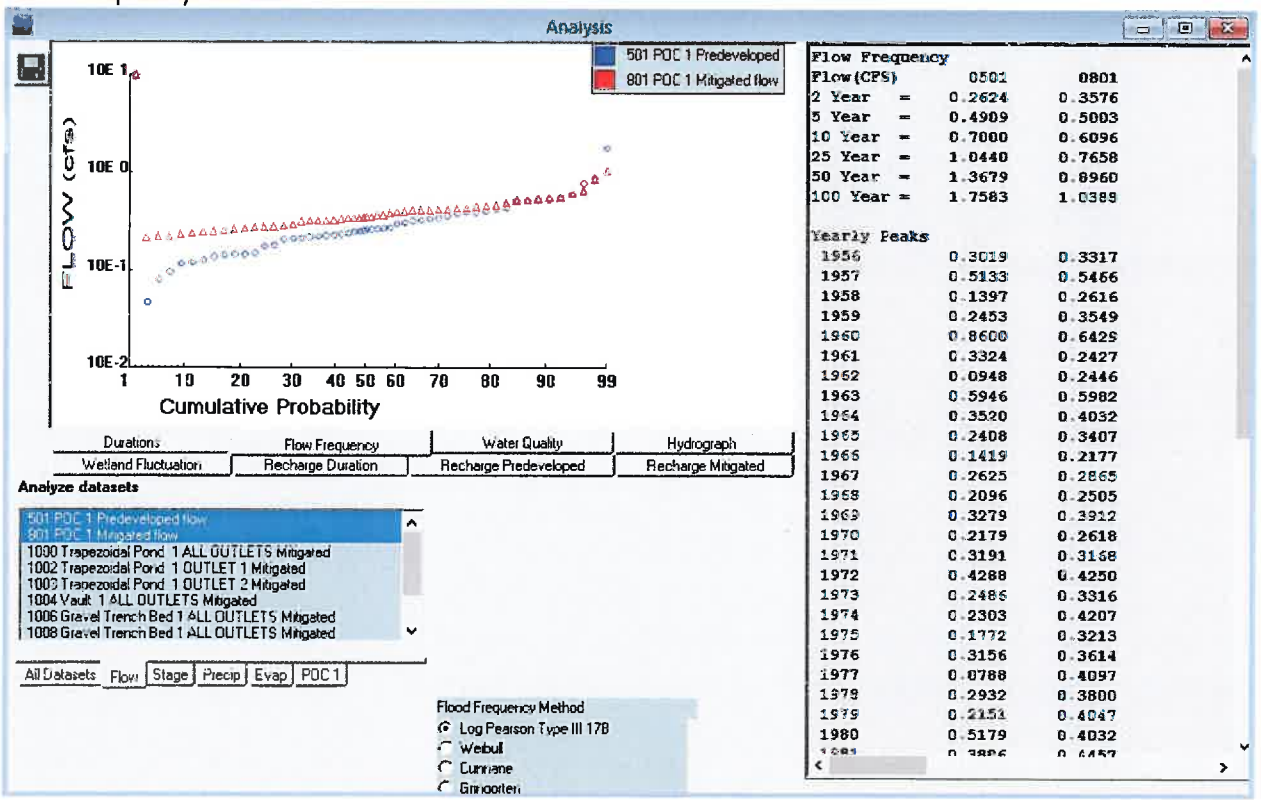
West Basin 2 - Vault Dimensions



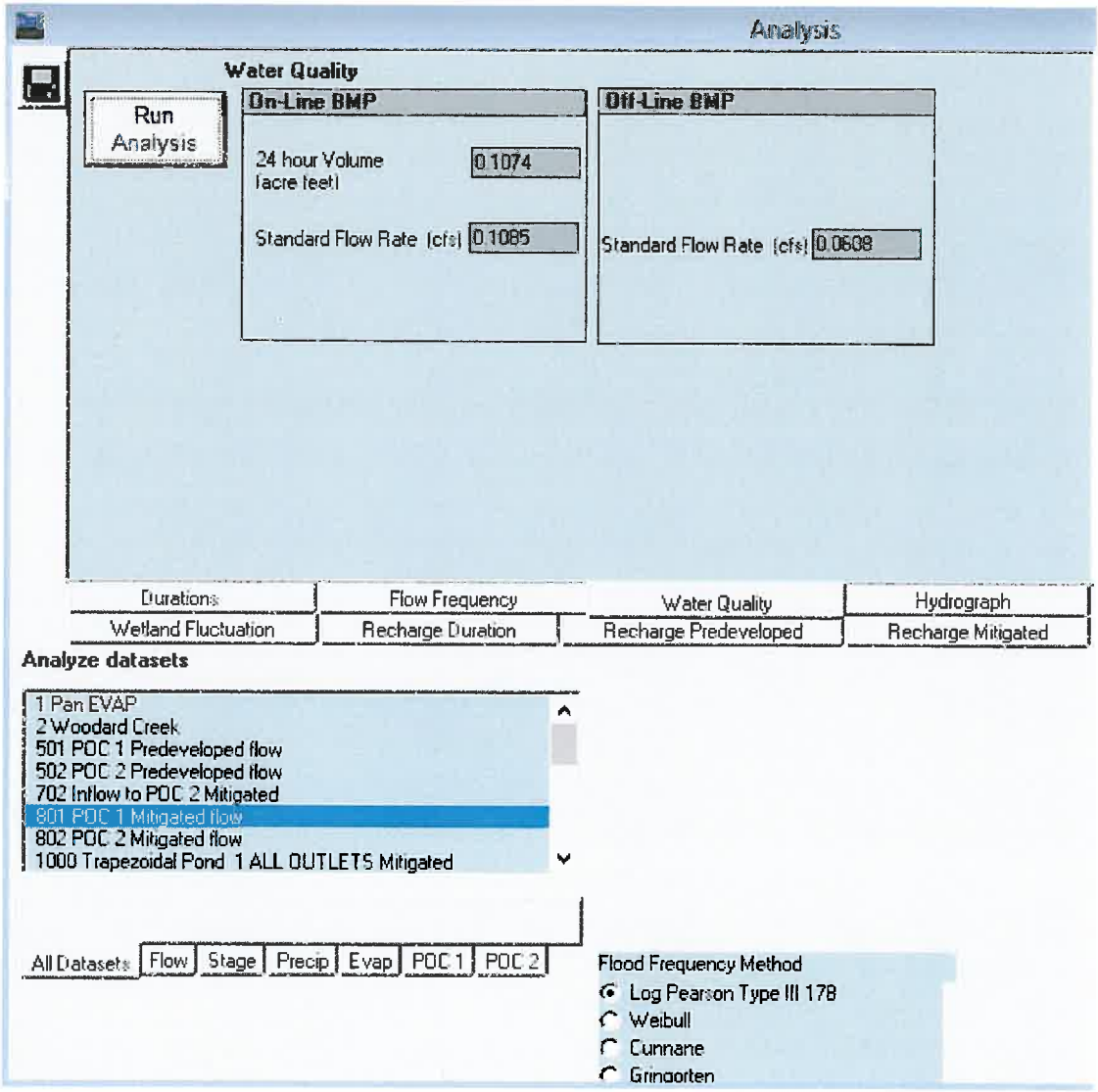
Flow Durations



Flow Frequency



West Basin 1 - Treatment



2-year Q = 0.11 cfs

Western Washington Hydrology Model
PROJECT REPORT

Project Name: West Basin
Site Address:
City :
Report Date : 3/3/2015
Gage : Woodard Creek
Data Start : 1955/10/01
Data End : 2008/09/30
Precip Scale: 1.00
WWHM3 Version:

PREDEVELOPED LAND USE

Name : West Basin
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Flat	5.17

Impervious Land Use	Acres

Element Flows To:
Surface **Interflow** **Groundwater**

Name : West Basin - 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Flat	.31
C, Lawn, Flat	.15

Impervious Land Use	Acres
ROADS FLAT	0.41
SIDEWALKS FLAT	0.14

Element Flows To:
Surface **Interflow** **Groundwater**

Name : West Basin -2
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Flat	.96
C, Lawn, Flat	.17

Impervious Land Use	Acres
ROADS FLAT	1.17
SIDEWALKS FLAT	0.46

Element Flows To:

Surface	Interflow	Groundwater
Vault 1,	Vault 1,	

Name : Vault 1
Width : 40 ft.
Length : 168 ft.
Depth: 7ft.
Discharge Structure
Riser Height: 6.5 ft.
Riser Diameter: 18 in.
Orifice 1 Diameter: 1.55 in. **Elevation:** 0 ft.
Orifice 1 Diameter: 2 in. **Elevation:** 4 ft.
Orifice 1 Diameter: 1.5 in. **Elevation:** 6 ft.

Element Flows To:

Outlet 1	Outlet 2

Vault Hydraulic Table

Stage(ft)	Area(acr)	Volume(acr-ft)	Dschrg(cfs)	Infilt(cfs)
0.000	0.154	0.000	0.000	0.000
0.078	0.154	0.012	0.018	0.000
0.156	0.154	0.024	0.025	0.000
0.233	0.154	0.036	0.030	0.000
0.311	0.154	0.048	0.035	0.000
0.389	0.154	0.060	0.039	0.000
0.467	0.154	0.072	0.043	0.000
0.544	0.154	0.084	0.047	0.000
0.622	0.154	0.096	0.050	0.000
0.700	0.154	0.108	0.053	0.000
0.778	0.154	0.120	0.056	0.000
0.856	0.154	0.132	0.058	0.000
0.933	0.154	0.144	0.061	0.000
1.011	0.154	0.156	0.063	0.000
1.089	0.154	0.168	0.066	0.000
1.167	0.154	0.180	0.068	0.000
1.244	0.154	0.192	0.070	0.000
1.322	0.154	0.204	0.073	0.000
1.400	0.154	0.216	0.075	0.000
1.478	0.154	0.228	0.077	0.000
1.556	0.154	0.240	0.079	0.000
1.633	0.154	0.252	0.081	0.000
1.711	0.154	0.264	0.083	0.000
1.789	0.154	0.276	0.084	0.000
1.867	0.154	0.288	0.086	0.000
1.944	0.154	0.300	0.088	0.000
2.022	0.154	0.312	0.090	0.000
2.100	0.154	0.324	0.091	0.000
2.178	0.154	0.336	0.093	0.000
2.256	0.154	0.348	0.095	0.000
2.333	0.154	0.360	0.096	0.000
2.411	0.154	0.372	0.098	0.000
2.489	0.154	0.384	0.100	0.000
2.567	0.154	0.396	0.101	0.000
2.644	0.154	0.408	0.103	0.000
2.722	0.154	0.420	0.104	0.000
2.800	0.154	0.432	0.106	0.000
2.878	0.154	0.444	0.107	0.000
2.956	0.154	0.456	0.108	0.000
3.033	0.154	0.468	0.110	0.000
3.111	0.154	0.480	0.111	0.000
3.189	0.154	0.492	0.113	0.000
3.267	0.154	0.504	0.114	0.000
3.344	0.154	0.516	0.115	0.000

3.422	0.154	0.528	0.117	0.000
3.500	0.154	0.540	0.118	0.000
3.578	0.154	0.552	0.119	0.000
3.656	0.154	0.564	0.121	0.000
3.733	0.154	0.576	0.122	0.000
3.811	0.154	0.588	0.123	0.000
3.889	0.154	0.600	0.124	0.000
3.967	0.154	0.612	0.126	0.000
4.044	0.154	0.624	0.149	0.000
4.122	0.154	0.636	0.165	0.000
4.200	0.154	0.648	0.176	0.000
4.278	0.154	0.660	0.186	0.000
4.356	0.154	0.672	0.194	0.000
4.433	0.154	0.684	0.202	0.000
4.511	0.154	0.696	0.209	0.000
4.589	0.154	0.708	0.216	0.000
4.667	0.154	0.720	0.222	0.000
4.744	0.154	0.732	0.228	0.000
4.822	0.154	0.744	0.234	0.000
4.900	0.154	0.756	0.239	0.000
4.978	0.154	0.768	0.245	0.000
5.056	0.154	0.780	0.250	0.000
5.133	0.154	0.792	0.255	0.000
5.211	0.154	0.804	0.260	0.000
5.289	0.154	0.816	0.264	0.000
5.367	0.154	0.828	0.269	0.000
5.444	0.154	0.840	0.273	0.000
5.522	0.154	0.852	0.278	0.000
5.600	0.154	0.864	0.282	0.000
5.678	0.154	0.876	0.286	0.000
5.756	0.154	0.888	0.291	0.000
5.833	0.154	0.900	0.295	0.000
5.911	0.154	0.912	0.299	0.000
5.989	0.154	0.924	0.303	0.000
6.067	0.154	0.936	0.322	0.000
6.144	0.154	0.948	0.333	0.000
6.222	0.154	0.960	0.342	0.000
6.300	0.154	0.972	0.350	0.000
6.378	0.154	0.984	0.358	0.000
6.456	0.154	0.996	0.365	0.000
6.533	0.154	1.008	0.461	0.000
6.611	0.154	1.020	0.919	0.000
6.689	0.154	1.032	1.584	0.000
6.767	0.154	1.044	2.402	0.000
6.844	0.154	1.056	3.350	0.000
6.922	0.154	1.068	4.410	0.000
7.000	0.154	1.080	5.573	0.000
7.078	0.154	1.092	6.829	0.000
7.156	0.000	0.000	8.173	0.000

MITIGATED LAND USE

ANALYSIS RESULTS

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.262418
5 year	0.490854
10 year	0.699954
25 year	1.044001
50 year	1.367862
100 year	1.758345

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.35759
5 year	0.500313
10 year	0.609639

25 year	0.765809
50 year	0.896031
100 year	1.038836

Yearly Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1957	0.302	0.332
1958	0.513	0.547
1959	0.140	0.262
1960	0.245	0.355
1961	0.860	0.643
1962	0.332	0.243
1963	0.095	0.245
1964	0.595	0.598
1965	0.352	0.403
1966	0.241	0.341
1967	0.142	0.218
1968	0.263	0.286
1969	0.210	0.250
1970	0.328	0.391
1971	0.218	0.262
1972	0.319	0.317
1973	0.429	0.425
1974	0.249	0.332
1975	0.230	0.421
1976	0.177	0.321
1977	0.316	0.361
1978	0.079	0.410
1979	0.293	0.380
1980	0.215	0.405
1981	0.518	0.403
1982	0.389	0.446
1983	0.204	0.409
1984	0.394	0.514
1985	0.255	0.278
1986	0.117	0.277
1987	0.416	0.385
1988	0.384	0.455
1989	0.172	0.276
1990	0.206	0.346
1991	0.526	0.515
1992	0.763	1.031
1993	2.866	1.225
1994	0.147	0.275
1995	0.114	0.312
1996	0.268	0.328
1997	0.372	0.484
1998	1.757	0.842
1999	0.549	0.550
2000	0.225	0.317
2001	0.135	0.235
2002	0.046	0.218
2003	0.257	0.315
2004	0.124	0.231
2005	0.261	0.332
2006	0.143	0.213
2007	0.233	0.341
2008	0.220	0.531
2009	0.511	0.441

Ranked Yearly Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	2.8655	1.2247
2	1.7570	1.0313
3	0.8600	0.8421
4	0.7626	0.6429
5	0.5946	0.5982
6	0.5488	0.5499
7	0.5258	0.5466

8	0.5179	0.5309
9	0.5133	0.5150
10	0.5113	0.5143
11	0.4288	0.4840
12	0.4164	0.4546
13	0.3936	0.4457
14	0.3886	0.4412
15	0.3836	0.4250
16	0.3719	0.4207
17	0.3520	0.4097
18	0.3324	0.4090
19	0.3279	0.4047
20	0.3191	0.4032
21	0.3156	0.4032
22	0.3019	0.3912
23	0.2932	0.3848
24	0.2677	0.3800
25	0.2625	0.3614
26	0.2605	0.3549
27	0.2575	0.3457
28	0.2555	0.3415
29	0.2486	0.3407
30	0.2453	0.3317
31	0.2408	0.3317
32	0.2327	0.3316
33	0.2303	0.3282
34	0.2246	0.3213
35	0.2195	0.3169
36	0.2179	0.3168
37	0.2151	0.3152
38	0.2096	0.3116
39	0.2064	0.2865
40	0.2044	0.2777
41	0.1772	0.2766
42	0.1723	0.2755
43	0.1472	0.2746
44	0.1433	0.2618
45	0.1419	0.2616
46	0.1397	0.2505
47	0.1347	0.2446
48	0.1243	0.2427
49	0.1175	0.2346
50	0.1143	0.2312
51	0.0948	0.2177
52	0.0788	0.2176
53	0.0460	0.2128

POC #1

The Facility PASSED.

Flow(CFS)	Predev	Dev	Percentage	Pass/Fail
0.1312	15773	15611	98	Pass
0.1437	12472	11017	88	Pass
0.1562	9688	7785	80	Pass
0.1687	7884	5828	73	Pass
0.1812	6191	4284	69	Pass
0.1937	5033	3327	66	Pass
0.2062	4037	2555	63	Pass
0.2186	3342	2020	60	Pass
0.2311	2749	1601	58	Pass
0.2436	2334	1350	57	Pass
0.2561	1961	1107	56	Pass
0.2686	1659	928	55	Pass
0.2811	1443	802	55	Pass
0.2936	1257	672	53	Pass
0.3061	1090	551	50	Pass
0.3186	946	479	50	Pass
0.3311	814	387	47	Pass
0.3436	709	335	47	Pass
0.3561	632	286	45	Pass

0.3685	549	243	44	Pass
0.3810	478	209	43	Pass
0.3935	429	177	41	Pass
0.4060	390	151	38	Pass
0.4185	355	127	35	Pass
0.4310	326	107	32	Pass
0.4435	305	92	30	Pass
0.4560	274	82	29	Pass
0.4685	252	74	29	Pass
0.4810	228	69	30	Pass
0.4935	200	57	28	Pass
0.5060	170	53	31	Pass
0.5184	134	43	32	Pass
0.5309	113	41	36	Pass
0.5434	91	37	40	Pass
0.5559	82	32	39	Pass
0.5684	77	29	37	Pass
0.5809	74	25	33	Pass
0.5934	67	24	35	Pass
0.6059	61	22	36	Pass
0.6184	56	21	37	Pass
0.6309	50	21	42	Pass
0.6434	45	20	44	Pass
0.6558	41	19	46	Pass
0.6683	37	15	40	Pass
0.6808	35	15	42	Pass
0.6933	31	13	41	Pass
0.7058	27	12	44	Pass
0.7183	23	12	52	Pass
0.7308	20	10	50	Pass
0.7433	15	8	53	Pass
0.7558	10	8	80	Pass
0.7683	9	8	88	Pass
0.7808	9	8	88	Pass
0.7933	9	8	88	Pass
0.8057	9	8	88	Pass
0.8182	9	8	88	Pass
0.8307	9	7	77	Pass
0.8432	9	5	55	Pass
0.8557	9	5	55	Pass
0.8682	8	4	50	Pass
0.8807	7	4	57	Pass
0.8932	7	4	57	Pass
0.9057	7	4	57	Pass
0.9182	7	4	57	Pass
0.9307	7	4	57	Pass
0.9432	7	4	57	Pass
0.9556	7	4	57	Pass
0.9681	7	4	57	Pass
0.9806	7	3	42	Pass
0.9931	7	3	42	Pass
1.0056	7	2	28	Pass
1.0181	7	2	28	Pass
1.0306	7	2	28	Pass
1.0431	7	1	14	Pass
1.0556	7	1	14	Pass
1.0681	7	1	14	Pass
1.0806	7	1	14	Pass
1.0931	6	1	16	Pass
1.1055	6	1	16	Pass
1.1180	6	1	16	Pass
1.1305	6	1	16	Pass
1.1430	6	1	16	Pass
1.1555	6	1	16	Pass
1.1680	6	1	16	Pass
1.1805	6	1	16	Pass
1.1930	6	1	16	Pass
1.2055	6	1	16	Pass
1.2180	6	1	16	Pass
1.2305	6	0	0	Pass
1.2429	6	0	0	Pass
1.2554	6	0	0	Pass

1.2679	6	0	0	Pass
1.2804	5	0	0	Pass
1.2929	5	0	0	Pass
1.3054	5	0	0	Pass
1.3179	5	0	0	Pass
1.3304	5	0	0	Pass
1.3429	5	0	0	Pass
1.3554	5	0	0	Pass
1.3679	4	0	0	Pass

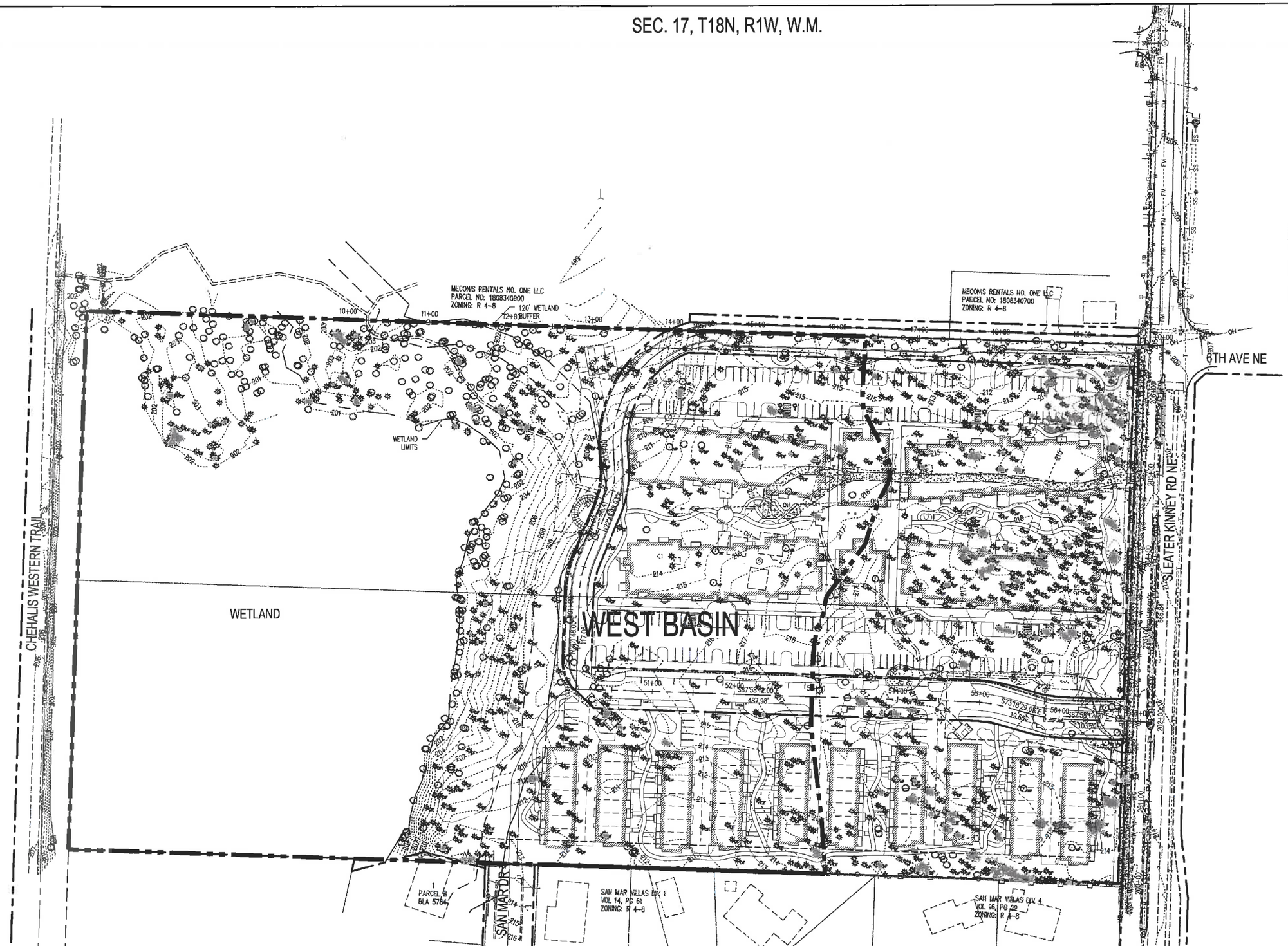
Water Quality BMP Flow and Volume for POC 1.
On-line facility volume: 0.0152 acre-feet
On-line facility target flow: 0.01 **cfs.**
Adjusted for 15 min: 0.019 **cfs.**
Off-line facility target flow: 0.0103 **cfs.**
Adjusted for 15 min: 0.0103 **cfs.**

Perlnd and Implnd Changes

No changes have been made.

EXHIBIT E6

SEC. 17, T18N, R1W, W.M.



EXISTING CONDITIONS:

WEST BASIN AREA:	14.17 ACRES
EX. FOREST AREA:	5.00 ACRES
EX. LAWN AREA:	2.10 ACRES
EX. IMPERVIOUS AREA:	0.60 ACRES
EX. POND AREA:	6.47 ACRES

CALL BEFORE YOU DIG

THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR THE LOCATION AND PROTECTION OF ALL EXISTING UTILITIES. THE CONTRACTOR SHALL VERIFY ALL UTILITY LOCATIONS PRIOR TO CONSTRUCTION BY CALLING THE UNDERGROUND LOCATE LINE AT (800) 424-5555 A MINIMUM OF 48 HOURS PRIOR TO ANY EXCAVATION.

Mar 03, 2015 - 4:26:02pm - User: rossj
N:\PROJECTS\1541 GOLDEN ALDER DEVELOPMENT\1541.01 BAYAN TRAILS\PHASE 20 - SPR SUBMITTAL\CADD\EXHIBITS\EX BASIN EXHIBIT.DWG

REVISIONS | BY | DATE

SCJ ALLIANCE
CONSULTING SERVICES
8730 TALLON LANE NE, SUITE 200, LACEY, WASHINGTON 98516
P: 360-352-1465 F: 360-352-1509
SCJALLIANCE.COM

SHEET TITLE: PREDEVELOPED CONDITIONS EXHIBIT HYDROPERIOD

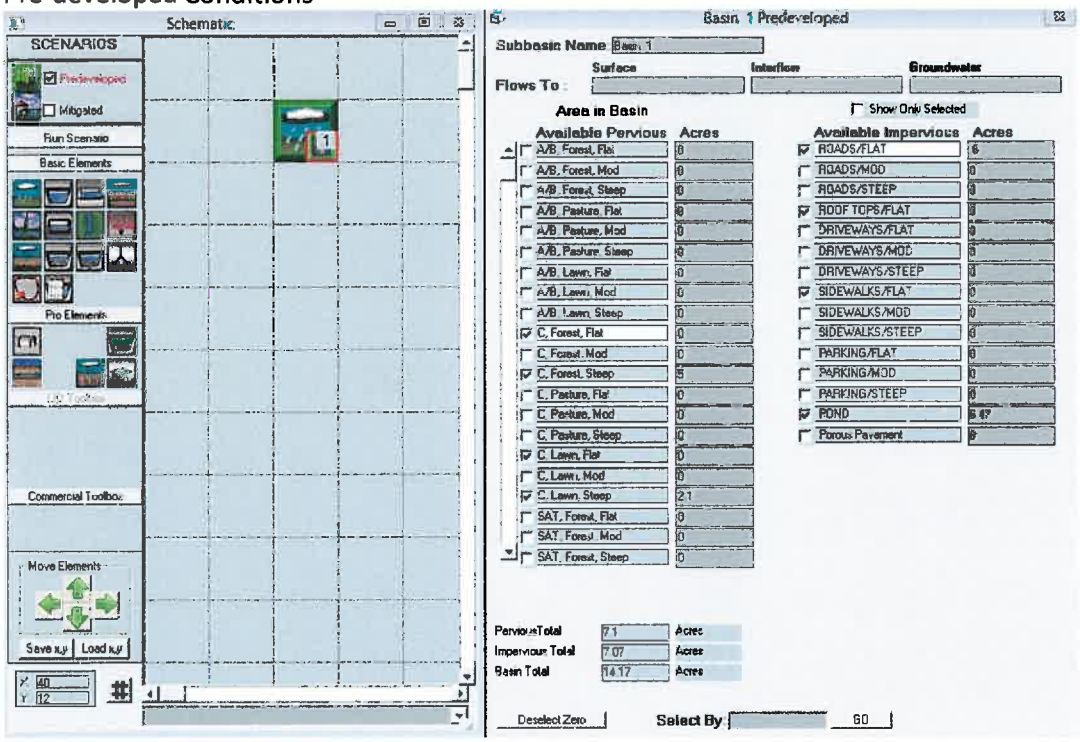
PROJECT NAME: BAYAN TRAILS
OLYMPIA, WASHINGTON

SEAL: ROSS D. JARVIS, STATE OF WASHINGTON, 43408, REGISTERED PROFESSIONAL ENGINEER

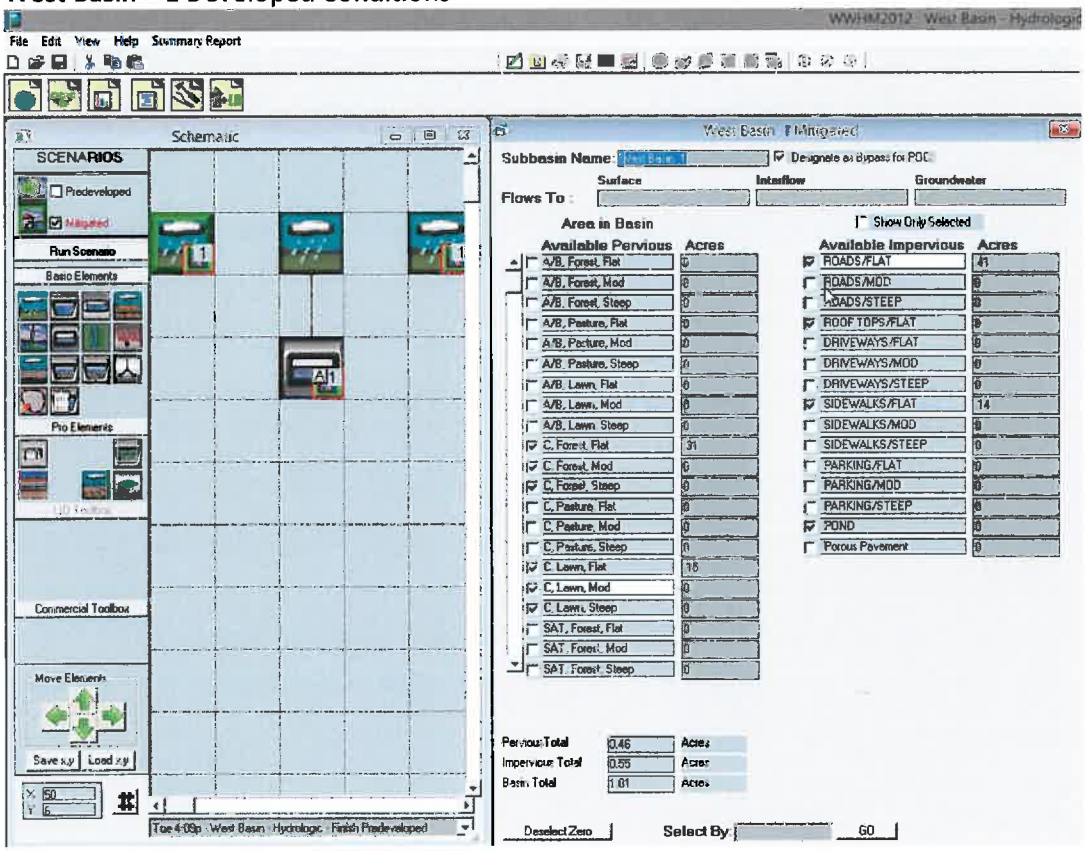
DESIGNER:	R. JARVIS
DRAWN BY:	L HURTADO
APPROVED BY:	R. JARVIS
DATE:	NOVEMBER, 2014
JOB No:	1541.01
DRAWING FILE No:	EX BASIN EXHIBIT
DRAWING No:	EX-01
SHEET No:	2 OF 13

West Basin - Hydroperiod

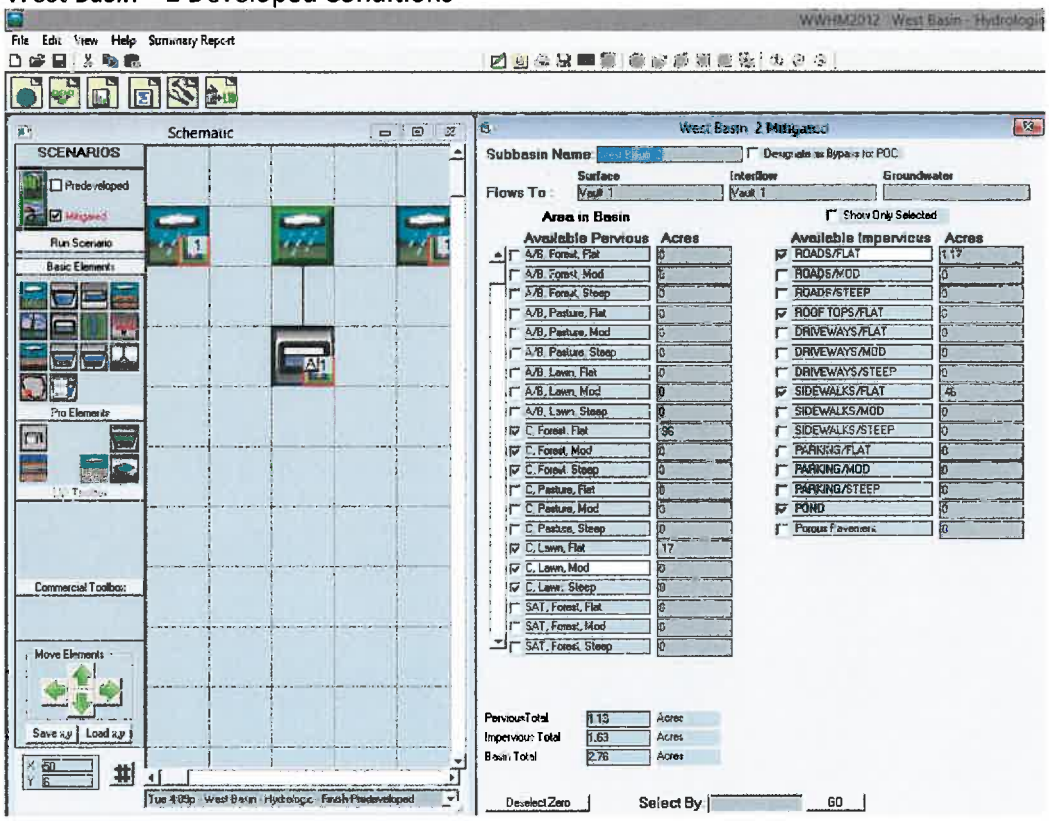
Pre-developed Conditions



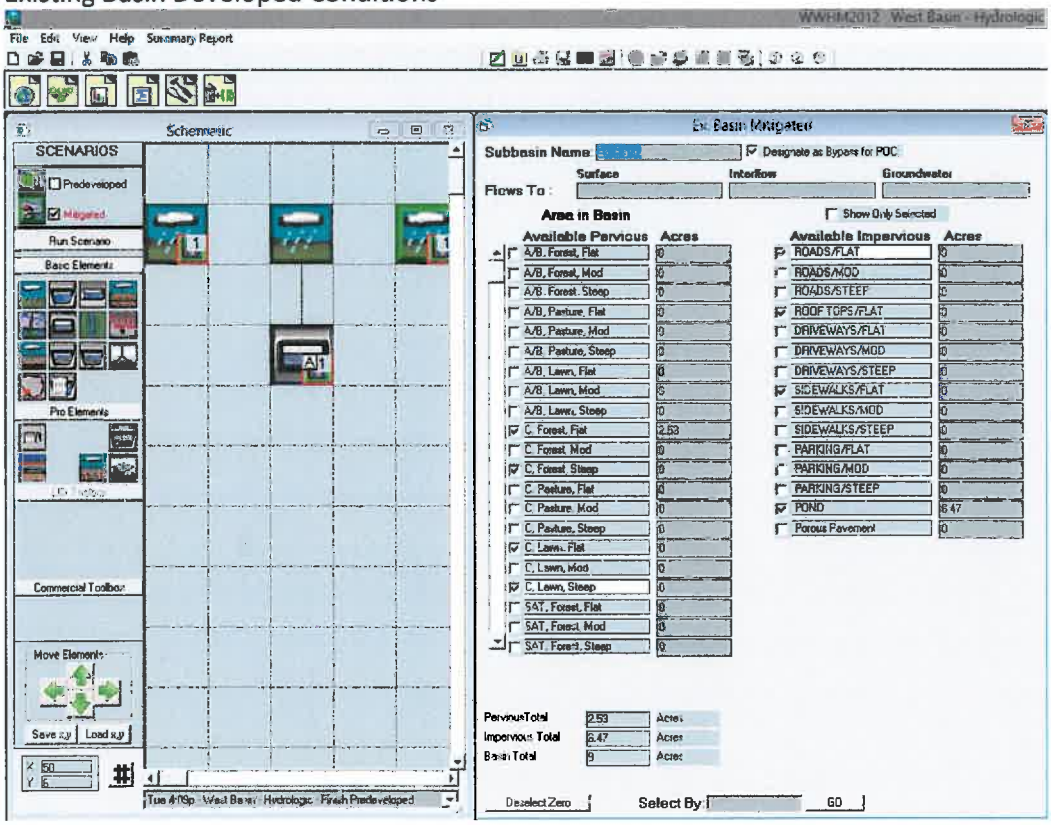
West Basin – 1 Developed Conditions



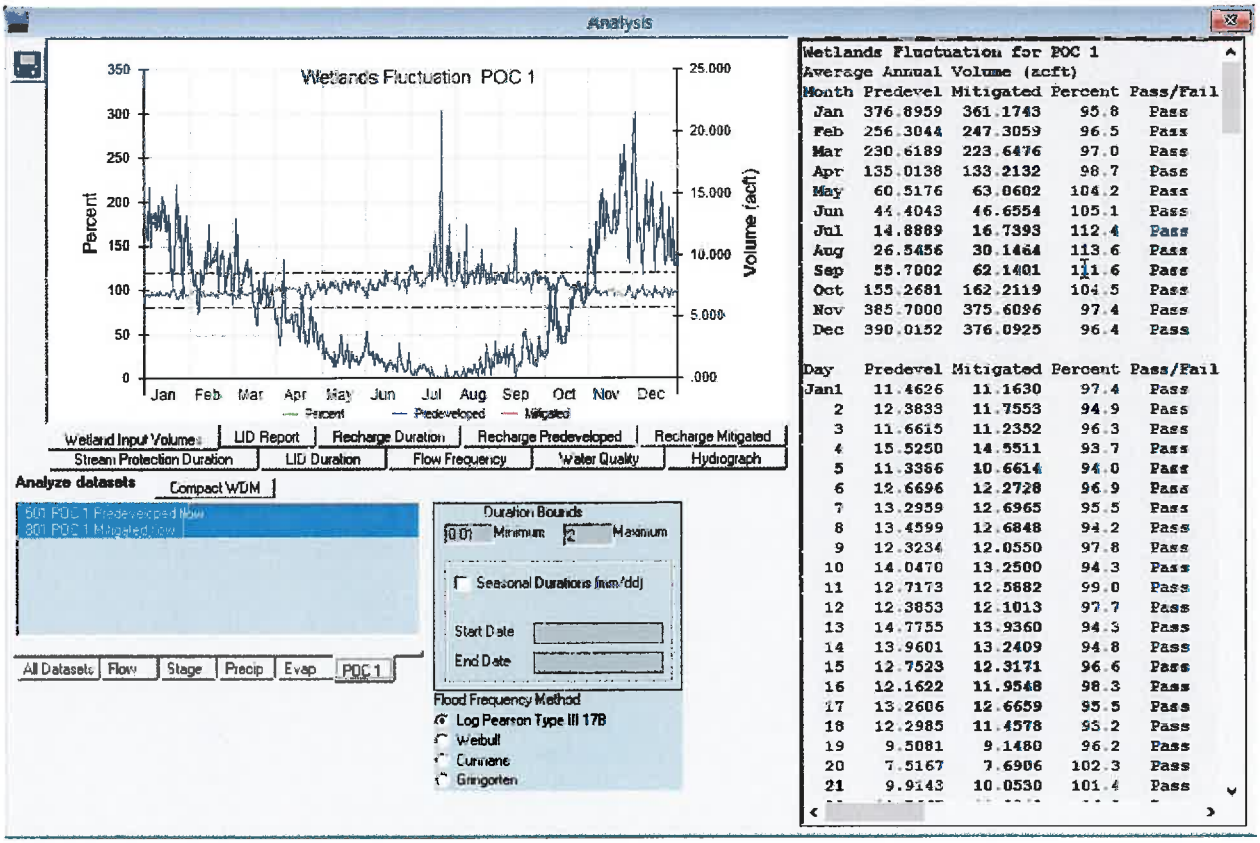
West Basin – 2 Developed Conditions



Existing Basin Developed Conditions



Wetland Fluctuations



Wetlands Fluctuation for POC 1
Average Annual Volume (acft)

Month	Predevel	Mitigated	Percent	Pass/Fail
Jan	376.8959	361.1743	95.8	Pass
Feb	256.3044	247.3059	96.5	Pass
Mar	230.6189	223.6476	97.0	Pass
Apr	135.0138	133.2132	98.7	Pass
May	60.5176	63.0602	104.2	Pass
Jun	44.4043	46.6554	105.1	Pass
Jul	14.8889	16.7393	112.4	Pass
Aug	26.5456	30.1464	113.6	Pass
Sep	55.7002	62.1401	111.6	Pass
Oct	155.2681	162.2119	104.5	Pass
Nov	385.7000	375.6096	97.4	Pass
Dec	390.0152	376.0925	96.4	Pass

Day	Predevel	Mitigated	Percent	Pass/Fail
Jan1	11.4626	11.1630	97.4	Pass
2	12.3833	11.7553	94.9	Pass
3	11.6615	11.2352	96.3	Pass
4	15.5250	14.5511	93.7	Pass
5	11.3386	10.6614	94.0	Pass
6	12.6696	12.2728	96.9	Pass
7	13.2959	12.6965	95.5	Pass
8	13.4599	12.6848	94.2	Pass
9	12.3234	12.0550	97.8	Pass
10	14.0470	13.2500	94.3	Pass
11	12.7173	12.5882	99.0	Pass
12	12.3853	12.1013	97.7	Pass
13	14.7755	13.9360	94.3	Pass
14	13.9601	13.2409	94.8	Pass
15	12.7523	12.3171	96.6	Pass
16	12.1622	11.9548	98.3	Pass
17	13.2606	12.6659	95.5	Pass
18	12.2985	11.4578	93.2	Pass
19	9.5081	9.1480	96.2	Pass
20	7.5167	7.6906	102.3	Pass
21	9.9143	10.0530	101.4	Pass

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	West Basin - Hydrologic
Site Name:	Bayan Trails
Site Address:	
City:	
Report Date:	3/3/2015
Gage:	Woodard Creek
Data Start:	1955/10/01
Data End:	2011/09/30
Timestep:	15 Minute
Precip Scale:	1.13
Version:	2015/02/27

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	Acres
C, Forest, Steep	5
C, Lawn, Steep	2.1
Pervious Total	7.1

Impervious Land Use	Acres
ROADS FLAT	0.6
POND	6.47
Impervious Total	7.07
Basin Total	14.17

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

West Basin 1

Bypass:	Yes
GroundWater:	No

Pervious Land Use	Acres
C, Forest, Flat	0.31
C, Lawn, Flat	0.15
Pervious Total	0.46

Impervious Land Use	Acres
ROADS FLAT	0.41
SIDEWALKS FLAT	0.14
Impervious Total	0.55
Basin Total	1.01

Element Flows To:

Surface	Interflow	Groundwater

West Basin 2

Bypass:	No
GroundWater:	No

Pervious Land Use	Acres
C, Lawn, Flat	0.17
C, Forest, Flat	0.96
Pervious Total	1.13

Impervious Land Use	Acres
ROADS FLAT	1.17
SIDEWALKS FLAT	0.46
Impervious Total	1.63
Basin Total	2.76

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Ex. Basin

Bypass:	Yes
GroundWater:	No

Pervious Land Use	Acres
C, Forest, Flat	2.53
Pervious Total	2.53

Impervious Land Use	Acres
POND	6.47
Impervious Total	6.47
Basin Total	9

Element Flows To:

Surface	Interflow	Groundwater

Routing Elements
Predeveloped Routing

Mitigated Routing

Vault 1

Width: 40 ft.
Length: 168 ft.
Depth: 7 ft.
Discharge Structure
Riser Height: 6.5 ft.
Riser Diameter: 18 in.
Orifice 1 Diameter: 1.55 in. Elevation:0 ft.
Orifice 2 Diameter: 2 in. Elevation:4 ft.
Orifice 3 Diameter: 1.5 in. Elevation:6 ft.
Element Flows To:
Outlet 1 Outlet 2

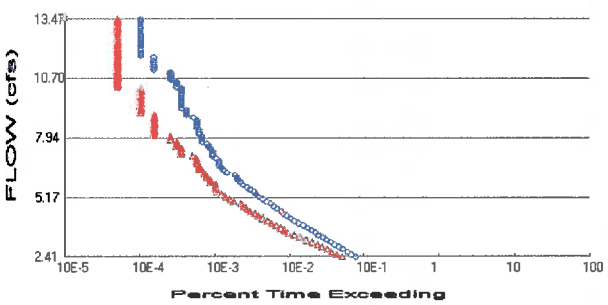
Vault Hydraulic Table

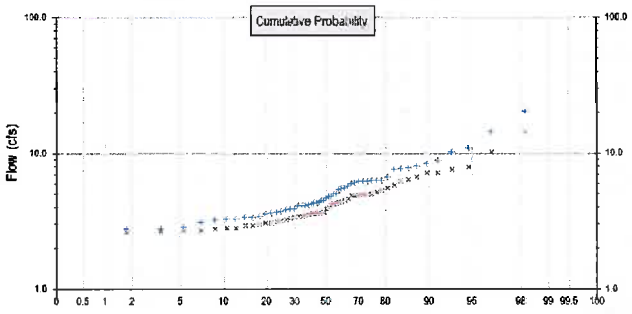
Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	0.154	0.000	0.000	0.000
0.0778	0.154	0.012	0.017	0.000
0.1556	0.154	0.024	0.024	0.000
0.2333	0.154	0.036	0.030	0.000
0.3111	0.154	0.048	0.035	0.000
0.3889	0.154	0.060	0.039	0.000
0.4667	0.154	0.072	0.043	0.000
0.5444	0.154	0.084	0.046	0.000
0.6222	0.154	0.096	0.049	0.000
0.7000	0.154	0.108	0.052	0.000
0.7778	0.154	0.120	0.055	0.000
0.8556	0.154	0.132	0.058	0.000
0.9333	0.154	0.144	0.061	0.000
1.0111	0.154	0.156	0.063	0.000
1.0889	0.154	0.168	0.065	0.000
1.1667	0.154	0.180	0.068	0.000
1.2444	0.154	0.192	0.070	0.000
1.3222	0.154	0.204	0.072	0.000
1.4000	0.154	0.216	0.074	0.000
1.4778	0.154	0.228	0.076	0.000
1.5556	0.154	0.240	0.078	0.000
1.6333	0.154	0.252	0.080	0.000
1.7111	0.154	0.264	0.082	0.000
1.7889	0.154	0.276	0.084	0.000
1.8667	0.154	0.288	0.086	0.000
1.9444	0.154	0.300	0.088	0.000
2.0222	0.154	0.312	0.089	0.000
2.1000	0.154	0.324	0.091	0.000
2.1778	0.154	0.336	0.093	0.000
2.2556	0.154	0.348	0.094	0.000
2.3333	0.154	0.360	0.096	0.000
2.4111	0.154	0.372	0.098	0.000
2.4889	0.154	0.384	0.099	0.000
2.5667	0.154	0.396	0.101	0.000
2.6444	0.154	0.408	0.102	0.000
2.7222	0.154	0.420	0.104	0.000
2.8000	0.154	0.432	0.105	0.000
2.8778	0.154	0.444	0.107	0.000

2.9556	0.154	0.456	0.108	0.000
3.0333	0.154	0.468	0.109	0.000
3.1111	0.154	0.480	0.111	0.000
3.1889	0.154	0.491	0.112	0.000
3.2667	0.154	0.503	0.114	0.000
3.3444	0.154	0.515	0.115	0.000
3.4222	0.154	0.527	0.116	0.000
3.5000	0.154	0.539	0.118	0.000
3.5778	0.154	0.551	0.119	0.000
3.6556	0.154	0.563	0.120	0.000
3.7333	0.154	0.575	0.121	0.000
3.8111	0.154	0.587	0.123	0.000
3.8889	0.154	0.599	0.124	0.000
3.9667	0.154	0.611	0.125	0.000
4.0444	0.154	0.623	0.149	0.000
4.1222	0.154	0.635	0.164	0.000
4.2000	0.154	0.647	0.176	0.000
4.2778	0.154	0.659	0.185	0.000
4.3556	0.154	0.671	0.194	0.000
4.4333	0.154	0.683	0.202	0.000
4.5111	0.154	0.695	0.209	0.000
4.5889	0.154	0.707	0.215	0.000
4.6667	0.154	0.719	0.222	0.000
4.7444	0.154	0.731	0.228	0.000
4.8222	0.154	0.743	0.233	0.000
4.9000	0.154	0.755	0.239	0.000
4.9778	0.154	0.767	0.244	0.000
5.0556	0.154	0.779	0.249	0.000
5.1333	0.154	0.791	0.254	0.000
5.2111	0.154	0.803	0.259	0.000
5.2889	0.154	0.815	0.264	0.000
5.3667	0.154	0.827	0.269	0.000
5.4444	0.154	0.839	0.273	0.000
5.5222	0.154	0.851	0.277	0.000
5.6000	0.154	0.863	0.282	0.000
5.6778	0.154	0.875	0.286	0.000
5.7556	0.154	0.887	0.290	0.000
5.8333	0.154	0.899	0.294	0.000
5.9111	0.154	0.911	0.298	0.000
5.9889	0.154	0.923	0.302	0.000
6.0667	0.154	0.935	0.321	0.000
6.1444	0.154	0.947	0.332	0.000
6.2222	0.154	0.959	0.341	0.000
6.3000	0.154	0.971	0.350	0.000
6.3778	0.154	0.983	0.357	0.000
6.4556	0.154	0.995	0.364	0.000
6.5333	0.154	1.007	0.460	0.000
6.6111	0.154	1.019	0.919	0.000
6.6889	0.154	1.031	1.583	0.000
6.7667	0.154	1.043	2.402	0.000
6.8444	0.154	1.055	3.349	0.000
6.9222	0.154	1.067	4.410	0.000
7.0000	0.154	1.079	5.572	0.000
7.0778	0.154	1.091	6.829	0.000
7.1556	0.000	0.000	8.172	0.000

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 7.1
Total Impervious Area: 7.07

Mitigated Landuse Totals for POC #1
Total Pervious Area: 4.12
Total Impervious Area: 8.65

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	4.816806
5 year	7.015148
10 year	8.752254
25 year	11.297926
50 year	13.469378
100 year	15.89435

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	4.018726
5 year	5.584378
10 year	6.777326
25 year	8.474028
50 year	9.883341
100 year	11.424054

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1956	4.326	3.567
1957	7.625	5.809
1958	3.435	2.916
1959	4.848	3.890
1960	10.266	7.536
1961	3.755	2.701
1962	3.096	2.941
1963	8.922	6.688
1964	5.932	4.483
1965	4.466	3.607

1966	2.755	2.519
1967	4.136	3.198
1968	3.244	2.754
1969	6.306	4.874
1970	3.358	2.822
1971	3.877	3.155
1972	5.390	4.258
1973	4.178	3.429
1974	6.229	4.944
1975	4.463	3.653
1976	4.269	3.565
1977	6.238	5.140
1978	5.590	4.592
1979	5.719	5.025
1980	6.023	4.358
1981	6.294	4.923
1982	5.042	4.267
1983	8.006	7.155
1984	4.112	3.381
1985	3.668	3.491
1986	4.664	3.674
1987	6.315	4.906
1988	3.397	2.965
1989	4.999	4.858
1990	6.179	5.297
1991	6.648	5.527
1992	20.540	14.272
1993	3.574	3.046
1994	4.132	3.510
1995	4.378	4.102
1996	7.698	6.260
1997	14.514	10.255
1998	8.390	6.353
1999	3.838	3.418
2000	3.264	3.250
2001	2.763	2.691
2002	3.603	3.061
2003	3.280	2.830
2004	3.884	3.317
2005	2.738	2.652
2006	4.274	3.635
2007	7.763	7.168
2008	5.473	4.352
2009	4.793	3.959
2010	11.021	7.874
2011	2.852	2.626

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	20.5400	14.2719
2	14.5139	10.2549
3	11.0214	7.8735
4	10.2664	7.5357
5	8.9224	7.1678
6	8.3905	7.1545
7	8.0064	6.6881
8	7.7631	6.3526

9	7.6983	6.2602
10	7.6247	5.8093
11	6.6484	5.5269
12	6.3152	5.2970
13	6.3060	5.1396
14	6.2943	5.0245
15	6.2384	4.9443
16	6.2291	4.9225
17	6.1792	4.9061
18	6.0235	4.8737
19	5.9320	4.8576
20	5.7195	4.5919
21	5.5896	4.4833
22	5.4727	4.3580
23	5.3902	4.3525
24	5.0425	4.2668
25	4.9987	4.2577
26	4.8477	4.1023
27	4.7934	3.9588
28	4.6635	3.8895
29	4.4655	3.6741
30	4.4628	3.6530
31	4.3783	3.6346
32	4.3263	3.6073
33	4.2743	3.5671
34	4.2688	3.5652
35	4.1785	3.5105
36	4.1363	3.4906
37	4.1322	3.4294
38	4.1123	3.4179
39	3.8837	3.3811
40	3.8770	3.3167
41	3.8379	3.2503
42	3.7554	3.1977
43	3.6685	3.1545
44	3.6028	3.0609
45	3.5742	3.0455
46	3.4350	2.9655
47	3.3967	2.9407
48	3.3577	2.9164
49	3.2804	2.8302
50	3.2639	2.8223
51	3.2442	2.7535
52	3.0957	2.7006
53	2.8517	2.6911
54	2.7628	2.6523
55	2.7555	2.6261
56	2.7383	2.5192

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
2.4084	1482	992	66	Pass
2.5201	1300	836	64	Pass
2.6319	1153	722	62	Pass
2.7436	1007	629	62	Pass
2.8553	883	535	60	Pass
2.9670	783	464	59	Pass
3.0788	698	395	56	Pass
3.1905	605	328	54	Pass
3.3022	541	270	49	Pass
3.4139	473	229	48	Pass
3.5257	430	188	43	Pass
3.6374	382	165	43	Pass
3.7491	337	150	44	Pass
3.8609	295	129	43	Pass
3.9726	258	112	43	Pass
4.0843	224	100	44	Pass
4.1960	200	86	43	Pass
4.3078	177	75	42	Pass
4.4195	159	67	42	Pass
4.5312	151	58	38	Pass
4.6429	131	52	39	Pass
4.7547	118	47	39	Pass
4.8664	108	44	40	Pass
4.9781	95	35	36	Pass
5.0899	85	31	36	Pass
5.2016	75	27	36	Pass
5.3133	70	24	34	Pass
5.4250	64	21	32	Pass
5.5368	57	20	35	Pass
5.6485	53	20	37	Pass
5.7602	46	20	43	Pass
5.8719	42	17	40	Pass
5.9837	39	17	43	Pass
6.0954	38	15	39	Pass
6.2071	36	15	41	Pass
6.3188	28	14	50	Pass
6.4306	25	12	48	Pass
6.5423	24	12	50	Pass
6.6540	22	12	54	Pass
6.7658	22	11	50	Pass
6.8775	22	11	50	Pass
6.9892	20	11	55	Pass
7.1009	18	10	55	Pass
7.2127	18	7	38	Pass
7.3244	18	7	38	Pass
7.4361	17	7	41	Pass
7.5478	16	6	37	Pass
7.6596	15	6	40	Pass
7.7713	13	6	46	Pass
7.8830	13	5	38	Pass
7.9948	13	5	38	Pass
8.1065	12	3	25	Pass
8.2182	12	3	25	Pass

8.3299	12	3	25	Pass
8.4417	11	3	27	Pass
8.5534	11	3	27	Pass
8.6651	11	3	27	Pass
8.7768	11	3	27	Pass
8.8886	10	3	30	Pass
9.0003	8	3	37	Pass
9.1120	8	2	25	Pass
9.2238	8	2	25	Pass
9.3355	7	2	28	Pass
9.4472	7	2	28	Pass
9.5589	7	2	28	Pass
9.6707	7	2	28	Pass
9.7824	7	2	28	Pass
9.8941	7	2	28	Pass
10.0058	7	2	28	Pass
10.1176	7	2	28	Pass
10.2293	7	2	28	Pass
10.3410	6	1	16	Pass
10.4527	6	1	16	Pass
10.5645	6	1	16	Pass
10.6762	5	1	20	Pass
10.7879	5	1	20	Pass
10.8997	5	1	20	Pass
11.0114	5	1	20	Pass
11.1231	3	1	33	Pass
11.2348	3	1	33	Pass
11.3466	3	1	33	Pass
11.4583	3	1	33	Pass
11.5700	3	1	33	Pass
11.6817	3	1	33	Pass
11.7935	2	1	50	Pass
11.9052	2	1	50	Pass
12.0169	2	1	50	Pass
12.1287	2	1	50	Pass
12.2404	2	1	50	Pass
12.3521	2	1	50	Pass
12.4638	2	1	50	Pass
12.5756	2	1	50	Pass
12.6873	2	1	50	Pass
12.7990	2	1	50	Pass
12.9107	2	1	50	Pass
13.0225	2	1	50	Pass
13.1342	2	1	50	Pass
13.2459	2	1	50	Pass
13.3577	2	1	50	Pass
13.4694	2	1	50	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 1 POC	☐	452.17			☐	0.00			
Total Volume Infiltrated		452.17	0.00	0.00		0.00	0.00	0%	No Treat Credit
Compliance with LID Standard 8% of 2-yr to 50-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

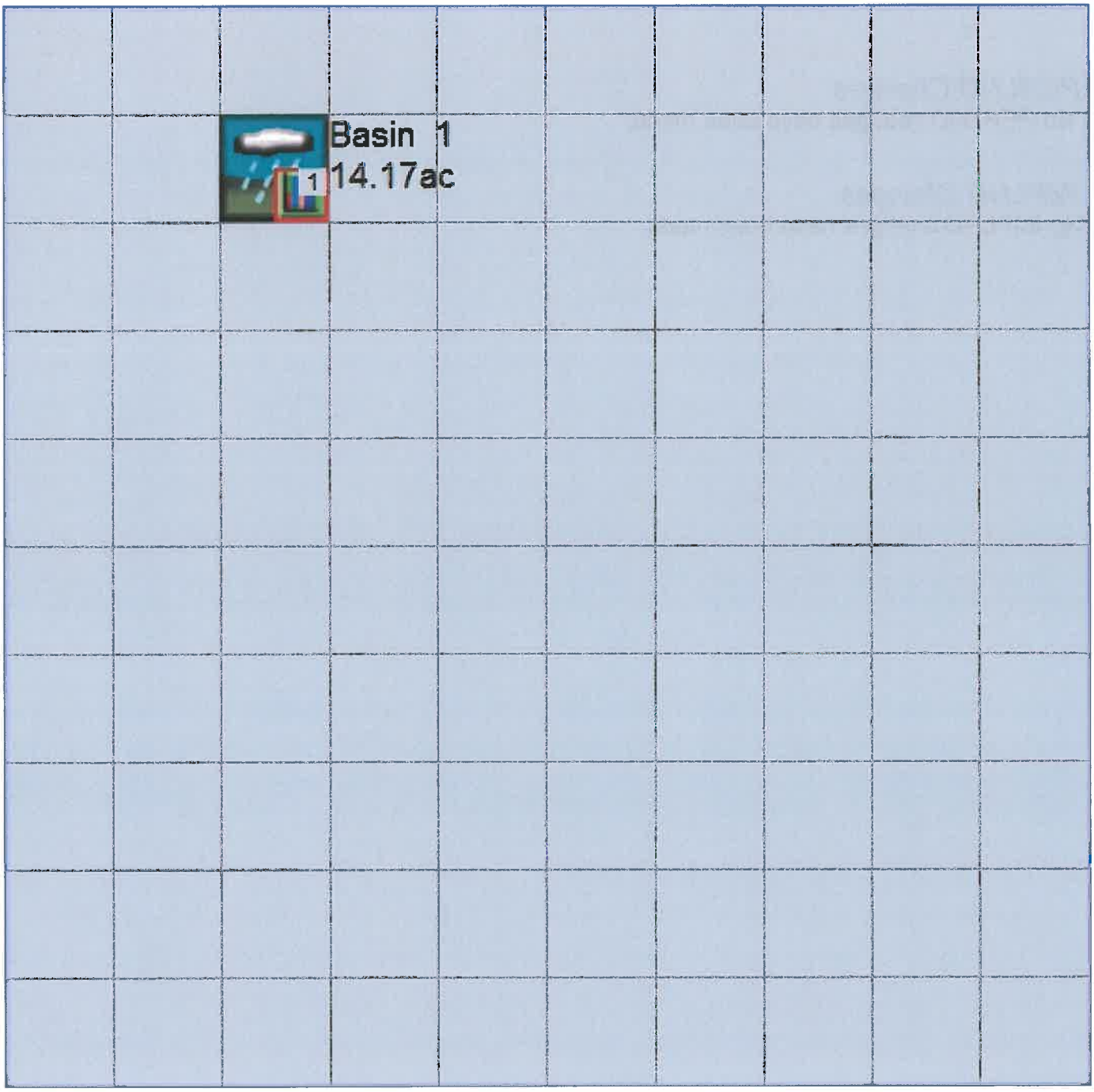
PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2011 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   West Basin - Hydrologic.wdm
MESSU       25   PreWest Basin - Hydrologic.MES
            27   PreWest Basin - Hydrologic.L61
            28   PreWest Basin - Hydrologic.L62
            30   POCWest Basin - Hydrologic1.dat
END FILES

OPN SEQUENCE
    INGRP               INDELT 00:15
      PERLND       12
      PERLND       18
      IMPLND        1
      IMPLND       14
      COPY        501
      DISPLY        1
    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
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1          1    1
  501          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             ***
   12     C, Forest, Steep         1    1    1    1   27    0
   18     C, Lawn, Steep           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 ***
   12          0    0    1    0    0    0    0    0    0    0    0    0
   18          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  *********
   12         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   18         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 ***
   12         0    0    0    0    0    0    0    0    0    0    0
   18         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
   12              0       4.5       0.08       400       0.15        0.5      0.996
   18              0       4.5       0.03       400       0.15        0.5      0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -   # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   12              0         0         2         2         0         0         0
   18              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -   #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   12           0.2       0.3      0.35         6       0.3       0.7
   18           0.1      0.15      0.25         6       0.3      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
   12             0         0         0          0       2.5         1          0
   18             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
   14      POND                    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
   14         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    0    1    9
   14         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
   14         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
   14           400      0.01       0.1        0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1             0         0
   14             0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1             0         0
   14             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                 <--Area-->     <-Target->   MBLK    ***
<Name>   #                 <-factor->     <Name>   #   Tbl#    ***
Basin  1***
PERLND  12                         5      COPY   501     12
PERLND  12                         5      COPY   501     13
PERLND  18                       2.1      COPY   501     12
PERLND  18                       2.1      COPY   501     13
IMPLND   1                       0.6      COPY   501     15
IMPLND  14                      6.47      COPY   501     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



<-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    1.125          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.125          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           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
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       1955 10 01        END    2011 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   West Basin - Hydrologic.wdm
MESSU       25   MitWest Basin - Hydrologic.MES
            27   MitWest Basin - Hydrologic.L61
            28   MitWest Basin - Hydrologic.L62
            30   POCWest Basin - Hydrologic1.dat
END FILES

OPN SEQUENCE
    INGRP               INDELT 00:15
      PERLND      10
      PERLND      16
      IMPLND       1
      IMPLND       8
      IMPLND      14
      RCHRES       1
      COPY         1
      COPY       501
      COPY       601
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Vault  1                    MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1          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           ***
   10     C, Forest, Flat          1    1    1    1   27    0
   16     C, Lawn, Flat            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 ***
```

```
  10          0    0    1    0    0    0    0    0    0    0    0    0
  16          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  *********
  10          0    0    4    0    0    0    0    0    0    0    0    0    1    9
  16          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 ***
  10          0    0    0    0    0    0    0    0    0    0    0
  16          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
  10              0       4.5       0.08       400       0.05        0.5      0.996
  16              0       4.5       0.03       400       0.05        0.5      0.996
END PWAT-PARM2

PWAT-PARM3
  <PLS >       PWATER input info: Part 3          ***
  # -   # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  10              0         0         2         2         0         0         0
  16              0         0         2         2         0         0         0
END PWAT-PARM3
PWAT-PARM4
  <PLS >      PWATER input info: Part 4                                  ***
  # -   #      CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
  10           0.2       0.5      0.35         6       0.5       0.7
  16           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
  10              0         0         0          0       2.5          1          0
  16              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
    8       SIDEWALKS/FLAT        1    1    1   27    0
   14       POND                  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
    8           0    0    1    0    0    0
   14           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    0    1    9
    8          0    0    4    0    0    0    1    9
   14          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
    8          0    0    0    0    0
   14          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
    8           400      0.01       0.1       0.1
   14           400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >       IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
    8              0         0
   14              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
    8              0         0
   14              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
West Basin  2***
PERLND  16                        0.17     RCHRES   1      2
PERLND  16                        0.17     RCHRES   1      3
PERLND  10                        0.96     RCHRES   1      2
PERLND  10                        0.96     RCHRES   1      3
IMPLND   1                        1.17     RCHRES   1      5
IMPLND   8                        0.46     RCHRES   1      5
West Basin  1***
PERLND  10                        0.31     COPY   501     12
PERLND  10                        0.31     COPY   601     12
PERLND  10                        0.31     COPY   501     13
PERLND  10                        0.31     COPY   601     13
PERLND  16                        0.15     COPY   501     12
PERLND  16                        0.15     COPY   601     12
PERLND  16                        0.15     COPY   501     13
PERLND  16                        0.15     COPY   601     13
IMPLND   1                        0.41     COPY   501     15
IMPLND   1                        0.41     COPY   601     15
IMPLND   8                        0.14     COPY   501     15
IMPLND   8                        0.14     COPY   601     15
Ex. Basin***
PERLND  10                        2.53     COPY   501     12
PERLND  10                        2.53     COPY   601     12
PERLND  10                        2.53     COPY   501     13
PERLND  10                        2.53     COPY   601     13
IMPLND  14                        6.47     COPY   501     15
IMPLND  14                        6.47     COPY   601     15
```

```
******Routing******
PERLND  16                          0.17     COPY     1     12
PERLND  10                          0.96     COPY     1     12
IMPLND   1                          1.17     COPY     1     15
IMPLND   8                          0.46     COPY     1     15
PERLND  16                          0.17     COPY     1     13
PERLND  10                          0.96     COPY     1     13
RCHRES   1                             1     COPY   501     16
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


<-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  1                 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
  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
  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
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN      DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><--------><------>***
    1               1      0.03       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
  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	0.154270	0.000000	0.000000		
0.077778	0.154270	0.011999	0.017597		
0.155556	0.154270	0.023998	0.024887		
0.233333	0.154270	0.035996	0.030480		
0.311111	0.154270	0.047995	0.035195		
0.388889	0.154270	0.059994	0.039349		
0.466667	0.154270	0.071993	0.043105		
0.544444	0.154270	0.083991	0.046559		
0.622222	0.154270	0.095990	0.049773		
0.700000	0.154270	0.107989	0.052792		
0.777778	0.154270	0.119988	0.055648		
0.855556	0.154270	0.131987	0.058364		
0.933333	0.154270	0.143985	0.060959		
1.011111	0.154270	0.155984	0.063449		
1.088889	0.154270	0.167983	0.065844		
1.166667	0.154270	0.179982	0.068155		
1.244444	0.154270	0.191980	0.070390		
1.322222	0.154270	0.203979	0.072556		
1.400000	0.154270	0.215978	0.074660		
1.477778	0.154270	0.227977	0.076706		
1.555556	0.154270	0.239976	0.078698		
1.633333	0.154270	0.251974	0.080642		
1.711111	0.154270	0.263973	0.082539		
1.788889	0.154270	0.275972	0.084394		
1.866667	0.154270	0.287971	0.086210		
1.944444	0.154270	0.299969	0.087987		
2.022222	0.154270	0.311968	0.089730		
2.100000	0.154270	0.323967	0.091439		
2.177778	0.154270	0.335966	0.093117		
2.255556	0.154270	0.347964	0.094765		
2.333333	0.154270	0.359963	0.096385		
2.411111	0.154270	0.371962	0.097979		
2.488889	0.154270	0.383961	0.099546		
2.566667	0.154270	0.395960	0.101090		
2.644444	0.154270	0.407958	0.102610		
2.722222	0.154270	0.419957	0.104108		
2.800000	0.154270	0.431956	0.105585		
2.877778	0.154270	0.443955	0.107041		
2.955556	0.154270	0.455953	0.108478		
3.033333	0.154270	0.467952	0.109896		
3.111111	0.154270	0.479951	0.111296		
3.188889	0.154270	0.491950	0.112679		
3.266667	0.154270	0.503949	0.114045		
3.344444	0.154270	0.515947	0.115394		
3.422222	0.154270	0.527946	0.116728		
3.500000	0.154270	0.539945	0.118047		
3.577778	0.154270	0.551944	0.119352		
3.655556	0.154270	0.563942	0.120642		
3.733333	0.154270	0.575941	0.121919		
3.811111	0.154270	0.587940	0.123182		
3.888889	0.154270	0.599939	0.124433		
3.966667	0.154270	0.611938	0.125671		
4.044444	0.154270	0.623936	0.149045		
4.122222	0.154270	0.635935	0.164839		
4.200000	0.154270	0.647934	0.176297		
4.277778	0.154270	0.659933	0.185875		
4.355556	0.154270	0.671931	0.194330		
4.433333	0.154270	0.683930	0.202014		
4.511111	0.154270	0.695929	0.209125		
4.588889	0.154270	0.707928	0.215787		
4.666667	0.154270	0.719927	0.222087		
4.744444	0.154270	0.731925	0.228084		
4.822222	0.154270	0.743924	0.233823		
4.900000	0.154270	0.755923	0.239340		
4.977778	0.154270	0.767922	0.244661		
5.055556	0.154270	0.779920	0.249810		
5.133333	0.154270	0.791919	0.254803		
5.211111	0.154270	0.803918	0.259656		
5.288889	0.154270	0.815917	0.264381		

```
  5.366667  0.154270  0.827916  0.268990
  5.444444  0.154270  0.839914  0.273492
  5.522222  0.154270  0.851913  0.277895
  5.600000  0.154270  0.863912  0.282205
  5.677778  0.154270  0.875911  0.286430
  5.755556  0.154270  0.887909  0.290575
  5.833333  0.154270  0.899908  0.294644
  5.911111  0.154270  0.911907  0.298643
  5.988889  0.154270  0.923906  0.302575
  6.066667  0.154270  0.935904  0.321701
  6.144444  0.154270  0.947903  0.332711
  6.222222  0.154270  0.959902  0.341861
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  6.533333  0.154270  1.007897  0.460555
  6.611111  0.154270  1.019896  0.919250
  6.688889  0.154270  1.031895  1.583773
  6.766667  0.154270  1.043893  2.402302
  6.844444  0.154270  1.055892  3.349706
  6.922222  0.154270  1.067891  4.410254
  7.000000  0.154270  1.079890  5.572884
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END FTABLES

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WDM      2 PREC     ENGL    1.125          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
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<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
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
END EXT TARGETS

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  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
```

```
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  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

Disclaimer

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Local (360)943-0304

www.clearcreeksolutions.com

EXHIBIT E6

SEC. 17, T18N, R1W, W.M.

MOD-WET FOR WEST BASIN-1

MOD-WET FOR EAST BASIN-1

6TH AVE NE

SLEATER KINNEY RD NE

SENIOR HOUSING BUILDING 'B' FFE:212.00 FFE:215.00 FFE:213.50

COMMUNITY BUILDING FFE:215.50

SENIOR HOUSING BUILDING 'A' FFE:215.00

SENIOR HOUSING BUILDING 'C' FFE:216.00

POOL BUILDING FFE:216.00

SENIOR HOUSING BUILDING 'D' FFE:216.00

BIORETENTION CELL #1

BIORETENTION CELL #2 (TYP.)

TOWNHOUSE BUILDING 10 FFE:213.50

TOWNHOUSE BUILDING 9 FFE:213.50

TOWNHOUSE BUILDING 8 FFE:215.00

TOWNHOUSE BUILDING 7 FFE:215.00

TOWNHOUSE BUILDING 6 FFE:217.00

TOWNHOUSE BUILDING 5 FFE:217.00

TOWNHOUSE BUILDING 4 FFE:216.00

TOWNHOUSE BUILDING 3 FFE:216.00

TOWNHOUSE BUILDING 2 FFE:215.00

TOWNHOUSE BUILDING 1 FFE:215.00

EX. CB
RIM: 211.38
IE:12" PVC N & S
207.93

EX. CB
RIM: 212.61
IE:12" PVC N & S
209.16

EX. CB
RIM: 213.38
IE:12" PVC N
209.90

BIORETENTION CELL #2

0 40 80
SCALE IN FEET

CALL BEFORE YOU DIG

THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR THE LOCATION AND PROTECTION OF ALL EXISTING UTILITIES. THE CONTRACTOR SHALL VERIFY ALL UTILITY LOCATIONS PRIOR TO CONSTRUCTION BY CALLING THE UNDERGROUND LOCATE LINE AT (800) 424-5555 A MINIMUM OF 48 HOURS PRIOR TO ANY EXCAVATION.

Nov 05, 2015 - 9:42:41am - User rossj
N:\PROJECTS\1541 GOLDEN ALOE DEVELOPMENT\1541.01 BAYAN TRAILS\PHASE 20 - SPR SUBMITTAL\CAD\EXHIBITS\DEV BASIN EXHIBIT.DWG

SCJ ALLIANCE
CONSULTING SERVICES
8730 TALLON LANE NE, SUITE 200, LACEY, WASHINGTON 98516
P: 360-352-1465 F: 360-352-1509
SCJALLIANCE.COM

REVISIONS | BY | DATE

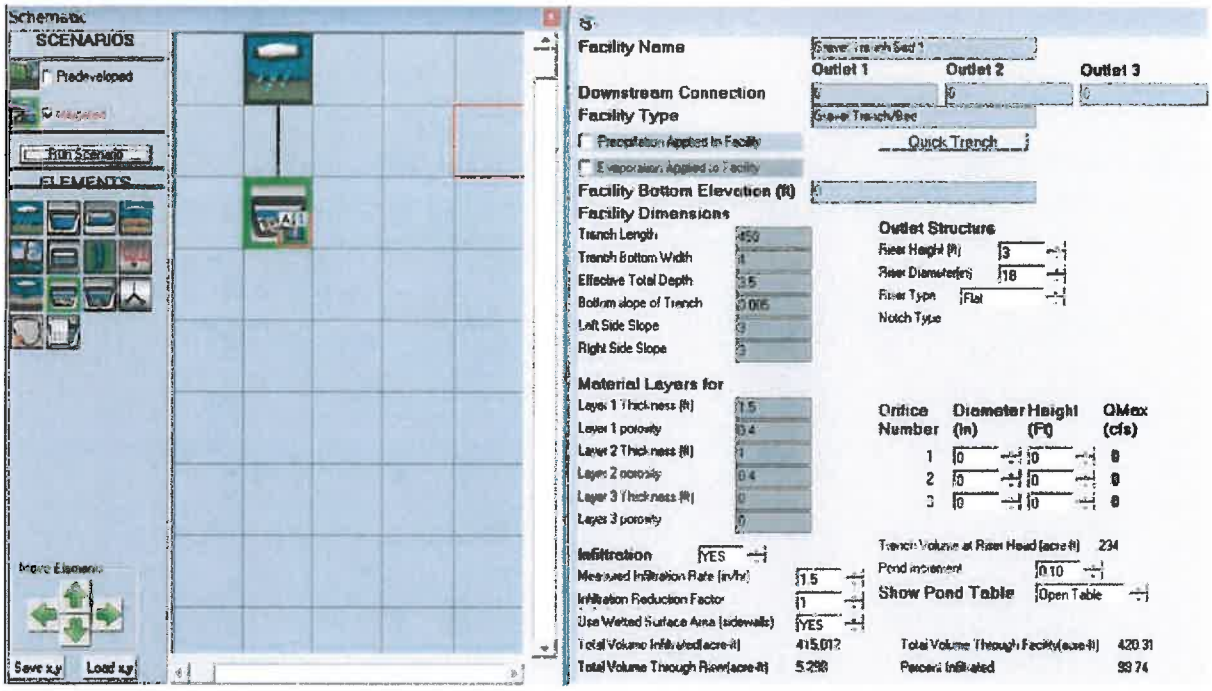
SHEET TITLE: BIORETENTION KEY MAP

PROJECT NAME: BAYAN TRAILS
OLYMPIA, WASHINGTON

SEAL:
ROSS D. JARVIS
STATE OF WASHINGTON
43668
REGISTERED
PROFESSIONAL ENGINEER

DESIGNER:	R. JARVIS
DRAWN BY:	L HURTADO
APPROVED BY:	R. JARVIS
DATE:	NOVEMBER, 2014
JOB No:	1541.01
DRAWING FILE No:	DEV BASIN EXHIBIT
DRAWING No:	BIO
SHEET No:	6 OF 13

BIORETENTION 1



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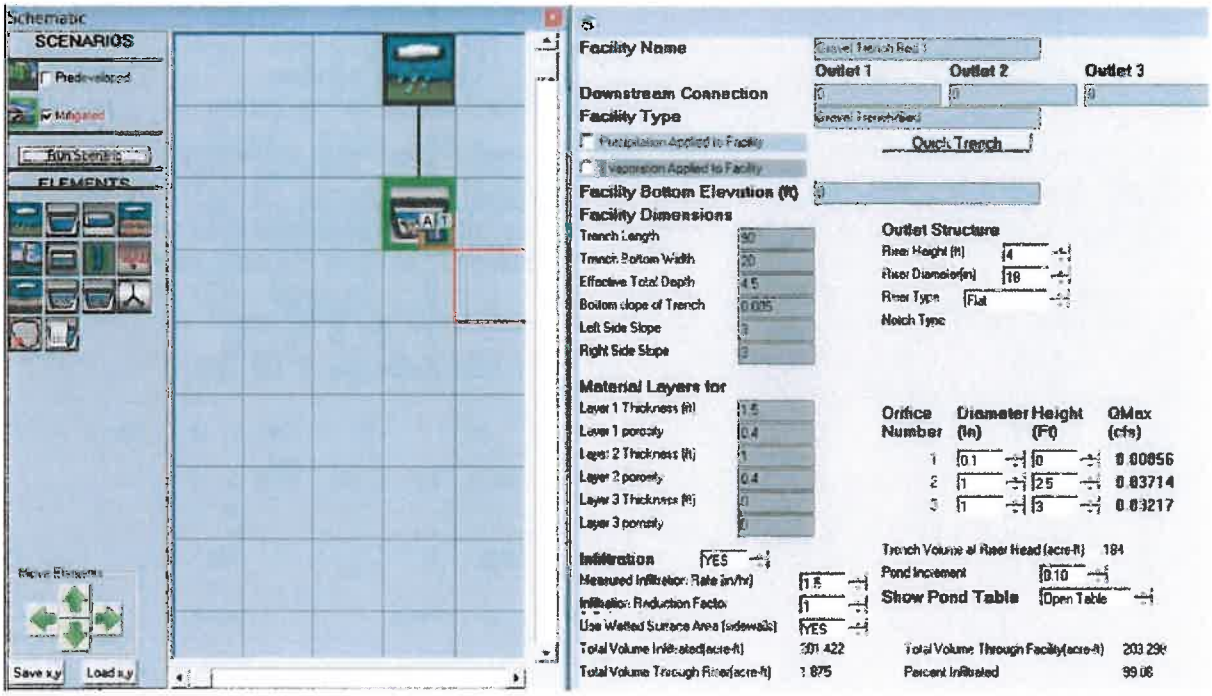

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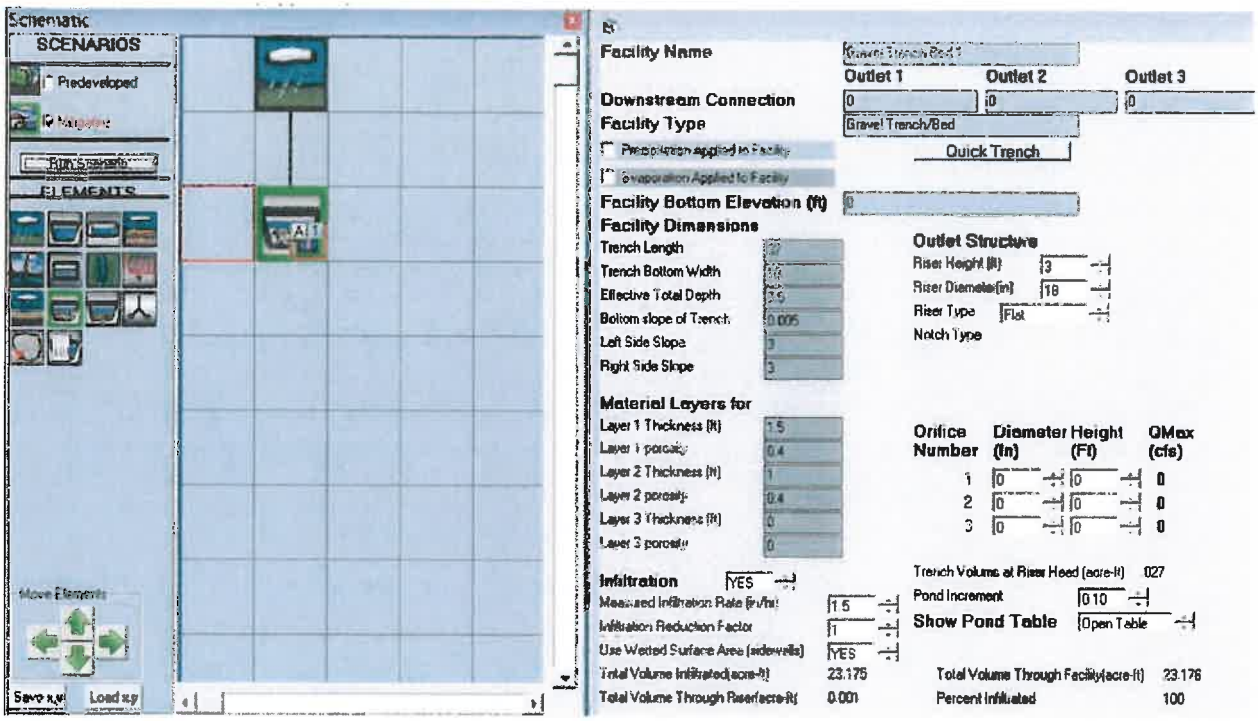
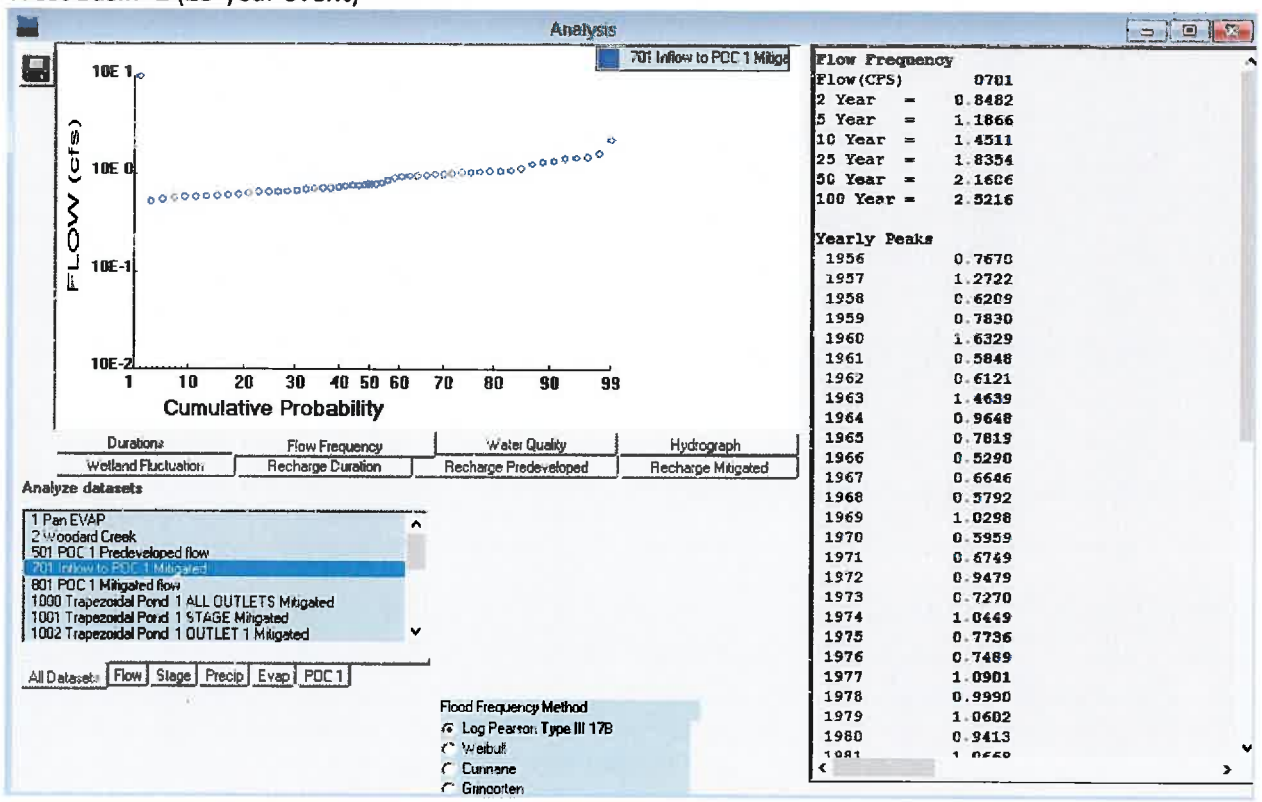


Conveyance Calculations

West Basin -2 (25-year event)



PIPE CAPACITY ANALYSIS

PROJECT NAME: Bayan Trails

PROJECT NUMBER: 1541.01

DATE: 11/10/2014

DESIGN STORM: 25-Year

DESIGN BASIS:

FROM	TO	PIPE DIAMETER (IN)	PIPE SLOPE (FT/FT)	MANNING'S n	HYDRAULIC RADIUS R	PIPE AREA (SF)	PIPE CAPACITY (CFS)	DRAINAGE AREA (SF)	CUMULATIVE AREA (SF)	CUMULATIVE DESIGN FLOW (CFS)	DEPTH OF FLOW (FT)	PERCENT FULL (%)
		12	0.0050	0.011	0.250	0.785	2.99			1.84	0.83	0.83

EXHIBIT E6

SHEA CARR JEWELL INC.

Appendix D

Geotechnical Report

EXHIBIT E6

Geotechnical Report
Bayan Trails Development
Olympia, Washington

October 21, 2014

Prepared for

Golden Alon Development
Olympia, Washington

LANDAU ASSOCIATES
1115 West Bay Drive NW, Suite 201
Olympia, WA 98502
(360) 791-3178

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FIGURES

APPENDICES

1.0 INTRODUCTION

This report summarizes the results of geotechnical engineering services conducted for Golden Alon Development Company's (Golden's) proposed Bayan Trails Development in Olympia, Washington. The general project location is shown on the Vicinity Map (Figure 1). The general configuration of the project alignment and some surrounding existing features are shown on the Site and Exploration Plan (Figure 2). Figure 3 presents the current proposed site layout.

This report has been prepared based on our discussions with representatives of Golden and Shea Carr Jewell Alliance (SCJ); a base map of the project alignment prepared by SCJ; data collected during our field exploration and laboratory testing programs; our familiarity with geologic conditions within the vicinity of the project area; and our experience on similar projects.

1.1 PROJECT DESCRIPTION

Based on information provided by SCJ, we understand that the project consists of 16 new, 1- to 3-story structures with associated pavements and utilities. Stormwater generated on site from new pavements will be handled by a series of ponds and swales that overflow to a detention vault. Roof runoff will be directed to downspout infiltration trenches that are sized according to City of Olympia (City) standards. The feasibility of a large-scale stormwater infiltration system was also explored as part of this geotechnical study.

1.2 SCOPE OF SERVICES

Golden retained Landau Associates to provide geotechnical engineering services to support design of the proposed Bayan Trails Development. Our services were provided in general accordance with the scope of services outlined in the terms of a signed agreement between Golden and Landau Associates, dated September 15, 2014. Our scope of services included the following specific tasks:

- Developing an exploration plan
- Reviewing logs of previous subsurface explorations at the site
- Arranging for underground utility location service prior to performing field activities
- Advancing a series of test pit explorations to characterize soil and groundwater conditions at the project site
- Collecting representative soil samples at selected depth intervals
- Logging the explorations and recording pertinent information, including soil sample depths, stratigraphy, soil engineering characteristics, and groundwater occurrence

- Conducting a geotechnical laboratory testing program consisting of natural moisture content determinations, grain size analyses, and California Bearing Ratio (CBR) analyses on select samples from the explorations
- Performing geotechnical engineering analyses and evaluating data derived from the subsurface investigation and laboratory testing program
- Developing geotechnical engineering conclusions and recommendations to support design of certain elements of the proposed development
- Preparing and submitting this written final report summarizing our findings, conclusions, and recommendations for the project. This report includes:
  - A site plan showing the locations of the explorations completed for this study
  - Descriptive logs of test pits and the results of the geotechnical laboratory testing program
  - A discussion of the soil and groundwater conditions observed in the test pits
  - General earthwork recommendations
  - An assessment of stormwater infiltration feasibility based on subsurface soil conditions observed in the explorations
  - Conclusions regarding the potential need to dewater excavations for underground structures, site utilities, and/or other below-grade improvements
  - Recommendations for design and construction of underground utilities
  - Recommendations for shallow foundation support
  - Recommendations for slab-on-grade support
  - An assessment of seismic risks at the site and recommended site factors for use in seismic design under the 2012 International Building Code (ICC 2011)
  - Pavement design recommendations for parking areas, drive aisles, and frontage streets in accordance with City requirements
  - Recommendations for retaining wall design.

2.0 SITE CONDITIONS

This section discusses the general geologic setting of the project area and describes the surface and subsurface conditions observed throughout the site at the time of our field investigation. Interpretations of the site conditions are based on the results of our review of available information, and the results of our site reconnaissance, subsurface explorations, and laboratory testing.

2.1 GEOLOGIC SETTING

General geologic information for the project area was obtained from the *Geologic Map of the Lacey 7.5-minute quadrangle, Thurston County, Washington* (Logan et al. 2003), published by the U.S. Geological Survey. According to this source, near-surface deposits in the vicinity of the project site consist of glacial till. Soil defined as glacial till typically consists of unstratified and highly compacted mixture of clay, silt, sand, and gravel deposited directly by glacier ice. This unit typically exhibits low permeability.

2.2 SURFACE CONDITIONS

The project site consists of two large residential parcels, roughly rectangular in shape, occupied by two single-family residences and associated outbuildings. The low point of the project site (about Elevation 203) is located in the western portion of the site. Vegetation on site consists of a mixture of conifer and deciduous trees and various underbrush.

2.3 SUBSURFACE SOIL CONDITIONS

Subsurface conditions at the project site were explored on September 23, 2014. The exploration program consisted of advancing and sampling 12 test pit explorations (TP-1 through TP-12) at the approximate locations illustrated on Figure 2. The test pits were advanced to depths ranging from about 6 to 17 feet (ft) below ground surface (BGS). A discussion of field exploration procedures, summary logs of the explorations, laboratory test procedures, and the test results are presented in Appendix A and B.

Based on the results of our subsurface exploration program, the site is interpreted to be underlain by recessional outwash overlying glacial till. Recessional outwash was observed in all of our explorations and glacial till was observed in all but three test pits (TP-5, TP-11, and TP-12). At the locations explored, the recessional outwash generally consists of medium dense silty sand or sand with silt and varying amounts of gravel. The glacial till generally consists of dense to very dense silty sand with varying amounts of gravel. None of our explorations fully penetrated through the glacial till deposit.

As part of our services, we also reviewed logs of subsurface explorations completed by SCJ in support of a wetlands study. Those explorations were located along the central portion of the site, and fill the gap in subsurface explorations that is evident when reviewing Figure 2. The reported subsurface conditions were similar glacial soils as described in the previous paragraphs.

2.4 GROUNDWATER CONDITIONS

At the time of our field investigation in mid-September 2014, the groundwater table was observed in one exploration, TP-5 at about 12 ft BGS. It should be noted that the groundwater conditions reported herein are for the specific locations and dates indicated, and therefore, may not necessarily be indicative of other locations and/or times. Furthermore, it is anticipated that groundwater conditions of the project site will vary depending on local subsurface conditions, the weather, and other factors. It is likely that the highest groundwater levels will occur in the winter/spring months. It is our opinion that there is a reasonably high potential for perched groundwater to develop near the contact between recessional outwash and glacial till during the wet season.

3.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our field explorations, laboratory testing, and engineering analyses performed, it is our opinion that subsurface conditions at the project site are suitable for the proposed residential development, provided the recommendations contained herein are incorporated into the project design. Geotechnical conclusions and recommendations are presented in the following sections for earthwork, construction dewatering, utility construction, stormwater infiltration feasibility, seismic design considerations, shallow foundation support, slab-on-grade support, retaining walls, and pavement design.

3.1 EARTHWORK

Earthwork to accommodate the proposed improvements for the project is expected to consist of site preparation (demolition of existing improvements and minor clearing, grubbing and stripping), site grading, subgrade preparation, and fill placement and compaction.

3.1.1 WET WEATHER CONSIDERATIONS

Earthwork-related construction will be influenced by weather conditions. Much of the near-surface soil at the site contains a significant amount of fine sand and silt, which will make the soil moisture sensitive. Earthwork activities involving moisture-sensitive soil should normally occur during the relatively warmer and drier period between about mid-summer to early fall. Completing these activities outside of this normal construction window could lead to a significant increase in construction costs due to weather-related delays, repair of disturbed areas, and the increased use of "all-weather" import fill materials.

Because of the moisture sensitivity, unprotected site soil, in either a compacted or uncompacted state, can degrade quickly to a slurry-like consistency in the presence of water and construction traffic. If the native subgrade or fill soil becomes loosened or disturbed, additional excavation to expose undisturbed soil and replacement with properly compacted structural fill will be required. For wet weather construction, the contractor may reduce the potential for disturbance of subgrades by the following:

- Protecting exposed subgrades from disturbance of construction activities by constructing gravel working mats
- Using a trackhoe with a smooth-bladed bucket to limit disturbance of the subgrade during excavation
- Suspending earthwork and other construction activities that may damage subgrades during rainy days
- Limiting and/or prohibiting construction traffic over unprotected soil

- Sloping excavated surfaces to promote runoff
- Sealing the exposed surface by rolling with a smooth-drum compactor or rubber-tire roller at the end of each working day and removing wet surface soil prior to commencing filling each day.

3.1.2 SITE PREPARATION

Clearing and grubbing of existing vegetation within the project site should be in accordance with the requirements in Section 2-01 of the 2014 Washington State Department of Transportation (WSDOT) *Standard Specifications for Road, Bridge, and Municipal Construction* (WSDOT Standard Specifications, WSDOT 2014). Material generated during clearing and grubbing should be properly disposed of at an approved offsite location. Topsoil, and/or other organic-rich soil, should be stripped to expose the underlying inorganic soil. Stripped material is not considered suitable for use as structural fill. Stripped material should either be wasted off site at an approved location or stockpiled for later use as topsoil.

Any utilities that will be abandoned that are less than 3 ft deep should be removed and disposed of at an approved offsite location. Deeper utilities may be left in place, but should be grouted full with controlled density fill (CDF), meeting the requirements in Section 2-09.3(1)E of the 2014 WSDOT Standard Specifications, in order to reduce the potential for differential settlement resulting from collapsed pipes and/or erosion. All incidental excavations associated with the removal of the existing improvements should be backfilled in accordance with the recommendations in Section 3.1.6 of this report.

3.1.3 TEMPORARY AND PERMANENT SLOPES

In order to accommodate the construction of the proposed improvements, temporary excavations may be required. Based on the soil conditions observed in our explorations, we anticipate that temporary excavations will generally encounter medium dense recessional outwash consisting of silty sand with gravel or sand with silt and gravel, or dense to very dense glacial till consisting of silty sand with gravel.

Temporary excavations in recessional outwash should be sloped no steeper than 1½H:1V (horizontal to vertical). Temporary excavations in glacial till should be sloped no steeper than 1H:1V. Temporary excavation slopes exposed for more than 1 day should be protected by covering with plastic sheeting or other approved means to prevent erosion. Temporary excavation slopes should be the sole responsibility of the contractor. All local, state, and federal safety codes should be followed. The contractor should implement measures to prevent surface-water runoff from entering excavations. All temporary excavation slopes should be monitored by the contractor during construction for any evidence of instability. If instability is detected, the contractor should flatten the temporary excavation slopes or

install temporary shoring. If groundwater or groundwater seepage is present, flatter excavation slopes should be expected.

All permanent cut and fill slopes should be sloped no steeper than 2H:1V. Permanent slopes should be hydroseeded as soon as practical to prevent erosion or covered with mulch, erosion control netting/blankets, or bonded fiber matrix.

3.1.4 SUBGRADE PREPARATION

Following clearing, stripping, and any required overexcavation to remove unsuitable material, and before placement of any structural fill to establish planned subgrade elevations, the upper 6 to 9 inches of exposed soil should be scarified, moisture conditioned, and compacted as described in Section 3.1.6 of this report. The prepared subgrade should be proof-rolled with a loaded dump truck, large self-propelled vibrating roller, or equivalent piece of equipment in the presence of a qualified geotechnical or civil engineer to check for the presence of soft, loose, and/or disturbed areas. If any soft, loose, and/or disturbed areas are revealed during proof-rolling, these areas should either be moisture conditioned and recompacted to the required density, or removed and replaced with imported structural fill, meeting the requirements in Section 3.1.5 of this report, compacted to the required density. Overexcavation of unsuitable subgrade material should be in accordance with Section 2-03.3(14)E of the 2014 WSDOT Standard Specifications. Completion of a proofroll of the compacted subgrade should be included as a note on the construction drawings.

3.1.5 STRUCTURAL FILL

The suitability of excavated soil or imported soil for use as structural fill will depend on the gradation and moisture content of the soil when it is placed. As the amount of fines increases, the soil becomes increasingly sensitive to small changes in moisture content and adequate compaction becomes more difficult to achieve. Soil containing more than about 5 percent fines cannot consistently be compacted to a dense, non-yielding condition when the water content is greater than about 2 to 3 percent above optimum moisture content. Optimum moisture content is the moisture content at which the greatest compacted dry density can be achieved.

Soil at the project site generally consists of sand and gravel with between about 2 to 13 percent fines content (material passing the U.S. No. 200 sieve, by weight) and is anticipated to be sensitive to moisture. The onsite soil will be suitable for use as fill if placed and compacted during dry weather, when the moisture content can be maintained near optimum. Based on its present natural moisture content, the onsite soil is near the optimum moisture content for compaction; however, some moisture conditioning should be anticipated in order to utilize this material as structural fill. In addition, the moisture content

would be expected to increase during wetter months to percentages well above optimum. Therefore, we recommend the use of onsite soil for structural fill be limited to the summer and early fall months. Soil affected by perched groundwater may be too wet for practical moisture conditioning and therefore, not suitable for use as structural fill. The contractor should be prepared to segregate suitable from non-suitable structural fill material.

If the onsite soil cannot be utilized for structural fill or if additional material is needed, import structural fill will be required. Import structural fill should meet the requirements for Select Borrow in Section 9-03.14(2) of the 2014 WSDOT Standard Specifications. If wet weather construction is anticipated, the amount of fines (material passing a U.S. No. 200 sieve) should not exceed 5 percent, by dry weight, based on a wet sieve analysis of that portion passing the ¾-inch sieve.

3.1.6 BACKFILL AND COMPACTION REQUIREMENTS

Structural fill should be placed and compacted in accordance with Section 2-03.3(14)C, Method C of the 2014 WSDOT Standard Specifications. Compaction and moisture control tests should be done in accordance with Section 2-03.3(14)D of the 2014 WSDOT Standard Specifications. The maximum dry density and optimum moisture content may also be determined by the ASTM International (ASTM) D 1557 test procedure.

3.2 CONSTRUCTION DEWATERING

Although groundwater was only observed in one of the explorations completed for this study, localized zones of shallow, perched groundwater may be encountered within excavations. Depending on the time of year, construction dewatering may be required to control groundwater flow into excavations. The contractor should be prepared to handle groundwater seepage.

It is expected that open sump pumping from the excavation where minor amounts of groundwater seepage are encountered will be sufficient, assuming the excavation walls remain stable. The contractor should be responsible for the design, installation, monitoring, and maintenance of any required dewatering system(s).

3.3 UTILITY CONSTRUCTION

The following sections provide geotechnical recommendations for design and construction of new site utilities. Geotechnical recommendations are included for installation of new site utilities including trench excavation and retention, pipe foundation support, pipe bedding and initial backfill, trench backfill and compaction criteria, settlement and buoyancy, and anticipated loads on pipes. The specific trench depths were unknown at the time this report was prepared.

3.3.1 TRENCHING AND EXCAVATION SUPPORT

It is anticipated that excavations for underground facilities will be in medium dense to very dense glacial soils. A heavy-duty, hydraulic excavator with sufficient reach should be able to excavate the proposed trenches to the planned depths. Though not observed in our explorations, cobbles and boulders are often present in glacial deposits and the contractor should be prepared to handle and dispose of such oversized material. The final trench bottom should be firm and free of loose and disturbed soil. We suggest that a smooth-bladed bucket be used to clean the trench bottom of loose and/or disturbed soil prior to placing the bedding material.

Trench excavation should conform to the requirements of Section 7-08.3(1)A of the 2014 WSDOT Standard Specifications. Actual trench configurations and maintenance of safe working conditions, including temporary excavation stability, should be the responsibility of the contractor. All applicable local, state, and federal safety codes should be followed. Temporary excavations in excess of 4 ft should either be shored or sloped in accordance with *Safety Standards for Construction Work, Part N*, located in Chapter 296-155 of the Washington Administrative Code (WAC). In the absence of groundwater seepage, recessional outwash encountered within the trench zone classifies as Type C soil per Chapter 296-155 of the WAC. Glacial till classifies as a Type B soil per Chapter 296-155 of the WAC. The prescriptive maximum allowable excavation slope for Type C soils is 1½H:1V. The prescriptive maximum excavation slope for Type B soils is 1H:1V. If groundwater seepage is present, flatter slopes, temporary shoring, and/or dewatering may be required.

If needed, the parameters provided in the following table can be utilized for design of temporary shoring. Temporary shoring typically consists of steel plates with internal bracing. Surcharge loads on trench support systems due to construction equipment, stockpiled material, and vehicle traffic should be included in the design. The temporary shoring design should be submitted to Golden for review prior to construction.

RECOMMENDED SOIL PARAMETERS FOR DESIGN OF TEMPORARY SHORING

Moist Unit Weight (pcf)	Cohesion (psf)	Internal Angle of Friction (degrees)
125	0	34

pcf = Pounds per cubic foot
psf = Pounds per square foot

3.3.2 PIPE FOUNDATION SUPPORT

Based on conditions observed at the exploration locations, soils at possible trench depths are anticipated to primarily consist of medium dense recessional outwash or dense to very dense glacial till.

These soil types should provide adequate foundation support for the proposed utilities provided the soil remains in a relatively undisturbed condition and the trench is properly dewatered.

The soil at the trench bottom can be easily disturbed by construction activities, and in a disturbed condition will generally provide poor foundation support for the pipeline. If the trench bottom becomes disturbed due to excavation and/or foot traffic during laying of the pipe, the trench bottom may need to be overexcavated to expose undisturbed foundation soil. Removal and replacement of unsuitable foundation material should be in accordance with Section 7-08.3(1)A of the 2014 WSDOT Standard Specifications. The overexcavation should be backfilled with suitable foundation material to provide a firm trench bottom. Foundation material should meet the requirements for Class A Foundation Material in Section 9-03.17 of the 2014 WSDOT Standard Specifications. Pipe foundation material should be placed and compacted in accordance with the recommendations provided in Section 3.1.6 of this report. Alternatively, if the trench bottom is relatively free of water, CDF could be used as foundation material and should meet the requirements in Section 2-09.3(1)E of the 2014 WSDOT Standard Specifications.

3.3.3 Pipe Bedding and Initial Backfill

To provide uniform support of buried utility pipes, the pipe should be bedded in accordance with Section 7-08.3(1)C of the 2014 WSDOT Standard Specifications and WSDOT Standard Plan B-55.20-00 (WSDOT 2013). Because of the potential for encountering oversized material, excavated material from the trenches would likely need to be processed (i.e., all particles greater than 3 inches should be removed) in order to be suitable for use as pipe-zone backfill. Therefore, we recommend that material excavated from the trench not be utilized as pipe-zone backfill. Bedding material for buried utility pipes should consist of Gravel Backfill for Pipe Zone Bedding per the requirements in Section 9-03.12(3) of the 2014 WSDOT Standard Specifications.

Pipe-bedding material and pipe-zone backfill should be brought up evenly around the pipe in relatively horizontal lifts not exceeding 6 inches, and worked under the haunches of the pipe by slicing with a shovel, vibration, or other approved procedures. Pipe-zone backfill should extend 6 inches above the crown of the pipe. Pipe bedding and pipe-zone backfill should be compacted to at least 90 percent of the maximum dry density determined in accordance with Section 2-03.3(14)D of the 2014 WSDOT Standard Specifications. The maximum dry density may also be determined by the ASTM D 1557 test procedure.

3.3.4 Trench Backfill and Compaction Criteria

As discussed in Section 3.1.5, onsite soil may be used for trench backfill provided the moisture content can be controlled to meet compaction requirements. Alternatively, import fill consisting of Bank

Run Gravel for Trench Backfill meeting the requirements of Section 9-03.19 of the 2014 WSDOT Standard Specifications could be utilized for trench backfill.

Backfilling of trenches should be in accordance with the requirements of Section 7-08.3(3) of the 2014 WSDOT Standard Specifications. Trench backfill should be placed in 6- to 8-inch loose lifts and compacted to a relative density of at least 95 percent of the maximum dry density. Determination of the maximum dry density should be in accordance with the requirements of Section 2-03.3(14)D of the 2014 WSDOT Standard Specifications. Alternatively, the maximum dry density may be determined using ASTM Test Method D 1557. Flooding and/or jetting of backfill should not be used as a means to consolidate or compact trench backfill. Hand-operated compaction equipment, or other approved methods, should be used to compact the first 18 inches of trench backfill above the pipe.

3.3.5 SETTLEMENT AND BUOYANCY

The net increase in bearing pressure below pipelines and manholes is generally small or negative due to the amount of soil displaced by the pipeline or structure. Therefore, provided that the pipeline/ manhole is underlain by firm, undisturbed soil, the ground surface over and adjacent to the pipe or manhole remains at about the same level prior to construction, and no additional load from a new structure is placed over the pipeline or manhole, we expect post-construction settlements of pipes and manholes to be negligible.

3.3.6 RESISTANCE TO LATERAL LOADS

Lateral resistance to forces occurring at bends in pressure conduits, such as waterlines, will be resisted mainly by soil friction along the length of the pipe. For concrete or coated-steel pipe and granular backfill, an ultimate interface friction angle of 24 degrees should be used. No factor of safety (FS) is included in the interface friction values. If thrust restraints (thrust blocks) are being considered to resist lateral forces, a passive soil resistance based on an equivalent fluid pressure of 240 pcf may be used. The value for passive resistance has been reduced by a factor of 2.0 to limit lateral deflections to less than 1 percent of the embedded depth and to make it compatible with the movement required to mobilize the soil/pipe friction. The value for passive resistance assumes that the pipeline is located above the groundwater table.

3.4 STORMWATER INFILTRATION

Medium dense, sandy gravel with silt and silty sand with gravel, which we identified as recessional outwash, are the predominant near-surface soils observed during our explorations. Dense to very dense glacial till is observed immediately underlying the recessional outwash, as shallow as 5 ft

BGS. Glacial till typically exhibits very low infiltration rates (less than 0.1 inch per hour [unfactored]) and is not well suited for onsite infiltration systems. Section 3.3.5 of the 2009 *Drainage Design and Erosion Control Manual for Olympia – Volume III* (Olympia 2009) states that sites where the lowest conductivity layer (in this instance glacial till) is within 5 ft of the base of the facility, the lowest hydraulic conductivity value shall be used as the equivalent hydraulic conductivity. Additionally, at least 3 to 5 ft of relatively permeable "reservoir" soil is required below the base of any infiltration facilities for infiltration to be considered. Consequently, due to the relatively shallow presence of glacial till and our conversations with SCJ regarding the required depth of large-scale infiltration systems, it is our opinion that large-scale stormwater infiltration systems at the site are not practical. We anticipate that bioswales and/or other shallow infiltration systems, such as gravel trenches for downspouts, will experience some infiltration when located within 3 ft of existing grades.

The project site is mapped as containing hydrologic Group C soils, per our review of the National Cooperative Soil Survey provided by the U.S. Department of Agriculture [(USDA) USDA 2014]. Based on our field explorations, it is our opinion that the soils within 5 ft of existing grades (recessional outwash) can be classified as hydrologic Group B soils. We recommend that hydrologic Group B soils be used to size downspout infiltration systems that are located within 3 ft of existing site grades.

Because large-scale infiltration is not practical, we understand that a detention vault with be used (see Figure 3). In accordance with our conversations with the City, we plan to install a monitoring well at the vault location in the coming month to confirm that the vault is not founded within seasonal high groundwater (per City code requirements).

3.5 SEISMIC DESIGN CONSIDERATIONS

The Pacific Northwest is seismically active and the site could be subject to ground shaking from a moderate to major earthquake. Consequently, earthquake shaking should be anticipated during the design life of the proposed improvements. The proposed improvements should be designed to resist earthquake loading using appropriate design methodology.

We understand that seismic design of the proposed improvements will be in accordance with the 2012 International Building Code (ICC 2011). The parameters presented in the table below may be used to compute seismic base shear forces.

2012 INTERNATIONAL BUILDING CODE SEISMIC DESIGN PARAMETERS

Spectral Response Acceleration at Short Periods (S_S) = 1.321 g
Spectral Response Acceleration at 1 Second Periods (S_1) = 0.538 g
Site Class = C
Site Coefficient (F_a) = 1.0
Site Coefficient (F_v) = 1.3

3.6 SHALLOW FOUNDATION SUPPORT

The following sections provide geotechnical recommendations for design and construction of shallow foundations. Geotechnical recommendations are included for design parameters, bearing capacity and footing dimensions, settlement, lateral load resistance, footing overexcavation, and foundation drainage.

3.6.1 DESIGN PARAMETERS

The information provided below in the table should only be used along with the complete recommendations provided in the report text.

SUMMARY DESIGN PARAMETERS FOR STRUCTURAL ENGINEER

Allowable Soil Bearing Pressure = 4,000 psf
Friction Coefficient (factored, equivalent fluid design) = 0.35
Passive Resistance (factored, equivalent fluid design) = 320 pcf
Active Earth Pressure = 35 pcf
At-rest Earth Pressure = 55 pcf
Seismic Earth Pressure = 10*H psf
Minimum Foundation Width = 18 inches (continuous), 24 inches (isolated)
Maximum Foundation Width (for settlement considerations) = 8 ft (continuous), 15 ft (isolated)

3.6.2 BEARING CAPACITY AND FOOTING DIMENSIONS

We recommend an allowable soil bearing pressure of 4,000 psf for shallow foundations that are established on medium dense or better onsite soils, or structural fill extending to such soils. This allowable soil bearing pressure applies to long term dead and live loads, exclusive of the weight of the footing and any overlying backfill. The allowable soil bearing pressure can be increased by one-third when considering total loads, including transient loads such as those induced by wind and seismic

forces. A higher bearing capacity is available for foundations bearing directly on glacial till. Please contact us if a higher bearing capacity is needed.

We recommend a minimum width of 18 inches for continuous wall footings and 24 inches for isolated column footings. For settlement considerations, we have assumed a maximum width of 8 ft for continuous wall footings and 15 ft for isolated column footings. We have also assumed that dead loads plus long term live loads constitute 70 percent or less of the total loads used to size the footing. Perimeter footings should be embedded at least 12 inches below the lowest adjacent grade where the ground is flat. Interior footings should be embedded a minimum of 6 inches below the nearest adjacent grade.

3.6.3 SETTLEMENT

We estimate that total settlement of footings that are designed and constructed as recommended should be less than 1 inch. We estimate that differential settlements will be ½ inch or less between comparably loaded isolated footings or along 50 ft of continuous footing. We anticipate that the settlement will occur as the building loads are applied during construction.

3.6.4 LATERAL LOAD RESISTANCE

Lateral loads on shallow foundation elements can be resisted by passive resistance on the sides of footings and by friction on the base of footings. Passive resistance should be estimated using an equivalent fluid weight of 320 pcf, assuming that the footings are backfilled with structural fill. Frictional resistance may be estimated using 0.35 for the coefficient of base friction.

The lateral resistance values provided above include a FS of 1.5. The passive earth pressure and friction components can be combined, provided that the passive component does not exceed two-thirds of the total. The top foot of soil should be neglected when calculating passive resistance, unless the foundation perimeter area is covered by a slab-on-grade or pavement.

3.6.5 FOOTING OVEREXCAVATION

We do not anticipate that appreciable foundation footing overexcavations will be required on this site during dry weather construction. However, overexcavations could be required if the near-surface soils become moisture-disturbed. If overexcavations are required, the overexcavation zone should extend a horizontal distance equal to at least one-half of the overexcavation depth on each side of the footing. For example, a 2-ft-wide footing with a 2-ft-deep overexcavation should have a 4-ft-wide overexcavation zone. All footing overexcavations should be backfilled with structural fill compacted to at least 95 percent of the maximum dry density, as stated in Section 3.1.6 of this report. The base of the

overexcavation should be evaluated by the geotechnical engineer prior to placement of concrete or structural fill.

3.6.6 FOUNDATION DRAINAGE

We recommend the use of perimeter foundation footing drains around the proposed structures. The drains should consist of a minimum 4-inch-diameter perforated pipe surrounded by clean drain rock, wrapped in filter fabric. The drain pipes should be connected to a positive outlet and include cleanouts. Roof drains should not be connected to footing drains.

Provided that the proposed development does not include occupied below-grade spaces, it is our opinion that underslab drains are not required. Landau Associates should be retained to review final building elevations and provide recommendations for underslab drains, if needed.

3.7 SLABS-ON-GRADE

Slabs-on-grade should be established on a subgrade that consists of uniformly firm and unyielding native soil or structural fill extending to such soil. Slab-on-grade subgrades should be prepared as described in Section 3.1.4 of this report.

A modulus of vertical subgrade reaction (subgrade modulus) can be used to design the slab. The subgrade modulus varies based on the dimensions of the slab and the magnitude of applied loads on the slab surface; slabs with larger dimensions and loads are influenced by soils to a greater depth. We recommend a subgrade modulus value of 250 pounds per cubic inch for the design of on-grade floor slabs with floor loads up to 500 psf. This subgrade modulus is for a 1-ft by 1-ft square plate, and is not the overall modulus of a larger area. We are available to provide alternate recommendations during design, based on any specific loading information available at that time.

We recommend that slabs-on-grade in interior spaces be underlain by a minimum 4-inch thick capillary break layer to reduce the potential for moisture migration into the slab. The capillary break material should consist of well graded sand and gravel containing less than 5 percent fines based on the fraction passing the ¾-inch sieve. If dry slabs are required (e.g., where adhesives are used to anchor carpet or tile to the slab), a waterproofing liner should be placed below the slab to act as a vapor barrier.

3.8 RETAINING WALLS

The following sections provide geotechnical recommendations for design and construction of retaining walls. Geotechnical recommendations are included for lateral soil pressures and buoyancy, lateral resistance and foundation support, and wall drainage.

3.8.1 LATERAL SOIL PRESSURES AND BUOYANCY

Lateral soil pressures acting on retaining walls will depend on the nature and density of soil behind the wall, the amount of lateral wall movement which occurs as backfill is placed, and the inclination of the backfill surface. For walls free to yield at the top at least one thousandth of the wall height (i.e., wall height times 0.001), soil pressures will be less than if movement is restrained. We recommend that walls free to yield at the top be designed using an equivalent fluid density of 35 pcf. Restrained walls (wall not allowed to rotate at least 0.001 times wall height) should be designed using an equivalent fluid density of 55 pcf. For seismic loading conditions, a rectangular earth pressure equal to 10H psf, where H is the height of the wall, should be added to the active pressures provided above. This seismic earth pressure is based on the Mononobe-Okabe theory and assumes one-half of the peak ground surface acceleration for the site. If the wall is designed for an at-rest condition, but is assumed to move during seismic conditions, then it is appropriate to combine the seismic surcharge pressure with the active pressure (rather than the at-rest pressure).

The lateral soil pressures provided above do not include traffic surcharges, the effects of sloping backfill, or hydrostatic pressure. The recommended soil pressures also assume that material behind the wall consists of structural fill or undisturbed native soil for a horizontal distance behind the wall equal to the wall height.

For the proposed detention vault, unless a perimeter/footing drain can be established at the base of the vault (unlikely due to vault depth without using pumps), hydrostatic pressure should be considered in the wall design. Without wall and footing drain systems, the vault should also be designed for full buoyancy considerations.

3.8.2 LATERAL RESISTANCE AND FOUNDATION SUPPORT

Lateral resistance and foundation support values for retaining wall footings should be designed in accordance with the Section 3.6 of this draft report.

3.8.3 WALL DRAINAGE

Drainage systems should be constructed to collect water and prevent the buildup of hydrostatic pressure against retaining walls. We recommend that wall drainage systems include a zone of free-draining backfill a minimum of 18 inches in width against the back of the wall. Free-draining backfill should conform to the WSDOT Standard Specification 9-03.12(2) *Gravel Backfill for Walls* (WSDOT 2014). The free-draining backfill zone should extend to within 1 ft of the top of the wall. A perforated, rigid, smooth-walled drain pipe with a minimum diameter of 4 inches should be placed along the base of

the wall within the free-draining backfill and extend for the entire wall length. The drain pipe should be sloped to drain by gravity to an approved discharge location.

We recognize that drainage systems may be unpractical around the detention vault, resulting in the need for hydrostatic pressure and buoyancy in the structural design of the vault.

3.9 PAVEMENT DESIGN

The following sections summarize the recommended flexible asphalt pavement section to be used for the proposed western extension of 6th Avenue Northeast (NE) and parking and loading areas.

3.9.1 RESILIENT MODULUS FOR PAVEMENT DESIGN

Based on the results of our CBR tests conducted on samples obtained in our explorations, and the relationship provided by Section 4B of the City's *Engineering Design and Development Standards* (Olympia 2013), the resilient modulus of the soil underlying the project site is estimated to be approximately 45,000 pounds per square inch. The results of our CBR tests and the corresponding pavement design calculations are presented in Appendix B.

3.9.2 FLEXIBLE PAVEMENT DESIGN

Pavement sections should be constructed on a subgrade that consists of uniformly firm and unyielding soil. Pavement subgrades should be prepared as described in Section 3.1.4 of this report. The light- and heavy-duty pavement section recommendations provided below assume a 20-year design life and a maximum equivalent single-axle loads of 50,000 for the heavy-duty section.

RECOMMENDED ASPHALT PAVEMENT DESIGN SECTIONS
PRIVATE ROADS/PARKING

Pavement Section Type	Asphalt Concrete Pavement Thickness	Crushed Surfacing Thickness
Heavy Duty (School Bus and Garbage Truck Access, Loading Docks, etc.)	4 inches	6 inches
Light Duty (Parking Areas and Light-vehicle Access Roads)	3 inches	4 inches

The pavement section recommendations for the proposed western extension of 6th Avenue NE provided below, assumes a 20-year design life and a maximum equivalent single-axle loads of 280,00 for the standard-duty section.

RECOMMENDED ASPHALT PAVEMENT DESIGN SECTIONS
6TH AVENUE NORTHEAST

Pavement Section Type	Asphalt Concrete Pavement Thickness	Crushed Surfacing Thickness
Standard Duty	3 inches	8 inches

Asphalt concrete should be Class B aggregate material or hot-mix asphalt Class ½ inch, PG64-22 conforming to Section 5-04 of the 2014 WSDOT Standard Specifications. The asphalt should be compacted to at least 91 percent of the Rice density. Base course material should be compacted to at least 95 percent of the maximum dry density (ASTM D1557) and meet the requirements for Crushed Surfacing Base Course in Section 9-03.9(3) of the 2014 WSDOT Standard Specifications. The upper 2 inches of crushed surfacing could consist of Crushed Surfacing Top Course to facilitate fine grading of the surface. Prevention of road-base saturation is essential for pavement durability; thus, efforts should be made to limit the amount of water entering the base course.

4.0 REVIEW OF DOCUMENTS AND CONSTRUCTION OBSERVATIONS

We recommend that Landau Associates be retained to review the geotechnical-related portions of the project plans and specifications to determine if they are consistent with the recommendations presented in this report. We also recommend that monitoring, testing, and consultation be provided during construction to confirm that the conditions encountered are consistent with those indicated by our explorations, to provide expedient recommendations should conditions be revealed during construction that differ from those anticipated, and to evaluate whether geotechnical-related construction activities comply with project plans/specifications and the recommendations contained in this report.

5.0 USE OF THIS REPORT

Landau Associates prepared this report for the exclusive use of Golden Alon Development Company for specific application to the design of the Bayan Trails Development project in Olympia, Washington. Use of this report by others or for another project is at the user's sole risk. Within the limitations of scope, schedule, and budget, our services have been conducted in accordance with generally accepted practices of the geotechnical engineering profession; no other warranty, express or implied, is made as to the professional advice included in this report.

The conclusions and recommendations contained in this report are based in part upon the subsurface data obtained from the explorations completed for this study. There may be some variation in subsurface soil and groundwater conditions along the project alignment, and the nature and extent of the variations may not become evident until construction. Accordingly, a contingency for unanticipated conditions should be included in the construction budget and schedule.

If variations in subsurface conditions are encountered during construction, Landau Associates should be notified for review of the recommendations in this report, and revision of such if necessary. If there is a substantial lapse of time between submission of this report and the start of construction, or if conditions change due to construction operations at or adjacent to the project site, we recommend that we review this report to determine the applicability of the conclusions and recommendations contained herein.

We appreciate the opportunity to provide geotechnical services on this project and look forward to assisting you during the construction phase of the project. If you have any questions or comments regarding the information contained in this report, or if we may be of further service, please call the undersigned at (360) 791-3178.

LANDAU ASSOCIATES, INC.

Jeff Whitman
Senior Staff Geotechnical Engineer

Calvin McCaughan, P.E.
Geotechnical Services Director

JRW/CAM/bar

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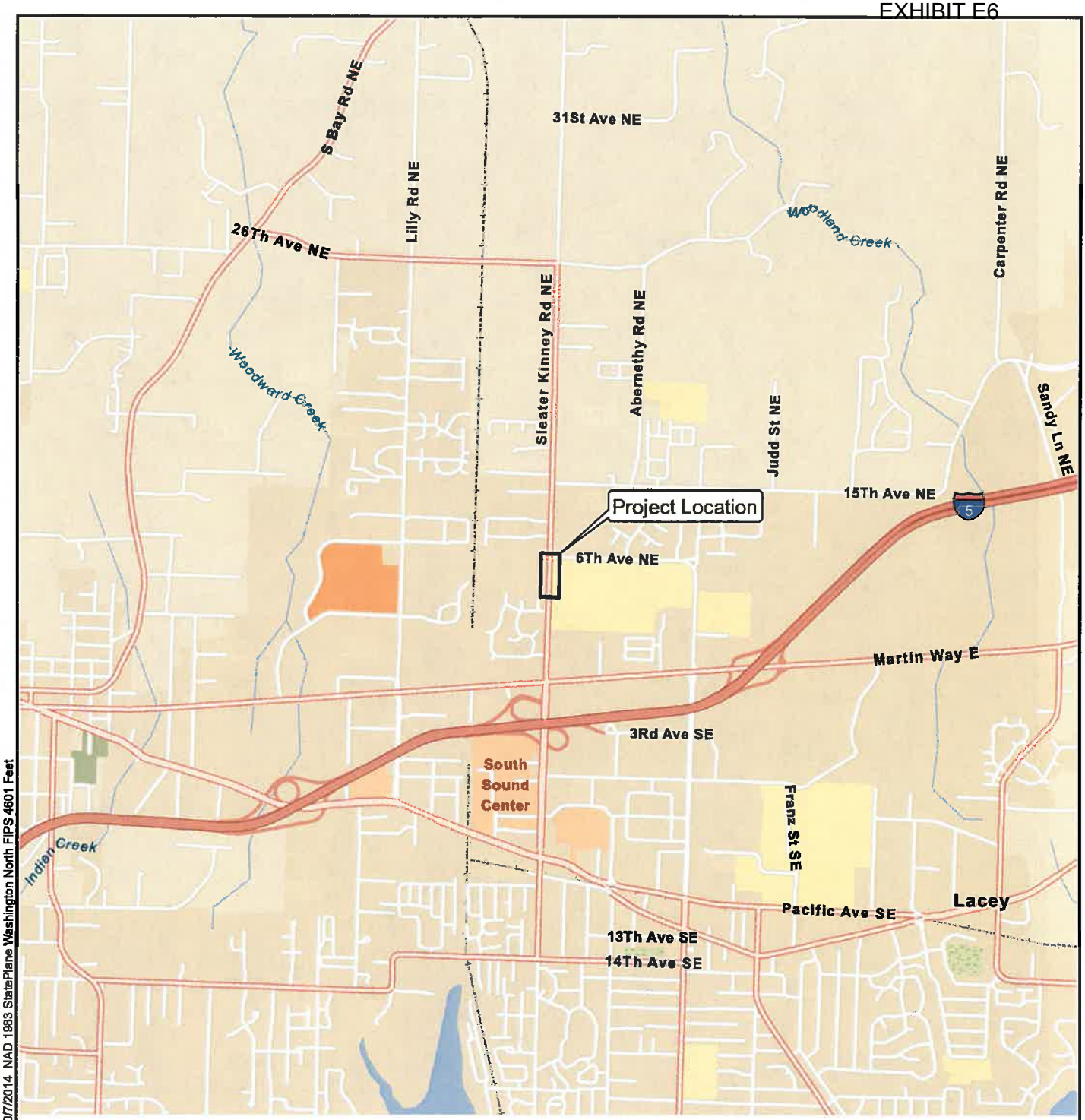

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0 0.5 1

Miles

Data Source: Esri 2012

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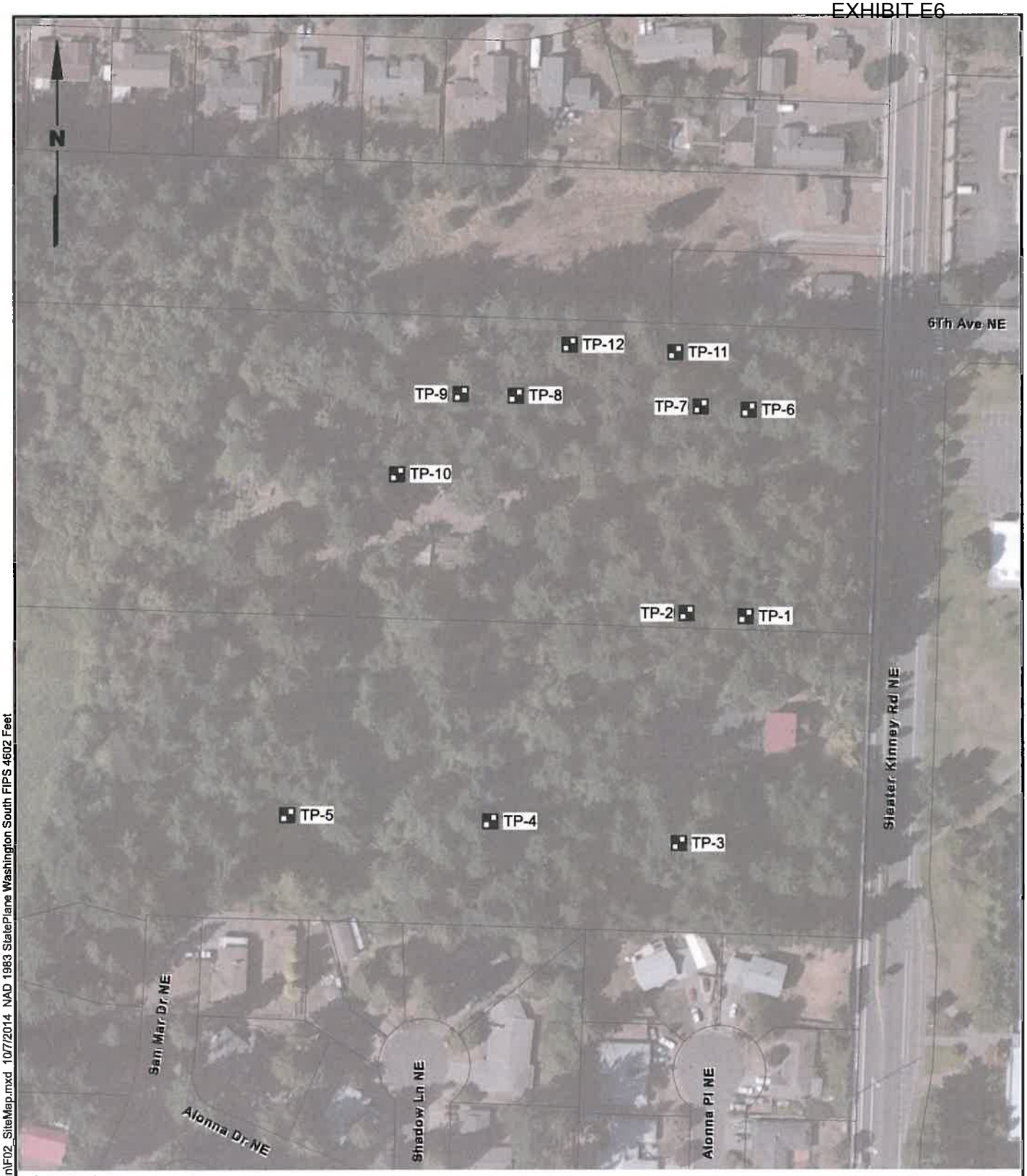
LANDAU ASSOCIATES

Bayan Trails Development Olympia, Washington	**Vicinity Map**	Figure 1

EXHIBIT E6



Legend

Test Pit Locations

Parcel Boundary

0 150 300

Feet

Data Source: Esri 2012, Esri World Imagery 2011

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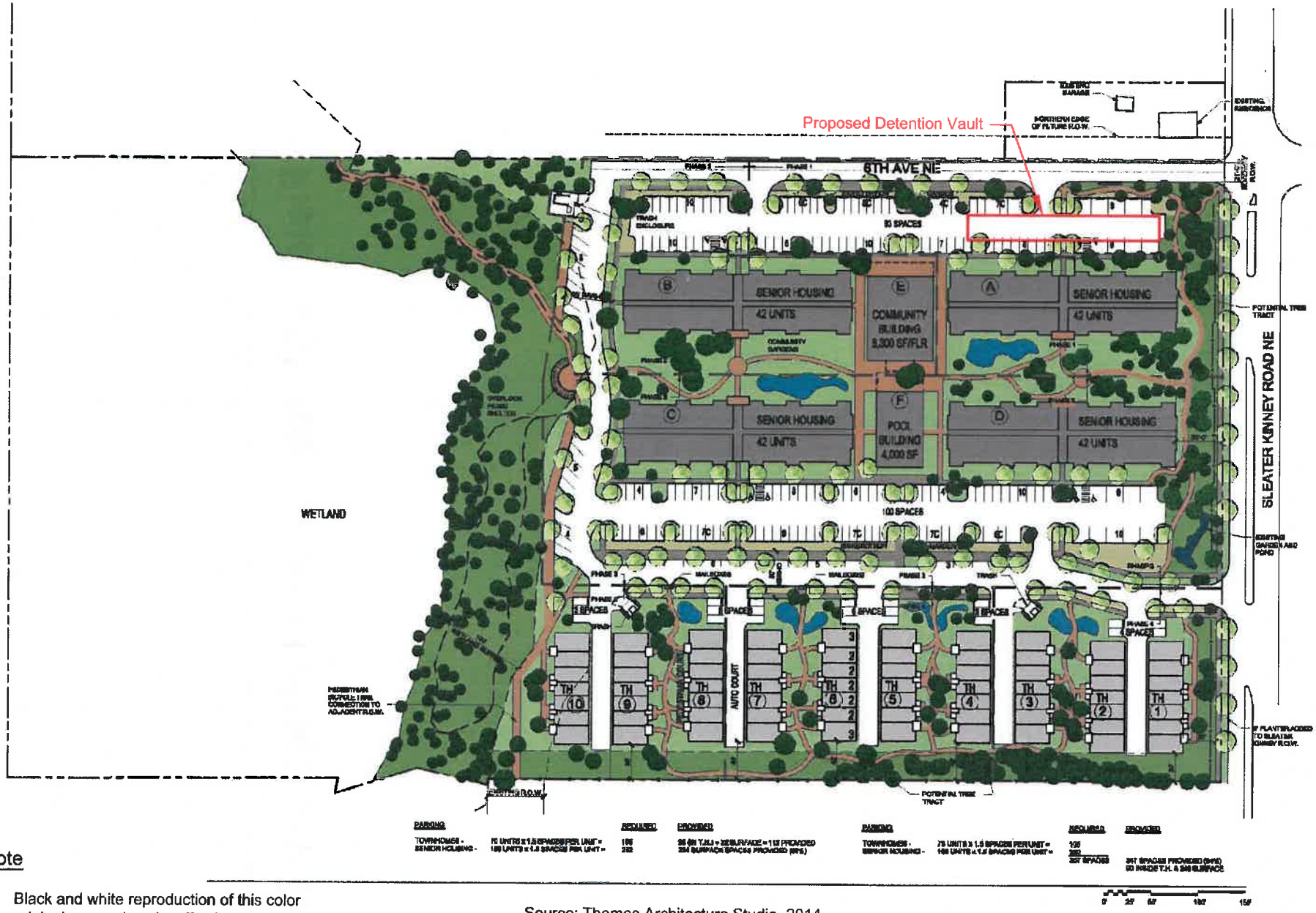
LANDAU ASSOCIATES

Bayan Trails Development Olympia, Washington	**Site and Exploration Plan**	Figure 2

EXHIBIT E6



Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Source: Thomas Architecture Studio, 2014

LANDAU ASSOCIATES

Bayan Trails Development
Olympia, Washington

Proposed Conditions Site Plan

Figure 3

APPENDIX A

Field Explorations and Laboratory Testing

APPENDIX A
FIELD EXPLORATIONS AND LABORATORY TESTING

FIELD EXPLORATIONS

Subsurface soil and groundwater conditions within the limits of the project area were explored on September 23, 2014. The exploration program consisted of advancing and sampling 12 exploratory test pits (TP-1 through TP-12) at the approximate locations shown on the Site and Exploration Plan (Figure 2 of this report). The test pits were advanced to a depth of about 6 feet (ft) to 17 ft below existing ground surface (BGS) using a track-mounted excavator. The test pits were excavated by Howard's Construction and Excavating of Olympia, Washington under subcontract to Landau Associates. The locations of the test pits were located approximately in the field using GPS. The ground surface elevations at the exploration locations were not determined.

The field exploration program was coordinated and monitored by a Landau Associates' geologist, who also obtained representative soil samples, maintained a detailed record of the observed subsurface soil and groundwater conditions, and described the soil encountered by visual and textural examination. Each representative soil type observed in our exploratory borings was described using the soil classification system shown on Figure A-1, in general accordance with ASTM International (ASTM) D 2488, *Standard Recommended Practice for Description of Soils (Visual-Manual Procedure)*. Logs of the explorations are presented on Figures A-2 through A-7. These logs represent our interpretation of subsurface conditions identified during the field exploration program. The stratigraphic contacts shown on the individual logs represent the approximate boundaries between soil types; actual transitions may be more gradual. The soil and groundwater conditions depicted are only for the specific date and locations reported and, therefore, are not necessarily representative of other locations and times. A further discussion of the soil and groundwater conditions observed at the explorations is contained in the main body of this report.

Disturbed samples of the soil encountered in test pits TP-1 through TP-12 were obtained after each observed geologic unit. Soil samples obtained from the explorations will be stored in our laboratory for 30 days after the date of the final report. After that date, the samples will be disposed of unless arrangements are made to retain them.

LABORATORY TESTING

Natural moisture content determinations, grain size analyses, and California Bearing Ratio (CBR) tests were conducted in Landau Associates' laboratory on representative samples obtained from the explorations. Laboratory testing was performed in general accordance with the ASTM standard test procedures described below. The samples were checked against the field log descriptions, which were

updated where appropriate in general accordance with ASTM D 2487, *Standard Test Method for Classification of Soils for Engineering Purposes*.

Natural moisture content determinations were performed on soil samples obtained from the borings in general accordance with ASTM D 2216. The natural moisture content is shown as W=xx (percent of dry weight) at the respective sample depth in the column labeled "Test Data" on the summary logs in this appendix.

Sieve analyses were performed on representative soil samples obtained from the explorations in accordance with ASTM D 422 to provide an indication of the grain size distribution. Samples selected for grain size analyses are designated with a "GS" in the column labeled "Test Data" on the summary test pit logs on Figures A-2 through A-7 in this appendix. The results of the grain size analyses are presented in the form of grain size distribution curves on Figure A-8 in this appendix.

The CBR, a semi-empirical index of the strength and deflection characteristics of a soil, was determined for two selected soil samples in general accordance with ASTM D 1883 test procedures. Three test specimens from each of the two soil samples were moisture conditioned to a moisture content near optimum as determined by test method ASTM D 1557. The three specimens were compacted using three different compactive efforts, thereby resulting in three different unit weights. After soaking the specimens for 72 hours, each specimen was subjected to penetration by a cylindrical rod. The CBR test results are presented in Appendix B.

Soil Classification System

	MAJOR DIVISIONS		GRAPHIC SYMBOL	USCS LETTER SYMBOL[1]	TYPICAL DESCRIPTIONS [2][3]
COARSE-GRAINED SOIL (More than 50% of material is larger than No. 200 sieve size)	GRAVEL AND GRAVELLY SOIL (More than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (Little or no fines)		GW	Well-graded gravel; gravel/sand mixture(s); little or no fines
				GP	Poorly graded gravel; gravel/sand mixture(s); little or no fines
		GRAVEL WITH FINES (Appreciable amount of fines)		GM	Silty gravel; gravel/sand/silt mixture(s)
				GC	Clayey gravel; gravel/sand/clay mixture(s)
	SAND AND SANDY SOIL (More than 50% of coarse fraction passed through No. 4 sieve)	CLEAN SAND (Little or no fines)		SW	Well-graded sand; gravelly sand; little or no fines
				SP	Poorly graded sand; gravelly sand; little or no fines
		SAND WITH FINES (Appreciable amount of fines)		SM	Silty sand; sand/silt mixture(s)
				SC	Clayey sand; sand/clay mixture(s)
FINE-GRAINED SOIL (More than 50% of material is smaller than No. 200 sieve size)	SILT AND CLAY (Liquid limit less than 50)			ML	Inorganic silt and very fine sand; rock flour; silty or clayey fine sand or clayey silt with slight plasticity
				CL	Inorganic clay of low to medium plasticity; gravelly clay; sandy clay; silty clay; lean clay
				OL	Organic silt; organic, silty clay of low plasticity
	SILT AND CLAY (Liquid limit greater than 50)			MH	Inorganic silt; micaceous or diatomaceous fine sand
				CH	Inorganic clay of high plasticity; fat clay
				OH	Organic clay of medium to high plasticity; organic silt
	HIGHLY ORGANIC SOIL			PT	Peat; humus; swamp soil with high organic content

OTHER MATERIALS	GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
PAVEMENT		AC or PC	Asphalt concrete pavement or Portland cement pavement
ROCK		RK	Rock (See Rock Classification)
WOOD		WD	Wood, lumber, wood chips
DEBRIS		DB	Construction debris, garbage

Notes:
1. USCS letter symbols correspond to symbols used by the Unified Soil Classification System and ASTM classification methods. Dual letter symbols (e.g., SP-SM for sand or gravel) indicate soil with an estimated 5-15% fines. Multiple letter symbols (e.g., ML/CL) indicate borderline or multiple soil classifications.
2. Soil descriptions are based on the general approach presented in the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), outlined in ASTM D 2488. Where laboratory index testing has been conducted, soil classifications are based on the Standard Test Method for Classification of Soils for Engineering Purposes, as outlined in ASTM D 2487.
3. Soil description terminology is based on visual estimates (in the absence of laboratory test data) of the percentages of each soil type and is defined as follows:

Primary Constituent:	> 50%	- "GRAVEL," "SAND," "SILT," "CLAY," etc.
Secondary Constituents:	> 30% and ≤ 50%	- "very gravelly," "very sandy," "very silty," etc.
	> 15% and ≤ 30%	- "gravelly," "sandy," "silty," etc.
Additional Constituents:	> 5% and ≤ 15%	- "with gravel," "with sand," "with silt," etc.
	≤ 5%	- "with trace gravel," "with trace sand," "with trace silt," etc., or not noted.

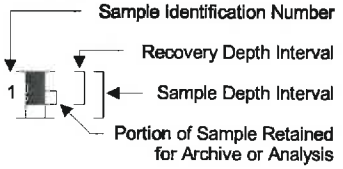
4. Soil density or consistency descriptions are based on judgement using a combination of sampler penetration blow counts, drilling or excavating conditions, field tests, and laboratory tests, as appropriate.

Drilling and Sampling Key

SAMPLER TYPE

Code	Description
a	3.25-inch O.D., 2.42-inch I.D. Split Spoon
b	2.00-inch O.D., 1.50-inch I.D. Split Spoon
c	Shelby Tube
d	Grab Sample
e	Single-Tube Core Barrel
f	Double-Tube Core Barrel
g	2.50-inch O.D., 2.00-inch I.D. WSDOT
h	3.00-inch O.D., 2.375-inch I.D. Mod. California
i	Other - See text if applicable
1	300-lb Hammer, 30-inch Drop
2	140-lb Hammer, 30-inch Drop
3	Pushed
4	Vibrocore (Rotosonic/Geoprobe)
5	Other - See text if applicable

SAMPLE NUMBER & INTERVAL



Field and Lab Test Data

Code	Description
PP = 1.0	Pocket Penetrometer, tsf
TV = 0.5	Torvane, tsf
PID = 100	Photoionization Detector VOC screening, ppm
W = 10	Moisture Content, %
D = 120	Dry Density, pcf
-200 = 60	Material smaller than No. 200 sieve, %
GS	Grain Size - See separate figure for data
AL	Atterberg Limits - See separate figure for data
GT	Other Geotechnical Testing
CA	Chemical Analysis

Groundwater

▽ Approximate water level at time of drilling (ATD)

▼ Approximate water level at time other than ATD

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Olympia, Washington

Soil Classification System and Key

Figure A-1

TP-01

SAMPLE DATA					SOIL PROFILE			GROUNDWATER
Depth (ft)	Elevation (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Excavated By: Howard Excavating Logged By: DAR	
0						SM	Dark brown, silty fine to coarse SAND with gravel and abundant organics (loose, moist)	Groundwater not encountered.
						GP	(TOPSOIL) Brown, fine to coarse GRAVEL with sand and silt (medium dense, damp) (RECESSIONAL OUTWASH)	
2		S1	d					
4						SM	Gray, silty, fine to coarse SAND with gravel (dense, moist) (GLACIAL TILL)	
6		S2	d					
8								
10								

Test Pit Completed 09/23/14
Total Depth of Test Pit = 7.0 ft.

TP-02

SAMPLE DATA					SOIL PROFILE			GROUNDWATER
Depth (ft)	Elevation (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Excavated By: Howard Excavating Logged By: DAR	
0						SM	Dark brown, silty fine to coarse SAND with gravel and abundant organics (loose, moist)	Groundwater not encountered.
						GP-GM	(TOPSOIL) Brown, very sandy GRAVEL with silt (medium dense, dry) (RECESSIONAL OUTWASH) -grades to tan	
2		S1	d	10/3/2014 W = 5 GS				
4						SM	Gray, silty fine to coarse SAND with gravel (dense, moist) (GLACIAL TILL)	
6								
8		S2	d					
10								

Test Pit Completed 09/24/14
Total Depth of Test Pit = 9.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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Bayan Trails Development
Olympia, Washington

Log of Test Pits

Figure
A-2

TP-03

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Excavated By: Howard Excavating Logged By: KMH	
0					SP-SM	Dark brown, gravelly fine to coarse SAND with silt and organics (medium dense, moist)	Groundwater not encountered.
2	S1	d			SM	(TOPSOIL) Orange-brown, silty fine to coarse SAND with gravel (medium dense, dry) (RECESSIONAL OUTWASH)	
4							
6					SM	Gray, silty, gravelly fine to coarse SAND (dense, moist) (GLACIAL TILL)	
8	S2	d					
10							

Test Pit Completed 09/23/14
Total Depth of Test Pit = 8.0 ft.

TP-04

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Excavated By: Howard Excavating Logged By: KMH	
0					SM	Dark-brown, gravelly, silty fine to coarse SAND (loose, damp)	Groundwater not encountered.
2	S1	d			SM	(TOPSOIL) Tan, silty fine to coarse SAND with gravel and organics (medium dense, dry) (RECESSIONAL OUTWASH)	
4							
6					SM	Gray, gravelly, silty, fine to coarse SAND (dense, damp) (GLACIAL TILL)	
8	S2	d	10/3/2014 W = 5 GS				
10							

Test Pit Completed 09/23/14
Total Depth of Test Pit = 7.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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Olympia, Washington

Log of Test Pits

Figure
A-3

TP-05

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Elevation (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Excavated By: Howard Excavating Logged By: KMH	
0						SM	Dark brown, silty fine to coarse SAND with gravel and organics (loose, damp)	
						SM	(TOPSOIL)	
		S1	d				Tan, silty fine to coarse SAND with gravel (medium dense, dry)	
5						SP	(RECESSIONAL OUTWASH)	
							Brown fine to medium SAND with gravel (medium dense, damp)	
		S2	d					
10								▽ Slow Seepage
		S3	d			SM	Brown, silty fine to coarse SAND with gravel (medium dense, moist)	
15								

Test Pit Completed 09/23/14
Total Depth of Test Pit = 15.0 ft.

TP-06

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Elevation (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Excavated By: Howard Excavating Logged By: KMH	
0						SM	Dark brown, silty fine to coarse SAND with gravel and abundant organics (loose, moist)	
		S1	d	10/6/2014 W = 2 GS		GP	(TOPSOIL)	Groundwater not encountered.
							Brown GRAVEL with sand (medium dense, dry)	
5							(RECESSIONAL OUTWASH)	
						SM	Brown, silty fine to coarse SAND with gravel (medium dense, moist)	
		S2	d			SM	(GLACIAL TILL)	
10							Gray-brown, silty, gravelly fine to coarse SAND (medium dense, damp)	
		S3	d				-grades to dense	
		S4	d					
15		S5	d			SM	Gray, silty, very gravelly fine to coarse SAND (very dense, damp)	

Test Pit Completed 09/23/14
Total Depth of Test Pit = 15.0 ft.

Top 5 feet caving and filling bottom

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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LANDAU ASSOCIATES

Bayan Trails Development
Olympia, Washington

Log of Test Pits

Figure
A-4

TP-07

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Excavated By: Howard Excavating Logged By: KMH	
0	S1	d	10/6/2014 W = 4 GS		SM GP	Dark brown, silty fine to coarse SAND with gravel and abundant organics (loose, moist) **(TOPSOIL)** Brown, fine to coarse GRAVEL with sand and trace silt (loose, dry) **(RECESSIONAL OUTWASH)**	Groundwater not encountered.
5	S2	d			SM/ ML	Brown, interbedded silty fine to medium SAND with trace gravel and SILT (medium dense, damp)	
10	S3	d			GP- GM	**(GLACIAL TILL)** Gray, very sandy fine to coarse GRAVEL with silt (very dense, damp)	
15	S4	d					

Test Pit Completed 09/23/14
Total Depth of Test Pit = 15.0 ft.

TP-08

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Excavated By: Howard Excavating Logged By: DAR	
0	S1	d	10/6/2014 W = 6 GS		SM SP- SM	Dark-brown, silty fine SAND with organics (loose, damp) **(TOPSOIL)** Orange-brown, very gravelly fine to medium SAND with silt (medium dense, damp) **(RECESSIONAL OUTWASH)**	Groundwater not encountered.
2							
4					SM	Gray, silty fine to coarse SAND with gravel (very dense, moist) **(GLACIAL TILL)**	
6	S2	d					
8							
10							

Test Pit Completed 09/23/14
Total Depth of Test Pit = 7.5 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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LANDAU ASSOCIATES

Bayan Trails Development
Olympia, Washington

Log of Test Pits

Figure
A-5

TP-09

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Excavated By: Howard Excavating Logged By: DAR	
0					SM	Dark-brown, silty fine SAND with organics (loose, damp) **(TOPSOIL)**	Groundwater not encountered.
2	S1	d			SM	Brown, silty fine to medium SAND with gravel (medium dense, damp) **(RECESSIONAL OUTWASH)**	
4							
6					SM	Gray, silty fine to coarse SAND with gravel (dense, moist) **(GLACIAL TILL)**	
8	S2	d					
10							

Test Pit Completed 09/23/14
Total Depth of Test Pit = 8.0 ft.

TP-10

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Excavated By: Howard Excavating Logged By: DAR	
0					SM	Dark-brown, silty fine to medium SAND with	Groundwater not encountered.
	S1	d			SM	organics and trace gravel (loose, damp) **(TOPSOIL)**	
5						Brown, silty fine to medium SAND with gravel (medium dense, damp) **(RECESSIONAL OUTWASH)**	
					SP	Gray, fine to coarse SAND with gravel and trace cobbles (medium dense, moist)	
	S2	d					
10					SM	Gray, silty fine to coarse SAND with gravel (dense, moist) **(GLACIAL TILL)**	
	S3	d				-grades to very dense	
15							
	S4	d					

Test Pit Completed 09/23/14

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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Bayan Trails Development
Olympia, Washington

Log of Test Pits

Figure
A-6

TP-11

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol		
0					SM	Excavation Method: Tracked Excavator Ground Elevation (ft): Excavated By: Howard Excavating Logged By: DAR Dark-brown, silty fine to medium SAND with trace gravel and organics (loose, damp) **(TOPSOIL)**	Groundwater not encountered.
2	S1	d			SM	Brown, silty fine to medium SAND (medium dense, damp) **(RECESSIONAL OUTWASH)** -collected three 5-gallon buckets for CBR	
4							
6							
8							
10							

Test Pit Completed 09/23/14
Total Depth of Test Pit = 6.0 ft.

TP-12

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol		
0					SM	Excavation Method: Tracked Excavator Ground Elevation (ft): Excavated By: Howard Excavating Logged By: KMH Dark-brown, silty fine to medium SAND with organics and trace gravel (loose, damp) **(TOPSOIL)**	Groundwater not encountered.
2	S1	d			SM	Brown, silty fine to medium SAND with gravel (loose, damp) **(RECESSIONAL OUTWASH)** -collected three 5-gallon buckets for CBR	
4							
6							
8							
10							

Test Pit Completed 09/23/14
Total Depth of Test Pit = 6.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

1491001.01 10/21/14 \\OLYMPIA1\PROJECTS\1491\001\T\1491001.010.GPJ TEST PIT LOG W/ ELEVATION

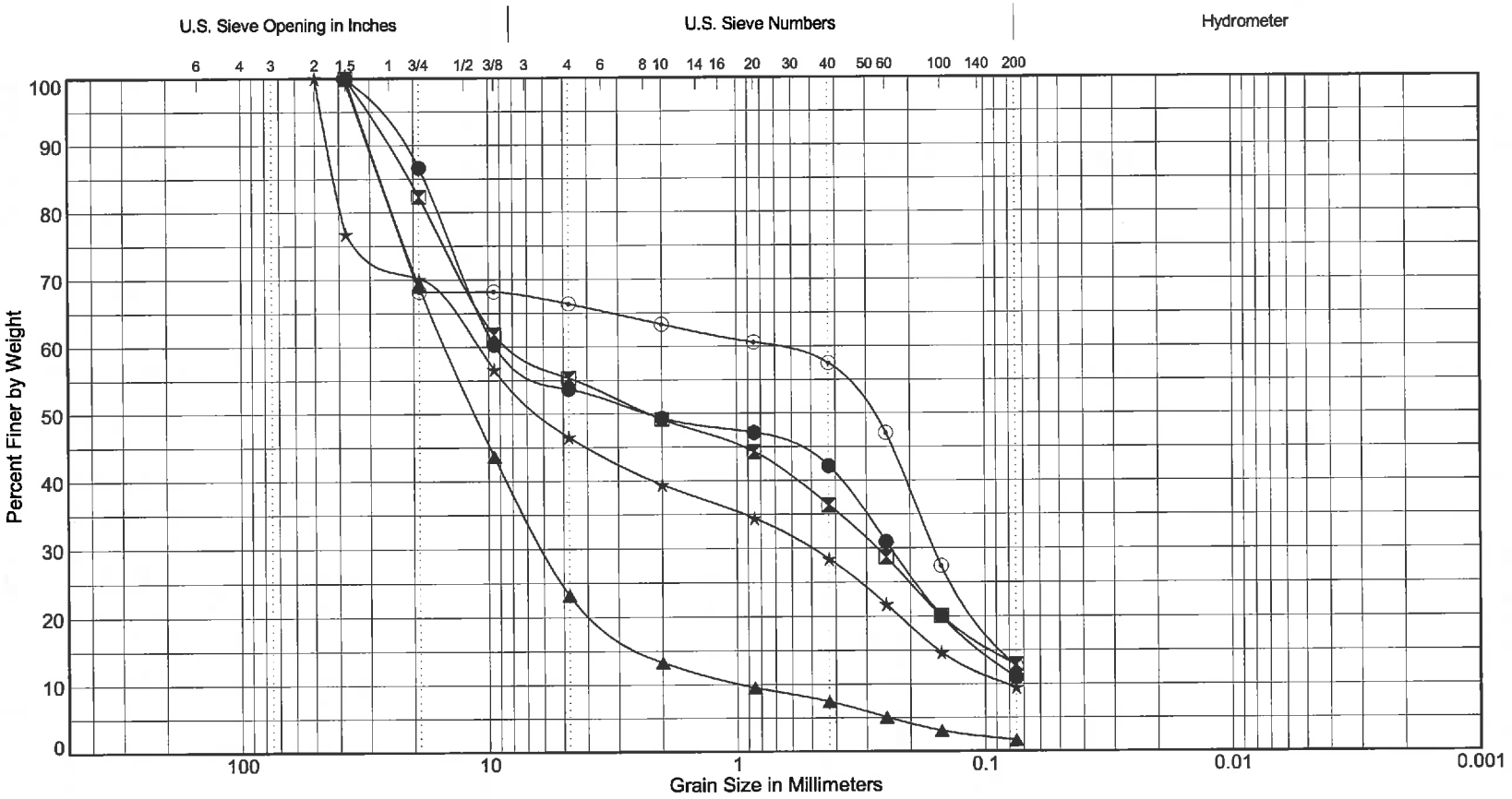
LANDAU ASSOCIATES

Bayan Trails Development
Olympia, Washington

Log of Test Pits

Figure
A-7

EXHIBIT E6



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	TP-02	S-1	2.0	5	Very sandy, GRAVEL with silt	GP-GM
⊠	TP-04	S-2	6.5	5	Very sandy, GRAVEL with silt	GP-GM
▲	TP-06	S-1	2.0	2	GRAVEL with sand	GW
★	TP-07	S-3	10.0	4	Very sandy, GRAVEL with silt	GP-GM
⊙	TP-08	S-1	3.0	6	Very gravelly, SAND with silt	SP-SM

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Bayan Trails Development
Olympia, Washington

Grain Size Distribution

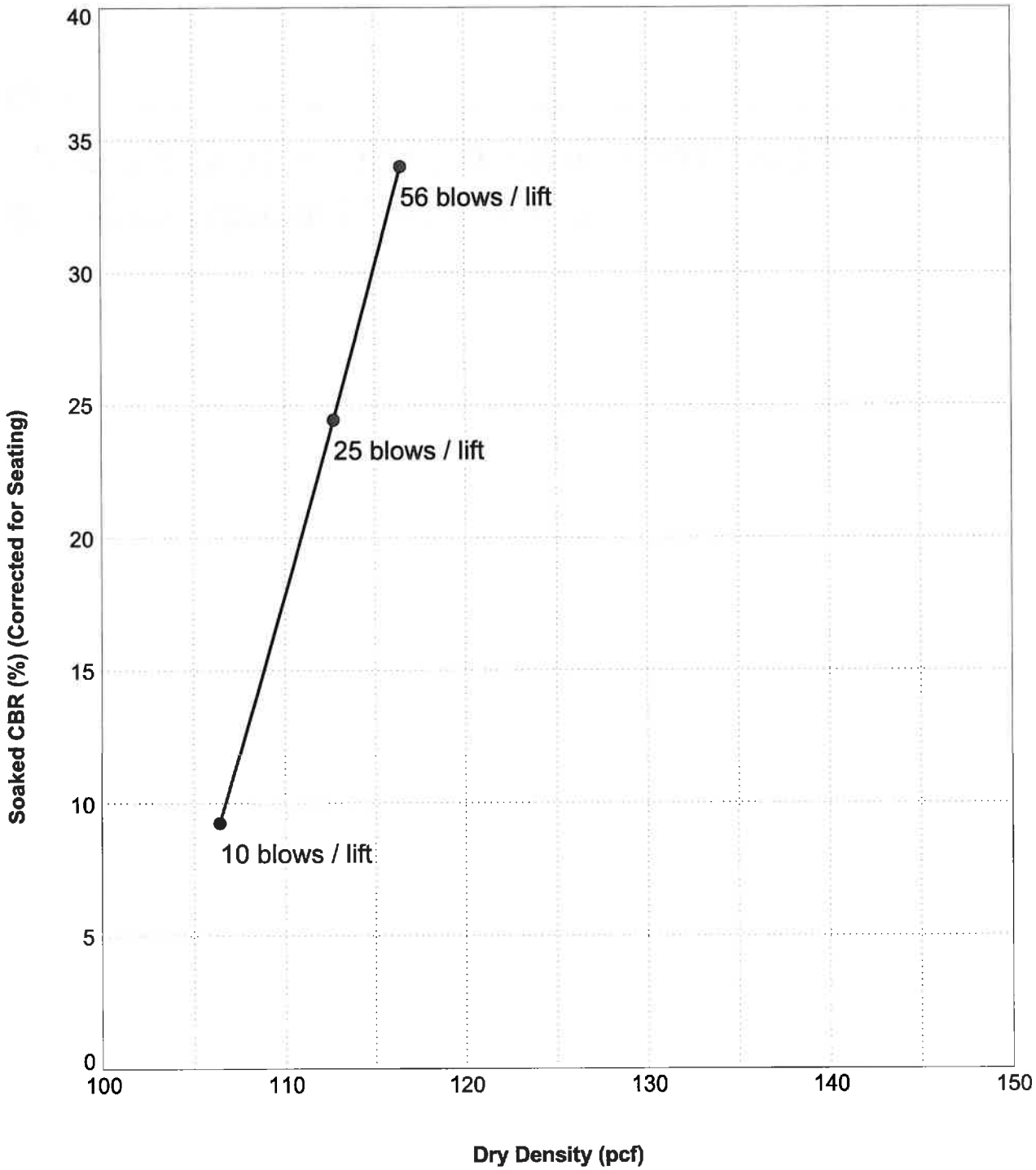
Figure
A-8

APPENDIX B

California Bearing Ratio Test Results and Pavement Design Calculatons

Sample ID: TP-12

Description:



Notes:
California Bearing Ratio test conducted in general accordance with ASTM D1883 test method.

1491001.01 10/20/14 C:\USERS\JWHITMAN\DESKTOP\PROJECTS\SALSIH PONDS\1491001.010.GPJ CBR VS DRY DENSITY

LANDAU ASSOCIATES	Bayan Trails Development Olympia, Washington	Soaked CBR vs Dry Density TP-12	Figure B-1

AASHTO Design Equation for Flexible Pavement

Reliabilty	0.85
Zr	-1.036
So	0.45
Po	4.2
Pt	2.3
Delta PSI	1.9
CBR	30
Mr	45000
W_{18}	280000
$\log(W_{18})$	5.447
Goal Seek to Zero	2.90E-05
SN	1.31

INPUT CELLS

A1 --	D1 (in)	A3 --	D3 (in)
0.42	3	0.14	0.36

$$\log(W_{18}) = Z_R \times S_o + 9.36\log(SN + 1) - 0.20 + \frac{\log\left(\frac{\Delta PSI}{4.2 - 1.5}\right)}{0.40 + \frac{1094}{(SN + 1)^{5.19}}} + 2.32\log(M_R) - 8.07$$

FIGURE B-2

PAVEMENT DESIGN – AASHTO METHOD

SEE PREVIOUS PAGE FOR INPUT IN DOUBLE BOXES ( )

SOIL TEST RESULTS MUST BE SUBMITTED WITH THIS WORKSHEET.

STREET CLASSIFICATION: NEIGHBORHOOD COLLECT

INITIAL AADT: 500 - 3000 % OF AADTT: 5

GROWTH RATE: 5

DESIGN LIFE: 20 YEARS

DESIGN (EAL): 260,000

RELIABILITY LEVEL (R%): 85 % STANDARD DEVIATION (S_o): .45

INITIAL SERVICEABILITY INDEX (Pi): 4.2

TERMINAL SERVICEABILITY INDEX (Pt): 2.5

$\Delta PSI = Pi - Pt = 4.2 - 2.5 = 1.9$

SUBGRADE: $Mr = 1500 \times CBR^*$

CBRVALUE* FROM SOILTEST= 30 => Mr 45,000 psi

USING AASHTO DESIGN METHOD:** SN = 1.31, PROVIDE NOMOGRAPH OR CALCULATIONS.

$$SN = (A_1 D_1) + (A_2 D_2) + (A_3 D_3) + (A_4 D_4)$$

STRUCTURAL COEFFICIENT:		
	CLASS B ASPHALT CONCRETE	$A_1 = 0.42$
	ASPHALT TREATED BASE	$A_2 = 0.34$
	CSTC OR CSBC	$A_3 = 0.14$
	BALLAST	$A_4 = 0.10$

$1.31 = (0.42 \cdot 3\text{ in}) + (0.14 \cdot D_3)$

$\Rightarrow 0.14 D_3 = 1.31 - 1.26$

$\Rightarrow D_3 = \frac{.05}{.14}$

$\Rightarrow D_3 = .36$ in < min req. thickness

∴ USE MIN. THICKNESS

* AASHTO T193: THE CALIFORNIA BEARING RATIO
ASTM D1883: BEARING OF LABORATORY COMPACTED SOILS

** AASHTO GUIDE FOR DESIGN OF PAVEMENT STRUCTURES

APPROVED BY	REVISED DATE	CITY OF OLYMPIA	STD. PLAN NO.
CITY ENGINEER	11/1/96	PAVEMENT DESIGN WORKSHEET	4-6B

4-6B.DWG

FIGURE D-2

PAVEMENT DESIGN–CONSTANTS

	STD. PLAN 4–2A & B	STD. PLAN 4–2A THRU 4–2G	STD. PLAN 4–2C THRU 4–2G	STD. PLAN 4–2H THRU 4–2I1	STD. PLAN 4–2J THRU 4–3
	ARTERIAL	INDUSTRIAL COLLECTOR	MAJOR COLLECTOR	NEIGHBORHOOD COLLECTOR	LOCAL ACCESS & COMMERCIAL ALLEYS
AADT	14,000–40,000	3,000–14,000	3,000–14,000	500–3,000	0–500
% AADTT	8	15	15	5	5
GROWTH RATE	5	5	5	5	2
LANE FACTOR	0.5	0.5	0.5	0.5	0.5
DESIGN EAL	4,000,000	6,000,000	2,400,000	280,000	50,000
R%	95	95	90	85	80
S_o	0.45	0.45	0.45	0.45	0.45
Pi	4.20	4.20	4.20	4.20	4.20
Pt	2.5	2.5	2.4	2.3	2.2
ΔPSI	1.7	1.7	1.8	1.9	2.0
MINIMUM PAVEMENT SECTION WITHOUT PAVEMENT DESIGN *					
AC	6"	6"	4"	4"	3"
CSTC	2"	2"	2"	2"	2"
GRAVEL BASE (BALLAST)	25"	28"	25"	16"	10"
MINIMUM PAVEMENT SECTION WITH PAVEMENT DESIGN *					
AC	4"	4"	3"	3"	3"
CSTC	2"	2"	2"	2"	2"
GRAVEL BASE	6"	10"	6"	6"	4"

*to use min. pavement section

NOTE:

- USE 2% STREET CROSS SLOPE AND NO MORE THAN 33 FEET OF ROADWAY SLOPED IN ANY DIRECTION.
- INVERTED CROWN MAY BE ALLOWED IN BOULEVARD STREET SECTIONS UPON PRIOR APPROVAL BY CITY.

* PAVEMENT DESIGN IS PER AASHTO DESIGN GUIDELINES AND CERTIFIED CALIFORNIA BEARING RATIO (CBR) SOILS TESTS. SEE STANDARD DRAWING 4–6B FOR PAVEMENT DESIGN WORKSHEET.

APPROVED BY	REVISED DATE	CITY OF OLYMPIA	STD. PLAN NO.
CITY ENGINEER	11/1/96	PAVEMENT DESIGN	4–6A

4–6A.DWG

FIGURE B-4

Appendix E

Preliminary Plans

EXHIBIT E6

SEC. 17, T18N, R1W, W.M.

90' WETLAND BUFFER (75% OF STD.)

120' STD. WETLAND BUFFER

S88°00'26.00"E 1290.78'

SOLID WASTE ENCLOSURE/ MAINTENANCE BUILDING

WETLAND LIMITS

OVERLOOK PICNIC SHELTER

WALKING TRAILS

10' GRAVEL ACCESS PATH

PHASE 1

PHASE 2

PHASE 3

PHASE 4

PHASE 5

PHASE 6

6TH AVE NE

SLEATER KINNEY RD NE

S20°46.00"W

EXISTING GARDEN AND POND TO REMAIN

MAILBOXES

SOLID WASTE ENCLOSURE

ELEVATED SIDEWALK PER LANDSCAPE ARCHITECT (TYP.)

N74°57'32.00"W 77.02'

S75°04'59.00"W 91.74'

S1°57'52.00"W 6.37'

S88°02'25.14"E 779.52'

0 40 80

SCALE IN FEET

LEGEND

- PROPERTY LINE / R.O.W. LINE
- SETBACK
- WETLAND
- WETLAND BUFFER
- PROPOSED BUILDING
- (XX) STALL COUNT
- ADA PARKING STALLS
- CONCRETE SIDEWALK
- WHEELSTOP
- PHASE LIMITS
- NEW FENCE

NOTE:

SEE SHEETS RD-XS-01, RD-01, & RD-02 FOR ROADWAY DIMENSIONS.

CALL BEFORE YOU DIG

THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR THE LOCATION AND PROTECTION OF ALL EXISTING UTILITIES. THE CONTRACTOR SHALL VERIFY ALL UTILITY LOCATIONS PRIOR TO CONSTRUCTION BY CALLING THE UNDERGROUND LOCATE LINE AT (800) 424-5555 A MINIMUM OF 48 HOURS PRIOR TO ANY EXCAVATION.

N:\PROJECTS\1541 GOLDEN AUM DEVELOPMENT\1541.01 BAYAN TRAILS\PHASE 20 - SPR SUBMITTAL\CADD\1541.01 SP-01.DWG

REVISIONS | DATE | BY

SCJ ALLIANCE
CONSULTING SERVICES
8730 TALLON LANE NE, SUITE 200, LACEY, WASHINGTON 98516
P: 360-352-1465 F: 360-352-1509
SCJALLIANCE.COM

SHEET TITLE: SITE PLAN

PROJECT NAME: BAYAN TRAILS
OLYMPIA, WASHINGTON

SEAL: ROSS D. JARVIS — STATE OF WASHINGTON — 43668 — REGISTERED PROFESSIONAL ENGINEER

02/12/2015

DESIGNED:	R. JARVIS
DRAWN BY:	L HURTADO
APPROVED BY:	R. JARVIS
DATE:	NOVEMBER, 2014
JOB No:	1541.01
DRAWING FILE No:	1541.01 SP-01
DRAWING No:	SP-01
SHEET No:	3 OF 13

EXHIBIT E6

SEC. 17, T18N, R1W, W.M.

90' WETLAND BUFFER (75% OF STD.)

120' STD. WETLAND BUFFER

BUFFER AVERAGING AREA (NATURAL VEGETATION TO BE PRESERVED)

WETLAND LIMITS

REMOVE EXISTING FENCE

RELOCATE EXISTING POWER/LIGHT POLE (SEE SHEET RD-02 FOR ADDITIONAL INFORMATION)

6TH AVE NE

CONSTRUCT SEDIMENT TRAP AS NECESSARY. DIRECT ON-SITE FLOWS TO SEDIMENT TRAP.

DEMOLISH EXISTING GRAVEL DRIVE

DEMOLISH EXISTING TELEPHONE LINE

DEMOLISH EXISTING GARDEN

DEMOLISH EXISTING OVERHEAD POWER AND POLES

DEMOLISH EXISTING CHICKEN COOP AND WOOD SHED

DEMOLISH EXISTING TRAIL

DEMOLISH EXISTING STRUCTURES AND SEPTIC DRAINFIELD

SLEATER KINNEY RD NE

REMOVE EXISTING FENCE

RELOCATE EXISTING LANDSCAPING FEATURE PER LANDSCAPE PLANS

PROTECT ORIENTAL GARDEN DURING CONSTRUCTION

DEMOLISH EXISTING POWER AND POLE

REMOVE EXISTING STRUCTURE, SIDEWALK, AND ASPHALT

DEMOLISH EXISTING PILLARS AND GATE

CONSTRUCT SEDIMENT TRAP AS NECESSARY. DIRECT ON-SITE FLOWS TO SEDIMENT TRAP.

N

0 40 80

SCALE IN FEET

LEGEND

- STABILIZED CONSTRUCTION ENTRANCE
- SEDEMENT TRAP
- INLET SEDIMENT PROTECTION
- SILT FENCE
- SWALE
- EXISTING TREES TO REMAIN
- EXISTING TREES TO BE REMOVED

CALL BEFORE YOU DIG

THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR THE LOCATION AND PROTECTION OF ALL EXISTING UTILITIES. THE CONTRACTOR SHALL VERIFY ALL UTILITY LOCATIONS PRIOR TO CONSTRUCTION BY CALLING THE UNDERGROUND LOCATE LINE AT (800) 424-5555 A MINIMUM OF 48 HOURS PRIOR TO ANY EXCAVATION.

N:\PROJECTS\1541 GOLDEN ALOE DEVELOPMENT\1541.01 BAYAN TRAILS\PHASE 20 - SPR SUBMITTAL\CADD\1541.01 EC-01.DWG

REVISIONS

BY	DATE	

SCJ ALLIANCE
CONSULTING SERVICES
8730 TALLON LANE NE, SUITE 200, LACEY, WASHINGTON 98516
P: 360-352-1465 F: 360-352-1509
SCJALLIANCE.COM

SHEET TITLE: TESC AND DEMOLITION PLAN

PROJECT NAME: BAYAN TRAILS
OLYMPIA, WASHINGTON

SEAL: ROSS D. JARVIS — STATE OF WASHINGTON — 23668 — REGISTERED PROFESSIONAL ENGINEER

02/12/2019

DESIGNER:	R. JARVIS
DRAWN BY:	L HURTADO
APPROVED BY:	R. JARVIS
DATE:	NOVEMBER, 2014
JOB No:	1541.01
DRAWING FILE No:	1541.01 EC-01
DRAWING No:	EC-01
SHEET No:	4 OF 13

SEC. 17, T18N, R1W, W.M.

EXHIBIT E6

90' WETLAND BUFFER (75% OF STD.)
120' STD. WETLAND BUFFER
WETLAND LIMITS
FLOW SPREADER
MODULAR WETLANDS MWS-L-4-8 RIM: 205.50 IE: 204.20
IE OUT: 204.06
CB RIM: 206.69 IE: 204.69
CB RIM: 206.25 IE: 204.25
IE: 204.00
20 LF OF 12" @ 0.0100 FT/FT
43 LF OF 12" @ 0.0102 FT/FT
50 LF OF 12" @ 0.0258 FT/FT
91 LF OF 12" @ 0.0489 FT/FT
CB RIM: 208.65 IE: 205.98
115'L x 10'W x 4'D INFILTRATION GALLERY
TIGHTLINE ROOF DOWNSPOUTS TO INFILTRATION GALLERY
10,000 SF x 3.5'D DETENTION VAULT
35 LF OF 8" @ 0.0050 FT/FT
CB RIM: 212.45 IE: 209.45
CB RIM: 210.69 IE: 209.00
36 LF OF 8" @ 0.0050 FT/FT
CB RIM: 208.17 IE: 204.75
25 LF OF 8" @ 0.0050 FT/FT
6TH AVE NE
CB RIM: 208.12 IE: 204.64 (FIELD VERIFY)
CB RIM: 208.77 IE: 205.23 (FIELD VERIFY)
59 LF OF 12" @ 0.0050 FT/FT
MODULAR WETLANDS MWS-L-4-8 RIM: 213.25 IE (OUT): 205.52
11 LF OF 12" @ 0.0000 FT/FT
SLEATER KINNEY RD NE
EX. CB RIM: 211.38 IE:12" PVC N & S 207.93
CB RIM: 214.00 IE: 209.03
CB RIM: 213.14 IE: 208.78
EX. CB RIM: 212.61 IE:12" PVC N & S 209.16
45 LF OF 8" @ 0.0050 FT/FT
62 LF OF 8" @ 0.0050 FT/FT
EX. CB RIM: 213.36 IE:12" PVC N 209.90
FFE:212.00
SENIOR HOUSING BUILDING 'B'
FFE:215.00
COMMUNITY BUILDING FFE:215.50
SENIOR HOUSING BUILDING 'A' FFE:215.00
CB RIM: 211.37 IE: 208.70
FFE:213.50
126 LF OF 12" @ 0.0065 FT/FT
CB RIM: 212.52 IE: 209.52
IE: 206.00
SENIOR HOUSING BUILDING 'C' FFE:216.00
POOL BUILDING FFE:216.00
SENIOR HOUSING BUILDING 'D' FFE:216.00
FLOW SPREADER
6,720 SF x 8.5'D DETENTION VAULT
TIGHTLINE ROOF DOWNSPOUTS TO INFILTRATION GALLERY
110'L x 10'W x 4'D INFILTRATION GALLERY
120 LF OF 8" @ 0.0050 FT/FT
CB RIM: 213.02 IE: 210.72
IE: 210.52
56 LF OF 8" @ 0.0050 FT/FT
10 LF OF 8" @ 0.0050 FT/FT
16 LF OF 8" @ 0.0050 FT/FT
FLOW CONTROL STRUCTURE IE: 211.84
IE: 211.84
39 LF OF 8" @ 0.0050 FT/FT
CB RIM: 212.80 IE: 210.88
72 LF OF 8" @ 0.0050 FT/FT
CB RIM: 214.66 IE: 212.01
34 LF OF 8" @ 0.0050 FT/FT
41 LF OF 8" @ 0.0050 FT/FT
79 LF OF 8" @ 0.0050 FT/FT
39 LF OF 8" @ 0.0050 FT/FT
CB RIM: 215.30 IE: 213.38
44 LF OF 8" @ 0.0050 FT/FT
CB RIM: 214.44 IE: 212.06
IE: 214.18
IE: 212.18
CB RIM: 214.30 IE: 212.38
CB RIM: 216.30 IE: 214.38
IE: 212.17
42 LF OF 8" @ 0.0050 FT/FT
49 LF OF 8" @ 0.0050 FT/FT
CB RIM: 214.30 IE: 212.38
IE: 212.17
TOWNHOUSE BUILDING 10 FFE:213.50
TOWNHOUSE BUILDING 9 FFE:213.50
TOWNHOUSE BUILDING 8 FFE:215.00
TOWNHOUSE BUILDING 7 FFE:215.00
TOWNHOUSE BUILDING 6 FFE:217.00
TOWNHOUSE BUILDING 5 FFE:217.00
TOWNHOUSE BUILDING 4 FFE:216.00
TOWNHOUSE BUILDING 3 FFE:216.00
TOWNHOUSE BUILDING 2 FFE:215.00
TOWNHOUSE BUILDING 1 FFE:215.00
62'L x 5'W x 3.5'D INFILTRATION GALLERY (TYP.)

N

0 40 80
SCALE IN FEET

LEGEND

- EXISTING CONTOURS (MAJOR/MINOR)
- PROPOSED CONTOURS (MAJOR/MINOR)
- SD — STORM PIPE
- FD — FOUNDATION DRAIN
- 30" CATCH BASIN
- 48" CATCH BASIN
- BIO RETENTION CELL/SWALE SEE DETAIL ON SHEET SD.02
- DOWNSPOUT INFILTRATION GALLERY
- CONCRETE INLET, CHANNEL, AND GRATE

CALL BEFORE YOU DIG

THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR THE LOCATION AND PROTECTION OF ALL EXISTING UTILITIES. THE CONTRACTOR SHALL VERIFY ALL UTILITY LOCATIONS PRIOR TO CONSTRUCTION BY CALLING THE UNDERGROUND LOCATE LINE AT (800) 424-5555 A MINIMUM OF 48 HOURS PRIOR TO ANY EXCAVATION.

N:\PROJECTS\1541 GOLDEN ACRE DEVELOPMENT\1541.01 BAYAN TRAILS\PHASE 2B - SPR SUBMITTAL\CADD\1541.01 SD-01.DWG

BY	DATE	REVISIONS

SCJ ALLIANCE
CONSULTING SERVICES
8730 TALLON LANE NE, SUITE 200, LACEY, WASHINGTON 98516
P: 360-352-1465 F: 360-352-1509
SCJALLIANCE.COM

SHEET TITLE: DRAINAGE PLAN

PROJECT NAME: BAYAN TRAILS
OLYMPIA, WASHINGTON

SEAL: ROSS D. JARVIS — STATE OF WASHINGTON — 43668 — REGISTERED PROFESSIONAL ENGINEER
09/09/2015

DESIGNER:	R. JARVIS
DRAWN BY:	L HURTADO
APPROVED BY:	R. JARVIS
DATE:	NOVEMBER, 2014
JOB No:	1541.01
DRAWING FILE No:	1541.01 SD-01
DRAWING No:	SD-01
SHEET No:	6 OF 13

EXHIBIT E6

CITY OF OLYMPIA
STORM DRAINAGE NOTES:

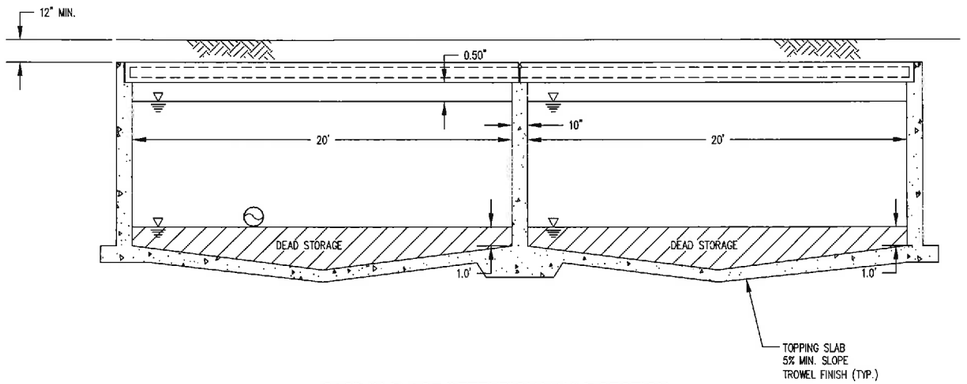
1. ALL WORKMANSHIP AND MATERIALS WILL BE IN ACCORDANCE WITH CITY OF OLYMPIA STANDARDS AND THE MOST CURRENT COPY OF THE STATE OF WASHINGTON STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND MUNICIPAL CONSTRUCTION(WSDOT/APWA).
2. TEMPORARY EROSION/WATER POLLUTION MEASURES WILL BE REQUIRED IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS AND THE DRAINAGE DESIGN AND EROSION CONTROL MANUAL FOR OLYMPIA.
3. COMPLY WITH ALL OTHER PERMITS AND OTHER REQUIREMENTS BY THE CITY OF OLYMPIA OR OTHER GOVERNING AUTHORITY OR AGENCY.
4. A PRECONSTRUCTION MEETING WILL BE HELD WITH THE CITY OF OLYMPIA, DEPARTMENT OF COMMUNITY PLANNING AND DEVELOPMENT, PRIOR TO THE START OF CONSTRUCTION.
5. ALL STORM CONVEYANCES AND RETENTION/DETENTION AREAS WILL BE HELD WITH THE CITY OF OLYMPIA, DEPARTMENT OF COMMUNITY PLANNING AND DEVELOPMENT, PRIOR TO THE START OF CONSTRUCTION.
6. STORM DRAIN PIPE WILL MEET THE FOLLOWING REQUIREMENTS. SUBMITTAL WILL INCLUDE THE PIPE TYPE AS ALLOWED IN THE DRAINAGE MANUAL.
7. SPECIAL STRUCTURES, OIL/WATER SEPARATORS, AND OUTLET CONTROLS WILL BE INSTALLED PURSUANT TO PLANS AND MANUFACTURER'S RECOMMENDATIONS.
8. PROVIDE TRAFFIC CONTROL PLAN(S) AS REQUIRED IN ACCORDANCE WITH MUTCD.
9. CALL UNDERGROUND LOCATE AT 1-800-424-5555 A MINIMUM OF 48 HOURS PRIOR TO ANY EXCAVATIONS.
10. WHERE CONNECTIONS REQUIRE "FIELD VERIFICATIONS," CONNECTION POINTS WILL BE EXPOSED BY CONTRACTOR AND FITTINGS VERIFIED 48 HOURS PRIOR TO DISTRIBUTING SHUTDOWN NOTICES.
11. ALL STORM LINES AND CATCH BASINS WILL BE HIGH-VELOCITY CLEANED AND PRESSURE TESTED IN ACCORDANCE WITH DIVISION 7 OF THE STANDARD SPECIFICATIONS PRIOR TO PAVING IN CONFORMANCE WITH THE ABOVE-REFERENCED SPECIFICATIONS. (SEE NOTE 1.) HYDRANT FLUSHING OF LINES IS NOT AN ACCEPTABLE CLEANING METHOD.
12. TESTING OF THE STORM MAIN WILL INCLUDE TELEVISION INSPECTION OF THE MAIN BY THE CITY AT THE CONTRACTOR'S EXPENSE. IMMEDIATELY PRIOR TO TELEVISION INSPECTION, ENOUGH WATER WILL BE RUN DOWN THE LINE DO IT COMES OUT THE LOWER MANHOLE AND THE LINE IS FLUSHED CLEAN. ACCEPTANCE OF THE LINE WILL BE MADE AFTER THE TELEVISION INSPECTION TAPE HAS BEEN REVIEWED AND APPROVED BY THE INSPECTOR. A WATER TEST OF ALL MANHOLES IN ACCORDANCE WITH OLYMPIA STANDARDS IS ALSO REQUIRED. TESTING WILL TAKE PLACE AFTER ALL UNDERGROUND UTILITIES ARE INSTALLED AND COMPACTION OF THE ROADWAY SUBGRADE IS COMPLETED.

SCJ ALLIANCE
GENERAL STORM DRAINAGE NOTES:

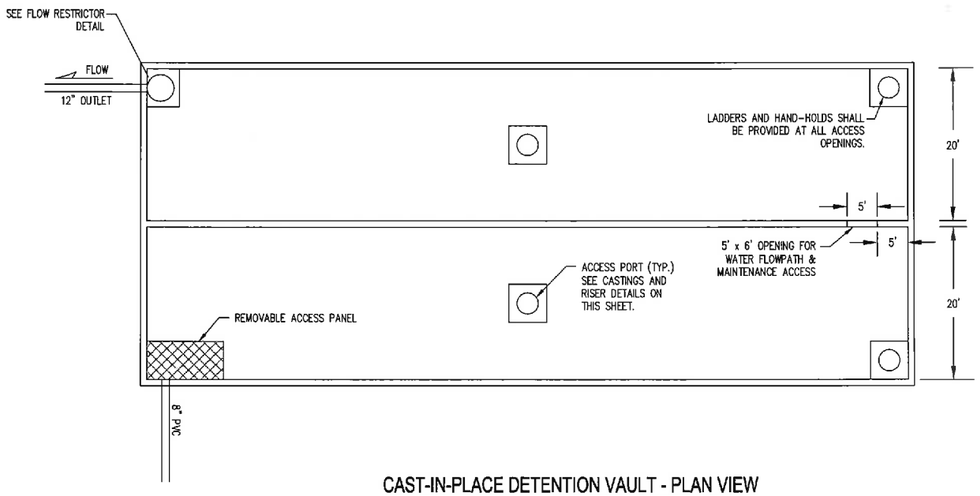
1. CONTRACTOR SHALL RECORD ANY FIELD DEVIATION FROM ENGINEERING PLAN. THESE RECORDS SHALL BE KEPT ON CONSTRUCTION DRAWINGS AND TURNED OVER TO ENGINEER UPON COMPLETION OF PROJECT.
2. THE CONTRACTOR SHALL VERIFY DIA, LENGTH, CONDITION, PIPE TYPE, SLOPE AND VERTICAL AND HORIZONTAL ALIGNMENT OF THE EXISTING ALIGNMENT OF THE PROPOSED POINT OF CONNECTION PRIOR TO CONNECTION AND REPORT ANY DISCREPANCIES TO ENGINEER PRIOR TO CONSTRUCTION.
3. CONTRACTOR SHALL FURNISH AND INSTALL ALL MATERIALS AND EQUIPMENT NECESSARY TO COMPLETE THIS WORK.
4. STATIONS AND OFFSETS FOR CATCH BASINS ALONG CURBS ARE CALLED OUT TO MIDPOINT BACK OF GRATE, THE REST ARE CALLED OUT TO CENTER OF STRUCTURE.
5. PIPE LENGTHS ARE CALLED OUT FROM CENTER OF STRUCTURE TO CENTER OF STRUCTURE.
6. PLAN LOCATIONS OF OTHER UTILITIES ARE DIAGRAMMATIC ONLY. CONTRACTOR TO VERIFY FOR THESE SYSTEMS. VERIFY AND COORDINATE LOCATIONS WITH NEW FACILITY INSTALLATIONS IF NOT WHERE SHOWN ON EXISTING PLANS.
7. PROVIDE MIN SLOPE OF 2% FOR ROOF DRAIN STUBS AND TO DRYWELLS.

CALL BEFORE YOU DIG

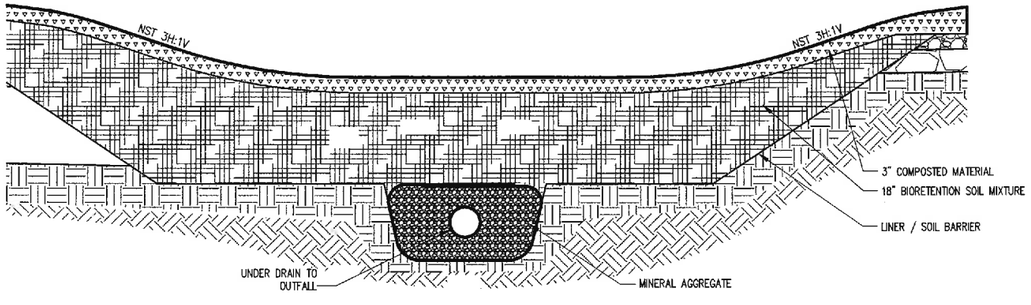
THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR THE LOCATION AND PROTECTION OF ALL EXISTING UTILITIES. THE CONTRACTOR SHALL VERIFY ALL UTILITY LOCATIONS PRIOR TO CONSTRUCTION BY CALLING THE UNDERGROUND LOCATE LINE AT (800) 424-5555 A MINIMUM OF 48 HOURS PRIOR TO ANY EXCAVATION.



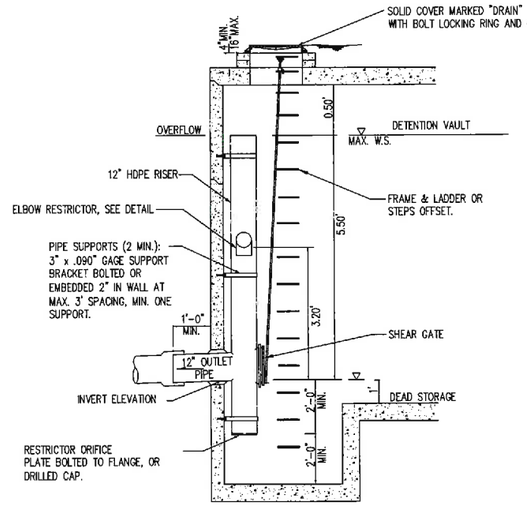
CAST-IN-PLACE DETENTION VAULT SECTION
NTS



CAST-IN-PLACE DETENTION VAULT - PLAN VIEW
NTS



BIORETENTION CELL / SWALE SECTION
NTS



FLOW RESTRICTOR DETAIL
NTS

ORIFICE SUMMARY

EAST BASIN - 1 (DETENTION VAULT):
EFFECTIVE DEPTH: 4'
RISER HEIGHT: 3'

ORIFICE #1: 1.53-INCH @ 0.00-FEET
ORIFICE #2: 3.19-INCH @ 2.00-FEET
ORIFICE #3: 1.91-INCH @ 2.25-FEET

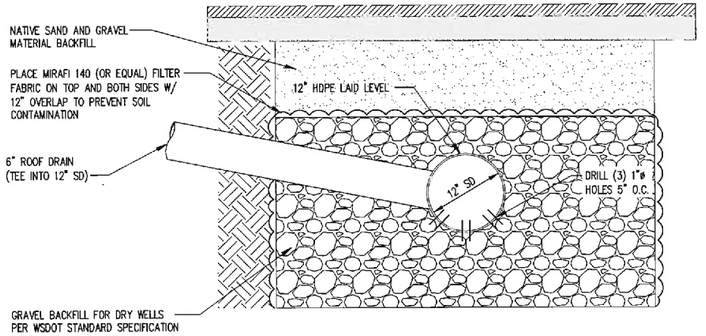
EAST BASIN - 2 (BIO-RETENTION POND):
EFFECTIVE DEPTH: 4.5'
RISER HEIGHT: 4.0'

ORIFICE #1: 0.1-INCH @ 0.00-FEET
ORIFICE #2: 1.0-INCH @ 2.50-FEET
ORIFICE #3: 1.0-INCH @ 3.00-FEET

WEST BASIN - 2 (DETENTION VAULT):
EFFECTIVE DEPTH: 7'
RISER HEIGHT: 6.5'

ORIFICE #1: 1.55-INCH @ 0.00-FEET
ORIFICE #2: 2.00-INCH @ 4.00-FEET
ORIFICE #3: 1.50-INCH @ 6.00-FEET

ELBOW RESTRICTOR DETAIL
NTS



INFILTRATION TRENCH SECTION
NTS

SCJ ALLIANCE
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NO.	DATE	BY	REVISIONS
1			

SHEET TITLE: DRAINAGE NOTES AND DETAILS

PROJECT NAME: BAYAN TRAILS, OLYMPIA, WASHINGTON

SEAL: ROSS D. JARVIS, STATE OF WASHINGTON, 23566, REGISTERED PROFESSIONAL ENGINEER
09/05/2015

DESIGNER:	R. JARVIS
DRAWN BY:	L HURTADO
APPROVED BY:	R. JARVIS
DATE:	NOVEMBER, 2014
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DRAWING FILE No:	1541.01 SD-02
DRAWING No:	SD-02
SHEET No:	7 OF 13

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