Attachment M

THE ENCLAVE AT OAK TREE
2022100898
Drainage Report

Prepared for: **DR Horton**
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Report Date: **July 7, 2023**

Prepared by: **Jared Greisz, EIT**

Reviewed by: **Chloe McIntyre, PE**
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Project No: 21-088
Project Name: THE ENCLAVE AT OAK TREE
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I hereby state that this Preliminary Drainage Control Plan for The Enclave at Oak Tree located at 2402 Marvin Road SE, Olympia WA 98513 has been prepared by me or under my supervision and meets the requirements of the Thurston County Drainage Design and Erosion Control Manual and the standard of care and expertise which is usual and customary in this community for professional engineers. I understand that Thurston County does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities prepared by me.

Signature

07/10/2023

Date

Seal

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FACILITY SUMMARY FORM

Complete one for each facility on the project site including flow control and water quality treatment facilities (BMPs) such as, but not limited to: detention ponds, vaults, or tanks; infiltration ponds, trenches, swales, or vaults; bioretention facilities; biofiltration BMPs; wet ponds; constructed wetlands; dispersion areas & flow spreaders; StormFilters & other proprietary devices; etc. Attach 8 ½" by 11" sketch showing location of facility. Applicant may prepare one copy of parts 1 to 5 for the project and then attach multiple copies of parts 6 to 8 for each separate facility.

Facility Name or Identifier (e.g., Pond A):	**West Infiltration Treatment Pond, East Infiltration Treatment Pond Tract E Infiltration Trench**
Total Number of Facilities Associated with Project: *(For which a Facility Summary Form is being prepared)*	**2**
Name of Road or Street to Access Facility:	**A Road, O Road**
Name of Nearest Major Cross Street:	**Marvin Rd SE**
Hearings Examiner Case Number:	
Thurston County Project No./Bldg Permit No.:	
Parcel Number(s):	11823430100, 11826110000, 11826110300

To Be Completed By Utility Staff:

Utility facility number	
Parcel number status, (num)	
Parcel Number Status, (num, 1ch) (0, Known; 1, Public; 2, Unknown; 3, Unassigned).................	
Basin and Subbasin: (num, 6ch) (2ch for basin, 2ch for subbasin, 2ch future)	

Part 1 – Project Name and Proponent

Project Name:	**McAllister Springs**
Project Owner:	**DR Horton**
Project Contact:	**Raelyn Hulquist**
Address:	**11241 Slater Ave NE, Ste. 200, Kirkland WA, 98033**
Phone:	**(425) 825-3180**
Project Proponent (if different):	
Address:	
Phone:	
Project Engineer:	**Chloe McIntyre, PE**
Firm:	**Hatton Godat Pantier**
Phone:	**(360) 943 – 1599**

Part 2 – Project Location

Section	**23**
Township	**18**
Range	**1 W**

Names and addresses of adjacent property owners:

Glick Family Trust	2322 Marvin Rd SE, Olympia WA 98503
McAllister Meadows Homeowners Association	17404 Meridian E Ste F PMB 171, Puyallup WA 98375
Justin & Karah Wright	8403 23rd Ave SE, Lacey WA 98513
Yohan Son	8409 23rd Ave SE, Lacey WA 98513
Nyra Gallardo	8415 23rd Ave SE, Lacey WA 98513
Bradley Lawrance Stark	8421 23rd Ave SE, Lacey WA 98513
Abhineet Chowdhary	8427 23rd Ave SE, Lacey WA 98513
Swathi Narayanamoorthy	8433 23rd Ave SE, Lacey WA 98513
Daniel J Wagner	8439 23rd Ave SE, Lacey WA 98513
Emily Sheikh	2308 Olivia St SE, Lacey WA 98513
Toni M Forster	2647 Woodgrove St SE, Olympia WA 98513
Janet E Contes	2645 Woodgrove St SE, Olympia WA 98513
John H Wasierski	8422 Woodgrove Ct SE, Olympia WA 98513
William & Rebeca Lindauer	8438 Woodgrove Ct SE, Olympia WA 98513
John P Stalcup	8344 Woodgrove Ct SE, Lacey WA 98513
Josephine E Evans Trust	PO Box 5901, Lacey WA 98509-5901
Cathleen J Cook	8328 Woodgrove Ct SE, Olympia WA 98513
Frank & Linda Tekin	8320 Woodgrove Ct SE, Olympia WA 98513
Debbie D Thompson	8312 Woodgrove Ct SE, Olympia WA 98513
Daniel & Sarah Evans	8304 Woodgrove Ct SE, Olympia WA 98513
Katherine & Marlon Wakefield	8248 Woodgrove Ct SE, Olympia WA 98503
Ingrid Velasquez	8240 Woodgrove Ct SE, Olympia WA 98513
Clayton B Alayon	2636 Marvin Rd SE, Olympia WA 98503
Lacey Amer Lgn Post 94	PO Box 5639, Lacey WA 98509
American Legion Post 94	PO Box 5639, Lacey WA 98509
McAllister Park Homeowners Association	8617 Martin Way E, Lacey WA 98516

Joan S Hicks	2503 Mugho St SE, Olympia WA 98513
Julie C Manson	2521 Mugho St SE, Olympia WA 98513
Robert & Alicia Keeney	8506 27th Ave SE, Olympia WA 98503

Part 3 – Type of Permit Application

Type of permit (e.g., Building, Plat, etc.): **Plat**

Other permits (☒):

☐ DOF /W HPA

☐ COE 404

☐ COE Wetlands

☐ DOE Dam Safety

☐ FEMA

☐ Floodplain

☐ Shoreline Management

☒ Rockery/Retaining Wall

☒ Encroachment

☒ Grading

☐ Other

Other agencies (e.g., federal, state, local) that have had or will review this Drainage and Erosion Control Plan: City of Lacey

Part 4 – Proposed Project Description

What stream basin is the project in (e.g., Percival, Woodland)?	**Woodland**
Project Area, acres (total area of all parcels)	**36.05**
Project Area Disturbed, acres (total of all areas disturbed by project) *(Include all area cleared, graded, etc. as part of this project)*	**27.94**
Onsite Impervious Surfaces: *(excluding offsite public/private street frontage)*	
Existing Impervious Surface, acres:	**0**
Replaced Impervious Surface, acres:	**0**
Existing Impervious Converted to Landscape, acres:	**0**
New Impervious Surface, acres:	**17.30**
Total Impervious, acres (existing, new, and replaced):	**17.30**

Zoning: Low Density Residential 3-6 (LD 3-6) and Moderate Density Residential (MD)

Onsite:

Residential Subdivision:	
Number of Lots:	182
Lot size (average), acres:	0.09
Building Permit/Commercial Plat:	
Building(s) Footprint, acres:	
Concrete Paving, acres:	
Gravel Surface, acres:	
Lattice Block or Porous Paving, acres:	
New Public Roads (including gravel shoulder), acres:	3.89
New Private Roads (including gravel shoulder), acres:	0
Frontage Improvements (including gravel shoulder), acres:	0.38
Existing road frontage to center of right-of-way, acres:	0.61

Part 5 – Pre-Developed Project Site Characteristics

Stream through site (Y/N) N

Name:

DNR Type:

Type of feature this facility discharges to (e.g., lake, stream, intermittent stream, pothole, roadside ditch, sheet flow to adjacent private property, etc.):

Infiltration to groundwater

Swales (Y/N)	**N**
Steep slopes—steeper than 15% (Y/N)	**Y**
Erosion hazard (Y/N)	**N**
100-year floodplain (Y/N)	**N**
Lakes or Wetlands (Y/N)	**Y**
Seeps/springs (Y/N)	**N**
High groundwater table (Y/N)	**Y**
Wellhead Protection Area (Y/N)	**Y**
Other:	

Part 6A – Facility Description West

Facility Type:	West Pond
Facility Description:	Treatment Infiltration Pond

Total Area Tributary to Facility Including Offsite (acres):	13.02
Total Onsite Area Tributary to Facility (acres):	12.41
Design Impervious Area Tributary to Facility (acres):	7.74
Design Landscaped Area Tributary to Facility (acres):	5.28
Design Native Vegetation Area Tributary to Facility (acres):	0
Design Total Tributary Area to Facility (acres):	13.02
Water Quality Design Volume (ft^3):	47,928
Water Quality Design Flow (cfs):	1.2728
100-Year Return Interval, 24-hr Design Flow (cfs):	9.5305

Part 6B – Facility Description East

Facility Type:	East Pond
Facility Description:	Treatment Infiltration Pond

Total Area Tributary to Facility Including Offsite (acres):	14.51
Total Onsite Area Tributary to Facility (acres):	14.51
Design Impervious Area Tributary to Facility (acres):	8.75
Design Landscaped Area Tributary to Facility (acres):	5.76
Design Native Vegetation Area Tributary to Facility (acres):	0
Design Total Tributary Area to Facility (acres):	14.51
Water Quality Design Volume (ft^3):	52,521
Water Quality Design Flow (cfs):	1.4397
100-Year Return Interval, 24-hr Design Flow (cfs):	10.8492

Part 6C – Facility Description Tract E

Facility Type:	Tract E Trench
Facility Description:	Infiltration Trench
Total Area Tributary to Facility Including Offsite (acres):	1.65
Total Onsite Area Tributary to Facility (acres):	1.65
Design Impervious Area Tributary to Facility (acres):	1.65
Design Landscaped Area Tributary to Facility (acres):	0
Design Native Vegetation Area Tributary to Facility (acres):	0
Design Total Tributary Area to Facility (acres):	1.65
Water Quality Design Volume (ft^3):	-
Water Quality Design Flow (cfs):	-
100-Year Return Interval, 24-hr Design Flow (cfs):	1.8956

Part 7 – Release to Groundwater (if applicable)

Design Infiltration Rate (in/hr):	2
Average Annual Infiltration per WWHM:	55.9 ac-ft
Designed for 100% Infiltration (Y/N):	Y
Designed for Infiltration Treatment (Y/N):	Y

Part 8 – Release to Surface Water (N/A)

Discharge Structure: (check all that apply)

Single Orifice	___________	Elev.	___________	Dia.	___________
Multiple Orifice	___________	Elev. 1	___________	Dia.	___________
		Elev. 2	___________	Dia.	___________
		Elev. 3	___________	Dia.	___________
Weir	___________	Elev.	___________	Type	___________
Overflow Weir	___________	Elev.	___________	Dia./Width:	___________
Spillway	___________	Elev.	___________	Dia./Width:	___________
Pump(s)	___________	Model/Type:	___________	Rating:	___________
Other	___________				

Discharge to Surface Water:

Return Period	**Pre-Developed**	**Post-Developed**
2-Year:	___________	___________
5-Year:	___________	___________
10-Year:	___________	___________
25-Year:	___________	___________
50-Year:	___________	___________
100-Year:	___________	___________

Pond Information:

Design Max Surface Water Elevation (ft, msl):	___________
Design Maximum Pond Depth (ft):	___________
Pond Volume at Max Design Water Level (ft^3):	___________
Overflow Water Elevation (ft, msl):	___________
Sediment Storage Volume (ft, depth below outlet):	___________

BOND QUANTITIES WORKSHEET

To be completed with final design

DRAINAGE REPORT

Section 1 Proposed Project Description

Section 1.1 Permits

The Enclave at Oak Tree project will require grading, encroachment, building, and utility permits.

Section 1.2 Project Location

The Enclave at Oak Tree project is located east of Marvin Road in the City of Lacey Growth Area of Thurston County. The site is located in Section 23, Township 18, Range 1W, W.M. on tax parcel numbers 11823430100, 11826110000, and 11826110300. See site Vicinity Map on page 17.

Section 1.3 Property Boundaries and Zoning

The project site is bounded by Marvin Road SE and single-family homes to the west, and single-family homes to the north, south, and east.

Zoning for the property is Low Density (3-6) and Medium Density Residential.

Section 1.4 Project Description

The Enclave at Oak Tree project proposes to construct 131 single-family homes and 51 townhomes across three parcels totaling 36.23 acres. Construction will include approximately 8.08 ac of roof area, 4.22 ac of roadway, 1.31 ac of sidewalk, 1.95 ac of driveway, and two infiltration ponds. See proposed Site Plan on page 18.

Installation of utilities includes street lighting, dry utilities, sewer, and water. Water and sewer will be provided via connections to City of Lacey utilities.

Once complete, the plat will create impervious surfaces covering approximately 49% of the site. Currently the site is undeveloped. A summary of pre-developed and proposed pervious and impervious areas is included in Section 8.

Stormwater design was completed following 2022 Thurston County Drainage and Erosion Control Manual (DDECM). Stormwater runoff generated from all roads, sidewalks, and single-family roofs will be conveyed to one of two infiltration treatment ponds for treatment and infiltration. Runoff from the roofs of lots 12-20, 56-67 and 102-116 will be conveyed to a 70’x40’x4’ infiltration trench located in Tract E.

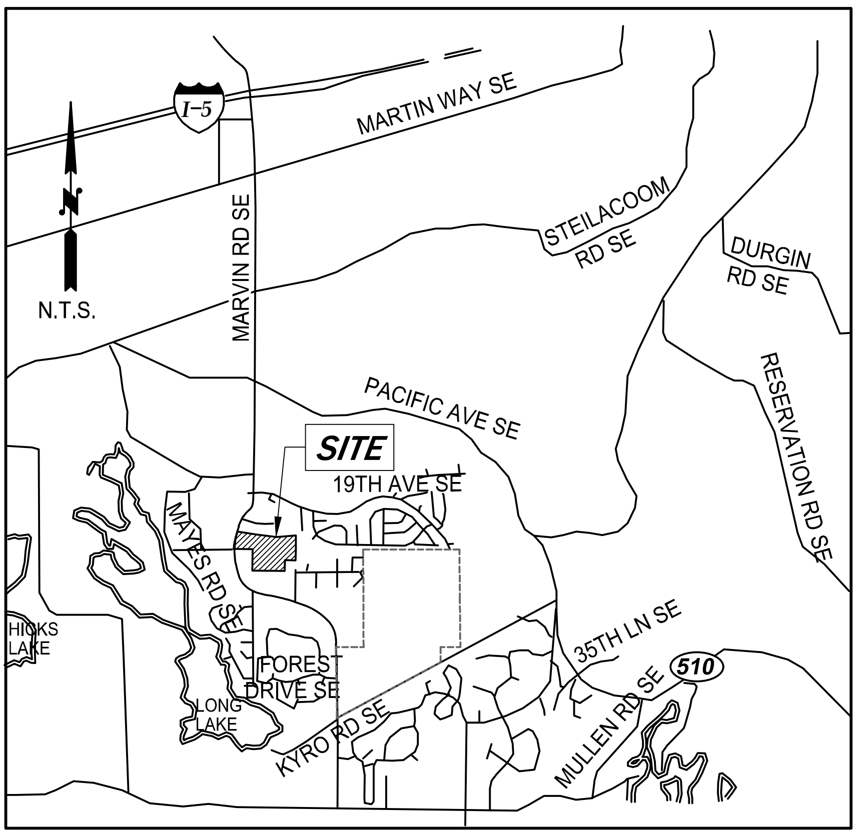
Onsite stormwater facilities have been sized using the WWHM continuous modeling software. Three basins were modeled: the west basin, the east basin, and the bypass basin. The west basin includes lots 1-14, 68-101, 131-146, and 173-182, and adjacent roads and sidewalks. The east basin includes lots 15-67 and 147-172, and adjacent roads and sidewalks. The bypass basin includes all project areas (including offsite frontage improvements) which cannot be collected and conveyed to proposed stormwater facilities.

Section 1.5 Timing of the Project

Construction is expected to take place from March 2024 to June 2025. Construction will take place over the wet season

Construction stormwater pollution source control measures have been selected to prevent adverse stormwater impacts from construction activities on downstream resources and on-site stormwater facilities. Refer to the Construction Stormwater Pollution Prevention Plan (C-SWPPP) submitted as part of this Drainage Control Plan for a more thorough explanation of construction BMPs associated with this project.

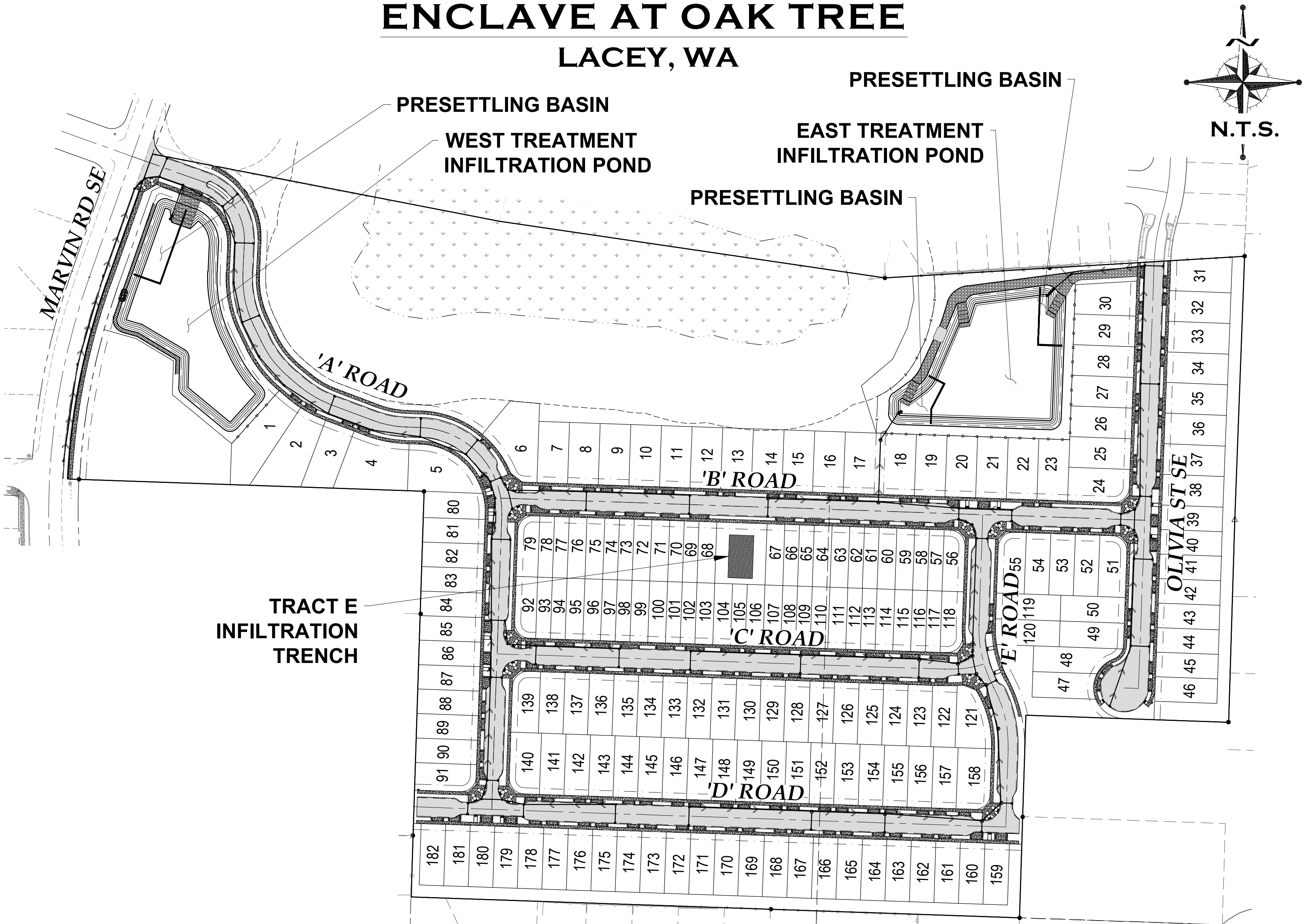
ENCLAVE AT OAK TREE
LACEY, WA



VICINITY MAP

ENCLAVE AT OAK TREE

LACEY, WA



SITE PLAN

Section 2 Existing Site Conditions

See page 21 for an Existing Conditions Map of the project site.

Section 2.1 Topography

The existing site generally slopes from southeast to northwest Elevations range from 234 in the southeast to 170 in the northwest at Marvin Road. See attached Existing Conditions Map on Page 21.

Section 2.2 Ground Cover

The site is vegetated with small to large trees. It has ferns, mixed brush undergrowth, scotch broom, blackberries, and grass. Existing oak trees will be preserved in Tract B.

Section 2.3 Drainage

In the existing condition runoff sheet flows from the south of the site to the north, towards the wetland in the north-central portion of the site.

Section 2.4 Soils

According to the NRCS soil survey, the site is largely comprised of Indianola loamy sand, most of which is 5 to 15% slopes. There is some Mukilteo muck, drained in the northern portion of the site at and near the wetland.

The Riley Group has conducted a geotechnical analysis dated April 1, 2022. The soils encountered were loose to medium dense deposits of silty sand with varying gravel, sand with varying silt and gravel, silty gravel with varying sand, gravel with varying silt and sand, and localized medium stiff silt.

A groundwater table was encountered at depths from 5.5 feet to 16 feet below existing grade. See further discussion of soils and groundwater in Section 3.

Section 2.5 Critical Areas

The site is located in a Category 1, 2, and 3 Critical Aquifer Recharge area. It is located within the 5-year time-of-travel wellhead protection area for the Lacey Water Department Group A system.

Section 2.6 Adjacent Areas

The site is bounded to the north-west by Marvin Rd SE, and to the north, south, east, and south-west by single-family homes. The site is within ½ mile of Long Lake.

Section 2.7 Precipitation Records

WWHM2012 continuous simulation hydrologic modeling software was used to size and analyze proposed BMPs for this project. WWHM2012 utilizes rainfall data for Thurston County from 1955 to 2011. See attached WWHM reports and output in Appendix 1.

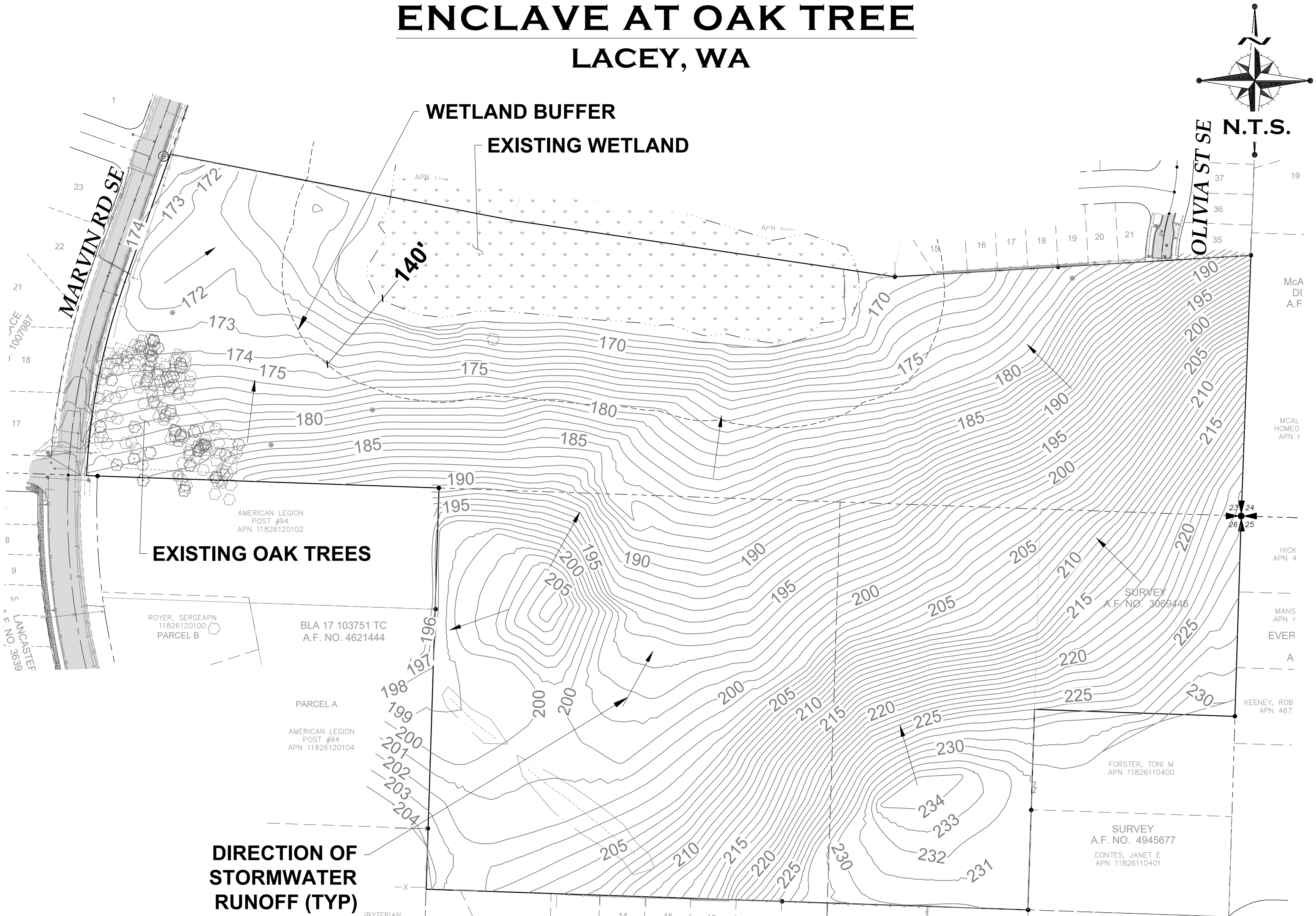
Section 2.8 Reports and Studies

A geotechnical report dated April 1, 2022 and conducted by The Riley Group, Inc. is included in Appendix 2 of this report. A Groundwater Monitoring report conducted by The Riley Group and dated August 16, 2022 is also included in Appendix 2 of this report.

The project is located in the WL-6 sub-basin of the Woodland Creek Basin Plan Area. The Woodland and Woodard Creek Comprehensive Drainage Basin Plan, August 1995, by Thurston County, the City of Lacey, and the City of Olympia indicates that this site could impact high peak flows in Woodland Creek. One of the alternatives presented in the Watershed Plan is infiltration of stormwater generated by development. Construction of Infiltration BMPs proposed by this project will reduce peak runoff from the site. The proposed stormwater mitigation measures for this project meet the intent of the recommended solution provided in the Basin Plan by reducing the peak runoff amounts contributing to Woodland Creek.

ENCLAVE AT OAK TREE

LACEY, WA



EXISTING CONDITIONS

Section 3 Geotechnical Report

The soil survey of Thurston County by US SCS indicates onsite soils are largely Indianola loamy sand with some Cagey loamy sand, Spana gravelly loam, and Mukilteo muck (See attached NRCS soils map in Appendix 2.)

A Geotechnical and stormwater evaluation was conducted by The Riley Group with findings summarized in a report dated April 1, 2022. The study consisted of 11 test pits and 3 borings. Samples from these excavations were tested for moisture content and grain size analysis for soil classification. Surface soils encountered were primarily 2-4 feet of brown silty sand with gravel, with sandy gravel with silt beneath. On top of these layers was 4-24” of sod. See Appendix 2 for Geotechnical Report.

The Riley Group monitored groundwater over the 2021-2022 wet season with findings summarized in a report dated August 16, 2022. Peak groundwater levels at the four monitoring wells ranged from depths of 5.75 feet bgs at MW-1 in the northwest of the site to 16.26 feet bgs in MW-3 slightly to its southeast. See Appendix 2 for a copy of the Groundwater Monitoring Report.

The Riley Group recommends an infiltration rate of 7.4 inches per hour at the location of the proposed west pond and 9.6 inches per hour at the proposed east pond. A long-term infiltration rate of 2 inches per hour was used in design to accommodate reduced separation to groundwater.

Section 4 Wells and Septic Systems

Records at Thurston County and the Department of Ecology were searched in order to locate the presence of wells and septic systems that may be located within the setback distances from the infiltration facilities. In addition, the Project Engineer, or someone under his/her direct supervision, has visited the site to verify the presence or absence of wells and septic systems as best can be done visually without trespassing onto other properties. All wells and septic systems found to be located within the setback distances from the infiltration facilities have been shown on the plans.

The site is within the 5-year time-of-travel well head protection area for the Lacey Water Department Group A water system.

Section 5 Fuel Tanks

Records at Thurston County and the Department of Ecology were searched in order to locate the presence of above and below ground fuel storage tanks that may be located within the setback distances from the infiltration facilities. In addition, the Project Engineer, or someone under his/her direct supervision, has visited the site to verify the absence of fuel tanks as best can be done visually without trespassing onto other properties. All fuel tanks found to be located within the setback distances from the infiltration facilities have been shown on the plans.

Section 6 Analysis of the 100-Year Flood

The Federal Emergency Management Agency prepares maps for all areas within Thurston County, including the incorporated cities therein. Panel #53067C0194E depicts the areas, if any, subjected to flooding in the vicinity of this proposal. By inspection of this map, this proposal appears to be located in Zone X, an area of minimal flooding. This area, therefore, is not located within the 100-year flood plain.

Section 7 Aesthetic Considerations for Facilities

All above ground stormwater facilities will be hydroseeded upon completion. Additional landscaping shall also be provided throughout the project in conformance with the approved landscaping and tree restoration plan, as applicable, and as otherwise required by the approving authority.

Signage designed in accordance with Appendix V-E of the 2022 Thurston County Drainage Design and Erosion Control Manual (DDECM) shall be installed for all aboveground stormwater facilities.

Section 8 Facility Sizing and Offsite Analysis

Section 8.1 Impervious and Pervious Area Tabulations

The Enclave at Oak Tree project is required to meet the criteria of the 2022 DDECM. The project site consists of three basins for stormwater modeling; the west basin, the east basin, and the bypass basin. The west basin will include lots 1-14, 68-101, 131-146, and 173-182, as well as Marvin Road frontage improvements. The east basin will include lots 15-67, 102-130, and 147-172. The bypass basin will include undeveloped portions of the site, including Tract A and the northern portion of the frontage improvements. See the attached Basin Map on page 25. Table 8.1 and Table 8.2 summarize the threshold discharge areas for each stormwater basin.

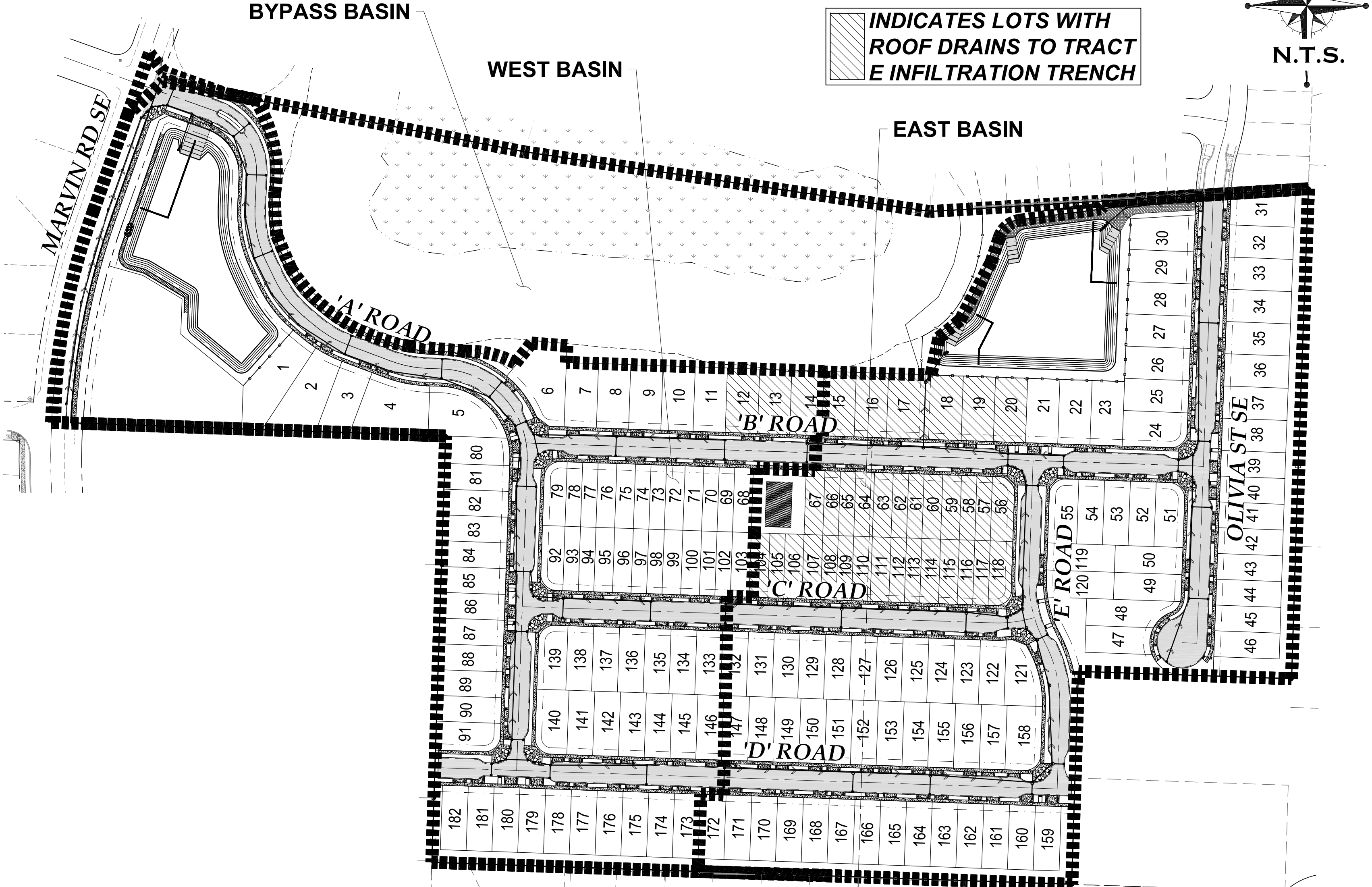
Table 8.1 Area Summary

Pre-Developed	Onsite	Frontage	Total	
Forest (A/B Flat)	5.49	0	5.49	
Forest (A/B Moderate)	22.69	0	22.69	
Forest (A/B Steep)	0.15	0	0.15	
Forest (C Flat)	5.40	0	5.40	
Forest (C Moderate)	2.24	0.61	2.84	
Forest (C Steep)	0.08	0	0.08	
Total	36.05	0.61	36.66	
100-Year Pre-Developed Flow Rate (cfs)	-	-	5.0155	
Developed	**West**	**East**	**Bypass**	**Total Site**
Roof (to Pond)	3.26	3.66	0	6.92
Roof (to Tract E Infiltration Trench)	0.18	1.47	0	1.65
Roads (Flat)	2.14	1.36	0	3.51
Roads (Moderate)	0	0.71	0	0.71
Sidewalk (Flat)	0.67	0.42	0	1.09
Sidewalk (Moderate)	0	0.22	0	0.22
Driveway	0.71	1.24	0	1.95
Pond	0.96	1.14	0	2.10
Lawn/Landscape (A/B Flat)	3.34	4.93	0	8.22
Lawn (A/B Moderate)	0.31	0	0	0.31
Lawn (A/B Steep)	0.22	0.83	0.58	1.64
Lawn (C Flat)	0.50	0	0	0.50
Forest (A/B Flat)	0	0	0.77	0.87
Forest (A/B Moderate)	0.91	0	1.53	1.75
Forest (C Flat)	0	0	1.53	1.75
Forest (C Moderate)	0	0	3.07	3.49
Total	13.20	15.98	7.48	36.66
100-Year Developed Flow Rate (cfs)	0	0	1.8060	1.8060

* Areas in table subject to rounding errors

ENCLAVE AT OAK TREE

LACEY, WA



BASIN MAP

Table 8.2 Area Conversion Summary by Threshold Discharge Area

(All areas measured in acres)	West	East	Bypass	Total Site
Existing Impervious Surface	0	0	0	0
Replaced Impervious Surface	0	0	0	0
New Impervious Surface	7.92	10.22	0	18.14
Converted Pervious Surface	4.29	5.76	0.61	10.66
Disturbed Areas	12.21	15.98	0.61	28.80
Undisturbed Areas	0	0	7.86	7.86

Section 8.2 Proposed BMP Design

The DDECM summarizes the thresholds which determine the applicability of the Core Requirements for each project. All new development projects are required to comply with Core Requirement #2; Construction Stormwater Pollution Prevention. Table 8.3 summarizes the thresholds which trigger compliance with the remaining Core Requirements.

Table 8.3 Thresholds for Core Requirement Applicability

	Required to comply with Core Requirements #1 through #5 & #11	Required to comply with Core Requirements #1 through #11
≥ 2,000 ft^2 of new, replaced, or new + replaced hard surface area	X	
≥ 7,000 ft^2 land disturbing activity	X	
≥ 5,000 ft^2 new + replaced hard surface area		X
Converts ≥ 0.75 acre of vegetation to lawn or landscape		X
Coverts ≥ 2.5 acres of native vegetation to pasture		X

This project adds approximately 790,000 square feet of impervious area; therefore, all Core Requirements apply.

The applicable Core Requirements are:

- Core Requirement #1: Stormwater Site Planning
- Core Requirement #2: Construction Stormwater Pollution Prevention Plan (SWPPP)
- Core Requirement #3: Source Control of Pollution
- Core Requirement #4: Preservation of Natural Drainage Systems and Outfalls
- Core Requirement #5: On-Site Stormwater Management

- Core Requirement #6: Runoff Treatment
- Core Requirement #7: Flow Control
- Core Requirement #8: Wetlands Protection
- Core Requirement #9: Operation and Maintenance
- Core Requirement #10: Financial Liability
- Core Requirement #11: Off-Site Analysis and Mitigation

Addressing these Core Requirements, it is anticipated that the proposed project will have little or no adverse effects on the downstream and surrounding hydrology. Each of the Core Requirements is discussed below.

CORE REQUIREMENT #1: STORMWATER SITE PLANNING

The main components of Stormwater Site Planning are Construction Stormwater Pollution Prevention Planning and Permanent Stormwater Control Planning. This Drainage Report, a Construction Stormwater Pollution Prevention Plan, Soils Report, Maintenance Plan, and copy of the proposed Maintenance Covenant for stormwater facilities will be submitted as part of The Enclave at Oak Tree Drainage Control Plan to meet this requirement.

CORE REQUIREMENT #2: CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN

A Construction Stormwater Pollution Prevention Plan (SWPPP) has been developed to address erosion and sediment control anticipated during construction and has been included as part of this Drainage Control Plan. The C-SWPPP addresses all thirteen elements as required by the Department of Ecology.

CORE REQUIREMENT #3: SOURCE CONTROL OF POLLUTION

Permanent source control BMPs are used to prevent stormwater from coming in contact with pollutants and are used as a cost-effective means of reducing pollutants in stormwater. The selection of permanent source control BMPs is based on the activities likely to occur on the site and the pollutants associated with those activities.

Based on a check of Volume IV of the DDECM, the applicable activities with Source Control BMP's on this site include automobile washing, automobile maintenance, storage of solid wastes and food wastes, composting, yard hazardous material use, storage and disposal, pet waste management and maintenance of stormwater drainage and treatment facilities.

There are two types of source control BMPs: operational and structural. Operational source control BMPs are non-structural practices that prevent or reduce pollutants from entering stormwater. Structural source control BMP's are physical, structural, or mechanical devices or facilities intended to prevent pollutants from entering stormwater. Section 1.5.1, Volume IV of the DDECM lists examples of both operational and structural source control BMP's.

Examples of Operational Source Control BMPs

A. Form a Pollution Prevention Team that will be responsible for inspecting the stormwater systems and potential pollution sources, operation and maintenance of stormwater systems and enforcement of preventing pollution discharges into the stormwater systems. The team will also be the emergency response team.

B. Good housekeeping includes containing and cleaning up spills on any exposed soils, vegetation or paved areas; sweeping paved surfaces; cleaning pollutants and debris from all BMPs regularly; and making repairs to containment systems, leaks and other sources that could pollute the drainage system.

C. Preventative Maintenance

1. Provide recycling or post signs to recycle materials such as oils, solvents and wood waste to the maximum extent practicable.
2. Prevent the discharge of unpermitted liquids and solids into the storm drainage system.
3. Use drip pans to collect leaks and spills from vehicles and equipment.
4. Store liquids in steel or plastic containers that are rigid, durable, corrosion resistant, non-absorbent, water tight, rodent-proof and equipped with a close fitting cover.

D. Spill Prevention and Cleanup

1. Stencil warning signs at stormwater catch basins and drains – “Dump no waste”.
2. Immediately stop, contain and clean up all spills.
3. Contact appropriate local agency (Fire Department, Thurston County Public Works, Health Department or Department of Ecology) for assistance and guidance.
4. Keep spill containment and clean up kits readily accessible.

E. Employee training shall include identification of pollutant sources, understanding pollutant control measures, spill response procedures and acceptable material handling practices.

F. Inspections

1. Inspections should occur, a minimum of twice a year, once during October 1 through April 30 and once during May 1 through September 30. Verify that BMPs are being implemented adequately and make note of any observations of floating materials, suspended solids, oil and grease, discoloration, turbidity or odor in stormwater discharges. Check pH as needed.
2. Determine whether there are unpermitted non-stormwater discharges to the drainage system and eliminate discharges.

G. Retain the following reports for at least three years:

1. Visual inspection reports.
2. Reports on spills of oil or hazardous substances greater than Reportable Quantities that cause a violation of the State of Washington’s Water Quality Standards. Contact Department of Ecology and ask for an oil spill operations or a hazardous waste specialist to determine if a spill is a substance of a Reportable Quantity. Southwest Region Dept. of Ecology: (360) 407-6300 or call 911.

Examples of Structural Source Control BMPs

A. Enclosing or covering pollutant sources (i.e., within a building or other enclosure, a roof over storage and working areas, a temporary tarpaulin, etc).

B. Physically segregating the pollutant source to prevent contact with uncontaminated stormwater that runs on the site from surrounding areas.

C. Devices that separate contaminated runoff and send it to appropriate treatment instead of discharging into the main stormwater flow. For instance, polluted runoff could be discharged to a sanitary sewer if a permit is first obtained from the sewer service provider. Contact your local sewer service provider to determine what the requirements for industrial pre-treatment are for your location.

The owner will receive a copy of the Pollution Source Control Program included in the Stormwater Maintenance Plan submitted as part of the Drainage Control Plan for The Enclave at Oak Tree project.

CORE REQUIREMENT #4: PRESERVATION OF NATURAL DRAINAGE SYSTEMS AND OUTFALLS

Infiltration BMPs will be used to reduce developed site runoff to the maximum extent feasible. In the existing condition, runoff from the project area sheet flows from the south towards the existing wetland in the north of the site. In the developed condition, runoff from the project will be collected by catch basins and conveyed by stormwater pipes to one of two onsite infiltration treatment ponds or an infiltration trench for 100% infiltration per WWHM models (see attached WWHM reports in Appendix 1). Runoff from the west basin will go to the west infiltration pond, runoff from the east basin to the east infiltration pond, with runoff from the roofs on lots 12-14 in the west basin and 15-20, 56-68, and 101-116 in the east basin going to the Tract E infiltration trench. Runoff from the bypass basin will continue to sheet flow to the north, matching existing. Proposed stormwater mitigation BMPs reduce stormwater runoff from the site and mimic pre-developed natural drainage patterns. Impacts to existing downstream drainage systems are not anticipated.

CORE REQUIREMENT #5: ON-SITE STORMWATER MANAGEMENT

The 2022 DDECM summarizes the requirements for employing on-site stormwater management BMPs, providing treatment, and flow control in decision charts. This project proposes to satisfy Core Requirement #5 by meeting the LID Performance Standard as defined in the 2022 DDECM.

The project proposes to implement Postconstruction Soil Quality and Depth (LID.02) in all new and disturbed lawn/landscape areas to retain greater stormwater functions, including increased infiltration potential and treatment of pollutants and sediments resulting from development. Two treatment infiltration ponds (IN.01) and a 70’x40’x4’ infiltration trench will be employed to infiltrate 100% of tributary stormwater runoff. The combination of stormwater BMPs used for this project results in the site meeting the Low Impact Development Performance Standard as illustrated on page 21 of the 21-088 Site Analysis WWHM report. See attached report in Appendix 1.

CORE REQUIREMENT #6: RUNOFF TREATMENT

Table 8.4 below summarizes the thresholds for construction of stormwater treatment facilities.

Table 8.4 Thresholds for Core Requirement #6: Runoff Treatment

	Required to Comply
≥ 5,000 sf of total effective pollution-generating hard surface (PGHS)	X
≥ ¾ acres of pollution-generating pervious surface (PGPS) from which there will be a surface discharge in a natural or artificial conveyance system from the site	X

This project generates more than 5,000 square feet of pollution-generating hard surfaces and is therefore required to provide stormwater runoff treatment.

The project receiving waters do not have pollutants of concern. Oil control is not required because the project is not a high use site. Phosphorus treatment is required because the project is within the drainage basin for Long Lake, one of the lakes listed in Section 4.2.8.2 of the Thurston County DDECM of water bodies requiring phosphorus control. Enhanced treatment is not required as the project is not commercial, industrial, or multi-family, and does not have high annual average daily traffic roads.

The project proposes to provide basic and phosphorus treatment by utilizing a pre-settling basin and infiltrating 100% of stormwater from pollution-generating surfaces through the infiltration treatment ponds.

The onsite treatment infiltration ponds were sized in accordance with the 2022 DDECM. Treatment for runoff from pollution-generating surfaces will be provided by the combined use of presettling basins and treatment infiltration ponds. The presettling basins were sized to hold a minimum of 30% of the Water Quality Volume for tributary stormwater runoff calculated by WWHM. The infiltration ponds will be constructed with a 24” amended treatment liner per the specifications in Volume V, Appendix V-B of the DDECM to meet the site suitability criteria for infiltration treatment. The treatment liner will allow the ponds to meet the requirements of Volume III, Section 2.3 of the DDECM.See Appendix 1 for associated WWHM reports and calculations.

Core Requirement #7: Flow Control

Table 8.5 below summarizes the thresholds for achievement of the standard flow control requirement for Western Washington.

Table 8.5 Thresholds for Core Requirement #7: Flow Control

	Required to Comply
≥ ¾ acres of native vegetation converted to lawn/landscape or ≥ 2.5 acres converted to pasture from which there is a surface discharge in a natural or artificial conveyance system from the site	X
≥ 10,000 sf of effective impervious area	X
≥ 0.10 cfs increase in the 100-year storm flow frequency using 1-hour time steps or ≥ 0.15 cfs increase in the 100-year storm flow frequency using 15-minute time steps	X

This project generates more than 10,000 square feet of effective hard surfaces and is therefore required to provide flow control.

Flow control for the project will be provided via onsite treatment infiltration ponds and an infiltration trench. The facilities are sized using the WWHM2012 continuous model to fully infiltrate runoff from the site, to meet predeveloped stormwater durations from 50% of the 2-year recurrence interval peak flow up to the full 50-year peak flow. Roof areas of 1950 sf for 40 foot wide lots and 2600 sf for 50 foot wide lots were assumed, with 1800 sf per townhome and 500 sf per driveway. An infiltration rate of 2 inches per hour was used for the ponds, consistent with site soils and treatment soil specifications identified in the 2022 DDECM. See calculations, the Site Analysis Report, and the Tract E Trench report in Appendix 1, which illustrate that the site meets stream protection durations.

Core Requirement #8: Wetlands Protection

This project does not propose to discharge to a wetland through a conveyance system. Wetlands protection is not required.

Core Requirement #9: Operation and Maintenance

Proper operation and maintenance of proposed stormwater facilities is a vital component to the success of stormwater mitigation. A Maintenance Plan and Stormwater Maintenance Agreement will be prepared and included as part of the Drainage Control Plan for The Enclave at Oak Tree project with final design.

Core Requirement #10: Financial Liability

Financial guarantees will be provided to ensure that:

1. The project will operate according to the design approved by the project engineer, and
2. Operation of erosion control facilities will provide protection against siltation of surface water, erosion, damage to permanent stormwater BMPs, and damage to adjacent properties.

Core Requirement #11: Off-Site Analysis and Mitigation

An off-site analysis was conducted to determine any potential water quality, erosion, slope stability, or drainage impacts that may be caused or aggravated by the proposed improvements.

The project proposes to use infiltration BMPs and post-construction soil enhancements to reduce overall site runoff from the pre-developed condition. A majority of onsite runoff will be conveyed via catch basins and piping to the west infiltration pond, east infiltration pond, or Tract E infiltration trench.

The site is split into three basins, the west basin for which runoff goes to the west infiltration pond, the east basin for which runoff goes to the east infiltration pond, and the bypass basin for which runoff matches existing conditions and sheet flows north. The facilities have been sized to fully infiltrate all tributary runoff.

The site is located in a Category 1, 2, and 3 Critical Aquifer Recharge Area and the 5-year time-of-travel area for the Group A Lacey Water system. Runoff from pollution-generating surfaces will be treated via infiltration treatment ponds prior to 100% infiltration so the project is not anticipated to have adverse impacts on the critical areas or water quality.

Conveyance capacity is not anticipated to be a problem. Onsite conveyance systems will be designed to convey the 25-year 24-hour flow in accordance with the DDECM. Flows tributary to downstream conveyances will be reduced by development of this site. See Section 8.3 for analysis. Erosion impacts are not anticipated. No stream channel or surface flow impacts are anticipated as the runoff is being fully infiltrated.

In the event that stormwater facilities fail or precipitation exceeds the capacity of the ponds, runoff will exit the ponds through appropriately sized overflow spillways for each pond. The east pond spillway will direct runoff toward the existing wetland in the northern portions of the site, matching existing conditions.

The west pond spillway will direct runoff toward Marvin Road, matching existing conditions. Runoff in Marvin Road will ultimately continue to flow to a low point north of the site, and eventually flow toward the existing wetland in the northern portions of this project.

The project will reduce overall runoff from the site, improving any existing capacity or flooding issues that may exist. No adverse downstream impacts are expected due to the development of the site.

Section 8.3 Conveyance System Analysis and Design

Onsite conveyance and piping will be sized to convey the 25-year flow in accordance with the 2022 Thurston County DDECM at final design.

Section 9 Utilities

Proposed utilities for the project are shown on the site plan and have been designed to accommodate the drainage design.

Section 10 Covenants, Dedications, and Easements

All stormwater facilities located on private property shall be owned, operated and maintained by the property owners, their heirs, successors and assigns. The property owners shall enter into an agreement with the governing body, a copy of which agreement is included in the Maintenance Plan included as part of the Drainage Control Plan. The agreement requires maintenance of the stormwater facilities in accordance with the maintenance plan provided and shall grant easement for access to the governing body to inspect the stormwater facilities. The agreement also makes provisions for the governing body to make repairs, after due notice is given to the owners, if repairs are necessary to ensure proper performance of the stormwater system and if the owners fail to make the necessary repairs. The cost of said repairs shall be borne by the property owners, their heirs, successors, and assigns.

Section 11 Property Owners Association Articles of Incorporation

All residential subdivisions shall form a Homeowners' Association (HOA) for the purpose of assigning responsibility and liability for the operation and maintenance of stormwater facilities jointly serving lots within the subdivision. The HOA is not required for facilities that serve a single property owner. Articles of Incorporation shall be prepared for the HOA and submitted to the governing body with Final Plat Approval.

Section 12 Other Permits or Conditions Place on the Project

Agency Permit/Approval

City of Lacey	Plan Review
Thurston County	Encroachment
Thurston County	Construction Permit

APPENDIX 1 DESIGN CALCULATIONS

Area Summary

	Pre-Developed			Developed			
	Onsite	Frontage	Total	West*	East	Bypass**	Total
Forest (A/Flat)	5.49		5.49			0.77	0.77
Forest (A/Moderate)	22.69		22.69	0.91		1.53	2.45
Forest (A/Steep)	0.15		0.15				
Forest (C/Flat)	5.40		5.40			1.53	1.53
Forest (C/Moderate)	2.24	0.61	2.85			3.07	3.07
Forest (C/Steep)	0.08		0.08				
Lawn (A/Flat)				3.34	4.93		8.26
Lawn (A/Moderate)				0.31			0.31
Lawn (A/Steep)				0.22	0.83	0.58	1.64
Lawn (C/Flat)				0.50			0.50
Roof (to Pond)				3.26	3.66		6.92
Roof (to Tract E)				0.18	1.47		1.65
Road (Flat)				2.14	1.36		3.51
Road (Moderate)				0.00	0.71		0.71
Driveway (Flat)				0.71	1.24		1.95
Sidewalk (Flat)				0.67	0.42		1.09
Sidewalk (Moderate)				0.00	0.22		0.22
Pond				0.96	1.14		2.10
Total	36.05	0.61	36.66	13.20	15.98	7.48	36.66

Developed Summary

Impervious			
West	East	Bypass	Total
7.92	10.22	0.00	18.14
60%	64%	0%	49%

Pervious			
West	East	Bypass	Total
5.28	5.76	7.48	18.52
40%	36%	100%	51%

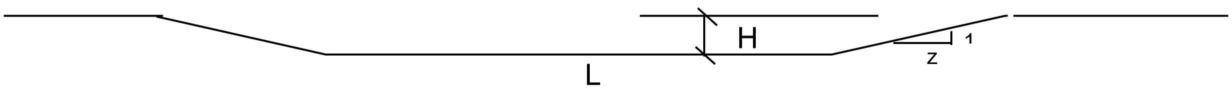
Assumptions:
Roof Area: 1950 SF per 40' wide lot
2600 SF per 50' wide lot
1800 SF per townhome
Driveway Area: 500 SF per lot
240 per townhome
*West Basin includes offsite areas associated with frontage
**Bypass Basin includes offsite areas associated with frontage

Presettling Basin Volume Summary

Basin	WQV (cf)	Required Volume (30% WQV) (cf)	Provided Volume				
			Bottom Elevation	Bottom Area (sf)	Top Elevation	Top Area (sf)	Volume (cf)
West	47,328	14198	170.5	3754	174	5696	16537.5
East-South	33,088	9926	174.5	1863	179	4319	13909.5
East-North	19,433	5830	174.5	1583	179	1912	7863.75

Emergency Overflow Spillway - West

Broad Crested Weir



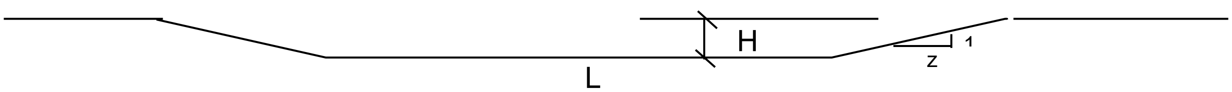
For this weir $Q_{100} = C\sqrt{2g}(2/3LH^{3/2} + 8/15Tan\ \theta H^{5/2})$

(equation 1 Volume V Page A-6 Thurston County 2016 DDECM)

C =	**0.6**	discharge coefficient
L =	**15.00'**	(6' Minimum)
z =	**3**	side slope
H =	**0.33'**	flow depth
Q =	9.61	cfs (100 Year Design Peak Inflow to Pond - 9.53 cfs)
V =	1.82	fps

Emergency Overflow Spillway - East

Broad Crested Weir



For this weir $Q_{100} = C\sqrt{2g}(2/3LH^{3/2} + 8/15Tan\,\theta H^{5/2})$

(equation 1 Volume V Page A-6 Thurston County 2016 DDECM)

C =	**0.6**	discharge coefficient
L =	**18.00'**	(6' Minimum)
z =	**3**	side slope
H =	**0.33'**	flow depth
Q =	11.44	cfs (100 Year Design Peak Inflow to Pond - 10.85 cfs)
V =	1.82	fps

WWHM2012

PROJECT REPORT

Site Analysis

General Model Information

Project Name:	21-088 Site Analysis
Site Name:	
Site Address:	
City:	
Report Date:	7/7/2023
Gage:	Woodland Creek
Data Start:	1955/10/01
Data End:	2011/09/30
Timestep:	15 Minute
Precip Scale:	0.889
Version Date:	2019/09/13
Version:	4.2.17

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

Onsite

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Flat	5.49
A B, Forest, Mod	22.69
A B, Forest, Steep	0.15
C, Forest, Flat	5.4
C, Forest, Mod	2.24
C, Forest, Steep	0.08
Pervious Total	36.05
Impervious Land Use	acre
Impervious Total	0
Basin Total	36.05

Element Flows To:

Surface	Interflow	Groundwater

Frontage

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	0.61
Pervious Total	0.61
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.61

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

W Basin

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Pasture, Flat	3.34
A B, Pasture, Mod	0.31
A B, Pasture, Steep	0.22
C, Pasture, Flat	0.5
A B IMP INF FLAT	0.18
A B, Forest, Mod	0.91
Pervious Total	5.46
Impervious Land Use	acre
ROADS FLAT	2.14
ROOF TOPS FLAT	3.26
DRIVEWAYS FLAT	0.71
SIDEWALKS FLAT	0.67
POND	0.96
Impervious Total	7.74
Basin Total	13.2

ROOFS GOING TO TRACT E INFILTRATION GALLERY

TRACT B UNDISTURBED AREA

Element Flows To:

Surface	Interflow	Groundwater
West Pond	West Pond	

E Basin

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Pasture, Flat	4.93
A B, Pasture, Steep	0.83
A B IMP INF FLAT	1.47
Pervious Total	7.23

ROOFS GOING TO
TRACT E INFILTRATION
GALLERY

Impervious Land Use	acre
ROADS FLAT	1.36
ROADS MOD	0.71
ROOF TOPS FLAT	3.66
DRIVEWAYS FLAT	1.24
SIDEWALKS FLAT	0.42
SIDEWALKS MOD	0.22
POND	1.14
Impervious Total	8.75
Basin Total	15.98

Element Flows To:

Surface	Interflow	Groundwater
East Pond	East Pond	

Basin 3

Bypass:	Yes
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Flat	0.77
A B, Forest, Mod	1.53
C, Forest, Flat	1.53
C, Forest, Mod	3.07
A B, Pasture, Steep	0.58
Pervious Total	7.48
Impervious Land Use	acre
Impervious Total	0
Basin Total	7.48

INCLUDES SOME LANDSCAPE AREAS NOT BEING CONVEYED TO A POND

Element Flows To:

Surface	Interflow	Groundwater

Routing Elements
Predeveloped Routing

Mitigated Routing

West Pond

Bottom Length: 264.27 ft.
Bottom Width: 100.00 ft.
Depth: 5 ft.
Volume at riser head: 2.8570 acre-feet.
Infiltration On
Infiltration rate: 2
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft.): 1528.661
Total Volume Through Riser (ac-ft.): 0
Total Volume Through Facility (ac-ft.): 1528.661
Percent Infiltrated: 100
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Side slope 1: 2.35 To 1
Side slope 2: 3 To 1
Side slope 3: 3 To 1
Side slope 4: 3 To 1
Discharge Structure
Riser Height: 4 ft.
Riser Diameter: 60 in.
Element Flows To:
Outlet 1 Outlet 2

Pond Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
170.00	0.606	0.000	0.000	0.000
170.06	0.609	0.033	0.000	1.223
170.11	0.611	0.067	0.000	1.223
170.17	0.614	0.101	0.000	1.223
170.22	0.617	0.136	0.000	1.223
170.28	0.619	0.170	0.000	1.223
170.33	0.622	0.204	0.000	1.223
170.39	0.624	0.239	0.000	1.223
170.44	0.627	0.274	0.000	1.223
170.50	0.630	0.309	0.000	1.223
170.56	0.632	0.344	0.000	1.223
170.61	0.635	0.379	0.000	1.223
170.67	0.637	0.414	0.000	1.223
170.72	0.640	0.450	0.000	1.223
170.78	0.643	0.486	0.000	1.223
170.83	0.645	0.521	0.000	1.223
170.89	0.648	0.557	0.000	1.223
170.94	0.651	0.593	0.000	1.223
171.00	0.653	0.630	0.000	1.223
171.06	0.656	0.666	0.000	1.223
171.11	0.658	0.703	0.000	1.223
171.17	0.661	0.739	0.000	1.223
171.22	0.664	0.776	0.000	1.223
171.28	0.666	0.813	0.000	1.223
171.33	0.669	0.850	0.000	1.223
171.39	0.672	0.887	0.000	1.223
171.44	0.675	0.925	0.000	1.223

171.50	0.677	0.962	0.000	1.223
171.56	0.680	1.000	0.000	1.223
171.61	0.683	1.038	0.000	1.223
171.67	0.685	1.076	0.000	1.223
171.72	0.688	1.114	0.000	1.223
171.78	0.691	1.153	0.000	1.223
171.83	0.693	1.191	0.000	1.223
171.89	0.696	1.230	0.000	1.223
171.94	0.699	1.268	0.000	1.223
172.00	0.702	1.307	0.000	1.223
172.06	0.704	1.346	0.000	1.223
172.11	0.707	1.386	0.000	1.223
172.17	0.710	1.425	0.000	1.223
172.22	0.713	1.465	0.000	1.223
172.28	0.715	1.504	0.000	1.223
172.33	0.718	1.544	0.000	1.223
172.39	0.721	1.584	0.000	1.223
172.44	0.724	1.624	0.000	1.223
172.50	0.726	1.665	0.000	1.223
172.56	0.729	1.705	0.000	1.223
172.61	0.732	1.746	0.000	1.223
172.67	0.735	1.786	0.000	1.223
172.72	0.738	1.827	0.000	1.223
172.78	0.740	1.868	0.000	1.223
172.83	0.743	1.910	0.000	1.223
172.89	0.746	1.951	0.000	1.223
172.94	0.749	1.993	0.000	1.223
173.00	0.752	2.034	0.000	1.223
173.06	0.754	2.076	0.000	1.223
173.11	0.757	2.118	0.000	1.223
173.17	0.760	2.160	0.000	1.223
173.22	0.763	2.203	0.000	1.223
173.28	0.766	2.245	0.000	1.223
173.33	0.769	2.288	0.000	1.223
173.39	0.771	2.331	0.000	1.223
173.44	0.774	2.373	0.000	1.223
173.50	0.777	2.417	0.000	1.223
173.56	0.780	2.460	0.000	1.223
173.61	0.783	2.503	0.000	1.223
173.67	0.786	2.547	0.000	1.223
173.72	0.789	2.591	0.000	1.223
173.78	0.791	2.635	0.000	1.223
173.83	0.794	2.679	0.000	1.223
173.89	0.797	2.723	0.000	1.223
173.94	0.800	2.767	0.000	1.223
174.00	0.803	2.812	0.000	1.223
174.06	0.806	2.857	0.695	1.223
174.11	0.809	2.901	1.964	1.223
174.17	0.812	2.946	3.607	1.223
174.22	0.815	2.992	5.552	1.223
174.28	0.817	3.037	7.755	1.223
174.33	0.820	3.083	10.18	1.223
174.39	0.823	3.128	12.82	1.223
174.44	0.826	3.174	15.65	1.223
174.50	0.829	3.220	18.64	1.223
174.56	0.832	3.266	21.79	1.223
174.61	0.835	3.313	25.08	1.223
174.67	0.838	3.359	28.49	1.223

174.72	0.841	3.406	32.01	1.223
174.78	0.844	3.453	35.62	1.223
174.83	0.847	3.500	39.32	1.223
174.89	0.850	3.547	43.08	1.223
174.94	0.853	3.594	46.89	1.223
175.00	0.856	3.641	50.74	1.223
175.06	0.859	3.689	54.60	1.223

East Pond

Bottom Length:	294.68 ft.	
Bottom Width:	100.00 ft.	
Depth:	6 ft.	
Volume at riser head:	3.8997 acre-feet.	
Infiltration On		
Infiltration rate:	2	
Infiltration safety factor:	1	
Total Volume Infiltrated (ac-ft.):		1685.247
Total Volume Through Riser (ac-ft.):		0
Total Volume Through Facility (ac-ft.):		1685.247
Percent Infiltrated:		100
Total Precip Applied to Facility:		0
Total Evap From Facility:		0
Side slope 1:	2 To 1	
Side slope 2:	2 To 1	
Side slope 3:	3 To 1	
Side slope 4:	0.82 To 1	
Discharge Structure		
Riser Height:	5 ft.	
Riser Diameter:	60 in.	
Element Flows To:		
Outlet 1	Outlet 2	

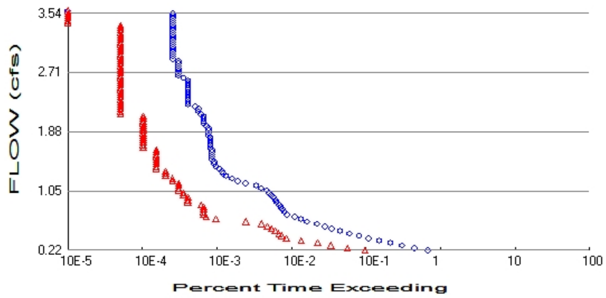
Pond Hydraulic Table

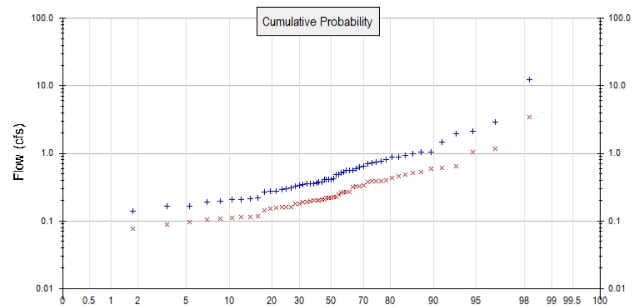
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
174.00	0.676	0.000	0.000	0.000
174.07	0.679	0.045	0.000	1.364
174.13	0.681	0.090	0.000	1.364
174.20	0.684	0.136	0.000	1.364
174.27	0.687	0.181	0.000	1.364
174.33	0.690	0.227	0.000	1.364
174.40	0.692	0.273	0.000	1.364
174.47	0.695	0.320	0.000	1.364
174.53	0.698	0.366	0.000	1.364
174.60	0.700	0.413	0.000	1.364
174.67	0.703	0.460	0.000	1.364
174.73	0.706	0.507	0.000	1.364
174.80	0.708	0.554	0.000	1.364
174.87	0.711	0.601	0.000	1.364
174.93	0.714	0.649	0.000	1.364
175.00	0.717	0.696	0.000	1.364
175.07	0.719	0.744	0.000	1.364
175.13	0.722	0.792	0.000	1.364
175.20	0.725	0.841	0.000	1.364
175.27	0.728	0.889	0.000	1.364
175.33	0.730	0.938	0.000	1.364
175.40	0.733	0.986	0.000	1.364
175.47	0.736	1.035	0.000	1.364
175.53	0.739	1.085	0.000	1.364
175.60	0.741	1.134	0.000	1.364
175.67	0.744	1.184	0.000	1.364
175.73	0.747	1.233	0.000	1.364
175.80	0.750	1.283	0.000	1.364
175.87	0.752	1.333	0.000	1.364

175.93	0.755	1.384	0.000	1.364
176.00	0.758	1.434	0.000	1.364
176.07	0.761	1.485	0.000	1.364
176.13	0.763	1.536	0.000	1.364
176.20	0.766	1.587	0.000	1.364
176.27	0.769	1.638	0.000	1.364
176.33	0.772	1.689	0.000	1.364
176.40	0.775	1.741	0.000	1.364
176.47	0.777	1.792	0.000	1.364
176.53	0.780	1.844	0.000	1.364
176.60	0.783	1.897	0.000	1.364
176.67	0.786	1.949	0.000	1.364
176.73	0.789	2.001	0.000	1.364
176.80	0.791	2.054	0.000	1.364
176.87	0.794	2.107	0.000	1.364
176.93	0.797	2.160	0.000	1.364
177.00	0.800	2.213	0.000	1.364
177.07	0.803	2.267	0.000	1.364
177.13	0.805	2.320	0.000	1.364
177.20	0.808	2.374	0.000	1.364
177.27	0.811	2.428	0.000	1.364
177.33	0.814	2.482	0.000	1.364
177.40	0.817	2.537	0.000	1.364
177.47	0.820	2.591	0.000	1.364
177.53	0.822	2.646	0.000	1.364
177.60	0.825	2.701	0.000	1.364
177.67	0.828	2.756	0.000	1.364
177.73	0.831	2.812	0.000	1.364
177.80	0.834	2.867	0.000	1.364
177.87	0.837	2.923	0.000	1.364
177.93	0.840	2.979	0.000	1.364
178.00	0.842	3.035	0.000	1.364
178.07	0.845	3.091	0.000	1.364
178.13	0.848	3.148	0.000	1.364
178.20	0.851	3.204	0.000	1.364
178.27	0.854	3.261	0.000	1.364
178.33	0.857	3.318	0.000	1.364
178.40	0.860	3.375	0.000	1.364
178.47	0.863	3.433	0.000	1.364
178.53	0.865	3.491	0.000	1.364
178.60	0.868	3.548	0.000	1.364
178.67	0.871	3.606	0.000	1.364
178.73	0.874	3.665	0.000	1.364
178.80	0.877	3.723	0.000	1.364
178.87	0.880	3.782	0.000	1.364
178.93	0.883	3.840	0.000	1.364
179.00	0.886	3.899	0.000	1.364
179.07	0.889	3.958	0.913	1.364
179.13	0.891	4.018	2.582	1.364
179.20	0.894	4.077	4.741	1.364
179.27	0.897	4.137	7.295	1.364
179.33	0.900	4.197	10.18	1.364
179.40	0.903	4.257	13.37	1.364
179.47	0.906	4.318	16.82	1.364
179.53	0.909	4.378	20.51	1.364
179.60	0.912	4.439	24.41	1.364
179.67	0.915	4.500	28.49	1.364
179.73	0.918	4.561	32.72	1.364

179.80	0.921	4.622	37.09	1.364
179.87	0.924	4.684	41.57	1.364
179.93	0.927	4.745	46.12	1.364
180.00	0.929	4.807	50.74	1.364
180.07	0.932	4.869	55.38	1.364

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 36.66
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 20.17
Total Impervious Area: 16.49

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.434447
5 year	0.923024
10 year	1.450028
25 year	2.45655
50 year	3.542738
100 year	5.011485

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.231698
5 year	0.448751
10 year	0.657383
25 year	1.016082
50 year	1.367619
100 year	1.805972

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1956	0.562	0.247
1957	0.760	0.428
1958	0.214	0.111
1959	0.337	0.200
1960	0.509	0.270
1961	0.412	0.209
1962	0.141	0.077
1963	1.050	0.584
1964	0.811	0.458
1965	0.354	0.193

1966	0.218	0.116
1967	0.530	0.224
1968	0.298	0.160
1969	0.198	0.106
1970	0.344	0.182
1971	2.108	0.642
1972	0.882	0.378
1973	0.373	0.201
1974	0.411	0.217
1975	1.031	0.614
1976	0.480	0.268
1977	0.167	0.096
1978	0.942	0.482
1979	0.567	0.331
1980	0.362	0.196
1981	0.651	0.387
1982	0.558	0.269
1983	0.587	0.330
1984	0.413	0.217
1985	0.191	0.109
1986	0.994	0.529
1987	0.751	0.316
1988	0.271	0.142
1989	0.276	0.155
1990	0.708	0.391
1991	2.881	1.035
1992	12.435	3.404
1993	1.486	0.399
1994	0.209	0.114
1995	0.492	0.263
1996	0.717	0.384
1997	1.967	1.182
1998	0.876	0.518
1999	0.376	0.204
2000	0.208	0.113
2001	0.066	0.036
2002	0.417	0.221
2003	0.165	0.088
2004	0.293	0.160
2005	0.267	0.150
2006	0.355	0.192
2007	0.308	0.162
2008	0.409	0.224
2009	0.619	0.338
2010	0.352	0.205
2011	0.325	0.178

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	12.4346	3.4039
2	2.8813	1.1824
3	2.1082	1.0351
4	1.9673	0.6424
5	1.4863	0.6144
6	1.0501	0.5838
7	1.0308	0.5294
8	0.9936	0.5177

9	0.9422	0.4818
10	0.8824	0.4578
11	0.8760	0.4284
12	0.8110	0.3995
13	0.7604	0.3906
14	0.7506	0.3871
15	0.7172	0.3844
16	0.7083	0.3782
17	0.6515	0.3381
18	0.6193	0.3308
19	0.5873	0.3299
20	0.5668	0.3159
21	0.5620	0.2699
22	0.5576	0.2695
23	0.5299	0.2675
24	0.5087	0.2633
25	0.4918	0.2472
26	0.4804	0.2236
27	0.4167	0.2235
28	0.4129	0.2211
29	0.4125	0.2175
30	0.4112	0.2171
31	0.4093	0.2085
32	0.3757	0.2048
33	0.3733	0.2039
34	0.3624	0.2010
35	0.3546	0.2001
36	0.3544	0.1960
37	0.3519	0.1928
38	0.3438	0.1918
39	0.3375	0.1823
40	0.3253	0.1777
41	0.3083	0.1622
42	0.2982	0.1602
43	0.2931	0.1597
44	0.2759	0.1548
45	0.2714	0.1499
46	0.2669	0.1416
47	0.2177	0.1159
48	0.2137	0.1143
49	0.2087	0.1135
50	0.2076	0.1110
51	0.1976	0.1090
52	0.1911	0.1057
53	0.1666	0.0964
54	0.1650	0.0876
55	0.1412	0.0770
56	0.0664	0.0364

Duration Flows
The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.2172	13081	1901	14	Pass
0.2508	8758	1105	12	Pass
0.2844	5987	664	11	Pass
0.3180	4145	440	10	Pass
0.3516	2949	266	9	Pass
0.3852	2117	167	7	Pass
0.4188	1571	146	9	Pass
0.4524	1167	133	11	Pass
0.4860	880	118	13	Pass
0.5195	681	105	15	Pass
0.5531	551	93	16	Pass
0.5867	428	78	18	Pass
0.6203	318	48	15	Pass
0.6539	261	19	7	Pass
0.6875	216	14	6	Pass
0.7211	169	13	7	Pass
0.7547	159	13	8	Pass
0.7883	149	13	8	Pass
0.8219	141	13	9	Pass
0.8555	134	12	8	Pass
0.8890	126	8	6	Pass
0.9226	120	8	6	Pass
0.9562	113	8	7	Pass
0.9898	104	7	6	Pass
1.0234	98	7	7	Pass
1.0570	91	6	6	Pass
1.0906	77	6	7	Pass
1.1242	66	6	9	Pass
1.1578	47	6	12	Pass
1.1914	37	5	13	Pass
1.2250	31	5	16	Pass
1.2585	26	4	15	Pass
1.2921	24	4	16	Pass
1.3257	23	4	17	Pass
1.3593	21	3	14	Pass
1.3929	19	3	15	Pass
1.4265	18	3	16	Pass
1.4601	18	3	16	Pass
1.4937	17	3	17	Pass
1.5273	17	3	17	Pass
1.5609	17	3	17	Pass
1.5945	17	3	17	Pass
1.6280	17	3	17	Pass
1.6616	16	2	12	Pass
1.6952	16	2	12	Pass
1.7288	16	2	12	Pass
1.7624	16	2	12	Pass
1.7960	16	2	12	Pass
1.8296	15	2	13	Pass
1.8632	15	2	13	Pass
1.8968	15	2	13	Pass
1.9304	15	2	13	Pass
1.9640	14	2	14	Pass

1.9975	13	2	15	Pass
2.0311	13	2	15	Pass
2.0647	13	2	15	Pass
2.0983	13	2	15	Pass
2.1319	12	1	8	Pass
2.1655	11	1	9	Pass
2.1991	11	1	9	Pass
2.2327	10	1	10	Pass
2.2663	8	1	12	Pass
2.2999	8	1	12	Pass
2.3335	8	1	12	Pass
2.3671	8	1	12	Pass
2.4006	8	1	12	Pass
2.4342	8	1	12	Pass
2.4678	8	1	12	Pass
2.5014	8	1	12	Pass
2.5350	8	1	12	Pass
2.5686	8	1	12	Pass
2.6022	8	1	12	Pass
2.6358	7	1	14	Pass
2.6694	6	1	16	Pass
2.7030	6	1	16	Pass
2.7366	6	1	16	Pass
2.7701	6	1	16	Pass
2.8037	6	1	16	Pass
2.8373	6	1	16	Pass
2.8709	6	1	16	Pass
2.9045	5	1	20	Pass
2.9381	5	1	20	Pass
2.9717	5	1	20	Pass
3.0053	5	1	20	Pass
3.0389	5	1	20	Pass
3.0725	5	1	20	Pass
3.1061	5	1	20	Pass
3.1396	5	1	20	Pass
3.1732	5	1	20	Pass
3.2068	5	1	20	Pass
3.2404	5	1	20	Pass
3.2740	5	1	20	Pass
3.3076	5	1	20	Pass
3.3412	5	1	20	Pass
3.3748	5	1	20	Pass
3.4084	5	0	0	Pass
3.4420	5	0	0	Pass
3.4756	5	0	0	Pass
3.5091	5	0	0	Pass
3.5427	5	0	0	Pass

Water Quality

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

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
West Pond POC	☐	1391.08			☐	100.00			
East Pond POC	☐	1533.57			☐	100.00			
Total Volume Infiltrated		2924.66	0.00	0.00		100.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

THE SITE PASSES THE LID PERFORMANCE STANDARD

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

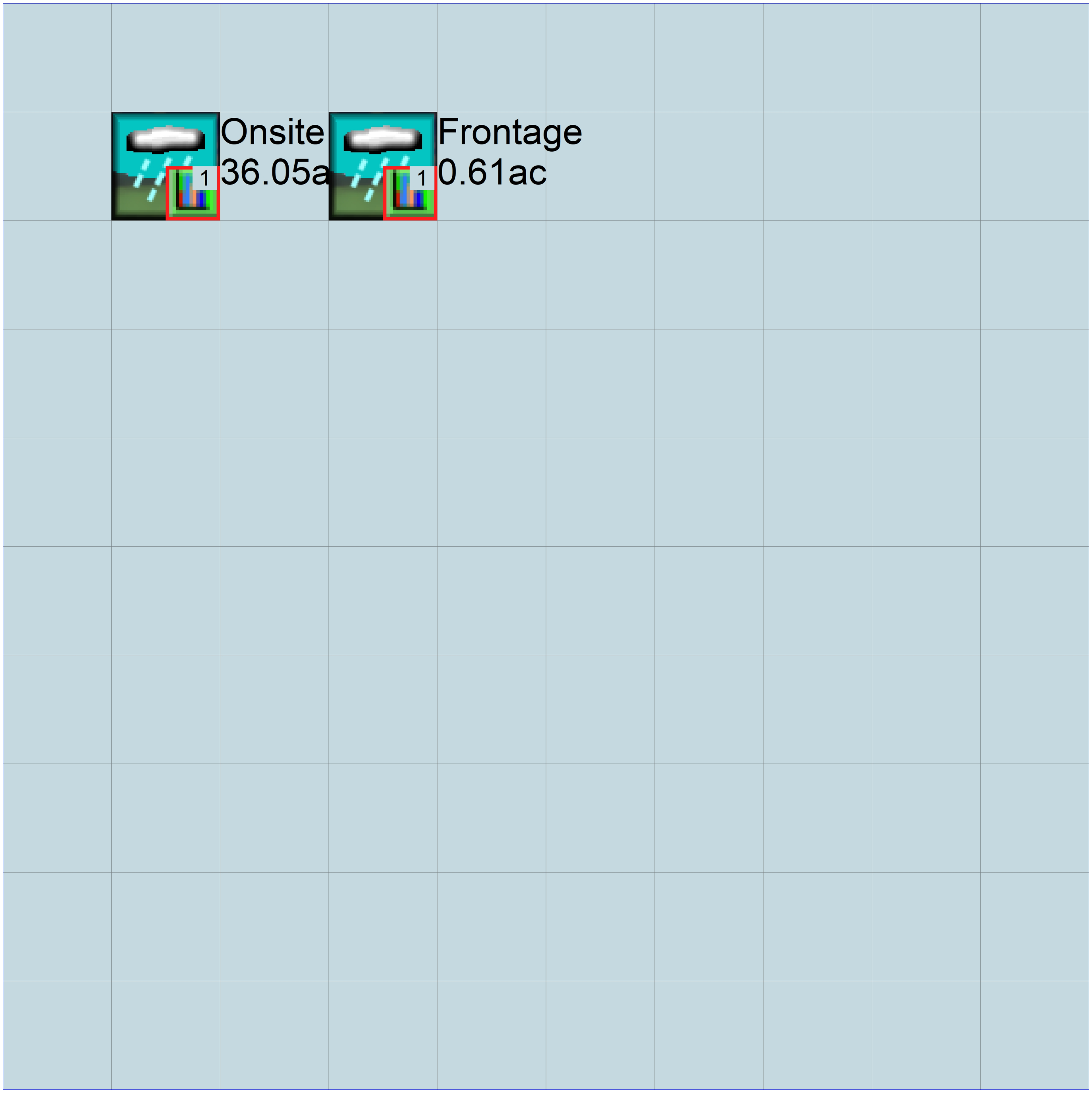
No PERLND changes have been made.

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   21-088 Site Analysis.wdm
MESSU      25   Pre21-088 Site Analysis.MES
           27   Pre21-088 Site Analysis.L61
           28   Pre21-088 Site Analysis.L62
           30   POC21-088 Site Analysis1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       1
      PERLND       2
      PERLND       3
      PERLND      10
      PERLND      11
      PERLND      12
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Onsite                      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            ***
    1     A/B, Forest, Flat       1    1    1    1   27    0
    2     A/B, Forest, Mod        1    1    1    1   27    0
    3     A/B, Forest, Steep      1    1    1    1   27    0
   10     C, Forest, Flat         1    1    1    1   27    0
   11     C, Forest, Mod          1    1    1    1   27    0
   12     C, Forest, 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 ***
  1         0    0    1    0    0    0    0    0    0    0    0    0
  2         0    0    1    0    0    0    0    0    0    0    0    0
  3         0    0    1    0    0    0    0    0    0    0    0    0
 10         0    0    1    0    0    0    0    0    0    0    0    0
 11         0    0    1    0    0    0    0    0    0    0    0    0
 12         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  *********
  1         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  2         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  3         0    0    4    0    0    0    0    0    0    0    0    0    1    9
 10         0    0    4    0    0    0    0    0    0    0    0    0    1    9
 11         0    0    4    0    0    0    0    0    0    0    0    0    1    9
 12         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 ***
  1         0    0    0    0    0    0    0    0    0    0    0
  2         0    0    0    0    0    0    0    0    0    0    0
  3         0    0    0    0    0    0    0    0    0    0    0
 10         0    0    0    0    0    0    0    0    0    0    0
 11         0    0    0    0    0    0    0    0    0    0    0
 12         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
  1              0         5         2       400      0.05       0.3     0.996
  2              0         5         2       400       0.1       0.3     0.996
  3              0         5         2       400      0.15       0.3     0.996
 10              0       4.5      0.08       400      0.05       0.5     0.996
 11              0       4.5      0.08       400       0.1       0.5     0.996
 12              0       4.5      0.08       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
  1              0         0         2         2         0         0         0
  2              0         0         2         2         0         0         0
  3              0         0         2         2         0         0         0
 10              0         0         2         2         0         0         0
 11              0         0         2         2         0         0         0
 12              0         0         2         2         0         0         0
END PWAT-PARM3
PWAT-PARM4
  <PLS >     PWATER input info: Part 4                               ***
  # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
  1            0.2       0.5      0.35         0       0.7       0.7
  2            0.2       0.5      0.35         0       0.7       0.7
  3            0.2       0.5      0.35         0       0.7       0.7
 10            0.2       0.5      0.35         6       0.5       0.7
 11            0.2       0.5      0.35         6       0.5       0.7
 12            0.2       0.3      0.35         6       0.3       0.7
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
  1              0         0         0         0         3         1         0
  2              0         0         0         0         3         1         0
  3              0         0         0         0         3         1         0
```

```
   10             0         0         0         0       2.5         1         0
   11             0         0         0         0       2.5         1         0
   12             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           ***
  END GEN-INFO
  *** Section IWATER***

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

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

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

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

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

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

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Onsite***
PERLND   1                        5.49     COPY   501     12
PERLND   1                        5.49     COPY   501     13
PERLND   2                       22.69     COPY   501     12
PERLND   2                       22.69     COPY   501     13
PERLND   3                        0.15     COPY   501     12
PERLND   3                        0.15     COPY   501     13
PERLND  10                         5.4     COPY   501     12
PERLND  10                         5.4     COPY   501     13
PERLND  11                        2.24     COPY   501     12
PERLND  11                        2.24     COPY   501     13
PERLND  12                        0.08     COPY   501     12
PERLND  12                        0.08     COPY   501     13
Frontage***
PERLND  11                        0.61     COPY   501     12
PERLND  11                        0.61     COPY   501     13

******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    0.889          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.889          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


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   21-088 Site Analysis.wdm
MESSU      25   Mit21-088 Site Analysis.MES
           27   Mit21-088 Site Analysis.L61
           28   Mit21-088 Site Analysis.L62
           30   POC21-088 Site Analysis1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       4
      PERLND       5
      PERLND       6
      PERLND      13
      PERLND      31
      PERLND       2
      IMPLND       1
      IMPLND       4
      IMPLND       5
      IMPLND       8
      IMPLND      14
      IMPLND       2
      IMPLND       9
      PERLND       1
      PERLND      10
      PERLND      11
      RCHRES       1
      RCHRES       2
      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        West Pond                   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           ***
   4     A/B, Pasture, Flat      1    1    1    1   27    0
   5     A/B, Pasture, Mod       1    1    1    1   27    0
   6     A/B, Pasture, Steep     1    1    1    1   27    0
  13     C, Pasture, Flat        1    1    1    1   27    0
  31      A/B/IMP INF/FLAT       1    1    1    1   27    0
   2     A/B, Forest, Mod        1    1    1    1   27    0
   1     A/B, Forest, Flat       1    1    1    1   27    0
  10     C, Forest, Flat         1    1    1    1   27    0
  11     C, Forest, Mod          1    1    1    1   27    0
END GEN-INFO
*** Section PWATER***

ACTIVITY
  <PLS > ************* Active Sections *****************************
  # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   4         0    0    1    0    0    0    0    0    0    0    0    0
   5         0    0    1    0    0    0    0    0    0    0    0    0
   6         0    0    1    0    0    0    0    0    0    0    0    0
  13         0    0    1    0    0    0    0    0    0    0    0    0
  31         0    0    1    0    0    0    0    0    0    0    0    0
   2         0    0    1    0    0    0    0    0    0    0    0    0
   1         0    0    1    0    0    0    0    0    0    0    0    0
  10         0    0    1    0    0    0    0    0    0    0    0    0
  11         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  *********
   4         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   5         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   6         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  13         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  31         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   2         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   1         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  10         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  11         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 ***
   4         0    0    0    0    0    0    0    0    0    0    0
   5         0    0    0    0    0    0    0    0    0    0    0
   6         0    0    0    0    0    0    0    0    0    0    0
  13         0    0    0    0    0    0    0    0    0    0    0
  31         0    0    0    0    0    0    0    0    0    0    0
   2         0    0    0    0    0    0    0    0    0    0    0
   1         0    0    0    0    0    0    0    0    0    0    0
  10         0    0    0    0    0    0    0    0    0    0    0
  11         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
   4             0         5       1.5       400      0.05       0.3     0.996
   5             0         5       1.5       400       0.1       0.3     0.996
   6             0         5       1.5       400      0.15       0.3     0.996
  13             0       4.5      0.06       400      0.05       0.5     0.996
  31             0         5       0.8       400      0.05       0.3     0.996
   2             0         5         2       400       0.1       0.3     0.996
   1             0         5         2       400      0.05       0.3     0.996
  10             0       4.5      0.08       400      0.05       0.5     0.996
  11             0       4.5      0.08       400       0.1       0.5     0.996
```

```
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -   # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    4            0         0         2         2         0         0         0
    5            0         0         2         2         0         0         0
    6            0         0         2         2         0         0         0
   13            0         0         2         2         0         0         0
   31            0         0         2         2         0         0         0
    2            0         0         2         2         0         0         0
    1            0         0         2         2         0         0         0
   10            0         0         2         2         0         0         0
   11            0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                   ***
    # -   #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    4           0.15       0.5       0.3         0       0.7       0.4
    5           0.15       0.5       0.3         0       0.7       0.4
    6           0.15       0.5       0.3         0       0.7       0.4
   13           0.15       0.4       0.3         6       0.5       0.4
   31            0.1       0.5      0.25         0       0.7      0.25
    2            0.2       0.5      0.35         0       0.7       0.7
    1            0.2       0.5      0.35         0       0.7       0.7
   10            0.2       0.5      0.35         6       0.5       0.7
   11            0.2       0.5      0.35         6       0.5       0.7
  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
    4            0         0         0         0         3         1         0
    5            0         0         0         0         3         1         0
    6            0         0         0         0         3         1         0
   13            0         0         0         0       2.5         1         0
   31            0         0         0         0         3         1         0
    2            0         0         0         0         3         1         0
    1            0         0         0         0         3         1         0
   10            0         0         0         0       2.5         1         0
   11            0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

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

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -   # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
    4         0    0    1    0    0    0
    5         0    0    1    0    0    0
    8         0    0    1    0    0    0
   14         0    0    1    0    0    0
    2         0    0    1    0    0    0
```

```
    9         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
    4         0    0    4    0    0    0    1    9
    5         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
    2         0    0    4    0    0    0    1    9
    9         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
    4         0    0    0    0    0
    5         0    0    0    0    0
    8         0    0    0    0    0
   14         0    0    0    0    0
    2         0    0    0    0    0
    9         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
    4            400      0.01       0.1       0.1
    5            400      0.01       0.1       0.1
    8            400      0.01       0.1       0.1
   14            400      0.01       0.1       0.1
    2            400      0.05       0.1      0.08
    9            400      0.05       0.1      0.08
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
    4              0         0
    5              0         0
    8              0         0
   14              0         0
    2              0         0
    9              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
    4              0         0
    5              0         0
    8              0         0
   14              0         0
    2              0         0
    9              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
W Basin***
PERLND   4                        3.34     RCHRES   1      2
```

```
PERLND   4                         3.34     RCHRES   1       3
PERLND   5                         0.31     RCHRES   1       2
PERLND   5                         0.31     RCHRES   1       3
PERLND   6                         0.22     RCHRES   1       2
PERLND   6                         0.22     RCHRES   1       3
PERLND  13                          0.5     RCHRES   1       2
PERLND  13                          0.5     RCHRES   1       3
PERLND   2                         0.91     RCHRES   1       2
PERLND   2                         0.91     RCHRES   1       3
IMPLND   1                         2.14     RCHRES   1       5
IMPLND   4                         3.26     RCHRES   1       5
IMPLND   5                         0.71     RCHRES   1       5
IMPLND   8                         0.67     RCHRES   1       5
IMPLND  14                         0.96     RCHRES   1       5
E Basin***
PERLND   4                         4.93     RCHRES   2       2
PERLND   4                         4.93     RCHRES   2       3
PERLND   6                         0.83     RCHRES   2       2
PERLND   6                         0.83     RCHRES   2       3
IMPLND   1                         1.36     RCHRES   2       5
IMPLND   2                         0.71     RCHRES   2       5
IMPLND   4                         3.66     RCHRES   2       5
IMPLND   5                         1.24     RCHRES   2       5
IMPLND   8                         0.42     RCHRES   2       5
IMPLND   9                         0.22     RCHRES   2       5
IMPLND  14                         1.14     RCHRES   2       5
Basin  3***
PERLND   1                         0.77     COPY   501      12
PERLND   1                         0.77     COPY   601      12
PERLND   1                         0.77     COPY   501      13
PERLND   1                         0.77     COPY   601      13
PERLND   2                         1.53     COPY   501      12
PERLND   2                         1.53     COPY   601      12
PERLND   2                         1.53     COPY   501      13
PERLND   2                         1.53     COPY   601      13
PERLND  10                         1.53     COPY   501      12
PERLND  10                         1.53     COPY   601      12
PERLND  10                         1.53     COPY   501      13
PERLND  10                         1.53     COPY   601      13
PERLND  11                         3.07     COPY   501      12
PERLND  11                         3.07     COPY   601      12
PERLND  11                         3.07     COPY   501      13
PERLND  11                         3.07     COPY   601      13
PERLND   6                         0.58     COPY   501      12
PERLND   6                         0.58     COPY   601      12
PERLND   6                         0.58     COPY   501      13
PERLND   6                         0.58     COPY   601      13

******Routing******
PERLND   4                         3.34     COPY     1      12
PERLND   5                         0.31     COPY     1      12
PERLND   6                         0.22     COPY     1      12
PERLND  13                          0.5     COPY     1      12
PERLND  31                         0.18     COPY     1      12
PERLND   2                         0.91     COPY     1      12
IMPLND   1                         2.14     COPY     1      15
IMPLND   4                         3.26     COPY     1      15
IMPLND   5                         0.71     COPY     1      15
IMPLND   8                         0.67     COPY     1      15
IMPLND  14                         0.96     COPY     1      15
PERLND   4                         3.34     COPY     1      13
PERLND   5                         0.31     COPY     1      13
PERLND   6                         0.22     COPY     1      13
PERLND  13                          0.5     COPY     1      13
PERLND  31                         0.18     COPY     1      13
PERLND   2                         0.91     COPY     1      13
PERLND   4                         4.93     COPY     1      12
PERLND   6                         0.83     COPY     1      12
PERLND  31                         1.47     COPY     1      12
IMPLND   1                         1.36     COPY     1      15
```

```
IMPLND   2                        0.71     COPY     1     15
IMPLND   4                        3.66     COPY     1     15
IMPLND   5                        1.24     COPY     1     15
IMPLND   8                        0.42     COPY     1     15
IMPLND   9                        0.22     COPY     1     15
IMPLND  14                        1.14     COPY     1     15
PERLND   4                        4.93     COPY     1     13
PERLND   6                        0.83     COPY     1     13
PERLND  31                        1.47     COPY     1     13
RCHRES   1                           1     COPY   501     17
RCHRES   2                           1     COPY   501     17
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     West Pond              2    1    1    1   28    0    1
    2     East Pond              2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

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

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
  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  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    2        0  1  0  0    4  5  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      0.05       0.0     170.0       0.5       0.0
    2             2      0.06       0.0     174.0       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  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2           0          4.0  5.0  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
   91    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)    (cfs)      (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.606670  0.000000  0.000000  0.000000
  0.055556  0.609241  0.033775  0.000000  1.223451
  0.111111  0.611816  0.067694  0.000000  1.223451
  0.166667  0.614396  0.101755  0.000000  1.223451
  0.222222  0.616980  0.135960  0.000000  1.223451
  0.277778  0.619569  0.170308  0.000000  1.223451
  0.333333  0.622162  0.204801  0.000000  1.223451
  0.388889  0.624760  0.239438  0.000000  1.223451
  0.444444  0.627363  0.274219  0.000000  1.223451
  0.500000  0.629970  0.309145  0.000000  1.223451
  0.555556  0.632581  0.344216  0.000000  1.223451
  0.611111  0.635198  0.379432  0.000000  1.223451
  0.666667  0.637818  0.414793  0.000000  1.223451
  0.722222  0.640444  0.450301  0.000000  1.223451
  0.777778  0.643073  0.485954  0.000000  1.223451
  0.833333  0.645708  0.521753  0.000000  1.223451
  0.888889  0.648347  0.557699  0.000000  1.223451
  0.944444  0.650990  0.593792  0.000000  1.223451
  1.000000  0.653638  0.630032  0.000000  1.223451
  1.055556  0.656291  0.666419  0.000000  1.223451
  1.111111  0.658948  0.702953  0.000000  1.223451
  1.166667  0.661609  0.739635  0.000000  1.223451
  1.222222  0.664275  0.776465  0.000000  1.223451
  1.277778  0.666946  0.813444  0.000000  1.223451
  1.333333  0.669621  0.850570  0.000000  1.223451
  1.388889  0.672301  0.887846  0.000000  1.223451
  1.444444  0.674986  0.925271  0.000000  1.223451
  1.500000  0.677675  0.962845  0.000000  1.223451
  1.555556  0.680368  1.000568  0.000000  1.223451
  1.611111  0.683066  1.038441  0.000000  1.223451
  1.666667  0.685769  1.076464  0.000000  1.223451
  1.722222  0.688476  1.114638  0.000000  1.223451
  1.777778  0.691187  1.152962  0.000000  1.223451
  1.833333  0.693904  1.191437  0.000000  1.223451
  1.888889  0.696624  1.230062  0.000000  1.223451
  1.944444  0.699350  1.268839  0.000000  1.223451
  2.000000  0.702080  1.307768  0.000000  1.223451
  2.055556  0.704814  1.346848  0.000000  1.223451
  2.111111  0.707553  1.386081  0.000000  1.223451
  2.166667  0.710297  1.425466  0.000000  1.223451
  2.222222  0.713045  1.465003  0.000000  1.223451
  2.277778  0.715797  1.504693  0.000000  1.223451
  2.333333  0.718554  1.544536  0.000000  1.223451
  2.388889  0.721316  1.584532  0.000000  1.223451
  2.444444  0.724082  1.624682  0.000000  1.223451
  2.500000  0.726853  1.664986  0.000000  1.223451
  2.555556  0.729629  1.705444  0.000000  1.223451
  2.611111  0.732408  1.746056  0.000000  1.223451
  2.666667  0.735193  1.786823  0.000000  1.223451
  2.722222  0.737982  1.827744  0.000000  1.223451
  2.777778  0.740776  1.868821  0.000000  1.223451
  2.833333  0.743574  1.910053  0.000000  1.223451
  2.888889  0.746376  1.951440  0.000000  1.223451
  2.944444  0.749183  1.992984  0.000000  1.223451
  3.000000  0.751995  2.034683  0.000000  1.223451
  3.055556  0.754812  2.076539  0.000000  1.223451
  3.111111  0.757632  2.118551  0.000000  1.223451
  3.166667  0.760458  2.160720  0.000000  1.223451
  3.222222  0.763288  2.203047  0.000000  1.223451
  3.277778  0.766122  2.245530  0.000000  1.223451
```

3.333333	0.768961	2.288171	0.000000	1.223451
3.388889	0.771805	2.330970	0.000000	1.223451
3.444444	0.774653	2.373928	0.000000	1.223451
3.500000	0.777506	2.417043	0.000000	1.223451
3.555556	0.780363	2.460317	0.000000	1.223451
3.611111	0.783225	2.503750	0.000000	1.223451
3.666667	0.786091	2.547342	0.000000	1.223451
3.722222	0.788962	2.591094	0.000000	1.223451
3.777778	0.791837	2.635005	0.000000	1.223451
3.833333	0.794717	2.679076	0.000000	1.223451
3.888889	0.797602	2.723307	0.000000	1.223451
3.944444	0.800491	2.767698	0.000000	1.223451
4.000000	0.803385	2.812250	0.000000	1.223451
4.055556	0.806283	2.856963	0.694997	1.223451
4.111111	0.809185	2.901838	1.964753	1.223451
4.166667	0.812093	2.946873	3.607895	1.223451
4.222222	0.815005	2.992070	5.552191	1.223451
4.277778	0.817921	3.037429	7.755179	1.223451
4.333333	0.820842	3.082950	10.18719	1.223451
4.388889	0.823767	3.128634	12.82521	1.223451
4.444444	0.826697	3.174480	15.64995	1.223451
4.500000	0.829632	3.220489	18.64436	1.223451
4.555556	0.832571	3.266662	21.79265	1.223451
4.611111	0.835515	3.312997	25.07977	1.223451
4.666667	0.838463	3.359497	28.49099	1.223451
4.722222	0.841416	3.406160	32.01172	1.223451
4.777778	0.844373	3.452988	35.62732	1.223451
4.833333	0.847335	3.499979	39.32303	1.223451
4.888889	0.850301	3.547136	43.08393	1.223451
4.944444	0.853272	3.594457	46.89489	1.223451
5.000000	0.856248	3.641944	50.74064	1.223451

END FTABLE 1
FTABLE 2
91 5

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.676502	0.000000	0.000000	0.000000		
0.066667	0.679190	0.045190	0.000000	1.364279		
0.133333	0.681881	0.090559	0.000000	1.364279		
0.200000	0.684575	0.136107	0.000000	1.364279		
0.266667	0.687271	0.181835	0.000000	1.364279		
0.333333	0.689971	0.227744	0.000000	1.364279		
0.400000	0.692673	0.273832	0.000000	1.364279		
0.466667	0.695378	0.320100	0.000000	1.364279		
0.533333	0.698087	0.366549	0.000000	1.364279		
0.600000	0.700798	0.413178	0.000000	1.364279		
0.666667	0.703512	0.459989	0.000000	1.364279		
0.733333	0.706228	0.506980	0.000000	1.364279		
0.800000	0.708948	0.554153	0.000000	1.364279		
0.866667	0.711671	0.601507	0.000000	1.364279		
0.933333	0.714396	0.649042	0.000000	1.364279		
1.000000	0.717124	0.696759	0.000000	1.364279		
1.066667	0.719856	0.744659	0.000000	1.364279		
1.133333	0.722590	0.792740	0.000000	1.364279		
1.200000	0.725327	0.841004	0.000000	1.364279		
1.266667	0.728066	0.889451	0.000000	1.364279		
1.333333	0.730809	0.938080	0.000000	1.364279		
1.400000	0.733555	0.986892	0.000000	1.364279		
1.466667	0.736303	1.035887	0.000000	1.364279		
1.533333	0.739055	1.085066	0.000000	1.364279		
1.600000	0.741809	1.134428	0.000000	1.364279		
1.666667	0.744566	1.183974	0.000000	1.364279		
1.733333	0.747326	1.233703	0.000000	1.364279		
1.800000	0.750089	1.283617	0.000000	1.364279		
1.866667	0.752854	1.333715	0.000000	1.364279		
1.933333	0.755623	1.383998	0.000000	1.364279		
2.000000	0.758394	1.434465	0.000000	1.364279		
2.066667	0.761169	1.485117	0.000000	1.364279		
2.133333	0.763946	1.535954	0.000000	1.364279		
2.200000	0.766726	1.586977	0.000000	1.364279		

```
  2.266667  0.769509  1.638185  0.000000  1.364279
  2.333333  0.772295  1.689578  0.000000  1.364279
  2.400000  0.775084  1.741157  0.000000  1.364279
  2.466667  0.777875  1.792923  0.000000  1.364279
  2.533333  0.780670  1.844874  0.000000  1.364279
  2.600000  0.783467  1.897012  0.000000  1.364279
  2.666667  0.786267  1.949337  0.000000  1.364279
  2.733333  0.789071  2.001848  0.000000  1.364279
  2.800000  0.791877  2.054546  0.000000  1.364279
  2.866667  0.794685  2.107432  0.000000  1.364279
  2.933333  0.797497  2.160504  0.000000  1.364279
  3.000000  0.800312  2.213765  0.000000  1.364279
  3.066667  0.803129  2.267213  0.000000  1.364279
  3.133333  0.805950  2.320849  0.000000  1.364279
  3.200000  0.808773  2.374673  0.000000  1.364279
  3.266667  0.811599  2.428685  0.000000  1.364279
  3.333333  0.814428  2.482886  0.000000  1.364279
  3.400000  0.817260  2.537276  0.000000  1.364279
  3.466667  0.820095  2.591854  0.000000  1.364279
  3.533333  0.822932  2.646622  0.000000  1.364279
  3.600000  0.825773  2.701579  0.000000  1.364279
  3.666667  0.828616  2.756725  0.000000  1.364279
  3.733333  0.831463  2.812061  0.000000  1.364279
  3.800000  0.834312  2.867587  0.000000  1.364279
  3.866667  0.837164  2.923302  0.000000  1.364279
  3.933333  0.840019  2.979209  0.000000  1.364279
  4.000000  0.842877  3.035305  0.000000  1.364279
  4.066667  0.845737  3.091592  0.000000  1.364279
  4.133333  0.848601  3.148070  0.000000  1.364279
  4.200000  0.851467  3.204739  0.000000  1.364279
  4.266667  0.854337  3.261599  0.000000  1.364279
  4.333333  0.857209  3.318651  0.000000  1.364279
  4.400000  0.860084  3.375894  0.000000  1.364279
  4.466667  0.862962  3.433329  0.000000  1.364279
  4.533333  0.865842  3.490955  0.000000  1.364279
  4.600000  0.868726  3.548774  0.000000  1.364279
  4.666667  0.871613  3.606786  0.000000  1.364279
  4.733333  0.874502  3.664990  0.000000  1.364279
  4.800000  0.877395  3.723386  0.000000  1.364279
  4.866667  0.880290  3.781976  0.000000  1.364279
  4.933333  0.883188  3.840758  0.000000  1.364279
  5.000000  0.886089  3.899734  0.000000  1.364279
  5.066667  0.888993  3.958903  0.913496  1.364279
  5.133333  0.891899  4.018266  2.582272  1.364279
  5.200000  0.894809  4.077823  4.741439  1.364279
  5.266667  0.897721  4.137574  7.295431  1.364279
  5.333333  0.900637  4.197520  10.18719  1.364279
  5.400000  0.903555  4.257659  13.37579  1.364279
  5.466667  0.906476  4.317994  16.82826  1.364279
  5.533333  0.909400  4.378523  20.51585  1.364279
  5.600000  0.912327  4.439247  24.41195  1.364279
  5.666667  0.915256  4.500167  28.49099  1.364279
  5.733333  0.918189  4.561281  32.72772  1.364279
  5.800000  0.921125  4.622592  37.09682  1.364279
  5.866667  0.924063  4.684098  41.57271  1.364279
  5.933333  0.927004  4.745800  46.12942  1.364279
  6.000000  0.929948  4.807699  50.74064  1.364279
  END FTABLE  2
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    0.889          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.889          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     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   O      1 1         1     WDM   1001 FLOW     ENGL      REPL
RCHRES   1 HYDR   O      2 1         1     WDM   1002 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1         1     WDM   1003 STAG     ENGL      REPL
RCHRES   2 HYDR   RO     1 1         1     WDM   1004 FLOW     ENGL      REPL
RCHRES   2 HYDR   O      1 1         1     WDM   1005 FLOW     ENGL      REPL
RCHRES   2 HYDR   O      2 1         1     WDM   1006 FLOW     ENGL      REPL
RCHRES   2 HYDR   STAGE  1 1         1     WDM   1007 STAG     ENGL      REPL
END EXT TARGETS

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

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

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

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

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

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

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

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Local (360)943-0304

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WWHM2012

PROJECT REPORT

Tract E Infiltration Trench

General Model Information

Project Name:	21-088 Tract E Trench
Site Name:	
Site Address:	
City:	
Report Date:	9/13/2022
Gage:	Woodland Creek
Data Start:	1955/10/01
Data End:	2011/09/30
Timestep:	15 Minute
Precip Scale:	0.889
Version Date:	2019/09/13
Version:	4.2.17

POC Thresholds

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

Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Flat	1.65
Pervious Total	1.65
Impervious Land Use	acre
Impervious Total	0
Basin Total	1.65

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Tract E tributary

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROOF TOPS FLAT	1.65
Impervious Total	1.65
Basin Total	1.65

Element Flows To:

Surface	Interflow	Groundwater
Gravel Trench Bed 1	Gravel Trench Bed 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Gravel Trench Bed 1

Bottom Length:	70.00 ft.
Bottom Width:	40.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	0
Pour Space of material for first layer:	0
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	5
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	316.912
Total Volume Through Riser (ac-ft.):	0.006
Total Volume Through Facility (ac-ft.):	316.917
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0

Discharge Structure

Riser Height:	4 ft.
Riser Diameter:	10 in.

Element Flows To:

Outlet 1	Outlet 2

Gravel Trench Bed Hydraulic Table

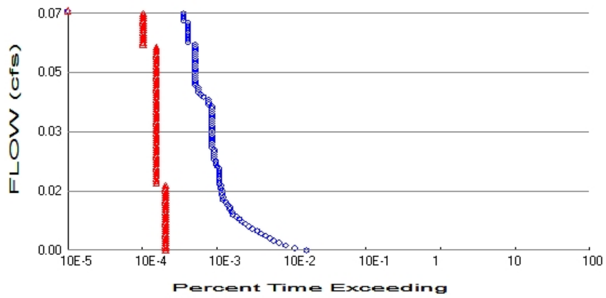
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.064	0.000	0.000	0.000
0.0556	0.064	0.003	0.000	0.324
0.1111	0.064	0.007	0.000	0.324
0.1667	0.064	0.010	0.000	0.324
0.2222	0.064	0.014	0.000	0.324
0.2778	0.064	0.017	0.000	0.324
0.3333	0.064	0.021	0.000	0.324
0.3889	0.064	0.025	0.000	0.324
0.4444	0.064	0.028	0.000	0.324
0.5000	0.064	0.032	0.000	0.324
0.5556	0.064	0.035	0.000	0.324
0.6111	0.064	0.039	0.000	0.324
0.6667	0.064	0.042	0.000	0.324
0.7222	0.064	0.046	0.000	0.324
0.7778	0.064	0.050	0.000	0.324
0.8333	0.064	0.053	0.000	0.324
0.8889	0.064	0.057	0.000	0.324
0.9444	0.064	0.060	0.000	0.324
1.0000	0.064	0.064	0.000	0.324
1.0556	0.064	0.067	0.000	0.324
1.1111	0.064	0.071	0.000	0.324
1.1667	0.064	0.075	0.000	0.324
1.2222	0.064	0.078	0.000	0.324
1.2778	0.064	0.082	0.000	0.324

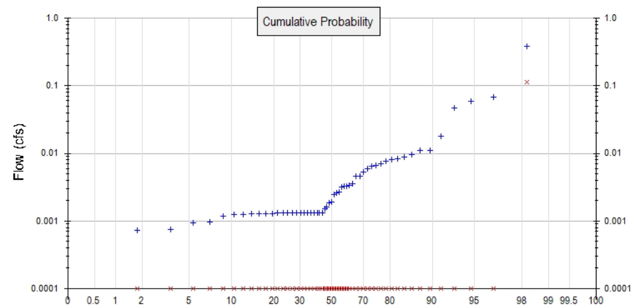
1.3333	0.064	0.085	0.000	0.324
1.3889	0.064	0.089	0.000	0.324
1.4444	0.064	0.092	0.000	0.324
1.5000	0.064	0.096	0.000	0.324
1.5556	0.064	0.100	0.000	0.324
1.6111	0.064	0.103	0.000	0.324
1.6667	0.064	0.107	0.000	0.324
1.7222	0.064	0.110	0.000	0.324
1.7778	0.064	0.114	0.000	0.324
1.8333	0.064	0.117	0.000	0.324
1.8889	0.064	0.121	0.000	0.324
1.9444	0.064	0.125	0.000	0.324
2.0000	0.064	0.128	0.000	0.324
2.0556	0.064	0.132	0.000	0.324
2.1111	0.064	0.135	0.000	0.324
2.1667	0.064	0.139	0.000	0.324
2.2222	0.064	0.142	0.000	0.324
2.2778	0.064	0.146	0.000	0.324
2.3333	0.064	0.150	0.000	0.324
2.3889	0.064	0.153	0.000	0.324
2.4444	0.064	0.157	0.000	0.324
2.5000	0.064	0.160	0.000	0.324
2.5556	0.064	0.164	0.000	0.324
2.6111	0.064	0.167	0.000	0.324
2.6667	0.064	0.171	0.000	0.324
2.7222	0.064	0.175	0.000	0.324
2.7778	0.064	0.178	0.000	0.324
2.8333	0.064	0.182	0.000	0.324
2.8889	0.064	0.185	0.000	0.324
2.9444	0.064	0.189	0.000	0.324
3.0000	0.064	0.192	0.000	0.324
3.0556	0.064	0.196	0.000	0.324
3.1111	0.064	0.200	0.000	0.324
3.1667	0.064	0.203	0.000	0.324
3.2222	0.064	0.207	0.000	0.324
3.2778	0.064	0.210	0.000	0.324
3.3333	0.064	0.214	0.000	0.324
3.3889	0.064	0.217	0.000	0.324
3.4444	0.064	0.221	0.000	0.324
3.5000	0.064	0.225	0.000	0.324
3.5556	0.064	0.228	0.000	0.324
3.6111	0.064	0.232	0.000	0.324
3.6667	0.064	0.235	0.000	0.324
3.7222	0.064	0.239	0.000	0.324
3.7778	0.064	0.242	0.000	0.324
3.8333	0.064	0.246	0.000	0.324
3.8889	0.064	0.250	0.000	0.324
3.9444	0.064	0.253	0.000	0.324
4.0000	0.064	0.257	0.000	0.324
4.0556	0.064	0.260	0.115	0.324
4.1111	0.064	0.264	0.323	0.324
4.1667	0.064	0.267	0.575	0.324
4.2222	0.064	0.271	0.835	0.324
4.2778	0.064	0.275	1.067	0.324
4.3333	0.064	0.278	1.242	0.324
4.3889	0.064	0.282	1.355	0.324
4.4444	0.064	0.285	1.458	0.324
4.5000	0.064	0.289	1.546	0.324

4.5556	0.064	0.292	1.630	0.324
4.6111	0.064	0.296	1.709	0.324
4.6667	0.064	0.300	1.785	0.324
4.7222	0.064	0.303	1.858	0.324
4.7778	0.064	0.307	1.929	0.324
4.8333	0.064	0.310	1.996	0.324
4.8889	0.064	0.314	2.062	0.324
4.9444	0.064	0.317	2.125	0.324
5.0000	0.064	0.321	2.187	0.324

Analysis Results

POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 1.65
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 1.65

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.002689
5 year	0.008506
10 year	0.016961
25 year	0.037955
50 year	0.06641
100 year	0.112821

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0
5 year	0
10 year	0
25 year	0
50 year	0
100 year	0

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1956	0.007	0.000
1957	0.003	0.000
1958	0.001	0.000
1959	0.002	0.000
1960	0.003	0.000
1961	0.005	0.000
1962	0.001	0.000
1963	0.008	0.000
1964	0.008	0.000
1965	0.002	0.000

1966	0.001	0.000
1967	0.008	0.000
1968	0.002	0.000
1969	0.001	0.000
1970	0.001	0.000
1971	0.058	0.000
1972	0.018	0.000
1973	0.001	0.000
1974	0.006	0.000
1975	0.003	0.000
1976	0.010	0.000
1977	0.001	0.000
1978	0.011	0.000
1979	0.001	0.000
1980	0.002	0.000
1981	0.005	0.000
1982	0.007	0.000
1983	0.003	0.000
1984	0.002	0.000
1985	0.001	0.000
1986	0.006	0.000
1987	0.011	0.000
1988	0.001	0.000
1989	0.001	0.000
1990	0.001	0.000
1991	0.067	0.000
1992	0.379	0.114
1993	0.046	0.000
1994	0.001	0.000
1995	0.003	0.000
1996	0.009	0.000
1997	0.005	0.000
1998	0.001	0.000
1999	0.001	0.000
2000	0.001	0.000
2001	0.001	0.000
2002	0.001	0.000
2003	0.001	0.000
2004	0.001	0.000
2005	0.001	0.000
2006	0.001	0.000
2007	0.001	0.000
2008	0.001	0.000
2009	0.003	0.000
2010	0.001	0.000
2011	0.004	0.000

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.3794	0.1139
2	0.0673	0.0000
3	0.0582	0.0000
4	0.0464	0.0000
5	0.0179	0.0000
6	0.0110	0.0000
7	0.0110	0.0000
8	0.0096	0.0000

9	0.0088	0.0000
10	0.0083	0.0000
11	0.0081	0.0000
12	0.0077	0.0000
13	0.0070	0.0000
14	0.0066	0.0000
15	0.0064	0.0000
16	0.0059	0.0000
17	0.0053	0.0000
18	0.0046	0.0000
19	0.0046	0.0000
20	0.0036	0.0000
21	0.0034	0.0000
22	0.0033	0.0000
23	0.0032	0.0000
24	0.0031	0.0000
25	0.0027	0.0000
26	0.0026	0.0000
27	0.0024	0.0000
28	0.0019	0.0000
29	0.0018	0.0000
30	0.0016	0.0000
31	0.0015	0.0000
32	0.0013	0.0000
33	0.0013	0.0000
34	0.0013	0.0000
35	0.0013	0.0000
36	0.0013	0.0000
37	0.0013	0.0000
38	0.0013	0.0000
39	0.0013	0.0000
40	0.0013	0.0000
41	0.0013	0.0000
42	0.0013	0.0000
43	0.0013	0.0000
44	0.0013	0.0000
45	0.0013	0.0000
46	0.0013	0.0000
47	0.0013	0.0000
48	0.0013	0.0000
49	0.0013	0.0000
50	0.0012	0.0000
51	0.0012	0.0000
52	0.0010	0.0000
53	0.0009	0.0000
54	0.0007	0.0000
55	0.0007	0.0000
56	0.0007	0.0000

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0013	310	4	1	Pass
0.0020	216	4	1	Pass
0.0027	163	4	2	Pass
0.0033	134	4	2	Pass
0.0040	113	4	3	Pass
0.0046	101	4	3	Pass
0.0053	89	4	4	Pass
0.0059	76	4	5	Pass
0.0066	68	4	5	Pass
0.0073	58	4	6	Pass
0.0079	53	4	7	Pass
0.0086	47	4	8	Pass
0.0092	43	4	9	Pass
0.0099	39	4	10	Pass
0.0105	36	4	11	Pass
0.0112	32	4	12	Pass
0.0119	31	4	12	Pass
0.0125	29	4	13	Pass
0.0132	29	4	13	Pass
0.0138	27	4	14	Pass
0.0145	26	4	15	Pass
0.0151	24	4	16	Pass
0.0158	24	4	16	Pass
0.0165	23	4	17	Pass
0.0171	23	4	17	Pass
0.0178	23	4	17	Pass
0.0184	22	4	18	Pass
0.0191	22	4	18	Pass
0.0197	21	3	14	Pass
0.0204	21	3	14	Pass
0.0211	21	3	14	Pass
0.0217	21	3	14	Pass
0.0224	21	3	14	Pass
0.0230	21	3	14	Pass
0.0237	21	3	14	Pass
0.0243	20	3	15	Pass
0.0250	19	3	15	Pass
0.0257	19	3	15	Pass
0.0263	18	3	16	Pass
0.0270	18	3	16	Pass
0.0276	18	3	16	Pass
0.0283	18	3	16	Pass
0.0289	18	3	16	Pass
0.0296	17	3	17	Pass
0.0303	17	3	17	Pass
0.0309	17	3	17	Pass
0.0316	17	3	17	Pass
0.0322	17	3	17	Pass
0.0329	17	3	17	Pass
0.0335	17	3	17	Pass
0.0342	17	3	17	Pass
0.0349	17	3	17	Pass
0.0355	17	3	17	Pass

0.0362	17	3	17	Pass
0.0368	17	3	17	Pass
0.0375	17	3	17	Pass
0.0381	17	3	17	Pass
0.0388	17	3	17	Pass
0.0395	17	3	17	Pass
0.0401	17	3	17	Pass
0.0408	17	3	17	Pass
0.0414	15	3	20	Pass
0.0421	15	3	20	Pass
0.0427	15	3	20	Pass
0.0434	13	3	23	Pass
0.0441	12	3	25	Pass
0.0447	11	3	27	Pass
0.0454	11	3	27	Pass
0.0460	11	3	27	Pass
0.0467	10	3	30	Pass
0.0474	10	3	30	Pass
0.0480	10	3	30	Pass
0.0487	10	3	30	Pass
0.0493	10	3	30	Pass
0.0500	10	3	30	Pass
0.0506	10	3	30	Pass
0.0513	10	3	30	Pass
0.0520	10	3	30	Pass
0.0526	10	3	30	Pass
0.0533	10	3	30	Pass
0.0539	10	3	30	Pass
0.0546	10	3	30	Pass
0.0552	10	3	30	Pass
0.0559	10	3	30	Pass
0.0566	10	3	30	Pass
0.0572	10	3	30	Pass
0.0579	10	2	20	Pass
0.0585	8	2	25	Pass
0.0592	8	2	25	Pass
0.0598	8	2	25	Pass
0.0605	8	2	25	Pass
0.0612	8	2	25	Pass
0.0618	8	2	25	Pass
0.0625	8	2	25	Pass
0.0631	8	2	25	Pass
0.0638	8	2	25	Pass
0.0644	7	2	28	Pass
0.0651	7	2	28	Pass
0.0658	7	2	28	Pass
0.0664	7	2	28	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
Gravel Trench Bed 1 POC	☐	288.39			☐	100.00			
Total Volume Infiltrated		288.39	0.00	0.00		100.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

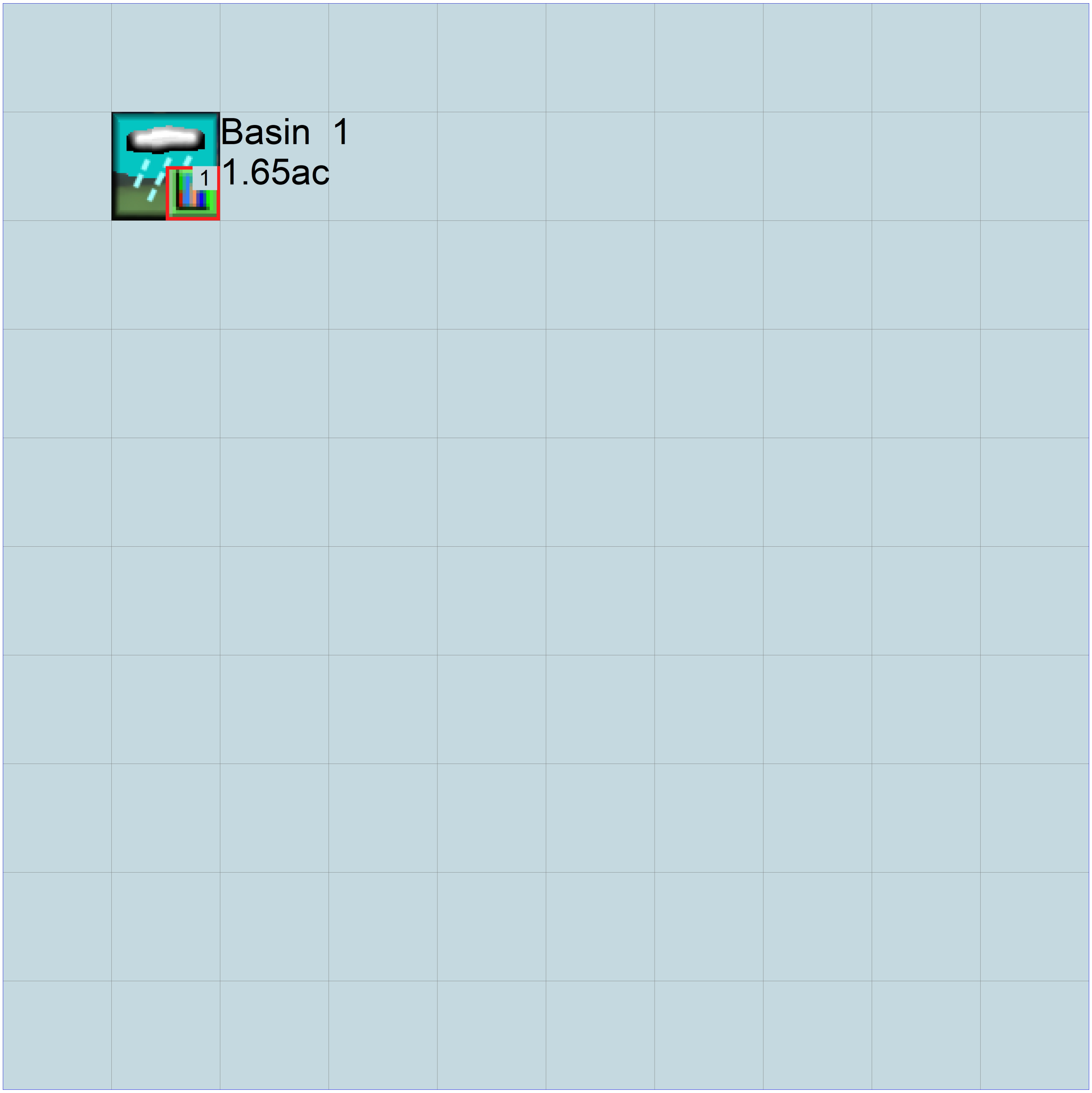
PERLND Changes

No PERLND changes have been made.

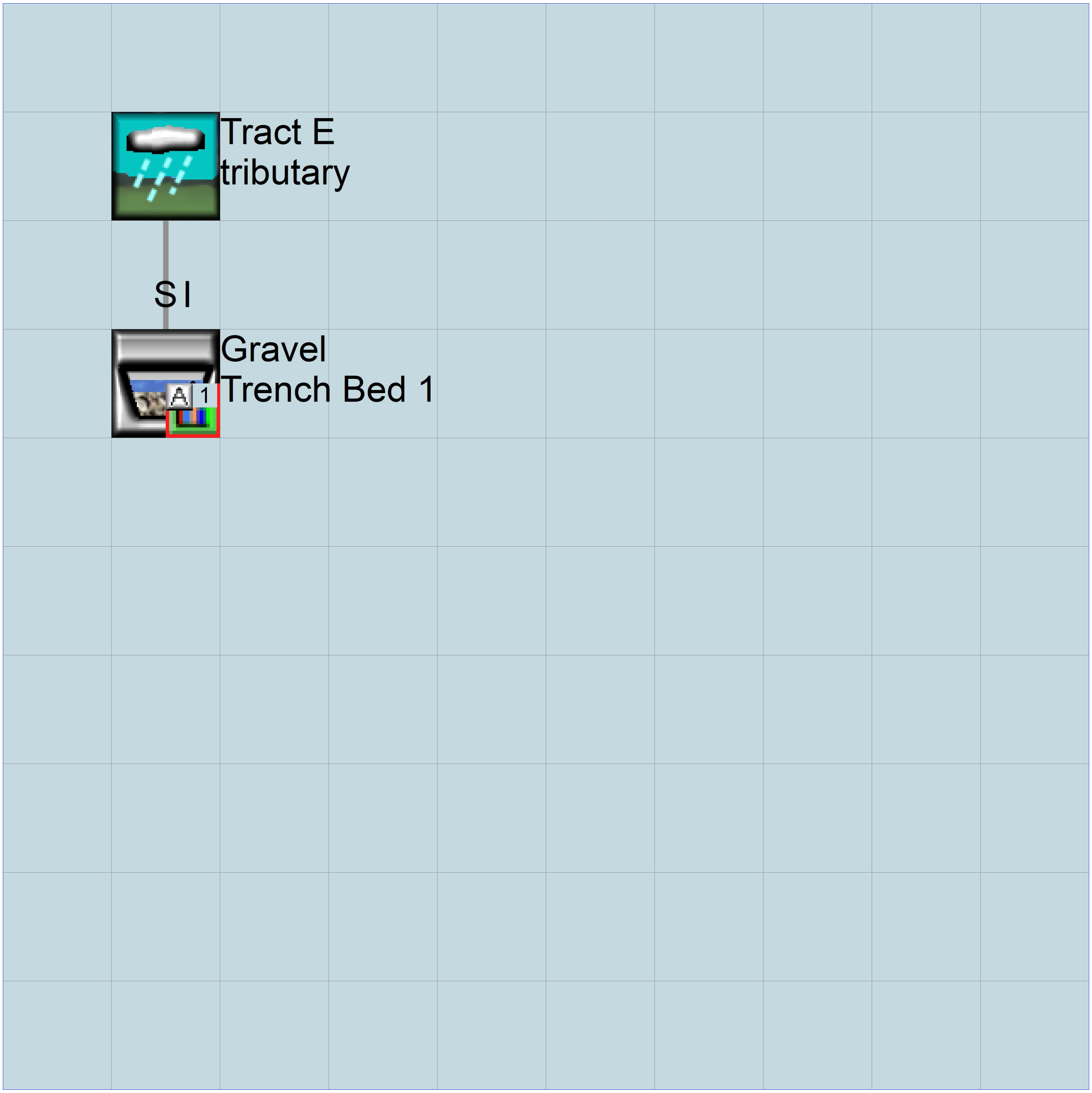
IMPLND Changes

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   21-088 Tract E Trench.wdm
MESSU      25   Pre21-088 Tract E Trench.MES
           27   Pre21-088 Tract E Trench.L61
           28   Pre21-088 Tract E Trench.L62
           30   POC21-088 Tract E Trench1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       1
      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           ***
    1     A/B, Forest, 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 ***
    1         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  *********
    1         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 ***
    1         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
    1             0         5         2       400      0.05       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    1             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    1            0.2       0.5      0.35         0       0.7       0.7
  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
    1             0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
  END GEN-INFO
  *** Section IWATER***

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

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

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

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

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

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

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND   1                        1.65     COPY   501     12
PERLND   1                        1.65     COPY   501     13

******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    0.889          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.889          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


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   21-088 Tract E Trench.wdm
MESSU      25   Mit21-088 Tract E Trench.MES
           27   Mit21-088 Tract E Trench.L61
           28   Mit21-088 Tract E Trench.L62
           30   POC21-088 Tract E Trench1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      IMPLND       4
      RCHRES       1
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Gravel Trench Bed 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           ***
  END GEN-INFO
  *** Section PWATER***

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

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

  PWAT-PARM1
```

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

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
  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
  END PWAT-STATE1

END PERLND

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

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

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    4         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     ***
    4         0    0    0    0    0
  END IWAT-PARM1

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

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

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

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Tract E tributary***
IMPLND   4                        1.65     RCHRES   1      5

******Routing******
IMPLND   4                        1.65     COPY     1     15
RCHRES   1                           1     COPY   501     17
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     Gravel Trench Be-005    2    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  5  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      0.01       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  5.0  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 5

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.064279	0.000000	0.000000	0.000000		
0.055556	0.064279	0.003571	0.000000	0.324074		
0.111111	0.064279	0.007142	0.000000	0.324074		
0.166667	0.064279	0.010713	0.000000	0.324074		
0.222222	0.064279	0.014284	0.000000	0.324074		
0.277778	0.064279	0.017855	0.000000	0.324074		
0.333333	0.064279	0.021426	0.000000	0.324074		
0.388889	0.064279	0.024997	0.000000	0.324074		
0.444444	0.064279	0.028569	0.000000	0.324074		
0.500000	0.064279	0.032140	0.000000	0.324074		
0.555556	0.064279	0.035711	0.000000	0.324074		
0.611111	0.064279	0.039282	0.000000	0.324074		
0.666667	0.064279	0.042853	0.000000	0.324074		
0.722222	0.064279	0.046424	0.000000	0.324074		
0.777778	0.064279	0.049995	0.000000	0.324074		
0.833333	0.064279	0.053566	0.000000	0.324074		
0.888889	0.064279	0.057137	0.000000	0.324074		
0.944444	0.064279	0.060708	0.000000	0.324074		
1.000000	0.064279	0.064279	0.000000	0.324074		
1.055556	0.064279	0.067850	0.000000	0.324074		
1.111111	0.064279	0.071421	0.000000	0.324074		
1.166667	0.064279	0.074992	0.000000	0.324074		
1.222222	0.064279	0.078563	0.000000	0.324074		
1.277778	0.064279	0.082134	0.000000	0.324074		
1.333333	0.064279	0.085706	0.000000	0.324074		
1.388889	0.064279	0.089277	0.000000	0.324074		
1.444444	0.064279	0.092848	0.000000	0.324074		
1.500000	0.064279	0.096419	0.000000	0.324074		
1.555556	0.064279	0.099990	0.000000	0.324074		
1.611111	0.064279	0.103561	0.000000	0.324074		
1.666667	0.064279	0.107132	0.000000	0.324074		
1.722222	0.064279	0.110703	0.000000	0.324074		
1.777778	0.064279	0.114274	0.000000	0.324074		
1.833333	0.064279	0.117845	0.000000	0.324074		
1.888889	0.064279	0.121416	0.000000	0.324074		
1.944444	0.064279	0.124987	0.000000	0.324074		
2.000000	0.064279	0.128558	0.000000	0.324074		
2.055556	0.064279	0.132129	0.000000	0.324074		
2.111111	0.064279	0.135700	0.000000	0.324074		
2.166667	0.064279	0.139272	0.000000	0.324074		
2.222222	0.064279	0.142843	0.000000	0.324074		
2.277778	0.064279	0.146414	0.000000	0.324074		
2.333333	0.064279	0.149985	0.000000	0.324074		
2.388889	0.064279	0.153556	0.000000	0.324074		
2.444444	0.064279	0.157127	0.000000	0.324074		
2.500000	0.064279	0.160698	0.000000	0.324074		
2.555556	0.064279	0.164269	0.000000	0.324074		
2.611111	0.064279	0.167840	0.000000	0.324074		
2.666667	0.064279	0.171411	0.000000	0.324074		
2.722222	0.064279	0.174982	0.000000	0.324074		
2.777778	0.064279	0.178553	0.000000	0.324074		
2.833333	0.064279	0.182124	0.000000	0.324074		
2.888889	0.064279	0.185695	0.000000	0.324074		
2.944444	0.064279	0.189266	0.000000	0.324074		
3.000000	0.064279	0.192837	0.000000	0.324074		
3.055556	0.064279	0.196409	0.000000	0.324074		
3.111111	0.064279	0.199980	0.000000	0.324074		
3.166667	0.064279	0.203551	0.000000	0.324074		
3.222222	0.064279	0.207122	0.000000	0.324074		
3.277778	0.064279	0.210693	0.000000	0.324074		
3.333333	0.064279	0.214264	0.000000	0.324074		
3.388889	0.064279	0.217835	0.000000	0.324074		
3.444444	0.064279	0.221406	0.000000	0.324074		
3.500000	0.064279	0.224977	0.000000	0.324074		
3.555556	0.064279	0.228548	0.000000	0.324074		

```
  3.611111  0.064279  0.232119  0.000000  0.324074
  3.666667  0.064279  0.235690  0.000000  0.324074
  3.722222  0.064279  0.239261  0.000000  0.324074
  3.777778  0.064279  0.242832  0.000000  0.324074
  3.833333  0.064279  0.246403  0.000000  0.324074
  3.888889  0.064279  0.249974  0.000000  0.324074
  3.944444  0.064279  0.253546  0.000000  0.324074
  4.000000  0.064279  0.257117  0.000000  0.324074
  4.055556  0.064279  0.260688  0.115525  0.324074
  4.111111  0.064279  0.264259  0.323094  0.324074
  4.166667  0.064279  0.267830  0.575411  0.324074
  4.222222  0.064279  0.271401  0.835581  0.324074
  4.277778  0.064279  0.274972  1.067215  0.324074
  4.333333  0.064279  0.278543  1.242541  0.324074
  4.388889  0.064279  0.282114  1.355566  0.324074
  4.444444  0.064279  0.285685  1.458162  0.324074
  4.500000  0.064279  0.289256  1.546614  0.324074
  4.555556  0.064279  0.292827  1.630275  0.324074
  4.611111  0.064279  0.296398  1.709847  0.324074
  4.666667  0.064279  0.299969  1.785876  0.324074
  4.722222  0.064279  0.303540  1.858799  0.324074
  4.777778  0.064279  0.307112  1.928967  0.324074
  4.833333  0.064279  0.310683  1.996671  0.324074
  4.888889  0.064279  0.314254  2.062153  0.324074
  4.944444  0.064279  0.317825  2.125618  0.324074
  5.000000  0.064279  0.321396  2.187243  0.324074
  5.055556  0.064279  0.324967  2.247179  0.324074
  END FTABLE  1
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    0.889          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.889          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***
RCHRES   1 HYDR   RO     1 1         1     WDM   1000 FLOW     ENGL      REPL
RCHRES   1 HYDR   O      1 1         1     WDM   1001 FLOW     ENGL      REPL
RCHRES   1 HYDR   O      2 1         1     WDM   1002 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1         1     WDM   1003 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1      48.4     WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1      48.4     WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

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

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

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Local (360)943-0304

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WWHM2012

PROJECT REPORT

Treatment and Overflow

General Model Information

Project Name:	21-088 Treatment
Site Name:	
Site Address:	
City:	
Report Date:	7/7/2023
Gage:	Woodland Creek
Data Start:	1955/10/01
Data End:	2011/09/30
Timestep:	15 Minute
Precip Scale:	0.889
Version Date:	2019/09/13
Version:	4.2.17

POC Thresholds

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

Landuse Basin Data

Predeveloped Land Use

West

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Pasture, Flat	1
Pervious Total	1
Impervious Land Use	acre
Impervious Total	0
Basin Total	1

Element Flows To:

Surface	Interflow	Groundwater

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Pasture, Flat	1
Pervious Total	1
Impervious Land Use	acre
Impervious Total	0
Basin Total	1

Element Flows To:

Surface	Interflow	Groundwater

Basin 3

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Pasture, Flat	1
Pervious Total	1
Impervious Land Use	acre
Impervious Total	0
Basin Total	1

Element Flows To:

Surface	Interflow	Groundwater

Basin 4

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Pasture, Flat	1
Pervious Total	1
Impervious Land Use	acre
Impervious Total	0
Basin Total	1

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

West

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Pasture, Flat	3.34
A B, Pasture, Mod	0.31
C, Pasture, Flat	0.5
A B IMP INF FLAT	0.18
A B, Pasture, Steep	0.22
A B, Forest, Mod	0.91
Pervious Total	5.46

ROOFS TO TRACT E
INFILTRATION GALLERY

TRACT B UNDISTURBED

Impervious Land Use	acre
ROADS FLAT	2.14
ROOF TOPS FLAT	3.26
DRIVEWAYS FLAT	0.71
SIDEWALKS FLAT	0.67
Impervious Total	6.78
Basin Total	12.24

AREA TRIBUTARY TO
PRESETTLING BASIN

Element Flows To:

Surface	Interflow	Groundwater

East

Bypass:	No	
GroundWater:	No	
Pervious Land Use	acre	
A B, Pasture, Flat	4.93	
A B, Pasture, Steep	0.83	
A B IMP INF FLAT	1.47	ROOFS TO TRACT E INFILTRATION GALLERY
Pervious Total	7.23	
Impervious Land Use	acre	
ROADS FLAT	1.36	
ROADS MOD	0.71	
ROOF TOPS FLAT	3.66	
DRIVEWAYS FLAT	1.24	
SIDEWALKS FLAT	0.42	
SIDEWALKS MOD	0.22	
Impervious Total	7.61	
Basin Total	14.84	AREA TRIBUTARY TO PRESETTLING BASINS

Element Flows To:

Surface	Interflow	Groundwater

West Pond

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
POND	0.96
Impervious Total	0.96
Basin Total	0.96

WEST POND AREA

Element Flows To:

Surface	Interflow	Groundwater

East Pond

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
POND	1.14
Impervious Total	1.14
Basin Total	1.14

EAST POND AREA

Element Flows To:

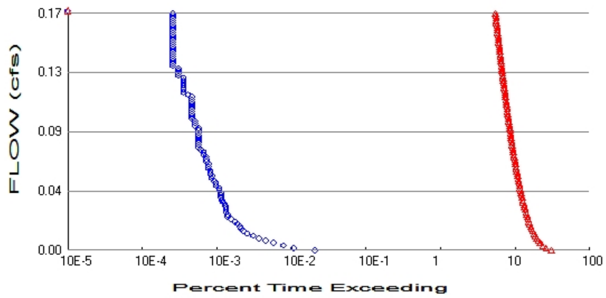
Surface	Interflow	Groundwater

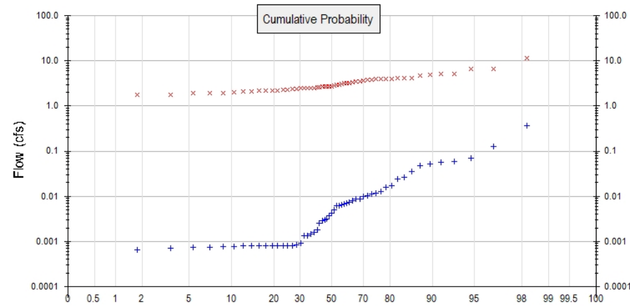
Routing Elements
Predeveloped Routing

Mitigated Routing

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1

Total Pervious Area:	1
Total Impervious Area:	0

Mitigated Landuse Totals for POC #1

Total Pervious Area:	5.46
Total Impervious Area:	6.78

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.00389
5 year	0.016357
10 year	0.036914
25 year	0.09235
50 year	0.17162
100 year	0.30529

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	2.900057
5 year	4.057934
10 year	4.944939
25 year	6.212091
50 year	7.268755
100 year	8.427576

100-YEAR INFLOW TO WEST POND PRESETTLING BASIN

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1956	0.016	2.631
1957	0.009	4.188
1958	0.002	2.175
1959	0.006	3.163
1960	0.013	3.311
1961	0.006	1.924
1962	0.001	2.404
1963	0.059	5.135
1964	0.047	3.973
1965	0.010	2.910

1966	0.001	2.104
1967	0.010	2.378
1968	0.005	2.096
1969	0.001	1.956
1970	0.001	1.787
1971	0.070	2.959
1972	0.026	2.704
1973	0.001	2.165
1974	0.007	3.599
1975	0.008	3.775
1976	0.011	2.693
1977	0.001	5.124
1978	0.055	3.217
1979	0.003	3.893
1980	0.003	2.532
1981	0.007	3.820
1982	0.024	3.427
1983	0.007	6.564
1984	0.007	2.535
1985	0.001	3.997
1986	0.036	4.216
1987	0.017	2.756
1988	0.001	1.766
1989	0.001	1.965
1990	0.001	3.105
1991	0.127	4.824
1992	0.363	11.472
1993	0.053	3.463
1994	0.001	2.455
1995	0.004	3.926
1996	0.012	3.231
1997	0.009	6.698
1998	0.001	4.690
1999	0.001	2.811
2000	0.001	2.531
2001	0.001	2.185
2002	0.001	2.505
2003	0.001	2.015
2004	0.001	2.335
2005	0.001	1.647
2006	0.002	2.765
2007	0.001	2.547
2008	0.001	2.218
2009	0.003	2.686
2010	0.003	4.135
2011	0.004	2.260

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.3630	11.4715
2	0.1266	6.6980
3	0.0705	6.5636
4	0.0593	5.1352
5	0.0554	5.1239
6	0.0526	4.8235
7	0.0474	4.6904
8	0.0359	4.2155

9	0.0259	4.1881
10	0.0239	4.1348
11	0.0169	3.9974
12	0.0156	3.9735
13	0.0126	3.9262
14	0.0116	3.8926
15	0.0112	3.8196
16	0.0103	3.7747
17	0.0097	3.5987
18	0.0087	3.4633
19	0.0087	3.4275
20	0.0078	3.3110
21	0.0072	3.2309
22	0.0071	3.2170
23	0.0067	3.1629
24	0.0066	3.1049
25	0.0062	2.9595
26	0.0062	2.9103
27	0.0050	2.8114
28	0.0042	2.7655
29	0.0037	2.7558
30	0.0032	2.7039
31	0.0030	2.6931
32	0.0029	2.6864
33	0.0026	2.6308
34	0.0018	2.5472
35	0.0016	2.5348
36	0.0014	2.5318
37	0.0013	2.5312
38	0.0013	2.5050
39	0.0009	2.4553
40	0.0008	2.4041
41	0.0008	2.3783
42	0.0008	2.3354
43	0.0008	2.2596
44	0.0008	2.2183
45	0.0008	2.1848
46	0.0008	2.1750
47	0.0008	2.1652
48	0.0008	2.1041
49	0.0008	2.0963
50	0.0008	2.0147
51	0.0008	1.9645
52	0.0007	1.9555
53	0.0007	1.9236
54	0.0007	1.7870
55	0.0007	1.7659
56	0.0006	1.6468

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0019	400	601642	150410	Fail
0.0037	210	512299	243951	Fail
0.0054	153	462031	301981	Fail
0.0071	112	426687	380970	Fail
0.0088	89	401160	450741	Fail
0.0105	71	381132	536805	Fail
0.0122	60	364441	607401	Fail
0.0139	50	350107	700214	Fail
0.0157	44	337933	768029	Fail
0.0174	41	326937	797407	Fail
0.0191	40	317119	792797	Fail
0.0208	37	308479	833727	Fail
0.0225	34	300428	883611	Fail
0.0242	30	292967	976556	Fail
0.0259	27	286291	1060337	Fail
0.0277	27	279811	1036337	Fail
0.0294	26	273920	1053538	Fail
0.0311	26	268226	1031638	Fail
0.0328	26	262924	1011246	Fail
0.0345	25	258015	1032059	Fail
0.0362	24	253106	1054608	Fail
0.0379	23	248590	1080826	Fail
0.0397	22	244270	1110318	Fail
0.0414	22	240146	1091572	Fail
0.0431	22	236219	1073722	Fail
0.0448	21	232292	1106152	Fail
0.0465	21	228758	1089323	Fail
0.0482	19	225223	1185384	Fail
0.0499	19	221885	1167815	Fail
0.0516	18	218547	1214150	Fail
0.0534	17	215405	1267088	Fail
0.0551	17	212460	1249764	Fail
0.0568	16	209318	1308237	Fail
0.0585	16	206569	1291056	Fail
0.0602	15	203624	1357493	Fail
0.0619	15	200875	1339166	Fail
0.0636	15	198322	1322146	Fail
0.0654	14	195828	1398771	Fail
0.0671	14	193334	1380957	Fail
0.0688	14	190939	1363850	Fail
0.0705	13	188583	1450638	Fail
0.0722	13	186305	1433115	Fail
0.0739	12	184086	1534050	Fail
0.0756	11	181906	1653690	Fail
0.0774	11	179825	1634772	Fail
0.0791	11	177783	1616209	Fail
0.0808	11	175859	1598718	Fail
0.0825	11	173895	1580863	Fail
0.0842	11	171931	1563009	Fail
0.0859	11	170086	1546236	Fail
0.0876	11	168279	1529809	Fail
0.0894	11	166433	1513027	Fail
0.0911	10	164705	1647050	Fail
0.0928	10	162958	1629580	Fail

0.0945	10	161289	1612890	Fail
0.0962	9	159698	1774422	Fail
0.0979	9	158049	1756100	Fail
0.0996	9	156458	1738422	Fail
0.1014	9	154907	1721188	Fail
0.1031	9	153317	1703522	Fail
0.1048	9	151746	1686066	Fail
0.1065	9	150273	1669700	Fail
0.1082	9	148702	1652244	Fail
0.1099	9	147249	1636100	Fail
0.1116	9	145855	1620611	Fail
0.1133	8	144481	1806012	Fail
0.1151	7	143145	2044928	Fail
0.1168	7	141849	2026414	Fail
0.1185	7	140534	2007628	Fail
0.1202	7	139179	1988271	Fail
0.1219	7	137883	1969757	Fail
0.1236	7	136607	1951528	Fail
0.1253	7	135271	1932442	Fail
0.1271	6	134034	2233900	Fail
0.1288	6	132876	2214600	Fail
0.1305	6	131678	2194633	Fail
0.1322	6	130402	2173366	Fail
0.1339	5	129184	2583680	Fail
0.1356	5	128085	2561700	Fail
0.1373	5	126965	2539300	Fail
0.1391	5	125885	2517700	Fail
0.1408	5	124805	2496100	Fail
0.1425	5	123745	2474900	Fail
0.1442	5	122704	2454080	Fail
0.1459	5	121605	2432100	Fail
0.1476	5	120525	2410500	Fail
0.1493	5	119504	2390080	Fail
0.1511	5	118483	2369660	Fail
0.1528	5	117442	2348840	Fail
0.1545	5	116460	2329200	Fail
0.1562	5	115537	2310740	Fail
0.1579	5	114457	2289140	Fail
0.1596	5	113534	2270680	Fail
0.1613	5	112592	2251840	Fail
0.1631	5	111649	2232980	Fail
0.1648	5	110687	2213740	Fail
0.1665	5	109745	2194900	Fail
0.1682	5	108920	2178400	Fail
0.1699	5	107977	2159540	Fail
0.1716	5	107133	2142660	Fail

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

Water Quality

Water Quality BMP Flow and Volume for POC #1

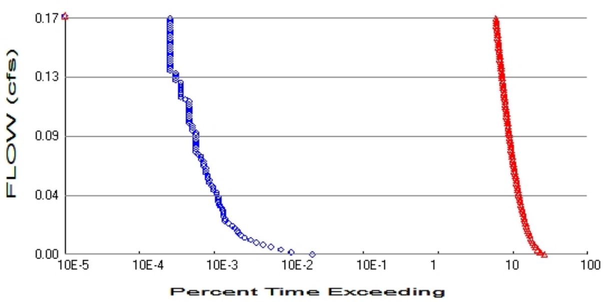
On-line facility volume:	1.0865 acre-feet
On-line facility target flow:	1.2728 cfs.
Adjusted for 15 min:	1.2728 cfs.
Off-line facility target flow:	0.7213 cfs.
Adjusted for 15 min:	0.7213 cfs.

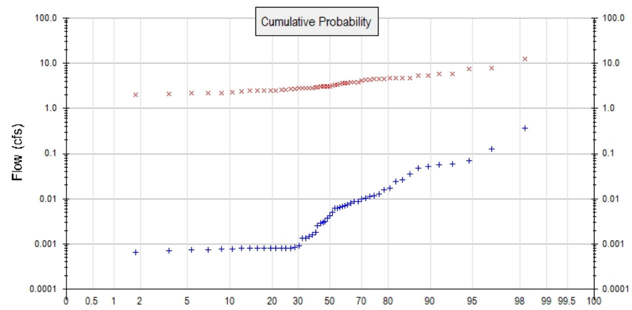
WEST POND WATER QUALITY VOLUME

LID Report

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

POC 2





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #2
Total Pervious Area: 1
Total Impervious Area: 0

Mitigated Landuse Totals for POC #2
Total Pervious Area: 7.23
Total Impervious Area: 7.61

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	**Flow(cfs)**
2 year	0.00389
5 year	0.016357
10 year	0.036914
25 year	0.09235
50 year	0.17162
100 year	0.30529

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	**Flow(cfs)**
2 year	3.297929
5 year	4.607933
10 year	5.610342
25 year	7.041026
50 year	8.233072
100 year	9.539501

100-YEAR INFLOW TO EAST POND PRESETTLING BASIN

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	**Predeveloped**	**Mitigated**
1956	0.016	3.027
1957	0.009	4.690
1958	0.002	2.461
1959	0.006	3.636
1960	0.013	3.779
1961	0.006	2.222
1962	0.001	2.792
1963	0.059	5.859
1964	0.047	4.619
1965	0.010	3.291
1966	0.001	2.412

1967	0.010	2.735
1968	0.005	2.487
1969	0.001	2.228
1970	0.001	2.063
1971	0.070	3.369
1972	0.026	3.079
1973	0.001	2.491
1974	0.007	4.170
1975	0.008	4.369
1976	0.011	3.115
1977	0.001	5.751
1978	0.055	3.657
1979	0.003	4.483
1980	0.003	2.839
1981	0.007	4.360
1982	0.024	3.887
1983	0.007	7.757
1984	0.007	2.888
1985	0.001	4.603
1986	0.036	4.734
1987	0.017	3.106
1988	0.001	1.973
1989	0.001	2.226
1990	0.001	3.443
1991	0.127	5.316
1992	0.363	12.739
1993	0.053	3.882
1994	0.001	2.763
1995	0.004	4.504
1996	0.012	3.604
1997	0.009	7.526
1998	0.001	5.381
1999	0.001	3.157
2000	0.001	2.924
2001	0.001	2.467
2002	0.001	2.829
2003	0.001	2.284
2004	0.001	2.605
2005	0.001	1.859
2006	0.002	3.097
2007	0.001	2.869
2008	0.001	2.522
2009	0.003	2.984
2010	0.003	4.614
2011	0.004	2.610

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	0.3630	12.7394
2	0.1266	7.7566
3	0.0705	7.5258
4	0.0593	5.8592
5	0.0554	5.7509
6	0.0526	5.3813
7	0.0474	5.3155
8	0.0359	4.7344
9	0.0259	4.6899

10	0.0239	4.6191
11	0.0169	4.6143
12	0.0156	4.6031
13	0.0126	4.5039
14	0.0116	4.4833
15	0.0112	4.3692
16	0.0103	4.3597
17	0.0097	4.1698
18	0.0087	3.8867
19	0.0087	3.8818
20	0.0078	3.7785
21	0.0072	3.6566
22	0.0071	3.6356
23	0.0067	3.6037
24	0.0066	3.4427
25	0.0062	3.3693
26	0.0062	3.2911
27	0.0050	3.1566
28	0.0042	3.1151
29	0.0037	3.1059
30	0.0032	3.0965
31	0.0030	3.0790
32	0.0029	3.0274
33	0.0026	2.9844
34	0.0018	2.9244
35	0.0016	2.8880
36	0.0014	2.8688
37	0.0013	2.8392
38	0.0013	2.8294
39	0.0009	2.7919
40	0.0008	2.7633
41	0.0008	2.7346
42	0.0008	2.6097
43	0.0008	2.6051
44	0.0008	2.5215
45	0.0008	2.4908
46	0.0008	2.4875
47	0.0008	2.4671
48	0.0008	2.4606
49	0.0008	2.4118
50	0.0008	2.2837
51	0.0008	2.2275
52	0.0007	2.2255
53	0.0007	2.2222
54	0.0007	2.0625
55	0.0007	1.9726
56	0.0006	1.8590

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0019	400	515441	128860	Fail
0.0037	210	456926	217583	Fail
0.0054	153	422563	276184	Fail
0.0071	112	397429	354847	Fail
0.0088	89	378579	425369	Fail
0.0105	71	363067	511361	Fail
0.0122	60	349911	583185	Fail
0.0139	50	338522	677044	Fail
0.0157	44	328508	746609	Fail
0.0174	41	319475	779207	Fail
0.0191	40	311228	778070	Fail
0.0208	37	303963	821521	Fail
0.0225	34	296894	873217	Fail
0.0242	30	290414	968046	Fail
0.0259	27	284523	1053788	Fail
0.0277	27	278829	1032700	Fail
0.0294	26	273527	1052026	Fail
0.0311	26	268422	1032392	Fail
0.0328	26	263709	1014265	Fail
0.0345	25	259193	1036772	Fail
0.0362	24	254873	1061970	Fail
0.0379	23	250750	1090217	Fail
0.0397	22	246823	1121922	Fail
0.0414	22	242895	1104068	Fail
0.0431	22	239361	1088004	Fail
0.0448	21	235826	1122980	Fail
0.0465	21	232488	1107085	Fail
0.0482	19	229150	1206052	Fail
0.0499	19	226009	1189521	Fail
0.0516	18	223063	1239238	Fail
0.0534	17	220118	1294811	Fail
0.0551	17	217172	1277482	Fail
0.0568	16	214423	1340143	Fail
0.0585	16	211674	1322962	Fail
0.0602	15	209122	1394146	Fail
0.0619	15	206569	1377126	Fail
0.0636	15	204016	1360106	Fail
0.0654	14	201464	1439028	Fail
0.0671	14	199107	1422192	Fail
0.0688	14	196947	1406764	Fail
0.0705	13	194670	1497461	Fail
0.0722	13	192412	1480092	Fail
0.0739	12	190311	1585925	Fail
0.0756	11	188210	1711000	Fail
0.0774	11	186266	1693327	Fail
0.0791	11	184263	1675118	Fail
0.0808	11	182338	1657618	Fail
0.0825	11	180493	1640845	Fail
0.0842	11	178647	1624063	Fail
0.0859	11	176801	1607281	Fail
0.0876	11	175014	1591036	Fail
0.0894	11	173286	1575327	Fail
0.0911	10	171617	1716169	Fail
0.0928	10	169987	1699869	Fail

0.0945	10	168397	1683969	Fail
0.0962	9	166767	1852966	Fail
0.0979	9	165255	1836166	Fail
0.0996	9	163743	1819366	Fail
0.1014	9	162310	1803444	Fail
0.1031	9	160778	1786422	Fail
0.1048	9	159306	1770066	Fail
0.1065	9	157813	1753477	Fail
0.1082	9	156360	1737333	Fail
0.1099	9	154966	1721844	Fail
0.1116	9	153631	1707011	Fail
0.1133	8	152276	1903450	Fail
0.1151	7	150941	2156300	Fail
0.1168	7	149605	2137214	Fail
0.1185	7	148251	2117871	Fail
0.1202	7	147014	2100200	Fail
0.1219	7	145796	2082800	Fail
0.1236	7	144579	2065414	Fail
0.1253	7	143302	2047171	Fail
0.1271	6	142144	2369066	Fail
0.1288	6	140966	2349433	Fail
0.1305	6	139729	2328816	Fail
0.1322	6	138531	2308850	Fail
0.1339	5	137431	2748620	Fail
0.1356	5	136253	2725060	Fail
0.1373	5	135212	2704240	Fail
0.1391	5	134132	2682640	Fail
0.1408	5	133052	2661040	Fail
0.1425	5	131992	2639840	Fail
0.1442	5	130912	2618240	Fail
0.1459	5	129734	2594680	Fail
0.1476	5	128693	2573860	Fail
0.1493	5	127751	2555020	Fail
0.1511	5	126769	2535380	Fail
0.1528	5	125826	2516520	Fail
0.1545	5	124845	2496900	Fail
0.1562	5	123843	2476860	Fail
0.1579	5	122803	2456060	Fail
0.1596	5	121880	2437600	Fail
0.1613	5	120976	2419520	Fail
0.1631	5	120054	2401080	Fail
0.1648	5	119209	2384180	Fail
0.1665	5	118267	2365340	Fail
0.1682	5	117422	2348440	Fail
0.1699	5	116480	2329600	Fail
0.1716	5	115675	2313500	Fail

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

Water Quality

Water Quality BMP Flow and Volume for POC #2

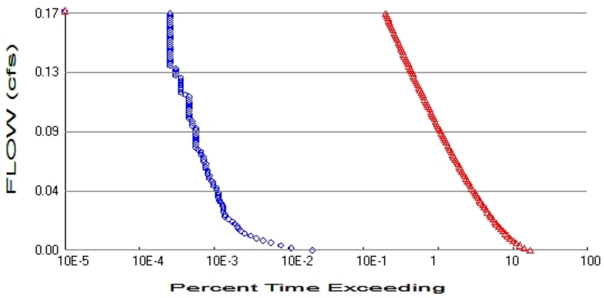
On-line facility volume:	1.2041 acre-feet
On-line facility target flow:	1.4397 cfs.
Adjusted for 15 min:	1.4397 cfs.
Off-line facility target flow:	0.8175 cfs.
Adjusted for 15 min:	0.8175 cfs.

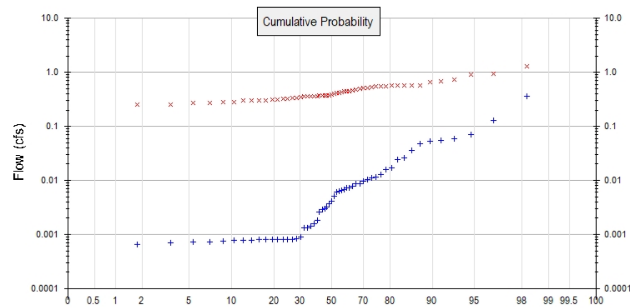
EAST POND WATER QUALITY VOLUME

LID Report

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

POC 3





+ Predeveloped   x Mitigated

Predeveloped Landuse Totals for POC #3
Total Pervious Area: 1
Total Impervious Area: 0

Mitigated Landuse Totals for POC #3
Total Pervious Area: 0
Total Impervious Area: 0.96

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #3

Return Period	**Flow(cfs)**
2 year	0.00389
5 year	0.016357
10 year	0.036914
25 year	0.09235
50 year	0.17162
100 year	0.30529

Flow Frequency Return Periods for Mitigated. POC #3

Return Period	**Flow(cfs)**
2 year	0.404164
5 year	0.554436
10 year	0.667796
25 year	0.827708
50 year	0.959568
100 year	1.102883

100-YEAR INFLOW TO WEST POND

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #3

Year	**Predeveloped**	**Mitigated**
1956	0.016	0.370
1957	0.009	0.576
1958	0.002	0.304
1959	0.006	0.438
1960	0.013	0.464
1961	0.006	0.271
1962	0.001	0.340
1963	0.059	0.675
1964	0.047	0.554
1965	0.010	0.410
1966	0.001	0.297

1967	0.010	0.335
1968	0.005	0.297
1969	0.001	0.275
1970	0.001	0.253
1971	0.070	0.412
1972	0.026	0.377
1973	0.001	0.305
1974	0.007	0.505
1975	0.008	0.521
1976	0.011	0.378
1977	0.001	0.721
1978	0.055	0.448
1979	0.003	0.551
1980	0.003	0.355
1981	0.007	0.525
1982	0.024	0.481
1983	0.007	0.929
1984	0.007	0.355
1985	0.001	0.566
1986	0.036	0.561
1987	0.017	0.373
1988	0.001	0.248
1989	0.001	0.277
1990	0.001	0.433
1991	0.127	0.577
1992	0.363	1.305
1993	0.053	0.488
1994	0.001	0.348
1995	0.004	0.556
1996	0.012	0.452
1997	0.009	0.910
1998	0.001	0.651
1999	0.001	0.398
2000	0.001	0.358
2001	0.001	0.309
2002	0.001	0.354
2003	0.001	0.284
2004	0.001	0.328
2005	0.001	0.233
2006	0.002	0.389
2007	0.001	0.360
2008	0.001	0.313
2009	0.003	0.376
2010	0.003	0.577
2011	0.004	0.319

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #3

Rank	Predeveloped	Mitigated
1	0.3630	1.3054
2	0.1266	0.9292
3	0.0705	0.9097
4	0.0593	0.7209
5	0.0554	0.6751
6	0.0526	0.6515
7	0.0474	0.5774
8	0.0359	0.5765
9	0.0259	0.5761

10	0.0239	0.5659
11	0.0169	0.5606
12	0.0156	0.5558
13	0.0126	0.5543
14	0.0116	0.5510
15	0.0112	0.5249
16	0.0103	0.5206
17	0.0097	0.5047
18	0.0087	0.4882
19	0.0087	0.4811
20	0.0078	0.4644
21	0.0072	0.4520
22	0.0071	0.4477
23	0.0067	0.4382
24	0.0066	0.4335
25	0.0062	0.4124
26	0.0062	0.4105
27	0.0050	0.3978
28	0.0042	0.3887
29	0.0037	0.3779
30	0.0032	0.3771
31	0.0030	0.3763
32	0.0029	0.3728
33	0.0026	0.3698
34	0.0018	0.3604
35	0.0016	0.3582
36	0.0014	0.3553
37	0.0013	0.3549
38	0.0013	0.3544
39	0.0009	0.3475
40	0.0008	0.3402
41	0.0008	0.3349
42	0.0008	0.3281
43	0.0008	0.3190
44	0.0008	0.3134
45	0.0008	0.3091
46	0.0008	0.3048
47	0.0008	0.3043
48	0.0008	0.2969
49	0.0008	0.2967
50	0.0008	0.2843
51	0.0008	0.2772
52	0.0007	0.2752
53	0.0007	0.2712
54	0.0007	0.2529
55	0.0007	0.2480
56	0.0006	0.2328

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0019	400	332238	83059	Fail
0.0037	210	276276	131560	Fail
0.0054	153	241324	157728	Fail
0.0071	112	215994	192851	Fail
0.0088	89	195985	220207	Fail
0.0105	71	179746	253163	Fail
0.0122	60	166237	277061	Fail
0.0139	50	154416	308832	Fail
0.0157	44	144049	327384	Fail
0.0174	41	134721	328587	Fail
0.0191	40	126357	315892	Fail
0.0208	37	118895	321337	Fail
0.0225	34	111924	329188	Fail
0.0242	30	105641	352136	Fail
0.0259	27	99907	370025	Fail
0.0277	27	94566	350244	Fail
0.0294	26	89775	345288	Fail
0.0311	26	85377	328373	Fail
0.0328	26	81155	312134	Fail
0.0345	25	77012	308048	Fail
0.0362	24	73242	305175	Fail
0.0379	23	69747	303247	Fail
0.0397	22	66408	301854	Fail
0.0414	22	63424	288290	Fail
0.0431	22	60577	275350	Fail
0.0448	21	57729	274900	Fail
0.0465	21	55059	262185	Fail
0.0482	19	52565	276657	Fail
0.0499	19	50189	264152	Fail
0.0516	18	48049	266938	Fail
0.0534	17	45987	270511	Fail
0.0551	17	44082	259305	Fail
0.0568	16	42256	264100	Fail
0.0585	16	40568	253550	Fail
0.0602	15	38899	259326	Fail
0.0619	15	37249	248326	Fail
0.0636	15	35796	238639	Fail
0.0654	14	34363	245450	Fail
0.0671	14	33008	235771	Fail
0.0688	14	31692	226371	Fail
0.0705	13	30475	234423	Fail
0.0722	13	29257	225053	Fail
0.0739	12	28138	234483	Fail
0.0756	11	27097	246336	Fail
0.0774	11	26096	237236	Fail
0.0791	11	25134	228490	Fail
0.0808	11	24152	219563	Fail
0.0825	11	23288	211709	Fail
0.0842	11	22463	204209	Fail
0.0859	11	21580	196181	Fail
0.0876	11	20755	188681	Fail
0.0894	11	19970	181545	Fail
0.0911	10	19243	192430	Fail
0.0928	10	18554	185540	Fail

0.0945	10	17878	178780	Fail
0.0962	9	17228	191422	Fail
0.0979	9	16584	184266	Fail
0.0996	9	16021	178011	Fail
0.1014	9	15520	172444	Fail
0.1031	9	14986	166511	Fail
0.1048	9	14448	160533	Fail
0.1065	9	13951	155011	Fail
0.1082	9	13401	148900	Fail
0.1099	9	12922	143577	Fail
0.1116	9	12453	138366	Fail
0.1133	8	12062	150775	Fail
0.1151	7	11636	166228	Fail
0.1168	7	11216	160228	Fail
0.1185	7	10802	154314	Fail
0.1202	7	10415	148785	Fail
0.1219	7	10067	143814	Fail
0.1236	7	9728	138971	Fail
0.1253	7	9421	134585	Fail
0.1271	6	9123	152050	Fail
0.1288	6	8828	147133	Fail
0.1305	6	8532	142200	Fail
0.1322	6	8239	137316	Fail
0.1339	5	7947	158940	Fail
0.1356	5	7687	153740	Fail
0.1373	5	7424	148480	Fail
0.1391	5	7175	143500	Fail
0.1408	5	6933	138660	Fail
0.1425	5	6721	134420	Fail
0.1442	5	6497	129940	Fail
0.1459	5	6293	125860	Fail
0.1476	5	6117	122340	Fail
0.1493	5	5901	118019	Fail
0.1511	5	5712	114240	Fail
0.1528	5	5531	110619	Fail
0.1545	5	5347	106940	Fail
0.1562	5	5188	103760	Fail
0.1579	5	4988	99760	Fail
0.1596	5	4836	96720	Fail
0.1613	5	4679	93580	Fail
0.1631	5	4522	90440	Fail
0.1648	5	4381	87620	Fail
0.1665	5	4263	85260	Fail
0.1682	5	4133	82660	Fail
0.1699	5	3986	79720	Fail
0.1716	5	3856	77120	Fail

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

Water Quality

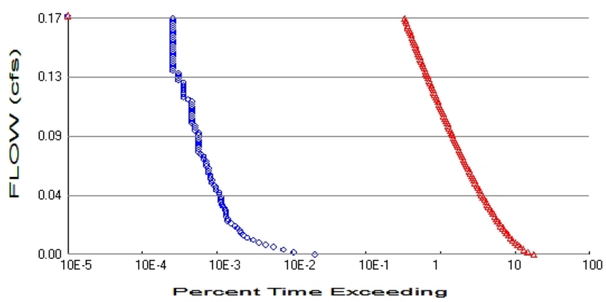
Water Quality BMP Flow and Volume for POC #3

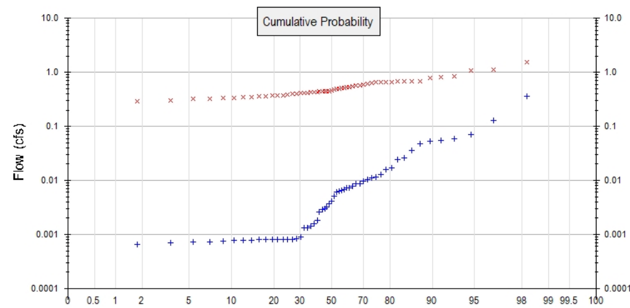
On-line facility volume:	0.1519 acre-feet
On-line facility target flow:	0.18 cfs.
Adjusted for 15 min:	0.18 cfs.
Off-line facility target flow:	0.102 cfs.
Adjusted for 15 min:	0.102 cfs.

LID Report

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

POC 4





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #4
Total Pervious Area: 1
Total Impervious Area: 0

Mitigated Landuse Totals for POC #4
Total Pervious Area: 0
Total Impervious Area: 1.14

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #4

Return Period	Flow(cfs)
2 year	0.00389
5 year	0.016357
10 year	0.036914
25 year	0.09235
50 year	0.17162
100 year	0.30529

Flow Frequency Return Periods for Mitigated. POC #4

Return Period	Flow(cfs)
2 year	0.479945
5 year	0.658393
10 year	0.793008
25 year	0.982904
50 year	1.139488
100 year	1.309675

100-YEAR INFLOW TO EAST POND

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #4

Year	Predeveloped	Mitigated
1956	0.016	0.439
1957	0.009	0.684
1958	0.002	0.361
1959	0.006	0.520
1960	0.013	0.552
1961	0.006	0.322
1962	0.001	0.404
1963	0.059	0.802
1964	0.047	0.658
1965	0.010	0.487
1966	0.001	0.353

1967	0.010	0.398
1968	0.005	0.352
1969	0.001	0.327
1970	0.001	0.300
1971	0.070	0.490
1972	0.026	0.448
1973	0.001	0.362
1974	0.007	0.599
1975	0.008	0.618
1976	0.011	0.449
1977	0.001	0.856
1978	0.055	0.532
1979	0.003	0.654
1980	0.003	0.421
1981	0.007	0.623
1982	0.024	0.571
1983	0.007	1.103
1984	0.007	0.422
1985	0.001	0.672
1986	0.036	0.666
1987	0.017	0.443
1988	0.001	0.295
1989	0.001	0.329
1990	0.001	0.515
1991	0.127	0.685
1992	0.363	1.550
1993	0.053	0.580
1994	0.001	0.413
1995	0.004	0.660
1996	0.012	0.537
1997	0.009	1.080
1998	0.001	0.774
1999	0.001	0.472
2000	0.001	0.425
2001	0.001	0.367
2002	0.001	0.421
2003	0.001	0.338
2004	0.001	0.390
2005	0.001	0.276
2006	0.002	0.462
2007	0.001	0.428
2008	0.001	0.372
2009	0.003	0.447
2010	0.003	0.686
2011	0.004	0.379

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #4

Rank	**Predeveloped**	**Mitigated**
1	0.3630	1.5502
2	0.1266	1.1035
3	0.0705	1.0803
4	0.0593	0.8561
5	0.0554	0.8017
6	0.0526	0.7736
7	0.0474	0.6856
8	0.0359	0.6846
9	0.0259	0.6841

10	0.0239	0.6720
11	0.0169	0.6657
12	0.0156	0.6601
13	0.0126	0.6582
14	0.0116	0.6543
15	0.0112	0.6233
16	0.0103	0.6182
17	0.0097	0.5994
18	0.0087	0.5797
19	0.0087	0.5714
20	0.0078	0.5515
21	0.0072	0.5368
22	0.0071	0.5316
23	0.0067	0.5204
24	0.0066	0.5148
25	0.0062	0.4898
26	0.0062	0.4874
27	0.0050	0.4724
28	0.0042	0.4615
29	0.0037	0.4487
30	0.0032	0.4478
31	0.0030	0.4469
32	0.0029	0.4427
33	0.0026	0.4391
34	0.0018	0.4280
35	0.0016	0.4254
36	0.0014	0.4220
37	0.0013	0.4214
38	0.0013	0.4209
39	0.0009	0.4127
40	0.0008	0.4040
41	0.0008	0.3977
42	0.0008	0.3896
43	0.0008	0.3789
44	0.0008	0.3722
45	0.0008	0.3671
46	0.0008	0.3619
47	0.0008	0.3614
48	0.0008	0.3526
49	0.0008	0.3524
50	0.0008	0.3376
51	0.0008	0.3291
52	0.0007	0.3268
53	0.0007	0.3220
54	0.0007	0.3003
55	0.0007	0.2946
56	0.0006	0.2764

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0019	400	347358	86839	Fail
0.0037	210	291592	138853	Fail
0.0054	153	257033	167995	Fail
0.0071	112	231899	207052	Fail
0.0088	89	211871	238057	Fail
0.0105	71	195455	275288	Fail
0.0122	60	181671	302785	Fail
0.0139	50	169830	339660	Fail
0.0157	44	159502	362504	Fail
0.0174	41	150096	366087	Fail
0.0191	40	141751	354377	Fail
0.0208	37	134034	362254	Fail
0.0225	34	126946	373370	Fail
0.0242	30	120544	401813	Fail
0.0259	27	114575	424351	Fail
0.0277	27	108940	403481	Fail
0.0294	26	103893	399588	Fail
0.0311	26	99102	381161	Fail
0.0328	26	94684	364169	Fail
0.0345	25	90600	362400	Fail
0.0362	24	86810	361708	Fail
0.0379	23	83236	361895	Fail
0.0397	22	79663	362104	Fail
0.0414	22	76266	346663	Fail
0.0431	22	73144	332472	Fail
0.0448	21	70159	334090	Fail
0.0465	21	67371	320814	Fail
0.0482	19	64700	340526	Fail
0.0499	19	62285	327815	Fail
0.0516	18	59870	332611	Fail
0.0534	17	57513	338311	Fail
0.0551	17	55255	325029	Fail
0.0568	16	53174	332337	Fail
0.0585	16	51112	319450	Fail
0.0602	15	49188	327920	Fail
0.0619	15	47421	316140	Fail
0.0636	15	45712	304746	Fail
0.0654	14	44141	315292	Fail
0.0671	14	42590	304214	Fail
0.0688	14	41137	293835	Fail
0.0705	13	39723	305561	Fail
0.0722	13	38349	294992	Fail
0.0739	12	36974	308116	Fail
0.0756	11	35737	324881	Fail
0.0774	11	34539	313990	Fail
0.0791	11	33381	303463	Fail
0.0808	11	32262	293290	Fail
0.0825	11	31221	283827	Fail
0.0842	11	30161	274190	Fail
0.0859	11	29159	265081	Fail
0.0876	11	28217	256518	Fail
0.0894	11	27313	248300	Fail
0.0911	10	26469	264690	Fail
0.0928	10	25644	256439	Fail

0.0945	10	24839	248389	Fail
0.0962	9	24034	267044	Fail
0.0979	9	23308	258977	Fail
0.0996	9	22601	251122	Fail
0.1014	9	21874	243044	Fail
0.1031	9	21167	235188	Fail
0.1048	9	20500	227777	Fail
0.1065	9	19871	220788	Fail
0.1082	9	19222	213577	Fail
0.1099	9	18644	207155	Fail
0.1116	9	18069	200766	Fail
0.1133	8	17535	219187	Fail
0.1151	7	16954	242200	Fail
0.1168	7	16473	235328	Fail
0.1185	7	16005	228642	Fail
0.1202	7	15544	222057	Fail
0.1219	7	15094	215628	Fail
0.1236	7	14646	209228	Fail
0.1253	7	14205	202928	Fail
0.1271	6	13767	229450	Fail
0.1288	6	13346	222433	Fail
0.1305	6	12942	215700	Fail
0.1322	6	12524	208733	Fail
0.1339	5	12178	243560	Fail
0.1356	5	11850	237000	Fail
0.1373	5	11477	229539	Fail
0.1391	5	11134	222680	Fail
0.1408	5	10786	215720	Fail
0.1425	5	10476	209520	Fail
0.1442	5	10199	203980	Fail
0.1459	5	9875	197500	Fail
0.1476	5	9604	192080	Fail
0.1493	5	9355	187100	Fail
0.1511	5	9101	182020	Fail
0.1528	5	8850	177000	Fail
0.1545	5	8599	171980	Fail
0.1562	5	8343	166860	Fail
0.1579	5	8106	162120	Fail
0.1596	5	7868	157360	Fail
0.1613	5	7664	153280	Fail
0.1631	5	7428	148560	Fail
0.1648	5	7210	144200	Fail
0.1665	5	7008	140160	Fail
0.1682	5	6825	136500	Fail
0.1699	5	6633	132660	Fail
0.1716	5	6456	129119	Fail

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

Water Quality

Water Quality BMP Flow and Volume for POC #4

On-line facility volume:	0 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
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

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   21-088 Treatment.wdm
MESSU      25   Pre21-088 Treatment.MES
           27   Pre21-088 Treatment.L61
           28   Pre21-088 Treatment.L62
           30   POC21-088 Treatment1.dat
           31   POC21-088 Treatment2.dat
           32   POC21-088 Treatment3.dat
           33   POC21-088 Treatment4.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       4
      COPY       501
      COPY       502
      COPY       503
      COPY       504
      DISPLY       1
      DISPLY       2
      DISPLY       3
      DISPLY       4
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        West                        MAX                    1    2   30    9
    2        Basin  2                    MAX                    1    2   31    9
    3        Basin  3                    MAX                    1    2   32    9
    4        Basin  4                    MAX                    1    2   33    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1        1    1
  501        1    1
  502        1    1
  503        1    1
  504        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            ***
    4     A/B, Pasture, 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 ***
    4         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  *********
    4         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 ***
    4         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
    4              0         5       1.5       400      0.05       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    4              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    4           0.15       0.5       0.3         0       0.7       0.4
  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
    4              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                    User  t-series Engl Metr ***
                                     in  out           ***
  END GEN-INFO
  *** Section IWATER***

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

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

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

```
  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

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

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

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
West***
PERLND   4                          1     COPY   501     12
PERLND   4                          1     COPY   501     13
Basin  2***
PERLND   4                          1     COPY   502     12
PERLND   4                          1     COPY   502     13
Basin  3***
PERLND   4                          1     COPY   503     12
PERLND   4                          1     COPY   503     13
Basin  4***
PERLND   4                          1     COPY   504     12
PERLND   4                          1     COPY   504     13

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

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



<-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    0.889          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.889          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
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    502 FLOW     ENGL      REPL
COPY   503 OUTPUT MEAN   1 1     48.4      WDM    503 FLOW     ENGL      REPL
COPY   504 OUTPUT MEAN   1 1     48.4      WDM    504 FLOW     ENGL      REPL
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


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   21-088 Treatment.wdm
MESSU      25   Mit21-088 Treatment.MES
           27   Mit21-088 Treatment.L61
           28   Mit21-088 Treatment.L62
           30   POC21-088 Treatment1.dat
           31   POC21-088 Treatment2.dat
           32   POC21-088 Treatment3.dat
           33   POC21-088 Treatment4.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       4
      PERLND       5
      PERLND      13
      PERLND      31
      PERLND       6
      PERLND       2
      IMPLND       1
      IMPLND       4
      IMPLND       5
      IMPLND       8
      IMPLND       2
      IMPLND       9
      IMPLND      14
      COPY       501
      COPY       502
      COPY       503
      COPY       504
      DISPLY       1
      DISPLY       2
      DISPLY       3
      DISPLY       4
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        West                        MAX                      1    2   30    9
    2        East                        MAX                      1    2   31    9
    3        West Pond                   MAX                      1    2   32    9
    4        East Pond                   MAX                      1    2   33    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  502         1    1
  503         1    1
  504         1    1
  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           ***
    4     A/B, Pasture, Flat      1    1    1    1   27    0
    5     A/B, Pasture, Mod       1    1    1    1   27    0
   13     C, Pasture, Flat        1    1    1    1   27    0
   31      A/B/IMP INF/FLAT       1    1    1    1   27    0
    6     A/B, Pasture, Steep     1    1    1    1   27    0
    2     A/B, Forest, Mod        1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    4         0    0    1    0    0    0    0    0    0    0    0    0
    5         0    0    1    0    0    0    0    0    0    0    0    0
   13         0    0    1    0    0    0    0    0    0    0    0    0
   31         0    0    1    0    0    0    0    0    0    0    0    0
    6         0    0    1    0    0    0    0    0    0    0    0    0
    2         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  *********
    4         0    0    4    0    0    0    0    0    0    0    0    0    1    9
    5         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   13         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   31         0    0    4    0    0    0    0    0    0    0    0    0    1    9
    6         0    0    4    0    0    0    0    0    0    0    0    0    1    9
    2         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 ***
    4         0    0    0    0    0    0    0    0    0    0    0
    5         0    0    0    0    0    0    0    0    0    0    0
   13         0    0    0    0    0    0    0    0    0    0    0
   31         0    0    0    0    0    0    0    0    0    0    0
    6         0    0    0    0    0    0    0    0    0    0    0
    2         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
    4              0         5       1.5       400      0.05       0.3     0.996
    5              0         5       1.5       400       0.1       0.3     0.996
   13              0       4.5      0.06       400      0.05       0.5     0.996
   31              0         5       0.8       400      0.05       0.3     0.996
    6              0         5       1.5       400      0.15       0.3     0.996
    2              0         5         2       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    4              0         0         2         2         0         0         0
    5              0         0         2         2         0         0         0
   13              0         0         2         2         0         0         0
```

```
  31              0         0         2         2         0         0         0
   6              0         0         2         2         0         0         0
   2              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                  ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    4           0.15       0.5       0.3         0       0.7       0.4
    5           0.15       0.5       0.3         0       0.7       0.4
   13           0.15       0.4       0.3         6       0.5       0.4
   31            0.1       0.5      0.25         0       0.7      0.25
    6           0.15       0.5       0.3         0       0.7       0.4
    2            0.2       0.5      0.35         0       0.7       0.7
  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
    4             0         0         0         0         3         1         0
    5             0         0         0         0         3         1         0
   13             0         0         0         0       2.5         1         0
   31             0         0         0         0         3         1         0
    6             0         0         0         0         3         1         0
    2             0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out          ***
    1      ROADS/FLAT             1    1    1   27    0
    4      ROOF TOPS/FLAT         1    1    1   27    0
    5      DRIVEWAYS/FLAT         1    1    1   27    0
    8      SIDEWALKS/FLAT         1    1    1   27    0
    2      ROADS/MOD              1    1    1   27    0
    9      SIDEWALKS/MOD          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
    4         0    0    1    0    0    0
    5         0    0    1    0    0    0
    8         0    0    1    0    0    0
    2         0    0    1    0    0    0
    9         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
    4         0    0    4    0    0    0    1    9
    5         0    0    4    0    0    0    1    9
    8         0    0    4    0    0    0    1    9
    2         0    0    4    0    0    0    1    9
    9         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
    4         0    0    0    0    0
    5         0    0    0    0    0
    8         0    0    0    0    0
    2         0    0    0    0    0
    9         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
    4            400      0.01       0.1       0.1
    5            400      0.01       0.1       0.1
    8            400      0.01       0.1       0.1
    2            400      0.05       0.1      0.08
    9            400      0.05       0.1      0.08
   14            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
    4              0         0
    5              0         0
    8              0         0
    2              0         0
    9              0         0
   14              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
    4              0         0
    5              0         0
    8              0         0
    2              0         0
    9              0         0
   14              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK    ***
<Name>   #                  <-factor->     <Name>   #   Tbl#    ***
West***
PERLND   4                        3.34     COPY   501     12
PERLND   4                        3.34     COPY   501     13
PERLND   5                        0.31     COPY   501     12
PERLND   5                        0.31     COPY   501     13
PERLND  13                         0.5     COPY   501     12
PERLND  13                         0.5     COPY   501     13
PERLND  31                        0.18     COPY   501     12
PERLND  31                        0.18     COPY   501     13
PERLND   6                        0.22     COPY   501     12
PERLND   6                        0.22     COPY   501     13
PERLND   2                        0.91     COPY   501     12
PERLND   2                        0.91     COPY   501     13
IMPLND   1                        2.14     COPY   501     15
IMPLND   4                        3.26     COPY   501     15
IMPLND   5                        0.71     COPY   501     15
IMPLND   8                        0.67     COPY   501     15
East***
PERLND   4                        4.93     COPY   502     12
```

```
PERLND   4                        4.93     COPY   502     13
PERLND   6                        0.83     COPY   502     12
PERLND   6                        0.83     COPY   502     13
IMPLND   1                        1.36     COPY   502     15
IMPLND   2                        0.71     COPY   502     15
IMPLND   4                        3.66     COPY   502     15
IMPLND   5                        1.24     COPY   502     15
IMPLND   8                        0.42     COPY   502     15
IMPLND   9                        0.22     COPY   502     15
West Pond***
IMPLND  14                        0.96     COPY   503     15
East Pond***
IMPLND  14                        1.14     COPY   504     15

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

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



<-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    0.889          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.889          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     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     2 OUTPUT MEAN   1 1     48.4      WDM    702 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    802 FLOW     ENGL      REPL
COPY     3 OUTPUT MEAN   1 1     48.4      WDM    703 FLOW     ENGL      REPL
COPY   503 OUTPUT MEAN   1 1     48.4      WDM    803 FLOW     ENGL      REPL
COPY     4 OUTPUT MEAN   1 1     48.4      WDM    704 FLOW     ENGL      REPL
COPY   504 OUTPUT MEAN   1 1     48.4      WDM    804 FLOW     ENGL      REPL
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
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

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Local (360)943-0304

www.clearcreeksolutions.com

APPENDIX 2 SUPPLEMENTAL REPORTS AND INFORMATION

GEOTECHNICAL ENGINEERING REPORT

PREPARED BY:

THE RILEY GROUP, INC.
17522 BOTHELL WAY NORTHEAST
BOTHELL, WASHINGTON 98011

PREPARED FOR:

D.R. HORTON
11241 SLATER AVENUE NORTHEAST, SUITE 200
KIRKLAND, WASHINGTON 98034

RGI PROJECT NO. 2022-004-1

MCALLISTER SPRINGS
2402 MARVIN ROAD SOUTHEAST
LACEY, THURSTON COUNTY, WASHINGTON

APRIL 1, 2022

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Bothell, Washington 98011
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RILEYGROUP

April 1, 2022

Bruce White
D.R. Horton
11241 Slater Avenue Northeast, Suite 200
Kirkland, Washington 98034

Subject: Geotechnical Engineering Report
McAllister Springs
2402 Marvin Road Southeast
Lacey, Thurston County, Washington
RGI Project No. 2022-004-1

Dear Bruce White:

As requested, The Riley Group, Inc. (RGI) has performed a Geotechnical Engineering Report (GER) for the McAllister Springs project located at 2402 Marvin Road Southeast, Lacey, Thurston County, Washington. Our services were completed in accordance with our proposal dated January 11, 2022 and authorized by Colin Lund with DR Horton on January 18, 2022. The information in this GER is based on our understanding of the proposed construction, and the soil and groundwater conditions encountered in the test pits and borings completed by RGI at the site on January 19, February 1, and February 8, 2022.

RGI recommends that you submit the project plans and specifications to RGI for a general review so that we may confirm that the recommendations in this GER are interpreted and implemented properly in the construction documents. RGI also recommends that a representative of our firm be present on site during portions of the project construction to confirm that the soil and groundwater conditions are consistent with those that form the basis for the engineering recommendations in this GER.

If you have any questions or require additional information, please contact us.

Respectfully submitted,

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Executive Summary

This Executive Summary should be used in conjunction with the entire Geotechnical Engineering Report (GER) for design and/or construction purposes. It should be recognized that specific details were not included or fully developed in this section, and the GER must be read in its entirety for a comprehensive understanding of the items contained herein. Section 7.0 should be read for an understanding of limitations.

RGI's geotechnical scope of work included the advancement of 11 test pits and 3 borings to approximate depths of 6 to 22 feet below existing site grades.

Based on the information obtained from our subsurface exploration, the site is suitable for development of the proposed project. The following geotechnical considerations were identified:

Soil Conditions: The soils encountered during field exploration include loose to medium dense deposits of silty sand with varying gravel, sand with varying silt and gravel, silty gravel with varying sand, and gravel with varying silt and sand, and localized medium stiff silt.

Groundwater: A groundwater table was encountered at depths of 5.5 to 16 feet at seven locations during our subsurface exploration.

Foundations: Foundations for the proposed building may be supported on conventional spread footings bearing on medium dense native soil or structural fill.

Slab-on-grade: Slab-on-grade floors and slabs for the proposed building can be supported on medium dense native soil or structural fill.

Pavements: The following pavement sections are recommended in accordance with the City of Lacey :

- **For minor local access streets**: 4 inches of Hot Mix Asphalt (HMA) class ½ inch PG 64-22 over 2 inches of crushed surfacing base course (CSBC) over 13 inches of ballast or 9 inches of crushed surfacing base course (CSBC)
- **For concrete pavement areas**: 4 inches of concrete for sidewalks and 6 inches for driveways over 1 inch of CSTC or well graded sand

1.0 Introduction

This Geotechnical Engineering Report (GER) presents the results of the geotechnical engineering services provided for the McAllister Springs project in Lacey, Washington. The purpose of this evaluation is to assess subsurface conditions and provide geotechnical recommendations for the construction of a residential development. Our scope of services included field explorations, laboratory testing, engineering analyses, and preparation of this GER.

The recommendations in the following sections of this GER are based upon our current understanding of the proposed site development as outlined below. If actual features vary or changes are made, RGI should review them in order to modify our recommendations as required. In addition, RGI requests to review the site grading plan, final design drawings and specifications when available to verify that our project understanding is correct and that our recommendations have been properly interpreted and incorporated into the project design and construction.

2.0 Project description

The project site is located at 2402 Marvin Road Southeast in Lacey, Washington. The approximate location of the site is shown on Figure 1.

The site is currently undeveloped. RGI understands the site will be developed with a residential subdivision which will include single family residences and townhomes, associated roadways and infrastructure, and two stormwater retention ponds.

At the time of preparing this GER, building plans were not available for our review. Based on our experience with similar construction, RGI anticipates that the proposed building will be supported on perimeter walls with bearing loads of two to six kips per linear foot, and a series of columns with a maximum load up to 30 kips. Slab-on-grade floor loading of 150 pounds per square foot (psf) are expected.

3.0 Field Exploration and Laboratory Testing

3.1 Field Exploration

On January 19, February 1, and February 8, 2022, RGI observed the excavation of 11 test pits and drilling of 3 borings. The approximate exploration locations are shown on Figure 2.

Field logs of each exploration were prepared by the geologist that continuously observed the excavation/drilling. These logs included visual classifications of the materials encountered during excavation/drilling as well as our interpretation of the subsurface conditions between samples. The test pit and boring logs included in Appendix A represent an interpretation of the field logs and include modifications based on laboratory observation and analysis of the samples.

3.2 Laboratory Testing

During the field exploration, a representative portion of each recovered sample was sealed in containers and transported to our laboratory for further visual and laboratory examination. Selected samples retrieved from the test pits and borings were tested for moisture content and grain size analysis to aid in soil classification and provide input for the recommendations provided in this GER. The results and descriptions of the laboratory tests are enclosed in Appendix A.

4.0 Site Conditions

4.1 Surface

The subject site is comprised of two parcels totaling approximately 33.7 acres in size. The site is bound to the north by single family residences, undeveloped land, and Olivia Street Southeast, to the east and south by undeveloped land and single family residences, and to the west by single family residences, undeveloped land, and Marvin Road Southeast.

The existing site is undeveloped. The site slopes south to southwest with about 68 feet of elevation change across the property. Slope gradients are less than 15 percent. The site is vegetated with small- to large-diameter trees with ferns and mixed brush undergrowth, blackberries, scotch broom, and grass. A wetland occupied the north central portion of the site.

4.2 Geology

Review of the *Geologic Map of the Lacey 7.5-minute Quadrangle, Thurston County, Washington,* by Robert L. Logan, etc. (2003) indicates that the soil through most of the site is mapped as Latest Vashon recessional sand and minor silt (Map Unit Qgos), which is sorted sand and minor silt deposited in and around the margins of glacial lakes. The Northeastern portion of the site is mapped as Vashon recessional outwash (Qgo), which is stratified sand and gravel deposited by meltwater streams issuing from the receding Vashon ice sheet. The northern portion of the site surrounding the wetland area is mapped as Peat (Qp), which is organic-matter-rich peat, silt, and clay deposited adjacent to wetlands. These descriptions are generally similar to the findings in our field explorations.

4.3 Soils

The soils encountered during field exploration include loose to medium dense deposits of silty sand with varying gravel, sand with varying silt and gravel, silty gravel with varying sand, and gravel with varying silt and sand, and localized medium stiff silt.

More detailed descriptions of the subsurface conditions encountered are presented in the test pit and boring logs included in Appendix A. Sieve analysis was performed on seven selected soil samples. Grain size distribution curves are included in Appendix A.

4.4 GROUNDWATER

A groundwater table was encountered at depths of 5.5 to 16 feet at seven locations during our subsurface exploration. The water table appears to be associated with the water level in the wetland area in the northern portion of the property.

It should be recognized that fluctuations of the groundwater table will occur due to seasonal variations in the amount of rainfall, runoff, and other factors not evident at the time the explorations were performed. In addition, perched water can develop within seams and layers contained in fill soils or higher permeability soils overlying less permeable soils following periods of heavy or prolonged precipitation. Therefore, groundwater levels during construction or at other times in the future may be higher or lower than the levels indicated on the logs. Groundwater level fluctuations should be considered when developing the design and construction plans for the project.

4.5 SEISMIC CONSIDERATIONS

Based on the International Building Code (IBC), RGI recommends the follow seismic parameters for design.

Table 1 IBC

Parameter	2018 Value
Site Soil Class[1]	D[2]
Site Latitude	47.0253
Site Longitude	-122.7634
Short Period Spectral Response Acceleration, S_S (g)	1.369
1-Second Period Spectral Response Acceleration, S_1 (g)	0.498
Adjusted Short Period Spectral Response Acceleration, S_{MS} (g)	1.398
Adjusted 1-Sec Period Spectral Response Acceleration, S_{M1} (g)	0.898[3]
Numeric seismic design value at 0.2 second; S_{DS}(g)	0.913
Numeric seismic design value at 1.0 second; S_{D1}(g)	0.599[3]

1. Note: In general accordance with Chapter 20 of ASCE 7-16, the Site Class is based on the average characteristics of the upper 100 feet of the subsurface profile.

2. Note: ASCE 7-16 require a site soil profile determination extending to a depth of 100 feet for seismic site classification. The current scope of our services does not include the required 100 foot soil profile determination. Test pits and borings extended to a maximum depth of 22 feet, and this seismic site class definition considers that very dense soil continues below the maximum depth of the subsurface exploration. Additional exploration to deeper depths would be required to confirm the conditions below the current depth of exploration.

3. Note: In accordance with ASCE 11.4.8, a ground motion hazard analysis is not required for the following cases:

- Structures on Site Class E sites with S_S greater than or equal to 1.0, provided the site coefficient Fa is taken as equal to that of Site Class C.
- Structures on Site Class D sites with S_1 greater than or equal to 0.2, provided that the value of the seismic response coefficient Cs is determined by Eq. 12.8-2 for values of $T \leq 1.5Ts$ and taken as equal to 1.5 times the value computed in accordance with either Eq. 12.8-3 for $T_L \geq T > 1.5T_s$ or Eq. 12.8-4 for $T > TL$.
- Structures on Site Class E sites with S_1 greater than or equal to 0.2, provided that T is less than or equal to T_s and the equivalent static force procedure is used for design.

The above exceptions do not apply to seismically isolated structures, structures with damping systems or structures designed using the response history procedures of Chapter 16.

Liquefaction is a phenomenon where there is a reduction or complete loss of soil strength due to an increase in water pressure induced by vibrations from a seismic event. Liquefaction mainly affects geologically recent deposits of fine-grained sands that are below the groundwater table. Soils of this nature derive their strength from intergranular friction. The generated water pressure or pore pressure essentially separates the soil grains and eliminates this intergranular friction, thus reducing or eliminating the soil's strength.

RGI reviewed the results of the field and laboratory testing and assessed the potential for liquefaction of the site's soil during an earthquake. Since the site is underlain by generally medium dense sand and gravel deposits, RGI considers that the possibility of liquefaction during an earthquake is low. Review of the *Liquefaction Susceptibility Map of Thurston County, Washington* by Stephen P. Palmer, etc. (2004) indicates the site is mapped as having a very low liquefaction susceptibility.

4.6 Geologic Hazard Areas

Regulated geologically hazardous areas include erosion, landslide, earthquake, or other geological hazards. Based on the definitions in the Thurston County Code, the site does not contain geologically hazardous areas.

5.0 Discussion and Recommendations

5.1 Geotechnical Considerations

Based on our study, the site is suitable for the proposed construction from a geotechnical standpoint. Foundations for the proposed building can be supported on conventional spread footings bearing on medium dense native soil or structural fill. Slab-on-grade floors and pavements can be similarly supported.

Detailed recommendations regarding the above issues and other geotechnical design considerations are provided in the following sections. These recommendations should be incorporated into the final design drawings and construction specifications.

5.2 Earthwork

Earthwork during plat work will include excavating the retention ponds, grading the lots, installing underground utilities, preparing roadway and sidewalk subgrades. Earthwork for the home construction, should include excavating and backfilling building foundations and tying into the lot utilities.

5.2.1 EROSION AND SEDIMENT CONTROL

Potential sources or causes of erosion and sedimentation depend on construction methods, slope length and gradient, amount of soil exposed and/or disturbed, soil type, construction sequencing and weather. The impacts on erosion-prone areas can be reduced by implementing an erosion and sedimentation control plan. The plan should be designed in accordance with applicable city and/or county standards.

RGI recommends the following erosion control Best Management Practices (BMPs):

- Scheduling site preparation and grading for the drier summer and early fall months and undertaking activities that expose soil during periods of little or no rainfall
- Retaining existing vegetation whenever feasible
- Establishing a quarry spall construction entrance
- Installing siltation control fencing or anchored straw or coir wattles on the downhill side of work areas
- Covering soil stockpiles with anchored plastic sheeting
- Revegetating or mulching exposed soils with a minimum 3-inch thickness of straw if surfaces will be left undisturbed for more than one day during wet weather or one week in dry weather
- Directing runoff away from exposed soils and slopes
- Minimizing the length and steepness of slopes with exposed soils and cover excavation surfaces with anchored plastic sheeting (Graded and disturbed slopes should be tracked in place with the equipment running perpendicular to the slope contours so that the track marks provide a texture to help resist erosion and channeling. Some sloughing and raveling of slopes with exposed or disturbed soil should be expected.)
- Decreasing runoff velocities with check dams, straw bales or coir wattles
- Confining sediment to the project site
- Inspecting and maintaining erosion and sediment control measures frequently (The contractor should be aware that inspection and maintenance of erosion control BMPs is critical toward their satisfactory performance. Repair and/or replacement of dysfunctional erosion control elements should be anticipated.)

Permanent erosion protection should be provided by reestablishing vegetation using hydroseeding and/or landscape planting. Until the permanent erosion protection is established, site monitoring should be performed by qualified personnel to evaluate the effectiveness of the erosion control measures. Provisions for modifications to the erosion control system based on monitoring observations should be included in the erosion and sedimentation control plan.

5.2.2 Stripping

Stripping efforts should include removal of pavements, vegetation, organic materials, and deleterious debris from areas slated for building, pavement, and utility construction. The test pits and borings encountered 4 to 24 inches of topsoil and rootmass. Deeper areas of stripping may be required in forested or heavily vegetated areas of the site.

5.2.3 Excavations

All temporary cut slopes associated with the site and utility excavations should be adequately inclined to prevent sloughing and collapse. The site soils consist of medium dense silty sand, sand, and gravel.

Accordingly, for excavations more than 4 feet but less than 20 feet in depth, the temporary side slopes should be laid back with a minimum slope inclination of 1.5H:1V (Horizontal:Vertical). If there is insufficient room to complete the excavations in this manner, or excavations greater than 20 feet in depth are planned, using temporary shoring to support the excavations should be considered. For open cuts at the site, RGI recommends:

- No traffic, construction equipment, stockpiles or building supplies are allowed at the top of cut slopes within a distance of at least five feet from the top of the cut
- Exposed soil along the slope is protected from surface erosion using waterproof tarps and/or plastic sheeting
- Construction activities are scheduled so that the length of time the temporary cut is left open is minimized
- Surface water is diverted away from the excavation
- The general condition of slopes should be observed periodically by a geotechnical engineer to confirm adequate stability and erosion control measures

In all cases, however, appropriate inclinations will depend on the actual soil and groundwater conditions encountered during earthwork. Ultimately, the site contractor must be responsible for maintaining safe excavation slopes that comply with applicable OSHA or WISHA guidelines.

5.2.4 Site Preparation

RGI anticipates that some areas of loose or soft soil will be exposed upon completion of stripping and grubbing. Proofrolling and subgrade verification should be considered an essential step in site preparation. After stripping, grubbing, and prior to placement of structural fill, RGI recommends proofrolling building and pavement subgrades and areas to receive structural fill. These areas should moisture conditioned and compacted to a firm and unyielding condition in order to achieve a minimum compaction level of 95 percent of the modified proctor maximum dry density as determined by the American Society of

Testing and Materials D1557-09 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (ASTM D1557).

Proofrolling and adequate subgrade compaction can only be achieved when the soils are within approximately ± 2 percent moisture content of the optimum moisture content. Soils which appear firm after stripping and grubbing may be proofrolled with a heavy compactor, loaded double-axle dump truck, or other heavy equipment under the observation of an RGI representative. This observer will assess the subgrade conditions prior to filling. The need for or advisability of proofrolling due to soil moisture conditions should be determined at the time of construction.

If fill is placed in areas of the site where existing slopes are steeper than 5:1 (Horizontal:Vertical), the area should be benched to reduce the potential for slippage between existing slopes and fills. Benches should be wide enough to accommodate compaction and earth moving equipment, and to allow placement of horizontal lifts of fill.

Subgrade soils that become disturbed due to elevated moisture conditions should be overexcavated to reveal firm, non-yielding, non-organic soils and backfilled with compacted structural fill. In order to maximize utilization of site soils as structural fill, RGI recommends that the earthwork portion of this project be completed during extended periods of warm and dry weather if possible.

If earthwork is completed during the wet season (typically November through May) it will be necessary to take extra precautionary measures to protect subgrade soils. Wet season earthwork will require additional mitigative measures beyond that which would be expected during the drier summer and fall months.

5.2.5 Structural Fill

Once stripping, clearing and other preparing operations are complete, cuts and fills can be made to establish desired building grades. Prior to placing fill, RGI recommends proof-rolling as described above.

RGI recommends fill below the foundation and floor slab, behind retaining walls, and below pavement and hardscape surfaces be placed in accordance with the following recommendations for structural fill. The structural fill should be placed after completion of site preparation procedures as described above.

The suitability of excavated site soils and import soils for compacted structural fill use will depend on the gradation and moisture content of the soil when it is placed. As the amount of fines (that portion passing the U.S. No. 200 sieve) increases, soil becomes increasingly sensitive to small changes in moisture content and adequate compaction becomes more difficult or impossible to achieve.

Soils containing more than about 5 percent fines cannot be consistently compacted to a dense, non-yielding condition when the moisture content is more than 2 percent above or below optimum. Optimum moisture content is that moisture that results in the greatest compacted dry density with a specified compactive effort.

Non-organic site soils are only considered suitable for structural fill provided that their moisture content is within about two percent of the optimum moisture level as determined by ASTM D1557. Excavated site soils may not be suitable for re-use as structural fill depending on the moisture content and weather conditions at the time of construction. If soils are stockpiled for future reuse and wet weather is anticipated, the stockpile should be protected with plastic sheeting that is securely anchored.

Even during dry weather, moisture conditioning (such as, windrowing and drying) of site soils to be reused as structural fill may be required. Even during the summer, delays in grading can occur due to excessively high moisture conditions of the soils or due to precipitation. If wet weather occurs, the upper wetted portion of the site soils may need to be scarified and allowed to dry prior to further earthwork, or may need to be wasted from the site.

The silt soils onsite are moisture sensitive and may require moisture conditioning prior to use as structural fill and will not be useable in wet weather. If on-site soils are or become unusable, it may become necessary to import clean, granular soils to complete site work that meet the grading requirements listed in Table 2 to be used as structural fill.

Table 2 Structural Fill Gradation

U.S. Sieve Size	Percent Passing
4 inches	100
No. 4 sieve	22 to 100
No. 200 sieve	0 to 5*

*Based on minus 3/4 inch fraction.

Prior to use, an RGI representative should observe and test all materials imported to the site for use as structural fill. Structural fill materials should be placed in uniform loose layers not exceeding 12 inches and compacted as specified in Table 3. The soil's maximum density and optimum moisture should be determined by ASTM D1557.

Table 3 Structural Fill Compaction ASTM D1557

Location	Material Type	Minimum Compaction Percentage	Moisture Content Range	
Foundations	On-site granular or approved imported fill soils:	95	+2	-2
Retaining Wall Backfill	On-site granular or approved imported fill soils:	92	+2	-2
Slab-on-grade	On-site granular or approved imported fill soils:	95	+2	-2
General Fill (non-structural areas)	On-site soils or approved imported fill soils:	90	+3	-2
Pavement – Subgrade and Base Course	On-site granular or approved imported fill soils:	95	+2	-2

Placement and compaction of structural fill should be observed by RGI. A representative number of in-place density tests should be performed as the fill is being placed to confirm that the recommended level of compaction is achieved.

5.2.6 Cut and Fill Slopes

All permanent cut and fill slopes (except interior slopes of retention pond) should be graded with a finished inclination no greater than 2H:1V. The interior slopes of the retention pond must be graded with a slope gradient no steeper than 3H:1V. Upon completion of construction, the slope face should be trackwalked, compacted and vegetated, or provided with other physical means to guard against erosion. All fill placed for slope construction should meet the structural fill requirements as described in Section 5.2.5.

Final grades at the top of the slopes must promote surface drainage away from the slope crest. Water must not be allowed to flow in an uncontrolled fashion over the slope face. If it is necessary to direct surface runoff towards the slope, it should be controlled at the top of the slope, piped in a closed conduit installed on the slope face, and taken to an appropriate point of discharge beyond the toe of the slope.

5.2.7 Wet Weather Construction Considerations

RGI recommends that preparation for site grading and construction include procedures intended to drain ponded water, control surface water runoff, and to collect shallow subsurface seepage zones in excavations where encountered. It will not be possible to successfully compact the subgrade or utilize on-site soils as structural fill if accumulated water is not drained prior to grading or if drainage is not controlled during construction. Attempting to grade the site without adequate drainage control measures will reduce the amount of on-site soil effectively available for use, increase the amount of select import fill materials required, and ultimately increase the cost of the earthwork phases of the project. Free water should not be allowed to pond on the subgrade soils. RGI anticipates that the use of berms and shallow drainage ditches, with sumps and pumps in utility trenches, will be required for surface water control during wet weather and/or wet site conditions.

5.3 FOUNDATIONS

Following site preparation and grading, the proposed building foundation can be supported on conventional spread footings bearing on dense native soil or structural fill. Loose, organic, or other unsuitable soils may be encountered in the proposed building footprint. If unsuitable soils are encountered, they should be overexcavated and backfilled with structural fill.

Perimeter foundations exposed to weather should be at a minimum depth of 18 inches below final exterior grades. Interior foundations can be constructed at any convenient depth below the floor slab. Finished grade is defined as the lowest adjacent grade within 5 feet of the foundation for perimeter (or exterior) footings and finished floor level for interior footings.

Table 4 Foundation Design

Design Parameter	Value
Allowable Bearing Capacity	2,000 psf[1]
Friction Coefficient	0.30
Passive pressure (equivalent fluid pressure)	250 pcf[2]

1. psf = pounds per square foot
2. pcf = pounds per cubic foot

The allowable foundation bearing pressures apply to dead loads plus design live load conditions. For short-term loads, such as wind and seismic, a 1/3 increase in this allowable capacity may be used. At perimeter locations, RGI recommends not including the upper 12 inches of soil in the computation of passive pressures because they can be affected by weather or disturbed by future grading activity. The passive pressure value assumes the foundation will be constructed neat against competent soil or backfilled with structural fill as described in Section 5.2.5. The recommended base friction and passive resistance value includes a safety factor of about 1.5.

With spread footing foundations designed in accordance with the recommendations in this section, maximum total and differential post-construction settlements of 1 inch and 1/2 inch, respectively, should be expected.

5.4 Retaining Walls

If retaining walls are needed in the building area, RGI recommends cast-in-place concrete walls be used. The magnitude of earth pressure development on retaining walls will partly depend on the quality of the wall backfill. RGI recommends placing and compacting wall backfill as structural fill. Wall drainage will be needed behind the wall face. A typical retaining wall drainage detail is shown in Figure 3.

With wall backfill placed and compacted as recommended, and drainage properly installed, RGI recommends using the values in the following table for design.

Table 5 Retaining Wall Design

Design Parameter	Value
Allowable Bearing Capacity	2,000 psf
Active Earth Pressure (unrestrained walls)	35 pcf
At-rest Earth Pressure (restrained walls)	50 pcf

For seismic design, an additional uniform load of 7 times the wall height (H) for unrestrained walls and 14H in psf for restrained walls should be applied to the wall surface. Friction at the base of foundations and passive earth pressure will provide resistance to these lateral loads. Values for these parameters are provided in Section 5.3.

5.5 Slab-on-Grade Construction

Once site preparation has been completed as described in Section 5.2, suitable support for slab-on-grade construction should be provided. RGI recommends that the concrete slab be placed on top of medium dense native soil or structural fill.

Immediately below the floor slab, RGI recommends placing a four-inch thick capillary break layer of clean, free-draining sand or gravel that has less than five percent passing the U.S. No. 200 sieve. This material will reduce the potential for upward capillary movement of water through the underlying soil and subsequent wetting of the floor slab. Where moisture by vapor transmission is undesirable, an 8- to 10-millimeter thick plastic membrane should be placed on a 4-inch thick layer of clean gravel.

For the anticipated floor slab loading, we estimate post-construction floor settlements of 1/4- to 1/2-inch.

5.6 Drainage

5.6.1 Surface

Final exterior grades should promote free and positive drainage away from the building area. Water must not be allowed to pond or collect adjacent to foundations or within the immediate building area. For non-pavement locations, RGI recommends providing a minimum drainage gradient of 3 percent for a minimum distance of 10 feet from the building perimeter. In paved locations, a minimum gradient of 1 percent should be provided unless provisions are included for collection and disposal of surface water adjacent to the structure.

5.6.2 Subsurface

RGI recommends installing perimeter foundation drains. A typical footing drain detail is shown on Figure 4. The foundation drains and roof downspouts should be tightlined separately to an approved discharge facility. Subsurface drains must be laid with a gradient sufficient to promote positive flow to a controlled point of approved discharge.

5.6.3 Infiltration

RGI understands that stormwater infiltration is proposed as part of site development. Two small-scale Pilot Infiltration Tests (PIT) were conducted at the site. Infiltration testing was completed following the small PIT test method as presented in the City of Lacey 2016 Stormwater Design Manual (CLSDM).

Table 6 Measured Infiltration Rates

Test Location	Test Depth (feet)	Measured Rate (inches/hour)	Design Rate (inches/hour)
TP-1	3	18.5	**7.4**
TP-2	6.5	24	**9.6**

Correction factors per the manual were applied to the field measured rate as described below:

$I_{design} = I_{measured} \times F_{testing} \times F_{geometry} \times F_{plugging}$

I_{design} = 18.5 inches/hour (0.50)(1)(0.8) = 7.4 inches/hour

I_{design} = 24 inches/hour (0.50)(1)(0.8) = 9.6 inches/hour

5.7 UTILITIES

Utility pipes should be bedded and backfilled in accordance with American Public Works Association (APWA) specifications. For site utilities located within the right-of-ways, bedding and backfill should be completed in accordance with Thurston County or City of Lacey specifications. At a minimum, trench backfill should be placed and compacted as structural fill, as described in Section 5.2.5. Where utilities occur below unimproved areas, the degree of compaction can be reduced to a minimum of 90 percent of the soil's maximum density as determined by the referenced ASTM D1557. As noted, soils excavated on site should be suitable for use as backfill material. If on-site soils are or become unusable, imported structural fill meeting the gradation provided in Table 2 should be used for trench backfill.

5.8 PAVEMENTS

Pavement subgrades should be prepared as described in Section 5.2 and as discussed below. Regardless of the relative compaction achieved, the subgrade must be firm and relatively unyielding before paving. The subgrade should be proof-rolled with heavy construction equipment to verify this condition.

5.8.1 FLEXIBLE PAVEMENTS

With the pavement subgrade prepared as described above, RGI recommends the following pavement sections for parking and drive areas paved with flexible asphalt concrete surfacing.

- **For drive areas**: 3 inches of Hot Mix Asphalt (HMA) over 6 inches of crushed rock base (CRB) over 12 inches of gravel base

5.8.2 CONCRETE PAVEMENTS

With the pavement subgrade prepared as described above, RGI recommends the following pavement sections for parking and drive areas paved with concrete surfacing.

- **For concrete pavement areas**: 4 inches of concrete for sidewalks and 6 inches for driveways over 1 inch of CSTC or well graded sand

The paving materials used should conform to the WSDOT specifications for HMA, concrete paving, CRB surfacing (9-03.9(3) Crushed Surfacing), and gravel base (9-03.10 Aggregate for Gravel Base).

Long-term pavement performance will depend on surface drainage. A poorly-drained pavement section will be subject to premature failure as a result of surface water infiltrating into the subgrade soils and reducing their supporting capability.

For optimum pavement performance, surface drainage gradients of no less than 2 percent are recommended. Also, some degree of longitudinal and transverse cracking of the pavement surface should be expected over time. Regular maintenance should be planned to seal cracks when they occur.

6.0 Additional Services

RGI is available to provide further geotechnical consultation throughout the design phase of the project. RGI should review the final design and specifications in order to verify that earthwork and foundation recommendations have been properly interpreted and incorporated into project design and construction.

RGI is also available to provide geotechnical engineering and construction monitoring services during construction. The integrity of the earthwork and construction depends on proper site preparation and procedures. In addition, engineering decisions may arise in the field in the event that variations in subsurface conditions become apparent. Construction monitoring services are not part of this scope of work. If these services are desired, please let us know and we will prepare a cost proposal.

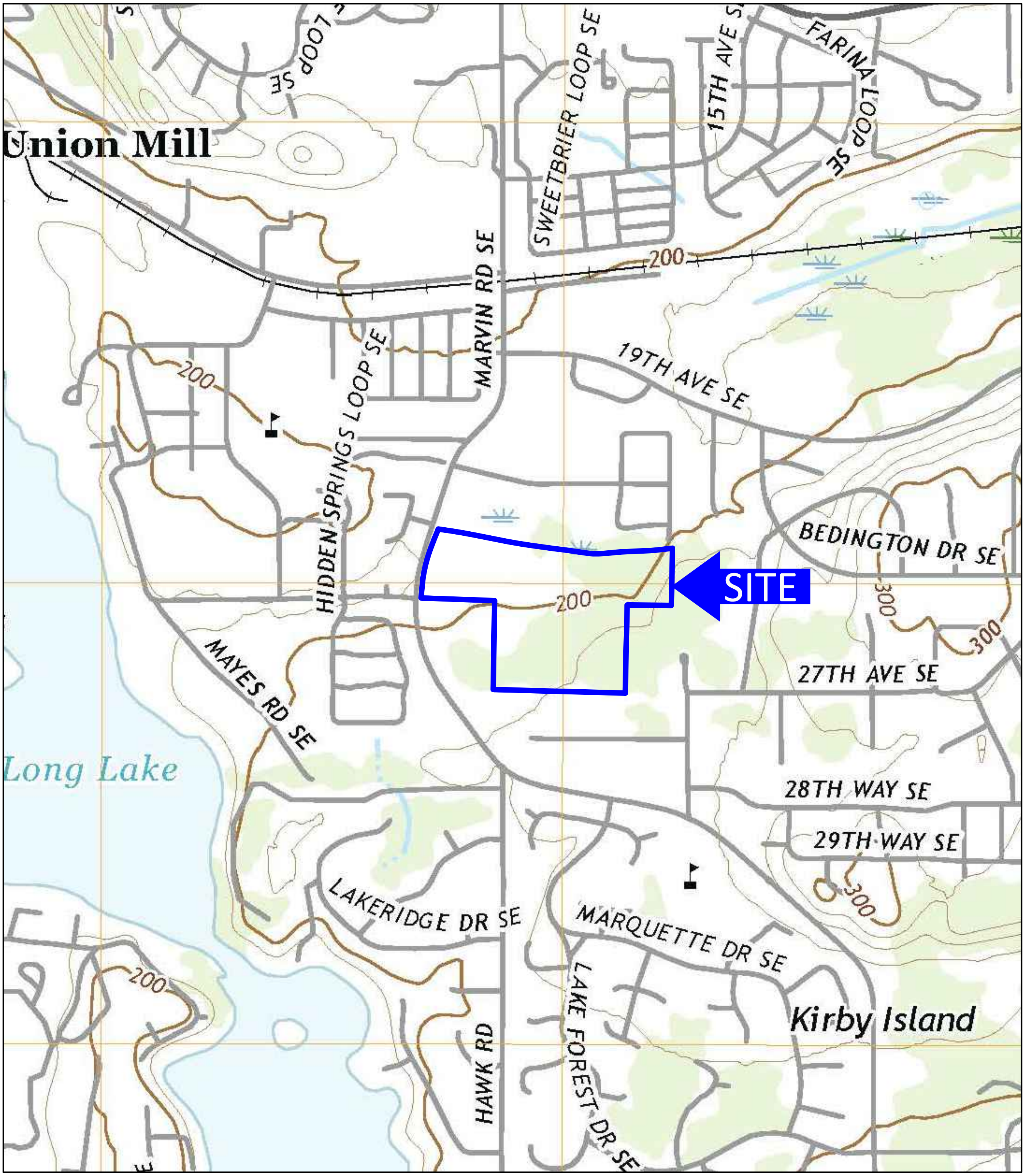
7.0 Limitations

This GER is the property of RGI, D.R. Horton, and its designated agents. Within the limits of the scope and budget, this GER was prepared in accordance with generally accepted geotechnical engineering practices in the area at the time this GER was issued. This GER is intended for specific application to the McAllister Springs project in Lacey, Washington, and for the exclusive use of D.R. Horton and its authorized representatives. No other warranty, expressed or implied, is made. Site safety, excavation support, and dewatering requirements are the responsibility of others.

The scope of services for this project does not include either specifically or by implication any environmental or biological (for example, mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, we can provide a proposal for these services.

The analyses and recommendations presented in this GER are based upon data obtained from the explorations performed on site. Variations in soil conditions can occur, the nature and extent of which may not become evident until construction. If variations appear evident, RGI should be requested to reevaluate the recommendations in this GER prior to proceeding with construction.

It is the client's responsibility to see that all parties to the project, including the designers, contractors, subcontractors, are made aware of this GER in its entirety. The use of information contained in this GER for bidding purposes should be done at the contractor's option and risk.



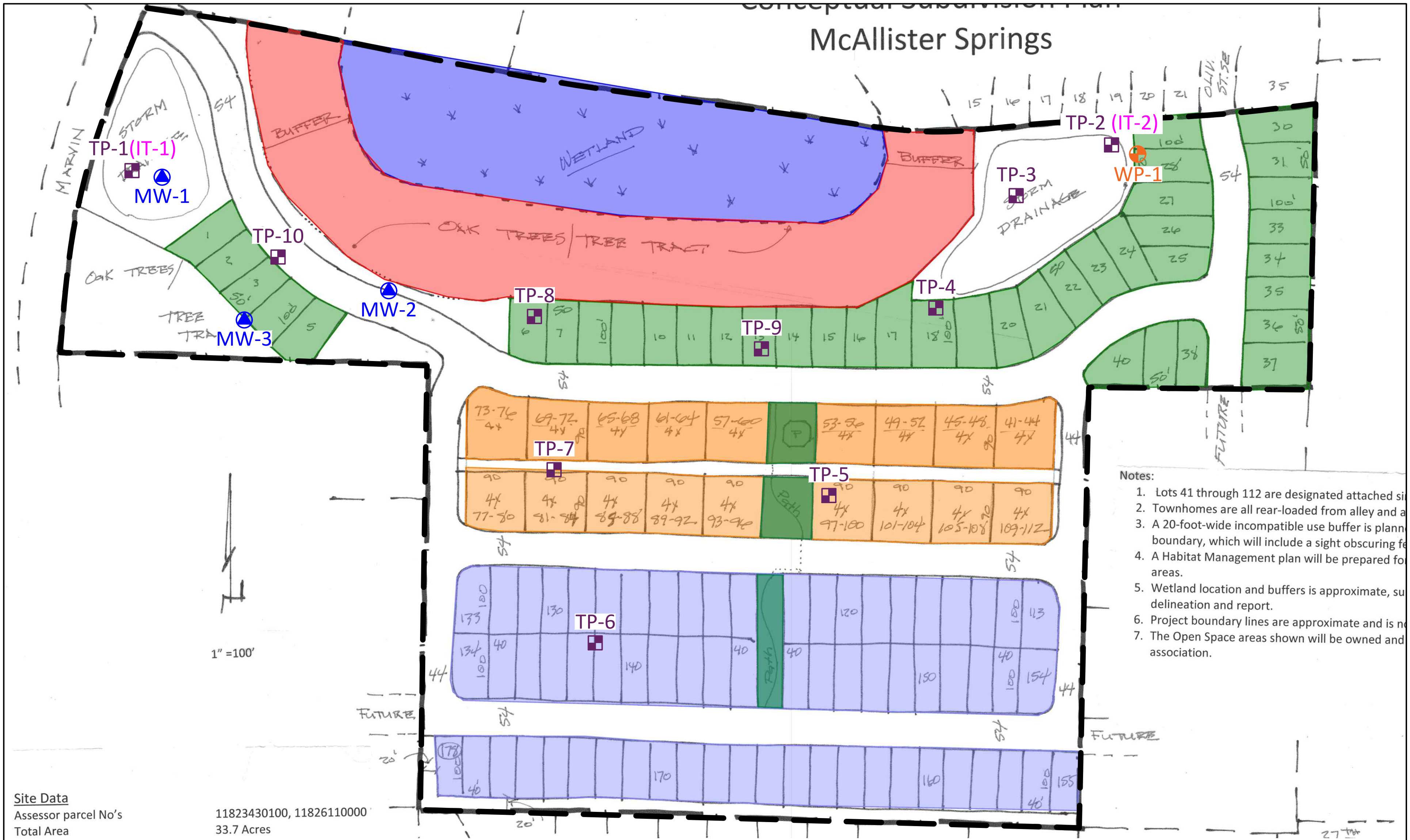
USGS, 2020, Lacey, Washington
7.5-Minute Quadrangle

Approximate Scale: 1"=1000'

0 500 1000 2000

N

RILEYGROUP Corporate Office 17522 Bothell Way Northeast Bothell, Washington 98011 Phone: 425.415.0551 Fax: 425.415.0311	McAllister Springs		Figure 1
	RGI Project Number: 2022-004-1	Site Vicinity Map	Date Drawn: 03/2022
	Address: 2402 Marvin Road Southeast, Lacey, Washington 98513		



= Well point by RGI, 02/08/22

= Test pit/Infiltration test (in magenta) by RGI, 02/01/22

= Monitoring well by RGI, 01/19/22

= Site boundary

Approximate Scale: 1"=200'

0 100 200 400

N

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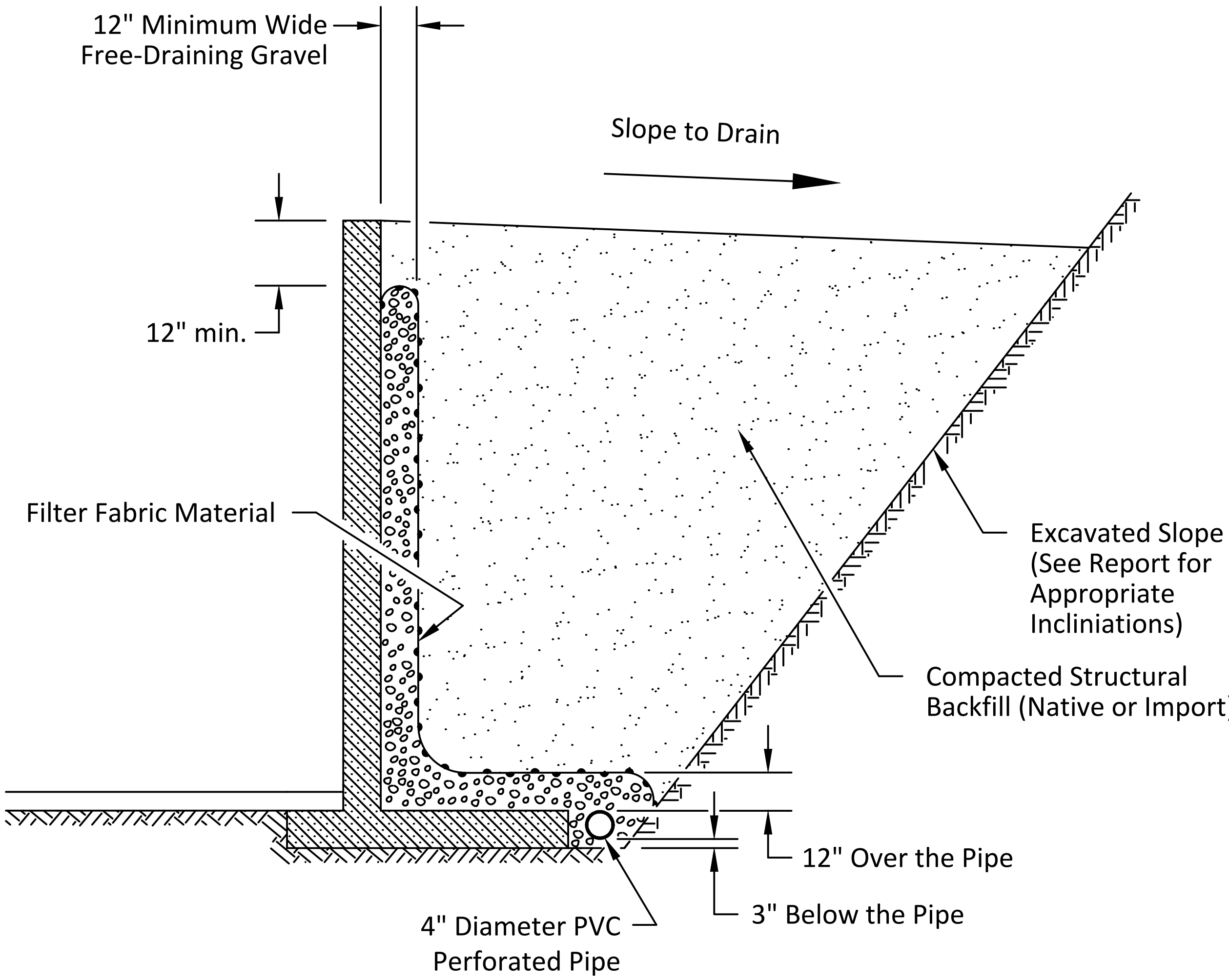
McAllister Springs		Figure 2
RGI Project Number: 2022-004-1	Geotechnical Exploration Plan	Date Drawn: 03/2022
Address: 2402 Marvin Road Southeast, Lacey, Washington 98513		



Not to Scale

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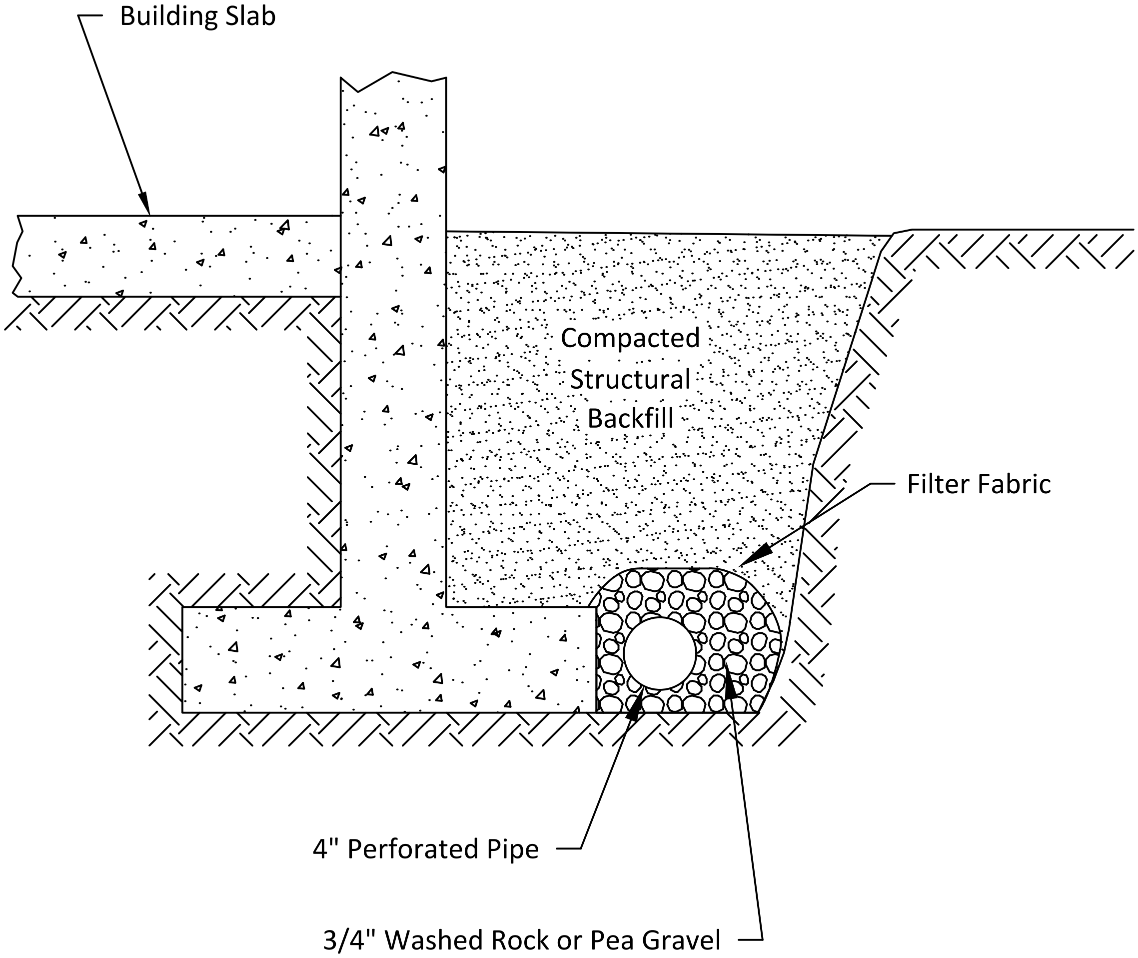
McAllister Springs		Figure 3
RGI Project Number: 2022-004-1	Retaining Wall Drainage Detail	Date Drawn: 03/2022
Address: 2402 Marvin Road Southeast, Lacey, Washington 98513		



Not to Scale

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Fax: 425.415.0311

McAllister Springs		Figure 4
RGI Project Number: 2022-004-1	Typical Footing Drain Detail	Date Drawn: 03/2022
Address: 2402 Marvin Road Southeast, Lacey, Washington 98513		

APPENDIX A
FIELD EXPLORATION AND LABORATORY TESTING

On January 19, February 1, and February 8, 2022, RGI performed field explorations using a tracked drill rig and mini excavator. We explored subsurface soil conditions at the site by observing the excavation/drilling of 11 test pits and 3 borings to a maximum depth of 22 feet below existing grade. The test pit and boring locations are shown on Figure 2. The test pit and boring locations were approximately determined by measurements from existing property lines and paved roads.

A geologist from our office conducted the field exploration and classified the soil conditions encountered, maintained a log of each test exploration, obtained representative soil samples, and observed pertinent site features. All soil samples were visually classified in accordance with the Unified Soil Classification System (USCS).

Representative soil samples obtained from the explorations were placed in closed containers and taken to our laboratory for further examination and testing. As a part of the laboratory testing program, the soil samples were classified in our in house laboratory based on visual observation, texture, plasticity, and the limited laboratory testing described below.

Moisture Content Determinations

Moisture content determinations were performed in accordance with ASTM D2216-10 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass (ASTM D2216) on representative samples obtained from the exploration in order to aid in identification and correlation of soil types. The moisture content of typical sample was measured and is reported on the test pit and boring logs.

Grain Size Analysis

A grain size analysis indicates the range in diameter of soil particles included in a particular sample. Grain size analyses was determined using D6913-04(2009) Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis (ASTM D6913) on seven of the samples.

Project Name: **McAllister Springs**	Test Pit No.: TP-1
Project Number: **2022-004-1**	**Sheet 1 of 1**
Client: **D.R. Horton**	

Date(s) Excavated: **2/1/2022**	Logged By **ELW**	Surface Conditions: **Grass**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **6.5 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Kelly's Excavating**	Approximate Surface Elevation **N/A**
Groundwater Level: **6'**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **2402 Marvin Road Southeast, Lacey, Thurston County, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0			TPSL		18" topsoil	
				GP-GM		Reddish brown GRAVEL with some sand and silt, medium dense, moist	3% moisture
				GP		Brown GRAVEL with some sand and trace silt, medium dense, moist	4% moisture, 1% fines
	5			GW		Brown GRAVEL with some sand and trace silt	3% moisture, 1% fines
						Becomes water bearing	5% moisture, 1% fines
						Test Pit terminated at 6.5'	
	10						

Project Name: **McAllister Springs** Project Number: **2022-004-1** Client: **D.R. Horton**	RILEYGROUP Test Pit No.: TP-2 **Sheet 1 of 1**

Date(s) Excavated: **2/1/2022**	Logged By **ELW**	Surface Conditions: **Ferns, Mixed Brush**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **10 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Kelly's Excavating**	Approximate Surface Elevation **N/A**
Groundwater Level: **9.5'**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **2402 Marvin Road Southeast, Lacey, Thurston County, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0			TPSL		8" topsoil	
				SP-SM		Brown SAND with some silt, medium dense, moist	17% moisture
				ML		Tan SILT, medium stiff, moist to wet	28% moisture
						Becomes moist	
	5					Slightly mottled	28% moisture
				SP-SM		Gray SAND with some silt, medium dense, moist	11% moisture, 6% fines
				SP		Gray SAND with trace silt, medium dense, moist	
						Becomes wet	23% moisture, 4% fines
						Becomes water bearing	
	10					Test Pit terminated at 10'	

Project Name: **McAllister Springs**	Test Pit No.: TP-3
Project Number: **2022-004-1**	**Sheet 1 of 1**
Client: **D.R. Horton**	RILEYGROUP

Date(s) Excavated: **2/1/2022**	Logged By **ELW**	Surface Conditions: **Ferns, Mixed Brush**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **8.5 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Kelly's Excavating**	Approximate Surface Elevation **N/A**
Groundwater Level: **8'**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **2402 Marvin Road Southeast, Lacey, Thurston County, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0			TPSL		8" topsoil	
				SM		Reddish brown silty SAND, medium dense, moist	
							17% moisture
						Becomes tan	
				SP		Brown SAND with trace silt, medium dense, moist	6% moisture, 2% fines
	5						
						Becomes gray, moist to wet	18% moisture
						Becomes water bearing	
						Test Pit terminated at 8.5'	
	10						

Project Name: **McAllister Springs**	Test Pit No.: TP-4
Project Number: **2022-004-1**	**Sheet 1 of 1**
Client: **D.R. Horton**	RILEYGROUP

Date(s) Excavated: **2/1/2022**	Logged By **ELW**	Surface Conditions: **Moss, Scotch Broom, Blackberries**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **6.5 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Kelly's Excavating**	Approximate Surface Elevation **N/A**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **2402 Marvin Road Southeast, Lacey, Thurston County, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0			TPSL		8" topsoil	
				SP-SM		Brown SAND with some silt, medium dense, moist	
		Grab					12% moisture
				SP		Gray gravelly SAND with trace silt, medium dense, moist	
	5						
						Test pit terminated at 6.5'	
	10						

Project Name: **McAllister Springs**
Project Number: **2022-004-1**
Client: **D.R. Horton**

RILEYGROUP

Test Pit No.: TP-5

Sheet 1 of 1

Date(s) Excavated: **2/1/2022**	Logged By **ELW**	Surface Conditions: **Mixed Brush**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **8 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Kelly's Excavating**	Approximate Surface Elevation **N/A**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **2402 Marvin Road Southeast, Lacey, Thurston County, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0			TPSL		6" topsoil	
				SP-SM		Brown SAND with some silt and gravel, medium dense, moist	12% moisture
	5			ML		Tan SILT, medium stiff, moist to wet	29% moisture
						Contains sand lenses	27% moisture
						Test Pit terminated at 8'	
	10						

Project Name: **McAllister Springs**	Test Pit No.: TP-6
Project Number: **2022-004-1**	**Sheet 1 of 1**
Client: **D.R. Horton**	RILEYGROUP

Date(s) Excavated: **2/1/2022**	Logged By **ELW**	Surface Conditions: **Scotch Broom**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **8 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Kelly's Excavating**	Approximate Surface Elevation **N/A**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **2402 Marvin Road Southeast, Lacey, Thurston County, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0			TPSL		6" topsoil	
				SM		Brown silty SAND, loose to medium dense, moist	15% moisture
				GP-GM		Gray GRAVEL with some sand and silt, medium dense, moist to wet	7% moisture, 8% fines
						Contains silt lenses	
	5			GP		Gray sandy GRAVEL with trace silt, medium dense, moist	3% moisture
						Test Pit terminated at 8'	
	10						

Project Name: **McAllister Springs**	Test Pit No.: TP-7
Project Number: **2022-004-1**	**Sheet 1 of 1**
Client: **D.R. Horton**	RILEYGROUP

Date(s) Excavated: **2/1/2022**	Logged By **ELW**	Surface Conditions: **Scotch Broom, Grass**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **6 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Kelly's Excavating**	Approximate Surface Elevation **N/A**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **2402 Marvin Road Southeast, Lacey, Thurston County, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0			TPSL		4" topsoil	
				GM		Brown silty sandy GRAVEL, medium dense, moist	
		Grab					11% moisture
				GP		Gray sandy GRAVEL with trace silt, medium dense, moist	
		Grab					4% moisture
	5						
						Test Pit terminated at 6'	
	10						

Project Name: **McAllister Springs** Project Number: **2022-004-1** Client: **D.R. Horton**	RILEYGROUP Test Pit No.: TP-8 **Sheet 1 of 1**

Date(s) Excavated: **2/1/2022**	Logged By **ELW**	Surface Conditions: **Scotch Broom, Grass**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **7 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Kelly's Excavating**	Approximate Surface Elevation **N/A**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **2402 Marvin Road Southeast, Lacey, Thurston County, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0			TPSL		8" topsoil	
				SM		Brown silty SAND with some gravel, medium dense, moist	17% moisture
				GP		Brown sandy GRAVEL with trace silt, medium dense, moist	3% moisture
	5						
				SP		Gray gravelly SAND with trace silt, medium dense, moist	3% moisture
						Test Pit terminated at 7'	
	10						

Project Name: **McAllister Springs**
Project Number: **2022-004-1**
Client: **D.R. Horton**

RILEYGROUP

Test Pit No.: TP-9

Sheet 1 of 1

Date(s) Excavated: **2/1/2022**	Logged By **ELW**	Surface Conditions: **Scotch Broom, Moss**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **6 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Kelly's Excavating**	Approximate Surface Elevation **N/A**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **2402 Marvin Road Southeast, Lacey, Thurston County, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0			TPSL		6" topsoil	
				SM		Brown silty SAND with some gravel, medium dense, moist	
				GP		Brown sandy GRAVEL with trace silt, medium dense, moist	
	5			SP		Gray gravelly SAND with trace silt, medium dense, moist	3% moisture
						Test Pit terminated at 6'	
	10						

Project Name: **McAllister Springs**	Test Pit No.: TP-10
Project Number: **2022-004-1**	**Sheet 1 of 1**
Client: **D.R. Horton**	RILEYGROUP

Date(s) Excavated: **2/1/2022**	Logged By **ELW**	Surface Conditions: **Scotch Broom, Grass**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **7 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Kelly's Excavating**	Approximate Surface Elevation **N/A**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **2402 Marvin Road Southeast, Lacey, Thurston County, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0			TPSL		24" topsoil	
	2			GP		Brown sandy GRAVEL with trace silt, medium dense, moist	
	4	Grab					3% moisture
	5.5					Becomes gray, moderate caving	
	6.5	Grab					4% moisture
	7					Test Pit terminated at 7'	
	10						

Project Name: **McAllister Springs**
Project Number: **2022-004-1**
Client: **D.R. Horton**

Key to Logs
Sheet 1 of 1

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
1	2	3	4	5	6	7	8

COLUMN DESCRIPTIONS

1 Elevation (feet): Elevation (MSL, feet).
2 Depth (feet): Depth in feet below the ground surface.
3 Sample Type: Type of soil sample collected at the depth interval shown.
4 Sample Number: Sample identification number.
5 USCS Symbol: USCS symbol of the subsurface material.
6 Graphic Log: Graphic depiction of the subsurface material encountered.
7 MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.
8 REMARKS AND OTHER TESTS: Comments and observations regarding drilling or sampling made by driller or field personnel.

FIELD AND LABORATORY TEST ABBREVIATIONS

CHEM: Chemical tests to assess corrosivity
COMP: Compaction test
CONS: One-dimensional consolidation test
LL: Liquid Limit, percent
PI: Plasticity Index, percent
SA: Sieve analysis (percent passing No. 200 Sieve)
UC: Unconfined compressive strength test, Qu, in ksf
WA: Wash sieve (percent passing No. 200 Sieve)

MATERIAL GRAPHIC SYMBOLS

Silty GRAVEL (GM)
Poorly graded GRAVEL (GP)
Poorly graded GRAVEL with Silt (GP-GM)
Well graded GRAVEL (GW)
SILT, SILT w/SAND, SANDY SILT (ML)
Silty SAND (SM)
Poorly graded SAND (SP)
Poorly graded SAND with Silt (SP-SM)
Topsoil

TYPICAL SAMPLER GRAPHIC SYMBOLS

Auger sampler
Bulk Sample
3-inch-OD California w/ brass rings
CME Sampler
Grab Sample
2.5-inch-OD Modified California w/ brass liners
Pitcher Sample
2-inch-OD unlined split spoon (SPT)
Shelby Tube (Thin-walled, fixed head)

OTHER GRAPHIC SYMBOLS

Water level (at time of drilling, ATD)
Water level (after waiting)
Minor change in material properties within a stratum
Inferred/gradational contact between strata
? Queried contact between strata

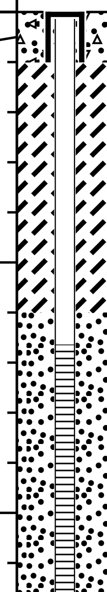
GENERAL NOTES

1: Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2: Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

Project Name: **McAllister Springs** Project Number: **2022-004-1** Client: **D.R. Horton**	RILEYGROUP Boring No.: **MW-1** **Sheet 1 of 1**

Date(s) Drilled: **1/19/2022**	Logged By: **JH**	Surface Conditions: **Grass, Scotch Broom**
Drilling Method(s): **Direct Push**	Drill Bit Size/Type: **2.25"**	Total Depth of Borehole: **12 feet bgs**
Drill Rig Type: **Track Rig**	Drilling Contractor: **Riley Group, Inc.**	Approximate Surface Elevation: **N/A**
Groundwater Level: **5.82 on 3/11/2022**	Sampling Method(s):	Hammer Data : **N/A**
Borehole Backfill: **Well Installed**	Location: **2402 Marvin Road Southeast, Lacey, Thurston County, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Well Log	Moisture (%)
	0					TPSL		6" topsoil		
						GP		Tan to gray sandy GRAVEL with trace silt, medium dense, moist		
	5									
								Becomes water bearing		
	10							Becomes gray		
								Boring terminated at 12'		
	15									
	20									



Project Name: **McAllister Springs**	Boring No.: **MW-2**
Project Number: **2022-004-1**	**Sheet 1 of 1**
Client: **D.R. Horton**	

Date(s) Drilled: **1/19/2022**	Logged By: **JH**	Surface Conditions: **Grass, Scotch Broom**
Drilling Method(s): **Direct Push**	Drill Bit Size/Type: **2.25"**	Total Depth of Borehole: **20 feet bgs**
Drill Rig Type: **Track Rig**	Drilling Contractor: **Riley Group, Inc.**	Approximate Surface Elevation: **N/A**
Groundwater Level: **12.85 on 3/11/2022**	Sampling Method(s):	Hammer Data : **N/A**
Borehole Backfill: **Well Installed**	Location: **2402 Marvin Road Southeast, Lacey, Thurston County, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Well Log	Moisture (%)
	0					TPSL		6" topsoil		
						GP		Tan to gray sandy GRAVEL with trace silt, medium dense, moist		
	5									
	10					GP		Gray GRAVEL with some sand and trace silt, medium dense, moist		
								Becomes water bearing		
	15									
	20							Boring terminated at 20'		

Project Name: **McAllister Springs**	Boring No.: **MW-3**
Project Number: **2022-004-1**	**Sheet 1 of 1**
Client: **D.R. Horton**	

Date(s) Drilled: **1/19/2022**	Logged By: **JH**	Surface Conditions: **Grass, Scotch Broom**
Drilling Method(s): **Direct Push**	Drill Bit Size/Type: **2.25"**	Total Depth of Borehole: **22 feet bgs**
Drill Rig Type: **Track Rig**	Drilling Contractor: **Riley Group, Inc.**	Approximate Surface Elevation: **N/A**
Groundwater Level: **16.26 on 3/11/2022**	Sampling Method(s):	Hammer Data : **N/A**
Borehole Backfill: **Well Installed**	Location: **2402 Marvin Road Southeast, Lacey, Thurston County, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Well Log	Moisture (%)
	0					TPSL		6" topsoil		
						GP		Tan to gray sandy GRAVEL with trace silt, medium dense, moist		
	5									
	10					GP		Gray gravel with some sand and trace silt, medium dense, moist		
	15							Becomes moist to wet		
								Becomes water bearing		
	20					GP		Gray sandy GRAVEL with trace silt, medium dense, water bearing		
								Boring terminated at 22'		

Project Name: **McAllister Springs**	RILEYGROUP Boring No.: **WP-1**
Project Number: **2022-004-1**	**Sheet 1 of 1**
Client: **D.R. Horton**	

Date(s) Drilled: **2/8/2022**	Logged By: **CN**	Surface Conditions: **Mixed Brush**
Drilling Method(s): **Test Pit**	Drill Bit Size/Type: **N/A**	Total Depth of Borehole: **10.5 feet bgs**
Drill Rig Type: **Mini Excavator**	Drilling Contractor: **Kelly's Excavating**	Approximate Surface Elevation: **N/A**
Groundwater Level: **9.19 on 3/11/2022**	Sampling Method(s):	Hammer Data : **N/A**
Borehole Backfill: **Well Installed**	Location: **2402 Marvin Road Southeast, Lacey, Thurston County, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION		Moisture (%)
	0					TPSL		12" topsoil		
						SP		Light brown SAND with trace silt, medium dense, moist		
	5									
								Becomes water bearing		
	10									
								Test pit terminated at 10.5'		
	15									
	20									

Project Name: **McAllister Springs**
Project Number: **2022-004-1**
Client: **D.R. Horton**

RILEYGROUP

Key to Log of Boring
Sheet 1 of 1

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Well Log	Moisture (%)
1	2	3	4	5	6	7	8	9	10	11

COLUMN DESCRIPTIONS

1 Elevation (feet): Elevation (MSL, feet).
2 Depth (feet): Depth in feet below the ground surface.
3 Sample Type: Type of soil sample collected at the depth interval shown.
4 Sample ID: Sample identification number.
5 Sampling Resistance, blows/ft: Number of blows to advance driven sampler one foot (or distance shown) beyond seating interval using the hammer identified on the boring log.
6 Recovery (%): Core Recovery Percentage is determined based on a ratio of the length of core sample recovered compared to the cored interval length.
7 USCS Symbol: USCS symbol of the subsurface material.
8 Graphic Log: Graphic depiction of the subsurface material encountered.
9 MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.
10 Well Log: Graphical representation of well installed upon completion of drilling and sampling.
11 Moisture (%): Moisture, expressed as a water content.

FIELD AND LABORATORY TEST ABBREVIATIONS

CHEM: Chemical tests to assess corrosivity
COMP: Compaction test
CONS: One-dimensional consolidation test
LL: Liquid Limit, percent
PI: Plasticity Index, percent
SA: Sieve analysis (percent passing No. 200 Sieve)
UC: Unconfined compressive strength test, Qu, in ksf
WA: Wash sieve (percent passing No. 200 Sieve)

MATERIAL GRAPHIC SYMBOLS

Bentonite chips
Portland Cement Concrete
Poorly graded GRAVEL (GP)
Poorly graded SAND (SP)
Topsoil

TYPICAL SAMPLER GRAPHIC SYMBOLS

Auger sampler
Bulk Sample
3-inch-OD California w/ brass rings
CME Sampler
Grab Sample
2.5-inch-OD Modified California w/ brass liners
Pitcher Sample
2-inch-OD unlined split spoon (SPT)
Shelby Tube (Thin-walled, fixed head)

OTHER GRAPHIC SYMBOLS

Water level (at time of drilling, ATD)
Water level (after waiting)
Minor change in material properties within a stratum
Inferred/gradational contact between strata
? Queried contact between strata

GENERAL NOTES

1: Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2: Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	McAllister Springs	SAMPLE ID/TYPE	TP-1
PROJECT NO.	2022-004-1	SAMPLE DEPTH	3'
TECH/TEST DATE	CM 2/8/2022	DATE RECEIVED	2/1/2022

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	1547.4
Wt Dry Soil & Tare (gm)	(w2)	1498.8
Weight of Tare (gm)	(w3)	133.4
Weight of Water (gm)	(w4=w1-w2)	48.6
Weight of Dry Soil (gm)	(w5=w2-w3)	1365.4
Moisture Content (%)	(w4/w5)*100	4

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

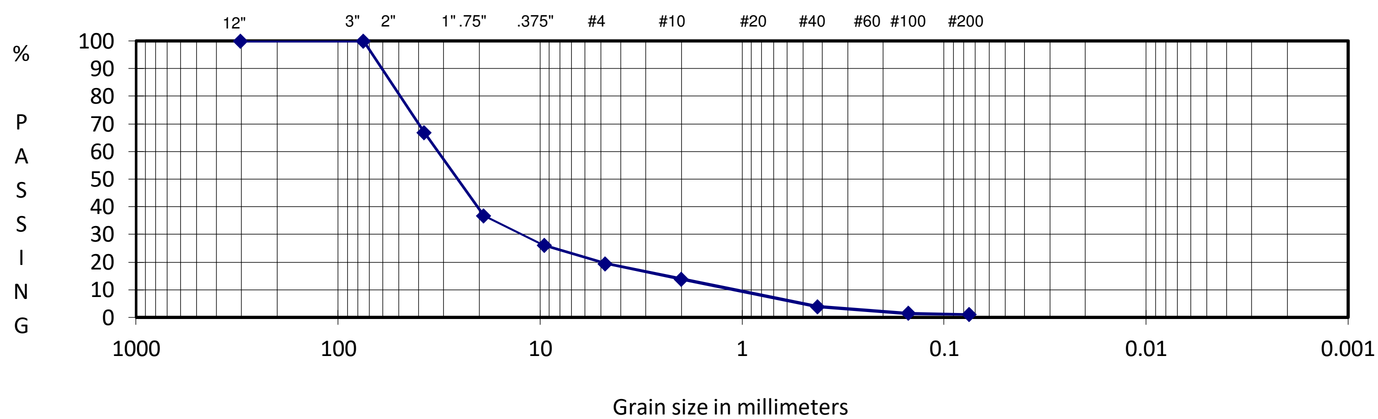
	Weight Of Sample (gm)	1498.8
	Tare Weight (gm)	133.4
(W6)	Total Dry Weight (gm)	1365.4

% COBBLES	0.0
% C GRAVEL	63.2
% F GRAVEL	17.4
% C SAND	5.6
% M SAND	10.0
% F SAND	2.8
% FINES	1.1
% TOTAL	100.0

D10 (mm)	1.1
D30 (mm)	13
D60 (mm)	32
Cu	29.1
Cc	4.8

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	133.4	0.00	0.00	100.00	cobbles
3.0"	133.4	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	586.2	452.80	33.16	66.84	coarse gravel
1.0"					coarse gravel
0.75"	996.5	863.10	63.21	36.79	fine gravel
0.50"					fine gravel
0.375"	1143.5	1010.10	73.98	26.02	fine gravel
#4	1234.2	1100.80	80.62	19.38	coarse sand
#10	1310.2	1176.80	86.19	13.81	medium sand
#20					medium sand
#40	1446.1	1312.70	96.14	3.86	fine sand
#60					fine sand
#100	1479.1	1345.70	98.56	1.44	fine sand
#200	1484.3	1350.90	98.94	1.06	fines
PAN	1498.8	1365.40	100.00	0.00	silt/clay



DESCRIPTION	GRAVEL with some sand and trace silt
USCS	GP

Prepared For:
D.R. Horton

Reviewed By:
ELW

RILEYGROUP

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	McAllister Springs	SAMPLE ID/TYPE	TP-1
PROJECT NO.	2022-004-1	SAMPLE DEPTH	5'
TECH/TEST DATE	CM 2/8/2022	DATE RECEIVED	2/1/2022

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	1287.8
Wt Dry Soil & Tare (gm)	(w2)	1250.9
Weight of Tare (gm)	(w3)	133.8
Weight of Water (gm)	(w4=w1-w2)	36.9
Weight of Dry Soil (gm)	(w5=w2-w3)	1117.1
Moisture Content (%)	(w4/w5)*100	3

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

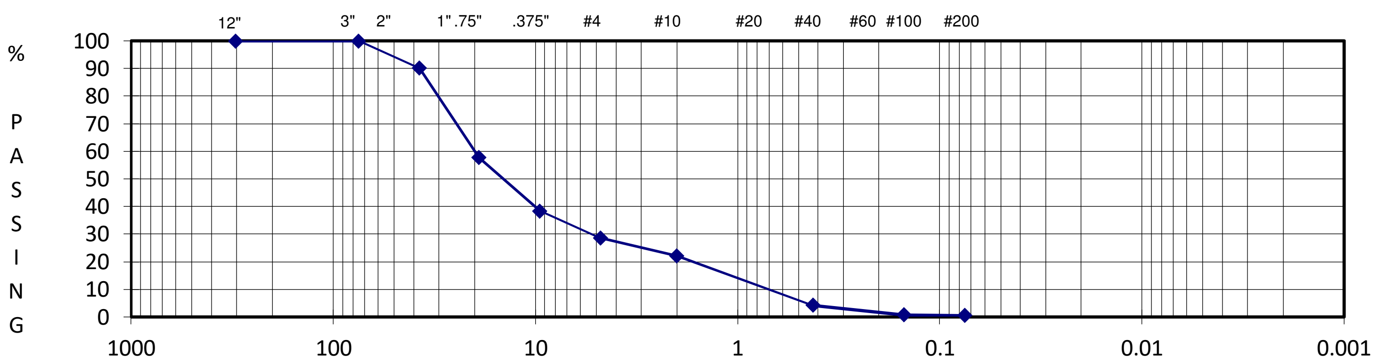
	Weight Of Sample (gm)	1250.9
	Tare Weight (gm)	133.8
(W6)	Total Dry Weight (gm)	1117.1

% COBBLES	0.0
% C GRAVEL	42.3
% F GRAVEL	29.2
% C SAND	6.5
% M SAND	17.9
% F SAND	3.7
% FINES	0.5
% TOTAL	100.0

D10 (mm)	0.7
D30 (mm)	5.1
D60 (mm)	20
Cu	28.6
Cc	1.9

SIEVE ANALYSIS

Sieve	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	133.8	0.00	0.00	100.00	cobbles
3.0"	133.8	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	244.6	110.80	9.92	90.08	coarse gravel
1.0"					coarse gravel
0.75"	606.0	472.20	42.27	57.73	fine gravel
0.50"					fine gravel
0.375"	822.8	689.00	61.68	38.32	fine gravel
#4	932.4	798.60	71.49	28.51	coarse sand
#10	1004.6	870.80	77.95	22.05	medium sand
#20					medium sand
#40	1204.3	1070.50	95.83	4.17	fine sand
#60					fine sand
#100	1242.3	1108.50	99.23	0.77	fine sand
#200	1245.1	1111.30	99.48	0.52	fines
PAN	1250.9	1117.10	100.00	0.00	silt/clay



Grain size in millimeters

DESCRIPTION	GRAVEL with some sand and trace silt
USCS	GW

Prepared For:
D.R. Horton

Reviewed By:
ELW

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	McAllister Springs	SAMPLE ID/TYPE	TP-1
PROJECT NO.	2022-004-1	SAMPLE DEPTH	6'
TECH/TEST DATE	CM 2/8/2022	DATE RECEIVED	2/1/2022

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	1557.5
Wt Dry Soil & Tare (gm)	(w2)	1487.1
Weight of Tare (gm)	(w3)	133.3
Weight of Water (gm)	(w4=w1-w2)	70.4
Weight of Dry Soil (gm)	(w5=w2-w3)	1353.8
Moisture Content (%)	(w4/w5)*100	5

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

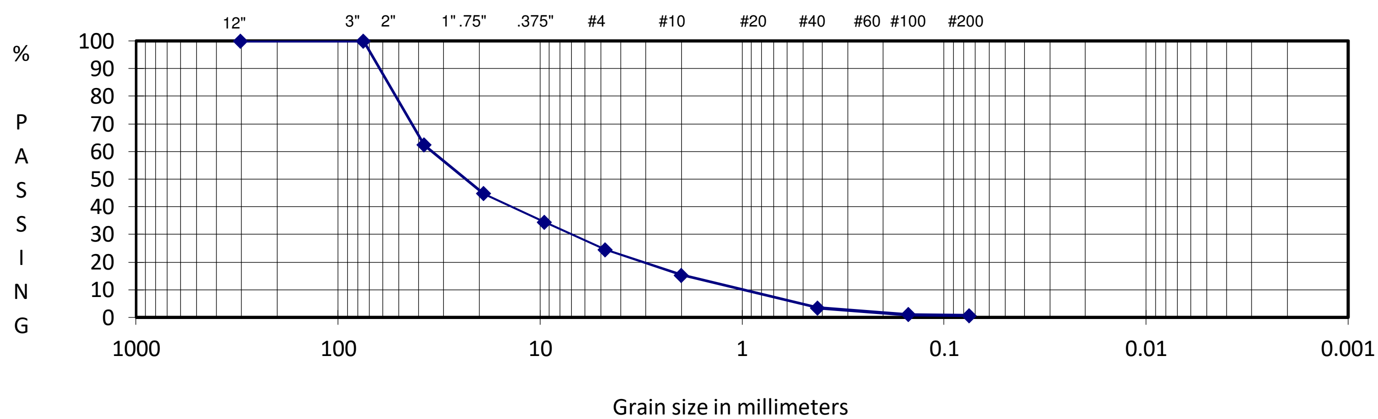
	Weight Of Sample (gm)	1487.1
	Tare Weight (gm)	133.3
(W6)	Total Dry Weight (gm)	1353.8

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	133.3	0.00	0.00	100.00	cobbles
3.0"	133.3	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	643.0	509.70	37.65	62.35	coarse gravel
1.0"					coarse gravel
0.75"	881.0	747.70	55.23	44.77	fine gravel
0.50"					fine gravel
0.375"	1021.1	887.80	65.58	34.42	fine gravel
#4	1155.6	1022.30	75.51	24.49	coarse sand
#10	1281.5	1148.20	84.81	15.19	medium sand
#20					medium sand
#40	1441.2	1307.90	96.61	3.39	fine sand
#60					fine sand
#100	1474.3	1341.00	99.05	0.95	fine sand
#200	1477.9	1344.60	99.32	0.68	fines
PAN	1487.1	1353.80	100.00	0.00	silt/clay

% COBBLES	0.0
% C GRAVEL	55.2
% F GRAVEL	20.3
% C SAND	9.3
% M SAND	11.8
% F SAND	2.7
% FINES	0.7
% TOTAL	100.0

D10 (mm)	1
D30 (mm)	6.5
D60 (mm)	34
Cu	34.0
Cc	1.2



DESCRIPTION	GRAVEL with some sand and trace silt
USCS	GW

Prepared For:
D.R. Horton

Reviewed By:
ELW

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	McAllister Springs	SAMPLE ID/TYPE	TP-2
PROJECT NO.	2022-004-1	SAMPLE DEPTH	7'
TECH/TEST DATE	CM 2/8/2022	DATE RECEIVED	2/1/2022

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	746.7
Wt Dry Soil & Tare (gm)	(w2)	683.2
Weight of Tare (gm)	(w3)	124.1
Weight of Water (gm)	(w4=w1-w2)	63.5
Weight of Dry Soil (gm)	(w5=w2-w3)	559.1
Moisture Content (%)	(w4/w5)*100	11

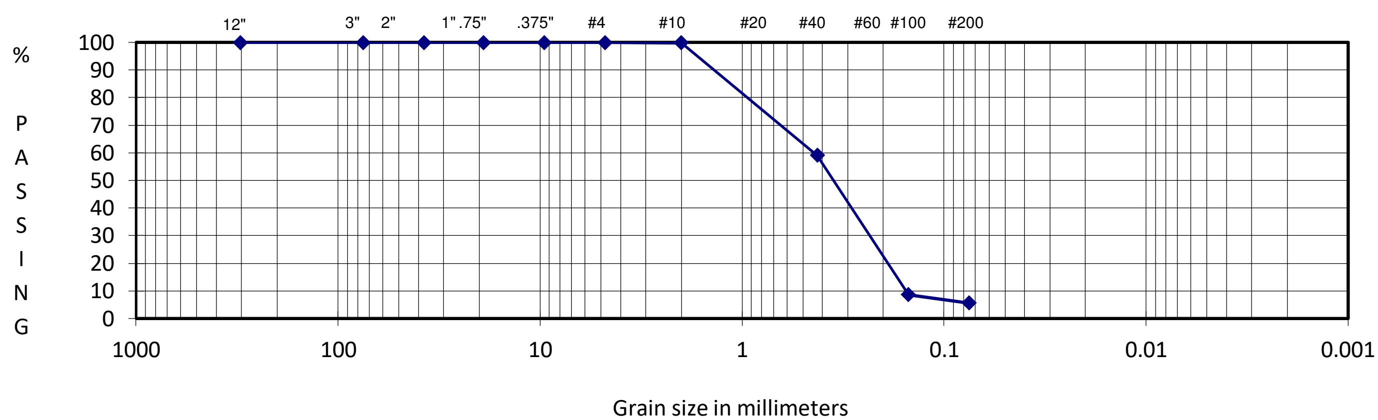
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

	Weight Of Sample (gm)	683.2
	Tare Weight (gm)	124.1
(W6)	Total Dry Weight (gm)	559.1

SIEVE ANALYSIS

% COBBLES	0.0	
% C GRAVEL	0.0	
% F GRAVEL	0.0	
% C SAND	0.2	
% M SAND	40.7	
% F SAND	53.5	
% FINES	5.6	
% TOTAL	100.0	
D10 (mm)	0.16	
D30 (mm)	0.23	
D60 (mm)	0.45	
Cu	2.8	
Cc	0.7	

Sieve	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	124.1	0.00	0.00	100.00	cobbles
3.0"	124.1	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	124.1	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	124.1	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	124.1	0.00	0.00	100.00	fine gravel
#4	124.1	0.00	0.00	100.00	coarse sand
#10	125.2	1.10	0.20	99.80	medium sand
#20					medium sand
#40	352.9	228.80	40.92	59.08	fine sand
#60					fine sand
#100	634.8	510.70	91.34	8.66	fine sand
#200	652.1	528.00	94.44	5.56	fines
PAN	683.2	559.10	100.00	0.00	silt/clay



DESCRIPTION SAND with some silt

USCS SP-SM

Prepared For:
D.R. Horton

Reviewed By:
ELW

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	McAllister Springs	SAMPLE ID/TYPE	TP-2
PROJECT NO.	2022-004-1	SAMPLE DEPTH	9'
TECH/TEST DATE	CM 2/8/2022	DATE RECEIVED	2/1/2022

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	770.2
Wt Dry Soil & Tare (gm)	(w2)	652.5
Weight of Tare (gm)	(w3)	133.2
Weight of Water (gm)	(w4=w1-w2)	117.7
Weight of Dry Soil (gm)	(w5=w2-w3)	519.3
Moisture Content (%)	(w4/w5)*100	23

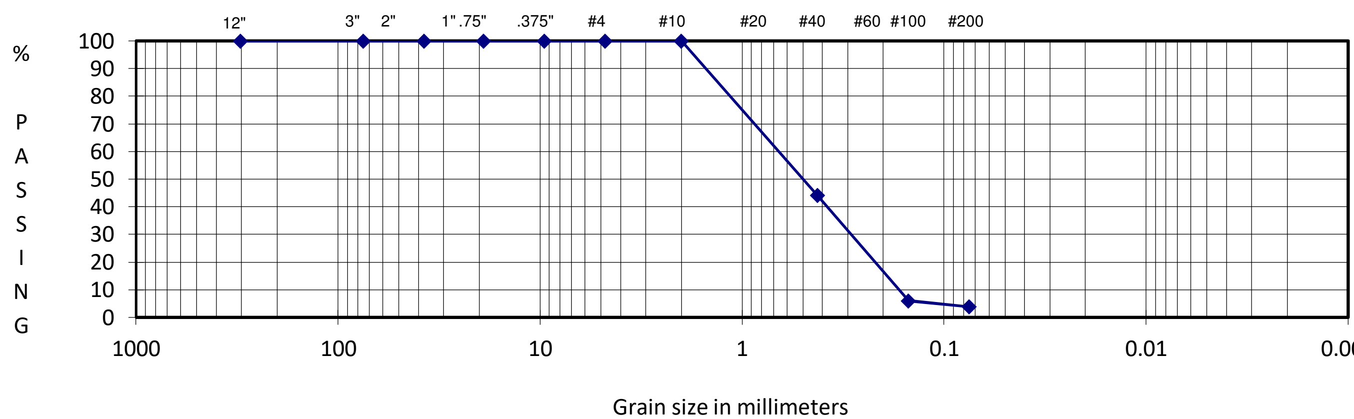
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

	Weight Of Sample (gm)	652.5
	Tare Weight (gm)	133.2
(W6)	Total Dry Weight (gm)	519.3

SIEVE ANALYSIS

% COBBLES	0.0	
% C GRAVEL	0.0	
% F GRAVEL	0.0	
% C SAND	0.0	
% M SAND	55.8	
% F SAND	40.4	
% FINES	3.7	
% TOTAL	100.0	
D10 (mm)	0.17	
D30 (mm)	0.29	
D60 (mm)	0.67	
Cu	3.9	
Cc	0.7	

Sieve	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	133.2	0.00	0.00	100.00	cobbles
3.0"	133.2	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	133.2	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	133.2	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	133.2	0.00	0.00	100.00	fine gravel
#4	133.2	0.00	0.00	100.00	coarse sand
#10	133.2	0.00	0.00	100.00	medium sand
#20					medium sand
#40	423.1	289.90	55.83	44.17	fine sand
#60					fine sand
#100	621.4	488.20	94.01	5.99	fine sand
#200	633.1	499.90	96.26	3.74	fines
PAN	652.5	519.30	100.00	0.00	silt/clay



DESCRIPTION	SAND with trace silt
USCS	SP

Prepared For:
D.R. Horton

Reviewed By:
ELW

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	McAllister Springs	SAMPLE ID/TYPE	TP-3
PROJECT NO.	2022-004-1	SAMPLE DEPTH	4'
TECH/TEST DATE	CM 2/8/2022	DATE RECEIVED	2/1/2022

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	678.5
Wt Dry Soil & Tare (gm)	(w2)	645.9
Weight of Tare (gm)	(w3)	134.1
Weight of Water (gm)	(w4=w1-w2)	32.6
Weight of Dry Soil (gm)	(w5=w2-w3)	511.8
Moisture Content (%)	(w4/w5)*100	6

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

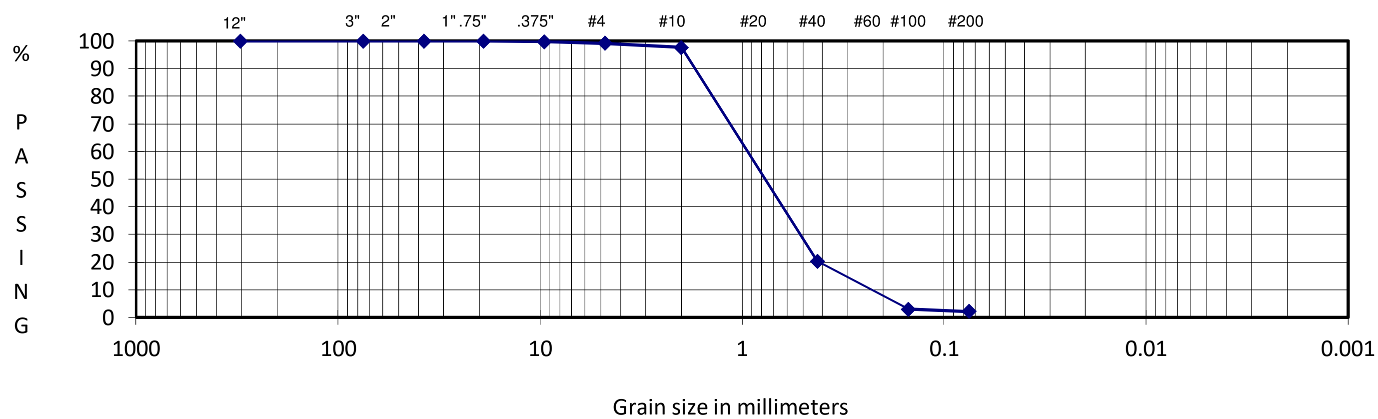
	Weight Of Sample (gm)	645.9
	Tare Weight (gm)	134.1
(W6)	Total Dry Weight (gm)	511.8

% COBBLES	0.0
% C GRAVEL	0.0
% F GRAVEL	0.8
% C SAND	1.6
% M SAND	77.3
% F SAND	18.2
% FINES	2.1
% TOTAL	100.0

D10 (mm)	0.23
D30 (mm)	0.5
D60 (mm)	0.92
Cu	4.0
Cc	1.2

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	134.1	0.00	0.00	100.00	cobbles
3.0"	134.1	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	134.1	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	134.1	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	135.7	1.60	0.31	99.69	fine gravel
#4	138.4	4.30	0.84	99.16	coarse sand
#10	146.4	12.30	2.40	97.60	medium sand
#20					medium sand
#40	541.8	407.70	79.66	20.34	fine sand
#60					fine sand
#100	630.9	496.80	97.07	2.93	fine sand
#200	635.2	501.10	97.91	2.09	fines
PAN	645.9	511.80	100.00	0.00	silt/clay



DESCRIPTION	SAND with trace silt
USCS	SW

Prepared For:
D.R. Horton

Reviewed By:
ELW

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	McAllister Springs	**SAMPLE ID/TYPE**	TP-6
PROJECT NO.	2022-004-1	**SAMPLE DEPTH**	3'
TECH/TEST DATE	CM 2/8/2022	**DATE RECEIVED**	2/1/2022

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	931.1
Wt Dry Soil & Tare (gm)	(w2)	876.6
Weight of Tare (gm)	(w3)	133.8
Weight of Water (gm)	(w4=w1-w2)	54.5
Weight of Dry Soil (gm)	(w5=w2-w3)	742.8
Moisture Content (%)	(w4/w5)*100	7

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

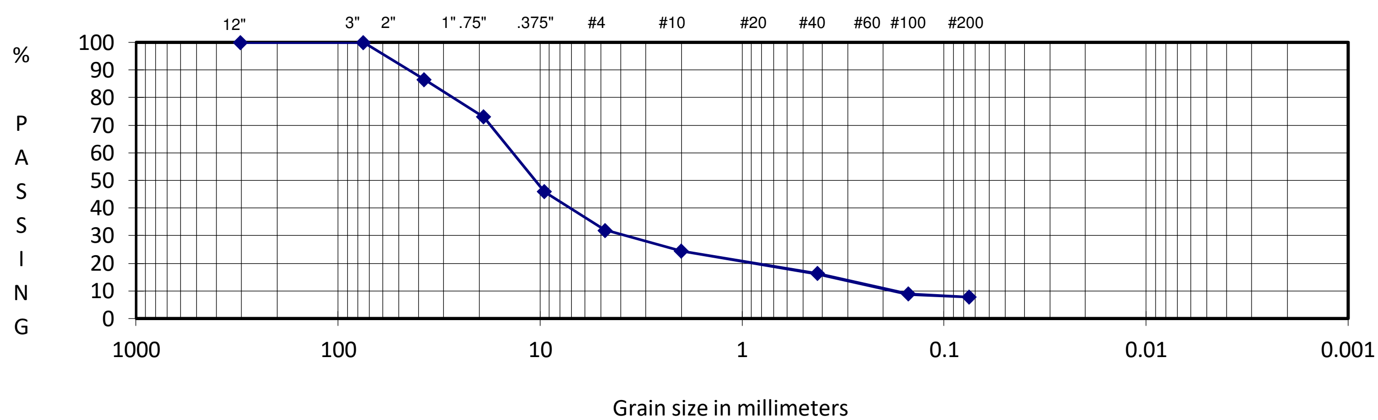
	Weight Of Sample (gm)	876.6
	Tare Weight (gm)	133.8
(W6)	Total Dry Weight (gm)	742.8

% COBBLES	**0.0**
% C GRAVEL	**27.0**
% F GRAVEL	**41.2**
% C SAND	**7.5**
% M SAND	**8.1**
% F SAND	**8.6**
% FINES	**7.7**
% TOTAL	**100.0**

D10 (mm)	0.18
D30 (mm)	0.8
D60 (mm)	15
Cu	83.3
Cc	0.2

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	133.8	0.00	0.00	100.00	cobbles
3.0"	133.8	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	234.2	100.40	13.52	86.48	coarse gravel
1.0"					coarse gravel
0.75"	334.2	200.40	26.98	73.02	fine gravel
0.50"					fine gravel
0.375"	535.7	401.90	54.11	45.89	fine gravel
#4	640.0	506.20	68.15	31.85	coarse sand
#10	695.6	561.80	75.63	24.37	medium sand
#20					medium sand
#40	755.5	621.70	83.70	16.30	fine sand
#60					fine sand
#100	810.9	677.10	91.16	8.84	fine sand
#200	819.5	685.70	92.31	7.69	fines
PAN	876.6	742.80	100.00	0.00	silt/clay



DESCRIPTION	GRAVEL with some sand and silt
USCS	GP-GM

Prepared For:
D.R. Horton

Reviewed By:
ELW

August 16, 2022

Bruce White
D.R. Horton
11241 Slater Avenue Northeast, Suite 200
Kirkland, Washington 98034

RE: Groundwater Level Monitoring
McAllister Springs
2402 Marvin Road Southwest
Lacey, Thurston County, Washington
RGI Job No. 2022-004-2

The Riley Group, Inc. (RGI) is pleased to present this report documenting groundwater level monitoring at the proposed McAllister Springs Site located at 2402 Marvin Road Southeast in Lacey, Washington as shown on Figure 1.

RGI oversaw the installation of monitoring wells MW-1, MW-2, MW-3, and WP-1 at the Site. Monitoring well locations are shown on Figure 2.

Groundwater Level Monitoring

Groundwater levels were monitored in monitoring wells MW-1, MW-2, MW-3, and WP-1 from January 2022 through April 2022 wet season. The highest/shallowest depth to groundwater levels are presented in Table 1 below:

Table 1: Groundwater Levels

Well	Seasonal High Depth to Groundwater Below grade (feet)
MW-1	5.75
MW-2	12.81
MW-3	16.26
WP-1	9.19

Limitations

This report is the property of RGI, DR Horton, and its designated agents. Within the limits of the scope and budget, the groundwater monitoring was completed in accordance with generally accepted geotechnical engineering practices in the area at the time this report was issued. This groundwater level monitoring is intended for specific application to the proposed McAllister Springs development in Lacey, Washington, and for the exclusive use of DR Horton and its authorized representatives.

Please call us at (425) 415-0551 if you have any questions or need additional information.

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Respectfully submitted,

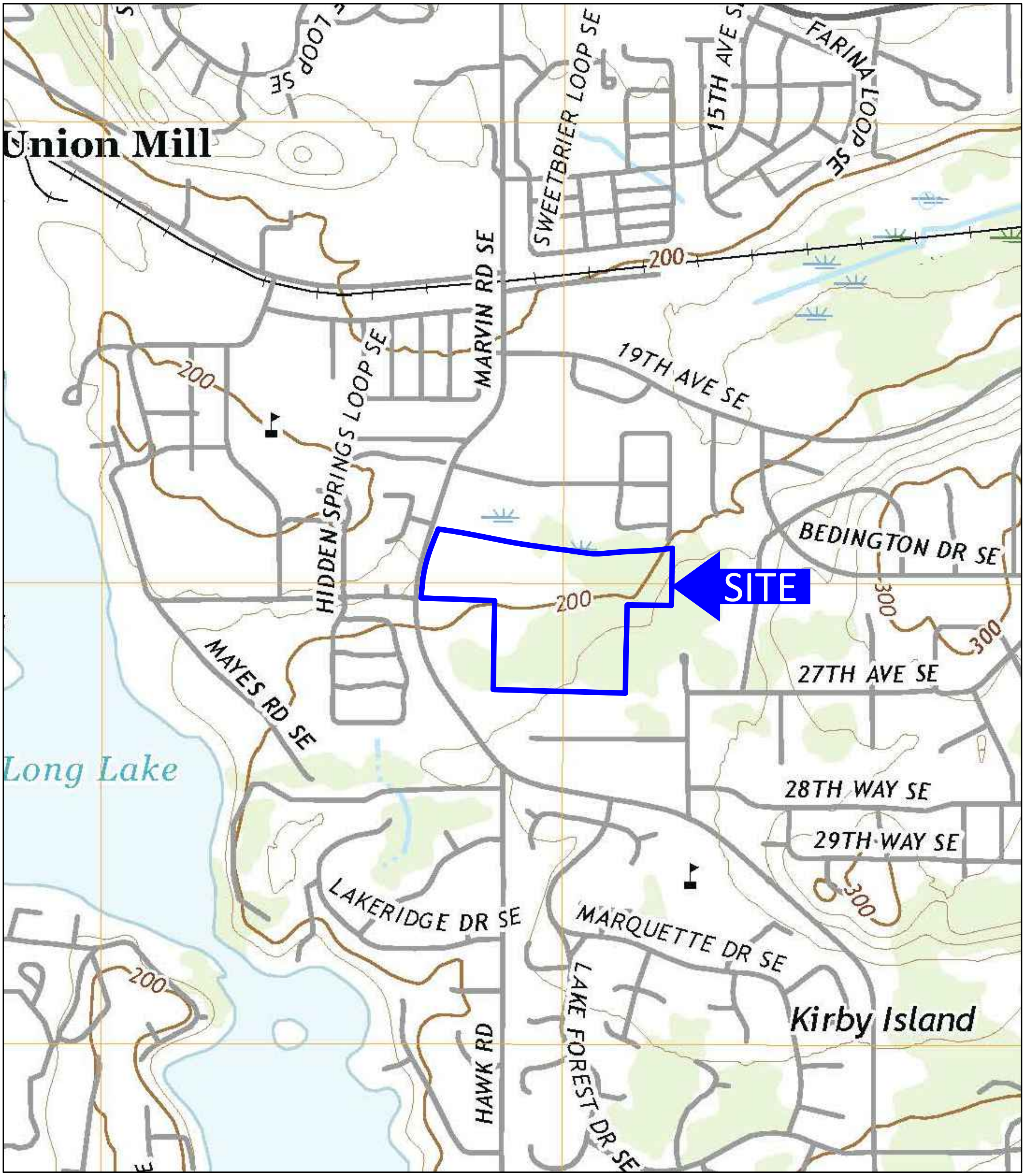
THE RILEY GROUP, INC.

State of Washington
Hydrogeologist
1079
Licensed Geologist
David John Baumgarten

8/16/2022

David J. Baumgarten, LHG
Associate Hydrogeologist

Attachments: Figure 1 Site Vicinity Map
Figure 2 Geotechnical Exploration Plan
Monitoring Well Logs (MW-1, MW-2, MW-3, WP-1)



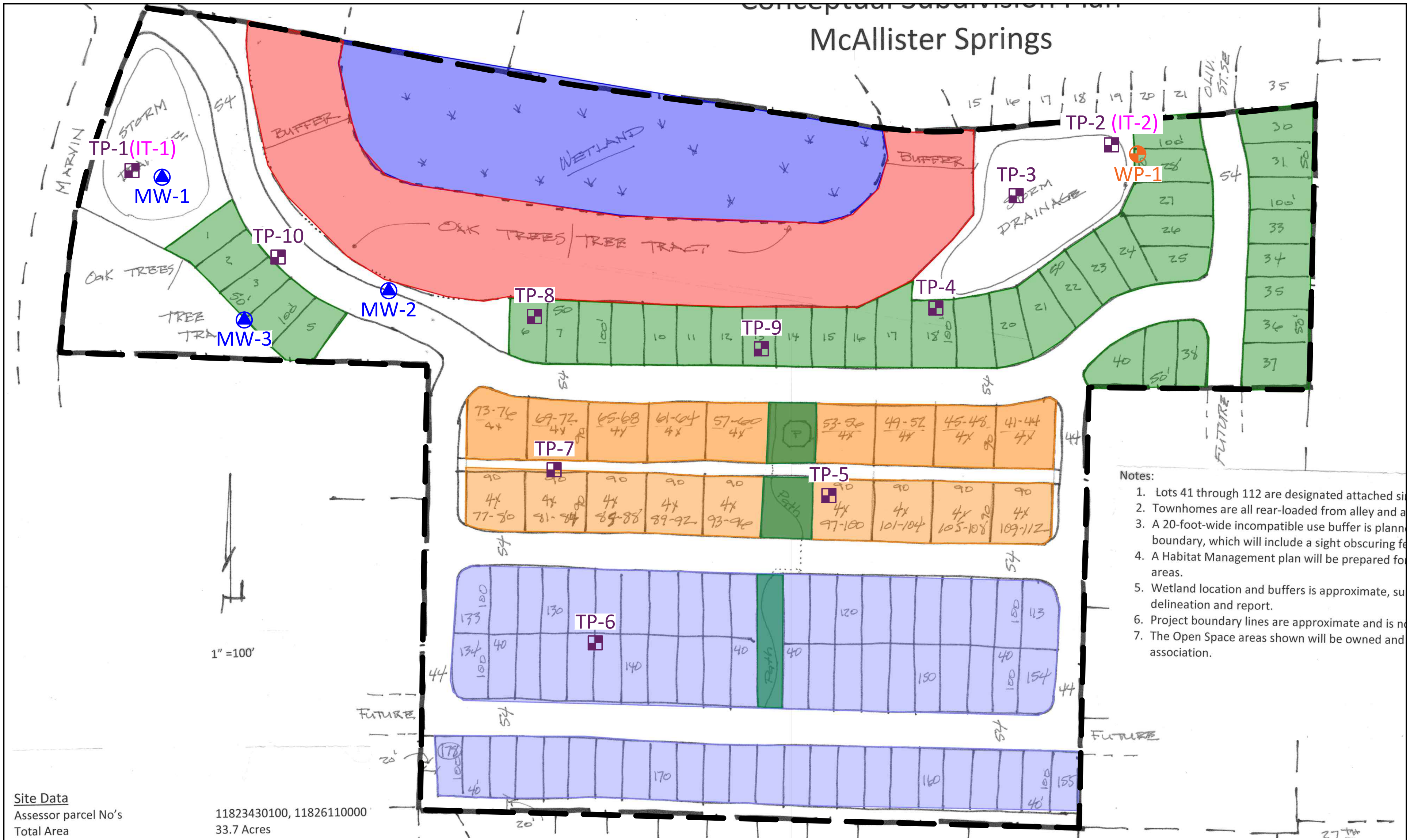
USGS, 2020, Lacey, Washington
7.5-Minute Quadrangle

Approximate Scale: 1"=1000'

0 500 1000 2000

N

RILEYGROUP Corporate Office 17522 Bothell Way Northeast Bothell, Washington 98011 Phone: 425.415.0551 Fax: 425.415.0311	McAllister Springs	Figure 1
	RGI Project Number: 2022-004-1 / Site Vicinity Map	Date Drawn: 03/2022
	Address: 2402 Marvin Road Southeast, Lacey, Washington 98513	



= Well point by RGI, 02/08/22
= Test pit/Infiltration test (in magenta) by RGI, 02/01/22
= Monitoring well by RGI, 01/19/22
= Site boundary

Approximate Scale: 1"=200'

0 100 200 400

N

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McAllister Springs		Figure 2
RGI Project Number: 2022-004-1	Geotechnical Exploration Plan	Date Drawn: 03/2022
Address: 2402 Marvin Road Southeast, Lacey, Washington 98513		

Project Name: **McAllister Springs**

Project Number: **2022-004-1**

Client: **D.R. Horton**

RILEYGROUP

Boring No.: **MW-1**

Sheet 1 of 1

Date(s) Drilled: **1/19/2022**	Logged By: **JH**	Surface Conditions: **Grass, Scotch Broom**
Drilling Method(s): **Direct Push**	Drill Bit Size/Type: **2.25"**	Total Depth of Borehole: **12 feet bgs**
Drill Rig Type: **Track Rig**	Drilling Contractor: **Riley Group, Inc.**	Approximate Surface Elevation: **N/A**
Groundwater Level: **5.82 on 3/11/2022**	Sampling Method(s):	Hammer Data : **N/A**
Borehole Backfill: **Well Installed**	Location: **2402 Marvin Road Southeast, Lacey, Thurston County, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Well Log	Moisture (%)
	0					TPSL		6" topsoil		
						GP		Tan to gray sandy GRAVEL with trace silt, medium dense, moist		
	5									
	▼							Becomes water bearing		
	10							Becomes gray		
								Boring terminated at 12'		
	15									
	20									

Project Name: **McAllister Springs**
Project Number: **2022-004-1**
Client: **D.R. Horton**

RILEYGROUP

Boring No.: **MW-2**
Sheet 1 of 1

Date(s) Drilled: **1/19/2022**	Logged By: **JH**	Surface Conditions: **Grass, Scotch Broom**
Drilling Method(s): **Direct Push**	Drill Bit Size/Type: **2.25"**	Total Depth of Borehole: **20 feet bgs**
Drill Rig Type: **Track Rig**	Drilling Contractor: **Riley Group, Inc.**	Approximate Surface Elevation: **N/A**
Groundwater Level: **12.85 on 3/11/2022**	Sampling Method(s):	Hammer Data : **N/A**
Borehole Backfill: **Well Installed**	Location: **2402 Marvin Road Southeast, Lacey, Thurston County, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Well Log	Moisture (%)
	0					TPSL		6" topsoil		
						GP		Tan to gray sandy GRAVEL with trace silt, medium dense, moist		
	5									
	10					GP		Gray GRAVEL with some sand and trace silt, medium dense, moist		
	▼							Becomes water bearing		
	15									
	20							Boring terminated at 20'		

Project Name: **McAllister Springs**	Boring No.: **MW-3**
Project Number: **2022-004-1**	**Sheet 1 of 1**
Client: **D.R. Horton**	RILEYGROUP

Date(s) Drilled: **1/19/2022**	Logged By: **JH**	Surface Conditions: **Grass, Scotch Broom**
Drilling Method(s): **Direct Push**	Drill Bit Size/Type: **2.25"**	Total Depth of Borehole: **22 feet bgs**
Drill Rig Type: **Track Rig**	Drilling Contractor: **Riley Group, Inc.**	Approximate Surface Elevation: **N/A**
Groundwater Level: **16.26 on 3/11/2022**	Sampling Method(s):	Hammer Data : **N/A**
Borehole Backfill: **Well Installed**	Location: **2402 Marvin Road Southeast, Lacey, Thurston County, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Well Log	Moisture (%)
	0					TPSL		6" topsoil		
						GP		Tan to gray sandy GRAVEL with trace silt, medium dense, moist		
	5									
	10					GP		Gray gravel with some sand and trace silt, medium dense, moist		
	15							Becomes moist to wet		
								Becomes water bearing		
	20					GP		Gray sandy GRAVEL with trace silt, medium dense, water bearing		
								Boring terminated at 22'		

Project Name: **McAllister Springs** Project Number: **2022-004-1** Client: **D.R. Horton**	RILEYGROUP Boring No.: **WP-1** **Sheet 1 of 1**

Date(s) Drilled: **2/8/2022**	Logged By: **CN**	Surface Conditions: **Mixed Brush**
Drilling Method(s): **Test Pit**	Drill Bit Size/Type: **N/A**	Total Depth of Borehole: **10.5 feet bgs**
Drill Rig Type: **Mini Excavator**	Drilling Contractor: **Kelly's Excavating**	Approximate Surface Elevation: **N/A**
Groundwater Level: **9.19 on 3/11/2022**	Sampling Method(s):	Hammer Data : **N/A**
Borehole Backfill: **Well Installed**	Location: **2402 Marvin Road Southeast, Lacey, Thurston County, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION		Moisture (%)
	0					TPSL		12" topsoil		
						SP		Light brown SAND with trace silt, medium dense, moist		
	5									
								Becomes water bearing		
	10									
								Test pit terminated at 10.5'		
	15									
	20									

Project Name: **McAllister Springs** Project Number: **2022-004-1** Client: **D.R. Horton**	RILEYGROUP Key to Log of Boring **Sheet 1 of 1**

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Well Log	Moisture (%)
1	2	3	4	5	6	7	8	9	10	11

COLUMN DESCRIPTIONS

1 Elevation (feet): Elevation (MSL, feet).
2 Depth (feet): Depth in feet below the ground surface.
3 Sample Type: Type of soil sample collected at the depth interval shown.
4 Sample ID: Sample identification number.
5 Sampling Resistance, blows/ft: Number of blows to advance driven sampler one foot (or distance shown) beyond seating interval using the hammer identified on the boring log.
6 Recovery (%): Core Recovery Percentage is determined based on a ratio of the length of core sample recovered compared to the cored interval length.
7 USCS Symbol: USCS symbol of the subsurface material.
8 Graphic Log: Graphic depiction of the subsurface material encountered.
9 MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.
10 Well Log: Graphical representation of well installed upon completion of drilling and sampling.
11 Moisture (%): Moisture, expressed as a water content.

FIELD AND LABORATORY TEST ABBREVIATIONS

CHEM: Chemical tests to assess corrosivity
COMP: Compaction test
CONS: One-dimensional consolidation test
LL: Liquid Limit, percent
PI: Plasticity Index, percent
SA: Sieve analysis (percent passing No. 200 Sieve)
UC: Unconfined compressive strength test, Qu, in ksf
WA: Wash sieve (percent passing No. 200 Sieve)

MATERIAL GRAPHIC SYMBOLS

Bentonite chips
Portland Cement Concrete
Poorly graded GRAVEL (GP)
Poorly graded SAND (SP)
Topsoil

TYPICAL SAMPLER GRAPHIC SYMBOLS

Auger sampler
Bulk Sample
3-inch-OD California w/ brass rings
CME Sampler
Grab Sample
2.5-inch-OD Modified California w/ brass liners
Pitcher Sample
2-inch-OD unlined split spoon (SPT)
Shelby Tube (Thin-walled, fixed head)

OTHER GRAPHIC SYMBOLS

Water level (at time of drilling, ATD)
Water level (after waiting)
Minor change in material properties within a stratum
Inferred/gradational contact between strata
? Queried contact between strata

GENERAL NOTES

1: Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2: Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.