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AKS

6. Preliminary Stormwater Design Report TIR (Included Separately)

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Camas Woods
(PA23-30)
Camas, Washington

Preliminary Stormwater
Technical Information Report

Date:	November 2024
Submitted To:	City of Camas Community Development Department 616 NE 4th Avenue Camas, WA 98607
Applicant:	HSR Capital, LLC (Andy Swanson) 19120 SE 34th Street, Suite #103 Vancouver, WA 98683 (503) 936-8514 | andy@hsr-capital.com
Engineering Contact:	Bryce Hanson, PE (360) 882-0419 | bryceh@aks-eng.com
Prepared By:	AKS Engineering & Forestry, LLC 9600 NE 126th Avenue, Suite 2520 Vancouver, WA 98682
AKS Job Number:	8397

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ENGINEERING & FORESTRY

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Certificate of the Engineer
Camas Woods Subdivision
Camas, Washington
Preliminary Technical Information Report

This Preliminary Technical Information Report (TIR) and the data contained herein were prepared by the undersigned, whose seal, as a Professional Engineer licensed to practice as such, is affixed below. All information required by Camas Municipal Code (CMC) Chapter 14.02 is included in the proposed stormwater plan and the proposed facilities are feasible.

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Appendix A: Map Submittals

Appendix B: New Development Flow Chart

Appendix C: Development Plans

Appendix D: Stormwater Basin Maps

Appendix E: BMP Details

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Appendix G: Wetland Protection

Appendix H: Soils Report

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References

2019 Stormwater Management Manual for Western Washington, (Ecology Publication No. 19-10-021, July 2019), Errata released January 22, 2020 – "SWMMWW"

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Preliminary Stormwater Technical Information Report (TIR)
CAMAS WOODS SUBDIVISION
CAMAS, WASHINGTON

Section A – Project Overview

This report analyzes the effects the proposed development will have on the existing stormwater conveyance system; documents the criteria, methodology, and informational sources used to design the proposed stormwater system; and presents the results from the hydraulic analysis.

Section A.1 – Site Location

The Camas Woods Subdivision is located on four parcels of land, totaling approximately 36.37 acres. Parcels 178159-000 and 17816-000 have a site address 920 SE Gardner RD, Camas, WA 98607, and 921 SE Gardner RD, Camas, WA 98607, respectively. Parcels 178108-000 and 178140-000 do not have current site addresses. Access to the site will be from Everett Drive. The project is located within the Northeast ¼ of Section 35, Township 2 North, Range 3 East, Willamette Meridian, Clark County (Parcel Serial Numbers: 178159-000, 178169-000, 178108-000, and 178140-000). The site is zoned North Shore Mixed Use (MX-NS), North Shore Higher Density Residential (HD-NS), North Shore Lower Density Residential (LD-NS), and North Shore Park/Open Space (POS-NS).

Section A.2 – Site Topography and Critical Areas

The site has two houses located on it with various outbuildings including sheds, a detached garage, and barn located in the southwest corner of the site on parcels 17859-000 and 178169-000. The western three parcels of the site (parcels: 178159-000, 178169-000 and 178108-000) are covered with field grass. The eastern portion (parcel: 178140-000) is primarily covered with Himalayan blackberry, field grasses, and trees that are dispersed across all areas of the site. The site is primarily categorized by rolling topography with a ridge across the middle of the site. Grades on site range from flat to between 5 and 10 percent with none shown to exceed 15 percent per Clark County GIS.

There is one delineated category III wetland with its boundary and buffer extending into the Northeast corner of the site. The majority of the wetland lies offsite on adjacent and neighboring parcels to the north and east.

Section A.3 – Existing On-Site Stormwater System

The site consists of two threshold discharge areas (TDA). Currently stormwater minimally infiltrates or sheet flows towards NE Everett Drive southwest of the site or towards Wetland A in the northeast corner of the site. See the pre-developed basin plans within Appendix D for existing drainage for the site.

Section A.4 – Site Parameters That Influence Stormwater Design

The Camas Woods Subdivision project site consists of soils with poor permeability, and shallow bedrock making infiltration infeasible, as outlined within the project geotechnical report (Appendix H). The site is in the Lacamas watershed above Round Lake dam, water exiting the site will require phosphorus treatment for all pollution-generating surfaces. Due to the ridge in the middle of the site stormwater will be analyzed as two separate TDAs.

Section A.5 – Adjacent Property Drainage

Adjacent properties do not or minimally drain onto the project site. Parcel 178109-000 is forested with a portion of its eastern boundary sloping gently towards the NW corner of the site. Rear yard storm lines

Exhibit 6 SUB24-1002

are proposed along this property boundary and any off-property run-on can be collected and routed to the on-site stormwater facility. All other adjacent property drainage remains off-site.

Section A.6 – Adjacent Site Areas

The site is bounded by The Heights Learning Center and Camas High School to the south. Properties to the west are zoned North Shore Higher Density Residential (HD-NS). The property bordering the east side of the site is zoned both North Shore Lower Density Residential (LD-NS) and North Shore Higher Density Residential (HD-NS). Properties north of the site are zoned Residential R-12, North Shore Park/Open Space (POS-NS) as well as North Shore Lower Density Residential (LD-NS).

Section A.7 – General Project Stormwater Description

Proposed site improvements for the development include sidewalks, public streets, open space tracts, 88 town homes, 118 single-family residences, 88 apartment units, ±10,000 SF of commercial use and a sewage pump station. Construction will take place in nine phases. It is proposed that the site will discharge stormwater in three locations while maintaining two TDAs. Site stormwater will be collected by catch basins and conveyed to the respective treatment and detention facility within each basin or subbasin.

TDA 1 includes the southwest portion of the site, and is divided into three subbasins (subbasins 1A, 1B & 1C) and outfalls to two locations within the ditch along NE Everett Drive to maintain existing stormwater flow paths. TDA 1 will utilize two underground detention facilities to meet MR#7 and mechanical filtration facilities will be installed to meet MR #6.

TDA 2 discharges to the northeast of the site towards Wetland A. This TDA is required to meet MR #8 in addition to the other minimum requirements. A detention pond located in Tract W will be used to comply with MR #7 and MR #8. Before entering the detention pond, stormwater from pollution generating surfaces will be treated by mechanical filtration to meet MR #6 guidelines for water quality.

Due to the location of the entire site being within the Lacamas Lake watershed above the Round Lake dam, water quality for the site is required to meet phosphorus treatment per the Stormwater Management Manual for Western Washington (SWMMWW). See the development plans, Appendix C, and the Stormwater Basin Map, Appendix D, for stormwater information.

Section B – Minimum Requirements

Section B.1 – Determination of Applicable Minimum Requirements

Proposed land disturbances shall include grading, excavation, and removal of unsuitable soils for the proposed developments. Due to the amount of proposed hard surfaces (greater than 5,000 square feet), the project is required to meet MR #'s 1 through 9 per Figure I-3.1 of the Stormwater Management Manual for Western Washington (SWMMWW) (see Appendix B).

The tables in this section provide information pertaining to each stormwater subbasin within the project area. See the Stormwater Basin Maps for basin locations (Appendix D).

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Table B-1: Proposed Hard Surface and Landscaping

Sub-Basin	Existing Hard Surfaces (acres)	New Hard Surfaces (acres)	Replaced Hard Surfaces (acres)	Native Vegetation Replaced with Landscaping (acres)	Total Land Disturbed (acres)
1A	0.214	11.679	0.000	2.839	14.732
1B	0.114	2.281	0.000	0.639	3.034
1C	0.080	0.115	0.080	0.055	0.330
2	0.000	10.500	0.000	5.642	16.142

Note: Assumes 400-square-foot driveway and 70% lot coverage for HD-NS Zoning, 600-square-foot driveway and 70% lot coverage for LD-NS.

Tables B-2 and B-3 present information for the mitigated site basins, differentiated between pollution- and non-pollution-generating surfaces. It is important to note that all non-pollution-generating areas directly mixing or having the opportunity to mix with stormwater runoff from pollution-generating surface areas are classified as pollution-generating.

Table B-2: Pollution-Generating Surfaces

Sub-Basin	Hard Surfaces (acres)	Pervious Surfaces (acres)	Total Surface Area (acres)
1A	11.544	2.839	14.383
1B	2.007	0.639	2.646
1C	0.275	0.055	0.330
2	8.359	5.091	13.450

Note: Assumes 400-square-foot driveway and 70% lot coverage for HD-NS Zoning, 600-square-foot driveway and 70% lot coverage for LD-NS.

Table B-3: Non-Pollution-Generating Surfaces

Sub-Basin	Hard Surfaces (acres)	Pervious Surfaces (acres)	Total Surface Area (acres)
1A	0.349	0.000	0.349
1B	0.388	0.000	0.388
1C	0.000	0.000	0.000
2	2.141	0.551	2.692

Note: Assumes 400-square-foot driveway and 70% lot coverage for HD-NS Zoning, 600-square-foot driveway and 70% lot coverage for LD-NS.

The developed basin's effective hard surfaces and the applicability of MRs #6 through #8 are summarized in Table B-4, below.

Table B-4: Effective Hard Surfaces

TDA	Hard Surface Area (acres)	MR #6 Required (Y/N)	MR #7 Required (Y/N)	MR #8 Required (Y/N)
1	14.563	Y	Y	N
2	10.500	Y	Y	Y

Note: Assumes 400-square-foot driveway and 70% lot coverage for HD-NS Zoning, 600-square-foot driveway and 70% lot coverage for LD-NS.

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Section C – Soils Evaluation

Section C.1 – Soil Suitability for Low Impact Development BMPs

The Camas Woods development is not suitable for infiltration of stormwater. The project geotechnical report dated October 11th, 2023, and within Appendix H, states "infiltration of concentrated stormwater is infeasible due to the presence of relatively shallow bedrock and slowly permeable soils". The Geotechnical Engineer recommends using WWHM soil group 4 for modeling.

Section C.2 – Water Table Information

Per the project geotechnical report, groundwater was observed at a depth of 11.5 feet below ground surface. Groundwater in the area is "generally present near the surface during the wet season", "dropping below depths of 10 to 15 feet in the dry season" see geotechnical report in Appendix H. Dewatering should be considered where subsurface construction activities intersect the shallow groundwater table.

Section C.3 – Soil Parameters

Since the stormwater system does not propose infiltration, soil parameters were not used to design the site's stormwater system. Runoff will be collected and conveyed via pipe to stormwater detention facilities.

Section C.4 – Infiltration Rate Testing

Infiltration rate testing determined an infiltration rate ranging from less than 0.02 to 2.5 inches per hour onsite. Infiltration potential is not feasible onsite due to the reasons included in Section C.1 and the geotechnical report.

Section C.5 – Complex Soil Conditions

A geotechnical report has been prepared and is attached to this report, see Appendix H. Existing soil conditions are summarized, and recommendations are presented in relation to site stormwater design considerations. No complex soil conditions are present on-site.

Section D – Source Control

Volume IV of the Stormwater Management Manual for Western Washington (SWMMWW) contains the following applicable source control best management practices (BMPs) for residential development. The source control BMPs and applicable notes to control stormwater runoff impacted by these activities will be included in the Erosion Control Plans and Details and in the Stormwater Pollution Prevention Plan (SWPPP).

- S407: Dust Control at Disturbed Land Areas and Unpaved Roadways and Parking Lots
- S411: BMPs for Landscaping and Lawn/Vegetation Management

Section E – On-Site Stormwater Management BMPs

Per Figure I-3.3 of the SWMMWW, the project proposes to not meet the LID Performance Standard and instead use List #2. Table I-3.2, List #2, of the SWMMWW was used to determine that LIDs for roof and hard surface runoff are infeasible due to lack of viable infiltration on-site (see the geotechnical report in Appendix H). Therefore, site runoff which is pollution-generating will be collected and treated by mechanical filtration. After receiving treatment stormwater will be detained and released at rates that mimic pre-developed flows. All pervious areas that will be disturbed with construction activities will meet post-construction soil quality and quantity requirements per BMP T5.13.

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Section F – Runoff Treatment Analysis and Design

MR #6 requires that at least 91% of the post-developed pollution-generating runoff volume, as predicted by a continuous runoff model, be treated. All water conveyed to the detention facilities through piping will be treated as pollutant-generating runoff due to the mixing of pollutant and non-pollutant generating surfaces before treatment. Stormwater will be treated by mechanical filter cartridges before entering the site's stormwater detention facilities.

The Camas Woods development is within the Lacamas Lake watershed, above the Round Lake dam, which requires phosphorus treatment. Lacamas lake is listed as a category 5-303d waterbody for total phosphorus. Phosphorous treatment will be met by using filter media approved by the Washington Department of Ecology. This design satisfies the design requirement of CMC Chapter 14.02 by adhering to all relevant regulations from the State of Washington and City of Camas.

Table F-1: Water Quality Structure

TDA & Subbasin	New Pollutant-Generating Impervious Surface (acres) (WWHM)	New Pollutant-Generating Pervious Surface (acres) (WWHM)	Required Water Quality Flow Rate (cubic feet per second)	Provided Water Quality Flow Rate* (cubic feet per second)	Required Number of Treatment Filter Cartridges (Cartridge size)
TDA 1 - 1A	11.544	2.839	1.4472	1.5071	36 (27")
TDA 1 - 1B	2.007	0.639	0.2566	0.2931	7 (27")
TDA 1 - 1C	0.275	0.055	0.0340	0.0419	1 (27")
TDA 2 - 2	8.359	5.091	0.9219	0.9629	23 (27")

Note: Provided water quality flow rate is determined by using approved flow rates for Contech Phosphosorb media (0.042 cfs per 27" cartridge).

Section G – Flow Control Analysis and Design

The Camas Woods development consists of 2 TDAs. The site will be required to meet flow control standards as stated above. As mentioned previously, infiltration will not be utilized on-site due to the lack of soil suitability, outlined within the project geotechnical report (Appendix H).

TDA 1 is split into three separate subbasins (subbasin 1A, 1B & 1C) and proposes to use two underground detention facilities installed within the parking areas for the HD-NS Lots 207 & 208, to meet flow control requirements. Subbasin 1A will utilize 96" CMP for detention, consisting of four linked rows, 222' long with a flow control structure. Subbasin 1B will utilize 72" CMP for detention, consisting of three linked rows, 122' long with a flow control structure. Subbasin 1C consists of just NE Everett Drive frontage areas and will be treated and directly connect to the outfall. All three of these subbasins will be analyzed at the point of compliance for TDA 1 to meet MR #7.

TDA 2 is comprised of stormwater runoff that drains to the north and east of the project site towards Wetland A and will meet MR #7 by detaining runoff within a single detention pond, with a flow control manhole. All roof, driveway and incidental landscape runoff within Basin 2 is proposed to flow through the detention pond in Tract W. The detention pond will be constructed with two separate cells that will be connected by an oversized pipe to maintain hydraulic connection, and will discharge from a flow control manhole and be dispersed within the wetland buffer for Wetland A.

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All facilities were sized with the use of WWHM 2012 and HydroCAD (see Appendix F for flow control WWHM output; see Appendix G for wetland protection WWHM).

Section H – Wetland Protection

The site contains one category III wetland associated with natural drainage on-site. The wetland is to be protected by a buffer. A wetland hydroperiod analysis (Method 2), general protection and protection from pollutants are required for this project based on Figure I-3.5, of the SWMMWW, and is included in Appendix G of this report. To meet protection from pollutants, site discharge will be treated before entering the wetlands. Discharge to the wetland will meet the requirements of not altering flow to the wetland on a monthly basis of greater 15%, and not altering flow to the wetland on a daily basis of greater than 20%, MR #8 should be considered met.

The wetland basin maps, Included in Appendix G, delineate the pre-developed and post-developed impervious, field, forest, and pond areas upstream of the wetland. The wetland basin areas shown below in Table H.1 are separated into areas draining to the wetlands from off-site, and areas onsite flowing to the wetland.

Table H-1: Wetland A Category III Basin Areas

Surface Type	Pre-developed Off-site Flow Area (acres)	Pre-developed On-site Flow Area (acres)	Post-developed Off-site Flow Area (acres)	Post-developed On-site Flow Area (acres)
Impervious	26.48	0.00	26.48	9.923
Field	148.30	5.04	148.30	5.642
Forest	147.76	10.54	147.76	0.000
Pond	0.00	0.00	0.00	0.581
Total	**322.54**	**15.58**	**322.54**	**16.146**

*Note: Post-developed pervious areas to follow BMP T5.13 and are modeled as Field. The total wetland basin area is approximately 339 acres excluding the wetland buffer and wetland boundary.

Wetland Hydroperiod Protection (Method 2) requires that the runoff entering the wetlands after development will remain similar to the pre-development condition. WWHM was used to obtain resultant flow rates (Appendix G). This model is separate and standalone from the flow control model discussed in MR #7. The final stormwater design will follow the requirements contained in Section I-C of the SWMMWW.

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Appendix A: Map Submittals

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Camas Woods

Project Site

Legend

Taxlots

NE Robinson Rd

27st Ct

SE Robinson Rd

SE 7th St

8th Cir

8th St

Camas

9th St

271st Ave

274th Ct

The Heights
Learning
Center

Adams St

47th Cir

Garfield St

Camas High
School

Everett Dr

500

Franklin St

45th St

SE Leadbetter Rd

Lacamas
Heights
Park

NE 43rd Ave

SE 15th St

Lacamas
Lake
Shoreline
Open
Space

Dallas Ct

Everett Ct

43rd Cir

Hayes St

270th Pl

273rd Ave

SE Nourse R

SE 15th St

1: 9,028

Notes:

1,504.7   0   752.33   1,504.7   Feet

WGS_1984_Web_Mercator_Auxiliary_Sphere
Clark County, WA. GIS - http://gis.clark.wa.gov

This map was generated by Clark County's "MapsOnline" website.
Clark County does not warrant the accuracy, reliability or timeliness of
any information on this map, and shall not be held liable for losses
caused by using this information. Taxlot (i.e., parcel) boundaries cannot
be used to determine the location of property lines on the ground.

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Camas Woods Soils Map

HcB

HcB

5th St

HcD

OdB

6th Cir

500

WgE

Project Site

8th St

9th St

HcB

Gardner Rd

27th Ave

Everett Dr

The Heights
Learning
Center

Garfield St

Legend

☐ Taxlots
☐ Soil Type

Notes:

1: 4,514

752.3   0   376.17   752.3   Feet

WGS_1984_Web_Mercator_Auxiliary_Sphere
Clark County, WA. GIS - http://gis.clark.wa.gov

Exhibit 6 SUB24-1002

Appendix B: New Development Flow Chart

Exhibit 6 SUB24-1002

Figure I-3.1: Flow Chart for Determining Requirements for New Development

Start Here

↓

Does the Site have 35% or more of existing hard surface coverage? → **Yes** → See Redevelopment Project Thresholds and the Figure *"Flow Chart for Determining Requirements for Redevelopment"*.

No

↓

Does the Project result in 5,000 square feet, or greater, of new plus replaced hard surface area? → **No** → Does the Project convert ¾ acres or more of vegetation to lawn or landscaped areas, or convert 2.5 acres or more of native vegetation to pasture?

Yes

↓

All Minimum Requirements apply to the new and replaced hard surfaces and converted vegetation areas.

Yes → (from convert vegetation question)

No ↓ (from convert vegetation question)

Does the Project result in 2,000 square feet, or greater, of new plus replaced hard surface area?

No ↓

Does the Project have land disturbing activities of 7,000 square feet or greater?

Yes → **Minimum Requirements #1 through #5 apply to the new and replaced hard surfaces and the land disturbed.**

No ↓

Minimum Requirement #2 applies.

DEPARTMENT OF ECOLOGY
State of Washington

Flow Chart for Determining Requirements for New Development

Revised March 2019

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Applies to Wetland A

Figure I-3.5: Flow Chart for Determining Wetland Protection Level Requirements

Category I or II

Start Here

What category of wetland does the TDA discharge (directly or indirectly) to?

Category III or IV

Does the TDA trigger the requirement for Flow Control BMPs per the TDA Thresholds outlined in Minimum Requirement #7: Flow Control?

Does the TDA trigger the requirement for Flow Control BMPs per the TDA Thresholds outlined in Minimum Requirement #7: Flow Control?

Yes

Yes   **No**   **No**

Is the habitat score greater than 5?

No   **Yes**

Is the wetland depressional or riverine impounding?
AND
Does the project proponent have legal access to the wetland?

No

Does the wetland provide habitat for rare, endangered, threatened, or sensitive species?
OR
Does the wetland contain a breeding population of any native amphibian?

Yes   **No**

The following Wetland Protection Levels apply to the TDA:

- General Protection
- Protection from Pollutants

Yes

The following Wetland Protection Levels apply to the TDA:

- General Protection
- Protection from Pollutants
- Wetland Hydroperiod Protection (Method 1)

The following Wetland Protection Levels apply to the TDA:

- General Protection
- Protection from Pollutants
- Wetland Hydroperiod Protection (Method 2)

DEPARTMENT OF ECOLOGY State of Washington

Flow Chart for Determining the Wetland Protection Levels Required

Revised May 2019

Exhibit 6 SUB24-1002

Appendix C: Development Plans

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EX. STORMWATER CULVERT

EX. 12" CULVERT TO BE REMAIN

PARCEL NO. 178105-000

STORMWATER TREATMENT CATCH BASIN

STORMWATER TREATMENT CATCH BASIN

STORMWATER FLOW CONTROL MANHOLE

UNDERGROUND STORMWATER DETENTION FACILITY

SITE STORMWATER DISCHARGE POINT

LOT 207 MULTI-FAMILY

STORMWATER MECHANICAL FILTER TREATMENT VAULT

NE EVERETT DRIVE

STORMWATER TREATMENT CATCH BASIN

PHASE 7

STORMWATER TREATMENT CATCH BASIN

UNDERGROUND STORMWATER DETENTION FACILITY

LOT 208 MIXED USE

PHASE 9

STORMWATER TREATMENT MANHOLE

STORMWATER TREATMENT MANHOLE

PHASE 8

SEE SHEET P10.1

EX. STORMWATER CULVERT

EX. STORMWATER DITCH

EX. STORMWATER CULVERT

STORMWATER FLOW CONTROL MANHOLE

N REKDAHL AVENUE

N REKDAHL AVENUE

TRACT A

TRACT B

STORMWATER CATCH BASIN (TYP)

STORMWATER MANHOLE (TYP)

STORMWATER LATERAL (TYP)

STORMWATER MAIN (TYP)

1 2 3 4 5 6 7

TRACT C

PHASE 1

GRADING LIMITS (TYP)

EX. STORMWATER CULVERT

SITE STORMWATER DISCHARGE POINT

STORMWATER MECHANICAL FILTER TREATMENT VAULT

PARCEL NO. 116031-010

SCALE: 1" = 40 FEET

40 0 8 20 40

ORIGINAL PAGE SIZE: 22" x 34"

LEGEND

EXISTING GROUND CONTOUR (2 FT)	352
EXISTING GROUND CONTOUR (10 FT)	350
FINISHED GRADE CONTOUR (2 FT)	352
FINISHED GRADE CONTOUR (10 FT)	350
DRAINAGE FLOW DIRECTION	→
GRADING LIMITS	— — —
STORM FACILITY ACCESS	

GENERAL NOTES

1. CONTOUR INTERVAL IS 2 FEET.

2. TREES ARE NOT SHOWN.

3. STORMWATER TREATMENT AND DETENTION FACILITIES FOR THIS DEVELOPMENT ARE TO BE OWNED AND MAINTAINED BY THE HOA.

4. NATIVE VEGETATION WITHIN TRACT X AND THE CRITICAL AREAS WILL BE RETAINED AS MUCH AS POSSIBLE AND ENHANCED, AS NEEDED, PER THE CRITICAL AREAS MITIGATION PLAN.

5. ACCORDING TO CLARK COUNTY GIS, THE SITE IS NOT WITHIN OR ADJACENT TO A 100-YEAR FLOODPLAIN OR SHORELINE MANAGEMENT AREA.

6. THERE ARE NO KNOWN EXISTING ON-SITE STORMWATER FACILITIES.

7. STORMWATER ALONG FRONTAGE IN NE EVERETT DRIVE IS CONVEYED THROUGH DITCHES AND CULVERTS ALONG THE WEST SIDE OF THE ROAD.

8. ACCORDING TO CLARK GIS, NO FLOODPLAIN, FLOODWAYS, OR SHORELINE EXIST ON-SITE.

9. A WETLAND HAS BEEN DESIGNATED ON-SITE BY ECOLOGICAL LAND SERVICES, SEE REPORT DATED 07/03/2024.

10. EXISTING DRAINAGE FLOW ROUTES ARE SOUTHWEST TOWARD INTO THE EXISTING DITCHES ALONG NE EVERETT DRIVE AND NORTH TOWARD WETLAND A, WITH THE SITE BEING SPLIT AT APPROXIMATELY THE CENTER BY A RIDGE. THE SITE IS TO BE CONSIDERED TWO THRESHOLD DISCHARGE AREAS (TDA).

11. PROPOSED DRAINAGE FLOW ROUTES TO FOLLOW EXISTING FLOW ROUTES TO EXTENT POSSIBLE, WITH STORMWATER DISCHARGED FROM STORMWATER FACILITIES INTO EXISTING DITCHES TO THE WEST OR WETLAND TO THE NORTH.

12. ROOF AREAS FOR ALL LOTS, RESIDENTIAL AND COMMERCIAL, DRAIN TO A STORMWATER LATERAL.

13. SEE OVERALL THRESHOLD DISCHARGE AREA (TDA) VICINITY MAP ON SHEET P10.0.

14. **POND IN TRACT W TO BE CONSTRUCTED WITH PHASES 4 & 5.**

TDA 1 =

TDA 2 =

TDA DISCHARGE LOCATION

TDA DISCHARGE LOCATION

PHASE 9

PHASE 7

PHASE 6

PHASE 8

TDA DISCHARGE LOCATION

TDA VICINITY MAP
N.T.S.

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VANCOUVER, WA 98682
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ENGINEERING · SURVEYING · NATURAL RESOURCES
FORESTRY · PLANNING · LANDSCAPE ARCHITECTURE

PRELIMINARY STORMWATER PLAN
CAMAS WOODS SUBDIVISION
CAMAS WOODS, LLC
CAMAS, WASHINGTON

PRELIMINARY
NOT FOR CONSTRUCTION

JOB NUMBER:	8397
DATE:	11/1/2024
DESIGNED BY:	CJS
DRAWN BY:	TWW
CHECKED BY:	BDH

P10.0

AKS DRAWING FILE: 8397 P10 STORMDWG | LAYOUT: P10.0

Exhibit 6 SUB24-1002

SCALE: 1"= 40 FEET

ORIGINAL PAGE SIZE: 22" x 34"

LEGEND

EXISTING GROUND CONTOUR (2 FT)	—352—
EXISTING GROUND CONTOUR (10 FT)	—350—
FINISHED GRADE CONTOUR (2 FT)	—352—
FINISHED GRADE CONTOUR (10 FT)	—350—
DRAINAGE FLOW DIRECTION	→
GRADING LIMITS	— — —
STORM FACILITY ACCESS	

GENERAL NOTES

1. CONTOUR INTERVAL IS 2 FEET.

2. TREES ARE NOT SHOWN.

3. STORMWATER TREATMENT AND DETENTION FACILITIES FOR THIS DEVELOPMENT ARE TO BE OWNED AND MAINTAINED BY THE HOA.

4. NATIVE VEGETATION WITHIN TRACT X AND THE CRITICAL AREAS WILL BE RETAINED AS MUCH AS POSSIBLE AND ENHANCED, AS NEEDED, PER THE CRITICAL AREAS MITIGATION PLAN.

5. ACCORDING TO CLARK COUNTY GIS, THE SITE IS NOT WITHIN OR ADJACENT TO A 100-YEAR FLOODPLAIN OR SHORELINE MANAGEMENT AREA.

6. THERE ARE NO KNOWN EXISTING ON-SITE STORMWATER FACILITIES.

7. STORMWATER ALONG FRONTAGE IN NE EVERETT DRIVE IS CONVEYED THROUGH DITCHES AND CULVERTS ALONG THE WEST SIDE OF THE ROAD.

8. ACCORDING TO CLARK GIS, NO FLOODPLAIN, FLOODWAYS, OR SHORELINE EXIST ON-SITE.

9. A WETLAND HAS BEEN DESIGNATED ON-SITE BY ECOLOGICAL LAND SERVICES, SEE REPORT DATED 07/03/2024.

10. EXISTING DRAINAGE FLOW ROUTES ARE SOUTHWEST TOWARD INTO THE EXISTING DITCHES ALONG NE EVERETT DRIVE AND NORTH TOWARD WETLAND A, WITH THE SITE BEING SPLIT AT APPROXIMATELY THE CENTER BY A RIDGE. THE SITE IS TO BE CONSIDERED TWO THRESHOLD DISCHARGE AREAS (TDA).

11. PROPOSED DRAINAGE FLOW ROUTES TO FOLLOW EXISTING FLOW ROUTES TO EXTENT POSSIBLE, WITH STORMWATER DISCHARGED FROM STORMWATER FACILITIES INTO EXISTING DITCHES TO THE WEST OR WETLAND TO THE NORTH.
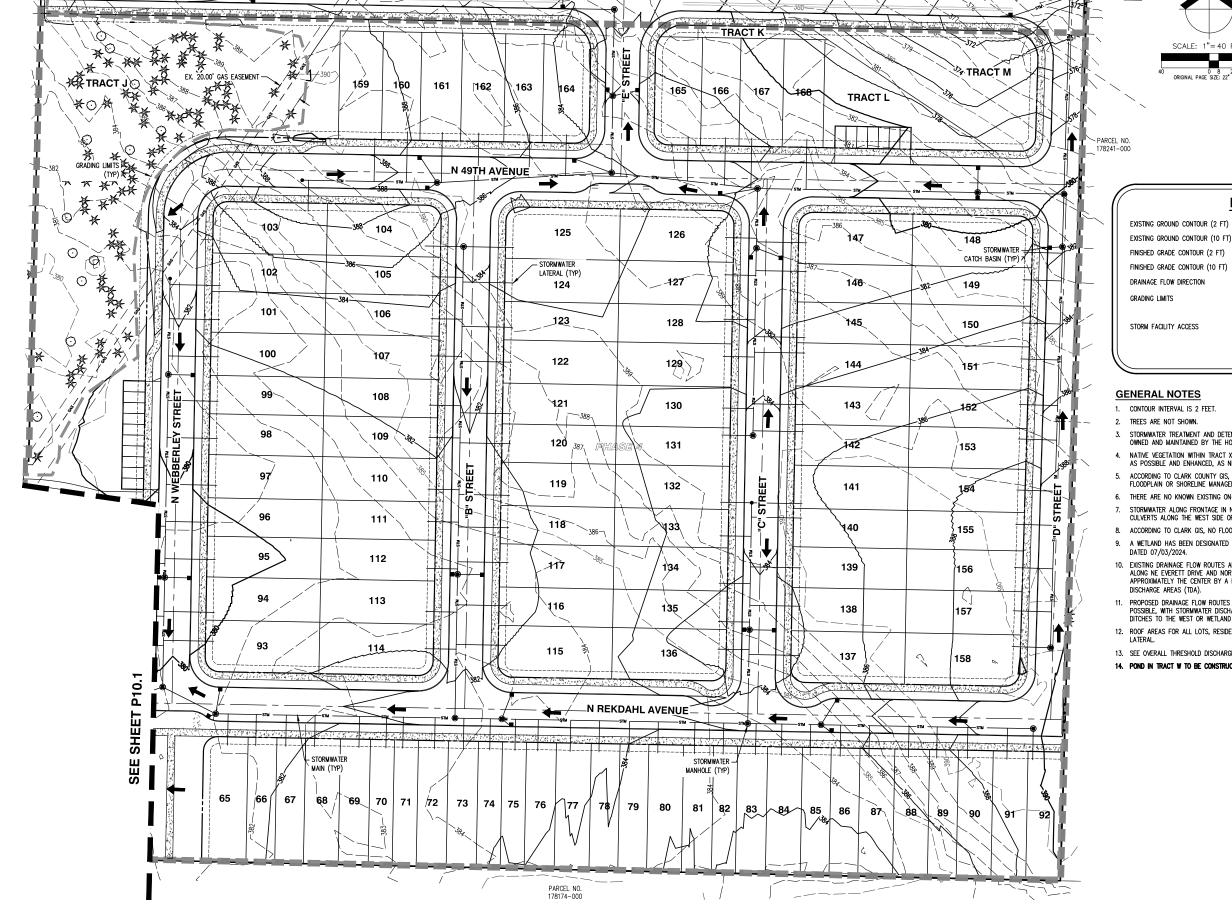
12. ROOF AREAS FOR ALL LOTS, RESIDENTIAL AND COMMERCIAL, DRAIN TO A STORMWATER LATERAL.

13. SEE OVERALL THRESHOLD DISCHARGE AREA (TDA) VICINITY MAP ON SHEET P10.0.

14. **POND IN TRACT W TO BE CONSTRUCTED WITH PHASES 4 & 5.**

PRELIMINARY STORMWATER PLAN
CAMAS WOODS SUBDIVISION
CAMAS WOODS, LLC | CAMAS, WASHINGTON

JOB NUMBER:	8397
DATE:	11/1/2024
DESIGNED BY:	CJS
DRAWN BY:	TWW
CHECKED BY:	BDH

P10.1

AKS DRAWING FILE: 8397 P10 STORM.DWG | LAYOUT: P10.1

Exhibit 6 SUB24-1002

SEE SHEET P10.3

SCALE: 1" = 40 FEET

TRACT J

EX. 20.00' GAS EASEMENT

GRADING LIMITS (TYP)

TRACT K

TRACT M

TRACT L

"E" STREET

159 160 161 162 163 164

165 166 167 168

PARCEL NO. 178241-000

N 49TH AVENUE

103 104
102 105
101 106
100 107
99 108
98 109
97 110
96 111
95 112
94 113
93 114

STORMWATER LATERAL (TYP)

125 126
124 127
123 128
122 129
121 130
120 131
119 132
118 133
117 134
116 135
115 136

STORMWATER CATCH BASIN (TYP)

147 148
146 149
145 150
144 151
143 152
142 153
141 154
140 155
139 156
138 157
137 158

PHASE 1

"B" STREET

"C" STREET

"D" STREET

N WEBBERLEY STREET

SEE SHEET P10.1

N REKDAHL AVENUE

STORMWATER MAIN (TYP)

STORMWATER MANHOLE (TYP)

65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92

PARCEL NO. 178174-000

LEGEND

EXISTING GROUND CONTOUR (2 FT)	—352—
EXISTING GROUND CONTOUR (10 FT)	—350—
FINISHED GRADE CONTOUR (2 FT)	—352—
FINISHED GRADE CONTOUR (10 FT)	—350—
DRAINAGE FLOW DIRECTION	→
GRADING LIMITS	
STORM FACILITY ACCESS	

GENERAL NOTES

1. CONTOUR INTERVAL IS 2 FEET.

2. TREES ARE NOT SHOWN.

3. STORMWATER TREATMENT AND DETENTION FACILITIES FOR THIS DEVELOPMENT ARE TO BE OWNED AND MAINTAINED BY THE HOA.

4. NATIVE VEGETATION WITHIN TRACT X AND THE CRITICAL AREAS WILL BE RETAINED AS MUCH AS POSSIBLE AND ENHANCED, AS NEEDED, PER THE CRITICAL AREAS MITIGATION PLAN.

5. ACCORDING TO CLARK COUNTY GIS, THE SITE IS NOT WITHIN OR ADJACENT TO A 100-YEAR FLOODPLAIN OR SHORELINE MANAGEMENT AREA.

6. THERE ARE NO KNOWN EXISTING ON-SITE STORMWATER FACILITIES.

7. STORMWATER ALONG FRONTAGE IN NE EVERETT DRIVE IS CONVEYED THROUGH DITCHES AND CULVERTS ALONG THE WEST SIDE OF THE ROAD.

8. ACCORDING TO CLARK GIS, NO FLOODPLAIN, FLOODWAYS, OR SHORELINE EXIST ON-SITE.

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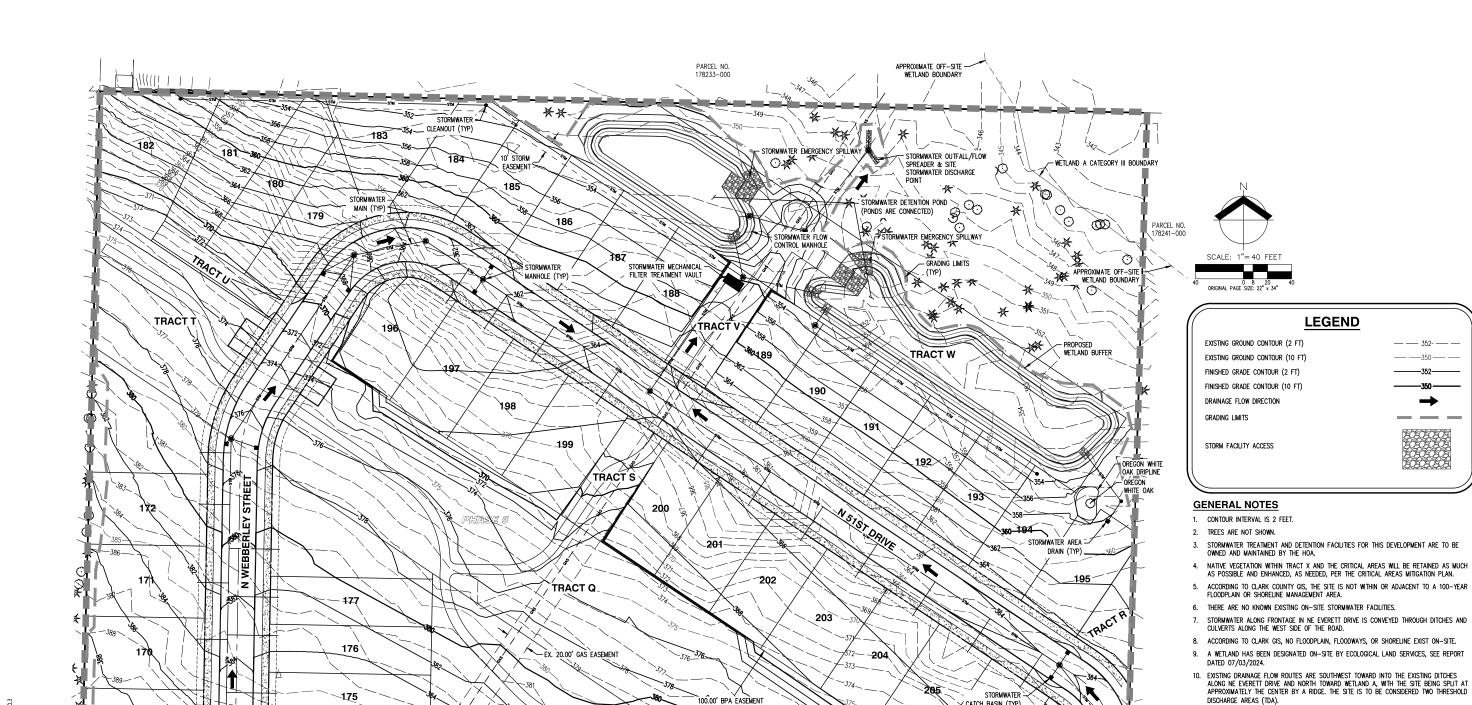
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13. SEE OVERALL THRESHOLD DISCHARGE AREA (TDA) VICINITY MAP ON SHEET P10.0.

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PRELIMINARY STORMWATER PLAN
CAMAS WOODS SUBDIVISION
CAMAS WOODS, LLC
CAMAS, WASHINGTON

PRELIMINARY NOT FOR CONSTRUCTION

JOB NUMBER:	8397
DATE:	11/1/2024
DESIGNED BY:	CJS
DRAWN BY:	TWW
CHECKED BY:	BDH

P10.2

AKS DRAWING FILE: 8397 P10 STORM.DWG | LAYOUT: P10.2

Exhibit 6 SUB24-1002

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SCALE: 1"= 40 FEET

ORIGINAL PAGE SIZE: 22" x 34"

LEGEND

EXISTING GROUND CONTOUR (2 FT)	— 352 —
EXISTING GROUND CONTOUR (10 FT)	— 350 —
FINISHED GRADE CONTOUR (2 FT)	—352—
FINISHED GRADE CONTOUR (10 FT)	—350—
DRAINAGE FLOW DIRECTION	→
GRADING LIMITS	— — —
STORM FACILITY ACCESS	

GENERAL NOTES

1. CONTOUR INTERVAL IS 2 FEET.

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4. NATIVE VEGETATION WITHIN TRACT X AND THE CRITICAL AREAS WILL BE RETAINED AS MUCH AS POSSIBLE AND ENHANCED, AS NEEDED, PER THE CRITICAL AREAS MITIGATION PLAN.

5. ACCORDING TO CLARK COUNTY GIS, THE SITE IS NOT WITHIN OR ADJACENT TO A 100-YEAR FLOODPLAIN OR SHORELINE MANAGEMENT AREA.

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14. POND IN TRACT W TO BE CONSTRUCTED WITH PHASES 4 & 5.

PRELIMINARY STORMWATER PLAN
CAMAS WOODS SUBDIVISION
CAMAS WOODS, LLC
CAMAS, WASHINGTON

PRELIMINARY
NOT FOR
CONSTRUCTION

JOB NUMBER:	8397
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CHECKED BY:	BDH

P10.3

SEE SHEET P10.2

AKS DRAWING FILE: 8397 P10 STORM.DWG | LAYOUT: P10.3

Exhibit 6 SUB24-1002

Appendix D: Stormwater Basin Maps

Exhibit 6 SUB24-1002

N

SCALE: 1"=150 FEET

150   0   30   75   150
ORIGINAL PAGE SIZE: 11" x 17"

PARCEL NO. 178226-015

PARCEL NO. 178233-000

WETLAND A

WETLAND BOUNDARY

PARCEL NO. 178109-000

TDA 2

PARCEL NO. 178241-000

LEGEND

EXISTING GROUND CONTOUR (2 FT)	
EXISTING GROUND CONTOUR (10 FT)	350
DRAINAGE FLOW DIRECTION	→
PRE-DEVELOPED BASIN BOUNDARY	▪▪▪▪
PRE-DEVELOPED TDA BOUNDARY	▬▪▬▪▬

PARCEL NO. 178216-000

PARCEL NO. 178105-000

RIDGELINE

PARCEL NO. 178105-000

STATE ROUTE 500

NE EVERETT DRIVE

PAVEMENT

BUILDINGS (TYP)

TDA 1

PARCEL NO. 116031-010

PARCEL NO. 178111-000

PARCEL NO. 178174-000

DATE: 10/28/2024

PRE-DEVELOPED BASIN MAP

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EXHIBIT

A

DRWN: NMG
CHKD: CJS
AKS JOB:
8397

DWG: 8397 PREDEV BASIN MAP | EXHIBIT A

Exhibit 6 SUB24-1002

LEGEND

EXISTING GROUND CONTOUR (2 FT)	– – – –
EXISTING GROUND CONTOUR (10 FT)	—— 350 ——
FINISHED GRADE CONTOUR (2 FT)	————
FINISHED GRADE CONTOUR (10 FT)	—— **350** ——
DRAINAGE FLOW DIRECTION	→
POST-DEVELOPED BASIN BOUNDARY (OFFSET 5' FOR CLARITY)	··········
POST-DEVELOPED TDA BOUNDARY	— — —
INTERNAL TDA DIVIDER	—·—·—

HATCH LEGEND

BASIN 1C (FRONTAGE AREA)	
SUBBASIN 1B (LOWER TDA AREA)	
SUBBASIN 1A (UPPER TDA AREA)	

SCALE: 1"=150 FEET

150   0 30 75   150

ORIGINAL PAGE SIZE: 11" x 17"

SEE EXHIBIT C

PROPOSED TDA BOUNDARY

TRACT J

PARCEL NO. 178216-000

PARCEL NO. 178105-000

SEE EXHIBIT C

PROPOSED STORMWATER DISCHARGE (BASIN 1A & 2A)

BASIN 1C (FRONTAGE AREA)

72" CMP UNDERGROUND DETENTION

FLOW CONTROL STRUCTURE

MECHANICAL FILTER TREATMENT VAULT

MECHANICAL FILTER TREATMENT VAULT

96" CMP UNDERGROUND DETENTION

STATE ROUTE 500

NE EVERETT DRIVE

FLOW CONTROL STRUCTURE

LOT 208

LOT 207

TRACT E

TRACT F

TRACT G

TRACT H

"A" STREET

N "B" STREET

N WEBBERLY STREET

SUBBASIN 1B (LOWER TDA AREA)

N REKDAHL AVENUE

SUBBASIN 1A (UPPER TDA AREA)

N REKDAHL AVENUE

STORMWATER MAIN (TYP)

TRACT A

TRACT B

TRACT C

TRACT D

MECHANICAL FILTER TREATMENT VAULT

PROPOSED STORMWATER DISCHARGE (BASIN 1C)

PARCEL NO. 116031-010

PARCEL NO. 178111-000

PARCEL NO. 178174-000

DATE: 10/29/2024

EXHIBIT

TDA 1 POST-DEVELOPED BASIN MAP

B

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DRWN: NMG
CHKD: CJS
AKS JOB:
8397

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LEGEND

EXISTING GROUND CONTOUR (2 FT)	– – – – –
EXISTING GROUND CONTOUR (10 FT)	—350—
FINISHED GRADE CONTOUR (2 FT)	———
FINISHED GRADE CONTOUR (10 FT)	**350**
DRAINAGE FLOW DIRECTION	→
POST-DEVELOPED BASIN BOUNDARY (OFFSET 5' FOR CLARITY)	··········
POST-DEVELOPED TDA BOUNDARY	—·—·—
INTERNAL TDA DIVIDER	—■—■—

HATCH LEGEND

TDA 2

N

SCALE: 1"=150 FEET

150   0 30 75   150

ORIGINAL PAGE SIZE: 11" x 17"

PARCEL NO. 178226-015

PARCEL NO. 178233-000

FLOW CONTROL STRUCTURE
MECHANICAL FILTER
TREATMENT VAULT

WETLAND BOUNDARY — WETLAND A

TRACT X

PROPOSED STROMWATER DISCHARGE

PARCEL NO. 178109-000

TRACT U
TRACT T
TRACT V
TRACT W
TRACT S
TRACT Q
TRACT P
TRACT N
TRACT R
TRACT M
TRACT L

N WEBBERLEY STREET

N 51ST DRIVE

TDA 2

SE 8TH STREET
PROPOSED TDA BOUNDARY

"E" STREET

SEE EXHIBIT B

N 49TH AVENUE

SEE EXHIBIT B

"C" STREET

"D" STREET

SEE EXHIBIT B

PARCEL NO. 178241-000

DATE: 10/29/2024

TDA 2 POST-DEVELOPED BASIN MAP

EXHIBIT

C

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AKS

DRWN: ALL
CHKD: CJS
AKS JOB: 8397

DWG: 8397 POSTDEV BASIN MAP | EXHIBIT C

Exhibit 6 SUB24-1002

Appendix E: BMP Details

Exhibit 6 SUB24-1002

V-11 Miscellaneous LID BMPs

V-11.1 Introduction to Miscellaneous LID BMPs

BMPs in this chapter have been grouped because they have the following in common:

- They employ Low Impact Development (LID) Principles

- They cannot be used to meet I-3.4.6 MR6: Runoff Treatment

- They cannot, by themselves, be used to meet the Flow Control Performance Standard or the LID Performance Standard.

    - Some of the BMPs in this chapter do allow for some amount of Flow Control credit. See the guidance for each individual BMP for details.

- The design methods for each BMP in this chapter are unique. They do not have strong enough design similarities to other BMPs in this volume to place them in the other BMP categories identified in this volume.

BMP T5.13: Post-Construction Soil Quality and Depth

Purpose and Definition

Naturally occurring (undisturbed) soil and vegetation provide important stormwater functions including: water infiltration; nutrient, sediment, and pollutant adsorption; sediment and pollutant biofiltration; water interflow storage and transmission; and pollutant decomposition. These functions are largely lost when development strips away native soil and vegetation and replaces it with minimal topsoil and sod. Not only are these important stormwater functions lost, but such landscapes themselves become pollution generating pervious surfaces due to increased use of pesticides, fertilizers and other landscaping and household/industrial chemicals, the concentration of pet wastes, and pollutants that accompany roadside litter.

Establishing soil quality and depth regains greater stormwater functions in the post development landscape, provides increased treatment of pollutants and sediments that result from development and habitation, and minimizes the need for some landscaping chemicals, thus reducing pollution through prevention.

Applications and Limitations

Establishing a minimum soil quality and depth is not the same as preservation of naturally occurring soil and vegetation. However, establishing a minimum soil quality and depth will provide improved on-site management of stormwater flow and water quality.

Soil organic matter can be attained through numerous materials such as compost, composted woody material, biosolids, and forest product residuals. It is important that the materials used to

Exhibit 6 SUB24-1002

meet this BMP be appropriate and beneficial to the plant cover to be established. Likewise, it is important that imported topsoils improve soil conditions and do not have an excessive percent of clay fines.

This BMP can be considered infeasible on till soil slopes greater than 33 percent.

Design Guidelines

Soil Retention

Retain, in an undisturbed state, the duff layer and native topsoil to the maximum extent practicable. In any areas requiring grading, remove and stockpile the duff layer and topsoil on site in a designated, controlled area, not adjacent to public resources and critical areas, to be reapplied to other portions of the site where feasible.

Soil Quality

All areas subject to clearing and grading that have not been covered by impervious surface, incorporated into a drainage facility or engineered as structural fill or slope shall, at project completion, demonstrate the following:

1. A topsoil layer with a minimum organic matter content of 10% dry weight in planting beds, and 5% organic matter content in turf areas, and a pH from 6.0 to 8.0 or matching the pH of the undisturbed soil. The topsoil layer shall have a minimum depth of eight inches except where tree roots limit the depth of incorporation of amendments needed to meet the criteria. Subsoils below the topsoil layer should be scarified at least 4 inches with some incorporation of the upper material to avoid stratified layers, where feasible.

2. Mulch planting beds with 2 inches of organic material.

3. Use compost and other materials that meet the following organic content requirements:

   a. The organic content for "pre-approved" amendment rates can be met only using compost meeting the compost specification for BMP T7.30: Bioretention, with the exception that the compost may have up to 35% biosolids or manure.

      The compost must also have an organic matter content of 40% to 65%, and a carbon to nitrogen ratio below 25:1.

      The carbon to nitrogen ratio may be as high as 35:1 for plantings composed entirely of plants native to the Puget Sound Lowlands region.

   b. Calculated amendment rates may be met through use of composted material meeting (a.) above; or other organic materials amended to meet the carbon to nitrogen ratio requirements, and not exceeding the contaminant limits identified in Table 220-B, Testing Parameters, in WAC 173-350-220.

The resulting soil should be conducive to the type of vegetation to be established.

Exhibit 6 SUB24-1002

Implementation Options

The soil quality design guidelines listed above can be met by using one of the methods listed below:

1. Leave undisturbed native vegetation and soil, and protect from compaction during construction.

2. Amend existing site topsoil or subsoil either at default "pre-approved" rates, or at custom calculated rates based on tests of the soil and amendment.

3. Stockpile existing topsoil during grading, and replace it prior to planting. Stockpiled topsoil must also be amended if needed to meet the organic matter or depth requirements, either at a default "pre-approved" rate or at a custom calculated rate.

4. Import topsoil mix of sufficient organic content and depth to meet the requirements.

More than one method may be used on different portions of the same site. Soil that already meets the depth and organic matter quality standards, and is not compacted, does not need to be amended.

Planning/Permitting/Inspection/Verification Guidelines & Procedures

Local governments are encouraged to adopt guidelines and procedures similar to those recommended in *Building Soil: Guidelines and Resources for Implementing Soil Quality and Depth BMP T5.13 in WDOE Stormwater Management Manual for Western Washington* (Stenn et al., 2016).

Maintenance

- Establish soil quality and depth toward the end of construction and once established, protect from compaction, such as from large machinery use, and from erosion.

- Plant vegetation and mulch the amended soil area after installation.

- Leave plant debris or its equivalent on the soil surface to replenish organic matter.

- Reduce and adjust, where possible, the use of irrigation, fertilizers, herbicides and pesticides, rather than continuing to implement formerly established practices.

Runoff Model Representation

All areas meeting the soil quality and depth design criteria may be entered into approved runoff models as "Pasture" rather than "Lawn/Landscaping".

Exhibit 6 SUB24-1002
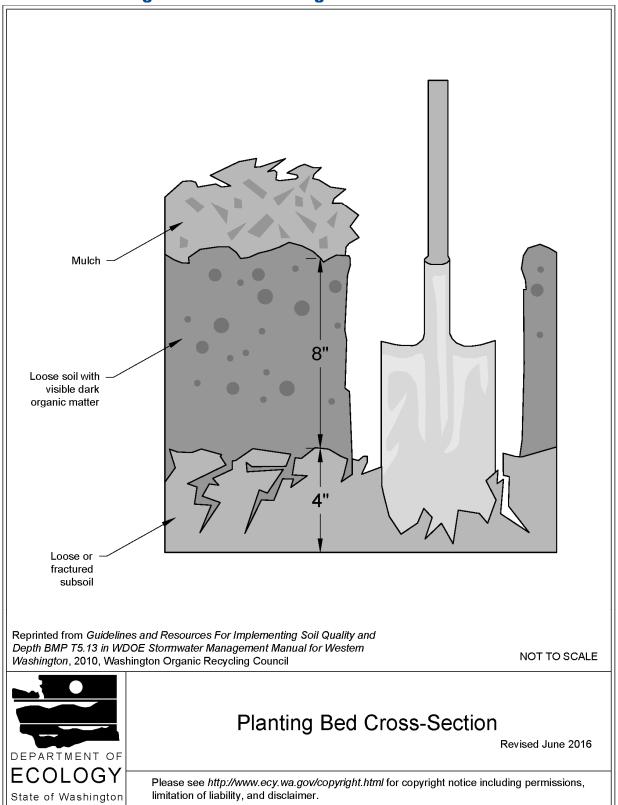
Figure V-11.1: Planting Bed Cross-Section

Mulch

Loose soil with
visible dark
organic matter

8"

4"

Loose or
fractured
subsoil

Reprinted from *Guidelines and Resources For Implementing Soil Quality and Depth BMP T5.13 in WDOE Stormwater Management Manual for Western Washington*, 2010, Washington Organic Recycling Council

NOT TO SCALE

DEPARTMENT OF
ECOLOGY
State of Washington

Planting Bed Cross-Section

Revised June 2016

Exhibit 6 SUB24-1002

V-12.3 Other Detention Design Options

This section presents options beyond the BMPs provided in this manual that the designer may want to consider incorporating into the project design for detaining flows to meet Flow Control requirements.

Use of Parking Lots for Additional Detention

Private parking lots may be used to provide additional detention volume for runoff events greater than the 2 year runoff event, provided all of the following are met:

1. The depth of water detained does not exceed 1 foot at any location in the parking lot for runoff events up to and including the 100 year event.

2. The gradient of the parking lot area subject to ponding is 1 percent or greater.

3. The emergency overflow path is identified and noted on the engineering plan(s). The overflow must not create a significant adverse impact to downhill properties or drainage system(s).

4. Fire lanes used for emergency equipment must be free of ponding water for all runoff events up to and including the 100 year event.

Use of Roofs for Detention

Detention ponding on roofs of structures may be used to meet Flow Control requirements provided all of the following are met:

1. The roof support structure is analyzed by a structural engineer to address the weight of ponded water.

2. The roof area subject to ponding is sufficiently waterproofed to achieve a minimum service life of 30 years.

3. The minimum pitch of the roof area subject to ponding is 1/4 inch per foot.

4. An overflow system is included in the design to safely convey the 100 year peak flow from the roof.

5. A mechanism is included in the design to allow the ponding area to be drained for maintenance purposes or in the event the restrictor device is plugged.

BMP D.1: Detention Ponds

The design criteria in this section are for detention ponds (this BMP). However, many of the criteria also apply to BMP T7.10: Infiltration Basins, BMP T10.10: Wetponds - Basic and Large, and BMP T10.40: Combined Detention and Wetpool Facilities.

Exhibit 6 SUB24-1002

Dam Safety for Detention BMPs

Stormwater detention BMPs that can impound 10 acre-feet (435,600 cubic feet; 3.26 million gallons) or more with the water level measured at the embankment crest, or have an embankment height of > 6 feet at the downstream toe, are subject to the state's dam safety requirements, even if water storage is intermittent and infrequent (WAC 173-175-020(1)). The principal safety concern is for the downstream population at risk if the dam should breach and allow an uncontrolled release of the pond contents. Peak flows from dam failures are typically much larger than the 100-year flows which detention BMPs are typically designed to accommodate.

The Dam Safety Office of the Department of Ecology uses consequence dependent design levels for critical project elements. There are eight design levels with storm recurrence intervals ranging from 1 in 500 for design step 1, to 1 in 1,000,000 for design step 8. The specific design step for a particular project depends on the downstream population and other resources that would be at risk from a failure of the dam. Precipitation events more extreme than the 100-year event may be rare at any one location, but have historically occurred somewhere within Washington State every few years on average.

With regard to the engineering design of stormwater detention BMPs, the primary effect of the state's dam safety requirements is in sizing the emergency spillway to accommodate the runoff from the dam safety design storm without overtopping the dam. The hydrologic computation procedures are the same as for the original pond design, except that the computations must use more extreme precipitation values and the appropriate dam safety design storm hyetographs. This information is described in detail within guidance documents developed by and available from Ecology's Dam Safety Office. In addition to the other design requirements for stormwater detention BMPs, dam safety requirements should be an integral part of planning and design for stormwater detention ponds. It is most cost-effective to consider these requirements from the beginning of the project.

In addition to the hydrologic and hydraulic issues related to precipitation and runoff, other dam safety requirements include geotechnical issues, construction inspection and documentation, dam breach analysis, inundation mapping, emergency action planning, and periodic inspections by project owners and by Dam Safety engineers. All of these requirements, plus procedural requirements for plan review and approval and payment of construction permit fees are described in detail in guidance documents developed by and available from the Dam Safety Office.

In addition to the written guidance documents, Dam Safety engineers are available to provide technical assistance to project owners and designers in understanding and addressing the dam safety requirements for their specific project. In the interest of providing a smooth integration of dam safety requirements into the stormwater detention project and streamlining Dam Safety's engineering review and issuance of the construction permit, it is recommended and requested that Dam Safety be contacted early in the project's planning process. The Dam Safety Office is located in the Ecology headquarters building in Lacey.

For more information about dam safety, please refer to Ecology's Dam Safety Office's Website at:

https://www.ecology.wa.gov/Water-Shorelines/Water-supply/Dams

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Design Criteria

Standard details for detention ponds are shown in Figure V-12.9: Typical Detention Pond, Figure V-12.10: Typical Detention Pond Sections, and Figure V-12.11: Overflow Structure. Control structure details and design guidance are provided in V-12.2 Control Structure Design.

General

1. Detention ponds must be designed as flow through systems (however, parking lot storage may be utilized through a back up system; see V-12.3 Other Detention Design Options). Developed flows must enter through a conveyance system separate from the control structure and outflow conveyance system. Maximizing distance between the inlet and outlet is encouraged to promote sedimentation.

2. Detention pond bottoms should be level and be located a minimum of 0.5 foot (preferably 1 foot) below the inlet and outlet to provide sediment storage.

3. Design guidelines for outflow control structures are specified in V-12.2 Control Structure Design.

4. A geotechnical analysis and report must be prepared for slopes over 15%, or if located within 200 feet of the top of a slope steeper than 40%, or landslide hazard area. The scope of the geotechnical report should include the assessment of impoundment seepage on the stability of the natural slope where the pond will be located within the setback limits set forth in this section.

Side Slopes

1. Interior side slopes up to the emergency overflow water surface should not be steeper than 3H:1V unless a fence is provided (see Fencing below).

2. Exterior side slopes must not be steeper than 2H:1V, unless analyzed for stability by a geotechnical engineer.

3. Detention pond walls may be vertical retaining walls, provided:

   - They are constructed of reinforced concrete per BMP D.3: Detention Vaults.

   - A fence is provided along the top of the wall.

   - The entire detention pond perimeter may be retaining walls, however, it is recommended that at least 25 percent of the pond perimeter be a vegetated soil slope not steeper than 3H:1V. If the entire pond perimeter is to be retaining walls, provide ladders on the walls for safety reasons.

   - The design is stamped by a licensed engineer in the state of Washington with structural expertise.

Exhibit 6 SUB24-1002

Other retaining walls such as rockeries, concrete, masonry unit walls, and keystone type walls may be used if designed by a geotechnical engineer or a civil engineer with structural expertise.

Embankments

1. Have a licensed engineer in the state of Washington with geotechnical expertise design pond berm embankments higher than 6 feet.

2. For berm embankments 6 feet or less, the minimum top width should be 6 feet, or as recommended by a geotechnical engineer.

3. Construct pond berm embankments on native consolidated soil (or adequately compacted and stable fill soils analyzed by a geotechnical engineer) free of loose surface soil materials, roots, and other organic debris.

4. Construct pond berm embankments greater than 4 feet in height by excavating a key equal to 50 percent of the berm embankment cross sectional height and width, unless specified otherwise by a geotechnical engineer.

5. Embankment compaction should be accomplished in such a manner as to produce a dense, low permeability engineered fill that can tolerate post-construction settlements with a minimum of cracking. Place the embankment fill on a stable subgrade and compact to a minimum of 95% of the Standard Proctor Maximum Density, ASTM Procedure D698. Placement moisture content should lie within 1% dry to 3% wet of the optimum moisture content. The referenced compaction standard may have to be increased to comply with local regulations.

    Construct the berm embankment of soils with the following characteristics: a minimum of 20% silt and clay, a maximum of 60% sand, a maximum of 60% silt, with nominal gravel and cobble content. Soils outside this specified range can be used, provided the design satisfactorily addresses the engineering concerns posed by these soils. The paramount concerns with these soils are their susceptibility to internal erosion or piping, and to surface erosion from wave action and runoff on the upstream and downstream slopes, respectively. Note: In general, excavated glacial till is well suited for berm embankment material.

6. Place anti seepage filter-drain diaphragms on outflow pipes in berm embankments impounding water with depths greater than 8 feet at the design water surface. See *Dam Safety Guidelines Part IV: Dam Design and Construction*, (Ecology, 1993) Section 3.3.B on pages 3-27 to 3-30.

Primary Overflow

1. Provide a primary overflow (usually a riser pipe within the control structure; see V-12.2 Control Structure Design) in all detention ponds, tanks, and vaults to bypass the 100 year developed peak flow over or around the restrictor system. This assumes the facility will be full due to plugged orifices or high inflows; the primary overflow is intended to protect against breaching of a pond embankment (or overflows of the upstream conveyance system in the case of a detention tank or vault). The design must provide controlled discharge directly into the downstream conveyance system or another acceptable discharge point.

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2. Provide a secondary inlet to the control structure in ponds as additional protection against overtopping should the inlet pipe to the control structure become plugged. A grated opening ("jailhouse window") in the control structure manhole functions as a weir (see Figure V-12.10: Typical Detention Pond Sections) when used as a secondary inlet.

Note: The maximum circumferential length of this opening must not exceed one half the control structure circumference. The "birdcage" overflow structure as shown in Figure V-12.11: Overflow Structure may also be used as a secondary inlet.

Emergency Overflow Spillway

1. In addition to the primary overflow (described above), ponds must have an emergency overflow spillway. For impoundments of 10 acre-feet or greater, the emergency overflow spillway must meet the state's dam safety requirements (see Dam Safety for Detention BMPs above). For impoundments under 10 acre-feet, ponds must have an emergency overflow spillway that is sized to pass the 100 year developed peak flow in the event of total control structure failure (e.g., blockage of the control structure outlet pipe) or extreme inflows. Emergency overflow spillways are intended to control the location of pond overtopping and direct overflows back into the downstream conveyance system or other acceptable discharge point.

2. Provide emergency overflow spillways for ponds with constructed berms over 2 feet in height, or for ponds located on grades in excess of 5 percent. As an option for ponds with berms less than 2 feet in height and located at grades less than 5 percent, emergency overflow may be provided by an emergency overflow structure, such as a Type II manhole fitted with a birdcage as shown in Figure V-12.11: Overflow Structure. The emergency overflow structure must be designed to pass the 100 year developed peak flow, with a minimum 6 inches of freeboard, directly to the downstream conveyance system or another acceptable discharge point. Where an emergency overflow spillway would discharge to a slope steeper than 15%, consideration should be given to providing an emergency overflow structure in addition to the spillway.

3. Armour the emergency overflow spillway with riprap in conformance with BMP C209: Outlet Protection. The spillway must be armored full width, beginning at a point midway across the berm embankment and extending downstream to where emergency overflows re enter the conveyance system (see Figure V-12.10: Typical Detention Pond Sections).

4. Emergency overflow spillway designs must be analyzed as broad crested trapezoidal weirs as described in Methods of Analysis (below). Either one of the weir sections shown in Figure V-12.10: Typical Detention Pond Sections may be used.

5. Design the emergency overflow spillway to allow a minimum of 1 foot of freeboard above the maximum design storm (100-year, 24-hour storm) water surface level.

Access

1. Provide maintenance access road(s) to the control structure and other drainage structures associated with the pond (e.g., inlet or bypass structures). It is recommended that manhole and catch basin lids be in or at the edge of the access road and at least 3 feet from a property line.

2. An access ramp is needed for removal of sediment with a trackhoe and truck. Extend the

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ramp to the pond bottom if the pond bottom is greater than 1,500 square feet (measured without the ramp). If the pond bottom is less than 1,500 square feet (measured without the ramp), the ramp may end at an elevation 4 feet above the pond bottom.

On large, deep ponds, provide truck access to the pond bottom via an access ramp so loading can be done in the pond bottom. On small deep ponds, the truck can remain on the ramp for loading. On small shallow ponds, a ramp to the bottom may not be required if the trackhoe can load a truck parked at the pond edge or on the internal berm of a wetpond or combined pond (trackhoes can negotiate interior pond side slopes).

3. The internal berm of BMP T10.10: Wetponds - Basic and Large, or BMP T10.40: Combined Detention and Wetpool Facilities, may be used for access if all of the following apply:

   - The internal berm is no more than 4 feet above the first wetpool cell.

   - The first wetpool cell is less than 1,500 square feet (measured without the ramp).

   - The internal berm is designed to support a loaded truck, considering the berm is normally submerged and saturated.

4. If a fence is required, access should be limited by a double posted gate or by bollards – two fixed bollards on each side of the access road and two removable bollards equally located between the fixed bollards.

5. The design guidelines for access roads and ramps:

   - A maximum grade of 15%.

   - A minimum of 40 feet outside turning radius.

   - Locate fence gates only on straight sections of road.

   - 15 feet in width on curves and 12 feet on straight sections.

   - Provide a paved apron where access roads connect to paved public roadways.

6. Construct access roads and ramps with permeable pavement, gravel surface, or modular grid pavement. All surfaces must conform to the jurisdictional standards and manufacturer's specifications.

Fencing

1. A fence is needed at the emergency overflow water surface elevation, or higher, where a pond interior side slope is steeper than 3H:1V, or where the impoundment is a wall greater than 24 inches in height. The fence need only be constructed for those slopes steeper than 3H:1V. Other regulations such as the International Building Code or Uniform Building Code may require fencing of vertical walls. If more than 10 percent of slopes are steeper 3H:1V, it is recommended that the entire pond be fenced.

   Fences discourage access to portions of a pond where steep side slopes (steeper than 3:1) increase the potential for slipping into the pond. Fences also serve to guide those who have fallen into a pond to side slopes that are flat enough (flatter than 3:1 and unfenced) to allow for easy escape.

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2. It is recommended that fences be 6 feet in height. For example designs, see WSDOT Standard Plan L-2, Type 1 or Type 3 chain link fence. The fence may be a minimum of 4 feet in height if the depth of the impoundment (measured from the lowest elevation in the bottom of the impoundment, directly adjacent to the bottom of the fenced slope, up to the emergency overflow water surface) is 5 feet or less. For example designs, see WSDOT Standard Plan L-2, Type 4 or Type 6 chain link fence.

3. Access road gates may be 16 feet in width consisting of two swinging sections 8 feet in width. Provide additional vehicular access gates as needed to facilitate maintenance access.

4. Pedestrian access gates (if needed) should be 4 feet in width.

5. Vertical metal balusters or 9 gauge galvanized steel fabric with bonded vinyl coating can be used as fence material. For steel fabric fences, consider the following aesthetic features:

    a. Vinyl coating that is compatible with the surrounding environment (e.g., green in open, grassy areas and black or brown in wooded areas). All posts, cross bars, and gates may be painted or coated the same color as the vinyl clad fence fabric.

    b. Fence posts and rails that conform to WSDOT Standard Plan L 2 for Types 1, 3, or 4 chain link fence.

6. For metal baluster fences, Uniform Building Code standards apply.

7. Wood fences may be used in subdivisions where the fence will be maintained by homeowners associations or adjacent lot owners.

8. Wood fences should have pressure treated posts (ground contact rated) either set in 24 inch deep concrete footings or attached to footings by galvanized brackets. Rails and fence boards may be cedar, pressure treated fir, or hemlock.

9. Where only short stretches of the pond perimeter (< 10 percent) have side slopes steeper than 3:1, use split rail fences (3 foot minimum height) or densely planted thorned hedges (e.g., barberry, holly) in place of a standard fence.

Signage

Detention ponds (this BMP), BMP T7.10: Infiltration Basins, BMP T10.10: Wetponds - Basic and Large, and BMP T10.40: Combined Detention and Wetpool Facilities should have a sign placed for maximum visibility from adjacent streets, sidewalks, and paths. An example of sign specifications for a permanent surface water control pond is illustrated in Figure V-12.12: Example of Permanent Surface Water Control Pond Sign.

Right of Way

Right-of-way may be needed for detention pond maintenance. It is recommended that any tract not abutting public right-of-way have 15-20 foot wide extension of the tract to an acceptable access location.

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Setbacks

It is recommended that detention ponds be a minimum of 20 feet from any structure, property line, and any vegetative buffer required by the local government. The detention pond water surface at the pond outlet invert elevation must be set back 100 feet from proposed or existing septic system drain-fields. However, the setback requirements are generally specified by the local government, uniform building code, or other statewide regulation and may be different from those mentioned above.

All detention ponds must be a minimum of 50 feet from the top of any steep (greater than 15%) slope. A geotechnical analysis and report must be prepared addressing the potential impact of the pond on a slope steeper than 15%.

Seeps and Springs

Intermittent seeps along cut slopes are typically fed by a shallow ground water source (interflow) flowing along a relatively impermeable soil stratum. These flows are storm driven and should discontinue after a few weeks of dry weather. However, more continuous seeps and springs, which extend through longer dry periods, are likely from a deeper ground water source. When continuous flows are intercepted and directed through detention ponds, adjustments to the pond design may have to be made to account for the additional base flow.

Planting Requirements

Sod or seed exposed earth on the pond bottom and interior side slopes with an appropriate seed mixture. Plant all remaining areas of the tract with grass or landscape and mulch with a 3 inch cover of hog fuel or shredded wood mulch. Shredded wood mulch is made from shredded tree trimmings, usually from trees cleared on site. The mulch should be free of garbage and weeds and should not contain excessive resin, tannin, or other material detrimental to plant growth. Do not use construction materials, wood debris, or wood treated with preservatives for producing shredded wood mulch.

Landscaping

Landscaping is encouraged for most stormwater tract areas (see below for areas not to be landscaped). However, if provided, landscaping should adhere to the criteria that follow so as not to hinder maintenance operations. Landscaped stormwater tracts may, in some instances, provide a recreational space. In other instances, "naturalistic" stormwater facilities may be placed in open space tracts.

Follow these guidelines if landscaping is proposed for facilities:

1. Do not plant trees or shrubs on berms meeting the criteria of dams regulated for safety.

2. Do not plant trees or shrubs within 10 feet of inlet or outlet pipes or manmade drainage structures such as spillways or flow spreaders. Avoid using species with roots that seek water, such as willow or poplar, within 50 feet of pipes or manmade structures.

3. Restrict planting on berms that impound water permanently or temporarily during storms. This restriction does not apply to cut slopes that form pond banks, only to berms.

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    a. Do not plant trees or shrubs on portions of water impounding berms taller than four feet high. Plant only grasses on berms taller than four feet.

       Grasses allow unobstructed visibility of berm slopes for detecting potential dam safety problems such as animal burrows, slumping, or fractures in the berm.

    b. Trees planted on portions of water impounding berms less than 4 feet high must be small, not higher than 20 feet mature height, and have a fibrous root system. Table V-12.2: Small Trees and Shrubs with Fibrous Roots gives some examples of trees with these characteristics developed for the central Puget Sound.

       These trees reduce the likelihood of blow down trees, or the possibility of channeling or piping of water through the root system, which may contribute to dam failure on berms that retain water.

  Note: The internal berm in a wetpond is not subject to this planting restriction since the failure of an internal berm would be unlikely to create a safety problem.

4. Plant all landscape material, including grass, in good topsoil. Make native underlying soils suitable for planting by amending with 4 inches of compost tilled into the subgrade. Refer to BMP T5.13: Post-Construction Soil Quality and Depth for soil quality standards.

5. Soil in which trees or shrubs are planted may need additional enrichment or additional compost top dressing. Consult a nursery, landscape professional, or arborist for site specific recommendations.

6. For a naturalistic effect as well as ease of maintenance, plant trees or in clumps to form "landscape islands" rather than spacing evenly.

7. The landscaped islands should be a minimum of six feet apart, and if set back from fences or other barriers, the setback distance should also be a minimum of 6 feet. Where tree foliage extends low to the ground, the six feet setback should be counted from the outer drip line of the trees (estimated at maturity).

  This setback allows a 6-foot wide mower to pass around and between clumps.

8. Evergreen or columnar deciduous trees along the west and south sides of ponds are recommended to reduce thermal heating. Evergreen trees or shrubs are preferred to avoid problems associated with leaf drop. Columnar deciduous trees (e.g., hornbeam, Lombardy poplar) typically have fewer leaves than other deciduous trees.

  In addition to shade, trees and shrubs also discourage waterfowl use and the attendant phosphorus enrichment problems they cause. Setback trees so the branches will not extend over the pond.

9. Drought tolerant species are recommended.

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Table V-12.2: Small Trees and Shrubs with Fibrous Roots

Small Trees / High Shrubs	Low Shrubs
*Red twig dogwood *(Cornus stolonifera)*	*Snowberry *(symporicarpus albus)*
*Serviceberry *(Amelanchier alnifolia)*	*Salmonberry *(Rubus spectabilis)*
*Filbert (*Corylus cornuta*, others)	Rosa rugosa (avoid spreading varieties)
Highbush cranberry *(Vaccinium opulus)*	Rock rose *(Cistus spp.)*
Blueberry *(Vaccinium spp.)*	Ceanothus spp. (Choose hardier varieties)
Fruit trees on dwarf rootstock	New Zealand flax *(Phormium penax)*
Rhododendron (native and ornamental varieties)	Ornamental grasses (e.g., *Miscanthis*, *Pennisetum*)
*Native species	

Guidelines for Naturalistic Planting

Stormwater BMPs may sometimes be located within open space tracts if "natural appearing." Two generic kinds of naturalistic planting are outlined below, but other options are also possible. Native vegetation is preferred in naturalistic plantings.

- Open Woodland

  In addition to the general landscaping guidelines above, the following are recommended.

  1. Landscaped islands (when mature) should cover a minimum of 30 percent or more of the tract, exclusive of the pond area.

  2. Underplant tree clumps with shade tolerant shrubs and groundcover plants. The goal is to provide a dense understory that need not be weeded or mowed.

  3. Place landscaped islands at several elevations rather than "ring" the pond, and vary the size of clumps from small to large to create variety.

  4. Not all islands need to have trees. Shrub or groundcover clumps are acceptable, but lack of shade should be considered in selecting vegetation.

  Note: Landscaped islands are best combined with the use of wood-based mulch (hog fuel) or chipped on-site vegetation for erosion control (only for slopes above the flow control water

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surface). It is often difficult to sustain a low maintenance understory if the site was previously hydroseeded. Compost or composted mulch (typically used for constructed wetland soil) can be used below the flow control water surface (materials that are resistant to and preclude flotation). The method of construction of soil landscape systems can also cause natural selection of specific plant species. Consult a soil restoration or wetland soil scientist for site-specific recommendations.

- Northwest Savannah or Meadow

  In addition to the general landscape guidelines above, the following are recommended.

  1. Landscape islands (when mature) should cover 10 percent or more of the site, exclusive of the pond area.

  2. Planting groundcovers and understory shrubs is encouraged to eliminate the need for mowing under the trees when they are young.

  3. Place landscape islands at several elevations rather than "ring" the pond.

Plant the remaining site area with an appropriate grass seed mix, which may include meadow or wildflower species. Native or dwarf grass mixes are preferred. Table V-12.3: Stormwater Tract "Low Grow" Seed Mix below gives an example of dwarf grass mix developed for central Puget Sound. Apply grass seed at 2.5 to 3 pounds per 1,000 square feet. Amended soil or good topsoil is required for all plantings.

Creation of areas of emergent vegetation in shallow areas of the pond is recommended. Native wetland plants, such as sedges (*Carex sp.*), bulrush (*Scirpus sp.*), water plantain (*Alisma sp.*), and bur-reed (*Sparganium sp.*) are recommended. If the pond does not hold standing water, a clump of wet tolerant, non invasive shrubs, such as salmonberry or snowberry, is recommended below the detention design water surface.

Note: This landscape style is best combined with the use of grass or sod for site stabilization and erosion control.

Table V-12.3: Stormwater Tract "Low Grow" Seed Mix

Seed Name	Percentage of Mix
Dwarf tall fescue	40%
Dwarf perennial rye "Barclay"*	30%
Red fescue	25%
Colonial bentgrass	5%
* If wildflowers are used and sowing is done before Labor Day, the amount of dwarf perrenial rye can be reduced proportionately to the amount of wildflower seed used.	

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Figure V-12.9: Typical Detention Pond

Access ramp into pond

15% max. slope

Tract lines as required

Pond inlet pipe

Flow

Note: This detail is a schematic representation only. Actual configuration will vary depending on specific site constraints and applicable design criteria.

6" sediment storage

Pond design water surface

12'/15' maintenance road

Level bottom

5' min.

A

Flow

Alternate emergency outflow structure for ponds not required to provide a spillway

C

Control structure

Compacted embankment

B

B

Flow

Outfall

See Figure III-3.2.2 for section cut diagrams

Emergency overflow spillway rip rap

C

A

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Typical Detention Pond

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Figure V-12.10: Typical Detention Pond Sections

control structure

emergency overflow water surface

overflow WS

pond design WS

debris barrier

6" sediment storage

a

top width of berm
6' min. 12'/15' min. for access road

2 min.
berm
embankment
1

existing ground profile

maximum
elevation 10-yr WS

key, if required

Section A-A

circumference length of opening sized for 100 yr flow

pond design WS

overflow WS

frame/grate for secondary inlet. Provide
vertical bars in frame @ 4" O.C.

See also the separate overflow
structure shown in Figure III-3.2.3

Section a-a

Section B-B has 2 options

L (as required for 6" depth)

10
1

1
10

0.9' min.

2" asphalt (for spillway on
access roads)

1.7' min.

emergency overflow water
surface (see Figure III-3.2.1)

overflow WS

3
1

1
3

design WS

Section B-B
Emergency Overflow Spillway

1' rock lining

overflow WS

design WS

emergency overflow WS

compacted
embankment

Rock lining per
BMP C209:Outlet
Protection in Vol. II

Section C-C

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Typical Detention Pond Sections

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Figure V-12.11: Overflow Structure

15° (typ.)
see note 1

¾" diameter smooth bars
equally spaced (4" O.C. max.)

4 hook clamps evenly placed.
See detail below.

A   A

Provide maintenance access by
welding 4 crossbars to 4 vertical
bars as shown. Hinge upper
ends with flanges/bolts and
provide locking mechanism
(padlock) on lower end. Locate
steps directly below.

Plan View

lower steel band ¾" x 4"
wide formed to fit in
groove of CB riser

upper steel
band ¾" x
4" wide

24"
see note 1

¾" dia. smooth round
bars welded equally
spaced. Bars shall be
welded to upper and
lower bands (24 bands
evenly spaced see note 1)

type 2 CB

standard galvanized
steps or ladder

Section A-A

45°

smooth
vertical bars

CB riser

hook clamp
anchored to
C.B. riser

Detail Hook Clamp

Notes:
1. Dimensions are for illustration on 54" diameter CB. For different diameter CB's adjust to maintain
   45 degree angle on "vertical" bars and 7" O.C. maximum spacing of bars around lower steel band.
2. Metal parts must be corrosion resistant; steel bars must be galvanized.
3. This debris barrier is also recommended for use on the inlet to roadway cross-culverts with high
   potential for debris collection (except on type 2 streams).

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Overflow Structure

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Figure V-12.12: Example of Permanent Surface Water Control Pond Sign

Stormwater Pond

This pond is in our care.

Runoff is held here after storms. It is released slowly or stored until the next storm when it is replaced by incoming flows. This helps prevent downstream flooding and erosion and helps clean the water. For more information or to report littering, vandalism or other problems, call:

TEL No._____
Pond Name and Number

48"

1 ½"

24"

3'-6" (typ.)

Sample Specifications:

Size:	48 inches by 24 inches
Material:	0.125-gauge aluminum
Face:	Non-reflective vinyl or 3 coats outdoor enamel (sprayed).
Lettering:	Silk screen enamel where possible, or vinyl letters.
Colors:	Beige background, teal letters.
Type face:	Helvetica condensed. Title: 3 inch; Sub-Title: 1 ½ inch; Text: 1 inch; Outer Border:; ⅛ inch; Border Distance from Edge: ¼ inch; all text 1 ¾ inch from border.
Posts:	Pressure treated, beveled tops, 1 ½ inch higher than sign.
Installation:	Secure to chain link fence if available. Otherwise install on two 4" x 4" posts, pressure treated, mounted atop gravel bed, installed in 30-inch concrete filled post holes (8-inch minimum diameter). Top of sign no higher than 42 inches from ground surface.
Placement:	Face sign in direction of primary visual or physical access. Do not block any access road. Do not place within 6 feet of structural facilities (e.g. manholes, spillways, pipe inlets).
Special Notes:	This facility is lined to protect groundwater (if a liner that restricts infiltration of stormwater exists).

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Example of Permanent Surface Water Control Pond Sign

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Maintenance

General

Maintenance is of primary importance if detention ponds are to continue to function as originally designed. A local government, a designated group such as a homeowners' association, or some individual must accept the responsibility for maintaining the control structures and the impoundment area. Formulate a specific maintenance plan outlining the schedule and scope of maintenance operations. Achieve debris removal in detention ponds by using trash racks or other screening devices.

Design with maintenance in mind. Good maintenance will be crucial to successful use of the detention pond. Hence, build in provisions to facilitate maintenance operations into the project when it is installed. Maintenance must be a basic consideration in design and in determination of first cost. See Appendix V-A: BMP Maintenance Tables for specific maintenance requirements.

Handle any standing water and sediments removed during the maintenance operation in a manner consistent with Appendix IV-B: Management of Street Waste Solids and Liquids.

Vegetation

If a shallow marsh is established, then periodic removal of dead vegetation may be necessary. Since decomposing vegetation can release pollutants captured in the wet pond, especially nutrients, it may be necessary to harvest dead vegetation annually prior to the winter wet season. Otherwise the decaying vegetation can export pollutants out of the pond and also can cause nuisance conditions to occur. If harvesting is to be done in BMP T10.30: Stormwater Treatment Wetlands, have a wetland scientist prepare a written harvesting procedure and submitted it with the drainage design to the local government.

Sediment

Maintenance of sediment forebays and attention to sediment accumulation within the pond is extremely important. Continually monitor sediment deposition in the pond. Owners, operators, and maintenance authorities should be aware that significant concentrations of metals (e.g., lead, zinc, and cadmium) as well as some organics such as pesticides, may be expected to accumulate at the bottom of stormwater ponds. Regularly conduct testing of sediment, especially near points of inflow, to determine the leaching potential and level of accumulation of potentially hazardous material before disposal.

Methods of Analysis

Detention Volume and Outflow

Design volumes and outflows for detention ponds to meet the performance standards as required in I-3.4.5 MR5: On-Site Stormwater Management, I-3.4.7 MR7: Flow Control, and/or I-3.4.8 MR8: Wetlands Protection and the hydrologic analysis and design methods in III-2 Modeling Your BMPs. Design guidelines for control structures are given in V-12.2 Control Structure Design.

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Note: The design water surface elevation is the highest elevation which occurs in order to meet the required outflow performance for the pond.

Detention Ponds in Infiltrative Soils

Detention ponds may occasionally be sited on till soils that are sufficiently permeable for a properly functioning infiltration system (see V-5 Infiltration BMPs). These detention ponds have a surface discharge through the control structure, and may also utilize infiltration as a second pond outflow. Detention ponds sized with infiltration as a second outflow must meet all the requirements of BMP T7.10: Infiltration Basins, including a soils report, testing, ground water protection, pre-settling, and construction techniques.

Emergency Overflow Spillway Capacity

For impoundments under 10-acre-feet, the emergency overflow spillway weir section must be designed to pass the 100 year runoff event for developed conditions assuming a broad crested weir. The **broad crested weir equation** for the spillway section in Figure V-12.13: Weir Section for Emergency Overflow Spillway, for example, would be:

$$Q_{100} = C(2g)^{1/2}\left[\tfrac{2}{3}LH^{3/2} + \tfrac{8}{15}\left(Tan\theta\right)H^{5/2}\right]$$

Where:

Q_{100} = peak flow for the 100-year runoff event (cfs)

C = discharge coefficient (0.6)

g = gravity (32.2 ft/sec^2)

L = length of weir (ft)

H = height of water over weir (ft)

θ = angle of side slopes

Q_{100} is either the peak volumetric flow rate calculated using a 10-minute time step from the 100-year, 24-hour storm and a Type 1A distribution, or the 100-year, 15 minute flow rate, indicated by an approved continuous runoff model.

Assuming C = 0.6 and Tanθ = 3 (for 3:1 slopes), the equation becomes:

$$Q_{100} = 3.21[LH^{3/2} + 2.4\,H^{5/2}]$$

To find width L for the weir section, the equation is rearranged to use the computed Q_{100} and trial values of H (0.2 feet minimum):

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

or

6 feet minimum

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Figure V-12.13: Weir Section for Emergency Overflow Spillway

emergency overflow
water surface

0.7' min.

θ

3
1

L

3
1

0.5' min.

overflow
water
surface

H (0.2' min.)

per "Outlet Protection" in Vol. II

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Weir Section for Emergency Overflow Spillway

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BMP D.2: Detention Tanks

Detention tanks are underground detention BMPs typically constructed with large diameter corrugated metal pipe. Standard detention tank details are shown in Figure V-12.14: Typical Detention Tank and Figure V-12.15: Detention Tank Access Detail. Control structure details are shown in V-12.2 Control Structure Design.

Design Criteria

General

Typical design guidelines are as follows:

1. Detention tanks may be designed as flow through systems with manholes in line (see Figure V-12.14: Typical Detention Tank) to promote sediment removal and facilitate maintenance. Detention tanks may be designed as back up systems if preceded by Runoff Treatment BMPs, since little sediment should reach the inlet/control structure and low head losses can be expected because of the proximity of the inlet/control structure to the tank.

2. Locate the detention tank bottom 0.5 feet below the inlet and outlet to provide dead storage for sediment.

3. Use a 36-inch minimum pipe diameter.

4. Tanks larger than 36 inches may be connected to each adjoining structure with a short section (2 foot maximum length) of 36 inch minimum diameter pipe.

5. Refer to the details of outflow control structures in V-12.2 Control Structure Design.

6. Design the emergency overflow to pass the 100 year storm.

Note: Control structures and access manholes should have additional ladder rungs to allow ready access to all detention tank access pipes when the catch basin sump is filled with water (see Figure V-12.1: Flow Restrictor (TEE), plan view).

Materials

Galvanized metals leach zinc into the environment, especially in standing water situations. This can result in zinc concentrations that can be toxic to aquatic life. Therefore, use of galvanized materials in stormwater BMPs and conveyance systems is discouraged. Where other metals, such as aluminum or stainless steel, or plastics are available, they should be used.

Pipe material, joints, and protective treatment for tanks should be in accordance with Section 9.05 of WSDOT's *Standard Specifications for Road, Bridge, and Municipal Construction* (WSDOT, 2016).

Structural Stability

Tanks must meet structural requirements for overburden support and traffic loading if appropriate. Accommodate H20 live loads for tanks lying under parking areas and access roads. Design metal tank end plates for structural stability at maximum hydrostatic loading conditions. Flat end plates

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generally require thicker gage material than the pipe and/or require reinforcing ribs. Place detention tanks on stable, well consolidated native material with a suitable bedding. Do not place detention tanks in fill slopes, unless analyzed in a geotechnical report for stability and constructability.

Buoyancy

In moderately pervious soils where seasonal ground water may induce flotation, balance buoyancy tendencies by either ballasting with backfill or concrete backfill, providing concrete anchors, or increasing the total weight. Calculations that demonstrate stability must be documented.

Access Openings

The following guidelines for access openings may be used.

1. The maximum depth from finished grade to tank invert should be 20 feet.

2. Position access openings a maximum of 50 feet from any location within the tank.

3. All tank access openings may have round, solid locking lids (usually 1/2 to 5/8-inch diameter Allen-head cap screws).

4. Thirty six inch minimum diameter CMP riser type manholes (Figure V-12.15: Detention Tank Access Detail) of the same gage as the tank material may be used for access along the length of the tank and at the upstream terminus of the tank in a backup system. The top slab is separated (1 inch minimum gap) from the top of the riser to allow for deflections from vehicle loadings without damaging the riser tank.

5. Make all tank access openings readily accessible by maintenance vehicles.

6. Tanks must comply with the OSHA confined space requirements, which includes clearly marking entrances to confined space areas. This may be accomplished by hanging a removable sign in the access riser(s), just under the access lid.

Access Roads

Access roads are needed to all detention tank control structures and risers. Design and construct access roads as specified for detention ponds in BMP D.1: Detention Ponds.

Right-of Way

Right-of-way may be needed for detention tank maintenance. It is recommended that any tract not abutting public right of way have a 15 to 20-foot wide extension of the tract to accommodate an access road to the detention tank.

Setbacks

It is recommended that detention tankss be a minimum of 20 feet from any structure, property line, and any vegetative buffer required by the local government and from any septic drainfield. However, the setback requirements are generally specified by the local government, uniform building code, or other statewide regulation and may be different from those mentioned above.

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All detention tankss must be a minimum of 50 feet from the top of any steep (greater than 15%) slope. A geotechnical analysis and report must be prepared addressing the potential impact of the tank on a slope steeper than 15%.

Maintenance

Build in provisions to facilitate maintenance operations into the project when it is installed. Maintenance must be a basic consideration in design and in determination of first cost. See Appendix V-A: BMP Maintenance Tables for specific maintenance requirements.

Methods of Analysis

Detention Volume and Outflow

Design volumes and outflows for detention tanks to meet the performance standards as required in I-3.4.5 MR5: On-Site Stormwater Management, I-3.4.7 MR7: Flow Control, and/or I-3.4.8 MR8: Wetlands Protection, and the hydrologic analysis and design methods in III-2 Modeling Your BMPs. Design guidelines for control structuresn are given in V-12.2 Control Structure Design.

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Figure V-12.14: Typical Detention Tank

optional parallel tank

inlet pipe
(backup systems,
where allowed)

access risers
(max spacing shown below)

36"

min. diameter
same as
inlet pipe

2' min.

A

A

36"

flow

control
structure

access risers

inlet pipe
(flow through)

type 2 CB
required for
flow through
system only

Plan View

"Flow-through" system shown solid.
Designs for "flow backup" system
and parallel tanks shown dashed.

2" min. diameter air
vent pipe welded to
tank (required if no
access riser on tank)

100' max

50' max

access risers

control
structure
(FROP-T
shown)

2'
max.

0.5' sediment storage

level

2' min.

36" min.
diameter (typ.)

detention tank size as
required

2'
max.

2' min.

Section A-A

"Flow-through" system shown solid.

Note:
All metal parts corrosion resistant. Steel parts galvanized and asphalt
coated (Treatment 1 or better), or aluminized steel (Type II or better).

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State of Washington

Typical Detention Tank

Revised May 2019

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Figure V-12.15: Detention Tank Access Detail

standard type 2-60" diam.
CB concrete top slab

36" CMP riser

frame locking lid (marked
"DRAIN") mounted over 24"
diam. eccentric opening

6"

Plan

standard locking M.H. frame and cover

maintain 1" gap between
bottom of slab & top of
riser - provide pliable
gasket to exclude dirt

36"

compacted pipe bedding

riser, 36" diam. min.,
same material & gage as
tank, welded or fused to
tank

detention tank

M.H. steps 12" O.C.

weld or bolt standard M.H. steps

24" max.

Section

Notes:
1. Use adjusting blocks as required to bring frame to grade.
2. All metal parts corrosion resistant. Steel parts galvanized and asphalt coated (Treatment 1 or better), or aluminized steel (Type II or better).
3. Must be located for access by maintenance vehicles.
4. May substitute WSDOT special Type IV manhole (RCP only)

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Detention Tank Access Detail

Revised May 2019

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Appendix F: Flow Control & Water Quality Analysis

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WWHM2012

PROJECT REPORT
TDA #1: FLOW CONTROL AND WATER QUALITY

SUBBASINS 1A, 1B, & 1C

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General Model Information

WWHM2012 Project Name: 8397 20241030 TDA 1 WWHM

Site Name:	Camas Woods
Site Address:	
City:	Camas Woods, 98607
Report Date:	11/1/2024
Gage:	Lacamas
Data Start:	1948/10/01
Data End:	2008/09/30
Timestep:	15 Minute
Precip Scale:	1.300
Version Date:	2023/01/27
Version:	4.2.19

POC Thresholds

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

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Landuse Basin Data
Predeveloped Land Use

Pre-Dev_TDA 1

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG4, Forest, Flat	16.941
SG4, Forest, Mod	2.628
Pervious Total	19.569

Impervious Land Use	acre
Impervious Total	0

Basin Total	19.569

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1A WQ

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG4, Forest, Flat	14.383
Pervious Total	14.383

Impervious Land Use	acre
Impervious Total	0
Basin Total	14.383

1A WQ

Exhibit 6 SUB24-1002

1B WQ

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG4, Forest, Flat	2.646
Pervious Total	2.646

Impervious Land Use	acre
Impervious Total	0
Basin Total	2.646

Exhibit 6 SUB24-1002

1C WQ

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG4, Forest, Flat	0.33

Pervious Total	0.33

Impervious Land Use	acre

Impervious Total	0

Basin Total	0.33

Exhibit 6 SUB24-1002

Mitigated Land Use

1A

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG4, Field, Flat	2.839
Pervious Total	2.839

Impervious Land Use	acre
ROADS FLAT	10.578
DRIVEWAYS FLAT	1.24
PARKING FLAT	0.073
Impervious Total	11.891
Basin Total	14.73

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1B

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG4, Field, Flat	0.639

Pervious Total	0.639

Impervious Land Use	acre
ROADS FLAT	2.356
PARKING FLAT	0.039

Impervious Total	2.395

Basin Total	3.034

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1C

Bypass:	Yes	
GroundWater:	No	
Pervious Land Use	acre	
SG4, Field, Flat	0.055	
Pervious Total	0.055	
Impervious Land Use	acre	
ROADS FLAT	0.275	
Impervious Total	0.275	
Basin Total	0.33	

1C

Exhibit 6 SUB24-1002

MIT_1A WQ

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG4, Field, Flat	2.839

Pervious Total	2.839

Impervious Land Use	acre
ROADS FLAT	11.4705
PARKING FLAT	0.0735

Impervious Total	11.544

Basin Total	14.383

MIT_1A WQ

Exhibit 6 SUB24-1002

MIT_1B WQ

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG4, Field, Flat	0.639
Pervious Total	0.639

Impervious Land Use	acre
ROADS FLAT	2.007
Impervious Total	2.007
Basin Total	2.646

MIT_1B WQ

Exhibit 6 SUB24-1002

MIT_1C WQ

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG4, Field, Flat	0.055

Pervious Total	0.055

Impervious Land Use	acre
ROADS FLAT	0.275

Impervious Total	0.275

Basin Total	0.33

MIT_1C WQ

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Routing Elements
Predeveloped Routing

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Mitigated Routing

1A CMP
Dimensions
Depth:	8 ft.
Tank Type:	Circular
Diameter:	8 ft.
Length:	888 ft.

Discharge Structure
Riser Height:	6.5 ft.
Riser Diameter:	24 in.
Notch Type:	Rectangular
Notch Width:	0.750 ft.
Notch Height:	1.450 ft.
Orifice 1 Diameter:	5.750 in. Elevation:0 ft.

Element Flows To:
Outlet 1   Outlet 2

Tank Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.000000	0.000000	0.000	0.000
0.0889	0.034190	0.002031	0.267	0.000
0.1778	0.048079	0.005724	0.378	0.000
0.2667	0.058549	0.010480	0.463	0.000
0.3556	0.067217	0.016080	0.535	0.000
0.4444	0.074713	0.022396	0.598	0.000
0.5333	0.081361	0.029338	0.655	0.000
0.6222	0.087356	0.036840	0.707	0.000
0.7111	0.092823	0.044852	0.756	0.000
0.8000	0.097851	0.053329	0.802	0.000
0.8889	0.102506	0.062237	0.845	0.000
0.9778	0.106835	0.071543	0.887	0.000
1.0667	0.110877	0.081221	0.926	0.000
1.1556	0.114662	0.091247	0.964	0.000
1.2444	0.118215	0.101598	1.000	0.000
1.3333	0.121557	0.112256	1.036	0.000
1.4222	0.124703	0.123203	1.070	0.000
1.5111	0.127670	0.134421	1.102	0.000
1.6000	0.130468	0.145895	1.134	0.000
1.6889	0.133109	0.157610	1.166	0.000
1.7778	0.135602	0.169554	1.196	0.000
1.8667	0.137955	0.181713	1.225	0.000
1.9556	0.140174	0.194075	1.254	0.000
2.0444	0.142267	0.206629	1.282	0.000
2.1333	0.144238	0.219364	1.310	0.000
2.2222	0.146093	0.232268	1.337	0.000
2.3111	0.147836	0.245333	1.364	0.000
2.4000	0.149470	0.258547	1.390	0.000
2.4889	0.151000	0.271902	1.415	0.000
2.5778	0.152429	0.285388	1.440	0.000
2.6667	0.153758	0.298997	1.465	0.000
2.7556	0.154992	0.312720	1.489	0.000
2.8444	0.156132	0.326549	1.513	0.000
2.9333	0.157180	0.340474	1.536	0.000
3.0222	0.158138	0.354489	1.559	0.000

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3.1111	0.159008	0.368585	1.582	0.000
3.2000	0.159790	0.382755	1.605	0.000
3.2889	0.160488	0.396990	1.627	0.000
3.3778	0.161100	0.411283	1.649	0.000
3.4667	0.161629	0.425627	1.670	0.000
3.5556	0.162076	0.440015	1.691	0.000
3.6444	0.162440	0.454438	1.712	0.000
3.7333	0.162723	0.468891	1.733	0.000
3.8222	0.162924	0.483364	1.754	0.000
3.9111	0.163045	0.497853	1.774	0.000
4.0000	0.163085	0.512348	1.794	0.000
4.0889	0.163045	0.526843	1.814	0.000
4.1778	0.162924	0.541331	1.833	0.000
4.2667	0.162723	0.555805	1.853	0.000
4.3556	0.162440	0.570257	1.872	0.000
4.4444	0.162076	0.584681	1.891	0.000
4.5333	0.161629	0.599068	1.910	0.000
4.6222	0.161100	0.613413	1.928	0.000
4.7111	0.160488	0.627706	1.947	0.000
4.8000	0.159790	0.641941	1.965	0.000
4.8889	0.159008	0.656111	1.983	0.000
4.9778	0.158138	0.670207	2.001	0.000
5.0667	0.157180	0.684221	2.024	0.000
5.1556	0.156132	0.698147	2.122	0.000
5.2444	0.154992	0.711975	2.268	0.000
5.3333	0.153758	0.725698	2.448	0.000
5.4222	0.152429	0.739307	2.656	0.000
5.5111	0.151000	0.752794	2.888	0.000
5.6000	0.149470	0.766149	3.141	0.000
5.6889	0.147836	0.779363	3.415	0.000
5.7778	0.146093	0.792428	3.707	0.000
5.8667	0.144238	0.805332	4.016	0.000
5.9556	0.142267	0.818066	4.341	0.000
6.0444	0.140174	0.830620	4.682	0.000
6.1333	0.137955	0.842983	5.038	0.000
6.2222	0.135602	0.855142	5.407	0.000
6.3111	0.133109	0.867085	5.791	0.000
6.4000	0.130468	0.878801	6.187	0.000
6.4889	0.127670	0.890275	6.596	0.000
6.5778	0.124703	0.901493	7.121	0.000
6.6667	0.121557	0.912439	8.115	0.000
6.7556	0.118215	0.923097	9.401	0.000
6.8444	0.114662	0.933449	10.87	0.000
6.9333	0.110877	0.943475	12.44	0.000
7.0222	0.106835	0.953153	14.00	0.000
7.1111	0.102506	0.962459	15.46	0.000
7.2000	0.097851	0.971366	16.73	0.000
7.2889	0.092823	0.979844	17.76	0.000
7.3778	0.087356	0.987855	18.53	0.000
7.4667	0.081361	0.995358	19.09	0.000
7.5556	0.074713	1.002300	19.77	0.000
7.6444	0.067217	1.008616	20.31	0.000
7.7333	0.058549	1.014216	20.84	0.000
7.8222	0.048079	1.018972	21.35	0.000
7.9111	0.034190	1.022665	21.85	0.000
8.0000	0.000000	1.024696	22.32	0.000
8.0889	0.000000	0.000000	22.79	0.000

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1B CMP

Dimensions
Depth: 6 ft.
Tank Type: Circular
Diameter: 6 ft.
Length: 366 ft.
Discharge Structure
Riser Height: 4.6 ft.
Riser Diameter: 18 in.
Notch Type: Rectangular
Notch Width: 0.375 ft.
Notch Height: 1.000 ft.
Orifice 1 Diameter: 2.875 in. Elevation:0 ft.
Element Flows To:
Outlet 1   Outlet 2
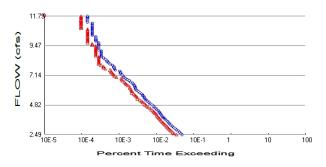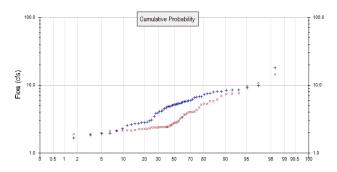
Tank Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.000000	0.000000	0.000	0.000
0.0667	0.010569	0.000471	0.057	0.000
0.1333	0.014862	0.001327	0.081	0.000
0.2000	0.018099	0.002430	0.100	0.000
0.2667	0.020778	0.003728	0.115	0.000
0.3333	0.023095	0.005192	0.129	0.000
0.4000	0.025151	0.006802	0.141	0.000
0.4667	0.027003	0.008541	0.153	0.000
0.5333	0.028694	0.010399	0.163	0.000
0.6000	0.030248	0.012364	0.173	0.000
0.6667	0.031687	0.014429	0.183	0.000
0.7333	0.033025	0.016587	0.192	0.000
0.8000	0.034274	0.018830	0.200	0.000
0.8667	0.035445	0.021155	0.208	0.000
0.9333	0.036543	0.023555	0.216	0.000
1.0000	0.037576	0.026026	0.224	0.000
1.0667	0.038549	0.028563	0.231	0.000
1.1333	0.039466	0.031164	0.238	0.000
1.2000	0.040331	0.033824	0.245	0.000
1.2667	0.041147	0.036541	0.252	0.000
1.3333	0.041918	0.039310	0.259	0.000
1.4000	0.042645	0.042129	0.265	0.000
1.4667	0.043331	0.044995	0.271	0.000
1.5333	0.043978	0.047905	0.277	0.000
1.6000	0.044587	0.050858	0.283	0.000
1.6667	0.045160	0.053849	0.289	0.000
1.7333	0.045699	0.056878	0.295	0.000
1.8000	0.046204	0.059942	0.300	0.000
1.8667	0.046677	0.063038	0.306	0.000
1.9333	0.047119	0.066165	0.311	0.000
2.0000	0.047530	0.069320	0.317	0.000
2.0667	0.047911	0.072501	0.322	0.000
2.1333	0.048264	0.075707	0.327	0.000
2.2000	0.048588	0.078936	0.332	0.000
2.2667	0.048884	0.082185	0.337	0.000
2.3333	0.049153	0.085453	0.342	0.000
2.4000	0.049395	0.088738	0.347	0.000

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2.4667	0.049610	0.092039	0.352	0.000
2.5333	0.049800	0.095352	0.357	0.000
2.6000	0.049963	0.098678	0.361	0.000
2.6667	0.050101	0.102014	0.366	0.000
2.7333	0.050214	0.105358	0.370	0.000
2.8000	0.050301	0.108708	0.375	0.000
2.8667	0.050363	0.112064	0.379	0.000
2.9333	0.050401	0.115423	0.384	0.000
3.0000	0.050413	0.118783	0.388	0.000
3.0667	0.050401	0.122144	0.392	0.000
3.1333	0.050363	0.125503	0.397	0.000
3.2000	0.050301	0.128859	0.401	0.000
3.2667	0.050214	0.132209	0.405	0.000
3.3333	0.050101	0.135553	0.409	0.000
3.4000	0.049963	0.138889	0.413	0.000
3.4667	0.049800	0.142214	0.417	0.000
3.5333	0.049610	0.145528	0.421	0.000
3.6000	0.049395	0.148828	0.425	0.000
3.6667	0.049153	0.152113	0.450	0.000
3.7333	0.048884	0.155382	0.492	0.000
3.8000	0.048588	0.158631	0.544	0.000
3.8667	0.048264	0.161859	0.603	0.000
3.9333	0.047911	0.165065	0.669	0.000
4.0000	0.047530	0.168247	0.739	0.000
4.0667	0.047119	0.171402	0.813	0.000
4.1333	0.046677	0.174529	0.890	0.000
4.2000	0.046204	0.177625	0.970	0.000
4.2667	0.045699	0.180689	1.052	0.000
4.3333	0.045160	0.183717	1.136	0.000
4.4000	0.044587	0.186709	1.221	0.000
4.4667	0.043978	0.189662	1.306	0.000
4.5333	0.043331	0.192572	1.393	0.000
4.6000	0.042645	0.195438	1.480	0.000
4.6667	0.041918	0.198257	1.757	0.000
4.7333	0.041147	0.201026	2.258	0.000
4.8000	0.040331	0.203742	2.894	0.000
4.8667	0.039466	0.206402	3.617	0.000
4.9333	0.038549	0.209003	4.379	0.000
5.0000	0.037576	0.211541	5.132	0.000
5.0667	0.036543	0.214012	5.829	0.000
5.1333	0.035445	0.216412	6.431	0.000
5.2000	0.034274	0.218736	6.911	0.000
5.2667	0.033025	0.220980	7.268	0.000
5.3333	0.031687	0.223138	7.531	0.000
5.4000	0.030248	0.225203	7.858	0.000
5.4667	0.028694	0.227168	8.120	0.000
5.5333	0.027003	0.229026	8.373	0.000
5.6000	0.025151	0.230765	8.616	0.000
5.6667	0.023095	0.232375	8.852	0.000
5.7333	0.020778	0.233839	9.080	0.000
5.8000	0.018099	0.235137	9.302	0.000
5.8667	0.014862	0.236240	9.518	0.000
5.9333	0.010569	0.237096	9.728	0.000
6.0000	0.000000	0.237567	9.933	0.000
6.0667	0.000000	0.000000	10.13	0.000

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Analysis Results
POC 1

+ Predeveloped   x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 19.569
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 3.533
Total Impervious Area: 14.561

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	4.981792
5 year	7.783575
10 year	9.310336
25 year	10.866796
50 year	11.792954
100 year	12.555055

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	3.118402
5 year	4.835397
10 year	6.289475
25 year	8.54831
50 year	10.578845
100 year	12.945385

Annual Peaks
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	3.831	3.382
1950	5.068	2.528
1951	6.720	2.409
1952	3.907	3.992
1953	5.341	2.318
1954	7.551	2.392
1955	4.137	2.255
1956	8.011	7.483
1957	6.251	2.703
1958	4.567	6.937

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Year	Predeveloped	Mitigated
1959	2.713	1.977
1960	2.610	2.768
1961	7.251	3.688
1962	4.895	2.440
1963	5.444	2.425
1964	5.175	2.374
1965	4.611	4.002
1966	5.954	2.798
1967	5.230	2.418
1968	6.749	2.981
1969	5.636	9.698
1970	17.961	14.464
1971	2.818	2.095
1972	4.795	2.355
1973	4.804	3.656
1974	7.523	7.602
1975	4.124	2.280
1976	5.970	3.179
1977	0.163	1.929
1978	8.537	5.286
1979	5.747	5.146
1980	3.487	2.130
1981	7.977	5.772
1982	5.372	5.298
1983	9.111	3.837
1984	2.968	2.152
1985	2.265	2.612
1986	2.799	2.407
1987	4.893	2.899
1988	1.954	2.133
1989	2.121	2.237
1990	1.904	2.151
1991	5.339	2.371
1992	5.819	2.166
1993	6.789	6.100
1994	5.194	4.091
1995	4.307	5.774
1996	8.351	10.774
1997	9.748	7.357
1998	7.880	2.818
1999	5.827	4.316
2000	2.860	1.854
2001	1.658	1.898
2002	8.440	2.562
2003	6.606	4.004
2004	1.841	2.403
2005	2.707	2.258
2006	5.053	2.373
2007	2.546	4.650
2008	3.067	3.339

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	17.9607	14.4641
2	9.7482	10.7743
3	9.1108	9.6977
4	8.5371	7.6016

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5	8.4404	7.4827
6	8.3515	7.3565
7	8.0114	6.9373
8	7.9773	6.0999
9	7.8803	5.7737
10	7.5512	5.7719
11	7.5234	5.2981
12	7.2513	5.2855
13	6.7887	5.1457
14	6.7489	4.6502
15	6.7199	4.3155
16	6.6060	4.0910
17	6.2515	4.0045
18	5.9701	4.0016
19	5.9541	3.9916
20	5.8273	3.8370
21	5.8194	3.6876
22	5.7468	3.6558
23	5.6363	3.3824
24	5.4444	3.3386
25	5.3718	3.1787
26	5.3407	2.9815
27	5.3388	2.8990
28	5.2300	2.8183
29	5.1943	2.7984
30	5.1748	2.7685
31	5.0684	2.7028
32	5.0530	2.6120
33	4.8946	2.5622
34	4.8926	2.5284
35	4.8037	2.4404
36	4.7945	2.4249
37	4.6105	2.4181
38	4.5673	2.4091
39	4.3070	2.4065
40	4.1375	2.4030
41	4.1241	2.3919
42	3.9069	2.3742
43	3.8312	2.3731
44	3.4873	2.3710
45	3.0674	2.3550
46	2.9676	2.3183
47	2.8598	2.2804
48	2.8181	2.2579
49	2.7990	2.2546
50	2.7133	2.2368
51	2.7067	2.1664
52	2.6100	2.1518
53	2.5461	2.1512
54	2.2650	2.1326
55	2.1209	2.1296
56	1.9536	2.0950
57	1.9037	1.9765
58	1.8412	1.9293
59	1.6579	1.8976
60	0.1627	1.8540

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Duration Flows
The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
2.4909	1016	719	70	Pass
2.5849	947	622	65	Pass
2.6788	879	571	64	Pass
2.7728	802	518	64	Pass
2.8667	728	484	66	Pass
2.9607	678	449	66	Pass
3.0547	617	421	68	Pass
3.1486	568	392	69	Pass
3.2426	518	362	69	Pass
3.3365	478	337	70	Pass
3.4305	445	315	70	Pass
3.5245	426	295	69	Pass
3.6184	390	279	71	Pass
3.7124	356	260	73	Pass
3.8063	332	244	73	Pass
3.9003	311	229	73	Pass
3.9943	291	218	74	Pass
4.0882	277	207	74	Pass
4.1822	263	192	73	Pass
4.2761	249	180	72	Pass
4.3701	236	169	71	Pass
4.4641	214	153	71	Pass
4.5580	200	143	71	Pass
4.6520	184	125	67	Pass
4.7459	174	116	66	Pass
4.8399	160	105	65	Pass
4.9339	144	100	69	Pass
5.0278	134	90	67	Pass
5.1218	120	84	70	Pass
5.2157	111	76	68	Pass
5.3097	104	66	63	Pass
5.4037	99	64	64	Pass
5.4976	94	60	63	Pass
5.5916	90	56	62	Pass
5.6855	85	52	61	Pass
5.7795	76	46	60	Pass
5.8735	70	46	65	Pass
5.9674	63	45	71	Pass
6.0614	58	44	75	Pass
6.1553	57	42	73	Pass
6.2493	56	41	73	Pass
6.3433	54	36	66	Pass
6.4372	51	33	64	Pass
6.5312	49	31	63	Pass
6.6251	43	29	67	Pass
6.7191	39	26	66	Pass
6.8131	34	25	73	Pass
6.9070	31	24	77	Pass
7.0010	28	18	64	Pass
7.0949	27	16	59	Pass
7.1889	25	15	60	Pass
7.2829	23	14	60	Pass
7.3768	23	13	56	Pass

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7.4708	22	13	59	Pass
7.5647	17	12	70	Pass
7.6587	16	9	56	Pass
7.7527	15	8	53	Pass
7.8466	15	8	53	Pass
7.9406	14	7	50	Pass
8.0345	12	6	50	Pass
8.1285	11	6	54	Pass
8.2225	10	6	60	Pass
8.3164	10	6	60	Pass
8.4104	9	6	66	Pass
8.5043	8	6	75	Pass
8.5983	7	6	85	Pass
8.6923	7	5	71	Pass
8.7862	7	5	71	Pass
8.8802	7	5	71	Pass
8.9741	7	5	71	Pass
9.0681	7	5	71	Pass
9.1621	6	5	83	Pass
9.2560	6	5	83	Pass
9.3500	6	5	83	Pass
9.4439	6	5	83	Pass
9.5379	6	4	66	Pass
9.6319	6	4	66	Pass
9.7258	6	3	50	Pass
9.8198	5	3	60	Pass
9.9138	5	3	60	Pass
10.0077	5	3	60	Pass
10.1017	5	3	60	Pass
10.1956	5	3	60	Pass
10.2896	4	3	75	Pass
10.3836	4	3	75	Pass
10.4775	4	3	75	Pass
10.5715	4	3	75	Pass
10.6654	4	3	75	Pass
10.7594	4	3	75	Pass
10.8534	4	2	50	Pass
10.9473	4	2	50	Pass
11.0413	4	2	50	Pass
11.1352	4	2	50	Pass
11.2292	4	2	50	Pass
11.3232	3	2	66	Pass
11.4171	3	2	66	Pass
11.5111	3	2	66	Pass
11.6050	3	2	66	Pass
11.6990	3	2	66	Pass
11.7930	3	2	66	Pass

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Water Quality

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 2.3159 acre-feet
On-line facility target flow: 1.8187 cfs.
Adjusted for 15 min: 1.8187 cfs.
Off-line facility target flow: 1.144 cfs.
Adjusted for 15 min: 1.144 cfs.
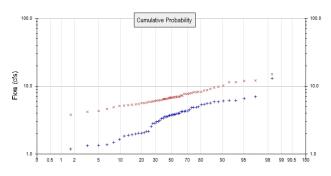
POC #1 not analyzed for Water Quality

POC #1 not analyzed for Water Quality

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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
1A CMP POC	☐	2364.38			☐	0.00			
1B CMP POC	☐	481.44			☐	0.00			
Total Volume Infiltrated		2845.82	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 = Passed

Exhibit 6 SUB24-1002

POC 2

+ Predeveloped   x Mitigated

Predeveloped Landuse Totals for POC #2
Total Pervious Area: 14.383
Total Impervious Area: 0

Mitigated Landuse Totals for POC #2
Total Pervious Area: 2.839
Total Impervious Area: 11.544

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	Flow(cfs)
2 year	3.608528
5 year	5.649168
10 year	6.762641
25 year	7.89861
50 year	8.574911
100 year	9.131591

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	Flow(cfs)
2 year	6.756175
5 year	8.649899
10 year	9.923216
25 year	11.560926
50 year	12.804744
100 year	14.070837

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	Predeveloped	Mitigated
1949	2.818	9.861
1950	3.695	5.842
1951	4.880	6.433
1952	2.861	6.595
1953	3.860	6.154
1954	5.379	8.557
1955	2.995	5.614
1956	5.873	7.068
1957	4.466	7.303
1958	3.313	7.947
1959	1.926	5.337

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Year		
1960	1.903	5.118
1961	5.289	6.759
1962	3.549	5.864
1963	3.943	6.921
1964	3.763	5.234
1965	3.374	5.476
1966	4.312	6.488
1967	3.757	6.489
1968	4.913	11.455
1969	4.003	10.237
1970	13.085	15.024
1971	2.069	6.046
1972	3.519	8.216
1973	3.504	6.885
1974	5.518	6.637
1975	3.007	4.637
1976	4.323	5.614
1977	0.118	3.733
1978	6.161	8.178
1979	4.170	9.182
1980	2.550	4.907
1981	5.857	7.732
1982	3.942	6.949
1983	6.558	8.687
1984	2.140	4.306
1985	1.649	5.392
1986	2.037	7.716
1987	3.555	5.204
1988	1.373	6.224
1989	1.492	7.855
1990	1.353	7.004
1991	3.838	7.222
1992	4.222	6.734
1993	4.963	8.242
1994	3.794	6.113
1995	3.148	6.498
1996	6.021	9.532
1997	6.972	12.114
1998	5.637	12.029
1999	4.213	5.740
2000	2.040	4.162
2001	1.176	3.780
2002	6.152	8.196
2003	4.837	6.202
2004	1.327	6.729
2005	1.984	7.654
2006	3.712	6.900
2007	1.838	5.935
2008	2.156	11.534

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	13.0846	15.0240
2	6.9724	12.1143
3	6.5581	12.0294
4	6.1615	11.5338
5	6.1523	11.4550

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6	6.0207	10.2373
7	5.8726	9.8613
8	5.8574	9.5321
9	5.6368	9.1820
10	5.5185	8.6873
11	5.3788	8.5566
12	5.2886	8.2421
13	4.9626	8.2155
14	4.9127	8.1960
15	4.8804	8.1775
16	4.8366	7.9467
17	4.4664	7.8551
18	4.3225	7.7324
19	4.3120	7.7162
20	4.2219	7.6543
21	4.2125	7.3030
22	4.1703	7.2217
23	4.0030	7.0683
24	3.9432	7.0041
25	3.9422	6.9489
26	3.8596	6.9214
27	3.8377	6.8996
28	3.7941	6.8848
29	3.7633	6.7594
30	3.7573	6.7340
31	3.7118	6.7293
32	3.6946	6.6369
33	3.5553	6.5954
34	3.5487	6.4983
35	3.5188	6.4890
36	3.5044	6.4884
37	3.3740	6.4333
38	3.3133	6.2244
39	3.1481	6.2019
40	3.0072	6.1540
41	2.9947	6.1131
42	2.8609	6.0461
43	2.8178	5.9351
44	2.5503	5.8636
45	2.1564	5.8416
46	2.1397	5.7404
47	2.0694	5.6144
48	2.0398	5.6141
49	2.0373	5.4765
50	1.9842	5.3917
51	1.9261	5.3373
52	1.9025	5.2336
53	1.8376	5.2041
54	1.6493	5.1185
55	1.4916	4.9072
56	1.3728	4.6366
57	1.3531	4.3057
58	1.3274	4.1622
59	1.1755	3.7800
60	0.1177	3.7327

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Duration Flows

POC #2 not analyzed for MR #7

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
1.8043	1041	8203	787	Fail
1.8727	960	7515	782	Fail
1.9410	894	6850	766	Fail
2.0094	811	6326	780	Fail
2.0778	746	5794	776	Fail
2.1462	693	5329	768	Fail
2.2146	631	4904	777	Fail
2.2830	583	4477	767	Fail
2.3514	536	4100	764	Fail
2.4198	484	3791	783	Fail
2.4882	456	3494	766	Fail
2.5566	425	3208	754	Fail
2.6249	403	2981	739	Fail
2.6933	367	2762	752	Fail
2.7617	336	2539	755	Fail
2.8301	314	2354	749	Fail
2.8985	298	2188	734	Fail
2.9669	280	2020	721	Fail
3.0353	265	1880	709	Fail
3.1037	253	1747	690	Fail
3.1721	238	1642	689	Fail
3.2405	221	1520	687	Fail
3.3089	201	1407	700	Fail
3.3772	186	1314	706	Fail
3.4456	175	1227	701	Fail
3.5140	167	1142	683	Fail
3.5824	145	1073	740	Fail
3.6508	139	999	718	Fail
3.7192	126	935	742	Fail
3.7876	113	875	774	Fail
3.8560	104	827	795	Fail
3.9244	101	763	755	Fail
3.9928	95	724	762	Fail
4.0611	90	676	751	Fail
4.1295	85	641	754	Fail
4.1979	80	604	755	Fail
4.2663	71	572	805	Fail
4.3347	62	532	858	Fail
4.4031	59	506	857	Fail
4.4715	57	481	843	Fail
4.5399	56	456	814	Fail
4.6083	53	432	815	Fail
4.6767	52	407	782	Fail
4.7451	48	383	797	Fail
4.8134	45	358	795	Fail
4.8818	39	341	874	Fail
4.9502	35	322	920	Fail
5.0186	33	297	900	Fail
5.0870	30	283	943	Fail
5.1554	27	266	985	Fail
5.2238	27	249	922	Fail
5.2922	24	238	991	Fail
5.3606	23	223	969	Fail
5.4290	22	215	977	Fail

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POC #2 not analyzed for MR #7

5.4973	20	208	1040	Fail
5.5657	16	193	1206	Fail
5.6341	15	181	1206	Fail
5.7025	14	167	1192	Fail
5.7709	14	159	1135	Fail
5.8393	14	153	1092	Fail
5.9077	12	142	1183	Fail
5.9761	11	133	1209	Fail
6.0445	9	124	1377	Fail
6.1129	9	116	1288	Fail
6.1812	7	112	1600	Fail
6.2496	7	107	1528	Fail
6.3180	7	106	1514	Fail
6.3864	7	100	1428	Fail
6.4548	7	94	1342	Fail
6.5232	7	90	1285	Fail
6.5916	6	86	1433	Fail
6.6600	6	79	1316	Fail
6.7284	6	75	1250	Fail
6.7968	6	72	1200	Fail
6.8652	6	71	1183	Fail
6.9335	6	68	1133	Fail
7.0019	5	63	1260	Fail
7.0703	5	58	1160	Fail
7.1387	5	57	1140	Fail
7.2071	5	54	1080	Fail
7.2755	5	51	1020	Fail
7.3439	5	49	980	Fail
7.4123	5	49	980	Fail
7.4807	5	49	980	Fail
7.5491	5	48	960	Fail
7.6174	4	42	1050	Fail
7.6858	4	40	1000	Fail
7.7542	4	37	925	Fail
7.8226	4	37	925	Fail
7.8910	4	35	875	Fail
7.9594	4	33	825	Fail
8.0278	4	33	825	Fail
8.0962	3	33	1100	Fail
8.1646	3	33	1100	Fail
8.2330	3	29	966	Fail
8.3013	3	27	900	Fail
8.3697	3	25	833	Fail
8.4381	3	24	800	Fail
8.5065	3	24	800	Fail
8.5749	3	23	766	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.

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Water Quality

Water Quality BMP Flow and Volume for POC #2
On-line facility volume: 1.8709 acre-feet
On-line facility target flow: 2.6062 cfs.
Adjusted for 15 min: 2.6062 cfs.
Off-line facility target flow: 1.4472 cfs.
Adjusted for 15 min: 1.4472 cfs.

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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

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POC 3

+ Predeveloped   x Mitigated

Predeveloped Landuse Totals for POC #3
Total Pervious Area: 2.646
Total Impervious Area: 0

Mitigated Landuse Totals for POC #3
Total Pervious Area: 0.639
Total Impervious Area: 2.007

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #3

Return Period	Flow(cfs)
2 year	0.66385
5 year	1.039261
10 year	1.244104
25 year	1.453085
50 year	1.577502
100 year	1.679913

Flow Frequency Return Periods for Mitigated. POC #3

Return Period	Flow(cfs)
2 year	1.210055
5 year	1.546866
10 year	1.76833
25 year	2.048055
50 year	2.257073
100 year	2.467081

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #3

Year	Predeveloped	Mitigated
1949	0.518	1.715
1950	0.680	1.049
1951	0.898	1.169
1952	0.526	1.188
1953	0.710	1.112
1954	0.990	1.554
1955	0.551	0.976
1956	1.080	1.290
1957	0.822	1.326
1958	0.610	1.430
1959	0.354	0.936

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1960	0.350	0.890
1961	0.973	1.234
1962	0.653	1.065
1963	0.725	1.245
1964	0.692	0.925
1965	0.621	0.990
1966	0.793	1.181
1967	0.691	1.173
1968	0.904	1.993
1969	0.736	1.781
1970	2.407	2.752
1971	0.381	1.051
1972	0.647	1.428
1973	0.645	1.197
1974	1.015	1.214
1975	0.553	0.807
1976	0.795	1.024
1977	0.022	0.649
1978	1.134	1.492
1979	0.767	1.648
1980	0.469	0.880
1981	1.078	1.409
1982	0.725	1.209
1983	1.206	1.585
1984	0.394	0.775
1985	0.303	0.965
1986	0.375	1.342
1987	0.654	0.930
1988	0.253	1.092
1989	0.274	1.366
1990	0.249	1.218
1991	0.706	1.302
1992	0.777	1.218
1993	0.913	1.492
1994	0.698	1.063
1995	0.579	1.139
1996	1.108	1.729
1997	1.283	2.191
1998	1.037	2.123
1999	0.775	1.047
2000	0.375	0.749
2001	0.216	0.673
2002	1.132	1.482
2003	0.890	1.127
2004	0.244	1.170
2005	0.365	1.331
2006	0.683	1.200
2007	0.338	1.064
2008	0.397	2.010

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #3

Rank	Predeveloped	Mitigated
1	2.4071	2.7522
2	1.2827	2.1910
3	1.2065	2.1234
4	1.1335	2.0104
5	1.1318	1.9928

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6	1.1076	1.7809
7	1.0804	1.7286
8	1.0776	1.7145
9	1.0370	1.6478
10	1.0152	1.5847
11	0.9895	1.5536
12	0.9729	1.4919
13	0.9130	1.4917
14	0.9038	1.4817
15	0.8978	1.4300
16	0.8898	1.4283
17	0.8217	1.4092
18	0.7952	1.3657
19	0.7933	1.3419
20	0.7767	1.3308
21	0.7750	1.3260
22	0.7672	1.3021
23	0.7364	1.2904
24	0.7254	1.2447
25	0.7252	1.2343
26	0.7100	1.2183
27	0.7060	1.2178
28	0.6980	1.2139
29	0.6923	1.2092
30	0.6912	1.2001
31	0.6829	1.1970
32	0.6797	1.1880
33	0.6541	1.1813
34	0.6528	1.1728
35	0.6473	1.1700
36	0.6447	1.1690
37	0.6207	1.1392
38	0.6095	1.1267
39	0.5792	1.1123
40	0.5532	1.0921
41	0.5509	1.0649
42	0.5263	1.0643
43	0.5184	1.0629
44	0.4692	1.0512
45	0.3967	1.0493
46	0.3936	1.0470
47	0.3807	1.0242
48	0.3753	0.9903
49	0.3748	0.9761
50	0.3650	0.9651
51	0.3543	0.9364
52	0.3500	0.9304
53	0.3381	0.9254
54	0.3034	0.8900
55	0.2744	0.8797
56	0.2525	0.8071
57	0.2489	0.7747
58	0.2442	0.7487
59	0.2163	0.6731
60	0.0217	0.6490

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Duration Flows

POC #3 not analyzed for MR #7

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.3319	1045	7576	724	Fail
0.3445	962	6903	717	Fail
0.3571	894	6284	702	Fail
0.3697	813	5775	710	Fail
0.3823	746	5279	707	Fail
0.3948	697	4898	702	Fail
0.4074	633	4441	701	Fail
0.4200	586	4086	697	Fail
0.4326	537	3745	697	Fail
0.4452	484	3425	707	Fail
0.4577	457	3198	699	Fail
0.4703	425	2954	695	Fail
0.4829	407	2733	671	Fail
0.4955	367	2516	685	Fail
0.5081	336	2325	691	Fail
0.5206	316	2159	683	Fail
0.5332	298	1989	667	Fail
0.5458	281	1841	655	Fail
0.5584	265	1706	643	Fail
0.5710	253	1612	637	Fail
0.5836	240	1481	617	Fail
0.5961	221	1368	619	Fail
0.6087	201	1273	633	Fail
0.6213	186	1173	630	Fail
0.6339	175	1108	633	Fail
0.6465	168	1036	616	Fail
0.6590	145	958	660	Fail
0.6716	139	908	653	Fail
0.6842	126	846	671	Fail
0.6968	114	798	700	Fail
0.7094	104	738	709	Fail
0.7220	101	697	690	Fail
0.7345	95	650	684	Fail
0.7471	90	620	688	Fail
0.7597	85	588	691	Fail
0.7723	80	555	693	Fail
0.7849	72	517	718	Fail
0.7974	62	486	783	Fail
0.8100	59	459	777	Fail
0.8226	57	436	764	Fail
0.8352	56	414	739	Fail
0.8478	53	389	733	Fail
0.8604	52	363	698	Fail
0.8729	48	342	712	Fail
0.8855	45	320	711	Fail
0.8981	39	301	771	Fail
0.9107	36	284	788	Fail
0.9233	33	271	821	Fail
0.9358	30	253	843	Fail
0.9484	27	240	888	Fail
0.9610	27	225	833	Fail
0.9736	24	214	891	Fail
0.9862	23	204	886	Fail
0.9987	22	193	877	Fail

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1.0113	20	182	910	Fail
1.0239	16	165	1031	Fail
1.0365	15	156	1040	Fail
1.0491	14	148	1057	Fail
1.0617	14	140	1000	Fail
1.0742	14	130	928	Fail
1.0868	12	127	1058	Fail
1.0994	11	121	1100	Fail
1.1120	9	113	1255	Fail
1.1246	9	110	1222	Fail
1.1371	7	102	1457	Fail
1.1497	7	98	1400	Fail
1.1623	7	94	1342	Fail
1.1749	7	86	1228	Fail
1.1875	7	84	1200	Fail
1.2001	7	78	1114	Fail
1.2126	6	74	1233	Fail
1.2252	6	68	1133	Fail
1.2378	6	65	1083	Fail
1.2504	6	61	1016	Fail
1.2630	6	60	1000	Fail
1.2755	6	57	950	Fail
1.2881	5	56	1120	Fail
1.3007	5	54	1080	Fail
1.3133	5	51	1020	Fail
1.3259	5	45	900	Fail
1.3385	5	43	860	Fail
1.3510	5	40	800	Fail
1.3636	5	40	800	Fail
1.3762	5	39	780	Fail
1.3888	5	38	760	Fail
1.4014	4	37	925	Fail
1.4139	4	36	900	Fail
1.4265	4	35	875	Fail
1.4391	4	31	775	Fail
1.4517	4	29	725	Fail
1.4643	4	28	700	Fail
1.4768	4	28	700	Fail
1.4894	3	26	866	Fail
1.5020	3	22	733	Fail
1.5146	3	22	733	Fail
1.5272	3	22	733	Fail
1.5398	3	22	733	Fail
1.5523	3	21	700	Fail
1.5649	3	20	666	Fail
1.5775	3	20	666	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.

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Water Quality

Water Quality BMP Flow and Volume for POC #3
On-line facility volume: 0.3362 acre-feet
On-line facility target flow: 0.4647 cfs.
Adjusted for 15 min: 0.4647 cfs.
Off-line facility target flow: 0.2566 cfs.
Adjusted for 15 min: 0.2566 cfs.

Water Quality

Water Quality for Subbasin 1B

Exhibit 6 SUB24-1002

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

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POC 4

+ Predeveloped   x Mitigated

Predeveloped Landuse Totals for POC #4
Total Pervious Area: 0.33
Total Impervious Area: 0

Mitigated Landuse Totals for POC #4
Total Pervious Area: 0.055
Total Impervious Area: 0.275

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #4
Return Period	Flow(cfs)
2 year	0.082793
5 year	0.129613
10 year	0.15516
25 year	0.181224
50 year	0.196741
100 year	0.209513

Flow Frequency Return Periods for Mitigated. POC #4
Return Period	Flow(cfs)
2 year	0.158329
5 year	0.202648
10 year	0.232442
25 year	0.270755
50 year	0.299848
100 year	0.32946

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #4
Year	Predeveloped	Mitigated
1949	0.065	0.235
1950	0.085	0.136
1951	0.112	0.149
1952	0.066	0.154
1953	0.089	0.143
1954	0.123	0.198
1955	0.069	0.134
1956	0.135	0.163
1957	0.102	0.169
1958	0.076	0.185
1959	0.044	0.126

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Year		
1960	0.044	0.122
1961	0.121	0.156
1962	0.081	0.136
1963	0.090	0.161
1964	0.086	0.123
1965	0.077	0.127
1966	0.099	0.150
1967	0.086	0.151
1968	0.113	0.273
1969	0.092	0.244
1970	0.300	0.346
1971	0.047	0.144
1972	0.081	0.196
1973	0.080	0.164
1974	0.127	0.153
1975	0.069	0.110
1976	0.099	0.130
1977	0.003	0.089
1978	0.141	0.189
1979	0.096	0.214
1980	0.059	0.115
1981	0.134	0.179
1982	0.090	0.165
1983	0.150	0.200
1984	0.049	0.100
1985	0.038	0.126
1986	0.047	0.184
1987	0.082	0.122
1988	0.031	0.147
1989	0.034	0.187
1990	0.031	0.167
1991	0.088	0.168
1992	0.097	0.156
1993	0.114	0.191
1994	0.087	0.146
1995	0.072	0.154
1996	0.138	0.221
1997	0.160	0.281
1998	0.129	0.284
1999	0.097	0.132
2000	0.047	0.097
2001	0.027	0.089
2002	0.141	0.190
2003	0.111	0.144
2004	0.030	0.160
2005	0.046	0.182
2006	0.085	0.164
2007	0.042	0.139
2008	0.049	0.274

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #4

Rank	Predeveloped	Mitigated
1	0.3002	0.3457
2	0.1600	0.2838
3	0.1505	0.2812
4	0.1414	0.2743
5	0.1412	0.2728

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6	0.1381	0.2438
7	0.1347	0.2349
8	0.1344	0.2209
9	0.1293	0.2143
10	0.1266	0.2005
11	0.1234	0.1981
12	0.1213	0.1957
13	0.1139	0.1912
14	0.1127	0.1903
15	0.1120	0.1887
16	0.1110	0.1871
17	0.1025	0.1851
18	0.0992	0.1838
19	0.0989	0.1823
20	0.0969	0.1786
21	0.0967	0.1691
22	0.0957	0.1680
23	0.0918	0.1668
24	0.0905	0.1654
25	0.0904	0.1643
26	0.0886	0.1640
27	0.0881	0.1630
28	0.0871	0.1613
29	0.0863	0.1603
30	0.0862	0.1563
31	0.0852	0.1559
32	0.0848	0.1540
33	0.0816	0.1535
34	0.0814	0.1529
35	0.0807	0.1507
36	0.0804	0.1499
37	0.0774	0.1489
38	0.0760	0.1474
39	0.0722	0.1456
40	0.0690	0.1440
41	0.0687	0.1435
42	0.0656	0.1429
43	0.0647	0.1386
44	0.0585	0.1362
45	0.0495	0.1357
46	0.0491	0.1337
47	0.0475	0.1325
48	0.0468	0.1296
49	0.0467	0.1271
50	0.0455	0.1264
51	0.0442	0.1260
52	0.0437	0.1233
53	0.0422	0.1219
54	0.0378	0.1217
55	0.0342	0.1146
56	0.0315	0.1104
57	0.0310	0.1004
58	0.0305	0.0970
59	0.0270	0.0889
60	0.0027	0.0887

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Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0414	1041	8758	841	Fail
0.0430	959	7967	830	Fail
0.0445	894	7290	815	Fail
0.0461	811	6692	825	Fail
0.0477	746	6185	829	Fail
0.0492	693	5651	815	Fail
0.0508	630	5220	828	Fail
0.0524	582	4790	823	Fail
0.0539	536	4378	816	Fail
0.0555	484	4025	831	Fail
0.0571	456	3734	818	Fail
0.0587	425	3455	812	Fail
0.0602	402	3162	786	Fail
0.0618	367	2939	800	Fail
0.0634	336	2720	809	Fail
0.0649	314	2520	802	Fail
0.0665	298	2329	781	Fail
0.0681	280	2156	770	Fail
0.0696	265	1998	753	Fail
0.0712	253	1869	738	Fail
0.0728	238	1736	729	Fail
0.0743	221	1628	736	Fail
0.0759	201	1516	754	Fail
0.0775	186	1416	761	Fail
0.0791	175	1316	752	Fail
0.0806	167	1235	739	Fail
0.0822	145	1149	792	Fail
0.0838	139	1082	778	Fail
0.0853	126	1004	796	Fail
0.0869	113	942	833	Fail
0.0885	104	883	849	Fail
0.0900	101	822	813	Fail
0.0916	95	772	812	Fail
0.0932	90	730	811	Fail
0.0947	85	688	809	Fail
0.0963	80	648	810	Fail
0.0979	71	608	856	Fail
0.0995	62	574	925	Fail
0.1010	59	536	908	Fail
0.1026	57	509	892	Fail
0.1042	56	489	873	Fail
0.1057	53	467	881	Fail
0.1073	52	433	832	Fail
0.1089	48	413	860	Fail
0.1104	45	392	871	Fail
0.1120	39	364	933	Fail
0.1136	36	344	955	Fail
0.1151	33	327	990	Fail
0.1167	30	306	1020	Fail
0.1183	28	291	1039	Fail
0.1199	27	272	1007	Fail
0.1214	24	252	1050	Fail
0.1230	24	245	1020	Fail
0.1246	22	230	1045	Fail

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0.1261	20	224	1120	Fail
0.1277	16	208	1300	Fail
0.1293	15	194	1293	Fail
0.1308	14	187	1335	Fail
0.1324	14	175	1250	Fail
0.1340	14	167	1192	Fail
0.1355	12	159	1325	Fail
0.1371	11	146	1327	Fail
0.1387	9	135	1500	Fail
0.1403	9	129	1433	Fail
0.1418	7	121	1728	Fail
0.1434	7	114	1628	Fail
0.1450	7	110	1571	Fail
0.1465	7	107	1528	Fail
0.1481	7	101	1442	Fail
0.1497	7	97	1385	Fail
0.1512	6	91	1516	Fail
0.1528	6	88	1466	Fail
0.1544	6	83	1383	Fail
0.1559	6	80	1333	Fail
0.1575	6	75	1250	Fail
0.1591	6	74	1233	Fail
0.1607	5	70	1400	Fail
0.1622	5	68	1360	Fail
0.1638	5	65	1300	Fail
0.1654	5	61	1220	Fail
0.1669	5	58	1160	Fail
0.1685	5	53	1060	Fail
0.1701	5	50	1000	Fail
0.1716	5	50	1000	Fail
0.1732	5	50	1000	Fail
0.1748	4	48	1200	Fail
0.1763	4	47	1175	Fail
0.1779	4	47	1175	Fail
0.1795	4	46	1150	Fail
0.1810	4	42	1050	Fail
0.1826	4	38	950	Fail
0.1842	4	36	900	Fail
0.1858	3	34	1133	Fail
0.1873	3	33	1100	Fail
0.1889	3	32	1066	Fail
0.1905	3	31	1033	Fail
0.1920	3	30	1000	Fail
0.1936	3	29	966	Fail
0.1952	3	29	966	Fail
0.1967	3	27	900	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.

Exhibit 6 SUB24-1002

Water Quality

Water Quality for Subbasin 1C

Water Quality BMP Flow and Volume for POC #4
On-line facility volume: 0.0433 acre-feet
On-line facility target flow: 0.0609 cfs.
Adjusted for 15 min: 0.0609 cfs.
Off-line facility target flow: 0.034 cfs.
Adjusted for 15 min: 0.034 cfs.

Water Quality

Water Quality for Subbasin 1C

Exhibit 6 SUB24-1002

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

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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.

Exhibit 6 SUB24-1002

Appendix
Predeveloped Schematic

Pre-Dev_TDA 1
19.57ac

1A WQ
14.38ac

1B WQ
2.65ac

1C WQ
0.33ac

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Mitigated Schematic

1A
14.73a

1B
3.03ac

1C
0.33ac

S I

S I

1A CM

1B CMP

MIT_1A WQ
14.38ac

MIT_1B WQ
2.65ac

MIT_1C WQ
0.33ac

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Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START        1948 10 01         END      2008 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    8397 20241030 TDA 1 WWHM.wdm
MESSU      25    Pre8397 20241030 TDA 1 WWHM.MES
           27    Pre8397 20241030 TDA 1 WWHM.L61
           28    Pre8397 20241030 TDA 1 WWHM.L62
           30    POC8397 20241030 TDA 1 WWHM1.dat
           31    POC8397 20241030 TDA 1 WWHM2.dat
           32    POC8397 20241030 TDA 1 WWHM3.dat
           33    POC8397 20241030 TDA 1 WWHM4.dat
END FILES

OPN SEQUENCE
    INGRP             INDELT 00:15
      PERLND     28
      PERLND     29
      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         Pre-Dev_TDA 1              MAX                   1    2   30    9
    2         1A WQ                      MAX                   1    2   31    9
    3         1B WQ                      MAX                   1    2   32    9
    4         1C WQ                      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          ***
```

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```
   28     SG4, Forest, Flat      1    1    1    1   27     0
   29     SG4, 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 ***
   28        0    0    1    0    0    0    0    0    0    0    0    0
   29        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 ********
   28        0    0    4    0    0    0    0    0    0    0    0    0    1    9
   29        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 ***
   28        0    0    0    0    0    0    0    0    0    0    0
   29        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
   28           0        6       0.04        400       0.05         0       0.96
   29           0        6       0.04        400        0.1         0       0.96
   END PWAT-PARM2

   PWAT-PARM3
     <PLS >        PWATER input info: Part 3        ***
     # - # ***PETMAX     PETMIN     INFEXP     INFILD     DEEPFR     BASETP     AGWETP
   28           0          0          3          2          0          0          0
   29           0          0          3          2          0          0          0
   END PWAT-PARM3
   PWAT-PARM4
     <PLS >        PWATER input info: Part 4                        ***
     # - #      CEPSC       UZSN       NSUR       INTFW        IRC      LZETP ***
   28          0.2        0.4       0.35          2        0.4        0.7
   29          0.2        0.4       0.35          2        0.4        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
   28           0          0          0          0        2.5          1          0
   29           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
```

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```
   <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#    ***
Pre-Dev_TDA 1***
PERLND  28                       16.941       COPY    501      12
PERLND  28                       16.941       COPY    501      13
PERLND  29                        2.628       COPY    501      12
PERLND  29                        2.628       COPY    501      13
1A WQ***
PERLND  28                       14.383       COPY    502      12
PERLND  28                       14.383       COPY    502      13
1B WQ***
PERLND  28                        2.646       COPY    503      12
PERLND  28                        2.646       COPY    503      13
1C WQ***
PERLND  28                        0.33        COPY    504      12
PERLND  28                        0.33        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
```

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

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

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

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

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>     # <Name> # tem strg<-factor->strg <Name>    #   #         <Name> # #  ***
WDM        2 PREC     ENGL    1.3              PERLND   1 999 EXTNL   PREC
WDM        2 PREC     ENGL    1.3              IMPLND   1 999 EXTNL   PREC
WDM        1 EVAP     ENGL    0.8              PERLND   1 999 EXTNL   PETINP
WDM        1 EVAP     ENGL    0.8              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
```

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Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START      1948 10 01        END     2008 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    8397 20241030 TDA 1 WWHM.wdm
MESSU      25    Mit8397 20241030 TDA 1 WWHM.MES
           27    Mit8397 20241030 TDA 1 WWHM.L61
           28    Mit8397 20241030 TDA 1 WWHM.L62
           31    POC8397 20241030 TDA 1 WWHM2.dat
           32    POC8397 20241030 TDA 1 WWHM3.dat
           33    POC8397 20241030 TDA 1 WWHM4.dat
           30    POC8397 20241030 TDA 1 WWHM1.dat
END FILES

OPN SEQUENCE
    INGRP             INDELT 00:15
      PERLND     31
      IMPLND      1
      IMPLND      5
      IMPLND     11
      RCHRES      1
      RCHRES      2
      COPY      502
      COPY      503
      COPY      504
      COPY        1
      COPY      501
      COPY      601
      DISPLY      2
      DISPLY      3
      DISPLY      4
      DISPLY      1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    2         MIT_1A WQ                    MAX                 1    2   31    9
    3         MIT_1B WQ                    MAX                 1    2   32    9
    4         MIT_1C WQ                    MAX                 1    2   33    9
    1         1A CMP                       MAX                 1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  502         1    1
  503         1    1
  504         1    1
  501         1    1
  601         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #     # OPCD ***
  END OPCODE
  PARM
    #     #          K ***
```

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```
      END PARM
   END GENER
PERLND
   GEN-INFO
     <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
     # - #                            User  t-series Engl Metr ***
                                       in  out             ***
    31     SG4, Field, 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 ***
    31        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 *********
    31        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 ***
    31        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
    31           0          6        0.03        400       0.05          0       0.96
   END PWAT-PARM2

   PWAT-PARM3
     <PLS >        PWATER input info: Part 3        ***
     # - # ***PETMAX      PETMIN      INFEXP      INFILD     DEEPFR     BASETP     AGWETP
    31           0          0           3          2          0          0          0
   END PWAT-PARM3
   PWAT-PARM4
     <PLS >        PWATER input info: Part 4                       ***
     # - #      CEPSC       UZSN        NSUR       INTFW        IRC      LZETP ***
    31          0.15        0.4         0.3          2         0.4        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
    31           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
     5     DRIVEWAYS/FLAT        1    1    1   27    0
    11     PARKING/FLAT          1    1    1   27    0
   END GEN-INFO
   *** Section IWATER***

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

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```
     5         0     0     1     0     0     0
    11         0     0     1     0     0     0
   END ACTIVITY

   PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # - # ATMP SNOW IWAT  SLD  IWG IQAL    *********
     1         0     0     4     0     0     4    1    9
     5         0     0     4     0     0     0    1    9
    11         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
     5         0     0     0     0     0
    11         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
     5          400      0.01        0.1        0.1
    11          400      0.01        0.1        0.1
   END IWAT-PARM2

   IWAT-PARM3
    <PLS >       IWATER input info: Part 3       ***
    # - # ***PETMAX    PETMIN
     1          0         0
     5          0         0
    11          0         0
   END IWAT-PARM3

   IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # - # ***  RETS       SURS
     1          0         0
     5          0         0
    11          0         0
   END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                    <--Area-->      <-Target->   MBLK   ***
<Name>    #                   <-factor->      <Name>    #   Tbl#   ***
1A***
PERLND  31                        2.839       RCHRES    1     2
PERLND  31                        2.839       RCHRES    1     3
IMPLND   1                       10.578       RCHRES    1     5
IMPLND   5                        1.24        RCHRES    1     5
IMPLND  11                        0.073       RCHRES    1     5
1B***
PERLND  31                        0.639       RCHRES    2     2
PERLND  31                        0.639       RCHRES    2     3
IMPLND   1                        2.356       RCHRES    2     5
IMPLND  11                        0.039       RCHRES    2     5
1C***
PERLND  31                        0.055       COPY    501    12
PERLND  31                        0.055       COPY    601    12
PERLND  31                        0.055       COPY    501    13
PERLND  31                        0.055       COPY    601    13
IMPLND   1                        0.275       COPY    501    15
IMPLND   1                        0.275       COPY    601    15
MIT_1A WQ***
PERLND  31                        2.839       COPY    502    12
PERLND  31                        2.839       COPY    502    13
```

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```
IMPLND   1                      11.4705    COPY    502     15
IMPLND  11                       0.0735    COPY    502     15
MIT_1B WQ***
PERLND  31                        0.639    COPY    503     12
PERLND  31                        0.639    COPY    503     13
IMPLND   1                        2.007    COPY    503     15
MIT_1C WQ***
PERLND  31                        0.055    COPY    504     12
PERLND  31                        0.055    COPY    504     13
IMPLND   1                        0.275    COPY    504     15

******Routing******
PERLND  31                        2.839    COPY      1     12
IMPLND   1                       10.578    COPY      1     15
IMPLND   5                         1.24    COPY      1     15
IMPLND  11                        0.073    COPY      1     15
PERLND  31                        2.839    COPY      1     13
PERLND  31                        0.639    COPY      1     12
IMPLND   1                        2.356    COPY      1     15
IMPLND  11                        0.039    COPY      1     15
PERLND  31                        0.639    COPY      1     13
RCHRES   1                            1    COPY    501     16
RCHRES   2                            1    COPY    501     16
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->   ***
<Name>    #          <Name> # #<-factor->strg <Name>    #    #      <Name> # #  ***
COPY   502 OUTPUT MEAN  1 1   48.4          DISPLY    2      INPUT  TIMSER 1
COPY   503 OUTPUT MEAN  1 1   48.4          DISPLY    3      INPUT  TIMSER 1
COPY   504 OUTPUT MEAN  1 1   48.4          DISPLY    4      INPUT  TIMSER 1
COPY   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     1A CMP               1    1    1    1    28    0    1
    2     1B CMP               1    1    1    1    28    0    1
  END GEN-INFO
  *** Section RCHRES***

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

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```
     END HYDR-PARM1

     HYDR-PARM2
       # - #    FTABNO      LEN      DELTH      STCOR       KS       DB50       ***
       <------><-------->< -------->< -------->< -------->< -------->< -------->     ***
        1            1       0.17        0.0        0.0        0.5        0.0
        2            2       0.07        0.0        0.0        0.5        0.0
     END HYDR-PARM2
     HYDR-INIT
       RCHRES  Initial conditions for each HYDR section                              ***
        # - # ***    VOL     Initial   value   of COLIND     Initial   value   of OUTDGT
            *** ac-ft     for each possible exit        for each possible exit
       <------><--------> <---><---><---><---><--- > *** <---><---><---><---><--->
        1           0       4.0   0.0   0.0   0.0   0.0          0.0   0.0   0.0   0.0   0.0
        2           0       4.0   0.0   0.0   0.0   0.0          0.0   0.0   0.0   0.0   0.0
     END HYDR-INIT
  END RCHRES


  SPEC-ACTIONS
  END SPEC-ACTIONS
  FTABLES
     FTABLE      1
      91    4
       Depth      Area      Volume   Outflow1 Velocity   Travel Time***
        (ft)    (acres) (acre-ft)    (cfs)   (ft/sec)      (Minutes)***
    0.000000  0.000000  0.000000  0.000000
    0.088889  0.034190  0.002031  0.267497
    0.177778  0.048079  0.005724  0.378297
    0.266667  0.058549  0.010480  0.463318
    0.355556  0.067217  0.016080  0.534993
    0.444444  0.074713  0.022396  0.598140
    0.533333  0.081361  0.029338  0.655230
    0.622222  0.087356  0.036840  0.707729
    0.711111  0.092823  0.044852  0.756594
    0.800000  0.097851  0.053329  0.802490
    0.888889  0.102506  0.062237  0.845898
    0.977778  0.106835  0.071543  0.887186
    1.066667  0.110877  0.081221  0.926635
    1.155556  0.114662  0.091247  0.964472
    1.244444  0.118215  0.101598  1.000880
    1.333333  0.121557  0.112256  1.036010
    1.422222  0.124703  0.123203  1.069986
    1.511111  0.127670  0.134421  1.102916
    1.600000  0.130468  0.145895  1.134892
    1.688889  0.133109  0.157610  1.165990
    1.777778  0.135602  0.169554  1.196281
    1.866667  0.137955  0.181713  1.225823
    1.955556  0.140174  0.194075  1.254670
    2.044444  0.142267  0.206629  1.282868
    2.133333  0.144238  0.219364  1.310460
    2.222222  0.146093  0.232268  1.337483
    2.311111  0.147836  0.245333  1.363970
    2.400000  0.149470  0.258547  1.389953
    2.488889  0.151000  0.271902  1.415459
    2.577778  0.152429  0.285388  1.440513
    2.666667  0.153758  0.298997  1.465139
    2.755556  0.154992  0.312720  1.489358
    2.844444  0.156132  0.326549  1.513189
    2.933333  0.157180  0.340474  1.536651
    3.022222  0.158138  0.354489  1.559759
    3.111111  0.159008  0.368585  1.582531
    3.200000  0.159790  0.382755  1.604979
    3.288889  0.160488  0.396990  1.627118
    3.377778  0.161100  0.411283  1.648959
    3.466667  0.161629  0.425627  1.670515
    3.555556  0.162076  0.440015  1.691797
    3.644444  0.162440  0.454438  1.712814
    3.733333  0.162723  0.468891  1.733576
    3.822222  0.162924  0.483364  1.754092
    3.911111  0.163045  0.497853  1.774371
```

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```
4.000000  0.163085  0.512348   1.794421
4.088889  0.163045  0.526843   1.814250
4.177778  0.162924  0.541331   1.833864
4.266667  0.162723  0.555805   1.853270
4.355556  0.162440  0.570257   1.872476
4.444444  0.162076  0.584681   1.891486
4.533333  0.161629  0.599068   1.910307
4.622222  0.161100  0.613413   1.928945
4.711111  0.160488  0.627706   1.947404
4.800000  0.159790  0.641941   1.965690
4.888889  0.159008  0.656111   1.983807
4.977778  0.158138  0.670207   2.001761
5.066667  0.157180  0.684221   2.024928
5.155556  0.156132  0.698147   2.122843
5.244444  0.154992  0.711975   2.268820
5.333333  0.153758  0.725698   2.448681
5.422222  0.152429  0.739307   2.656379
5.511111  0.151000  0.752794   2.888283
5.600000  0.149470  0.766149   3.141895
5.688889  0.147836  0.779363   3.415364
5.777778  0.146093  0.792428   3.707240
5.866667  0.144238  0.805332   4.016353
5.955556  0.142267  0.818066   4.341731
6.044444  0.140174  0.830620   4.682549
6.133333  0.137955  0.842983   5.038097
6.222222  0.135602  0.855142   5.407753
6.311111  0.133109  0.867085   5.790970
6.400000  0.130468  0.878801   6.187258
6.488889  0.127670  0.890275   6.596177
6.577778  0.124703  0.901493   7.121774
6.666667  0.121557  0.912439   8.115793
6.755556  0.118215  0.923097   9.401706
6.844444  0.114662  0.933449  10.87676
6.933333  0.110877  0.943475  12.44470
7.022222  0.106835  0.953153  14.00647
7.111111  0.102506  0.962459  15.46499
7.200000  0.097851  0.971366  16.73599
7.288889  0.092823  0.979844  17.76256
7.377778  0.087356  0.987855  18.53245
7.466667  0.081361  0.995358  19.09767
7.555556  0.074713  1.002300  19.77066
7.644444  0.067217  1.008616  20.31911
7.733333  0.058549  1.014216  20.84711
7.822222  0.048079  1.018972  21.35683
7.911111  0.034190  1.022665  21.85008
8.000000  0.001000  1.024696  22.32838
END FTABLE    1
FTABLE        2
 91    4
  Depth      Area     Volume   Outflow1 Velocity   Travel Time***
   (ft)    (acres)  (acre-ft)   (cfs)    (ft/sec)     (Minutes)***
0.000000  0.000000  0.000000   0.000000
0.066667  0.010569  0.000471   0.057915
0.133333  0.014862  0.001327   0.081904
0.200000  0.018099  0.002430   0.100311
0.266667  0.020778  0.003728   0.115829
0.333333  0.023095  0.005192   0.129501
0.400000  0.025151  0.006802   0.141861
0.466667  0.027003  0.008541   0.153228
0.533333  0.028694  0.010399   0.163808
0.600000  0.030248  0.012364   0.173744
0.666667  0.031687  0.014429   0.183142
0.733333  0.033025  0.016587   0.192081
0.800000  0.034274  0.018830   0.200622
0.866667  0.035445  0.021155   0.208814
0.933333  0.036543  0.023555   0.216697
1.000000  0.037576  0.026026   0.224303
1.066667  0.038549  0.028563   0.231659
1.133333  0.039466  0.031164   0.238788
1.200000  0.040331  0.033824   0.245711
```

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```
1.266667    0.041147    0.036541    0.252444
1.333333    0.041918    0.039310    0.259002
1.400000    0.042645    0.042129    0.265398
1.466667    0.043331    0.044995    0.271644
1.533333    0.043978    0.047905    0.277749
1.600000    0.044587    0.050858    0.283723
1.666667    0.045160    0.053849    0.289573
1.733333    0.045699    0.056878    0.295308
1.800000    0.046204    0.059942    0.300934
1.866667    0.046677    0.063038    0.306456
1.933333    0.047119    0.066165    0.311880
2.000000    0.047530    0.069320    0.317212
2.066667    0.047911    0.072501    0.322455
2.133333    0.048264    0.075707    0.327615
2.200000    0.048588    0.078936    0.332695
2.266667    0.048884    0.082185    0.337698
2.333333    0.049153    0.085453    0.342628
2.400000    0.049395    0.088738    0.347488
2.466667    0.049610    0.092039    0.352281
2.533333    0.049800    0.095352    0.357010
2.600000    0.049963    0.098678    0.361677
2.666667    0.050101    0.102014    0.366285
2.733333    0.050214    0.105358    0.370835
2.800000    0.050301    0.108708    0.375330
2.866667    0.050363    0.112064    0.379772
2.933333    0.050401    0.115423    0.384163
3.000000    0.050413    0.118783    0.388504
3.066667    0.050401    0.122144    0.392797
3.133333    0.050363    0.125503    0.397043
3.200000    0.050301    0.128859    0.401245
3.266667    0.050214    0.132209    0.405403
3.333333    0.050101    0.135553    0.409519
3.400000    0.049963    0.138889    0.413594
3.466667    0.049800    0.142214    0.417629
3.533333    0.049610    0.145528    0.421625
3.600000    0.049395    0.148828    0.425584
3.666667    0.049153    0.152113    0.450715
3.733333    0.048884    0.155382    0.492570
3.800000    0.048588    0.158631    0.544470
3.866667    0.048264    0.161859    0.603854
3.933333    0.047911    0.165065    0.669152
4.000000    0.047530    0.168247    0.739244
4.066667    0.047119    0.171402    0.813267
4.133333    0.046677    0.174529    0.890518
4.200000    0.046204    0.177625    0.970406
4.266667    0.045699    0.180689    1.052420
4.333333    0.045160    0.183717    1.136108
4.400000    0.044587    0.186709    1.221069
4.466667    0.043978    0.189662    1.306935
4.533333    0.043331    0.192572    1.393374
4.600000    0.042645    0.195438    1.480076
4.666667    0.041918    0.198257    1.757245
4.733333    0.041147    0.201026    2.258463
4.800000    0.040331    0.203742    2.894887
4.866667    0.039466    0.206402    3.617647
4.933333    0.038549    0.209003    4.379720
5.000000    0.037576    0.211541    5.132757
5.066667    0.036543    0.214012    5.829915
5.133333    0.035445    0.216412    6.431396
5.200000    0.034274    0.218736    6.911709
5.266667    0.033025    0.220980    7.268251
5.333333    0.031687    0.223138    7.530994
5.400000    0.030248    0.225203    7.858740
5.466667    0.028694    0.227168    8.120768
5.533333    0.027003    0.229026    8.372999
5.600000    0.025151    0.230765    8.616465
5.666667    0.023095    0.232375    8.852026
5.733333    0.020778    0.233839    9.080413
5.800000    0.018099    0.235137    9.302248
5.866667    0.014862    0.236240    9.518069
```

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```
      5.933333  0.010569  0.237096  9.728345
      6.000000  0.001000  0.237567  9.933485
    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    1.3            PERLND   1 999 EXTNL  PREC
WDM       2 PREC    ENGL    1.3            IMPLND   1 999 EXTNL  PREC
WDM       1 EVAP    ENGL    0.8            PERLND   1 999 EXTNL  PETINP
WDM       1 EVAP    ENGL    0.8            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   STAGE  1 1        1     WDM   1001 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
COPY   601 OUTPUT MEAN   1 1     48.4     WDM    901 FLOW     ENGL      REPL
RCHRES   2 HYDR   RO     1 1        1     WDM   1002 FLOW     ENGL      REPL
RCHRES   2 HYDR   STAGE  1 1        1     WDM   1003 STAG     ENGL      REPL
COPY     2 OUTPUT MEAN   1 1     48.4     WDM    702 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     48.4     WDM    802 FLOW     ENGL      REPL
COPY   602 OUTPUT MEAN   1 1     48.4     WDM    902 FLOW     ENGL      REPL
COPY     3 OUTPUT MEAN   1 1     48.4     WDM    703 FLOW     ENGL      REPL
COPY   503 OUTPUT MEAN   1 1     48.4     WDM    803 FLOW     ENGL      REPL
COPY   603 OUTPUT MEAN   1 1     48.4     WDM    903 FLOW     ENGL      REPL
COPY     4 OUTPUT MEAN   1 1     48.4     WDM    704 FLOW     ENGL      REPL
COPY   504 OUTPUT MEAN   1 1     48.4     WDM    804 FLOW     ENGL      REPL
COPY   604 OUTPUT MEAN   1 1     48.4     WDM    904 FLOW     ENGL      REPL
END EXT TARGETS


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


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


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


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


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


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


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


END MASS-LINK
```

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```
END RUN
```

Exhibit 6 SUB24-1002

Predeveloped HSPF Message File

Exhibit 6 SUB24-1002

Mitigated HSPF Message File

Exhibit 6 SUB24-1002

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Exhibit 6 SUB24-1002

WWHM2012

PROJECT REPORT
TDA #2: FLOW CONTROL
AND WATER QUALITY

Exhibit 6 SUB24-1002

General Model Information

WWHM2012 Project Name: 8397 TDA 2 WQ

Site Name: Camas Woods

Site Address:

City: Camas, WA 98607

Report Date: 10/29/2024

Gage: Lacamas

Data Start: 1948/10/01

Data End: 2008/09/30

Timestep: 15 Minute

Precip Scale: 1.300

Version Date: 2023/01/27

Version: 4.2.19

POC Thresholds

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

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

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Landuse Basin Data
Predeveloped Land Use

Pre-Dev_TDA 2

Bypass: No

GroundWater: No

Pervious Land Use	acre
SG4, Forest, Flat	8.422
SG4, Forest, Mod	7.263

Pervious Total   15.685

Impervious Land Use   acre

Impervious Total   0

Basin Total   15.685

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TDA 2 WQ

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG4, Forest, Flat	13.45
Pervious Total	13.45

Impervious Land Use	acre
Impervious Total	0
Basin Total	13.45

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Mitigated Land Use

Post-Dev_TDA 2

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Field, Flat   5.642

 Pervious Total   5.642

Impervious Land Use acre
 ROADS FLAT   9.046
 DRIVEWAYS FLAT   0.826
 PARKING FLAT   0.051
 POND   0.581

 Impervious Total   10.504

 Basin Total   16.146

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TDA 2 MIT WQ

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG4, Field, Flat	8.359
Pervious Total	8.359

Impervious Land Use	acre
ROADS FLAT	5.091
Impervious Total	5.091

Basin Total	13.45

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Routing Elements
Predeveloped Routing

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Mitigated Routing

Tract W Pond

Bottom Length: 155.00 ft.
Bottom Width: 78.00 ft.
Depth: 4 ft.
Volume at riser head: 0.9930 acre-feet.
Side slope 1:   3 To 1
Side slope 2:   3 To 1
Side slope 3:   3 To 1
Side slope 4:   3 To 1
Discharge Structure
Riser Height: 3 ft.
Riser Diameter: 18 in.
Notch Type: Rectangular
Notch Width: 1.480 ft.
Notch Height: 0.690 ft.
Orifice 1 Diameter: 7.000 in. Elevation:0 ft.
Element Flows To:
Outlet 1   Outlet 2

Pond Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.277	0.000	0.000	0.000
0.0444	0.279	0.012	0.280	0.000
0.0889	0.280	0.024	0.396	0.000
0.1333	0.281	0.037	0.485	0.000
0.1778	0.283	0.049	0.560	0.000
0.2222	0.284	0.062	0.626	0.000
0.2667	0.286	0.075	0.686	0.000
0.3111	0.287	0.087	0.741	0.000
0.3556	0.289	0.100	0.792	0.000
0.4000	0.290	0.113	0.841	0.000
0.4444	0.292	0.126	0.886	0.000
0.4889	0.293	0.139	0.929	0.000
0.5333	0.294	0.152	0.971	0.000
0.5778	0.296	0.165	1.010	0.000
0.6222	0.297	0.179	1.048	0.000
0.6667	0.299	0.192	1.085	0.000
0.7111	0.300	0.205	1.121	0.000
0.7556	0.302	0.219	1.155	0.000
0.8000	0.303	0.232	1.189	0.000
0.8444	0.305	0.246	1.221	0.000
0.8889	0.306	0.259	1.253	0.000
0.9333	0.308	0.273	1.284	0.000
0.9778	0.309	0.287	1.314	0.000
1.0222	0.311	0.300	1.344	0.000
1.0667	0.312	0.314	1.373	0.000
1.1111	0.314	0.328	1.401	0.000
1.1556	0.315	0.342	1.429	0.000
1.2000	0.317	0.356	1.456	0.000
1.2444	0.318	0.370	1.483	0.000
1.2889	0.320	0.385	1.509	0.000
1.3333	0.321	0.399	1.535	0.000
1.3778	0.323	0.413	1.560	0.000

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1.4222	0.324	0.428	1.585	0.000
1.4667	0.326	0.442	1.610	0.000
1.5111	0.327	0.457	1.634	0.000
1.5556	0.329	0.471	1.658	0.000
1.6000	0.331	0.486	1.682	0.000
1.6444	0.332	0.501	1.705	0.000
1.6889	0.334	0.515	1.728	0.000
1.7333	0.335	0.530	1.750	0.000
1.7778	0.337	0.545	1.772	0.000
1.8222	0.338	0.560	1.795	0.000
1.8667	0.340	0.575	1.816	0.000
1.9111	0.341	0.591	1.838	0.000
1.9556	0.343	0.606	1.859	0.000
2.0000	0.345	0.621	1.880	0.000
2.0444	0.346	0.636	1.901	0.000
2.0889	0.348	0.652	1.921	0.000
2.1333	0.349	0.667	1.942	0.000
2.1778	0.351	0.683	1.962	0.000
2.2222	0.352	0.699	1.982	0.000
2.2667	0.354	0.714	2.001	0.000
2.3111	0.356	0.730	2.021	0.000
2.3556	0.357	0.746	2.088	0.000
2.4000	0.359	0.762	2.193	0.000
2.4444	0.360	0.778	2.321	0.000
2.4889	0.362	0.794	2.470	0.000
2.5333	0.364	0.810	2.636	0.000
2.5778	0.365	0.826	2.817	0.000
2.6222	0.367	0.843	3.013	0.000
2.6667	0.369	0.859	3.221	0.000
2.7111	0.370	0.875	3.441	0.000
2.7556	0.372	0.892	3.673	0.000
2.8000	0.373	0.909	3.915	0.000
2.8444	0.375	0.925	4.168	0.000
2.8889	0.377	0.942	4.430	0.000
2.9333	0.378	0.959	4.702	0.000
2.9778	0.380	0.976	4.984	0.000
3.0222	0.382	0.993	5.189	0.000
3.0667	0.383	1.010	5.427	0.000
3.1111	0.385	1.027	5.757	0.000
3.1556	0.387	1.044	6.156	0.000
3.2000	0.388	1.061	6.607	0.000
3.2444	0.390	1.078	7.097	0.000
3.2889	0.392	1.096	7.610	0.000
3.3333	0.393	1.113	8.135	0.000
3.3778	0.395	1.131	8.654	0.000
3.4222	0.397	1.148	9.156	0.000
3.4667	0.398	1.166	9.626	0.000
3.5111	0.400	1.184	10.05	0.000
3.5556	0.402	1.202	10.42	0.000
3.6000	0.403	1.220	10.74	0.000
3.6444	0.405	1.238	11.01	0.000
3.6889	0.407	1.256	11.22	0.000
3.7333	0.408	1.274	11.40	0.000
3.7778	0.410	1.292	11.65	0.000
3.8222	0.412	1.310	11.85	0.000
3.8667	0.414	1.329	12.03	0.000
3.9111	0.415	1.347	12.21	0.000
3.9556	0.417	1.366	12.39	0.000

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4.0000	0.419	1.384	12.57	0.000
4.0444	0.420	1.403	12.74	0.000

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Analysis Results
POC 1

+ Predeveloped   x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 15.685
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 5.642
Total Impervious Area: 10.504

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	4.142813
5 year	6.431146
10 year	7.67274
25 year	8.93545
50 year	9.685549
100 year	10.302135

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	2.458193
5 year	3.706597
10 year	4.719907
25 year	6.238124
50 year	7.558839
100 year	9.057141

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	3.123	2.824
1950	4.144	2.272
1951	5.543	2.007
1952	3.160	2.772
1953	4.456	1.927
1954	6.510	1.982
1955	3.440	1.858
1956	6.463	6.247
1957	5.353	2.446
1958	3.867	4.661

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1959	2.357	1.476
1960	2.195	1.896
1961	5.922	2.891
1962	4.053	1.998
1963	4.520	1.951
1964	4.255	1.993
1965	3.735	3.221
1966	4.978	2.451
1967	4.423	1.952
1968	5.537	2.008
1969	4.890	5.264
1970	14.706	9.912
1971	2.315	1.683
1972	3.857	1.980
1973	3.921	2.977
1974	6.060	6.306
1975	3.370	1.893
1976	4.960	2.563
1977	0.140	1.428
1978	7.145	4.460
1979	4.749	3.895
1980	2.829	1.750
1981	6.430	4.521
1982	4.322	4.058
1983	7.672	3.273
1984	2.489	1.778
1985	1.857	1.973
1986	2.297	1.825
1987	4.030	2.753
1988	1.734	1.619
1989	1.880	1.706
1990	1.649	1.630
1991	4.510	1.918
1992	4.812	1.751
1993	5.513	4.386
1994	4.226	3.484
1995	3.499	4.002
1996	7.008	7.252
1997	8.327	5.975
1998	6.730	2.064
1999	4.859	3.526
2000	2.544	1.360
2001	1.444	1.380
2002	6.902	2.140
2003	5.345	3.375
2004	1.545	1.809
2005	2.183	1.861
2006	4.096	1.976
2007	2.131	3.107
2008	2.721	2.001

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	14.7064	9.9121
2	8.3270	7.2520
3	7.6715	6.3065
4	7.1448	6.2475

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5	7.0077	5.9750
6	6.9023	5.2645
7	6.7304	4.6607
8	6.5097	4.5206
9	6.4631	4.4601
10	6.4296	4.3858
11	6.0600	4.0580
12	5.9217	4.0023
13	5.5427	3.8946
14	5.5368	3.5263
15	5.5133	3.4843
16	5.3534	3.3746
17	5.3447	3.2735
18	4.9779	3.2210
19	4.9597	3.1068
20	4.8903	2.9768
21	4.8587	2.8911
22	4.8120	2.8238
23	4.7490	2.7723
24	4.5196	2.7526
25	4.5095	2.5628
26	4.4563	2.4514
27	4.4234	2.4462
28	4.3218	2.2720
29	4.2548	2.1396
30	4.2264	2.0638
31	4.1443	2.0083
32	4.0957	2.0073
33	4.0533	2.0010
34	4.0301	1.9984
35	3.9205	1.9926
36	3.8669	1.9823
37	3.8566	1.9796
38	3.7345	1.9760
39	3.4987	1.9730
40	3.4399	1.9521
41	3.3695	1.9514
42	3.1598	1.9268
43	3.1229	1.9183
44	2.8294	1.8961
45	2.7205	1.8929
46	2.5441	1.8610
47	2.4893	1.8582
48	2.3567	1.8254
49	2.3148	1.8088
50	2.2965	1.7777
51	2.1948	1.7514
52	2.1834	1.7502
53	2.1309	1.7063
54	1.8796	1.6831
55	1.8567	1.6296
56	1.7344	1.6190
57	1.6490	1.4762
58	1.5447	1.4278
59	1.4436	1.3799
60	0.1397	1.3600

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Duration Flows
The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
2.0714	982	743	75	Pass
2.1483	908	654	72	Pass
2.2252	837	599	71	Pass
2.3021	767	550	71	Pass
2.3790	696	496	71	Pass
2.4560	633	463	73	Pass
2.5329	580	427	73	Pass
2.6098	535	397	74	Pass
2.6867	487	365	74	Pass
2.7636	462	336	72	Pass
2.8405	431	307	71	Pass
2.9174	398	286	71	Pass
2.9943	374	261	69	Pass
3.0712	346	245	70	Pass
3.1482	313	229	73	Pass
3.2251	298	209	70	Pass
3.3020	286	191	66	Pass
3.3789	273	180	65	Pass
3.4558	255	165	64	Pass
3.5327	237	157	66	Pass
3.6096	224	147	65	Pass
3.6865	212	135	63	Pass
3.7634	203	127	62	Pass
3.8403	186	117	62	Pass
3.9173	164	96	58	Pass
3.9942	152	90	59	Pass
4.0711	132	82	62	Pass
4.1480	122	78	63	Pass
4.2249	115	68	59	Pass
4.3018	109	64	58	Pass
4.3787	103	61	59	Pass
4.4556	97	56	57	Pass
4.5325	89	51	57	Pass
4.6095	83	45	54	Pass
4.6864	80	41	51	Pass
4.7633	71	38	53	Pass
4.8402	69	36	52	Pass
4.9171	63	36	57	Pass
4.9940	59	35	59	Pass
5.0709	57	33	57	Pass
5.1478	52	31	59	Pass
5.2247	51	26	50	Pass
5.3016	49	25	51	Pass
5.3786	43	25	58	Pass
5.4555	41	25	60	Pass
5.5324	38	22	57	Pass
5.6093	34	19	55	Pass
5.6862	28	18	64	Pass
5.7631	27	18	66	Pass
5.8400	24	16	66	Pass
5.9169	24	14	58	Pass
5.9938	22	11	50	Pass
6.0708	19	11	57	Pass

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6.1477	18	10	55	Pass
6.2246	18	9	50	Pass
6.3015	18	7	38	Pass
6.3784	17	6	35	Pass
6.4553	15	6	40	Pass
6.5322	12	6	50	Pass
6.6091	12	6	50	Pass
6.6860	11	6	54	Pass
6.7629	10	6	60	Pass
6.8399	10	6	60	Pass
6.9168	9	6	66	Pass
6.9937	9	5	55	Pass
7.0706	8	5	62	Pass
7.1475	7	5	71	Pass
7.2244	7	5	71	Pass
7.3013	7	3	42	Pass
7.3782	7	3	42	Pass
7.4551	7	3	42	Pass
7.5321	7	3	42	Pass
7.6090	7	3	42	Pass
7.6859	6	3	50	Pass
7.7628	6	3	50	Pass
7.8397	6	3	50	Pass
7.9166	6	3	50	Pass
7.9935	6	3	50	Pass
8.0704	5	3	60	Pass
8.1473	5	3	60	Pass
8.2242	5	2	40	Pass
8.3012	5	2	40	Pass
8.3781	4	2	50	Pass
8.4550	4	2	50	Pass
8.5319	4	2	50	Pass
8.6088	4	2	50	Pass
8.6857	4	1	25	Pass
8.7626	4	1	25	Pass
8.8395	4	1	25	Pass
8.9164	4	1	25	Pass
8.9934	4	1	25	Pass
9.0703	4	1	25	Pass
9.1472	4	1	25	Pass
9.2241	4	1	25	Pass
9.3010	4	1	25	Pass
9.3779	4	1	25	Pass
9.4548	4	1	25	Pass
9.5317	4	1	25	Pass
9.6086	4	1	25	Pass
9.6855	4	1	25	Pass

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Water Quality

POC #1 not analyzed for Water Quality
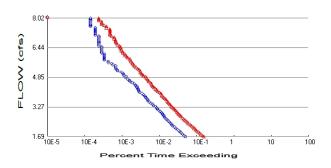
Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 1.915 acre-feet
On-line facility target flow: 1.4316 cfs.
Adjusted for 15 min: 1.4316 cfs.
Off-line facility target flow: 0.862 cfs.
Adjusted for 15 min: 0.862 cfs.
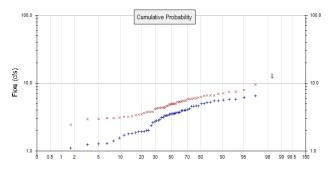
Water Quality

POC #1 not analyzed for Water Quality

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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
Tract W Pond POC	☐	2335.08			☐	0.00			
Total Volume Infiltrated		2335.08	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 = Passed

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POC 2

+ Predeveloped   x Mitigated

Predeveloped Landuse Totals for POC #2
Total Pervious Area: 13.45
Total Impervious Area: 0

Mitigated Landuse Totals for POC #2
Total Pervious Area: 8.359
Total Impervious Area: 5.091

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	Flow(cfs)
2 year	3.374447
5 year	5.282715
10 year	6.323959
25 year	7.386241
50 year	8.018671
100 year	8.539241

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	Flow(cfs)
2 year	4.73019
5 year	6.34509
10 year	7.398016
25 year	8.714047
50 year	9.686187
100 year	10.652932

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	Predeveloped	Mitigated
1949	2.635	4.352
1950	3.455	4.332
1951	4.564	5.343
1952	2.675	4.930
1953	3.609	4.940
1954	5.030	6.996
1955	2.800	3.761
1956	5.492	6.125
1957	4.177	5.971
1958	3.098	5.871
1959	1.801	3.174

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1960	1.779	3.081
1961	4.946	5.873
1962	3.319	4.809
1963	3.687	5.254
1964	3.519	4.282
1965	3.155	4.361
1966	4.032	5.466
1967	3.514	5.044
1968	4.594	5.532
1969	3.743	5.988
1970	12.236	13.475
1971	1.935	2.948
1972	3.291	3.781
1973	3.277	4.607
1974	5.161	5.859
1975	2.812	3.645
1976	4.042	4.829
1977	0.110	1.650
1978	5.762	7.025
1979	3.900	6.565
1980	2.385	3.460
1981	5.477	6.579
1982	3.686	4.964
1983	6.133	7.464
1984	2.001	3.177
1985	1.542	3.730
1986	1.905	3.422
1987	3.325	4.236
1988	1.284	3.233
1989	1.395	3.771
1990	1.265	3.091
1991	3.589	5.461
1992	3.948	5.291
1993	4.641	6.518
1994	3.548	4.291
1995	2.944	4.401
1996	5.630	7.889
1997	6.520	9.490
1998	5.271	7.443
1999	3.939	4.927
2000	1.908	3.060
2001	1.099	2.446
2002	5.753	6.624
2003	4.523	5.216
2004	1.241	2.973
2005	1.855	3.376
2006	3.471	4.611
2007	1.718	4.201
2008	2.017	6.231

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	12.2358	13.4749
2	6.5201	9.4898
3	6.1327	7.8885
4	5.7618	7.4638
5	5.7532	7.4433

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6	5.6301	7.0247
7	5.4917	6.9963
8	5.4775	6.6238
9	5.2711	6.5791
10	5.1605	6.5647
11	5.0299	6.5178
12	4.9455	6.2315
13	4.6407	6.1254
14	4.5940	5.9885
15	4.5639	5.9713
16	4.5229	5.8729
17	4.1767	5.8709
18	4.0421	5.8587
19	4.0323	5.5323
20	3.9480	5.4659
21	3.9393	5.4610
22	3.8998	5.3429
23	3.7433	5.2913
24	3.6874	5.2541
25	3.6864	5.2160
26	3.6093	5.0445
27	3.5888	4.9643
28	3.5480	4.9402
29	3.5192	4.9298
30	3.5136	4.9265
31	3.4710	4.8290
32	3.4549	4.8090
33	3.3247	4.6108
34	3.3185	4.6065
35	3.2905	4.4006
36	3.2771	4.3611
37	3.1552	4.3524
38	3.0983	4.3322
39	2.9439	4.2909
40	2.8122	4.2823
41	2.8005	4.2365
42	2.6753	4.2008
43	2.6350	3.7815
44	2.3849	3.7705
45	2.0165	3.7605
46	2.0009	3.7302
47	1.9352	3.6451
48	1.9075	3.4601
49	1.9052	3.4221
50	1.8555	3.3760
51	1.8012	3.2331
52	1.7791	3.1773
53	1.7184	3.1743
54	1.5423	3.0907
55	1.3948	3.0807
56	1.2837	3.0601
57	1.2653	2.9729
58	1.2413	2.9479
59	1.0993	2.4456
60	0.1101	1.6495

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Duration Flows   POC #2 not analyzed for MR #7
The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
1.6872	1041	3282	315	Fail
1.7512	959	2996	312	Fail
1.8151	894	2746	307	Fail
1.8791	811	2512	309	Fail
1.9430	746	2318	310	Fail
2.0070	693	2114	305	Fail
2.0709	632	1962	310	Fail
2.1349	583	1802	309	Fail
2.1989	536	1674	312	Fail
2.2628	484	1535	317	Fail
2.3268	456	1404	307	Fail
2.3907	425	1280	301	Fail
2.4547	402	1178	293	Fail
2.5186	367	1088	296	Fail
2.5826	336	1008	300	Fail
2.6465	314	927	295	Fail
2.7105	298	858	287	Fail
2.7744	280	791	282	Fail
2.8384	265	741	279	Fail
2.9023	253	692	273	Fail
2.9663	238	648	272	Fail
3.0303	221	608	275	Fail
3.0942	201	567	282	Fail
3.1582	186	528	283	Fail
3.2221	175	491	280	Fail
3.2861	167	457	273	Fail
3.3500	145	429	295	Fail
3.4140	139	401	288	Fail
3.4779	126	376	298	Fail
3.5419	113	357	315	Fail
3.6058	104	339	325	Fail
3.6698	101	314	310	Fail
3.7338	95	291	306	Fail
3.7977	90	268	297	Fail
3.8617	85	252	296	Fail
3.9256	80	241	301	Fail
3.9896	71	230	323	Fail
4.0535	62	210	338	Fail
4.1175	59	190	322	Fail
4.1814	57	178	312	Fail
4.2454	56	168	300	Fail
4.3093	53	150	283	Fail
4.3733	52	140	269	Fail
4.4372	48	133	277	Fail
4.5012	45	130	288	Fail
4.5652	39	121	310	Fail
4.6291	35	111	317	Fail
4.6931	33	107	324	Fail
4.7570	30	101	336	Fail
4.8210	27	95	351	Fail
4.8849	27	89	329	Fail
4.9489	24	78	325	Fail
5.0128	23	73	317	Fail
5.0768	22	69	313	Fail

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5.1407	20	65	325	Fail
5.2047	16	64	400	Fail
5.2686	15	60	400	Fail
5.3326	14	55	392	Fail
5.3966	14	50	357	Fail
5.4605	14	45	321	Fail
5.5245	12	43	358	Fail
5.5884	11	40	363	Fail
5.6524	9	39	433	Fail
5.7163	9	36	400	Fail
5.7803	7	35	500	Fail
5.8442	7	34	485	Fail
5.9082	7	30	428	Fail
5.9721	7	28	400	Fail
6.0361	7	26	371	Fail
6.1001	7	25	357	Fail
6.1640	6	22	366	Fail
6.2280	6	22	366	Fail
6.2919	6	20	333	Fail
6.3559	6	20	333	Fail
6.4198	6	19	316	Fail
6.4838	6	19	316	Fail
6.5477	5	18	360	Fail
6.6117	5	16	320	Fail
6.6756	5	15	300	Fail
6.7396	5	14	280	Fail
6.8035	5	14	280	Fail
6.8675	5	14	280	Fail
6.9315	5	13	260	Fail
6.9954	5	13	260	Fail
7.0594	5	11	220	Fail
7.1233	4	10	250	Fail
7.1873	4	10	250	Fail
7.2512	4	10	250	Fail
7.3152	4	10	250	Fail
7.3791	4	10	250	Fail
7.4431	4	10	250	Fail
7.5070	4	8	200	Fail
7.5710	3	8	266	Fail
7.6349	3	7	233	Fail
7.6989	3	6	200	Fail
7.7629	3	6	200	Fail
7.8268	3	6	200	Fail
7.8908	3	5	166	Fail
7.9547	3	5	166	Fail
8.0187	3	5	166	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.

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Water Quality

Water Quality BMP Flow and Volume for POC #2
On-line facility volume: 1.4107 acre-feet
On-line facility target flow: 1.7749 cfs.
Adjusted for 15 min: 1.7749 cfs.
Off-line facility target flow: 0.9219 cfs.
Adjusted for 15 min: 0.9219 cfs.

Water Quality

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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

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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.

Exhibit 6 SUB24-1002

Appendix
Predeveloped Schematic

Pre-Dev_TDA 2
15.69ac

TDA 2 WQ
13.45ac

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Mitigated Schematic

Post-Dev_TD 2
16.15ac

TDA 2 MIT WQ
13.45ac

S I

Tract W Pond

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Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END      2008 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   8397 TDA 2 WQ.wdm
MESSU     25   Pre8397 TDA 2 WQ.MES
          27   Pre8397 TDA 2 WQ.L61
          28   Pre8397 TDA 2 WQ.L62
          30   POC8397 TDA 2 WQ1.dat
          31   POC8397 TDA 2 WQ2.dat
END FILES

OPN SEQUENCE
    INGRP             INDELT 00:15
      PERLND     28
      PERLND     29
      COPY      501
      COPY      502
      DISPLY      1
      DISPLY      2
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # - #<----------Title------------>***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Pre-Dev_TDA 2               MAX                   1    2   30    9
    2        TDA 2 WQ                    MAX                   1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # - #  NPT  NMN ***
    1        1    1
  501        1    1
  502        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           ***
    28     SG4, Forest, Flat     1    1    1    1   27    0
    29     SG4, 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 ***
    28        0    0    1    0    0    0    0    0    0    0    0    0
    29        0    0    1    0    0    0    0    0    0    0    0    0
```

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```
   END ACTIVITY

   PRINT-INFO
     <PLS > ***************** Print-flags ***************************** PIVL  PYR
     # - # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
     28         0    0    4    0    0    0    0    0    0    0    0    0    1    9
     29         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 ***
     28       0    0    0    0    0    0    0    0    0    0    0
     29       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
     28           0         6      0.04       400      0.05         0      0.96
     29           0         6      0.04       400       0.1         0      0.96
   END PWAT-PARM2

   PWAT-PARM3
     <PLS >       PWATER input info: Part 3        ***
     # - # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
     28         0         0         3         2         0         0         0
     29         0         0         3         2         0         0         0
   END PWAT-PARM3
   PWAT-PARM4
     <PLS >       PWATER input info: Part 4                            ***
     # - #     CEPSC      UZSN      NSUR      INTFW       IRC     LZETP ***
     28          0.2       0.4      0.35         2       0.4       0.7
     29          0.2       0.4      0.35         2       0.4       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
     28          0         0         0         0       2.5         1         0
     29          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
```

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```
    <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#    ***
Pre-Dev_TDA 2***
PERLND  28                         8.422     COPY    501     12
PERLND  28                         8.422     COPY    501     13
PERLND  29                         7.263     COPY    501     12
PERLND  29                         7.263     COPY    501     13
TDA 2 WQ***
PERLND  28                         13.45     COPY    502     12
PERLND  28                         13.45     COPY    502     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



<-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       ***
```

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```
    <------><--------><--------><--------><--------><--------><-------->        ***
   END HYDR-PARM2
   HYDR-INIT
     RCHRES   Initial conditions for each HYDR section                          ***
      # - # ***   VOL     Initial  value  of COLIND    Initial   value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
    <------><-------->        <---><---><---><---><---> *** <---><---><---><---><--->
   END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>    # <Name> # tem strg<-factor->strg <Name>     #    #         <Name> # #  ***
WDM       2 PREC      ENGL     1.3           PERLND   1 999 EXTNL   PREC
WDM       2 PREC      ENGL     1.3           IMPLND   1 999 EXTNL   PREC
WDM       1 EVAP      ENGL     0.8           PERLND   1 999 EXTNL   PETINP
WDM       1 EVAP      ENGL     0.8           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
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
```

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Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START      1948 10 01      END    2008 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   8397 TDA 2 WQ.wdm
MESSU     25   Mit8397 TDA 2 WQ.MES
          27   Mit8397 TDA 2 WQ.L61
          28   Mit8397 TDA 2 WQ.L62
          31   POC8397 TDA 2 WQ2.dat
          30   POC8397 TDA 2 WQ1.dat
END FILES

OPN SEQUENCE
    INGRP          INDELT 00:15
      PERLND    31
      IMPLND     1
      IMPLND     5
      IMPLND    11
      IMPLND    14
      RCHRES     1
      COPY     502
      COPY       1
      COPY     501
      DISPLY     2
      DISPLY     1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<---------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    2        TDA 2 MIT WQ            MAX                  1    2   31    9
    1        Tract W Pond            MAX                  1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1        1    1
  502        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               ***
   31     SG4, Field, Flat     1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
```

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```
   <PLS > ************* Active Sections ****************************
   # - # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
  31         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 *********
  31         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 ***
  31         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
  31           0          6       0.03        400       0.05          0       0.96
  END PWAT-PARM2

  PWAT-PARM3
   <PLS >        PWATER input info: Part 3       ***
   # - # ***PETMAX     PETMIN     INFEXP     INFILD     DEEPFR     BASETP     AGWETP
  31           0          0          3          2          0          0          0
  END PWAT-PARM3
  PWAT-PARM4
   <PLS >       PWATER input info: Part 4                         ***
   # - #    CEPSC       UZSN       NSUR      INTFW        IRC      LZETP ***
  31         0.15        0.4        0.3          2        0.4        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
  31           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
   5      DRIVEWAYS/FLAT         1    1    1    27    0
  11      PARKING/FLAT           1    1    1    27    0
  14      POND                   1    1    1    27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
   <PLS > ************* Active Sections ****************************
   # - # ATMP SNOW IWAT  SLD  IWG IQAL    ***
   1         0    0    1    0    0    0
   5         0    0    1    0    0    0
  11         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    4    1    9
   5         0    0    4    0    0    0    1    9
  11         0    0    4    0    0    0    1    9
```

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```
    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
      5         0    0    0    0    0
     11         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
      5           400      0.01        0.1        0.1
     11           400      0.01        0.1        0.1
     14           400      0.01        0.1        0.1
   END IWAT-PARM2

   IWAT-PARM3
     <PLS >       IWATER input info: Part 3        ***
     # -  # ***PETMAX    PETMIN
      1           0          0
      5           0          0
     11           0          0
     14           0          0
   END IWAT-PARM3

   IWAT-STATE1
     <PLS > *** Initial conditions at start of simulation
     # -  # ***  RETS       SURS
      1           0          0
      5           0          0
     11           0          0
     14           0          0
   END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                    <--Area-->      <-Target->   MBLK    ***
<Name>    #                   <-factor->      <Name>    #  Tbl#    ***
Post-Dev_TDA 2***
PERLND  31                         5.642      RCHRES    1     2
PERLND  31                         5.642      RCHRES    1     3
IMPLND   1                         9.046      RCHRES    1     5
IMPLND   5                         0.826      RCHRES    1     5
IMPLND  11                         0.051      RCHRES    1     5
IMPLND  14                         0.581      RCHRES    1     5
TDA 2 MIT WQ***
PERLND  31                         8.359      COPY    502    12
PERLND  31                         8.359      COPY    502    13
IMPLND   1                         5.091      COPY    502    15

******Routing******
PERLND  31                         5.642      COPY      1    12
IMPLND   1                         9.046      COPY      1    15
IMPLND   5                         0.826      COPY      1    15
IMPLND  11                         0.051      COPY      1    15
IMPLND  14                         0.581      COPY      1    15
PERLND  31                         5.642      COPY      1    13
RCHRES   1                             1      COPY    501    16
END SCHEMATIC

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

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```
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      Tract W Pond        1    1    1    1    28    0    1
  END GEN-INFO
  *** Section RCHRES***

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

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

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

  HYDR-PARM2
    # -  #    FTABNO      LEN      DELTH     STCOR       KS       DB50    ***
    <------><-------->< -------->< -------->< -------->< -------->< -------->  ***
    1           1       0.03       0.0        0.0        0.5        0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                      ***
    # -  # ***   VOL      Initial  value  of COLIND      Initial  value  of OUTDGT
          *** ac-ft      for each possible exit        for each possible exit
    <------><-------->    <---><---><---><---><---> *** <---><---><---><---><--->
    1         0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   91    4
     Depth      Area     Volume   Outflow1 Velocity  Travel Time***
      (ft)    (acres)  (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.277548  0.000000  0.000000
  0.044444  0.278976  0.012367  0.280326
  0.088889  0.280408  0.024798  0.396441
  0.133333  0.281842  0.037292  0.485539
  0.177778  0.283280  0.049851  0.560652
  0.222222  0.284721  0.062473  0.626828
  0.266667  0.286165  0.075159  0.686656
  0.311111  0.287613  0.087910  0.741673
  0.355556  0.289064  0.100725  0.792882
  0.400000  0.290518  0.113605  0.840978
  0.444444  0.291975  0.126549  0.886469
  0.488889  0.293436  0.139558  0.929737
```

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```
0.533333   0.294900   0.152632   0.971078
0.577778   0.296367   0.165771   1.010730
0.622222   0.297838   0.178976   1.048884
0.666667   0.299311   0.192246   1.085698
0.711111   0.300788   0.205581   1.121304
0.755556   0.302269   0.218983   1.155814
0.800000   0.303752   0.232450   1.189323
0.844444   0.305239   0.245983   1.221913
0.888889   0.306729   0.259582   1.253656
0.933333   0.308222   0.273248   1.284616
0.977778   0.309719   0.286980   1.314846
1.022222   0.311219   0.300778   1.344397
1.066667   0.312722   0.314644   1.373312
1.111111   0.314228   0.328576   1.401631
1.155556   0.315738   0.342575   1.429388
1.200000   0.317251   0.356642   1.456617
1.244444   0.318767   0.370775   1.483346
1.288889   0.320286   0.384977   1.509602
1.333333   0.321809   0.399245   1.535409
1.377778   0.323335   0.413582   1.560790
1.422222   0.324864   0.427986   1.585764
1.466667   0.326397   0.442459   1.610351
1.511111   0.327932   0.456999   1.634568
1.555556   0.329471   0.471608   1.658432
1.600000   0.331014   0.486286   1.681957
1.644444   0.332559   0.501032   1.705157
1.688889   0.334108   0.515847   1.728046
1.733333   0.335660   0.530730   1.750636
1.777778   0.337216   0.545683   1.772938
1.822222   0.338774   0.560705   1.794963
1.866667   0.340336   0.575797   1.816721
1.911111   0.341901   0.590957   1.838221
1.955556   0.343470   0.606188   1.859473
2.000000   0.345041   0.621488   1.880485
2.044444   0.346616   0.636858   1.901264
2.088889   0.348194   0.652299   1.921819
2.133333   0.349776   0.667809   1.942156
2.177778   0.351361   0.683390   1.962283
2.222222   0.352949   0.699041   1.982205
2.266667   0.354540   0.714763   2.001929
2.311111   0.356134   0.730556   2.021643
2.355556   0.357732   0.746420   2.088725
2.400000   0.359333   0.762354   2.193035
2.444444   0.360938   0.778360   2.321906
2.488889   0.362545   0.794438   2.470659
2.533333   0.364156   0.810587   2.636575
2.577778   0.365770   0.826807   2.817817
2.622222   0.367388   0.843100   3.013034
2.666667   0.369008   0.859464   3.221180
2.711111   0.370632   0.875900   3.441413
2.755556   0.372259   0.892409   3.673036
2.800000   0.373890   0.908990   3.915461
2.844444   0.375524   0.925644   4.168181
2.888889   0.377160   0.942370   4.430756
2.933333   0.378801   0.959169   4.702797
2.977778   0.380444   0.976041   4.983959
3.022222   0.382091   0.992987   5.189112
3.066667   0.383741   1.010005   5.427006
3.111111   0.385394   1.027097   5.757929
3.155556   0.387051   1.044263   6.156817
3.200000   0.388711   1.061502   6.607857
3.244444   0.390374   1.078815   7.097164
3.288889   0.392040   1.096202   7.610928
3.333333   0.393710   1.113663   8.134962
3.377778   0.395383   1.131198   8.654857
3.422222   0.397059   1.148808   9.156455
3.466667   0.398738   1.166492   9.626547
3.511111   0.400421   1.184251   10.05373
3.555556   0.402107   1.202085   10.42941
3.600000   0.403796   1.219994   10.74890
```

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```
    3.644444  0.405489  1.237978  11.01263
    3.688889  0.407184  1.256038  11.22743
    3.733333  0.408883  1.274173  11.40797
    3.777778  0.410586  1.292383  11.65908
    3.822222  0.412291  1.310669  11.85032
    3.866667  0.414000  1.329031  12.03678
    3.911111  0.415712  1.347469  12.21882
    3.955556  0.417427  1.365984  12.39673
    4.000000  0.419146  1.384574  12.57082
    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     1.3           PERLND    1 999 EXTNL   PREC
WDM       2 PREC     ENGL     1.3           IMPLND    1 999 EXTNL   PREC
WDM       1 EVAP     ENGL     0.8           PERLND    1 999 EXTNL   PETINP
WDM       1 EVAP     ENGL     0.8           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   STAGE  1 1        1      WDM    1001 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
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
END EXT TARGETS

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


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


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


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


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


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


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


END MASS-LINK

END RUN
```

Exhibit 6 SUB24-1002

Predeveloped HSPF Message File

Exhibit 6 SUB24-1002

Mitigated HSPF Message File

Exhibit 6 SUB24-1002

Disclaimer

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Local (360)943-0304

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Exhibit 6 SUB24-1002

Appendix G: Wetland Protection

Exhibit 6 SUB24-1002

WETLAND BASIN AREA STATISTICS

OFF-SITE PERVIOUS AREAS

SUBBASIN	FOREST FLAT	FOREST MOD	FIELD FLAT	FIELD MOD
A	67.87	0.00	54.51	0.00
B	0.00	46.33	0.00	31.63
C	4.31	0.00	18.87	0.00
D	13.2	0.00	0.00	5.95
E	0.00	1.26	0.00	0.00
F	0.00	10.65	0.00	15.68
G	4.14	0.00	11.13	10.53
	89.52*	58.24*	84.51**	63.79**

*TOTAL FOREST AREA: 147.76 AC   **TOTAL FIELD AREA: 148.30 AC

OFF-SITE AREA SUMMARY

SUBBASIN	IMPERVIOUS	PERVIOUS
A	10.26	122.38
B	7.88	77.96
C	3.30	23.18
D	1.51	19.15
E	0.00	1.26
F	1.79	26.33
G	1.74	25.80
TOTAL	26.48	296.06

ON-SITE AREA SUMMARY

LAND COVER	AREA
FOREST FLAT	5.72 AC
FIELD MOD	5.04 AC
FOREST MOD	4.82 AC

Map labels: (SR 500), WETLAND A TYPE III, SE ROBINSON RD, NE EVERETT ST (SR 500), PROJECT SITE, SE 283RD AVE, WETLAND BUFFER

Subbasin labels: A, B, C, D, E, F, G, H

LEGEND

EXISTING GROUND CONTOUR (2 FT)	
EXISTING GROUND CONTOUR (10 FT)	
PRE-DEVELOPED BASIN BOUNDARY	
WETLAND BOUNDARY	
150' WETLAND BUFFER BOUNDARY	

NOTES

1. REFER TO OFF-SITE AND ON-SITE STATISTICS TABLES FOR CURRENT LAND COVER.
2. ALL AREAS SHOWN ARE IN ACRES.
3. LATEST AVAILABLE AERIAL IMAGERY FROM BING LIVE MAPS.
4. WETLAND BOUNDARY PER CLARK COUNTY GIS.
5. TOTAL PRE-DEVELOPED BASIN AREA INCLUDING THE OFF-SITE AND ON-SITE IS APPROXIMATELY 339 ACRES.
6. TOTAL WETLAND BUFFER AREA IS APPROXIMATELY 52 ACRES.

SCALE : 1" = 600'
SHEET SIZE 11" x 17"

DATE: 11/5/2024

PRE-DEVELOPED WETLAND EXHIBIT

CAMAS WOODS

AKS ENGINEERING & FORESTRY, LLC
9600 NE 126TH AVE, STE 2520
VANCOUVER, WA 98682
360.882.0419   WWW.AKS-ENG.COM

EXHIBIT
A

DRWN: NMG
CHKD: CJS
AKS JOB: 8397

DWG: 8397 WETLAND | FIGURE A

Exhibit 6 SUB24-1002

WETLAND BASIN AREA STATISTICS

OFF-SITE PERVIOUS AREAS

SUBBASIN	FOREST FLAT	FOREST MOD	FIELD FLAT	FIELD MOD
A	67.87	0.00	54.51	0.00
B	0.00	46.33	0.00	31.63
C	4.31	0.00	18.87	0.00
D	13.2	0.00	0.00	5.95
E	0.00	1.26	0.00	0.00
F	0.00	10.65	0.00	15.68
G	4.14	0.00	11.13	10.53
	89.52*	58.24*	84.51**	63.79**

*TOTAL FOREST AREA: 147.76 AC   **TOTAL FIELD AREA: 148.30 AC

OFF-SITE AREA SUMMARY

SUBBASIN	IMPERVIOUS	PERVIOUS
A	10.26	122.38
B	7.88	77.96
C	3.30	23.18
D	1.51	19.15
E	0.00	1.26
F	1.79	26.33
G	1.74	25.80
TOTAL	26.48	296.06

ON-SITE AREA SUMMARY

LAND COVER	AREA
IMPERVIOUS	10.504 AC
FIELD FLAT	5.642 AC

LEGEND

EXISTING GROUND CONTOUR (2 FT)	— — —
EXISTING GROUND CONTOUR (10 FT)	—— ——
POST-DEVELOPED BASIN BOUNDARY	————
WETLAND BOUNDARY	– – – –
150' WETLAND BUFFER BOUNDARY	–·–·–

NOTES

1. REFER TO OFF-SITE AND ON-SITE STATISTICS TABLES FOR CURRENT LAND COVER.
2. ALL AREAS SHOWN ARE IN ACRES.
3. ON-SITE STATISTICS REPRESENT PROPOSED DEVELOPMENT CONDITIONS.
4. LATEST AVAILABLE AERIAL IMAGERY FROM BING LIVE MAPS.
5. WETLAND BOUNDARY PER CLARK COUNTY GIS.
6. TOTAL POST-DEVELOPED BASIN AREA INCLUDING THE OFF-SITE AND ON-SITE IS APPROXIMATELY 339 ACRES.
7. TOTAL WETLAND BUFFER AREA IS APPROXIMATELY 52 ACRES.

DATE: 11/5/2024

EXHIBIT B

POST-DEVELOPED WETLAND EXHIBIT

CAMAS WOODS

AKS ENGINEERING & FORESTRY, LLC
9600 NE 126TH AVE, STE 2520
VANCOUVER, WA 98682
360.882.0419   WWW.AKS-ENG.COM

DRWN: NMG
CHKD: CJS
AKS JOB: 8397

SCALE : 1" = 600'
SHEET SIZE 11" x 17"

(SR 500)

WETLAND A TYPE III

NE EVERETT ST (SR 500)

SE ROBINSON RD

PROJECT SITE

SEE POST DEVELOPMENT BASIN MAP FOR MORE DETAIL

SE 283RD AVE

WETLAND BUFFER

DWG: 8397 WETLAND | FIGURE B

Exhibit 6 SUB24-1002

WWHM2012

PROJECT REPORT

MR #8: WETLAND PROTECTION ANALYSIS

Exhibit 6 SUB24-1002

General Model Information

WWHM2012 Project Name: 8397 MR8 Wetland Protection

Site Name:

Site Address:

City:

Report Date:	11/5/2024
Gage:	Lacamas
Data Start:	1948/10/01
Data End:	2008/09/30
Timestep:	15 Minute
Precip Scale:	1.300
Version Date:	2023/01/27
Version:	4.2.19

POC Thresholds

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

Exhibit 6 SUB24-1002

Landuse Basin Data
Predeveloped Land Use

Field Flat (A)

Bypass: No

GroundWater: No

Pervious Land Use	acre
SG4, Field, Flat	54.51

Landuse Basin Data

Exhibit 6 SUB24-1002

Forest Flat (A)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Forest, Flat   67.87

Forest Flat (A)

Exhibit 6 SUB24-1002

Field Mod (B)

Bypass: No

GroundWater: No

Pervious Land Use	acre
SG4, Field, Mod	31.63

Exhibit 6 SUB24-1002

Roadway (A)

Bypass:	No	
Impervious Land Use	acre	
ROADS FLAT	3.73	

Exhibit 6 SUB24-1002

Impervious (A)

Bypass: No
Impervious Land Use   acre
 ROADS FLAT   3.9

Exhibit 6 SUB24-1002

Impervious (A)

Bypass: No
Impervious Land Use   acre
 ROADS FLAT   2.63

Exhibit 6 SUB24-1002

Forest Mod (B)

Bypass: No

GroundWater: No

Pervious Land Use	acre
SG4, Forest, Mod	42.8

Exhibit 6 SUB24-1002

Forest Flat (C)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Forest, Flat   4.31

Exhibit 6 SUB24-1002

Impervious (C)

Bypass:	No
Impervious Land Use	acre
ROADS FLAT	3.3

Exhibit 6 SUB24-1002

Field Flat (C)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Field, Flat   18.87

Exhibit 6 SUB24-1002

Impervious (D)

Bypass: No
Impervious Land Use   acre
 ROADS FLAT   0.9

Exhibit 6 SUB24-1002

Forest Flat (D)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Forest, Flat   6.59

Forest Flat (D)

Exhibit 6 SUB24-1002

Field Mod (D)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Field, Mod   5.95

Exhibit 6 SUB24-1002

Impervious (D)

Bypass:	No
Impervious Land Use	acre
ROADS FLAT	0.44

Exhibit 6 SUB24-1002

Forest Flat (D)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Forest, Flat   6.61

Exhibit 6 SUB24-1002

Impervious (D)

Bypass:	No
Impervious Land Use	acre
ROADS FLAT	0.17

Exhibit 6 SUB24-1002

Forest Mod (E)

Bypass: No

GroundWater: No

Pervious Land Use	acre
SG4, Forest, Mod	1.26

Exhibit 6 SUB24-1002

Field Mod (F)

Bypass: No

GroundWater: No

Pervious Land Use	acre
SG4, Field, Mod	15.68

Exhibit 6 SUB24-1002

Forest Mod (F)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Forest, Mod   10.65

Exhibit 6 SUB24-1002

Impervious (F)

Bypass: No
Impervious Land Use   acre
 ROADS FLAT   1.43

Exhibit 6 SUB24-1002

Impervious (F)

Bypass:	No
Impervious Land Use	acre
ROADS FLAT	0.36

Exhibit 6 SUB24-1002

Forest Mod (On-site)

Bypass: No

GroundWater: No

Pervious Land Use	acre
SG4, Forest, Mod	4.82

Exhibit 6 SUB24-1002

Impervious (B)

Bypass: No
Impervious Land Use   acre
 ROADS FLAT   2.98

Exhibit 6 SUB24-1002

Impervious (B)

Bypass:	No
Impervious Land Use	acre
ROADS FLAT	4.9

Exhibit 6 SUB24-1002

Forest Mod (B)

Bypass: No

GroundWater: No

Pervious Land Use	acre
SG4, Forest, Mod	3.53

Exhibit 6 SUB24-1002

Forest Flat (G)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Forest, Flat   4.14

Forest Flat (G)

Exhibit 6 SUB24-1002

Impervious (G)

Bypass:	No
Impervious Land Use	acre
ROADS FLAT	0.49

Exhibit 6 SUB24-1002

Field Flat (G)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Field, Flat   11.13

Exhibit 6 SUB24-1002

Impervious (G)

Bypass: No
Impervious Land Use   acre
 ROADS FLAT   1.25

Exhibit 6 SUB24-1002

Field Mod (G)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Field, Mod   10.53

Exhibit 6 SUB24-1002

Wetland Buffer North

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Forest, Mod   26.91

Exhibit 6 SUB24-1002

Wetland Buffer South

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Forest, Mod   24.83

Wetland Buffer South

Exhibit 6 SUB24-1002

Forest Flat (On-site)

Bypass: No

GroundWater: No

Pervious Land Use	acre
SG4, Forest, Flat	5.72

Exhibit 6 SUB24-1002

Field Flat (On-site)

Bypass: No

GroundWater: No

Pervious Land Use	acre
SG4, Field, Flat	5.04

Exhibit 6 SUB24-1002

Mitigated Land Use

Impervious (A)

Bypass:	No
Impervious Land Use	acre
ROADS FLAT	3.9

Exhibit 6 SUB24-1002

Field Flat (A)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Field, Flat   54.51

Exhibit 6 SUB24-1002

Impervious (A)

Bypass:	No
Impervious Land Use	acre
ROADS FLAT	2.63

Exhibit 6 SUB24-1002

Forest Flat (A)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Forest, Flat   67.87

Forest Flat (A)

Exhibit 6 SUB24-1002

Roadway (A)

Bypass: No
Impervious Land Use   acre
 ROADS FLAT   3.73

Exhibit 6 SUB24-1002

Field Mod (B)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Field, Mod   31.63

Exhibit 6 SUB24-1002

Forest Mod (B)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Forest, Mod   42.8

Exhibit 6 SUB24-1002

Field Flat (C)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Field, Flat   18.87

Exhibit 6 SUB24-1002

Forest Flat (C)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Forest, Flat   4.31

Exhibit 6 SUB24-1002

Impervious (C)

Bypass: No
Impervious Land Use   acre
 ROADS FLAT   3.3

Exhibit 6 SUB24-1002

Impervious (D)

Bypass: No
Impervious Land Use   acre
 ROADS FLAT   0.9

Exhibit 6 SUB24-1002

Forest Flat (D)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Forest, Flat   6.59

Exhibit 6 SUB24-1002

Impervious (D)

Bypass: No
Impervious Land Use   acre
 ROADS FLAT   0.44

Exhibit 6 SUB24-1002

Field Mod (D)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Field, Mod   5.95

Exhibit 6 SUB24-1002

Impervious (D)

Bypass:	No
Impervious Land Use	acre
ROADS FLAT	0.17

Exhibit 6 SUB24-1002

Forest Flat (D)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Forest, Flat   6.61

Exhibit 6 SUB24-1002

Forest Mod (E)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Forest, Mod   1.26

Exhibit 6 SUB24-1002

Field Mod (F)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Field, Mod   15.68

Exhibit 6 SUB24-1002

Forest Mod (F)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Forest, Mod   10.65

Exhibit 6 SUB24-1002

Impervious (F)

Bypass: No
Impervious Land Use   acre
 ROADS FLAT   0.36

Exhibit 6 SUB24-1002

Impervious (F)

Bypass: No
Impervious Land Use   acre
 ROADS FLAT   1.43

Exhibit 6 SUB24-1002

On-site Developed

Bypass: No

GroundWater: No

Pervious Land Use	acre
SG4, Field, Flat	5.642
Pervious Total	5.642

Impervious Land Use	acre
ROADS FLAT	9.046
DRIVEWAYS FLAT	0.826
PARKING FLAT	0.051
POND	0.581
Impervious Total	10.504
Basin Total	16.146

Exhibit 6 SUB24-1002

Impervious (B)

Bypass: No
Impervious Land Use   acre
 ROADS FLAT   2.98

Exhibit 6 SUB24-1002

Impervious (B)

Bypass: No
Impervious Land Use   acre
 ROADS FLAT   4.9

Exhibit 6 SUB24-1002

Forest Mod (B)

Bypass: No

GroundWater: No

Pervious Land Use	acre
SG4, Forest, Mod	3.53

Exhibit 6 SUB24-1002

Forest Flat (G)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Forest, Flat   4.14

Forest Flat (G)

Exhibit 6 SUB24-1002

Field Flat (G)

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Field, Flat   11.13

Exhibit 6 SUB24-1002

Field Mod (G)

Bypass: No

GroundWater: No

Pervious Land Use	acre
SG4, Field, Mod	10.53

Exhibit 6 SUB24-1002

Impervious (G)

Bypass: No
Impervious Land Use   acre
 ROADS FLAT   0.49

Exhibit 6 SUB24-1002

Impervious (G)

Bypass:	No
Impervious Land Use	acre
ROADS FLAT	1.25

Exhibit 6 SUB24-1002

Wetland Buffer North

Bypass: No

GroundWater: No

Pervious Land Use   acre
 SG4, Forest, Mod   26.91

Wetland Buffer North

Exhibit 6 SUB24-1002

Wetland Buffer South

Bypass: No

GroundWater: No

Pervious Land Use	acre
SG4, Forest, Mod	24.83

Exhibit 6 SUB24-1002

Routing Elements
Predeveloped Routing

Exhibit 6 SUB24-1002

Mitigated Routing

Trapezoidal Pond 1

Bottom Length:	155.00 ft.
Bottom Width:	78.00 ft.
Depth:	4 ft.
Volume at riser head:	0.9930 acre-feet.
Side slope 1:	3 To 1
Side slope 2:	3 To 1
Side slope 3:	3 To 1
Side slope 4:	3 To 1
Discharge Structure	
Riser Height:	3 ft.
Riser Diameter:	18 in.
Notch Type:	Rectangular
Notch Width:	1.480 ft.
Notch Height:	0.690 ft.
Orifice 1 Diameter:	7.000 in. Elevation:0 ft.
Element Flows To:	

Outlet 1   Outlet 2
Wetland Buffer South

Pond Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.277	0.000	0.000	0.000
0.0444	0.279	0.012	0.280	0.000
0.0889	0.280	0.024	0.396	0.000
0.1333	0.281	0.037	0.485	0.000
0.1778	0.283	0.049	0.560	0.000
0.2222	0.284	0.062	0.626	0.000
0.2667	0.286	0.075	0.686	0.000
0.3111	0.287	0.087	0.741	0.000
0.3556	0.289	0.100	0.792	0.000
0.4000	0.290	0.113	0.841	0.000
0.4444	0.292	0.126	0.886	0.000
0.4889	0.293	0.139	0.929	0.000
0.5333	0.294	0.152	0.971	0.000
0.5778	0.296	0.165	1.010	0.000
0.6222	0.297	0.179	1.048	0.000
0.6667	0.299	0.192	1.085	0.000
0.7111	0.300	0.205	1.121	0.000
0.7556	0.302	0.219	1.155	0.000
0.8000	0.303	0.232	1.189	0.000
0.8444	0.305	0.246	1.221	0.000
0.8889	0.306	0.259	1.253	0.000
0.9333	0.308	0.273	1.284	0.000
0.9778	0.309	0.287	1.314	0.000
1.0222	0.311	0.300	1.344	0.000
1.0667	0.312	0.314	1.373	0.000
1.1111	0.314	0.328	1.401	0.000
1.1556	0.315	0.342	1.429	0.000
1.2000	0.317	0.356	1.456	0.000
1.2444	0.318	0.370	1.483	0.000
1.2889	0.320	0.385	1.509	0.000
1.3333	0.321	0.399	1.535	0.000
1.3778	0.323	0.413	1.560	0.000

Exhibit 6 SUB24-1002

1.4222	0.324	0.428	1.585	0.000
1.4667	0.326	0.442	1.610	0.000
1.5111	0.327	0.457	1.634	0.000
1.5556	0.329	0.471	1.658	0.000
1.6000	0.331	0.486	1.682	0.000
1.6444	0.332	0.501	1.705	0.000
1.6889	0.334	0.515	1.728	0.000
1.7333	0.335	0.530	1.750	0.000
1.7778	0.337	0.545	1.772	0.000
1.8222	0.338	0.560	1.795	0.000
1.8667	0.340	0.575	1.816	0.000
1.9111	0.341	0.591	1.838	0.000
1.9556	0.343	0.606	1.859	0.000
2.0000	0.345	0.621	1.880	0.000
2.0444	0.346	0.636	1.901	0.000
2.0889	0.348	0.652	1.921	0.000
2.1333	0.349	0.667	1.942	0.000
2.1778	0.351	0.683	1.962	0.000
2.2222	0.352	0.699	1.982	0.000
2.2667	0.354	0.714	2.001	0.000
2.3111	0.356	0.730	2.021	0.000
2.3556	0.357	0.746	2.088	0.000
2.4000	0.359	0.762	2.193	0.000
2.4444	0.360	0.778	2.321	0.000
2.4889	0.362	0.794	2.470	0.000
2.5333	0.364	0.810	2.636	0.000
2.5778	0.365	0.826	2.817	0.000
2.6222	0.367	0.843	3.013	0.000
2.6667	0.369	0.859	3.221	0.000
2.7111	0.370	0.875	3.441	0.000
2.7556	0.372	0.892	3.673	0.000
2.8000	0.373	0.909	3.915	0.000
2.8444	0.375	0.925	4.168	0.000
2.8889	0.377	0.942	4.430	0.000
2.9333	0.378	0.959	4.702	0.000
2.9778	0.380	0.976	4.984	0.000
3.0222	0.382	0.993	5.189	0.000
3.0667	0.383	1.010	5.427	0.000
3.1111	0.385	1.027	5.757	0.000
3.1556	0.387	1.044	6.156	0.000
3.2000	0.388	1.061	6.607	0.000
3.2444	0.390	1.078	7.097	0.000
3.2889	0.392	1.096	7.610	0.000
3.3333	0.393	1.113	8.135	0.000
3.3778	0.395	1.131	8.654	0.000
3.4222	0.397	1.148	9.156	0.000
3.4667	0.398	1.166	9.626	0.000
3.5111	0.400	1.184	10.05	0.000
3.5556	0.402	1.202	10.42	0.000
3.6000	0.403	1.220	10.74	0.000
3.6444	0.405	1.238	11.01	0.000
3.6889	0.407	1.256	11.22	0.000
3.7333	0.408	1.274	11.40	0.000
3.7778	0.410	1.292	11.65	0.000
3.8222	0.412	1.310	11.85	0.000
3.8667	0.414	1.329	12.03	0.000
3.9111	0.415	1.347	12.21	0.000
3.9556	0.417	1.366	12.39	0.000

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| 4.0000 | 0.419 | 1.384 | 12.57 | 0.000 |
| 4.0444 | 0.420 | 1.403 | 12.74 | 0.000 |

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Analysis Results
POC 1

+ Predeveloped   x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 363.38
Total Impervious Area: 26.48

Mitigated Landuse Totals for POC #1
Total Pervious Area: 353.442
Total Impervious Area: 36.984

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	93.216962
5 year	136.366642
10 year	158.862955
25 year	181.241503
50 year	194.330145
100 year	204.986556

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	92.410457
5 year	134.846566
10 year	158.499968
25 year	183.572901
50 year	199.446697
100 year	213.077533

Annual Peaks
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	74.275	74.238
1950	94.119	93.456
1951	116.548	114.686
1952	93.147	94.675
1953	96.796	97.185
1954	127.661	126.361
1955	76.560	76.508
1956	155.059	155.827
1957	119.403	117.884
1958	109.891	111.875

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1959	44.150	45.228
1960	55.040	55.238
1961	122.026	120.493
1962	111.984	111.003
1963	105.518	104.815
1964	97.603	96.721
1965	95.400	94.974
1966	118.985	117.319
1967	87.839	88.632
1968	109.563	109.021
1969	88.242	88.124
1970	352.377	346.023
1971	61.383	62.490
1972	88.720	87.908
1973	106.078	105.902
1974	148.752	149.869
1975	81.859	81.561
1976	113.335	111.908
1977	9.798	12.736
1978	152.821	150.916
1979	126.509	127.075
1980	68.515	68.015
1981	147.759	145.379
1982	98.090	98.657
1983	152.479	149.284
1984	57.904	59.187
1985	42.289	47.818
1986	50.667	50.993
1987	79.750	80.114
1988	32.567	33.391
1989	36.109	40.727
1990	41.676	43.027
1991	89.825	90.221
1992	101.360	102.662
1993	130.272	130.186
1994	100.518	100.003
1995	89.223	91.282
1996	166.566	170.013
1997	139.142	141.098
1998	128.225	130.103
1999	91.360	91.132
2000	42.026	41.946
2001	30.828	31.462
2002	142.260	140.366
2003	116.738	115.870
2004	31.535	33.868
2005	56.233	57.321
2006	101.501	100.425
2007	52.491	57.729
2008	57.905	60.051

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	352.3770	346.0230
2	166.5660	170.0130
3	155.0590	155.8270
4	152.8210	150.9160

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5	152.4790	149.8690
6	148.7520	149.2840
7	147.7590	145.3790
8	142.2600	141.0980
9	139.1420	140.3660
10	130.2720	130.1860
11	128.2250	130.1030
12	127.6610	127.0750
13	126.5090	126.3610
14	122.0260	120.4930
15	119.4030	117.8840
16	118.9850	117.3190
17	116.7380	115.8700
18	116.5480	114.6860
19	113.3350	111.9080
20	111.9840	111.8750
21	109.8910	111.0030
22	109.5630	109.0210
23	106.0780	105.9020
24	105.5180	104.8150
25	101.5010	102.6620
26	101.3600	100.4250
27	100.5180	100.0030
28	98.0897	98.6573
29	97.6028	97.1852
30	96.7964	96.7210
31	95.4003	94.9739
32	94.1193	94.6751
33	93.1467	93.4559
34	91.3600	91.2824
35	89.8254	91.1315
36	89.2232	90.2208
37	88.7202	88.6319
38	88.2423	88.1237
39	87.8385	87.9075
40	81.8592	81.5605
41	79.7502	80.1136
42	76.5603	76.5077
43	74.2747	74.2375
44	68.5147	68.0150
45	61.3828	62.4900
46	57.9047	60.0512
47	57.9038	59.1869
48	56.2327	57.7294
49	55.0397	57.3209
50	52.4912	55.2376
51	50.6673	50.9933
52	44.1504	47.8182
53	42.2889	45.2284
54	42.0264	43.0272
55	41.6761	41.9459
56	36.1085	40.7271
57	32.5674	33.8679
58	31.5354	33.3913
59	30.8281	31.4623
60	9.7976	12.7361

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Duration Flows

The Duration Matching Failed

POC #1 not analyzed MR #7: Flow Control

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
46.6085	1524	1597	104	Fail
48.1006	1422	1492	104	Fail
49.5928	1325	1383	104	Fail
51.0849	1229	1284	104	Fail
52.5770	1152	1199	104	Fail
54.0692	1054	1106	104	Fail
55.5613	994	1036	104	Fail
57.0534	914	957	104	Fail
58.5456	847	884	104	Fail
60.0377	781	811	103	Fail
61.5299	730	752	103	Fail
63.0220	690	705	102	Fail
64.5141	652	659	101	Fail
66.0063	613	620	101	Fail
67.4984	572	581	101	Fail
68.9906	537	554	103	Fail
70.4827	512	517	100	Pass
71.9748	479	484	101	Fail
73.4670	447	451	100	Pass
74.9591	426	427	100	Pass
76.4512	391	399	102	Fail
77.9434	367	374	101	Fail
79.4355	343	352	102	Fail
80.9277	313	322	102	Fail
82.4198	293	288	98	Pass
83.9119	274	279	101	Fail
85.4041	254	259	101	Fail
86.8962	237	238	100	Pass
88.3883	222	222	100	Pass
89.8805	206	207	100	Pass
91.3726	197	198	100	Pass
92.8648	191	189	98	Pass
94.3569	173	174	100	Pass
95.8490	162	162	100	Pass
97.3412	151	152	100	Pass
98.8333	141	135	95	Pass
100.3254	130	124	95	Pass
101.8176	117	117	100	Pass
103.3097	109	110	100	Pass
104.8019	104	104	100	Pass
106.2940	101	98	97	Pass
107.7861	95	93	97	Pass
109.2783	89	90	101	Pass
110.7704	84	85	101	Pass
112.2626	78	76	97	Pass
113.7547	72	73	101	Pass
115.2468	66	65	98	Pass
116.7390	61	62	101	Pass
118.2311	58	58	100	Pass
119.7232	55	55	100	Pass
121.2154	54	53	98	Pass
122.7075	51	51	100	Pass
124.1997	47	48	102	Pass
125.6918	44	45	102	Pass

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127.1839	42	40	95	Pass
128.6761	40	38	95	Pass
130.1682	35	33	94	Pass
131.6603	31	31	100	Pass
133.1525	31	30	96	Pass
134.6446	29	29	100	Pass
136.1368	28	29	103	Pass
137.6289	28	27	96	Pass
139.1210	23	25	108	Pass
140.6132	20	20	100	Pass
142.1053	20	18	90	Pass
143.5975	18	17	94	Pass
145.0896	16	15	93	Pass
146.5817	15	14	93	Pass
148.0739	14	13	92	Pass
149.5660	13	12	92	Pass
151.0581	12	10	83	Pass
152.5503	11	10	90	Pass
154.0424	10	10	100	Pass
155.5346	9	10	111	Fail
157.0267	9	8	88	Pass
158.5188	9	8	88	Pass
160.0110	8	8	100	Pass
161.5031	7	7	100	Pass
162.9952	7	7	100	Pass
164.4874	7	7	100	Pass
165.9795	7	7	100	Pass
167.4717	6	7	116	Fail
168.9638	6	7	116	Fail
170.4559	6	6	100	Pass
171.9481	6	6	100	Pass
173.4402	6	6	100	Pass
174.9324	6	5	83	Pass
176.4245	6	5	83	Pass
177.9166	4	4	100	Pass
179.4088	4	4	100	Pass
180.9009	4	4	100	Pass
182.3930	4	4	100	Pass
183.8852	4	4	100	Pass
185.3773	4	4	100	Pass
186.8695	4	4	100	Pass
188.3616	4	4	100	Pass
189.8537	4	4	100	Pass
191.3459	4	4	100	Pass
192.8380	4	4	100	Pass
194.3301	4	4	100	Pass

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.

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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.

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Wetland Input Volumes

- Percent   - Predeveloped   - Mitigated

Wetlands Input Volume for POC 1
Average Annual Volume (acft)
Series 1: 501 POC 1 Predeveloped flow
Series 2: 801 POC 1 Mitigated flow

Month	Series 1	Series 2	Percent	Pass/Fail
Jan	184.9612	186.5968	100.9	Pass
Feb	138.6052	138.8726	100.2	Pass
Mar	109.4658	109.4181	100.0	Pass
Apr	60.5365	60.1827	99.4	Pass
May	37.1870	37.0045	99.5	Pass
Jun	20.9337	20.7494	99.1	Pass
Jul	9.4884	9.1503	96.4	Pass
Aug	5.1274	4.8561	94.7	Pass
Sep	3.2793	3.2142	98.0	Pass
Oct	9.5765	10.3358	107.9	Pass
Nov	72.6104	76.1657	104.9	Pass
Dec	158.2271	161.5418	102.1	Pass

Day	Predevel	Mitigated	Percent	Pass/Fail
Jan1	5.4379	5.5127	101.4	Pass
2	5.4301	5.4962	101.2	Pass
3	6.1497	6.2178	101.1	Pass
4	5.0204	5.0621	100.8	Pass
5	5.9629	6.0490	101.4	Pass
6	5.9364	6.0209	101.4	Pass
7	5.4094	5.4750	101.2	Pass
8	5.6525	5.7444	101.6	Pass
9	6.7750	6.8522	101.1	Pass
10	5.6031	5.6430	100.7	Pass
11	5.9014	5.9871	101.5	Pass
12	6.0612	6.1234	101.0	Pass
13	7.1734	7.2757	101.4	Pass
14	7.2615	7.3255	100.9	Pass

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15	6.7714	6.8727	101.5	Pass
16	6.8480	6.9000	100.8	Pass
17	6.6029	6.6474	100.7	Pass
18	6.9819	7.0387	100.8	Pass
19	6.9608	6.9659	100.1	Pass
20	5.0161	4.9865	99.4	Pass
21	6.0042	6.0096	100.1	Pass
22	6.0486	6.1163	101.1	Pass
23	5.4199	5.4478	100.5	Pass
24	6.1530	6.2150	101.0	Pass
25	5.4377	5.4320	99.9	Pass
26	5.7512	5.7786	100.5	Pass
27	5.1391	5.1575	100.4	Pass
28	4.7763	4.7776	100.0	Pass
29	5.1851	5.2253	100.8	Pass
30	7.3612	7.4659	101.4	Pass
31	5.6962	5.6956	100.0	Pass
Feb1	5.2220	5.2483	100.5	Pass
2	4.5032	4.4591	99.0	Pass
3	3.8883	3.8415	98.8	Pass
4	3.7428	3.7232	99.5	Pass
5	5.4148	5.4884	101.4	Pass
6	5.7035	5.7316	100.5	Pass
7	5.5931	5.6329	100.7	Pass
8	5.1228	5.1464	100.5	Pass
9	5.0311	5.0377	100.1	Pass
10	4.1569	4.1350	99.5	Pass
11	4.5112	4.5496	100.9	Pass
12	4.4575	4.4694	100.3	Pass
13	4.0115	3.9883	99.4	Pass
14	4.0996	4.1099	100.3	Pass
15	4.9575	4.9974	100.8	Pass
16	5.1870	5.2490	101.2	Pass
17	6.2256	6.3070	101.3	Pass
18	5.3635	5.3879	100.5	Pass
19	6.2917	6.3201	100.5	Pass
20	5.1299	5.1291	100.0	Pass
21	4.7535	4.7409	99.7	Pass
22	5.3768	5.3860	100.2	Pass
23	5.3224	5.3392	100.3	Pass
24	4.5804	4.5452	99.2	Pass
25	4.1416	4.1186	99.4	Pass
26	5.1151	5.1199	100.1	Pass
27	4.0937	4.0735	99.5	Pass
28	3.4248	3.3815	98.7	Pass
29	4.0243	4.0286	100.1	Pass
Mar1	3.6272	3.6109	99.5	Pass
2	4.0593	4.0855	100.6	Pass
3	4.0088	4.0268	100.5	Pass
4	3.9934	4.0040	100.3	Pass
5	3.6444	3.6435	100.0	Pass
6	3.7855	3.7803	99.9	Pass
7	4.0605	4.0952	100.9	Pass
8	4.6979	4.7256	100.6	Pass
9	3.7354	3.7161	99.5	Pass
10	4.3492	4.3531	100.1	Pass
11	4.4421	4.4575	100.3	Pass
12	4.1138	4.1139	100.0	Pass

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13	3.9489	3.9353	99.7	Pass
14	3.8542	3.8266	99.3	Pass
15	3.5682	3.5515	99.5	Pass
16	3.0714	3.0388	98.9	Pass
17	3.1010	3.0833	99.4	Pass
18	2.8498	2.8258	99.2	Pass
19	2.8924	2.8780	99.5	Pass
20	2.5991	2.5783	99.2	Pass
21	2.8461	2.8566	100.4	Pass
22	3.0418	3.0573	100.5	Pass
23	3.1977	3.2280	100.9	Pass
24	3.6135	3.6332	100.5	Pass
25	2.9783	2.9662	99.6	Pass
26	3.1650	3.1636	100.0	Pass
27	3.0595	3.0467	99.6	Pass
28	3.4073	3.4145	100.2	Pass
29	3.0468	3.0393	99.8	Pass
30	2.6855	2.6531	98.8	Pass
31	2.3828	2.3460	98.5	Pass
Apr1	2.1890	2.1523	98.3	Pass
2	2.0906	2.0648	98.8	Pass
3	1.9300	1.9050	98.7	Pass
4	2.2389	2.2354	99.8	Pass
5	2.0219	2.0051	99.2	Pass
6	2.3141	2.3070	99.7	Pass
7	2.3228	2.3423	100.8	Pass
8	2.5467	2.5591	100.5	Pass
9	2.1391	2.1161	98.9	Pass
10	2.0753	2.0535	98.9	Pass
11	2.5624	2.5767	100.6	Pass
12	2.4374	2.4302	99.7	Pass
13	2.0969	2.0817	99.3	Pass
14	1.9601	1.9374	98.8	Pass
15	1.8709	1.8506	98.9	Pass
16	1.8439	1.8260	99.0	Pass
17	1.7305	1.7065	98.6	Pass
18	1.8920	1.8975	100.3	Pass
19	1.9070	1.9075	100.0	Pass
20	2.0442	2.0457	100.1	Pass
21	2.2945	2.3133	100.8	Pass
22	2.1630	2.1589	99.8	Pass
23	1.9164	1.8926	98.8	Pass
24	1.8081	1.7883	98.9	Pass
25	1.6405	1.6166	98.5	Pass
26	1.7861	1.7861	100.0	Pass
27	1.5124	1.4944	98.8	Pass
28	1.4753	1.4601	99.0	Pass
29	1.3452	1.3266	98.6	Pass
30	1.3059	1.2968	99.3	Pass
May1	1.2944	1.2900	99.7	Pass
2	1.2712	1.2640	99.4	Pass
3	1.2280	1.2150	98.9	Pass
4	1.3657	1.3732	100.6	Pass
5	1.4492	1.4469	99.8	Pass
6	1.3802	1.3652	98.9	Pass
7	1.2178	1.1988	98.4	Pass
8	1.1364	1.1212	98.7	Pass
9	1.1917	1.1845	99.4	Pass

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10	1.1158	1.0966	98.3	Pass
11	1.0521	1.0287	97.8	Pass
12	1.0560	1.0484	99.3	Pass
13	1.1077	1.1032	99.6	Pass
14	1.1239	1.1184	99.5	Pass
15	1.0323	1.0163	98.4	Pass
16	1.6208	1.6572	102.2	Pass
17	1.3496	1.3567	100.5	Pass
18	1.2700	1.2717	100.1	Pass
19	1.3181	1.3156	99.8	Pass
20	1.2160	1.2016	98.8	Pass
21	1.1948	1.1871	99.4	Pass
22	1.1123	1.0989	98.8	Pass
23	1.1913	1.1900	99.9	Pass
24	1.1779	1.1923	101.2	Pass
25	1.2224	1.2194	99.8	Pass
26	1.0486	1.0357	98.8	Pass
27	0.9630	0.9470	98.3	Pass
28	0.9126	0.8987	98.5	Pass
29	0.8138	0.7959	97.8	Pass
30	1.4480	1.4694	101.5	Pass
31	0.9492	0.9449	99.5	Pass
Jun1	0.8894	0.8729	98.2	Pass
2	0.9649	0.9653	100.0	Pass
3	0.9290	0.9263	99.7	Pass
4	0.8119	0.7967	98.1	Pass
5	1.1954	1.2202	102.1	Pass
6	0.9477	0.9575	101.0	Pass
7	0.9529	0.9552	100.2	Pass
8	0.8955	0.8914	99.5	Pass
9	0.8305	0.8207	98.8	Pass
10	0.7603	0.7499	98.6	Pass
11	0.6888	0.6747	98.0	Pass
12	0.6633	0.6541	98.6	Pass
13	0.6395	0.6316	98.8	Pass
14	0.6089	0.5994	98.4	Pass
15	0.5804	0.5690	98.0	Pass
16	0.5535	0.5411	97.8	Pass
17	0.5671	0.5581	98.4	Pass
18	0.5674	0.5594	98.6	Pass
19	0.6657	0.6845	102.8	Pass
20	0.7160	0.7196	100.5	Pass
21	0.6362	0.6222	97.8	Pass
22	0.5717	0.5546	97.0	Pass
23	0.5195	0.5028	96.8	Pass
24	0.4959	0.4844	97.7	Pass
25	0.4863	0.4789	98.5	Pass
26	0.4802	0.4745	98.8	Pass
27	0.4677	0.4595	98.3	Pass
28	0.4577	0.4489	98.1	Pass
29	0.4412	0.4312	97.7	Pass
30	0.4274	0.4174	97.7	Pass
Jul1	0.4093	0.3977	97.1	Pass
2	0.3939	0.3817	96.9	Pass
3	0.3788	0.3663	96.7	Pass
4	0.3663	0.3538	96.6	Pass
5	0.3563	0.3437	96.5	Pass
6	0.3471	0.3344	96.3	Pass

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7	0.3409	0.3290	96.5	Pass
8	0.3528	0.3454	97.9	Pass
9	0.3445	0.3348	97.2	Pass
10	0.3369	0.3256	96.6	Pass
11	0.3259	0.3138	96.3	Pass
12	0.3147	0.3023	96.1	Pass
13	0.3042	0.2918	95.9	Pass
14	0.2955	0.2832	95.8	Pass
15	0.2968	0.2873	96.8	Pass
16	0.2946	0.2845	96.6	Pass
17	0.2883	0.2771	96.1	Pass
18	0.2923	0.2855	97.7	Pass
19	0.2936	0.2865	97.6	Pass
20	0.2929	0.2852	97.4	Pass
21	0.2864	0.2767	96.6	Pass
22	0.2727	0.2614	95.9	Pass
23	0.2599	0.2482	95.5	Pass
24	0.2493	0.2376	95.3	Pass
25	0.2414	0.2299	95.2	Pass
26	0.2347	0.2232	95.1	Pass
27	0.2290	0.2176	95.0	Pass
28	0.2247	0.2136	95.1	Pass
29	0.2209	0.2098	95.0	Pass
30	0.2162	0.2052	94.9	Pass
31	0.2112	0.2001	94.8	Pass
Aug1	0.2063	0.1953	94.7	Pass
2	0.2025	0.1916	94.6	Pass
3	0.1983	0.1874	94.5	Pass
4	0.1936	0.1828	94.4	Pass
5	0.1893	0.1786	94.4	Pass
6	0.1867	0.1762	94.4	Pass
7	0.1849	0.1745	94.4	Pass
8	0.1807	0.1703	94.3	Pass
9	0.1760	0.1658	94.2	Pass
10	0.1717	0.1616	94.1	Pass
11	0.1681	0.1581	94.0	Pass
12	0.1644	0.1545	94.0	Pass
13	0.1609	0.1511	93.9	Pass
14	0.1588	0.1493	94.0	Pass
15	0.1578	0.1484	94.0	Pass
16	0.1542	0.1448	93.9	Pass
17	0.1500	0.1408	93.8	Pass
18	0.1475	0.1384	93.9	Pass
19	0.1485	0.1397	94.0	Pass
20	0.1458	0.1370	94.0	Pass
21	0.1413	0.1327	93.9	Pass
22	0.1437	0.1364	95.0	Pass
23	0.1501	0.1437	95.8	Pass
24	0.1580	0.1549	98.1	Pass
25	0.1670	0.1633	97.8	Pass
26	0.1613	0.1553	96.3	Pass
27	0.1488	0.1421	95.5	Pass
28	0.1383	0.1317	95.2	Pass
29	0.1336	0.1273	95.3	Pass
30	0.1285	0.1223	95.2	Pass
31	0.1260	0.1204	95.6	Pass
Sep1	0.1241	0.1183	95.3	Pass
2	0.1201	0.1144	95.2	Pass

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3	0.1172	0.1123	95.8	Pass
4	0.1156	0.1105	95.6	Pass
5	0.1120	0.1067	95.3	Pass
6	0.1081	0.1028	95.0	Pass
7	0.1044	0.0991	94.9	Pass
8	0.1023	0.0972	95.0	Pass
9	0.1024	0.0975	95.2	Pass
10	0.1027	0.0978	95.3	Pass
11	0.1000	0.0951	95.2	Pass
12	0.0968	0.0921	95.1	Pass
13	0.0952	0.0908	95.3	Pass
14	0.0998	0.0957	95.9	Pass
15	0.1007	0.0966	95.9	Pass
16	0.0978	0.0939	96.0	Pass
17	0.1175	0.1244	105.8	Pass
18	0.1222	0.1238	101.3	Pass
19	0.1312	0.1371	104.5	Pass
20	0.1367	0.1391	101.7	Pass
21	0.1252	0.1243	99.2	Pass
22	0.1137	0.1120	98.5	Pass
23	0.1063	0.1047	98.6	Pass
24	0.1046	0.1074	102.6	Pass
25	0.1078	0.1101	102.2	Pass
26	0.1024	0.1022	99.8	Pass
27	0.0960	0.0951	99.0	Pass
28	0.0948	0.0964	101.8	Pass
29	0.0955	0.0965	101.0	Pass
30	0.0978	0.0980	100.2	Pass
Oct1	0.0965	0.0964	99.9	Pass
2	0.0948	0.0962	101.5	Pass
3	0.0962	0.0989	102.8	Pass
4	0.1070	0.1119	104.7	Pass
5	0.1115	0.1149	103.0	Pass
6	0.1146	0.1194	104.2	Pass
7	0.1276	0.1416	111.0	Pass
8	0.2094	0.2513	120.0	Pass
9	0.2474	0.2714	109.7	Pass
10	0.2817	0.3141	111.5	Pass
11	0.3034	0.3281	108.2	Pass
12	0.2738	0.2857	104.4	Pass
13	0.2340	0.2441	104.3	Pass
14	0.2043	0.2119	103.7	Pass
15	0.1723	0.1776	103.1	Pass
16	0.1612	0.1687	104.7	Pass
17	0.1631	0.1749	107.2	Pass
18	0.1711	0.1826	106.7	Pass
19	0.1976	0.2130	107.8	Pass
20	0.2739	0.3124	114.1	Pass
21	0.5603	0.5971	106.6	Pass
22	0.5311	0.5678	106.9	Pass
23	0.3942	0.4081	103.5	Pass
24	0.3696	0.3953	107.0	Pass
25	0.3448	0.3656	106.0	Pass
26	0.3973	0.4560	114.8	Pass
27	0.5608	0.6316	112.6	Pass
28	0.7967	0.8729	109.6	Pass
29	0.8240	0.8908	108.1	Pass
30	1.0589	1.1375	107.4	Pass

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31	0.8816	0.9419	106.8	Pass
Nov1	1.0109	1.0797	106.8	Pass
2	0.8611	0.9147	106.2	Pass
3	1.0787	1.1724	108.7	Pass
4	0.8343	0.8704	104.3	Pass
5	1.0132	1.1020	108.8	Pass
6	1.0352	1.1175	107.9	Pass
7	1.4323	1.5474	108.0	Pass
8	1.4985	1.5973	106.6	Pass
9	1.3865	1.4721	106.2	Pass
10	2.3655	2.5248	106.7	Pass
11	1.6737	1.7577	105.0	Pass
12	1.7284	1.8324	106.0	Pass
13	1.7427	1.8492	106.1	Pass
14	3.1325	3.2743	104.5	Pass
15	2.0666	2.1778	105.4	Pass
16	1.9354	2.0537	106.1	Pass
17	2.5443	2.6966	106.0	Pass
18	3.6036	3.7911	105.2	Pass
19	2.8686	3.0367	105.9	Pass
20	2.8855	3.0541	105.8	Pass
21	2.9248	3.0724	105.0	Pass
22	3.5767	3.7799	105.7	Pass
23	4.6258	4.8468	104.8	Pass
24	4.7471	4.9512	104.3	Pass
25	4.2692	4.3908	102.8	Pass
26	4.1191	4.2433	103.0	Pass
27	3.6622	3.7214	101.6	Pass
28	3.0688	3.1167	101.6	Pass
29	4.0382	4.1814	103.5	Pass
30	3.3263	3.4246	103.0	Pass
Dec1	4.9960	5.2077	104.2	Pass
2	5.1291	5.3395	104.1	Pass
3	5.4481	5.6222	103.2	Pass
4	4.5546	4.6796	102.7	Pass
5	4.8851	5.0080	102.5	Pass
6	4.5170	4.6165	102.2	Pass
7	3.9861	4.0478	101.5	Pass
8	4.0011	4.0873	102.2	Pass
9	4.8547	5.0173	103.3	Pass
10	4.7483	4.9139	103.5	Pass
11	4.8462	4.9548	102.2	Pass
12	5.8488	5.9903	102.4	Pass
13	4.9985	5.0749	101.5	Pass
14	5.1628	5.2371	101.4	Pass
15	4.9735	5.0959	102.5	Pass
16	4.1260	4.1737	101.2	Pass
17	3.8014	3.8403	101.0	Pass
18	4.5118	4.6253	102.5	Pass
19	5.2287	5.3420	102.2	Pass
20	6.9454	7.1246	102.6	Pass
21	5.8181	5.9363	102.0	Pass
22	5.5261	5.6346	102.0	Pass
23	5.6292	5.7170	101.6	Pass
24	5.6759	5.7086	100.6	Pass
25	5.8653	5.9621	101.7	Pass
26	6.1577	6.2508	101.5	Pass
27	5.4339	5.4904	101.0	Pass

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28	5.8749	5.9556	101.4	Pass
29	5.7401	5.8104	101.2	Pass
30	5.6104	5.6467	100.6	Pass
31	4.7339	4.7791	101.0	Pass

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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
Trapezoidal Pond 1	☐	2335.08			☐	0.00			
Total Volume Infiltrated		2335.08	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

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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.

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Appendix
Predeveloped Schematic

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Mitigated Schematic

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Predeveloped UCI File
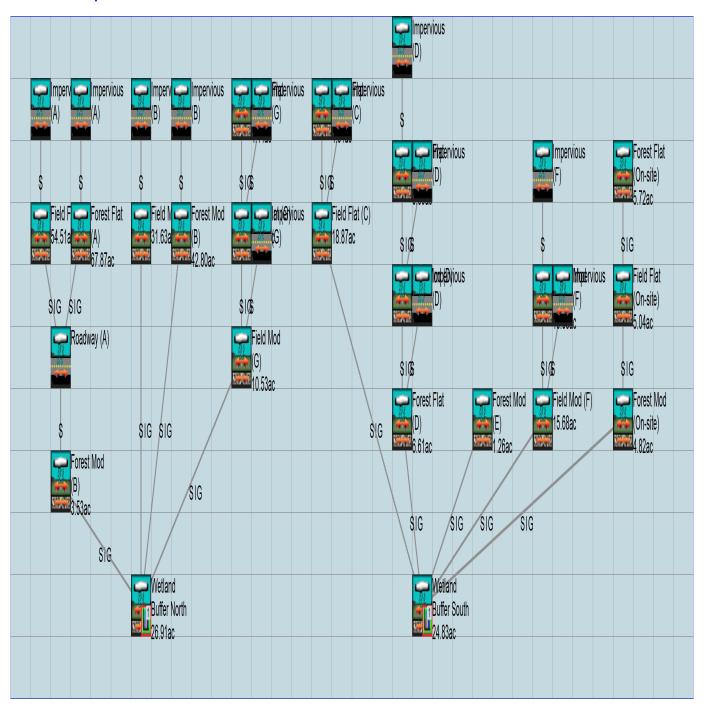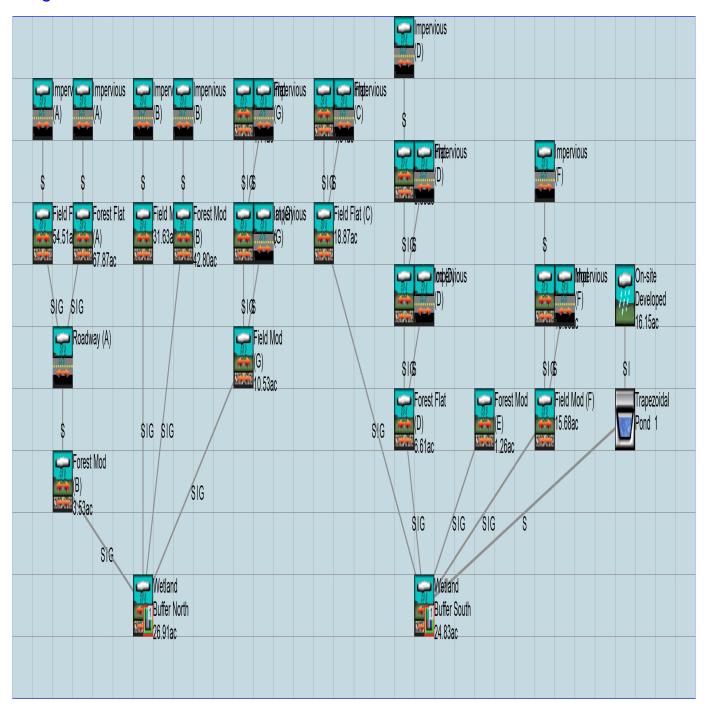
```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01         END       2008 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    8397 MR8 Wetland Protection.wdm
MESSU     25    Pre8397 MR8 Wetland Protection.MES
          27    Pre8397 MR8 Wetland Protection.L61
          28    Pre8397 MR8 Wetland Protection.L62
          30    POC8397 MR8 Wetland Protection1.dat
END FILES

OPN SEQUENCE
    INGRP             INDELT 00:15
      IMPLND     17
      IMPLND     18
      PERLND     53
      IMPLND     19
      IMPLND     20
      IMPLND     21
      IMPLND     22
      PERLND     58
      IMPLND     23
      IMPLND     33
      IMPLND     36
      IMPLND     37
      PERLND     85
      IMPLND     40
      IMPLND     41
      PERLND     92
      PERLND     47
      PERLND     49
      PERLND     50
      PERLND     51
      PERLND     55
      PERLND     60
      PERLND     93
      PERLND     54
      PERLND     63
      PERLND     86
      PERLND     56
      PERLND     59
      IMPLND     16
      PERLND     87
      PERLND     57
      PERLND     84
      PERLND     90
      PERLND     91
      COPY      501
      COPY        1
      DISPLY      1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Wetland Buffer North        MAX                   1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
```

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```
    # -  #  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          ***
   53     SG4, Forest, Flat      1     1     1    1   27   0
   58     SG4, Forest, Mod       1     1     1    1   27   0
   85     SG4, Forest, Flat      1     1     1    1   27   0
   92     SG4, Forest, Flat      1     1     1    1   27   0
   47     SG4, Field, Flat       1     1     1    1   27   0
   49     SG4, Forest, Flat      1     1     1    1   27   0
   50     SG4, Field, Mod        1     1     1    1   27   0
   51     SG4, Forest, Mod       1     1     1    1   27   0
   55     SG4, Forest, Flat      1     1     1    1   27   0
   60     SG4, Forest, Mod       1     1     1    1   27   0
   93     SG4, Field, Flat       1     1     1    1   27   0
   54     SG4, Field, Flat       1     1     1    1   27   0
   63     SG4, Forest, Mod       1     1     1    1   27   0
   86     SG4, Field, Flat       1     1     1    1   27   0
   56     SG4, Field, Mod        1     1     1    1   27   0
   59     SG4, Field, Mod        1     1     1    1   27   0
   87     SG4, Field, Mod        1     1     1    1   27   0
   57     SG4, Forest, Flat      1     1     1    1   27   0
   84     SG4, Forest, Mod       1     1     1    1   27   0
   90     SG4, Forest, Mod       1     1     1    1   27   0
   91     SG4, 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 ***
   53        0    0    1    0    0    0    0    0    0    0    0    0
   58        0    0    1    0    0    0    0    0    0    0    0    0
   85        0    0    1    0    0    0    0    0    0    0    0    0
   92        0    0    1    0    0    0    0    0    0    0    0    0
   47        0    0    1    0    0    0    0    0    0    0    0    0
   49        0    0    1    0    0    0    0    0    0    0    0    0
   50        0    0    1    0    0    0    0    0    0    0    0    0
   51        0    0    1    0    0    0    0    0    0    0    0    0
   55        0    0    1    0    0    0    0    0    0    0    0    0
   60        0    0    1    0    0    0    0    0    0    0    0    0
   93        0    0    1    0    0    0    0    0    0    0    0    0
   54        0    0    1    0    0    0    0    0    0    0    0    0
   63        0    0    1    0    0    0    0    0    0    0    0    0
   86        0    0    1    0    0    0    0    0    0    0    0    0
   56        0    0    1    0    0    0    0    0    0    0    0    0
   59        0    0    1    0    0    0    0    0    0    0    0    0
   87        0    0    1    0    0    0    0    0    0    0    0    0
   57        0    0    1    0    0    0    0    0    0    0    0    0
   84        0    0    1    0    0    0    0    0    0    0    0    0
   90        0    0    1    0    0    0    0    0    0    0    0    0
   91        0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
```

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```
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC   *********
   53        0    0    4    0    0    0    0    0    0    0    0    0    1    9
   58        0    0    4    0    0    0    0    0    0    0    0    0    1    9
   85        0    0    4    0    0    0    0    0    0    0    0    0    1    9
   92        0    0    4    0    0    0    0    0    0    0    0    0    1    9
   47        0    0    4    0    0    0    0    0    0    0    0    0    1    9
   49        0    0    4    0    0    0    0    0    0    0    0    0    1    9
   50        0    0    4    0    0    0    0    0    0    0    0    0    1    9
   51        0    0    4    0    0    0    0    0    0    0    0    0    1    9
   55        0    0    4    0    0    0    0    0    0    0    0    0    1    9
   60        0    0    4    0    0    0    0    0    0    0    0    0    1    9
   93        0    0    4    0    0    0    0    0    0    0    0    0    1    9
   54        0    0    4    0    0    0    0    0    0    0    0    0    1    9
   63        0    0    4    0    0    0    0    0    0    0    0    0    1    9
   86        0    0    4    0    0    0    0    0    0    0    0    0    1    9
   56        0    0    4    0    0    0    0    0    0    0    0    0    1    9
   59        0    0    4    0    0    0    0    0    0    0    0    0    1    9
   87        0    0    4    0    0    0    0    0    0    0    0    0    1    9
   57        0    0    4    0    0    0    0    0    0    0    0    0    1    9
   84        0    0    4    0    0    0    0    0    0    0    0    0    1    9
   90        0    0    4    0    0    0    0    0    0    0    0    0    1    9
   91        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 ***
   53        0    0    0    0    0    0    0    0    0    0    0
   58        0    0    0    0    0    0    0    0    0    0    0
   85        0    0    0    0    0    0    0    0    0    0    0
   92        0    0    0    0    0    0    0    0    0    0    0
   47        0    0    0    0    0    0    0    0    0    0    0
   49        0    0    0    0    0    0    0    0    0    0    0
   50        0    0    0    0    0    0    0    0    0    0    0
   51        0    0    0    0    0    0    0    0    0    0    0
   55        0    0    0    0    0    0    0    0    0    0    0
   60        0    0    0    0    0    0    0    0    0    0    0
   93        0    0    0    0    0    0    0    0    0    0    0
   54        0    0    0    0    0    0    0    0    0    0    0
   63        0    0    0    0    0    0    0    0    0    0    0
   86        0    0    0    0    0    0    0    0    0    0    0
   56        0    0    0    0    0    0    0    0    0    0    0
   59        0    0    0    0    0    0    0    0    0    0    0
   87        0    0    0    0    0    0    0    0    0    0    0
   57        0    0    0    0    0    0    0    0    0    0    0
   84        0    0    0    0    0    0    0    0    0    0    0
   90        0    0    0    0    0    0    0    0    0    0    0
   91        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
   53          0         6      0.04        400       0.05          0       0.96
   58          0         6      0.04        400        0.1          0       0.96
   85          0         6      0.04        400       0.05          0       0.96
   92          0         6      0.04        400       0.05          0       0.96
   47          0         6      0.03        400       0.05          0       0.96
   49          0         6      0.04        400       0.05          0       0.96
   50          0         6      0.03        400        0.1          0       0.96
   51          0         6      0.04        400        0.1          0       0.96
   55          0         6      0.04        400       0.05          0       0.96
   60          0         6      0.04        400        0.1          0       0.96
   93          0         6      0.03        400       0.05          0       0.96
   54          0         6      0.03        400       0.05          0       0.96
   63          0         6      0.04        400        0.1          0       0.96
   86          0         6      0.03        400       0.05          0       0.96
   56          0         6      0.03        400        0.1          0       0.96
   59          0         6      0.03        400        0.1          0       0.96
   87          0         6      0.03        400        0.1          0       0.96
```

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```
57               0         6      0.04        400      0.05         0        0.96
84               0         6      0.04        400       0.1         0        0.96
90               0         6      0.04        400       0.1         0        0.96
91               0         6      0.04        400       0.1         0        0.96
END PWAT-PARM2

PWAT-PARM3
  <PLS >       PWATER input info: Part 3          ***
  # - # ***PETMAX    PETMIN     INFEXP     INFILD     DEEPFR     BASETP     AGWETP
53               0         0         3          2         0          0          0
58               0         0         3          2         0          0          0
85               0         0         3          2         0          0          0
92               0         0         3          2         0          0          0
47               0         0         3          2         0          0          0
49               0         0         3          2         0          0          0
50               0         0         3          2         0          0          0
51               0         0         3          2         0          0          0
55               0         0         3          2         0          0          0
60               0         0         3          2         0          0          0
93               0         0         3          2         0          0          0
54               0         0         3          2         0          0          0
63               0         0         3          2         0          0          0
86               0         0         3          2         0          0          0
56               0         0         3          2         0          0          0
59               0         0         3          2         0          0          0
87               0         0         3          2         0          0          0
57               0         0         3          2         0          0          0
84               0         0         3          2         0          0          0
90               0         0         3          2         0          0          0
91               0         0         3          2         0          0          0
END PWAT-PARM3
PWAT-PARM4
  <PLS >       PWATER input info: Part 4                          ***
  # - #     CEPSC      UZSN       NSUR       INTFW      IRC      LZETP ***
53             0.2       0.4       0.35          2       0.4        0.7
58             0.2       0.4       0.35          2       0.4        0.7
85             0.2       0.4       0.35          2       0.4        0.7
92             0.2       0.4       0.35          2       0.4        0.7
47            0.15       0.4        0.3          2       0.4        0.4
49             0.2       0.4       0.35          2       0.4        0.7
50            0.15       0.4        0.3          2       0.4        0.4
51             0.2       0.4       0.35          2       0.4        0.7
55             0.2       0.4       0.35          2       0.4        0.7
60             0.2       0.4       0.35          2       0.4        0.7
93            0.15       0.4        0.3          2       0.4        0.4
54            0.15       0.4        0.3          2       0.4        0.4
63             0.2       0.4       0.35          2       0.4        0.7
86            0.15       0.4        0.3          2       0.4        0.4
56            0.15       0.4        0.3          2       0.4        0.4
59            0.15       0.4        0.3          2       0.4        0.4
87            0.15       0.4        0.3          2       0.4        0.4
57             0.2       0.4       0.35          2       0.4        0.7
84             0.2       0.4       0.35          2       0.4        0.7
90             0.2       0.4       0.35          2       0.4        0.7
91             0.2       0.4       0.35          2       0.4        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
53               0         0         0          0        2.5         1          0
58               0         0         0          0        2.5         1          0
85               0         0         0          0        2.5         1          0
92               0         0         0          0        2.5         1          0
47               0         0         0          0        2.5         1          0
49               0         0         0          0        2.5         1          0
50               0         0         0          0        2.5         1          0
51               0         0         0          0        2.5         1          0
55               0         0         0          0        2.5         1          0
```

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```
   60                  0          0           0          0        2.5        1          0
   93                  0          0           0          0        2.5        1          0
   54                  0          0           0          0        2.5        1          0
   63                  0          0           0          0        2.5        1          0
   86                  0          0           0          0        2.5        1          0
   56                  0          0           0          0        2.5        1          0
   59                  0          0           0          0        2.5        1          0
   87                  0          0           0          0        2.5        1          0
   57                  0          0           0          0        2.5        1          0
   84                  0          0           0          0        2.5        1          0
   90                  0          0           0          0        2.5        1          0
   91                  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            ***
   17        ROADS/FLAT            1    1    1   27    0
   18        ROADS/FLAT            1    1    1   27    0
   19        ROADS/FLAT            1    1    1   27    0
   20        ROADS/FLAT            1    1    1   27    0
   21        ROADS/FLAT            1    1    1   27    0
   22        ROADS/FLAT            1    1    1   27    0
   23        ROADS/FLAT            1    1    1   27    0
   33        ROADS/FLAT            1    1    1   27    0
   36        ROADS/FLAT            1    1    1   27    0
   37        ROADS/FLAT            1    1    1   27    0
   40        ROADS/FLAT            1    1    1   27    0
   41        ROADS/FLAT            1    1    1   27    0
   16        ROADS/FLAT            1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***


  ACTIVITY
    <PLS > ************* Active Sections ***************************
    # -  # ATMP SNOW IWAT   SLD   IWG IQAL    ***
   17        0    0    1    0     0    0
   18        0    0    1    0     0    0
   19        0    0    1    0     0    0
   20        0    0    1    0     0    0
   21        0    0    1    0     0    0
   22        0    0    1    0     0    0
   23        0    0    1    0     0    0
   33        0    0    1    0     0    0
   36        0    0    1    0     0    0
   37        0    0    1    0     0    0
   40        0    0    1    0     0    0
   41        0    0    1    0     0    0
   16        0    0    1    0     0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT   SLD   IWG IQAL   *********
   17        0    0    4    0     0    0     1    9
   18        0    0    4    0     0    0     1    9
   19        0    0    4    0     0    0     1    9
   20        0    0    4    0     0    0     1    9
   21        0    0    4    0     0    0     1    9
   22        0    0    4    0     0    0     1    9
   23        0    0    4    0     0    0     1    9
   33        0    0    4    0     0    0     1    9
   36        0    0    4    0     0    0     1    9
   37        0    0    4    0     0    0     1    9
   40        0    0    4    0     0    0     1    9
   41        0    0    4    0     0    0     1    9
```

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```
 16          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      ***
 17          0    0    0    0    0
 18          0    0    0    0    0
 19          0    0    0    0    0
 20          0    0    0    0    0
 21          0    0    0    0    0
 22          0    0    0    0    0
 23          0    0    0    0    0
 33          0    0    0    0    0
 36          0    0    0    0    0
 37          0    0    0    0    0
 40          0    0    0    0    0
 41          0    0    0    0    0
 16          0    0    0    0    0
END IWAT-PARM1

IWAT-PARM2
  <PLS >       IWATER input info: Part 2        ***
  # -  # ***   LSUR     SLSUR      NSUR     RETSC
 17          400      0.01       0.1       0.1
 18          400      0.01       0.1       0.1
 19          400      0.01       0.1       0.1
 20          400      0.01       0.1       0.1
 21          400      0.01       0.1       0.1
 22          400      0.01       0.1       0.1
 23          400      0.01       0.1       0.1
 33          400      0.01       0.1       0.1
 36          400      0.01       0.1       0.1
 37          400      0.01       0.1       0.1
 40          400      0.01       0.1       0.1
 41          400      0.01       0.1       0.1
 16          400      0.01       0.1       0.1
END IWAT-PARM2

IWAT-PARM3
  <PLS >       IWATER input info: Part 3        ***
  # -  # ***PETMAX    PETMIN
 17          0         0
 18          0         0
 19          0         0
 20          0         0
 21          0         0
 22          0         0
 23          0         0
 33          0         0
 36          0         0
 37          0         0
 40          0         0
 41          0         0
 16          0         0
END IWAT-PARM3

IWAT-STATE1
  <PLS > *** Initial conditions at start of simulation
  # -  # ***  RETS      SURS
 17          0         0
 18          0         0
 19          0         0
 20          0         0
 21          0         0
 22          0         0
 23          0         0
 33          0         0
 36          0         0
 37          0         0
```

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```
     40               0        0
     41               0        0
     16               0        0
   END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                 <--Area-->      <-Target->   MBLK   ***
<Name>    #                <-factor->      <Name>   #   Tbl#   ***
Field Flat (A)***
PERLND  47                    14.6139      IMPLND  16     54
PERLND  47                    14.6139      IMPLND  16     55
PERLND  47                    14.6139      IMPLND  16     56
Roadway (A)***
IMPLND  16                     1.0567      PERLND  84     50
Field Flat (C)***
PERLND  54                       0.76      PERLND  91     30
PERLND  54                       0.76      PERLND  91     34
PERLND  54                       0.76      PERLND  91     38
Impervious (D)***
IMPLND  21                     0.0739      PERLND  56     50
Forest Flat (A)***
PERLND  49                    18.1957      IMPLND  16     54
PERLND  49                    18.1957      IMPLND  16     55
PERLND  49                    18.1957      IMPLND  16     56
Field Mod (B)***
PERLND  50                     1.1754      PERLND  90     30
PERLND  50                     1.1754      PERLND  90     34
PERLND  50                     1.1754      PERLND  90     38
Impervious (A)***
IMPLND  17                     0.0715      PERLND  47     50
Forest Mod (B)***
PERLND  51                     1.5905      PERLND  90     30
PERLND  51                     1.5905      PERLND  90     34
PERLND  51                     1.5905      PERLND  90     38
Impervious (A)***
IMPLND  18                     0.0388      PERLND  49     50
Forest Flat (C)***
PERLND  53                     0.2284      PERLND  54     30
PERLND  53                     0.2284      PERLND  54     34
PERLND  53                     0.2284      PERLND  54     38
Impervious (C)***
IMPLND  19                     0.1749      PERLND  54     50
Impervious (D)***
IMPLND  20                     0.1366      PERLND  55     50
Forest Flat (D)***
PERLND  55                     1.1076      PERLND  56     30
PERLND  55                     1.1076      PERLND  56     34
PERLND  55                     1.1076      PERLND  56     38
Impervious (D)***
IMPLND  22                     0.0257      PERLND  57     50
Field Mod (D)***
PERLND  56                     0.9002      PERLND  57     30
PERLND  56                     0.9002      PERLND  57     34
PERLND  56                     0.9002      PERLND  57     38
Impervious (F)***
IMPLND  23                     0.1343      PERLND  60     50
Forest Flat (D)***
PERLND  57                     0.2662      PERLND  91     30
PERLND  57                     0.2662      PERLND  91     34
PERLND  57                     0.2662      PERLND  91     38
Impervious (F)***
IMPLND  33                      0.023      PERLND  59     50
Forest Mod (E)***
PERLND  58                     0.0507      PERLND  91     30
PERLND  58                     0.0507      PERLND  91     34
PERLND  58                     0.0507      PERLND  91     38
Impervious (B)***
IMPLND  36                     0.0942      PERLND  50     50
```

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```
Field Mod (F)***
PERLND  59                      0.6315     PERLND  91     30
PERLND  59                      0.6315     PERLND  91     34
PERLND  59                      0.6315     PERLND  91     38
Impervious (B)***
IMPLND  37                      0.1145     PERLND  51     50
Forest Mod (F)***
PERLND  60                      0.6792     PERLND  59     30
PERLND  60                      0.6792     PERLND  59     34
PERLND  60                      0.6792     PERLND  59     38
Impervious (G)***
IMPLND  40                       0.044     PERLND  86     50
Impervious (G)***
IMPLND  41                      0.1187     PERLND  87     50
Forest Mod (On-site)***
PERLND  63                      0.1941     PERLND  91     30
PERLND  63                      0.1941     PERLND  91     34
PERLND  63                      0.1941     PERLND  91     38
Forest Mod (B)***
PERLND  84                      0.1312     PERLND  90     30
PERLND  84                      0.1312     PERLND  90     34
PERLND  84                      0.1312     PERLND  90     38
Forest Flat (G)***
PERLND  85                       0.372     PERLND  86     30
PERLND  85                       0.372     PERLND  86     34
PERLND  85                       0.372     PERLND  86     38
Field Flat (G)***
PERLND  86                       1.057     PERLND  87     30
PERLND  86                       1.057     PERLND  87     34
PERLND  86                       1.057     PERLND  87     38
Field Mod (G)***
PERLND  87                      0.3913     PERLND  90     30
PERLND  87                      0.3913     PERLND  90     34
PERLND  87                      0.3913     PERLND  90     38
Forest Flat (On-site)***
PERLND  92                      1.1349     PERLND  93     30
PERLND  92                      1.1349     PERLND  93     34
PERLND  92                      1.1349     PERLND  93     38
Field Flat (On-site)***
PERLND  93                      1.0456     PERLND  63     30
PERLND  93                      1.0456     PERLND  63     34
PERLND  93                      1.0456     PERLND  63     38
Wetland Buffer North***
PERLND  90                       26.91     COPY   501     12
PERLND  90                       26.91     COPY   501     13
PERLND  90                       26.91     COPY   501     14
Wetland Buffer South***
PERLND  91                       24.83     COPY   501     12
PERLND  91                       24.83     COPY   501     13
PERLND  91                       24.83     COPY   501     14

******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                         ***
```

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```
  END GEN-INFO
  *** Section RCHRES***

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

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

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

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

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #         <Name> # #  ***
WDM      2 PREC     ENGL    1.3            PERLND   1 999 EXTNL   PREC
WDM      2 PREC     ENGL    1.3            IMPLND   1 999 EXTNL   PREC
WDM      1 EVAP     ENGL    0.8            PERLND   1 999 EXTNL   PETINP
WDM      1 EVAP     ENGL    0.8            IMPLND   1 999 EXTNL   PETINP


END EXT SOURCES

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

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


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


  MASS-LINK       14
PERLND     PWATER AGWO      0.083333      COPY            INPUT  MEAN
  END MASS-LINK   14


  MASS-LINK       30
PERLND     PWATER SURO                    PERLND          EXTNL  SURLI
```

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```
  END MASS-LINK    30

   MASS-LINK       34
PERLND     PWATER IFWO                        PERLND          EXTNL  IFWLI
   END MASS-LINK    34

   MASS-LINK       38
PERLND     PWATER AGWO                        PERLND          EXTNL  AGWLI
   END MASS-LINK    38

   MASS-LINK       50
IMPLND     IWATER SURO                        PERLND          EXTNL  SURLI
   END MASS-LINK    50

   MASS-LINK       54
PERLND     PWATER SURO                        IMPLND          EXTNL  SURLI
   END MASS-LINK    54

   MASS-LINK       55
PERLND     PWATER IFWO                        IMPLND          EXTNL  SURLI
   END MASS-LINK    55

   MASS-LINK       56
PERLND     PWATER AGWO                        IMPLND          EXTNL  SURLI
   END MASS-LINK    56


END MASS-LINK

END RUN
```

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Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END     2008 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    8397 MR8 Wetland Protection.wdm
MESSU      25    Mit8397 MR8 Wetland Protection.MES
           27    Mit8397 MR8 Wetland Protection.L61
           28    Mit8397 MR8 Wetland Protection.L62
           30    POC8397 MR8 Wetland Protection1.dat
END FILES

OPN SEQUENCE
    INGRP             INDELT 00:15
       IMPLND     24
       IMPLND     25
       PERLND     69
       IMPLND     27
       IMPLND     28
       IMPLND     29
       IMPLND     30
       PERLND     73
       IMPLND     32
       IMPLND     31
       PERLND     31
       IMPLND      1
       IMPLND      5
       IMPLND     11
       IMPLND     14
       IMPLND     34
       IMPLND     35
       PERLND     81
       IMPLND     38
       IMPLND     39
       PERLND     64
       PERLND     65
       PERLND     66
       PERLND     67
       PERLND     70
       PERLND     75
       RCHRES      1
       PERLND     68
       PERLND     82
       PERLND     71
       PERLND     74
       IMPLND     26
       PERLND     83
       PERLND     72
       PERLND     80
       PERLND     88
       PERLND     89
       COPY      501
       COPY        1
       DISPLY      1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Wetland Buffer North        MAX                   1   2   30    9
  END DISPLY-INFO1
```

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```
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          ***
    69      SG4, Forest, Flat    1    1   1   1    27    0
    73      SG4, Forest, Mod     1    1   1   1    27    0
    31      SG4, Field, Flat     1    1   1   1    27    0
    81      SG4, Forest, Flat    1    1   1   1    27    0
    64      SG4, Field, Flat     1    1   1   1    27    0
    65      SG4, Forest, Flat    1    1   1   1    27    0
    66      SG4, Field, Mod      1    1   1   1    27    0
    67      SG4, Forest, Mod     1    1   1   1    27    0
    70      SG4, Forest, Flat    1    1   1   1    27    0
    75      SG4, Forest, Mod     1    1   1   1    27    0
    68      SG4, Field, Flat     1    1   1   1    27    0
    82      SG4, Field, Flat     1    1   1   1    27    0
    71      SG4, Field, Mod      1    1   1   1    27    0
    74      SG4, Field, Mod      1    1   1   1    27    0
    83      SG4, Field, Mod      1    1   1   1    27    0
    72      SG4, Forest, Flat    1    1   1   1    27    0
    80      SG4, Forest, Mod     1    1   1   1    27    0
    88      SG4, Forest, Mod     1    1   1   1    27    0
    89      SG4, 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 ***
    69        0    0    1    0    0    0    0    0    0    0    0    0
    73        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
    81        0    0    1    0    0    0    0    0    0    0    0    0
    64        0    0    1    0    0    0    0    0    0    0    0    0
    65        0    0    1    0    0    0    0    0    0    0    0    0
    66        0    0    1    0    0    0    0    0    0    0    0    0
    67        0    0    1    0    0    0    0    0    0    0    0    0
    70        0    0    1    0    0    0    0    0    0    0    0    0
    75        0    0    1    0    0    0    0    0    0    0    0    0
    68        0    0    1    0    0    0    0    0    0    0    0    0
    82        0    0    1    0    0    0    0    0    0    0    0    0
    71        0    0    1    0    0    0    0    0    0    0    0    0
    74        0    0    1    0    0    0    0    0    0    0    0    0
    83        0    0    1    0    0    0    0    0    0    0    0    0
    72        0    0    1    0    0    0    0    0    0    0    0    0
    80        0    0    1    0    0    0    0    0    0    0    0    0
    88        0    0    1    0    0    0    0    0    0    0    0    0
    89        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  *********
```

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```
69            0    0    4    0    0    0    0    0    0    0    0    0    1    9
73            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
81            0    0    4    0    0    0    0    0    0    0    0    0    1    9
64            0    0    4    0    0    0    0    0    0    0    0    0    1    9
65            0    0    4    0    0    0    0    0    0    0    0    0    1    9
66            0    0    4    0    0    0    0    0    0    0    0    0    1    9
67            0    0    4    0    0    0    0    0    0    0    0    0    1    9
70            0    0    4    0    0    0    0    0    0    0    0    0    1    9
75            0    0    4    0    0    0    0    0    0    0    0    0    1    9
68            0    0    4    0    0    0    0    0    0    0    0    0    1    9
82            0    0    4    0    0    0    0    0    0    0    0    0    1    9
71            0    0    4    0    0    0    0    0    0    0    0    0    1    9
74            0    0    4    0    0    0    0    0    0    0    0    0    1    9
83            0    0    4    0    0    0    0    0    0    0    0    0    1    9
72            0    0    4    0    0    0    0    0    0    0    0    0    1    9
80            0    0    4    0    0    0    0    0    0    0    0    0    1    9
88            0    0    4    0    0    0    0    0    0    0    0    0    1    9
89            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 ***
69            0    0    0    0    0    0    0    0    0    0    0
73            0    0    0    0    0    0    0    0    0    0    0
31            0    0    0    0    0    0    0    0    0    0    0
81            0    0    0    0    0    0    0    0    0    0    0
64            0    0    0    0    0    0    0    0    0    0    0
65            0    0    0    0    0    0    0    0    0    0    0
66            0    0    0    0    0    0    0    0    0    0    0
67            0    0    0    0    0    0    0    0    0    0    0
70            0    0    0    0    0    0    0    0    0    0    0
75            0    0    0    0    0    0    0    0    0    0    0
68            0    0    0    0    0    0    0    0    0    0    0
82            0    0    0    0    0    0    0    0    0    0    0
71            0    0    0    0    0    0    0    0    0    0    0
74            0    0    0    0    0    0    0    0    0    0    0
83            0    0    0    0    0    0    0    0    0    0    0
72            0    0    0    0    0    0    0    0    0    0    0
80            0    0    0    0    0    0    0    0    0    0    0
88            0    0    0    0    0    0    0    0    0    0    0
89            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
69           0      6     0.04     400     0.05        0       0.96
73           0      6     0.04     400      0.1        0       0.96
31           0      6     0.03     400     0.05        0       0.96
81           0      6     0.04     400     0.05        0       0.96
64           0      6     0.03     400     0.05        0       0.96
65           0      6     0.04     400     0.05        0       0.96
66           0      6     0.03     400      0.1        0       0.96
67           0      6     0.04     400      0.1        0       0.96
70           0      6     0.04     400     0.05        0       0.96
75           0      6     0.04     400      0.1        0       0.96
68           0      6     0.03     400     0.05        0       0.96
82           0      6     0.03     400     0.05        0       0.96
71           0      6     0.03     400      0.1        0       0.96
74           0      6     0.03     400      0.1        0       0.96
83           0      6     0.03     400      0.1        0       0.96
72           0      6     0.04     400     0.05        0       0.96
80           0      6     0.04     400      0.1        0       0.96
88           0      6     0.04     400      0.1        0       0.96
89           0      6     0.04     400      0.1        0       0.96
END PWAT-PARM2

PWAT-PARM3
```

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```
  <PLS >      PWATER input info: Part 3          ***
  # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
 69          0         0         3         2         0         0         0
 73          0         0         3         2         0         0         0
 31          0         0         3         2         0         0         0
 81          0         0         3         2         0         0         0
 64          0         0         3         2         0         0         0
 65          0         0         3         2         0         0         0
 66          0         0         3         2         0         0         0
 67          0         0         3         2         0         0         0
 70          0         0         3         2         0         0         0
 75          0         0         3         2         0         0         0
 68          0         0         3         2         0         0         0
 82          0         0         3         2         0         0         0
 71          0         0         3         2         0         0         0
 74          0         0         3         2         0         0         0
 83          0         0         3         2         0         0         0
 72          0         0         3         2         0         0         0
 80          0         0         3         2         0         0         0
 88          0         0         3         2         0         0         0
 89          0         0         3         2         0         0         0
END PWAT-PARM3
PWAT-PARM4
  <PLS >      PWATER input info: Part 4                          ***
  # -  #      CEPSC     UZSN      NSUR      INTFW      IRC      LZETP ***
 69          0.2       0.4       0.35        2        0.4       0.7
 73          0.2       0.4       0.35        2        0.4       0.7
 31          0.15      0.4       0.3         2        0.4       0.4
 81          0.2       0.4       0.35        2        0.4       0.7
 64          0.15      0.4       0.3         2        0.4       0.4
 65          0.2       0.4       0.35        2        0.4       0.7
 66          0.15      0.4       0.3         2        0.4       0.4
 67          0.2       0.4       0.35        2        0.4       0.7
 70          0.2       0.4       0.35        2        0.4       0.7
 75          0.2       0.4       0.35        2        0.4       0.7
 68          0.15      0.4       0.3         2        0.4       0.4
 82          0.15      0.4       0.3         2        0.4       0.4
 71          0.15      0.4       0.3         2        0.4       0.4
 74          0.15      0.4       0.3         2        0.4       0.4
 83          0.15      0.4       0.3         2        0.4       0.4
 72          0.2       0.4       0.35        2        0.4       0.7
 80          0.2       0.4       0.35        2        0.4       0.7
 88          0.2       0.4       0.35        2        0.4       0.7
 89          0.2       0.4       0.35        2        0.4       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
 69          0         0         0         0        2.5        1         0
 73          0         0         0         0        2.5        1         0
 31          0         0         0         0        2.5        1         0
 81          0         0         0         0        2.5        1         0
 64          0         0         0         0        2.5        1         0
 65          0         0         0         0        2.5        1         0
 66          0         0         0         0        2.5        1         0
 67          0         0         0         0        2.5        1         0
 70          0         0         0         0        2.5        1         0
 75          0         0         0         0        2.5        1         0
 68          0         0         0         0        2.5        1         0
 82          0         0         0         0        2.5        1         0
 71          0         0         0         0        2.5        1         0
 74          0         0         0         0        2.5        1         0
 83          0         0         0         0        2.5        1         0
 72          0         0         0         0        2.5        1         0
 80          0         0         0         0        2.5        1         0
 88          0         0         0         0        2.5        1         0
 89          0         0         0         0        2.5        1         0
END PWAT-STATE1
```

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```
END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name-------->   Unit-systems    Printer ***
    # -  #                        User  t-series Engl Metr ***
                                        in   out               ***
    24        ROADS/FLAT           1    1    1    27    0
    25        ROADS/FLAT           1    1    1    27    0
    27        ROADS/FLAT           1    1    1    27    0
    28        ROADS/FLAT           1    1    1    27    0
    29        ROADS/FLAT           1    1    1    27    0
    30        ROADS/FLAT           1    1    1    27    0
    32        ROADS/FLAT           1    1    1    27    0
    31        ROADS/FLAT           1    1    1    27    0
     1        ROADS/FLAT           1    1    1    27    0
     5        DRIVEWAYS/FLAT       1    1    1    27    0
    11        PARKING/FLAT         1    1    1    27    0
    14        POND                 1    1    1    27    0
    34        ROADS/FLAT           1    1    1    27    0
    35        ROADS/FLAT           1    1    1    27    0
    38        ROADS/FLAT           1    1    1    27    0
    39        ROADS/FLAT           1    1    1    27    0
    26        ROADS/FLAT           1    1    1    27    0
  END GEN-INFO
  *** Section IWATER***


  ACTIVITY
   <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    ***
    24        0    0    1    0    0    0
    25        0    0    1    0    0    0
    27        0    0    1    0    0    0
    28        0    0    1    0    0    0
    29        0    0    1    0    0    0
    30        0    0    1    0    0    0
    32        0    0    1    0    0    0
    31        0    0    1    0    0    0
     1        0    0    1    0    0    0
     5        0    0    1    0    0    0
    11        0    0    1    0    0    0
    14        0    0    1    0    0    0
    34        0    0    1    0    0    0
    35        0    0    1    0    0    0
    38        0    0    1    0    0    0
    39        0    0    1    0    0    0
    26        0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
   <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL      *********
    24        0    0    4    0    0    0    1    9
    25        0    0    4    0    0    0    1    9
    27        0    0    4    0    0    0    1    9
    28        0    0    4    0    0    0    1    9
    29        0    0    4    0    0    0    1    9
    30        0    0    4    0    0    0    1    9
    32        0    0    4    0    0    0    1    9
    31        0    0    4    0    0    0    1    9
     1        0    0    4    0    0    0    1    9
     5        0    0    4    0    0    0    1    9
    11        0    0    4    0    0    0    1    9
    14        0    0    4    0    0    0    1    9
    34        0    0    4    0    0    0    1    9
    35        0    0    4    0    0    0    1    9
    38        0    0    4    0    0    0    1    9
    39        0    0    4    0    0    0    1    9
    26        0    0    4    0    0    0    1    9
```

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```
   END PRINT-INFO

   IWAT-PARM1
     <PLS >  IWATER variable monthly parameter value flags  ***
     # -  # CSNO RTOP  VRS   VNN RTLI      ***
     24        0    0    0    0    0
     25        0    0    0    0    0
     27        0    0    0    0    0
     28        0    0    0    0    0
     29        0    0    0    0    0
     30        0    0    0    0    0
     32        0    0    0    0    0
     31        0    0    0    0    0
      1        0    0    0    0    0
      5        0    0    0    0    0
     11        0    0    0    0    0
     14        0    0    0    0    0
     34        0    0    0    0    0
     35        0    0    0    0    0
     38        0    0    0    0    0
     39        0    0    0    0    0
     26        0    0    0    0    0
   END IWAT-PARM1

   IWAT-PARM2
     <PLS >       IWATER input info: Part 2          ***
     # -  # ***   LSUR      SLSUR       NSUR      RETSC
     24        400       0.01        0.1        0.1
     25        400       0.01        0.1        0.1
     27        400       0.01        0.1        0.1
     28        400       0.01        0.1        0.1
     29        400       0.01        0.1        0.1
     30        400       0.01        0.1        0.1
     32        400       0.01        0.1        0.1
     31        400       0.01        0.1        0.1
      1        400       0.01        0.1        0.1
      5        400       0.01        0.1        0.1
     11        400       0.01        0.1        0.1
     14        400       0.01        0.1        0.1
     34        400       0.01        0.1        0.1
     35        400       0.01        0.1        0.1
     38        400       0.01        0.1        0.1
     39        400       0.01        0.1        0.1
     26        400       0.01        0.1        0.1
   END IWAT-PARM2

   IWAT-PARM3
     <PLS >       IWATER input info: Part 3          ***
     # -  # ***PETMAX     PETMIN
     24        0          0
     25        0          0
     27        0          0
     28        0          0
     29        0          0
     30        0          0
     32        0          0
     31        0          0
      1        0          0
      5        0          0
     11        0          0
     14        0          0
     34        0          0
     35        0          0
     38        0          0
     39        0          0
     26        0          0
   END IWAT-PARM3

   IWAT-STATE1
     <PLS > *** Initial conditions at start of simulation
```

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```
     # -  # ***   RETS        SURS
    24             0           0
    25             0           0
    27             0           0
    28             0           0
    29             0           0
    30             0           0
    32             0           0
    31             0           0
     1             0           0
     5             0           0
    11             0           0
    14             0           0
    34             0           0
    35             0           0
    38             0           0
    39             0           0
    26             0           0
   END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                    <--Area-->      <-Target->    MBLK    ***
<Name>    #                   <-factor->      <Name>    #   Tbl#    ***
On-site Developed***
PERLND  31                        5.642       RCHRES    1      2
PERLND  31                        5.642       RCHRES    1      3
IMPLND   1                        9.046       RCHRES    1      5
IMPLND   5                        0.826       RCHRES    1      5
IMPLND  11                        0.051       RCHRES    1      5
IMPLND  14                        0.581       RCHRES    1      5
Field Flat (C)***
PERLND  68                         0.76       PERLND   89     30
PERLND  68                         0.76       PERLND   89     34
PERLND  68                         0.76       PERLND   89     38
Impervious (D)***
IMPLND  28                       0.1366       PERLND   70     50
Impervious (A)***
IMPLND  24                       0.0715       PERLND   64     50
Field Flat (A)***
PERLND  64                      14.6139       IMPLND   26     54
PERLND  64                      14.6139       IMPLND   26     55
PERLND  64                      14.6139       IMPLND   26     56
Forest Flat (A)***
PERLND  65                      18.1957       IMPLND   26     54
PERLND  65                      18.1957       IMPLND   26     55
PERLND  65                      18.1957       IMPLND   26     56
Field Mod (B)***
PERLND  66                       1.1754       PERLND   88     30
PERLND  66                       1.1754       PERLND   88     34
PERLND  66                       1.1754       PERLND   88     38
Impervious (A)***
IMPLND  25                       0.0388       PERLND   65     50
Forest Mod (B)***
PERLND  67                       1.5905       PERLND   88     30
PERLND  67                       1.5905       PERLND   88     34
PERLND  67                       1.5905       PERLND   88     38
Roadway (A)***
IMPLND  26                       1.0567       PERLND   80     50
Impervious (C)***
IMPLND  27                       0.1749       PERLND   68     50
Forest Flat (C)***
PERLND  69                       0.2284       PERLND   68     30
PERLND  69                       0.2284       PERLND   68     34
PERLND  69                       0.2284       PERLND   68     38
Impervious (D)***
IMPLND  29                       0.0739       PERLND   71     50
Forest Flat (D)***
PERLND  70                       1.1076       PERLND   71     30
```

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```
PERLND   70                        1.1076    PERLND  71     34
PERLND   70                        1.1076    PERLND  71     38
Impervious (D)***
IMPLND   30                        0.0257    PERLND  72     50
Field Mod (D)***
PERLND   71                        0.9002    PERLND  72     30
PERLND   71                        0.9002    PERLND  72     34
PERLND   71                        0.9002    PERLND  72     38
Impervious (F)***
IMPLND   32                         0.023    PERLND  74     50
Forest Flat (D)***
PERLND   72                        0.2662    PERLND  89     30
PERLND   72                        0.2662    PERLND  89     34
PERLND   72                        0.2662    PERLND  89     38
Impervious (F)***
IMPLND   31                        0.1343    PERLND  75     50
Forest Mod (E)***
PERLND   73                        0.0507    PERLND  89     30
PERLND   73                        0.0507    PERLND  89     34
PERLND   73                        0.0507    PERLND  89     38
Impervious (B)***
IMPLND   34                        0.0942    PERLND  66     50
Field Mod (F)***
PERLND   74                        0.6315    PERLND  89     30
PERLND   74                        0.6315    PERLND  89     34
PERLND   74                        0.6315    PERLND  89     38
Impervious (B)***
IMPLND   35                        0.1145    PERLND  67     50
Forest Mod (F)***
PERLND   75                        0.6792    PERLND  74     30
PERLND   75                        0.6792    PERLND  74     34
PERLND   75                        0.6792    PERLND  74     38
Impervious (G)***
IMPLND   38                         0.044    PERLND  82     50
Impervious (G)***
IMPLND   39                        0.1187    PERLND  83     50
Forest Mod (B)***
PERLND   80                        0.1312    PERLND  88     30
PERLND   80                        0.1312    PERLND  88     34
PERLND   80                        0.1312    PERLND  88     38
Forest Flat (G)***
PERLND   81                         0.372    PERLND  82     30
PERLND   81                         0.372    PERLND  82     34
PERLND   81                         0.372    PERLND  82     38
Field Flat (G)***
PERLND   82                         1.057    PERLND  83     30
PERLND   82                         1.057    PERLND  83     34
PERLND   82                         1.057    PERLND  83     38
Field Mod (G)***
PERLND   83                        0.3913    PERLND  88     30
PERLND   83                        0.3913    PERLND  88     34
PERLND   83                        0.3913    PERLND  88     38
Wetland Buffer North***
PERLND   88                         26.91    COPY   501     12
PERLND   88                         26.91    COPY   501     13
PERLND   88                         26.91    COPY   501     14
Wetland Buffer South***
PERLND   89                         24.83    COPY   501     12
PERLND   89                         24.83    COPY   501     13
PERLND   89                         24.83    COPY   501     14


******Routing******
PERLND   66                         31.63    COPY     1     12
PERLND   66                         31.63    COPY     1     13
PERLND   66                         31.63    COPY     1     14
PERLND   67                          42.8    COPY     1     12
PERLND   67                          42.8    COPY     1     13
PERLND   67                          42.8    COPY     1     14
PERLND   68                         18.87    COPY     1     12
PERLND   68                         18.87    COPY     1     13
```

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```
PERLND  68                      18.87    COPY    1    14
PERLND  72                       6.61    COPY    1    12
PERLND  72                       6.61    COPY    1    13
PERLND  72                       6.61    COPY    1    14
PERLND  73                       1.26    COPY    1    12
PERLND  73                       1.26    COPY    1    13
PERLND  73                       1.26    COPY    1    14
PERLND  74                      15.68    COPY    1    12
PERLND  74                      15.68    COPY    1    13
PERLND  74                      15.68    COPY    1    14
RCHRES   1                       .0403   PERLND 89    60
RCHRES   1                               COPY    1    16
PERLND  80                       3.53    COPY    1    12
PERLND  80                       3.53    COPY    1    13
PERLND  80                       3.53    COPY    1    14
PERLND  83                      10.53    COPY    1    12
PERLND  83                      10.53    COPY    1    13
PERLND  83                      10.53    COPY    1    14
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     Trapezoidal Pond-058   1    1    1    1    28    0    1
  END GEN-INFO
  *** Section RCHRES***


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

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

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

  HYDR-PARM2
    # -  #    FTABNO     LEN     DELTH    STCOR       KS     DB50      ***
    <------><-------><-------><-------><-------><-------><------->     ***
    1          1      0.03     0.0      0.0      0.5      0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                 ***
    # -  # ***   VOL    Initial value of COLIND    Initial value of OUTDGT
          *** ac-ft    for each possible exit      for each possible exit
    <------><-------->    <---><---><---><---><---> *** <---><---><---><---><--->
```

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```
     1              0           4.0   0.0  0.0  0.0  0.0           0.0  0.0  0.0  0.0  0.0
   END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE     1
   91    4
     Depth      Area      Volume    Outflow1 Velocity    Travel Time***
     (ft)    (acres)  (acre-ft)    (cfs)    (ft/sec)     (Minutes)***
  0.000000  0.277548  0.000000  0.000000
  0.044444  0.278976  0.012367  0.280326
  0.088889  0.280408  0.024798  0.396441
  0.133333  0.281842  0.037292  0.485539
  0.177778  0.283280  0.049851  0.560652
  0.222222  0.284721  0.062473  0.626828
  0.266667  0.286165  0.075159  0.686656
  0.311111  0.287613  0.087910  0.741673
  0.355556  0.289064  0.100725  0.792882
  0.400000  0.290518  0.113605  0.840978
  0.444444  0.291975  0.126549  0.886469
  0.488889  0.293436  0.139558  0.929737
  0.533333  0.294900  0.152632  0.971078
  0.577778  0.296367  0.165771  1.010730
  0.622222  0.297838  0.178976  1.048884
  0.666667  0.299311  0.192246  1.085698
  0.711111  0.300788  0.205581  1.121304
  0.755556  0.302269  0.218983  1.155814
  0.800000  0.303752  0.232450  1.189323
  0.844444  0.305239  0.245983  1.221913
  0.888889  0.306729  0.259582  1.253656
  0.933333  0.308222  0.273248  1.284616
  0.977778  0.309719  0.286980  1.314846
  1.022222  0.311219  0.300778  1.344397
  1.066667  0.312722  0.314644  1.373312
  1.111111  0.314228  0.328576  1.401631
  1.155556  0.315738  0.342575  1.429388
  1.200000  0.317251  0.356642  1.456617
  1.244444  0.318767  0.370775  1.483346
  1.288889  0.320286  0.384977  1.509602
  1.333333  0.321809  0.399245  1.535409
  1.377778  0.323335  0.413582  1.560790
  1.422222  0.324864  0.427986  1.585764
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  1.911111  0.341901  0.590957  1.838221
  1.955556  0.343470  0.606188  1.859473
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  2.088889  0.348194  0.652299  1.921819
  2.133333  0.349776  0.667809  1.942156
  2.177778  0.351361  0.683390  1.962283
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  2.266667  0.354540  0.714763  2.001929
  2.311111  0.356134  0.730556  2.021643
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```

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```
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     3.200000  0.388711   1.061502   6.607857
     3.244444  0.390374   1.078815   7.097164
     3.288889  0.392040   1.096202   7.610928
     3.333333  0.393710   1.113663   8.134962
     3.377778  0.395383   1.131198   8.654857
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     3.511111  0.400421   1.184251  10.05373
     3.555556  0.402107   1.202085  10.42941
     3.600000  0.403796   1.219994  10.74890
     3.644444  0.405489   1.237978  11.01263
     3.688889  0.407184   1.256038  11.22743
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     3.866667  0.414000   1.329031  12.03678
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     3.955556  0.417427   1.365984  12.39673
     4.000000  0.419146   1.384574  12.57082
   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     1.3           PERLND    1 999 EXTNL   PREC
WDM       2 PREC      ENGL     1.3           IMPLND    1 999 EXTNL   PREC
WDM       1 EVAP      ENGL     0.8           PERLND    1 999 EXTNL   PETINP
WDM       1 EVAP      ENGL     0.8           IMPLND    1 999 EXTNL   PETINP


END EXT SOURCES

EXT TARGETS
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<Name>    #         <Name> # #<-factor->strg <Name>    # <Name>     tem strg strg***
COPY      1 OUTPUT MEAN   1 1      48.4      WDM      701 FLOW      ENGL      REPL
COPY    501 OUTPUT MEAN   1 1      48.4      WDM      801 FLOW      ENGL      REPL
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
```

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


   MASS-LINK        14
PERLND     PWATER AGWO        0.083333    COPY           INPUT  MEAN
   END MASS-LINK     14


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


   MASS-LINK        30
PERLND     PWATER SURO                    PERLND         EXTNL  SURLI
   END MASS-LINK     30


   MASS-LINK        34
PERLND     PWATER IFWO                    PERLND         EXTNL  IFWLI
   END MASS-LINK     34


   MASS-LINK        38
PERLND     PWATER AGWO                    PERLND         EXTNL  AGWLI
   END MASS-LINK     38


   MASS-LINK        50
IMPLND     IWATER SURO                    PERLND         EXTNL  SURLI
   END MASS-LINK     50


   MASS-LINK        54
PERLND     PWATER SURO                    IMPLND         EXTNL  SURLI
   END MASS-LINK     54


   MASS-LINK        55
PERLND     PWATER IFWO                    IMPLND         EXTNL  SURLI
   END MASS-LINK     55


   MASS-LINK        56
PERLND     PWATER AGWO                    IMPLND         EXTNL  SURLI
   END MASS-LINK     56


   MASS-LINK        60
RCHRES     ROFLOW        12.00000         PERLND         EXTNL  SURLI
   END MASS-LINK     60


END MASS-LINK

END RUN
```

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Predeveloped HSPF Message File

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Mitigated HSPF Message File

Exhibit 6 SUB24-1002

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Appendix H: Soils Report

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Report of Geotechnical Engineering Services

Webberley Development

Camas, Washington

October 11, 2023

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Columbia West
Engineering, Inc

October 11, 2023

HSR Development
500 E. Broadway, Suite 120
Vancouver, Washington 98660

Attn: Steven Waugh

Report of Geotechnical Engineering Services
Webberley Development
Camas, Washington
Columbia West Project: HSR-3-01-1

Columbia West is pleased to present this report of geotechnical engineering services for the Webberley Development in Camas, Washington. Our services were conducted in accordance with our proposal dated August 21, 2023.

We appreciate the opportunity to work on the project. Please contact us if you have any questions regarding this document.

Sincerely,

Columbia West

Daniel Lehto, PE
Principal Engineer

DEL:ASR:MAC

Attachments
Document ID: Webberley Development Geotechnical Report.docx

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EXECUTIVE SUMMARY

This executive summary presents the primary geotechnical considerations associated with the proposed Webberley Development project located in Camas, Washington. Our conclusions and recommendations are based upon the subsurface information presented in this report and proposed development information provided by the design team. Detailed discussion of the geotechnical considerations summarized here is presented in respective sections of the report.

- Based on subsurface exploration and testing, infiltration of concentrated stormwater is infeasible due to the presence of relatively shallow bedrock and slowly permeable soils. In our opinion, the behavior of site soils indicate they should be classified as WWHM Group 4 soils. See Section 6.0, Infiltration Testing for details.

- Based upon site research, surface reconnaissance, and subsurface exploration, specific Geologic Hazards, as defined by the *Camas Municipal Code, Section 16.59,* were not encountered at the site.

- Excavator refusal was encountered in several test pits in the proposed development area as shallow as 6 feet BGS and groundwater was encountered at 11.5 feet BGS in TP-2 in August 2023. Deep excavations at the site may require rock excavation techniques and/or dewatering systems to install necessary elements.

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GEOTECHNICAL SITE INVESTIGATION
WEBBERLEY DEVELOPMENT
CAMAS, WASHINGTON

1.0   INTRODUCTION

Columbia West Engineering, Inc. (Columbia West) was retained by HSR Development to conduct a geotechnical site investigation for the proposed Webberley Development project located in Camas, Washington. The purpose of the investigation was to provide geotechnical engineering recommendations for use in design and construction of the proposed development. This report summarizes the investigation and provides field assessment documentation and laboratory analytical test reports. This report is subject to the limitations expressed in Section 11.0, *Conclusion and Limitations*, and Appendix C.

1.1   GENERAL SITE INFORMATION

As indicated on Figures 1 and 2, the subject site is located east and west of 921 SE Gardner Road in Camas, Washington. The site is comprised of tax parcels 178140000, 178159000, 178169000, and 178108000 totaling approximately 36.12 acres. The approximate latitude and longitude are N 45° 36' 56" and W 122° 23' 53", and the legal description is a portion of the NE ¼ of Section 35, T2N, R3E, Willamette Meridian. The regulatory jurisdictional agency is the City of Camas.

1.2   PROJECT UNDERSTANDING

Based on client correspondence and review of the preliminary site plan shown in Figure 2A, proposed development includes construction of a 156-lot residential subdivision and a 10-building multi-family residential and commercial development. Proposed development also includes paved access roads, paved parking lots, essential underground utilities, and stormwater management facilities. Grading plans were not available at the time this report was prepared.

We anticipate maximum loads for the buildings will be less than 40 kips per column and 5 kips per foot for perimeter footings. Allowable total and differential static settlement tolerances for the structures are 1 inch and 0.5 inch over a 50-foot span, respectively. We also anticipate that proposed structures will be Risk Category II with a fundamental period less than 0.5 second. We should be contacted to revise our recommendations if the assumptions stated above are incorrect.

2.0   SCOPE OF SERVICES

Columbia West's scope of services was outlined in a proposal dated August 21, 2023. In accordance with our proposal, we performed the following geotechnical services:
- Reviewed information available in our files from previous geological and geotechnical studies conducted at and in the vicinity of the site.
- Reviewed preliminary site plans and structural information provided by the design team.
- Conducted subsurface exploration at the site, to include:
  - Excavated 12 test pits to depths ranging from 6 to 13 feet BGS. Infiltration testing was conducted in eight test pits.
- Collected disturbed soil samples from test pits for laboratory analysis.
- Classified and logged observed soil and groundwater conditions.

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- Prepared this geotechnical site investigation report for the proposed development, which includes:
    - Summary of soil index properties, regional geology, soil conditions, and observed groundwater conditions.
    - Summary of geologic and seismic literature research used to evaluate relevant seismic risks, including locations of faults, earthquake magnitudes, and seismic factors from the *2018 IBC* and *ASCE 7-16*
    - Infiltration test results
    - Fill- and load-induced settlement potential
    - Geotechnical design and construction recommendations for:
        - Shallow foundations
        - Lateral earth pressures
        - Site preparation and grading, organic stripping, fill placement and compaction, over-excavation, and construction monitoring and testing,
        - Structural fill materials, onsite soil suitability, and import aggregate specifications,
        - Utility trench excavation and backfill,
        - Drainage and management of groundwater conditions,
        - Asphaltic concrete pavement construction for access roads and parking lots
        - Seismic design parameters in accordance with *ASCE 7-16*

3.0   REGIONAL GEOLOGY AND SOIL CONDITIONS

The subject site lies within the Willamette Valley/Puget Sound Lowland, a wide physiographic depression flanked by the mountainous Coast Range on the west and the Cascade Range on the east. Inclined or uplifted structural zones within the Willamette Valley/Puget Sound Lowland constitute highland areas and depressed structural zones form sediment-filled basins. The site is located in the central eastern portion of the Portland/Vancouver Basin, an open, somewhat elliptical, northwest-trending syncline approximately 60 miles wide.

According to the *Geologic Map of the Camas Quadrangle, Clark County, Washington, and Multnomah County, Oregon* (US Geological Survey, Scientific Investigations Map 3017, 2008) and the *Geologic Map of the Washougal Quadrangle, Clark County, Washington, and Multnomah County, Oregon* (US Geological Survey, Scientific Investigations Map 3257, 2013), near-surface geology is expected to primarily consist of Pleistocene to Pliocene, unconsolidated to semiconsolidated, deeply weathered sedimentary deposits of the Unnamed conglomerate (QTc). The unnamed conglomerate is lithologically similar to the Pliocene or late Miocene Troutdale Formation, differing primarily in age of emplacement, degree of weathering, and the presence of hyaloclastite interbeds. Previously published geologic mapping has identified the QTc unit as the Troutdale Formation.

The *Web Soil Survey* (United States Department of Agriculture, Natural Resource Conservation Service [USDA NRCS], 2022 Website) identifies surface soils as Hesson clay loam with a small pocket of Washougal gravelly loam mapped in the northwest corner of Parcel 178140000. Hesson soils are generally fine-textured clays, silts, and sands with low permeability, moderate to high water capacity, and low shear strength. They are generally moisture sensitive, somewhat compressible, and described as having low to moderate shrink-swell potential. Washougal soils are generally clayey gravel soils that form on river terraces. They are generally moderately permeable, have moderate shear strength and minor shrink-swell potential.

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4.0   REGIONAL SEISMOLOGY

Recent research and subsurface mapping investigations within the Pacific Northwest appear to suggest the historic potential risk for a large earthquake event with strong localized ground movement may be underestimated. Past earthquakes in the Pacific Northwest appear to have caused landslides and ground subsidence, in addition to severe flooding near coastal areas. Earthquakes may also induce soil liquefaction, which occurs when elevated horizontal ground acceleration and velocity cause soil particles to interact as a fluid as opposed to a solid. Liquefaction of soil can result in lateral spreading and temporary loss of bearing capacity and shear strength. Liquefaction is discussed later in Section 7.0, *Geologic Hazards*

Three scenario earthquakes are possible with the local seismic setting. Two of the possible earthquake sources are associated with the Cascadia Subduction Zone (CSZ), and the third event is a shallow, local crustal earthquake that could occur in the North American Plate. The three earthquake scenarios are discussed below.

Cascadia Subduction Zone

The Cascadia Subduction Zone is a potential source of strong earthquake activity in the Portland/Vancouver Basin. This phenomenon is the result of the earth's large tectonic plate movement. Geologic evidence indicates that volcanic ocean floor activity along the Juan de Fuca ridge in the Pacific Ocean causes the Juan de Fuca Plate to perpetually move east and subduct under the North American Continental Plate. The subduction zone results in historic volcanic and potential earthquake activity in proximity to the plate interface, believed to lie approximately 20 to 50 miles west of the general location of the Oregon and Washington coast (Geomatrix Consultants, 1995).

Evidence suggests that this subduction zone has generated eight great earthquakes in the last 4,000 years, with the most recent event occurring approximately 300 years ago (Weaver and Shedlock, 1991).

Two types of subduction zone earthquakes are possible and considered in this report:

1   An interface event earthquake on the seismogenic part of the interface between the Juan de Fuca Plate and the North American Plate on the CSZ. This source is capable of generating earthquakes with a moment magnitude of 9.0.

2   A deep intraplate earthquake on the seismogenic part of the subducting Juan de Fuca Plate. These events typically occur at depths of between 30 and 60 km. This source is capable of generating an event with a moment magnitude of up to 8.0.

Crustal Events

There are at least six major known fault zones in the vicinity of the site that may be capable of generating potentially destructive horizontal accelerations. These fault zones are described briefly in Table 1.

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Table 1. Faults Within the Site Vicinity

Fault Name	Proximity to Site (km) per USGS	Mapped Length (km) per USGS
Beaverton fault zone	29	15
Helvetia fault zone	27	7
Oatfield fault zone	20	29
Portland Hills fault zone	15	49
East Bank fault	15	29
Lacamas Lake fault	1	24

5.0 GEOTECHNICAL AND GEOLOGIC FIELD INVESTIGATION

Subsurface conditions were explored by excavating 12 test pits (TP-1 through TP-12) using a track-mounted excavator at the approximate locations shown on Figure 2. The test pits were excavated on August 23, 2023 to a maximum depth of 13 feet BGS. Subsurface conditions were logged in accordance with the Unified Soil Classification System (USCS). Disturbed soil samples were collected at representative depth intervals. Test pit logs are presented in Appendix A. Analytical laboratory test results are presented in Appendix B. Soil descriptions and classification information are provided in Appendix A.

5.1 SURFACE INVESTIGATION AND SITE DESCRIPTION

The site is located just east and west of 921 SE Gardner Road in Camas, Washington. The site is comprised of tax parcels 178140000, 178159000, 178169000, and 178108000 totaling approximately 36.12 acres. The site is bound by SE Gardner Road to the west, Lacamas Heights Elementary School and Camas High School to the south, and acreage-parcel residential properties to the north and east. The site can be divided into two general areas for discussion: a developed, divided 10-acre portion to the west and a single 26.12-acre undeveloped parcel to the east. Multiple single-family homes exist on the generally cleared, divided 10-acre portion adjacent to SE Gardner Road and no structures are built on the forested eastern parcel. A Bonneville Power Authority (BPA) easement exists on the western parcel and trends northwest-southeast in the northern third of the property. Most site terrain is relatively flat to gently rolling and characterized by grades of 5 to 10 percent.

5.2 SUBSURFACE CONDITIONS

The test pits were excavated through grass surface and a 3- to 4-inch-thick root zone. An organic top soil zone extended to approximately 12 inches BGS. Underlying the surface vegetation, fine-grained residual soil and sedimentary conglomerate were encountered to the maximum explored depth of 13 feet BGS. Subsurface lithology may generally be described by the soil units identified in the following text.

5.2.1 Residual Soil

Underlying the surface vegetation, medium dense (stiff) to dense (stiff) silt, silty or clayey sand, and silty or clayey gravel was observed to depths from 6 feet to the maximum depth explored of 13 feet BGS. The moisture content of the residual soil ranged from 11 to 41 percent at the time of exploration. Atterberg limits analysis indicates that the residual soils exhibit moderate plasticity

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behavior. Soils at the site are interpreted as residual soils derived from weathered sedimentary conglomerate bedrock.

5.2.2 Sedimentary Conglomerate
Underlying the fine-grained alluvium, sedimentary conglomerate of dense to very dense silty gravel with clay and cobbles.

5.2.3 Groundwater
Groundwater was observed at a depth of 11.5 feet BGS in test pits TP-2. Note that groundwater levels are subject to seasonal variance and may rise during extended periods of increased precipitation. Perched groundwater is typical in the Camas area, generally present near the surface during the wet season and dropping below depths of 10 to 15 feet in the dry season.

6.0   INFILTRATION TESTING

6.1   GENERAL
Infiltration potential of site soils was evaluated through in situ infiltration testing within test pits TP-1, TP-2, TP-3, TP-5, TP-7, TP-8, TP-9 and TP-10. Single-ring, falling head infiltration testing was performed by embedding a 3-inch standpipe into undisturbed native soil, filling the apparatus with water, and measuring time relative to changes in hydraulic head. Using Darcy's Law for saturated flow in homogenous media, the coefficient of permeability (k) was then calculated. Representative soil samples were collected from select test locations and submitted for laboratory analysis. Results of in situ infiltration testing are presented in Table 2.

6.2   RESULTS
Results of in situ infiltration testing are presented in Table 2.

Table 2. Infiltration Test Results

Test Number	Location	Depth (feet BGS)	Passing No. 200	Depth to Groundwater (feet BGS)	Saturated Hydraulic Conductivity (in/hr)	Recommended WWHM Soil Group
IT-1.1	TP-1	3	-	Not Observed	<0.02	4
IT-1.2		6	-	Not Observed	<0.02	4
IT-2.1	TP-2	3	31	11.5	2.5	4
IT-2.2		6	19	11.5	2.5	4
IT-3.1	TP-3	3	-	Not Observed	0.5	4
IT-5.1	TP-5	3	-	Not Observed	0.3	4
IT-5.2		6	-	Not Observed	<0.2	4
IT-7.1	TP-7	3	-	Not Observed	0.3	4
IT-7.2		6	-	Not Observed	1.0	4
IT-8.1	TP-8	3	-	Not Observed	0.2	4
IT-9.1	TP-9	4	40	Not Observed	2.0	4
IT-10.1	TP-10	4	40	Not Observed	0.4	4

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6.2.1 Soil Group Classification

Based on results of infiltration testing and the presence of near-surface relatively impermeable conglomerate (QTc) site geology, infiltration potential is considered minimal at the site. The presence of near-surface seeps and springs may become evident in cut areas during earthwork activities. Columbia West classified near-surface soils into a representative soil group based upon site-specific infiltration test results and review of published literature. As indicated in Table 2, observed near-surface infiltration rates ranged from less than 0.02 to 2.5 inches per hour in the tested locations. Based upon review of USDA hydrologic soil group criteria (USDA, 2007), Appendix 2-A of the *2021 Clark County Stormwater Manual,* and the *Clark County WWHM Soil Groupings Memorandum* (Otak, 2010), the behavior of site soils generally meet the criteria for *Western Washington Hydrology Model WWHM* Soil Group 4 as presented in Table 2.

7.0   GEOLOGIC HAZARDS

Camas Municipal Code, Section 16.59 defines geologic hazard requirements for proposed development in areas subject to City of Camas jurisdiction. Three potential geologic hazards are identified: (1) erosion hazard areas, (2) landslide hazard areas, and (3) seismic hazard areas.

Columbia West conducted a geologic hazard review to assess whether these hazards are present at the subject property proposed for development, and if so, to provide mitigation recommendations. The geologic hazard review was based upon physical and visual reconnaissance, subsurface exploration, laboratory analysis of collected soil samples, and review of maps and other published technical literature. The results of the geologic hazard review are discussed in the following sections.

7.1 EROSION HAZARDS

Camas Municipal Code, Section 16.59.020.A defines an erosion hazard as areas where slope grades meet or exceed 40 percent. Based upon review of slope grade mapping published by *Clark County Maps Online,* maximum slope grades of 0 to 15 percent are mapped in the southwestern portion of the site. Therefore, site slopes do not meet the definition of an erosion hazard according to *Camas Municipal Code*.

7.2 LANDSLIDE HAZARDS

Columbia West conducted a review of available mapping, *Clark County GIS data*, and site reconnaissance to evaluate the potential presence of a landslide hazard on or near the subject site. There are no landslide hazards mapped on the property nor did Columbia West observe any slope stability hazards during site reconnaissance.

7.3 SEISMIC HAZARD AREAS

Seismic hazards include areas subject to severe risk of earthquake-induced damage. Damage may occur due to soil liquefaction, dynamic settlement, ground shaking amplification, or surface faulting rupture. These seismic hazards are discussed below.

7.3.1 Soil Liquefaction and Dynamic Settlement

According to *the Liquefaction Susceptibility Map of Clark County, Washington* (Washington State Department of Natural Resources, 2004), the site is mapped as very low susceptibility for liquefaction. Liquefaction, defined as the transformation of the behavior of a granular material from a solid to a liquid due to increased pore-water pressure and reduced effective stress, may occur when granular materials quickly compact under cyclic stresses caused by a seismic event. The effects of

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liquefaction may include immediate ground settlement, lateral spreading, and differential compaction.

Soils most susceptible to liquefaction are recent geologic deposits, such as river and floodplain sediments. These soils are generally saturated, cohesionless, loose to medium dense sands within 50 feet of ground surface. Potentially liquefiable soils located above the existing, historic, or expected ground water levels do not generally pose a liquefaction hazard. It is important to note that changes in perched ground water elevation may occur due to project development or other factors not observed at the time of investigation.

Based upon the results of subsurface exploration, literature review, and laboratory analysis, the above-mentioned criteria were not observed during the geotechnical site investigation. Therefore, the potential for soil liquefaction is considered to be very low.

7.3.2 Ground Shaking Amplification

Review of the *Site Class Map of Clark County, Washington* (Washington State Department of Natural Resources, 2004), indicates that site soils may be represented by Site Class C as defined in *2018 IBC Section 1613.3.2*. A designation of Site Class C indicates that minor amplification of seismic energy may occur during a seismic event due to subsurface conditions. However, this is typical for many areas within Clark County, does not represent a geologic hazard in Columbia West's opinion, and will not prohibit development if properly accounted for during the design process. Additional seismic information is presented in Section 8.2, *Seismic Design Considerations*.

7.3.3 Fault Rupture

Because there are no known geologic seismic faults within the site boundaries, fault rupture is unlikely.

8.0   DESIGN RECOMMENDATIONS

The geotechnical site investigation suggests the proposed development is generally compatible with surface and subsurface soils, provided the recommendations presented in this report are incorporated in design and implemented during construction. Design and construction recommendations are presented in the following sections.

8.1   Shallow Foundation Support

Proposed residential structures may be supported by conventional spread footings bearing on firm native soil or engineered structural fill.

Any loose or disturbed soil should be improved or removed and replaced with structural fill. If footing subgrade soils are above their optimum moisture content, we recommend that a minimum of 6 inches of compacted aggregate be placed over exposed subgrade soils. The aggregate pad should extend 6 inches beyond the edge of the foundations and consist of imported granular material as described in Section 9.6.1, *Structural Fill*. Columbia West should observe exposed subgrade conditions prior to placement of crushed aggregate to verify adequate subgrade support.

8.1.1   Footing Dimensions and Bearing Capacity

Continuous perimeter wall and isolated spread footings should have minimum width dimensions of 18 and 24 inches, respectively. The base of exterior footings should bear at least 18 inches below

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the lowest adjacent exterior grade. The base of interior footings should bear at least 12 inches below the base of the floor.

Footings bearing on subgrade prepared as recommended above should be sized based on an allowable bearing pressure of 2,000 psf. As the allowable bearing pressure is a net bearing pressure, the weight of the footing and associated backfill may be ignored when calculating footing sizes. The recommended allowable bearing pressure applies to the total of dead plus long-term live loads and may be increased by 50 percent for transient lateral forces such as seismic or wind.

8.1.2   Shallow Foundation Settlement

Foundation settlement is a significant structural design consideration. Provided subgrade soils are prepared as described above and in Section 9.1, *Site Preparation and Grading*, we anticipate that post-construction static foundation settlement will be less than approximately 1 inch. Differential settlement between comparably loaded foundations is not expected to exceed approximately 0.5 inch over a distance of 50 feet.

8.1.3   Resistance to Sliding

Lateral foundation loads can be resisted by passive earth pressure on the sides of the footing and by friction at the base of the footings. Recommended passive earth pressure for footings confined by native soil or engineered structural fill is 250 pcf. The upper 12 inches of soil should be neglected when calculating passive pressure resistance. Adjacent floor slabs and pavement, if present, should also be neglected from the analysis. The recommended passive pressure resistance assumes that a minimum horizontal clearance of 10 feet is maintained between the footing face and adjacent downgradient slopes.

The estimated coefficient of friction between in situ native soil or engineered structural fill and in-place poured concrete is 0.35. The estimated coefficient of friction between compacted crushed aggregate and in-place poured concrete is 0.45.

8.1.4   Subgrade Observation

Upon completion of stripping and prior to the placement of structural fill or pavement improvements, exposed subgrade soil should be evaluated by proof rolling with a fully-loaded dump truck or similar heavy, rubber tire construction equipment. When the subgrade is too wet for proof rolling, a foundation probe may be used to identify areas of soft, loose, or unsuitable soil. Subgrade evaluation should be performed by Columbia West. If soft or yielding subgrade areas are identified during evaluation, we recommend the subgrade be over-excavated and backfilled with compacted imported granular fill.

8.1.5   Floor Slabs

Floor slabs can be supported on firm, competent, native soil or engineered structural fill prepared as described in this report. Disturbed soils and unsuitable fills in proposed slab locations, if encountered, should be removed and replaced with structural fill.

To provide a capillary break, slabs should be underlain by at least 6 inches of compacted crushed aggregate that contains less than 5 percent by weight passing the No. 200 Sieve. Geotextile may be used below the crushed aggregate layer to increase subgrade support. Recommendations for floor slab base aggregate and subgrade geotextile are discussed in Section 9.6, *Materials*.

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Floor slabs with maximum floor load of 100 psf may be designed assuming a modulus of subgrade reaction, k, of 125 pci.

8.2 SEISMIC DESIGN CONSIDERATIONS

Seismic design for proposed structures is prescribed by *ASCE 7-16*. Based on literature review and results of subsurface exploration conducted by Columbia West, site soils meet the criteria for Site Class C. Seismic design parameters for Site Class C are presented in Table 3.

Table 3. ASCE 7-16 Seismic Design Parameters[1]

	Short Period	1 Second Period
MCE Spectral Acceleration	0.787	0.345
Site Class	C	
Site Coefficient	Fa = 1.2	Fv = 1.5
Adjusted Spectral Response Acceleration	$S_{MS} = 0.944$	$S_{M1} = 0.517$
Design Spectral Response Acceleration	$S_{DS} = 0.629$	$S_{D1} = 0.345$

1. The structural engineer should evaluate *ASCE 7-16* code requirements and exceptions to determine if these parameters are valid for design.

As discussed in Section 7.3, *Seismic Hazards Area*, liquefaction and lateral spreading are not design considerations for the site.

8.3 RETAINING STRUCTURES

Lateral earth pressures should be considered during design of retaining walls and below-grade structures. Hydrostatic pressure and additional surcharge loading should also be considered. Wall foundation construction and bearing capacity should adhere to specifications provided previously in Section 8.1, *Shallow Foundation Support*.

Permanent retaining walls that are not restrained from rotation and are retaining undisturbed native soil should be designed for active earth pressures using an equivalent fluid pressure of 39 pcf. Walls retaining undisturbed native soils that are restrained from rotation should be designed for an at-rest equivalent fluid pressure of 64 pcf. For walls with imported well-drained granular backfill meeting WSDOT 9.03.12(2), an equivalent fluid pressure of 34 pcf is applicable for active and 60 pcf for at rest is applicable.

The recommended earth pressures assume a maximum wall height of 10 feet with level backfill. These values also assume that adequate drainage is provided behind retaining walls to prevent hydrostatic pressures from developing. Lateral earth pressures induced by surcharge loads may be estimated using the criteria presented on Figure 3.

Seismic forces may be calculated by superimposing a uniform lateral force of $10H^2$ pounds per lineal foot of wall, where H is the total wall height in feet. The force should be applied as a distributed load with the resultant located at 0.6H from the base of the wall.

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8.3.1   Wall Drainage and Backfill

A minimum 6-inch-diameter, perforated collector pipe should be placed at the base of retaining walls. The pipe should be embedded in a minimum 2-foot-wide zone of angular drain rock that is wrapped in a drainage geotextile fabric and extends up the back of the wall to within 1 foot of finished grade. The drain rock and geotextile drainage fabric should meet the specifications provided in Section 9.6, *Materials*. The perforated collector pipes should discharge at an appropriate location away from the base of the wall. The discharge pipe(s) should not be tied directly into stormwater drainage systems, unless measures are taken to prevent backflow into the drainage system of the wall.

Backfill material placed behind the walls and extending a horizontal distance of ½ H, where H is the height of the retaining wall, should consist of select granular material placed and compacted as described in Section 9.6.1, *Structural Fill*.

Settlement of up to 1 percent of the wall height commonly occurs immediately adjacent to the wall as the wall rotates and develops active lateral earth pressures. Consequently, we recommend that construction of flatwork adjacent to retaining walls be delayed at least four weeks after placement of wall backfill, unless survey data indicates that settlement is complete prior to that time.

8.4   PAVEMENT RECOMMENDATIONS

We understand that public roadways for the subdivision will be constructed in accordance with City of Camas standards. For dry weather construction, pavement surface sections should bear upon competent subgrade consisting of scarified and compacted native soil or engineered structural fill. Wet weather construction may require an increased thickness of base aggregate as discussed later in Section 9.2, *Construction Traffic and Staging*.

In general, AC paving is not recommended during cold weather (temperatures less than 40 degrees Fahrenheit). Compacting under these conditions can result in low compaction and premature pavement distress. Each AC mix design has a recommended compaction temperature range that is specific for the particular AC binder used. In colder temperatures, it is more difficult to maintain the temperature of the AC mix, as it can lose heat while stored in the delivery truck, as it is placed, and in the time between placement and compaction.

If AC paving must take place during cold-weather construction as defined in this section, the contractor and design team should discuss options for minimizing risk to pavement serviceability.

8.5   DRAINAGE

At a minimum, site drainage should include surface water collection and conveyance to properly designed stormwater management structures and facilities. Drainage design in general should conform to City of Camas regulations. Finished site grading should be conducted with positive drainage away from structures at a minimum 2 percent slope for a distance of at least 10 feet. Depressions or shallow areas that may retain ponding water should be avoided.

Recommendations for foundation drains and subdrains are presented in the following sections. Drain rock and geotextile drainage fabric should meet the requirements presented in Section 9.6, *Materials*. Drains should be closely monitored after construction to assess their effectiveness. If additional surface or shallow subsurface seeps become evident, the drainage provisions may require

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modification or additional drains. We should be consulted to provide appropriate recommendations.

8.5.1   Foundation Drains

Roof drains are recommended for all structures. Perimeter building foundation drains should be considered for shallow foundations constructed below existing site grades but are not necessary for the functionality of the buildings.

Foundation and roof drains, where installed, should consist of separate systems that gravity flow away from foundations to an approved discharge location. Perimeter foundation drains should consist of 4-inch perforated PVC pipe surrounded by a minimum 2-foot-wide zone of clean, washed drain rock wrapped with geotextile drainage fabric. The wrapped drain rock zone should extend up the sides of embedded walls to within 12 inches of proposed finished grade. Foundation drains should be constructed with a minimum slope of ½ percent. The drainpipe's invert elevation should be at least 18 inches below the elevation of the floor slab. Figure 4 presents a typical foundation drain detail.

8.5.2   Subdrains

Subdrains should be considered if portions of the site are cut below surrounding grades. Shallow groundwater or seeps should be conveyed via drainage channel or perforated pipe into an approved discharge. Recommendations for design and installation of perforated drainage pipe may be performed on a case-by-case basis by Columbia West during construction. Failure to provide adequate surface and sub-surface drainage may result in soil slumping or unanticipated settlement of structures exceeding tolerable limits. A typical perforated drainpipe trench detail is presented in Figure 5.

9.0   CONSTRUCTION RECOMMENDATIONS

9.1   SITE PREPARATION AND GRADING

Site vegetation primarily consisted of grass and a 3- to 4-inch-thick root zone at the time of our exploration. Thicker root zones may be present in areas of mature trees and shrub growth. Moderately organic topsoil was observed to a depth of approximately 12 inches BGS. Pavement, vegetation, organic material, unsuitable fill, and deleterious material should be cleared from areas identified for structures and site grading. Vegetation, root zones, organic material, and debris should be removed from the site. Stripped topsoil should also be removed or used only as landscape fill in nonstructural areas with slopes less than 25 percent. The post-construction maximum depth of landscape fill placed or spread at any location onsite should not exceed one foot. Actual stripping depths should be determined based upon visual observations made during construction when soil conditions are exposed.

9.1.1   Subgrade Evaluation

Upon completion of stripping and prior to the placement of structural fill or pavement improvements, exposed subgrade soil should be evaluated by proof rolling with a fully-loaded dump truck or similar heavy, rubber tire construction equipment. When the subgrade is too wet for proof rolling, a foundation probe may be used to identify areas of soft, loose, or unsuitable soil. Subgrade evaluation should be performed by Columbia West. If soft or yielding subgrade areas are

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identified during evaluation, we recommend the subgrade be over-excavated and backfilled with compacted imported granular fill.

9.2   CONSTRUCTION TRAFFIC AND STAGING

Near-surface clay will be easily disturbed during construction. If not carefully executed, site preparation, excavation, and grading can create extensive soft areas resulting in significant repair costs. Earthwork planning should include considerations for minimizing subgrade disturbance, particularly during wet-weather conditions.

If construction occurs during wet-weather conditions, or if the moisture content of the surficial soil is more than a few percentage points above optimum, site stripping and cutting may need to be accomplished using track-mounted equipment. Under these conditions, granular haul roads and staging areas will also be necessary to provide a firm support base and sustain construction equipment.

The recommended base aggregate thickness for pavement sections is intended to support post-construction design traffic loads and will not provide adequate support for construction traffic. Staging areas and haul roads will require an increased base thickness during wet weather conditions. The configuration of staging and haul road areas, as well as the required thickness of granular material, will vary with the contractor's means and methods. Therefore, design and construction of staging areas and haul roads should be the responsibility of the contractor. Based on our experience, between 12 and 18 inches of imported granular material is generally required in staging areas and between 18 and 24 inches in haul road areas. In areas of heavy construction traffic, geotextile separation fabric may be placed between the subgrade soil and imported granular material to increase subgrade support and minimize fines migration into the base aggregate layer.

Project stakeholders should understand that wet weather construction is risky and costly. Proper construction methods and techniques are critical to overall project integrity and should be observed and documented by Columbia West.

9.3   CUT AND FILL SLOPES

Fill slopes should consist of structural fill material as discussed in Section 9.6.1, *Structural Fill*. Fill placed on existing grades steeper than 5H:1V should be horizontally benched at least 10 feet into the slope. Fill slopes greater than six feet in height should be vertically keyed into existing subsurface soil. A typical fill slope cross-section is shown in Figure 7. Drainage implementations, including subdrains or perforated drainpipe trenches, may also be necessary in proximity to cut and fill slopes if seeps or springs are encountered. Drainage design may be performed on a case-by-case basis. Extent, depth, and location of drainage may be determined in the field by Columbia West during construction when soil conditions are exposed. Failure to provide adequate drainage may result in soil sloughing, settlement, or erosion.

Final cut or fill slopes at the site should not exceed 2H:1V or 10 feet in height without individual slope stability analysis. The values above assume a minimum horizontal setback for loads of 10 feet from top of cut or fill slope face or overall slope height divided by three (H/3), whichever is greater. A minimum slope setback detail for structures is presented in Figure 8.

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Concentrated drainage or water flow over the face of slopes should be prohibited, and adequate protection against erosion is required. Fill slopes should be overbuilt, compacted, and trimmed at least two feet horizontally to provide adequate compaction of the outer slope face. Proper cut and fill slope construction is critical to overall project stability and should be observed and documented by Columbia West.

9.4   EXCAVATION

The site was explored to a maximum depth of 13 feet BGS with an excavator. Weathered conglomerate bedrock was encountered as shallow as 2 feet BGS (TP-6) and several test pits terminated by refusal on competent bedrock as shallow as 6 feet in the area proposed for development. If significant excavation depths are required to install utilities or other structural elements, additional exploration may be warranted to determine if conventional earthmoving equipment in proper working condition is capable of making necessary site excavations. Blasting or pecking may be required for significant excavation depths.

Groundwater was observed at a depth of 11.5 feet BGS in test pit TP-2. Recommendations as described in Section 9.5, *Dewatering*, should be considered where subsurface construction activities intersect the shallow groundwater table.

Temporary excavation sidewalls should maintain a vertical cut to a depth of approximately 4 feet in the near-surface clay, provided groundwater seepage is not present in the sidewalls. In sandy soil, excavations will likely slough and cave, even at shallow depths. Open-cut excavation techniques may be used to excavate trenches between 4 and 8 feet deep, provided the walls of the excavation are cut at a maximum slope of 1H:1V and groundwater seepage is not present. Excavation slopes should be reduced to 1.5H:1V or 2H:1V if excessive sloughing or raveling occurs.

Shoring may be required if open-cut excavations are infeasible or if excavations are proposed adjacent to existing infrastructure. Typical methods for stabilizing excavations consist of soldier piles and timber lagging, sheet pile walls, tiebacks and shotcrete, or prefabricated hydraulic shoring. As a wide variety of shoring and dewatering systems are available, we recommend that the contractor be responsible for selecting the appropriate shoring and dewatering systems.

The contractor should be held responsible for site safety, sloping, and shoring. All excavation activity should be conducted in accordance with applicable OSHA requirements. Columbia West is not responsible for contractor activities and in no case should excavation be conducted in excess of applicable local, state, and federal laws.

9.5   DEWATERING

Groundwater was observed as shallow as 11.5 feet BGS at the time of our drilling. Based on this observation, groundwater will likely be encountered in utility trench excavations and in areas of cut. Generalized recommendations for temporary construction dewatering are presented in the following section.

9.5.1 Construction Dewatering

The contractor should be responsible for temporary drainage of surface water, perched water, and groundwater. Dewatering should be performed to the extent necessary to prevent standing water and/or erosion of exposed site soils. During rough and finished grading of building pad areas, the contractor should keep all footing excavations and slab subgrade soils free of standing water.

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The contractor's proposed dewatering plan should be capable of maintaining groundwater levels at least two feet below the base of proposed trench excavations. Without adequate trench dewatering, running soil, caving, and sloughing will increase backfill volumes and may result in damage to adjacent structures or utilities. Significant pumping and dewatering may be required to temporarily reduce the groundwater elevation to the recommended depth. Dewatering via a sump within excavation zones may be insufficient to control groundwater and provide excavation side slope stability. Dewatering may be more feasibly conducted by installing a system of temporary well points and pumps around proposed excavation areas or utility trenches. Depending on proposed utility depths, a site-specific dewatering plan may be necessary.

If groundwater is present at the base of utility excavations, we recommend placing 18 to 24 inches of stabilization material at the base of the excavation. Subgrade geotextile placed directly over trench subgrade soils may reduce the required thickness of the stabilization material. The actual thickness of stabilization material should be determined at the time of construction based on observed field conditions. Trench stabilization material should be placed in one lift and compacted until well keyed. Stabilization material and geotextile fabric should meet the requirements presented in Section 9.6, *Materials*.

9.6   MATERIALS

9.6.1   Structural Fill

Areas proposed for fill placement should be appropriately prepared as described in Section 9.1, *Site Preparation and Grading*. Engineered fill placement should be observed by Columbia West. Compaction of engineered structural fill should be verified by nuclear gauge field compaction testing performed in accordance with *ASTM D6938*. Field compaction testing should be performed for each vertical foot of engineered fill placed.

Various materials may be acceptable for use as structural fill. Structural fill should be free of organic material or other unsuitable material and meet specifications provided in the following sections. Representative samples of proposed engineered structural fill should be submitted for laboratory analysis and approval by Columbia West prior to placement.

9.6.1.1 Onsite Soil

Most onsite soil will be suitable for use as structural fill if adequately dried or moisture-conditioned to achieve recommended compaction specifications. Native clay soil with a plasticity index greater than 25, if encountered, should be evaluated and approved by Columbia West prior to use as structural fill. Laboratory analysis indicated that the moisture content of the near-surface clay was above optimum at the time of exploration. Moisture conditioning will likely be necessary to dry the soil prior to applying compaction effort. In addition, the near-surface clay will be moisture sensitive and difficult, if not impossible, to compact during wet weather conditions. Therefore, structural fill placement using onsite soil should be performed during dry summer months if possible. Onsite soil may also require addition of moisture during extended periods of dry weather.

Onsite soil used as structural fill should be placed in loose lifts not exceeding 8 inches in depth and compacted using standard conventional compaction equipment. The soil moisture content should be within a few percentage points of optimum conditions. The soil should be compacted to at least

95 percent of maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557).* Compacted onsite fill soils should be covered shortly after placement.

9.6.1.2 Imported Granular Material

Imported granular material should consist of pit- or quarry-run rock, crushed rock, or crushed gravel and sand. The imported granular material should also be durable, angular, and fairly well graded between coarse and fine material; should have less than 5 percent fines (material passing the U.S. Standard No. 200 sieve) by dry weight; and should have at least two mechanically fractured faces. Imported granular material should be placed in loose lifts not exceeding 12 inches in depth and compacted to at least 95 percent of maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557).* During wet-weather conditions or where wet subgrade conditions are present, the initial loose lift of granular fill should be approximately 18 inches thick and should be compacted with a smooth-drum roller operating in static mode.

9.6.1.3 Stabilization Material

Stabilization material should consist of durable, 4- or 6-inch-minus pit- or quarry-run rock, crushed rock, or crushed gravel and sand that is free of organics and other deleterious material. The material should have a maximum particle size of 6 inches with less than 5 percent by dry weight passing the U.S. Standard No. 4 sieve. The material should have at least two mechanically fractured faces.

Stabilization material should be placed in loose lifts between 12 and 24 inches thick and be compacted to a firm, unyielding condition. Equipment with vibratory action should not be used when compacting stabilization material over wet, fine-textured soils. If stabilization material is used to stabilize soft subgrade below pavement or construction haul roads, a subgrade geotextile should be placed as a separation barrier between the soil subgrade and the stabilization material.

9.6.1.4 Trench Backfill

Trench backfill placed below, adjacent to, and up to at least 12 inches above utility lines (i.e., the pipe zone) should consist of well-graded granular material meeting *WSDOT 9-03.12(3)* specifications for *Gravel Backfill for Pipe Zone Bedding.* Pipe zone backfill should be compacted to at least 90 percent of maximum dry density, as determined by the modified Proctor moisture-density relationship test *(ASTM D1557),* or as required by the local jurisdictional agency or pipe manufacturer.

Within structural areas (below pavement and building pads), trench backfill above the pipe zone should consist of *WSDOT 9-03.19 Bank Run Gravel for Trench Backfill* or *WSDOT 9-03.14(2) Select Borrow* with a maximum particle size of 2 ½-inches. Trench backfill material within 18 inches of the top of utility pipes should be hand compacted (i.e., no heavy compaction equipment). Remaining trench backfill should be compacted to at least 95 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557),* or as required by the local jurisdictional agency or pipe manufacturer.

Outside of structural areas, trench backfill placed above the pipe zone should be compacted to at least 90 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557),* or as required by the local jurisdictional agency or pipe manufacturer.

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9.6.1.5 Floor Slab Base Aggregate

Base aggregate for building floor slabs should consist of 1 ¼"-minus crushed aggregate meeting *WSDOT 9-03.9(3)* specifications for *Crushed Surfacing*. Slab base aggregate should be compacted to at least at least 95 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557)*.

9.6.2 Pavement Base Aggregate

Base aggregate for pavement should consist of 1 ¼"-minus crushed aggregate meeting *WSDOT 9-03.9(3)* specifications for *Crushed Surfacing*. Pavement base aggregate should be compacted to at least at least 95 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557)*.

9.6.2.1 Retaining Wall Backfill

Backfill material placed behind retaining walls and extending a horizontal distance of ½ H, where H is the height of the retaining wall, should consist of free-draining granular material meeting *WSDOT 9-03.12(2)* specifications for *Gravel Backfill for Walls*. The wall backfill should be separated from structural fill, native soil, and/or topsoil using a geotextile fabric that meets the specifications provided below for drainage geotextiles.

Wall backfill located within a horizontal distance of 3 feet from the face of a retaining wall should be compacted to 90 percent of the maximum dry density, as determined by *ASTM D1557*. Backfill placed within 3 feet of the wall should be compacted in loose lifts less than 6 inches thick using hand-operated tamping equipment (such as a jumping jack or vibratory plate compactor). Remaining wall backfill should be compacted to at least 95 percent of the maximum dry density, as determined by *ASTM D1557*.

9.6.2.2 Retaining Wall Leveling Pad

Crushed aggregate used as a leveling pad for retaining wall footings should consist of 1 ¼"-minus crushed aggregate meeting *WSDOT 9-03.9(3)* specifications for *Crushed Surfacing*. The leveling pad material should be compacted to at least 95 percent of the maximum dry density as determined by the modified Proctor moisture-density relationship test *(ASTM D1557)*.

9.6.2.3 Drain Rock

Drain rock should consist of angular, granular material with a maximum particle size of 2 inches and less than 2 percent by weight passing the No. 200 sieve. Drain rock should be free of roots, organic debris, and other unsuitable material and should have at least two mechanically fractured faces. Drain rock should be compacted to a firm, unyielding condition. Drain rock should be completely wrapped in a geotextile drainage fabric meeting the requirements presented below.

9.6.3 Geotextile Fabric

9.6.3.1 Subgrade Geotextile

Subgrade geotextile should meet the specifications provided in *WSDOT 9-33.2(1), Table 3, Geotextile for Separation or Soil Stabilization*. The geotextile should be installed in accordance with the manufacturer's recommendations. A minimum initial aggregate base lift of 6 inches is required over geotextiles. All stabilization material should be underlain by a subgrade geotextile.

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9.6.3.2   Drainage Geotextile

Subgrade geotextile should meet the specifications provided in *WSDOT 9-33.2(1), Table 2, Geotextile for Underground Drainage Filtration Properties*. The AOS should be between the No. 70 and No. 100 sieve. The water permittivity should be greater than 1.5/sec. The geotextile should be installed in accordance with the manufacturer's recommendations. A minimum initial aggregate base lift of 6 inches is required over geotextiles.

9.6.4   Geotextile Fabric

9.6.4.1   Subgrade Geotextile

Subgrade geotextile should meet the specifications provided in *WSDOT 9-33.2(1), Table 3, Geotextile for Separation or Soil Stabilization*. The geotextile should be installed in accordance with the manufacturer's recommendations. A minimum initial aggregate base lift of 6 inches is required over geotextiles. All stabilization material should be underlain by a subgrade geotextile.

9.6.4.2   Drainage Geotextile

Subgrade geotextile should meet the specifications provided in *WSDOT 9-33.2(1), Table 2, Geotextile for Underground Drainage Filtration Properties*. The AOS should be between the No. 70 and No. 100 sieve. The water permittivity should be greater than 1.5/sec. The geotextile should be installed in accordance with the manufacturer's recommendations. A minimum initial aggregate base lift of 6 inches is required over geotextiles.

9.6.5   Pavement

9.6.5.1   Asphaltic Concrete

Asphaltic concrete should consist of HMA Class ½" adhering to *WSDOT 9-03.8(6), HMA Proportions of Materials*. The asphalt binder should consist of PG 58-22 meeting *WSDOT 9-02.1(4), Performance Graded (PG) Asphalt Binder*. Asphalt should be compacted to 91 percent of the theoretical maximum density as determined by *ASTM D2041*. Minimum and maximum asphalt lift thicknesses should be 2 and 3 inches, respectively. Nuclear gauge density testing should be conducted to verify adherence to recommended specifications. Testing frequency should be in accordance with WSDOT and City of Camas specifications.

9.7   EROSION CONTROL MEASURES

Soil at this site is susceptible to erosion by wind and water; therefore, erosion control measures should be carefully planned and installed before construction begins. Surface water runoff should be collected and directed away from sloped areas to prevent water from running down the slope face. Measures that can be employed to reduce erosion include the use of silt fences, hay bales, buffer zones of natural growth, sedimentation ponds, and granular haul roads. All erosion control methods should be in accordance with local jurisdiction standards.

10.0   OBSERVATION OF CONSTRUCTION

Satisfactory earthwork and foundation performance depends to a large degree on the quality of construction. Subsurface conditions observed during construction should be compared with those encountered during the subsurface explorations. Recognition of changed conditions often requires

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experience; therefore, qualified personnel should visit the site with sufficient frequency to detect whether subsurface conditions change significantly from those anticipated. In addition, sufficient observation of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications.

11.0   CONCLUSIONS AND LIMITATIONS

This geotechnical site investigation report was prepared in accordance with accepted standard conventional principles and practices of geotechnical engineering. This investigation pertains only to material tested and observed as of the date of this report and is based upon proposed site development as described in the text herein. This report is a professional opinion containing recommendations established by engineering interpretations of subsurface soils based upon conditions observed during site exploration. Soil conditions may differ between tested locations or over time. Slight variations may produce impacts to the performance of structural facilities if not adequately addressed. This underscores the importance of diligent QA/QC construction observation and testing to verify soil conditions are as anticipated in this report.

Therefore, this report contains several recommendations for field observation and testing by Columbia West personnel during construction activities. Columbia West cannot accept responsibility for deviations from recommendations described in this report. Future performance of structural facilities is often related to the degree of construction observation by qualified personnel. These services should be performed to the full extent recommended.

This report is not an environmental assessment and should not be construed as a representative warranty of site subsurface conditions. The discovery of adverse environmental conditions, or subsurface soils that deviate from those described in this report, should immediately prompt further investigation. The above statements are in lieu of all other statements expressed or implied.

♦ ♦ ♦

Sincerely,
Columbia West Engineering, Inc.
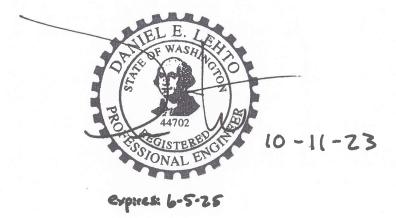
Daniel E. Lehto, PE, GE
Principal

DEL:ASR:MAC

Document ID: Webberly Development Geotechnical Report

10 - 11 - 23

expires 6-5-25

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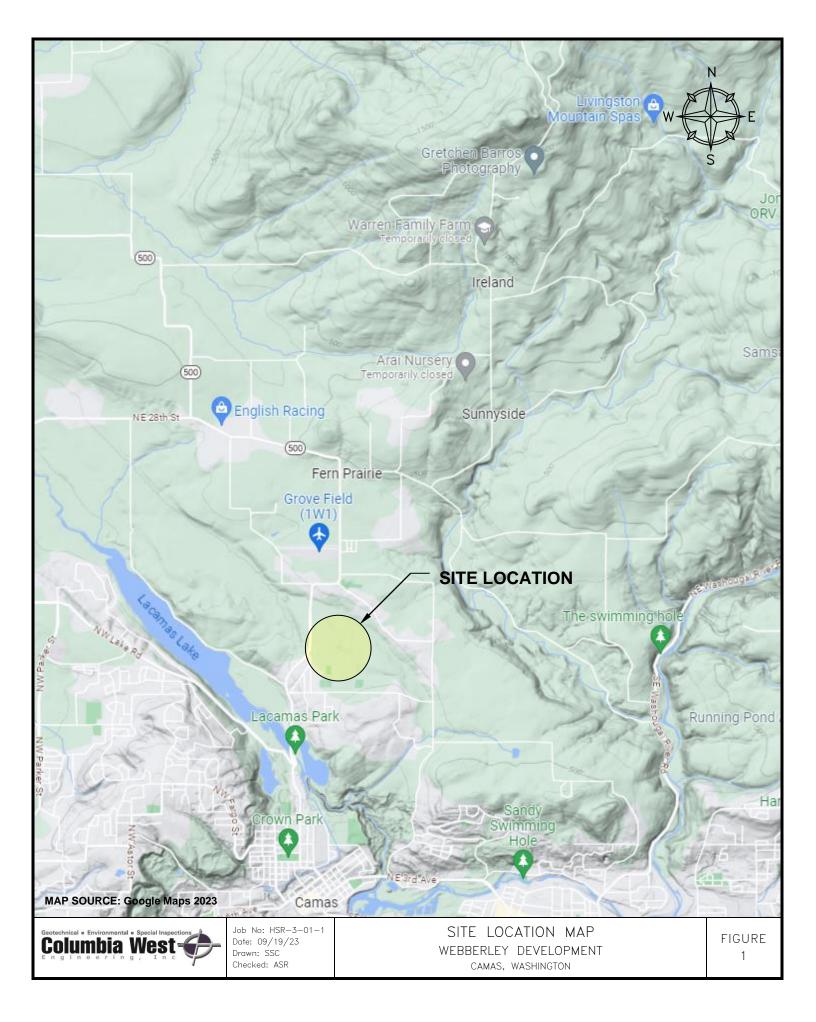
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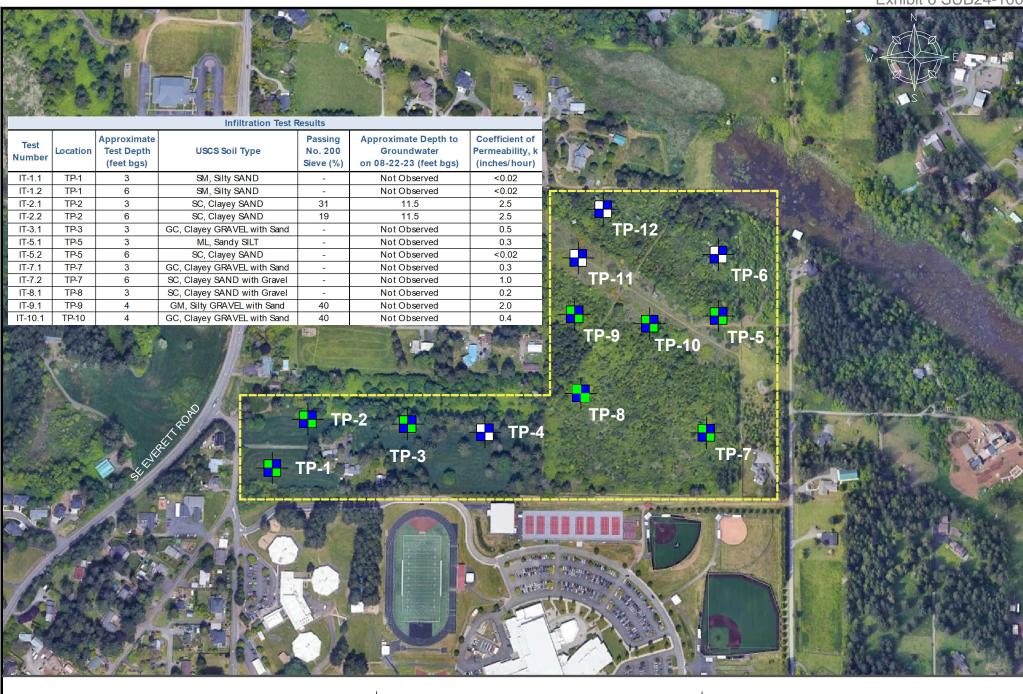
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SITE LOCATION

MAP SOURCE: Google Maps 2023

| Columbia West Engineering, Inc
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Date: 09/19/23
Drawn: SSC
Checked: ASR | SITE LOCATION MAP
WEBBERLEY DEVELOPMENT
CAMAS, WASHINGTON | FIGURE
1 |

Exhibit 6 SUB24-1002

Infiltration Test Results

Test Number	Location	Approximate Test Depth (feet bgs)	USCS Soil Type	Passing No. 200 Sieve (%)	Approximate Depth to Groundwater on 08-22-23 (feet bgs)	Coefficient of Permeability, k (inches/hour)
IT-1.1	TP-1	3	SM, Silty SAND	-	Not Observed	<0.02
IT-1.2	TP-1	6	SM, Silty SAND	-	Not Observed	<0.02
IT-2.1	TP-2	3	SC, Clayey SAND	31	11.5	2.5
IT-2.2	TP-2	6	SC, Clayey SAND	19	11.5	2.5
IT-3.1	TP-3	3	GC, Clayey GRAVEL with Sand	-	Not Observed	0.5
IT-5.1	TP-5	3	ML, Sandy SILT	-	Not Observed	0.3
IT-5.2	TP-5	6	SC, Clayey SAND	-	Not Observed	<0.02
IT-7.1	TP-7	3	GC, Clayey GRAVEL with Sand	-	Not Observed	0.3
IT-7.2	TP-7	6	SC, Clayey SAND with Gravel	-	Not Observed	1.0
IT-8.1	TP-8	3	SC, Clayey SAND with Gravel	-	Not Observed	0.2
IT-9.1	TP-9	4	GM, Silty GRAVEL with Sand	40	Not Observed	2.0
IT-10.1	TP-10	4	GC, Clayey GRAVEL with Sand	40	Not Observed	0.4

Map labels: SE EVERETT ROAD, TP-12, TP-11, TP-6, TP-9, TP-10, TP-5, TP-8, TP-2, TP-3, TP-4, TP-1, TP-7

Legend:
- – – – APPROXIMATE SITE BOUNDARY
- APPROXIMATE LOCATION OF TEST PIT
- APPROXIMATE LOCATION OF TEST PIT WITH INFILTRATION

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Job No: HSR-3-01-01
Date: 08/23/23
Drawn: SSC
Checked: DEL

EXPLORATION LOCATION MAP
WEBBERLEY DEVELOPMENT
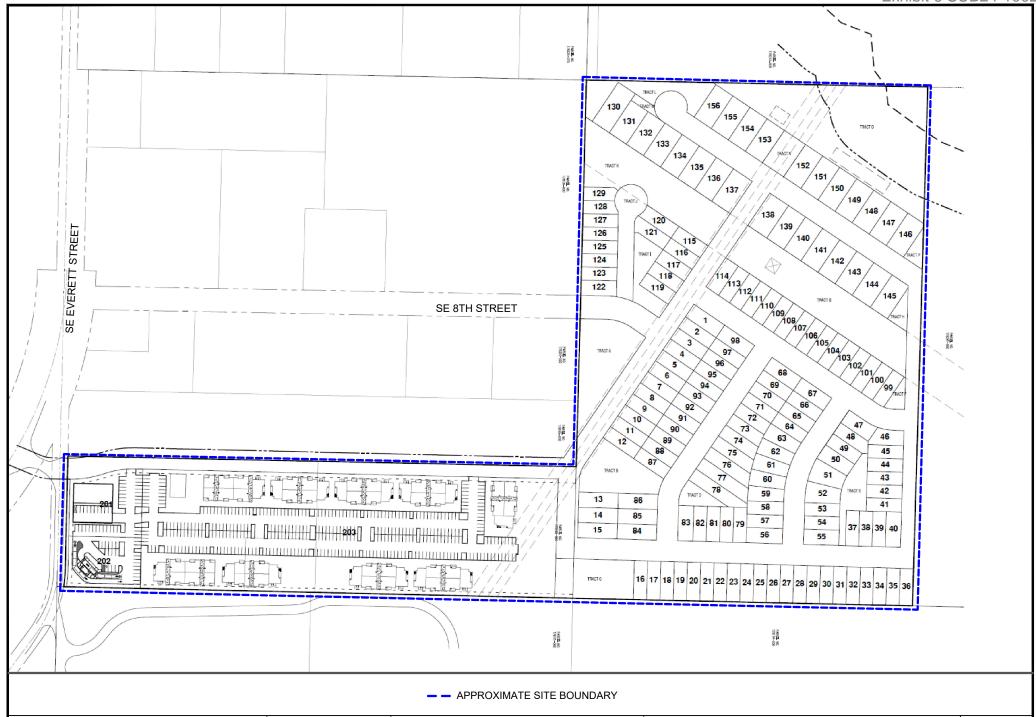
NOTES:
1. APPROXIMATE SITE LOCATION: EAST AND WEST OF 921 SE GARDNER ROAD IN CAMAS, WASHINGTON 98607.
2. SITE CONSISTS OF TAX PARCEL NOS. 178159000, 178169000, 178108000, AND 178140000 TOTALING APPROXIMATELY 36.12 ACRES.
3. AERIAL PHOTO SOURCED FROM GOOGLE EARTH.
4. EXPLORATION LOCATIONS ARE APPROXIMATE AND NOT SURVEYED.
5. TEST PITS BACKFILLED WITH ONSITE SOILS ON AUGUST 23, 2023.

FIGURE 2

Exhibit 6 SUB24-1002

- - APPROXIMATE SITE BOUNDARY

| Geotechnical ■ Environmental ■ Special Inspections **Columbia West** Engineering, Inc | Job No: HSR-3-01-01 Date: 10/4/23 Drawn: MAC Checked: ASR | PRELIMINARY SITE PLAN WEBBERLEY DEVELOPMENT | NOTES: 1. APPROXIMATE SITE LOCATION: EAST AND WEST OF 921 SE GARDNER ROAD IN CAMAS, WASHINGTON 98607. 2. SITE CONSISTS OF TAX PARCEL NOS. 178159000, 178169000, 178108000, AND 178140000 TOTALING APPROXIMATELY 36.12 ACRES. 3. SITE PLAN PROVIDED BY AKS ENGINEERING. | FIGURE 2A |
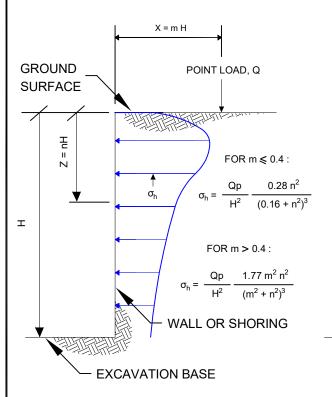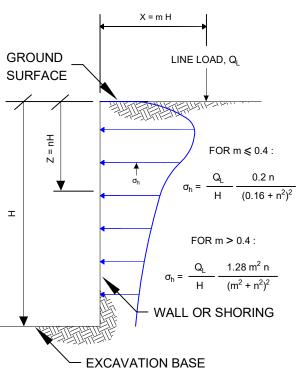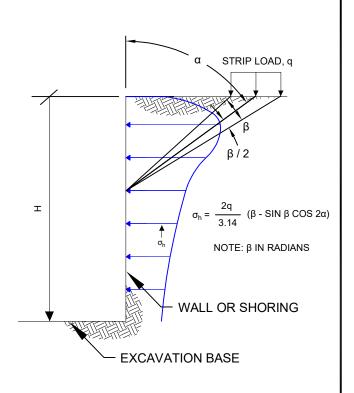
Exhibit 6 SUB24-1002

VERTICAL POINT LOAD

$X = m\,H$

GROUND SURFACE

POINT LOAD, Q

$Z = nH$

σ_h

H

FOR $m \leqslant 0.4$:

$$\sigma_h = \frac{Qp}{H^2}\ \frac{0.28\,n^2}{(0.16 + n^2)^3}$$

FOR $m > 0.4$:

$$\sigma_h = \frac{Qp}{H^2}\ \frac{1.77\,m^2\,n^2}{(m^2 + n^2)^3}$$

WALL OR SHORING

EXCAVATION BASE

LINE LOAD PARALLEL TO WALL

$X = m\,H$

GROUND SURFACE

LINE LOAD, Q_L

$Z = nH$

σ_h

H

FOR $m \leqslant 0.4$:

$$\sigma_h = \frac{Q_L}{H}\ \frac{0.2\,n}{(0.16 + n^2)^2}$$

FOR $m > 0.4$:

$$\sigma_h = \frac{Q_L}{H}\ \frac{1.28\,m^2\,n}{(m^2 + n^2)^2}$$

WALL OR SHORING

EXCAVATION BASE

STRIP LOAD PARALLEL TO WALL

α

STRIP LOAD, q

β

$\beta / 2$

H

σ_h

$$\sigma_h = \frac{2q}{3.14}\ (\beta - \text{SIN}\ \beta\ \text{COS}\ 2\alpha)$$

NOTE: β IN RADIANS

WALL OR SHORING

EXCAVATION BASE
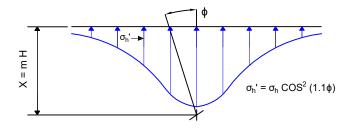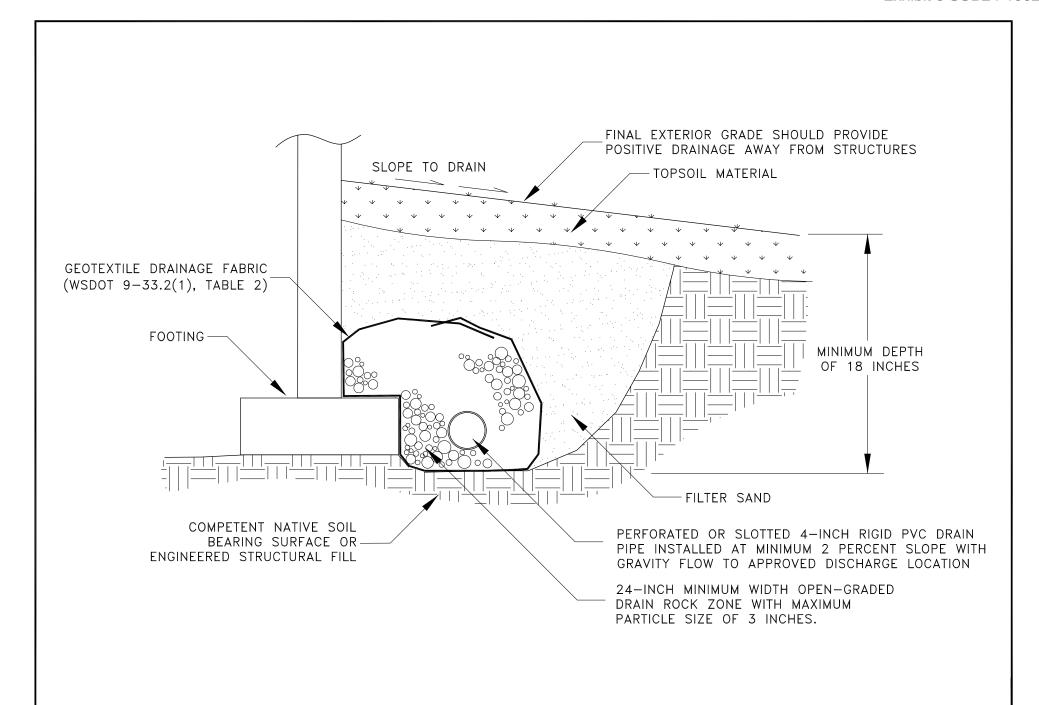
VERTICAL POINT LOAD
HORIZONTAL PRESSURE DISTRIBUTION

ϕ

σ_h'

$X = m\,H$

$\sigma_h' = \sigma_h\ \text{COS}^2\ (1.1\phi)$

NOTES:
1. FIGURE SHOULD BE USED JOINTLY WITH RECOMMENDATIONS PRESENTED IN THE REPORT TEXT.
2. LATERAL EARTH PRESSURES ASSUME RIGID WALLS WITH BACKFILL MATERIALS HAVING A POISSON'S RATIO OF 0.5.
3. TOTAL LATERAL EARTH PRESSURES RESULTING FROM COMBINED LOADS MAY BE CALCULATED USING SUPERPOSITION.
4. DRAWING IS NOT TO SCALE.

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SURCHARGE—INDUCED LATERAL EARTH PRESSURES

FIGURE

3

Exhibit 6 SUB24-1002

FINAL EXTERIOR GRADE SHOULD PROVIDE POSITIVE DRAINAGE AWAY FROM STRUCTURES

SLOPE TO DRAIN

TOPSOIL MATERIAL

GEOTEXTILE DRAINAGE FABRIC (WSDOT 9-33.2(1), TABLE 2)

FOOTING

MINIMUM DEPTH OF 18 INCHES

FILTER SAND

COMPETENT NATIVE SOIL BEARING SURFACE OR ENGINEERED STRUCTURAL FILL

PERFORATED OR SLOTTED 4-INCH RIGID PVC DRAIN PIPE INSTALLED AT MINIMUM 2 PERCENT SLOPE WITH GRAVITY FLOW TO APPROVED DISCHARGE LOCATION

24-INCH MINIMUM WIDTH OPEN-GRADED DRAIN ROCK ZONE WITH MAXIMUM PARTICLE SIZE OF 3 INCHES.

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TYPICAL PERIMETER FOOTING DRAIN DETAIL

NOTES:
1. DRAWING IS NOT TO SCALE.
2. DRAWING REPRESENTS TYPICAL PERIMETER FOOTING DRAIN DETAIL AND MAY NOT BE SITE-SPECIFIC.

FIGURE
4

Exhibit 6 SUB24-1002

STRUCTURAL AREAS   NON-STRUCTURAL AREAS

ASPHALT PAVEMENT SURFACE

1 1/4"-0 CRUSHED AGGREGATE ROAD BASE

STRUCTURAL FILL

NON-STRUCTURAL FILL / TOPSOIL

MINIMUM 1 FOOT

2 FEET (TYPICAL)

VARIES

OPEN-GRADED FRACTURED-FACE ANGULAR DRAIN ROCK WITH MAXIMUM 3-INCH PARTICLE SIZE

GEOTEXTILE FILTER FABRIC (WSDOT 9-33.2(1), TABLE 2)

MINIMUM 6-INCH DIAMETER RIGID PVC OR HDPE DRAIN PIPE

UNDISTURBED NATIVE SOIL

MINIMUM 2 FEET

NOTE: LOCATION, INVERT ELEVATION, DEPTH OF TRENCH, AND EXTENT OF PERFORATED PIPE REQUIRED MAY BE MODIFIED BY THE GEOTECHNICAL ENGINEER DURING CONSTRUCTION BASED UPON FIELD OBSERVATION AND SITE-SPECIFIC SOIL CONDITIONS.

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TYPICAL PERFORATED DRAINPIPE TRENCH DETAIL

NOTES:
1. DRAWING IS NOT TO SCALE.
2. DRAWING REPRESENTS TYPICAL PERFORATED DRAIN PIPE TRENCH DETAIL AND MAY NOT BE SITE-SPECIFIC.

FIGURE
5

Exhibit 6 SUB24-1002

TYPICAL DRAINAGE MAT CROSS-SECTION

FINISHED GRADE

ORIGINAL GROUND SURFACE

ORIGINAL TOPSOIL/ UNCONSOLIDATED
MATERIAL LAYER

ENGINEERED STRUCTURAL FILL COMPACTED
TO AT LEAST 95 PERCENT OF MAXIMUM
DRY DENSITY (ASTM D698)

GRANULAR FILL (LESS THAN 5 PERCENT PASSING
NO. 200 SIEVE) COMPACTED TO AT LEAST 95
PERCENT OF MAXIMUM DRY DENSITY (ASTM D1557)

DEPTH VARIES.
DETERMINED BY
CONDITIONS AND ONSITE
OBSERVATIONS OF
GEOTECHNICAL ENGINEER

EXCAVATE TO COMPETENT
NATIVE SOIL

POSSIBLE
GW SEEPS

DEPTH VARIES. DETERMINED BY
CONDITIONS AND ONSITE OBSERVATIONS
OF GEOTECHNICAL ENGINEER

TYPICAL BENCH INTO
FIRM COMPETENT NATIVE SOIL

POSSIBLE
GW SEEPS

2X4 GABION (TYPICAL) DRAINAGE
MAT WRAPPED ENTIRELY IN MIRAFI
140 N GEOTEXTILE FABRIC

WIDTH VARIES. DETERMINED
BY CONDITIONS AND ONSITE
OBSERVATIONS OF
GEOTECHNICAL ENGINEER

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TYPICAL DRAINAGE MAT
CROSS SECTION

NOTES:
1. DRAWING IS NOT TO SCALE.
2. DRAWING REPRESENTS TYPICAL DRAINAGE
   MAT SECTION AND MAY NOT BE
   SITE−SPECIFIC.

FIGURE

6

Exhibit 6 SUB24-1002

EXISTING GROUND SURFACE

COMPACTED ENGINEERED STRUCTURAL FILL
PLACED IN 8-INCH LIFTS

TYPICAL CUT SLOPE;
GRADE MAY BE DETERMINED BY
SITE GEOTECHNICAL ENGINEER
BUT NOT TO EXCEED 2H:1V

TYPICAL FILL SLOPE;
GRADE MAY BE DETERMINED BY
SITE GEOTECHNICAL ENGINEER
BUT NOT TO EXCEED 2H:1V

POSSIBLE GROUND
WATER SEEP

ROUTE DRAINS THROUGH SOLID PIPE TO
DAYLIGHT AT SLOPE FACE. MAINTAIN SOLID
PIPE TO APPROVED DISCHARGE LOCATION.
DO NOT ALLOW TO FLOW OVER SLOPE FACE.

4 FEET (TYPICAL)

POSSIBLE GROUND
WATER SEEP

TOE BENCH/KEY

POSSIBLE GROUND
WATER SEEP

2 FEET (TYPICAL)

NEED FOR DRAINS SHOULD BE DETERMINED BY
GEOTECHNICAL ENGINEER DURING CONSTRUCTION

MINIMUM
5 FEET

MINIMUM 10 FEET

TYPICAL DRAIN SECTION DETAIL

DRAIN SPECIFICATIONS

GEOTEXTILE FABRIC SHALL MEET WSDOT 9-33.2(1), TABLE 2, GEOTEXTILE
FOR UNDERGROUND DRAINAGE FILTRATION PROPERTIES WITH AOS
BETWEEN No. 70 AND No. 100 SIEVE. WATER PERMITIVITY SHOULD BE
GREATER THAN 1.5/SEC.

WASHED DRAIN ROCK SHALL BE OPEN-GRADED ANGULAR DRAIN ROCK
WITH LESS THAN 2 PERCENT PASSING THE No. 200 SIEVE AND A
MAXIMUM PARTICLE SIZE OF 2 INCHES.

GEOTEXTILE FABRIC

WASHED DRAIN ROCK

MINIMUM 3-INCH DIAMETER
PERFORATED DRAIN PIPE

MINIMUM
2 FEET

MINIMUM
2 FEET

MINIMUM
2 FEET

MINIMUM
2 FEET

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TYPICAL CUT AND FILL
SLOPE CROSS SECTION

NOTES:
1. DRAWING IS NOT TO SCALE.
2. DRAWING REPRESENTS TYPICAL CUT AND FILL
   SLOPE CROSS SECTION AND MAY NOT BE
   SITE-SPECIFIC.

FIGURE

7

Exhibit 6 SUB24-1002

PROPOSED STRUCTURE

COMPACTED ENGINEERED STRUCTURAL
FILL OR COMPETENT NATIVE CUT SOIL

MAX 2H:1V

10 FEET

FOOTING

H

RECOMMENDED MINIMUM HORIZONTAL SETBACK
DISTANCE BETWEEN BOTTOM EDGE OF FOOTING
AND FACE OF SLOPE IS 10 FEET OR SLOPE
HEIGHT DIVIDED BY 3, WHICHEVER IS GREATER.

MINIMUM SETBACK DISTANCE ASSUMES SLOPE
EXISTS ON ONE PROPERTY BORDER. FOR PROPERTY
CORNERS WITH ADJOINING SLOPES, ADDITIONAL
ENGINEERING ANALYSIS MAY BE REQUIRED.

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TYPICAL MINIMUM FOUNDATION
SLOPE SETBACK DETAIL

NOTES:
1. DRAWING IS NOT TO SCALE.
2. SLOPES AND PROFILES SHOWN ARE APPROXIMATE.
3. DRAWING REPRESENTS TYPICAL FOUNDATION
   SETBACK DETAIL AND MAY NOT BE SITE-SPECIFIC.

FIGURE
8

APPENDIX A
SUBSURFACE EXPLORATION PROGRAM
FIELD EXPLORATIONS

GENERAL

We explored subsurface conditions at the site by excavating eight test pits (TP-1 through TP-12) to depths between 6 and 13 feet BGS. Excavation services were provided by L&S Contractors of Battle Ground, Washington on August 23, 2023. The test pit locations are shown on Figures 2. The test pit logs are presented in this appendix.

SOIL SAMPLING

Representative grab samples of the soil observed in the test pit explorations were obtained from the walls and/or base of the test pits using the excavator bucket.

SOIL CLASSIFICATION

The soil samples were classified in accordance with the Unified Soil Classification System presented in Appendix C. The exploration log indicates the depths at which the soils or their characteristics change, although the change actually could be gradual. If the change occurred between sample locations, the depth was interpreted. Classifications are shown on the exploration log.

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Webberley Development	HSR Development		HSR-3-01-01	TP-1

PROJECT LOCATION	CONTRACTOR	EQUIPMENT	TECHNICIAN	DATE
Camas, Washington	L&S Contractors	Excavator	SSC/SMF	8/23/23

TEST PIT LOCATION	GROUNDWATER DEPTH	START TIME	FINISH TIME
See Figure 2	Groundwater not observed.	0820	1120

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Approximately 3 inches of root zone underlain by 6 to 8 inches of topsoil.					
	TP1.1			ML		Light brown sandy SILT with gravel, damp, medium stiff, low plasticity. Intermixed rounded 1/2 to 2 inch rounded gravel.					IT-1.1 Depth = 3 feet
5	TP1.2			SC		Red-brown clayey SAND with gravel, moist, medium dense, low to medium plasticity.					IT-1.2 Depth = 6 feet
10				GC		WEATHERED CONGLOMERATE: Red and brown clayey GRAVEL with sand, dense, damp to moist, 1 to 6 inch subrounded gravel.					
15						Bottom of test pit at 11 feet BGS. Groundwater not observed.					

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Webberley Development	HSR Development		HSR-3-01-01	TP-2

PROJECT LOCATION	CONTRACTOR	EQUIPMENT	TECHNICIAN	DATE
Camas, Washington	L&S Contractors	Excavator	SSC/SMF	8/23/23

TEST PIT LOCATION	GROUNDWATER DEPTH	START TIME	FINISH TIME
See Figure	Groundwater observed at 11.5 feet BGS.	0855	1125

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Approximately 3 inches of root zone underlain by 6 inches of topsoil.					
				SC		Light brown clayey SAND with gravel, damp, medium stiff, low plasticity. Intermixed rounded 1/2 to 2 inch rounded gravel.					
	TP2.1		A-2-7(2)			Intermixed rounded 1/2 to 2 inch rounded gravel.	22	31	53	25	IT-2.1 Depth = 3 feet
5											
	TP2.2					Red-brown, increase in plasticity.	32	19			IT-2.2 Depth = 6 feet
10				GC		WEATHERED CONGLOMERATE: Gray clayey GRAVEL with sand, moist to wet, medium dense, medium plasticity.					
						Bottom of test pit at 13 feet BGS. Groundwater observed 11.5 feet BGS.					
15											

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Webberley Development	HSR Development		HSR-3-01-01	TP-3

PROJECT LOCATION	CONTRACTOR	EQUIPMENT	TECHNICIAN	DATE
Camas, Washington	L&S Contractors	Excavator	SSC/SMF	8/23/23

TEST PIT LOCATION	GROUNDWATER DEPTH	START TIME	FINISH TIME
See Figure	Groundwater not observed.	0935	1135

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Approximately 3 inches of root zone underlain by 6 inches of topsoil.					
				ML		Light brown sandy SILT with gravel, damp, stiff. 1/2 to 3 inch rounded gravels.					
	TP3.1			GC		Red and brown clayey GRAVEL with sand, moist, dense.					IT-3.1 ⊓ Depth = 3 feet
5											
10						Excavator comment: digging like dense soil.					
						Bottom of test pit at 13 feet BGS. Groundwater not observed.					
15											

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Webberley Development	HSR Development		HSR-3-01-01	TP-4

PROJECT LOCATION	CONTRACTOR	EQUIPMENT	TECHNICIAN	DATE
Camas, Washington	L&S Contractors	Excavator	SSC/SMF	8/23/23

TEST PIT LOCATION	GROUNDWATER DEPTH	START TIME	FINISH TIME
See Figure	Groundwater not observed.	1030	1100

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Approximately 3 inches of root zone underlain by 6 inches of topsoil.					
				ML		Light brown sandy SILT with gravel, stiff, damp, with 1/2 to 3 inch rounded gravel.					
				GC		Red and brown clayey GRAVEL with sand, dense, damp to moist, 1 to 6 inch subrounded gravel.					
5											
10						18 inch rounded boulder at 10 feet.					
						Excavator comment: digging like dense soil.					
						Bottom of test pit at 13 feet BGS. Groundwater not observed.					
15											

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Webberley Development	HSR Development		HSR-3-01-01	TP-5

PROJECT LOCATION	CONTRACTOR	EQUIPMENT	TECHNICIAN	DATE
Camas, Washington	L&S Contractors	Excavator	SSC/SMF	8/23/23

TEST PIT LOCATION	GROUNDWATER DEPTH	START TIME	FINISH TIME
See Figure	Groundwater not observed.	1155	1600

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Approximately 4 inches of root zone underlain by 10 inches of topsoil.					
				ML		Brown sandy SILT with gravel, damp, stiff, low plasticity.					
	TP5.1										IT-5.1 Depth = 3 feet
5	TP5.2			SC		Red and brown clayey SAND with gravel, dense, damp to moist, 1 to 6 inch subrounded gravel.					IT-5.2 Depth = 6 feet
10				GC		WEATHERED CONGLOMERATE: Dark brown clayey GRAVEL with sand, moist, medium dense to dense.					
						Bottom of test pit at 12.5 feet BGS. Groundwater not observed.					
15											

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Webberley Development	HSR Development		HSR-3-01-01	TP-6

PROJECT LOCATION	CONTRACTOR	EQUIPMENT	TECHNICIAN	DATE
Camas, Washington	L&S Contractors	Excavator	SSC/SMF	8/23/23

TEST PIT LOCATION	GROUNDWATER DEPTH	START TIME	FINISH TIME
See Figure 2	Groundwater not observed.	1230	1300

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Approximately 4 inches of root zone underlain by 8 inches of topsoil.					
				ML		Brown sandy SILT, damp, medium stiff, low plasticity.					
				SC		WEATHERED CONGLOMERATE: Yellow and brown clayey SAND, moist, very dense, fines have medium plasticity.					
5											
						Bottom of test pit at 7 feet BGS due to practical refusal on competent conglomerate. Groundwater not observed.					
10											
15											

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Webberley Development	HSR Development		HSR-3-01-01	TP-7

PROJECT LOCATION	CONTRACTOR	EQUIPMENT	TECHNICIAN	DATE
Camas, Washington	L&S Contractors	Excavator	SSC/SMF	8/23/23

TEST PIT LOCATION	GROUNDWATER DEPTH	START TIME	FINISH TIME
See Figure	Groundwater not observed.	1305	1615

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Approximately 4 inches of root zone underlain by 8 inches of topsoil.					
				ML		Brown sandy SILT with gravel, damp, medium stiff, low plasticity, 1/2 to 3 inch rounded gravel.					
	TP7.1			GC		Red and brown clayey GRAVEL with sand, moist, dense.					IT-7.1 □ Depth = 3 feet
5	TP7.2			SC		WEATHERED CONGLOMERATE: Yellow and brown clayey SAND, moist, very dense, fines have medium plasticity, 1/2 to 6 inch gravel.					IT-7.2 □ Depth = 6 feet
10						Slow excavation observed from 10 to 11 feet.					
						Bottom of test pit at 11 feet BGS. Groundwater not observed.					
15											

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Webberley Development	HSR Development		HSR-3-01-01	TP-8

PROJECT LOCATION	CONTRACTOR	EQUIPMENT	TECHNICIAN	DATE
Camas, Washington	L&S Contractors	Excavator	SSC/SMF	8/23/23

TEST PIT LOCATION	GROUNDWATER DEPTH	START TIME	FINISH TIME
See Figure	Groundwater not observed.	1348	1630

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Approximately 4 inches of root zone underlain by 8 inches of topsoil.					
				CL		Light brown sandy lean CLAY with minor gravel, damp, stiff, minor rounded gravel.					
	TP8.1			SC		Brown clayey SAND with gravel, damp to moist, denst, low to medium plasticity, 1 to 6 inch sub rounded gravel.					IT-8.1 ⊓ Depth = 3 feet
5											
	TP8.2		A-2-7(0)				19	18	50	22	
10											
						Excavator comment: digging like dense soil.					
						Bottom of test pit at 13 feet BGS. Groundwater not observed.					
15											

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TEST PIT LOG

PROJECT NAME	CLIENT	PROJECT NO.	TEST PIT NO.
Webberley Development	HSR Development	HSR-3-01-01	TP-9

PROJECT LOCATION	CONTRACTOR	EQUIPMENT	TECHNICIAN	DATE
Camas, Washington	L&S Contractors	Excavator	SSC/SMF	8/23/23

TEST PIT LOCATION	GROUNDWATER DEPTH	START TIME	FINISH TIME
See Figure	Groundwater not observed.	1420	1645

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Approximately 2 inches of root zone underlain by 4 inches of topsoil.					
				SM		Light brown silty SAND with gravel, moist, dense, 1 to 6 inch subrounded gravel.					
5	TP9.1						28	40			IT-9.1 Depth = 4 feet
10				GC		WEATHERED CONGLOMERATE: Brown clayey GRAVEL with sand, dense, damp to moist, 1 to 6 inch subrounded gravel. 2-foot long boulder at 8 feet.					
15						Bottom of test pit at 13 feet BGS. Groundwater not observed.					

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TEST PIT LOG

PROJECT NAME Webberley Development	CLIENT HSR Development		PROJECT NO. HSR-3-01-01	TEST PIT NO. TP-10
PROJECT LOCATION Camas, Washington	CONTRACTOR L&S Contractors	EQUIPMENT Excavator	TECHNICIAN SSC/SMF	DATE 8/23/23
TEST PIT LOCATION See Figure	GROUNDWATER DEPTH Groundwater not observed.		START TIME 1440	FINISH TIME 1645

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Approximately 4 inches of root zone underlain by 8 inches of topsoil.					
	TP10.1		A-7-6(3)	GM		Brown silty GRAVEL with sand and cobbles, very dense, damp, 1 to 10 inch subangular gravel.	11	40	47	19	
	TP10.2						20	41			IT-10.1 ⊓ Depth = 4 feet
5											
10						Excavator comment: digging like dense soil.					
						Bottom of test pit at 13 feet BGS. Groundwater not observed.					
15											

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Webberley Development	HSR Development		HSR-3-01-01	TP-11

PROJECT LOCATION	CONTRACTOR	EQUIPMENT	TECHNICIAN	DATE
Camas, Washington	L&S Contractors	Excavator	SSC/SMF	8/23/23

TEST PIT LOCATION	GROUNDWATER DEPTH	START TIME	FINISH TIME
See Figure 2	Groundwater not observed.	1518	1538

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Approximately 2 inches of root zone underlain by 4 inches of topsoil.					
				GC		Brown clayey GRAVEL with sand, damp, dense, fines have low to medium plasticity, 1 to 10 inch subrounded gravel.					
5											
10											
						Excavator comment: digging like dense soil.					
						Bottom of test pit at 13 feet BGS. Groundwater not observed.					
15											

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TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
Webberley Development	HSR Development		HSR-3-01-01	TP-12

PROJECT LOCATION	CONTRACTOR	EQUIPMENT	TECHNICIAN	DATE
Camas, Washington	L&S Contractors	Excavator	SSC/SMF	8/23/23

TEST PIT LOCATION	GROUNDWATER DEPTH	START TIME	FINISH TIME
See Figure 2	Groundwater not observed.	1545	1605

Depth (feet)	Sample Field ID	SCS Soil Survey Description	AASHTO Soil Type	USCS Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Infiltration Testing
0						Approximately 2 inches of root zone underlain by 4 inches of topsoil.					
				SC		Brown clayey SAND, medium dense, fines have low to medium plasticity, sparse gravel.					
5				SC		WEATHERED CONGLOMERATE: Red and yellow and orange weathered clayey SAND wth gravel, moist, very dense, fines have low to medium plasticity, 1 to 3 inch gravel.					
						Bottom of test pit at 6 feet BGS due to practical refusal on competent bedrock. Groundwater not observed.					
10											
15											

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APPENDIX B
LABORATORY TESTING

CLASSIFICATION

The soil samples were classified in the laboratory to confirm field classifications. The laboratory classifications are shown on the exploration log if those classifications differed from the field classifications.

ATTERBERG LIMITS

Atterberg limits (plastic and liquid limits) testing was performed on select soil samples in general accordance with ASTM D4318. The plastic limit is defined as the moisture content where the soil becomes brittle. The liquid limit is defined as the moisture content where the soil begins to act similar to a liquid. The plasticity index is the difference between the liquid and plastic limits. The test results are presented in this appendix.

MOISTURE CONTENT

We determined the natural moisture content of select soil samples in general accordance with ASTM D2216. The natural moisture content is a ratio of the weight of the water to soil in a test sample and is expressed as a percentage. The test results are presented in this appendix.

PARTICLE-SIZE ANALYSIS

We completed particle-size analysis on select soil samples in general accordance with ASTM D6913. This test is a quantitative determination of the soil particle size distribution expressed as a percentage of dry soil weight.

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MOISTURE CONTENT, PERCENT PASSING NO. 200 SIEVE BY WASHING

PROJECT	CLIENT	PROJECT NO.	REPORT DATE
Webberley Development	HSR Development	HSR-3-01-1	09/12/23
Camas, Washington	500 E Broadway, Suite 120	DATE SAMPLED	
	Vancouver, Washington 98660	08/23/23	
		SAMPLED BY	
		SSC	

LABORATORY TEST DATA

TEST PROCEDURE
ASTM D2216 - Method A, ASTM D1140

LAB ID	CONTAINER MASS	MOIST MASS + PAN	DRY MASS + PAN	AFTER WASH DRY MASS + PAN	MATERIAL DESCRIPTION	FIELD ID	SAMPLE DEPTH	MOISTURE CONTENT	PASSING NO. 200 SIEVE
S23-1126	784.4	2,401.2	2,109.7	sieved sample	light brown Clayey SAND	TP2.1	3 feet	22%	31%
S23-1127	786.9	2,475.4	2,069.9	1,832.4	red/brown Clayey SAND	TP2.2	6 feet	32%	19%
S23-1128	853.1	3,834.0	3,349.7	sieved sample	brown Clayey SAND with Gravel	TP8.2	6 feet	19%	18%
S23-1129	773.0	2,309.2	1,969.4	1,487.0	light brown Silty SAND with Gravel	TP9.1	4 feet	28%	40%
S23-1130	1,744.3	51,010.0	46,200.1	sieved sample	brown Silty GRAVEL with Sand and Cobbles	TP10.1	2 feet	11%	40%
S23-1131	866.5	2,585.1	2,298.6	1,717.8	brown Clayey GRAVEL with Sand	TP10.2	4 feet	20%	41%

NOTES:	DATE TESTED	TESTED BY
Sample weights received for Lab ID: S23-1126, 1128, and 1130 did not meet the minimum size requirements; entire sample used for analysis.	09/05/23	MRS/KMS

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PARTICLE-SIZE ANALYSIS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
Webberley Development	HSR Development	HSR-3-01-1	S23-1126
Camas, Washington	500 E Broadway, Suite 120	REPORT DATE	FIELD ID
	Vancouver, Washington 98660	09/12/23	TP2.1
		DATE SAMPLED	SAMPLED BY
		08/23/23	SSC

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
light brown Clayey SAND	Test Pit TP-02	SC, Clayey Sand
	depth = 3 feet	

SPECIFICATIONS	AASHTO CLASSIFICATION
none	A-2-7(2)

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Rainhart "Mary Ann" Sifter, air-dried prep, hand washed, composite sieve - #4 split	ASTM D6913, Method A

ADDITIONAL DATA

initial dry mass (g) = 1325.3

as-received moisture content = 22%   coefficient of curvature, C_C = n/a

liquid limit = 53   coefficient of uniformity, C_U = n/a

plastic limit = 28   effective size, $D_{(10)}$ = n/a

plasticity index = 25 $D_{(30)}$ = n/a

fineness modulus = n/a $D_{(60)}$ = 0.412 mm

NOTES: Entire sample used for analysis; did not meet minimum size required.

SIEVE DATA

% gravel = 7.9%

% sand = 61.0%

% silt and clay = 31.1%

	SIEVE SIZE		PERCENT PASSING			
	US	mm	SIEVE act.	SIEVE interp.	SPECS max	SPECS min
GRAVEL	6.00"	150.0		100%		
	4.00"	100.0		100%		
	3.00"	75.0		100%		
	2.50"	63.0		100%		
	2.00"	50.0		100%		
	1.75"	45.0		100%		
	1.50"	37.5	100%			
	1.25"	31.5		100%		
	1.00"	25.0	99%			
	7/8"	22.4		98%		
	3/4"	19.0	98%			
	5/8"	16.0		97%		
	1/2"	12.5	96%			
	3/8"	9.50	95%			
	1/4"	6.30	93%			
	#4	4.75	92%			
SAND	#8	2.36		88%		
	#10	2.00	88%			
	#16	1.18		80%		
	#20	0.850	74%			
	#30	0.600		68%		
	#40	0.425	61%			
	#50	0.300		53%		
	#60	0.250	49%			
	#80	0.180		44%		
	#100	0.150	41%			
	#140	0.106		36%		
	#170	0.090		34%		
	#200	0.075	31%			

GRAIN SIZE DISTRIBUTION (plot of % passing vs particle size (mm))

DATE TESTED	TESTED BY
09/07/23	MRS

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ATTERBERG LIMITS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
Webberley Development Camas, Washington	HSR Development 500 E Broadway, Suite 120 Vancouver, Washington 98660	HSR-3-01-1	S23-1126
		REPORT DATE	FIELD ID
		09/12/23	TP2.1
		DATE SAMPLED	SAMPLED BY
		08/23/23	SSC

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
light brown Clayey SAND	Test Pit TP-02 depth = 3 feet	SC, Clayey Sand

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Liquid Limit Machine, Hand Rolled	ASTM D4318

ATTERBERG LIMITS

liquid limit = 53
plastic limit = 28
plasticity index = 25

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	31.13	31.35	32.82	33.02
dry soil + pan weight, g =	27.79	27.86	28.69	28.60
pan weight, g =	20.98	20.97	20.88	20.56
N (blows) =	35	29	24	19
moisture, % =	49.1 %	50.7 %	52.9 %	55.0 %

SHRINKAGE

shrinkage limit = n/a
shrinkage ratio = n/a

PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	27.68	27.07		
dry soil + pan weight, g =	26.20	25.75		
pan weight, g =	20.87	21.02		
moisture, % =	27.8 %	27.9 %		

LIQUID LIMIT

PLASTICITY CHART

ADDITIONAL DATA

% gravel = 7.9%
% sand = 61.0%
% silt and clay = 31.1%
% silt = n/a
% clay = n/a
moisture content = 22%

DATE TESTED	TESTED BY
09/11/23	KMS

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PARTICLE-SIZE ANALYSIS REPORT

PROJECT Webberley Development Camas, Washington	CLIENT HSR Development 500 E Broadway, Suite 120 Vancouver, Washington 98660	PROJECT NO. HSR-3-01-1	LAB ID S23-1128
		REPORT DATE 09/12/23	FIELD ID TP8.2
		DATE SAMPLED 08/23/23	SAMPLED BY SSC

MATERIAL DATA

MATERIAL SAMPLED brown Clayey SAND with Gravel	MATERIAL SOURCE Test Pit TP-08 depth = 6 feet	USCS SOIL TYPE SC, Clayey Sand with Gravel
SPECIFICATIONS none		AASHTO CLASSIFICATION A-2-7(0)

LABORATORY TEST DATA

LABORATORY EQUIPMENT Rainhart "Mary Ann" Sifter, air-dried prep, hand washed, composite sieve - #4 split	TEST PROCEDURE ASTM D6913, Method A

ADDITIONAL DATA

initial dry mass (g) = 2496.6
as-received moisture content = 19%
liquid limit = 50
plastic limit = 28
plasticity index = 22
fineness modulus = n/a

coefficient of curvature, C_C = n/a
coefficient of uniformity, C_U = n/a
effective size, $D_{(10)}$ = n/a
$D_{(30)}$ = 0.210 mm
$D_{(60)}$ = 2.178 mm

NOTES: Entire sample used for analysis; did not meet minimum size required.

SIEVE DATA

% gravel = 32.8%
% sand = 48.8%
% silt and clay = 18.4%

	SIEVE SIZE		PERCENT PASSING			
	US	mm	SIEVE act.	SIEVE interp.	SPECS max	min
GRAVEL	6.00"	150.0		100%		
	4.00"	100.0		100%		
	3.00"	75.0		100%		
	2.50"	63.0		100%		
	2.00"	50.0		100%		
	1.75"	45.0		100%		
	1.50"	37.5	100%			
	1.25"	31.5		99%		
	1.00"	25.0	97%			
	7/8"	22.4		94%		
	3/4"	19.0	90%			
	5/8"	16.0		86%		
	1/2"	12.5	81%			
	3/8"	9.50	76%			
	1/4"	6.30	70%			
	#4	4.75	67%			
SAND	#8	2.36		61%		
	#10	2.00	59%			
	#16	1.18		54%		
	#20	0.850	51%			
	#30	0.600		46%		
	#40	0.425	42%			
	#50	0.300		36%		
	#60	0.250	32%			
	#80	0.180		28%		
	#100	0.150	26%			
	#140	0.106		22%		
	#170	0.090		20%		
	#200	0.075	18%			

GRAIN SIZE DISTRIBUTION

DATE TESTED 09/07/23	TESTED BY MRS

sieve sizes   sieve data

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ATTERBERG LIMITS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
Webberley Development	HSR Development	HSR-3-01-1	S23-1128
Camas, Washington	500 E Broadway, Suite 120	REPORT DATE	FIELD ID
	Vancouver, Washington 98660	09/12/23	TP8.2
		DATE SAMPLED	SAMPLED BY
		08/23/23	SSC

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
brown Clayey SAND with Gravel	Test Pit TP-08	SC, Clayey Sand with Gravel
	depth = 6 feet	

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Liquid Limit Machine, Hand Rolled	ASTM D4318

ATTERBERG LIMITS

liquid limit =	50
plastic limit =	28
plasticity index =	22

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	33.98	31.68	32.77	
dry soil + pan weight, g =	29.59	27.92	28.72	
pan weight, g =	20.44	20.43	20.96	
N (blows) =	30	24	17	
moisture, % =	48.0 %	50.2 %	52.2 %	

SHRINKAGE

shrinkage limit =	n/a
shrinkage ratio =	n/a

PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	27.61	27.64		
dry soil + pan weight, g =	26.15	26.03		
pan weight, g =	20.93	20.42		
moisture, % =	28.0 %	28.7 %		

LIQUID LIMIT

PLASTICITY CHART

ADDITIONAL DATA

% gravel =	32.8%
% sand =	48.8%
% silt and clay =	18.4%
% silt =	n/a
% clay =	n/a
moisture content =	19%

DATE TESTED	TESTED BY
09/06/23	KMS

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PARTICLE-SIZE ANALYSIS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
Webberley Development Camas, Washington	HSR Development 500 E Broadway, Suite 120 Vancouver, Washington 98660	HSR-3-01-1	S23-1130
		REPORT DATE 09/12/23	FIELD ID TP10.1
		DATE SAMPLED 08/23/23	SAMPLED BY SSC

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
brown Silty GRAVEL with Sand and Cobbles	Test Pit TP-10 depth = 2 feet	GM, Silty Gravel with Sand and cobbles
SPECIFICATIONS none		AASHTO CLASSIFICATION A-7-6(3)

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Rainhart "Mary Ann" Sifter, air-dried prep, hand washed, composite sieve - #4 split	ASTM D6913, Method A

ADDITIONAL DATA

initial dry mass (g) = 44455.8
as-received moisture content = 11%   coefficient of curvature, C_C = n/a
liquid limit = 47   coefficient of uniformity, C_U = n/a
plastic limit = 28   effective size, $D_{(10)}$ = n/a
plasticity index = 19 $D_{(30)}$ = n/a
fineness modulus = n/a $D_{(60)}$ = 4.135 mm
NOTES: Entire sample used for analysis; did not meet minimum size required.

SIEVE DATA

% gravel = 39.5%
% sand = 21.0%
% silt and clay = 39.6%

SIEVE SIZE		PERCENT PASSING			
		SIEVE		SPECS	
US	mm	act.	interp.	max	min
6.00"	150.0		100%		
4.00"	100.0	100%			
3.00"	75.0	94%			
2.50"	63.0		90%		
2.00"	50.0	84%			
1.75"	45.0		81%		
1.50"	37.5		77%		
1.25"	31.5		74%		
1.00"	25.0	68%			
7/8"	22.4		68%		
3/4"	19.0	66%			
5/8"	16.0		65%		
1/2"	12.5	64%			
3/8"	9.50		63%		
1/4"	6.30	61%			
#4	4.75	61%			
#8	2.36		58%		
#10	2.00	57%			
#16	1.18		55%		
#20	0.850	54%			
#30	0.600		52%		
#40	0.425	50%			
#50	0.300		48%		
#60	0.250	47%			
#80	0.180		46%		
#100	0.150	45%			
#140	0.106		42%		
#170	0.090		41%		
#200	0.075	40%			

GRAVEL / SAND

GRAIN SIZE DISTRIBUTION

DATE TESTED	TESTED BY
09/08/23	MRS

• sieve sizes   ●— sieve data

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ATTERBERG LIMITS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
Webberley Development Camas, Washington	HSR Development 500 E Broadway, Suite 120 Vancouver, Washington 98660	HSR-3-01-1	S23-1130
		REPORT DATE 09/12/23	FIELD ID TP10.1
		DATE SAMPLED 08/23/23	SAMPLED BY SSC

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
brown Silty GRAVEL with Sand and Cobbles	Test Pit TP-10 depth = 2 feet	GM, Silty Gravel with Sand and cobbles

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Liquid Limit Machine, Hand Rolled	ASTM D4318

ATTERBERG LIMITS

liquid limit = 47
plastic limit = 28
plasticity index = 19

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	31.40	32.97	33.85	
dry soil + pan weight, g =	28.04	29.08	29.53	
pan weight, g =	20.56	20.67	20.67	
N (blows) =	35	25	18	
moisture, % =	44.9 %	46.3 %	48.8 %	

SHRINKAGE

shrinkage limit = n/a
shrinkage ratio = n/a

PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	27.76	28.65		
dry soil + pan weight, g =	26.23	26.96		
pan weight, g =	20.77	20.94		
moisture, % =	28.0 %	28.1 %		

LIQUID LIMIT

moisture, % vs number of blows, "N"

PLASTICITY CHART

ADDITIONAL DATA

% gravel = 39.5%
% sand = 21.0%
% silt and clay = 39.6%
% silt = n/a
% clay = n/a
moisture content = 11%

DATE TESTED	TESTED BY
09/06/23	KMS

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APPENDIX C
REPORT LIMITATIONS AND IMPORTANT INFORMATION

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Geotechnical and Environmental Report Limitations and Important Information

Report Purpose, Use, and Standard of Care

This report has been prepared in accordance with standard fundamental principles and practices of geotechnical engineering and/or environmental consulting, and in a manner consistent with the level of care and skill typical of currently practicing local engineers and consultants. This report has been prepared to meet the specific needs of specific individuals for the indicated site. It may not be adequate for use by other consultants, contractors, or engineers, or if change in project ownership has occurred. It should not be used for any other reason than its stated purpose without prior consultation with Columbia West Engineering, Inc. (Columbia West). It is a unique report and not applicable for any other site or project. If site conditions are altered, or if modifications to the project description or proposed plans are made after the date of this report, it may not be valid. Columbia West cannot accept responsibility for use of this report by other individuals for unauthorized purposes, or if problems occur resulting from changes in site conditions for which Columbia West was not aware or informed.

Report Conclusions and Preliminary Nature

This geotechnical or environmental report should be considered preliminary and summary in nature. The recommendations contained herein have been established by engineering interpretations of subsurface soils based upon conditions observed during site exploration. The exploration and associated laboratory analysis of collected representative samples identifies soil conditions at specific discreet locations. It is assumed that these conditions are indicative of actual conditions throughout the subject property. However, soil conditions may differ between tested locations at different seasonal times of the year, either by natural causes or human activity. Distinction between soil types may be more abrupt or gradual than indicated on the soil logs. This report is not intended to stand alone without understanding of concomitant instructions, correspondence, communication, or potential supplemental reports that may have been provided to the client.

Because this report is based upon observations obtained at the time of exploration, its adequacy may be compromised with time. This is particularly relevant in the case of natural disasters, earthquakes, floods, or other significant events. Report conclusions or interpretations may also be subject to revision if significant development or other manmade impacts occur within or in proximity to the subject property. Groundwater conditions, if presented in this report, reflect observed conditions at the time of investigation. These conditions may change annually, seasonally or as a result of adjacent development.

Additional Investigation and Construction QA/QC

Columbia West should be consulted prior to construction to assess whether additional investigation above and beyond that presented in this report is necessary. Even slight variations in soil or site conditions may produce impacts to the performance of structural facilities if not adequately addressed. This underscores the importance of diligent QA/QC construction observation and testing to verify soil conditions do not differ materially or significantly from the interpreted conditions utilized for preparation of this report.

Therefore, this report contains several recommendations for field observation and testing by Columbia West personnel during construction activities. Actual subsurface conditions are more

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readily observed and discerned during the earthwork phase of construction when soils are exposed. Columbia West cannot accept responsibility for deviations from recommendations described in this

report or future performance of structural facilities if another consultant is retained during the construction phase or Columbia West is not engaged to provide construction observation to the full extent recommended.

Collected Samples

Uncontaminated samples of soil or rock collected in connection with this report will be retained for thirty days. Retention of such samples beyond thirty days will occur only at client's request and in return for payment of storage charges incurred. All contaminated or environmentally impacted materials or samples are the sole property of the client. Client maintains responsibility for proper disposal.

Report Contents

This geotechnical or environmental report should not be copied or duplicated unless in full, and even then only under prior written consent by Columbia West, as indicated in further detail in the following text section entitled *Report Ownership*. The recommendations, interpretations, and suggestions presented in this report are only understandable in context of reference to the whole report. Under no circumstances should the soil boring or test pit excavation logs, monitor well logs, or laboratory analytical reports be separated from the remainder of the report. The logs or reports should not be redrawn or summarized by other entities for inclusion in architectural or civil drawings, or other relevant applications.

Report Limitations for Contractors

Geotechnical or environmental reports, unless otherwise specifically noted, are not prepared for the purpose of developing cost estimates or bids by contractors. The extent of exploration or investigation conducted as part of this report is usually less than that necessary for contractor's needs. Contractors should be advised of these report limitations, particularly as they relate to development of cost estimates. Contractors may gain valuable information from this report but should rely upon their own interpretations as to how subsurface conditions may affect cost, feasibility, accessibility and other components of the project work. If believed necessary or relevant, contractors should conduct additional exploratory investigation to obtain satisfactory data for the purposes of developing adequate cost estimates. Clients or developers cannot insulate themselves from attendant liability by disclaiming accuracy for subsurface ground conditions without advising contractors appropriately and providing the best information possible to limit potential for cost overruns, construction problems, or misunderstandings.

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Consultant Responsibility

Geotechnical and environmental engineering and consulting is much less exact than other scientific or engineering disciplines, and relies heavily upon experience, judgment, interpretation, and opinion often based upon media (soils) that are variable, anisotropic, and non-homogenous. This often results in unrealistic expectations, unwarranted claims, and uninformed disputes against a geotechnical or environmental consultant. To reduce potential for these problems and assist relevant parties in better understanding of risk, liability, and responsibility, geotechnical and environmental reports often provide definitive statements or clauses defining and outlining consultant responsibility. The client is encouraged to read these statements carefully and request additional information from Columbia West if necessary.

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