PARKLANDS II SHORT PLAT

PRELIMINARY TECHNICAL INFORMATION REPORT

Prepared for:

MASIA, LLC
JON ELLSWORTH
3405 NW MCMASTER DRIVE
CAMAS, WA 98607
(360) 798-2400
JONELLSWORTHRE@GMAIL.COM

Prepared by:

SGA ENGINEERING & DESIGN, PLLC
2005 BROADWAY
VANCOUVER, WA 98663
(360) 993-0911
JINTERMILL@SGAENGINEERING.COM



This project complies with Camas Municipal Code (CMC) 14.02 Stormwater Control and the July 2024 Department of Ecology Stormwater Management Manual for Western Washington (SWMMWW).

ENG #: TBD
DATE: 05/04/2026
JOB #: 2451

TABLE OF CONTENTS

Page

Section A - Project Overview 3

Section B – Approval Conditions Summary 3

Section C - Downstream Analysis 3

Section D - Quantity Control Analysis and Design 3

Section E - Conveyance Systems Analysis and Design 4

Section F - Water Quality Design 5

Section G - Soils Evaluation 5

Section H - Special Reports and Studies 5

Section I – Other Permits 5

Section J – Groundwater Monitoring Program 5

Section K – Maintenance and Operations 5

Section L – Technical Appendix 5

Appendix A – Basin Map

Appendix B – Design Criteria

Appendix C – Design Calculations

Appendix D – Soils Report

Appendix E – Stormfilter Maintenance Manuals

SECTION A - Project Overview

The Parklands II Short Plat proposes to develop parcels 986043913 & 986043914, approximately 3.24 acres total, into an 8-lot short plat. The two parcels had been recorded as lots 43 and 44 of the Estates at the Archery final plat and part of the Parklands at Camas Meadows approved final engineering design. The site is located at 3711 & 3815 NW Camas Meadows Dr, Camas, WA 98607. The site is bordered by developed residential lots, public and private roads on the west, south and east. Tract 'A' of the Estates at the Archery borders the site to the north which contains a wetland and previously mitigated buffer on the property line. The development does not propose any encroachments to the wetland buffer.

The site was mass graded with the original development and stabilized with grass. The grading plan consists of two terraced pads with the overall grades sloping south to north. Temporary erosion control measures are still in place to direct runoff to the northern boundary of the site. A dispersion trench was installed within a 10' storm easement on the northern perimeter of the parcels to disperse runoff to the existing wetlands, per the Final Stormwater Report for the Parklands at Camas Meadows. The existing dispersion trench was sized for the future, developed conveyance and quantity control of this project, as well as the surrounding developments. Each future development is responsible for providing enhanced water quality treatment for phosphorus removal. The existing conveyance pipes across the proposed the site to be developed will be rerouted across the site to best fit the new lot layout (along with the existing easements through a plat alt). The Parklands at Camas Meadows documented the entire basin as a flow control exempt basin, and modifications are proposed to the existing dispersion trench.

This project will consist of site grading, constructing roads, and utilities necessary to develop the site. Stormwater control will conform to the requirements of the 2024 Stormwater Management Manual for Western Washington. Contech Stormfilters will provide phosphorus removal for proposed pollution generating surfaces prior to conveyance to the existing dispersion trench on site. The developed site will propose less than or equal to the original impervious area included in the design for the proposed parcels in the Parklands at Camas Meadows Final Stormwater Design.

SECTION B – Minimum Requirements

Based on the project thresholds and the applicability criteria outlined in Volume I, Section I-3.3 and Figures I-3.1 and I-3.2 of the 2024 Stormwater Management Manual for Western Washington (SWMMWW), all Minimum Requirements #1 through #9 are triggered for this project.

Table A. – Surface Area Breakdown Onsite

Existing Impervious Surface	**0.00 Acres**
New Impervious Surface	**1.88 Acres**
Replaced Impervious Surface	**0.00 Acres**
***Native Vegetation Converted to Lawn or Landscaping**	**1.37 Acres**
Native Vegetation Converted to Pasture	**0.00 Acres**
Total Land-disturbing Activity	**3.25 Acres**

*The existing vegetation on site is grass from the stabilization of mass grading

1. Table B shows the effective impervious area on site and the increase in 100-year flood frequency from pre-developed to developed conditions.

Table B. – TDA Summary

TDA	Original Parklands Impervious Area	Proposed Impervious Area
POC 1	2.91 Acres	1.88 Acres

2. All TDAs must meet *Minimum Requirement #6: Runoff Treatment for Phosphorus Removal*
3. All TDAs are exempt from *Minimum Requirement #7: Flow Control with the basin release to Lacamas Lake, a flow control exempt water body, as approved through the Parklands at Camas Meadows Final Stormwater Report.*
4. All TDAs must meet Minimum Requirement #8: Wetland Protection.

Minimum Requirement 1. – Preparation of Stormwater Site Plans*:*
The final stormwater plan and final engineering plans with layouts and construction details will be prepared after the project receives preliminary approval.

Minimum Requirement 2. – Construction Stormwater Pollution Prevention*:*
A Construction Stormwater Pollution Prevention Plan (SWPPP) is required and will be prepared. The contractor will comply with construction SWPPP requirements including elements 1-13.

Minimum Requirement 3. – Source Control of Pollution*:*
All development activities shall comply with the applicable source control requirements of the City of Camas Municipal Code, City of Camas Engineering Design Standards, and the 2024 Stormwater Management Manual for Western Washington (SWMMWW), as adopted by the City. The BMPs that may apply to land disturbance could be **BMPs for Dust Control at Disturbed Land Areas and Unpaved Roadways and Parking Lots, BMPs for Landscaping and Lawn/Vegetation Management, BMPs for Maintenance of Stormwater Drainage and Treatment Systems, BMPs for Urban Streets.** Refer to Section D of this report.

Minimum Requirement 4. – Preservation of Natural Drainage Systems and Outfalls*:*
The proposed improvements associated with this parcel will preserve the existing conveyance. Existing drainage patterns shall be maintained, and discharges from the project site shall occur as is, to the maximum extent practicable. The site runoff currently sheet flows to the northern

property line where an existing dispersion trench releases to the mitigated buffer, as approved and constructed through the Parklands at Camas Meadows project. Refer to Section L of this report.

Minimum Requirement 5. – Onsite Stormwater Management*:*
The BMPs that may apply to Onsite Stormwater Management for this project could include T5.13 - Post-Construction Soil Quality and Depth and T5.21 - Better Site Design. Onsite Stormwater Management is a means to implement inexpensive practices on individual properties to reduce the amount of disruption of the natural hydrology. Refer to Section E of this Report.

Minimum Requirement #6. – Runoff Treatment:
Since the thresholds for impervious area added exceeds the limits, enhanced treatment is required. The stormwater system ultimately discharges to Lacamas Lake, which requires phosphorus treatment. Enhanced treatment for phosphorus removal is proposed in the form of Contech Phosphosorb Stormfilter cartridges that will meet or exceed the required treatment parameters. Refer to Section F of this report.

Minimum Requirement #7. – Runoff Flow Control:
As documented by the Parkland at Camas Meadows Subdivisions' stormwater reports, this parcel is part of a flow control exempt TDA. The developed site will propose less than or equal to the original impervious area included in the design for the proposed parcels in the Parklands at Camas Meadows Final Stormwater Design. The previous layout with impervious area shown is in Appendix A. All treated runoff will be dispersed by the existing dispersion trench on site.

Minimum Requirement #8. – Wetlands Protection:
No wetlands exist on site. A wetland buffer is adjacent to the project. Wetland Protection was provided by the original development of the Parklands at Camas Meadows. There are no proposed modifications or disturbances to the wetland or wetland buffer adjacent to the project.

Minimum Requirement #9. – Operation and Maintenance:
The storm systems will be privately owned and maintained by a Homeowners Association. See Contech's website for maintenance on stormfilter catch basins. Operation and maintenance shall comply with City of Camas requirements and the 2024 SWMMWW.

SECTION C – Soils Evaluation

Refer to the Final Geotechnical Report by Columbia West Engineering, Inc dated June 23, 2015. for the full soils evaluation in Appendix D.

The Soil Survey of Clark County, Washington, November 1972 identifies the onsite soils as, Hesson Clam Loam (HcD, HcB). The hydrologic soil group for these soils is "C" and WWHM3 Soil Groups (SG) 3.

SECTION D – Source Control

All development activities shall comply with the applicable requirements of the City of Camas

Municipal Code and the 2024 Stormwater Management Manual for Western Washington (SWMMWW), as adopted by the City. The BMPs that may apply to land disturbance could be 'BMPs for Dust Control at Disturbed Land Areas and Unpaved Roadways and Parking Lots,' 'BMPs for Landscaping and Lawn/Vegetation Management,' BMPs for Maintenance of Stormwater Drainage and Treatment Systems' and 'BMPs for Urban Streets'.

SECTION E - Onsite Stormwater Management BMPs

1. The following are a list of onsite stormwater management BMPs:

T5.13 – Post-Construction Soil Quality and Depth

2. Refer to Section C above for geotechnical information

3./4. **T5.13 – Post-Construction Soil Quality and Depth (Volume V, SMMWW)**

Since the majority of the site has been or will be stripped of topsoil and/or organic material for grading purposes, the remaining open spaces, yards, and landscaping areas shall be restored with the appropriate soil quality and depths.

T5.21 – Better Site Design (Volume V, SMMWW)

An attempt to provide better site design has been considered to the extent practical. Sensitive areas with wetlands and significant trees have been left out of the development.

5./6./7. A Contech Stormfilters stormwater system is proposed on this project. They are shown on the Stormwater plan.

8. N/A; no pervious pavement is proposed.

9. N/A; no reversed slope sidewalks are proposed.

SECTION F - Runoff Treatment Analysis and Design

1. Based on the proposed site conditions and use, phosphorous treatment is proposed.

2. Since the thresholds for impervious area added exceeds the limits, enhanced runoff treatment is required. The stormwater system will meet or exceed the required treatment parameters as described in the Washington State Department of Ecology 2024 Stormwater Management Manual for Western Washington (SWMM), Appendix III-C.

3. See Section C for Geotechnical information.

4. The following are the BMPs used in the design.

Exhibit 8 SP26-1005

Contech Stormfilters

Table B. – Phosphosorb Stormfilter Details

Basin	Water Quality Flow Rate	PSORB Cartridges	Treatment Capacity
C	0.0678	2 – 27" PSORB	0.0840 CFS

5. Water quality treatment system design complies with the applicable requirements of the 2024 SWMMWW, including Volume V (Runoff Treatment BMPs) and Volume I (Minimum Requirements), and provides basic treatment and phosphorus removal as required.

6. See Water Quality Basin Map in Appendix C for pollution generating areas summary.

SECTION G - Flow Control Analysis and Design

Refer to the discussion above, Section C of this report for soils information.

As previously mentioned in Sections A and B of this report, Lacamas Lake is identified as a flow control exempt receiving water body. Since it is flow control exempt, no flow control detention or release rate control is required for this project. Runoff from Parklands II Short Plat will be conveyed through 12" and 18" ADS storm pipes on-site to the existing drainage system downstream, before ultimately being discharged to Lacamas Lake.

The site was analyzed as 1 TDA with the on-site predeveloped basin. All basins flow to the northeast corner of the site.

The site was evaluated using the continuous model using the WWHM2012 software. Electronic copies of the WWHM files will be submitted upon request.

SECTION H – Wetlands Protection

Since there are no Category I or II classified Wetlands on site, the provision for wetland protection is subject to whether or not the City determines protection is required, and to what extent.

The original Parklands TIR addresses their level of wetland protection, with details and calculations in appendix B-2 of their report. We are proposing to convey runoff into existing manholes within the existing storm lines A and B, which have already been designed to meet the previously required wetland protection requirements by the City of Camas.

There are wetlands located around the site, and wetland analysis has been provided in the Parklands Final Storm TIR to provide basic protection.

References

United States Department of Agriculture, Soil Conservation Service. "Soil Survey of Clark County Washington," Washington, D.C., 1972.

United States Department of Agriculture, Soil Conservation Service, Engineering Division, "Technical Release 55: Urban Hydrology for Small Watersheds, 2nd Ed.," Washington, D.C., 1986.

United States Department of Transportation, Federal Highway Administration, "Hydraulic Engineering Circular No. 12: Drainage of Highway Pavements," Springfield, VA, 1984.

United States Department of Transportation, Federal Highway Administration, "Hydraulic Engineering Circular No. 15: Design of Roadside Channels with Flexible Linings," Springfield, VA, 1984.

Washington State Department of Ecology. *Stormwater Management Manual for Western Washington (SWMMWW), 2024 Edition, Volumes I–V.* Olympia, WA, 2024Washington State Department of

Transportation, "Hydraulic Manual," Olympia, WA, 1989.

Clark County Department of Assessment and GIS, "2000 Clark County Road Atlas," Vancouver, WA, 2000.

Appendix A

General Location Map **A1**

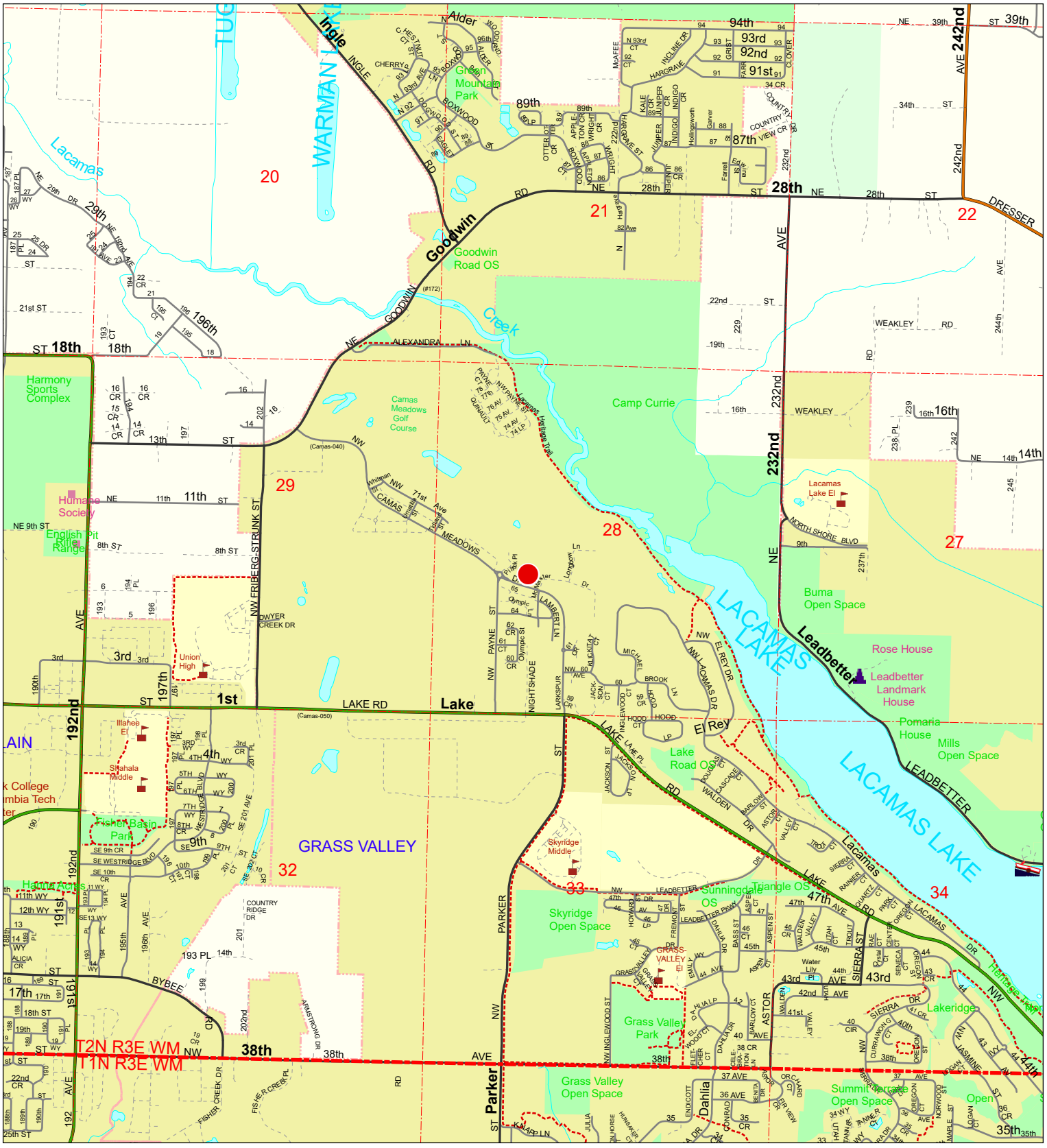
Elevation Contours Map **A2**

Soil Types Map **A3**

Pre-Developed Basin Map **A4**

Previously Analyzed Basin Map **A5**

Developed Basin Map **A6**

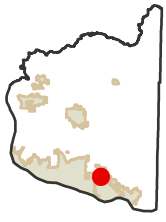


General Location

Account: 986043914, 986043913
Owner: MAS1A LLC
Address: 3405 NW MCMASTER DR
C/S/Z: CAMAS, WA 98607

Location of Subject Property(s)

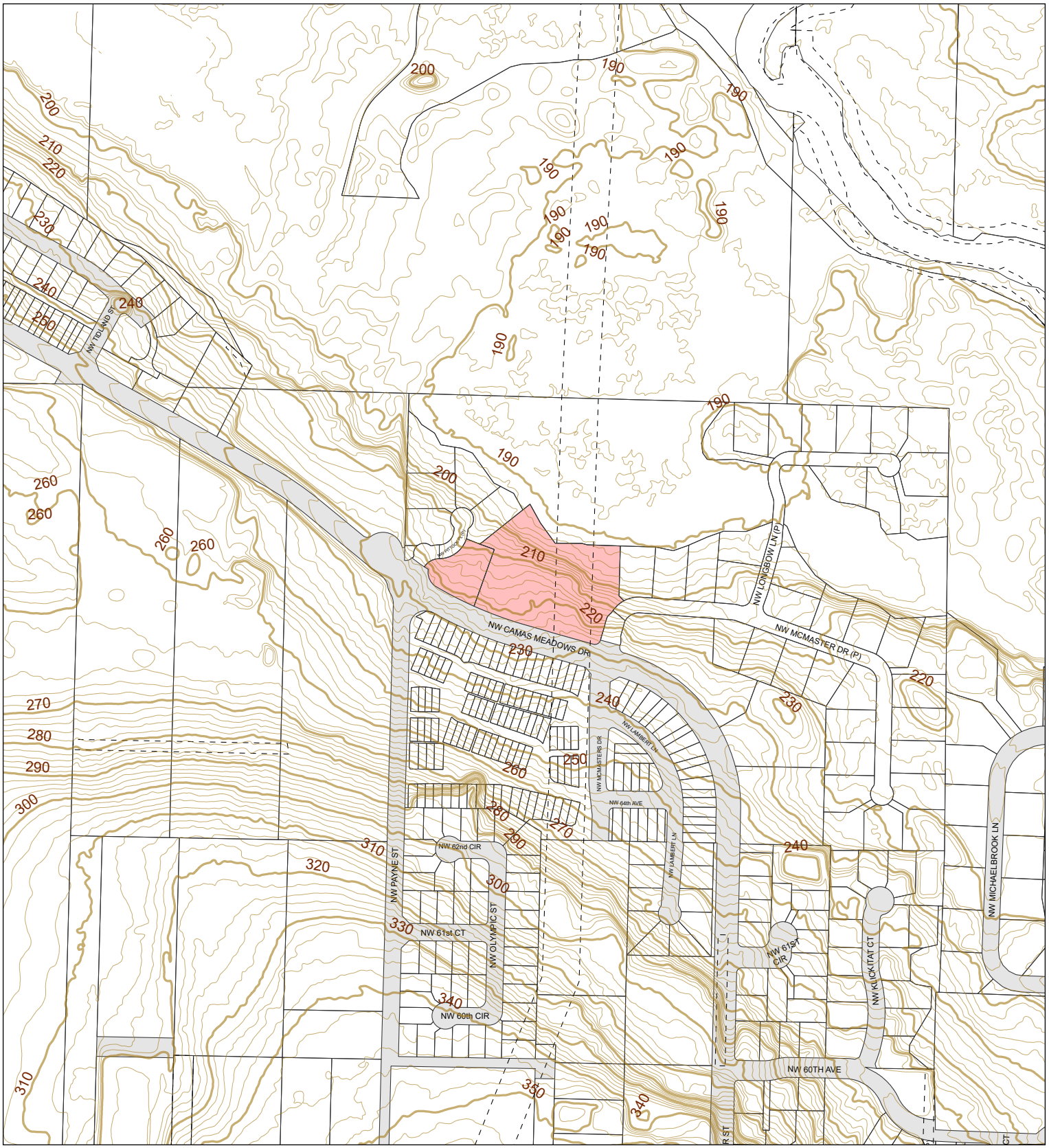
Printed on: November 04, 2025



Geographic Information System

0 1,000 2,000 Feet

Information shown on this map was collected from several sources. Clark County accepts no responsibility for any inaccuracies that may be present.



Elevation Contours

Printed on: November 04, 2025

Account: 986043914, 986043913
Owner: MAS1A LLC
Address: 3405 NW MCMASTER DR
C/S/Z: CAMAS, WA 98607

CLARK COUNTY, WASHINGTON
Geographic Information System

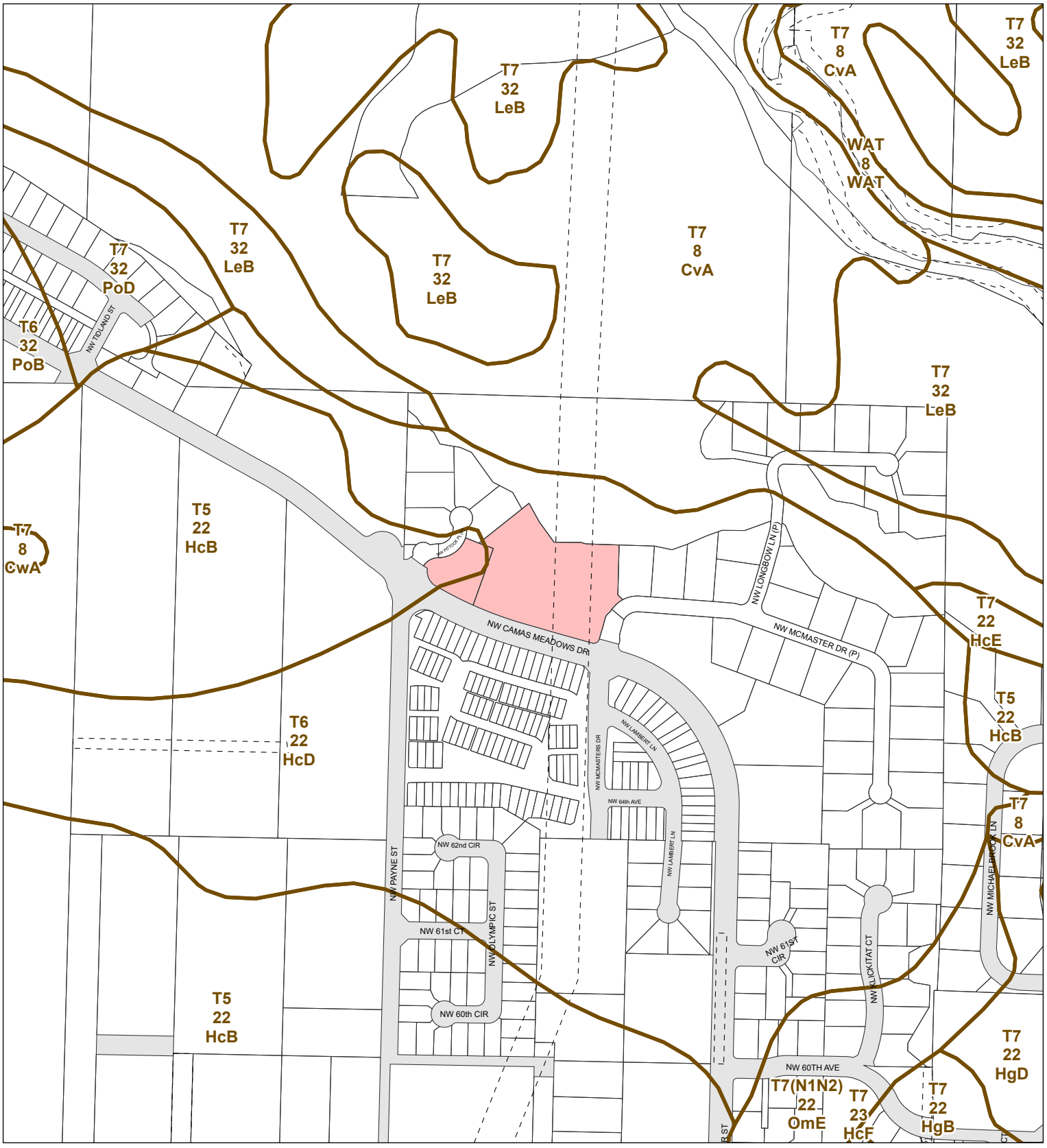
N

0 200 400 Feet

Subject Property(s)
Public Road
Transportation or Major Utility Easement
10' Elevation Contours
2' Elevation Contours

23120	23121	23122
23129	23128	23127
23132	23133	23134

Information shown on this map was collected from several sources. Clark County accepts no responsibility for any inaccuracies that may be present.



CLARK COUNTY, WASHINGTON

Geographic Information System

N

0 200 400 Feet

Soil Types

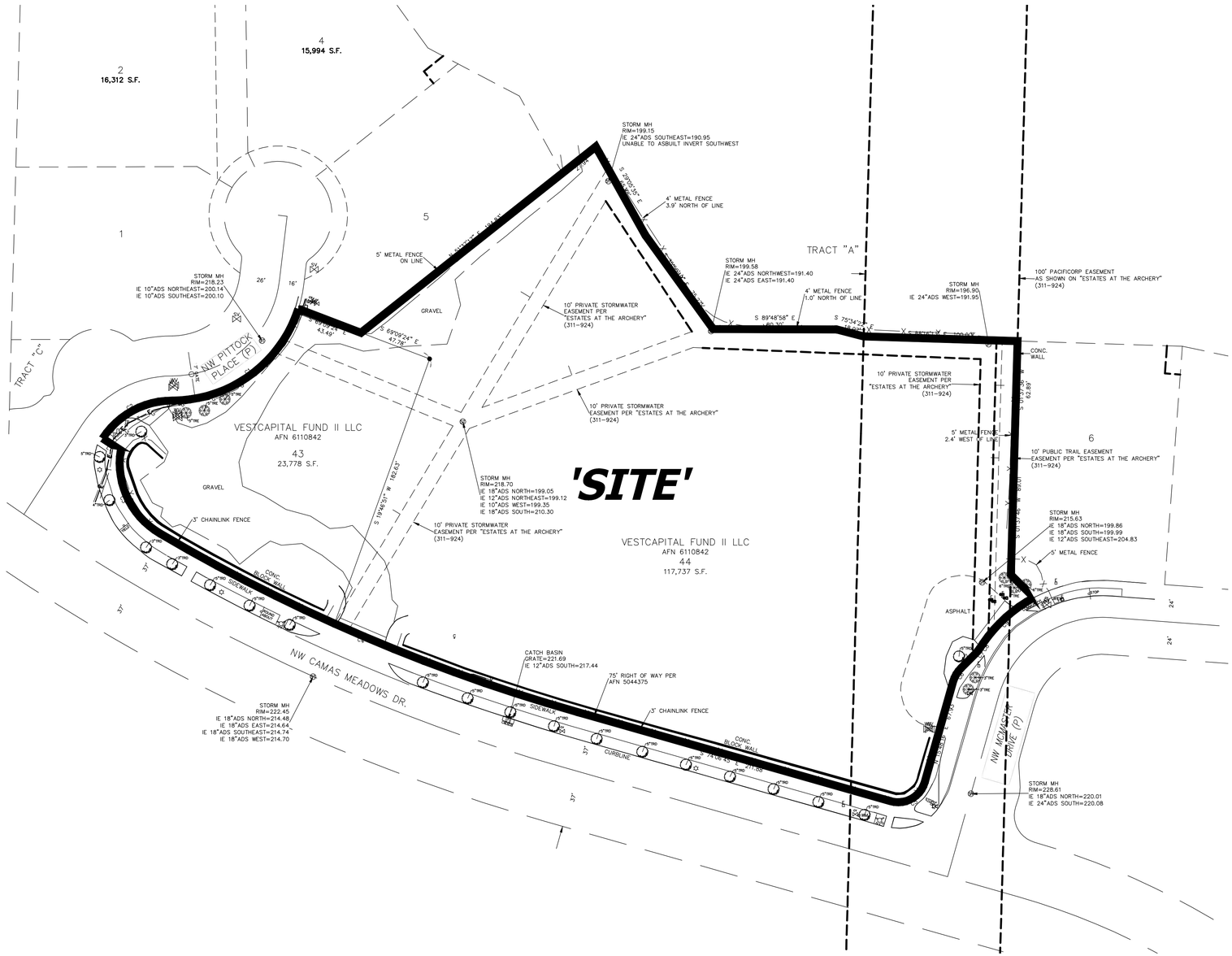
Account: 986043914, 986043913
Owner: MAS1A LLC
Address: 3405 NW MCMASTER DR
C/S/Z: CAMAS, WA 98607

Subject Property(s)
Public Road
Transportation or Major Utility Easement
Soil Type Boundary

Printed on: November 04, 2025

23120	23121	23122
23129	23128	23127
23132	23133	23134

Information shown on this map was collected from several sources. Clark County accepts no responsibility for any inaccuracies that may be present.



PREDEVELOPED BASIN	
	Acres
EX AC	0.00
Total Imperv	0.00
Total Perv	3.25
Total	3.25

0 40 80 120

Scale: 1" = 40'

SCA ENGINEERING & DESIGN
CIVIL ENGINEERING ~ LAND PLANNING
DEVELOPMENT SERVICES
LANDSCAPE ARCHITECTURE

2005 BROADWAY
VANCOUVER, WA 98663
PHONE (360)993-0911
FAX (360)993-0912

PROFESSIONAL ENGINEER — NOAH D. MOSS — REGISTERED — WASHINGTON

PARKLANDS II
SHORT PLAT

PREDEVELOPED BASIN MAP

CITY OF CAMAS

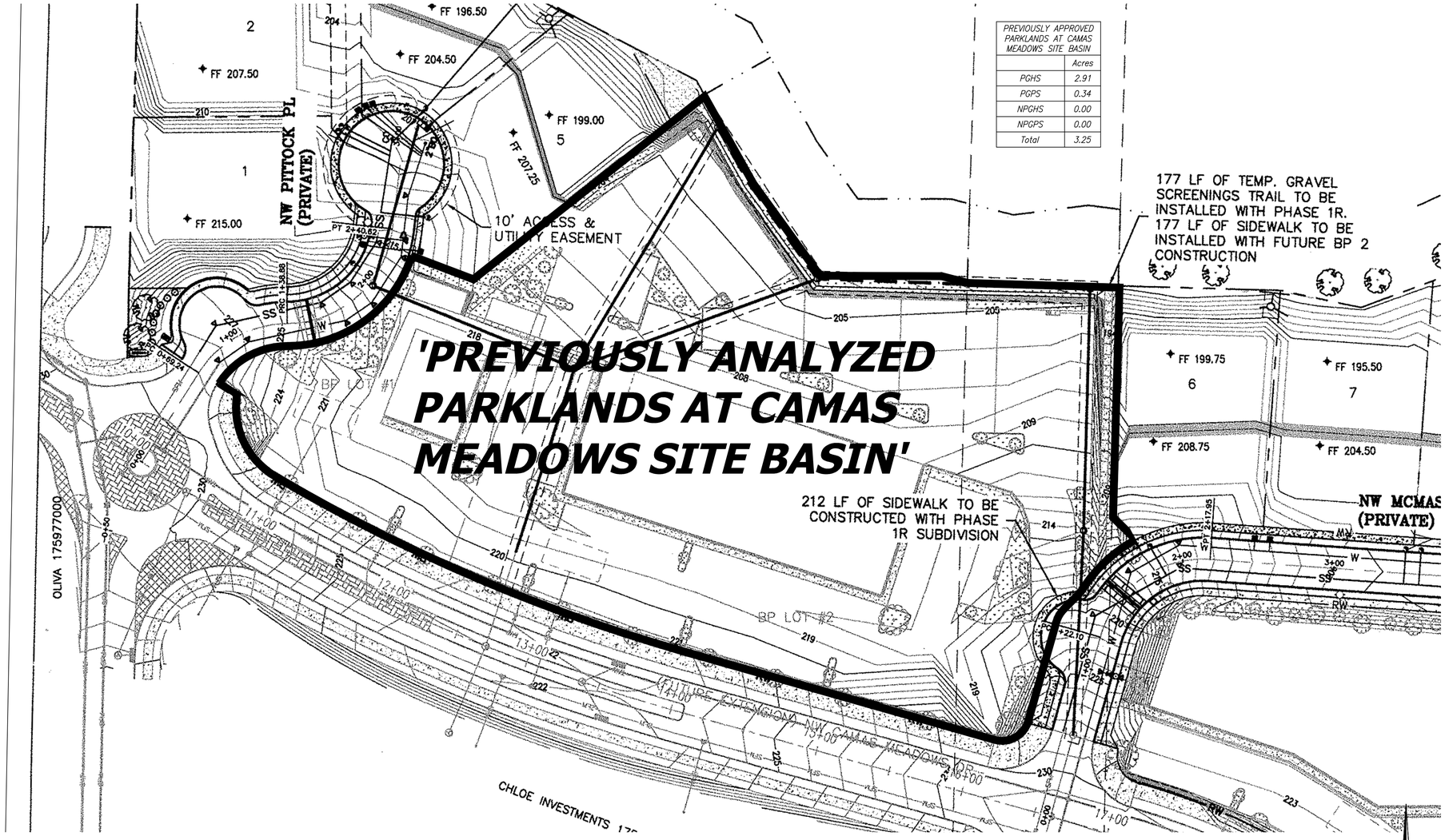
PRELIMINARY

REVISIONS

DESIGNED BY:	NDM
DRAWN BY:	NDM
CHECKED BY:	JAI
SCALE:	1" = 40'

JOB NUMBER	SHEET
2507	PREDEV

© SCA ENGINEERING PLLC - DATE PLOTTED: Apr. 02, 2026 - 11:08 AM SCA DRAWING FILE: W:\DWG\2451- PARKLANDS II\STORMWATER\DWGS\2451- PREDEV BASIN.DWG



PREVIOUSLY APPROVED PARKLANDS AT CAMAS MEADOWS SITE BASIN	
	Acres
PGHS	2.91
PGPS	0.34
NPGHS	0.00
NPGPS	0.00
Total	3.25

SCA ENGINEERING & DESIGN
CIVIL ENGINEERING ~ LAND PLANNING
DEVELOPMENT SERVICES
LANDSCAPE ARCHITECTURE
2005 BROADWAY
VANCOUVER, WA 98663
PHONE (360)993-0911
FAX (360)993-0912

PROFESSIONAL ENGINEER — JOHN A. INVERNIZZI — 19605 — REGISTERED — NON-TRANSFERABLE

PARKLANDS II SHORT PLAT

DEVELOPED BASIN MAP

CITY OF CAMAS — WASHINGTON

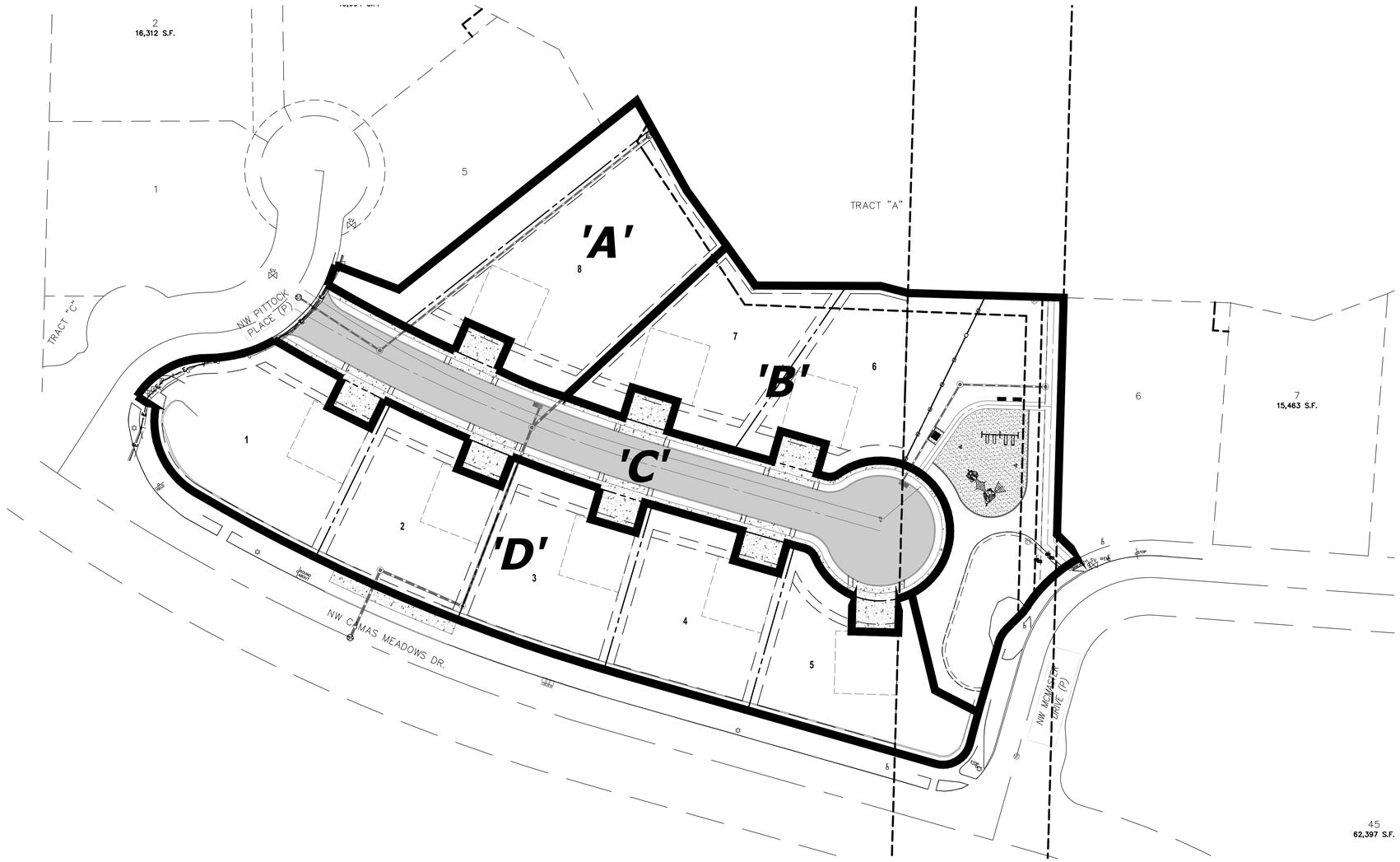
PRELIMINARY

REVISIONS

DESIGNED BY:	NDM
DRAWN BY:	NDM
CHECKED BY:	JAI
SCALE:	1" = 40'

JOB NUMBER	SHEET
2451	DEV

© SCA ENGINEERING PLLC – DATE PLOTTED: Apr. 02, 2026 – 2:14 PM SCA DRAWING FILE: W:\DWG\2451– PARKLANDS II\STORMWATER\DWGS\DEVELOPED BASIN MAP – ORIGINAL PARKLANDS TM #REALDWG

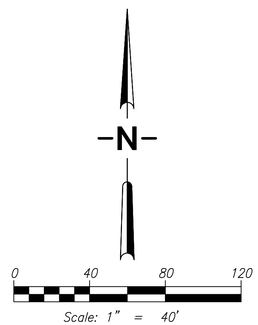


DEVELOPED A	
	Acres
PGHS	0.00
PGPS	0.00
NPGHS	0.19
NPGPS	0.29
Total	0.48

DEVELOPED B	
	Acres
PGHS	0.00
PGPS	0.00
NPGHS	0.47
NPGPS	0.44
Total	0.91

DEVELOPED C	
	Acres
PGHS	0.58
PGPS	0.07
NPGHS	0.00
NPGPS	0.00
Total	0.65

DEVELOPED D	
	Acres
PGHS	0.64
PGPS	0.57
NPGHS	0.00
NPGPS	0.00
Total	1.22



Scale: 1" = 40'

SGA ENGINEERING & DESIGN
CIVIL ENGINEERING ~ LAND PLANNING
DEVELOPMENT SERVICES
LANDSCAPE ARCHITECTURE

2005 BROADWAY
VANCOUVER, WA 98663
PHONE (360)993-0911
FAX (360)993-0912

PROFESSIONAL ENGINEER

PARKLANDS II
SHORT PLAT

DEVELOPED BASIN MAP

CITY OF CAMAS WASHINGTON

PRELIMINARY

REVISIONS

DESIGNED BY:	NDM
DRAWN BY:	NDM
CHECKED BY:	JAI
SCALE:	1" = 40'

JOB NUMBER	SHEET
2451	DEV

© SGA ENGINEERING PLLC - DATE PLOTTED: Mar. 18, 2026 - 2:06 PM SGA DRAWING FILE: W:\DWG\2451- PARKLANDS II\STORMWATER\DWGS\DEVELOPED BASIN MAP.DWG

EXHIBIT 20

THE ARCHERY BUSINESS PARK SITE SUMMARY DATA SUMMARY						
THE ARCHERY BP PHASE LOT AREA (SF)	BP PHASE #	BUILDING #	DIMENSIONS	FOOT PRINT AREA UP TO (SF)	ADDITIONAL POSSIBLE 2ND FLOOR AREA UP TO (SF)	POSSIBLE # OF STORIES OR DESCRIPTION
8,015	1	N/A	N/A	N/A	N/A	BP 1 ROW
24,700	1	1	50'x60	3,000	3,000	1
117,646	2A	2A	90'x220'	19,800	19,800	BP ON LEVELS 1 & 2
15,480	2A	N/A	N/A	N/A	N/A	BP 2 BUFFER
7,248	2A	N/A	N/A	N/A	N/A	BP 2 ROW
62,710	3	3	VARIES	20,000 MIN	20,000	1+ LOWER PARKING
127,653	4	4A	100'x135'	15,000	15,000	1
	4	4B	100'x160'	16,000	16,000	1
363,452 (8.34 AC)			TOTALS:	73,800	73,800	
ARCHERY UNITS	2B	2B	90'x220'	19,800	UP TO 59,400	UNITS ON LEVELS 3,4,5

ARCHERY LIVING UNITS ON BLDG 2B UPPER LEVELS 3,4,5 PLUS DAYLIGHT BASEMENT SECURED PARKING GARAGE.
ANY RESIDENTIAL UNITS IN THE BP TO AREA ALSO MEET REQUIREMENTS OF THE MASTER PLAN.

PARKING REQUIREMENTS PER MASTER PLAN.
GENERAL OFFICE = 1 SPACE PER 400 SQUARE FEET OF GROSS FLOOR AREA
REQUIRED PARKING = 254 SPACES. 498 TOTAL SPACES PROVIDED.
AVAILABLE PARKING TO BE PROVIDED TO MEET OR EXCEED REQUIREMENT IN FINAL SITE PLAN. RECIPROCAL PARKING USE AGREEMENTS BETWEEN PHASES AND BUILDING 3 AND 4 TO BE ESTABLISHED.
NET AVAILABLE BP AREA: 8.34 AC = 53% OF ORIGINAL PARCEL AREA
1–EXISTING PARCEL # 175948000 15.70 ACRES ZONED BP
2–EXISTING PARCEL # 986031650 20.98 ACRES ZONED R–15
3–EXISTING CITY ROW 2.5 ACRES AT 74 FT WIDE

RESIDENTIAL PHASING OF SINGLE FAMILY DETACHED:
PHASE 1R – AS SHOWN
PHASE 2R – MINIMUM OF 9 LOTS
PHASE 3R – MINIMUM OF 9 LOTS
NOTE: PHASE 2R & 3R CANNOT PULL HOUSE BUILDING PERMIT UNTIL AGREED TO BP PHASE IS STARTED PER MASTER PLAN.
ACCESSORY DWELLING UNITS (ADU) TO BE ALLOWED ON ALL RESIDENTIAL LOTS & ENCOURAGED IN RESIDENTIAL CCRS & HOA.

DEVELOPER & APPLICANT:
PARKLANDS AT CAMAS MEADOWS LLC
KEVIN DEFORD 360–823–6222 ngdelopment@gmail.com
AARON BARR 503–319–4021 abarrmail@gmail.com
20705 SE EVERGREEN HWY CAMAS, WA 98607

FOR ALL LOTS WITH ACCESS EASEMENTS NOTE:
PER TABLE 17.19.040–1 FOOT NOTE 2, SHARED ACCESS TO 1 OR 2 LOTS = 20' WIDE PRIVATE EASEMENT WITH 12'–20' PAVED, NO PARKING AND ALL LOTS SPRINKLERED.

BOUNDARIES:
BOUNDARIES ARE BASED ON SURVEY FROM MGS AND WETLAND BOUNDARY FROM ECOLOGICAL LAND SERVICES,INC. FINAL BOUNDARIES AND LOT LINES MAY CHANGE SLIGHTLY PRIOR TO FINAL ENGINEERING AND FINAL PLAT.

PRELIMINARY PLAT AND BINDING SITE PLAN:
REFER TO MASTER PLAN AND DEVELOPMENT AGREEMENT D.A. FOR PROJECT SPECIFIC RESIDENTIAL AND BUSINESS PARK DEVELOPMENT STANDARDS TABLE.

PRIVATE STREET PER PVT2
30' PRIVATE R/W
20' PAVED ROAD WITH CURB AND GUTTER
NO PARKING BOTH SIDES
5' ATTACHED SIDEWALK WEST SIDE
CENTERLINE 240 LF
NW PARKLANDS TRAIL DR ASPHALT PAVING = 4,927 SF
PER TABLE 17.19.040–1–B TO MINIMIZE BUFFER IMPACTS, MINIMIZE STREET WIDTH & ATTACH SIDEWALK, ALL LOTS SPRINKLERED AS > 100' IN LENGTH.

PRIVATE STREET PER PVT3
42' PRIVATE TRACT R/W
28' PAVED ROAD WITH CURB AND GUTTER
5' DETACHED SIDEWALK ONE SIDE
NW 10TH FAIRWAY DR ASPHALT PAVING = 11,151 SF
NW PARKLANDS TRAIL DR ASPHALT PAVING = 6,541 SF
NW 17TH GREEN DR ASPHALT PAVING = 10,815 SF
NO PARKING ONE SIDE

PRIVATE STREET PER PVT4
48' PRIVATE R/W
28' PAVED ROAD WITH CURB AND GUTTER
5' PLANTER BOTH SIDES
5' DETACHED SIDEWALK BOTH SIDES
CENTERLINE 1480 LF
NW 16TH FAIRWAY CT ASPHALT PAVING = 11,194 SF
NW GOLF DR ASPHALT PAVING = 28,860 SF

ALL CUL–DE–SAC TURNAROUNDS PER ST36 FOR SPRINKLERED DEVELOPMENT WITH 30' PAVED & 5' ATTACHED SIDEWALK WITH OUTER SIDEWALK TURNAROUND RADIUS BULB = 35'
35' RADIUS CUL–DE–SAC BULB
30' PAVED CUL–DE–SAC BULB

EXISTING CONDITION NOTES:
NO EXISTING STRUCTURES ONSITE.
EXISTING FIRE HYDRANT LOCATION:
200' WEST OF SITE ON NW CAMAS MEADOWS DR.
375' SOUTH OF SITE ON NW LAKESPUR ST.

GRADING NOTES:
SEE THE GRADING PLAN FOR PROPOSED ONSITE GRADING.

STREET NOTES:
STREET LIGHTS AND STREET TREES TO BE DESIGNED BY OTHERS PRIOR TO FINAL PLAT.

◇ STREET LIGHTS
▬ PROPOSED ENTRY SIGN LOCATIONS
▪ TRAIL ACCESS SIGNAGE

GRAPHIC SCALE 1"=60'
0 60 120

KESSI ENGINEERING
CONSULTING PLANNING CIVIL ENGINEERING PROJECT MANAGEMENT
6400 NE HWY 99 #G–169
VANCOUVER, WA 98665
Tel: (360) 991–9300
www.kessiconsulting.com

DATE: 07 DEC 2015

PARKLANDS EXECUTIVE SUBDIVISION AND THE ARCHERY BUSINESS PARK SITE PLAN AT CAMAS MEADOWS GOLF COURSE
PRELIMINARY PLAT & SITE PLAN WITH MASTER PLAN

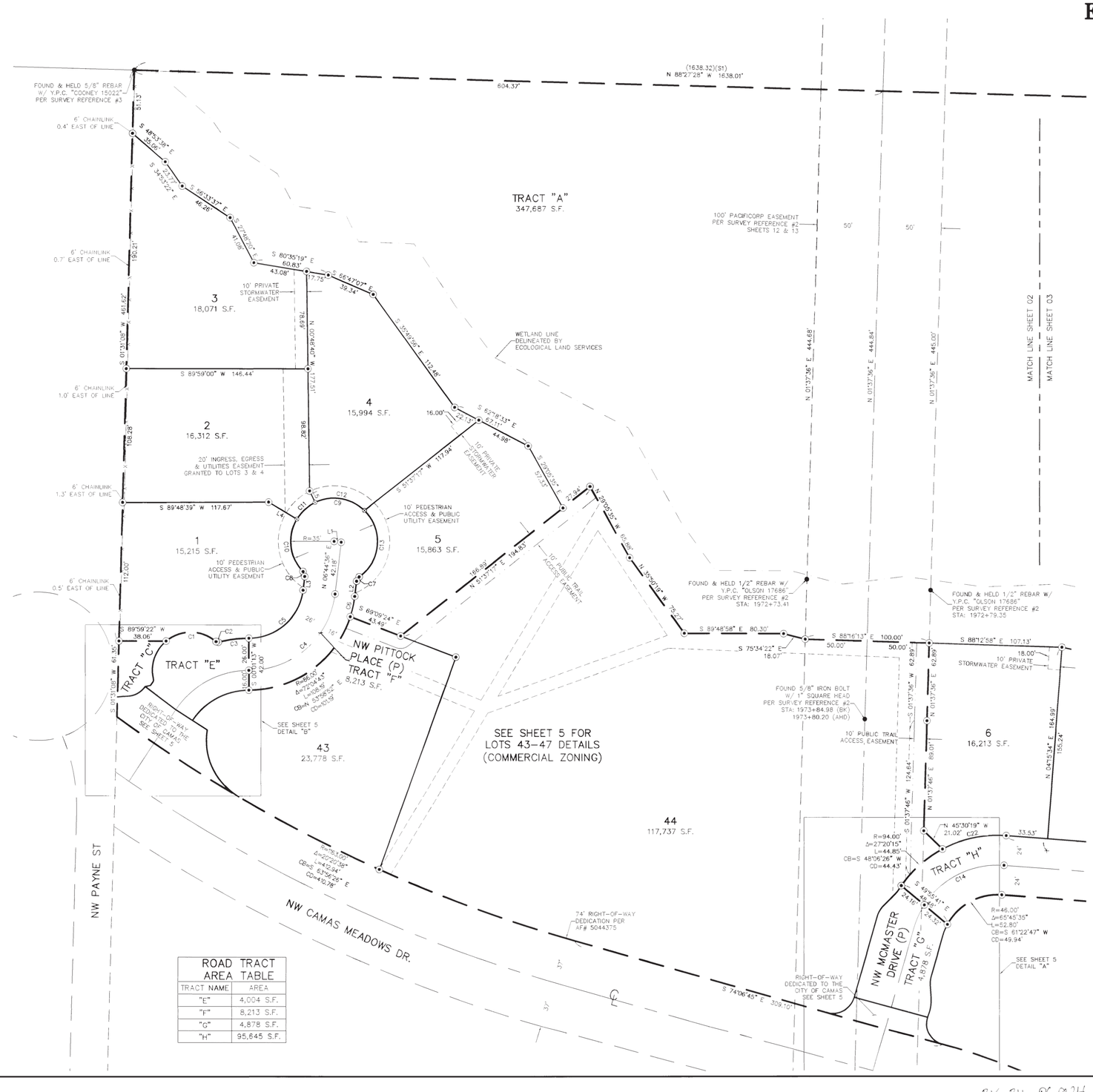
SHEET 1

This map/plat is being furnished as an aid in locating the herein described Land in relation to adjoining streets, natural boundaries and other land, and is not a survey of the land depicted. Except to the extent a policy of title insurance is expressly modified by endorsement, if any, the Company does not insure dimensions, distances, location of easements, acreage or other matters shown thereon.

BK 311 PG 924

ESTATES AT THE ARCHERY

PRELIMINARY APPROVED AS
"PARKLANDS AT CAMAS MEADOWS"
A SUBDIVISION IN A PORTION OF
THE NW 1/4 OF THE SE 1/4 AND THE
NW 1/4 AND THE NE 1/4 OF THE SW 1/4
OF SECTION 28,
T. 2 N., R. 3 E., W.M.
CITY OF CAMAS, CLARK COUNTY, WA
SHEET 2 OF 6



SURVEY REFERENCES:

1) SURVEY BOOK 49, PAGE 186
2) SURVEY BOOK 51, PAGE 161
3) SURVEY BOOK 49, PAGE 167
4) "LACAMAS SHORES – PHASE 6C" SUBDIVISION BOOK J, PAGE 531
5) "LACAMAS SHORES – PHASE 6D" SUBDIVISION BOOK J, PAGE 559
6) "LACAMAS ESTATES" SUBDIVISION BOOK 311, PAGE 414
7) "LARKSPUR ESTATES PH. 1" SUBDIVISION BOOK 311, PAGE 358
8) "LARKSPUR ESTATES PH. 2" SUBDIVISION BOOK 311, PAGE 401
9) SURVEY BOOK 53, PAGE 111
10) SURVEY BOOK 54, PAGE 024

DEED REFERENCE:

GRANTOR: CHINOOK LANDOWNWERS GROUP OF VANCOUVER, WASHINGTON, L.L.C.
GRANTEE: ESTATES AT PARKLANDS LLC
AFN: 5408391
DATE: MAY 31, 2017

LEGEND:

- ● INDICATES MONUMENT FOUND AS NOTED
- ⊙ INDICATES 1/2" x 24" REBAR WITH YELLOW PLASTIC CAP INSCRIBED "RENTON 37535", SET
- ⊗ INDICATES ROCK NAIL WITH BRASS WASHER INSCRIBED "PLS 37535", SET
- \+ INDICATES ROCK NAIL WITH BRASS WASHER INSCRIBED "PLS 37535" SET AS A WITNESS CORNER AT THE EXTENSION OF LOT LINE IN THE CURB
- ○ INDICATES CALCULATED POSITION NOTHING SET

BASIS OF BEARINGS: NAD83(2011)(EPOCH:2010.0000), WASHINGTON STATE PLANE COORDINATE SYSTEM SOUTH ZONE, U.S. SURVEY FEET

10/31/17
DANIEL ADOLPH RENTON
STATE OF WASHINGTON
37535
REGISTERED PROFESSIONAL LAND SURVEYOR

40 20 0 40 60 80
SCALE 1 INCH = 40 FEET

CURVE TABLE
SHEETS 2–4

CURVE	RADIUS	DELTA	ARC DIST.	CHORD BEARING	CHORD DIST.
C1	31.00'	80°48'31"	43.72'	N 89°26'32" W	40.19'
C2	2.00'	55°47'04"	1.95'	S 76°55'49" E	1.87'
C3	96.00'	14°50'35"	24.87'	S 82°35'56" W	24.80'
C4	70.00'	83°16'37"	101.74'	N 48°22'55" E	93.02'
C5	44.00'	83°16'37"	63.95'	N 48°22'55" E	58.47'
C6	86.00'	11°11'55"	16.81'	N 12°20'33" E	16.78'
C7	5.00'	47°58'14"	4.19'	S 30°43'43" W	4.07'
C8	5.00'	50°54'50"	4.44'	N 18°42'49" W	4.30'
C9	35.00'	278°53'04"	170.36'	N 84°43'42" W	45.52'
C10	35.00'	75°06'12"	45.88'	S 06°37'08" E	42.66'
C11	35.00'	33°12'11"	20.28'	S 47°32'04" W	20.00'
C12	35.00'	70°05'45"	42.82'	N 80°48'58" W	40.20'
C13	35.00'	100°28'55"	61.38'	N 04°28'22" E	53.81'
C14	70.00'	61°45'45"	75.46'	S 63°22'42" W	71.86'
C15	70.00'	15°29'29"	18.93'	N 77°59'42" W	18.87'
C16	70.00'	71°33'54"	87.43'	N 34°28'00" W	81.86'
C17	100.00'	3°49'07"	6.66'	N 17°50'29" E	6.66'
C18	70.00'	11°06'06"	13.56'	N 10°22'52" E	13.54'
C19	70.00'	22°35'32"	27.60'	N 06°27'57" W	27.42'
C20	70.00'	20°06'55"	24.58'	S 07°42'16" E	24.45'
C21	35.00'	89°09'49"	54.47'	S 46°56'06" W	49.13'
C22	94.00'	32°29'00"	53.29'	S 78°01'03" W	52.58'
C23	46.00'	15°29'29"	12.44'	N 77°59'42" W	12.40'
C24	94.00'	13°34'37"	22.27'	N 78°57'07" W	22.22'
C25	25.00'	88°05'09"	38.43'	N 63°47'37" E	34.76'
C26	25.00'	90°00'00"	39.27'	S 25°14'57" E	35.36'
C27	46.00'	71°33'54"	57.46'	N 34°28'00" W	53.79'
C28	94.00'	71°33'56"	117.41'	N 34°28'00" W	109.93'
C29	94.00'	8°34'43"	14.07'	N 65°57'36" W	14.06'
C30	94.00'	34°32'25"	56.67'	N 44°24'02" W	55.81'
C31	94.00'	13°05'07"	21.47'	N 20°35'16" W	21.42'
C32	94.00'	15°21'40"	25.20'	N 06°21'52" W	25.13'
C33	10.00'	40°49'14"	7.12'	S 19°05'40" E	6.97'
C34	10.00'	41°01'53"	7.16'	N 21°49'53" E	7.01'
C35	35.00'	261°51'07"	159.96'	S 88°34'44" E	52.89'
C36	35.00'	67°38'20"	41.32'	N 05°41'07" W	38.96'
C37	35.00'	34°38'19"	21.16'	N 45°27'13" E	20.84'
C38	35.00'	53°04'46"	32.42'	N 89°18'46" E	31.28'
C39	35.00'	34°52'34"	21.30'	S 46°42'35" E	20.98'
C40	35.00'	71°37'08"	43.75'	S 06°32'16" W	40.96'
C41	74.00'	3°49'07"	4.93'	N 17°50'29" E	4.93'
C42	116.00'	3°49'07"	7.73'	N 17°50'29" E	7.73'
C43	70.00'	11°06'06"	13.56'	N 10°22'52" E	13.54'
C44	85.00'	11°06'06"	16.47'	N 10°22'52" E	16.44'
C45	50.00'	22°35'32"	19.72'	N 06°27'57" W	19.59'
C46	84.00'	22°35'32"	33.12'	N 06°27'57" W	32.91'
C47	90.00'	20°06'55"	31.60'	S 07°42'16" E	31.43'
C48	56.00'	20°06'55"	19.66'	S 07°42'16" E	19.56'
C49	70.00'	89°09'49"	108.93'	S 46°56'06" W	98.27'
C50	20.00'	89°09'49"	31.12'	S 46°56'06" W	28.08'
C51	70.00'	19°22'58"	23.68'	S 12°02'41" W	23.57'
C52	70.00'	22°12'38"	27.14'	S 32°50'28" W	26.97'
C53	70.00'	47°34'13"	58.12'	S 67°43'54" W	56.46'
C54	5.00'	72°32'33"	6.33'	N 52°12'44" W	5.92'
C55	35.00'	252°32'33"	154.27'	N 37°47'16" E	56.44'
C56	35.00'	96°03'16"	58.68'	S 63°58'05" E	52.04'
C57	35.00'	37°14'17"	22.75'	N 49°23'08" E	22.35'
C58	35.00'	46°31'43"	28.42'	N 07°30'08" E	27.65'
C59	35.00'	34°56'47"	21.35'	N 33°14'07" W	21.02'
C60	35.00'	37°46'30"	23.08'	N 69°35'45" W	22.66'
C61	85.00'	1°57'15"	2.90'	N 14°57'18" E	2.90'
C62	85.00'	9°08'51"	13.57'	N 09°24'15" E	13.56'

LINE TABLE
SHEETS 2–4

LINE	BEARING	DISTANCE
L1	S 83°15'24" E	5.78'
L2	N 06°44'36" E	12.46'
L3	S 06°44'36" W	11.13'
L4	N 59°04'02" W	26.51'
L5	S 25°51'51" E	10.23'
L6	N 17°45'43" W	36.12'
L7	N 62°21'12" E	17.47'
L8	S 01°31'00" W	9.00'

ROAD TRACT AREA TABLE

TRACT NAME	AREA
"E"	4,004 S.F.
"F"	8,213 S.F.
"G"	4,878 S.F.
"H"	95,645 S.F.

MINISTER–GLAESER SURVEYING INC.
2200 E. EVERGREEN BLVD.
VANCOUVER, WA 98661
(360) 694–3313

JOB NO. 15–185
DATE: 10–31–17
CALC BY: DLS
DRAWN BY: CSA
CHECKED BY: DAR
FILE: 15185.DWG

BK 311 PG 924

Design Criteria Appendix B

WWHM Soil Groups

Memorandum

otak

700 Washington Street
Suite 401.
Vancouver, WA 98660
Phone (360) 737-9613
Fax (360) 737-9651

To: Rod Swanson, Clark County Environmental Services

From: Tim Kraft

Copies: File

Date: December 21, 2010

Subject: Clark County WWHM Soil Groupings

The Clark County version of the Western Washington Hydrology Model (WWHM) includes five soils groups to represent the many soil types found within the county limits. Although there are over 110 different soil types throughout Clark County, similarities between the soils allows them to be grouped into categories for modeling purposes.

Clark County soils are grouped into five categories largely based on their permeability and runoff potential. These categories include:

- Soil Group (SG) 1 – Excessively drained soils (hydrologic soil groups A & B)
- Soil Group (SG) 2 – Well drained soils (mostly hydrologic soil group B)
- Soil Group (SG) 3 – Moderately drained soils (hydrologic soil groups B & C)
- Soil Group (SG) 4 – Poorly drained soils (slowly infiltrating C soils, as well as D soils)
- Soil Group (SG) 5 – Wetland soils (mucks).

Soil Groups 1 and 2 are those most suitable for traditional infiltration facilities such as trenches and drywells, while Soil Group 3 may only be suitable for slower infiltrating facilities such as rain gardens and other Low Impact Development (LID) measures. Soil Groups 4 and 5 are those which are typically not suitable for infiltration.

For additional information on the classification of soils for use in the Clark County WWHM model, please see the report titled "Development of the Clark County Version of the Western Washington Hydrology Model", which can be found on the county's community development web site.

The following table lists the WWHM soil group for each NCRS soil type in Clark County.

Map Symbol	Soil Name	HSG
Soils Group (SG) 1		
LeB	LAUREN	B
LgB	LAUREN	B
LgD	LAUREN	B
LgF	LAUREN	B
LIB	LAUREN	B
Ro	ROUGH BROKEN LAND	A
SvA	SIFTON	B
WnB	WIND RIVER VARIANT	B
WnD	WIND RIVER VARIANT	B
WnG	WIND RIVER VARIANT	B
WrB	WIND RIVER VARIANT	B
WrF	WIND RIVER VARIANT	B
	PITS	A
	BONNEVILLE STONY SAND LOAM	A
Soils Group (SG) 2		
BpB	BEAR PRARIE	B
BpC	BEAR PRARIE	B
CnB	CINEBAR	B
CnD	CINEBAR	B
CnE	CINEBAR	B
CnG	CINEBAR	B
CrE	CINEBAR	B
CrG	CINEBAR	B
CsF	CISPUS	B
CtA	CLOQUATO	B
HlA	HILLSBORO	B
HlB	HILLSBORO	B
HlC	HILLSBORO	B
HlD	HILLSBORO	B
HlE	HILLSBORO	B

Map Symbol	Soil Name	HSG
HlF	HILLSBORO	B
Soils Group (SG) 2 (continued)		
KeC	KINNEY	B
KeE	KINNEY	B
KeF	KINNEY	B
KnF	KINNEY	B
LaE	LARCHMOUNT	B
LaG	LARCHMOUNT	B
LcG	LARCHMOUNT	B
MsB	MOSSYROCK	B
NbA	NEWBERG	B
NbB	NEWBERG	B
PhB	PILCHUCK	C
PuA	PUYALLUP	B
SaC	SALKUM	B
VaB	VADER	B
VaC	VADER	B
WaA	WASHOUGAL	B
WgB	WASHOUGAL	B
WgE	WASHOUGAL	B
WhF	WASHOUGAL	B
YaA	YACOLT	B
YaC	YACOLT	B
YcB	YACOLT	B

Soils Group (SG) 3

DoB	DOLLAR	C
HcB	HESSON	C
HcD	HESSON	C
HcE	HESSON	C
HcF	HESSON	C
HgB	HESSON	C
HgD	HESSON	C
HhE	HESSON	C
HoA	HILLSBORO	B

Map Symbol	Soil Name	HSG
HoB	HILLSBORO	B
Soils Group (SG) 3 (continued)		
HoC	HILLSBORO	B
HoD	HILLSBORO	B
HoE	HILLSBORO	B
HoG	HILLSBORO	B
HsB	HILLSBORO	B
McB	McBEE	C
MeA	McBEE	C
MIA	McBEE	C
OeD	OLEQUA	B
OeE	OLEQUA	B
OeF	OLEQUA	B
OlB	OLYMPIC	B
OID	OLYMPIC	B
OlE	OLYMPIC	B
OIF	OLYMPIC	B
OmE	OLYMPIC	B
OmF	OLYMPIC	B
OpC	OLYMPIC VARIANT	C
OpE	OLYMPIC VARIANT	C
OpG	OLYMPIC VARIANT	C
OrC	OLYMPIC VARIANT	C
PoB	POWELL	C
PoD	POWELL	C
PoE	POWELL	C
SmA	SAUVIE	B
SmB	SAUVIE	B
SnA	SAUVIE	D
SpB	SAUVIE	B

Soils Group (SG) 4

CvA	COVE	D
CwA	COVE	D
GeB	GEE	C

Exhibit 8 SP26-1005

Map Symbol	Soil Name	HSG
GeD	GEE	C
Soils Group (SG) 4 (continued)		
GeE	GEE	C
GeF	GEE	C
GuB	GUMBOOT	D
HtA	HOCKINSON	D
HuB	HOCKINSON	D
HvA	HOCKINSON	D
LrC	LAUREN	C
LrF	LAUREN	C
MnA	MINNIECE	D
MnD	MINNIECE	D
MoA	MINNIECE VARIANT	D
OdB	ODNE	D
OhD	OLEQUA VARIANT	C
OhF	OLEQUA VARIANT	C
SlB	SARA	D
SlD	SARA	D
SlF	SARA	D
Soils Group (SG) 5		
Sr	SEMIAHMOO	C
Su	SEMIAHMOO VARIANT	D
ThA	TISCH	D

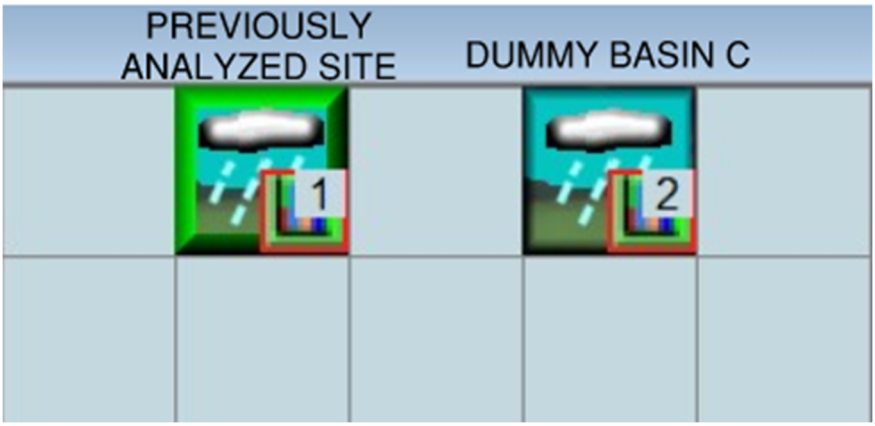
Hydraulic Calculations Appendix C

Water Quality Design

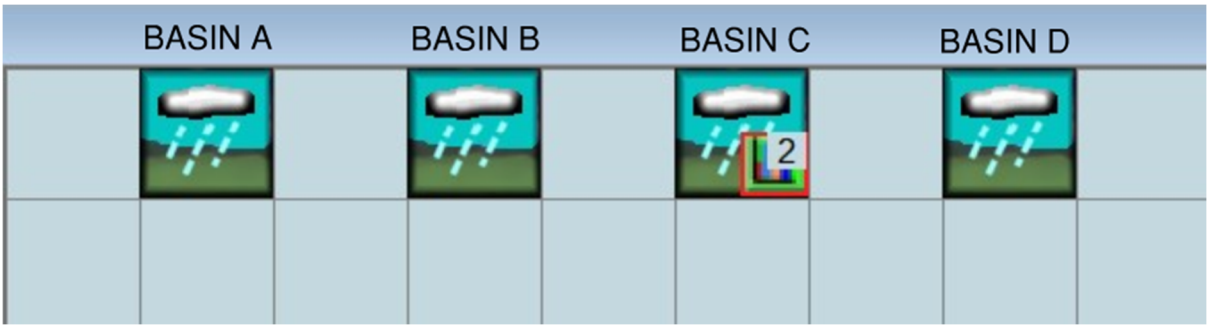
Western Washington Hydrology Model (WWHM) Project Report

WWHM SCHEMATIC

Predeveloped:



Mitigated:

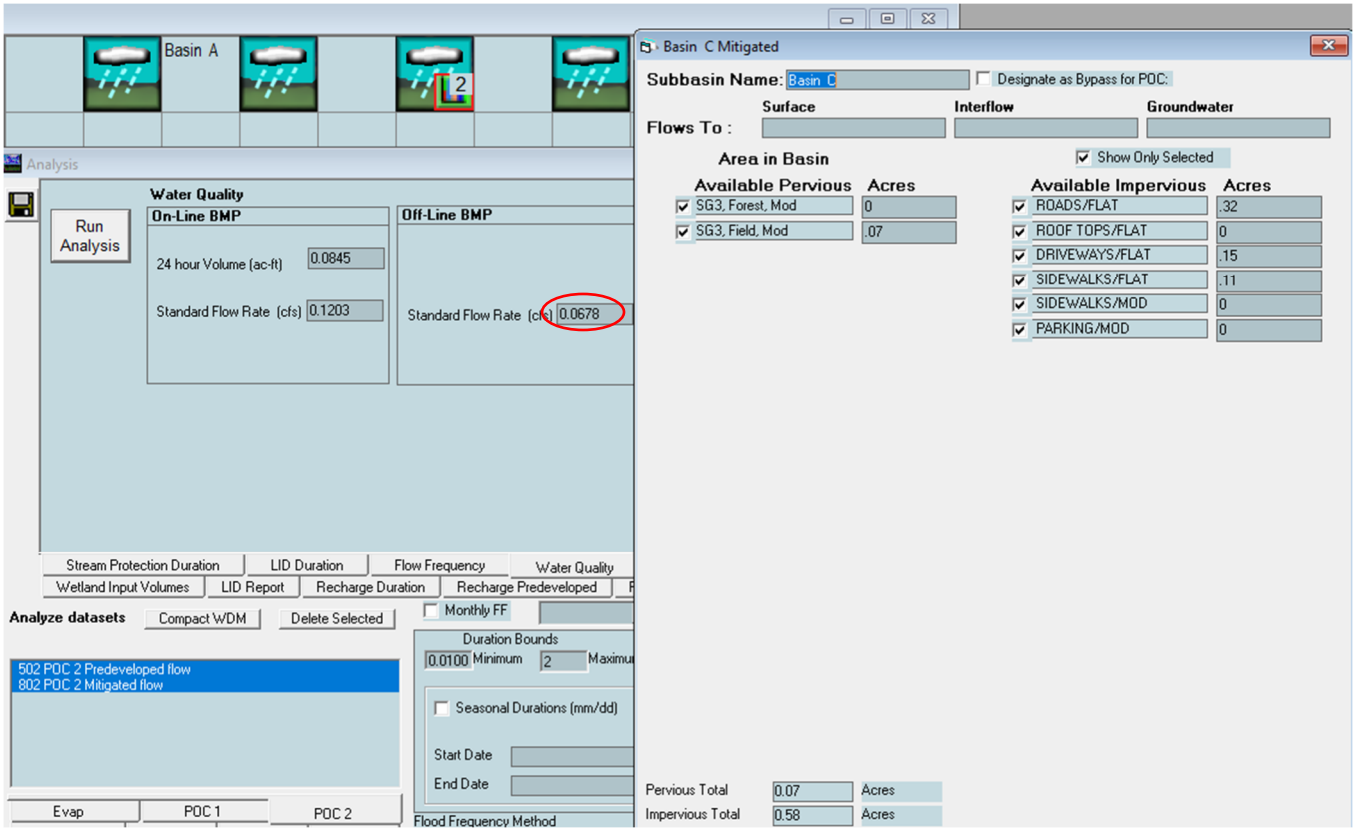


Water Quality

BASIN C:

WQ = 0.0678 CFS ~ (2) 27” PHOSPHOSORB CARTRIDGE

(2*0.0420 = 0.0840 CFS CAPACITY)



WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: Previously Analyzed Site

Site Name:	Parklands II
Site Address:	3711 NW Camas Meadows Dr
City:	Camas
Report Date:	3/23/2026
Gage:	Lacamas
Data Start:	1948/10/01
Data End:	2008/09/30
Timestep:	15 Minute
Precip Scale:	1.300
Version Date:	2024/06/28
Version:	4.3.1

POC Thresholds

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

Landuse Basin Data

Predeveloped Land Use

Previously Analyzed Site

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG3, Forest, Mod	0.33
Pervious Total	0.33

Impervious Land Use	acre
PARKING MOD	2.92
Impervious Total	2.92
Basin Total	3.25

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

Mitigated Land Use

Basin A

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG3, Field, Mod	0.29
Pervious Total	0.29

Impervious Land Use	acre
ROOF TOPS FLAT	0.19
Impervious Total	0.19
Basin Total	0.48

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

Basin B

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG3, Field, Mod	0.44
Pervious Total	0.44

Impervious Land Use	acre
ROADS FLAT	0.17
ROOF TOPS FLAT	0.26
SIDEWALKS FLAT	0.04
Impervious Total	0.47
Basin Total	0.91

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

Basin C

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG3, Field, Mod	0.07
Pervious Total	0.07

Impervious Land Use	acre
ROADS FLAT	0.32
DRIVEWAYS FLAT	0.15
SIDEWALKS FLAT	0.11
Impervious Total	0.58
Basin Total	0.65

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

Basin 4

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG3, Field, Mod	0.58
Pervious Total	0.58

Impervious Land Use	acre
ROOF TOPS FLAT	0.64
Impervious Total	0.64
Basin Total	1.22

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

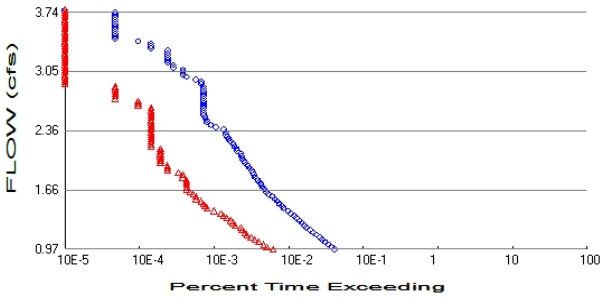
Routing Elements

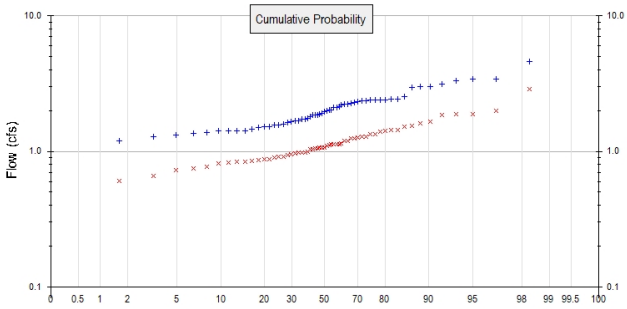
Predeveloped Routing

Mitigated Routing

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.33
Total Impervious Area: 2.92

Mitigated Landuse Totals for POC #1
Total Pervious Area: 1.38
Total Impervious Area: 1.88

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	1.94387
5 year	2.516003
10 year	2.895756
25 year	3.378837
50 year	3.742024
100 year	4.108653

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	1.082781
5 year	1.413891
10 year	1.644682
25 year	1.950124
50 year	2.188058
100 year	2.435161

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	2.961	1.606
1950	1.565	0.864
1951	1.654	1.131
1952	1.861	0.972
1953	1.556	0.946
1954	2.387	1.446
1955	2.217	0.915
1956	2.116	1.187
1957	1.981	1.195
1958	2.412	1.245

1959	1.420	0.843
1960	1.635	0.834
1961	1.760	1.069
1962	1.426	0.877
1963	1.670	1.056
1964	1.590	0.810
1965	1.423	0.845
1966	2.013	0.983
1967	1.884	1.045
1968	3.310	1.863
1969	3.127	1.665
1970	3.393	2.891
1971	1.732	0.985
1972	2.986	1.338
1973	2.021	1.121
1974	1.520	1.044
1975	1.287	0.752
1976	1.458	0.944
1977	1.191	0.608
1978	2.439	1.413
1979	2.292	1.392
1980	1.313	0.773
1981	1.796	1.287
1982	1.846	1.129
1983	2.244	1.527
1984	1.360	0.658
1985	1.419	0.824
1986	2.527	1.256
1987	1.672	0.910
1988	1.902	0.982
1989	2.391	1.280
1990	2.261	1.141
1991	2.377	1.112
1992	1.858	1.061
1993	2.343	1.332
1994	2.152	0.996
1995	1.972	1.030
1996	2.357	1.542
1997	2.988	1.978
1998	3.429	1.893
1999	1.384	0.905
2000	1.495	0.724
2001	0.959	0.573
2002	2.195	1.430
2003	1.725	1.063
2004	2.106	1.096
2005	2.410	1.247
2006	2.393	1.123
2007	1.511	0.875
2008	4.579	1.868

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	4.5786	2.8914
2	3.4295	1.9776
3	3.3934	1.8934
4	3.3103	1.8683

5	3.1271	1.8629
6	2.9876	1.6654
7	2.9857	1.6059
8	2.9613	1.5421
9	2.5271	1.5273
10	2.4391	1.4457
11	2.4124	1.4302
12	2.4104	1.4130
13	2.3929	1.3920
14	2.3911	1.3384
15	2.3873	1.3318
16	2.3773	1.2874
17	2.3566	1.2797
18	2.3430	1.2561
19	2.2922	1.2469
20	2.2614	1.2446
21	2.2435	1.1951
22	2.2175	1.1868
23	2.1950	1.1409
24	2.1520	1.1312
25	2.1163	1.1293
26	2.1059	1.1233
27	2.0211	1.1215
28	2.0133	1.1124
29	1.9809	1.0957
30	1.9718	1.0690
31	1.9023	1.0634
32	1.8844	1.0611
33	1.8607	1.0562
34	1.8583	1.0452
35	1.8463	1.0444
36	1.7963	1.0298
37	1.7599	0.9959
38	1.7316	0.9851
39	1.7250	0.9831
40	1.6724	0.9825
41	1.6696	0.9718
42	1.6540	0.9465
43	1.6352	0.9439
44	1.5895	0.9146
45	1.5653	0.9102
46	1.5556	0.9048
47	1.5196	0.8769
48	1.5108	0.8751
49	1.4952	0.8641
50	1.4578	0.8446
51	1.4260	0.8427
52	1.4227	0.8339
53	1.4204	0.8238
54	1.4194	0.8098
55	1.3839	0.7734
56	1.3596	0.7521
57	1.3128	0.7238
58	1.2869	0.6578
59	1.1915	0.6084
60	0.9586	0.5732

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.9719	867	129	14	Pass
0.9999	789	107	13	Pass
1.0279	710	97	13	Pass
1.0559	645	83	12	Pass
1.0839	590	74	12	Pass
1.1118	548	66	12	Pass
1.1398	497	58	11	Pass
1.1678	445	54	12	Pass
1.1958	404	50	12	Pass
1.2238	367	48	13	Pass
1.2517	340	40	11	Pass
1.2797	317	38	11	Pass
1.3077	294	35	11	Pass
1.3357	269	31	11	Pass
1.3637	248	28	11	Pass
1.3916	226	26	11	Pass
1.4196	206	21	10	Pass
1.4476	180	17	9	Pass
1.4756	171	16	9	Pass
1.5036	156	15	9	Pass
1.5315	147	14	9	Pass
1.5595	139	12	8	Pass
1.5875	127	12	9	Pass
1.6155	112	11	9	Pass
1.6435	106	10	9	Pass
1.6715	100	9	9	Pass
1.6994	94	9	9	Pass
1.7274	90	9	10	Pass
1.7554	85	9	10	Pass
1.7834	81	9	11	Pass
1.8114	74	8	10	Pass
1.8393	72	8	11	Pass
1.8673	69	7	10	Pass
1.8953	67	5	7	Pass
1.9233	62	5	8	Pass
1.9513	59	5	8	Pass
1.9792	55	4	7	Pass
2.0072	52	4	7	Pass
2.0352	50	4	8	Pass
2.0632	49	4	8	Pass
2.0912	48	4	8	Pass
2.1191	43	4	9	Pass
2.1471	42	4	9	Pass
2.1751	39	3	7	Pass
2.2031	38	3	7	Pass
2.2311	35	3	8	Pass
2.2590	33	3	9	Pass
2.2870	31	3	9	Pass
2.3150	30	3	10	Pass
2.3430	30	3	10	Pass
2.3710	28	3	10	Pass
2.3990	22	3	13	Pass
2.4269	19	3	15	Pass

2.4549	17	3	17	Pass
2.4829	17	3	17	Pass
2.5109	16	3	18	Pass
2.5389	15	3	20	Pass
2.5668	15	3	20	Pass
2.5948	15	3	20	Pass
2.6228	15	3	20	Pass
2.6508	15	2	13	Pass
2.6788	15	2	13	Pass
2.7067	15	2	13	Pass
2.7347	15	1	6	Pass
2.7627	15	1	6	Pass
2.7907	15	1	6	Pass
2.8187	15	1	6	Pass
2.8466	15	1	6	Pass
2.8746	15	1	6	Pass
2.9026	14	0	0	Pass
2.9306	14	0	0	Pass
2.9586	12	0	0	Pass
2.9865	9	0	0	Pass
3.0145	8	0	0	Pass
3.0425	8	0	0	Pass
3.0705	8	0	0	Pass
3.0985	6	0	0	Pass
3.1264	6	0	0	Pass
3.1544	5	0	0	Pass
3.1824	5	0	0	Pass
3.2104	5	0	0	Pass
3.2384	5	0	0	Pass
3.2664	5	0	0	Pass
3.2943	5	0	0	Pass
3.3223	3	0	0	Pass
3.3503	3	0	0	Pass
3.3783	3	0	0	Pass
3.4063	2	0	0	Pass
3.4342	1	0	0	Pass
3.4622	1	0	0	Pass
3.4902	1	0	0	Pass
3.5182	1	0	0	Pass
3.5462	1	0	0	Pass
3.5741	1	0	0	Pass
3.6021	1	0	0	Pass
3.6301	1	0	0	Pass
3.6581	1	0	0	Pass
3.6861	1	0	0	Pass
3.7140	1	0	0	Pass
3.7420	1	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
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 = Passed

POC 2

POC #2 was not reported because POC must exist in both scenarios and both scenarios must have been run.

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

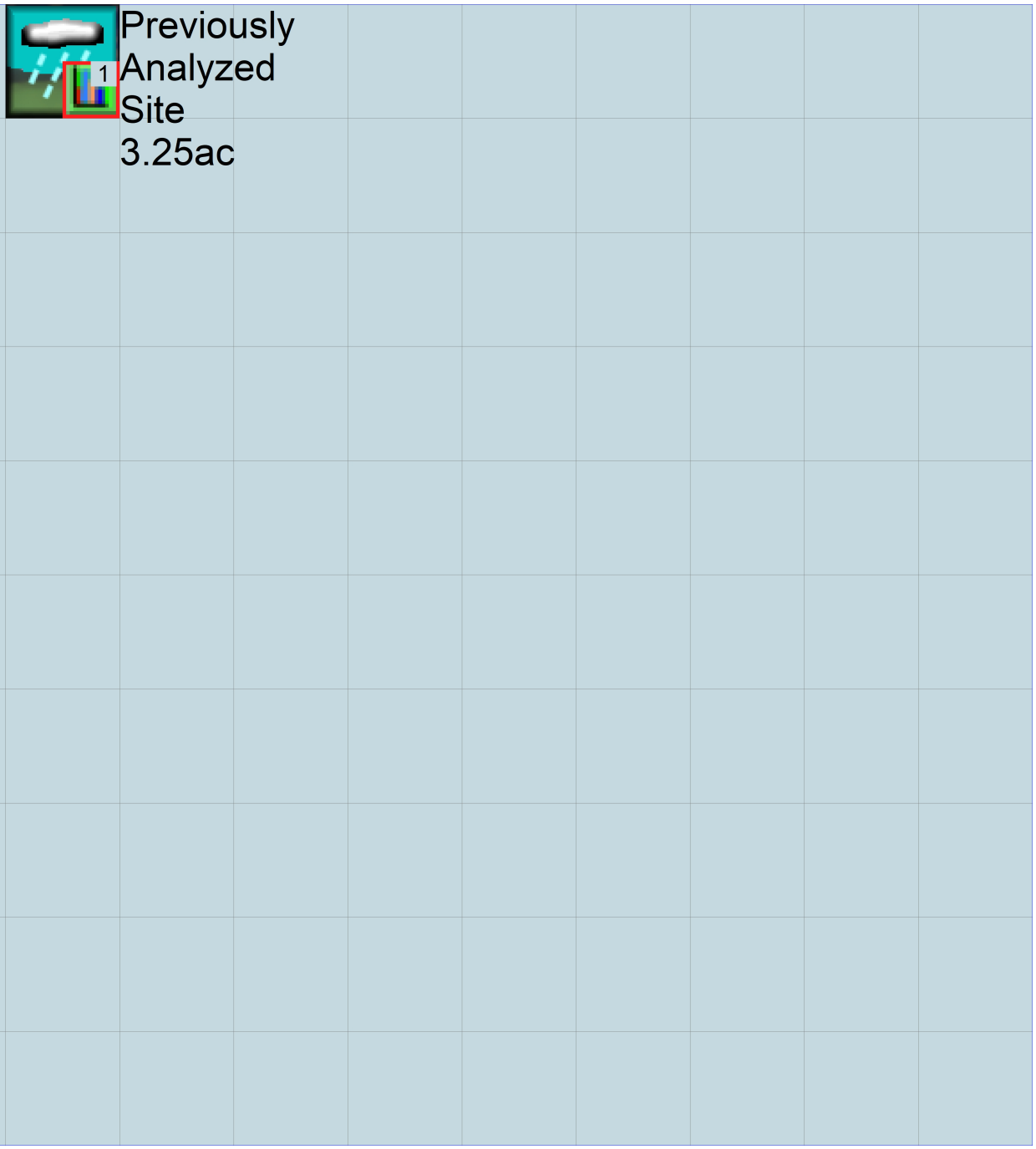
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic



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   Previously Analyzed Site.wdm
MESSU       25   PrePreviously Analyzed Site.MES
            27   PrePreviously Analyzed Site.L61
            28   PrePreviously Analyzed Site.L62
            30   POCPreviously Analyzed Site1.dat
END FILES

OPN SEQUENCE
    INGRP               INDELT 00:15
      PERLND      20
      IMPLND      12
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Previously Analyzed Site    MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   20     SG3, 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 ***
   20         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  *********
   20         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 ***
   20         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
   20             0         9      0.08       400       0.1         0      0.96
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   20              0         0       2.5         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   20            0.2         1      0.35         4       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
   20             0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
   12      PARKING/MOD            1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
   12         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
   12         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     ***
   12         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
   12            400      0.05       0.1      0.08
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
   12              0         0
```

```
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
   12             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                 <--Area-->     <-Target->   MBLK   ***
<Name>   #                 <-factor->     <Name>   #   Tbl#   ***
Previously Analyzed Site***
PERLND  20                       0.33     COPY   501     12
PERLND  20                       0.33     COPY   501     13
IMPLND  12                       2.92     COPY   501     15

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

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



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

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

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

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

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

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

SPEC-ACTIONS
```

```
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.3            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       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       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   Previously Analyzed Site.wdm
MESSU       25   MitPreviously Analyzed Site.MES
            27   MitPreviously Analyzed Site.L61
            28   MitPreviously Analyzed Site.L62
            30   POCPreviously Analyzed Site1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      23
      IMPLND       4
      IMPLND       1
      IMPLND       8
      IMPLND       5
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  A                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   23     SG3, Field, 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 ***
   23         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  *********
   23         0    0    4    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 ***
   23         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
   23              0         9      0.06       400       0.1         0      0.96
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   23              0         0       2.5         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   23          0.15         1       0.3         4       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
   23              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

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

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

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

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

```
    1         0    0    0    0    0
    8         0    0    0    0    0
    5         0    0    0    0    0
  END IWAT-PARM1

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

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

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

END IMPLND

SCHEMATIC
<-Source->                 <--Area-->     <-Target->   MBLK   ***
<Name>   #                 <-factor->     <Name>   #   Tbl#   ***
Basin  A***
PERLND  23                       0.29     COPY   501     12
PERLND  23                       0.29     COPY   501     13
IMPLND   4                       0.19     COPY   501     15
Basin B***
PERLND  23                       0.44     COPY   501     12
PERLND  23                       0.44     COPY   501     13
IMPLND   1                       0.17     COPY   501     15
IMPLND   4                       0.26     COPY   501     15
IMPLND   8                       0.04     COPY   501     15
Basin  C***
PERLND  23                       0.07     COPY   501     12
PERLND  23                       0.07     COPY   501     13
IMPLND   1                       0.32     COPY   501     15
IMPLND   5                       0.15     COPY   501     15
IMPLND   8                       0.11     COPY   501     15
Basin  4***
PERLND  23                       0.58     COPY   501     12
PERLND  23                       0.58     COPY   501     13
IMPLND   4                       0.64     COPY   501     15

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

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



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

```
END NETWORK

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

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

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

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

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

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC      ENGL    1.3           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     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       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

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

```
  END MASS-LINK   13

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


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

Legal Notice

This program and accompanying documentation are provided 'as-is' without warranty of any kind. The entire risk regarding the performance and results of this program is assumed by End User. Clear Creek Solutions Inc. and the governmental licensee or sublicensees disclaim all warranties, either expressed or implied, including but not limited to implied warranties of program and accompanying documentation. In no event shall Clear Creek Solutions Inc. be liable for any damages whatsoever (including without limitation to damages for loss of business profits, loss of business information, business interruption, and the like) arising out of the use of, or inability to use this program even if Clear Creek Solutions Inc. or their authorized representatives have been advised of the possibility of such damages. Software Copyright © by : Clear Creek Solutions, Inc. 2005-2026; All Rights Reserved.

Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: Parklands II Short Plat

Site Name:	Parklands II
Site Address:	3711 NW Camas Meadows Dr
City:	Camas
Report Date:	3/23/2026
Gage:	Lacamas
Data Start:	1948/10/01
Data End:	2008/09/30
Timestep:	15 Minute
Precip Scale:	1.300
Version Date:	2024/06/28
Version:	4.3.1

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

Landuse Basin Data

Predeveloped Land Use

Previously Analyzed Site

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG3, Forest, Mod	0.33
Pervious Total	0.33

Impervious Land Use	acre
PARKING MOD	2.92
Impervious Total	2.92
Basin Total	3.25

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

Dummy Basin C

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG3, Field, Mod	0.07
Pervious Total	0.07

Impervious Land Use	acre
ROADS FLAT	0.32
DRIVEWAYS FLAT	0.15
SIDEWALKS FLAT	0.11
Impervious Total	0.58
Basin Total	0.65

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 2	POC 2	

Mitigated Land Use

Basin A

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG3, Field, Mod	0.29
Pervious Total	0.29

Impervious Land Use	acre
ROOF TOPS FLAT	0.19
Impervious Total	0.19
Basin Total	0.48

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

Basin B

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG3, Field, Mod	0.44
Pervious Total	0.44

Impervious Land Use	acre
ROADS FLAT	0.17
ROOF TOPS FLAT	0.26
SIDEWALKS FLAT	0.04
Impervious Total	0.47
Basin Total	0.91

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

Basin C

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG3, Field, Mod	0.07
Pervious Total	0.07

Impervious Land Use	acre
ROADS FLAT	0.32
DRIVEWAYS FLAT	0.15
SIDEWALKS FLAT	0.11
Impervious Total	0.58
Basin Total	0.65

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 2	POC 2	

Basin D

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG3, Field, Mod	0.58
Pervious Total	0.58

Impervious Land Use	acre
ROOF TOPS FLAT	0.64
Impervious Total	0.64
Basin Total	1.22

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

Routing Elements

Predeveloped Routing

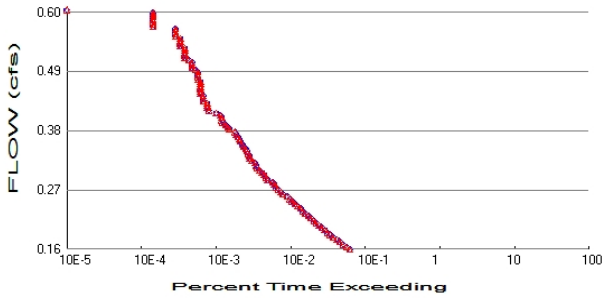
Mitigated Routing

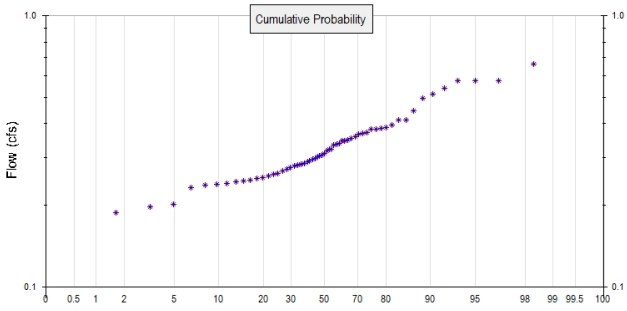
Analysis Results

POC 1

POC #1 was not reported because POC must exist in both scenarios and both scenarios must have been run.

POC 2





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #2
Total Pervious Area: 0.07
Total Impervious Area: 0.58

Mitigated Landuse Totals for POC #2
Total Pervious Area: 0.07
Total Impervious Area: 0.58

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	**Flow(cfs)**
2 year	0.315647
5 year	0.405443
10 year	0.465971
25 year	0.54397
50 year	0.603309
100 year	0.663788

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	**Flow(cfs)**
2 year	0.315647
5 year	0.405443
10 year	0.465971
25 year	0.54397
50 year	0.603309
100 year	0.663788

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	**Predeveloped**	**Mitigated**
1949	0.495	0.495
1950	0.261	0.261
1951	0.286	0.286
1952	0.292	0.292
1953	0.272	0.272
1954	0.381	0.381
1955	0.282	0.282
1956	0.334	0.334
1957	0.321	0.321
1958	0.369	0.369
1959	0.260	0.260

1960	0.257	0.257
1961	0.289	0.289
1962	0.253	0.253
1963	0.310	0.310
1964	0.248	0.248
1965	0.241	0.241
1966	0.279	0.279
1967	0.297	0.297
1968	0.574	0.574
1969	0.513	0.513
1970	0.663	0.663
1971	0.304	0.304
1972	0.413	0.413
1973	0.346	0.346
1974	0.282	0.282
1975	0.232	0.232
1976	0.244	0.244
1977	0.188	0.188
1978	0.358	0.358
1979	0.414	0.414
1980	0.239	0.239
1981	0.337	0.337
1982	0.348	0.348
1983	0.381	0.381
1984	0.198	0.198
1985	0.252	0.252
1986	0.387	0.387
1987	0.238	0.238
1988	0.303	0.303
1989	0.395	0.395
1990	0.352	0.352
1991	0.321	0.321
1992	0.298	0.298
1993	0.365	0.365
1994	0.307	0.307
1995	0.317	0.317
1996	0.446	0.446
1997	0.539	0.539
1998	0.575	0.575
1999	0.247	0.247
2000	0.202	0.202
2001	0.177	0.177
2002	0.370	0.370
2003	0.275	0.275
2004	0.338	0.338
2005	0.385	0.385
2006	0.346	0.346
2007	0.267	0.267
2008	0.575	0.575

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	**Predeveloped**	**Mitigated**
1	0.6625	0.6625
2	0.5748	0.5748
3	0.5748	0.5748
4	0.5744	0.5744
5	0.5393	0.5393

6	0.5134	0.5134
7	0.4954	0.4954
8	0.4458	0.4458
9	0.4139	0.4139
10	0.4128	0.4128
11	0.3947	0.3947
12	0.3873	0.3873
13	0.3846	0.3846
14	0.3813	0.3813
15	0.3808	0.3808
16	0.3701	0.3701
17	0.3692	0.3692
18	0.3652	0.3652
19	0.3577	0.3577
20	0.3519	0.3519
21	0.3481	0.3481
22	0.3462	0.3462
23	0.3459	0.3459
24	0.3380	0.3380
25	0.3368	0.3368
26	0.3344	0.3344
27	0.3214	0.3214
28	0.3211	0.3211
29	0.3173	0.3173
30	0.3103	0.3103
31	0.3071	0.3071
32	0.3038	0.3038
33	0.3030	0.3030
34	0.2976	0.2976
35	0.2966	0.2966
36	0.2923	0.2923
37	0.2895	0.2895
38	0.2861	0.2861
39	0.2824	0.2824
40	0.2821	0.2821
41	0.2786	0.2786
42	0.2746	0.2746
43	0.2716	0.2716
44	0.2670	0.2670
45	0.2615	0.2615
46	0.2599	0.2599
47	0.2571	0.2571
48	0.2534	0.2534
49	0.2516	0.2516
50	0.2481	0.2481
51	0.2467	0.2467
52	0.2441	0.2441
53	0.2415	0.2415
54	0.2385	0.2385
55	0.2376	0.2376
56	0.2320	0.2320
57	0.2018	0.2018
58	0.1975	0.1975
59	0.1875	0.1875
60	0.1766	0.1766

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.1578	1294	1294	100	Pass
0.1623	1175	1175	100	Pass
0.1668	1052	1052	100	Pass
0.1713	952	952	100	Pass
0.1758	876	876	100	Pass
0.1803	775	775	100	Pass
0.1848	711	711	100	Pass
0.1893	653	653	100	Pass
0.1938	598	598	100	Pass
0.1983	544	544	100	Pass
0.2028	502	502	100	Pass
0.2073	458	458	100	Pass
0.2118	430	430	100	Pass
0.2163	389	389	100	Pass
0.2208	363	363	100	Pass
0.2253	327	327	100	Pass
0.2298	303	303	100	Pass
0.2343	285	285	100	Pass
0.2388	258	258	100	Pass
0.2433	239	239	100	Pass
0.2478	221	221	100	Pass
0.2523	205	205	100	Pass
0.2568	187	187	100	Pass
0.2613	164	164	100	Pass
0.2658	156	156	100	Pass
0.2703	142	142	100	Pass
0.2748	135	135	100	Pass
0.2793	127	127	100	Pass
0.2838	120	120	100	Pass
0.2883	103	103	100	Pass
0.2928	98	98	100	Pass
0.2973	93	93	100	Pass
0.3018	87	87	100	Pass
0.3063	80	80	100	Pass
0.3108	75	75	100	Pass
0.3153	73	73	100	Pass
0.3198	70	70	100	Pass
0.3243	63	63	100	Pass
0.3288	59	59	100	Pass
0.3333	59	59	100	Pass
0.3378	56	56	100	Pass
0.3423	54	54	100	Pass
0.3468	52	52	100	Pass
0.3513	49	49	100	Pass
0.3558	47	47	100	Pass
0.3603	44	44	100	Pass
0.3648	43	43	100	Pass
0.3693	41	41	100	Pass
0.3738	39	39	100	Pass
0.3783	38	38	100	Pass
0.3828	32	32	100	Pass
0.3873	30	30	100	Pass
0.3918	28	28	100	Pass

0.3963	26	26	100	Pass
0.4008	25	25	100	Pass
0.4053	25	25	100	Pass
0.4098	24	24	100	Pass
0.4143	21	21	100	Pass
0.4188	17	17	100	Pass
0.4233	16	16	100	Pass
0.4278	16	16	100	Pass
0.4323	16	16	100	Pass
0.4368	14	14	100	Pass
0.4413	14	14	100	Pass
0.4458	14	14	100	Pass
0.4503	13	13	100	Pass
0.4548	13	13	100	Pass
0.4593	13	13	100	Pass
0.4638	13	13	100	Pass
0.4683	13	13	100	Pass
0.4728	13	13	100	Pass
0.4773	12	12	100	Pass
0.4818	12	12	100	Pass
0.4863	12	12	100	Pass
0.4908	12	12	100	Pass
0.4953	11	11	100	Pass
0.4998	10	10	100	Pass
0.5043	10	10	100	Pass
0.5088	10	10	100	Pass
0.5133	9	9	100	Pass
0.5178	8	8	100	Pass
0.5223	8	8	100	Pass
0.5268	8	8	100	Pass
0.5313	8	8	100	Pass
0.5358	8	8	100	Pass
0.5403	7	7	100	Pass
0.5448	7	7	100	Pass
0.5493	7	7	100	Pass
0.5538	7	7	100	Pass
0.5583	6	6	100	Pass
0.5628	6	6	100	Pass
0.5673	6	6	100	Pass
0.5718	6	6	100	Pass
0.5763	3	3	100	Pass
0.5808	3	3	100	Pass
0.5853	3	3	100	Pass
0.5898	3	3	100	Pass
0.5943	3	3	100	Pass
0.5988	3	3	100	Pass
0.6033	3	3	100	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #2

On-line facility volume:	0.0845 acre-feet
On-line facility target flow:	0.1203 cfs.
Adjusted for 15 min:	0.1203 cfs.
Off-line facility target flow:	0.0678 cfs.
Adjusted for 15 min:	0.0678 cfs.

LID Report

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

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

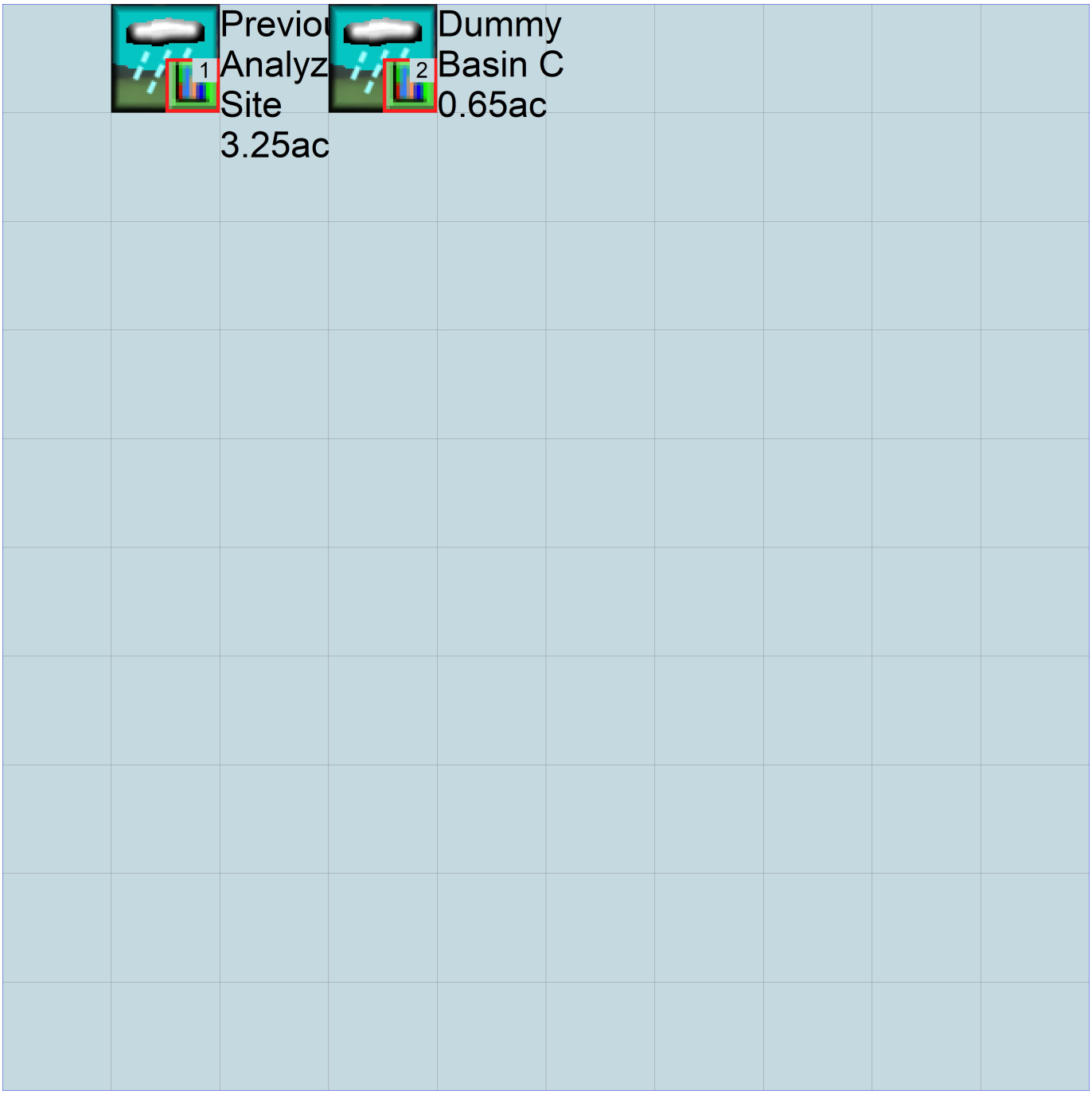
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       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   Parklands II Short Plat.wdm
MESSU       25   PreParklands II Short Plat.MES
            27   PreParklands II Short Plat.L61
            28   PreParklands II Short Plat.L62
            30   POCParklands II Short Plat1.dat
            31   POCParklands II Short Plat2.dat
END FILES

OPN SEQUENCE
    INGRP               INDELT 00:15
      PERLND      20
      IMPLND      12
      PERLND      23
      IMPLND       1
      IMPLND       5
      IMPLND       8
      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        Previously Analyzed Site    MAX                   1    2   30    9
    2        Dummy Basin C               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           ***
   20     SG3, Forest, Mod        1    1    1    1   27    0
   23     SG3, Field, 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 ***
   20         0    0    1    0    0    0    0    0    0    0    0    0
   23         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  *********
   20         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   23         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 ***
   20         0    0    0    0    0    0    0    0    0    0    0
   23         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
   20              0         9      0.08       400       0.1         0      0.96
   23              0         9      0.06       400       0.1         0      0.96
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   20              0         0       2.5         2         0         0         0
   23              0         0       2.5         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   20            0.2         1      0.35         4       0.4       0.7
   23           0.15         1       0.3         4       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
   20              0         0         0         0         3         1         0
   23              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

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

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
   12         0    0    1    0    0    0
    1         0    0    1    0    0    0
    5         0    0    1    0    0    0
    8         0    0    1    0    0    0
  END ACTIVITY
```

```
  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
   12         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
    8         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
   12         0    0    0    0    0
    1         0    0    0    0    0
    5         0    0    0    0    0
    8         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
   12            400      0.05       0.1      0.08
    1            400      0.01       0.1       0.1
    5            400      0.01       0.1       0.1
    8            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
   12              0         0
    1              0         0
    5              0         0
    8              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
   12             0         0
    1             0         0
    5             0         0
    8             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                 <--Area-->     <-Target->   MBLK   ***
<Name>   #                 <-factor->     <Name>   #   Tbl#   ***
Previously Analyzed Site***
PERLND  20                       0.33     COPY   501     12
PERLND  20                       0.33     COPY   501     13
IMPLND  12                       2.92     COPY   501     15
Dummy Basin C***
PERLND  23                       0.07     COPY   502     12
PERLND  23                       0.07     COPY   502     13
IMPLND   1                       0.32     COPY   502     15
IMPLND   5                       0.15     COPY   502     15
IMPLND   8                       0.11     COPY   502     15

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

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

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

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

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

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

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

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

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.3            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

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


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       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   Parklands II Short Plat.wdm
MESSU       25   MitParklands II Short Plat.MES
            27   MitParklands II Short Plat.L61
            28   MitParklands II Short Plat.L62
            31   POCParklands II Short Plat2.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      23
      IMPLND       4
      IMPLND       1
      IMPLND       8
      IMPLND       5
      COPY       502
      DISPLY       2
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    2        Basin  C                   MAX                    1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         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           ***
   23     SG3, Field, 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 ***
   23         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  *********
   23         0    0    4    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 ***
   23         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
   23              0         9      0.06       400       0.1         0      0.96
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   23              0         0       2.5         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   23          0.15         1       0.3         4       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
   23              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

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

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

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

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

```
    1         0    0    0    0    0
    8         0    0    0    0    0
    5         0    0    0    0    0
  END IWAT-PARM1

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

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

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

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  C***
PERLND  23                        0.07     COPY   502     12
PERLND  23                        0.07     COPY   502     13
IMPLND   1                        0.32     COPY   502     15
IMPLND   5                        0.15     COPY   502     15
IMPLND   8                        0.11     COPY   502     15

******Routing******
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



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

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

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

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

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

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

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.3            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     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       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

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

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


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

Legal Notice

This program and accompanying documentation are provided 'as-is' without warranty of any kind. The entire risk regarding the performance and results of this program is assumed by End User. Clear Creek Solutions Inc. and the governmental licensee or sublicensees disclaim all warranties, either expressed or implied, including but not limited to implied warranties of program and accompanying documentation. In no event shall Clear Creek Solutions Inc. be liable for any damages whatsoever (including without limitation to damages for loss of business profits, loss of business information, business interruption, and the like) arising out of the use of, or inability to use this program even if Clear Creek Solutions Inc. or their authorized representatives have been advised of the possibility of such damages. Software Copyright © by : Clear Creek Solutions, Inc. 2005-2026; All Rights Reserved.

Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com

Geotechnical Report Appendix D

Refer to Section G of the application packet

Geotechnical Site Investigation

Parklands at Camas Meadows

Camas, Washington

June 23, 2015

Geotechnical ■ Environmental ■ Special Inspections
Columbia West
Engineering, Inc

11917 NE 95th Street
Vancouver, Washington
98682
Phone: 360-823-2900
Fax: 360-823-2901



Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

GEOTECHNICAL SITE INVESTIGATION
PARKLANDS AT CAMAS MEADOWS
CAMAS, WASHINGTON

Prepared For:

Mr. Aaron Barr & Mr. Kevin Deford
Parklands at Camas Meadows, LLC
PO Box 61962
Vancouver, WA 98666

Site Location:

NE of NW Payne Street and NW Camas Meadows Drive Intersection
Parcels 175948000 and 986031650
Camas, Washington

Prepared By:

Columbia West Engineering, Inc.
11917 NE 95th Street
Vancouver, Washington 98682
Phone: 360-823-2900
Fax: 360-823-2901

Date Prepared:

June 23, 2015

TABLE OF CONTENTS

LIST OF FIGURES ii
LIST OF APPENDICES iii
1.0 INTRODUCTION 1
1.1 General Site Information 1
1.2 Proposed Development 1
2.0 REGIONAL GEOLOGY AND SOIL CONDITIONS 1
3.0 REGIONAL SEISMOLOGY 2
4.0 GEOTECHNICAL FIELD INVESTIGATION 5
4.1 Surface Investigation and Site Description 5
4.2 Subsurface Exploration and Investigation 5
4.2.1 Soil Type Description 5
4.2.2 Groundwater 6
5.0 DESIGN RECOMMENDATIONS 6
5.1 Site Preparation and Grading 7
5.2 Engineered Structural Fill 7
5.3 Cut and Fill Slopes 8
5.4 Foundations 8
5.5 Slabs on Grade 9
5.6 Settlement 10
5.7 Excavation 10
5.8 Dewatering 11
5.9 Lateral Earth Pressure 11
5.10 Seismic Design Considerations 12
5.11 Soil Liquefaction and Dynamic Settlement 13
5.12 Drainage 14
5.13 Bituminous Asphalt and Portland Cement Concrete 14
5.14 Wet Weather Construction Methods and Techniques 15
5.15 Erosion Control Measures 16
5.16 Soil Shrink/Swell Potential 17
5.17 Utility Installation 17
6.0 CONCLUSION AND LIMITATIONS 17
REFERENCES
FIGURES
APPENDICES

LIST OF FIGURES

Number	Title
1	Site Location Map
2	Subsurface Exploration Location Map
3	Typical Cut and Fill Slope Cross-Section
4	Minimum Foundation Slope Setback Detail
5	Typical Perimeter Footing Drain Detail
6	Typical Perforated Drain Pipe Trench Detail

LIST OF APPENDICES

Number	Title
A	Analytical Laboratory Test Results
B	Subsurface Exploration Logs
C	Soil Classification Information
D	Photo Log
E	Report Limitations and Important Information

GEOTECHNICAL SITE INVESTIGATION
PARKLANDS AT CAMAS MEADOWS
CAMAS, WASHINGTON

1.0 INTRODUCTION

Columbia West Engineering, Inc. was retained by Parklands at Camas Meadows, LLC to conduct a geotechnical site investigation for proposed development on tax parcel numbers 986031650 and 175948000 in Camas, Washington. The purpose of the investigation was to observe and assess subsurface soil conditions at specific locations and provide subsequent appropriate geotechnical engineering analyses to support property development feasibility, planning, and design recommendations. The specific scope of services was outlined in a proposal contract dated May 27, 2015. 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 6.0, *Conclusion and Limitations*, and Appendix E.

1.1 General Site Information

As indicated on Figures 1 and 2, the subject site is located northeast of the intersection of NW Payne Street and NW Camas Meadows Drive in Camas, Washington. The site is comprised of two tax parcels numbered 986031650 and 175948000 totaling approximately 36.4 acres. The regulatory jurisdictional agency is the City of Camas, Washington. The approximate latitude and longitude are N 45° 37’ 40” and W 122° 26’ 54”, and the legal description is a portion of the SW and SE ¼ of Section 28, T2N, R3E, Willamette Meridian.

1.2 Proposed Development

Review of preliminary site plans provided by the client indicates that proposed development will consist of approximately 46 residential lots and 6 commercial buildings, parking areas, loading docks, private roadways and a future extension of NW Camas Meadows Drive. Stormwater facilities and underground utilities may also be constructed as part of proposed development. Columbia West understands that cut and fill areas will likely be proposed at the property. This report is based upon proposed development as described above and may not be applicable if modified.

2.0 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 within the central portion of the Portland/Vancouver Basin, an open, somewhat elliptical, northwest-trending syncline approximately 60 miles wide.

According to the *Geologic Map of the Lacamas Quadrangle, Clark County, Washington* (US Geological Survey, Science Investigations Map 2924, 2006), the primary geologic unit present at the site is a Pleistocene gravel facies unit deposited by cataclysmic, glacial-outburst floods associated with Lake Missoula in Montana. However, in the areas explored during subsurface excavation, the unconsolidated boulder to cobbly gravel unit was either extremely thin or missing completely. Instead, the subsurface investigation revealed that the bulk of the site is underlain by two similar sedimentary formations. Test pit exploration indicated that the western corner of the site is underlain by an unnamed, Pleistocene to Pliocene, semi-consolidated, pebble to cobble conglomerate (QTc). This geologic unit 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 this unit as the Troutdale Formation.

The southern and eastern portion of the site is underlain by the Hyaoclastic sandstone member of the Troutdale formation (Ttfh). This Pliocene to Pleistocene formation is comprised of coarse-grained sandstone and pebble conglomerate containing basalt pebbles and cobbles. This geologic unit 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 this unit as the Troutdale Formation.

The *Web Soil Survey (United States Department of Agriculture, Natural Resource Conservation Service [USDA NRCS], 2013 Website)* indicates the site is underlain by three soil types. Hesson clay loam soils are mapped on the majority of the site from the northwest corner to the southwest corner of the property, while Cove silty clay loam and Lauren gravelly loam soils are mapped in the northern and northwestern portions of the property, respectively. Soils resembling the Lauren series were not encountered during subsurface excavation.

Although actual on-site soils may vary from the broad USDA descriptions, Lauren soils are generally coarse-textured, well drained soils with rapid permeability. Cove soils are generally fine-textured, poorly drained soils with very slow permeability and high shrink-swell potential. Hesson soils are fine-textured, well drained soils with moderately slow permeability and moderate shrink-swell potential.

3.0 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.

There are at least four 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 the following text.

Portland Hills Fault Zone

The Portland Hills Fault Zone consists of several northwest-trending faults located along the northeastern margin of the Tualatin Mountains, also known as the Portland Hills, and the southwest margin of the Portland Basin. The fault zone is approximately 25 to 30 miles in length and is located approximately 17 miles southwest of the site. According to *Seismic Design Mapping, State of Oregon (Geomatrix Consultants, 1995),* there is no definitive consensus among geologists as to the zone fault type. Several alternate interpretations have been suggested.

According to the *USGS Earthquake Hazards Program*, the fault was originally mapped as a down-to-the-northeast normal fault, but has also been mapped as part of a regional-scale zone of right-lateral, oblique slip faults, and as a steep escarpment caused by asymmetrical folding above a south-west dipping, blind thrust fault. The Portland Hills fault offsets Miocene Columbia River Basalts, and Miocene to Pliocene sedimentary rocks of the Troutdale Formation. No fault scarps on surficial Quaternary deposits have been described along the fault trace, and the fault is mapped as buried by the Pleistocene aged Missoula flood deposits.

However, evidence is thought to exist which suggests that fault movement has impacted shallow Holocene deposits and deeper Pleistocene sediments. Seismologists recorded a M3.2 earthquake thought to be associated with the fault zone near Kelly Point Park in November 2012, a M3.9 earthquake thought to be associated with the fault zone near Kelly Point Park in April 2003, and a M3.5 earthquake possibly associated with the fault zone occurred approximately 1.3 miles east of the fault in 1991. Therefore, the Portland Hills Fault Zone is generally thought to be potentially active and capable of producing possible damaging earthquakes.

Gales Creek-Newberg-Mt. Angel Fault Zone

Located approximately 35 miles southwest of the site, the northwest-striking, approximately 50-mile long Gales Creek-Newberg-Mt. Angel Structural Zone forms the northwestern boundary between the Oregon Coast Range and the Willamette Valley, and consists of a series of discontinuous northwest-trending faults. The southern end the fault zone forms the southwest margin of the Tualatin basin. Possible late-Quaternary geomorphic surface deformation may exist along the structural zone *(Geomatrix Consultants, 1995)*.

According to the *USGS Earthquake Hazards Program*, the Mount Angel fault is mapped as a high-angle, reverse-oblique fault, which offsets Miocene rocks of the Columbia River Basalts, and Miocene and Pliocene sedimentary rocks. The fault appears to have controlled emplacement of the Frenchman Spring Member of the Wanapum Basalts, and thus must have a history that predates the Miocene age of these rocks. No unequivocal

evidence of deformation of Quaternary deposits has been described, but a thick sequence of sediments deposited by the Missoula floods covers much of the southern part of the fault trace.

Although no definitive evidence of impacts to Holocene sediments have clearly been identified, the Mount Angel fault appears to have been the location of minor earthquake swarms in 1990 near Woodburn, Oregon, and a M5.6 earthquake in March 1993 near Scotts Mills, approximately four miles south of the mapped extent of the Mt. Angel fault. It is unclear if the earthquake occurred along the fault zone or a parallel structure. Therefore, the Gales Creek-Newberg-Mt. Angel Structural Zone is considered potentially active.

Lacamas Lake-Sandy River Fault Zone

The northwest-trending Lacamas Creek Fault and northeast-trending Sandy River Fault intersect north of Camas, Washington approximately 1 mile east of the site, and form part of the northeastern margin of the Portland basin. According to *Geology and Groundwater Conditions of Clark County Washington (USGS Water Supply Paper 1600, Mundorff, 1964)* and the *Geologic Map of the Lake Oswego Quadrangle (Oregon DOGAMI Series GMS-59, 1989)*, the Lacamas Creek fault zone consists of shear contact between the Troutdale Formation and underlying Oligocene andesite-basalt bedrock. Secondary shear contact associated with the fault zone may have produced a series of prominent northwest-southeast geomorphic lineaments in proximity to the site.

According to the *USGS Earthquake Hazards Program* the fault has been mapped as a normal fault with down-to-the-southwest displacement, and has also been described as a steeply northeast or southwest-dipping, oblique, right-lateral, slip-fault. The trace of the Lacamas Lake fault is marked by the very linear lower reach of Lacamas Creek. No fault scarps on Quaternary surficial deposits have been described. The Lacamas Lake fault offsets Pliocene-aged sedimentary conglomerates generally identified as the Troutdale formation, and Pliocene to Pleistocene aged basalts generally identified as the Boring Lava formation.

Recent seismic reflection data across the probable trace of the fault under the Columbia River yielded no unequivocal evidence of displacement underlying the Missoula flood deposits, however, recorded mild seismic activity during the recent past indicates this area may be potentially seismogenic.

Cascadia Subduction Zone

The Cascadia Subduction Zone has recently been recognized as 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)*.

4.0 GEOTECHNICAL FIELD INVESTIGATION

A geotechnical field investigation consisting of visual reconnaissance and eight test pits (TP-1 through TP-8) was conducted at the site on June 4, 2015. Subsurface soil profiles were logged in accordance with Unified Soil Classification System (USCS) specifications. Disturbed soil samples were collected from relevant soil horizons and submitted for laboratory analysis. Laboratory test results are presented in Appendix A. Subsurface exploration locations are indicated on Figure 2. Exploration logs are presented in Appendix B. Soil descriptions and classification information are provided in Appendix C. A photo log is provided in Appendix D.

4.1 Surface Investigation and Site Description

The approximately 36.4-acre subject site occupies two tax parcels to the east of the Camas Meadows Golf Club located at 4105 NW Camas Meadows Drive in Camas, Washington. The site was previously undeveloped and is densely vegetated with large fir and deciduous trees, associated understory vegetation, and a wetland area. The site lies at the toe of a north-facing slope near the western end of Lacamas Lake. Site elevations range from approximately 240 feet elevation in the southern portion of the site to approximately 190 feet elevation along the northern property boundary. Slope grades range from isolated short slopes of approximately 20 percent in the south central portion of the property to generally flat in the wetland area of the northern property boundary. Most slopes are gentle and range from 5 to 10 percent.

4.2 Subsurface Exploration and Investigation

Test pit explorations TP-1 through TP-8 were advanced at the site to a maximum depth of 16.5 feet using a track-mounted excavator on June 4, 2015. Subsurface exploration locations were selected to observe soil characteristics in proximity to proposed development areas and are indicated on Figure 2.

4.2.1 Soil Type Description

The field investigation indicated the site is generally covered with approximately 10 to 18 inches of topsoil and associated organic-rich root zone material at the locations observed. Underlying the topsoil layer, fine-textured silt and clay soils underlain by weathered conglomerate bedrock and competent conglomerate bedrock were encountered. Subsurface lithology may generally be described by the following soil types for engineering purposes.

Soil Type 1 – *Sandy SILT to Sandy FAT CLAY*

Soil Type 1 was observed to consist primarily of medium brown medium stiff, moist to wet, moderate to high plasticity sandy SILT to sandy FAT CLAY. Soil Type 1 was observed underlying the topsoil layer in test pits TP-3 through TP-6 and TP-8 to a maximum depth of 5 feet.

Analytical laboratory testing conducted upon representative soil samples obtained from test pits TP-3 (sandy SILT) and TP-6 (sandy FAT CLAY) indicate approximately 57 to 63 percent by weight passing the No. 200 sieve and in situ moisture content ranging from 32

to 36 percent. Atterberg test results indicated a liquid limit ranging from 44 to 51 percent and a plasticity index ranging from 16 to 25 percent. Soil Type 1 is classified as ML, sandy SILT, and CH, sandy FAT CLAY according to USCS specifications and A-7-6(7) and A-7-6(7) according to AASHTO specifications.

Soil Type 2 – Clayey SAND to Poorly Graded GRAVEL with silt and sand

Soil Type 2 was observed to consist primarily of light brown to multi-colored, dense to very dense, moist to wet, clayey SAND and poorly graded GRAVEL with silt and sand. Soil Type 2 represents weathered conglomerate bedrock. Soil Type 2 was encountered underlying surficial fine textured soils or topsoil in all test pits.

Analytical laboratory testing conducted upon representative soil samples obtained from test pit TP-8 indicate approximately 8 to 20 percent by weight passing the No. 200 sieve and in situ moisture content ranging from 33 to 43 percent. Atterberg test results indicated a liquid limit ranging from 43 to 46 percent and a plasticity index of 18 percent. Soil Type 2 is classified as SC, clayey SAND and GP-GM, poorly-graded GRAVEL with silt and sand according to USCS specifications and A-2-7(0) according to AASHTO specifications.

Soil Type 3: Weathered and Competent Conglomerate Bedrock

Weathered and competent conglomerate bedrock was encountered in all test pits at various depths. The conglomerate bedrock encountered generally resembled the descriptions of the unnamed Pleistocene to Pliocene, semi-consolidated, pebble to cobble conglomerate (QTc) and the Hyaoclastic sandstone member of the Troutdale formation (Ttfh). The bedrock consisted of angular to sub-rounded clasts of various sizes cemented in a matrix of sand, silt, and clay. The bedrock was very dense and excavator refusal was noted at various depths as indicated in Table 1 in Section 5.7, *Excavation.*

4.2.2 Groundwater

Groundwater was encountered in test pits TP-1 and TP-8 at depths of 2.5 feet and 15 feet below ground surface, respectively. Standing water was observed at the ground surface elevation in the wetland which occupies the central north portion of the site. According to *Clark County Maps Online*, the static aquifer elevation in the vicinity of the subject site ranges from 190 to 210 feet amsl. These elevations correspond to an approximate depth to groundwater between 0 and 20 feet below ground surface.

Groundwater levels are often subject to seasonal variance and may rise during extended periods of increased precipitation. Perched groundwater may also be present in localized areas. Seeps and springs may become evident during site grading, primarily along slopes or in areas cut below existing grade. Structures, roads, and drainage design should be planned accordingly. Piezometer installation and long-term monitoring, beyond the scope of this investigation, would be necessary to provide more detailed groundwater information.

5.0 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 utilized and incorporated into the design and construction processes. Design recommendations are presented in the following text sections.

5.1 Site Preparation and Grading

Vegetation, organic material, unsuitable fill, and deleterious material that may be encountered should be cleared from areas identified for structures and site grading. Vegetation, other 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 anticipated stripping depth for sod and highly organic topsoil is anticipated to vary from 10 to 18 inches. The required stripping depth may increase in areas of heavy organics, large tree root balls, or disturbed soil. Actual stripping depths should be determined based upon visual observations made during construction when soil conditions are exposed. The post-construction maximum depth of landscape fill placed or spread at any location onsite should not exceed one foot.

Previously disturbed soil, debris, unsuitable, or undocumented fill encountered during grading or construction activities should be removed completely and thoroughly from structural areas. This includes old foundations, basement walls, utilities, associated soft soils, and debris. Excavation areas should be backfilled with engineered structural fill.

Site grading activities should be performed in accordance with requirements specified in the 2012 *International Building Code* (IBC), Chapter 18 and Appendix J, with exceptions noted in the text herein. Site preparation, soil stripping, grading activities, and demolition debris removal verification should be observed and documented by an experienced geotechnical engineer or designated representative.

5.2 Engineered Structural Fill

Areas proposed for fill placement should be appropriately prepared as described in the preceding text. Surface soils should then be scarified and compacted prior to additional fill placement. Engineered structural fill should be placed upon prepared subgrade in loose lifts not exceeding 12 inches in depth and compacted using standard conventional compaction equipment. The soil moisture content should be within three percentage points of optimum conditions. A field density at least equal to 95 percent of the maximum dry density, obtained from the standard Proctor moisture-density relationship test (ASTM D698), is recommended for structural fill placement. Engineered structural fill placed on sloped grades should be benched to provide a horizontal surface for compaction.

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. Engineered fill placement should be observed by an experienced geotechnical engineer or designated representative.

Engineered structural fill placement activities should be performed during dry summer months if possible. If fill placement occurs during dry weather conditions, clean, fine-textured native soils are anticipated be suitable for use as structural fill if adequately

moisture-conditioned to achieve recommended compaction specifications. Areas of sandy FAT CLAY that may be encountered may not be suitable for building foundation subgrade or road subgrade embankments. The use of clay soils for structural fill should be analyzed by Columbia West during site grading activities.

Because they are moisture-sensitive, fine-textured soils such as Soil Type 1 are often difficult to excavate and compact during wet weather conditions. If adequate compaction is not achievable with clean, fine-textured soils, import fill consisting of well-graded granular material with a maximum particle size of three inches and no more than five percent passing the No. 200 sieve is recommended for structural fill.

Representative samples of proposed engineered structural fill should be submitted for laboratory analysis and approval by the geotechnical engineer prior to placement. Laboratory analyses should include particle-size gradation and Proctor moisture-density analysis.

5.3 Cut and Fill Slopes

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 3. Drainage implementations, including subdrains or perforated drain pipe 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 the geotechnical engineer 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 15 feet in total 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 4.

Concentrated drainage or water flow over the face of slopes should be prohibited, and adequate protection against erosion is required. Fill slopes should be constructed by placing fill material in maximum 12-inch level lifts, compacting as described in Section 5.2, *Engineered Structural Fill* and horizontally benching where appropriate. 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 by an experienced geotechnical engineer.

5.4 Foundations

Review of preliminary site plans indicates that both residential and commercial/light industrial buildings are proposed. Foundations are anticipated to consist of shallow continuous perimeter or column spread footings. Footings should be designed by a licensed structural engineer and conform to the recommendations below. Typical building

loads are not expected to exceed approximately 3 to 4 kips per foot for perimeter footings or 80 kips per column. If actual loading exceeds anticipated loading, additional analysis should be conducted for the specific load conditions and proposed footing dimensions.

The existing ground surface should be prepared as described in Section 5.1, *Site Preparation and Grading*, and Section 5.2, *Engineered Structural Fill*. Foundations should bear upon a 12-inch-thick layer of crushed aggregate base compacted to at least 95 percent of modified Proctor maximum dry density (ASTM D1557) placed on firm competent in situ soil or engineered structural fill. Disturbed surface soils and unsuitable fill should be removed from foundation alignments and replaced with structural fill.

Footings should have a minimum width of 18 inches and extend to a depth at least 18 inches below lowest adjacent grade to provide adequate bearing capacity and protection against frost heave. Foundations constructed during wet weather conditions may require over-excavation of saturated subgrade soils and granular structural backfill prior to concrete placement. Over-excavation recommendations should be provided by a qualified geotechnical engineer during foundation excavation and construction. Excavations adjacent to foundations should not extend within a 1.5H:1V angle projected down from the outside bottom footing edge without additional geotechnical analysis.

Allowable bearing capacity is typically a function of footing dimension and subsurface soil properties, including settlement and shear resistance. Based upon in situ field testing and laboratory analysis, the estimated allowable bearing capacity for well-drained foundations prepared as described above and bearing on Soil Type 1 is 1,500 psf. The estimated allowable bearing capacity for well-drained foundations bearing upon Soil Types 2 and 3 is 2,000 psf. Bearing capacity may be increased by one-third for transient lateral forces such as seismic or wind. The estimated coefficient of friction between in situ compacted native soil or engineered structural fill and in-place poured concrete is 0.35. Lateral forces may also be resisted by an assumed passive soil equivalent fluid pressure of 250 psf/f against embedded footings. The upper six inches of soil should be neglected in passive pressure calculations.

Foundations should not be permitted to bear upon existing fill, soft soil, or disturbed soil. Because soil is often heterogeneous and anisotropic, it is recommended that an experienced geotechnical engineer or designated representative observe foundation excavations prior to placing forms or reinforcing bar to verify subgrade support conditions are as anticipated in this report.

5.5 Slabs on Grade

The proposed structures may have slab-on-grade floors. Slabs should be supported on firm, competent, in situ soil or engineered structural fill. Disturbed soils and unsuitable fills in proposed slab locations should be removed and replaced with structural fill.

Preparation and compaction beneath slabs should be performed in accordance with the recommendations presented in Section 5.1, *Site Preparation and Grading* and Section 5.2, *Engineered Structural Fill*. Slabs should be underlain by at least 6 inches of free-draining 1

¼"-0 crushed aggregate meeting WSDOT 9-03.9(3). Geotextile filter fabric conforming to *WSDOT 2010 Standard Specification M 41-10, 9-33.2(1), Geotextile Properties, Table 3: Geotextile for Separation or Soil Stabilization* may be used below the crushed aggregate to increase subgrade support. If desired, a moisture barrier may be constructed beneath the slabs. Slabs should be appropriately waterproofed in accordance with the desired type of finished flooring. Slab thickness and reinforcement should be designed by an experienced structural engineer in accordance with anticipated loads.

5.6 Settlement

Total long-term static footing displacement for shallow to medium-depth foundations constructed as described in this report is not anticipated to exceed approximately 1 inch. Differential settlement between comparably loaded footing elements is not expected to exceed approximately ½ inch over a span of 50 feet. The resulting vertical displacement after loading may be due to elastic distortion, dissipation of excess pore pressure, or soil creep.

5.7 Excavation

Soils at the site were explored to a maximum depth of 16.5 feet using a track-mounted excavator. As mentioned previously, weathered and competent conglomerate bedrock was encountered in all test pits at various depths ranging from 3 to 16.5 feet below ground surface. Table 1 presents a summary of depths to bedrock and groundwater.

Table 1. *Depth to bedrock and groundwater*.

Test Pit	Depth to Bedrock Refusal (feet below ground surface)	Depth of Seep or Groundwater (feet below ground surface)
TP-1	3	2.5
TP-2	3.5	not encountered
TP-3	4.5	not encountered
TP-4	3	not encountered
TP-5	4.5	not encountered
TP-6	6.5	not encountered
TP-7	3.5	not encountered
TP-8	16.5	15

The conglomerate was generally weathered in the top few feet, but became dense and massive with depth. If significant utilities or other excavations are designed at elevations that encounter bedrock, specialized rock-excavation techniques or blasting may be necessary. As mentioned previously, groundwater seeps were also observed during the site investigation, often at a depth coincident with the soil-to-bedrock interface.

Near-surface soils are likely classified as Washington State Industrial Safety and Health Administration (WISHA) Type C. For temporary open-cut excavations deeper than four feet, but less than 20 feet in soils of these types, the maximum allowable slope is 1.5H:1V. WISHA soil type should be confirmed during field construction activities by the contractor. Soil is often anisotropic and heterogeneous, and it is possible that WISHA soil types determined in the field may differ from those described above.

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

5.8 Dewatering

Groundwater elevation and hydrostatic pressure should be carefully considered during design of utilities, retaining walls, or other structures that require below-grade excavation. As described previously, groundwater may be encountered in the vicinity of proposed development areas. Utility trenches in shallow groundwater areas or excavations and cuts that remain open for even short periods of time may undermine or collapse due to groundwater effects. Placement of layers of riprap or quarry spalls in localized areas on shallow excavation side slopes may be required to limit instability. Over-excavation and stabilization of pipe trenches or other excavations with imported crushed aggregate or gabion rock may also be necessary to provide adequate subgrade support.

Pumping and dewatering may be required to temporarily reduce the groundwater elevation to allow construction of proposed below-grade structures, installation of utilities, or placement of structural fills. 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. Well pumps should remain functioning at all times during the excavation and construction period. Suitable back-up pumps and power supplies should be available to prevent unanticipated shut-down of dewatering equipment. Failure to operate pumps full-time may result in flooding of the excavation zones, resulting in damage to forms, slopes, or equipment.

5.9 Lateral Earth Pressure

If retaining walls are proposed, lateral earth pressures should be carefully considered for design. Hydrostatic pressure and additional surcharge loading should also be considered. Retained material may include engineered structural backfill or undisturbed soil. Structural wall backfill should consist of imported granular material meeting *Section 9-03.12(2)* of WSDOT Standard Specifications. Backfill should be prepared and compacted to at least 95 percent of maximum dry density as determined by the modified Proctor test (ASTM D1557). Recommended parameters for lateral earth pressures for in situ undisturbed native soils and engineered structural fill consisting of imported granular fill meeting WSDOT specifications for *Gravel Backfill for Walls 9-03.12(2)* are presented in Table 1. Soil Type 1 is excluded due to the relative thin profile observed on the site.

The design parameters presented in Table 2 are valid for static loading cases. The recommended earth pressures do not include surcharge loads, dynamic loading, hydrostatic pressure, or seismic design.

Table 2. Lateral Earth Pressure Parameters for Level Backfill

Backfill Material	Equivalent Fluid Pressure for Level Backfill			Wet Density	Drained Internal Angle of Friction
	At-rest	Active	Passive		
WSDOT 9-03.12(2) compacted aggregate backfill	54 pcf	33 pcf	589 pcf	135 pcf	38°
In situ undisturbed clayey SAND and Poorly Graded GRAVEL with silt and sand (Soil Type 2)	64 pcf	43 pcf	360 pcf	125 pcf	29°

** The upper 6 inches of soil should be neglected in passive pressure calculations. If exterior grade from top or toe of retaining wall is sloped, Columbia West should be contacted to provide location-specific lateral earth pressures.*

If seismic design is required, 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 resultant force should be applied at 0.6H from the base of the wall.

A continuous one-foot-thick zone of free-draining, washed, open-graded 1-inch by 2-inch drain rock and a 4-inch perforated gravity drain pipe is assumed behind retaining walls. Geotextile filter fabric should be placed between the drain rock and backfill soil. Specifications for drainpipe design are presented in Section 5.12, *Drainage*. If walls cannot be gravity drained, saturated base conditions and/or applicable hydrostatic pressures should be assumed.

Final retaining wall design should be reviewed and approved by Columbia West. Retaining wall subgrade and backfill activities should also be observed and tested for compliance with recommended specifications by the geotechnical engineer or designated representative during construction.

5.10 Seismic Design Considerations

According to the *United States Geologic Survey (USGS) 2010 ASCE 7 Seismic Design Maps Summary Report,* the anticipated peak ground and maximum considered earthquake spectral response accelerations resulting from seismic activity for the subject site are summarized in Table 3.

The listed probabilistic ground motion values are based upon “firm rock” sites with an assumed shear wave velocity of 2,500 ft/s in the upper 100 feet of soil profile. These values should be adjusted for site class effects by applying site coefficients Fa and Fv as defined in 2012 IBC Tables 1613.3.3(1) and (2). The site coefficients are intended to more accurately characterize estimated peak ground and respective earthquake spectral response accelerations by considering site-specific soil characteristics and index properties.

The *Site Class Map of Clark County, Washington (Washington State Department of Natural Resources, 2004),* indicates site soils may be represented by Site Class C. Based upon observed subsurface soil conditions at the site, and review of well logs and local

geologic maps, site soils may be considered to be Site Class C as defined in 2012 IBC Section 1613.3.5. This site class designation indicates that some amplification of seismic energy may occur during a seismic event because of subsurface conditions. This assessment is preliminary and is based upon limited field exploration and research of existing published literature. Additional exploration would be necessary to provide soil site class information at greater depths.

Table 3. Approximate Probabilistic Ground Motion Values for 'firm rock' sites based on subject property longitude and latitude

	2% Probability of Exceedance in 50 yrs
Peak Ground Acceleration	0.38 g
0.2 sec Spectral Acceleration	0.89 g
1.0 sec Spectral Acceleration	0.38 g

Localized peak ground accelerations exceeding the adjusted values may occur in some areas in direct proximity to an earthquake's origin. This may be a result of amplification of seismic energy due to depth to competent bedrock, compression and shear wave velocity of bedrock, presence and thickness of loose, unconsolidated alluvial deposits, soil plasticity, grain size, and other factors.

Identification of specific seismic response spectra for the site is beyond the scope of this investigation. If site structures are designed in accordance with recommendations specified in the 2012 IBC, the potential for peak ground accelerations in excess of the adjusted and amplified values should be understood.

5.11 Soil Liquefaction and Dynamic Settlement

According to the *Alternative 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 or non-plastic silt materials quickly compact under cyclic stresses caused by a seismic event. The effects of liquefaction may include immediate ground settlement and lateral spreading.

Soils most susceptible to liquefaction are generally saturated, cohesionless, loose to medium-dense sands within 50 feet of the ground surface. Recent research has also indicated that low plasticity silts and clays may also be subject to sand-like liquefaction behavior if the plasticity index determined by the Atterberg Limits analysis is less than 8. 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 the geotechnical investigation, the potential for liquefaction of shallow soils at the site is considered to be low.

5.12 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. Depressions or shallow areas that may retain ponding water should be avoided. Roof drains, low-point drains, and perimeter foundation drains are recommended for structures. Drains should consist of separate systems and gravity flow with a minimum two-percent slope away from foundations into the stormwater system or approved discharge location. Concentrated discharge of water should be prohibited across slopes and water should not be diverted, routed, or allowed to flow over or across slope faces.

Perimeter foundation drains should consist of 3-inch perforated PVC pipe surrounded by a minimum of 1 ft^3 of clean, washed drain rock per linear foot of pipe and wrapped with geotextile filter fabric. Open-graded drain rock with a maximum particle size of 3 inches and less than 2 percent passing the No. 200 sieve is recommended. Geotextile filter fabric should consist of Mirafi 140N or approved equivalent, with AOS between No. 70 and No. 100 sieve. The water permittivity should be greater than 1.5/sec. Figure 5 presents a typical foundation drain. Perimeter drains may limit increased hydrostatic pressure beneath footings and assist in reducing potential perched moisture areas.

Subdrains should also be considered if portions of the site are cut below surrounding grades. Shallow groundwater, springs, or seeps should be conveyed via drainage channel or perforated pipe into the stormwater management system or an approved discharge. Recommendations for design and installation of perforated drainage pipe may be performed on a case-by-case basis by the geotechnical engineer 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 drain pipe trench detail is presented in Figure 6.

Foundation drains and subdrains should be closely monitored after construction to assess their effectiveness. If additional surface or shallow subsurface seeps become evident, the drainage provisions may require modification or additional drains. The geotechnical engineer should be consulted to provide appropriate recommendations.

5.13 Bituminous Asphalt and Portland Cement Concrete

Preliminary site plans indicate that proposed development includes private asphalt concrete driveways and parking areas. Additionally, an extension of the City of Camas' NW Camas Meadows Drive may be constructed as part of the development. Pavement section thickness should be carefully considered to provide adequate lifespan and

serviceability. Pavement section design is outside the scope of this investigation; however, Columbia West can provide section design services in the future if requested. Columbia West recommends adherence to the City of Camas standards for public works construction if improvements to public roads are proposed.

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 pavement construction is discussed later in Section 5.14, *Wet Weather Construction Methods and Techniques*. Areas proposed for asphalt pavement construction should be prepared as described in Section 5.1, *Site Preparation and Grading*. Subgrade conditions should be evaluated and tested by a licensed geotechnical engineer or designated representative prior to placement of crushed aggregate base. Subgrade evaluation should include nuclear gauge density testing and wheel proof-roll observations conducted with a 12-cubic yard, double-axle dump truck or equivalent. Nuclear gauge density testing should be conducted at 250-foot intervals or as determined by the onsite geotechnical engineer. Subgrade soil should be compacted to at least 95 percent of the modified Proctor dry density, as determined by ASTM D698. Areas of observed deflection or rutting during proof-roll evaluation should be excavated to a firm surface and replaced with compacted crushed aggregate.

Crushed aggregate base should be compacted and tested in accordance with the specifications outlined above. Asphalt concrete pavement should be compacted to at least 91 percent of maximum Rice density. Nuclear gauge density testing should be conducted to verify adherence to recommended specifications. Testing frequency should be in accordance with Washington Department of Transportation and City of Camas specifications.

Portland cement concrete curbs should be installed in accordance with the City of Camas specifications. Aggregate base should be observed and proof-rolled in the presence of an experienced geotechnical engineer or designated representative. Soft areas that deflect or rut should be stabilized prior to pouring concrete. Concrete should be tested during installation in accordance with ASTM C171, C138, C231, C143, C1064, and C31. This includes casting of cylinder specimen at a frequency of four cylinders per 100 cubic yards of poured concrete. Recommended field and analytical laboratory concrete testing includes slump, air entrainment, temperature, and unit weight.

5.14 Wet Weather Construction Methods and Techniques

Wet weather construction often results in significant shear strength reduction and soft areas that may rut or deflect. Installation of granular working layers may be necessary to provide a firm support base and sustain construction equipment. Granular layers should consist of all-weather gravel, 4-inch by 6-inch gabion, or other similar material (6-inch maximum size with less than 5 percent passing the No. 200 sieve).

Construction equipment traffic across exposed fine-textured soil should be minimized. Equipment traffic induces dynamic loading, which may result in weak areas and significant reduction in shear strength for soils above plastic limit. Wet weather construction may

generate significant excess quantities of soft wet soil, which should be removed from the site or stockpiled in a designated area.

Construction during wet weather conditions may require increased base thickness. Road base should consist of 3"-0 or 1¼"-0 crushed aggregate and should be placed on previously stripped and structurally competent subgrade. Over-excavation may be necessary to provide a firm base upon which to place crushed aggregate. Geotextile filter fabric such as Mirafi 500X or an approved equivalent is also recommended. Crushed aggregate base should be installed in a single lift with trucks end-dumping from an advancing layer of granular fill. During extended wet periods, stripping activities may also need to be conducted from an advancing layer of granular fill. Once installed, the crushed aggregate base should be compacted with several passes from a static drum roller. A vibratory compactor is not recommended because it may further disturb the subgrade. Subdrains may also be necessary to provide subgrade drainage and maintain structural integrity.

Crushed aggregate base should be compacted to at least 95 percent of maximum dry density according to the modified Proctor density test (ASTM D1557). Compaction should be verified by nuclear gauge density testing. Observation of a proof-roll with a loaded dump truck is also recommended as an indication of subgrade performance.

It should be understood that wet weather construction is risky and costly. An experienced geotechnical engineer or designated representative should observe and document wet weather construction activities. Proper construction methods and techniques are critical to overall project integrity.

5.15 Erosion Control Measures

Based upon field observations and laboratory testing, the erosion hazard for site soils in flat to shallow-gradient portions of the property is likely to be low. The potential for erosion generally increases in sloped areas. Therefore, disturbance to vegetation in sloped areas should be minimized during construction activities. Soil is also prone to erosion if unprotected and unvegetated during periods of increased precipitation. Erosion can be minimized by performing construction activities during dry summer months.

Site-specific erosion control measures should be implemented to address the maintenance of exposed areas. This may include silt fence, biofilter bags, straw wattles, or other suitable methods. During construction activities, exposed areas should be well-compacted and protected from erosion with visqueen, surface tactifier, or other means, as appropriate. Temporary slopes or exposed areas may be covered with straw, crushed aggregate, or riprap in localized areas to minimize erosion. Erosion and water runoff during wet weather conditions may be controlled by application of strategically placed channels and small detention depressions with overflow pipes.

After grading, exposed surfaces should be vegetated as soon as possible with erosion-resistant native species. Jute mesh or straw may be applied to enhance vegetation. Once established, vegetation should be properly maintained. Disturbance to existing native

vegetation and surrounding organic soil should also be minimized during construction activities.

5.16 Soil Shrink/Swell Potential

Based upon laboratory analysis, subsurface soils contain as much as 63 percent by weight passing the No. 200 sieve and exhibit a plasticity index ranging from 16 to 25 percent. This indicates low to moderate potential for soil shrinking or swelling.

5.17 Utility Installation

Utility installation may require subsurface excavation and trenching. Excavation, trenching and shoring should conform to federal (Occupational Safety and Health Administration) (OSHA) (29 CFR, Part 1926) and *WISHA* (WAC, Chapter 296-155) regulations. Site soils may slough when cut vertically and sudden precipitation events or perched groundwater may result in accumulation of water within excavation zones and trenches.

Utilities should be installed in general accordance with manufacturer's recommendations. Utility trench backfill should consist of crushed aggregate or other coarse-textured, free-draining material acceptable to the client, City of Camas, and the site geotechnical engineer. Trench backfill material within 18 inches of the top of utility pipes should be hand compacted (i.e., no heavy compaction equipment). The remaining backfill should be compacted to at least 95 percent of maximum dry density as determined by the standard Proctor moisture-density test (ASTM D698). Clean, free-draining, fine bedding sand is recommended for use in the pipe zone. With exception of the pipe zone, backfill should be placed in loose lifts not exceeding 12 inches in thickness.

Compaction of utility trench backfill material should be verified by nuclear gauge field compaction testing performed in accordance with ASTM D6938. It is recommended that field compaction testing be performed at 200-foot intervals along the utility trench centerline at the surface and midpoint depth of the trench. Compaction frequency and specifications may be modified for non-structural areas in accordance with recommendations of the site geotechnical engineer.

6.0 CONCLUSION 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. Even 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 significantly from those described in this report, should immediately prompt further investigation. The above statements are in lieu of all other statements expressed or implied.

This report was prepared solely for the client and is not to be reproduced without prior authorization from Columbia West. Final engineering plans and specifications for the project should be reviewed and approved by Columbia West as they relate to geotechnical and grading issues prior to final design approval. Columbia West is not responsible for independent conclusions or recommendations made by other parties based upon information presented in this report. Unless a particular service was expressly included in the scope, it was not performed and there should be no assumptions based upon services not provided. Additional report limitations and important information about this document are presented in Appendix E. This information should be carefully read and understood by the client and other parties reviewing this document.

Sincerely,

COLUMBIA WEST ENGINEERING, Inc.

Daniel E. Lehto, PE, GE
Principal



REFERENCES

Annual Book of ASTM Standards, Soil and Rock (I), v04.08, American Society for Testing and Materials, 1999.

Beeson, M.H., Tolan, T.L., Madin, I.P., *Geologic Map of the Lake Oswego Quadrangle, Clackamas, Multnomah, and Washington Counties, Oregon*; Oregon Department of Geology and Mineral Industries; Geological Map Series GMS-59, 1989.

Clark County Maps Online (http://gis.clark.wa.gov/ccgis/mol/property.htm)

Evarts, Russel C., *Geologic Map of the Lacamas Creek Quadrangle, Clark County, Washington.* US Geological Survey, Science Investigations Map 2924, 2006.

Geomatrix Consultants, *Seismic Design Mapping, State of Oregon*, January 1995.

International Building Code: *2012 International Building Code, 2012 edition*, International Code Council, 2012.

Mundorff, M.J., *Geology and Groundwater Conditions of Clark County*, USGS Water Supply Paper 1600, 1964.

Palmer, Stephen P., Magsino, Sammantha L., Poelstra, James L., and Niggemann, Rebecca A., *Site Class Map of Clark County, Washington; Liquefaction Susceptibility Map of Clark County Washington;* Washington State Department of Natural Resources, September 2004.

Phillips, William M., *Geological Map of the Vancouver Quadrangle, Washington and Oregon,* Open File Report 87-10, Washington State Department of Natural Resources, Division of Geology and Earth Resources, 1987.

Safety and Health Regulations for Construction, 29 CFR Part 1926, Occupational Safety and Health Administration (OSHA), revised July 1, 2001.

Safety Standards for Construction Work, Part N, Excavation, Trenching and Shoring, Washington Administrative Code, Chapter 296-155, Division of Industrial Safety and Health, Washington Department of Labor and Industries, February, 1993.

United States Geologic Survey (USGS)*, 2008 NSHMP PSHA Interactive Deaggregation,* Web Application, Accessed February 2014

Web Soil Survey, Natural Resources Conservation Service, United States Department of Agriculture *2013 website* (http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm.).

Wong, Ivan, et al, *Earthquake Scenario and Probabilistic Earthquake Ground Shaking Maps for the Portland, Oregon, Metropolitan Area*, IMS-16, Oregon Department of Geology and Mineral Industries, 2000.

FIGURES



MAP SOURCE: Google Maps 2014

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc
11917 NE 95th Street
Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Design	Drawn: ASR		
Checked: DEL	Date: 6/12/15		
Client: PACM, LLC	Rev	By	Date
Job No.: 15153			
CAD File: FIGURE 1			
Scale: ~1:50,000			

SITE LOCATION MAP

PARKLANDS AT CAMAS MEADOWS
CAMAS, WASHINGTON

FIGURE 1



NOTES:
1. SITE LOCATION: 2150 NE IONE STREET.
2. DRAWING IS NOT TO SCALE.
3. BASE MAP OBTAINED FROM BING MAPS.
4. TEST PIT LOCATIONS ARE APPROXIMATE AND NOT SURVEYED.
5. SOIL BOTING BACKFILLED WITH BENTONITE ON 6-26-2013.

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc
11917 NE 95th STREET
VANCOUVER, WASHINGTON 98682
PHONE: 360-823-2900 FAX: 360-823-2901
www.columbiawestengineering.com

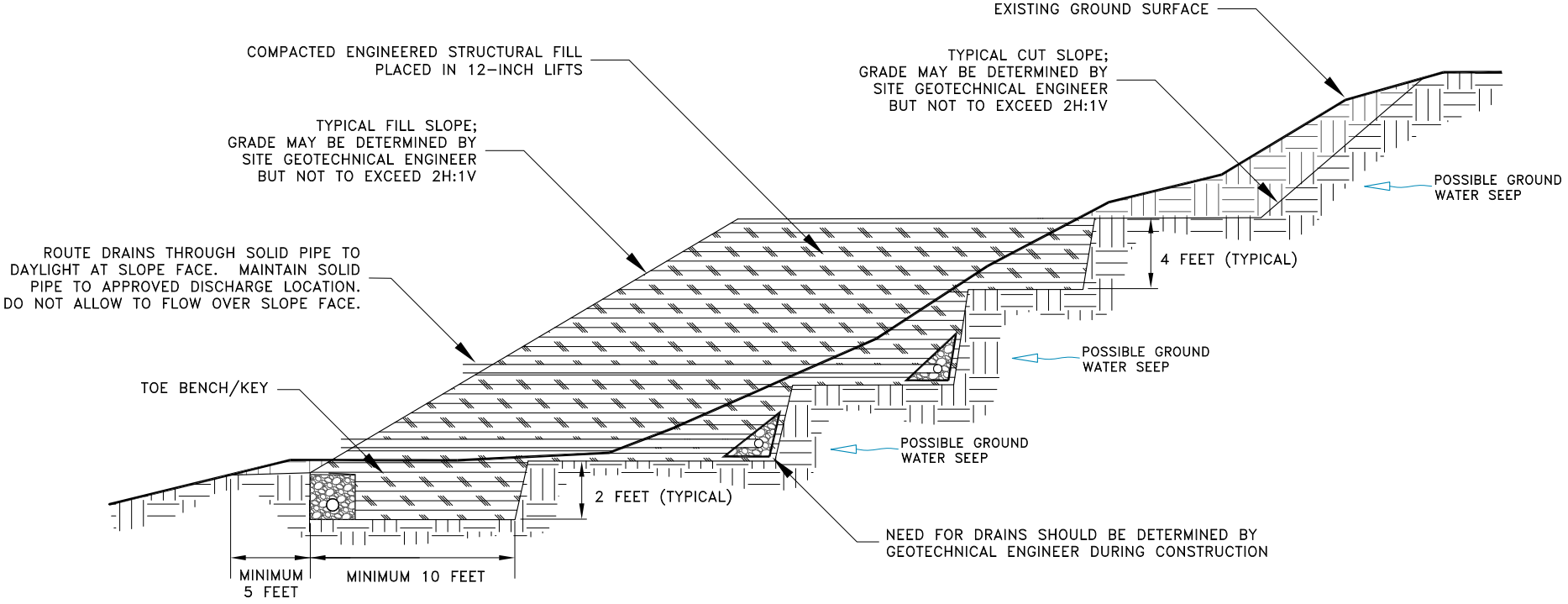
Design:	Drawn: ASR			
Checked: DEL	Date: 6/12/15			
Client: PACM, LLC	Rev	By	Date	
Job No: 15153				
CAD File: FIGURE 2				
Scale: NONE				

SUBSURFACE EXPLORATION LOCATION MAP

PARKLANDS AT CAMAS MEADOWS
CAMAS, WASHINGTON

FIGURE 2

TYPICAL CUT AND FILL SLOPE CROSS-SECTION

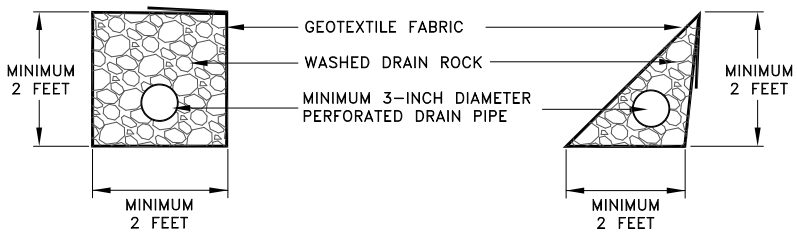


DRAIN SPECIFICATIONS

GEOTEXTILE FABRIC SHALL CONSIST OF MIRAFI 140N OR APPROVED EQUIVALENT WITH AOS BETWEEN No. 70 AND No. 100 SIEVE.

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 3 INCHES.

TYPICAL DRAIN SECTION DETAIL



NOTES:
1. DRAWING IS NOT TO SCALE.
2. SLOPES AND PROFILES SHOWN ARE APPROXIMATE.
3. DRAWING REPRESENTS TYPICAL FILL AND CUT SLOPE SECTION, AND MAY NOT BE SITE–SPECIFIC.

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc
11917 NE 95th STREET
VANCOUVER, WASHINGTON 98682
PHONE: 360-823-2900 FAX: 360-823-2901
www.columbiawestengineering.com

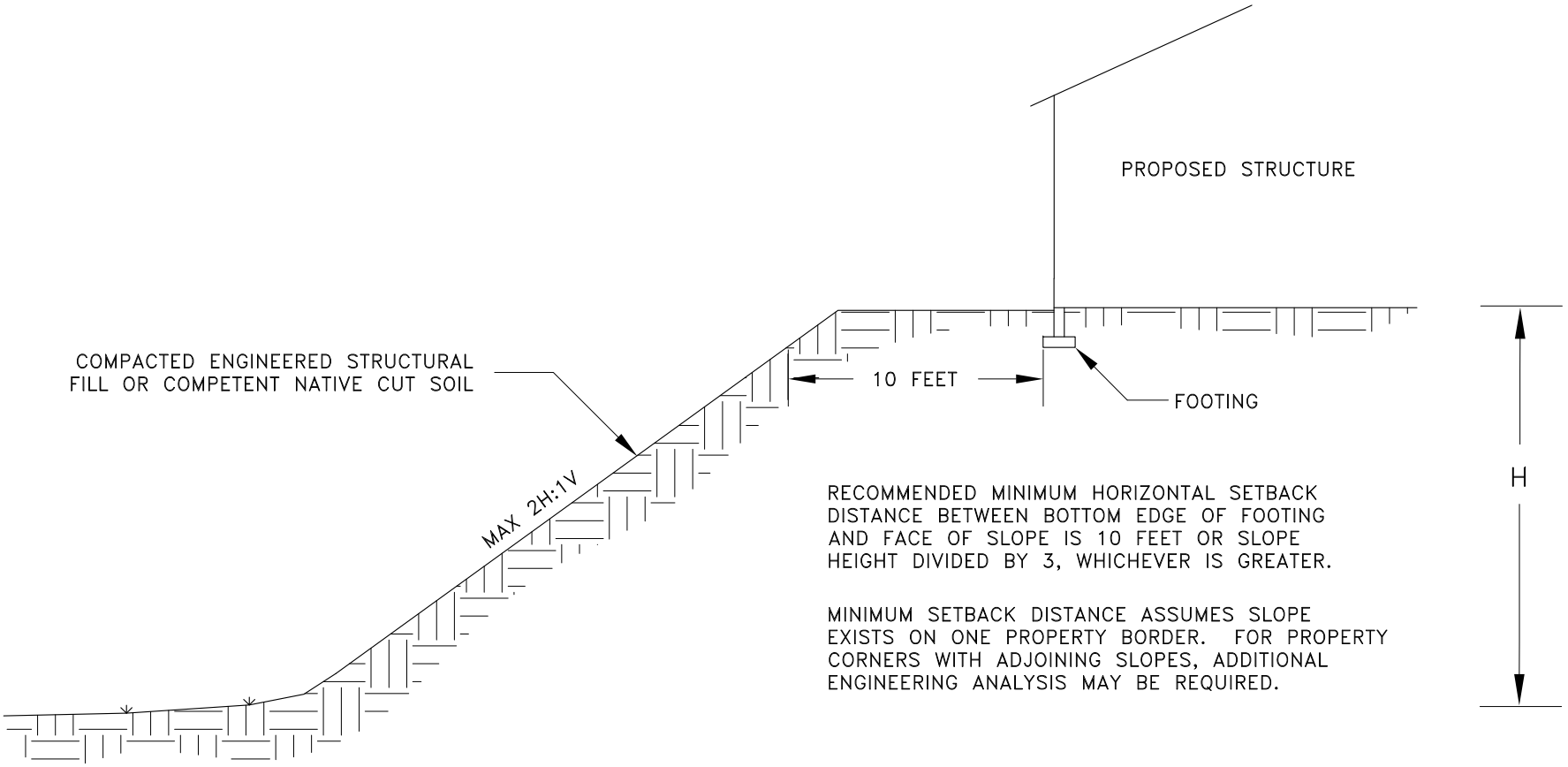
Design:	Drawn: ASR		
Checked: DEL	Date: 6/12/15		
Client: PACM, LLC	Rev	By	Date
Job No: 15153			
CAD File: FIGURE 3			
Scale: NONE			

TYPICAL CUT AND FILL SLOPE CROSS–SECTION

PARKLANDS AT CAMAS MEADOWS
CAMAS, WASHINGTON

FIGURE 3

TYPICAL CUT AND FILL SLOPE CROSS-SECTION



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.

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.

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc
11917 NE 95th STREET
VANCOUVER, WASHINGTON 98682
PHONE: 360-823-2900 FAX: 360-823-2901
www.columbiawestengineering.com

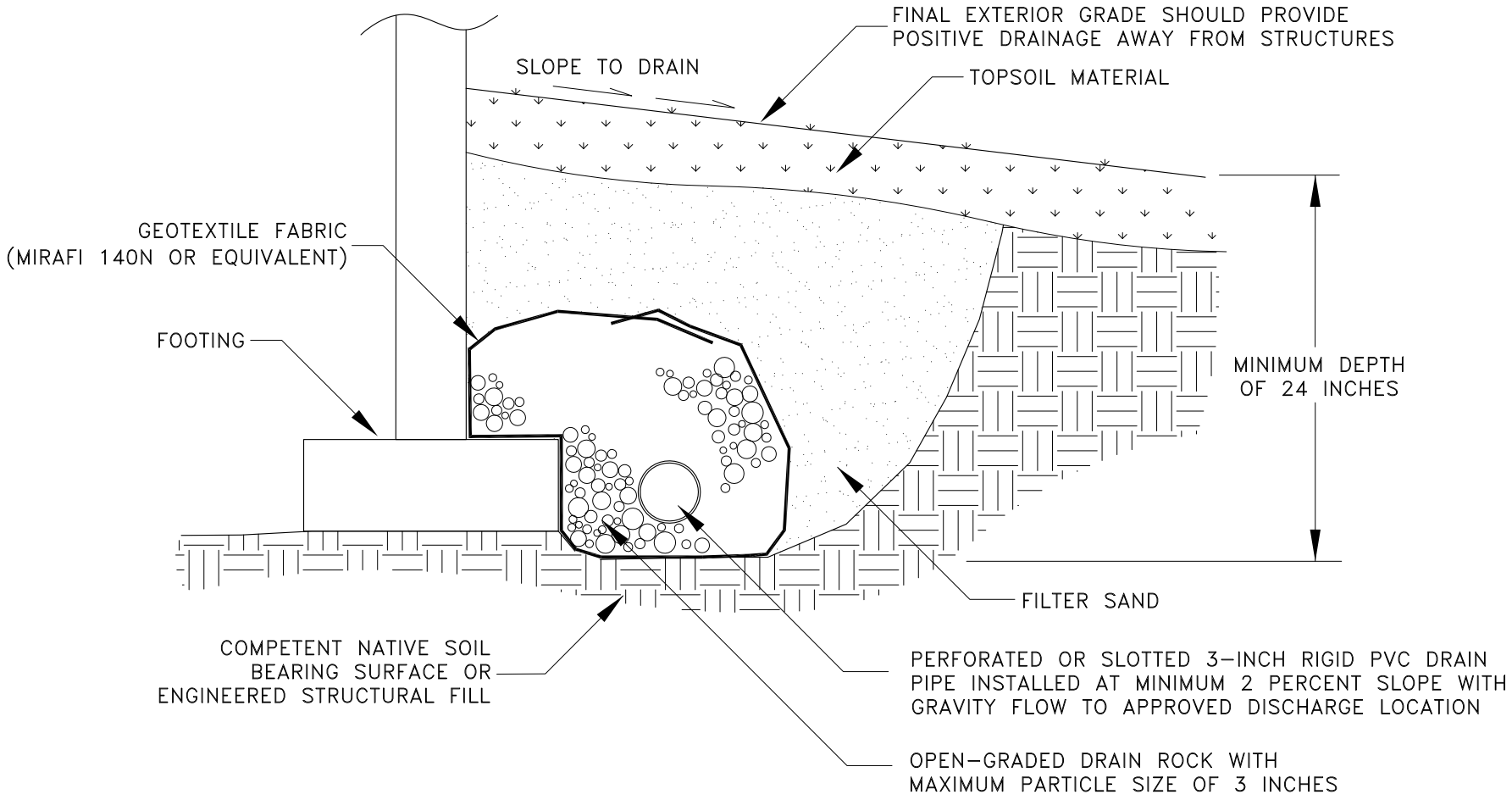
Design:	Drawn: ASR			
Checked: DEL	Date: 06/12/15			
Client: PACM, LLC	Rev	By	Date	
Job No: 15153				
CAD File: FIGURE 4				
Scale: NONE				

MINIMUM FOUNDATION SLOPE SETBACK DETAIL

PARKLANDS AT CAMAS MEADOWS
CAMAS, WASHINGTON

FIGURE 4

TYPICAL PERIMETER FOOTING DRAIN DETAIL



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

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc
11917 NE 95th STREET
VANCOUVER, WASHINGTON 98682
PHONE: 360-823-2900 FAX: 360-823-2901
www.columbiawestengineering.com

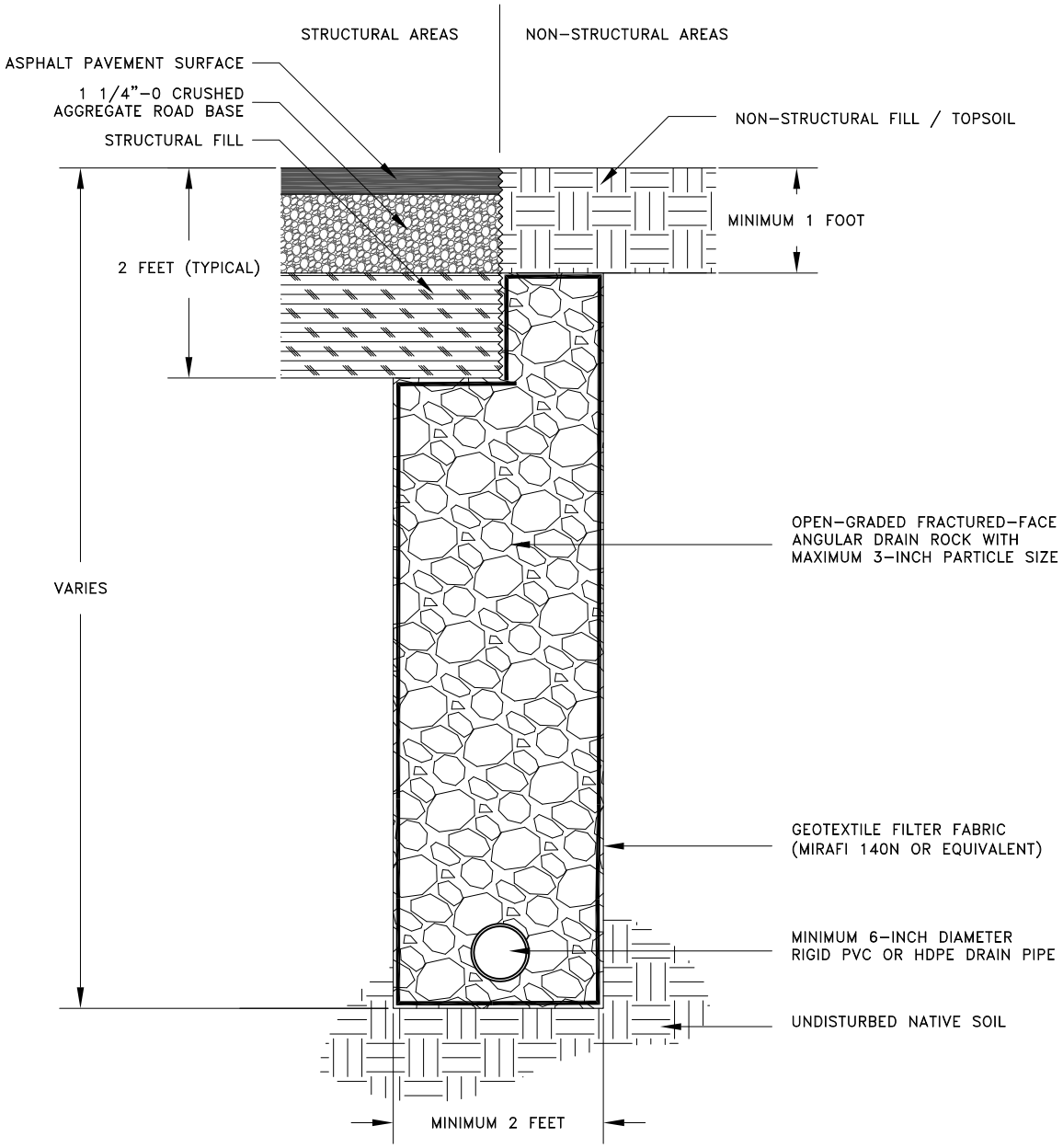
Design:	Drawn: ASR			
Checked: DEL	Date: 6/12/15			
Client: PACM, LLC	Rev	By	Date	
Job No: 15153				
CAD File: FIGURE 5				
Scale: NONE				

TYPICAL PERIMETER FOOTING DRAIN DETAIL

PARKLANDS AT CAMAS MEADOWS
CAMAS, WASHINGTON

FIGURE 5

TYPICAL PERFORATED DRAIN PIPE TRENCH DETAIL



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.

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc
11917 NE 95th STREET
VANCOUVER, WASHINGTON 98682
PHONE: 360-823-2900 FAX: 360-823-2901
www.columbiawestengineering.com

Design:	Drawn: ASR		
Checked: DEL	Date: 06/12/15		
Client: PACM, LLC	Rev	By	Date
Job No: 15153			
CAD File: FIGURE 6			
Scale: NONE			

TYPICAL PERFORATED DRAIN PIPE TRENCH DETAIL

PARKLANDS AT CAMAS MEADOWS
CAMAS, WASHINGTON

FIGURE 6

APPENDIX A
ANALYTICAL LABORATORY TEST RESULTS

11917 NE 95th Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

PARTICLE-SIZE ANALYSIS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
Parklands at Camas Meadows Camas, Washington	Mr. Aaron Barr & Mr. Kevin Deford Parklands at Camas Meadows, LLC PO Box 61962 Vancouver, WA 98666	15153	S15-359
		REPORT DATE 06/16/15	FIELD ID TP3.1
		DATE SAMPLED 06/04/15	SAMPLED BY HDG

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
Sandy SILT	Test Pit TP-03 depth = 2 feet	ML, Sandy Silt
SPECIFICATIONS none		AASHTO SOIL TYPE A-7-6(7)

LABORATORY TEST DATA

LABORATORY EQUIPMENT: Rainhart "Mary Ann" Sifter 637

TEST PROCEDURE: ASTM D6913, D422

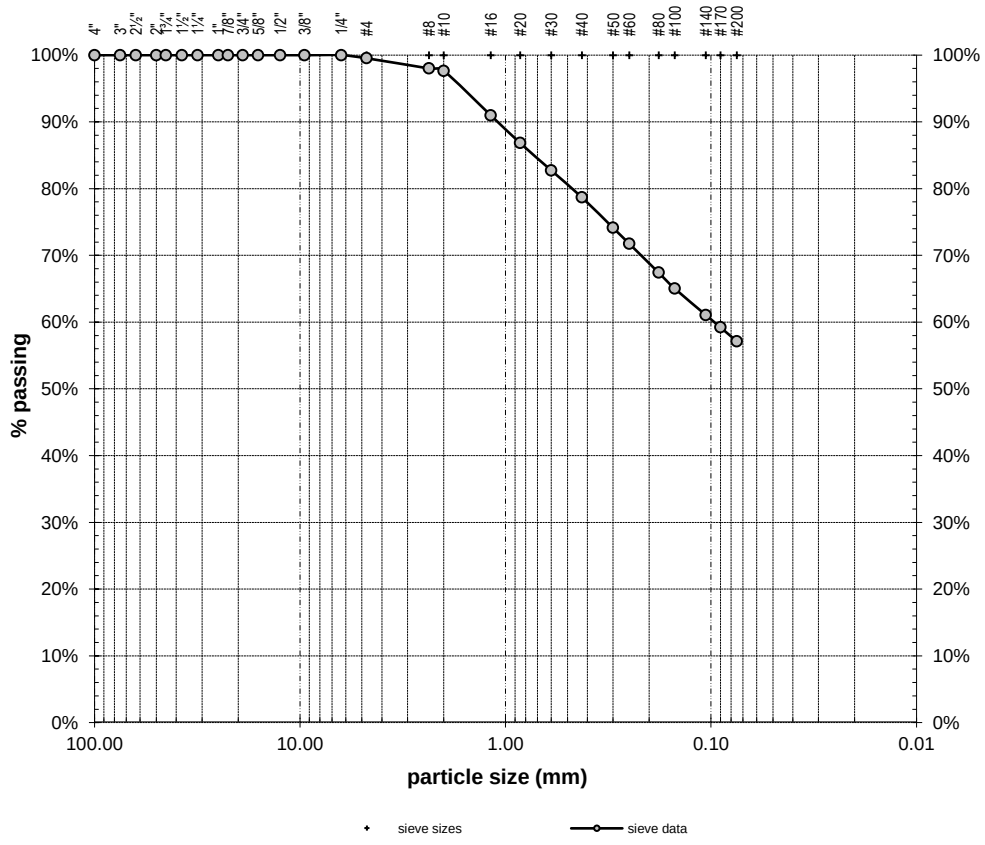
ADDITIONAL DATA

initial dry mass (g) =	158.3		
as-received moisture content =	36.4%	coefficient of curvature, C_C =	n/a
liquid limit =	44	coefficient of uniformity, C_U =	n/a
plastic limit =	28	effective size, $D_{(10)}$ =	n/a
plasticity index =	16	$D_{(30)}$ =	n/a
fineness modulus =	n/a	$D_{(60)}$ =	0.097 mm

SIEVE DATA

% gravel =	0.5%
% sand =	42.4%
% silt and clay =	57.1%

GRAIN SIZE DISTRIBUTION



	SIEVE SIZE US	SIEVE SIZE mm	PERCENT PASSING SIEVE act.	PERCENT PASSING SIEVE interp.	SPECS max	SPECS min
GRAVEL	6.00"	150.0		100.0%		
	4.00"	100.0		100.0%		
	3.00"	75.0		100.0%		
	2.50"	63.0		100.0%		
	2.00"	50.0		100.0%		
	1.75"	45.0		100.0%		
	1.50"	37.5		100.0%		
	1.25"	31.5		100.0%		
	1.00"	25.0		100.0%		
	7/8"	22.4		100.0%		
	3/4"	19.0		100.0%		
	5/8"	16.0		100.0%		
	1/2"	12.5		100.0%		
	3/8"	9.50		100.0%		
	1/4"	6.30	100.0%			
	#4	4.75	99.5%			
SAND	#8	2.36		98.0%		
	#10	2.00	97.6%			
	#16	1.18		91.0%		
	#20	0.850	86.8%			
	#30	0.600		82.7%		
	#40	0.425	78.7%			
	#50	0.300		74.1%		
	#60	0.250	71.7%			
	#80	0.180		67.4%		
	#100	0.150	65.0%			
	#140	0.106		61.1%		
	#170	0.090		59.2%		
	#200	0.075	57.1%			

DATE TESTED	TESTED BY
06/08/15	BTT/MJR

This report may not be reproduced except in full without prior written authorization by Columbia West Engineering, Inc.

COLUMBIA WEST ENGINEERING, INC. authorized signature

11917 NE 95th Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

ATTERBERG LIMITS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
Parklands at Camas Meadows Camas, Washington	Mr. Aaron Barr & Mr. Kevin Deford Parklands at Camas Meadows, LLC PO Box 61962 Vancouver, WA 98666	15153	S15-359
		REPORT DATE: 06/16/15	FIELD ID: TP3.1
		DATE SAMPLED: 06/04/15	SAMPLED BY: HDG

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
Sandy SILT	Test Pit TP-03 depth = 2 feet	ML, Sandy Silt

LABORATORY TEST DATA

LABORATORY EQUIPMENT: Liquid Limit Machine, Hand Rolled

TEST PROCEDURE: ASTM D4318

ATTERBERG LIMITS

liquid limit =	44
plastic limit =	28
plasticity index =	16

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	33.30	33.31	33.93	
dry soil + pan weight, g =	29.59	29.37	29.72	
pan weight, g =	20.83	20.70	20.68	
N (blows) =	30	20	15	
moisture, % =	42.4 %	45.4 %	46.6 %	

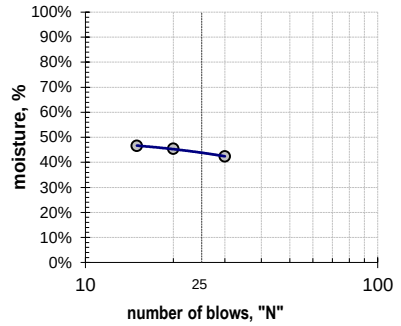
SHRINKAGE

shrinkage limit =	n/a
shrinkage ratio =	n/a

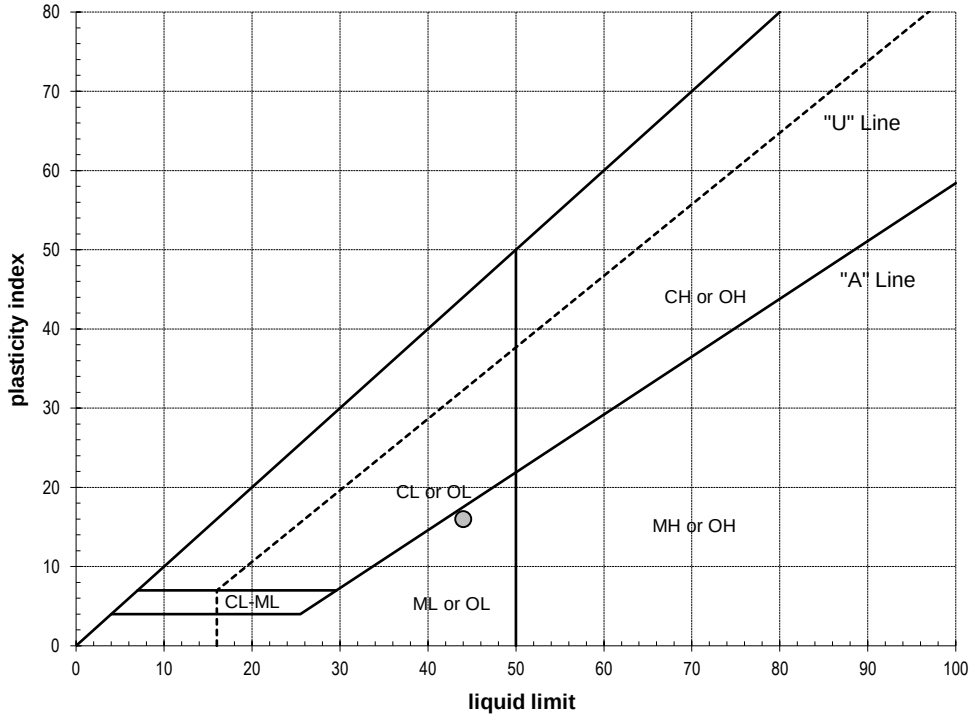
PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	27.85	27.97		
dry soil + pan weight, g =	26.28	26.35		
pan weight, g =	20.69	20.50		
moisture, % =	28.1 %	27.7 %		

LIQUID LIMIT



PLASTICITY CHART



ADDITIONAL DATA

% gravel =	0.5%
% sand =	42.4%
% silt and clay =	57.1%
% silt =	n/a
% clay =	n/a
moisture content =	36.4%

DATE TESTED	TESTED BY
06/15/15	MJR

This report may not be reproduced except in full without prior written authorization by Columbia West Engineering, Inc.

COLUMBIA WEST ENGINEERING, INC. authorized signature

11917 NE 95th Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

PARTICLE-SIZE ANALYSIS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
Parklands at Camas Meadows Camas, Washington	Mr. Aaron Barr & Mr. Kevin Deford Parklands at Camas Meadows, LLC PO Box 61962 Vancouver, WA 98666	15153	S15-360
		REPORT DATE 06/16/15	FIELD ID TP6.1
		DATE SAMPLED 06/04/15	SAMPLED BY HDG

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
Sandy Fat CLAY	Test Pit TP-06 depth = 2.5 feet	CH, Sandy Fat Clay
SPECIFICATIONS none		AASHTO SOIL TYPE A-7-6(14)

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Rainhart "Mary Ann" Sifter 637	ASTM D6913, D422

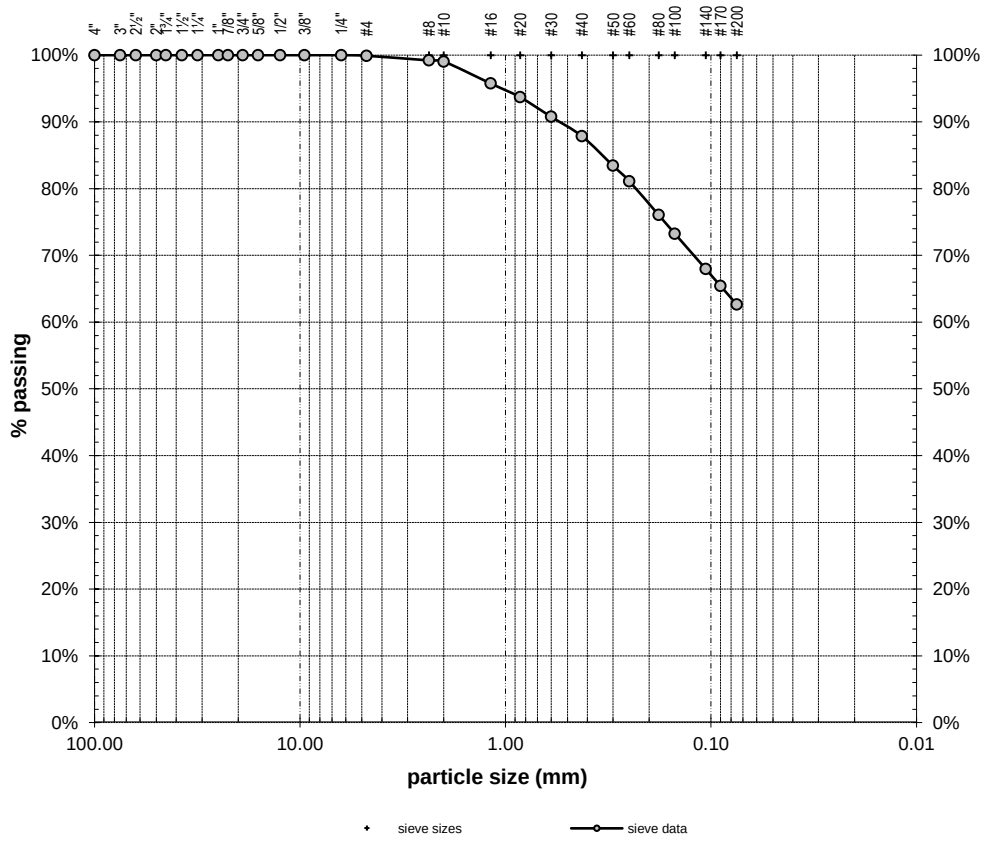
ADDITIONAL DATA

initial dry mass (g) =	173.4		
as-received moisture content =	32.3%	coefficient of curvature, C_C =	n/a
liquid limit =	51	coefficient of uniformity, C_U =	n/a
plastic limit =	26	effective size, $D_{(10)}$ =	n/a
plasticity index =	25	$D_{(30)}$ =	n/a
fineness modulus =	n/a	$D_{(60)}$ =	n/a

SIEVE DATA

% gravel =	0.1%
% sand =	37.3%
% silt and clay =	62.6%

GRAIN SIZE DISTRIBUTION



	SIEVE SIZE US	SIEVE SIZE mm	PERCENT PASSING SIEVE act.	PERCENT PASSING SIEVE interp.	SPECS max	SPECS min
GRAVEL	6.00"	150.0		100.0%		
	4.00"	100.0		100.0%		
	3.00"	75.0		100.0%		
	2.50"	63.0		100.0%		
	2.00"	50.0		100.0%		
	1.75"	45.0		100.0%		
	1.50"	37.5		100.0%		
	1.25"	31.5		100.0%		
	1.00"	25.0		100.0%		
	7/8"	22.4		100.0%		
	3/4"	19.0		100.0%		
	5/8"	16.0		100.0%		
	1/2"	12.5		100.0%		
	3/8"	9.50		100.0%		
	1/4"	6.30	100.0%			
	#4	4.75	99.9%			
SAND	#8	2.36		99.2%		
	#10	2.00	99.0%			
	#16	1.18		95.7%		
	#20	0.850	93.7%			
	#30	0.600		90.8%		
	#40	0.425	87.9%			
	#50	0.300		83.4%		
	#60	0.250	81.1%			
	#80	0.180		76.1%		
	#100	0.150	73.2%			
	#140	0.106		67.9%		
	#170	0.090		65.4%		
	#200	0.075	62.6%			

DATE TESTED	TESTED BY
06/08/15	BTT/MJR

This report may not be reproduced except in full without prior written authorization by Columbia West Engineering, Inc.

COLUMBIA WEST ENGINEERING, INC. authorized signature

11917 NE 95th Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

ATTERBERG LIMITS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
Parklands at Camas Meadows Camas, Washington	Mr. Aaron Barr & Mr. Kevin Deford Parklands at Camas Meadows, LLC PO Box 61962 Vancouver, WA 98666	15153	S15-360
		REPORT DATE: 06/16/15	FIELD ID: TP6.1
		DATE SAMPLED: 06/04/15	SAMPLED BY: HDG

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
Sandy Fat CLAY	Test Pit TP-06 depth = 2.5 feet	CH, Sandy Fat Clay

LABORATORY TEST DATA

LABORATORY EQUIPMENT: Liquid Limit Machine, Hand Rolled

TEST PROCEDURE: ASTM D4318

ATTERBERG LIMITS

liquid limit =	51
plastic limit =	26
plasticity index =	25

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	34.63	34.09	37.32	
dry soil + pan weight, g =	30.07	29.61	31.60	
pan weight, g =	20.69	20.73	20.85	
N (blows) =	33	25	15	
moisture, % =	48.6 %	50.5 %	53.2 %	

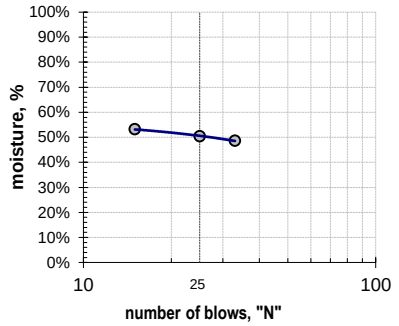
SHRINKAGE

shrinkage limit =	n/a
shrinkage ratio =	n/a

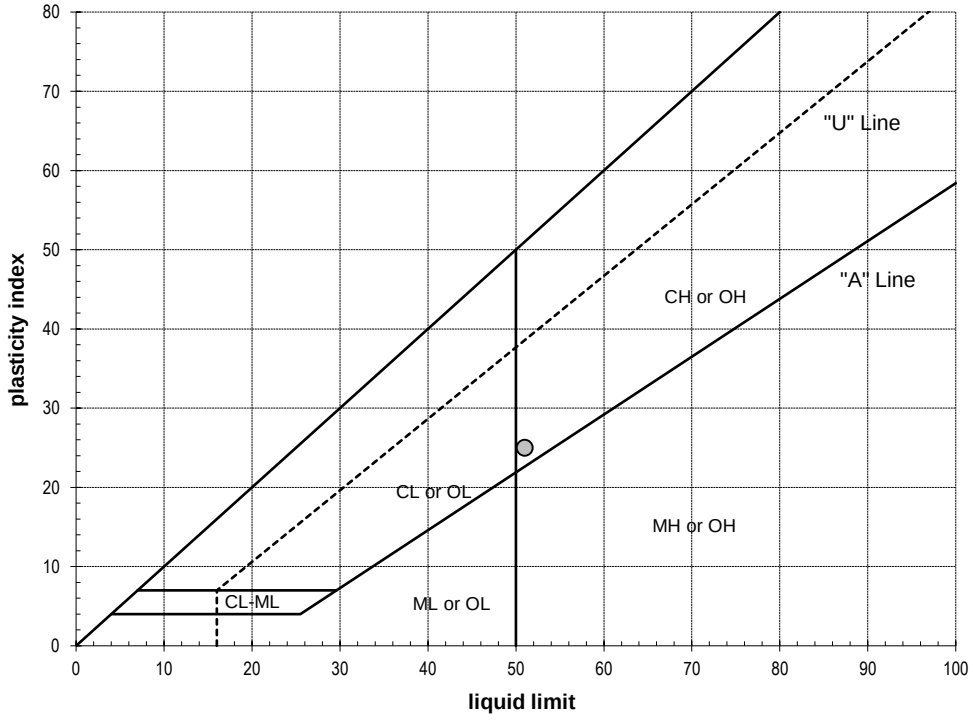
PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	27.64	27.63		
dry soil + pan weight, g =	26.18	26.21		
pan weight, g =	20.69	20.82		
moisture, % =	26.6 %	26.4 %		

LIQUID LIMIT



PLASTICITY CHART



ADDITIONAL DATA

% gravel =	0.1%
% sand =	37.3%
% silt and clay =	62.6%
% silt =	n/a
% clay =	n/a
moisture content =	32.3%

DATE TESTED	TESTED BY
06/15/15	MJR

This report may not be reproduced except in full without prior written authorization by Columbia West Engineering, Inc.

COLUMBIA WEST ENGINEERING, INC. authorized signature

11917 NE 95th Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

PARTICLE-SIZE ANALYSIS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
Parklands at Camas Meadows Camas, Washington	Mr. Aaron Barr & Mr. Kevin Deford Parklands at Camas Meadows, LLC PO Box 61962 Vancouver, WA 98666	15153	S15-361
		REPORT DATE 06/16/15	FIELD ID TP8.2
		DATE SAMPLED 06/04/15	SAMPLED BY HDG

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
Clayey SAND	Test Pit TP-08 depth = 8 feet	SC, Clayey Sand
SPECIFICATIONS none		AASHTO SOIL TYPE A-2-7(0)

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Rainhart "Mary Ann" Sifter 637	ASTM D6913, D422

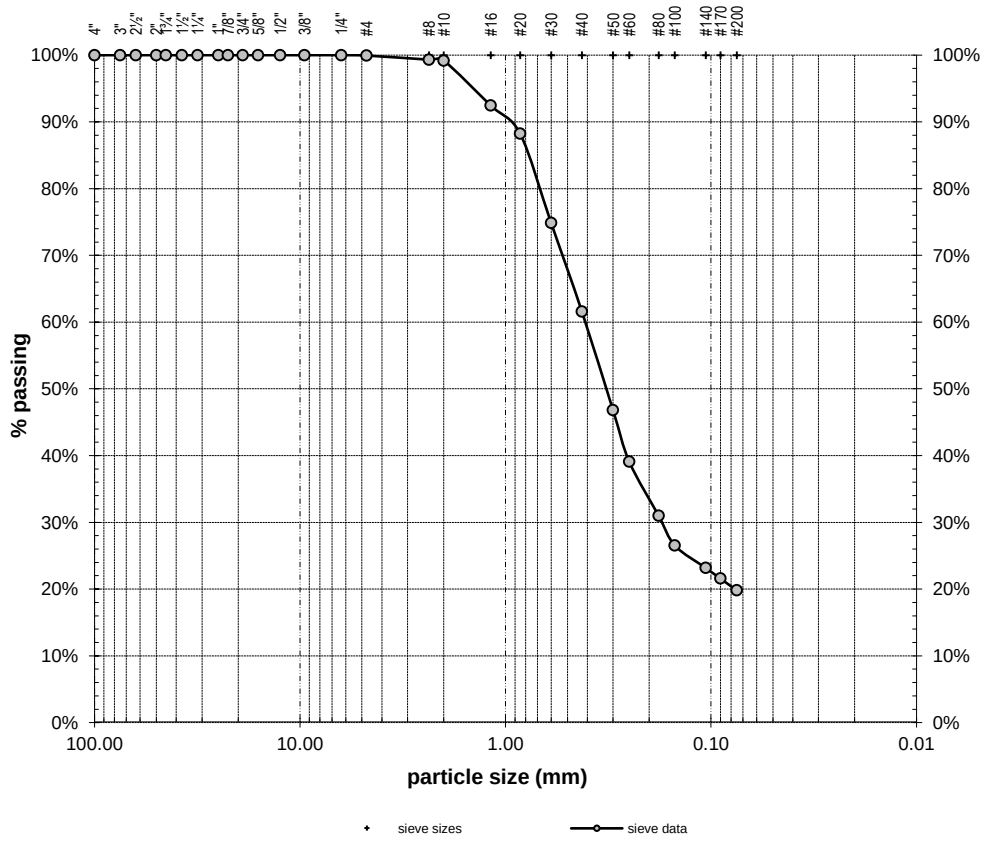
ADDITIONAL DATA

initial dry mass (g) =	151.9		
as-received moisture content =	42.6%	coefficient of curvature, C_C =	n/a
liquid limit =	43	coefficient of uniformity, C_U =	n/a
plastic limit =	25	effective size, $D_{(10)}$ =	n/a
plasticity index =	18	$D_{(30)}$ =	0.173 mm
fineness modulus =	n/a	$D_{(60)}$ =	0.410 mm

SIEVE DATA

% gravel =	0.1%
% sand =	80.1%
% silt and clay =	19.8%

GRAIN SIZE DISTRIBUTION



	SIEVE SIZE US	SIEVE SIZE mm	PERCENT PASSING SIEVE act.	PERCENT PASSING SIEVE interp.	SPECS max	SPECS min
GRAVEL	6.00"	150.0		100.0%		
	4.00"	100.0		100.0%		
	3.00"	75.0		100.0%		
	2.50"	63.0		100.0%		
	2.00"	50.0		100.0%		
	1.75"	45.0		100.0%		
	1.50"	37.5		100.0%		
	1.25"	31.5		100.0%		
	1.00"	25.0		100.0%		
	7/8"	22.4		100.0%		
	3/4"	19.0		100.0%		
	5/8"	16.0		100.0%		
	1/2"	12.5		100.0%		
	3/8"	9.50		100.0%		
	1/4"	6.30	100.0%			
	#4	4.75	99.9%			
SAND	#8	2.36		99.3%		
	#10	2.00	99.2%			
	#16	1.18		92.4%		
	#20	0.850	88.3%			
	#30	0.600		74.8%		
	#40	0.425	61.6%			
	#50	0.300		46.8%		
	#60	0.250	39.1%			
	#80	0.180		31.0%		
	#100	0.150	26.5%			
	#140	0.106		23.2%		
	#170	0.090		21.6%		
	#200	0.075	19.8%			

DATE TESTED	TESTED BY
06/08/15	BTT/MJR

This report may not be reproduced except in full without prior written authorization by Columbia West Engineering, Inc.

COLUMBIA WEST ENGINEERING, INC. authorized signature

11917 NE 95th Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

ATTERBERG LIMITS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
Parklands at Camas Meadows Camas, Washington	Mr. Aaron Barr & Mr. Kevin Deford Parklands at Camas Meadows, LLC PO Box 61962 Vancouver, WA 98666	15153	S15-361
		REPORT DATE: 06/16/15	FIELD ID: TP8.2
		DATE SAMPLED: 06/04/15	SAMPLED BY: HDG

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
Clayey SAND	Test Pit TP-08 depth = 8 feet	SC, Clayey Sand

LABORATORY TEST DATA

LABORATORY EQUIPMENT: Liquid Limit Machine, Hand Rolled

TEST PROCEDURE: ASTM D4318

ATTERBERG LIMITS

liquid limit = 43
plastic limit = 25
plasticity index = 18

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	39.55	37.83	35.98	
dry soil + pan weight, g =	33.98	32.70	31.23	
pan weight, g =	20.69	20.73	20.63	
N (blows) =	30	23	17	
moisture, % =	41.9 %	42.9 %	44.8 %	

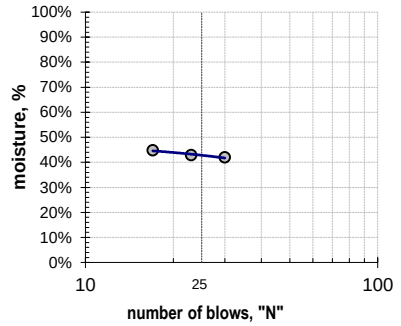
SHRINKAGE

shrinkage limit = n/a
shrinkage ratio = n/a

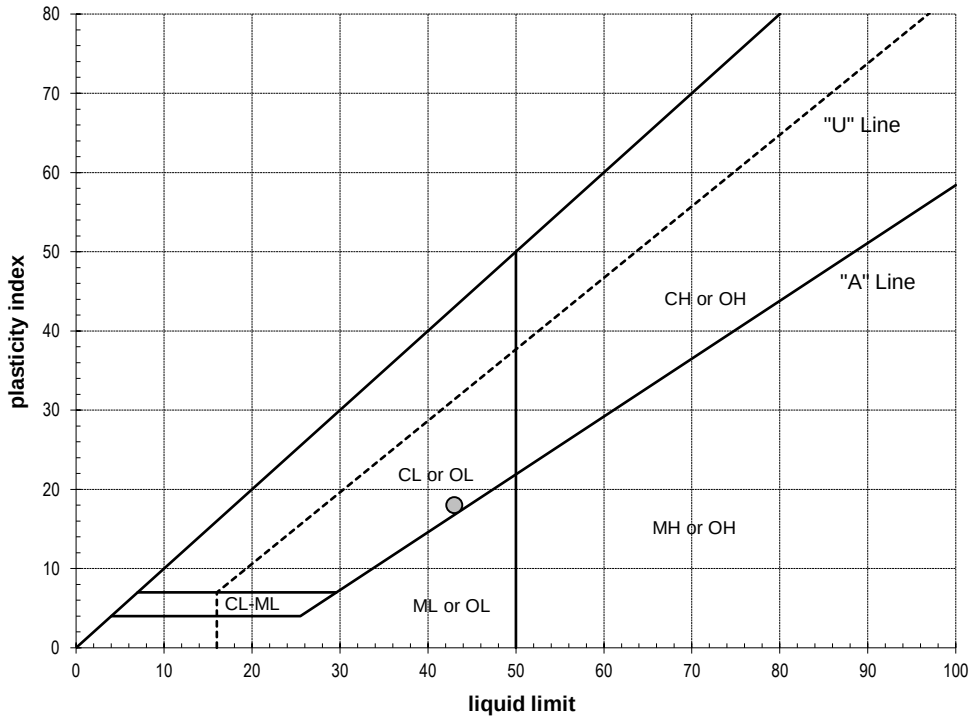
PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	27.97	28.28		
dry soil + pan weight, g =	26.54	26.79		
pan weight, g =	20.74	20.77		
moisture, % =	24.7 %	24.8 %		

LIQUID LIMIT



PLASTICITY CHART



ADDITIONAL DATA

% gravel = 0.1%
% sand = 80.1%
% silt and clay = 19.8%
% silt = n/a
% clay = n/a
moisture content = 42.6%

DATE TESTED	TESTED BY
06/15/15	MJR

This report may not be reproduced except in full without prior written authorization by Columbia West Engineering, Inc.

COLUMBIA WEST ENGINEERING, INC. authorized signature

11917 NE 95th Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

PARTICLE-SIZE ANALYSIS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
Parklands at Camas Meadows Camas, Washington	Mr. Aaron Barr & Mr. Kevin Deford Parklands at Camas Meadows, LLC PO Box 61962 Vancouver, WA 98666	15153	S15-362
		REPORT DATE 06/16/15	FIELD ID TP8.3
		DATE SAMPLED 06/04/15	SAMPLED BY HDG

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
Poorly graded GRAVEL with Silt and Sand	Test Pit TP-08 depth = 12 feet	GP-GM, Poorly graded gravel with silt and sand
SPECIFICATIONS none		AASHTO SOIL TYPE A-2-7(0)

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Rainhart "Mary Ann" Sifter 637	ASTM D6913, D422

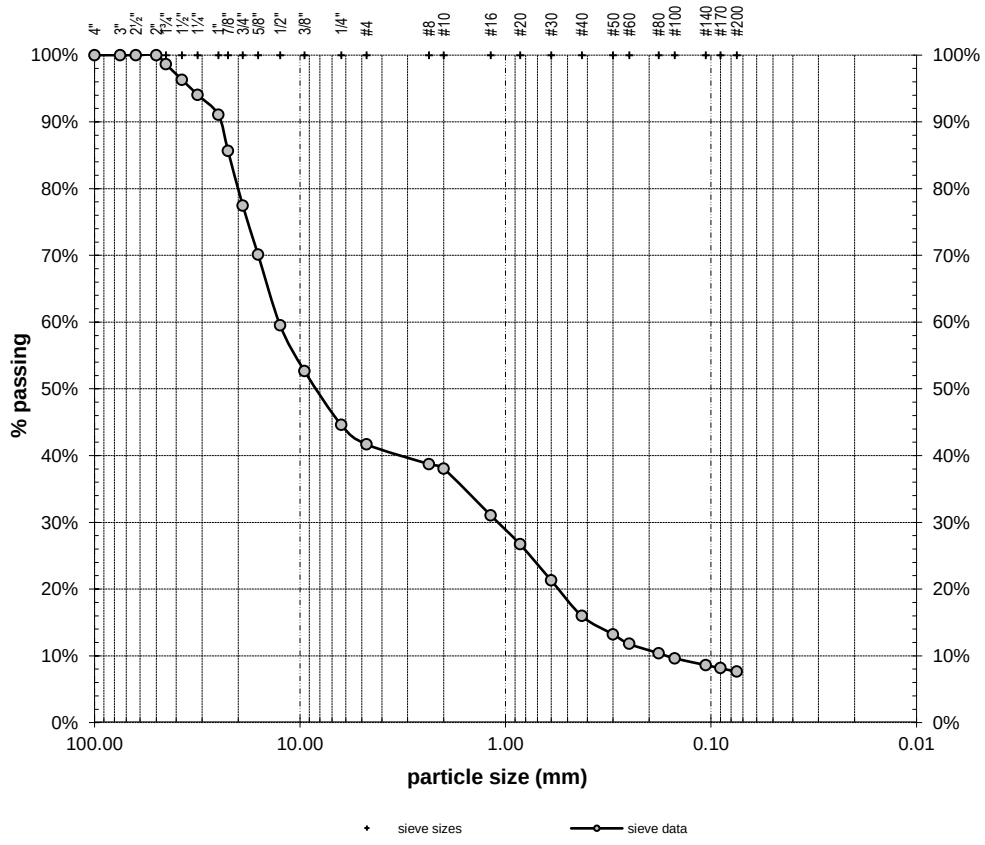
ADDITIONAL DATA

initial dry mass (g) =	3089.1		
as-received moisture content =	33.2%	coefficient of curvature, C_C =	0.57
liquid limit =	46	coefficient of uniformity, C_U =	76.93
plastic limit =	28	effective size, $D_{(10)}$ =	0.164 mm
plasticity index =	18	$D_{(30)}$ =	1.091 mm
fineness modulus =	n/a	$D_{(60)}$ =	12.637 mm

SIEVE DATA

% gravel = 58.3%
% sand = 34.1%
% silt and clay = 7.6%

GRAIN SIZE DISTRIBUTION



	SIEVE SIZE US	SIEVE SIZE mm	PERCENT PASSING SIEVE act.	SIEVE interp.	SPECS max	SPECS min
GRAVEL	6.00"	150.0		100.0%		
	4.00"	100.0		100.0%		
	3.00"	75.0		100.0%		
	2.50"	63.0		100.0%		
	2.00"	50.0	100.0%			
	1.75"	45.0		98.6%		
	1.50"	37.5		96.3%		
	1.25"	31.5		94.0%		
	1.00"	25.0	91.1%			
	7/8"	22.4		85.6%		
	3/4"	19.0	77.5%			
	5/8"	16.0		70.1%		
	1/2"	12.5	59.5%			
	3/8"	9.50	52.6%			
	1/4"	6.30	44.6%			
	#4	4.75	41.7%			
SAND	#8	2.36		38.7%		
	#10	2.00	38.0%			
	#16	1.18		31.0%		
	#20	0.850	26.7%			
	#30	0.600		21.3%		
	#40	0.425	16.0%			
	#50	0.300		13.2%		
	#60	0.250	11.8%			
	#80	0.180		10.4%		
	#100	0.150	9.6%			
	#140	0.106		8.6%		
	#170	0.090		8.1%		
	#200	0.075	7.6%			

DATE TESTED	TESTED BY
06/08/15	BTT/MJR

This report may not be reproduced except in full without prior written authorization by Columbia West Engineering, Inc.

COLUMBIA WEST ENGINEERING, INC. authorized signature

11917 NE 95th Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

ATTERBERG LIMITS REPORT

PROJECT	CLIENT	PROJECT NO.	LAB ID
Parklands at Camas Meadows Camas, Washington	Mr. Aaron Barr & Mr. Kevin Deford Parklands at Camas Meadows, LLC PO Box 61962 Vancouver, WA 98666	15153	S15-362
		REPORT DATE: 06/16/15	FIELD ID: TP8.3
		DATE SAMPLED: 06/04/15	SAMPLED BY: HDG

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
Poorly graded GRAVEL with Silt and Sand	Test Pit TP-08 depth = 12 feet	GP-GM, Poorly graded gravel with silt and sand

LABORATORY TEST DATA

LABORATORY EQUIPMENT: Liquid Limit Machine, Hand Rolled

TEST PROCEDURE: ASTM D4318

ATTERBERG LIMITS

liquid limit = 46
plastic limit = 28
plasticity index = 18

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	39.57	37.55	37.51	
dry soil + pan weight, g =	33.76	32.29	32.08	
pan weight, g =	20.69	20.82	20.87	
N (blows) =	35	25	18	
moisture, % =	44.5 %	45.9 %	48.4 %	

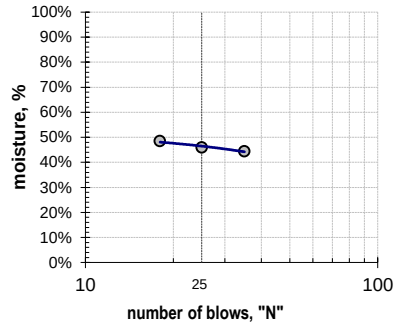
SHRINKAGE

shrinkage limit = n/a
shrinkage ratio = n/a

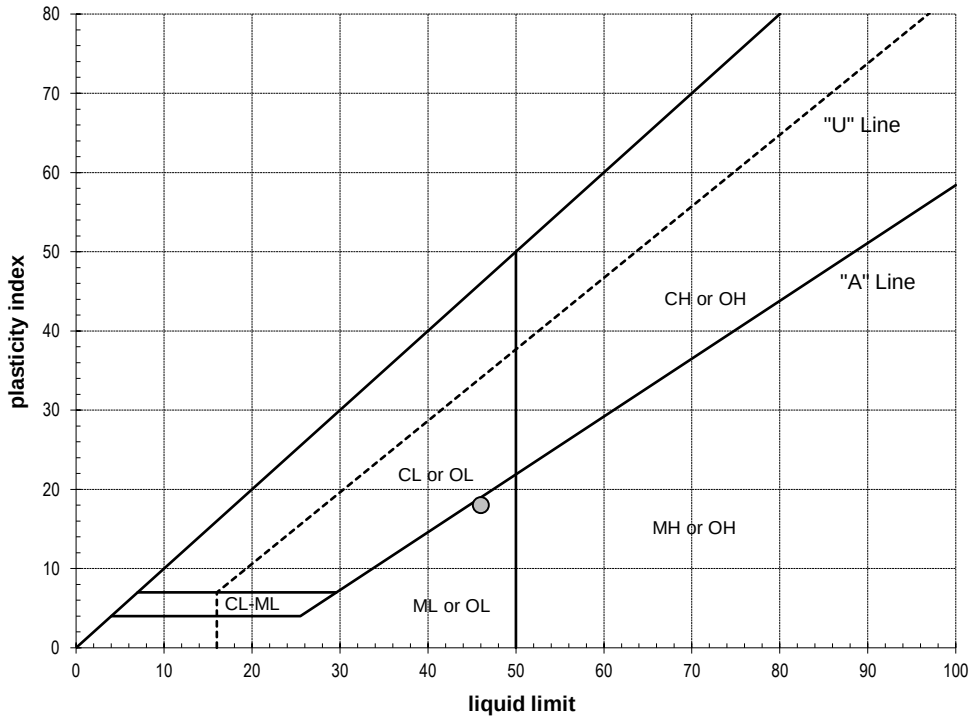
PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	27.57	27.51		
dry soil + pan weight, g =	26.11	26.06		
pan weight, g =	20.82	20.80		
moisture, % =	27.6 %	27.6 %		

LIQUID LIMIT



PLASTICITY CHART



ADDITIONAL DATA

% gravel =	58.3%
% sand =	34.1%
% silt and clay =	7.6%
% silt =	n/a
% clay =	n/a
moisture content =	33.2%

DATE TESTED	TESTED BY
06/15/15	MJR

This report may not be reproduced except in full without prior written authorization by Columbia West Engineering, Inc.

COLUMBIA WEST ENGINEERING, INC. authorized signature

APPENDIX B
SUBSURFACE EXPLORATION LOGS

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
The Parklands at Camas Meadows	Parklands, LLC		15153	TP-1
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Camas, Washington		Excavator	HDG	6/4/15
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	186	2.5 ft bgs	1030	1035

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 10 to 12 inches of topsoil and root zone material.					
				GP-GM		Poorly graded GRAVEL with silt and sand, dense, wet to saturated. Represents weathered conglomerate bedrock.					
▼						Difficult excavation. 6" to 8" weathered cobbles observed.					
						Refusal at 3.0 feet, competent conglomerate bedrock encountered. Bottom of test pit at 3.0 feet. Groundwater encountered at 2.5 feet.					
5											
10											
15											
20											

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
The Parklands at Camas Meadows	Parklands, LLC		15153	TP-2
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Camas, Washington		Excavator	HDG	6/4/15
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	190	Not encountered.	1000	1015

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 12 to 14 inches of topsoil and root zone material.					
				GP-GM		Poorly graded GRAVEL with silt and sand, dense, wet to saturated. Represents weathered conglomerate bedrock.					
						Difficult excavation. 6" to 8" weathered cobbles observed.					
						Refusal at 3.5 feet, competent conglomerate bedrock encountered. Bottom of test pit at 3.5 feet. Groundwater not encoutered.					
5											
10											
15											
20											

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
The Parklands at Camas Meadows	Parklands, LLC		15153	TP-3
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Camas, Washington		Excavator	HDG	6/4/15
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	208	Not encountered.	1115	1130

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 16 to 18 inches of topsoil and root zone material.					
	TP3.1		A-7-6(7)	CL		Brown sandy CLAY, moist, medium stiff, fines are medium plasticity.	36.4	57.1	44	16	
				GP-GM		Poorly graded GRAVEL with silt and sand, dense, wet to saturated, gravels are rounded to subrounded. Represents weathered conglomerate bedrock. Difficult excavation.					
5						Refusal at 4.5 feet, competent conglomerate bedrock encountered. Bottom of test pit at 4.5 feet. Groundwater not encoutered.					
10											
15											
20											

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
The Parklands at Camas Meadows	Parklands, LLC		15153	TP-4
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Camas, Washington		Excavator	HDG	6/4/15
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	214	Not encountered.	1150	1200

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 12 to 16 inches of topsoil and root zone material.					
				CL		Brown sandy CLAY, moist, medium stiff, fines are medium plasticity.					
				GP-GM		Poorly graded GRAVEL with silt and sand, dense, wet to saturated, gravels are rounded to subrounded. Represents weathered conglomerate bedrock.					
5						Refusal at 3.0 feet, competent conglomerate bedrock encountered. Bottom of test pit at 3.0 feet. Groundwater not encountered.					
10											
15											
20											

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
The Parklands at Camas Meadows	Parklands, LLC		15153	TP-5
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Camas, Washington		Excavator	HDG	6/4/15
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	228	Not encountered.	1245	1255

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 12 to 14 inches of topsoil and root zone material.					
				CL		Brown sandy CLAY, moist, medium stiff, fines are medium plasticity.					
				GP-GM		Poorly graded GRAVEL with silt and sand, dense, wet to saturated, gravels are rounded to subrounded. Represents weathered conglomerate bedrock. Difficult excavation.					
5						Refusal at 4.5 feet, competent conglomerate bedrock encountered. Bottom of test pit at 4.5 feet. Groundwater not encoutered.					
10											
15											
20											

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
The Parklands at Camas Meadows	Parklands, LLC		15153	TP-6
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Camas, Washington		Excavator	HDG	6/4/15
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	210	Not encountered.	1215	1230

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 12 to 14 inches of topsoil and root zone material.					
	TP6.1		A-7-6(14)	CH		Brown sandy FAT CLAY, moist, medium stiff, fines are moderate to high plasticity.	32.3	62.6	51	25	
5				GP-GM		Poorly graded GRAVEL with silt and sand, dense, wet to saturated, gravels are rounded to subrounded. Represents weathered conglomerate bedrock. Difficult excavation. 6" to 8" weathered cobbles observed.					
10						Refusal at 6.5 feet, competent conglomerate bedrock encountered. Bottom of test pit at 6.5 feet. Groundwater not encountered.					
15											
20											

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
The Parklands at Camas Meadows	Parklands, LLC		15153	TP-7
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Camas, Washington		Excavator	HDG	6/4/15
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	218	Not encountered.	810	815

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 12 to 14 inches of topsoil and root zone material.					
				GP-GM		Poorly graded GRAVEL with silt and sand, dense, wet to saturated, gravels are rounded to subrounded. Represents weathered conglomerate bedrock. Difficult excavation. 6" to 8" weathered cobbles observed.					
5						Refusal at 3.5 feet, competent conglomerate bedrock encountered. Bottom of test pit at 3.5 feet. Groundwater not encoutered.					
10											
15											
20											

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900, Fax: 360-823-2901
www.columbiawestengineering.com

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

TEST PIT LOG

PROJECT NAME	CLIENT		PROJECT NO.	TEST PIT NO.
The Parklands at Camas Meadows	Parklands, LLC		15153	TP-8
PROJECT LOCATION	**CONTRACTOR**	**EQUIPMENT**	**ENGINEER**	**DATE**
Camas, Washington		Excavator	HDG	6/4/15
TEST PIT LOCATION	**APPROX. SURFACE ELEVATION**	**GROUNDWATER DEPTH**	**START TIME**	**FINISH TIME**
See Figure 2	210	Not encountered	830	900

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 16 to 18 inches of topsoil and root zone material.					
				CL		Brown sandy CLAY, moist, medium stiff, fines are medium plasticity.					
5											
	TP8.2		A-2-7(0)	SC		Light brown clayey SAND, moist, dense, lightly cemented, fines are medium plasticity. Difficult excavation.	42.6	19.8	43	18	
10											
	TP8.3		A-2-7(0)	GP-GM		Poorly graded GRAVEL with silt and sand, dense, saturated, gravels are subrounded to rounded. Groundwater seep.	33.2	7.6	46	18	
15											
						Refusal at 16.5 feet, competent conglomerate bedrock encountered.. Bottom of test pit at 16.5 feet. Groundwater encoutered at 15.5 feet.					
20											

APPENDIX C
SOIL CLASSIFICATION INFORMATION

SOIL DESCRIPTION AND CLASSIFICATION GUIDELINES

Particle-Size Classification

COMPONENT	ASTM/USCS		AASHTO	
	size range	sieve size range	size range	sieve size range
Cobbles	> 75 mm	greater than 3 inches	> 75 mm	greater than 3 inches
Gravel	75 mm – 4.75 mm	3 inches to No. 4 sieve	75 mm – 2.00 mm	3 inches to No. 10 sieve
Coarse	75 mm – 19.0 mm	3 inches to 3/4-inch sieve	-	-
Fine	19.0 mm – 4.75 mm	3/4-inch to No. 4 sieve	-	-
Sand	4.75 mm – 0.075 mm	No. 4 to No. 200 sieve	2.00 mm – 0.075 mm	No. 10 to No. 200 sieve
Coarse	4.75 mm – 2.00 mm	No. 4 to No. 10 sieve	2.00 mm – 0.425 mm	No. 10 to No. 40 sieve
Medium	2.00 mm – 0.425 mm	No. 10 to No. 40 sieve	-	-
Fine	0.425 mm – 0.075 mm	No. 40 to No. 200 sieve	0.425 mm – 0.075 mm	No. 40 to No. 200 sieve
Fines (Silt and Clay)	< 0.075 mm	Passing No. 200 sieve	< 0.075 mm	Passing No. 200 sieve

Consistency for Cohesive Soil

CONSISTENCY	SPT N-VALUE (BLOWS PER FOOT)	POCKET PENETROMETER (UNCONFINED COMPRESSIVE STRENGTH, tsf)
Very Soft	2	less than 0.25
Soft	2 to 4	0.25 to 0.50
Medium Stiff	4 to 8	0.50 to 1.0
Stiff	8 to 15	1.0 to 2.0
Very Stiff	15 to 30	2.0 to 4.0
Hard	30 to 60	greater than 4.0
Very Hard	greater than 60	-

Relative Density for Granular Soil

RELATIVE DENSITY	SPT N-VALUE (BLOWS PER FOOT)
Very Loose	0 to 4
Loose	4 to 10
Medium Dense	10 to 30
Dense	30 to 50
Very Dense	more than 50

Moisture Designations

TERM	FIELD IDENTIFICATION
Dry	No moisture. Dusty or dry.
Damp	Some moisture. Cohesive soils are usually below plastic limit and are moldable.
Moist	Grains appear darkened, but no visible water is present. Cohesive soils will clump. Sand will bulk. Soils are often at or near plastic limit.
Wet	Visible water on larger grains. Sand and silt exhibit dilatancy. Cohesive soil can be readily remolded. Soil leaves wetness on the hand when squeezed. Soil is much wetter than optimum moisture content and is above plastic limit.

AASHTO SOIL CLASSIFICATION SYSTEM

TABLE 1. Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (35 Percent or Less Passing .075 mm)				Silt-Clay Materials (More than 35 Percent Passing 0.075)		
Group Classification	A-1	A-3	A-2	A-4	A-5	A-6	A-7
Sieve analysis, percent passing:							
2.00 mm (No. 10)	-	-	-				
0.425 mm (No. 40)	50 max	51 min	-	-	-	-	-
0.075 mm (No. 200)	25 max	10 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing 0.425 mm (No. 40)							
Liquid limit				40 max	41 min	40 max	41 min
Plasticity index	6 max	N.P.		10 max	10 max	11 min	11 min
General rating as subgrade	Excellent to good				Fair to poor		

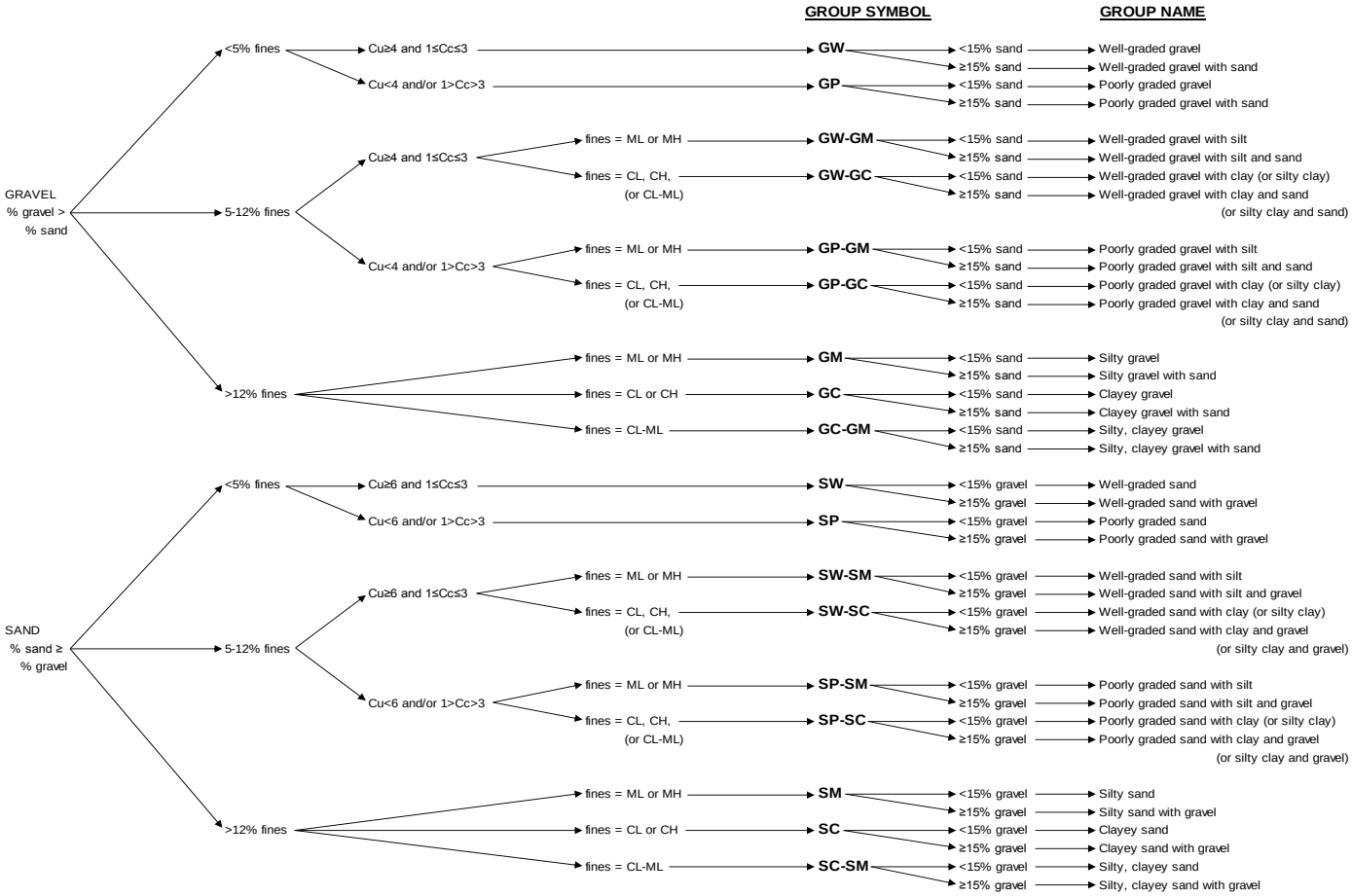
Note: The placing of A-3 before A-2 is necessary in the "left to right elimination process" and does not indicate superiority of A-3 over A-2.

TABLE 2. Classification of Soils and Soil-Aggregate Mixtures

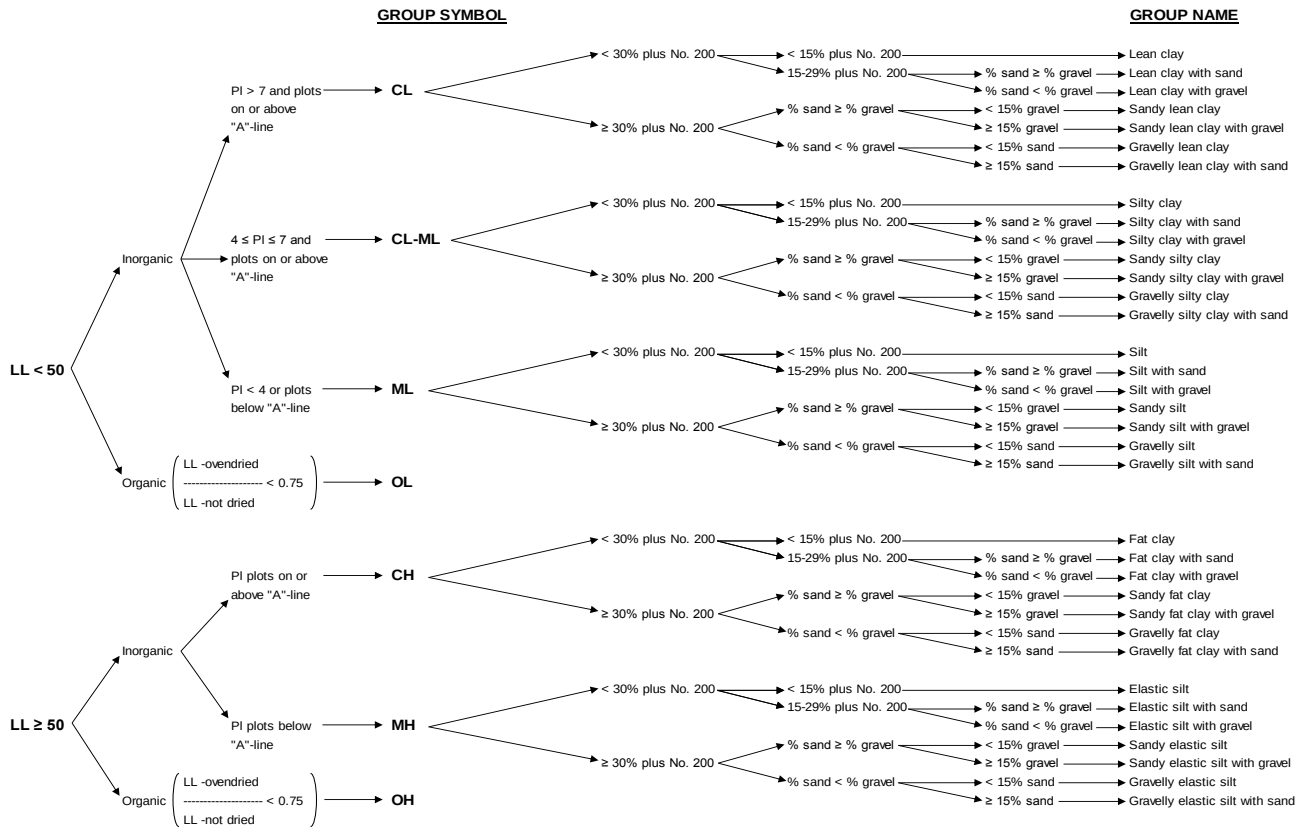
General Classification	Granular Materials (35 Percent or Less Passing 0.075 mm)							Silt-Clay Materials (More than 35 Percent Passing 0.075 mm)			
	A-1			A-2							A-7
Group Classification	A-1-a	A-1-b	A-3	A-2-4	A-2-5	A-2-6	A-2-7	A-4	A-5	A-6	A-7-5, A-7-6
Sieve analysis, percent passing:											
2.00 mm (No. 10)	50 max	-	-	-	-	-	-	-	-	-	-
0.425 mm (No. 40)	30 max	50 max	51 min	-	-	-	-	-	-	-	-
0.075 mm (No. 200)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing 0.425 mm (No. 40)											
Liquid limit				40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
Plasticity index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11min
Usual types of significant constituent materials	Stone fragments, gravel and sand		Fine sand	Silty or clayey gravel and sand				Silty soils		Clayey soils	
General ratings as subgrade	Excellent to Good							Fair to poor			

Note: Plasticity index of A-7-5 subgroup is equal to or less than LL minus 30. Plasticity index of A-7-6 subgroup is greater than LL minus 30 (see Figure 2).

AASHTO = American Association of State Highway and Transportation Officials



Flow Chart for Classifying Coarse-Grained Soils (More Than 50% Retained on No. 200 Sieve)



Flow Chart for Classifying Fine-Grained Soil (50% or More Passes No. 200 Sieve)

APPENDIX D
PHOTO LOG

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

PHOTO LOG
Parklands at Camas Meadows
Camas, Washington



Shallow conglomerate bedrock in Test Pit TP-1



Shallow hyaoclastic sandstone bedrock in Test Pit TP-3



Shallow groundwater near Test Pit TP-1



Deeper conglomerate bedrock encountered in Test Pit TP-8

APPENDIX E
REPORT LIMITATIONS AND IMPORTANT INFORMATION

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

Date: June 23, 2015
Project: Parklands at Camas Meadows
Camas, Washington

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 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.

Report Ownership

Columbia West retains the ownership and copyright property rights to this entire report and its contents, which may include, but may not be limited to, figures, text, logs, electronic media, drawings, laboratory reports, and appendices. This report was prepared solely for the client, and other relevant approved users or parties, and its distribution must be contingent upon prior express written consent by Columbia West. Furthermore, client or approved users may not use, lend, sell, copy, or distribute this document without express written consent by Columbia West. Client does not own nor have rights to electronic media files that constitute this report, and under no circumstances should said electronic files be distributed or copied. Electronic media is susceptible to unauthorized manipulation or modification, and may not be reliable.

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.

Operations and Maintenance Manual
Appendix E

Catch Basin Maintenance Guide	**E1**
Manhole Maintenance Guide	**E2**
Stormwater Conveyance Pipe Maintenance Guide	**E3**
Contech Stormfilter Maintenance Guide	**E4**

Exhibit 8 SP26-1005

Catch Basin

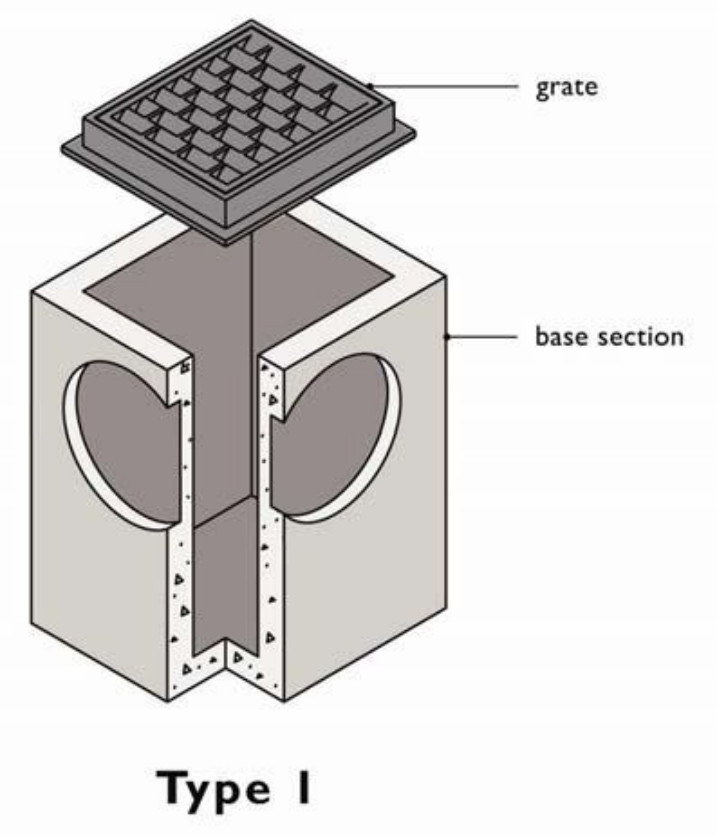
A catch basin is an underground concrete structure typically fitted with a slotted grate to collect stormwater runoff and route it through underground pipes. Catch basins can also be used as a junction in a pipe system and may have a solid lid. There are two types.

A Type 1 catch basin is a rectangular box with approximate dimensions of 3'x2'x5'. Type 1 catch basins are utilized when the connected conveyance pipes are less than 18 inches in diameter and the depth from the gate to the bottom of the pipe is less than 5 feet.

A Type 2 catch basin, also commonly referred to as a storm manhole, is listed separately under "Manhole" in this book.

Catch basins typically provide a storage volume (sump) below the outlet pipe to allow sediments and debris to settle out of the stormwater runoff. Some catch basins are also fitted with a spill control device (inverted elbow on outlet pipe) intended to contain large quantities of grease or debris.

Catch basins are frequently associated with all stormwater facilities.



Key Operations and Maintenance Considerations

- The most common tool for cleaning catch basins is an industrial vacuum truck with a tank and vacuum hose (e.g. Vactor® truck) to remove sediment and debris from the sump.
- A catch basin may be an enclosed space where harmful chemicals and vapors can accumulate. Therefore, if the inspection and maintenance requires entering a catch basin, it should be conducted by an individual trained and certified to work in hazardous confined spaces.

Catch Basin			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
			Note: table spans multiple pages.
General	Trash and Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No trash or debris located immediately in front of catch basin or on grate opening.
		Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the catch basin.
		Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin.
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into basin.)	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached.	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.

	Basin Walls/ Bottom	Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation Inhibiting System	Vegetation growing across and blocking more than 10% of the basin opening.	No vegetation blocking opening to basin.
		Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants, or other pollutants. Sheen, obvious oil, or other contaminants present. • Identify and remove source, AND • Report to Clark County Clean Water Program.	No contaminants or pollutants present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure (Intent is to keep cover from sealing off access to maintenance).	Cover can be removed by one maintenance person.
Metal Grates (If Applicable)	Grate Opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.
Oil/Debris Trap (If Applicable)	Dislodged	Oil or debris trap is misaligned with or dislodged from the outlet pipe.	Trap is connected to and aligned with outlet pipe.

Exhibit 8 SP26-1005

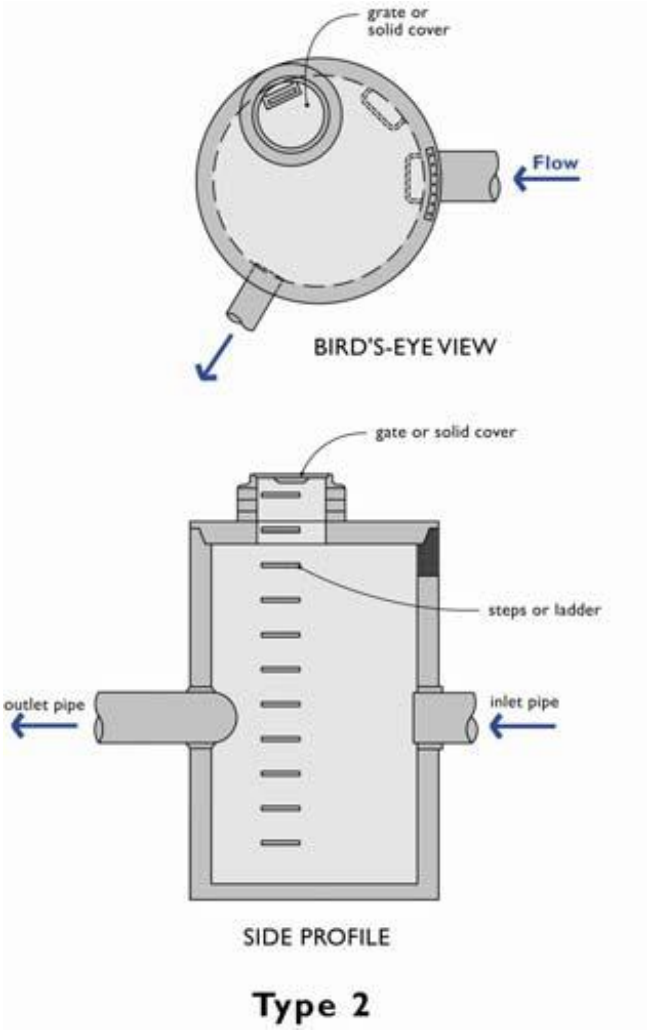
Manhole

A manhole is an underground concrete structure typically fitted with a slotted grate to collect stormwater runoff and route it through underground pipes. Manholes can also be used as a junction in a pipe system and may have a solid lid. A manhole is also known as a Type 2 catch basin.

Manholes are round concrete structures ranging in diameter from 4 feet to 8 feet. They are used when the connecting conveyance pipe is 18 inches or greater or the depth from grate to pipe bottom exceeds 5 feet. Manholes typically have steps mounted on the side of the structure to allow access.

Manholes typically provide a storage volume (sump) below the outlet pipe to allow sediments and debris to settle out of the stormwater runoff. Some manholes are also fitted with a spill control device (inverted elbow on outlet pipe) intended to contain large quantities of grease or oils.

Manholes are often associated with other stormwater facilities.



Key Operations and Maintenance Considerations

- The most common tool for cleaning manholes is a truck with a tank and vacuum hose (Vactor® truck) to remove sediment and debris from the sump.
- A manhole may be an enclosed space where harmful chemicals and vapors can accumulate. Therefore, if the inspection and maintenance requires entering a manhole, it should be conducted by an individual trained and certified to work in hazardous confined spaces.

Manhole			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
			Note: table spans multiple pages.
General	Trash and Debris	Trash or debris which is located immediately in front of the opening or is blocking inletting capacity of the basin by more than 10%.	No trash or debris located immediately in front of manhole or on grate opening.
		Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the basin.
		Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the basin.
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into manhole.)	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached.	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
		Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering manhole through cracks.	Pipe is regrouted and secure at basin wall.

	Settlement/ Misalignment	If failure of manhole has created a safety, function, or design problem.	Manhole replaced or repaired to design standards.
	Vegetation Inhibiting System	Vegetation growing across and blocking more than 10% of the opening.	No vegetation blocking opening to manhole.
		Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants, or other pollutants. Sheen, obvious oil, or other contaminants present. • Identify and remove source, AND • Report to Clark County Clean Water Program.	No contaminants or pollutants present.
Manhole Cover	Cover Not in Place	Cover is missing or only partially in place. Any open manhole is a safety hazard and requires immediate maintenance.	Manhole cover is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure (Intent is to keep cover from sealing off access to maintenance).	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to manhole wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate Opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

Exhibit 8 SP26-1005

Stormwater Conveyance Pipe

Storm sewer pipes convey stormwater. Inlet and outlet stormwater pipes convey stormwater in, through, and out of stormwater facilities.

Pipes are built from many materials and are sometimes perforated to allow stormwater to infiltrate into the ground. Pipes are cleaned to remove sediment or blockages when problems are identified. Stormwater pipes must be clear of obstructions and breaks to prevent localized flooding. All stormwater pipes should be in proper working order and free of the possible defects listed below.

Key Operations and Maintenance Considerations

- The most common tool for cleaning stormwater conveyance pipes is a truck with a tank, vacuum hose, and a jet hose (Vactor® truck) to flush sediment and debris from the pipes.

Stormwater Conveyance Pipe			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
General	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants, or other pollutants. Sheen, obvious oil, or other contaminants present. • Identify and remove source, AND • Report to Clark County Clean Water Program.	No contaminants or pollutants present.
	Drainage Slow	Decreased capacity that indicates slow drainage. Does not meet facility design infiltration rate. The Water Quality Design Storm Volume does not infiltrate within 48 hours (if perforated pipe). Water remains in the pipe for greater than 24 hours after the end of most moderate rainfall events.	Perforated drain pipe has been cleaned and drainage rates are per design specifications. (Do not allow removed sediment and water to discharge back into the storm sewer.)
	Obstructions, Including Roots	Root enters or deforms pipe, reducing flow.	Roots have been removed from pipe (using mechanical methods; do not put root-dissolving chemicals in storm sewer pipes). If necessary, vegetation over the line removed.
	Pipe Dented or Broken	Inlet/outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced per design standards.
	Pipe Rusted or Deteriorated	Any part of the piping that is crushed or deformed more than 20% or any other failure to the piping.	Pipe repaired and/or replaced per design standards.
	Sediment and Debris	Sediment depth is greater than 20% of pipe diameter.	Pipe has been cleaned and is free of sediment/ debris. (Upstream debris traps installed where applicable.)
	Debris Barrier or Trash Rack Missing	Stormwater pipes > than 18 inches need debris barrier.	Debris barrier present on all stormwater pipes 18 inches and greater.

CONTECH®
ENGINEERED SOLUTIONS

StormFilter Inspection and Maintenance Procedures



The Stormwater Management StormFilter®

Maintenance Guidelines

The primary purpose of the Stormwater Management StormFilter® is to filter and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the StormFilter to its full efficiency and effectiveness.

Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. Maintenance activities may be required in the event of a chemical spill or due to excessive sediment loading from site erosion or extreme storms. It is a good practice to inspect the system after major storm events.

Maintenance Procedures

Although there are many effective maintenance options, we believe the following procedure to be efficient, using common equipment and existing maintenance protocols. The following two-step procedure is recommended::

1. **Inspection**
   - Inspection of the vault interior to determine the need for maintenance.
2. **Maintenance**
   - Cartridge replacement
   - Sediment removal

Inspection and Maintenance Timing

At least one scheduled inspection should take place per year with maintenance following as warranted.

First, an inspection should be done before the winter season. During the inspection the need for maintenance should be determined and, if disposal during maintenance will be required, samples of the accumulated sediments and media should be obtained.

Second, if warranted, a maintenance (replacement of the filter cartridges and removal of accumulated sediments) should be performed during periods of dry weather.



In addition to these two activities, it is important to check the condition of the StormFilter unit after major storms for potential damage caused by high flows and for high sediment accumulation that may be caused by localized erosion in the drainage area. It may be necessary to adjust the inspection/ maintenance schedule depending on the actual operating conditions encountered by the system. In general, inspection activities can be conducted at any time, and maintenance should occur, if warranted, during dryer months in late summer to early fall.

Maintenance Frequency

The primary factor for determining frequency of maintenance for the StormFilter is sediment loading.

A properly functioning system will remove solids from water by trapping particulates in the porous structure of the filter media inside the cartridges. The flow through the system will naturally decrease as more and more particulates are trapped. Eventually the flow through the cartridges will be low enough to require replacement. It may be possible to extend the usable span of the cartridges by removing sediment from upstream trapping devices on a routine as-needed basis, in order to prevent material from being re-suspended and discharged to the StormFilter treatment system.

The average maintenance lifecycle is approximately 1-5 years. Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction may need to be inspected and maintained more often than those with fully stabilized surface conditions.

Regulatory requirements or a chemical spill can shift maintenance timing as well. The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after major storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual StormFilter system or site. It is recommended that the site owner develop a database to properly manage StormFilter inspection and maintenance programs..



Inspection Procedures

The primary goal of an inspection is to assess the condition of the cartridges relative to the level of visual sediment loading as it relates to decreased treatment capacity. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, then typically large amounts of sediments will be present and very little flow will be discharged from the drainage pipes. If this is the case, then maintenance is warranted and the cartridges need to be replaced.

Warning: In the case of a spill, the worker should abort inspection activities until the proper guidance is obtained. Notify the local hazard control agency and Contech Engineered Solutions immediately.

To conduct an inspection:

Important: Inspection should be performed by a person who is familiar with the operation and configuration of the StormFilter treatment unit and the unit's role, relative to detention or retention facilities onsite.

1. If applicable, set up safety equipment to protect and notify surrounding vehicle and pedestrian traffic.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the access portals to the vault and allow the system vent.
4. Without entering the vault, visually inspect the inside of the unit, and note accumulations of liquids and solids.
5. Be sure to record the level of sediment build-up on the floor of the vault, in the forebay, and on top of the cartridges. If flow is occurring, note the flow of water per drainage pipe. Record all observations. Digital pictures are valuable for historical documentation.
6. Close and fasten the access portals.
7. Remove safety equipment.
8. If appropriate, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.
9. Discuss conditions that suggest maintenance and make decision as to whether or not maintenance is needed.

Maintenance Decision Tree

The need for maintenance is typically based on results of the inspection. The following Maintenance Decision Tree should be used as a general guide. (Other factors, such as Regulatory Requirements, may need to be considered).

Please note Stormwater Management StormFilter devices installed downstream of, or integrated within, a stormwater storage facility typically have different operational parameters (i.e. draindown time). In these cases, the inspector must understand the relationship between the retention/detention facility and the treatment system by evaluating site specific civil engineering plans, or contacting the engineer of record, and make adjustments to the below guidance as necessary. Sediment deposition depths and patterns within the StormFilter are likely to be quite different compared to systems without upstream storage and therefore shouldn't be used exclusively to evaluate a need for maintenance.

1. Sediment loading on the vault floor.
   a. If >4" of accumulated sediment, maintenance is required.
2. Sediment loading on top of the cartridge.
   a. If >1/4" of accumulation, maintenance is required.
3. Submerged cartridges.
   a. If >4" of static water above cartridge bottom for more than 24 hours after end of rain event, maintenance is required. (Catch basins have standing water in the cartridge bay.)
4. Plugged media.
   a. While not required in all cases, inspection of the media within the cartridge may provide valuable additional information.
   b. If pore space between media granules is absent, maintenance is required.
5. Bypass condition.
   a. If inspection is conducted during an average rain fall event and StormFilter remains in bypass condition (water over the internal outlet baffle wall or submerged cartridges), maintenance is required.
6. Hazardous material release.
   a. If hazardous material release (automotive fluids or other) is reported, maintenance is required.
7. Pronounced scum line.
   a. If pronounced scum line (say ≥ 1/4" thick) is present above top cap, maintenance is required.

Maintenance

Depending on the configuration of the particular system, maintenance personnel will be required to enter the vault to perform the maintenance.

Important: If vault entry is required, OSHA rules for confined space entry must be followed.

Filter cartridge replacement should occur during dry weather. It may be necessary to plug the filter inlet pipe if base flows is occurring.

Replacement cartridges can be delivered to the site or customers facility. Information concerning how to obtain the replacement cartridges is available from Contech Engineered Solutions.

Warning: In the case of a spill, the maintenance personnel should abort maintenance activities until the proper guidance is obtained. Notify the local hazard control agency and Contech Engineered Solutions immediately.

To conduct cartridge replacement and sediment removal maintenance:

1. If applicable, set up safety equipment to protect maintenance personnel and pedestrians from site hazards.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the doors (access portals) to the vault and allow the system to vent.
4. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
5. Make notes about the external and internal condition of the vault. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
6. Using appropriate equipment offload the replacement cartridges (up to 150 lbs. each) and set aside.
7. Remove used cartridges from the vault using one of the following methods:

Method 1:

A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Disconnect each filter cartridge from the underdrain connector by rotating counterclockwise 1/4 of a turn. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

   Using appropriate hoisting equipment, attach a cable from the boom, crane, or tripod to the loose cartridge. Contact Contech Engineered Solutions for suggested attachment devices.

B. Remove the used cartridges (up to 250 lbs. each) from the vault.



Important: Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner.

C. Set the used cartridge aside or load onto the hauling truck.

D. Continue steps a through c until all cartridges have been removed.

Method 2:

A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Disconnect each filter cartridge from the underdrain connector by rotating counterclockwise 1/4 of a turn. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

B. Unscrew the cartridge cap.

C. Remove the cartridge hood and float.

D. At location under structure access, tip the cartridge on its side.

E. Empty the cartridge onto the vault floor. Reassemble the empty cartridge.

F. Set the empty, used cartridge aside or load onto the hauling truck.

G. Continue steps a through e until all cartridges have been removed.

8. Remove accumulated sediment from the floor of the vault and from the forebay. This can most effectively be accomplished by use of a vacuum truck.
9. Once the sediments are removed, assess the condition of the vault and the condition of the connectors.
10. Using the vacuum truck boom, crane, or tripod, lower and install the new cartridges. Once again, take care not to damage connections.
11. Close and fasten the door.
12. Remove safety equipment.
13. Finally, dispose of the accumulated materials in accordance with applicable regulations. Make arrangements to return the used **empty** cartridges to Contech Engineered Solutions.

Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in accordance with regulatory protocols. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads.

Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. This typically requires coordination with a local landfill for solid waste disposal. For liquid waste disposal a number of options are available including a municipal vacuum truck decant facility, local waste water treatment plant or on-site treatment and discharge.

Related Maintenance Activities - Performed on an as-needed basis

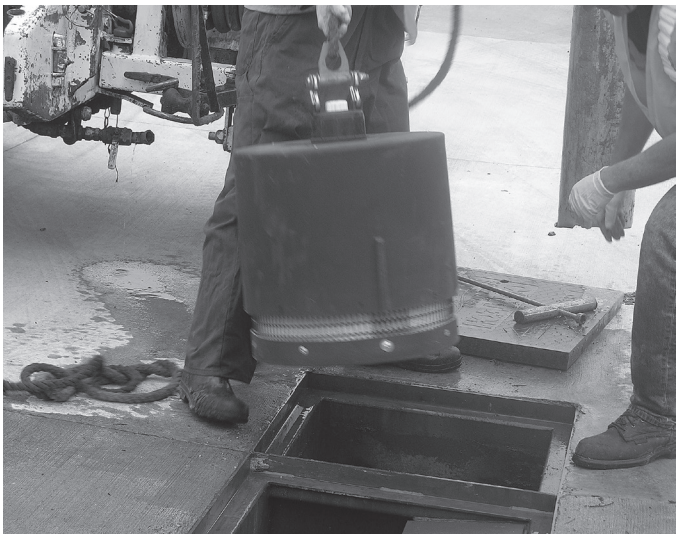
StormFilter units are often just one of many structures in a more comprehensive stormwater drainage and treatment system.

In order for maintenance of the StormFilter to be successful, it is imperative that all other components be properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities.

In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil loading, and discharges of inappropriate materials.







Inspection Report

Date: _____ Personnel: _____

Location: _____ System Size: _____ Months in Service: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other: _____

Sediment Thickness in Forebay: _____ Date: _____

Sediment Depth on Vault Floor: _____

Sediment Depth on Cartridge Top(s): _____

Structural Damage: _____

Estimated Flow from Drainage Pipes (if available): _____

Cartridges Submerged: Yes ☐ No ☐ Depth of Standing Water: _____

StormFilter Maintenance Activities (check off if done and give description)

☐ Trash and Debris Removal: _____

☐ Minor Structural Repairs: _____

☐ Drainage Area Report _____

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

Items Needing Further Work: _____

Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals.

Other Comments:

_____

_____

_____

_____

_____

_____

_____

_____

Review the condition reports from the previous inspection visits.

StormFilter Maintenance Report

Date: _____ Personnel: _____

Location: _____ System Size: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other: _____

List Safety Procedures and Equipment Used: _____

_____

_____

System Observations

Months in Service: _____

Oil in Forebay (if present): Yes ☐ No ☐

Sediment Depth in Forebay (if present): _____

Sediment Depth on Vault Floor: _____

Sediment Depth on Cartridge Top(s): _____

Structural Damage: _____

Drainage Area Report

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

StormFilter Cartridge Replacement Maintenance Activities

Remove Trash and Debris: Yes ☐ No ☐ Details: _____

Replace Cartridges: Yes ☐ No ☐ Details: _____

Sediment Removed: Yes ☐ No ☐ Details: _____

Quantity of Sediment Removed (estimate?):

Minor Structural Repairs: Yes ☐ No ☐ Details: _____

Residuals (debris, sediment) Disposal Methods: _____

Notes:

_____

_____

_____

_____

_____

_____

_____

RECYCLED PAPER

CONTECH®
ENGINEERED SOLUTIONS

© 2020 CONTECH ENGINEERED SOLUTIONS LLC, A QUIKRETE COMPANY

800-338-1122

www.ContechES.com

All Rights Reserved. Printed in the USA.

Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater and earth stabilization products. For information on other Contech division offerings, visit www.ContechES.com or call 800.338.1122.

Support

- Drawings and specifications are available at www.conteches.com.
- Site-specific design support is available from our engineers.

NOTHING IN THIS CATALOG SHOULD BE CONSTRUED AS A WARRANTY. APPLICATIONS SUGGESTED HEREIN ARE DESCRIBED ONLY TO HELP READERS MAKE THEIR OWN EVALUATIONS AND DECISIONS, AND ARE NEITHER GUARANTEES NOR WARRANTIES OF SUITABILITY FOR ANY APPLICATION. CONTECH MAKES NO WARRANTY WHATSOEVER, EXPRESS OR IMPLIED, RELATED TO THE APPLICATIONS, MATERIALS, COATINGS, OR PRODUCTS DISCUSSED HEREIN. ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND ALL IMPLIED WARRANTIES OF FITNESS FOR ANY PARTICULAR PURPOSE ARE DISCLAIMED BY CONTECH. SEE CONTECH'S CONDITIONS OF SALE (AVAILABLE AT WWW.CONTECHES.COM/COS) FOR MORE INFORMATION.