

Appendix E – Flood Hazard Area Analysis



HanmiGlobal Partner

Technical Memorandum



HanmiGlobal Partner

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To: Mike Peebles, PE
From: Joshua Owens, PE
Prepared By: Melanie McCandless, EI
Copies: Tammi Connolly, PE; File
Date: March 21, 2016
Subject: Everett Heights Flood Hazard Area Analysis
Project No.: 17338

Introduction

The purpose of this analysis was to delineate the flood hazard area and determine the base flood elevations for the unnamed tributary to Pendleton Creek, in the Fanno Creek watershed, flowing through the future Everett Heights development. This analysis satisfies the requirements of Portland City Code Section 24.50.050(I) – Unidentified Watercourse Flood Zones. The watercourse was modeled under existing conditions and the flows using HEC-RAS 4.1. The sections below summarize the hydrologic, hydraulic, and mapping analyses completed.

Hydrology

The flows in the creek were calculated by applying the Rational Method to the contributing subbasins per Chapter 6 of the Portland Sewer and Drainage Facilities Design Manual (Manual). Tables 6.2 and 6.3 of the Manual specify that the Rational Method be used for open channel analysis in watersheds smaller than 50 acres. The basin draining to the stream is 28 acres (see Table 1).

The contributing basin was delineated in ArcMap using publicly available topographic data and the Portland Maps sewer assets layers (see Figure 1 and attached Portland Maps Sewer Assets Map). No stormwater conveyance currently exists in the Pendleton subbasin. The Upper subbasin has partial stormwater conveyance and the Lower subbasin is fully conveyed by stormwater infrastructure which outfalls to the channel through the Everett Heights development.

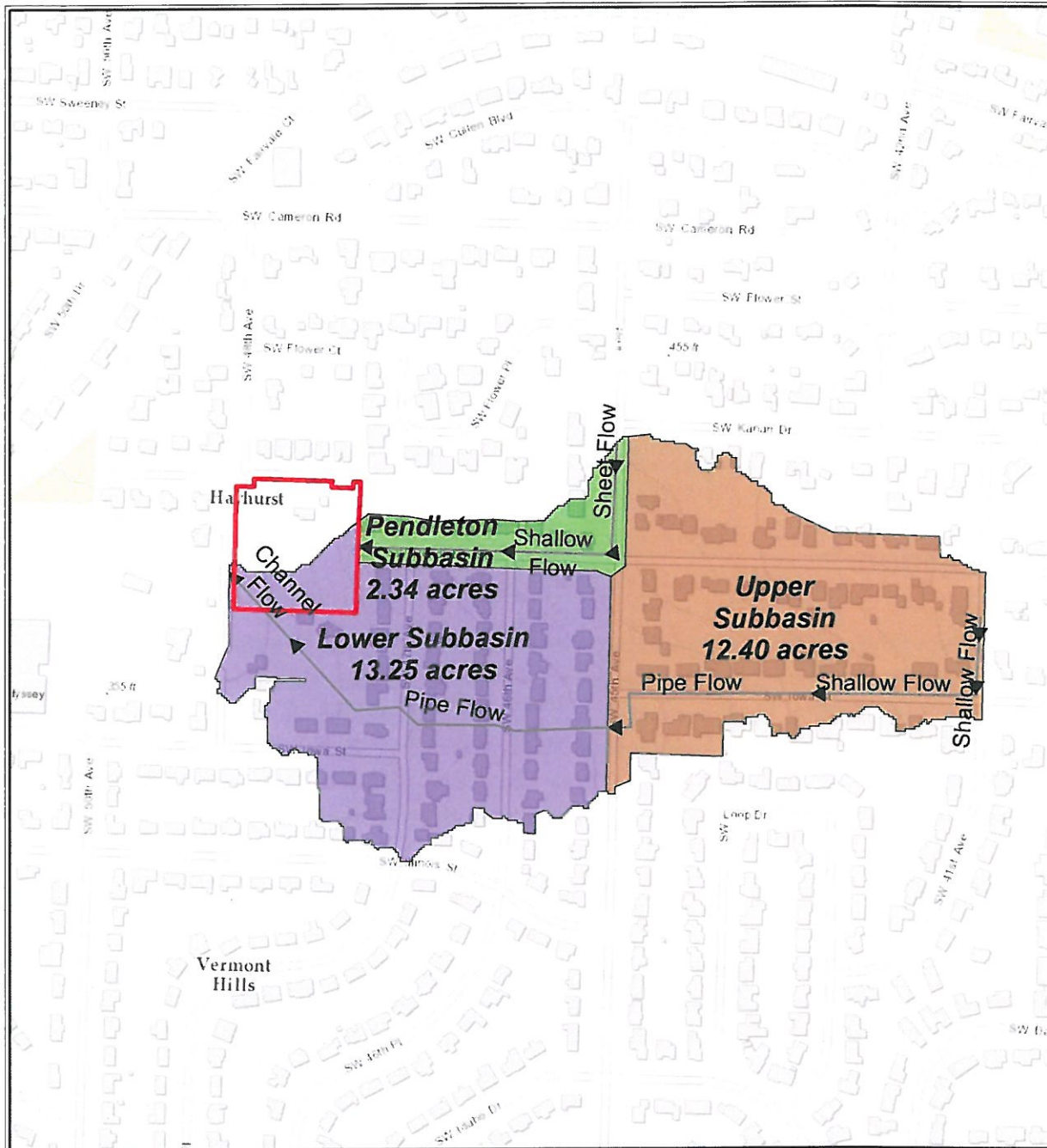


Figure I: Subbasins

Everett Heights Development

Time of Concentration Flow Segments



Subbasins Pendleton

Lower Upper

The subbasins were characterized by Zoning, Slope, and Hydrologic Soil Group to determine the runoff coefficients for developed areas per Table 6.4 in the Manual (see attached Subbasin Characterization Details). A weighted runoff coefficient was determined for each subbasin (see Table 1). Five minute times-of-concentration were assumed for all of the subbasins due to the steep slopes and paved surfaces (see Figure 1). The rainfall intensity for the 100-year recurrence interval and five minute duration is 4.14 inches/hour from Table 6.11 of the Manual. Peak runoff values were calculated from the rational method as:

$$Q = C_{weighted} \times i \times A_{total}$$

Where

Q : Peak runoff, cubic feet per second

$C_{weighted}$: Weighted runoff coefficient for subbasin (see Table 1)

i : Rainfall intensity, inches per hour (constant value = 4.14)

A_{total} : Total subbasin area, acres (see Table 1)

The peak runoff values per subbasin are reported in Table 1. The combined flow of 64.28 cubic feet per second was used for the hydraulic modeling. No peak attenuation through routing was assumed because of the short and steep conveyance paths.

Table 1: Subbasin Areas and Weighted Runoff Coefficients

Subbasin	Total Area, A_{total} (Acre)	Weighted Runoff Coefficient, $C_{weighted}$	Peak Runoff, Q (cubic feet per second)
Lower	13.25	0.56	30.63
Pendleton	2.34	0.56	5.45
Upper	12.40	0.55	28.20
Total	27.99	-	64.28

Hydraulics

The U.S. Army Corps of Engineers HEC-RAS 4.1 program was used to model the flood hydraulics in the channel through the site. Topographic survey data collected for the development project supplemented with field observations of channel geometry was the basis of the cross-sections used in the model (see Figure 2). Roughness values were determined from field observations to be between 0.03 in-channel to 0.08 on the floodplain.

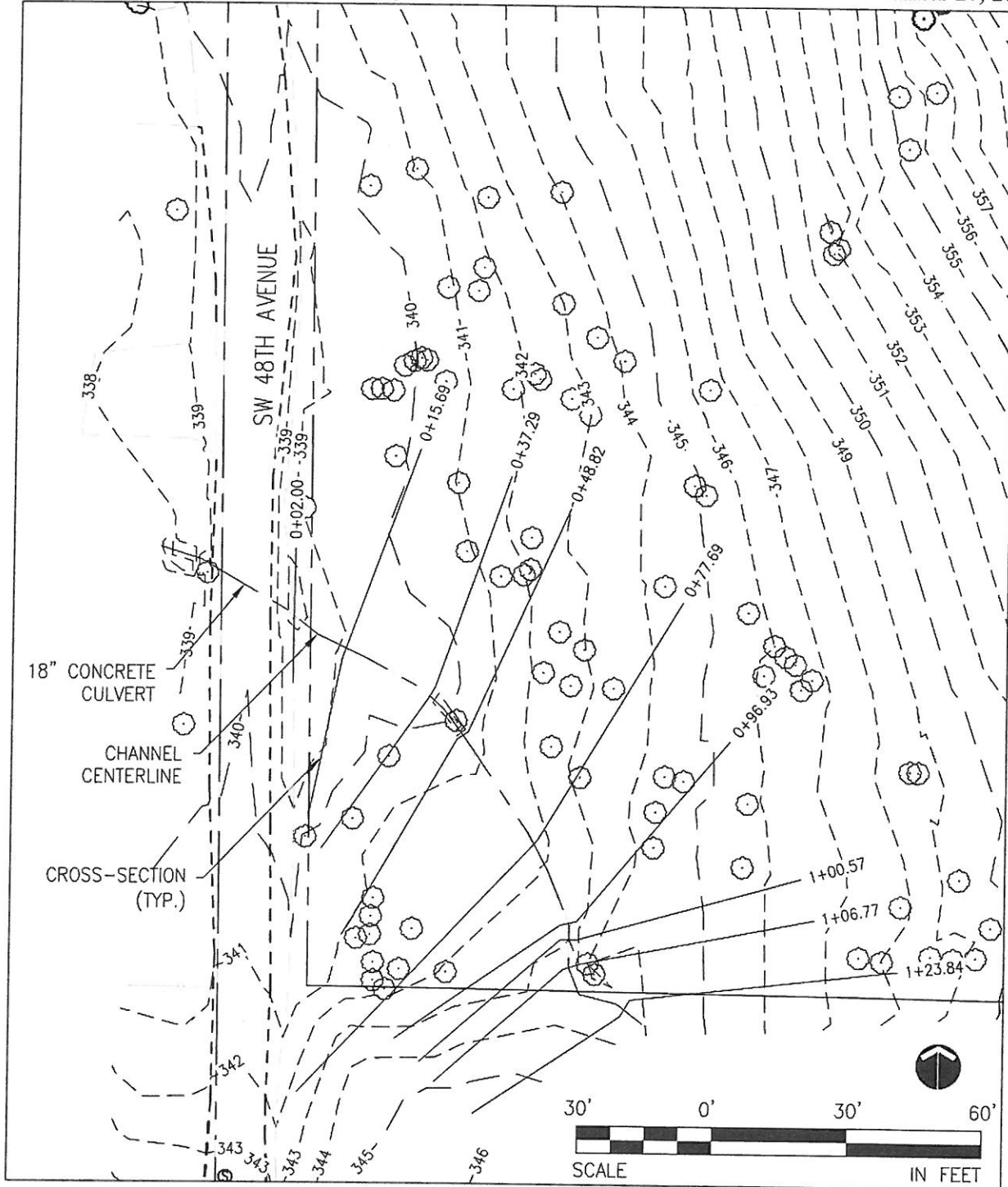
The downstream boundary condition was determined by evaluation of the existing culvert under SW 48th Avenue. The Federal Highway Administration's program HY-8 was used to determine the water surface elevation at the culvert during the design flow rate of 64.28 cubic feet per second (see attached HY-8 Culvert Report). The tailwater on the culvert under SW 48th Avenue was assumed to

be equal to the embankment overflow elevation of the next downstream culvert based on field observation.

The results of the HEC-RAS analysis are attached.

Flood Hazard Area Mapping

The water surface profile (see attached HEC-RAS output) was used to determine the flood inundation extents and base flood elevations (see Figure 3). Flows on the right bank are generally confined by the steep hillside until the culvert backwater causes flow to back up into the ditch to the north. Flows on the left bank will overflow the channel and drain across the southwest portion of the site into the SW 48th Ave ditch and then to the culvert. The modeled floodway extent was less than the fifteen-foot minimum width specified in Portland City Code Section 24.50.050(I) – Unidentified Watercourse Flood Zones. A fifteen-foot floodway was mapped (see Figure 3).



REFERENCE ONLY

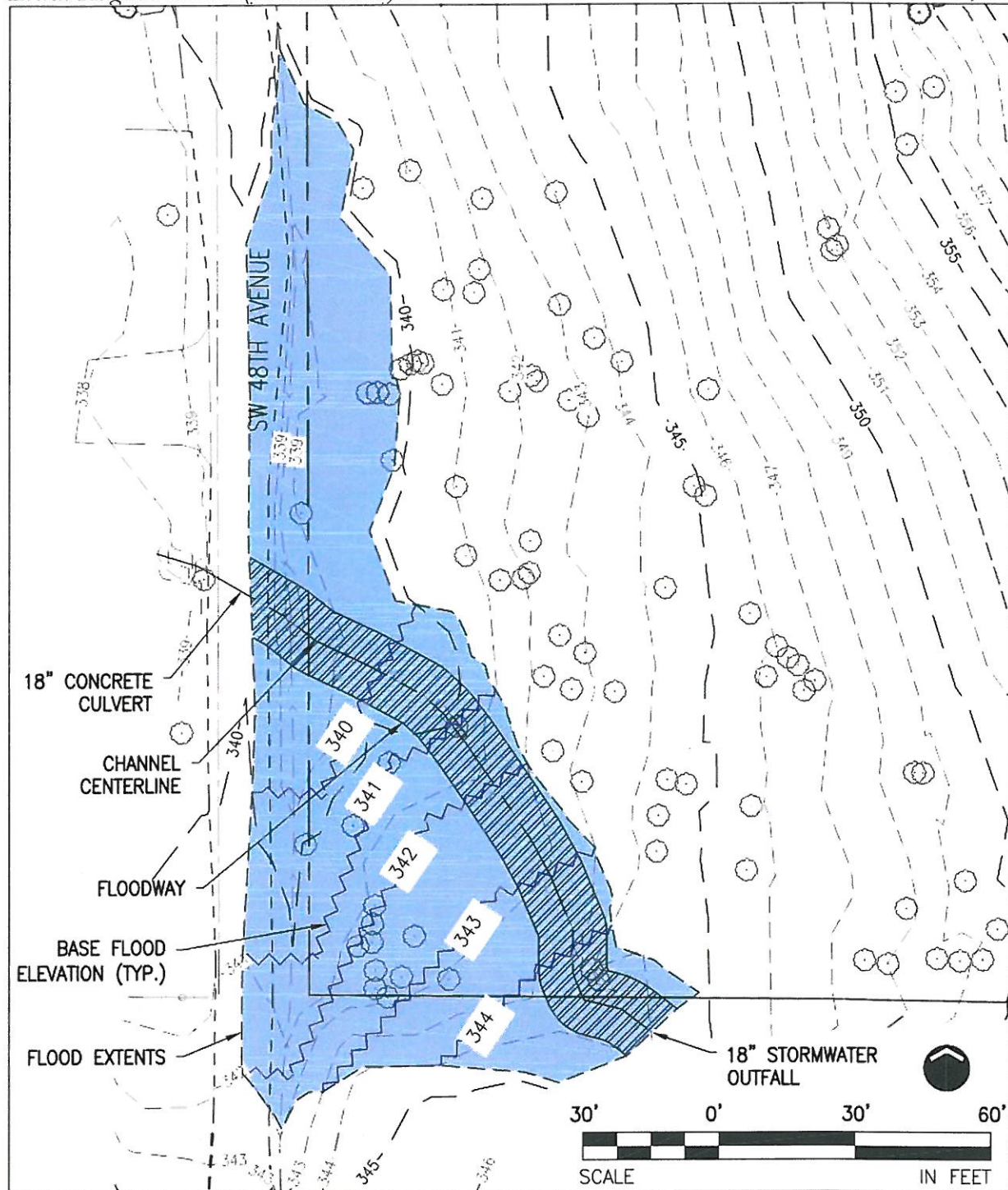


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Everett Heights Subdivision Flood Hazard Analysis

Hydraulic Model Schematic
Figure 2



REFERENCE ONLY



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Everett Heights Subdivision Flood Hazard Analysis

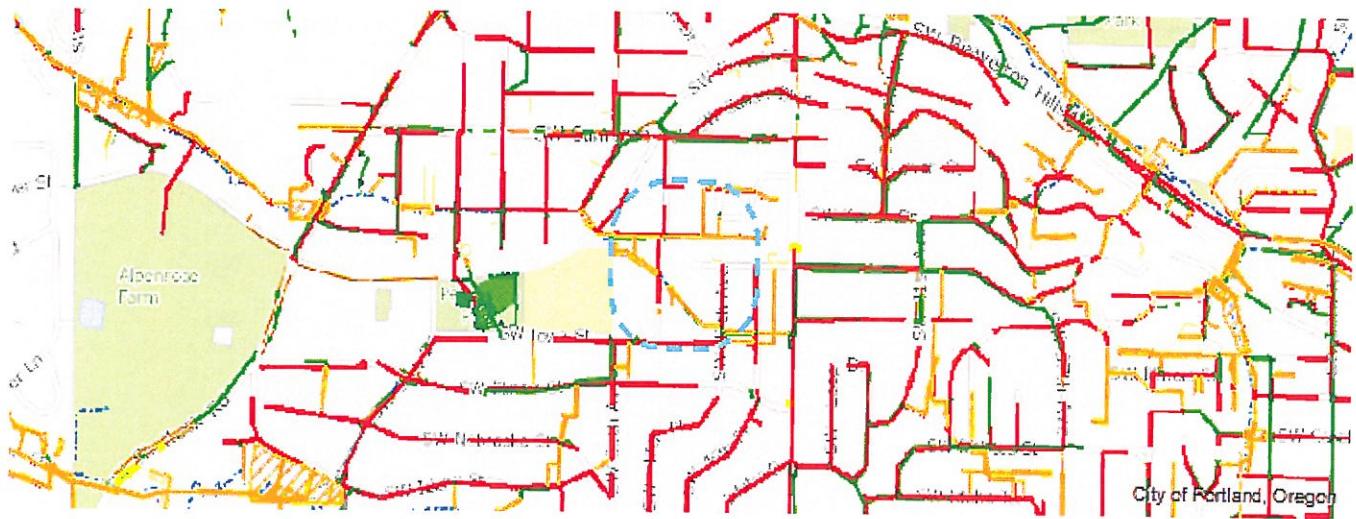
Flood Hazard Area Map
Figure 3

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Attachments

- Portland Maps Sewer Assets Map
- Web Soil Survey Report: Hydrologic Soil Group
- Subbasin Characterization Details
- HY-8 Culvert Report
- HEC-RAS output

Attachment I — Portland Maps Sewer
Assets Map
(FHA)



5920 SW 48TH AVE

PORTLAND, OR 97221

SEWER ASSETS (within 350 feet)

Nodes

ID	Description	System	File(s)	Distance
ACL579	DISCHARGE POINTS	STORM		185'
ACL578	DISCHARGE POINTS	STORM		194'
AQR225	INLETS	INLETS		202'
ACL389	DROP MANHOLES	SEWER		203'
APD673	DISCHARGE POINTS	STORM		205'

Lines

ID	Description	System	File(s)	Distance
ACL398 ACL579	NATURAL CHANNEL	STORM		180'
ACL389 ACL387	SANITARY GRAVITY MAIN	SEWER		181'
ACL502 ACL501	SANITARY GRAVITY MAIN	SEWER		182'
ACL391 ACL388	STORM GRAVITY MAIN	STORM		183'
ACL579 ACL578	CULVERT	STORM		189'

Easements

Tracking ID	Right of Way	Quit Claim	Private
389	3298	No	No
1347	3298	No	No
3537	4202	No	No
3822	1884, 1889	No	No
3944	1889	No	No

Jobs

Job Number	Job Name	Location	Quarter Section
00034	SW 47th Ave & Vermont Hills		3624
02615	SW Cameron Rd & Kanan St		3623,3624,3524,3523,
03310	SW FLOWER PLACE		3624
03368	SW Flower Pl		3624
03564	SW FLOWER CT E OF SW 48TH AVE		3624

Service Requests

Request Number	Problem	Address
4255	TRCON - TRAFFIC CONTROL ISSUES - CONES, BAGS, METER HOODS, BARRICADES, NO-PARKERS, STOP SIGNS, ETC.	4707 SW PENDLETON ST
5069	HOLE - HOLE, CAVITY, SUNKEN/OPEN CUT OR CRACKS IN STREET	4768 SW IOWA ST
11225	CBPL - CATCH BASIN - PLUGGED	5037 SW IOWA ST
14648	CLNSW - CLEAN SEWER	5037 SW IOWA ST
26617	LOCT - LOCATE SEWER/ASSET	5911 SW 48TH AVE

SEWPER

Type	Account Number	Description
DCIP	R649741930	
DCIP	R649741940	
DCIP	R991183010	

Type	Account Number	Description
Comment	R649741930	^OT 3-DEC-98 05:07:29 County Use Code Change, Update Username = DOUGA From = To = B 0000 DCIP
Comment	R649741930	^DA 20-AUG-98 08:47:10 ROESLER,DANIEL W & SUSAN K Username = CHARLESA

Historic Sewer Boards

File	Type	Quarter Section	Size
3624_NE.PDF	BES Sewer Boards	3624	401.9 KB
3624_NW.PDF	BES Sewer Boards	3624	342.8 KB
3624_SE.PDF	BES Sewer Boards	3624	499.9 KB
3624_SW.PDF	BES Sewer Boards	3624	477.2 KB
3624.jpg	PBOT/MO Sewer Boards (Pre 1980)	3624	10,611.5 KB

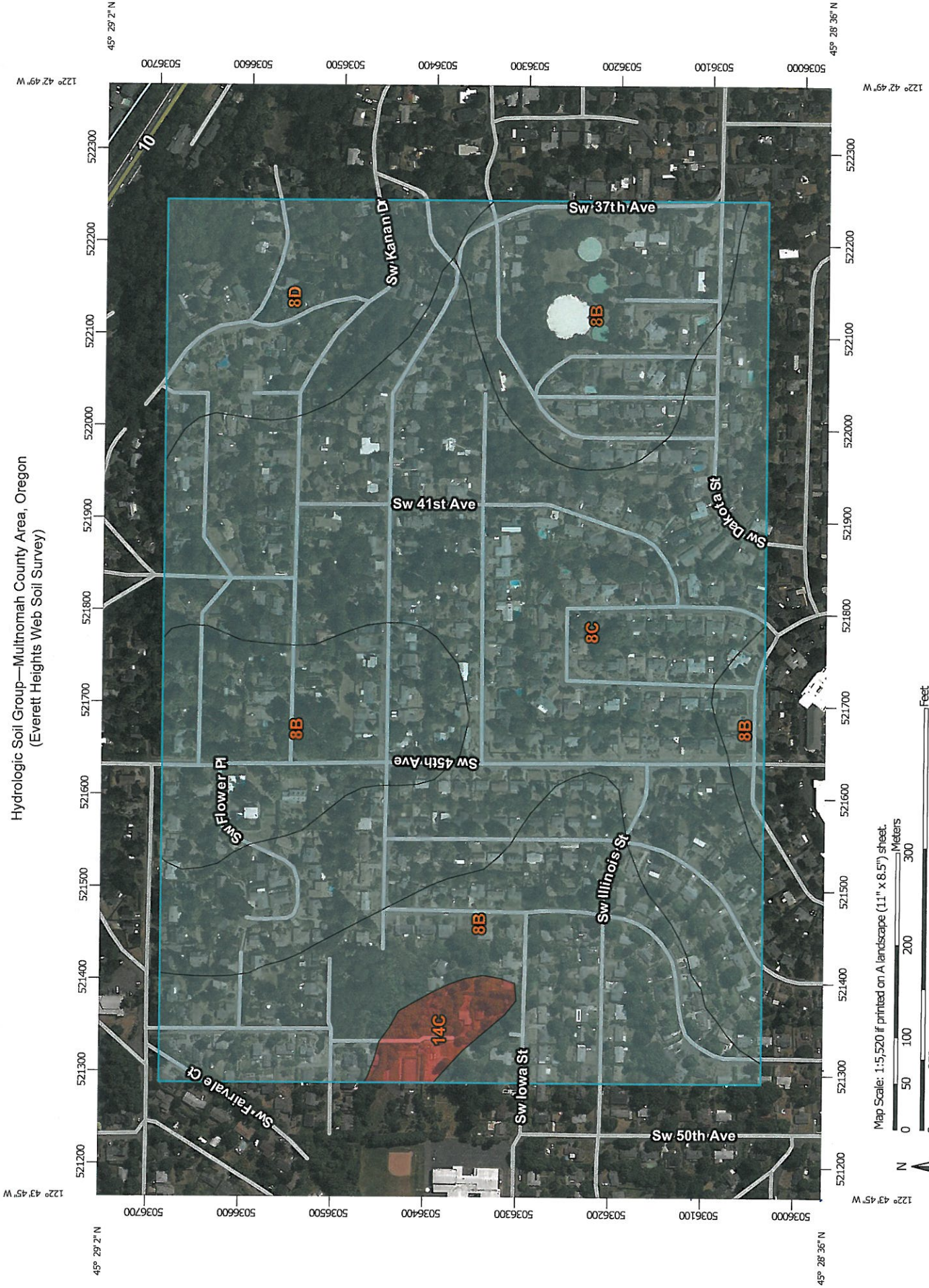
Disclaimer: The data and associated maps in this Historic Sewer Boards area are historic reference material only. They are not complete and have not been updated, nor will they be updated, with more current data. The information contained here is provided for historical reference only and is not intended to depict current conditions. No effort has been made to determine the accuracy of the data or associated maps. This disclaimer is in addition to the disclaimers shown at the bottom of the page.

Attachment 2—Web Soil Survey
Report: Hydrologic Soil Group
(FHA)



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


























Hydrologic Soil Group—Multnomah County Area, Oregon
(Everett Heights Web Soil Survey)



Natural Resources
Conservation Service

Web Soil Survey
National Cooperative Soil Survey

MAP LEGEND

Area of Interest (AOI)		Area of Interest (AOI)		C
Soils		A		C/D
Soil Rating Polygons		A/D		D
		B		Not rated or not available
		B/D		Streams and Canals
		C		Transportation
		C/D		+++ Rails
		D		Interstate Highways
		Not rated or not available		US Routes
				Major Roads
				Local Roads
				Aerial Photography
				Background
				
				
				
				
				
				
				
				
				
				
				
				
				

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Multnomah County Area, Oregon
Survey Area Data: Version 13, Sep 18, 2015

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

Date(s) aerial images were photographed: Jul 26, 2014—Sep 5, 2014

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Multnomah County Area, Oregon (OR051)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8B	Cascade-Urban land complex, 0 to 8 percent slopes	C	62.6	40.5%
8C	Cascade-Urban land complex, 8 to 15 percent slopes	C	73.5	47.5%
8D	Cascade-Urban land complex, 15 to 30 percent slopes	C	16.0	10.3%
14C	Delena silt loam, 3 to 12 percent slopes	D	2.7	1.7%
Totals for Area of Interest			154.7	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Attachment 3—Subbasin
Characterization Details
(FHA)



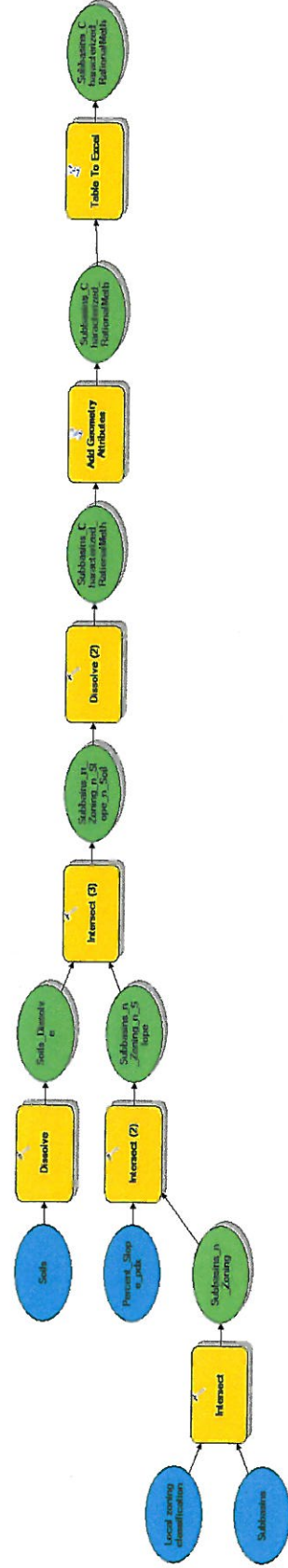
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Everett Heights Flood Hazard Analysis... Subbasin Characterization Details

Subbasin Name	Zone	Percent Slope	Hydrologic Soil Group	Subarea (Ac.)	Area (Ac.)	Runoff Coefficient, C	Weighted Runoff Coefficient, $C_{weighted}$
Lower	R7	5	C	1.67	13.25	0.47	0.56
	R7	5	D	0.79		0.51	
	R7	10	C	5.94		0.55	
	R7	10	D	0.71		0.59	
	R7	15	C	3.52		0.61	
	R7	20	C	0.62		0.61	
	R7	5	C	0.13		0.47	
Pendleton	R7	10	C	1.56	2.34	0.55	0.56
	R7	15	C	0.64		0.61	
	R7	20	C	0.00		0.61	
	R7	5	C	2.43		0.47	
Upper	R7	10	C	6.87	12.4	0.55	0.55
	R7	15	C	2.98		0.61	
	R7	20	C	0.10		0.61	
	R7	25	C	0.02		0.61	
	R7	5	C	2.43		0.47	

Subbasins were characterized using publicly available GIS datasets for zoning, percent slope, and hydrologic soil groups. A geoprocessing model (below) was used to aggregate the data by these characteristics and calculate the subareas for each set of characteristics (above). The weighted runoff coefficient was calculated by the subarea in proportion to the total subbasin area as:

$$C_{weighted} = \frac{\sum(C \times Subarea)}{Area}$$



Attachment 4—HY-8 Culvert Report
(FHA)

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 60 cfs

Design Flow: 68.24 cfs

Maximum Flow: 80 cfs

Table 1 - Summary of Culvert Flows at Crossing: 48th Ave.

Headwater Elevation (ft)	Total Discharge (cfs)	Ex18Conc Discharge (cfs)	Roadway Discharge (cfs)	Iterations
339.83	60.00	12.09	47.80	6
339.83	62.00	12.12	49.85	3
339.84	64.00	12.14	51.62	2
339.85	66.00	12.17	53.79	3
339.86	68.00	12.19	55.60	2
339.86	68.24	12.19	55.82	2
339.87	72.00	12.24	59.73	3
339.88	74.00	12.26	61.59	2
339.88	76.00	12.28	63.47	2
339.89	78.00	12.30	65.68	3
339.90	80.00	12.32	67.58	2
339.30	10.22	10.22	0.00	Overtopping

Rating Curve Plot for Crossing: 48th Ave.

Total Rating Curve

Crossing: 48th Ave.

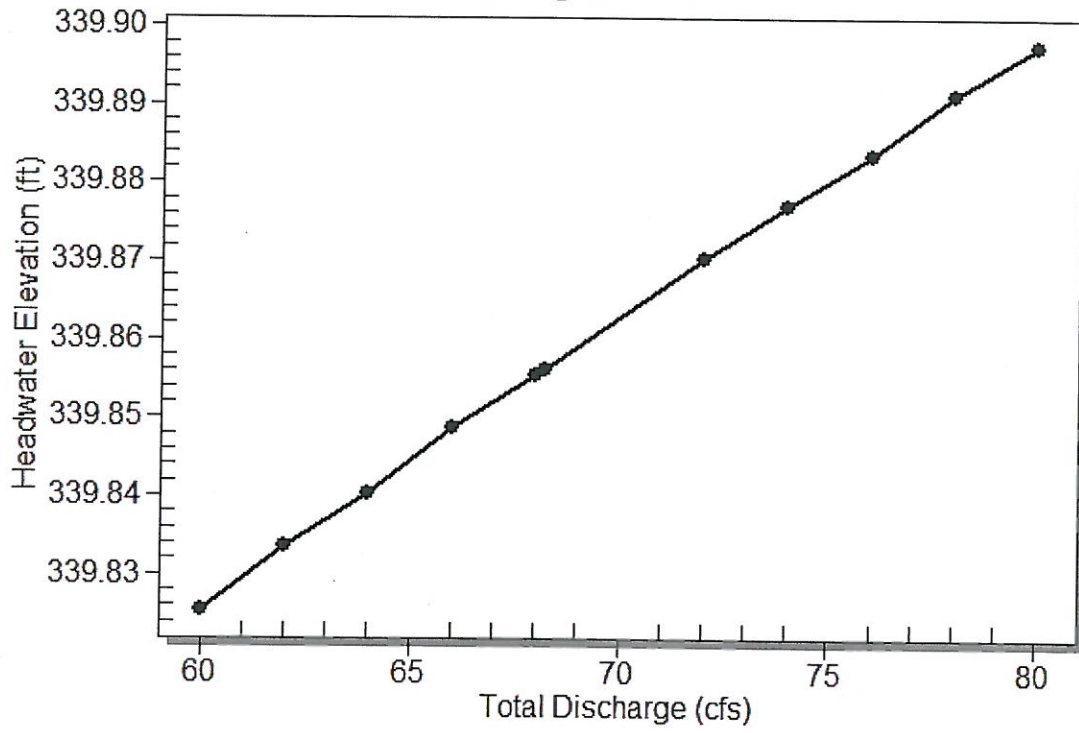


Table 2 - Culvert Summary Table: Ex18Conc

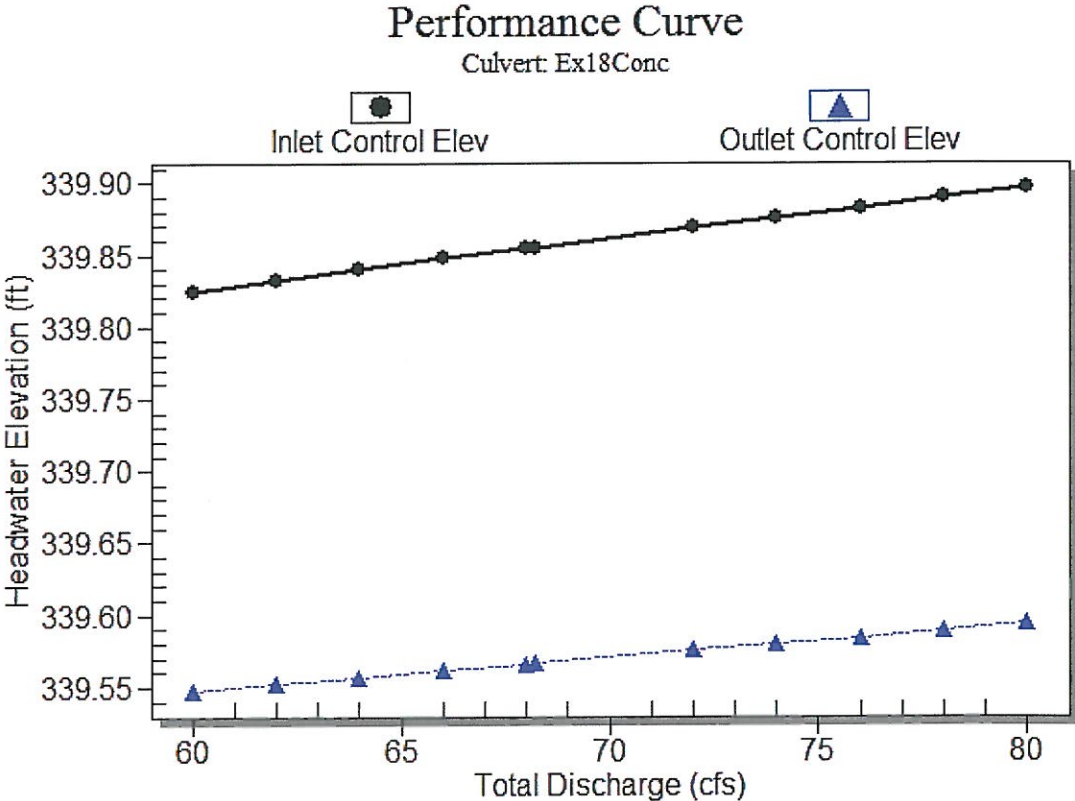
Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
60.00	12.09	339.83	2.835	2.557	5-S1f	0.933	1.318	1.500	2.190	7.167	0.000
62.00	12.12	339.83	2.843	2.562	5-S1f	0.935	1.319	1.500	2.190	7.182	0.000
64.00	12.14	339.84	2.850	2.567	5-S1f	0.936	1.320	1.500	2.190	7.196	0.000
66.00	12.17	339.85	2.858	2.572	5-S1f	0.937	1.321	1.500	2.190	7.211	0.000
68.00	12.19	339.86	2.864	2.576	5-S1f	0.938	1.321	1.500	2.190	7.224	0.000
68.24	12.19	339.86	2.865	2.577	5-S1f	0.938	1.322	1.500	2.190	7.225	0.000
72.00	12.24	339.87	2.879	2.586	5-S1f	0.941	1.322	1.500	2.190	7.252	0.000
74.00	12.26	339.88	2.886	2.590	5-S1f	0.942	1.323	1.500	2.190	7.265	0.000
76.00	12.28	339.88	2.893	2.594	5-S1f	0.943	1.324	1.500	2.190	7.277	0.000
78.00	12.30	339.89	2.900	2.599	5-S1f	0.944	1.325	1.500	2.190	7.292	0.000
80.00	12.32	339.90	2.907	2.604	5-S1f	0.945	1.326	1.500	2.190	7.304	0.000

Straight Culvert

Inlet Elevation (invert): 336.99 ft, Outlet Elevation (invert): 336.49 ft

Culvert Length: 22.38 ft, Culvert Slope: 0.0224

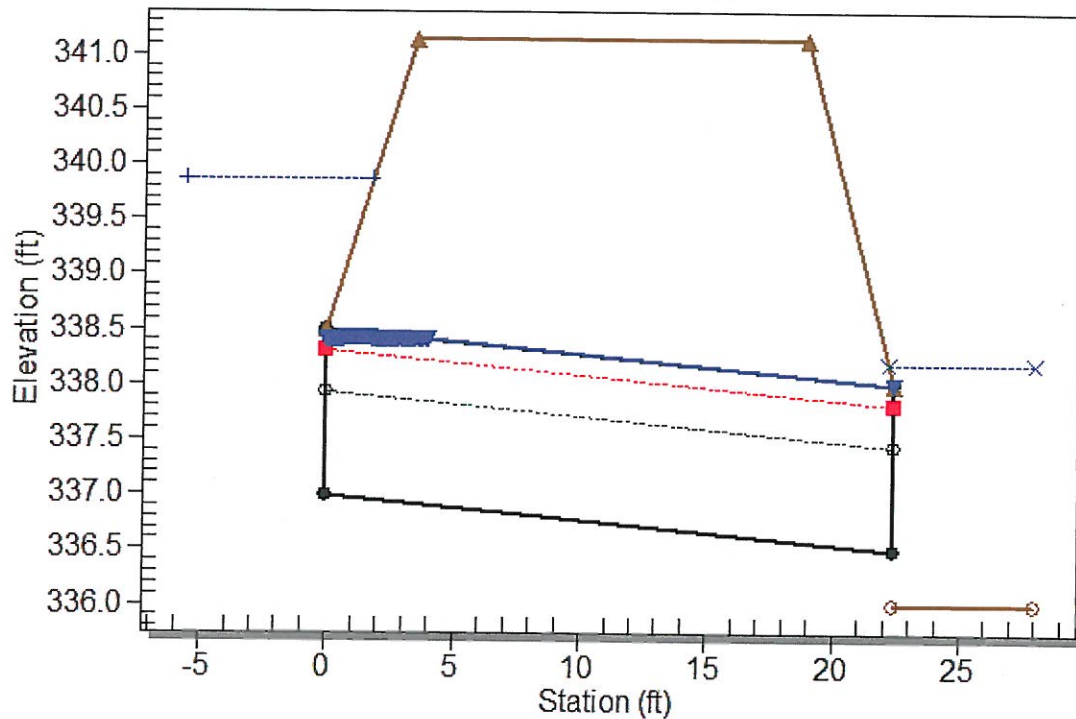
Culvert Performance Curve Plot: Ex18Conc



Water Surface Profile Plot for Culvert: Ex18Conc

Crossing - 48th Ave., Design Discharge - 68.2 cfs

Culvert - Ex18Conc, Culvert Discharge - 12.2 cfs



Site Data - Ex18Conc

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 336.99 ft

Outlet Station: 22.37 ft

Outlet Elevation: 336.49 ft

Number of Barrels: 1

Culvert Data Summary - Ex18Conc

Barrel Shape: Circular

Barrel Diameter: 1.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: NONE

Table 3 - Downstream Channel Rating Curve (Crossing: 48th Ave.)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
60.00	338.19	2.19
62.00	338.19	2.19
64.00	338.19	2.19
66.00	338.19	2.19
68.00	338.19	2.19
68.24	338.19	2.19
72.00	338.19	2.19
74.00	338.19	2.19
76.00	338.19	2.19
78.00	338.19	2.19
80.00	338.19	2.19

Tailwater Channel Data - 48th Ave.

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 338.19 ft

Roadway Data for Crossing: 48th Ave.

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

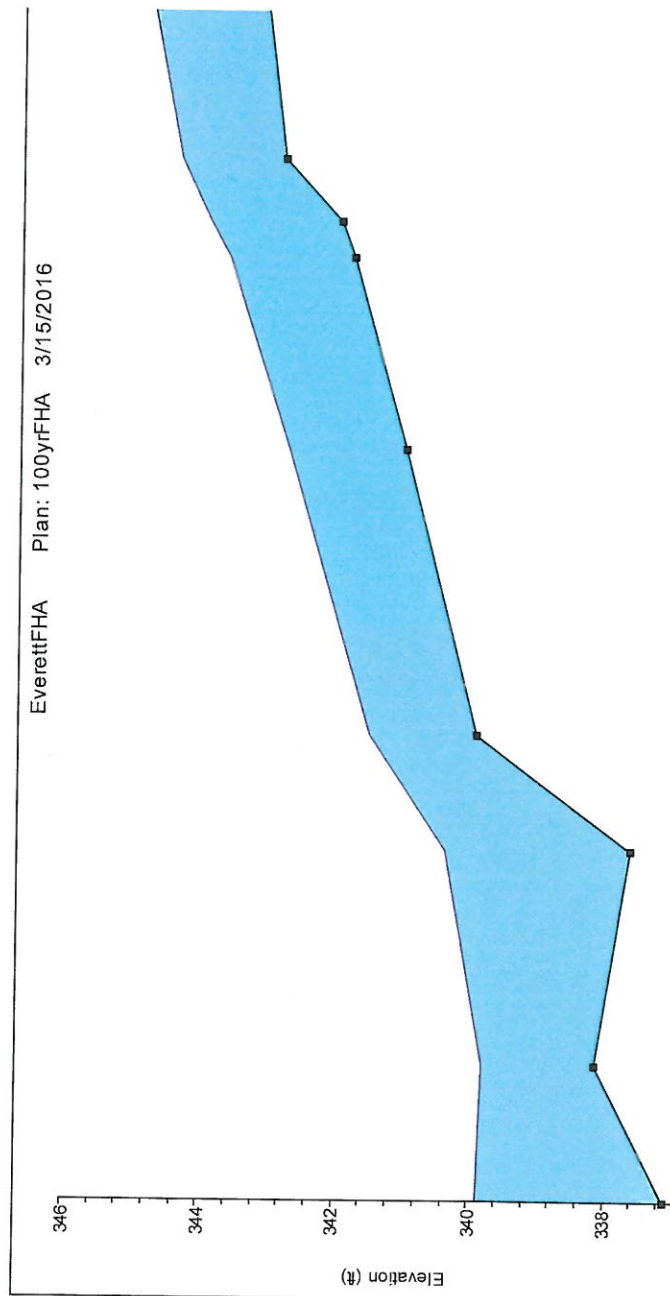
Roadway Surface: Gravel

Roadway Top Width: 15.50 ft

Attachment 5—HEC-RAS Output
(FHA)

Everett Heights Flood Hazard Analysis: HEC-RAS Model Results

River Sta	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)
01+24	343.13	344.84	344.84	345.18	0.013809	6.83	27.08	40.37
01+07	342.82	344.35	344.35	344.76	0.011585	5.66	17.91	53.48
01+01	341.97	343.92	343.92	344.47	0.012985	6.88	16.45	48.2
00+97	341.77	343.63	343.63	344.06	0.013834	6.93	21	62.5
00+78	340.99	342.71	342.71	343.13	0.014597	6.86	20.98	55.85
00+49	339.9	341.5	341.5	341.82	0.011885	6.04	27.11	74.12
00+37	337.63	340.38	340.38	340.77	0.010879	6.11	23.63	33.76
00+16	338.14	339.79		339.98	0.007597	4.77	35.25	58.98
00+02	337.11	339.86	338.68	339.91	0.000842	2.49	57.42	30



Appendix F – Operations and Maintenance



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CITY OF PORTLAND
Stormwater
Management
Manual

FORM 2

OPERATIONS & MAINTENANCE FORM

PRIVATE STORMWATER MANAGEMENT FACILITIES

This O&M Form supercedes document number _____

(for official county use only)

PROJECT NAME _____

PERMIT INFORMATION

Permit # _____

Permit Submittal Date _____

SITE INFORMATION (include all parcels)

R# (6 Digits) _____

Site Address _____

City / State / Zip _____

Preparation Date: _____

OWNER INFORMATION (ALL LEGAL OWNERS)

Name (1) _____

Name (2) _____

Address (Mailing) _____

City / State / Zip _____

O&M PREPARER INFORMATION

Name _____

Address (Mailing) _____

City / State / Zip _____

Phone (area code required) _____

Email _____

Site Legal Description:

Responsible Party for Maintenance (check one)

- Homeowners Association Property Owner
- Property Management Company Tenant
- Other (describe) _____
(not Contractor or Consultant)

Contact Information for Responsible Party

Contact Name _____

Contact Organization _____

Phone (area code required) _____

Email: _____

Maintenance Practices and Schedule

These operation and maintenance practices are required in accordance with Portland City Code, Chapter 17.38.

The requirements are based on the current version of the *City of Portland Stormwater Management Manual* on the date of permit submittal.

For the **Simplified Approach**, please attach the current O&M Specifications for each facility type from the *Stormwater Management Manual*, Chapter 3.3.1.

For the **Presumptive and Performance Approaches**, please attach the approved, site specific O&M Plan per the *Stormwater Management Manual*, Chapter 3.3.2.

OPERATIONS & MAINTENANCE FORM

PRIVATE STORMWATER MANAGEMENT FACILITIES

SITE PLAN

Provide a site plan sketch in the area provided below, or attach a scaled site plan to this submittal that includes all of the information required as shown in Appendix D6 on page D.6-1, in Operations & Maintenance Form Instructions, Site Plan.

STEP 1 – COMPLETE THE FOLLOWING TABLE

Stormwater Facility Type (Chapter 2)	Stormwater Facility Size (sf)	Drainage is from Roof or Lot?	Impervious Area Treated (sf)	Discharge Point
Totals				

Maintaining the stormwater management facility or facilities listed above shown on the following (or attached) site plan is a required condition of building permit approval for the identified property. Property owners are required to operate and maintain facilities in accordance with the O&M plan on file with the City of Portland. This requirement is binding on all current and future owners of the property. Failure to comply with the O&M plan can trigger an enforcement action, including penalties. The O&M plan may be modified by written consent of current owners and written approval of the Bureau of Environmental Services.

STEP 2 – REQUIRED SITE PLAN

(insert or draw here, or attach separate sheet)

I Have Attached a Site Plan