STORMWATER MANAGEMENT REPORT

Prepared For:

VJ2 Development

695 Commercial Street

Salem, OR 97301

Project Location:

Elysian Subdivision

2280-2298 NW Fendle Way

McMinnville, OR 97128

Prepared By:

PRELIMINARY FOR REVIEW

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May 2022

TABLE OF CONTENTS

LIST OF TABLES

APPENDICES

Section A. Project Introduction

Summary of Improvements

The proposed project is located on an approximate 4.11-acre parcel south of West Baker Creek Road and between the north and south termini of Meadows Drive in McMinnville, Oregon in Yamhill County. Refer to the Supplemental Civil Drawings in Appendix VI for a site map of the project area.

The existing site contains undeveloped agricultural land and mitigated wetlands. The project scope is to develop the site for 18 single-family residential lots with associated improvements, connecting Meadows Drive from the north-south, and designated open grassed areas. The project includes site preparation and construction of the facilities which will include new roads, sidewalks, and associated public improvements.

Stormwater improvements associated with the project include the construction of a stormwater quality treatment and detention facility.

Purpose of Stormwater Quality & Detention

The purpose of the stormwater quality and detention facilities are to remove pollutants from developed stormwater runoff and control the stormwater release rates to mimic rates that occurred in predeveloped site conditions. Management of stormwater for quality and quantity is required within the project drainage area to mitigate stormwater impacts in order to comply with project DEQ 401 Certification, Section 404 permit, City of McMinnville stormwater design standards, and National Marine Fisheries Service (NMFS) SLOPES V standards.

Regulatory Agency Approvals

Impacts to jurisdictional wetlands and drainage ways are proposed with the Elysian Subdivision project. Construction of proposed site improvements will impact jurisdictional wetlands. It is anticipated that conformance to the SLOPES V regulations will be required due to the wetland impacts.

In order to expedite projects, the Army Corps of Engineers (COE) in cooperation with NMFS has created the SLOPES V guidelines, dated March 14, 2014. In this document NMFS has issued a programmatic biological opinion with a conclusion by NMFS that compliance with SLOPES V guidelines is not likely to jeopardize the continued existence of a variety of endangered native salmon and steelhead fish species.

The SLOPES V document specifies a number of criteria that must be met for design and construction and/or refurbishment of a facility that impacts the regulated body of water as well as criteria for management of stormwater discharged from improved roadway surfaces within the project's contributing drainage basin area.

This Stormwater Management Report will address the stormwater requirements of the SLOPES V guidelines and the City of McMinnville stormwater design standards when City standards are more restrictive.

Summary of Agency Stormwater Quality and Detention Requirements

Below is a summary of the SLOPES V guidelines and the City of McMinnville standards.

SLOPES V Guidelines:

- Water quality facilities must be designed to treat for post-construction stormwater runoff from all contributing impervious area for 50% of the 2-year event (i.e., 1.3 inches in a 24-hour period).
- 50% of the developed 2-year peak flow rate and duration matches 50% of the predeveloped 2-year peak flow and duration.
- The developed 10-year peak flow rate and duration matches the predeveloped 10-year peak flow rate and duration.
- Use low impact development (LID) to infiltrate or evaporate runoff to the maximum extent feasible (MEF).
- Stormwater treatment is required for all contributing impervious area.

City of McMinnville Stormwater Standards:

- The developed 10-year peak flow rate must be equal to or less than the peak runoff rate of the predeveloped 10-year, 24-hour storm event.

For this project all contributing impervious area per SLOPES V is treated to the SLOPES V standards. Stormwater runoff will also be controlled to the SLOPES V standards except where the City of McMinnville Standards are more conservative. The City of McMinnville Standards are the same or less conservative than the SLOPES V standards and therefore stormwater runoff will also be controlled to the SLOPES V standards as summarized above.

Summary of Stormwater Facilities

The proposed stormwater facility will be designed to treat runoff from the proposed developments and provide detention per SLOPES V standards. The following sections describe the facilities used for stormwater treatment and detention. The entire site drains to a ditch running through the southern portion of the property which will eventually flow into Cozine Creek. The drainage basin runoff will be controlled by a flow control structure at the outlet from the LID facility.

1. Developed Basin

   The stormwater from the Developed Basin (the entire site) is treated and detained via a vegetated swale LID at the bottom of a dry detention pond. The LID facility is located in the southeastern corner of the site and is irregular in shape.

Section B. Stormwater Plan Narrative

Pollutants of Concern

The Elysian Subdivision project consists of new roads, sidewalks, designated open grassed areas, and associated improvements. The impervious area within the project scope that contributes pollutants to the stormwater runoff primarily consists of roads, driveways, and roof runoff. These sources all create project pollutants of concern most commonly associated with residential development runoff. The Oregon Department of Environmental Quality (DEQ) lists the following as common pollutants associated with residential development runoff:

- Solids and Sediment
- Metals (zinc, copper, lead, etc.)
- Petroleum Hydrocarbons (oil, grease, etc.)
- Nutrients (nitrogen, phosphorous, etc.)
- Pesticides, Herbicides & Fungicides

Name and Status of Receiving Waters

Stormwater from the project site discharges into the North Branch Cozine Creek which then flows to Cozine Creek, the South Yamhill River, Yamhill River, and joins the Willamette River at approximate river mile 55.

Cozine Creek is 303(d) listed for biological criteria and dissolved oxygen year-round and listed for E. coli and temperature in summer.

The Yamhill River is 303(d) listed for biological criteria, copper, iron, lead, mercury, and temperature year-round. The Yamhill is also listed for dissolved oxygen January - May, and listed for E. coli and fecal coliform in fall/winter/spring. The Yamhill is TMDL approved for chlorophyll year-round and pH and phosphorus May – October.

The Willamette River is 303(d) listed for mercury year-round and listed for chlorophyll in summer. The Willamette is also TMDL approved for temperature year-round and E. coli in fall/winter/spring.

Refer to Appendix I for a copy of DEQ's water quality assessment, identification of pollutants sampled and water body status for the streams mentioned above.

The SLOPES V standards are designed to protect streams from stormwater runoff from developed sites. By designing stormwater facilities to SLOPES V standards TMDLs will not be infringed upon. Furthermore, dissolved oxygen (DO) will not be impacted because DO-reducing pollutants will be removed through contact with the vegetation and amended topsoil in the designed vegetated swale. Fecal coliform and E. Coli will not be increased because storm drains are not susceptible to fecal sources. Phosphorus will be sufficiently removed through the vegetated swale. For chlorophyll and pH, the primary pollutant is phosphorus, which the swale is designed to remove. Temperature is primarily impacted by removal of shade trees along stream banks and stream widening. No trees

are proposed for removal along the stream bank nor is the stream proposed to be modified. Biological criteria TMDLs will not be infringed on because the vegetated swale is designed to treat urban stormwater runoff to safe levels for aquatic species.

Groundwater Management Area

Upon review of available groundwater management information on the Oregon DEQ website it does not appear the project is within a groundwater management area or EPA-designated sole source aquifer.

NPDES Permit Sites

Refer to Appendix I for a list of Oregon DEQ water quality permitted facilities in the McMinnville area.

Contributing Impervious Area

The proposed project will generate approximately 2.73 acres of impervious area on the 4.11-acre site. This area was calculated by measuring the road coverage (assumed 100% impervious) and residential lot coverage (assumed 65% impervious) of the proposed development. The contributing area was analyzed as one basin for predeveloped and developed conditions as shown on the drawings in Appendix II. Refer to Section C of this report and the HydroCAD Analysis in Appendix III for more details.

LID and MEF per SLOPES V Standards

The SLOPES V standards require stormwater facilities to utilize low impact development (LID) practices to infiltrate and evaporate runoff to the maximum extent feasible (MEF).

To meet the SLOPES V requirement, the proposed stormwater design treats 100% of the impervious surface with LID. The design utilizes a vegetated swale at the bottom of a dry detention pond (see Appendix II and V for more details).

Narrative Description of Stormwater Management Plan

The proposed stormwater LID for the treatment of stormwater were designed per Clean Water Services design standards for vegetated swales. Clean Water Services standards were used because the City of McMinnville has not adopted LID standards for residential development at this time. Detention and water quality for the site are provided by a vegetated swale at the bottom of a dry detention pond. Refer to Appendix II for a map of the site.

For design of the LID please refer to Sections C and D.

1. Constraints

   There are several project constraints that were addressed to accommodate stormwater quality treatment and detention. These constraints included wetland impacts, low infiltration rates of the existing soils, and limited grade.

The following sections describe how project constraints were accommodated.

1) Developed Basin

Due to the lack of infiltration on site the detention facilities required a larger footprint. Additionally, the stormwater facility has limited grade drop available from the existing inlet to the discharge point in the ditch on the south side of the property. Rain gardens or similar LID facilities were ruled out as design possibilities for the site due to the grade drop required by their large sections of media and drain rock.

The site plan was modified to accommodate the required detention and water quality facilities.

Pollutant Removal Summary

An integrated approach has been taken to address the pollutants of concern (sediment, metals, pest-herb-fungicides, and hydrocarbons) that can be expected to be produced in this project. The proposed water quality LIDs in this document remove sediment, metals, organics, and petroleum hydrocarbons.

As illustrated in Appendix VI, site runoff discharges to a ditch running through the south portion of the property which eventually flows into Cozine Creek. The LID is sized to meet the requirements of Clean Water Services design standards. Please refer to Section C for the facility sizing.

Section C. Basin Characteristic and Flow Control Summary

The following sections describe the hydrology of the predeveloped site and flow control provided to conform to City of McMinnville and SLOPES V standards.

Hydrological Summary

The project site plan will utilize LID to the MEF per SLOPES V standards. The stormwater system will consist of a vegetated swale at the bottom of a dry detention pond to treat and detain the stormwater generated from the project area (contributing impervious area per SLOPES V).

Hydrologic Parameters, Existing and Developed Conditions

The hydrologic parameters that were used to complete the water quality and detention calculations are discussed below. The hydrologic parameters include basin areas, curve numbers (CN), predeveloped and developed time of concentrations (Tc), 24-hour rainfall depths for each recurrence interval, and the hydrological analysis method used to generate hydrographs. These basin characteristics are summarized in Table C-1, Table C-2, and Table C-3.

1) Hydrologic Analysis Methodology

   HydroCAD modeling software was used to size the stormwater facilities. The Santa Barbara Unit Hydrograph Type 1A storm was used to model the required design storms. Design storms used were the, half the 2-year, 24-hour (also used as the water quality storm) and the 10-year, 24-hour storm events.

2) 24-Hour Rainfall Depths

   In accordance with SLOPES V and City of McMinnville standards the storm events used in this report include the half the 2-year (also used as the water quality storm) and the 10-year, 24-hour rainfall events as listed in Table C-1. These stormwater depths were determined from the Precipitation Frequency Atlas (Atlas 2) maps developed by the National Oceanic and Atmospheric Administration (NOAA) for the State of Oregon. Refer to Appendix III for the Atlas 2 maps.

   Table C-1| 24-Hour Design Storm Rainfall Depths

	24-Hour Rainfall Depths for McMinnville, OR				
Recurrence Interval, Years	2	10	25	50	100
24-Hour Depths, Inches	2.6	3.8	4.2	4.7	5.2

Source: NOAA Atlas 2 maps

3) Curve Number Determination

   The developed and predeveloped basins consist of an area of 3.78 acres on the 4.11-acre site. Curve numbers were assigned per the USDA Soil Conservation

Service's Technical Release 55 (TR-55) recommendations. See Appendix III for the NRSC soil survey maps of the project area, that correspond to basin CN's.

The predeveloped site is predominately grass-covered and was assigned an area-weighted average curve number of 77. The native soils onsite are a mixture of C and C/D-rated soils. Per the NRCS Soil Report, a C/D classification indicates a D rating for natural soil conditions. Soils with a C/D classification are therefore assumed D-rated for predeveloped conditions. The CN is weighted by the area of C and D-rated soils on the site with good coverage of pasture/grassland.

The Developed Basin was assigned an area-weighted average curve number of 92. This corresponds to 1.05 acres of pervious area, CN of 77, and 2.73 acres of impervious area, CN of 98.

4) Time of Concentration Determination

Predeveloped and developed Tc's were calculated for each basin using the TR-55 design guidelines utilizing sheet and shallow concentrated flow equations.

Table C-2 summarizes the Tc equation inputs for the predeveloped and developed Tc's. The developed Tc used was 5 minutes, which is the minimum Tc that can be used by the modeling software. The developed Tc may be a little longer than 5 minutes, but 5 minutes was used to add a factor of safety into the model, as a lower developed Tc increases the developed flows slightly.

Table C-2| Basin Time of Concentration Characteristics

Basin ID	Overland Flow Length (ft)	Manning's n	Slope of Overland Flow (ft/ft)	Tc (Min.)
Pre Developed	525	0.15	0.01	42.9
Developed	-	-	-	5

5) Basin Characteristics

Table C-3 provides a summary of the developed onsite drainage basins' impervious and pervious area (used for the developed calculations), and the predeveloped and developed curve numbers (CN) as previously discussed.

Table C-3| Hydrologic Parameters

Basin ID	Source (Roof/Road/ Other)	Impervious Area (AC)	Pervious Area (AC)	Design Storm		Weighted CN
				½ 2 Year (cfs)	10 Year (cfs)	
Predeveloped	Native	-	3.78	0.14	0.76	77
Developed	Road/Roof/ Landscape	2.73	1.05	0.78	2.86	92

Hydrologic Analysis

The hydrological analysis, as previously mentioned, was completed using HydroCAD Modeling Software utilizing the SBUH method and a Type IA 24-hour rainfall distribution. A listing of the predeveloped peak flows for half the 2-year and 10-year storm events are found in Table C-4. Refer to Appendix III for hydrographs for each predeveloped and developed storm events.

Table C-4| Calculated Allowable Peak Flows

Basin Area/Facility	Design Storm (cfs)	
	½ 2 Year	10 Year
Predeveloped Site	0.14	0.76

Flow Control System Design

Based on the flow control requirements described in Section A, the flow control structure was sized to detain the developed storm events and release the stored runoff at allowable peak flow rates as described above. Refer to the drawings in Appendix II for more details on detention and flow-control design. A summary of the stormwater detention requirements are listed below:

- Capture half the 2-yr developed runoff to be released at a rate equal to or less than half the 2-yr peak predeveloped rate.
- Capture the 10-yr developed runoff to be released at a rate equal to or less than the 10-yr peak predeveloped rate.

The flow control structure is designed to meet the stormwater release and detention requirements above. See Table C-5 for a summary of outlet sizing and developed release rates. The flow control structure consists of two (2) outlets at differing elevations within a flow control manhole to control the design storms. Refer to Civil Drawings in Appendix VI for details.

Table C-5| Summary of Flow Control

Storm Event	Outlet Size (in)	Outlet Elevation (ft)	Peak WSE[1] (ft)	Release Rate (cfs)	Allowable Release Rate (cfs)
½ 2 year	2.4	156.60	157.56	0.14	0.14
10 year	3.9	157.70	159.38	0.76	0.76
100 year Emergency O/F[2]	12	159.40	159.82	3.30	-

[1] WSE = Water Surface Elevation

[2] Emergency O/F provided by weir cut in top of pond.

Evaluation of the allowable (Table C-4) and post developed (Table C-5) release rates confirms the stormwater design is in conformance with the SLOPES V design standards. Refer to Appendix III for the HydroCAD Analysis.

Conveyance Capacity Calculations

The stormwater facilities were designed to convey the developed 10-year, 24-hour storm. The 10-year storm produces 0.76 cfs of runoff after detention. Within the subdivision 8-inch pipes flow into a 12-inch pipe and then into a 15-inch pipe which then outfalls into the detention pond/swale. The 8-inch pipes have a conveyance capacity of 0.77 cfs, the 12-inch pipes have a conveyance capacity of 2.25 cfs, and the 15-inch pipes have a conveyance capacity of 4.09 cfs, therefore the pipe sizing is adequate to convey the 10-year storm.

The new 15-inch pipe connects to a relocated drainage ditch and then flows into a new 24-inch pipe at a slope of 0.16%. The new 24-inch pipe has a capacity of 10.45 cfs. The amount of runoff produced for the site will occupy 7.2% of the 24-inch pipe capacity. By inspection, the downstream 24-inch pipe has adequate capacity to convey the 10-year storm.

The existing 21” pipe in Meadows drive connects to an upsized 24” pipe. The existing 21” pipe has a conveyance capacity of approximately 10.02 cfs. The new 24” pipe connecting to the upstream, existing 21” pipe has a capacity of 14.31 cfs. We have increased the downstream pipe capacity in meadows drive by approximately 43%.

Section D. Water Quality Design

The stormwater management plan for the project utilizes a vegetated swale to provide water quality treatment. The developed site conditions produce 0.78 cfs of detained runoff during the water quality storm event. Refer to Appendix III for a hydrograph of the developed water quality storm event (i.e. the half 2-year event). The section below describes the water quality design provided by LID of the proposed stormwater management design. The HydroCAD modeling results show that all runoff flows through the vegetated swale with a satisfactory residence time and depth during the water quality event.

Vegetated Swales

The wetlands on site deem stormwater infiltration facilities infeasible. Due to the lack of infiltration, a flow-through vegetated swale is proposed to treat the water quality storm with an LID facility. Infiltration was assumed to be zero in the design. The site plan was modified to incorporate a vegetated swale which is used to provide water quality treatment for the entire proposed development and existing offsite drainage.

The vegetated swale contains dense vegetation along the bottom and will be landscaped in accordance with Clean Water Services standards (see Appendix V). Clean Water Services standards were used because the City of McMinnville has not adopted LID standards for residential development at this time.

See Table D-1 below for a summary of the vegetated swale design. Refer to the drawings in Appendix II for swale sizing summaries and Appendix III for HydroCAD Analysis of the designed vegetated swale.

Table D-1 | Summary of Vegetated Swale Design

Clean Water Services Design Standards		
Criteria	Allowable	Designed
Manning's n	0.24	0.24
Max. Water Quality Flow Depth (ft)	0.5	0.37
Min. hydraulic Residence Time (min)	9	18.9
Max. Conveyance Flow Velocity (fps)	2.0	0.19
Min. Length (ft)	100	215
Min. Bottom Width (ft)	2	9

After treatment, the swale discharges to a ditch running through the south portion of the property after passing through a flow control structure. Refer to the drawings in Appendix II and the Supplemental Civil Drawings in Appendix VI for more details.

Section E. Storm Drain System Operation & Maintenance

All facilities constructed as a part of this project will be owned, operated, and maintained by Don Jones for the Elysian Subdivision. Don Jones proposes to maintain the LID structure in accordance with the Operation and Maintenance Manuals included in Appendix IV.

Elysian Subdivision
McMinnville, Oregon
Stormwater Management Report

APPENDIX I

Environmental Watershed Data

RECEIVING WATERS TMDL STATUS

Department of Environmental Quality

3/5/2020 2:06:41 PM (Page 1 of 1)

Oregon's 2012 Integrated Report Cozine Creek

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Basin Name Subbasin 4th Field HUC Record ID	Water Body LLID River Miles Segment Miles Beach Name Beach ID	Pollutant	Season	Criteria	Beneficial Uses	Status	2012 Assessment Action	[Data Source] Supporting Data
Willamette Yamhill 17090008 24588	Cozine Creek 1231877452053 0 to 6.8 6.8	Dissolved Oxygen	January 1 - May 15	Spawning: Not less than 11.0 mg/L or 95% of saturation		Cat 5: Water quality limited, 303(d) list, TMDL needed	No status change	2012 Data: [DEQ] STATION 34234 at RM 0.4 from 03/16/2007 to 04/20/2010, 16 of 21 (76%) samples < 11.0 mg/l and < 95% saturation 2010 Data: EPA addition to 303(d) list 12/14/2012: Sixteen exceedences of the spawning criteria out of 22 days of sampling between 3/16/07 and 4/27/10at LASAR station 34234, Lower Cozine Creek at Davis Street Bridge. Fourteen exceedences of the spawning criteria out of 22 days of sampling between 3/16/07 and 4/27/10 at LASAR station 34235, Middle Cozine at Old Sheridan Road. Previous Status: Cat 5: Water quality limited, 303(d) list, TMDL needed Previous Action: EPA addition to 303(d) list Previous Assessment Year: 2010

Willamette Yamhill 17090008 24587	Cozine Creek 1231877452053 0 to 5 5	Dissolved Oxygen	Year Round (Non-spawning)	Cool water: Not less than 6.5 mg/l		Cat 5: Water quality limited, 303(d) list, TMDL needed	No status change	2012 Data: [DEQ] STATION 30677 at RM 0.1 from 07/05/2008 to 07/05/2008, 0 of 1 (0%) samples < 6.5 mg/L. [DEQ] STATION 34234 at RM 0.4 from 05/19/2007 to 10/12/2010, 7 of 15 (47%) samples < 6.5 mg/L. [DEQ] STATION 35065 at RM 2.5 from 07/05/2008 to 07/05/2008, 0 of 1 (0%) samples < 6.5 mg/L 2010 Data: EPA addition to 303(d) list 12/14/2012: Seven exceedences of the cool water aquatic life criterion out of 16 days of sampling between 5/19/07 and 10/12/10 at LASAR station34234, Lower Cozine Creek at Davis Street Bridge. Two exceedences of the cool water aquatic life criterion out of 16 days of sampling between 5/19/07 and 10/12/10 at LASAR station 34235, Middle Cozine at Old Sheridan Road. Previous Status: Cat 5: Water quality limited, 303(d) list, TMDL needed Previous Action: EPA addition to 303(d) list Previous Assessment Year: 2010
Willamette Yamhill 17090008 24589	Cozine Creek 1231877452053 0 to 6.8 6.8	E. Coli	Summer	30-day log mean of 126 E. coli organisms per 100 ml; no single sample > 406 organisms per 100 ml	Water contact recreation	Cat 5: Water quality limited, 303(d) list, TMDL needed	No action	2010 Data: EPA addition to 303(d) list 12/14/2012: Seven exceedences of the 406 maximum criteria out of 9 days of sampling at LASAR station 30877, Cozine Creek at mouth (South Yamhill), between 8/26/03 and 9/15/04. Previous Status: Cat 5: Water quality limited, 303(d) list, TMDL needed Previous Action: EPA addition to 303(d) list Previous Assessment Year: 2010
Willamette Yamhill 17090008 7052	Cozine Creek 1231877452053 0 to 6.8 6.8	Fecal Coliform	Undefined		Water contact recreation	Cat 3: Insufficient data	No action	Previous Status: Insufficient data Previous Action: Added to database Previous Assessment Year: 1998

Willamette Yamhill 17090008 24590	Cozine Creek 1231877452053 0 to 6.8 6.8	Temperature	Year Round	Rearing: 17.8 C		Cat 5: Water quality limited, 303(d) list, TMDL needed	No action	2010 Data: EPA addition to 303(d) list 12/14/2012: Exceedences of the salmonid rearing criterion (18C) as high as 22.1 C in July 2003 and 23.1 C in July 2004 at LASAR station 30677, Cozine Creek at mouth (South Yamhill). Previous Status: Cat 5: Water quality limited, 303(d) list, TMDL needed Previous Action: EPA addition to 303(d) list Previous Assessment Year: 2010
Willamette Yamhill 17090008 25910	North Branch Cozine Creek 1232010452090 0 to 1.7 1.7	Dissolved Oxygen	Year Round (Non-spawning)	Cool water: Not less than 6.5 mg/l		Cat 3: Insufficient data	Added to database	2012 Data: [DEQ] STATION 35067 at RM 0.1 from 07/05/2008 to 07/05/2008, 0 of 1 (0%) samples < 6.5 mg/L. [DEQ] STATION 35066 at RM 0.2 from 07/05/2008 to 07/05/2008, 0 of 1 (0%) samples < 6.5 mg/L

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Contact

For more information about DEQ's Integrated Report and 303(d) list contact Joshua Emerson (mailto:emerson.joshua@deq.state.or.us) at 503-229-5740.

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3/9/2020 9:25:17 AM (Page 1 of 1)

Oregon's 2012 Integrated Report South Yamhill River

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Basin Name Subbasin 4th Field HUC Record ID	Water Body LLID River Miles Segment Miles Beach Name Beach ID	Pollutant	Season	Criteria	Beneficial Uses	Status	2012 Assessment Action	[Data Source] Supporting Data
Willamette Yamhill 17090008 17292	South Yamhill River 1231445452258 0 to 61.8 61.8	Alkalinity	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 3B: Insufficient data, potential concern	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10948 River Mile 16.7: From 1/24/1994 to 12/22/2003, 11 out of 88 samples < 20 mg/L (Table 20 criterion). Previous Status: Cat 3B: Potential concern Previous Action: Added to database Previous Assessment Year: 2004
Willamette Yamhill 17090008 17293	South Yamhill River 1231445452258 0 to 61.8 61.8	Ammonia	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 2: Attaining some criteria/uses	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10948 River Mile 16.7: From 1/24/1994 to 12/22/2003, 0 out of 136 samples > applicable Table 20 criterion. Previous Status: Cat 2: Attaining some criteria/uses Previous Action: Added to database Previous Assessment Year: 2004

Willamette Yamhill 17090008 25897	South Yamhill River 1231445452258 0 to 61.7 61.7	Arsenic	Year Round	Table 40 Human Health Criteria for Toxic Pollutants	Human health; Aquatic life	Cat 2: Attaining some criteria/uses	Added to database	2012 Data: [ODEQ] STATION 33885 at RM 14.9 for 1 samples from 09/20/2006 to 09/20/2006, 0 of 1 valid samples exceed the 2.1 ug/L criteria. [ODEQ] STATION 10948 at RM 16.7 for 11 samples from 04/15/2008 to 02/17/2010, 0 of 11 valid samples exceed the 2.1 ug/L criteria. [ODEQ] STATION 36317 at RM 37.4 for 1 samples from 09/22/2010 to 09/22/2010, 0 of 1 valid samples exceed the 2.1 ug/L criteria
Willamette Yamhill 17090008 7304	South Yamhill River 1231445452258 0 to 18.1 18.1	Atrazine	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, Desethylatrazine, Desisoproylatrazine, Diuron, Ethoprop, Hexazinone, Metolachlor, Metribuzin, Napropamide and Simazine were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 25901	South Yamhill River 1231445452258 0 to 61.7 61.7	Cadmium	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 2: Attaining some criteria/uses	Added to database	2012 Data: [ODEQ] STATION 10948 at RM 16.7 for 11 samples from 04/15/2008 to 02/17/2010, 0 of 11 valid samples exceed the hardness dependent criteria

Willamette Yamhill 17090008 17294	South Yamhill River 1231445452258 0 to 18.1 18.1	Chlorophyll a	FallWinterSpring	Reservoir, river, estuary, non-thermally stratified lake: 0.015 mg/l	Aesthetics; Livestock watering; Water supply; Water contact recreation; Fishing	Cat 3: Insufficient data	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10948 River Mile 16.7: From 5/23/1995 to 5/31/1995, average Chlorophyll a of 0.012 for 1 samples in 1 months. Previous Status: Cat 3: Insufficient data Previous Action: Added to database Previous Assessment Year: 2004
Willamette Yamhill 17090008 6249	South Yamhill River 1231445452258 0 to 18.1 18.1	Chlorophyll a	Summer	Reservoir, river, estuary, non-thermally stratified lake: 0.015 mg/l	Fishing; Aesthetics; Livestock watering; Water contact recreation; Water supply	Cat 2: Attaining some criteria/uses	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10948 River Mile 16.7: From 7/2/1996 to 9/29/1996, average Chlorophyll a of 0.005 for 3 samples in 3 months. Previous Data: DEQ Data (3 Sites: 402623, 402624, 402625; RM 1.0 - 16.5): 29% (2 of 7), 0% (0 of 19, 50) Summer values respectively exceeded chlorophyll a standard (15 ug/l) with a maximum value of 20 between WY 1986 - 1995. Did not meet "Minimum Data Requirements", data did not exceed the 3-month average criteria. Previous Assessment Year: 1998 Previous Status: Cat 2: Attaining some criteria/uses Previous Action: No status change Previous Assessment Year: 2004
Willamette Yamhill 17090008 6880	South Yamhill River 1231445452258 18.1 to 42.6 24.5	Chlorophyll a	Summer	Reservoir, river, estuary, non-thermally stratified lake: 0.015 mg/l	Water contact recreation; Water supply; Aesthetics; Livestock watering; Fishing	Cat 2: Attaining some criteria/uses	No action	Previous Data: DEQ Data (Site 402627; RM 36.0): 0% (0 of 13) Summer values exceeded chlorophyll a standard (15 ug/l) between 1986 - 1988. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998

Willamette Yamhill 17090008 6882	South Yamhill River 1231445452258 42.6 to 61.7 19.1	Chlorophyll a	Summer	Reservoir, river, estuary, non-thermally stratified lake: 0.015 mg/l	Water contact recreation; Aesthetics; Livestock watering; Water supply; Fishing	Cat 2: Attaining some criteria/uses	No action	Previous Data: DEQ Data (Site 402631; RM 53.4): 0% (0 of 5) Summer values exceeded chlorophyll a standard (15 ug/l) between 1986 - 1987. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 25895	South Yamhill River 1231445452258 0 to 61.7 61.7	Chromium	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 2: Attaining some criteria/uses	Added to database	2012 Data: [ODEQ] STATION 10948 at RM 16.7 for 9 samples from 04/15/2008 to 02/17/2010, 0 of 9 valid samples exceed the 11 ug/L criteria
Willamette Yamhill 17090008 7146	South Yamhill River 1231445452258 0 to 18.1 18.1	Copper	Year Round	Table 20 Toxic Substances	Aquatic life; Human health	Cat 5: Water quality limited, 303(d) list, TMDL needed	Status modification - Added to 303(d) list	2012 Data: [ODEQ] STATION 10948 at RM 16.7 for 10 samples from 04/15/2008 to 02/17/2010, 4 of 10 valid samples exceed the hardness dependent criteria Previous Data: Copper and Nickel were found in water, but levels were below the water quality standards Table 20 values. No other trace metals were detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 25902	South Yamhill River 1231445452258 18.1 to 61.7 43.6	Copper	Year Round	Table 20 Toxic Substances	Aquatic life; Human health	Cat 3: Insufficient data	Added to database	2012 Data: [ODEQ] STATION 36317 at RM 37.4 for 1 samples from 09/22/2010 to 09/22/2010, 0 of 1 valid samples exceed the hardness dependent criteria

Willamette Yamhill 17090008 7531	South Yamhill River 1231445452258 0 to 18.1 18.1	Cycloate	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, Desethylatrazine, Desisoproylatrazine, Diuron, Ethoprop, Hexazinone, Metolachlor, Metribuzin, Napropamide and Simazine were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 7563	South Yamhill River 1231445452258 0 to 18.1 18.1	Desethylatrazine	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, Desethylatrazine, Desisoproylatrazine, Diuron, Ethoprop, Hexazinone, Metolachlor, Metribuzin, Napropamide and Simazine were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 7573	South Yamhill River 1231445452258 0 to 18.1 18.1	Desisoproylatrazine	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, Desethylatrazine, Desisoproylatrazine, Diuron, Ethoprop, Hexazinone, Metolachlor, Metribuzin, Napropamide and Simazine were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998

Willamette Yamhill 17090008 20969	South Yamhill River 1231445452258 0 to 41 41	Dissolved Oxygen	January 1 - May 15	Spawning: Not less than 11.0 mg/L or 95% of saturation	Resident trout spawning	Cat 2: Attaining some criteria/uses	Delisted - Data show criteria met	2012 Data: [DEQ] STATION 31547 at RM 5.5 from 02/11/2005 to 02/11/2005, 0 of 1 (0%) samples < 11.0 mg/l and < 95% saturation. [DEQ] STATION 10948 at RM 16.7 from 02/16/2000 to 04/05/2011, 2 of 25 (8%) samples < 11.0 mg/l and < 95% saturation. [DEQ] STATION 10949 at RM 27 from 05/14/2009 to 05/14/2009, 0 of 1 (0%) samples < 11.0 mg/l and < 95% saturation Previous Data: [ODA] LASAR 10948 River Mile 16.7: From 1/24/1994 to 4/29/2003, 8 out of 31 samples (26%) < 11 mg/l and applicable % saturation. Previous Status: Cat 5: Water quality limited, 303(d) list, TMDL needed Previous Action: Added to database Previous Assessment Year: 2004

Willamette Yamhill 17090008 12156	South Yamhill River 1231445452258 0 to 61.8 61.8	Dissolved Oxygen	Year Round (Non-spawning)	Cool water: Not less than 6.5 mg/l	Cool-water aquatic life	Cat 2: Attaining some criteria/uses	No status change	2012 Data: [DEQ] STATION 31547 at RM 5.5 from 08/11/2004 to 07/13/2005, 0 of 3 (0%) samples < 6.5 mg/L. [DEQ] STATION 33885 at RM 14.9 from 09/20/2006 to 09/20/2006, 0 of 1 (0%) samples < 6.5 mg/L. [DEQ] STATION 10948 at RM 16.7 from 06/26/2000 to 12/07/2011, 0 of 53 (0%) samples < 6.5 mg/L. [DEQ] STATION 36089 at RM 36.7 from 10/21/2009 to 10/21/2009, 0 of 1 (0%) samples < 6.5 mg/L. [DEQ] STATION 36088 at RM 36.7 from 10/21/2009 to 10/21/2009, 0 of 1 (0%) samples < 6.5 mg/L. [DEQ] STATION 36087 at RM 36.7 from 10/21/2009 to 10/21/2009, 0 of 1 (0%) samples < 6.5 mg/L. [DEQ] STATION 35072 at RM 37.4 from 09/20/2011 to 09/20/2011, 0 of 1 (0%) samples < 6.5 mg/L. [DEQ] STATION 35451 at RM 38.7 from 06/03/2009 to 06/03/2009, 0 of 3 (0%) samples < 6.5 mg/L Previous Data: [DEQ/ODA - Salem] LASAR 10948 River Mile 16.7: From 6/1/1994 to 12/22/2003, 0 out of 54 samples (0%) < 6.5 mg/l and applicable % saturation. Previous Status: Cat 2: Attaining some criteria/uses Previous Action: Added to database Previous Assessment Year: 2004

Willamette Yamhill 17090008 25903	South Yamhill River 1231445452258 41 to 61.8 20.8	Dissolved Oxygen	October 15 - May 15	Spawning: Not less than 11.0 mg/L or 95% of saturation		Cat 3: Insufficient data	Added to database	2012 Data: [DEQ] STATION 36082 at RM 42.7 from 10/20/2009 to 10/20/2009, 0 of 1 (0%) samples < 11.0 mg/l and < 95% saturation. [DEQ] STATION 36081 at RM 42.7 from 10/20/2009 to 10/20/2009, 0 of 1 (0%) samples < 11.0 mg/l and < 95% saturation. [DEQ] STATION 36080 at RM 42.8 from 10/20/2009 to 10/20/2009, 0 of 1 (0%) samples < 11.0 mg/l and < 95% saturation. [DEQ] STATION 36079 at RM 52.5 from 10/20/2009 to 10/20/2009, 0 of 1 (0%) samples < 11.0 mg/l and < 95% saturation. [DEQ] STATION 36077 at RM 52.5 from 10/20/2009 to 10/20/2009, 0 of 1 (0%) samples < 11.0 mg/l and < 95% saturation. [DEQ] STATION 36078 at RM 52.5 from 10/20/2009 to 10/20/2009, 1 of 1 (100%) samples < 11.0 mg/l and < 95% saturation. [DEQ] STATION 35450 at RM 54.5 from 05/14/2009 to 05/14/2009, 0 of 1 (0%) samples < 11.0 mg/l and < 95% saturation
Willamette Yamhill 17090008 7611	South Yamhill River 1231445452258 0 to 18.1 18.1	Diuron	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, Desethylatrazine, Desisoproylatrazine, Diuron, Ethoprop, Hexazinone, Metolachlor, Metribuzin, Napropamide and Simazine were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998

Willamette Yamhill 17090008 17296	South Yamhill River 1231445452258 0 to 18.1 18.1	E. Coli	FallWinterSpring	30-day log mean of 126 E. coli organisms per 100 ml; no single sample > 406 organisms per 100 ml	Water contact recreation	Cat 2: Attaining some criteria/uses	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10948 River Mile 16.7: From 1/16/1996 to 12/22/2003, 1 out of 43 samples (2%) > 406 organisms; maximum 30-day log mean of 0 Previous Status: Cat 2: Attaining some criteria/uses Previous Action: Added to database Previous Assessment Year: 2004
Willamette Yamhill 17090008 17297	South Yamhill River 1231445452258 0 to 18.1 18.1	E. Coli	Summer	30-day log mean of 126 E. coli organisms per 100 ml; no single sample > 406 organisms per 100 ml	Water contact recreation	Cat 2: Attaining some criteria/uses	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10948 River Mile 16.7: From 1/16/1996 to 12/22/2003, 0 out of 19 samples (0%) > 406 organisms; maximum 30-day log mean of 0 Previous Status: Cat 2: Attaining some criteria/uses Previous Action: Added to database Previous Assessment Year: 2004
Willamette Yamhill 17090008 7632	South Yamhill River 1231445452258 0 to 18.1 18.1	Ethoprop	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, Desethylatrazine, Desisoproylatrazine, Diuron, Ethoprop, Hexazinone, Metolachlor, Metribuzin, Napropamide and Simazine were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998

Willamette Yamhill 17090008 6085	South Yamhill River 1231445452258 18.1 to 42.6 24.5	Fecal Coliform	FallWinterSpring	Fecal coliform log mean of 200 organisms per 100 ml; no more than 10% > 400 per 100 ml	Water contact recreation	Cat 5: Water quality limited, 303(d) list, TMDL needed	No action	Previous Data: DEQ Data (2 Sites: 402627, 402628; RM 36.0, 39.5): 20% (3 of 15), 17% (2 of 12) FWS values exceeded fecal coliform standard (400) with maximum values of 460, 1100 respectively between 1986 - 1988. Previous Status: 303(d) Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 6878	South Yamhill River 1231445452258 18.1 to 42.6 24.5	Fecal Coliform	Summer	Fecal coliform log mean of 200 organisms per 100 ml; no more than 10% > 400 per 100 ml	Water contact recreation	Cat 5: Water quality limited, 303(d) list, TMDL needed	No action	Previous Data: DEQ Data (Site 402627; RM 36.0): 44% (4 of 9) Summer values exceeded fecal coliform standard (400) with a maximum value of 460 between 1986 - 1988. Previous Status: 303(d) Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 6087	South Yamhill River 1231445452258 42.6 to 61.7 19.1	Fecal Coliform	FallWinterSpring	Fecal coliform log mean of 200 organisms per 100 ml; no more than 10% > 400 per 100 ml	Water contact recreation	Cat 2: Attaining some criteria/uses	No action	Previous Data: DEQ Data (Site 402631; RM 53.4): 0% (0 of 12) FWS values exceeded fecal coliform standard (400) between 1986 - 1988. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 6086	South Yamhill River 1231445452258 42.6 to 61.7 19.1	Fecal Coliform	Summer	Fecal coliform log mean of 200 organisms per 100 ml; no more than 10% > 400 per 100 ml	Water contact recreation	Cat 5: Water quality limited, 303(d) list, TMDL needed	No action	Previous Data: DEQ Data (Site 402631; RM 53.4): 40% (2 of 5) Summer values exceeded fecal coliform standard (400) with a maximum value of 460 between 1986 - 1987. Previous Status: 303(d) Previous Action: Added to database Previous Assessment Year: 1998

Willamette Yamhill 17090008 6341	South Yamhill River 1231445452258 18.1 to 42.6 24.5	Flow Modification	Undefined	The creation of tastes or odors or toxic or other conditions that are deleterious to fish or other aquatic life or affect the potability of drinking water or the palatability of fish or shellfish may not be allowed.	Salmonid fish rearing; Resident fish and aquatic life; Salmonid fish spawning	Cat 4C: Water quality limited, not a pollutant	No action	Cutthroat populations are a stock of concern with low flows and high temperatures constraining populations in some coast range streams (ODFW, 92); IWR (59461) is often not met at USGS gage (14194000). Previous Status: Water quality limited not needing a TMDL Previous Action: Delisted - Water quality limited, not a pollutant Previous Assessment Year: 2002
Willamette Yamhill 17090008 6342	South Yamhill River 1231445452258 42.6 to 61.7 19.1	Flow Modification	Undefined	The creation of tastes or odors or toxic or other conditions that are deleterious to fish or other aquatic life or affect the potability of drinking water or the palatability of fish or shellfish may not be allowed.	Salmonid fish spawning; Resident fish and aquatic life; Salmonid fish rearing	Cat 3: Insufficient data	Status modification	Incorrectly assigned Water Quality Limited status in 2002 de-listing action. Status corrected to reflect 1998 assessment status. Previous Status: Water quality limited not needing a TMDL Previous Action: Delisted - Water quality limited, not a pollutant Previous Assessment Year: 2002
Willamette Yamhill 17090008 7652	South Yamhill River 1231445452258 0 to 18.1 18.1	Hexazinone	Year Round	Table 20 Toxic Substances	Drinking water; Resident fish and aquatic life; Anadromous fish passage	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, Desethylatrazine, Desisoproylatrazine, Diuron, Ethoprop, Hexazinone, Metolachlor, Metribuzin, Napropamide and Simazine were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998

Willamette Yamhill 17090008 8384	South Yamhill River 1231445452258 0 to 18.1 18.1	Iron	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 5: Water quality limited, 303(d) list, TMDL needed	No status change	2012 Data: [ODEQ] STATION 10948 at RM 16.7 for 26 samples from 02/16/2000 to 10/04/2007, 0 of 0 valid samples exceed the 1000 ug/L criteria Previous Data: [DEQ/ODA - Salem] LASAR 10948 River Mile 16.7: From 1/24/1994 to 8/13/2001, 10 out of 69 samples > applicable Table 20 criterion. Previous Data: LASAR 10948 RM 16.8: 2/4 samples > 300 ug/L. Previous Assessment Year: 2002 Previous Status: Cat 5: Water quality limited, 303(d) list, TMDL needed Previous Action: No status change Previous Assessment Year: 2004
Willamette Yamhill 17090008 25896	South Yamhill River 1231445452258 0 to 61.7 61.7	Lead	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 5: Water quality limited, 303(d) list, TMDL needed	Added to database	2012 Data: [ODEQ] STATION 10948 at RM 16.7 for 9 samples from 04/15/2008 to 02/17/2010, 2 of 9 valid samples exceed the hardness dependent criteria. [ODEQ] STATION 36317 at RM 37.4 for 1 samples from 09/22/2010 to 09/22/2010, 0 of 1 valid samples exceed the hardness dependent criteria
Willamette Yamhill 17090008 17299	South Yamhill River 1231445452258 0 to 61.8 61.8	Manganese	Year Round	Table 20 Toxic Substances	Human health	Cat 3B: Insufficient data, potential concern	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10948 River Mile 16.7: From 1/24/1994 to 8/13/2001, 1 out of 69 samples > applicable Table 20 criterion. Previous Status: Cat 3B: Potential concern Previous Action: Added to database Previous Assessment Year: 2004

Willamette Yamhill 17090008 6796	South Yamhill River 1231445452258 0 to 18.1 18.1	Mercury	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 3B: Insufficient data, potential concern	No action	Previous Data: USGS Data (Site at Hwy 99 Bridge): 1 value detected above standard, a minimum of two exceedences needed to be listed - did not meet listing criteria. Previous Status: Potential concern Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 7741	South Yamhill River 1231445452258 0 to 18.1 18.1	Metolachlor	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, Desethylatrazine, Desisoproylatrazine, Diuron, Ethoprop, Hexazinone, Metolachlor, Metribuzin, Napropamide and Simazine were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 7754	South Yamhill River 1231445452258 0 to 18.1 18.1	Metribuzin	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Drinking water; Anadromous fish passage	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, Desethylatrazine, Desisoproylatrazine, Diuron, Ethoprop, Hexazinone, Metolachlor, Metribuzin, Napropamide and Simazine were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998

Willamette Yamhill 17090008 7762	South Yamhill River 1231445452258 0 to 18.1 18.1	Napropamide	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, Desethylatrazine, Desisoproylatrazine, Diuron, Ethoprop, Hexazinone, Metolachlor, Metribuzin, Napropamide and Simazine were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 7771	South Yamhill River 1231445452258 0 to 18.1 18.1	Nickel	Year Round	Table 20 Toxic Substances	Aquatic life; Human health	Cat 2: Attaining some criteria/uses	No status change	2012 Data: [ODEQ] STATION 10948 at RM 16.7 for 10 samples from 04/15/2008 to 02/17/2010, 0 of 10 valid samples exceed the hardness dependent criteria Previous Data: Copper and Nickel were found in water, but levels were below the water quality standards Table 20 values. No other trace metals were detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 6509	South Yamhill River 1231445452258 0 to 18.1 18.1	pH	FallWinterSpring	pH 6.5 to 8.5	Water contact recreation; Salmonid fish spawning; Anadromous fish passage; Resident fish and aquatic life; Salmonid fish rearing	Cat 2: Attaining some criteria/uses	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10948 River Mile 16.7: From 1/24/1994 to 12/22/2003, 0 out of 60 samples (0%) outside pH criteria range 6.5 to 8.5. Previous Data: DEQ Data (Site 402625; RM 16.5): 0% (0 of 73) FWS values exceeded pH standard (6.5 - 8.5) between WY 1986 - 1995. Previous Assessment Year: 1998 Previous Status: Cat 2: Attaining some criteria/uses Previous Action: No status change Previous Assessment Year: 2004

Willamette Yamhill 17090008 6877	South Yamhill River 1231445452258 0 to 18.1 18.1	pH	Summer	pH 6.5 to 8.5	Water contact recreation; Salmonid fish spawning; Anadromous fish passage; Resident fish and aquatic life; Salmonid fish rearing	Cat 2: Attaining some criteria/uses	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10948 River Mile 16.7: From 6/1/1994 to 8/4/2003, 0 out of 28 samples (0%) outside pH criteria range 6.5 to 8.5. Previous Data: DEQ Data (3 Sites: 402623, 402624, 402625; RM 1.0 - 16.5): 0% (0 of 7, 18, 52) Summer values respectively exceeded pH standard (6.5 - 8.5) between WY 1986 - 1995. Previous Assessment Year: 1998 Previous Status: Cat 2: Attaining some criteria/uses Previous Action: No status change Previous Assessment Year: 2004
Willamette Yamhill 17090008 6510	South Yamhill River 1231445452258 18.1 to 42.6 24.5	pH	FallWinterSpring	pH 6.5 to 8.5	Resident fish and aquatic life; Anadromous fish passage; Salmonid fish rearing; Water contact recreation; Salmonid fish spawning	Cat 2: Attaining some criteria/uses	No action	Previous Data: DEQ Data (2 Sites: 402627, 402628; RM 36.0, 39.5): 0% (0 of 15, 12) FWS values respectively exceeded pH standard (6.5 -8.5) between 86 - 88. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 6879	South Yamhill River 1231445452258 18.1 to 42.6 24.5	pH	Summer	pH 6.5 to 8.5	Salmonid fish spawning; Salmonid fish rearing; Water contact recreation; Resident fish and aquatic life; Anadromous fish passage	Cat 2: Attaining some criteria/uses	No action	Previous Data: DEQ Data (Site 402627; RM 36.0): 0% (0 of 12) Summer values exceeded pH standard (6.5 -8.5) between 1986 - 1988. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998

Willamette Yamhill 17090008 6511	South Yamhill River 1231445452258 42.6 to 61.7 19.1	pH	FallWinterSpring	pH 6.5 to 8.5	Salmonid fish spawning; Salmonid fish rearing; Resident fish and aquatic life; Anadromous fish passage; Water contact recreation	Cat 2: Attaining some criteria/uses	No action	Previous Data: DEQ Data (Site 402631; RM 53.4): 0% (0 of 12) FWS values exceeded pH standard (6.5 - 8.5) between 1986 - 1988. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 6881	South Yamhill River 1231445452258 42.6 to 61.7 19.1	pH	Summer	pH 6.5 to 8.5	Resident fish and aquatic life; Salmonid fish rearing; Water contact recreation; Salmonid fish spawning; Anadromous fish passage	Cat 2: Attaining some criteria/uses	No action	Previous Data: DEQ Data (Site 402631; RM 53.4): 0% (0 of 5) Summer values exceeded pH standard (6.5 - 8.5) between 1986 - 1987. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 21575	South Yamhill River 1231445452258 0 to 61.8 61.8	Phosphate Phosphorus	Summer	Total phosphates as phosphorus (P): Benchmark 50 ug/L in streams to control excessive aquatic growths	Aquatic life	Cat 2: Attaining some criteria/uses	No action	Previous Data: [DEQ] LASAR 10948 River Mile 16.7: From 6/1/1994 to 8/4/2003, 1 out of 27 samples > 50 ug/L benchmark criterion. Previous Status: Cat 2: Attaining some criteria/uses Previous Action: Added to database Previous Assessment Year: 2004
Willamette Yamhill 17090008 6422	South Yamhill River 1231445452258 0 to 18.1 18.1	Phosphorus	May 1 - October 31	Biocriteria: Waters of the state must be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities.	Aesthetics	Cat 4A: Water quality limited, TMDL approved	No action	Previous Data: DEQ Data (Site 402625; RM 16.5): 0% (0 of 10) May through October values exceeded phosphorus TMDL standard (70 ug/l) with a maximum value of 60 ug/l between 6/94 - 10/95. Previous Status: TMDL approved Previous Action: Added to database Previous Assessment Year: 1998

Willamette Yamhill 17090008 6423	South Yamhill River 1231445452258 18.1 to 42.6 24.5	Phosphorus	May 1 - October 31	Biocriteria: Waters of the state must be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities.	Aesthetics	Cat 4A: Water quality limited, TMDL approved	No action	Previous Data: DEQ Data (Site 402627, RM 36.0): 0% (0 of 19) May through October values exceeded TMDL phosphorus standard (70 ug/l) between 1986 - 1988. Previous Status: TMDL approved Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 6424	South Yamhill River 1231445452258 42.6 to 61.7 19.1	Phosphorus	May 1 - October 31	Biocriteria: Waters of the state must be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities.	Aesthetics	Cat 4A: Water quality limited, TMDL approved	No action	Previous Data: DEQ Data (Site 402631, RM 53.4): 14% (1 of 7) May through October values exceeded TMDL phosphorus standard (70 ug/l) with a maximum of 110 ug/l between 1986 - 1988. Previous Status: TMDL approved Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 6687	South Yamhill River 1231445452258 0 to 18.1 18.1	Sedimentation	Undefined	The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry may not be allowed.	Resident fish and aquatic life; Salmonid fish spawning; Salmonid fish rearing	Cat 3: Insufficient data	No action	Previous Status: Insufficient data Previous Action: Added to database Previous Assessment Year: 1998

Willamette Yamhill 17090008 6688	South Yamhill River 1231445452258 18.1 to 42.6 24.5	Sedimentation	Undefined	The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry may not be allowed.	Salmonid fish rearing; Salmonid fish spawning; Resident fish and aquatic life	Cat 3: Insufficient data	No action	Previous Status: Insufficient data Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 6689	South Yamhill River 1231445452258 42.6 to 61.7 19.1	Sedimentation	Undefined	The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry may not be allowed.	Salmonid fish spawning; Salmonid fish rearing; Resident fish and aquatic life	Cat 3: Insufficient data	No action	Previous Status: Insufficient data Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 25898	South Yamhill River 1231445452258 0 to 61.7 61.7	Selenium	Year Round	Table 20 Toxic Substances	Aquatic life; Human health	Cat 2: Attaining some criteria/uses	Added to database	2012 Data: [ODEQ] STATION 10948 at RM 16.7 for 11 samples from 04/15/2008 to 02/17/2010, 0 of 11 valid samples exceed the 35 ug/L criteria. [ODEQ] STATION 36317 at RM 37.4 for 1 samples from 09/22/2010 to 09/22/2010, 0 of 1 valid samples exceed the 35 ug/L criteria
Willamette Yamhill 17090008 25894	South Yamhill River 1231445452258 0 to 61.7 61.7	Silver	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 2: Attaining some criteria/uses	Added to database	2012 Data: [ODEQ] STATION 10948 at RM 16.7 for 11 samples from 04/15/2008 to 02/17/2010, 0 of 11 valid samples exceed the 0.12 ug/L criteria

Willamette Yamhill 17090008 7890	South Yamhill River 1231445452258 0 to 18.1 18.1	Simazine	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, Desethylatrazine, Desisoproylatrazine, Diuron, Ethoprop, Hexazinone, Metolachlor, Metribuzin, Napropamide and Simazine were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 5963	South Yamhill River 1231445452258 0 to 18.1 18.1	Temperature	Summer	Rearing: 17.8 C	Salmonid fish rearing; Anadromous fish passage	Cat 5: Water quality limited, 303(d) list, TMDL needed	No action	Previous Data: DEQ Data (Site 402625; RM 16.5): 88% (46 of 52) Summer values exceeded temperature standard (64) with exceedances each year and a maximum of 81.5 in WY 1986 - 1995. Previous Status: 303(d) Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 5964	South Yamhill River 1231445452258 18.1 to 42.6 24.5	Temperature	Summer	Rearing: 17.8 C	Anadromous fish passage; Salmonid fish rearing	Cat 5: Water quality limited, 303(d) list, TMDL needed	No action	Previous Data: DEQ Data (Site 402627; RM 36): 75% (9 of 12) Summer values exceeded temperature standard (64) with exceedances each year and a maximum of 75.9 in WY 1986 - 1988. Previous Status: 303(d) Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 5965	South Yamhill River 1231445452258 42.6 to 61.7 19.1	Temperature	Undefined		Salmonid fish rearing; Resident fish and aquatic life; Anadromous fish passage; Salmonid fish spawning	Cat 3: Insufficient data	No action	Previous Status: Insufficient data Previous Action: Added to database Previous Assessment Year: 1998

Willamette Yamhill 17090008 25900	South Yamhill River 1231445452258 0 to 61.7 61.7	Zinc	Year Round	Table 20 Toxic Substances	Aquatic life; Human health	Cat 3B: Insufficient data, potential concern	Added to database	2012 Data: [ODEQ] STATION 10948 at RM 16.7 for 9 samples from 04/15/2008 to 02/17/2010, 1 of 9 valid samples exceed the hardness dependent criteria. [ODEQ] STATION 36317 at RM 37.4 for 1 samples from 09/22/2010 to 09/22/2010, 0 of 1 valid samples exceed the hardness dependent criteria

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Contact

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Oregon's 2012 Integrated Report Yamhill River

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Basin Name Subbasin 4th Field HUC Record ID	Water Body LLID River Miles Segment Miles Beach Name Beach ID	Pollutant	Season	Criteria	Beneficial Uses	Status	2012 Assessment Action	[Data Source] Supporting Data
Willamette Yamhill 17090008 17303	North Yamhill River 1231445452259 0 to 32.5 32.5	Alkalinity	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 3B: Insufficient data, potential concern	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10649 River Mile 15: From 1/24/1996 to 7/18/2001, 0 out of 3 samples < 20 mg/L (Table 20 criterion). [DEQ/ODA - Salem] LASAR 10929 River Mile 4.4: From 1/24/1994 to 12/22/2003, 3 out of 82 samples < 20 mg/L (Table 20 criterion). Previous Status: Cat 3B: Potential concern Previous Action: Added to database Previous Assessment Year: 2004
Willamette Yamhill 17090008 17304	North Yamhill River 1231445452259 0 to 32.5 32.5	Ammonia	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 2: Attaining some criteria/uses	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10649 River Mile 15: From 1/24/1996 to 7/18/2001, 0 out of 4 samples > applicable Table 20 criterion. [DEQ/ODA - Salem] LASAR 10929 River Mile 4.4: From 1/24/1994 to 12/22/2003, 0 out of 116 samples > applicable Table 20 criterion. Previous Status: Cat 2: Attaining some criteria/uses Previous Action: Added to database Previous Assessment Year: 2004

Willamette Yamhill 17090008 25479	North Yamhill River 1231445452259 0 to 32.4 32.4	Arsenic	Year Round	Table 40 Human Health Criteria for Toxic Pollutants	Human health; Aquatic life	Cat 2: Attaining some criteria/uses	Added to database	2012 Data: [ODEQ] STATION 33921 at RM 0.8 for 1 samples from 09/21/2006 to 09/21/2006, 0 of 1 valid samples exceed the 2.1 ug/L criteria. [ODEQ] STATION 10929 at RM 4.4 for 20 samples from 04/15/2008 to 02/17/2010, 0 of 20 valid samples exceed the 2.1 ug/L criteria. [ODEQ] STATION 33891 at RM 14.5 for 2 samples from 09/14/2006 to 09/14/2006, 0 of 2 valid samples exceed the 2.1 ug/L criteria
Willamette Yamhill 17090008 7305	North Yamhill River 1231445452259 0 to 20.1 20.1	Atrazine	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, simazine and Terbacil were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 24075	North Yamhill River 1231445452259 0 to 32.4 32.4	Biological Criteria	Year Round	Biocriteria: Waters of the state must be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities.	Aquatic life	Cat 5: Water quality limited, 303(d) list, TMDL needed	No action	2010 Data: EPA addition to 303(d) list 12/14/2012: LASAR 33921 River Mile 0.8 FROM 9/21/2006 To 9/21/2006 1 out of 1 (100%) samples outside MWCF regional criteria. LASAR 33891 River Mile 14.46 FROM 9/14/2006 To 9/14/2006 1 out of 1 (100%) samples outside MWCF regional criteria. LASAR 30942 River Mile 19.9 FROM 9/10/2003 To 9/10/2003 1 out of 1 (100%) samples outside MWCF regional criteria. Previous Status: Cat 5: Water quality limited, 303(d) list, TMDL needed Previous Action: Status modification - EPA addition to 303(d) list Previous Assessment Year: 2010
Willamette Yamhill 17090008 25482	North Yamhill River 1231445452259 0 to 32.4 32.4	Cadmium	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 2: Attaining some criteria/uses	Added to database	2012 Data: [ODEQ] STATION 10929 at RM 4.4 for 20 samples from 04/15/2008 to 02/17/2010, 0 of 20 valid samples exceed the hardness dependent criteria

Willamette Yamhill 17090008 17305	North Yamhill River 1231445452259 0 to 20.1 20.1	Chlorophyll a	FallWinterSpring	Reservoir, river, estuary, non-thermally stratified lake: 0.015 mg/l	Water contact recreation; Aesthetics; Water supply; Fishing; Livestock watering	Cat 3: Insufficient data	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10929 River Mile 4.4: From 5/23/1995 to 5/31/1995, average Chlorophyll a of 0.012 for 1 samples in 1 months. Previous Status: Cat 3: Insufficient data Previous Action: Added to database Previous Assessment Year: 2004
Willamette Yamhill 17090008 6248	North Yamhill River 1231445452259 0 to 20.1 20.1	Chlorophyll a	Summer	Reservoir, river, estuary, non-thermally stratified lake: 0.015 mg/l	Fishing; Water supply; Water contact recreation; Aesthetics; Livestock watering	Cat 2: Attaining some criteria/uses	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10929 River Mile 4.4: From 6/10/1996 to 9/7/1996, average Chlorophyll a of 0.013 for 3 samples in 3 months. [DEQ] LASAR 10649 River Mile 15: From 7/18/2001 to 9/30/2001, average Chlorophyll a of 0.005 for 1 samples in 1 months. Previous Data: DEQ Data (3 Sites: 402605, 402606, 402607; RM 1.5 - 10.0): 0% (0 of 7); 14% (6 of 42); 5% (1 of 20) Summer values respectively exceeded chlorophyll a standard (15 ug/l) with maximum values of 51, 18 between 1986 - 1995. Previous Assessment Year: 1998 Previous Status: Cat 2: Attaining some criteria/uses Previous Action: No status change Previous Assessment Year: 2004
Willamette Yamhill 17090008 25481	North Yamhill River 1231445452259 0 to 32.4 32.4	Chlorpyrifos	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 3: Insufficient data	Added to database	2012 Data: [USGS] STATION 452149123194900 at RM 25.5 for 2 samples from 05/18/2004 to 08/27/2004, 0 of 2 valid samples exceed the 0.041 ug/L criteria
Willamette Yamhill 17090008 25473	North Yamhill River 1231445452259 0 to 32.4 32.4	Chromium	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 2: Attaining some criteria/uses	Added to database	2012 Data: [ODEQ] STATION 10929 at RM 4.4 for 16 samples from 04/15/2008 to 02/17/2010, 0 of 16 valid samples exceed the 11 ug/L criteria
Willamette Yamhill 17090008 25474	North Yamhill River 1231445452259 0 to 32.4 32.4	Copper	Year Round	Table 20 Toxic Substances	Aquatic life; Human health	Cat 5: Water quality limited, 303(d) list, TMDL needed	Added to database	2012 Data: [ODEQ] STATION 10929 at RM 4.4 for 18 samples from 04/15/2008 to 02/17/2010, 2 of 18 valid samples exceed the hardness dependent criteria

Willamette Yamhill 17090008 7530	North Yamhill River 1231445452259 0 to 20.1 20.1	Cycloate	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, simazine and Terbacil were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 21958	North Yamhill River 1231445452259 0 to 14 14	Dissolved Oxygen	January 1 - May 15	Spawning: Not less than 11.0 mg/L or 95% of saturation	Resident trout spawning	Cat 5: Water quality limited, 303(d) list, TMDL needed	No status change	2012 Data: [DEQ] STATION 10929 at RM 4.4 from 02/16/2000 to 02/17/2010, 5 of 19 (26%) samples < 11.0 mg/l and < 95% saturation. [DEQ] STATION 34039 at RM 9.4 from 03/16/2007 to 04/27/2010, 13 of 22 (59%) samples < 11.0 mg/l and < 95% saturation Previous Data: DEQ] LASAR 10929 River Mile 4.4: From 1/24/1994 to 4/29/2003, 11 out of 31 samples (35%) < 11 mg/L and applicable % saturation. Previous Status: Cat 5: Water quality limited, 303(d) list, TMDL needed Previous Action: Added to database Previous Assessment Year: 2004

Willamette Yamhill 17090008 12157	North Yamhill River 1231445452259 0 to 20.1 20.1	Dissolved Oxygen	Year Round (Non-spawning)	Cool water: Not less than 6.5 mg/l	Cool-water aquatic life	Cat 2: Attaining some criteria/uses	Status modification - Attaining criteria/uses	Segment modified to reflect current application of cool water criterion. Cool water criterion previously applied from RM 0 to 28.5. Current data show attainment of criterion. 2012 Data: [DEQ] STATION 33921 at RM 0.8 from 09/21/2006 to 09/21/2006, 0 of 1 (0%) samples < 6.5 mg/L. [DEQ] STATION 10929 at RM 4.4 from 06/26/2000 to 12/07/2011, 1 of 53 (2%) samples < 6.5 mg/L. [DEQ] STATION 35165 at RM 8.6 from 10/16/2008 to 10/16/2008, 0 of 1 (0%) samples < 6.5 mg/L. [DEQ] STATION 35166 at RM 8.6 from 10/16/2008 to 10/16/2008, 0 of 1 (0%) samples < 6.5 mg/L. [DEQ] STATION 35164 at RM 8.6 from 10/16/2008 to 10/16/2008, 0 of 1 (0%) samples < 6.5 mg/L. [DEQ] STATION 34039 at RM 9.4 from 05/25/2007 to 05/26/2010, 0 of 14 (0%) samples < 6.5 mg/L. [DEQ] STATION 34036 at RM 13.2 from 05/31/2005 to 10/30/2006, 0 of 10 (0%) samples < 6.5 mg/L. [DEQ] STATION 35163 at RM 14 from 10/16/2008 to 10/16/2008, 0 of 1 (0%) samples < 6.5 mg/L. [DEQ] STATION 35161 at RM 14 from 10/16/2008 to 10/16/2008, 0 of 1 (0%) samples < 6.5 mg/L. [DEQ] STATION 10649 at RM 15 from 07/18/2001 to 07/18/2001, 0 of 1 (0%) samples < 6.5 mg/L. [DEQ] STATION 34035 at RM 15.8 from 05/31/2005 to 08/11/2011, 0 of 11 (0%) samples < 6.5 mg/L. [DEQ] STATION 30942 at RM 19.9 from 05/31/2005 to 09/30/2006, 0 of 8 (0%) samples < 6.5 mg/L Previous Data: [DEQ/ODA - Salem] LASAR 10649 River Mile 15: From 7/18/2001 to 7/18/2001, 0 out of 1 samples (0%) < 6.5 mg/l and applicable % saturation. Previous Status: Cat 3: Insufficient data Previous Action: Added to database Previous Assessment Year: 2004

Willamette Yamhill 17090008 12485	North Yamhill River 1231445452259 14 to 30.7 16.7	Dissolved Oxygen	October 15 - May 15	Spawning: Not less than 11.0 mg/L or 95% of saturation	Salmon and steelhead spawning	Cat 3: Insufficient data	No status change	2012 Data: [DEQ] STATION 34035 at RM 15.8 from 10/26/2005 to 10/29/2006, 2 of 2 (100%) samples < 11.0 mg/l and < 95% saturation. [DEQ] STATION 30942 at RM 19.9 from 10/26/2005 to 10/29/2006, 1 of 2 (50%) samples < 11.0 mg/l and < 95% saturation. [DEQ] STATION 35448 at RM 20.2 from 05/13/2009 to 05/13/2009, 0 of 1 (0%) samples < 11.0 mg/l and < 95% saturation Previous Data: [DEQ/ODA - Salem] LASAR 10649 River Mile 15: From 1/24/1996 to 1/24/1996, 1 out of 1 samples (100%) < 11 mg/l and applicable % saturation. Previous Status: Cat 3: Insufficient data Previous Action: Added to database Previous Assessment Year: 2004
Willamette Yamhill 17090008 24883	North Yamhill River 1231445452259 20.1 to 32.4 12.3	Dissolved Oxygen	Year Round (Non-spawning)	Cold water: Not less than 8.0 mg/l or 90% of saturation	Cold-water aquatic life	Cat 3: Insufficient data	Added to database	Current application of cold water criterion to this segment. 2012 Data: [USGS] STATION 452149123194900 at RM 25.5 from 05/18/2004 to 08/27/2004, 0 of 2 (0%) samples < 8.0 mg/l and < 90% saturation
Willamette Yamhill 17090008 17307	North Yamhill River 1231445452259 0 to 20.1 20.1	E. Coli	FallWinterSpring	30-day log mean of 126 E. coli organisms per 100 ml; no single sample > 406 organisms per 100 ml	Water contact recreation	Cat 5: Water quality limited, 303(d) list, TMDL needed	No action	Previous Data: [ODA] LASAR 10649 River Mile 15: From 1/24/1996 to 1/24/1996, 0 out of 1 samples (0%) > 406 organisms; maximum 30-day log mean of 0 [DEQ/ODA - Salem] LASAR 10929 River Mile 4.4: From 1/16/1996 to 12/22/2003, 5 out of 41 samples (12%) > 406 organisms; maximum 30-day log mean of 0 Previous Status: Cat 5: Water quality limited, 303(d) list, TMDL needed Previous Action: Added to database Previous Assessment Year: 2004
Willamette Yamhill 17090008 17308	North Yamhill River 1231445452259 0 to 20.1 20.1	E. Coli	Summer	30-day log mean of 126 E. coli organisms per 100 ml; no single sample > 406 organisms per 100 ml	Water contact recreation	Cat 2: Attaining some criteria/uses	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10929 River Mile 4.4: From 1/16/1996 to 12/22/2003, 1 out of 18 samples (6%) > 406 organisms; maximum 30-day log mean of 0 Previous Status: Cat 2: Attaining some criteria/uses Previous Action: Added to database Previous Assessment Year: 2004

Willamette Yamhill 17090008 24582	North Yamhill River 1231445452259 12.3 to 32.4 20.1	E. Coli	Summer	30-day log mean of 126 E. coli organisms per 100 ml; no single sample > 406 organisms per 100 ml	Water contact recreation	Cat 5: Water quality limited, 303(d) list, TMDL needed	No action	2010 Data: EPA addition to 303(d) list 12/14/2012: Two exceedences of the 406 maximum criteria out of 9 days of sampling at LASAR station 34035, North Yamhill River at bridge on Moores Valley Road (North Yamhill), between 8/16/05 and 9/12/06; the geometic mean criteria is also exceeded at this station between 8/26/03 and 9/24/03 and between 8/25/04 and between 8/15/06 and 9/12/06. Two exceedences of the 406 maximum criteria out of 17 days of sampling at LASAR station 30942, North Yamhill River below Turner Creek, between 8/26/03 and 9/12/06. Exceedence of thegeometric mean criteria at LASAR station 34036, North Yamhill River downstream of Yamhill Creek (North Yamhill), between 8/15/06 and 9/12/05. Previous Status: Cat 5: Water quality limited, 303(d) list, TMDL needed Previous Action: EPA addition to 303(d) list Previous Assessment Year: 2010
Willamette Yamhill 17090008 6081	North Yamhill River 1231445452259 0 to 20.1 20.1	Fecal Coliform	FallWinterSpring	Fecal coliform log mean of 200 organisms per 100 ml; no more than 10% > 400 per 100 ml	Water contact recreation	Cat 5: Water quality limited, 303(d) list, TMDL needed	No action	Previous Data: DEQ Data (2 Sites: 402605, 402606; RM 1.5, 4.5): 30% (6 of 20), 40% (21 of 53) FWS values respectively exceeded fecal coliform standard (400) with maximum values of 2400, 2400 between WY 1986 - 1995. Previous Status: 303(d) Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 6082	North Yamhill River 1231445452259 20.1 to 32.4 12.3	Fecal Coliform	Undefined		Water contact recreation	Cat 3: Insufficient data	No action	Previous Status: Insufficient data Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 6340	North Yamhill River 1231445452259 0 to 20.1 20.1	Flow Modification	Undefined	The creation of tastes or odors or toxic or other conditions that are deleterious to fish or other aquatic life or affect the potability of drinking water or the palatability of fish or shellfish may not be allowed.	Resident fish and aquatic life; Salmonid fish rearing; Salmonid fish spawning	Cat 4C: Water quality limited, not a pollutant	No action	Cutthroat populations are a stock of concern with low flows and high temperatures constraining populations in some coast range streams (ODFW, 92); IWR (70746) is often not met at USGS gage (14197000). Previous Status: Water quality limited not needing a TMDL Previous Action: Delisted - Water quality limited, not a pollutant Previous Assessment Year: 2002

Willamette Yamhill 17090008 17309	North Yamhill River 1231445452259 0 to 32.5 32.5	Iron	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 5: Water quality limited, 303(d) list, TMDL needed	No status change	2012 Data: [ODEQ] STATION 10929 at RM 4.4 for 33 samples from 02/16/2000 to 10/04/2007, 0 of 0 valid samples exceed the 1000 ug/L criteria Previous Data: [DEQ/ODA - Salem] LASAR 10929 River Mile 4.4: From 1/24/1994 to 8/13/2001, 12 out of 63 samples > applicable Table 20 criterion. Previous Status: Cat 5: Water quality limited, 303(d) list, TMDL needed Previous Action: Added to database Previous Assessment Year: 2004
Willamette Yamhill 17090008 25477	North Yamhill River 1231445452259 0 to 32.4 32.4	Lead	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 3B: Insufficient data, potential concern	Added to database	2012 Data: [ODEQ] STATION 10929 at RM 4.4 for 14 samples from 04/15/2008 to 02/17/2010, 1 of 14 valid samples exceed the hardness dependent criteria
Willamette Yamhill 17090008 25471	North Yamhill River 1231445452259 0 to 32.4 32.4	Malathion	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 3: Insufficient data	Added to database	2012 Data: [USGS] STATION 452149123194900 at RM 25.5 for 2 samples from 05/18/2004 to 08/27/2004, 0 of 2 valid samples exceed the 0.1 ug/L criteria
Willamette Yamhill 17090008 17310	North Yamhill River 1231445452259 0 to 32.5 32.5	Manganese	Year Round	Table 20 Toxic Substances	Human health	No criteria	Delisted - Criteria change or use clarification	The freshwater manganese criterion has been withdrawn Previous Data: [DEQ/ODA - Salem] LASAR 10929 River Mile 4.4: From 1/24/1994 to 8/13/2001, 3 out of 63 samples > applicable Table 20 criterion. Previous Status: Cat 5: Water quality limited, 303(d) list, TMDL needed Previous Action: Added to database Previous Assessment Year: 2004
Willamette Yamhill 17090008 25475	North Yamhill River 1231445452259 0 to 32.4 32.4	Nickel	Year Round	Table 20 Toxic Substances	Aquatic life; Human health	Cat 2: Attaining some criteria/uses	Added to database	2012 Data: [ODEQ] STATION 10929 at RM 4.4 for 16 samples from 04/15/2008 to 02/17/2010, 0 of 16 valid samples exceed the hardness dependent criteria
Willamette Yamhill 17090008 6421	North Yamhill River 1231445452259 20.1 to 32.4 12.3	Nutrients	Undefined		Aesthetics	Cat 3: Insufficient data	No action	Previous Status: Insufficient data Previous Action: Added to database Previous Assessment Year: 1998

Willamette Yamhill 17090008 6508	North Yamhill River 1231445452259 0 to 20.1 20.1	pH	FallWinterSpring	pH 6.5 to 8.5	Salmonid fish rearing; Resident fish and aquatic life; Anadromous fish passage; Water contact recreation; Salmonid fish spawning	Cat 2: Attaining some criteria/uses	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10649 River Mile 15: From 1/24/1996 to 1/24/1996, 0 out of 1 samples (0%) outside pH criteria range 6.5 to 8.5. [DEQ/ODA - Salem] LASAR 10929 River Mile 4.4: From 1/24/1994 to 12/22/2003, 0 out of 56 samples (0%) outside pH criteria range 6.5 to 8.5. Previous Data: DEQ Data (2 Sites: 402605, 402606; RM 1.5, 4.5): 0% (0 of 20, 53) FWS values respectively exceeded pH standard (6.5 - 8.5) between WY 1986 - 1995. Previous Assessment Year: 1998 Previous Status: Cat 2: Attaining some criteria/uses Previous Action: No status change Previous Assessment Year: 2004
Willamette Yamhill 17090008 6875	North Yamhill River 1231445452259 0 to 20.1 20.1	pH	Summer	pH 6.5 to 8.5	Water contact recreation; Resident fish and aquatic life; Anadromous fish passage; Salmonid fish rearing; Salmonid fish spawning	Cat 2: Attaining some criteria/uses	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10649 River Mile 15: From 7/18/2001 to 7/18/2001, 0 out of 1 samples (0%) outside pH criteria range 6.5 to 8.5. [DEQ/ODA - Salem] LASAR 10929 River Mile 4.4: From 8/29/1994 to 8/4/2003, 0 out of 25 samples (0%) outside pH criteria range 6.5 to 8.5. Previous Data: DEQ Data (3 Sites: 402605, 402606, 402607; RM 1.5 - 10.0): 0% (0 of 6, 43, 20) Summer values respectively exceeded pH standard (6.5 - 8.5) between WY 1986 - 1995. Previous Assessment Year: 1998 Previous Status: Cat 2: Attaining some criteria/uses Previous Action: No status change Previous Assessment Year: 2004
Willamette Yamhill 17090008 21576	North Yamhill River 1231445452259 0 to 32.5 32.5	Phosphate Phosphorus	Summer	Total phosphates as phosphorus (P): Benchmark 50 ug/L in streams to control excessive aquatic growths	Aquatic life	Cat 3B: Insufficient data, potential concern	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10649 River Mile 15: From 7/18/2001 to 7/18/2001, 1 out of 1 samples > 50 ug/L benchmark criterion. [DEQ] LASAR 10929 River Mile 4.4: From 8/29/1994 to 8/4/2003, 3 out of 24 samples > 50 ug/L benchmark criterion. Previous Status: Cat 3B: Potential concern Previous Action: Added to database Previous Assessment Year: 2004

Willamette Yamhill 17090008 6420	North Yamhill River 1231445452259 0 to 20.1 20.1	Phosphorus	May 1 - October 31	Biocriteria: Waters of the state must be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities.	Aesthetics	Cat 4A: Water quality limited, TMDL approved	No action	Previous Data: DEQ Data (Site 402606; RM 4.5): 0% (0 of 10) May through October values exceeded phosphorus TMDL standard (70 ug/l) with a maximum value of 60 ug/l between 6/94 - 10/95. Previous Status: TMDL approved Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 6686	North Yamhill River 1231445452259 0 to 20.1 20.1	Sedimentation	Undefined	The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry may not be allowed.	Salmonid fish spawning; Resident fish and aquatic life; Salmonid fish rearing	Cat 3: Insufficient data	No action	Previous Status: Insufficient data Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 25478	North Yamhill River 1231445452259 0 to 32.4 32.4	Selenium	Year Round	Table 20 Toxic Substances	Aquatic life; Human health	Cat 2: Attaining some criteria/uses	Added to database	2012 Data: [ODEQ] STATION 10929 at RM 4.4 for 20 samples from 04/15/2008 to 02/17/2010, 0 of 20 valid samples exceed the 35 ug/L criteria
Willamette Yamhill 17090008 25476	North Yamhill River 1231445452259 0 to 32.4 32.4	Silver	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 2: Attaining some criteria/uses	Added to database	2012 Data: [ODEQ] STATION 10929 at RM 4.4 for 20 samples from 04/15/2008 to 02/17/2010, 0 of 20 valid samples exceed the 0.12 ug/L criteria
Willamette Yamhill 17090008 7889	North Yamhill River 1231445452259 0 to 20.1 20.1	Simazine	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, simazine and Terbacil were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 5962	North Yamhill River 1231445452259 0 to 20.1 20.1	Temperature	Summer	Rearing: 17.8 C	Salmonid fish rearing; Anadromous fish passage	Cat 5: Water quality limited, 303(d) list, TMDL needed	No action	Previous Data: DEQ Data (Site 402606; RM 4.5): 77% (33 of 43) Summer values exceeded temperature standard (64) with exceedances each year and a maximum of 78.8 in WY 1986 - 1995. Previous Status: 303(d) Previous Action: Added to database Previous Assessment Year: 1998

Willamette Yamhill 17090008 7136	North Yamhill River 1231445452259 20.1 to 32.4 12.3	Temperature	Summer	Rearing: 17.8 C	Anadromous fish passage; Salmonid fish rearing	Cat 5: Water quality limited, 303(d) list, TMDL needed	No action	Previous Data: Two BLM sites: RM 20 and 27 in 1995, 7 day aver. max. temperature was 71.9/64.4°F, both sites exceeded temperature standard (64 °F) Previous Status: 303(d) Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 7910	North Yamhill River 1231445452259 0 to 20.1 20.1	Terbacil	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, simazine and Terbacil were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 25480	North Yamhill River 1231445452259 0 to 32.4 32.4	Zinc	Year Round	Table 20 Toxic Substances	Aquatic life; Human health	Cat 2: Attaining some criteria/uses	Added to database	2012 Data: [ODEQ] STATION 10929 at RM 4.4 for 13 samples from 04/15/2008 to 02/17/2010, 0 of 13 valid samples exceed the hardness dependent criteria
Willamette Yamhill 17090008 17292	South Yamhill River 1231445452258 0 to 61.8 61.8	Alkalinity	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 3B: Insufficient data, potential concern	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10948 River Mile 16.7: From 1/24/1994 to 12/22/2003, 11 out of 88 samples < 20 mg/L (Table 20 criterion). Previous Status: Cat 3B: Potential concern Previous Action: Added to database Previous Assessment Year: 2004
Willamette Yamhill 17090008 17293	South Yamhill River 1231445452258 0 to 61.8 61.8	Ammonia	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 2: Attaining some criteria/uses	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10948 River Mile 16.7: From 1/24/1994 to 12/22/2003, 0 out of 136 samples > applicable Table 20 criterion. Previous Status: Cat 2: Attaining some criteria/uses Previous Action: Added to database Previous Assessment Year: 2004

Willamette Yamhill 17090008 25897	South Yamhill River 1231445452258 0 to 61.7 61.7	Arsenic	Year Round	Table 40 Human Health Criteria for Toxic Pollutants	Human health; Aquatic life	Cat 2: Attaining some criteria/uses	Added to database	2012 Data: [ODEQ] STATION 33885 at RM 14.9 for 1 samples from 09/20/2006 to 09/20/2006, 0 of 1 valid samples exceed the 2.1 ug/L criteria. [ODEQ] STATION 10948 at RM 16.7 for 11 samples from 04/15/2008 to 02/17/2010, 0 of 11 valid samples exceed the 2.1 ug/L criteria. [ODEQ] STATION 36317 at RM 37.4 for 1 samples from 09/22/2010 to 09/22/2010, 0 of 1 valid samples exceed the 2.1 ug/L criteria
Willamette Yamhill 17090008 7304	South Yamhill River 1231445452258 0 to 18.1 18.1	Atrazine	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, Desethylatrazine, Desisoproylatrazine, Diuron, Ethoprop, Hexazinone, Metolachlor, Metribuzin, Napropamide and Simazine were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 25901	South Yamhill River 1231445452258 0 to 61.7 61.7	Cadmium	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 2: Attaining some criteria/uses	Added to database	2012 Data: [ODEQ] STATION 10948 at RM 16.7 for 11 samples from 04/15/2008 to 02/17/2010, 0 of 11 valid samples exceed the hardness dependent criteria
Willamette Yamhill 17090008 17294	South Yamhill River 1231445452258 0 to 18.1 18.1	Chlorophyll a	FallWinterSpring	Reservoir, river, estuary, non-thermally stratified lake: 0.015 mg/l	Aesthetics; Livestock watering; Water supply; Water contact recreation; Fishing	Cat 3: Insufficient data	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10948 River Mile 16.7: From 5/23/1995 to 5/31/1995, average Chlorophyll a of 0.012 for 1 samples in 1 months. Previous Status: Cat 3: Insufficient data Previous Action: Added to database Previous Assessment Year: 2004

Willamette Yamhill 17090008 6249	South Yamhill River 1231445452258 0 to 18.1 18.1	Chlorophyll a	Summer	Reservoir, river, estuary, non-thermally stratified lake: 0.015 mg/l	Fishing; Aesthetics; Livestock watering; Water contact recreation; Water supply	Cat 2: Attaining some criteria/uses	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10948 River Mile 16.7: From 7/2/1996 to 9/29/1996, average Chlorophyll a of 0.005 for 3 samples in 3 months. Previous Data: DEQ Data (3 Sites: 402623, 402624, 402625; RM 1.0 - 16.5): 29% (2 of 7), 0% (0 of 19, 50) Summer values respectively exceeded chlorophyll a standard (15 ug/l) with a maximum value of 20 between WY 1986 - 1995. Did not meet "Minimum Data Requirements", data did not exceed the 3-month average criteria. Previous Assessment Year: 1998 Previous Status: Cat 2: Attaining some criteria/uses Previous Action: No status change Previous Assessment Year: 2004
Willamette Yamhill 17090008 6880	South Yamhill River 1231445452258 18.1 to 42.6 24.5	Chlorophyll a	Summer	Reservoir, river, estuary, non-thermally stratified lake: 0.015 mg/l	Water contact recreation; Water supply; Aesthetics; Livestock watering; Fishing	Cat 2: Attaining some criteria/uses	No action	Previous Data: DEQ Data (Site 402627; RM 36.0): 0% (0 of 13) Summer values exceeded chlorophyll a standard (15 ug/l) between 1986 - 1988. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 6882	South Yamhill River 1231445452258 42.6 to 61.7 19.1	Chlorophyll a	Summer	Reservoir, river, estuary, non-thermally stratified lake: 0.015 mg/l	Water contact recreation; Aesthetics; Livestock watering; Water supply; Fishing	Cat 2: Attaining some criteria/uses	No action	Previous Data: DEQ Data (Site 402631; RM 53.4): 0% (0 of 5) Summer values exceeded chlorophyll a standard (15 ug/l) between 1986 - 1987. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 25895	South Yamhill River 1231445452258 0 to 61.7 61.7	Chromium	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 2: Attaining some criteria/uses	Added to database	2012 Data: [ODEQ] STATION 10948 at RM 16.7 for 9 samples from 04/15/2008 to 02/17/2010, 0 of 9 valid samples exceed the 11 ug/L criteria

Willamette Yamhill 17090008 7146	South Yamhill River 1231445452258 0 to 18.1 18.1	Copper	Year Round	Table 20 Toxic Substances	Aquatic life; Human health	Cat 5: Water quality limited, 303(d) list, TMDL needed	Status modification - Added to 303(d) list	2012 Data: [ODEQ] STATION 10948 at RM 16.7 for 10 samples from 04/15/2008 to 02/17/2010, 4 of 10 valid samples exceed the hardness dependent criteria Previous Data: Copper and Nickel were found in water, but levels were below the water quality standards Table 20 values. No other trace metals were detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 25902	South Yamhill River 1231445452258 18.1 to 61.7 43.6	Copper	Year Round	Table 20 Toxic Substances	Aquatic life; Human health	Cat 3: Insufficient data	Added to database	2012 Data: [ODEQ] STATION 36317 at RM 37.4 for 1 samples from 09/22/2010 to 09/22/2010, 0 of 1 valid samples exceed the hardness dependent criteria
Willamette Yamhill 17090008 7531	South Yamhill River 1231445452258 0 to 18.1 18.1	Cycloate	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, Desethylatrazine, Desisoproylatrazine, Diuron, Ethoprop, Hexazinone, Metolachlor, Metribuzin, Napropamide and Simazine were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 7563	South Yamhill River 1231445452258 0 to 18.1 18.1	Desethylatrazine	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, Desethylatrazine, Desisoproylatrazine, Diuron, Ethoprop, Hexazinone, Metolachlor, Metribuzin, Napropamide and Simazine were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998

Willamette Yamhill 17090008 7573	South Yamhill River 1231445452258 0 to 18.1 18.1	Desisoproylatrazine	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, Desethylatrazine, Desisoproylatrazine, Diuron, Ethoprop, Hexazinone, Metolachlor, Metribuzin, Napropamide and Simazine were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 20969	South Yamhill River 1231445452258 0 to 41 41	Dissolved Oxygen	January 1 - May 15	Spawning: Not less than 11.0 mg/L or 95% of saturation	Resident trout spawning	Cat 2: Attaining some criteria/uses	Delisted - Data show criteria met	2012 Data: [DEQ] STATION 31547 at RM 5.5 from 02/11/2005 to 02/11/2005, 0 of 1 (0%) samples < 11.0 mg/l and < 95% saturation. [DEQ] STATION 10948 at RM 16.7 from 02/16/2000 to 04/05/2011, 2 of 25 (8%) samples < 11.0 mg/l and < 95% saturation. [DEQ] STATION 10949 at RM 27 from 05/14/2009 to 05/14/2009, 0 of 1 (0%) samples < 11.0 mg/l and < 95% saturation Previous Data: [ODA] LASAR 10948 River Mile 16.7: From 1/24/1994 to 4/29/2003, 8 out of 31 samples (26%) < 11 mg/l and applicable % saturation. Previous Status: Cat 5: Water quality limited, 303(d) list, TMDL needed Previous Action: Added to database Previous Assessment Year: 2004

Willamette Yamhill 17090008 12156	South Yamhill River 1231445452258 0 to 61.8 61.8	Dissolved Oxygen	Year Round (Non-spawning)	Cool water: Not less than 6.5 mg/l	Cool-water aquatic life	Cat 2: Attaining some criteria/uses	No status change	2012 Data: [DEQ] STATION 31547 at RM 5.5 from 08/11/2004 to 07/13/2005, 0 of 3 (0%) samples < 6.5 mg/L. [DEQ] STATION 33885 at RM 14.9 from 09/20/2006 to 09/20/2006, 0 of 1 (0%) samples < 6.5 mg/L. [DEQ] STATION 10948 at RM 16.7 from 06/26/2000 to 12/07/2011, 0 of 53 (0%) samples < 6.5 mg/L. [DEQ] STATION 36089 at RM 36.7 from 10/21/2009 to 10/21/2009, 0 of 1 (0%) samples < 6.5 mg/L. [DEQ] STATION 36088 at RM 36.7 from 10/21/2009 to 10/21/2009, 0 of 1 (0%) samples < 6.5 mg/L. [DEQ] STATION 36087 at RM 36.7 from 10/21/2009 to 10/21/2009, 0 of 1 (0%) samples < 6.5 mg/L. [DEQ] STATION 35072 at RM 37.4 from 09/20/2011 to 09/20/2011, 0 of 1 (0%) samples < 6.5 mg/L. [DEQ] STATION 35451 at RM 38.7 from 06/03/2009 to 06/03/2009, 0 of 3 (0%) samples < 6.5 mg/L Previous Data: [DEQ/ODA - Salem] LASAR 10948 River Mile 16.7: From 6/1/1994 to 12/22/2003, 0 out of 54 samples (0%) < 6.5 mg/l and applicable % saturation. Previous Status: Cat 2: Attaining some criteria/uses Previous Action: Added to database Previous Assessment Year: 2004

Willamette Yamhill 17090008 25903	South Yamhill River 1231445452258 41 to 61.8 20.8	Dissolved Oxygen	October 15 - May 15	Spawning: Not less than 11.0 mg/L or 95% of saturation		Cat 3: Insufficient data	Added to database	2012 Data: [DEQ] STATION 36082 at RM 42.7 from 10/20/2009 to 10/20/2009, 0 of 1 (0%) samples < 11.0 mg/l and < 95% saturation. [DEQ] STATION 36081 at RM 42.7 from 10/20/2009 to 10/20/2009, 0 of 1 (0%) samples < 11.0 mg/l and < 95% saturation. [DEQ] STATION 36080 at RM 42.8 from 10/20/2009 to 10/20/2009, 0 of 1 (0%) samples < 11.0 mg/l and < 95% saturation. [DEQ] STATION 36079 at RM 52.5 from 10/20/2009 to 10/20/2009, 0 of 1 (0%) samples < 11.0 mg/l and < 95% saturation. [DEQ] STATION 36077 at RM 52.5 from 10/20/2009 to 10/20/2009, 0 of 1 (0%) samples < 11.0 mg/l and < 95% saturation. [DEQ] STATION 36078 at RM 52.5 from 10/20/2009 to 10/20/2009, 1 of 1 (100%) samples < 11.0 mg/l and < 95% saturation. [DEQ] STATION 35450 at RM 54.5 from 05/14/2009 to 05/14/2009, 0 of 1 (0%) samples < 11.0 mg/l and < 95% saturation
Willamette Yamhill 17090008 7611	South Yamhill River 1231445452258 0 to 18.1 18.1	Diuron	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, Desethylatrazine, Desisoproylatrazine, Diuron, Ethoprop, Hexazinone, Metolachlor, Metribuzin, Napropamide and Simazine were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 17296	South Yamhill River 1231445452258 0 to 18.1 18.1	E. Coli	FallWinterSpring	30-day log mean of 126 E. coli organisms per 100 ml; no single sample > 406 organisms per 100 ml	Water contact recreation	Cat 2: Attaining some criteria/uses	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10948 River Mile 16.7: From 1/16/1996 to 12/22/2003, 1 out of 43 samples (2%) > 406 organisms; maximum 30-day log mean of 0 Previous Status: Cat 2: Attaining some criteria/uses Previous Action: Added to database Previous Assessment Year: 2004

Willamette Yamhill 17090008 17297	South Yamhill River 1231445452258 0 to 18.1 18.1	E. Coli	Summer	30-day log mean of 126 E. coli organisms per 100 ml; no single sample > 406 organisms per 100 ml	Water contact recreation	Cat 2: Attaining some criteria/uses	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10948 River Mile 16.7: From 1/16/1996 to 12/22/2003, 0 out of 19 samples (0%) > 406 organisms; maximum 30-day log mean of 0 Previous Status: Cat 2: Attaining some criteria/uses Previous Action: Added to database Previous Assessment Year: 2004
Willamette Yamhill 17090008 7632	South Yamhill River 1231445452258 0 to 18.1 18.1	Ethoprop	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, Desethylatrazine, Desisoproylatrazine, Diuron, Ethoprop, Hexazinone, Metolachlor, Metribuzin, Napropamide and Simazine were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 6085	South Yamhill River 1231445452258 18.1 to 42.6 24.5	Fecal Coliform	FallWinterSpring	Fecal coliform log mean of 200 organisms per 100 ml; no more than 10% > 400 per 100 ml	Water contact recreation	Cat 5: Water quality limited, 303(d) list, TMDL needed	No action	Previous Data: DEQ Data (2 Sites: 402627, 402628; RM 36.0, 39.5): 20% (3 of 15), 17% (2 of 12) FWS values exceeded fecal coliform standard (400) with maximum values of 460, 1100 respectively between 1986 - 1988. Previous Status: 303(d) Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 6878	South Yamhill River 1231445452258 18.1 to 42.6 24.5	Fecal Coliform	Summer	Fecal coliform log mean of 200 organisms per 100 ml; no more than 10% > 400 per 100 ml	Water contact recreation	Cat 5: Water quality limited, 303(d) list, TMDL needed	No action	Previous Data: DEQ Data (Site 402627; RM 36.0): 44% (4 of 9) Summer values exceeded fecal coliform standard (400) with a maximum value of 460 between 1986 - 1988. Previous Status: 303(d) Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 6087	South Yamhill River 1231445452258 42.6 to 61.7 19.1	Fecal Coliform	FallWinterSpring	Fecal coliform log mean of 200 organisms per 100 ml; no more than 10% > 400 per 100 ml	Water contact recreation	Cat 2: Attaining some criteria/uses	No action	Previous Data: DEQ Data (Site 402631; RM 53.4): 0% (0 of 12) FWS values exceeded fecal coliform standard (400) between 1986 - 1988. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998

Willamette Yamhill 17090008 6086	South Yamhill River 1231445452258 42.6 to 61.7 19.1	Fecal Coliform	Summer	Fecal coliform log mean of 200 organisms per 100 ml; no more than 10% > 400 per 100 ml	Water contact recreation	Cat 5: Water quality limited, 303(d) list, TMDL needed	No action	Previous Data: DEQ Data (Site 402631; RM 53.4): 40% (2 of 5) Summer values exceeded fecal coliform standard (400) with a maximum value of 460 between 1986 - 1987. Previous Status: 303(d) Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 6341	South Yamhill River 1231445452258 18.1 to 42.6 24.5	Flow Modification	Undefined	The creation of tastes or odors or toxic or other conditions that are deleterious to fish or other aquatic life or affect the potability of drinking water or the palatability of fish or shellfish may not be allowed.	Salmonid fish rearing; Resident fish and aquatic life; Salmonid fish spawning	Cat 4C: Water quality limited, not a pollutant	No action	Cutthroat populations are a stock of concern with low flows and high temperatures constraining populations in some coast range streams (ODFW, 92); IWR (59461) is often not met at USGS gage (14194000). Previous Status: Water quality limited not needing a TMDL Previous Action: Delisted - Water quality limited, not a pollutant Previous Assessment Year: 2002
Willamette Yamhill 17090008 6342	South Yamhill River 1231445452258 42.6 to 61.7 19.1	Flow Modification	Undefined	The creation of tastes or odors or toxic or other conditions that are deleterious to fish or other aquatic life or affect the potability of drinking water or the palatability of fish or shellfish may not be allowed.	Salmonid fish spawning; Resident fish and aquatic life; Salmonid fish rearing	Cat 3: Insufficient data	Status modification	Incorrectly assigned Water Quality Limited status in 2002 de-listing action. Status corrected to reflect 1998 assessment status. Previous Status: Water quality limited not needing a TMDL Previous Action: Delisted - Water quality limited, not a pollutant Previous Assessment Year: 2002
Willamette Yamhill 17090008 7652	South Yamhill River 1231445452258 0 to 18.1 18.1	Hexazinone	Year Round	Table 20 Toxic Substances	Drinking water; Resident fish and aquatic life; Anadromous fish passage	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, Desethylatrazine, Desisoproylatrazine, Diuron, Ethoprop, Hexazinone, Metolachlor, Metribuzin, Napropamide and Simazine were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998

Willamette Yamhill 17090008 8384	South Yamhill River 1231445452258 0 to 18.1 18.1	Iron	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 5: Water quality limited, 303(d) list, TMDL needed	No status change	2012 Data: [ODEQ] STATION 10948 at RM 16.7 for 26 samples from 02/16/2000 to 10/04/2007, 0 of 0 valid samples exceed the 1000 ug/L criteria Previous Data: [DEQ/ODA - Salem] LASAR 10948 River Mile 16.7: From 1/24/1994 to 8/13/2001, 10 out of 69 samples > applicable Table 20 criterion. Previous Data: LASAR 10948 RM 16.8: 2/4 samples > 300 ug/L. Previous Assessment Year: 2002 Previous Status: Cat 5: Water quality limited, 303(d) list, TMDL needed Previous Action: No status change Previous Assessment Year: 2004
Willamette Yamhill 17090008 25896	South Yamhill River 1231445452258 0 to 61.7 61.7	Lead	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 5: Water quality limited, 303(d) list, TMDL needed	Added to database	2012 Data: [ODEQ] STATION 10948 at RM 16.7 for 9 samples from 04/15/2008 to 02/17/2010, 2 of 9 valid samples exceed the hardness dependent criteria. [ODEQ] STATION 36317 at RM 37.4 for 1 samples from 09/22/2010 to 09/22/2010, 0 of 1 valid samples exceed the hardness dependent criteria
Willamette Yamhill 17090008 17299	South Yamhill River 1231445452258 0 to 61.8 61.8	Manganese	Year Round	Table 20 Toxic Substances	Human health	Cat 3B: Insufficient data, potential concern	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10948 River Mile 16.7: From 1/24/1994 to 8/13/2001, 1 out of 69 samples > applicable Table 20 criterion. Previous Status: Cat 3B: Potential concern Previous Action: Added to database Previous Assessment Year: 2004
Willamette Yamhill 17090008 6796	South Yamhill River 1231445452258 0 to 18.1 18.1	Mercury	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 3B: Insufficient data, potential concern	No action	Previous Data: USGS Data (Site at Hwy 99 Bridge): 1 value detected above standard, a minimum of two exceedences needed to be listed - did not meet listing criteria. Previous Status: Potential concern Previous Action: Added to database Previous Assessment Year: 1998

Willamette Yamhill 17090008 7741	South Yamhill River 1231445452258 0 to 18.1 18.1	Metolachlor	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, Desethylatrazine, Desisoproylatrazine, Diuron, Ethoprop, Hexazinone, Metolachlor, Metribuzin, Napropamide and Simazine were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 7754	South Yamhill River 1231445452258 0 to 18.1 18.1	Metribuzin	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Drinking water; Anadromous fish passage	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, Desethylatrazine, Desisoproylatrazine, Diuron, Ethoprop, Hexazinone, Metolachlor, Metribuzin, Napropamide and Simazine were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 7762	South Yamhill River 1231445452258 0 to 18.1 18.1	Napropamide	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, Desethylatrazine, Desisoproylatrazine, Diuron, Ethoprop, Hexazinone, Metolachlor, Metribuzin, Napropamide and Simazine were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 7771	South Yamhill River 1231445452258 0 to 18.1 18.1	Nickel	Year Round	Table 20 Toxic Substances	Aquatic life; Human health	Cat 2: Attaining some criteria/uses	No status change	2012 Data: [ODEQ] STATION 10948 at RM 16.7 for 10 samples from 04/15/2008 to 02/17/2010, 0 of 10 valid samples exceed the hardness dependent criteria Previous Data: Copper and Nickel were found in water, but levels were below the water quality standards Table 20 values. No other trace metals were detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998

Willamette Yamhill 17090008 6509	South Yamhill River 1231445452258 0 to 18.1 18.1	pH	FallWinterSpring	pH 6.5 to 8.5	Water contact recreation; Salmonid fish spawning; Anadromous fish passage; Resident fish and aquatic life; Salmonid fish rearing	Cat 2: Attaining some criteria/uses	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10948 River Mile 16.7: From 1/24/1994 to 12/22/2003, 0 out of 60 samples (0%) outside pH criteria range 6.5 to 8.5. Previous Data: DEQ Data (Site 402625; RM 16.5): 0% (0 of 73) FWS values exceeded pH standard (6.5 - 8.5) between WY 1986 - 1995. Previous Assessment Year: 1998 Previous Status: Cat 2: Attaining some criteria/uses Previous Action: No status change Previous Assessment Year: 2004
Willamette Yamhill 17090008 6877	South Yamhill River 1231445452258 0 to 18.1 18.1	pH	Summer	pH 6.5 to 8.5	Water contact recreation; Salmonid fish spawning; Anadromous fish passage; Resident fish and aquatic life; Salmonid fish rearing	Cat 2: Attaining some criteria/uses	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10948 River Mile 16.7: From 6/1/1994 to 8/4/2003, 0 out of 28 samples (0%) outside pH criteria range 6.5 to 8.5. Previous Data: DEQ Data (3 Sites: 402623, 402624, 402625; RM 1.0 - 16.5): 0% (0 of 7, 18, 52) Summer values respectively exceeded pH standard (6.5 - 8.5) between WY 1986 - 1995. Previous Assessment Year: 1998 Previous Status: Cat 2: Attaining some criteria/uses Previous Action: No status change Previous Assessment Year: 2004
Willamette Yamhill 17090008 6510	South Yamhill River 1231445452258 18.1 to 42.6 24.5	pH	FallWinterSpring	pH 6.5 to 8.5	Resident fish and aquatic life; Anadromous fish passage; Salmonid fish rearing; Water contact recreation; Salmonid fish spawning	Cat 2: Attaining some criteria/uses	No action	Previous Data: DEQ Data (2 Sites: 402627, 402628; RM 36.0, 39.5): 0% (0 of 15, 12) FWS values respectively exceeded pH standard (6.5 -8.5) between 86 - 88. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 6879	South Yamhill River 1231445452258 18.1 to 42.6 24.5	pH	Summer	pH 6.5 to 8.5	Salmonid fish spawning; Salmonid fish rearing; Water contact recreation; Resident fish and aquatic life; Anadromous fish passage	Cat 2: Attaining some criteria/uses	No action	Previous Data: DEQ Data (Site 402627; RM 36.0): 0% (0 of 12) Summer values exceeded pH standard (6.5 -8.5) between 1986 - 1988. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 6511	South Yamhill River 1231445452258 42.6 to 61.7 19.1	pH	FallWinterSpring	pH 6.5 to 8.5	Salmonid fish spawning; Salmonid fish rearing; Resident fish and aquatic life; Anadromous fish passage; Water contact recreation	Cat 2: Attaining some criteria/uses	No action	Previous Data: DEQ Data (Site 402631; RM 53.4): 0% (0 of 12) FWS values exceeded pH standard (6.5 - 8.5) between 1986 - 1988. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998

Willamette Yamhill 17090008 6881	South Yamhill River 1231445452258 42.6 to 61.7 19.1	pH	Summer	pH 6.5 to 8.5	Resident fish and aquatic life; Salmonid fish rearing; Water contact recreation; Salmonid fish spawning; Anadromous fish passage	Cat 2: Attaining some criteria/uses	No action	Previous Data: DEQ Data (Site 402631; RM 53.4): 0% (0 of 5) Summer values exceeded pH standard (6.5 - 8.5) between 1986 - 1987. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 21575	South Yamhill River 1231445452258 0 to 61.8 61.8	Phosphate Phosphorus	Summer	Total phosphates as phosphorus (P): Benchmark 50 ug/L in streams to control excessive aquatic growths	Aquatic life	Cat 2: Attaining some criteria/uses	No action	Previous Data: [DEQ] LASAR 10948 River Mile 16.7: From 6/1/1994 to 8/4/2003, 1 out of 27 samples > 50 ug/L benchmark criterion. Previous Status: Cat 2: Attaining some criteria/uses Previous Action: Added to database Previous Assessment Year: 2004
Willamette Yamhill 17090008 6422	South Yamhill River 1231445452258 0 to 18.1 18.1	Phosphorus	May 1 - October 31	Biocriteria: Waters of the state must be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities.	Aesthetics	Cat 4A: Water quality limited, TMDL approved	No action	Previous Data: DEQ Data (Site 402625; RM 16.5): 0% (0 of 10) May through October values exceeded phosphorus TMDL standard (70 ug/l) with a maximum value of 60 ug/l between 6/94 - 10/95. Previous Status: TMDL approved Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 6423	South Yamhill River 1231445452258 18.1 to 42.6 24.5	Phosphorus	May 1 - October 31	Biocriteria: Waters of the state must be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities.	Aesthetics	Cat 4A: Water quality limited, TMDL approved	No action	Previous Data: DEQ Data (Site 402627, RM 36.0): 0% (0 of 19) May through October values exceeded TMDL phosphorus standard (70 ug/l) between 1986 - 1988. Previous Status: TMDL approved Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 6424	South Yamhill River 1231445452258 42.6 to 61.7 19.1	Phosphorus	May 1 - October 31	Biocriteria: Waters of the state must be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities.	Aesthetics	Cat 4A: Water quality limited, TMDL approved	No action	Previous Data: DEQ Data (Site 402631, RM 53.4): 14% (1 of 7) May through October values exceeded TMDL phosphorus standard (70 ug/l) with a maximum of 110 ug/l between 1986 - 1988. Previous Status: TMDL approved Previous Action: Added to database Previous Assessment Year: 1998

Willamette Yamhill 17090008 6687	South Yamhill River 1231445452258 0 to 18.1 18.1	Sedimentation	Undefined	The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry may not be allowed.	Resident fish and aquatic life; Salmonid fish spawning; Salmonid fish rearing	Cat 3: Insufficient data	No action	Previous Status: Insufficient data Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 6688	South Yamhill River 1231445452258 18.1 to 42.6 24.5	Sedimentation	Undefined	The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry may not be allowed.	Salmonid fish rearing; Salmonid fish spawning; Resident fish and aquatic life	Cat 3: Insufficient data	No action	Previous Status: Insufficient data Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 6689	South Yamhill River 1231445452258 42.6 to 61.7 19.1	Sedimentation	Undefined	The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry may not be allowed.	Salmonid fish spawning; Salmonid fish rearing; Resident fish and aquatic life	Cat 3: Insufficient data	No action	Previous Status: Insufficient data Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 25898	South Yamhill River 1231445452258 0 to 61.7 61.7	Selenium	Year Round	Table 20 Toxic Substances	Aquatic life; Human health	Cat 2: Attaining some criteria/uses	Added to database	2012 Data: [ODEQ] STATION 10948 at RM 16.7 for 11 samples from 04/15/2008 to 02/17/2010, 0 of 11 valid samples exceed the 35 ug/L criteria. [ODEQ] STATION 36317 at RM 37.4 for 1 samples from 09/22/2010 to 09/22/2010, 0 of 1 valid samples exceed the 35 ug/L criteria
Willamette Yamhill 17090008 25894	South Yamhill River 1231445452258 0 to 61.7 61.7	Silver	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 2: Attaining some criteria/uses	Added to database	2012 Data: [ODEQ] STATION 10948 at RM 16.7 for 11 samples from 04/15/2008 to 02/17/2010, 0 of 11 valid samples exceed the 0.12 ug/L criteria

Willamette Yamhill 17090008 7890	South Yamhill River 1231445452258 0 to 18.1 18.1	Simazine	Year Round	Table 20 Toxic Substances	Resident fish and aquatic life; Anadromous fish passage; Drinking water	Cat 2: Attaining some criteria/uses	No action	Previous Data: Atrazine, Cycloate, Desethylatrazine, Desisoproylatrazine, Diuron, Ethoprop, Hexazinone, Metolachlor, Metribuzin, Napropamide and Simazine were found but either do not have or were below any water quality standard, guidance level or criteria. No other pesticides detected. Previous Status: Attaining Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 5963	South Yamhill River 1231445452258 0 to 18.1 18.1	Temperature	Summer	Rearing: 17.8 C	Salmonid fish rearing; Anadromous fish passage	Cat 5: Water quality limited, 303(d) list, TMDL needed	No action	Previous Data: DEQ Data (Site 402625; RM 16.5): 88% (46 of 52) Summer values exceeded temperature standard (64) with exceedances each year and a maximum of 81.5 in WY 1986 - 1995. Previous Status: 303(d) Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 5964	South Yamhill River 1231445452258 18.1 to 42.6 24.5	Temperature	Summer	Rearing: 17.8 C	Anadromous fish passage; Salmonid fish rearing	Cat 5: Water quality limited, 303(d) list, TMDL needed	No action	Previous Data: DEQ Data (Site 402627; RM 36): 75% (9 of 12) Summer values exceeded temperature standard (64) with exceedances each year and a maximum of 75.9 in WY 1986 - 1988. Previous Status: 303(d) Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 5965	South Yamhill River 1231445452258 42.6 to 61.7 19.1	Temperature	Undefined		Salmonid fish rearing; Resident fish and aquatic life; Anadromous fish passage; Salmonid fish spawning	Cat 3: Insufficient data	No action	Previous Status: Insufficient data Previous Action: Added to database Previous Assessment Year: 1998
Willamette Yamhill 17090008 25900	South Yamhill River 1231445452258 0 to 61.7 61.7	Zinc	Year Round	Table 20 Toxic Substances	Aquatic life; Human health	Cat 3B: Insufficient data, potential concern	Added to database	2012 Data: [ODEQ] STATION 10948 at RM 16.7 for 9 samples from 04/15/2008 to 02/17/2010, 1 of 9 valid samples exceed the hardness dependent criteria. [ODEQ] STATION 36317 at RM 37.4 for 1 samples from 09/22/2010 to 09/22/2010, 0 of 1 valid samples exceed the hardness dependent criteria

Willamette Yamhill 17090008 16915	Yamhill River 1229962452299 0 to 11.2 11.2	Alkalinity	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 3B: Insufficient data, potential concern	No action	Previous Data: [DEQ] LASAR 10648 River Mile 0: From 8/30/1995 to 8/30/1995, 0 out of 1 samples < 20 mg/L (Table 20 criterion). [DEQ/ODA - Salem] LASAR 10363 River Mile 5: From 1/24/1994 to 12/22/2003, 9 out of 83 samples < 20 mg/L (Table 20 criterion). Previous Status: Cat 3B: Potential concern Previous Action: Added to database Previous Assessment Year: 2004
Willamette Yamhill 17090008 16916	Yamhill River 1229962452299 0 to 11.2 11.2	Ammonia	Year Round	Table 20 Toxic Substances	Aquatic life	Cat 2: Attaining some criteria/uses	No action	Previous Data: [DEQ/ODA - Salem] LASAR 10363 River Mile 5: From 1/24/1994 to 12/22/2003, 0 out of 112 samples > applicable Table 20 criterion. [DEQ] LASAR 10648 River Mile 0: From 8/30/1995 to 8/30/1995, 0 out of 1 samples > applicable Table 20 criterion. Previous Status: Cat 2: Attaining some criteria/uses Previous Action: Added to database Previous Assessment Year: 2004
Willamette Yamhill 17090008 7157	Yamhill River 1229962452299 0 to 11.2 11.2	Antimony	Year Round	Toxic substances may not be introduced above natural background levels in the waters of the State in amounts, concentrations, or combinations that may be harmful, may chemically change to harmful forms in the environment, or may accumulate in sediment...	Drinking water; Resident fish and aquatic life; Anadromous fish passage	Cat 3B: Insufficient data, potential concern	No action	Previous Data: Antimony, Arsenic, Chromium, Copper, Manganese, Nickel and Zinc were found in elevated levels in sediments when compared to various guidelines or guidance values, however, sediment toxicity does not correlate well with sediment contaminant concentrations and is dependent on local conditions. To determine toxicity a demonstration of a beneficial use impairment is needed. No data on beneficial use impairment (e.g. bioassays) is available. For constituents in sediment there is no single type of sediment-quality guideline generally accepted in the scientific literature. Previous Status: Potential concern Previous Action: Added to database Previous Assessment Year: 1998

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Contact

For more information about DEQ's Integrated Report and 303(d) list contact Joshua Emerson (mailto:emerson.joshua@deq.state.or.us) at 503-229-5740.

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Facility #: 119465 C.C. MEISEL CO., INC. DBA MEISEL ROCK PRODUCTS (aka. PENLAND FARM) END OF DORSEY ROAD MCMINNVILLE, OR 97128	View Permit(s) (StatusOfPermitApplicationResults.aspx?facilityID=119465)
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Facility #: 112705 FIRST STUDENT INC. (aka. FIRST STUDENT, INC. #10449 - MCMINNVILLE) 1936 NE LAFAYETTE AVE MCMINNVILLE, OR 97128	View Permit(s) (StatusOfPermitApplicationResults.aspx?facilityID=112705)
Facility #: 125556 GALLANT CONSTRUCTION CORPORATION (aka. SAWTOOTH INDUSTRIAL DEVELOPMENT) 1445 NE MILLER STREET MCMINNVILLE, OR 97128	View Permit(s) (StatusOfPermitApplicationResults.aspx?facilityID=125556)

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Facility #: 125973 Hoilien, Michael Dean (aka. Michael Dean Hoilien) 2701 NW HORIZON DR MCMINNVILLE, OR 97128	View Permit(s) (StatusOfPermitApplicationResults.aspx?facilityID=125973)
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Facility #: 123808 KLAUS, DEAN C. (aka. YOUR SPACE STORAGE ADDITION) 1500 LAFAYETTE AVE MCMINNVILLE, OR 97128	View Permit(s) (StatusOfPermitApplicationResults.aspx?facilityID=123808)

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Facility #: 123659 LAFAYETTE PLACE APARTMENTS, LLC (aka. LAFAYETTE PLACE APARTMENTS) LAFAYETTE AVE AND ORCHARD AVE MCMINNVILLE, OR 97128	View Permit(s) (StatusOfPermitApplicationResults.aspx?facilityID=123659)
Facility #: 125084 LCG PENCE CONSTRUCTION (aka. MCMINNVILLE HIGH SCHOOL ADDITION AND REMODEL-PHASE 1) 615 NE 15TH STREET MCMINNVILLE, OR 97128	View Permit(s) (StatusOfPermitApplicationResults.aspx?facilityID=125084)
Facility #: 125347 LGI Homes - Oregon LLC (aka. LGI Homes) NW HILL RD AND NW BAKER RD MCMINNVILLE, OR 97128	View Permit(s) (StatusOfPermitApplicationResults.aspx?facilityID=125347)
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Facility #: 123043 MCMINNVILLE AREA HABITAT FOR HUMANITY (aka. ATLANTIC STREET COMMUNITY) 105 NW ATLANTIC ST. MCMINNVILLE, OR 97128	View Permit(s) (StatusOfPermitApplicationResults.aspx?facilityID=123043)

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Facility #: 107116 MORELAND OIL CO. (aka. MORELAND OIL CO.) 1700 NE LAFAYETTE AVE MCMINNVILLE, OR 97128-3432	View Permit(s) (StatusOfPermitApplicationResults.aspx?facilityID=107116)
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Facility #: 126006 Olde Stone Village NW, LLC (aka. Olde Stone Village RV Storage Expansion) NE HEATHER DRIVE AND NE DAWN DRIVE MCMINNVILLE, OR 97128	View Permit(s) (StatusOfPermitApplicationResults.aspx?facilityID=126006)

Facility #: 125768 PACIFIC NORTH CONSTRUCTION (aka. PACIFIC NORTH CONSTRUCTION) 2090 NE Colvin Ct Mcminnville, OR 97128	View Permit(s) (StatusOfPermitApplicationResults.aspx?facilityID=125768)
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Facility #: 124107 PREMIER DEVELOPMENT, LLC (aka. WEST VALLEY ESTATES PHASE 4) SW MT. WASHINGTON STREET MCMINNVILLE, OR 97128	View Permit(s) (StatusOfPermitApplicationResults.aspx?facilityID=124107)
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Facility #: 125844 RB&R CONTRACTORS (aka. THE VILLAGE AT BLACK ROCK FALLS) 1730 SW 2ND ST MCMINNVILLE, OR 97128	View Permit(s) (StatusOfPermitApplicationResults.aspx?facilityID=125844)
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Facility #: 106959 RIVERBEND LANDFILL CO. (aka. RIVERBEND LANDFILL) 13469 SW HIGHWAY 18 MCMINNVILLE, OR 97128	View Permit(s) (StatusOfPermitApplicationResults.aspx?facilityID=106959)
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Facility #: 125325 SP SOLAR 7, LLC (aka. DAYTON CUTOFF SOLAR FARM) 9810 SE AMITY DAYTON HWY MCMINNVILLE, OR 97128-8713	View Permit(s) (StatusOfPermitApplicationResults.aspx?facilityID=125325)
Facility #: 109341 UFP MCMINNVILLE, LLC (aka. PLANT 388) 1726 SW HWY 18 MCMINNVILLE, OR 97128	View Permit(s) (StatusOfPermitApplicationResults.aspx?facilityID=109341)
Facility #: 123879 ULTIMATE RB, INC. (aka. RB RUBBER) 904 NE 10TH AVENUE MCMINNVILLE, OR 97128	View Permit(s) (StatusOfPermitApplicationResults.aspx?facilityID=123879)

Facility #: 107592 West Coast Feed and Seed LLC (aka. West Coast Feed and Seed) 102 SE BOOTH BEND ROAD MCMINNVILLE, OR 97128	View Permit(s) (StatusOfPermitApplicationResults.aspx?facilityID=107592)
Facility #: 124842 WEST HILLS PROPERTIES LLC (aka. VALLEY'S EDGE PHASE 4) NW 2ND ST AND SW VALLEY'S EDGE ST MCMINNVILLE, OR 97128	View Permit(s) (StatusOfPermitApplicationResults.aspx?facilityID=124842)
Facility #: 124336 WEST HILLS PROPERTIES, LLC (aka. BROOKSHIRE PHASE 1) WESTERN END OF NW SECOND ST MCMINNVILLE, OR 97128	View Permit(s) (StatusOfPermitApplicationResults.aspx?facilityID=124336)
Facility #: 125020 WORLD CLASS TECHNOLOGY CORPORATION (aka. WORLD CLASS TECHNOLOGY SITE EXPANSION) NE ALPHA DR & NE RIVERSIDE DR. MCMINNVILLE, OR 97128	View Permit(s) (StatusOfPermitApplicationResults.aspx?facilityID=125020)
Facility #: 125263 YAMHILL COMMUNITY DEVELOPMENT CORPORATION (aka. WHISPERING MEADOWS) 3055 NE CUMULUS AVE MCMINNVILLE, OR 97114	View Permit(s) (StatusOfPermitApplicationResults.aspx?facilityID=125263)

If you would like to contact DEQ regarding a permit application, please contact your local DEQ office (http://www.deq.state.or.us/about/locations.htm).

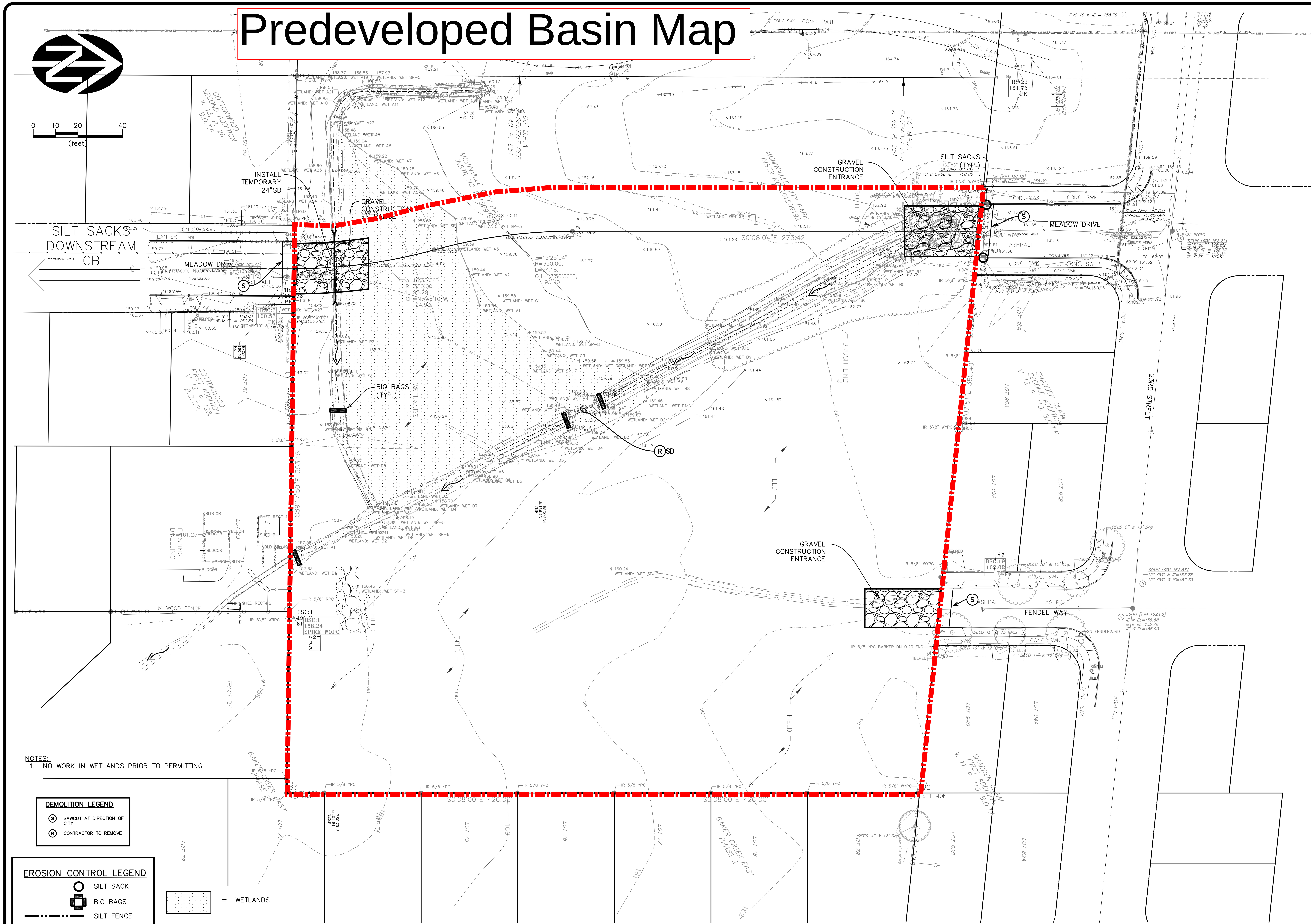
Department of Environmental Quality (http://www.oregon.gov/DEQ/)
700 NE Multnomah Street, Suite 600 Portland, OR 97232
Hours: Mon-Fri, 8 a.m.-5 p.m
Email: DEQInfo@deq.state.or.us (mailto:DEQInfo@deq.state.or.us) | Phone: 503-229-5696 | Fax: 503-229-6124

APPENDIX II

Drainage Basin Map

PREDEVELOPED BASIN MAP

Predeveloped Basin Map



NOTES:
1. NO WORK IN WETLANDS PRIOR TO PERMITTING

DEMOLITION LEGEND
(S) SAWCUT AT DIRECTION OF CITY
(R) CONTRACTOR TO REMOVE

EROSION CONTROL LEGEND
SILT SACK
BIO BAGS
SILT FENCE
= WETLANDS

NO.	DATE	DESCRIPTION	BY
		REVISIONS	

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

DSN. JW
DRN. IH
CKD. JW
DATE 05/2008

REVIEW REVIEW

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

VJ-2 DEVELOPMENT
FENDEL WAY SUBDIVISION

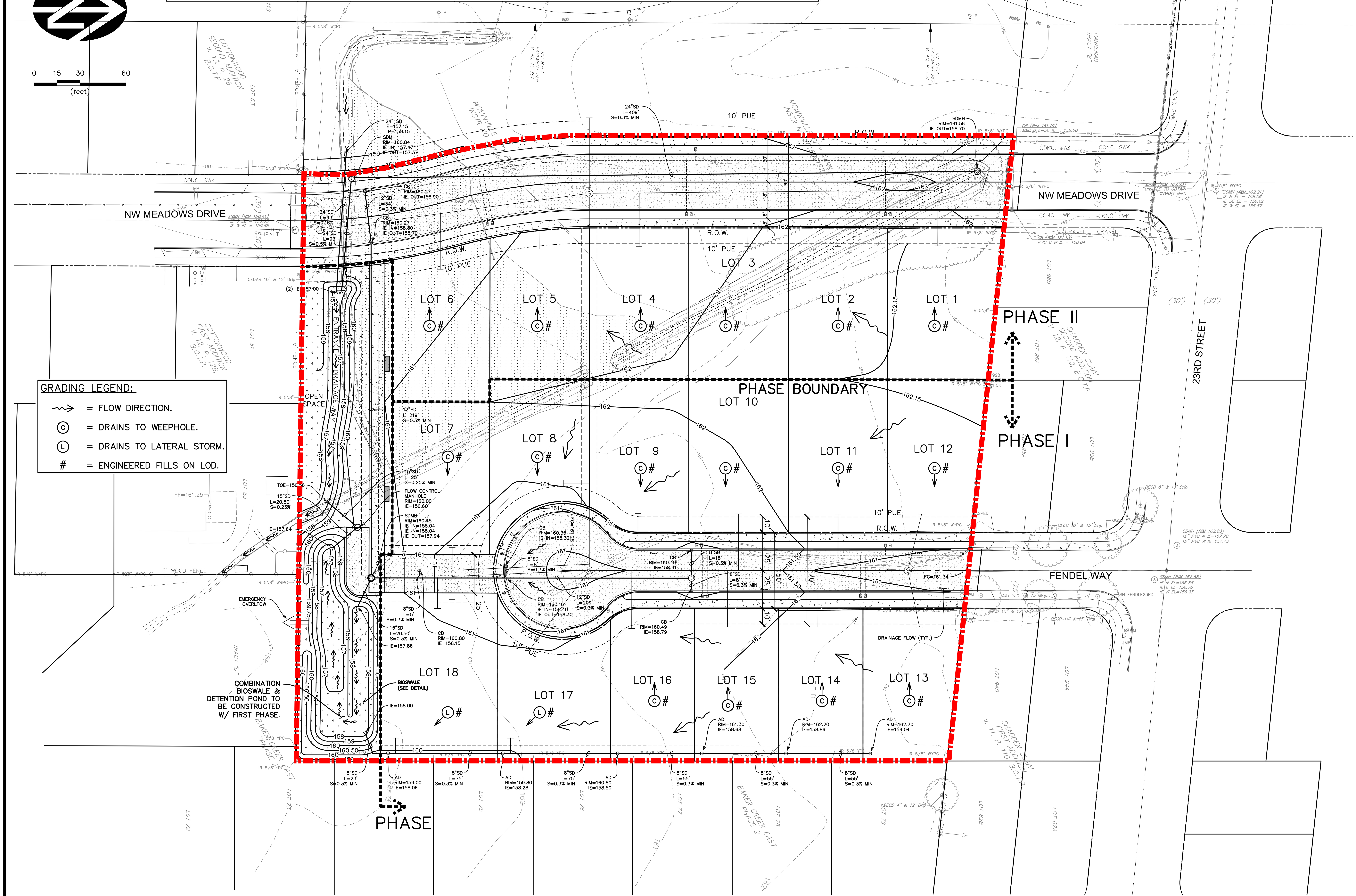
PRE-DEVELOPED EROSION CONTROL PLAN

DRAWING
C1.0

JOB NUMBER
2931.0000.0

DEVELOPED BASIN MAP

Developed Drainage Basin Map



VJ-2 DEVELOPMENT
ELYSIAN SUBDIVISION

OVERALL GRADING AND DRAINAGE PLAN

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. SE., Suite 100, Salem, OR 97302
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

REVIEW

DSN. JW
DRN. IH/AK
CKD. JW
DATE: 05/02/2008

VERIFY SCALE: BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

NO. | DATE | DESCRIPTION | BY
REVISIONS

DRAWING
C3.0

JOB NUMBER
2931.0000.0

APPENDIX III

Basin Hydrologic Characteristics

SOILS MAPS WITH HYDROLOGIC SOIL GROUP

Map Scale: 1:1,200 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 15 30 60 90

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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:
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: Yamhill County, Oregon
Survey Area Data: Version 7, Sep 10, 2019

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

Date(s) aerial images were photographed: Apr 16, 2015—Feb 12, 2017

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

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
2301A	Amity silt loam, 0 to 3 percent slopes	C/D	2.0	40.6%
2310A	Woodburn silt loam, 0 to 3 percent slopes	C	2.9	59.4%
Totals for Area of Interest			**4.9**	**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

Map Scale: 1:1,200 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 15 30 60 90

Feet
0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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:
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: Yamhill County, Oregon
Survey Area Data: Version 7, Sep 10, 2019

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

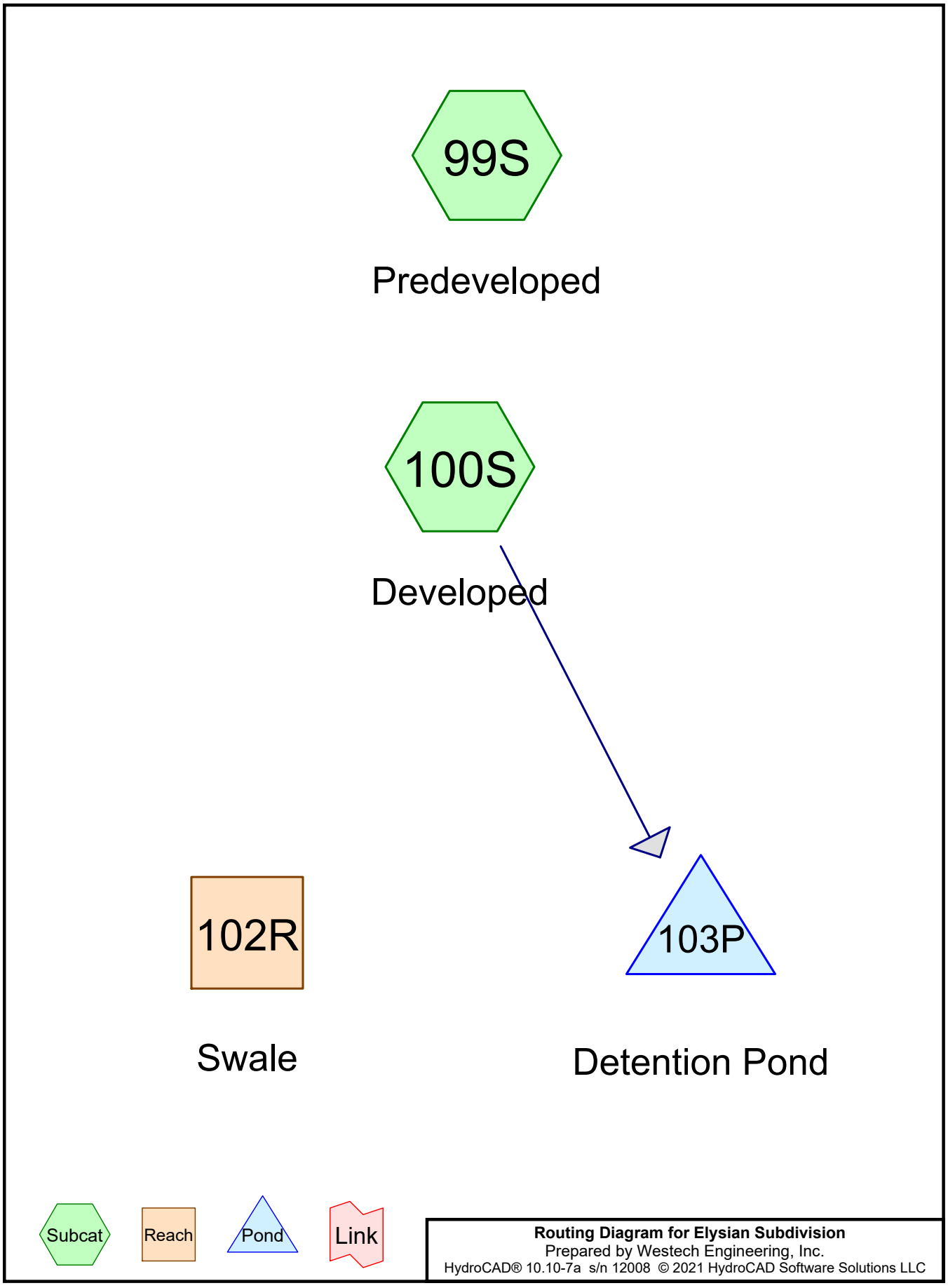
Date(s) aerial images were photographed: Apr 16, 2015—Feb 12, 2017

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
2301A	Amity silt loam, 0 to 3 percent slopes	2.0	40.6%
2310A	Woodburn silt loam, 0 to 3 percent slopes	2.9	59.4%
Totals for Area of Interest		**4.9**	**100.0%**

HYDROCAD ANALYSIS



Routing Diagram for Elysian Subdivision
Prepared by Westech Engineering, Inc.

Summary for Subcatchment 99S: Predeveloped

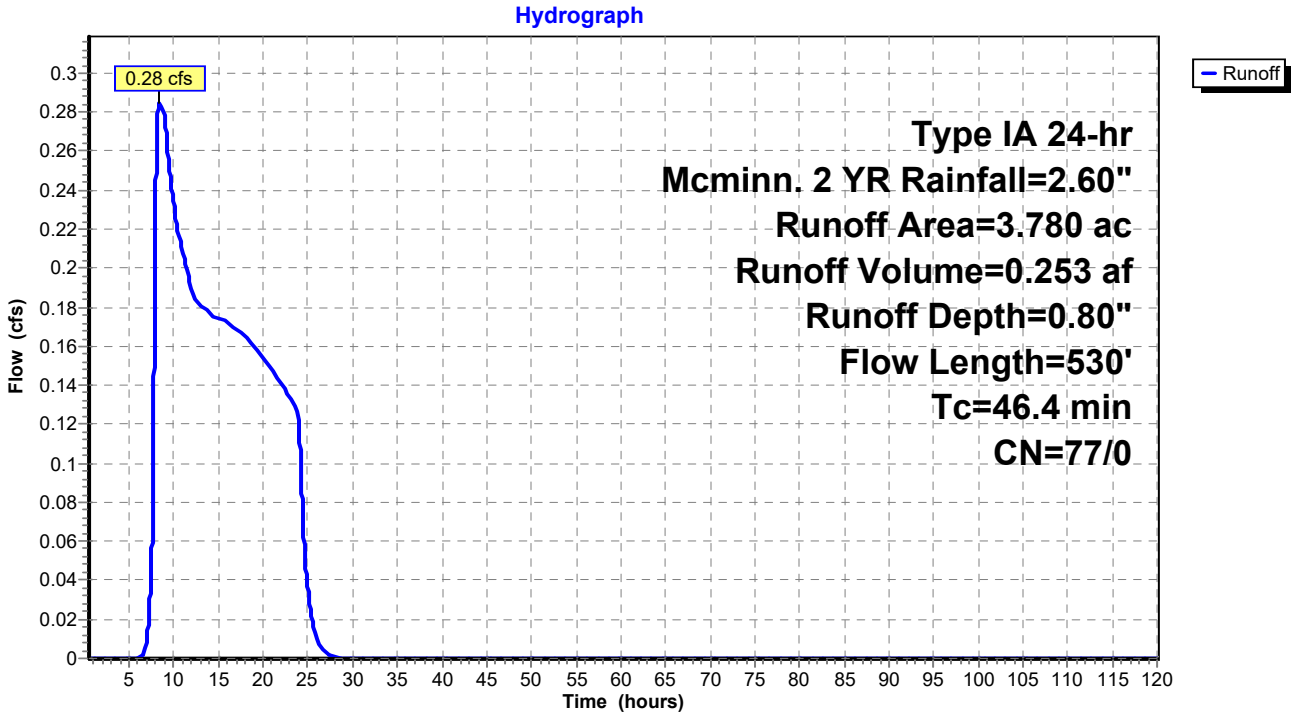
Runoff = 0.28 cfs @ 8.37 hrs, Volume= 0.253 af, Depth= 0.80"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.01 hrs
Type IA 24-hr Mcminn. 2 YR Rainfall=2.60"

Area (ac)	CN	Description
2.200	74	Pasture/grassland/range, Good, HSG C
1.580	80	Pasture/grassland/range, Good, HSG D
3.780	77	Weighted Average
3.780		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.4	300	0.0107	0.12		**Sheet Flow,** Cultivated: Residue>20% n= 0.170 P2= 2.20"
6.0	230	0.0083	0.64		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
46.4	530	Total			

Subcatchment 99S: Predeveloped



Summary for Subcatchment 99S: Predeveloped

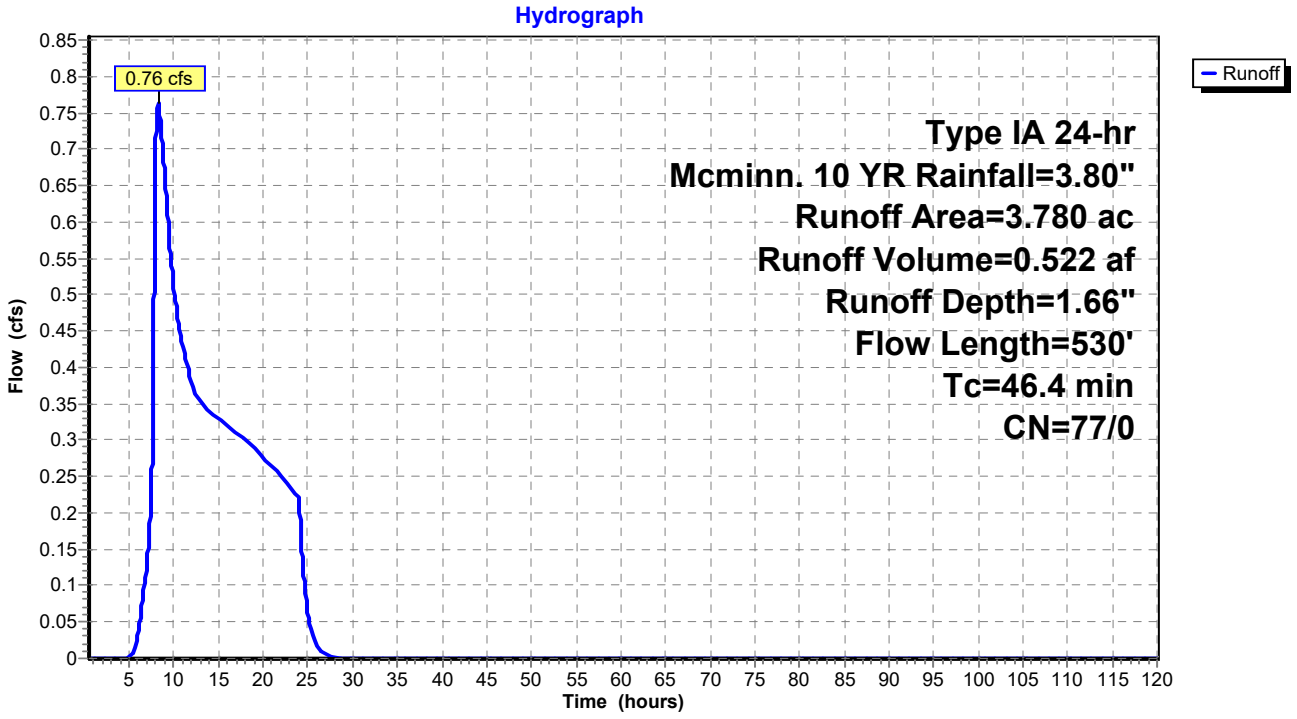
Runoff = 0.76 cfs @ 8.22 hrs, Volume= 0.522 af, Depth= 1.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.01 hrs
Type IA 24-hr Mcminn. 10 YR Rainfall=3.80"

Area (ac)	CN	Description
2.200	74	Pasture/grassland/range, Good, HSG C
1.580	80	Pasture/grassland/range, Good, HSG D
3.780	77	Weighted Average
3.780		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.4	300	0.0107	0.12		**Sheet Flow,** Cultivated: Residue>20% n= 0.170 P2= 2.20"
6.0	230	0.0083	0.64		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
46.4	530	Total			

Subcatchment 99S: Predeveloped



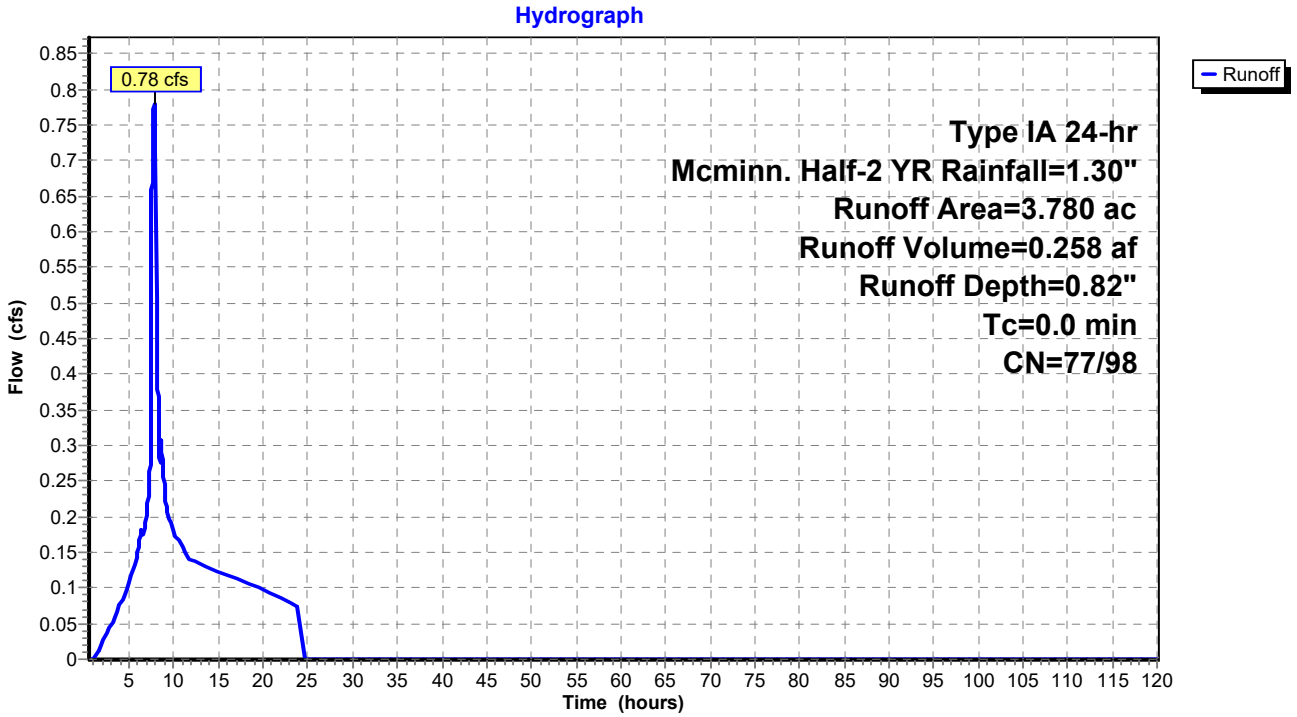
Summary for Subcatchment 100S: Developed

Runoff = 0.78 cfs @ 7.80 hrs, Volume= 0.258 af, Depth= 0.82"
Routed to Reach 102R : Swale

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.01 hrs
Type IA 24-hr Mcminn. Half-2 YR Rainfall=1.30"

Area (ac)	CN	Description
0.500	74	>75% Grass cover, Good, HSG C
0.550	80	>75% Grass cover, Good, HSG D
2.730	98	Paved parking, HSG C
3.780	92	Weighted Average
1.050		27.78% Pervious Area
2.730		72.22% Impervious Area

Subcatchment 100S: Developed



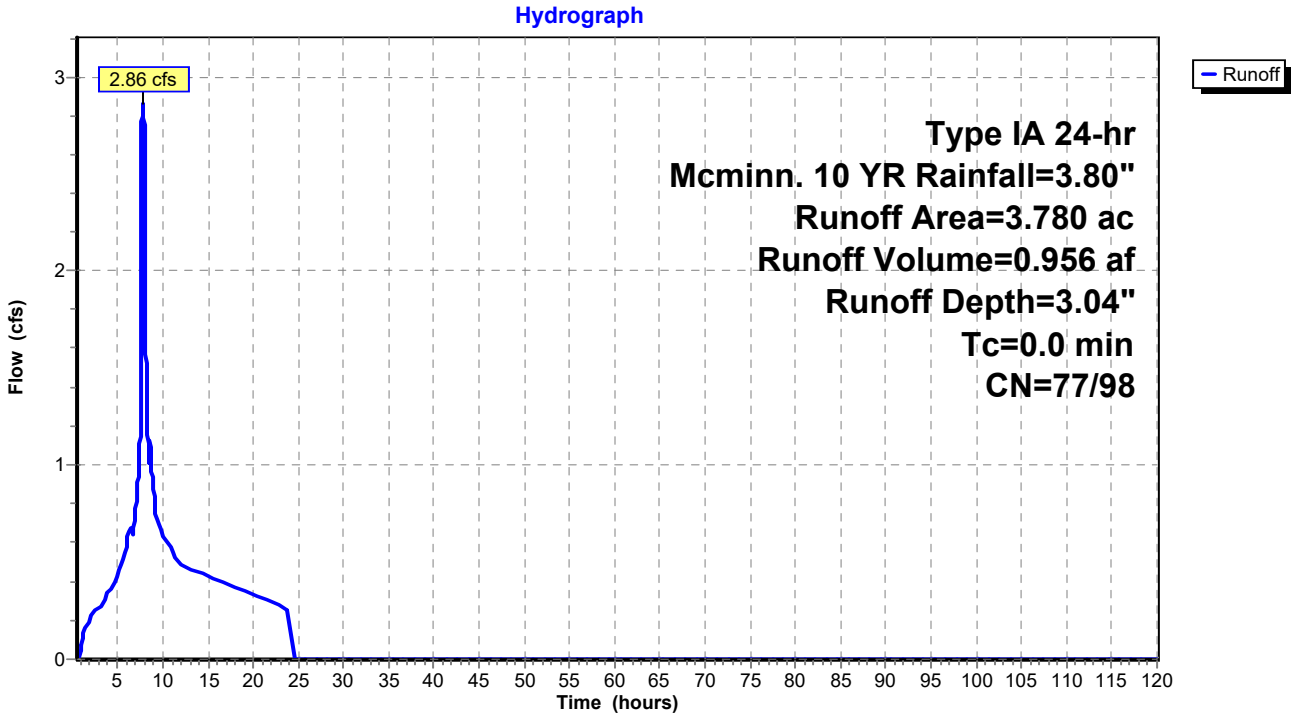
Summary for Subcatchment 100S: Developed

Runoff = 2.86 cfs @ 7.81 hrs, Volume= 0.956 af, Depth= 3.04"
Routed to Reach 102R : Swale

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.01 hrs
Type IA 24-hr Mcminn. 10 YR Rainfall=3.80"

Area (ac)	CN	Description
0.500	74	>75% Grass cover, Good, HSG C
0.550	80	>75% Grass cover, Good, HSG D
2.730	98	Paved parking, HSG C
3.780	92	Weighted Average
1.050		27.78% Pervious Area
2.730		72.22% Impervious Area

Subcatchment 100S: Developed



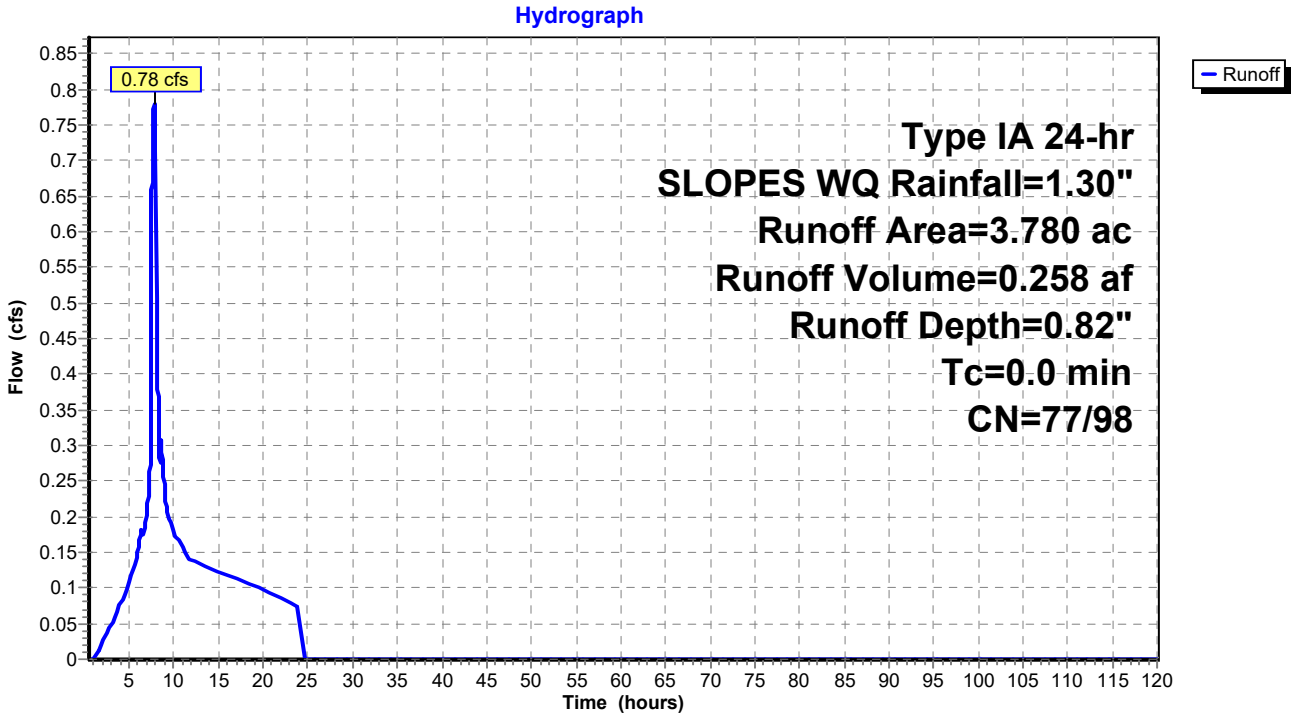
Summary for Subcatchment 100S: Developed

Runoff = 0.78 cfs @ 7.80 hrs, Volume= 0.258 af, Depth= 0.82"
Routed to Reach 102R : Swale

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.01 hrs
Type IA 24-hr SLOPES WQ Rainfall=1.30"

Area (ac)	CN	Description
0.500	74	>75% Grass cover, Good, HSG C
0.550	80	>75% Grass cover, Good, HSG D
2.730	98	Paved parking, HSG C
3.780	92	Weighted Average
1.050		27.78% Pervious Area
2.730		72.22% Impervious Area

Subcatchment 100S: Developed



Summary for Pond 103P: Detention Pond

Inflow Area = 3.780 ac, 72.22% Impervious, Inflow Depth = 0.82" for Mcminn. Half-2 YR event
Inflow = 0.78 cfs @ 7.80 hrs, Volume= 0.258 af
Outflow = 0.14 cfs @ 11.60 hrs, Volume= 0.250 af, Atten= 82%, Lag= 228.0 min
Primary = 0.14 cfs @ 11.60 hrs, Volume= 0.250 af

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.01 hrs
Peak Elev= 157.56' @ 11.60 hrs Surf.Area= 4,058 sf Storage= 4,002 cf

Plug-Flow detention time= 427.5 min calculated for 0.250 af (97% of inflow)
Center-of-Mass det. time= 404.2 min (1,112.4 - 708.2)

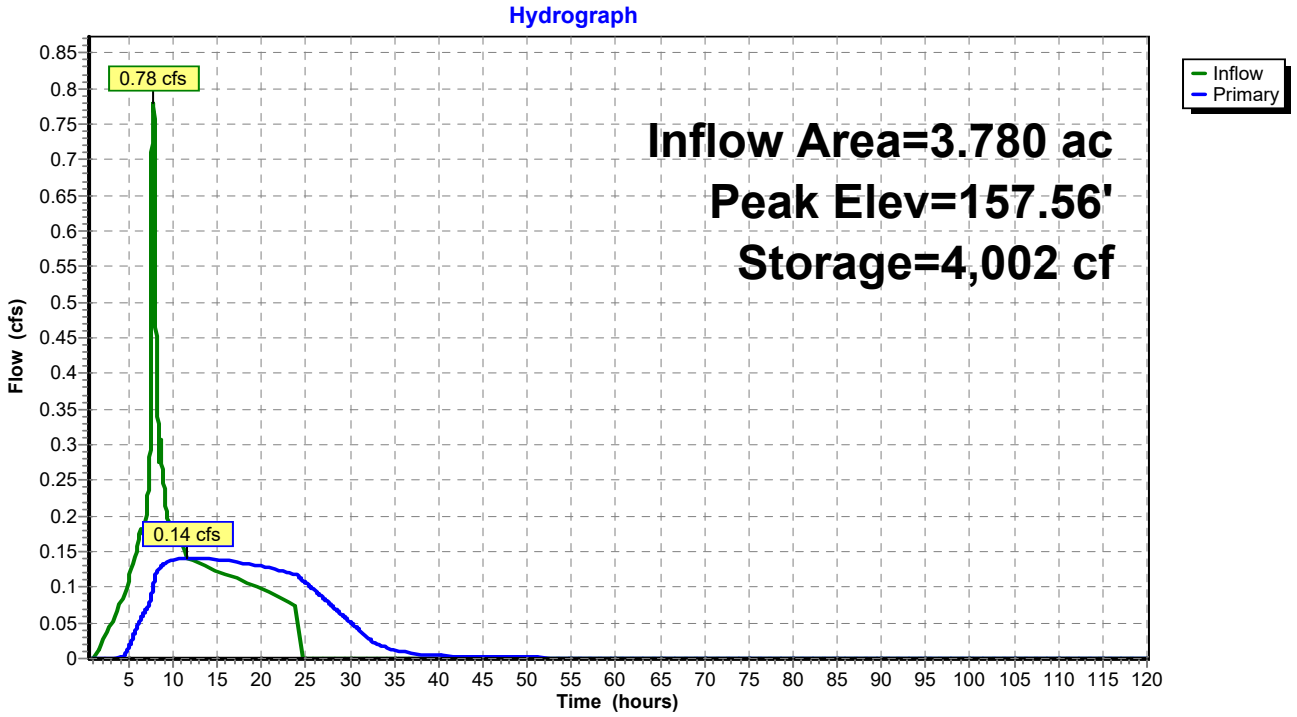
Volume	Invert	Avail.Storage	Storage Description
#1	156.50'	15,533 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
156.50	3,500	0	0
157.00	3,750	1,813	1,813
158.00	4,300	4,025	5,838
159.00	4,840	4,570	10,408
160.00	5,410	5,125	15,533

Device	Routing	Invert	Outlet Devices
#1	Primary	156.60'	**2.4" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	157.60'	**3.9" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	159.40'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.14 cfs @ 11.60 hrs HW=157.56' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 0.14 cfs @ 4.47 fps)
- **2=Orifice/Grate** (Controls 0.00 cfs)
- **3=Orifice/Grate** (Controls 0.00 cfs)

Pond 103P: Detention Pond



Summary for Pond 103P: Detention Pond

Inflow Area = 3.780 ac, 72.22% Impervious, Inflow Depth = 3.04" for Mcminn. 10 YR event
Inflow = 2.86 cfs @ 7.81 hrs, Volume= 0.956 af
Outflow = 0.76 cfs @ 9.23 hrs, Volume= 0.948 af, Atten= 74%, Lag= 85.3 min
Primary = 0.76 cfs @ 9.23 hrs, Volume= 0.948 af

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.01 hrs
Peak Elev= 159.38' @ 9.23 hrs Surf.Area= 5,056 sf Storage= 12,283 cf

Plug-Flow detention time= 276.4 min calculated for 0.948 af (99% of inflow)
Center-of-Mass det. time= 270.2 min (950.3 - 680.1)

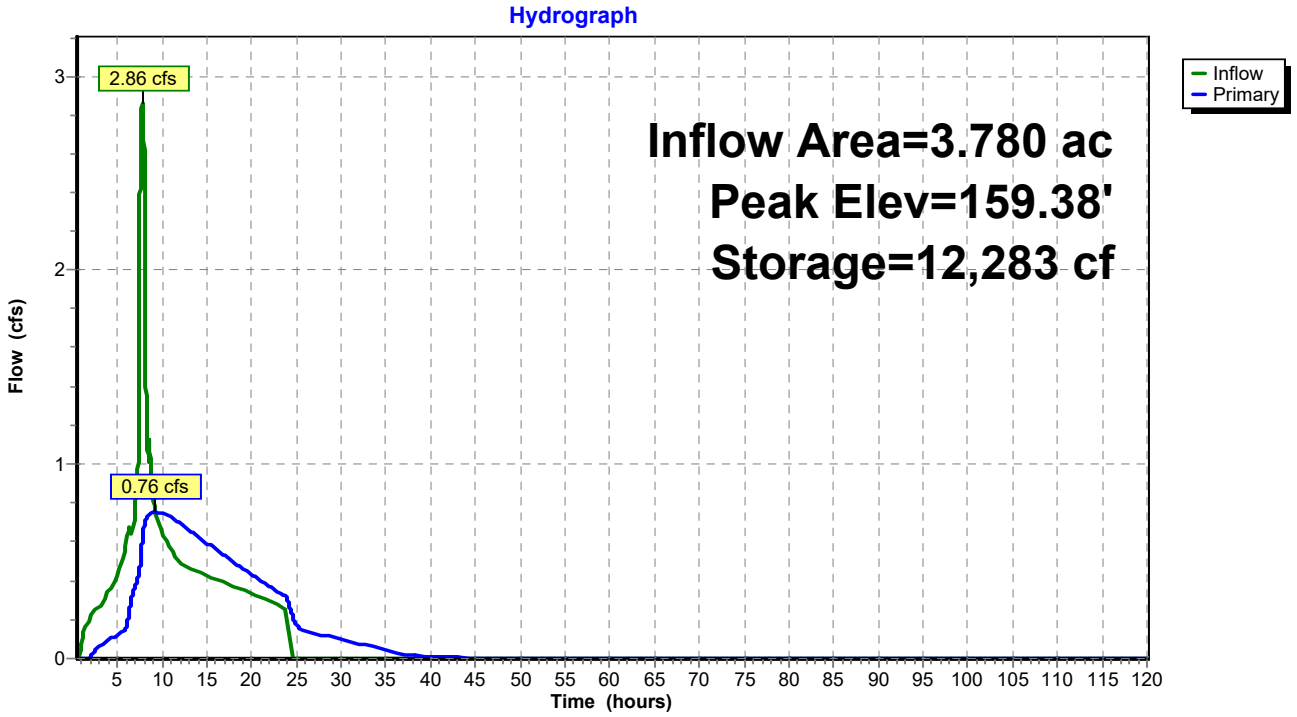
Volume	Invert	Avail.Storage	Storage Description
#1	156.50'	15,533 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
156.50	3,500	0	0
157.00	3,750	1,813	1,813
158.00	4,300	4,025	5,838
159.00	4,840	4,570	10,408
160.00	5,410	5,125	15,533

Device	Routing	Invert	Outlet Devices
#1	Primary	156.60'	**2.4" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	157.60'	**3.9" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	159.40'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.76 cfs @ 9.23 hrs HW=159.38' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 0.25 cfs @ 7.88 fps)
- **2=Orifice/Grate** (Orifice Controls 0.51 cfs @ 6.12 fps)
- **3=Orifice/Grate** (Controls 0.00 cfs)

Pond 103P: Detention Pond



Summary for Pond 103P: Detention Pond

Inflow Area = 3.780 ac, 72.22% Impervious, Inflow Depth > 4.65" for Mcminn. 100 YR event
Inflow = 4.40 cfs @ 7.80 hrs, Volume= 1.464 af
Outflow = 3.30 cfs @ 8.01 hrs, Volume= 1.455 af, Atten= 25%, Lag= 12.4 min
Primary = 3.30 cfs @ 8.01 hrs, Volume= 1.455 af

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.01 hrs
Peak Elev= 159.82' @ 8.01 hrs Surf.Area= 5,308 sf Storage= 14,576 cf

Plug-Flow detention time= 236.5 min calculated for 1.455 af (99% of inflow)
Center-of-Mass det. time= 232.1 min (904.0 - 671.8)

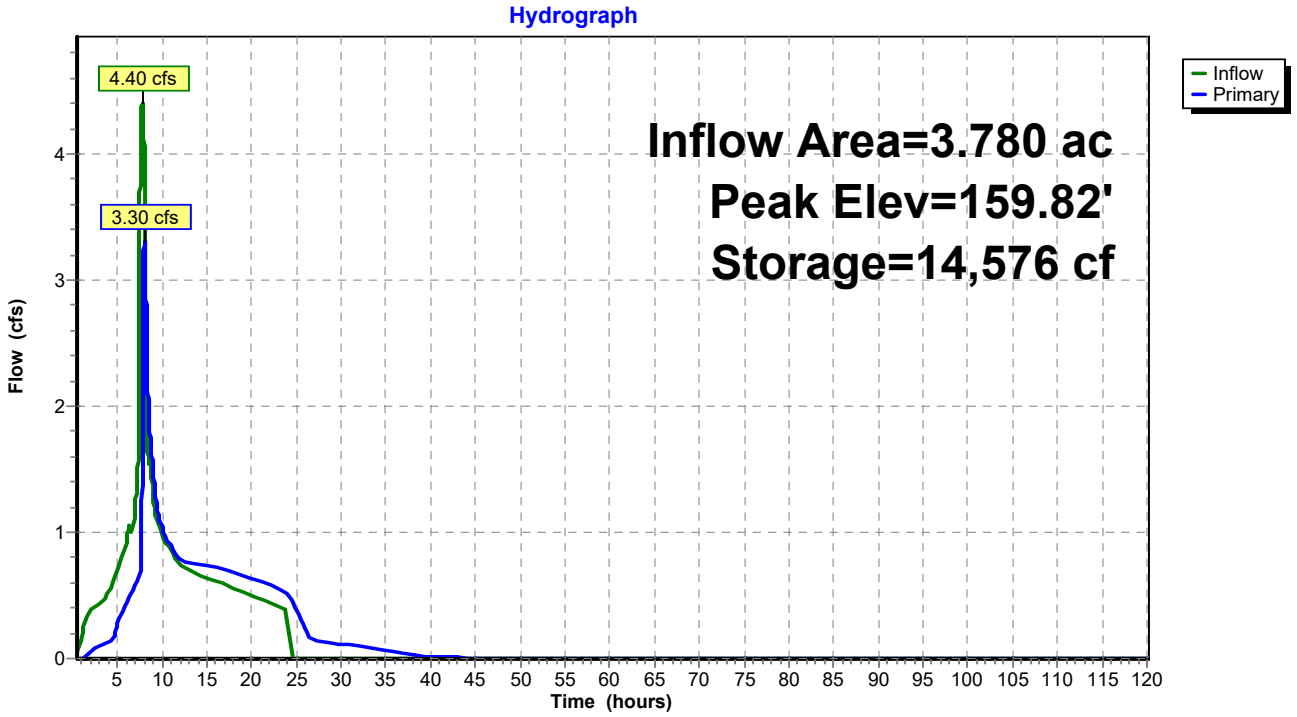
Volume	Invert	Avail.Storage	Storage Description
#1	156.50'	15,533 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
156.50	3,500	0	0
157.00	3,750	1,813	1,813
158.00	4,300	4,025	5,838
159.00	4,840	4,570	10,408
160.00	5,410	5,125	15,533

Device	Routing	Invert	Outlet Devices
#1	Primary	156.60'	**2.4" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	157.60'	**3.9" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	159.40'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.29 cfs @ 8.01 hrs HW=159.82' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 0.27 cfs @ 8.51 fps)
- **2=Orifice/Grate** (Orifice Controls 0.57 cfs @ 6.91 fps)
- **3=Orifice/Grate** (Orifice Controls 2.45 cfs @ 3.12 fps)

Pond 103P: Detention Pond



Summary for Pond 103P: Detention Pond

Inflow Area = 3.780 ac, 72.22% Impervious, Inflow Depth = 0.82" for SLOPES WQ event
Inflow = 0.78 cfs @ 7.80 hrs, Volume= 0.258 af
Outflow = 0.14 cfs @ 11.60 hrs, Volume= 0.250 af, Atten= 82%, Lag= 228.0 min
Primary = 0.14 cfs @ 11.60 hrs, Volume= 0.250 af

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.01 hrs
Peak Elev= 157.56' @ 11.60 hrs Surf.Area= 4,058 sf Storage= 4,002 cf

Plug-Flow detention time= 427.5 min calculated for 0.250 af (97% of inflow)
Center-of-Mass det. time= 404.2 min (1,112.4 - 708.2)

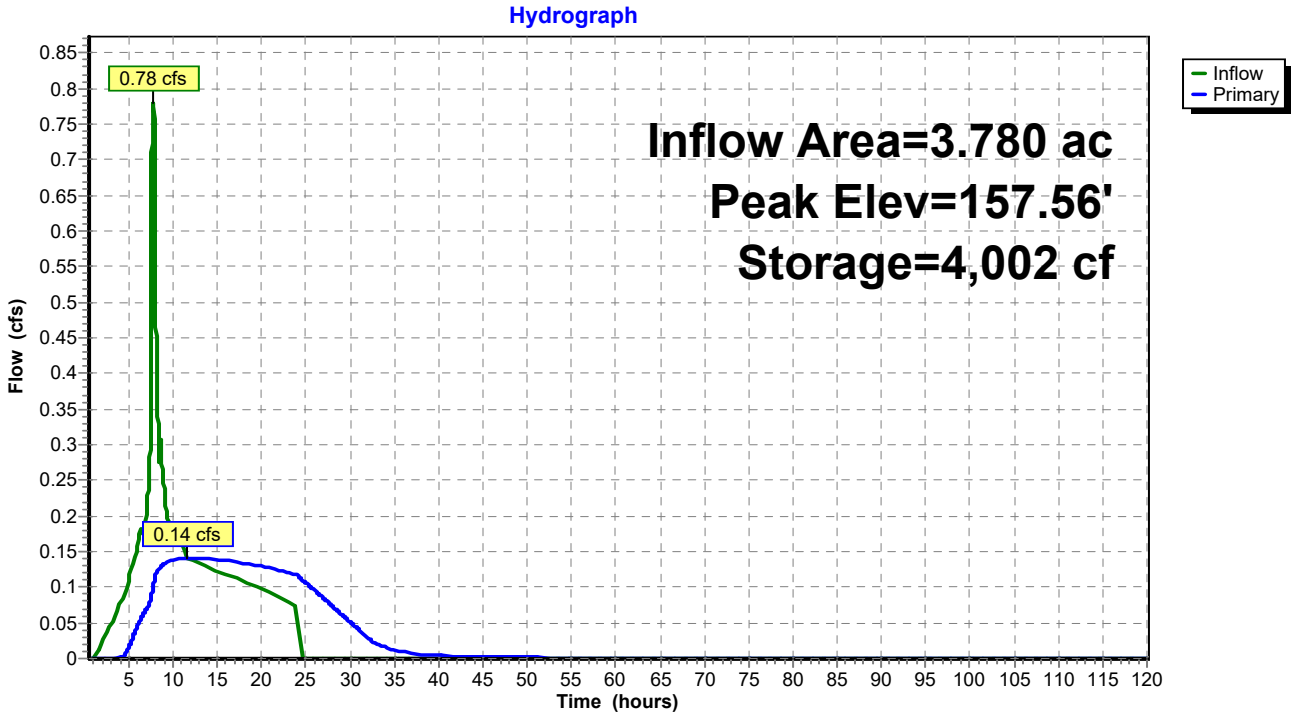
Volume	Invert	Avail.Storage	Storage Description
#1	156.50'	15,533 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
156.50	3,500	0	0
157.00	3,750	1,813	1,813
158.00	4,300	4,025	5,838
159.00	4,840	4,570	10,408
160.00	5,410	5,125	15,533

Device	Routing	Invert	Outlet Devices
#1	Primary	156.60'	**2.4" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	157.60'	**3.9" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	159.40'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.14 cfs @ 11.60 hrs HW=157.56' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 0.14 cfs @ 4.47 fps)
- **2=Orifice/Grate** (Controls 0.00 cfs)
- **3=Orifice/Grate** (Controls 0.00 cfs)

Pond 103P: Detention Pond



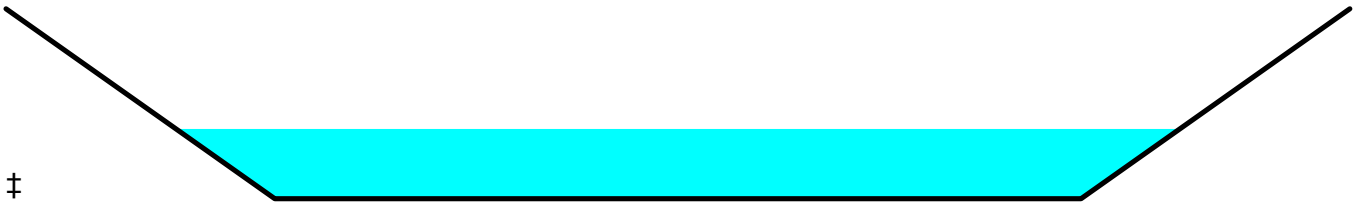
Summary for Reach 102R: Swale

Inflow Area = 3.780 ac, 72.22% Impervious, Inflow Depth = 0.82" for SLOPES WQ event
Inflow = 0.78 cfs @ 7.80 hrs, Volume= 0.258 af
Outflow = 0.69 cfs @ 8.00 hrs, Volume= 0.258 af, Atten= 11%, Lag= 11.7 min

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.19 fps, Min. Travel Time= 19.2 min
Avg. Velocity = 0.06 fps, Avg. Travel Time= 64.3 min

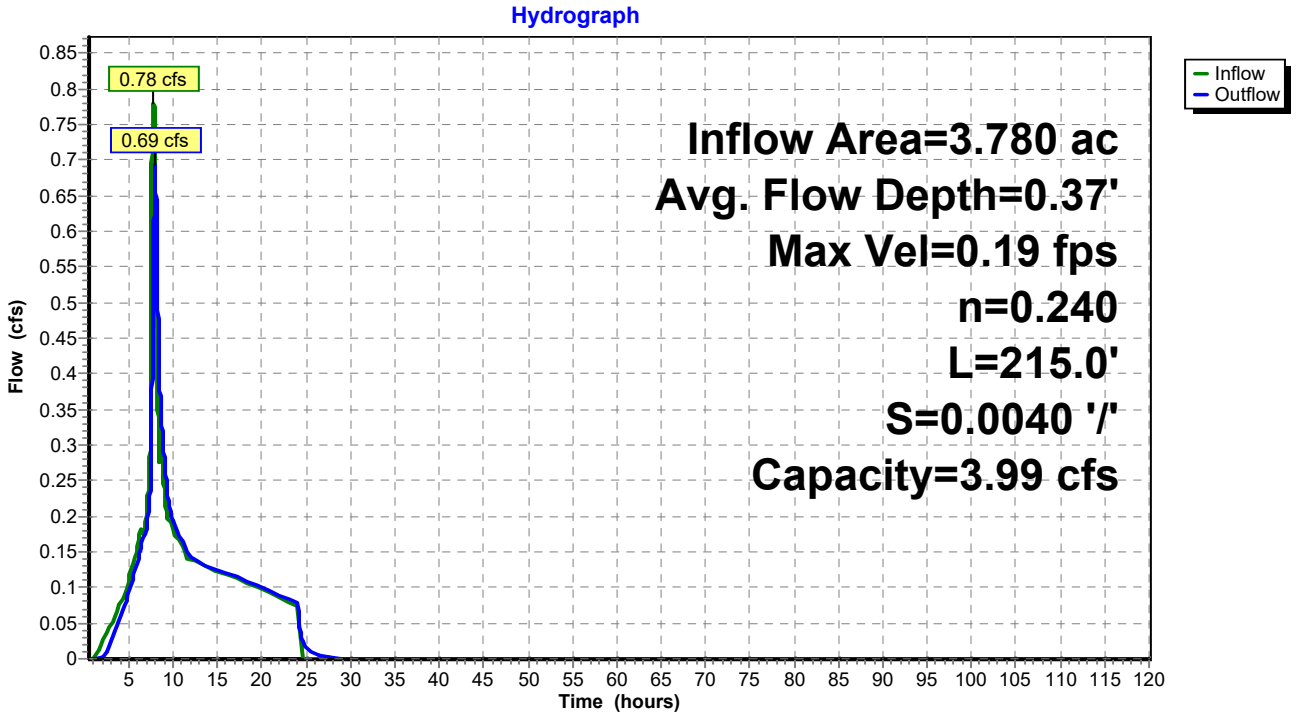
Peak Storage= 799 cf @ 8.00 hrs
Average Depth at Peak Storage= 0.37' , Surface Width= 11.21'
Bank-Full Depth= 1.00' Flow Area= 12.0 sf, Capacity= 3.99 cfs

9.00' x 1.00' deep channel, n= 0.240
Side Slope Z-value= 3.0 '/' Top Width= 15.00'
Length= 215.0' Slope= 0.0040 '/'
Inlet Invert= 157.86', Outlet Invert= 157.00'



‡

Reach 102R: Swale



PRECIPITATION FREQUENCY ATLAS – ATLAS 2

NOAA ATLAS 2

Precipitation-Frequency Atlas of the Western United States

J. F. Miller, R. H. Frederick, and R. J. Tracey

Volume X–Oregon

U.S. DEPARTMENT OF COMMERCE
Frederick B. Dent, Secretary

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Prepared for U.S. Department of Agriculture, Soil Conservation Service, Engineering Division

NOAA ATLAS 2

Precipitation Frequency Atlas of the Western United States

Volume	I.	Montana
Volume	II.	Wyoming
Volume	III.	Colorado
Volume	IV.	New Mexico
Volume	V.	Idaho
Volume	VI.	Utah
Volume	VII.	Nevada
Volume	VIII.	Arizona
Volume	IX.	Washington
Volume	X.	Oregon
Volume	XI.	California

UDC 551.577.36(084.4)(795)

551.5	Meteorology
.577	Precipitation
.36	Frequencies
(084.4)	Atlases
(795)	Oregon

Contents

List of Illustrations

List of Tables

Abstract

Each volume of this Atlas contains precipitation-frequency maps for 6- and 24-hr durations for return periods from 2 to 100 yrs for one of the 11 western states (west of about 103° W.). Also included are methods and nomograms for estimating values for durations other than 6 and 24 hrs. This new series of maps differs from previous publications through greater attention to the relation between topography and precipitation-frequency values. This relation is studied objectively through the use of multiple regression screening techniques which develop equations used to assist in interpolating values between stations in regions of sparse data. The maps were drawn on a scale of 1:1,000,000 and reduced to 1:2,000,000 for publication.

In addition to the maps, each volume includes a historical review of precipitation-frequency studies, a discussion of the data handling and analysis methods, a section on the use and interpretation of the maps, and a section outlining information pertinent to the precipitation-frequency regime in the individual state. This state section includes a discussion of the importance of snow in the precipitation-frequency analysis and formulas and nomograms for obtaining values for 1-, 2-, 3-, and 12-hr durations.

Preface

Previous precipitation-frequency studies for the 11 western states have considered topography in only a general sense despite the numerous mountain ranges present. As a result, variation in precipitation-frequency values is greater than was portrayed in these studies. In this Atlas, the relation between precipitation-frequency values and topography has been considered both objectively and subjectively.

This work has been supported and financed by the Soil Conservation Service, Department of Agriculture, to provide material for use in developing planning and design criteria for the Watershed Protection and Flood Prevention program (P.L. 566, 83d Congress and as amended).

Each volume of the Atlas can be considered to consist of three parts. The first part contains several sections giving a historical review of the field, a discussion of the approach and methods used in the development of the precipitation-frequency maps, and a discussion of how to interpret and use the maps. This section outlines the general background information and is applicable to all states. The second part of the Atlas contains a discussion of items pertinent to the individual state. Included in this section are methods and nomograms designed to estimate precipitation-frequency values for durations other than 6 and 24 hrs. These procedures were developed for broad geographic regions; the ones applicable to a particular state are included in the appropriate volume. The last part contains the maps for the 6- and 24-hr durations for return periods of 2, 5, 10, 25, 50, and 100 yrs.

Coordination with the Soil Conservation Service was maintained through Kenneth M. Kent, Chief, Hydrology Branch, Engineering Division, and through his successor, Robert E. Rallison. The work was done in the Special Studies Branch, Water Management Information Division, Office of Hydrology, National Weather Service. Hugo V. Goodyear, Chief of the Branch (since retired) made many contributions to the preparation of the final manuscript. Overall direction and guidance was furnished by William E. Hiatt, Associate Director (Hydrology), National Weather Service, his successor, Max A. Kohler, and Joseph Paulhus, former Chief, Water Management Information Division. Data tabulations, computations and many other assisting duties were done by the Branch meteorological technicians.

Introduction

Objective

Although generalized maps of precipitation-frequency values have been available for many years, the construction of isopluvial lines in mountainous regions has been done considering topography and its effect on precipitation in a general sense only. Investigations for this Atlas were undertaken to depict more accurately variations in the precipitation-frequency regime in mountainous regions of the 11 conterminous states west of approximately 103° W. These investigations are intended to provide material for use in developing planning and design criteria for the Watershed Protection and Flood Prevention programs.

Primary emphasis has been placed on developing generalized maps for precipitation of 6- and 24-hr duration and for return periods of 2 to 100 yrs. Procedures also have been developed to estimate values for 1-hr duration. Values for other durations can be estimated from the 1-, 6-, and 24-hr duration values.

Historical Review

The first generalized study of the precipitation-frequency regime for the United States was prepared in the early 1930's by David L. Yarnell (1935). Yarnell's publication contains a series of generalized rainfall maps for durations of 5 min to 24 hrs for return periods of 2 to 100 yrs. Yarnell's study served as a basic source of frequency data for economic and engineering design until the middle 1950's. The maps were based on data from about 200 first-order Weather Bureau stations equipped with recording precipitation gages. In 1940, about 5 yrs after Yarnell's study was published, a hydrologic network of recording gages, supported largely by the U.S. Army Corps of Engineers, was installed. This was done to supplement the Weather Bureau recording-gage network and the network of a relatively large number of nonrecording gages maintained by private individuals in cooperation with the Weather Bureau, for a long period of years. The additional recording gages have subsequently increased the amount of short-duration (1- to 24-hr) precipitation data by a factor of about 20.

Weather Bureau Technical Paper No. 24, published in two parts, (U.S. Weather Bureau 1953–54a) was prepared for the Corps of Engineers, in connection with its military construction program. This Technical Paper contained the results of the first investigation of precipitation-frequency information for an extensive region of the increased hydrologic data network. The results showed the importance of the additional data for defining the short-duration rainfall-frequency regime in a mountainous region of the western United States. In many instances, the differences between the values given in Technical Paper No. 24 and those given by Yarnell reach a factor of three, with Yarnell's figures generally higher. Results from these two studies in the United States were then used to prepare similar reports for the coastal regions of North Africa (U.S. Weather Bureau 1954b) and for several Arctic regions (U.S. Weather Bureau 1955a) where recording-gage data were lacking. These reports were also prepared in cooperation with the Corps of Engineers to support its military construction program.

In 1955, the Weather Bureau and the Soil Conservation Service began a cooperative effort to define the depth-area-duration precipitation-frequency regime in the entire United States. *Weather Bureau Technical Paper* No. 25 (U.S. Weather Bureau 1955b), partly a byproduct of previous work done for the Corps of Engineers, was the first study published under the sponsorship of the Soil Conservation Service; it contains a series of precipitation intensity-duration-frequency curves for about 200 first-order Weather Bureau stations. This was followed by *Weather Bureau Technical Paper* No. 28 (U.S. Weather Bureau 1956) which was an expansion of information contained in Technical Paper No. 24 to longer return periods and durations. The five parts of *Weather Bureau Technical Paper* No. 29 (U.S. Weather Bureau 1957–60), for the region east of longitude 90° W., were published next. This Technical Paper included seasonal variation on a frequency basis and area-depth curves so that the point-frequency values could be transformed to areal-frequency values.

In the next study, *Weather Bureau Technical Paper* No. 40 (U.S. Weather Bureau 1961), the results of previous Weather Bureau investigations of the precipitation-frequency regime of the conterminous United States were combined into a single publication. Investigations by the Weather Bureau during the 1950's had not covered the region between longitudes 90° and 105° W. Technical Paper No. 40 contained the results of an investigation for this region, and was the first such study of the midwestern plains region since Yarnell's work of the early 1930's. Topography was considered only in a general sense in this and earlier studies.

Technical Paper No. 40 has been accepted as the standard source for precipitation-frequency information in the United States for the past decade. Results presented in that publication are most reliable in relatively flat plains. While the averages of point values over relatively large mountainous regions are reliable, the variations within such regions are not adequately defined. In the largest of these regions, the western United States, topography plays a significant role in the incidence and distribution of precipitation. Consequently, the variations in precipitation-frequency values are actually greater than portrayed in the region. Investigations reported herein were made using currently available longer records and the maximum number of stations possible (consistent with the constraints explained in the section on Basic Data).

Analysis

Approach

The approach used for this Atlas is basically the same as that used for Technical Paper No. 40, in which simplified relations between duration and return period were used to determine numerous combinations of return periods and durations from several generalized key maps. For this Atlas, relations were developed between precipitation-frequency values and meteorologic and topographic factors at observing sites. These were used to aid in interpolating values between stations on the key maps.

The key maps developed in this study were for 2- and 100-yr return periods for 6- and 24-hr durations. The initial map developed was for the 2-yr return period for the 24-hr duration. This return period was selected because values for shorter return periods can be estimated with greater reliability than for longer return periods. The 24-hr duration was selected because this permitted use of data from both recording and nonrecording gages. Also, because an extensive nonrecording-gage network was in existence for many years before the recording-gage network was established in 1940, the period of record available for 24-hr observations is much longer than that for the 6-hr duration. The second map developed was for the 100-yr return period for the 24-hr duration. In the development of this map the advantage of maximum sample size and length of record was retained at the expense of some decrease in reliability of computed values. The 6-hr maps for the 2- and 100-yr return periods followed. For the 6-hr duration, the sample size was materially smaller in both numbers and length of record because only recording-gage data could be used. After these four maps were completed, values for intermediate return periods were computed for a grid of about 47,000 points, and appropriate maps were prepared.

In previous studies, topography was considered only in a general sense and the isopluvials were drawn by interpolating subjectively between the individual stations. In preparing this Atlas, multiple linear regression equations were developed for each of many regions of the western United States as an aid to estimating the precipitation-frequency values at each of about 47,000 grid points. These equations related topographic and climatologic factors to the variations in the precipitation-frequency values. Isopluvials were smoothed subjectively between values in adjoining regions. The subjective smoothing was based upon experience in analyzing precipitation-frequency maps; the amount of smoothing was rarely greater than the standard error of estimate for the equations in the adjoining regions.

Basic Data

Station location. Frequency analysis of precipitation data requires a relatively long and stable station record. In analyzing a mean annual or a seasonal precipitation map, it is possible to use double-mass curve analysis to evaluate the effects of changes in station location or exposure. Within limits, the effects of differing locations on the annual precipitation values can be eliminated by use of relations determined from the double-mass curve analysis (Weiss and Wilson 1953). However, no technique for evaluation and modification of a series of extreme precipitation values has been developed. Therefore, it was necessary to ensure that the data used in this Atlas represented, as nearly as possible, observations taken from a single location.

Official records of station locations (latitude, longitude, and elevation) were examined to determine physical moves. The criterion was adopted that if a move at any station changed the elevation 100 ft or more or changed the horizontal location 5 mi or more, its data were treated as though they came from separate stations. In some cases, a station retained the same name but investigation indicated that it had been moved beyond acceptable limits. In such cases, the records for the station were terminated and new records were started. In other cases, published sources indicated location changes beyond acceptable limits, but subsequent inspection of records indicated these changes were corrections to reported values of elevation, latitude, or longitude rather than actual physical moves. Thus, the observations for the station actually were continuous at one location. Occasionally, a lesser move resulted in a significant difference in exposure, such as from the windward to the lee side of a mountain range. Data from stations such as these also were treated as data from separate stations.

Types of data. The primary data used in this Atlas can be divided into two categories. First, there are data from recording gages; these data are published for clock-hour intervals. These data were processed to obtain maximum 6- and 24-consecutive clock-hour amounts for each month of record. The time interval selected did not have to start at a particular hour; for example, the 6-hr interval might be from 1 to 7 a.m., or from 3 to 9 p.m.; the 24-hr interval might be from 4 a.m. on one day to 4 a.m. on the following day, or from 2 p.m. on one day to 2 p.m. on the next. Second, there is the large amount of data from nonrecording gages. At these gages, observations are usually made once each day at a given time for each station. At observation time, the amount of precipitation that fell in the preceding 24-hr interval is measured; this precipitation may have fallen during any part or all of the 24-hr period. These data are commonly referred to as observation-day amounts.

A subset of data in the first category is the recording-gage data from the long-record first-order Weather Bureau (now National Weather Service) stations. There are approximately 200 such stations in the entire country (about 50 in the western United States). Maximum values for each year of record from these stations have been tabulated for the various durations to the nearest minute. The maximum 6-hr amount recorded each year is for a period of 360 consecutive minutes, regardless of the time beginning; for example, such a period might begin at 2:03 p.m. or at 3:59 p.m. Similarly, data for the 24-hr duration are for a 1,440-min period. These amounts are commonly referred to as *n*-minute amounts.

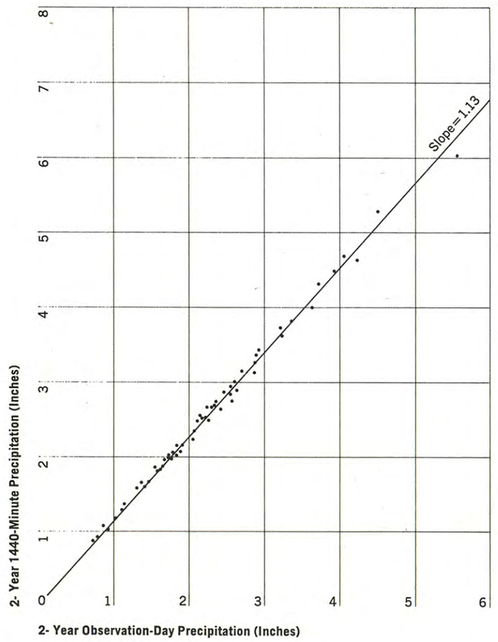


Figure 1. *Relation between 2-yr 1,440-min precipitation and 2-yr observation-day precipitation.*

Fixed- versus true-interval precipitation values. The continuous clock-hour and observation-day data from most stations are available for intervals fixed by arbitrary clock intervals. Because the time of occurrence of precipitation is a random phenomenon, straddling often occurs; for example, part of the maximum precipitation may start in one time interval and end in the succeeding time interval. Seldom does maximum precipitation for a specified duration occur within a mandatory measurement interval. For this reason, it was necessary to use relations between fixed-time intervals (of actual occurrence) and the 360- and 1,440-min periods to make maximum use of available data.

These relations have been investigated in previous studies (U.S. Weather Bureau 1954a, 1956, 1957–60). It was found that on the average 1.13 times a statistical value for a particular return period, based on a series of annual maximum observation-day (fixed-interval) amounts, was equivalent to a statistical value for the same return period obtained from a series of 1,440-min (true-interval) values. The ratio of statistical values computed from a series of six consecutive clock-hour measurements to those from a series of 360-min observations is 1.02; a similar ratio of statistical values computed from 24 consecutive clock-hour amounts to those from 1,440 min values is 1.01.

These ratios (for example, *n*-year 1,440-min precipitation equals 1.13 times *n*-year observation-day precipitation) are not built on a causal relation. They are average index ratios because the distributions of observation-day, *n*-hour, and *n*-minute precipitation are irregular and unpredictable. For example, the annual maxima of the two series for the same year do not necessarily come from the same storm. Graphical comparison of the values for the 2-yr return period based on observation-day and 1,440-min precipitation data is shown in figure 1.

The frequency and amount of straddling that occur can be investigated on probability considerations as well as empirically. The time axis can be represented by a straight line separated into uniform time intervals by an evenly spaced series of points. These intervals can represent individual hours, 6- or 24-hr periods, an observation day, and so forth. The maximum precipitation for any duration can be assumed to occur at a uniform rate in a time unit exactly equal to one of the fixed intervals, but without regard to the location of the fixed intervals. This time unit may fall at random with respect to the fixed intervals and will, in general, overlap two adjacent intervals. Using probability theory, Weiss (1964) confirmed the empirical values used.

Data sources. The primary data sources used were *Climatological Data for the United States by Sections* (National Climatic Center 1897–1970) and *Hourly Precipitation Data* (National Climatic Center 1940–70). In California, it was possible to increase the data sample 15 to 20 percent by using unpublished data from gages maintained by the State, local agencies, private corporations, or individuals (California, Department of Water Resources 1900–69). Published data are routinely of high quality because of periodic checks of observing sites and observation techniques and the quality-control procedures used in the publication process. The quality of unpublished data must be checked by a review of the inspection records of the organization maintaining the gage and by a careful screening of the data.

Length and period of record. In preparing generalized maps of precipitation-frequency values, a uniform period of record several times the length of the return period desired and computed at a relatively dense network of stations (for sampling all data and topographic extremes) is the ideal. In practical work, compromises are necessary.

The use of a nonuniform record period, especially when the period is short, may result in unrealistic relations between stations. For instance, if data taken during a short-record period at one station were taken during a relatively dry period, while data from the neighboring station were taken during a relatively wet period, the interstation relation would not be valid. Because the objective of this investigation is to define the geographic variation in mountainous regions, it is desirable to minimize other causes of variation. Use of a standard base period would minimize the above variation. This is common practice in the preparation of mean annual precipitation maps and also can be applied to the preparation of precipitation-frequency maps for shorter return periods.

Determination of precipitation-frequency values is usually based upon the longest record available. These values are assumed to be reasonably representative of the values that would be obtained if the entire record were known. The use of a short-record base period requires testing to determine if the data provide unbiased results representative of values that would be obtained from use of a long-record base period. For most regions covered in this study, the most recent 15-yr period immediately preceding the period when the maps for this Atlas were developed was used to compute precipitation values for the 2-yr return period. At locations with at least 30 years of data, the 2-yr values from the 15-yr base period were compared with the 2-yr values computed using the total record. If the differences between the two series were small and randomly distributed, the 15-yr base period was adopted for all stations. Figure 2 shows the result of such a test for the 24-hr duration values for stations in Washington. The same test was made for the rest of the western states.

In most of California and Nevada, the values computed from the 15-yr base period data showed significant differences and some bias to values based upon the total record. In this region, it was necessary to use values based on the longest record possible for each station in preparation of the 2-yr maps. Stations without data during all or most of the more recent years were identified on the working maps.

To make use of data from the maximum number of stations, data from stations with 10 to 14 yrs of record were used in preparing the 2-yr maps. Such stations also were suitably identified on the working maps so that the analyst could use judgment in his interpretation of such values.

While a 15-yr record provides data several times the length of the return period for 2-yr maps, it provides only a small fraction of the length of the 100-yr return period. During a 15-yr period, some stations may experience precipitation amounts equivalent to a return period of 50, 100, or more years. However, the probability of having a 100-yr value in any preselected 15-yr period is only 0.14. Similarly, the probability of *not* having a true 15-yr return period value in any preselected 15-yr period is about 0.09. Thus, in a given 15-yr period, the probability that a station has received its true 100-yr value is not greatly different from the probability that its neighboring station has *not* experienced its true 15-yr value. While, admittedly, this would be an extreme case, this example shows the importance of using as long a record as possible when preparing precipitation-frequency maps for long return periods. In this study, records for as long as possible for each station (without violating the 100-ft or 5-mi criterion) were used to compute the 100-yr return period values. The length of record and a confidence band to indicate the range of values likely to be experienced at each station were included in the plotting model. With this information, the analyst could more effectively evaluate the reliability of each data point.

Published and unpublished data from approximately 3,300 stations were used in this study. The number of stations grouped by length of record and state are shown in table 1. Many recording gages were established at sites where nonrecording gages had been located for many years. In table 1, the first column for each state shows the number of stations with recording-gage data. The second column for each state shows the total period of record for which observation-day data were available for each of these stations. The total record includes both recording and nonrecording data for the recording-gage station. (Note: The total number of stations in columns 1 and 2 are equal.) The third column for each state shows the number of stations with nonrecording-gage data only.

Figure 3 shows the location of the 1,030 recording stations used in this study. The length of record indicated is for the longest available record and includes the period where only a nonrecording gage may have been located at the particular station. Figure 4 shows the location of the 2,292 nonrecording gages that, together with the recording gages, were used to provide data to define the 24-hr isopluvial pattern. A few additional stations with records of less than 10 yrs were used to provide guidance for estimating the precipitation pattern in extremely mountainous regions where no other data were available. Most of the data were for observation days. Empirical adjustments were used to convert statistical analyses of these data to the equivalent of 1,440-min data.

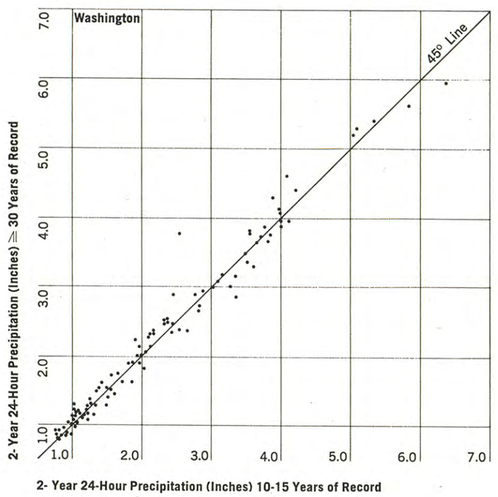


Figure 2. *Test of 2-yr 24-hr precipitation values from short- and long-record stations for the State of Washington.*

Table 1. *Number of precipitation stations by length and type of record in each Western State*

Years of record	State																																	
	Arizona			New Mexico			Colorado			Utah			Wyoming			Montana			Idaho			Washington			Oregon			Nevada			California			Total				Percent			
	RGR	TR	NR	RGR	TR	NR	RGR	TR	NR	RGR	TR	NR	RGR	TR	NR	RGR	TR	NR	RGR	TR	NR	RGR	TR	NR	RGR	TR	NR	RGR	TR	NR	RGR	TR	NR	Stns.	RGR	TR	NR	Total
10-14	6	5	38	29	10	33	18	18	28	13	8	20	23	16	31	29	22	78	19	18	10	31	20	19	26	19	33	11	6	10	98	95	209	303	237	509	812	29.4	23.0	22.2	24.4
15-19	9	8	28	8	16	34	14	11	29	2	0	11	2	1	11	5	3	19	2	1	7	4	2	13	3	3	13	6	5	5	37	35	92	92	85	262	354	8.9	8.3	11.4	10.6
20-24	23	12	30	34	12	36	52	36	31	18	9	16	31	20	14	59	50	23	3	2	5	15	14	21	15	15	29	6	7	6	47	42	132	303	219	343	646	29.4	21.3	15.0	19.4
25-29		1	15		7	15		3	15		2	7		3	7		2	15	16	10	11	37	25	8	50	36	30	15	5	4	140	114	97	258	208	224	482	25.0	20.2	9.8	14.5
30-34		1	9		3	15		3	7		1	7		1	8		2	14		2	7		1	19		3	25		3	3	53	54	59	53	74	173	226	5.1	7.2	7.6	6.8
35-39		2	10		3	11		0	9		4	4		2	6		2	9		1	4		4	19		4	11		1	3	14	18	43	14	41	129	143	1.4	4.0	5.6	4.3
40-44		6	53		2	16		2	10		1	9		1	8		1	8		0	10		4	12		0	9		0	2	5	15	70	5	32	207	212	0.5	3.1	9.0	6.4
45-49		0	1		4	16		0	10		0	5		3	8		1	5		0	15		3	8		1	4		5	3	0	2	16	0	19	91	91	0.0	1.8	4.0	2.7
50-54		1	1		5	13		4	12		2	13		2	6		5	11		1	14		4	15		2	10		2	4	0	1	13	0	29	112	112	0.0	2.8	4.9	3.4
55-59		1	4		8	14		2	7		1	3		5	8		1	9		4	8		0	9		4	6		0	5	0	3	13	0	29	86	86	0.0	2.8	3.8	2.6
60-64		0	1		1	3		0	6		2	14		0	5		4	3		0	6		3	4		1	2		1	2	1	6	13	1	18	59	60	0.1	1.7	2.6	1.8
65-69		1	1		0	4		1	8		3	4		2	2		0	1		1	3		7	8		3	7		3	2	0	2	19	0	23	59	59	0.0	2.2	2.6	1.8
70-74								4	6														0	1		3	1				0	8	21	0	15	29	29	0.0	1.5	1.3	0.9
75-79																															0	0	4	0	0	4	4	0.0	0.0	0.2	0.1
80-84																															1	1	4	1	1	4	5	0.1	0.1	0.2	0.2
85-89																																0	0		0	0	0	0.0	0.0	0.0	0.0
90-94																																0	1		0	1	1	0.0	0.0	0.0	0.0+
Number:																																									
By type	38		191	71		210	84		178	33		113	56		114	93		195	40		100	87		156	94		180	38		49	396		806	1,030		2,292	3,322				
Total stns	229			281			262			146			170			288			140			243			274			87			1,202			3,322							
Percent:																																									
By type	3.7		8.3	6.9		9.2	8.2		7.8	3.2		4.9	5.4		5.0	9.0		8.5	3.9		4.4	8.4		6.8	9.1		7.9	3.7		2.1	38.4		35.1								
Total stns	6.9			8.4			7.9			4.4			5.1			8.6			4.2			7.3			8.2			2.6			36.1										

Note: RGR = stations having recording-gage record.
TR = stations having recording gage for part of the record; total record includes both recording- and nonrecording-gage record.
NR = stations having only nonrecording-gage record.

Data tabulations. The maximum observed 24-hr (and 1- and 6-hr for recording gages) precipitation amount for each month was tabulated for each station. The maximum amount for each year of record was determined from these maximum monthly amounts. In the tabulations, data for some stations were missing or of questionable reliability for all or part of one or more years. For each such case, the data were evaluated individually to obtain the maximum length of record for the station. For instance, if data for a few months were missing, the maximum amount recorded for the remainder of the year was used to determine the maximum yearly amount if it appeared reasonable when compared with other years and with the maxima for that year at surrounding stations. This could result in an underestimation of the accepted amount, but it is felt that such errors are small and of little consequence.

Every effort was made to keep spurious data to a minimum. Reports of unusually large amounts at a station, or of large amounts at one station surrounded by stations reporting little or no precipitation, were examined to determine whether these large amounts were meteorologically reasonable. Cool season data were examined to ascertain if unusually large amounts were depth of snow rather than its water equivalent. However, not all large amounts were examined, nor could conclusive determinations be made regarding all of the large amounts that were examined. It is believed that most of the spurious data have been corrected.

Frequency Analysis

Two types of series. There are two methods of selecting data for analysis of extreme values. The first method produces the annual series. This method selects the largest single event that occurred within each year of record. In the annual series, year may be calendar year, water year, or any other consecutive 12-mo period. The limiting factor is that one, and only one, piece of datum is accepted for each year. The second method of selecting data produces the partial-duration series. This method recognizes that large amounts are not calendar bound and that more than one large event may occur in the time unit used as a year. In a partial-duration series, the largest N events are used regardless of how many occur in the same year; the only restriction is that independence of individual events be maintained. The number of events used is at least equal to the number of years of record.

One requirement in the preparation of this Atlas is that the results be expressed in terms of partial-duration frequencies. To avoid the laborious processing of partial-duration data, the annual series data were collected and analyzed and the resulting statistics were transformed to partial-duration statistics.

Conversion factors between annual and partial-duration series. Table 2 gives the empirical factors used to multiply partial-duration series analysis values to obtain the equivalent annual series analysis values. It is based on a sample of about 200 widely scattered first-order Weather Bureau stations. Only about one-fourth of these stations are in the western United States. The factors used in table 2 were taken from *Weather Bureau Technical Paper* No. 40. Reciprocals of these factors were used to convert the statistics of the annual series to those of the partial-duration series.

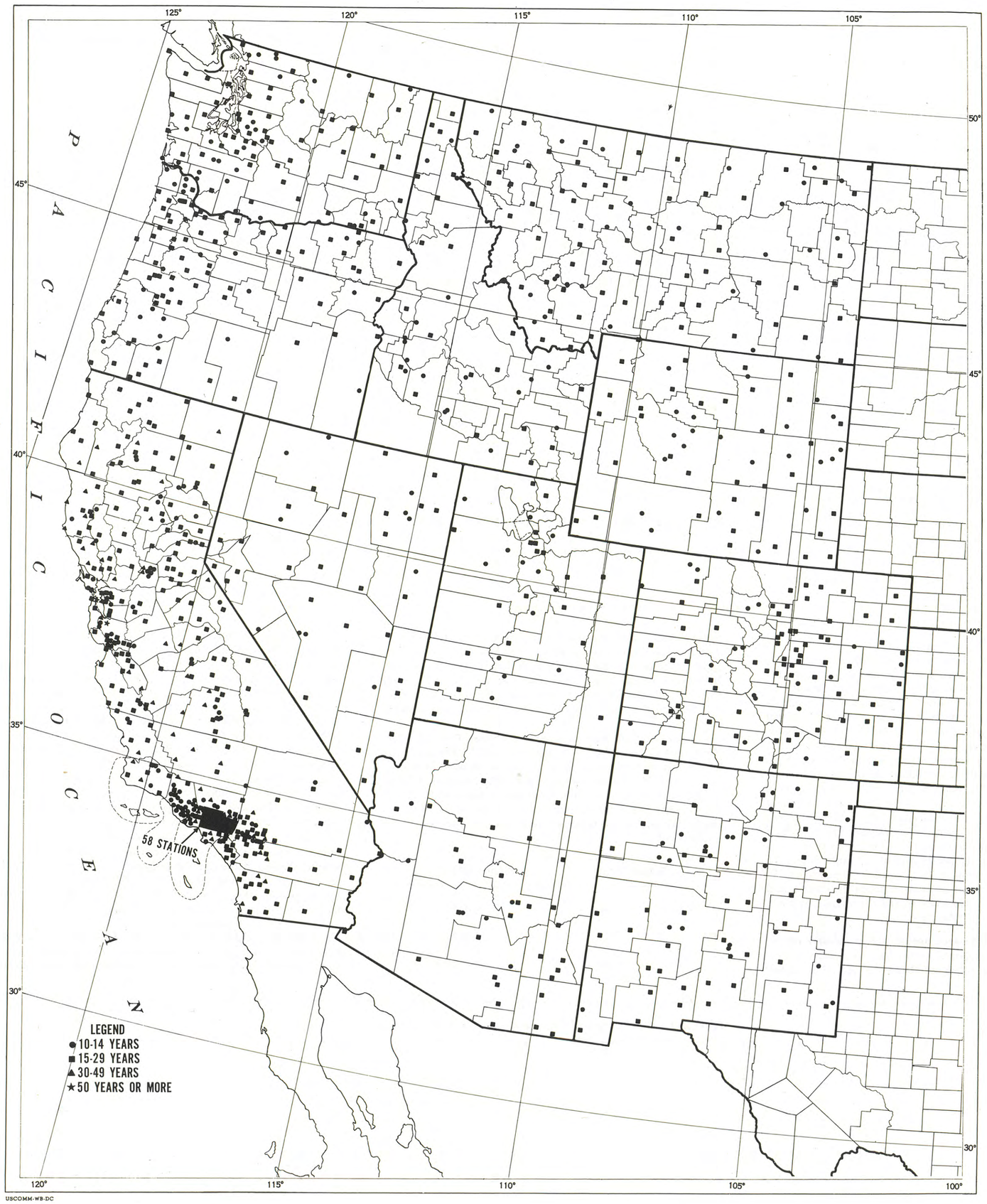
These relations have also been investigated by Langbein (1949) and Chow (1950) with equivalent results. The quality of the relation between the mean of the partial-duration series and that of the annual series data for 6- and 24-hr durations is shown in figure 5. The means for both series are equivalent to the 2.3-yr return period. Tests for samples of from 10 to 50 yrs of record length indicate that the factors of table 2 are independent of the record length.

Return period	Conversion factor
2-yr	0.88
5-yr	0.96
10-yr	0.99

Table 2. *Empirical factors for converting partial-duration series to annual series*

Frequency distribution. The frequency distribution used was the Fisher-Tippett Type I distribution; the fitting procedure was that developed by Gumbel (1958). This distribution and fitting procedure were used by the National Weather Service in previous studies of short-duration precipitation values (U.S. Weather Bureau 1953, 1954a, 1954b, 1955a, 1955b, 1956, 1957–60, and 1961). Studies by Hershfield and Kohler (1960) and Hershfield (1962) have demonstrated the applicability of this distribution to precipitation extremes. The distribution was fitted by the method of moments. The 2-yr value measures the first moment, the central tendency of the distribution. The relation of the 2-yr to the 100-yr value is a measure of the second moment, the dispersion of the distribution. The 2-yr and 100-yr precipitation can be used for estimating values for other return periods.

The return-period diagram, figure 6, taken from *Weather Bureau Technical Paper* No. 40, is based on data from National Weather Service stations having long records. The spacing of the vertical lines on the diagram is partly empirical and partly theoretical. From 1- to 10-yr return periods, it is entirely empirical, based on freehand curves drawn through plottings of partial-duration series data. For 20-yr and longer return periods, reliance was placed on the Gumbel procedure for fitting annual series data to the Fisher-Tippett Type I distribution. The transition was smoothed subjectively between the 10- and 20-yr return periods. If



precipitation values for return periods between 2 and 100 yrs are desired, it is necessary to obtain the 2- and 100-yr values from this series of generalized precipitation-frequency maps. These values are then plotted on the appropriate verticals and connected with a straight line. The precipitation values for the intermediate return periods are determined by reading values where the straight line intersects the appropriate verticals. If the rainfall values are then converted to the annual series by applying the factors of table 2 and plotted on either Gumbel or log-normal graph paper, the points will very nearly approximate a straight line.

Isopluvial Maps

Methodology. The factors considered to determine the sequence of preparation of the basic isopluvial maps for this series of generalized precipitation-frequency maps were (1) availability of data, (2) reliability of estimates for the return period, and (3) range of durations and return periods. Because of the large amount of data for the 24-hr duration and the relatively small standard error associated with the 2-yr values, a map showing such data was selected for preparation as the basic map for this series. The second map was prepared for the 24-hr duration and 100 yrs, the longest return period of interest. Next, the 2-yr 6-hr and the 100-yr 6-hr precipitation maps were prepared. These four key maps envelop the range of durations and return periods required and provide the data to be used for obtaining values for four intermediate return period maps at each duration.

Development of relations for interpolating precipitation-frequency values. The adequacy of the basic data network for determining precipitation-frequency values varies from place to place within the western United States. The greatest station density occurs along the Pacific coast west of the Cascade and Sierra Nevada Ranges (figs. 3 and 4). The lowest densities are in the intermountain plateau—between the Cascade-Sierra Nevada ranges and the Continental Divide—particularly in Nevada and in the Salmon River Mountains of Idaho. Even within particular regions, the stations are not evenly distributed. Most of the stations are located in the coastal plains, the river valleys, the western portion of the Great Plains, and the lower foothills of the mountains. Relatively few stations are located on steep slopes or on crests of mountains, in sparsely populated areas, or in areas where access is difficult.

It is desirable, therefore, to develop relations that can be used in interpolating precipitation-frequency values between stations in regions where data are relatively scarce. A preferred method is to relate variations in precipitation-frequency directly to variations in topographic factors; this is done when an adequate relation can be developed. The primary advantage of this procedure is that topographic factors can be determined at any point in a region. Topographic maps can be prepared from aerial photographs or surveys, or by other methods that do not require observations taken at a fixed point over a period of time. Among topographic factors frequently considered are: (1) elevation of the station, either the actual elevation or some effective elevation (an average elevation determined along a circle of a given radius around the station); (2) slope of the terrain near the station, both in the small and large scales; (3) distances from both major and minor barriers; (4) distances and directions from moisture sources; and (5) roughness of the terrain in the vicinity of the station.

Figure 3. *Geographic distribution of stations with recording gages. Symbols indicate total length of record available.*

It has not been possible to develop such relations for all regions. Hence, it also was necessary to develop relations that included climatological or meteorological factors. The factors selected for use must be available at locations where precipitation data for durations of between 1 and 24 hrs are not available. Otherwise, they would not provide additional information needed for use in interpolating between locations with frequency values. An example of such a factor is normal annual precipitation. In the construction of such a map, data from snow courses, adjusted short records, and storage gages that give weekly, seasonal, or annual accumulations of precipitation can be used. Such records do not yield the short-duration precipitation amounts necessary for this study. Thus, normal annual precipitation data, particularly because it provides greater areal coverage in mountainous regions, might be of definite use in developing the patterns of the precipitation-frequency maps.

Several other meteorologic factors can be used in combination with normal annual precipitation data and topographic factors to interpolate short-duration precipitation-frequency values at intermediate points. Examples of such factors are: (1) number of thunderstorm days, (2) number of days or hours with precipitation above a threshold value, (3) percentage frequencies of various wind directions and speeds, and (4) percentage frequencies of class intervals of relative humidity. Since these factors can be obtained only where there are recording meteorological gages or where there are observers to record the data they do not supplement the available short-duration precipitation-frequency values by providing data at additional sites.

It would have been desirable to develop a single equation, utilizing physiographic factors, to interpolate between locations with short-duration precipitation-frequency values for the western United States. Such an equation could not be developed, so relations for interpolating the precipitation-frequency values were developed for each of several smaller regions considered to be meteorologically homogeneous. The extent of each region was determined from consideration of the weather situations that could be expected to produce large precipitation amounts. Among the questions asked and answered were: What is the source and from what direction does moisture for major storms come and are there major orographic barriers that influence the precipitation process? Figure 7 shows some of the principal paths of moisture inflow for the western United States and the major orographic barriers to such inflow.

The regions selected for their homogeneity normally are river basins or combinations of river basins. The river basins selected were usually bounded by major orographic barriers that significantly influence the precipitation regime. The size of these regions varied, partly because of meteorologic and topographic considerations and partly because of the availability of data. Some regions included more variability in topographic and meteorologic factors than was ideal. Efforts made to reduce the size of the regions were not successful because sample sizes decreased to less than acceptable limits.

After the geographic regions were selected, various topographic factors that could cause variation of precipitation-frequency values within limited regions such as slope, elevation, roughness, and orientation were examined. Individual precipitation-frequency values and exposures around the stations were examined to gain insight into topographic factors that could be im-

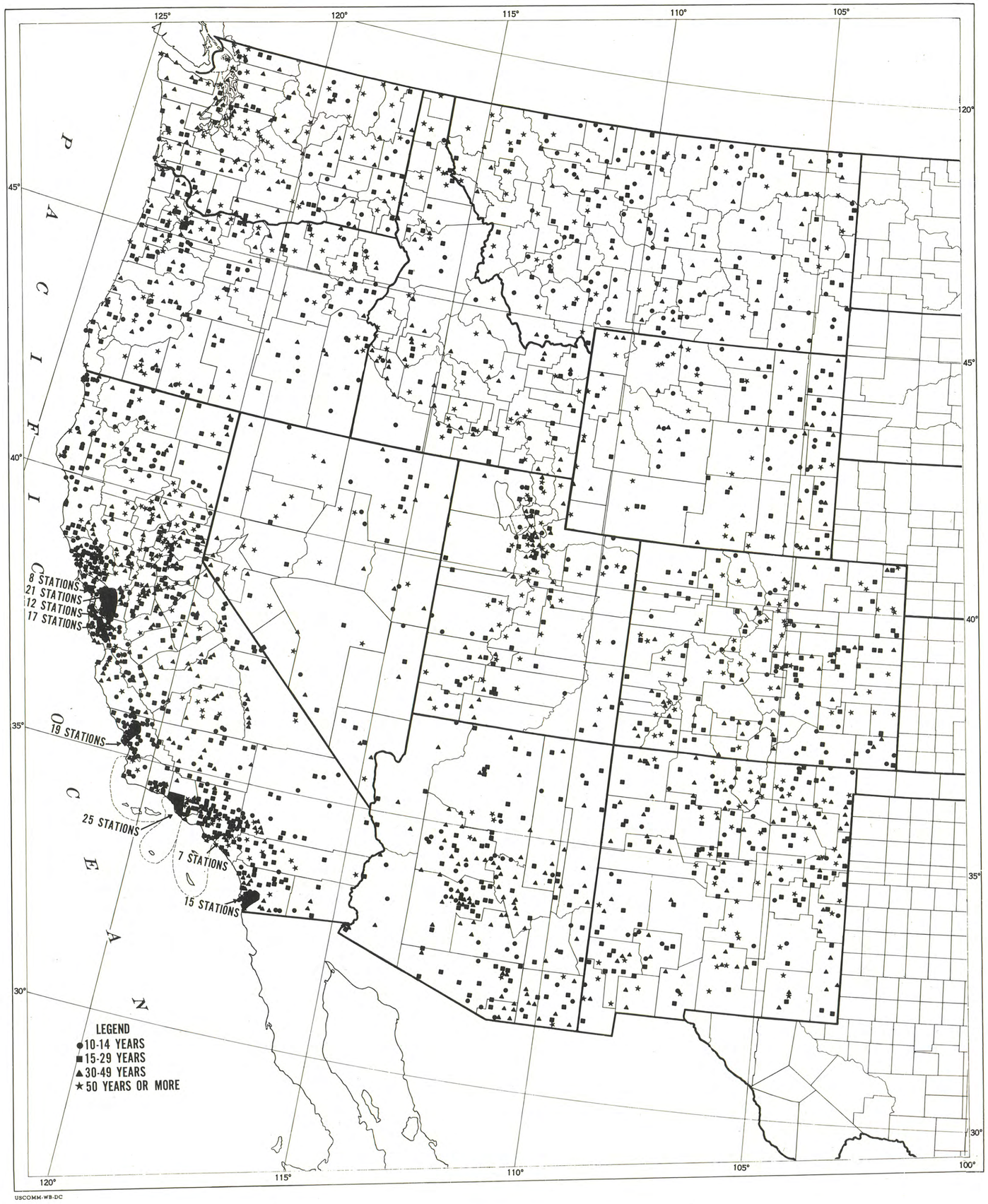
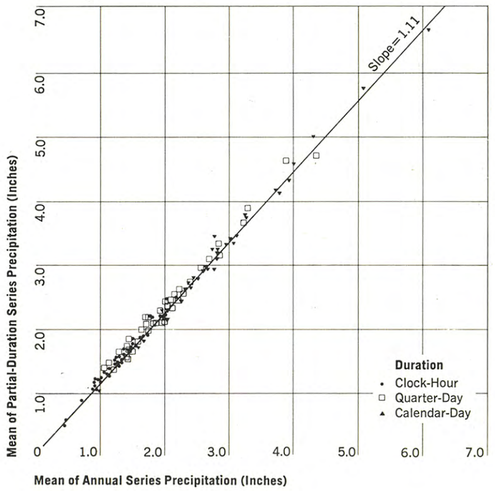


Figure 4. *Geographic distribution of stations with nonrecording gages. Symbols indicate total length of record available.*

Figure 5. *Relation between annual and partial-duration series.*



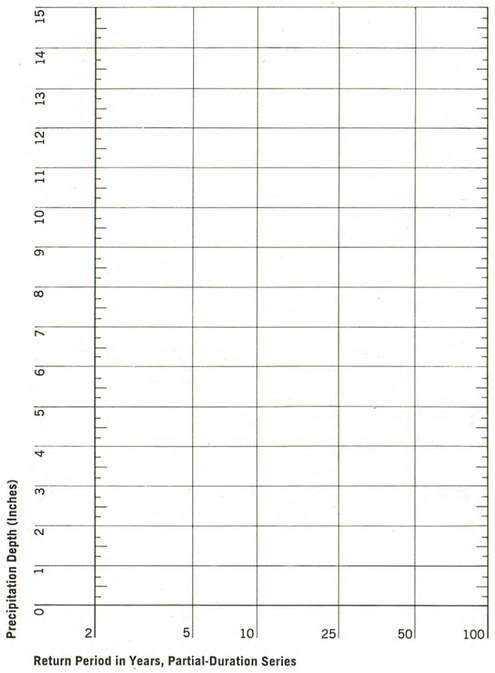


Figure 6. *Precipitation depth versus return period for partial-duration series.*

Figure 7. *Principal paths of moisture inflow in the western United States for storms producing large precipitation amounts. Toned areas are major orographic barriers.*

portant. Next, an examination was made of factors that combined topographic and meteorologic considerations, such as distance and direction to moisture sources. Each factor considered was a measure of some physical reality, and each was understandably related to variation in the precipitation-frequency regime.

Finally, various climatological and meteorological factors that could be indexes of variation of the precipitation-frequency values were considered. The procedure used for developing interpolating equations was a multiple-regression screening technique. This process was done by computer using a least-squares technique. The computer program was capable of accepting a total of 174 independent variables for as many locations as data were available. The number of variables screened for the various relations ranged between 60 and 100. This does not mean that 60 or more completely different factors could be identified. For example, several factors might involve different measures of slope. Moreover, these measures of slope might be over different distances or have different orientations. In each instance, the practice was to permit the computer to select the most critical of the various measures of each factor.

Although the computer program treated each variable as linear during the regression analysis, it was possible through internal computations to use logarithms, powers, roots, reciprocals, or combinations of any or all of the factors. The computer program selected the single variable most highly correlated with the precipitation-frequency value under investigation. The next step was to select the variable that, combined with the variable already selected, would explain the greatest variation in the precipitation-frequency values. The third, fourth, fifth, and further variables were selected in a similar manner. The program continued to select

Region of applicability[1]	Corr. coeff.	No. of stations	Mean of computed stn. values (inches)	Standard error of estimate (inches)
Gila, Williams, and lower Colorado River Basins (1)	0.84	86	1.86	0.21
Little Colorado, San Juan, and Virgin River Basins, except higher elevations of south-facing slopes (2)[2]	0.81	105	1.36	0.20
Higher elevations of south-facing slopes of Little Colorado, San Juan, and Virgin River Basins (2)[2]	0.93	41	1.31	0.13
Rio Grande Basin north of El Paso, Tex. (3)	0.77	110	1.35	0.18
Crest of Continental Divide and Sangre de Cristo Mountains to generalized 7,000-ft contour from southern Wyoming to southern tip of Sangre de Cristo Mountains (4)	0.83	122	1.43	0.22
Upper Colorado and Gunnison River Basins and Green River Basin below confluence of Green and Yampa Rivers (5)	0.79	69	1.12	0.13
Yampa River Basin, Green River Basin above confluence of Green and Yampa Rivers, and Bear River Basin east of Wasatch Mountains (6)	0.83	29	1.03	0.08
Mountains of central Utah (7)	0.85	86	1.35	0.18
Western Utah and Nevada, except Snake and Virgin River Basins and spillover zone east of Sierra Nevada Crest (8)[3]	0.71	79	1.03	0.13
Western Utah and Nevada, except Snake and Virgin River Basins and spillover zone east of Sierra Nevada crest (8)[3]	0.71	55	1.04	0.15
Big Horn River Basin above Saint Xavier and minor portions of North Platte, Powder, Tongue, and Yellowstone River Basins (9)	0.78	55	1.25	0.21
Upper Missouri River Basin above Holter Dam, Mont.; Snake River Basin above Alpine, Wyo.; and upper Yellowstone River Basin above Springdale, Mont. (10)	0.76	57	1.19	0.16
From generalized 4,000-ft contour on east to crests of Crazy and Little Belt Mountains and Lewis Range on west (11)	0.80	52	1.67	0.26
West of Continental Divide, but east of Bitteroot Range and Cabinet and Selkirk Mountains (12)	0.85	44	1.36	0.12
Mountainous region of eastern Washington and Oregon and of Idaho west of Bitteroot Range crest and Continental Divide, and north of southern boundary of Snake River Basin—excluding Snake River Valley below a generalized 5,000-ft contour (13)	0.78	147	1.44	0.24
Orographic region east of crest of Cascade Range and west of Snake River Basin (14)	0.90	115	1.75	0.35
Western slopes of Coast Ranges, Olympic Mountains, and Cascade Range (15)	0.87	125	3.69	0.48
Eel River Basin; southern portion of Klamath River Basin; and Cottonwood, Elder, Thomas, and Gladstone Creeks (16)	0.91	39	4.19	0.50
Russian River, Cache and Putah Creeks, and coastal drainages west of Russian River (17)	0.84	63	5.31	0.78
Santa Cruz Mountains and La Panza, Santa Lucia, and Coast Ranges (18)	0.95	55	4.32	0.45
Diablo, Gabilan, and Temblor Ranges (19)	0.82	58	2.21	0.35
San Rafael, San Bernardino, Santa Monica, and San Gabriel Mountains (20)	0.88	149	3.98	0.59
Santa Ana, Santa Rosa, Coyote, and other extreme southern coastal mountains (21)	0.88	34	2.44	0.33
Northern Sierra Nevada north of Mokelumne River Basin (22)	0.92	84	4.56	0.53
Southern Sierra Nevada south of Consumnes River Basin (23)	0.88	61	3.43	0.53
Southeastern desert region of California (24)	0.89	41	1.07	0.16
Spillover zone east of Sierra Nevada crest (25)	0.94	41	2.05	0.27
Spillover zone east of crest of coastal mountains of southern California (26)	0.97	10	2.08	0.15

[1] Numbers in parentheses refer to geographic regions shown in figure 8.
[2] Two different equations were used in region 2. See text for explanation.
[3] Two different equations were used in region 8. See text for explanation.

Table 3. *Statistical parameters for relations used for interstation interpolation of 2-yr 24-hr precipitation values*

variables until the variance explained by an additional variable was less than some preselected amount or until a fixed number of variables was selected. Final equations did not contain more than five independent variables.

In the development of these equations, data from all stations with daily or hourly observations were considered. The data sample used was not completely adequate. First, it did not include for each factor the full range of values that occur within the region. Application of the equation, therefore, required unavoidable extrapolation. Second, the number of data points used to develop these equations was occasionally less than desirable. Nevertheless, the equations provided the best available method of developing preliminary estimates of frequency values in regions lacking adequate data.

Relations for interpolating between 24-hr precipitation-frequency data points. Figure 8 shows generalized boundaries of the regions used to develop relations for interpolation between locations with 2-yr 24-hr precipitation values. Topographic maps show recognizable topographic barriers chosen as the boundary lines of most regions. For example, the boundary separating regions 3 and 4 from those to the west is the Continental Divide. The boundary separating region 15 from 14 is the crest of the Cascade Range. A few of the boundaries between adjoining regions may appear somewhat arbitrary, but examination of detailed topographic maps will show a physical basis for each.

In areas where topographic variation is gradual and where there are no large differences in elevations or slopes over short distances, precipitation-frequency values at a station usually are representative of a much larger area than are such values in a mountainous region. Within the western United States, some rather extensive regions met this criteria. Within these regions, there were also numerous stations with suitable records. The lack of topographic controls means only there is limited variation in precipitation-frequency values, and this variation is such that it can be depicted using the numerous station data points. No equations for interpolating between stations were developed for such regions (shown shaded in fig. 8).

The equations developed for interpolating between locations with 2-yr 24-hr precipitation values in regions of sparse data were not all equally reliable. On the average, the 28 equations developed for estimating the 2-yr 24-hr precipitation values at intermediate points in western United States explained about 70 percent of the variance. The standard error of estimate averaged about 13 percent of the average station value for 2-yr 24-hr precipitation. The correlation coefficient, the number of stations used, the average 2-yr precipitation value, and the standard error of estimate for each equation used to estimate 2-yr 24-hr precipitation values are shown in table 3.

The equation that explained the least variance, only slightly over one-half, was for western Utah and most of Nevada (region 8, fig. 8). This is a region with diverse topography and no well-defined orographic barrier. It is also a region where a wide variety of storms produce large precipitation amounts. The equation developed for the coastal mountains of California (region 18, fig. 8) explained the greatest portion of the variance, about 90 percent. The region consists primarily of mountain ranges oriented north-northwest to south-southeast; within this region, large precipitation amounts generally result from one storm type.

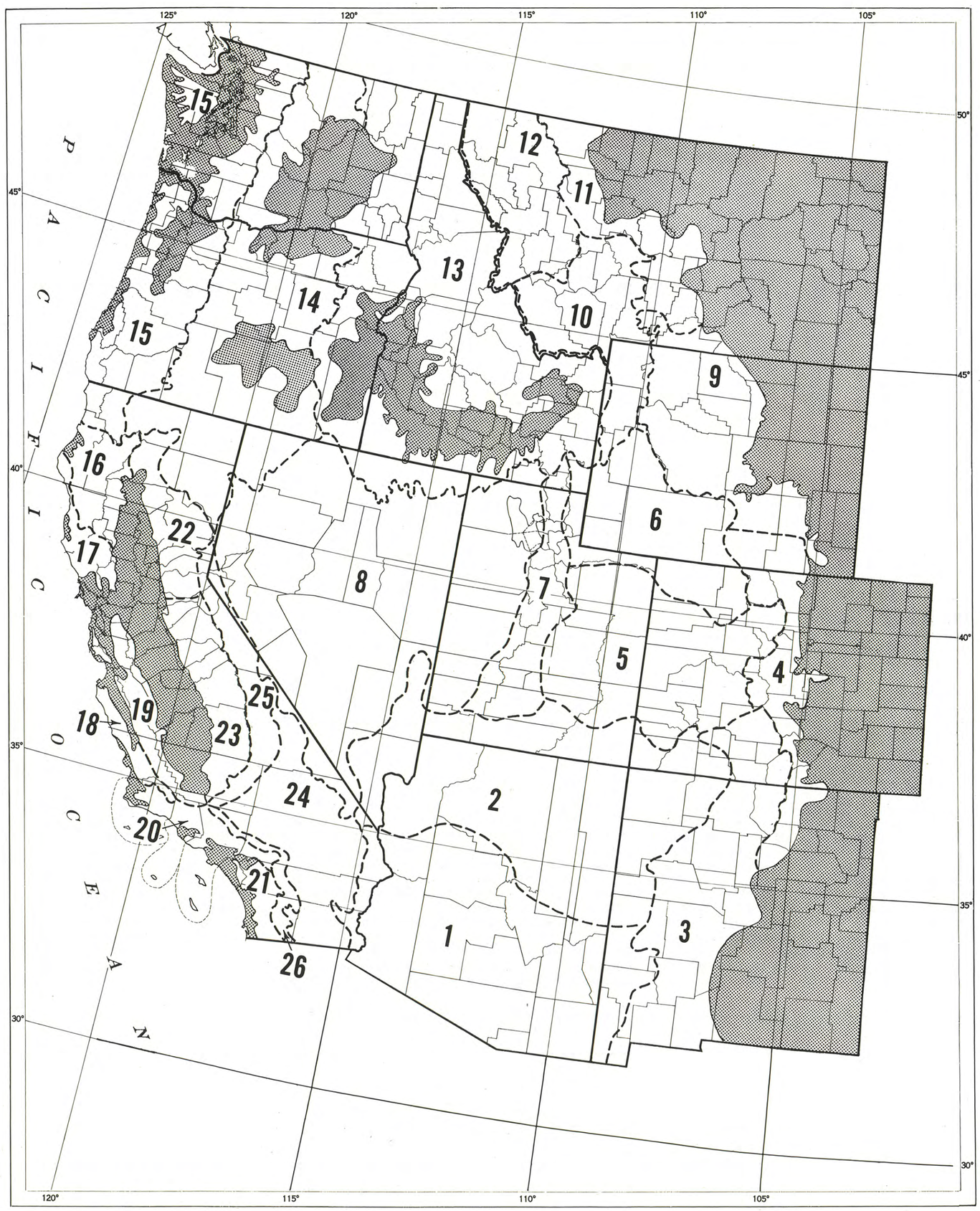


Figure 8. *Regions used to develop statistical parameters for interstation interpolation of 2-yr 24-hr precipitation values.*

Table 4. *Factors most useful in relations for interstation interpolation for 2-yr 24-hr precipitation values*

Factors (by category)	Number of equations using factor	Percent of equations using factor	Number of times each factor used	Percent of total number of times each factor used
Slope	18	64	37	42
Normal annual precipitation	15	54	15	17
Barrier to airflow	10	36	11	12
Elevation	10	36	10	11
Distance to moisture	9	32	9	10
Location (latitude or longitude)	4	14	5	6
Roughness	2	7	2	2

Two equations were developed for region 8 (fig. 8), which includes western Utah and Nevada except for the Snake and Virgin River Basins and a spillover zone east of the Sierra Nevada. The two relations had nearly equal correlation coefficients and standard error of estimates. The first equation was developed using normal annual precipitation, the second topographic factors only. The equation using normal annual precipitation data was developed during preparation of maps for Utah because reliable normal annual precipitation maps were available. Investigations continued, and a relation that gave about equally reliable results was obtained during the development of the maps for Nevada. Values computed using both equations for points near the Nevada-Utah border showed results that did not differ greatly. The second equation was then used to prepare the maps for Nevada.

Table 4 shows the factors, grouped in general categories, found most useful in depicting variations in the 2-yr 24-hr precipitation values for the western United States. The first and second columns show the number and percent of equations in which each factor was used. The total for the second column is larger than 100 percent because several factors were used in the equations developed for each region. The third column shows the total number of times each factor was used, and the fourth what percentage each factor used was of the total number of factors. For example, of the 89 different factors used in the 28 equations, 37 were some measure of slope; the use of the slope factor represents 42 percent of the total number of factors used.

The single most important factor considered was slope, a topographic factor. Measurement of slope varied from region to region. In some regions, slope was measured directly by dividing the difference in height between two points by the distance between the points. In the Cascade and Coast Ranges of Washington and Oregon, the difference between the station elevation and the average elevation at a distance of 20 miles in the western quadrant proved to be the most significant factor. A less direct measure was used in north-central Wyoming and south-central Montana, where the greatest change in elevation between the station and the lowest point within 20 miles was used and the distance between the station and such a point was not involved. In several portions of California, a more complicated method was used. A path 5 miles wide was oriented along the prevailing direction of moist airflow. At 1-mi intervals along this path, the average height was measured. The difference in height between adjoining lines indicated whether there was an upslope or a downslope in this particular segment. The summation of the upslopes and downslopes, separately, was an indirect measurement of slope. A combination of these upslopes and downslopes, each divided by the distance between the station and the center of the area included between two adjoining lines, was a direct measurement of slope.

The second most important topographic factor was found to be the barrier to moist airflow; this factor is actually a combination of meteorology and topography. In selecting a barrier, the first consideration was the direction of moist air inflow. The barrier had to be normal, or nearly normal, to this direction. The barrier range, or ranges, had to be sufficiently massive to cause a significant disruption in the airflow. Barriers of limited lateral extent that would permit air to flow around as easily as over were not considered. A generalized crest line was drawn along the significant barrier, and measurements of barrier height or distances or directions to this barrier were then made from the station to this generalized crestline. The orientation of barriers to moist airflow was determined as appropriate for each region. For example, along the Pacific coast, a westerly direction of moist airflow was used; in Colorado and New Mexico, a southeasterly airflow was appropriate. The direction selected was determined from an examination of the moist air inflow in storms that produce large precipitation amounts in these regions. In some regions, the distance behind the barrier was important. In others, the height of the barrier proved to be more significant.

The distance to the principal moisture source, a combination of topographic and meteorologic influences, was another important factor. In northeastern New Mexico, central Colorado, and southeastern Wyoming (region 4, fig. 8), examination of a topographic map and consideration of the moist air inflow in storms that produced large precipitation amounts (fig. 7), made it evident that the general moist airflow was from the Gulf of Mexico. Distance to moisture was therefore measured in that direction.

Another topographic factor used frequently was the elevation of the station, either the actual station elevation or, preferably, where narrow valleys and ridges predominate in the area the average elevation around the station at some distance (effective elevation). Elevation alone usually correlated rather poorly with precipitation-frequency values. In many regions, the simple correlation between elevation and precipitation-frequency values was not statistically significant at either the 0.01 or 0.05 level. It was not elevation alone but a combination of elevation with other factors, such as slope, height of intervening barriers, and distance to moisture source, that was significant.

Normal annual precipitation was used in many of these index relations. However, the policy adopted was that normal annual precipitation was not used if an equally reliable relation could be derived solely on the basis of topographic factors, even though normals could have been used in almost every region. The one exception was the southeastern desert regions of California, where normal annual precipitation did not correlate well with precipitation-frequency values. Normal annual precipitation maps are most exact at points where data are available. Isopleths used to arrive at estimates in areas where data are not available are only as accurate as the standard error of estimate of the relation used in the interpolation and as the skill of the analyst will permit. Therefore, where estimates of normal annual precipitation (or other climatological factors) are used to develop precipitation-frequency maps, the error incorporated in development of the normal annual precipitation map is combined with the standard error of estimate of the relation for precipitation-frequency maps. Normal annual precipitation maps were, however, helpful and were used. Storage-gage and snow-course data, streamflow data, and vegetation maps are useful for drawing accurate normal annual or seasonal precipitation maps in regions where lack of short-duration precipitation data decreases the reliability of relations between frequency values and topographic factors. Normal annual precipitation was used as a factor where topographic factors could not be quantified to estimate the precipitation-frequency values with sufficient accuracy.

Table 5 shows the statistical parameters of the interpolating equations used to estimate the 100-yr 24-hr precipitation values. The equations were developed for the same regions as those for the 2-yr return period, with one exception (fig. 9). This was in Arizona where data from the Gila, Williams, and lower Colorado Basins were combined with data from the San Juan, Little Colorado, and Virgin River Basins. In regions relatively unaffected by orography, equations were developed that related the 2-yr 24-hr precipitation values to those for the 100-yr return period. These equations were developed as an additional aid for interpolating between stations in these regions because of the relatively few stations with long records available. Although the longest record stations were generally within the nonorographic regions, most states had less than 20 percent of the stations within these regions with 50 or more years of record. Equations for these regions provided an objective method of providing space-averaged ratios between 100-yr 24-hr precipitation values and 2-yr 24-hr precipitation values.

As with the relations for estimating the values for the 2-yr return period, the equations did not all have the same degree of reliability. The orographic region for which the equation accounted for the least variance (not quite one-half of the variation) was the region including the Yampa River Basin, the Green River Basin above the confluence of the Green and Yampa Rivers, and the Bear River Basin east of the Wasatch Mountains (region 5, fig. 9). For several regions in California, over 90 percent of the variance was accounted for by the equations. The equation developed for the San Rafael, San Bernardino, Santa Monica, and San Gabriel Mountains (region 20, fig. 9) accounted for the greatest amount of the variation. On the average, the 35 equations developed to interpolate the 100-yr 24-hr precipitation values in this portion of the United States accounted for about 75 percent of the variance, and the standard error of estimate averaged about 12 percent of the average station value.

There was one region (region 7, fig. 9) for which two equations were developed. In the preparation of frequency maps for Utah, basins that were wholly or partly within Utah were investigated. One region extended westward from Utah to include most of Nevada. Within this region, a relation was developed that accounted for about 60 percent of the variance. During subsequent investigations, a superior relation was developed when frequency maps for Nevada were prepared. The newly developed equation accounted for about 80 percent of the variance.

Table 6 shows the factors found most useful for interpolating variations in the 100-yr 24-hr precipitation values in sparse-data areas of the western United States. This table is in the same format as table 4. The definitions of the variables—slope, distance to moisture, elevation, etc.—are the same as those for table 4. Again, slope is the most important topographic factor. The next most important topographic factor was elevation. In the equations, the 2-yr 24-hr precipitation values were used in interpolation. In table 6, it can be seen that the 2-yr 24-hr precipitation value was the most important variable. However, this may be misleading because about one-fourth of the regions for which equations were developed were considered nonorographic. In such regions, the use of the 2-yr 24-hr precipitation value in an equation was similar to using an average 100- to 2-yr ratio. Frequently, these equations included a location factor that reflected the variation of such a ratio over the region. As with other meteorological or climatological factors—for example, normal annual precipitation—it would have been preferable to avoid the use of precipitation-frequency values in the equations. However, this was not always possible.

Relations for estimating the 6-hr precipitation-frequency values. Data from both recording and nonrecording gages can be incorporated in equations for estimating precipitation-frequency values for the 24-hr duration. For durations of less than 24 hrs, only data from recording gages can be used. This frequently reduces the number of data points within a particular region by one-half or more. The effect of topography on precipitation-frequency values decreases as the duration decreases. Thus, there is less variability in the precipitation-frequency values for the 6-hr duration. For these reasons, larger regions are used to develop interpolation equations for 6-hr duration maps. Figure 10 shows the regions used to develop the equations for estimating 2-yr 6-hr precipitation values. The regions used for developing relations for the 100-yr return period were the same with one exception; the region south of the Snake, Bear, Yampa, and North Platte River Basins (region 1, fig. 10). This region was divided approximately along the Arizona-Utah and the New Mexico-Colorado boundary lines into Regions 1A and 1B.

The equation for the northern Sierra Nevada region of California (region 7, fig. 10) accounted for the least amount of variation—about 60 percent—in the 2-yr 6-hr precipitation values (table 7). The equation for the coastal mountains of California (region 6, fig. 10) accounted for over 90 percent of the variation and was the most reliable equation developed. On the average, the equations accounted for over 80 percent of the variations and had a standard error of estimate of about 11 percent of the average 2-yr 6-hr precipitation values.

For the 100-yr 6-hr precipitation values, the equation for the coastal mountains of California (region 6, fig. 10) accounted for the greatest amount of variation in these values (table 8). In this region, over 90 percent of the variation in the data sample was accounted for. The equation for the northern Great Basin (region 3, fig. 10) accounted for the least variation. In this region, the equation accounted for about 60 percent of the variation. On the average, the equations accounted for over 80 percent of the variation with a standard error of estimate of about 14 percent of the

Region of applicability[1]	Corr. coeff.	No. of stations	Mean of computed stn. values (inches)	Standard error of estimate (inches)
Gila, Williams, San Juan, Little Colorado, and Virgin River Basins (1)	0.80	148	3.98	0.59
Rio Grande Basin north of El Paso, Tex. (2)	0.78	110	3.26	0.48
Crest of Continental Divide and Sangre de Cristo Mountains to generalized 7,000-ft contour from southern Wyoming to southern tip of Sangre de Cristo Mountains (3)	0.91	69	3.28	0.38
Upper Colorado and Gunnison River Basins and Green River Basin below confluence of Green and Yampa Rivers (4)	0.79	53	2.57	0.31
Yampa River Basin, Green River Basin above confluence of Green and Yampa Rivers, and Bear River east of Wasatch Mountains (5)	0.68	27	2.41	0.30
Mountains of central Utah (6)	0.88	65	2.84	0.25
Western Utah and Nevada, except Snake and Virgin River Basins and spillover zone east of Sierra Nevada crest (7)[2]	0.77	64	2.50	0.29
Western Utah and Nevada, except Snake and Virgin River Basins and spillover zone east of Sierra Nevada crest (7)[2]	0.90	55	2.42	0.22
Big Horn River Basin above Saint Xavier and minor portions of North Platte, Powder, Tongue, and Yellowstone River Basins (8)	0.94	47	3.10	0.31
Upper Missouri River Basin above Holter Dam, Mont.; Snake River Basin above Alpine, Wyo.; and upper Yellowstone River Basin above Springdale, Mont. (9)	0.88	48	2.68	0.34
From generalized 4,000-ft contour on the east to crests of Crazy and Little Belt Mountains and Lewis Range on the west (10)	0.85	41	3.71	0.44
West of Continental Divide, but east of Bitteroot Range and Cabinet and Selkirk Mountains (11)	0.90	37	2.87	0.20
Mountainous region of eastern Washington and Oregon and of Idaho west of Bitteroot Range crest and Continental Divide, and north of southern boundary of Snake River Basin—excluding Snake River Valley below a generalized 5,000-ft contour (12)	0.87	99	2.74	0.32
Orographic region east of crest of Cascade Range and west of Snake River Basin (13)	0.92	115	3.76	0.61
Western slopes of Coast Ranges, Olympic Mountains, and Cascade Range (14)	0.80	119	7.09	1.13
Spillover zone east of crest of Sierra Nevada (15)	0.91	28	5.39	0.75
Eel River Basin; southern portion of Klamath River Basin; and Cottonwood, Elder, Thomas, and Gladstone Creeks (16)	0.85	26	8.34	1.42
Russian River, Cache and Putah Creeks, and coastal drainages west of Russian River (17)	0.88	35	10.17	1.24
Santa Cruz Mountains and La Panza, Santa Lucia, and Coast Ranges (18)	0.96	26	10.90	1.25
Diablo, Gabilan, and Temblor Ranges (19)	0.97	29	5.26	0.48
San Rafael, San Bernardino, Santa Monica, and San Gabriel Mountains (20)	0.98	68	11.72	0.97
Santa Ana, Santa Rosa, Coyote, and other extreme southern coastal mountains (21)	0.87	29	6.74	1.06
Northern Sierra Nevada north of Mokelumne River Basin (22)	0.96	65	9.74	1.01
Southern Sierra Nevada south of Consumnes River Basin (23)	0.89	42	8.14	1.29
Southeastern desert region of California (24)	0.93	41	3.37	0.47
Spillover zone east of crest of coastal mountains of southern California (25)	0.98	10	6.20	0.50
New Mexico east of Rio Grande Basin (26)	0.66	136	5.28	0.88
Colorado east of generalized 7,000-ft contour, and southeastern Wyoming east of generalized 7,000-ft contour and south of North Platte River Basin (27)	0.82	119	4.73	0.52
Eastern Wyoming and southeastern Montana east of generalized 6,000- to 5,000-ft contour and south of generalized 4,000-ft contour in vicinity of Wyoming-Montana border (28)	0.83	66	4.08	0.45
Montana east and north of generalized 4,000-ft contour (29)	0.76	83	3.86	0.42
Snake River Valley below 5,000 ft (30)	0.85	48	2.25	0.21
Coastal Plain, Puget Sound region, and Williamette Valley below 1,000 ft (31)	0.94	146	5.47	0.62
Nonorographic region east of crest of Cascade Range (32)	0.71	50	2.07	0.25
Sacramento and San Joaquin River Valleys of California below 1,000 ft (33)	0.94	102	4.07	0.51
Coastal lowlands of California (34)	0.87	180	6.65	1.03

[1] Numbers in parentheses refer to geographic regions shown in figure 9.
[2] Two different equations were used in region 7. See text for explanation.

Table 5. *Statistical parameters for relations used for interstation interpolation of 100-yr 24-hr precipiation values*

average 100-yr 6-hr precipitation values.

The factors used most frequently in the equations for estimating the 2-yr 6-hr precipitation values are listed in table 9; those for the 100-yr 6-hr precipitation values are given in table 10. The format and definitions of variables of tables 9 and 10 are the same as those of table 4. For the 2-yr return period, the factor used most frequently was a measurement of slope. Most equations, however, related variations in the 6-hr precipitation values to variations in the 24-hr values. For the 100-yr return period, slope and elevation were equally important topographic factors. As with the 100-yr 24-hr and 2-yr 6-hr maps, precipitation-frequency values were used in the equations for some regions.

Typical multiple linear regression equations. It is beyond the scope of this publication to present all the equations used for estimating precipitation-frequency values for this Atlas. However, it is useful to discuss in some detail two equations used to estimate the 2-yr 24-hr precipitation values. The factors used and the accuracy of the results obtained are typical of other equations developed.

The first of these is the equation for the northern Coastal Mountains of California (region 16, fig. 8). This region includes the Eel River Basin, some southern portions of the Klamath River Basin, and the western portion of the Sacramento River Basin. This equation is

$$Y = 3.117 + 1.814(X_1) + 0.016(X_2) - 0.049(X_3), \quad (1)$$

where Y is the 2-yr 24-hr precipitation value in inches, and X_1 is the average elevation (in hundreds of feet) of the points on a 1-mile radius circle centered on the station and divided by the distance (in miles) to the coast. X_2 is the slope of the terrain near

Table 6. *Factors most useful in relations for interstation interpolation for 100-yr 24-hr precipitation values*

Factors (by category)	Number of equations using factor	Percent of equations using factor	Number of times each factor used	Percent of total number of times each factor used
2-yr 24-hr precipitation	27	77	27	29
Slope	26	74	26	28
Elevation	20	57	20	22
Distance to moisture	6	17	6	7
Location (latitude or longitude)	5	14	6	7
Normal annual precipitation	4	11	4	4
Barrier to airflow	2	6	2	2
Roughness	1	3	1	1

Region of applicability*	Corr. coeff.	No. of stations	Mean of computed stn. values (inches)	Standard error of estimate (inches)
Arizona, New Mexico, extreme eastern California, Nevada south of the Snake River Basin, Utah south of the Snake and Bear River Basins, and Colorado south of the Yampa and North Platte River Basins (1a and 1b)	0.92	262	1.10	0.16
Montana and Wyoming east of a generalized crestline extending along the Continental Divide in northern Montana, the Crazy and Little Belt Mountains, the Absaroka Range, and the Continental Divide in southern Wyoming (2)	0.94	125	1.07	0.10
Region north of the southern boundaries of the Snake, Bear, and Yampa River Basins and between a generalized crestline of the Cascades and a generalized crestline extending along the Continental Divide in northern Montana, the Crazy and Little Belt Mountains, the Absaroka Range, and the Continental Divide in southern Wyoming and northern Colorado (3)	0.91	151	0.73	0.07
Orographic regions of western Washington, Oregon, and California from the crest of the Cascade Range to the Pacific Ocean extending southward to include the area drained by the Klamath and Salmon Rivers in northern California (4)	0.78	57	1.66	0.23
Nonorographic coastal lowlands of Washington and Oregon (5)	0.97	59	1.41	0.10
Coastal mountains of California from the Trinity River Basin in the north to the Mexican border (6)	0.97	87	1.85	0.16
Northern Sierra Nevada north of Mokelumne River Basin (7)	0.78	31	2.03	0.34
Southern Sierra Nevada south of Consumnes River Basin (8)	0.92	26	1.68	0.18
Spillover zone east of the crests of the Sierra Nevada and the coastal mountains of southern California and the southeastern desert region of California (9)	0.86	25	0.84	0.12
Coastal lowlands and San Joaquin and Sacramento Valleys of California (10)	0.95	73	1.37	0.11

* Numbers in parentheses refer to geographic regions shown in figure 10.

Table 7. *Statistical parameters for relations used for interstation interpolation of 2-yr 6-hr precipitation values*

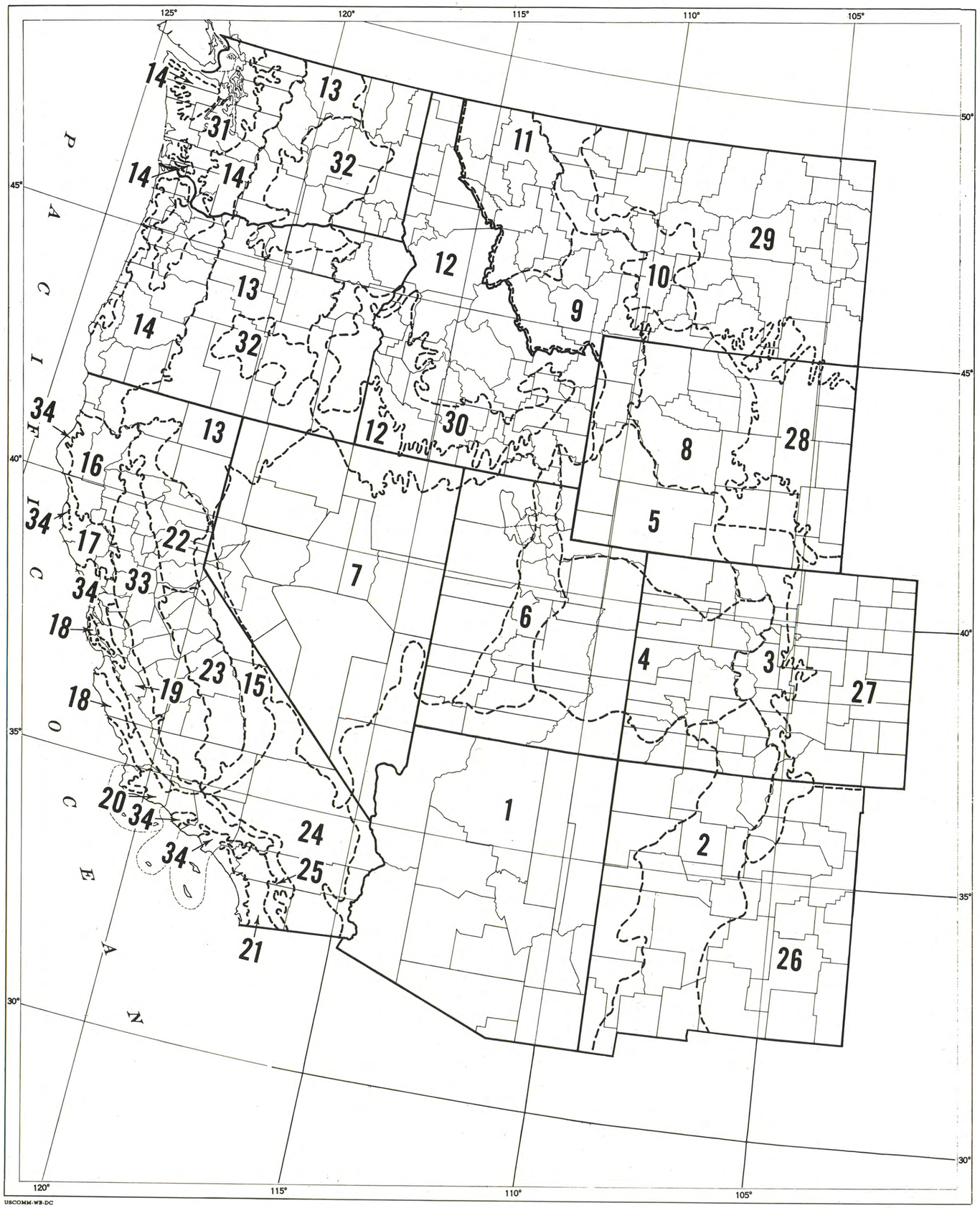


Figure 9. *Regions used to develop statistical parameters for interstation interpolation of 100-yr 24-hr precipitation values.*

the station (in hundreds of feet per mile). X_2 was computed by subtracting the average height along a 90° arc centered 10 miles southwest of the station (downwind for the most prevalent storm-wind direction) from the average height along a 90° arc centered 5 miles northeast of the station (upwind for the most prevalent storm-wind direction). X_3 is the average height (in hundreds of feet) of the final crest (measured along a 10° arc) divided by the distance (in miles) between the station and the final crest. The final crest was a generalized crestline that separated the Sacramento River Basin from basins to the west; it was drawn on a 1:1,000,000 World Aeronautical Chart. Distances to the east of this crest were considered negative.

The first factor, X_1, combines the measurements of the horizontal and vertical distances from moisture. It also measures the average slope between the station and the coast. The second factor, X_2, is a measure of the lift imparted to the airflow in the vicinity of the station—small-scale slope. The third factor, X_3, is a measure of large-scale lifting—large-scale slope. It can also be considered to represent the general distortion in the large-scale moist airflow caused by the major orographic barrier.

This equation explains about 84 percent of the variance in the 2-yr 24-hr precipitation values, with a standard error of estimate of 0.50 in. which is about 12 percent of the average 2-yr 24-hr precipitation value for stations in the region. Of the total variance, the first variable accounts for about 70 percent, the second, 9 percent, and the third, 4 percent. Other variables examined did not account for significant additional portions of the variance. The geographic distribution of the errors is shown in figure 11. The upper number at each station is the actual difference (in hundredths of inches) between the value computed from observed data and that estimated from the equation. The lower number is the error expressed in a percent of the 2-yr 24-hr precipitation value at the station. No discernible regional pattern in the errors was apparent. Although the factors used in this and the other equations have a physical meaning, the equation is a statistical relation of physical factors. There is no intention to imply a cause-and-effect relation. The requisite knowledge of the precipitation process is not yet available to develop equations that incorporate the dynamics of motion, condensation, and other factors to predict precipitation frequency.

The second illustrative equation was developed for the Big Horn River Basin, south of Saint Xavier, Mont. (region 9, fig. 8). Minor portions of the North Platte, Powder, Tongue, and Yellowstone River Basins were also included in this region. The equation is

$$Y = 1.497 + 0.027(X_4) + 0.002(X_5) - 0.023(X_6). \quad (2)$$

Y is the estimated 2-yr 24-hr precipitation value in inches. X_4 is the difference between the station elevation and the lowest elevation within 20 miles (in hundreds of feet). X_5 is the difference between the sum of the maximum heights within 40 miles along radials to the northwest, west, and southwest, and the sum of the maximum elevations within 40 miles along radials to the northeast, east, and southeast (in hundreds of feet). X_6 is the direction to the nearest point on the Continental Divide within the sector from southwest to north. If, however, there is a peak higher than 9,000 ft within this sector and it is closer to the station than is the Continental Divide, X_6 is the direction to this peak.

All three variables are related to the effect of the ground slope in the vicinity of the station. The first two variables measure differences in height over small and medium distances and reflect the importance of the steepness of the slope in the precipitation process. Here, the moist airflow of large storms comes from an easterly direction, frequently associated with a cyclonic center south or southeast of the region, and ground elevation generally increases toward the west or northwest. The third variable relates the orientation of the ground slope and its effectiveness in the precipitation process to an optimum inflow direction. The total amount of the variance accounted for by this relation is about 60 percent, with a standard error of estimate of 0.21 in., or about 17 percent of the average 2-yr 24-hr precipitation value. The first variable accounts for about 41 percent of the variance; the second, 11 percent; and the last, 8 percent. The geographic distribution of the errors from this equation is shown in figure 12.

It would have been possible to include normal annual precipitation in this relation. This factor would have accounted for an additional 15 percent of the variance and a corresponding decrease in the standard error of estimate. Where this factor could be determined from data, the use of normal annual precipitation would have improved the results. As indicated earlier, the results would include some points for which short-duration precipitation data were not available. At points where such data were not available, any improvement would have been dependent on the ability to estimate normal annual precipitation. In using an equation with normal annual precipitation, the standard error of estimate incorporated in the procedure for preparing normal annual precipitation maps is combined with the standard error of estimate for the interpolating equation for 2-yr 24-hr precipitation values. When this combined error is greater than the standard error of estimate for an interpolating equation for 2-yr 24-hr precipitation that does not include normal annual precipitation, there is a loss of accuracy through use of the equation including normal annual precipitation. Within this particular region, the uncertainty in estimating normal annual precipitation at nondata points was sufficiently large and an equation developed using only topographic factors was sufficiently reliable that use of the equation containing normal annual precipitation for estimating the 2-yr 24-hr precipitation values was not justified.

Drawing of isopluvial lines on four key maps. In preparing the isopluvial maps, the computed precipitation-frequency values for all stations were plotted. In addition to the computed values, the width of the confidence band, computed according to standard statistical procedures, was plotted for the 100-yr return-period maps. Values estimated from the equations described in the preceding section were plotted for a latitude-longitude grid with 5-min grid points. The total number of grid points was approximately 47,000. Along the boundaries of each region, values were estimated by the equations applicable to each of the adjoining regions.

In the construction of isopluvial lines, the question arises as to how much the station and grid-point data should be smoothed for the most effective use of the maps. When drawing the isopluvial lines through the field of grid points and station data, the standard error of estimate for the various multiple regression equations and the confidence band about the station data must be considered. Also, smoothing between adjoining regions, where multiple regression equations give somewhat different values at the boundary

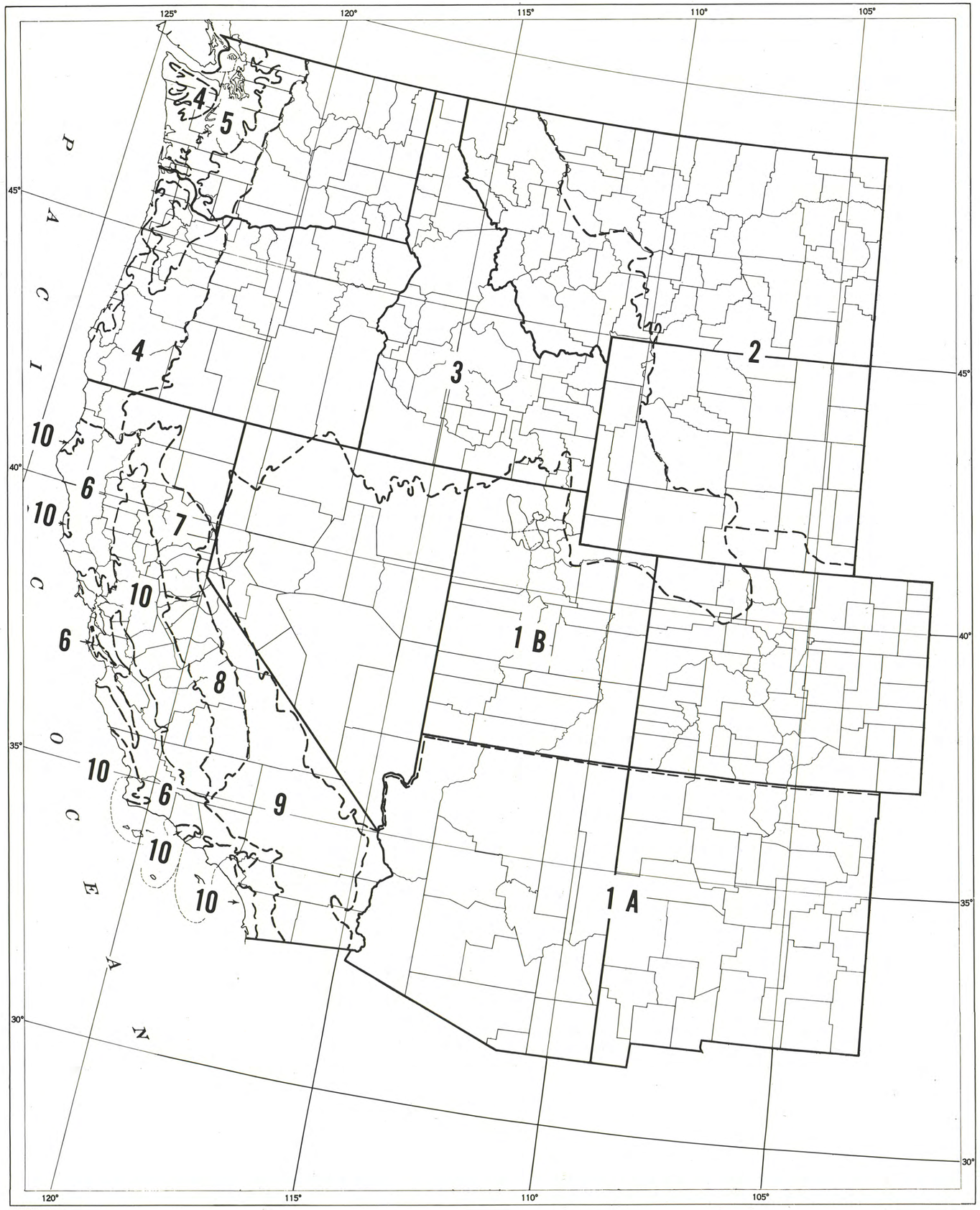


Figure 10. *Regions used to develop statistical parameters for interstation interpolation of 2-yr and 100-yr 6-hr precipitation values.*

Table 8. *Statistical parameters for relations used for interstation interpolation of 100-yr 6-hr precipitation values*

Region of applicability*	Corr. coeff.	No. of stations	Mean of computed stn. values (inches)	Standard error of estimate (inches)
Arizona, New Mexico, and lower Colorado River Basin in southeastern California (1a)	0.91	103	3.16	0.50
Nevada south of the Snake River Basin, Utah south of the Snake and Bear River Basins, and Colorado south of the Yampa and North Platte River Basins (1b)	0.91	144	2.34	0.47
Montana and Wyoming east of a generalized crestline extending along the Continental Divide in northern Montana, the Crazy and Little Belt Mountains, the Absaroka Range, and the Continental Divide in southern Wyoming (2)	0.92	110	2.62	0.31
Region north of the southern boundaries of the Snake, Bear, and Yampa River Basins and between a generalized crestline of the Cascades and a generalized crestline extending along the Continental Divide in northern Montana, the Crazy and Little Belt Mountains, the Absaroka Range, and the Continental Divide in southern Wyoming and northern Colorado (3)	0.79	120	1.62	0.22
Orographic regions of western Washington, Oregon, and California from the crest of the Cascade Range to the Pacific Ocean extending southward to include the area drained by the Klamath and Salmon Rivers in northern California (4)	0.89	57	2.98	0.33
Nonorographic coastal lowlands of Washington and Oregon (5)	0.91	59	2.49	0.31
Coastal mountains of California from the Trinity River Basin in the north to the Mexican border (6)	0.97	87	3.95	0.39
Northern Sierra Nevada north of Mokelumne River Basin (7)	0.93	31	3.81	0.45
Southern Sierra Nevada south of Consumnes River Basin (8)	0.93	26	3.87	0.50
Spillover zone east of the crests of the Sierra Nevada and the coastal mountains of southern California and the southeastern desert region of California (9)	0.84	25	2.29	0.36
Coastal lowlands and San Joaquin and Sacramento Valleys of California (10)	0.87	71	2.98	0.41

* Numbers in parentheses refer to geographic regions shown in figure 10.

Table 9. *Factors most useful in relations for interstation interpolation of 2-yr 6-hr precipitation values*

Factors (by category)	Number of equations using factor	Percent of equations using factor	Number of times each factor used	Percent of total number of times each factor used
Slope	4	40	10	38
2-yr 24-hr precipitation	7	70	7	27
Location (latitude or longitude)	4	40	4	15
Elevation	3	30	3	12
Barrier to airflow	1	10	1	4
Distance to moisture	1	10	1	4

Table 10. *Factors most useful in relations for interstation interpolation for 100-yr 6-hr precipitation values*

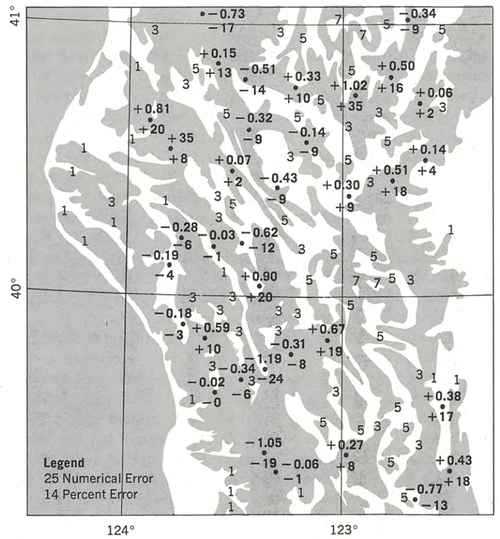
Factors (by category)	Number of equations using factor	Percent of equations using factor	Number of times each factor used	Percent of total number of times each factor used
2-yr 6-hr precipitation	5	55	5	23
100-yr 24-hr precipitation	4	36	4	19
Elevation	4	36	4	19
Slope	4	36	4	19
2-yr 24-hr precipitation	1	9	1	5
Normal annual precipitation	1	9	1	5
Distance to moisture	1	9	1	5
Location	1	9	1	5

lines, must be considered separately. Isolines can be drawn to fit every point plotted on the map, although this would not allow for some of the random differences between adjoining grid points that result from errors in the multiple regression equation or sampling errors in station data. Also, the courseness of even a 5-min latitude-longitude grid is such that sometimes narrow ridges and valleys are missed. Because of these considerations, occasionally it was necessary to make additional computations for such locations. Some subjective smoothing must be used to make allowances for factors that could not be expressed quantitatively.

In analysis, smoothness and closeness of fit are basically inconsistent in that smoothing cannot be carried beyond a certain point without some sacrifice of closeness of fit and vice versa. As the isolines were drawn, the sampling error of the station values and the standard error of estimate were considered.

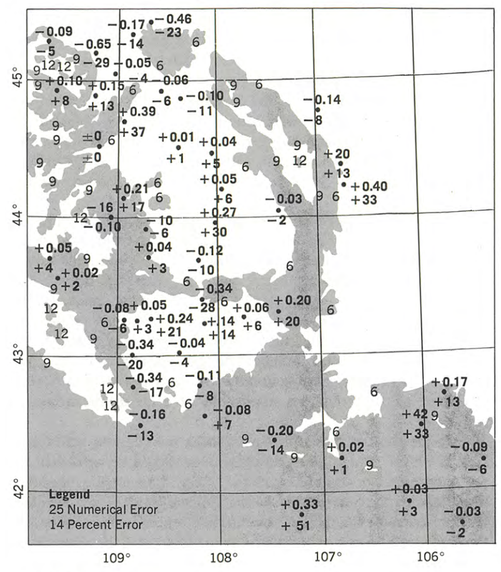
Additional working maps. Additional working maps were prepared showing the 100- to 2-yr ratios for the 6- and 24-hr durations and the 6- to 24-hr ratios for the 2- and 100-yr return periods. To minimize the exaggerated effect of an outlier (anomolous event) from a short record, only data from those stations with a minimum record length of 20 yrs for the 6- and 24-hr durations at the 100-yr return period were used in these working maps. Experience has shown that for long-record station data, the ratio of 6- to 24-hr values for the same return period and the 100- to 2-yr ratio for the same duration do not vary greatly over relatively large areas. The variation present is consistent with the variations in relations between meteorologic and topographic characteristics. Climatic factors that provide general guides on variations of precipitation-frequency values were examined and considered in a qualitative sense. Among these factors are the mean annual number of thunderstorm days (U.S. Weather Bureau 1952, 1947), normal monthly number of days above various threshold values (Environmental Science Services Administration, Weather Bureau, 1966), and mean number of days with rain (Environmental Science Services Administration, Environmental Data Service 1968).

Intermediate maps. The 47,000-point grid described earlier was also used in the analysis of the isopluvial patterns of the eight intermediate maps. These maps—for 5-, 10-, 25-, and 50-yr return periods for 6- and 24-hr durations were prepared primarily for the convenience of the user, because it is technically sufficient to provide two points of the frequency curve for a particular duration and to describe the method of interpolation. Four values, one from each of the four key maps, were read for each grid point. These four values were used in a computer program based on the return-period diagram (fig. 6) to compute values for eight additional maps. The key maps were used as underlays to maintain the basic isopluvial pattern on all maps.



Eel River Basin

Figure 11. *Geographic distribution of errors for equation used to interpolate 2-yr 24-hr precipitation values for the Eel River Basin; southern portion of Klamath River Basin; and Cottonwood, Elder, Thomas; and Gladstone Creeks, California.*



Big Horn River Basin

Figure 12. *Geographic distribution of errors for equation used to interpolate 2-yr 24-hr precipitation values for the Big Horn River Basin above Saint Xavier, Montana; minor portions of the North Platte, Powder, and Tongue River Basins in eastern Wyoming; and minor portions of the Yellowstone River Basin in northwestern Wyoming and southeastern Montana.*

Interpretation of Results

Season of Occurrence

The maps in this Atlas are based upon data for the entire year. In certain sections of the West, precipitation is highly seasonal. Thus, rainy season precipitation-frequency values approach the annual values. In sections where the greatest annual *n*-hour precipitation amount may be observed in any season, seasonal precipitation-frequency maps would differ from those presented in this Atlas. In no case could the seasonal value be greater than the annual value. However, the seasonal values would be a certain percent of the annual values, with the percent varying according to the frequency of large storms during the season under investigation. Generalizations about the seasonal distribution of large storms can be obtained from ESSA, *U.S. Weather Bureau Technical Paper* No. 57 (Environmental Science Services Administration, Weather Bureau, 1966). Currently, there is no convenient manner of applying this knowledge to the maps of this Atlas, other than subjectively.

Within Vs. Among Storms

Data for the various duration maps and diagrams in this Atlas were determined independently; that is, there was no requirement that the maximum 6- or 1-hr amount for a particular year be included within the maximum 24-hr amount for that year. The maps, therefore, represent an "among" storm distribution. In regions where winter-type storms predominate, the 6-hr value for a particular return period would more closely approximate the 6-hr value within the 24-hr storm for the same return period than would generally be the case in regions where convective storms predominate. In a study for the United States east of the Mississippi River, Miller (1971) showed that the ratio between the 2-yr 1-hr value computed from the maximum 1-hr amount within the 24-hr maximum and the 2-yr 1-hr value computed using maximum 1-hr amounts varied between 0.52 and 0.91. Studies have not been undertaken of this relation in the West, but a wide range in such ratios and similar ratios for the 6-hr duration could be expected.

Point Probabilities

The maps in this Atlas are derived from and depict point probabilities; the data points are independent of each other. Precipitation over a region is variable, even in large general area storms; neighboring stations do not necessarily experience maximum annual amounts from the same storm. Thus, the individual points on these maps express individual probabilities. That a point within a particular watershed may receive an amount equal to or greater than its 50- or 100-yr value on a particular day does not affect probabilities for any other point within that watershed. A second point within the watershed may experience an amount equal to or greater than its 50- or 100-yr value within the same storm or on the next day, within the next week or at any other time.

Areal Analysis

A value read from an isopluvial map in this Atlas is the value for that point and the amount for that particular duration which will be equaled or exceeded, on the average, once during the period indicated on the individual map. In hydrologic design, engineers are more concerned with the average depth of precipitation over an area than with the depth at a particular point. Depth-area curves were developed to meet this need. The depth-area curve is an attempt to relate the average of all point values for a given duration and frequency within a basin to the average depth over the basin for the same duration and frequency.

Generally, there are two types of depth-area relations. The first is the storm-centered relation; that is, the maximum precipitation occurring when the storm is centered on the area affected (fig. 13). The second type is the geographically fixed-area relation where the area is fixed and the storm is either centered over it or is displaced so only a portion of the storm affects the area (fig. 13). We can say that storm-centered rainfall data represent profiles of discrete storms, whereas the fixed-area data are statistical averages in which the maximum point values frequently come from different storms. At times, the maximum areal value for the network is from a storm that does not produce maximum point amounts. Each type of depth-area relation is useful, but each must be applied to appropriate data. Generally, the storm-centered relations are used for preparing estimates of probable maximum precipitation, while the geographically fixed relations are used for studies of precipitation-frequency values for basins.

Dense networks of precipitation gages are required to furnish basic data used in developing depth-area relations for fixed areas. The criteria used in selecting dense networks for the determination of areal precipitation-frequencies by the National Weather Service have been:

1. A network should be composed entirely of recording gages. The use of nonrecording gages may greatly increase the number and density of stations within a network, but it involves the construction of mass curves and introduces additional subjectivity. Nonrecording gages are read at various hours, usually early morning, late afternoon, or midnight. Because of conflicting activities, a cooperative observer may not always be able to read his precipitation gage at the exact hour specified. In these cases, the exact time of the observation may not be available, so it is hard to relate the reported amounts to those of surrounding stations with the precision required for development of depth-area relations.
2. A minimum length of record should be established to ensure a reasonable estimate of the 2-yr areal precipitation.
3. Gage locations and exposures should remain consistent during the period of record analyzed.
4. Gages should be located so that there is at least one gage located within each 100 square-mile area.

The average depth-area curves in this Atlas (fig. 14) are for fixed areas and were developed from dense networks meeting the above criteria. The curves were first prepared for an earlier study (U.S. Weather Bureau 1957–60) and have since been rechecked against longer record data; no changes were needed. Application of these curves must be consistent with the manner in which they were developed. The following steps are used:

1. Estimate point values from a grid of many points over the basin of interest for the duration and return period required.
2. Compute an average of the point values obtained in step 1.
3. Use figure 14 to obtain an areal reduction factor required for the precipitation duration and size of area under consideration.
4. Multiply the average value obtained in step 2 by the ratio obtained in step 3. The value obtained in this step provides the areal value for the basin of interest for the duration and return period under consideration.

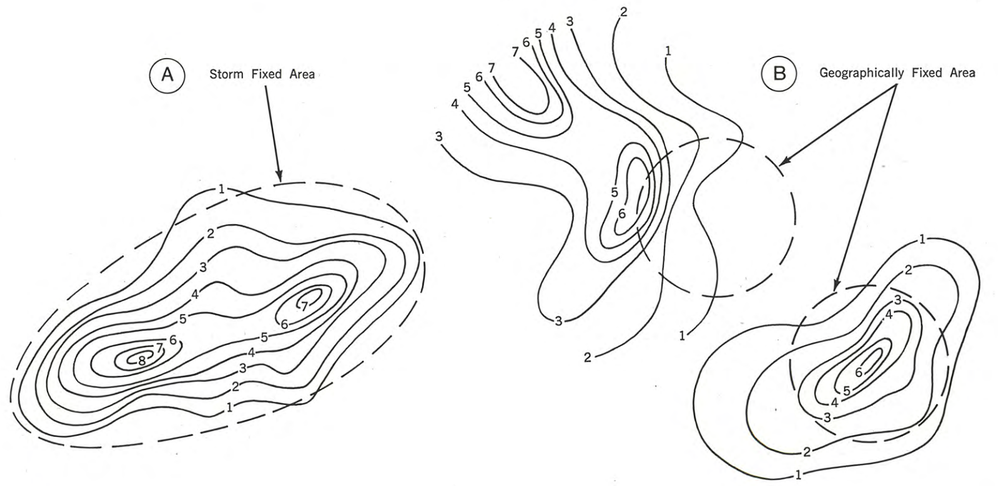


Figure 13. *Examples of (A) isohyetal pattern centered over basin as would be the case for storm-centered depth-area curves and (B) two possible occurrences of isohyetal patterns over a geographically fixed area as would be the case in development of curves for a geographically fixed area.*

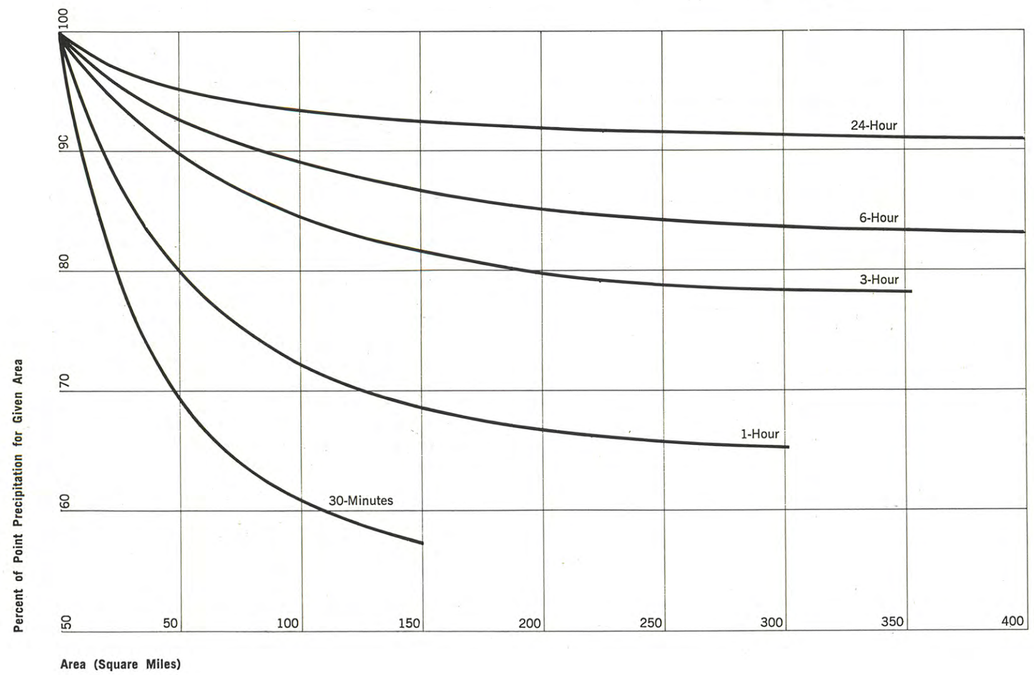


Figure 14. *Depth-Area curves.*

Data used to develop and validate the curves of figure 14 exhibited no systematic regional pattern. Duration turned out to be the major factor. The curves shown are based on data for the 2-yr return period. Within the accuracy of the data available, it could be shown that neither magnitude nor return period was a significant factor.

Importance of Snow in Estimating Frequency Values

The contribution of snow amounts to the precipitation-frequency values for durations of 24 hours or less has been investigated in most of the western United States. In many parts of this region, particularly at higher elevations, snow accounts for over 50 percent of the normal annual precipitation. Thus, the importance of snowfall to short-duration (6- to 24-hr) precipitation-frequency values is of interest for a more complete understanding of the precipitation-frequency regime.

Mean annual precipitation containing a high percentage of snow occurrences does not necessarily mean that snow contributed significantly to the annual series of maximum 6- or 24-hr precipitation amounts. This problem was investigated by tabulating two sets of data for all stations where snowfall observations were made routinely. The first set of data contained the greatest 24-hr (and 6-hr amounts at recording-gage stations) precipitation amount for each year, regardless of type of precipitation (water equivalent for snowfall amounts). The second series was restricted solely to rainfall events. In some cases, the second series contained amounts as low as the fifth highest for a particular year. Results of these investigations are reported in the section for each state.

Reliability of Results

The term "reliability" is used here as an indication of the degree of confidence that can be placed in the accuracy of the results obtained from the maps. The reliability of these results is influenced by the sampling errors in time and space, and by the manner in which the maps were constructed. Sampling errors in time and space result from: (1) the chance occurrence of an anomalous storm which has a disproportionate effect on the statistics for one station, but not on those for a nearby station, and (2) the geographic distribution of stations. In the relatively nonorographic regions (shown shaded on fig. 8), the occurrence of large precipitation events can be considered to be relatively random over a limited geographic area. Thus, a large precipitation event (especially of convective nature) at a station could just as easily have occurred at a neighboring station or between stations. Results from a generalized analysis based on space-averaging techniques are considered more nearly correct than results determined from an analysis of only individual station data. In the more mountainous regions, orography has greater control on the location and magnitude of the largest storms and simple space averaging between neighboring stations is inappropriate; consideration must be given to effects of the slopes of surrounding terrain, station elevations, the intervening barrier between station location and moisture source, etc.

The locations of the stations used in the analyses are shown in figures 3 and 4. This geographic network of stations does not reveal with complete accuracy the very detailed structure of the isopluvial patterns in the mountainous regions of the West. The multiple regression equations discussed earlier were used to help in interpolation between values computed for these stations. The standard error of estimate for these relations should be considered when using the precipitation-frequency values shown on the maps. In general, the accuracy of the estimates obtained from the maps of this Atlas varies from a minimum of about 10 percent for the shorter return periods in relatively nonorographic regions to 20 percent for the longer return periods in the more rugged orographic regions.

The values shown on these maps are in general agreement with those of *Weather Bureau Technical Paper* No. 40 (U.S. Weather Bureau 1961). Differences are found because of the greater attention paid to physiographic features in the present study. Even though the precipitation-frequency maps presented are prepared considering physiographic factors, only those of a major scale could be considered. There are some basins, therefore, that are more sheltered or exposed than a generalized topographic map would indicate. The map values may not be representative of the precipitation regimes in such basins.

The major centers of large precipitation-frequency values are located on the most exposed and steepest slopes of the mountains. Objective studies (such as the regression analysis previously discussed) and experience in precipitation-frequency analysis have indicated some general guidelines for the placement of isopluvial centers along crests and on slopes of mountain ranges. Two examples will serve to illustrate such guidelines. For an initial completely exposed orographic barrier, where the crest of the range was 3,000 to 4,000 ft. above the plains region to the windward of the mountain and the slope was on the order of 300 ft per mile, the largest isopluvial line should extend past the crest and include a little of the lee side of the mountain. Where the crest of the range was 8,000 to 10,000 ft above the plains region to the windward of the mountain range and the slope was on the order of 1,000 ft per mile, the isopluvial center would generally be about 4,000 to 6,000 ft above the plains region. For mountain ranges with crests and slopes having other combinations of these values, the placement of the highest precipitation-frequency values would depend upon the degree of exposure of the mountain range to moisture-bearing wind, the steepness of the slope, the height of the crest, and other orographic factors. In general, isopluvial centers for the longer return periods tend to be located at lower elevations than the centers for the shorter return periods. The distance downslope that the center is displaced depends on the exposure and steepness of the slope. Centers will be displaced less on a steep slope than on a gentle slope similarly exposed.

Oregon

Discussion of Maps

Figures 19 through 30 present precipitation-frequency maps for Oregon for 6- and 24-hr durations for return periods of 2, 5, 10, 25, 50, and 100 yrs. The isopluvial maps represent the 360- and 1,440-min durations for the partial-duration series. Data were tabulated for clock and observation-day intervals for the annual series and were adjusted by the empirical factors given in the ANALYSIS section.

Isoline interval. The isoline intervals selected were designed to provide a reasonably complete description of the isopluvial pattern in various regions of the state. For that portion of Oregon that extends from the eastern foothills of the Cascade Range westward to the coast, the isoline interval for the 24-hr duration is 0.5 in. for precipitation-frequency values below 8.0 in., with an interval of 1.0 in. above that value at the 2- and 5-yr return period. For the 10- through 100-yr return period, the 7-0-in. precipitation-frequency value separates the 0.5-in. and 1.0-in. intervals. At the 6-hr duration, the isoline interval in this part of the State is 0.1 in. below a precipitation-frequency value of 1.4 in. and 0.2 in. from 1.4 to 3.0 in. Above 3.0 in., the interval is 0.4 in. for 2- through 25-yr return periods and 0.5 in. for return periods of 50 and 100 yrs. For that portion of the state east of the eastern foothills of the Cascade Range, the isoline interval on the 24-hr precipitation-frequency maps is 0.2 in. for values up to 3.0 in. and 0.4 in. for values over 3.0 in. On the maps for the 6-hr duration, the interval is 0.1 in. for values to 1.6 in. on the 2- to 25-yr return periods and to 1.4 in. at the 50- and 100-yr return periods. From 1.6 in. (or 1.4 in. for the 50- and 100-yr maps) to 3.0 in., the isoline interval is 0.2 in. and above 3.0 in. the interval is 0.4 in. Dashed intermediate lines have been placed between widely separated isolines and in regions where a linear interpolation between the normal isopluvial interval would lead to erroneous interpolation. "Lows" that close within the boundaries of a particular map have been hatched on the low-valued side of the isoline.

Importance of snow in precipitation-frequency values. The maps in this Atlas represent frequency values of precipitation regardless of type. For many hydrologic purposes, precipitation falling as rain must be treated in a different manner from that falling as snow. The contribution of snow amounts to precipitation-frequency values in Oregon and the Pacific Northwest (roughly Idaho, Oregon, Washington, and small adjacent portions of California and Nevada) was investigated. In this area, there were 179 stations having 10 to 15 yrs of observations of snowfall as part of the precipitation observing program. Sixty-two of these stations are in Oregon. Table 11 shows the distribution of these stations by regions considered to be more meteorologically realistic than are state boundaries. For each of the 179 stations (56 of which were equipped with recording precipitation gages), two data series were formed as discussed under Interpretation of Results, Importance of Snow in Estimating Frequency Values.

A ratio was formed of the 2-yr 24-hr value for the series containing maximum annual events without regard to type of precipitation and the 2-yr 24-hr value for the series with snow occurrences eliminated. At more than 75 percent of the stations in the Pacific Northwest, this ratio showed differences between the two series to be 10 percent or less. A similar ratio for the 25-yr return period showed a difference as great as 10 percent at only about 5 percent of the stations. Further analysis was made for stations having ratios that showed the greatest difference between the two series.

Data from stations in the coastal plains region of Washington and Oregon (Region 31, fig. 9) showed that the maximum annual 24-hr event can contain snow, but such a case occurs only about 5 percent of the time. Less than half the stations within this region had any maximum annual event that included snow, and ratios for all durations and stations showed less than 10 percent difference between the two data series. Thus, snow was not considered to be of importance to precipitation-frequency values in this region.

Most of the mountainous portions of Oregon are included within Regions 13 and 14 of figure 9. In these regions, it is not unusual for the maximum annual event to include some snow or even to be composed of all or mostly snow. However, the areas where such events cause major differences between the series of all precipitation data regardless of type and the series composed exclusively of rain are relatively limited in extent. These areas are at the higher elevations of the Cascades and immediately to the lee of the crest of the Cascades. In this area of Washington and Oregon, data are available from about 20 stations ranging in elevation from 2,000 ft to over 6,500 ft. These data indicate that the 2-yr 24-hr values for a series containing only rain events would be 10 to 20 percent lower than the values presented on the precipitation-frequency maps in this Atlas at elevations of 2,000 to 4,000 ft, and the differences would range upward to 30 and possibly as much as 50 percent lower above 5,000 ft. The area to the lee of the crest of the Cascades would be limited to somewhat less than 50 mi in width; and in this narrow band, the rain-only series would be from 20 to as much as 35 percent less than the values presented on the 2-yr 24-hr map for Oregon.

Data from stations in the nonorographic regions east of the Cascades (Region 32, fig. 9) show snow to be of minor importance in the precipitation-frequency regime. Less than one maximum annual value out of every five will contain any snow, and 80 percent of the stations available for analysis showed differences of less than 10 percent in the two series of data tabulated.

The remainder of Oregon is included within Region 12, figure 9. Most of this region lies in Idaho. Analysis of the data for this region leads to the conclusion that snow is not an important factor in the precipitation-frequency regime. Ratios between 2-yr 24-hr values from the two series of data that were tabulated showed differences between the two series to be mostly small. It was found that maximum annual values that contained snow were most likely to be found in the lower two-thirds of the ranked data sample. This is discussed in more detail in NOAA Atlas 2, "Precipitation-Frequency Atlas of Western United States, Volume V—Idaho" (National Oceanic and Atmospheric Administration 1973).

The data analysis of the two series showed that the curves converge with increasing return period. At the 25-yr return period, only about 5 percent of the 179 stations showed differences greater than 10 percent between the two series. These stations were not concentrated in any region and did not show a geographic pattern. Generally, such differences result when one or a few of the larger values in the data series composed of all maximum annual events contains some snow, while the rain-only amount for that year is small and becomes a much lower ranked value in the exclusively rain series.

At the 6-hr duration, the data are restricted to stations with recording gages (12 recording precipitation-gage stations in Oregon). An analysis similar to that for the 24-hr duration showed that the ratio of the maximum annual series and the series without snow was lower at the 6-hr duration than at the 24-hr duration. This is meteorologically realistic since the portion of a 24-hr storm that contains snow is most likely to be of less intensity than is the maximum 6-hr period of that storm.

The conclusion was made that, except as previously noted, the elimination of amounts containing snow does not materially change the precipitation-frequency values on maps for Oregon. For the 24-hr duration where there are differences between results computed from the two series at the 2-yr return period, the differences would decrease to no more than half as large at the 25-yr recurrence interval and be negligible at the 100-yr recurrence interval.

In the selection of data for the series made up of amounts containing rain only, an observation was eliminated no matter how much snow was reported. Thus, an eliminated amount could have contained only a small portion of the precipitation as snow or it could have been all snow. In some cases, the amount of rain in a storm with little snow could have been greater than the value actually selected for that year since only a few stations report water content of snow (which would have enabled the tabulator to segregate such cases). Thus, the data could yield rain-only values actually less than the true amount but could not give results greater than the true amount. Therefore, the ratios compared tended to show maximum differences.

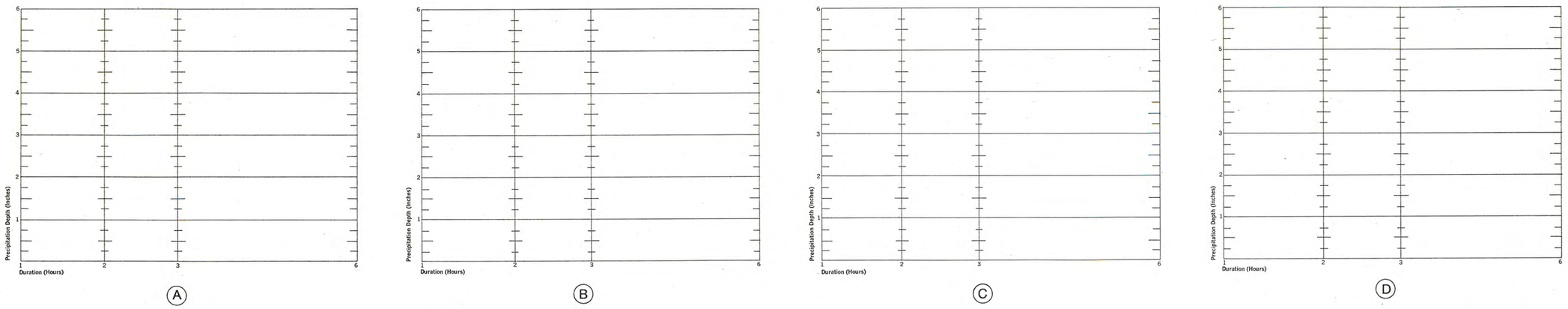


Figure 15. *Precipitation depth-duration diagram (1- to 6-hr).*
a. Mountainous regions of Washington and Oregon east of crest of Cascade Range and of Idaho and Montana west of Continental Divide and north of southern boundary of Snake River Basin (Region 1, fig. 18).
b. Nonorographic region east of crest of Cascade Range (Region 2, fig. 18).
c. Coastal plains, Puget Sound region, and Willamette Valley below 1,000 ft (Region 3, fig. 18). Olympic Mountains, western slopes of Cascade and Coast Ranges (Region 4 fig. 18).
d. Southeastern Oregon drained by the Quinn River (Region 5, fig. 18).

Procedures for Estimating Values for Durations Other Than 6 and 24 Hrs

The isopluvial maps in this Atlas are for 6- and 24-hr durations. For many hydrologic purposes, values for other durations are necessary. Such values can be estimated using the 6- and 24-hr maps and the empirical methods outlined in the following sections. The procedures detailed below for obtaining 1-, 2-, and 3-hr estimates were developed specifically for this Atlas. The procedures for obtaining estimates for less than 1-hr duration and for 12-hr duration were adopted from *Weather Bureau Technical Paper* No. 40 (U.S. Weather Bureau 1961) only after investigation demonstrated their applicability to data from the area covered by this Atlas.

Procedures for estimating 1-hr (60-min) precipitation-frequency values. Multiple-regression screening techniques were used to develop equations for estimating 1-hr values. Factors considered in the screening process were restricted to those that could be determined easily from the maps of this Atlas or from generally available topographic maps.

The 11 western states were separated into several geographic regions. The regions were chosen on the basis of meteorological and climatological homogeneity and are generally combinations of river basins separated by prominent divides. Five of these geographic regions are partially within Oregon. For convenience and use as an overlay on the precipitation-frequency maps, the regions are outlined on figure 18. The first region includes the mountainous sections of eastern Oregon east of the crest of the Cascades (Region 1, fig. 18). This is part of a larger region that includes all the mountainous sections from the crest of the Cascades eastward to the Continental Divide and north of the southern boundary of the Snake River Basin. Region 2, figure 18, is the essentially nonorographic portions of eastern Oregon. There are three such nonorographic regions between the crest of the Cascades and the Continental Divide found to have similar relations between data for 1-, 6-, and 24-hr durations. One of these is completely within Oregon, whereas the other two extend partially into Oregon from Washington and Idaho. The coastal lowlands and nonorographic sections of western Washington and Oregon below 1,000-ft elevation make up another region (Region 3, fig. 18). This includes the Willamette Valley below 1,000 ft. The fourth region consists of the western slopes of the Cascade and the Coast Ranges of Oregon (Region 4, fig. 18). This region extends into Washington, where it also includes the Olympic Mountains. Region 5, figure 18, in southeastern Oregon is a small portion of a region that extends from central Utah through Nevada and into the desert regions of California. In Oregon, this is the area drained by the Quinn River. Equations to provide estimates for the 1-hr duration for the 2- and 100-yr return periods are shown in table 12. Also listed are the statistical parameters associated with each equation. The variable $[(X_1)(X_1/X_2)]$ or $[X_3)(X_3/X_4)]$ can be regarded as the 6-hr value times the slope of a line connecting the 6- and 24-hr values for the appropriate return period. The variable Y_2 appears in the right side of the 100-yr 1-hr equations for Regions 3 and 4. If the 2-yr 1-hr value is not required, the equation for Y_2 can be substituted and the second equation for Y_{100} shown in table 12 can be used.

Table 11. *Percent of snowfall stations in Pacific Northwest by regions*

Number of region in figure 9	Region	Percent of stations
12	Mountainous region of Idaho west of Bitterroot Range crest and Continental Divide and north of southern boundary of Snake River Basin—excluding Snake River Valley below a generalized 5,000-ft contour	30
13	Orographic region east of crest of Cascade Range and west of Snake River Basin	20
14	Olympic Mountains and western slopes of Coast and Cascade Ranges	14
30	Snake River Valley below 5,000 ft	13
31	Coastal Plain, Puget Sound region, and Willamette Valley below 1,000 ft	12
32	Nonorographic region east of crest of Cascade Range	11

As with any separation into regions, the boundary can only be regarded as the sharpest portion of a zone of transition between regions. These equations have been tested for boundary discontinuities by computing values using equations from both sides of the boundary. Differences were found to be mostly under 15 percent. However, it is suggested that when computing estimates along or within a few miles of a regional boundary computations be made using equations applicable to each region and that the average of such computations be adopted.

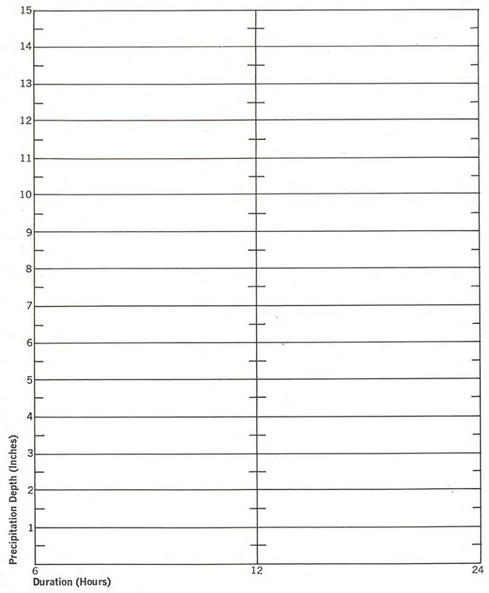


Figure 16. *Precipitation depth-duration diagram (6- to 24-hr).*

Estimates of 1-hr precipitation-frequency values for return periods between 2 and 100 yrs. The 1-hr values for the 2- and 100-yr return periods can be plotted on the nomogram of figure 6 to obtain values for return periods greater than 2 yrs or less than 100 yrs. Draw a straight line connecting the 2- and 100-yr values and read the desired return-period value from the nomogram.

Estimates for 2- and 3-hr (120- and 180-min) precipitation-frequency values. To obtain estimates of precipitation-frequency values for 2 or 3 hrs, plot the 1- and 6-hr values from the Atlas on the appropriate nomogram of figure 15. Draw a straight line connecting the 1- and 6-hr values, and read the 2- and 3-hr values from the nomogram. This nomogram is independent of return period. It was developed using data from the same regions used to develop the 1-hr equations.

The mathematical solution from the data used to develop figure 15 gives the following equations for estimating the 2- and 3-hr values:

For Region 1, figure 18	2-hr = 0.250 (6-hr) + 0.750 (1-hr)	(3)
	3-hr = 0.467 (6-hr) + 0.533 (1-hr)	(4)
For Region 2, figure 18	2-hr = 0.278 (6-hr) + 0.722 (1-hr)	(5)
	3-hr = 0.503 (6-hr) + 0.497 (1-hr)	(6)
For Regions 3 and 4, figure 18	2-hr = 0.240 (6-hr) + 0.760 (1-hr)	(7)
	3-hr = 0.468 (6-hr) + 0.532 (1-hr)	(8)
For Region 5, figure 18	2-hr = 0.299 (6-hr) + 0.701 (1-hr)	(9)
	3-hr = 0.526 (6-hr) + 0.476 (1-hr)	(10)

Estimates for 12-hr (720-min) precipitation-frequency values. To obtain estimates for the 12-hr duration, plot values from the 6- and 24-hr maps on figure 16. Read the 12-hr estimates at the intersection of the line connecting these points with the 12-hr duration line of the nomogram.

Estimates for less than 1 hr. To obtain estimates for durations of less than 1 hr, apply the values in table 13 to the 1-hr value for the return period of interest.

Illustration of Use of Precipitation-Frequency Maps, Diagrams, and Equations

To illustrate the use of these maps, values were read from figures 19 to 30 for the point at 44°00′ N. and 118°00′ W. These values are shown in boldface type in table 14. The values read from the maps should be plotted on the return-period diagram of figure 6 because (1) not all points are as easy to locate on a series of maps as are latitude-longitude intersections, (2) there may be some slight registration differences in printing, and (3) precise interpolation between isolines is difficult. This has been done for the 24-hr values in table 14 (fig. 17a) and a line of best fit has been drawn subjectively. On this nomogram, the 2- and 25-yr values appear to be somewhat off the line. The value read from the maps is corrected (as shown by the strikeout in table 14); such corrected values are adopted in preference to the original readings.

The 2- and 100-yr 1-hr values for the point were computed from the equations applicable to Region 2, figure 18 (table 12) since the point is in the nonorographic region. The 2-yr 1-hr is estimated at 0.37 in. (latitude of 44° and longitude of 118° and the 2-yr 6- and 24-hr values from table 14); the estimated 100-yr 1-hr value is 1.07 in. (100-yr 6- and 24-hr values from table 14). By plotting these 1-hr values on figure 6 and connecting them with a straight line, one can obtain estimates for return periods of 5, 10, 25, and 50 yrs.

The 2- and 3-hr values can be estimated by using the proper nomogram of figure 15 or equations (5) and (6). The 1- and 6-hr values for the desired return period are obtained as above. Plot these points on the nomogram in figure 15 and connect them with a straight line. Read the estimates for 2 or 3 hrs at the intersections of the connecting line and the 2- and 3-hr vertical lines. An example is shown in figure 17b for the 2-yr return period. The 2-yr 2-hr (0.50 in.) and 2-yr 3-hr (0.55 in.) values are in italics in table 14 and compare closely with the values of 0.47 and 0.57, which would result from application of equations (5) and (6).

Table 12. *Equations for estimating 1-hr values in Oregon with statistical parameters for each equation*

Region of applicability*	Equation	Corr. coeff.	No. of stations	Mean of computed stn. values (inches)	Standard error of estimate (inches)
Mountainous regions of Washington and Oregon east of crest of Cascade Range and of Idaho and Montana west of Continental Divide and north of southern boundary of Snake River Basin (1)	$Y_2 = 0.019 + 0.711[(X_1)(X_1/X_2)] + 0.001Z$	0.82	98	0.40	0.031
	$Y_{100} = 0.338 + 0.670[(X_3)(X_3/X_4)] + 0.001Z$	.80	79	1.04	.141
Nonorographic region east of crest of Cascade Range (2)	$Y_2 = 0.077 + 0.715[(X_1)(X_2/X_3)] - 0.0004(X_5)(X_6)$	.86	30	0.35	.034
	$Y_{100} = 0.187 + 0.833[(X_3)(X_3/X_4)]$	.87	30	1.08	.161
Coastal plains, Puget Sound region, and Willamette Valley below 1,000 ft (3)	$Y_2 = 0.157 + 0.513[(X_1)(X_1/X_2)]$	.89	61	0.52	.050
	$Y_{100} = 0.324 + 0.752[(Y_2)(X_3/X_1)]$	.82	61	1.01	.113
	$Y_{100} = 0.324 + 0.118(X_3/X_1) + 0.386[(X_1)(X_3/X_2)]$				
Olympic Mountains, western slopes of Cascade and Coast Ranges (4)	$Y_2 = 0.160 + 0.520[(X_1)(X_1/X_2)]$	.86	70	0.54	.054
	$Y_{100} = 0.177 + 0.965[(Y_2)(X_3/X_1)]$	.74	66	1.10	.171
	$Y_{100} = 0.177 + 0.154(X_3/X_1) + 0.502[(X_1)(X_3/X_2)]$				
Southeastern Oregon drained by the Quinn River (5)	$Y_2 = 0.005 + 0.852[(X_1)(X_1/X_2)]$	.89	65	0.41	.047
	$Y_{100} = 0.322 + 0.789[(X_3)(X_3/X_4)]$	.87	65	1.25	.196

* Numbers in parentheses refer to geographic regions shown in figure 18. See text for more complete description.

List of variables
Y_2 = 2-yr 1-hr estimated value
Y_{100} = 100-yr 1-hr estimated value
X_1 = 2-yr 6-hr value from precipitation-frequency maps
X_2 = 2-yr 24-hr value from precipitation-frequency maps
X_3 = 100-yr 6-hr value from precipitation-frequency maps
X_4 = 100-yr 24-hr value from precipitation-frequency maps
X_5 = latitude (in decimals) minus 40°
X_6 = longitude (in decimals) minus 100°
Z = point elevation in hundreds of feet

Table 13. *Adjustment factors to obtain n-min estimates from 1-hr values*

Duration (min)	5	10	15	30
Ratio to 1-hr	0.29	0.45	0.57	0.79

(Adopted from *U.S. Weather Bureau Technical Paper* No. 40, 1961.)

Figure 17. *Illustration of use of precipitation-frequency diagrams using values from precipitation-frequency maps and relations.*

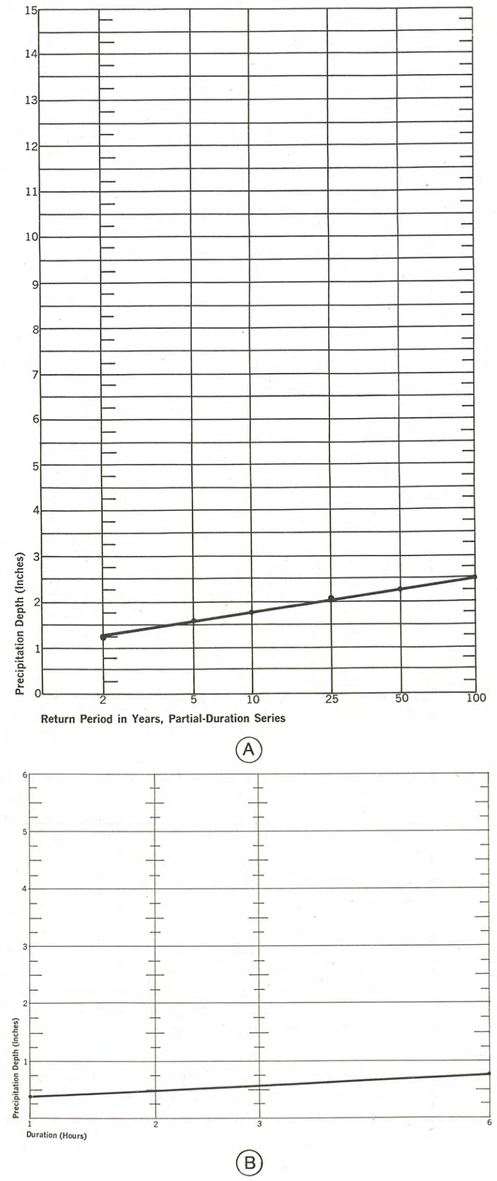


Table 14. *Precipitation data for depth-frequency atlas computation point 44°00′ N., 118°00′ W.*

	1-hr	2-hr	3-hr	6-hr	24-hr
					1.26
2-yr	*0.37*	*0.47*	*0.57*	0.74	~~1.23~~
5-yr				0.95	1.56
10-yr				1.12	1.75
					2.02
25-yr				1.34	~~2.05~~
50-yr				1.49	2.25
100-yr	*1.07*			1.63	2.50

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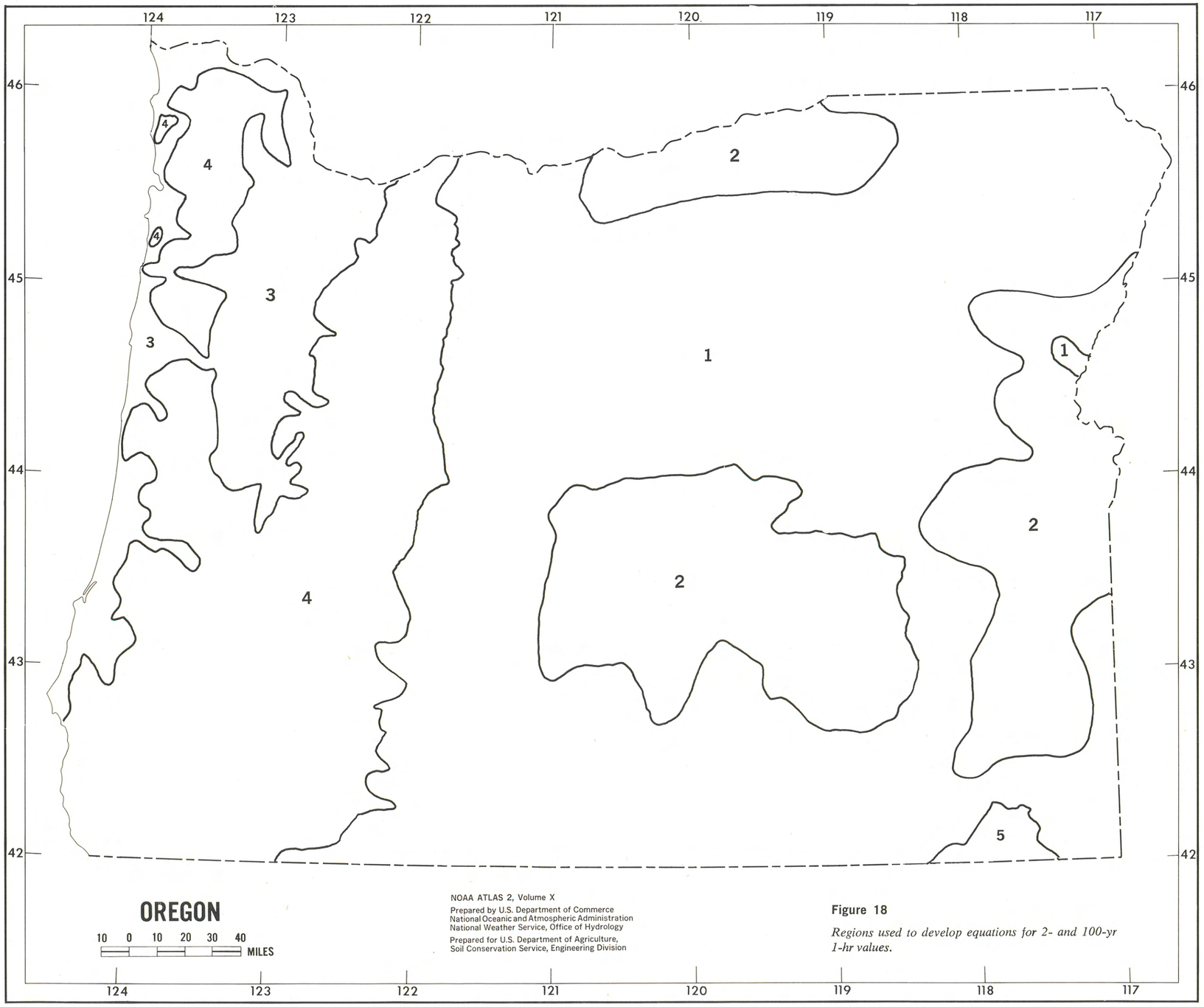

Figure 18

Regions used to develop equations for 2- and 100-yr 1-hr values.

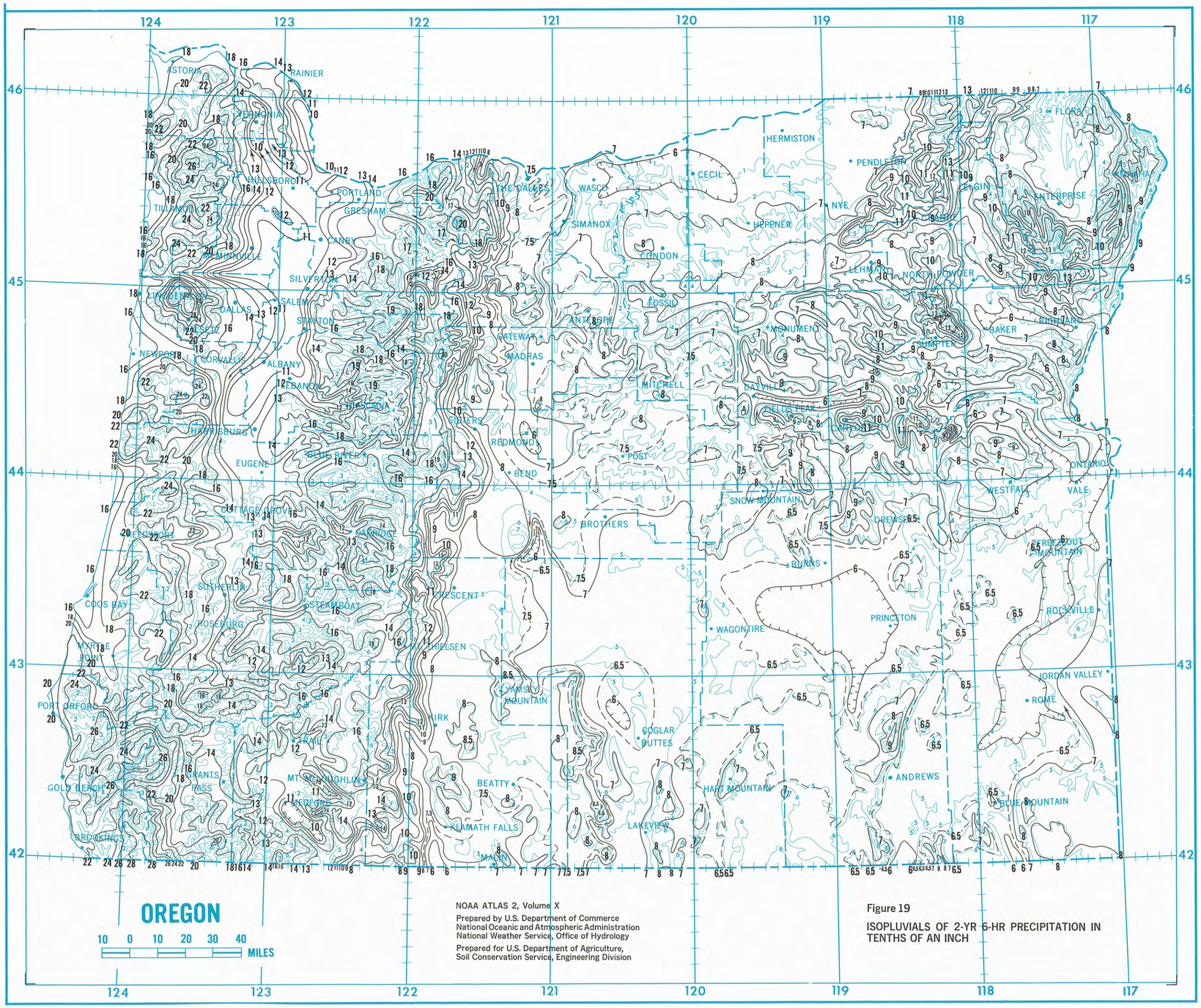

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Figure 19

ISOPLUVIALS OF 2-YR 6-HR PRECIPITATION IN TENTHS OF AN INCH

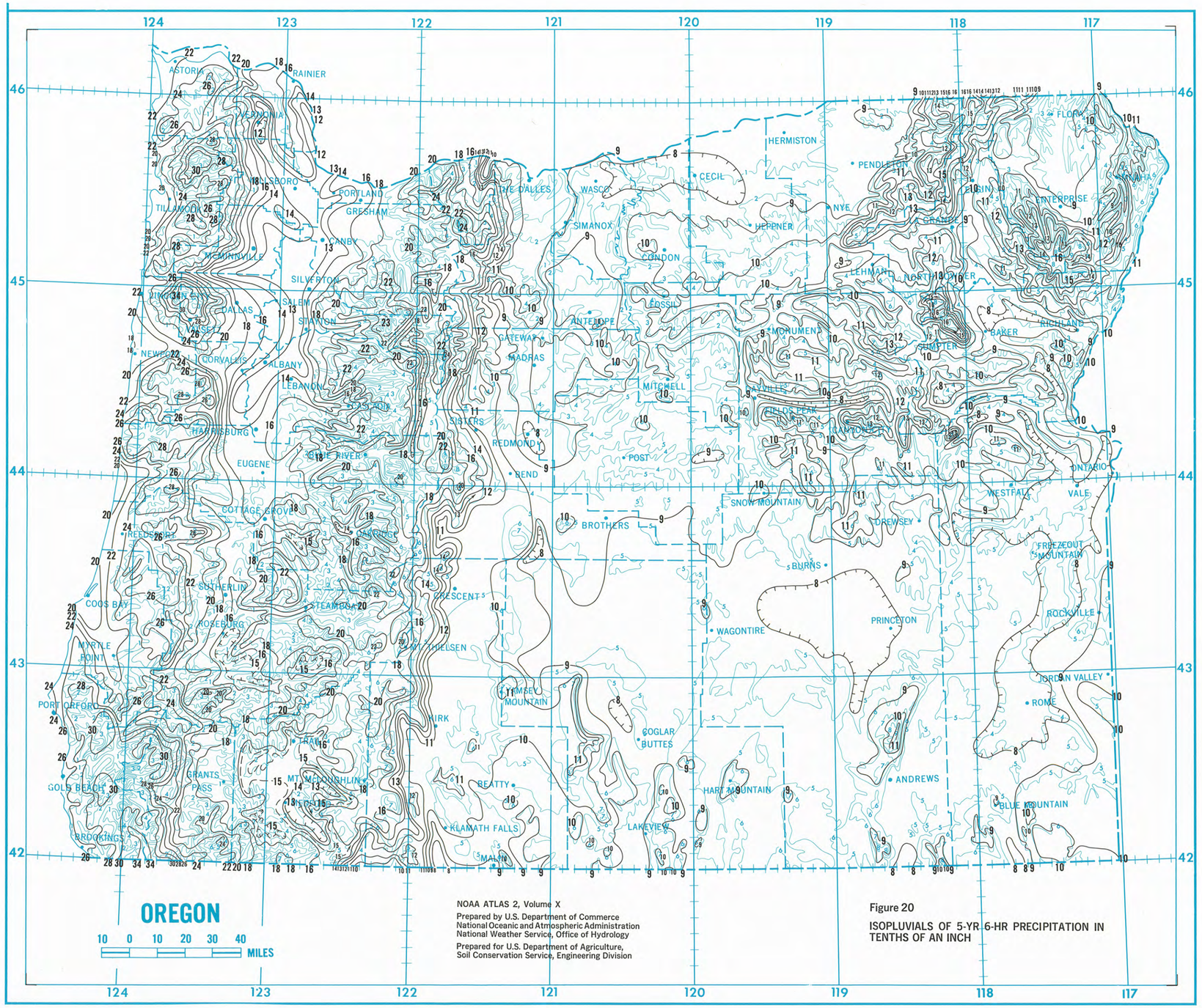

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Figure 20

ISOPLUVIALS OF 5-YR 6-HR PRECIPITATION IN TENTHS OF AN INCH

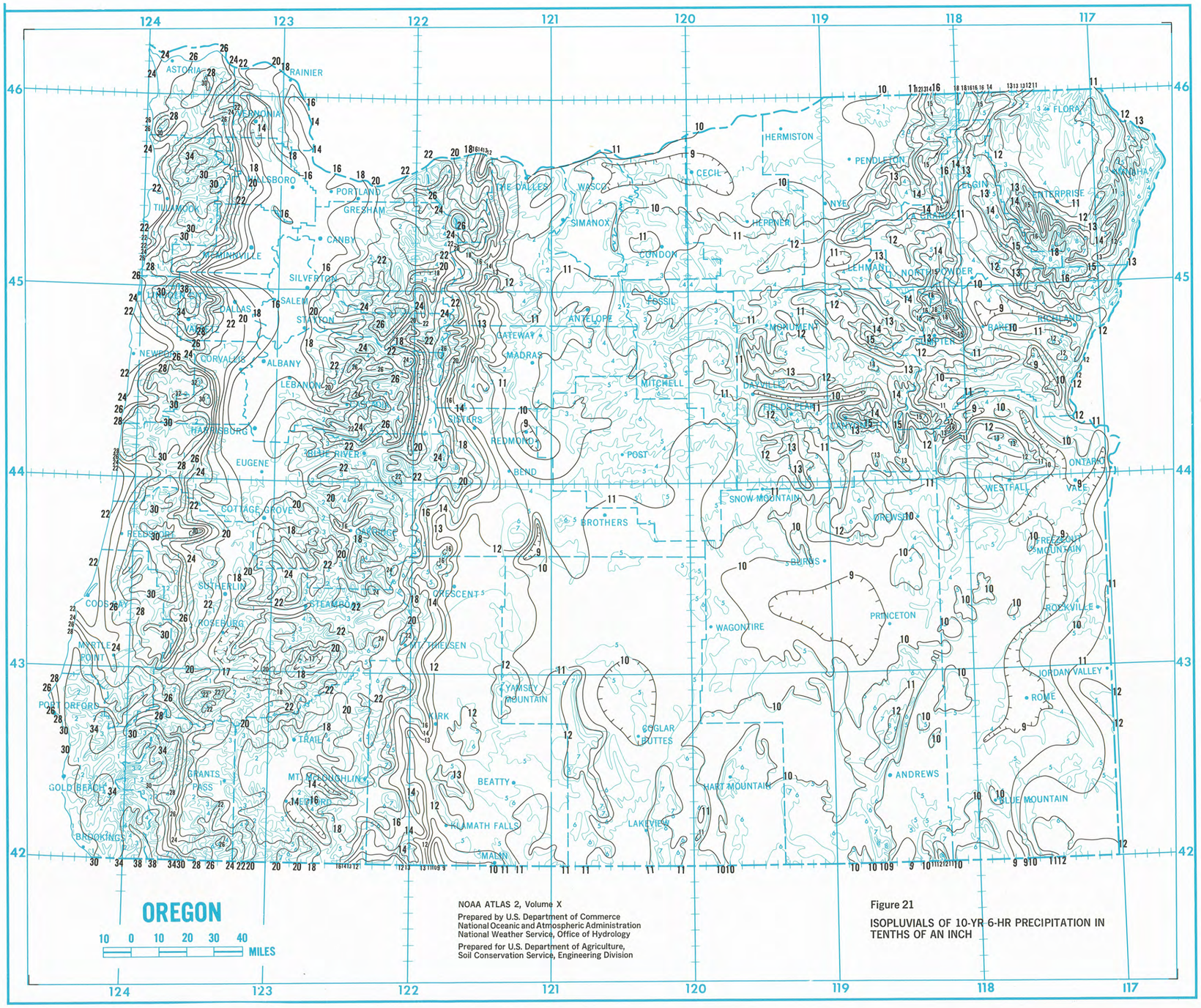

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Figure 21

ISOPLUVIALS OF 10-YR 6-HR PRECIPITATION IN TENTHS OF AN INCH

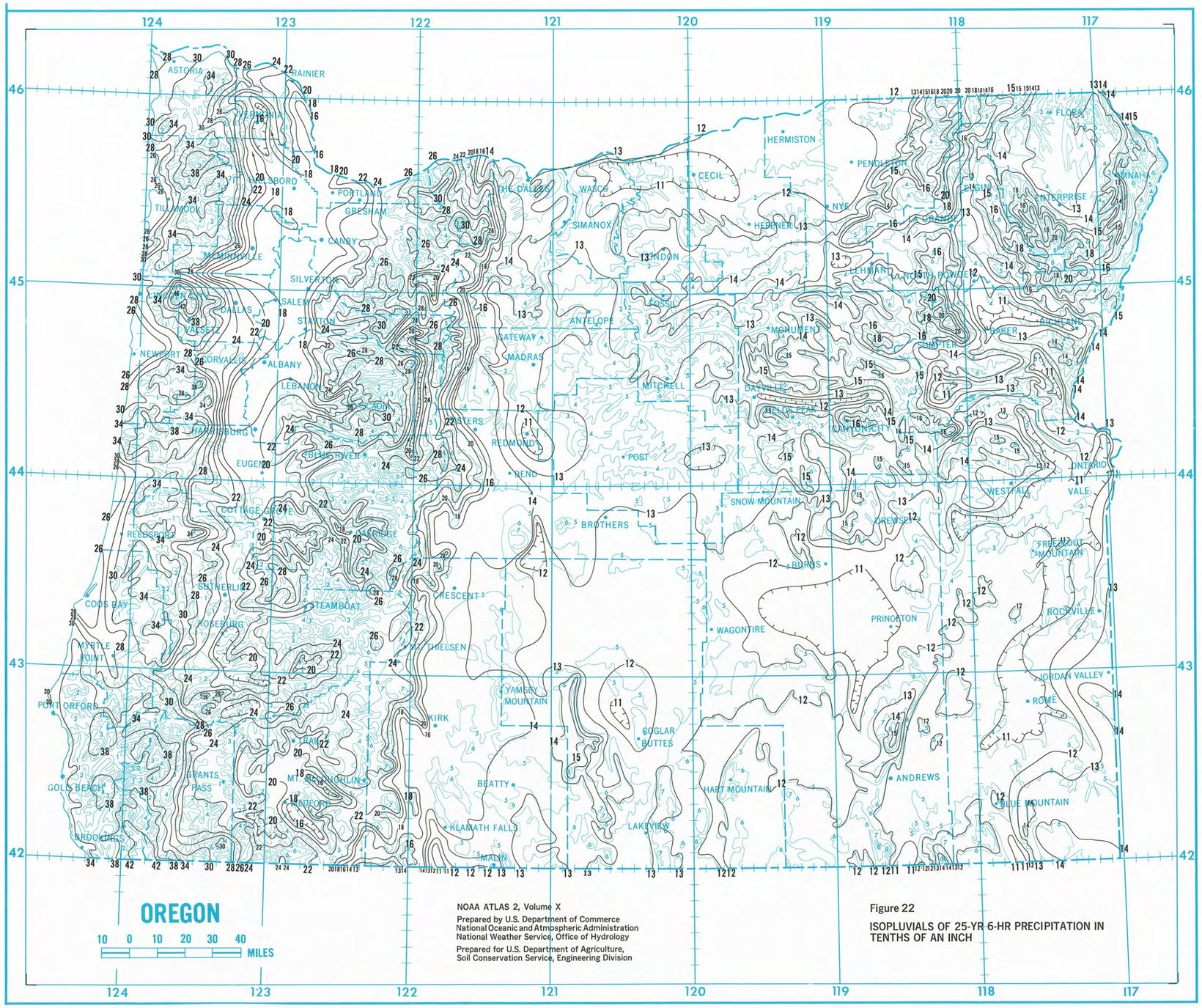

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Figure 22

ISOPLUVIALS OF 25-YR 6-HR PRECIPITATION IN TENTHS OF AN INCH

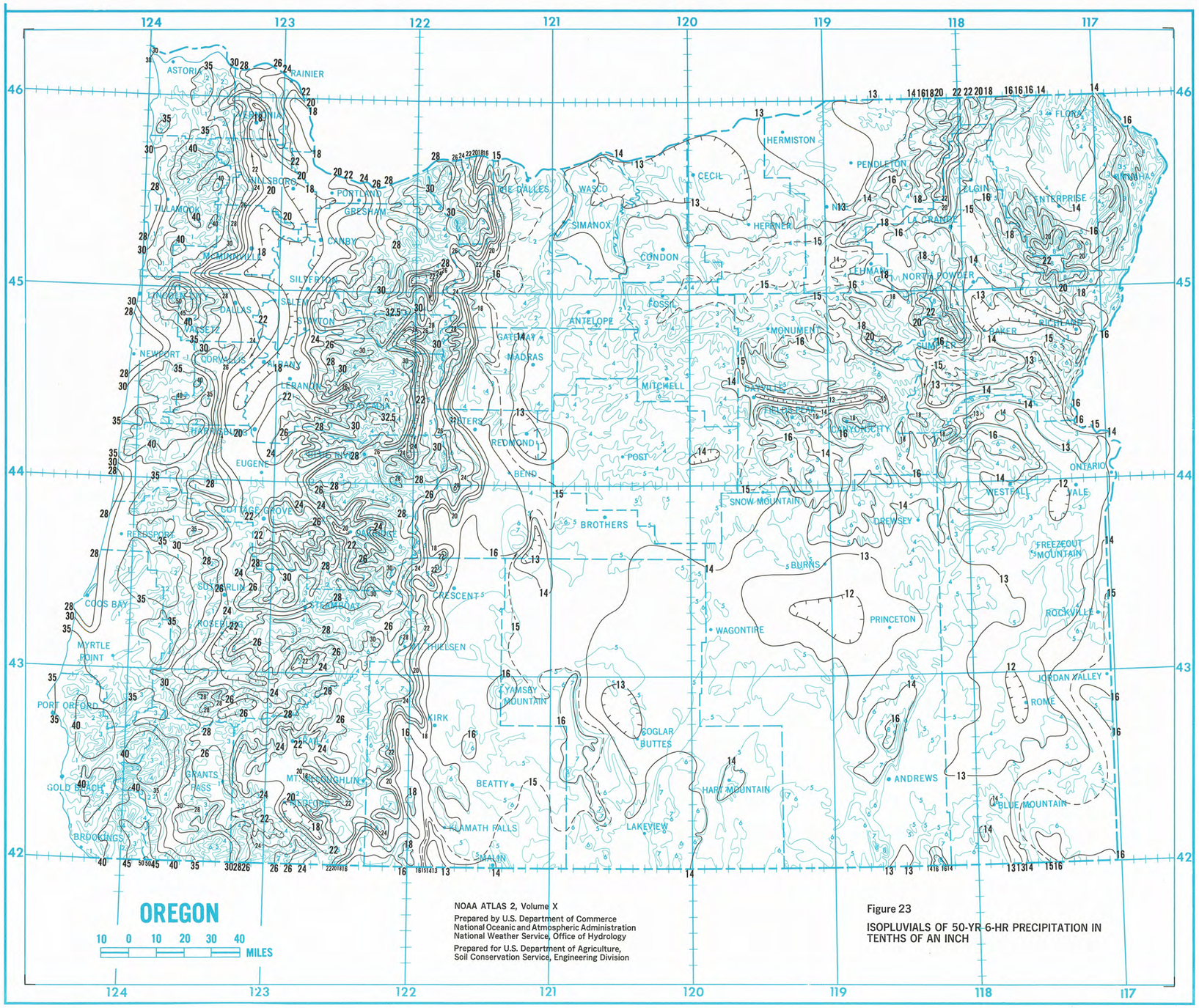

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Figure 23

ISOPLUVIALS OF 50-YR 6-HR PRECIPITATION IN TENTHS OF AN INCH

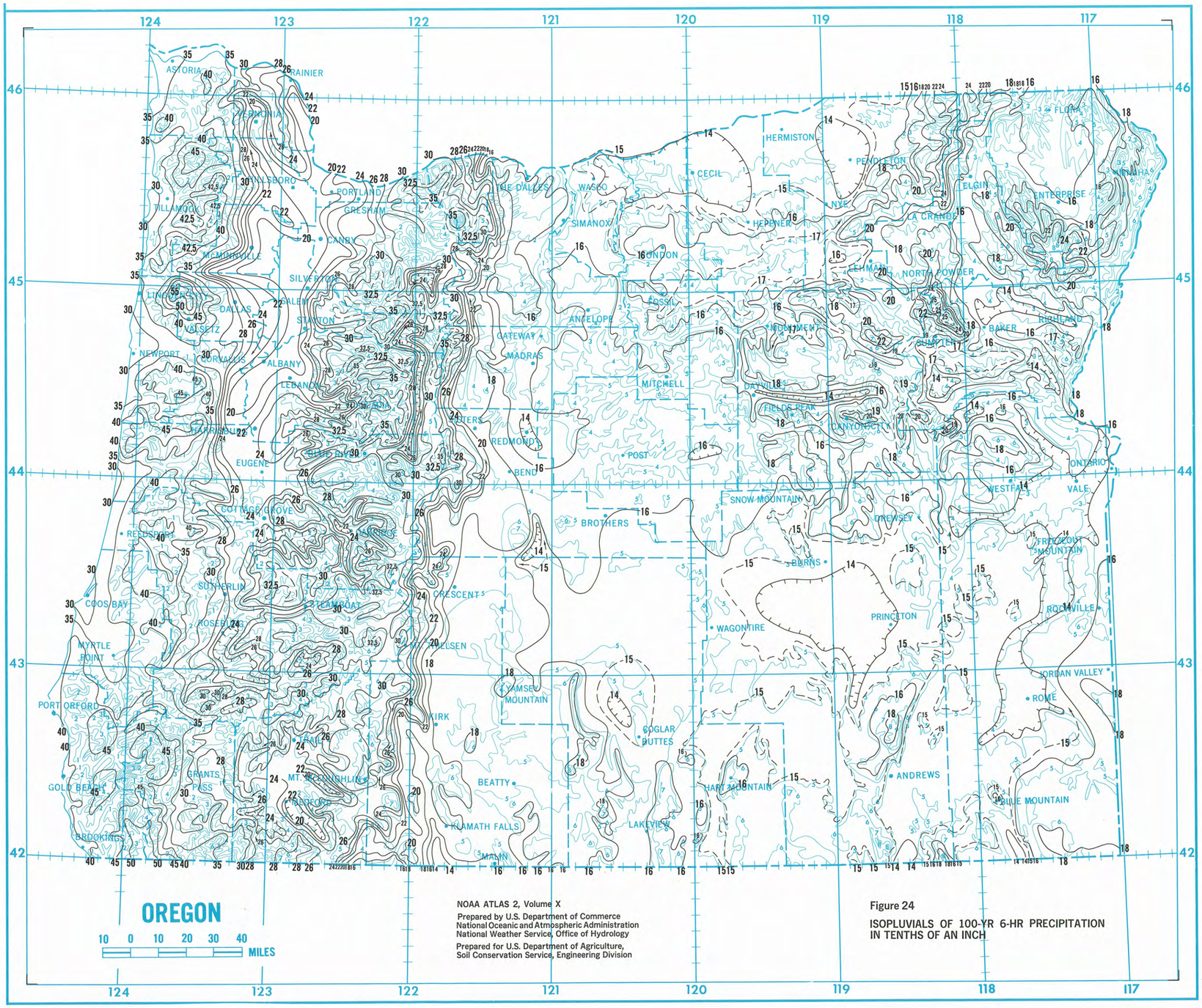

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Figure 24

ISOPLUVIALS OF 100-YR 6-HR PRECIPITATION
IN TENTHS OF AN INCH

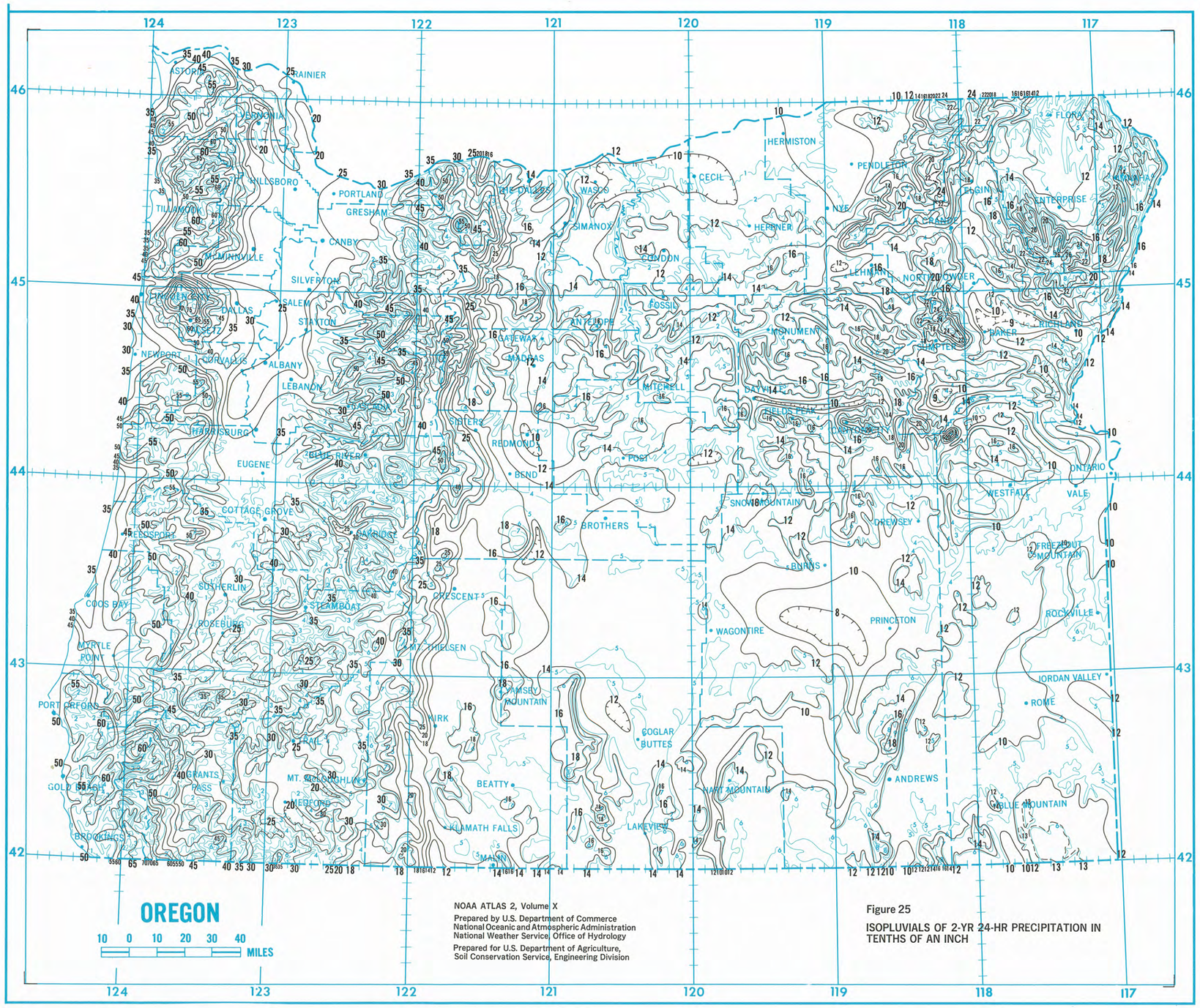

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Figure 25

ISOPLUVIALS OF 2-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

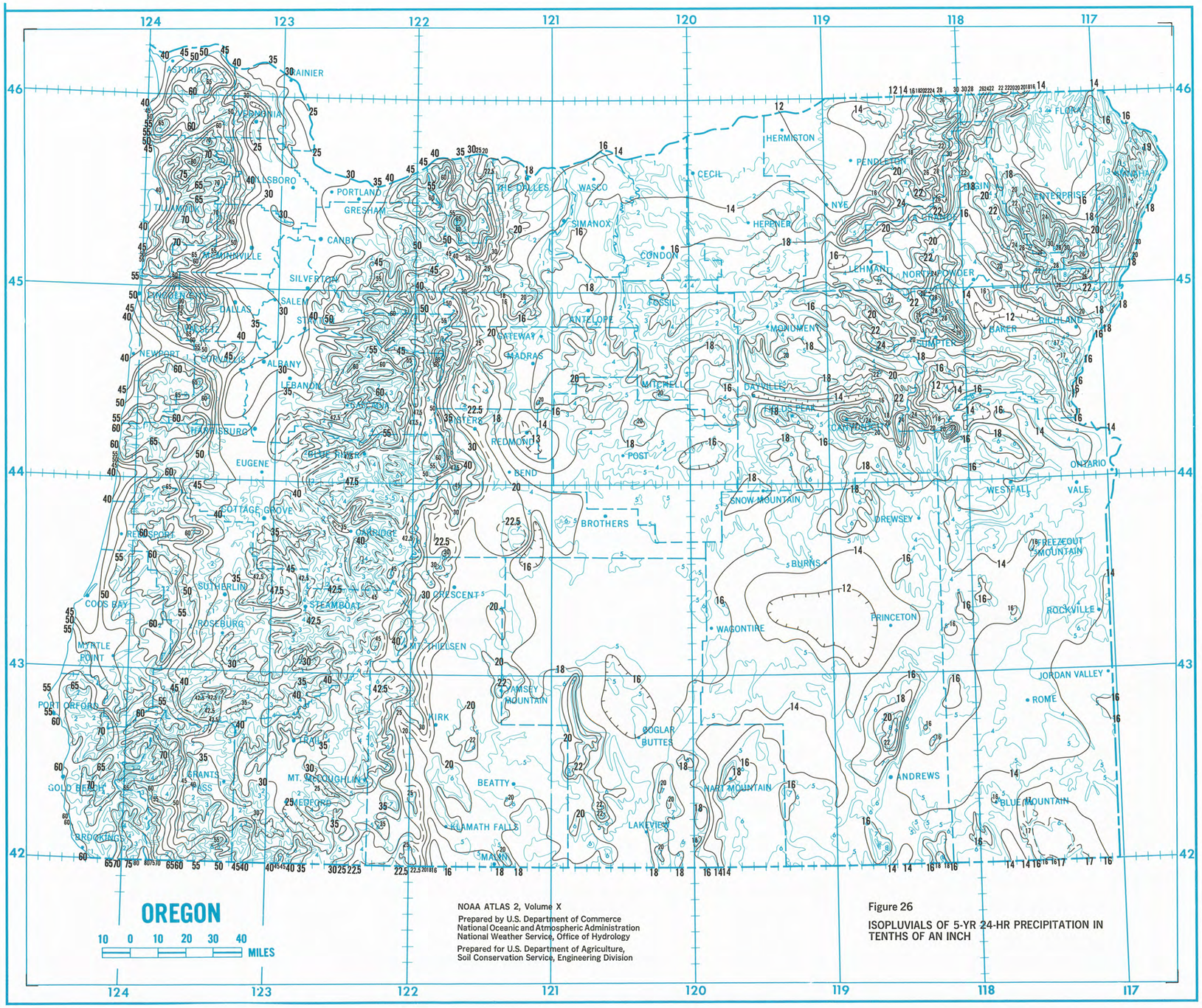

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Figure 26

ISOPLUVIALS OF 5-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

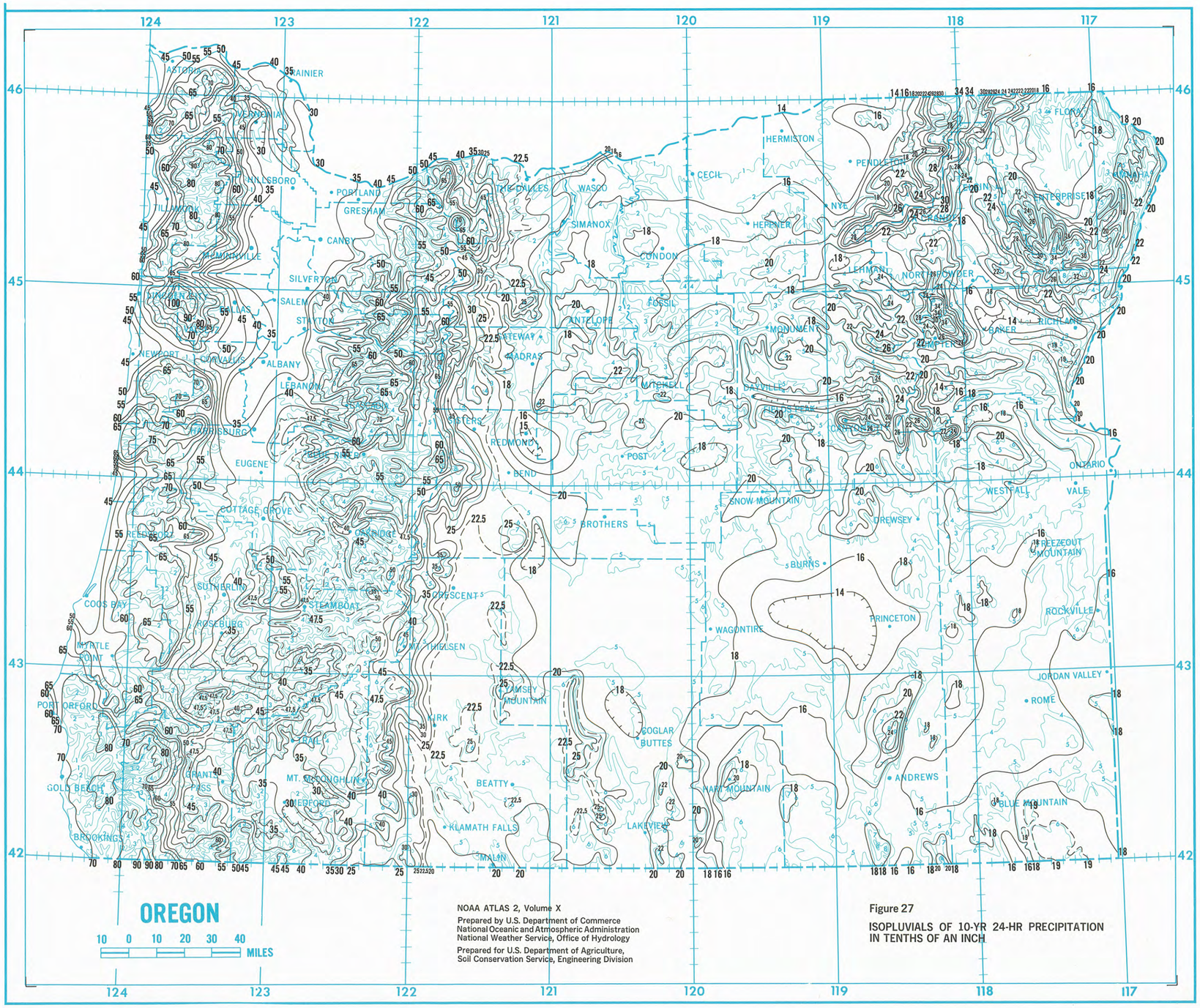

Figure 27

ISOPLUVIALS OF 10-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

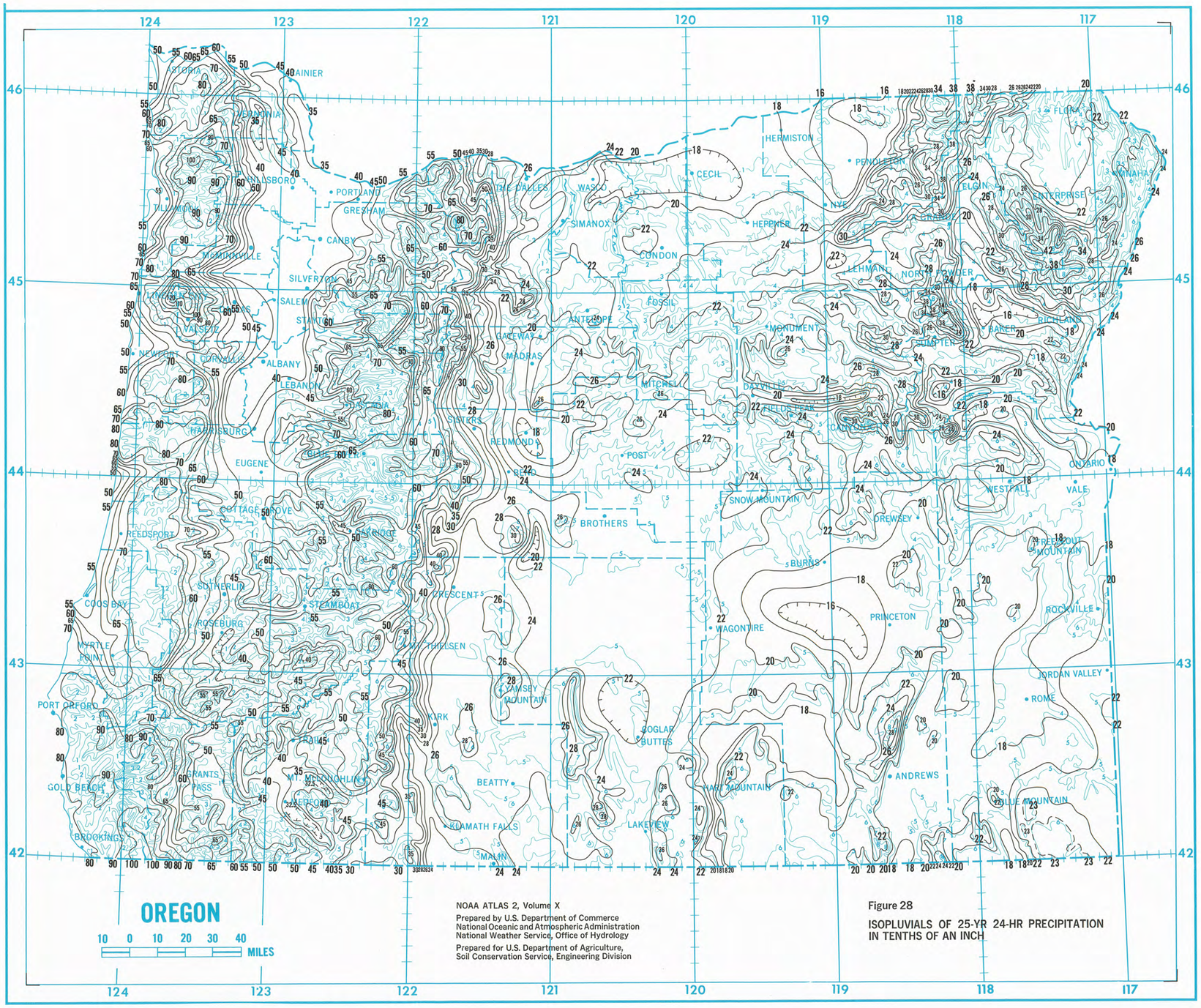

Figure 28

ISOPLUVIALS OF 25-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

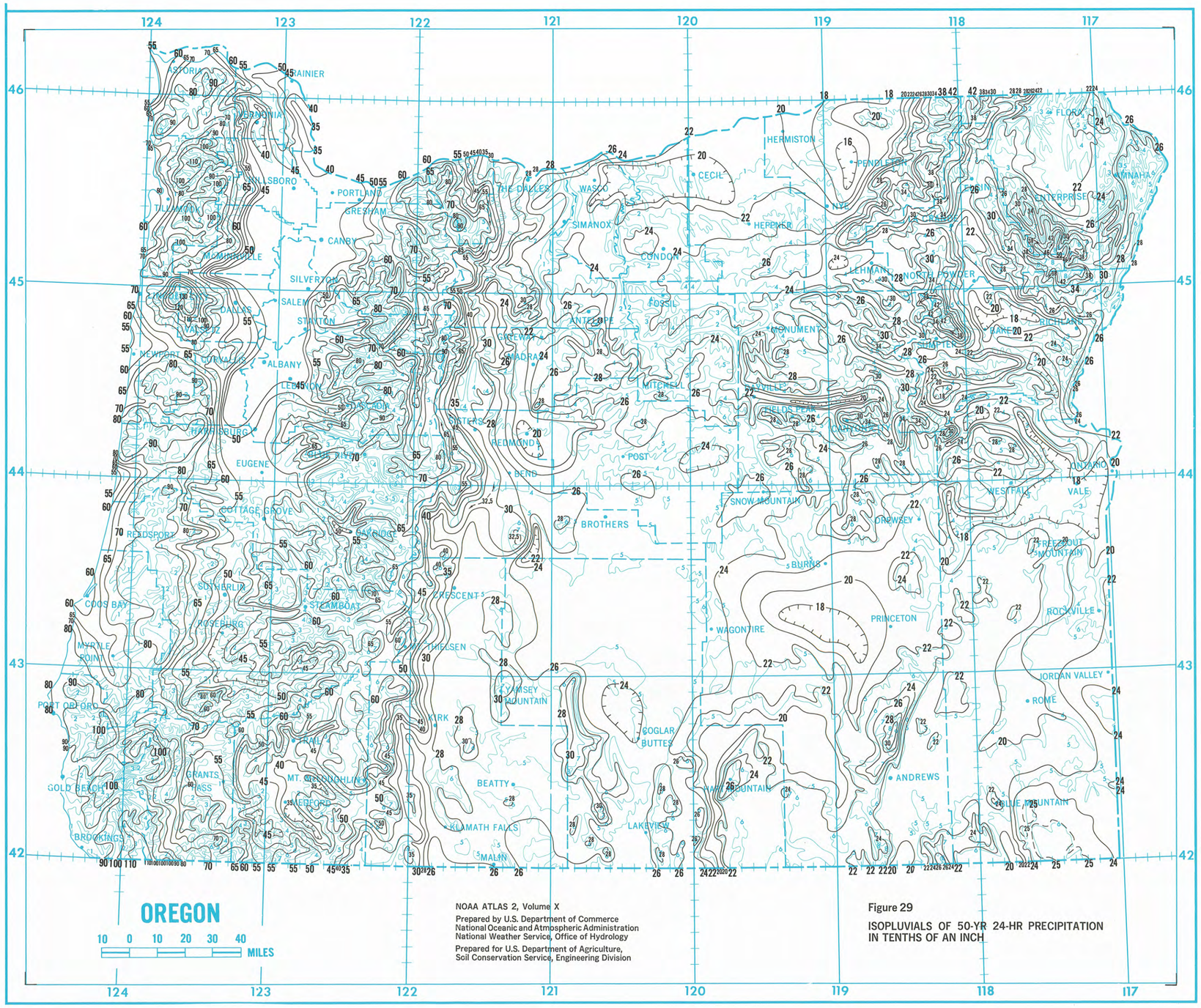

Figure 29

ISOPLUVIALS OF 50-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

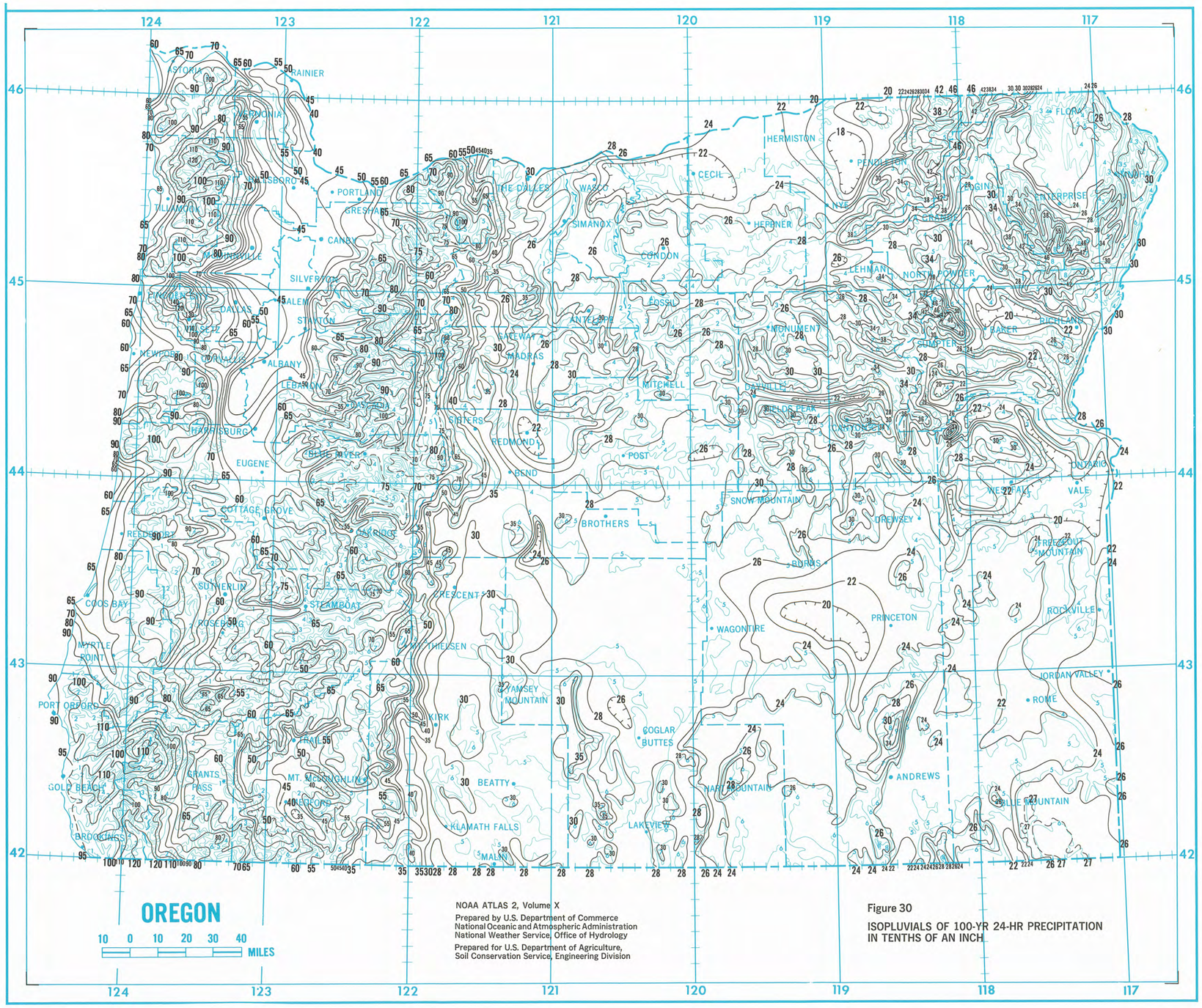

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Figure 30

ISOPLUVIALS OF 100-YR 24-HR PRECIPITATION
IN TENTHS OF AN INCH

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Elysian Subdivision
McMinnville, Oregon
Stormwater Management Report

APPENDIX IV

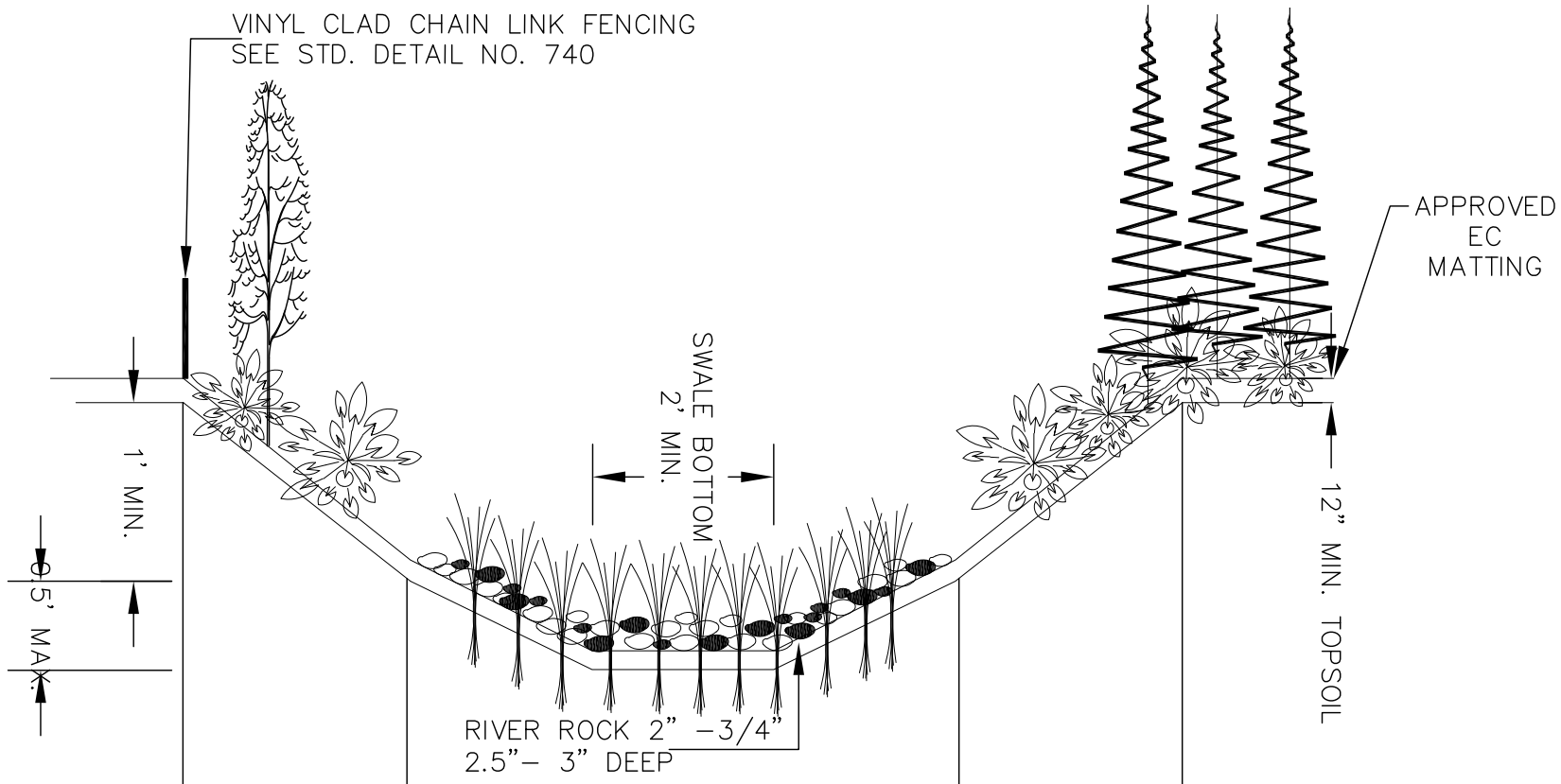
Operation & Maintenance Plans

VEGETATED SWALES

WATER QUALITY SWALE

DRAWING NO. 700

REVISED 12-06



SWALE AREA	FREEBOARD AREA	TREATMENT AREA 6' MINIMUM WIDTH			FREEBOARD AREA	BUFFER/MITIGATION AREA
EC MATTING	ECONOJUTE*	COCONUT FIBER OR GEOJUTE PLUS*			ECONOJUTE*	ECONOJUTE* (S> 20%)
SEED MIX	LOW GROW MIX SEE NOTE #5	NONE			LOW GROW MIX SEE NOTE #5	AS APPROVED BY DISTRICT OR CITY
MAX. SLOPE	2.5:1	4:1	FLAT BOTTOM	4:1	2.5:1	NA

* OR AS APPROVED

NOTES:

1. REFER TO APPENDIX A, CWS DESIGN & CONSTRUCTION STANDARDS, FOR LANDSCAPING REQUIREMENTS INCLUDING TREE PLACEMENT, TOPSOIL AND PLANTING SPECIFICATIONS.
2. PROVIDE IRRIGATION AS APPROVED BY CWS.
3. JUTE MATTING- GEOJUTE PLUS IN TREATMENT AREA, ECONOJUTE FOR ALL OTHER AREAS, OR SIMILIAR FABRICS. COCONUT FIBER IS ALSO ACCEPTABLE.
4. 12-INCHES OF TOPSOIL SHALL BE PLACED THROUGHOUT THE WATER QUALITY TRACT.
5. FREEBOARD AREA SEED MIX, DWARF TALL FESCUE 40%, DWARF PERENIAL RYE 30%, CREEPING RED FESCUE 25%, COLONIAL BENT GRASS 5%. APPLY AT A RATE OF 120# / ACRE.

Clean Water Services

CONSTRUCTION

1. Water Quality Swale shall be over-excavated and filled to final grade with 12-inch amended topsoil. Topsoil amendments shall be garden compost, not conventional fertilizer amendments.
2. A biodegradable Erosion Control Matting shall be placed over the topsoil throughout the swale cross section, fabric shall be held in place in accordance with the manufacturer's installation requirements. Anchor spacing shall be based on 3 fps flow over the fabric.
    a. Treatment area - high-density jute matting (Geojute Plus or other approved equal)
    b. All other areas - low-density jute matting (Econojute or other approved equal)
3. 2.5-3 inches of 2"-$\frac{3}{4}$" river run rock shall be placed over the matting evenly throughout the length and width of the swale.
4. Plant materials shall be placed in accordance with the plan and plant table as shown on approved plans.
5. The water quality swale treatment area plantings can be deemed "substantially complete" once active green growth has occurred to an average growth of 3" and plant density is an average of approx. 6 plants (minimum 1-inch plugs or equivalent) per square foot.
6. The facility shall be deemed acceptable to begin the maintenance period when plant growth and density matches the engineer's design as shown on the approved plans and all other requirements have been met. The engineer must certify the facility to be functional, in accordance with the approved plan design to begin the two-year maintenance period.

MAINTENANCE

1. The permittee is responsible for the maintenance of this facility for a minimum of two years following construction and acceptance of this facility per Chapter 2.
2. Irrigation is to be provided per separate irrigation plan as approved.
   Note: Irrigation needs are to be met using a temporary irrigation system with a timer during the dry season. Systems should be winterized during the wet season to assure longevity and guard against damage from freezing temperatures. Water source shall be as shown on the approved plans.
3. Engineer or Owners Representative is to visit and evaluate the site a minimum of twice annually (Spring and Fall). The landscaping shall be evaluated and replanted as necessary to ensure a minimum of 80% survival rate of the required vegetation and 90% aerial coverage. Non-native, invasive plant species shall be removed when occupying more than 20% of the site.
4. The facility shall be re-excavated and planted if siltation greater than 3 inches in depth occurs within the two-year maintenance period.

WATER QUALITY SWALE CONSTRUCTION & MAINTENANCE NOTES

DETAIL NO. 710

REVISED 12-06

Clean Water Services

PLANTING REQUIREMENTS

Appendix A

PLANTING REQUIREMENTS

1.0 INTRODUCTION

1.1 General

The District recognizes the importance of Water Quality Sensitive Areas, Vegetated Corridors, and Stormwater Facilities that, along with the Tualatin River, are under its jurisdiction. To improve water quality and preserve aquatic species, and meet the intent of both the federal Clean Water and the Endangered Species Acts, the District developed requirements for planting of Vegetated Corridors, Sensitive Areas, and Stormwater Facilities.

Successful revegetation is critical to the proper function of Sensitive Areas, Vegetated Corridors, and Stormwater Facilities for the benefit of water quality and quantity management, and aquatic species preservation. This Appendix aids professionals, the development community, and field crews in planning, designing and implementing successful revegetation projects in these areas. This document guides design decisions to promote successful planting efforts, while allowing flexibility to address opportunities and constraints at each site.

1.2 Jurisdiction

Most Sensitive Areas are regulated by the Division of State Lands (DSL) and/or the U.S. Army Corps of Engineers (Corps). Where the Corps and/or DSL permit mitigation, planting plans for these areas shall follow DSL and Corps guidelines and approved plans. Vegetated Corridors and Stormwater Facilities are regulated by the District and the plans and management strategies for these areas shall follow the steps outlined in this document. Alternative plans and management strategies may be approved by the District.

1.3 Professional Assistance

Revegetation in Sensitive Areas, Vegetated Corridors and Stormwater Facilities should facilitate succession toward low-maintenance plant communities. Consultation with a professional landscape architect, ecologist, or horticulturist knowledgeable in native plants is highly recommended when preparing plans. Satisfying the landscaping requirements may require the services of a registered landscape architect. See ORS 671.310 through 671.459.

Non-native, invasive plant management and wildlife damage management strategies are provided in Clean Water Services *Integrated Pest Management (IPM) Plan*. Especially challenging management situations may require assistance from a landscape maintenance contractor or a wildlife biologist.

2.0 PLANTING PLAN METHODS

Planting plans shall be required for development projects with Vegetated Corridors or Stormwater Facilities. When a planting plan is required, four major components shall be addressed: hydrology, soils, plant materials, and maintenance. When developing planting plans, the following steps should be used:

2.1 Step 1: Assess Hydrologic and Hydraulic Conditions

a. Determine the frequency and duration of water inundation, including appropriate elevations of the revegetation area. Watershed hydrology and hydraulic models for major streams are available from the District. In some cases, current site conditions (i.e. wetland presence) will suffice. For Stormwater Facilities, the models used to design and size the facility shall be used to determine frequency, duration and surface water elevations within the facility.

b. Assign appropriate hydrologic zones to the revegetation area and apply them to the plan. Most project sites include one or more of the following planting zones with respect to hydrology during the growing season:

   1. Wet - standing or flowing water/nearly constant saturation; anaerobic soils

   2. Moist - periodically saturated; anaerobic and/or aerobic soils

   3. Dry - infrequent inundation/saturation, if any; aerobic soils

2.2 Step 2: Assess Soil Conditions and Assign Appropriate Preparation Specifications to Plans

a. Determine the organic content and non-native, invasive seed bank likely in the soil. For most Stormwater Facilities, the soil is often high in clay, gravel, or minerals devoid of topsoil and organic material, and/or high in non-native, invasive weed content. The conditions in Sensitive Areas and Vegetated Corridors vary greatly.

b. For upland sites with at least one foot of native topsoil, but containing a non-native, invasive seed bank or plants, add notes to the plan to remove the undesirable plants, roots, and seeds (*see IPM Plan*) prior to planting.

c. For upland sites with either disturbed and compacted soils or less than one foot of topsoil and invasive, non-native seed bank or plants that have become established, the following notes shall be added to the plan:

   1. Remove the undesirable plants, roots, and seeds (*see IPM Plan*) prior to adding topsoil.

2. Till the sub-grade in these areas to a depth of at least four inches and add at least 12 inches of clean compost-amended topsoil. The compost-amended topsoil shall have the following characteristics to ensure a good growing medium:
   A) Texture – material passes through one-inch screen
   B) Fertility – 35% organic matter

3. In the event of floodplain grading, over-excavate the sub grade to ensure 12 inches of topsoil can be applied without impacting surface water elevations.

d. For wet areas in Sensitive Areas and Stormwater Facilities, the soil conditions shall be hydric or graded to hold sufficient water to promote hydric soil formation. The addition of organic muck soil will improve plant establishment for some bulbs and tubers.

e. Where appropriate and necessary for erosion control or to enhance organic matter, leaf compost may be placed uniformly on topsoil. (Refer to Chapter 6, Erosion Prevention and Sediment Control). Other amendments, conditioners, and bio-amendments may be added as needed to support the specified plants or adjust the soil pH. Traditional fertilization techniques (applying N-P-K) are not necessary for native plants.

2.3 Step 3: Identify Plants to be Preserved, Select Revegetation Plant Materials, Quantities, Placement, and Assign Planting Zones and Specifications to Plans

a. Preservation: Every effort shall be made to protect a site's existing native vegetation. Native vegetation along Sensitive Areas and Vegetated Corridors shall be retained to the maximum extent practicable.

b. Selection: Plant selection shall be from a native species palette and shall consider site soil types, hydrologic conditions, and shade requirements. Containerized or bare root plants may be used. A list of common native plant community types appropriate for planting Sensitive Areas, Vegetated Corridors and Stormwater Facilities is provided in Table A-1. Upon approval from the District, limited use of non-invasive non-native plants may be permitted in highly urbanized and other unique settings such as regional town centers. Unless approved by District staff, planting restrictions are limited to the following:

1. Deep rooting trees and shrubs (e.g. willow) shall not be planted on top of concrete pipes, or within 10 feet of retaining walls, inlet/outlet structures or other culverts; and

2. Large trees or shrubs shall not be planted on berms over four feet tall that impound water. Small trees or shrubs with fibrous root systems may be installed on berms that impound water and are less than four feet tall.

c. Quantities:

1. Vegetated Corridors and Sensitive Areas
Trees and shrubs shall be planted using the following equations to achieve the specified densities on a per acre basis.

A) Total number of trees per acre = area in square feet x 0.01
B) Total number of shrubs per acre = area in square feet x 0.05
C) Groundcover = plant and seed to achieve 100% areal coverage

2. Stormwater Facilities
A) Stormwater Facilities in tracts or easements less than 30 feet wide shall be planted using the following equations to achieve the specified densities on a per acre basis:
i. Total number of shrubs per acre = area in square feet x 0.05
ii. Groundcover = plant and seed to achieve 100% areal coverage
B) Stormwater Facilities in tracts or easements 30 feet wide or more shall be planted using the following equations to achieve the specified densities on a per acre basis:
i. Total number of trees per acre = area in square feet x 0.01
ii. Total number of shrubs per acre = area in square feet x 0.05
iii. Groundcover = plant and seed to achieve 100% areal coverage

d. Size: Potted plants shall follow size requirements outlined in Table A-1. Bare root plants shall be 12 to 16 inches long.

e. Placement: Plant placement shall be consistent with naturally occurring plant communities. Trees and shrubs shall be placed in singles or clusters of the same species to provide a natural planting scheme. This arrangement may follow curved rows to facilitate maintenance. Distribution and relative abundance shall be dependant on the plant species and on the size of the revegetation area. The Vegetated Corridor revegetation area shall be overseeded with native seed mixes appropriate to the plant community and hydrologic zone of the site (see Table A-1: Plant Communities for Revegetation). Plant placement and seeding shall promote maximum vegetative cover to minimize weed establishment.

2.4 Step 4: Determine Plant Installation Requirements and Assign Specifications to Plans

a. Timing
Containerized stock shall be installed only from February 1 through May 1 and October 1 through November 15. Bare root stock shall be installed only from December 15 through April 15. Plantings outside these times may require additional measures to ensure survival which shall be specified on the plans.

b. Erosion Control
Grading, soil preparation, and seeding shall be performed during optimal weather conditions and at low flow levels to minimize sediment impacts. Site disturbance shall be minimized and desirable vegetation retained, where possible. Slopes shall be graded to support the establishment of vegetation. Where seeding is used for erosion control, an appropriate native grass, Regreen (or its equivalent), or sterile wheat shall be used to stabilize slopes until permanent vegetation is established. Biodegradable fabrics (coir, coconut or approved jute matting (minimum 1/4" square holes) may be used to stabilize slopes and channels. Fabrics such as burlap may be used to secure plant plugs in place and to discourage floating upon inundation. No plastic mesh that can entangle wildlife is permitted. Consult Chapter 6 - Erosion Prevention and Sediment Control for additional information.

c. Mulching
Trees, shrubs, and groundcovers planted in upland areas shall be mulched a minimum of three inches in depth and 18 inches in diameter, to retain moisture and discourage weed growth around newly installed plant material. Appropriate mulches are made from composted bark or leaves that have not been chemically treated. The use of mulch in frequently inundated areas shall be limited, to avoid any possible water quality impacts including the leaching of tannins and nutrients, and the migration of mulch into waterways.

d. Plant Protection from Wildlife
Depending on site conditions, appropriate measures shall be taken to limit wildlife-related damage (*see IPM Plan*).

e. Irrigation
Appropriate plant selection, along with adequate site preparation and maintenance, reduces the need for irrigation. However, unless site hydrology is currently adequate, a District/City approved irrigation system or equivalent (i.e., polymer, plus watering) shall be used during the two-year plant establishment period. Watering shall be at a minimum rate of at least one inch per week from June 15 through October 15. Other irrigation techniques, such as deep watering, may be allowed with prior approval by District staff.

f. Access
Maintenance access for plant maintenance shall be provided for Sensitive Areas and Vegetated Corridors via a five-foot easement or shared boundary with Stormwater Facilities. Stormwater Facilities access requirements are provided in Chapter 4.

2.5 Step 5: Determine Plant Monitoring and Maintenance Requirements

a. Monitoring
Site visits are necessary throughout the growing season to assess the status of the plantings, irrigation, mulching, etc. and ensure successful revegetation.

b. Weed Control
The removal of non-native, invasive weeds shall be necessary throughout the maintenance period, or until a healthy stand of desirable vegetation is established (*see IPM Plan*).

c. Plant Replacement and Preservation
Installed plants that fail to meet the acceptance criteria (see Chapter 2) shall be replaced during the maintenance period. Prior to replacement, the cause of loss (wildlife damage, poor plant stock, etc.) shall be documented with a description of the corrective actions taken.

2.6 Step 6: Prepare Construction Documents and Specifications

The construction documents and specifications shall include:

a. Sensitive Area and Vegetated Corridor boundaries as shown on the Service Provider Letter, including limits of approved, temporary construction encroachment. Orange construction fencing shall be noted at Vegetated Corridor boundaries as well as at encroachment limits during construction. Note permanent type fencing and signage between the development and the Vegetated Corridor for project completion is required.

b. Site Preparation plan and specifications, including limits of clearing, existing plants and trees to be preserved, and methods for removal and control of invasive, non-native species, and location and depth of topsoil and or compost to be added to revegetation area.

c. Planting plan and specifications, including all of the following:
   1. Planting table that documents the common name, scientific name, distribution (zone and spacing), condition and size of plantings
   2. Installation methods for plant materials
   3. Mulching
   4. Plant tagging for identification
   5. Plant protection
   6. Seeding mix, methods, rates, and areas

d. Irrigation plan and specifications, including identification of water source, watering timing and frequency, and maintenance of the system.

e. Maintenance schedule; including responsible party and contact information, dates of inspection (minimum three per growing season and one prior to onset of growing season) and estimated maintenance schedule (as necessary) over the two-year monitoring period.

f. Easement descriptions for all Vegetated Corridor and Sensitive Areas that are required as part of the development.

g. Good rated corridor notes i.e. invasive species removal resulting in cleared areas exceeding 25 square feet shall be replanted with native vegetation.

h. Access points for installation and maintenance including vehicle access if available.

i. Standard drawing details (north arrow, scale bar, property boundaries, project name, drawing date, name of designer and Property Owner).

TABLE A-1
SUGGESTED PLANT COMMUNITIES FOR REVEGETATION

Plant Commiunities	Minimum Species Composition	Plant Category	Water Requirements	Light Requirements	Minimum Rooting Size	Minimum Plant Height	Spacing Format
Riparian Forest (RF)							
Red alder (Alnus rubra)	X	Tree	Moist	Sun	1 gal	3'	Single
Western red cedar (Thuja plicata)	X	Tree	Moist	Shade	2 gal	2'	Single
Red elderberry (Sambucus racemosa)	X	Shrub	Moist	Part	1 gal	1.5'	Single
Black twinberry (Lonicera involcrata)		Shrub	Moist	Part	1 gal	1.5'	Single
Red-osier dogwood (Cornus stoniferia)	X	Shrub	Wet	Part	1 gal	2'	Cluster
Indian plum (Oemleris cerasiformis)	X	Shrub	Moist	Shade	2 gal	2'	Cluster
Swamp rose (Rosa pisocarpa)		Shrub	Moist	Part	1 gal	1.5'	Cluster
Pacific ninebark (Pysocarpus capitatus)		Shrub	Moist	Shade	1 gal	2'	Single
Snowberry (Symphoricarpos albus)	X	Shrub	Dry	Part	1 gal	1.5'	Cluster
Salmonberry (Rubus spectabilis)	X	Shrub	Moist	Shade	1 gal	1.5'	Cluster
Maidenhair fern (Adiatum aleuticum)		Herb	Moist	Shade	4"	na	Cluster
Lady fern (Athyrium filix-femina)		Herb	Moist	Shade	1 gal	na	Cluster
Skunk cabbage (Lysichiton americanum)		Herb	Wet	Shade	bulbs	na	Cluster
False lily-of-the-valley (Maianthemum dilatatum)		Herb	Moist	Shade	bulbs, 4"	na	Cluster
Candy flower (Claytonia sibirica)		Herb	Moist	Shade	4"	na	Cluster
Miners lettuce (Montia perfoliata)		Herb	Moist	Shade	4"	na	Cluster
Stream violet (Viola glabella)		Herb	Moist	Shade	4"	na	Cluster
Youth-on-age (Tolmiea menziesii)		Herb	Moist	Shade	4"	na	Cluster
Insideout flower (Vancouveria hexandra)		Herb	Moist	Shade	4"	na	Cluster
Dewey's sedge (Carex deweyana)		Herb	Dry	Shade	plugs, 4"	4"	Mass
Hair bentgrass (Agrostis scabra)		Grass	Moist	Part	seed	na	Mass
Spike bentgrass (Agrostis exarata)	X	Grass	Moist	Part	seed	na	Mass
Tall manna-grass (Glyceria elata)	X	Grass	Moist	Part	seed	na	Mass

Plant Commiunities	Minimum Species Composition	Plant Category	Water Requirements	Light Requirements	Minimum Rooting Size	Minimum Plant Height	Spacing Format
Upland Forest (UF)							
Red alder (Alnus rubra)	X	Tree	Moist	Sun	1 gal	3'	Single
Big leaf maple (Acer macrophyllum)	X	Tree	Dry	Sun	2gal	3'	Single
Douglas Fir (Pseudotsuga menziesii)	X	Tree	Dry	Sun	2gal	3'	Single
Grand fir (Abies grandis)	X	Tree	Dry	Sun	2 gal	2'	Single
Pacific yew (Taxus brevifolia)		Tree	Moist	Shade	2 gal	2'	Single
Cascara (Rhamnus purshiana)		Tree	Dry	Part	2 gal	2'	Single
Pacific dogwood (Cornus nuttallii)		Tree	Moist	Shade	1 gal	2'	Single
Bitter cherry (Prunus emarginata)		Tree	Moist	Part	2 gal	2'	Single
Vine Maple (Acer circinatum)	X	Tree	Moist	Part	2 gal	2'	Single
Oceanspray (Holodiscus discolor)	X	Shrub	Dry	Sun	1 gal	1.5'	Single
Red elderberry (Sambucus racemosa)	X	Shrub	Moist	Part	1 gal	1.5'	Single
Red flowering currant (Ribes sanguineum)	X	Shrub	Dry	Sun	1 gal	1.5'	Cluster
Cascade Oregon grape (Mahonia nervosa)		Shrub	Moist	Part	1 gal	4"	Cluster
Tall Oregon grape (Mahonia aquifolium)		Shrub	Dry	Sun	1 gal	6"	Single
Red huckleberry (Vaccinium parvifolium)		Shrub	Moist	Shade	1 gal	1.5'	Cluster
Thimbleberry (Rubus pariflorus)		Shrub	Moist	Shade	1 gal	1.5'	Cluster
Snowberry (symphoricarpos albus)	X	Shrub	Dry	Part	1 gal	1.5'	Cluster
Baldhip Rose (Rosa gymnocarpa)	X	Shrub	Dry	Part	1 gal	1.5'	Cluster
Serviceberry (Almelanchier alnifolia)		Shrub	Dry	Part	2 gal	2'	Single
Sword fern (Polystichum munitum)		Shrub	Moist	Shade	2 gal	na	Cluster
Deer fern (Blechnum spicant)		Herb	Moist	Shade	1 gal	na	Cluster
Orange honeysuckle (Lonicera ciliosa)		Herb	Moist	Shade	2 gal	na	Single
Salal (Gaultheria shallon)		Herb	Moist	Part	1 gal	4"	Cluster
Wood strawberry (Fragaria vesca)		Herb	Moist	Shade	4"	na	Cluster
Western trillium (Trillium ovatum)		Herb	Moist	Shade	4"	na	Cluster
Five-stemmed mitrewort (Mitella pentandra)		Herb	Moist	Shade	1 gal	na	Cluster
Red columbine (Aquilegia formosa)		Herb	Dry	Part	4"	na	Cluster
False solomon's seal (Smilacina racemosa)		Herb	Moist	Shade	4"	na	Cluster
Native California brome (Bromus carinatus)	X	Grass	Dry	Sun	seed	na	Mass
Blue Wildrye (Elymus glaucus)	X	Grass	Dry	Part	seed	na	Mass

Plant Commiunities	Minimum Species Composition	Plant Category	Water Requirements	Light Requirements	Minimum Rooting Size	Minimum Plant Height	Spacing Format
Oak Woodland / Savanna (OW)							
Oregon white oak (Quercus garryana)	X	Tree	Dry	Sun	2 gal	2'	Single
Snowberry (Symphoricarpos albus)	X	Shrub	Dry	Part	1 gal	1.5'	Cluster
Serviceberry (Almelanchier alnifolia)	X	Shrub	Dry	Part	1 gal	2'	Single
Oceanspray (Holodiscus discolor)	X	Shrub	Dry	Sun	1 gal	1.5'	Cluster
Training blackberry (Rubus ursinus)		Shrub	Dry	Sun	1 gal	1.5'	Cluster
Cascade Oregon grape (Mahonia nervosa)		Herb	Moist	Part	1 gal	4"	Cluster
Blue wild-rye (Elymus glacus)	X	Grass	Dry	Part	seed	na	Mass
Native California brome (Bromus carinatus)	X	Grass	Dry	Sun	seed	na	Mass
Ash Forested Wetland (FW)							
Oregon Ash (Fraxinus latifolia)	X	Tree	Moist	Part	2 gal	3'	Single
Pacific Ninebark (Physocarpus capitatus)	X	Shrub	Moist	Shade	2 gal	2'	Single
Red-osier dogwood (Cornus sericea)	X	Shrub	Wet	Part	1 gal	2'	Cluster
Snowberry (Symphoricarpus albus)	X	Shrub	Dry	Part	1gal	1.5'	Cluster
Slough sedge (Carex obnupta)	X	Herb	Moist	Part	plugs	6"	Mass
Candy flower (Claytonia sibirica)		Herb	Moist	Shade	4"	na	Cluster
Streambank springbeauty (Montia parvifolia)		Herb	Moist	Shade	4"	na	Cluster
Dewey's sedge (Carex deweyana)		Herb	Dry	Shade	plugs	4"	Mass
Small fruited bulrush (Scirpus microcarpus)		Herb	Wet	Sun	plugs	4"	Mass
Tall mannagrass (Glyceria elata)	X	Grass	Moist	Shade	seed	na	Mass

Plant Commiunities	Minimum Species Composition	Plant Category	Water Requirements	Light Requirements	Minimum Rooting Size	Minimum Plant Height	Spacing Format
Shrub / Scrub Wetland (SS)							
Pacific willow (Salix lasiandra)	X	Tree	Wet	Sun	1 gal	3'	Single
Sitka willow (Salix sitchensis)		Tree	Moist	Sun	1 gal	3'	Cluster
Douglas hawthorne (Crataegus douglasii)		Tree	Moist	Part	2 gal	2'	Cluster
Pacific Crabapple (Malus fusca)	X	Tree	Moist	Part	2 gal	2'	Cluster
Scouler willow (Salix scouleriana)	X	Shrub	Moist	Sun	1 gal	3'	Cluster
Red-osier dogwood (Cornus sericea)	X	Shrub	Wet	Part	1 gal	2'	Cluster
Clustered rose (Rosa pisocarpa)		Shrub	Wet	Part	1 gal	1.5'	Cluster
Douglas's spiraea (Spiraea douglasii)	X	Shrub	Wet	Sun	1 gal	1.5'	Cluster
Nodding beggartick (Bidens cernua)		Herb	Wet	Sun	1 gal	1.5'	Cluster
Spreading rush (Juncus patens)		Herb	Moist	Part	plugs	6"	Mass
Western manna-grass (Glyceria occidentalis)	X	Grass	Wet	Sun	seed	na	Mass
Emergent Marsh (EM)							
Nodding beggarstick (Bidens cernua)	X	Herb	Moist	Sun	1 gal	1.5'	Cluster
Hardstem bulrush (Scirpus acutus)		Herb	Wet	Sun	plugs	1.5'	Cluster
Small-fruited bulrush (Scirpus microcarpus)	X	Herb	Wet	Sun	plugs	6"	Mass
Creeping spike rush (Eleocharis palustris)	8	Herb	Wet	Sun	seed, plugs	4"	Mass
Wapato (Sagittaria latifolia)		Herb	Wet	Sun	bulbs	na	Cluster
American water plantain (Alisma plantago-aquatica)		Herb	Wet	Sun	bulbs	na	Cluster
Soft stemmed bulrush (Scirpus taberaemontani)		Herb	Wet	Sun	plugs	1.5'	Cluster
American brooklime (Veronica americana)		Herb	Wet	Sun	plugs	na	Cluster
Marsh speedwell (Veronica scutellata)		Herb	Wet	Sun	plugs	na	Cluster
American sloughgrass (Beckmannia syzigachne)	X	Grass	Wet	Sun	seed, plugs	na	Mass
Western manna-grass (Glyceria occidentalis)	X	Grass	Wet	Sun	seed	na	Mass

Plant Commiunities	Minimum Species Composition	Plant Category	Water Requirements	Light Requirements	Minimum Rooting Size	Minimum Plant Height	Spacing Format
Storm Water Facility (SWF)							
Oregon Ash (Fraxinus latifolia)		Tree	Moist	Part	2 gal	3'	Single
Vine Maple (Acer circinatum)	X	Tree	Moist	Part	2 gal	2'	Single
Cascara (Rhamnus purshiana)		Tree	Moist/Dry	Part	1 gal	2'	Single
Bitter cherry (Prunus emarginata)		Tree	Moist	Part	2 gal	2'	Single
Mock orange (Philadelphus lewisii)		Shrub	Wet/dry	Part	1 gal	2'	Cluster
Red-osier dogwood (Cornus sericea)	X	Shrub	Wet	Part	1 gal	2'	Cluster
Pacific ninebark (Pysocarpus capitatus)		Shrub	Moist	Shade	1 gal	2'	Single
Oceanspray (Holodiscus discolor)	X	Shrub	Dry	Sun	1 gal	1.5'	Single
Serviceberry (Almelanchier alnifolia)	X	Shrub	Dry	Part	1 gal	2'	Single
Clustured rose (Rosa pisocarpa)		Shrub	Moist	Sun	1 gal	1.5'	Cluster
Snowberry (Symphoricarpus albus)	X	Shrub	Dry	Part	1gal	1.5'	Cluster
Douglas's spiraea (Spiraea douglasii)	X	Shrub	Wet	Sun	1 gal	1.5'	Cluster
Red flowering currant (Ribes sanguineum)	X	Shrub	Dry	Sun	1 gal	1.5'	Cluster
Nodding beggartick (Bidens cernua)		Herb	Wet	Sun	1 gal	1.5'	Cluster
Spreading rush (Juncus patens)		Herb	Moist	Part	plugs	6"	Mass
Small-fruited bulrush (Scirpus microcarpus)		Herb	Wet	Sun	plugs	6"	Mass
Slough sedge (Carex obnupta)	X	Herb	Moist	Part	plugs	6"	Mass
Toad rush (Juncus bufonius)*		Herb	Dry	Sun	seed, plugs	4"	Mass
Rossi Sedge (Carex rossi)*		Herb	Moist	Sun	plugs	4"	Mass
NW Native Wildflower mix		Herb	Mix	Sun	seed	na	Mass
Oregon Bentgrass (Agrostis oregonesis)*	X	Grass	Dry	Sun	seed	na	Mass
Idaho bentgrass (Agrostis idahoensis)*		Grass	Dry	Sun	seed	na	Mass
Western manna-grass (Glyceria occidentalis)		Grass	Wet	Sun	seed	na	Mass

* - Grows 5-30 cm tall

APPENDIX V

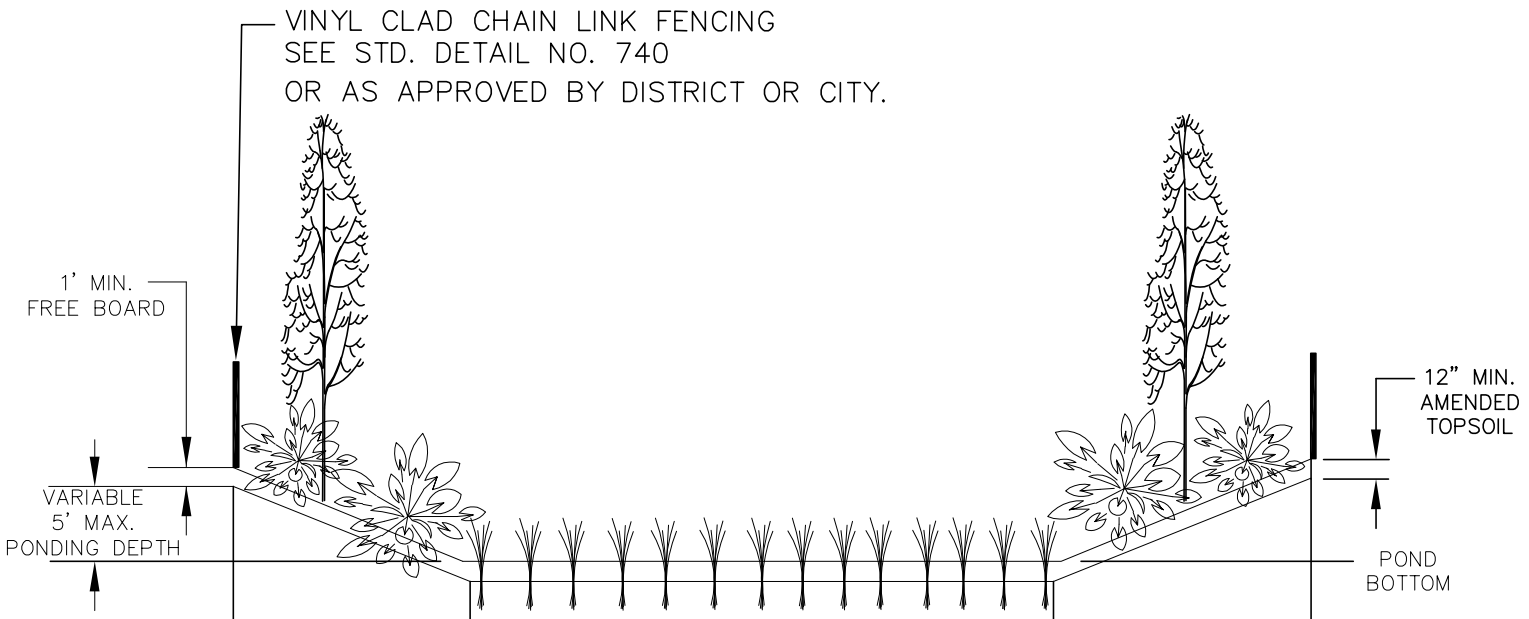
Detail Drawings/Specifications

VEGETATED SWALES

DETENTION POND

DRAWING NO. 700

REVISED 10-31-19



	SIDE SLOPE AREA	DETENTION AREA 6' MINIMUM WIDTH	SIDE SLOPE AREA
EC MATTING	ECONOJUTE*	COCONUT FIBER OR GEOJUTE PLUS*	ECONOJUTE*
SEED MIX	LOW GROW MIX SEE NOTE #5	NONE	LOW GROW MIX SEE NOTE #5
MAX. SLOPE	3H:1V TYP	FLAT BOTTOM	3H:1V TYP

* OR AS APPROVED

NOTES:

1. REFER TO CHAPTER 4, CWS DESIGN & CONSTRUCTION STANDARDS, FOR LANDSCAPING REQUIREMENTS INCLUDING TREE PLACEMENT, TOPSOIL AND PLANTING SPECIFICATIONS.
2. PROVIDE IRRIGATION AS APPROVED BY CWS.
3. JUTE MATTING– GEOJUTE PLUS IN DETENTION AREA, ECONOJUTE FOR ALL OTHER AREAS, OR SIMILIAR FABRICS. COCONUT FIBER IS ALSO ACCEPTABLE.
4. 12 INCHES OF AMENDED TOPSOIL SHALL BE PLACED THROUGHOUT THE WATER QUANTITY FACILITY.
5. SIDE SLOPE AREA SEED MIX, DWARF TALL FESCUE 40%, DWARF PERENNIAL RYE 30%, CREEPING RED FESCUE 25%, COLONIAL BENT GRASS 5%. APPLY AT A RATE OF 120# / ACRE.

Clean Water Services

CONSTRUCTION

1. Detention Pond shall be over-excavated and filled to final grade with 12-inch amended topsoil. Topsoil amendments shall be garden compost, not conventional fertilizer amendments.
2. A biodegradable Erosion Control Matting shall be placed over the topsoil throughout the Detention Pond cross section, fabric shall be held in place in accordance with the manufacturer's installation requirements. Anchor spacing shall be based on 3 fps flow over the fabric.
    a. Pond bottom - high-density jute matting (Geojute Plus or other approved equal)
    b. All other areas - low-density jute matting (Econojute or other approved equal)
3. Plant materials shall be placed in accordance with the plan and plant table as shown on approved plans.
4. The facility shall be deemed acceptable to begin the maintenance period when plant growth and density matches the Engineer's design as shown on the approved plans and all other requirements have been met. The Engineer must certify the facility to be functional, in accordance with the approved plan design to begin the two-year maintenance period..

MAINTENANCE

1. The permittee is responsible for the maintenance of this facility for a minimum of two years following construction and acceptance of this facility per Chapter 2.
2. Irrigation is to be provided per separate irrigation plan as approved.
   Note: Irrigation needs are to be met using a temporary irrigation system with a timer during the dry season. Systems should be winterized during the wet season to assure longevity and guard against damage from freezing temperatures. Water source shall be as shown on the approved plans.
3. Engineer or Owner's Representative is required to perform Monitoring and Maintenance of the Site and provide Documentation as required in Appendix A, 2.5 of the Design and Construction Standards. The Approved Plans shall include a Maintenance Schedule per Appendix A, 2.6.e of the Design and Construction Standards.
4. The Facility shall be re-excavated and planted if siltation greater than 3 inches in depth occurs within the two-year maintenance period.

DETENTION POND CONSTRUCTION & MAINTENANCE NOTES

DETAIL NO. 701

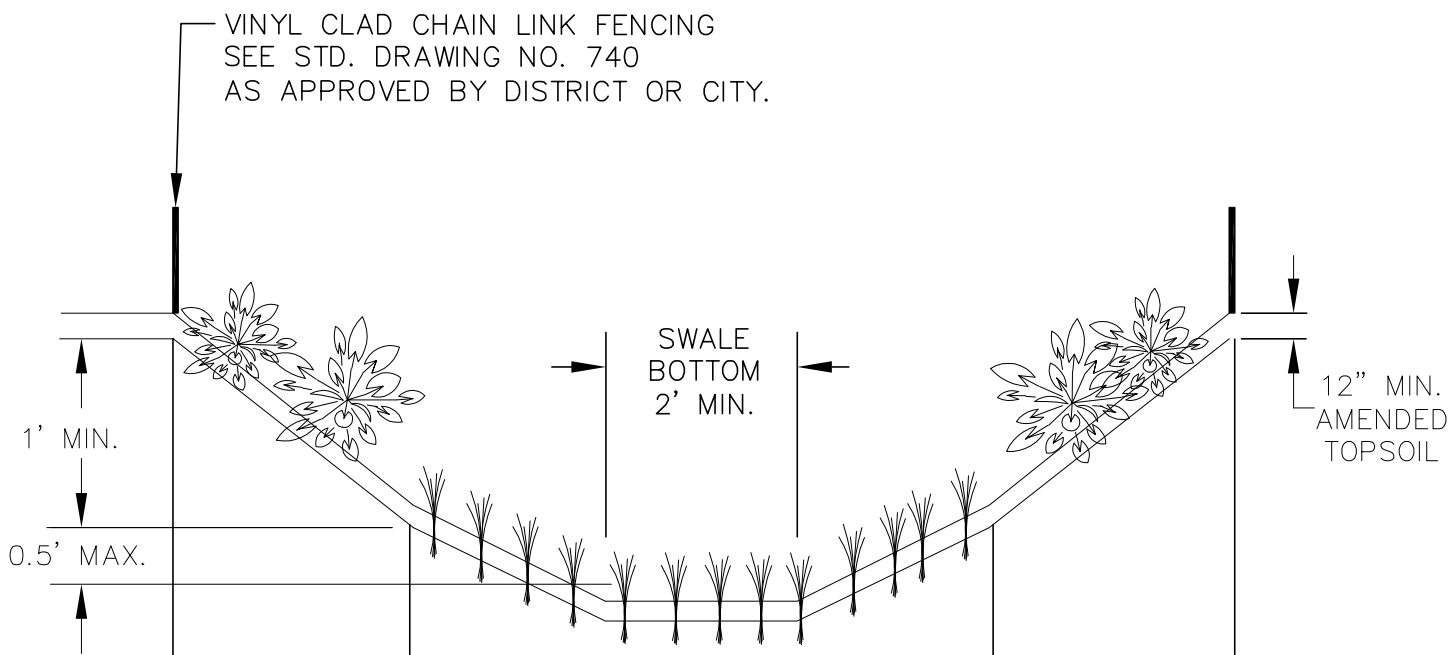
REVISED 10-31-19

Clean Water Services

WATER QUALITY SWALE

DRAWING NO. 705

REVISED 10-31-19



SWALE AREA	SIDE SLOPE AREA	TREATMENT AREA 6' MINIMUM WIDTH			SIDE SLOPE AREA
EC MATTING	ECONOJUTE*	COCONUT FIBER OR GEOJUTE PLUS*			ECONOJUTE*
SEED MIX	LOW GROW MIX SEE NOTE #5	NONE			LOW GROW MIX SEE NOTE #5
MAX. SLOPE	2.5H:1V	4H:1V TYP	FLAT BOTTOM	4H:V1	2.5H:V1

* OR AS APPROVED

NOTES:

1. REFER TO CHAPTER 4, CWS DESIGN & CONSTRUCTION STANDARDS, FOR LANDSCAPING REQUIREMENTS INCLUDING TREE PLACEMENT, TOPSOIL AND PLANTING SPECIFICATIONS.
2. PROVIDE IRRIGATION AS APPROVED BY CWS.
3. JUTE MATTING– GEOJUTE PLUS IN TREATMENT AREA, ECONOJUTE FOR ALL OTHER AREAS, OR SIMILIAR FABRICS. COCONUT FIBER IS ALSO ACCEPTABLE.
4. 12 INCHES OF AMENDED TOPSOIL SHALL BE PLACED THROUGHOUT THE WATER QUALITY FACILITY.
5. FREEBOARD AREA SEED MIX, DWARF TALL FESCUE 40%, DWARF PERENNIAL RYE 30%, CREEPING RED FESCUE 25%, COLONIAL BENT GRASS 5%. APPLY AT A RATE OF 120# / ACRE.

Clean Water Services

CONSTRUCTION

1. Water Quality Facility shall be over-excavated and filled to final grade with 12-inch amended topsoil. Topsoil amendments shall be garden compost, not conventional fertilizer amendments.
2. A biodegradable Erosion Control Matting shall be placed over the topsoil throughout the swale cross section, fabric shall be held in place in accordance with the manufacturer's installation requirements. Anchor spacing shall be based on 3 fps flow over the fabric.
    a. Treatment area - high-density jute matting (Geojute Plus or other approved equal)
    b. All other areas - low-density jute matting (Econojute or other approved equal)
3. Plant materials shall be placed in accordance with the plan and plant table as shown on approved plans.
4. The water quality facility treatment area plantings can be deemed "substantially complete" once active green growth has occurred to an average growth of 3" and plant density is an average of approx. 6 plants (minimum 1-inch plugs or equivalent) per square foot.
5. The facility shall be deemed acceptable to begin the maintenance period when plant growth and density matches the engineer's design as shown on the approved plans and all other requirements have been met. The engineer must certify the facility to be functional, in accordance with the approved plan design to begin the two-year maintenance period.

MAINTENANCE

5. The permittee is responsible for the maintenance of this facility for a minimum of two years following construction and acceptance of this facility per Chapter 2.
6. Irrigation is to be provided per separate irrigation plan as approved.
   Note: Irrigation needs are to be met using a temporary irrigation system with a timer during the dry season. Systems should be winterized during the wet season to assure longevity and guard against damage from freezing temperatures. Water source shall be as shown on the approved plans.
7. Engineer or Owner's Representative is required to perform Monitoring and Maintenance of the Site and provide Documentation as required in Appendix A, 2.5 of the Design and Construction Standards. The Approved Plans shall include a Maintenance Schedule per Appendix A, 2.6.e of the Design and Construction Standards.
8. The facility shall be re-excavated and planted if siltation greater than 3 inches in depth occurs within the two-year maintenance period.

WATER QUALITY SWALE CONSTRUCTION & MAINTENANCE NOTES

DETAIL NO. 706

REVISED 10-31-19

Clean Water Services

APPENDIX VI

Supplemental Civil Drawings

0 15 30 60
(feet)

NW MEADOWS DRIVE

NW MEADOWS DRIVE

FENDEL WAY

S89°17'50"E 353.15'

S0°08'00"E 426.00'

S0°08'04"E 273.42'

S0°07'51"E 380.40'

BSC:1
158.24
SPIKE WOPC

BSC:1
160.53
PK

BSC:19
162.02

21010

21003

21001

21000

COTTONWOOD SECOND ADDITION V. 13, P. 26 B.C.T.P.

COTTONWOOD FIRST ADDITION V. 12, P. 25 B.C.T.P.

SHADDEN CLAIM SECOND ADDITION V. 12, P. 110, B.C.T.P.

SHADDEN CLAIM FIRST ADDITION V. 11, P. 110, B.C.T.P.

BAKER CREEK PHASE 2 EAST

BAKER CREEK PHASE 2

MOMNVILLE CITY PARK INSTR NO 2015-09152

60' B.P.A. EASEMENT PER V. 407, P. 251

PARKMAD TRACT 'B'

TRACT 'D'

LOT 119 LOT 63 LOT 18 LOT 22 LOT 21 LOT 20 LOT 19 LOT 75 LOT 76 LOT 77 LOT 78 LOT 79 LOT 80 LOT 81 LOT 82 LOT 83 LOT 84 LOT 85A LOT 85B LOT 86A LOT 86B LOT 87 LOT 88 LOT 89 LOT 90 LOT 91 LOT 92 LOT 93 LOT 94 LOT 95 LOT 96 LOT 97 LOT 98 LOT 99 LOT 100 LOT 101 LOT 102 LOT 103 LOT 104 LOT 105 LOT 106 LOT 107 LOT 108 LOT 109 LOT 110 LOT 111 LOT 112 LOT 113 LOT 114 LOT 115 LOT 116 LOT 117 LOT 118 LOT 119 LOT 120 LOT 121 LOT 122 LOT 123 LOT 124

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH, ADJUST THIS SHEET, ADJUST SCALES ACCORDINGLY

DSN. JW
DRN. IH
CKD. JW
DATE: 01/27/2022

NO.	DATE	DESCRIPTION REVISIONS	BY
1			

REVIEW REVIEW

REGISTERED PROFESSIONAL ENGINEER OREGON JULY 27, 1990 WILLIAM T. WELLS

RENEWS: 6/30/2022

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

VJ-2 DEVELOPMENT
ELYSIAN SUBDIVISION

EXISTING CONDITIONS PLAN

DRAWING
C0.1

JOB NUMBER
2931.0000.0

5/5/2022 2:28:05 PM
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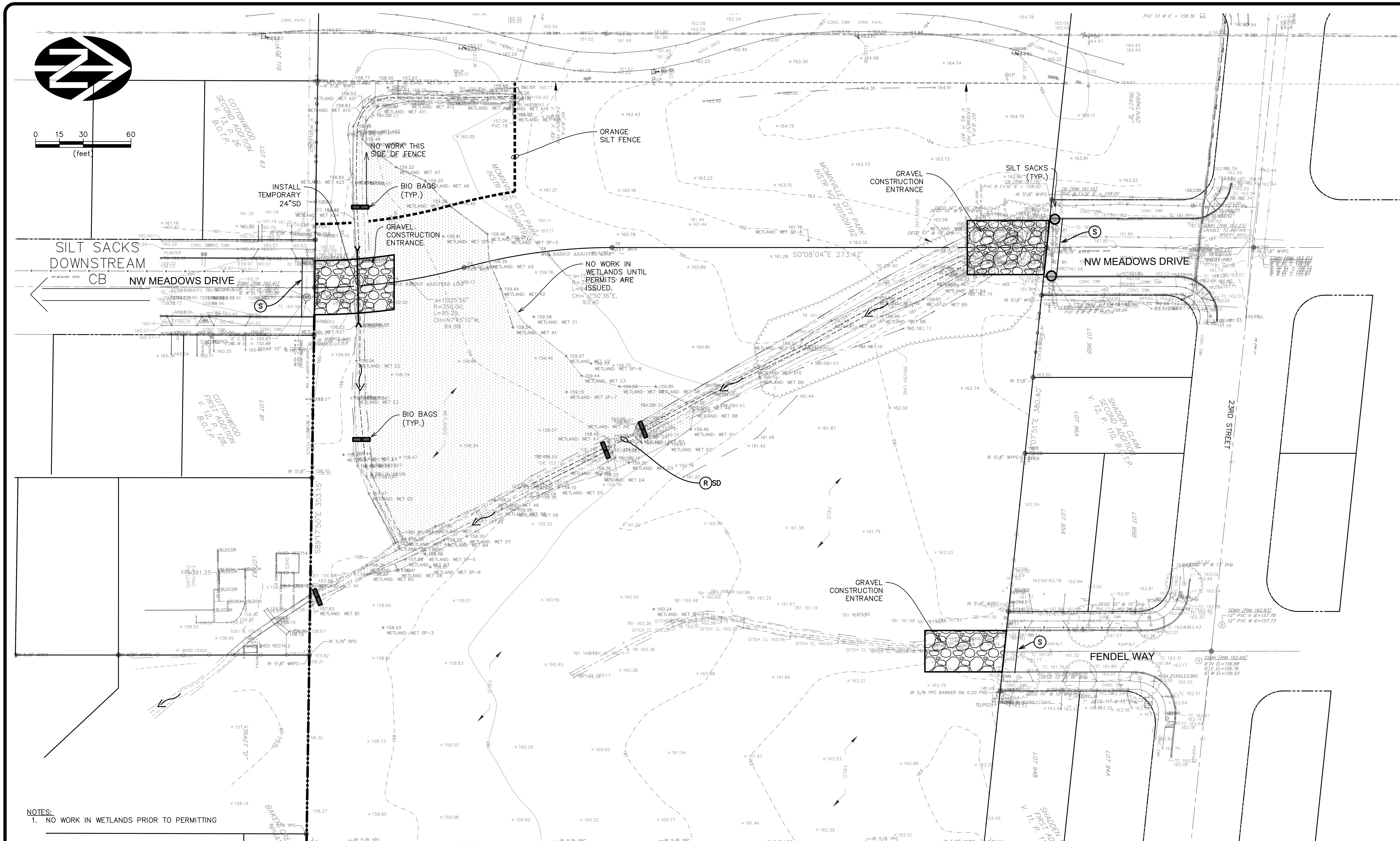


NOTES:
1. NO WORK IN WETLANDS PRIOR TO PERMITTING

DEMOLITION LEGEND

- (S) SAWCUT AT DIRECTION OF CITY
- (R) CONTRACTOR TO REMOVE

EROSION CONTROL LEGEND

- SILT SACK
- BIO BAGS
- SILT FENCE
- = WETLANDS

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

REGISTERED PROFESSIONAL ENGINEER OREGON WILLIAM J. WELLS RENEWS: 6/30/2022

REVIEW

VERIFY SCALE: BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

DSN.	JW
DRN.	IH
CKD.	JW
DATE	05/2022

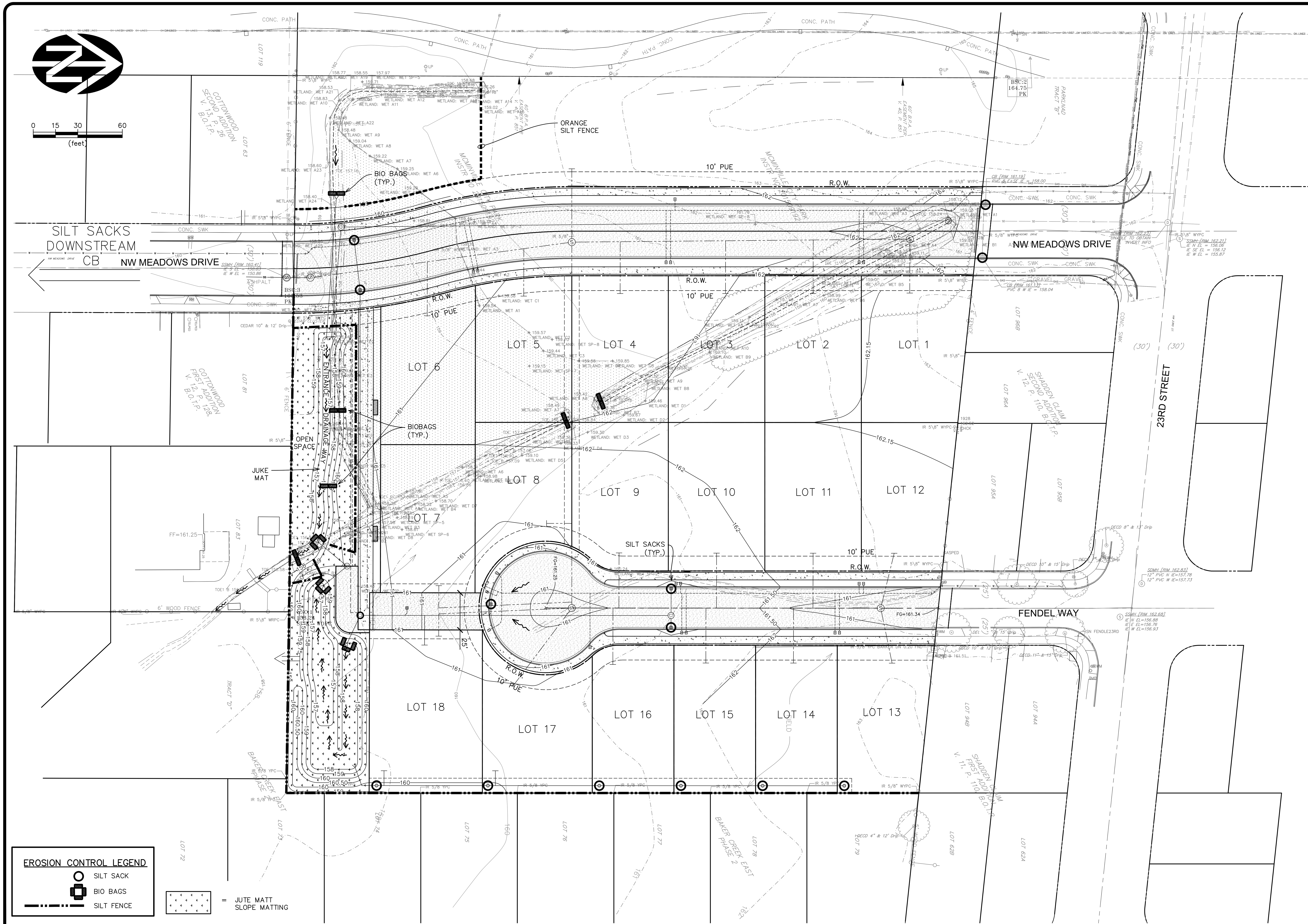
NO.	DATE	DESCRIPTION	BY
		REVISIONS	

VJ-2 DEVELOPMENT
ELYSIAN SUBDIVISION

PRE-DEVELOPED EROSION CONTROL PLAN

DRAWING C1.0

JOB NUMBER 2931.0000.0



NO.	DATE	DESCRIPTION	BY
1			

REVISIONS

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING

0 1"

IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

DSN. JW
DRN. IH
CKD. JW
DATE: 06/2008

REVIEW REVIEW

REGISTERED PROFESSIONAL ENGINEER 61515 OREGON NOV. 12, 2008 WILLIAM J. WELLS

RENEWS: 6/30/2022

WE
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VJ-2 DEVELOPMENT

ELYSIAN SUBDIVISION

POST EROSION CONTROL PLAN

DRAWING C1.1

JOB NUMBER 2931.0000.0

DEQ EROSION CONTROL STANDARD NOTES:

1. Hold a pre-construction meeting of project construction personnel that includes the inspector to discuss erosion and sediment control measures and construction limits. (Schedule A.8.c.i.(3))
2. All inspections must be made in accordance with DEQ 1200-C permit requirements. (Schedule A.12.b and Schedule B.1)
3. Inspection logs must be kept in accordance with DEQ's 1200-C permit requirements. (Schedule B.1.c and B.2)
4. Retain a copy of the ESCP and all revisions on site and make it available on request to DEQ, Agent, or the local municipality. During inactive periods of greater than seven (7) consecutive calendar days, the above records must be retained by the permit registrant but do not need to be at the construction site. (Schedule B.2.c)
5. All permit registrants must implement the ESCP. Failure to implement any of the control measures or practices described in the ESCP is a violation of the permit. (Schedule A 8.a)
6. The ESCP must be accurate and reflect site conditions. (Schedule A.12.c.i)
7. Submission of all ESCP revisions is not required. Submittal of the ESCP revisions is only under specific conditions. Submit all necessary revision to DEQ or Agent within 10 days. (Schedule A.12.c.iv. and v)
8. Phase clearing and grading to the maximum extent practical to prevent exposed inactive areas from becoming a source of erosion. (Schedule A.7.a.iii)
9. Identify, mark, and protect (by construction fencing or other means) critical riparian areas and vegetation including important trees and associated rooting zones, and vegetation areas to be preserved. Identify vegetative buffer zones between the site and sensitive areas (e.g., wetlands), and other areas to be preserved, especially in perimeter areas. (Schedule A.8.c.i.(1) and (2))
10. Preserve existing vegetation when practical and re-vegetate open areas. Re-vegetate open areas when practicable before and after grading or construction. Identify the type of vegetative seed mix used. (Schedule A.7.a.v)
11. Maintain and delineate any existing natural buffer within the 50-feet of waters of the state. (Schedule A.7.b.i.and (2(a)(b))
12. Install perimeter sediment control, including storm drain inlet protection as well as all sediment basins, traps, and barriers prior to land disturbance. (Schedule A.8.c.i.(5))
13. Control both peak flow rates and total stormwater volume, to minimize erosion at outlets and downstream channels and streambanks. (Schedule A.7.c)
14. Control sediment as needed along the site perimeter and at all operational internal storm drain inlets at all times during construction, both internally and at the site boundary. (Schedule A.7.d.i)
15. Establish concrete truck and other concrete equipment washout areas before beginning concrete work. (Schedule A.8.c.i.(6))
16. Apply temporary and/or permanent soil stabilization measures immediately on all disturbed areas as grading progresses. Temporary or permanent stabilizations measures are not required for areas that are intended to be left unvegetated, such as dirt access roads or utility pole pads.(Schedule A.8.c.ii.(3))
17. Establish material and waste storage areas, and other non-stormwater controls. (Schedule A.8.c.i.(7))
18. Prevent tracking of sediment onto public or private roads using BMPs such as: construction entrance, graveled (or paved) exits and parking areas, gravel all unpaved roads located onsite, or use an exit tire wash. These BMPs must be in place prior to land-disturbing activities. (Schedule A 7.d.ii and A.8.c.i(4))
19. When trucking saturated soils from the site, either use water-tight trucks or drain loads on site. (Schedule A.7.d.ii.(5))
20. Control prohibited discharges from leaving the construction site, i.e., concrete wash-out, wastewater from cleanout of stucco, paint and curing compounds. (Schedule A.6)
21. Use BMPs to prevent or minimize stormwater exposure to pollutants from spills; vehicle and equipment fueling, maintenance, and storage; other cleaning and maintenance activities; and waste handling activities. These pollutants include fuel, hydraulic fluid, and other oils from vehicles and machinery, as well as debris, fertilizer, pesticides and herbicides, paints, solvents, curing compounds and adhesives from construction operations. (Schedule A.7.e.i.(2))
22. Implement the following BMPs when applicable: written spill prevention and response procedures, employee training on spill prevention and proper disposal procedures, spill kits in all vehicles, regular maintenance schedule for vehicles and machinery, material delivery and storage controls, training and signage, and covered storage areas for waste and supplies. (Schedule A. 7.e.iii.)
23. Use water, soil-binding agent or other dust control technique as needed to avoid wind-blown soil. (Schedule A 7.a.iv)
24. The application rate of fertilizers used to reestablish vegetation must follow manufacturer's recommendations to minimize nutrient releases to surface waters. Exercise caution when using time-release fertilizers within any waterway riparian zone. (Schedule A.9.b.iii)
25. If an active treatment system (for example, electro-coagulation, flocculation, filtration, etc.) for sediment or other pollutant removal is employed, submit an operation and maintenance plan (including system schematic, location of system, location of inlet, location of discharge, discharge dispersion device design, and a sampling plan and frequency) before operating the treatment system. Obtain plan approval before operating the treatment system. Operate and maintain the treatment system according to manufacturer's specifications. (Schedule A.9.d)
26. Temporarily stabilize soils at the end of the shift before holidays and weekends, if needed. The registrant is responsible for ensuring that soils are stable during rain events at all times of the year. (Schedule A 7.b)
27. As needed based on weather conditions, at the end of each workday soil stockpiles must be stabilized or covered, or other BMPs must be implemented to prevent discharges to surface waters or conveyance systems leading to surface waters. (Schedule A 7.e.ii.(2))
28. Construction activities must avoid or minimize excavation and bare ground activities during wet weather. (Schedule A.7.a.i)
29. Sediment fence: remove trapped sediment before it reaches one third of the above ground fence height and before fence removal. (Schedule A.9.c.i)
30. Other sediment barriers (such as biobags): remove sediment before it reaches two inches depth above ground height and before BMP removal. (Schedule A.9.c.i)
31. Catch basins: clean before retention capacity has been reduced by fifty percent. Sediment basins and sediment traps: remove trapped sediments before design capacity has been reduced by fifty percent and at completion of project. (Schedule A.9.c.iii& iv)
32. Within 24 hours, significant sediment that has left the construction site, must be remediated. Investigate the cause of the sediment release and implement steps to prevent a recurrence of the discharge within the same 24 hours. Any in-stream clean-up of sediment shall be performed according to the Oregon Division of State Lands required timeframe. (Schedule A.9.b.i)
33. The intentional washing of sediment into storm sewers or drainage ways must not occur. Vacuuming or dry sweeping and material pickup must be used to cleanup released sediments. (Schedule A.9.b.ii)
34. The entire site must be temporarily stabilized using vegetation or a heavy mulch layer, temporary seeding, or other method should all construction activities cease for 30 days or more. (Schedule A.7.f.i)
35. Provide temporary stabilization for that portion of the site where construction activities cease for 14 days or more with a covering of blown straw and a tackifier, loose straw, or an adequate covering of compost mulch until work resumes on that portion of the site. (Schedule A.7.f.ii)
36. Do not remove temporary sediment control practices until permanent vegetation or other cover of exposed areas is established. Once construction is complete and the site is stabilized, all temporary erosion controls and retained soils must be removed and disposed of properly, unless doing so conflicts with local requirements. (Schedule A.8.c.iii(1) and D.3.c.ii and iii)

Rev. 12/15/15 By: Krista Ratliff

YEAR: / MONTH:	'20 06	'20 07	'20 08	'20 09	'20 10	'20 11	'20 12	'21 01	'21 02	'21 03	'21 04	'21 05
CLEARING	X	X	X									
EXCAVATION	X	X	X									
GRADING	X	X	X	X	X							
CONSTRUCTION	X	X	X	X	X	X	X	X	X	X	X	X
SEDIMENT CONTROLS:												
Silt Fencing	X	X	X	X	X	X	X	X	X	X	X	X
Sediment Traps	X	X	X	X	X	X	X	X	X	X	X	X
Sediment Basins	X	X	X	X	X	X	X	X	X	X	X	X
Storm Inlet Protection	X	X	X	X	X	X	X	X	X	X	X	X
Drainage Swales												
Check Dams												
Contour Furrows												
Terracing												
Pipe Slope Drains												
Rock Outlet Protection												
Gravel Construction Entrance												
Grass-lined Channel (Turf Reinforcement Mats)												
Protection of trees with construction fences												
Temporary Seeding and Planting												
Permanent Seeding and Planting					X	X	X	X	X	X	X	X
Other:												

CONTROL MEASURE	PHASE 1	PHASE 2	PHASE 3	PHASE 4	PHASE 5
Silt Fencing	X	X	X	X	
Construction Entrance					
Sediment Traps	X	X	X	X	
Storm Inlet Protection			X	X	
Concrete Washout					
Rock Outlet Protection					
Permanent Seeding and Planting					X

Phase 1: Prior to Ground Disturbance
Phase 2: After Completion of Rough Grading
Phase 3: After Installation of Storm Facilities
Phase 4: After Paving & Construction
Phase 5: After Project Completion and Cleanup

INSPECTION FREQUENCY FOR BMP

Site Condition	Minimum Frequency
1. Active period	Daily when stormwater runoff, including runoff from snowmelt, is occurring. At least once every 14 days, regardless of whether stormwater runoff is occurring.
2. Prior to the site becoming inactive or in anticipation of site inaccessibility.	Once to ensure that erosion and sediment control measures are in working order. Any necessary maintenance and repair must be made prior to leaving the site.
3. Inactive periods greater than seven (14) consecutive calendar days	Once every month.
4. Periods during which the site is inaccessible due to inclement weather	If practical, inspections must occur daily at a relevant and accessible discharge point or downstream location.
5. Periods during which discharge is unlikely due to frozen conditions	Monthly. Resume monitoring immediately upon melt, or when weather conditions make discharge likely.

BMP Rationale

A comprehensive list of available Best Management Practices (BMP) options based on DEQ's 1200-C Permit Application and ESCP Guidance Document has been reviewed to complete this Erosion and Sediment Control Plan. Some of the above listed BMPs were not chosen because they were determined to not effectively manage erosion prevention and sediment control for this project based on specific site conditions, including soil conditions, topographic constraints, accessibility to the site, and other related conditions. As the project progresses and there is a need to revise the ESCP, an Action Plan will be submitted.

SOIL TYPE(S): PER MARION CO. SOIL SURVEY THE SITE SOILS INCLUDE, "WOODBURN SILT LOAM, 0 TO 3 PERCENT SLOPES"

EROSION HAZARD: PER MARION CO. SOIL SURVEY EROSION HAZARD RANGES FROM "SLIGHT".

SITE AREA: 3.79 AC

DISTURBANCE AREA: 4.10 AC

LOCAL RAIN GAGE: MCMINNVILLE MUNICIPAL AIRPORT OR, US
LAT/LONG 45.194, -123.1368

SUPPLEMENTAL WESTECH NOTES:

1. Erosion control measures shall be maintained in such a manner as to ensure that sediment and sediment-laden water does not enter the drainge system, roadways, or violate applicable water quality standards.
2. The erosion control construction, maintenance, replacement and upgrading of the erosion control facilities is the responsibility of the Contractor until all construction is completed and approved, and permanent erosion control (i.e. vegetation/landscaping) is established on all disturbed areas.
3. All recommended erosion control procedures are dependent on construction methods, staging, site conditions, weather and scheduling. During the construction period, erosion control facilities shall be upgraded as necessary due to unexpected storm events and to ensure that sediment and sediment laden water does not leave the site.
4. The Contractor is responsible for control of sediment transport within project limits. If an installed erosion control system does not adequately contain sediment on site, then the erosion control measures shall be adjusted or supplemented by the Contractor as necessary to ensure that sediment laden water does not leave the site. Additional measures shall be provided as required to ensure that all paved areas are kept clean for the duration of the project. Additional interim measures will include, at a minimum, installation of silt fences in accordance with the details shown on the drawings. These measures shall be installed along all exposed embankments and cut slopes to prevent sediment transport.
5. All existing and newly constructed storm inlets and drains shall be protected until pavement surfaces are completed and/or vegetation is established.
6. Erosion control facilities and sediment fences on active sites shall be inspected by the Contractor at least daily during any period with measurable precipitation. Any required repairs or maintenance shall be completed immediately. The erosion control facilities on inactive sites shall be inspected and maintained by the Contractor a minimum of once a month or within 24 hours following the start of a storm event.
7. All catch basins and conveyance lines shall be cleaned prior to paving. The cleaning operation shall not flush sediment-laden water into the downstream system. The Contractor shall remove all accumulated sediment from all impacted catch basins and storm pipes prior to acceptance by the Owner.
8. The Contractor is solely responsible for protection of all adjacent property and downstream facilities from erosion and siltation during project construction. Any damage resulting from such erosion and siltation shall be corrected at the sole expense of the Contractor.
9. The Contractor shall provide site watering as necessary to prevent wind erosion of fine-grained soils.
10. Unless otherwise indicated on the drawings, all temporary erosion control facilities, including sediment fences, silt sacks, bio-bags, etc. shall be removed by the Contractor within 30 days after permanent landscaping/vegetation is established.
11. Sediment fences shall be constructed of continuous filter fabric to avoid use of joints. When joints are necessary, filter cloth shall be spliced together only at a support post, with a minimum 6-inch overlap, and both ends securely fastened to a post.
12. Sediment fence shall be installed per drawing details. Sediment fences shall have adequate support to contain all silt and sediment captured.
13. The standard strength filter fabric shall be fastened securely to stitched loops installed on the upslope side of the posts, and 6 inches of the fabric shall be extended into the trench. The fabric shall not extend more than 30 inches above the original ground surface. Filter fabric shall not be stapled to existing trees.
14. Bio-filter bags shall be clean 100 percent wood product waste. Bags shall be 18-inch x 18-inch x 30-inch, weigh approximately 45 lbs., and be contained in a bag made of 1/2-inch plastic mesh.
15. Sediment barriers shall be maintained until the up-slope area has been permanently stabilized. At no time shall more than 10-inches of sediment be allowed to accumulate behind sediment fences. No more than 2 inches of sediment shall be allowed to accumulate behind bio-filter bags. Sediment shall be removed prior to reaching the above stated depths. New sediment barriers shall be installed uphill as required to control sediment transport.
16. Stabilized construction entrances shall be installed at the beginning of construction and maintained for the duration of the project. Additional measures may be required to ensure that all paved areas are kept clean for the duration of the project.
17. The Contractor shall verify that all trucks are well sealed when transporting saturated soils from the site. Water drippage from trucks transporting saturated soils must be reduced to less than 1 gallon per hour prior to leaving the site.
18. The entrance shall be maintained in a condition that will prevent tracking or flow of mud onto the public right-of-way or approved access point. The entrance may require periodic top dressing as conditions demand, and repair and/or cleanout of any structures used to trap sediment.
19. All materials spilled, dropped, washed, or tracked from vehicles onto roadways or into storm drains must be removed immediately, and the Contractor shall provide protection of downstream inlets and catch basins to ensure sediment laden water does not enter the storm drain system.
20. Temporary grass cover measures must be fully established by October 15th, or other cover measures (ie. erosion control blankets with anchors, 3-inches minimum of straw mulch, 6 mil HDPE plastic sheet, etc.) shall be in place over all disturbed soil areas until April 30th. To establish an adequate grass stand for controlling erosion by October 15th, it is recommended that seeding and mulching occur by September 1st. Straw mulch, if used, shall not leave any bare ground visible through the straw.
21. Minimum wet weather slope protection. For slopes steeper than 3H:1V but less than 2H:1V, use Tensar/North American Green Type S150 erosion control blanket. For slopes 2H:1V or steeper, use Tensar/North American Green Type SC150 erosion control blanket. Use a minimum of 2-inches straw mulch or Tensar/North American Green Type S150 for slopes flatter than 3H:1V. Slope protection shall be placed on all disturbed areas immediately after completion of each section of construction activity, until the erosion control seeding has been established. As an option during temporary or seasonal work stoppages, a 6-mil HDPE plastic sheet may be placed on exposed slopes. The plastic sheet shall be provided with an anchor trench at the top and bottom of the slope, and shall be sandbagged on the slopes as required to prevent damage or displacement by wind.
22. Permanent erosion control vegetation on all embankments and disturbed areas shall be re-established as soon as construction is completed.
23. Soil preparation. Topsoil should be prepared according to landscape plans, if available, or recommendations of grass seed supplier. It is recommended that slopes be textured before seeding by rack walking (ie. driving a crawling tractor up and down the slopes to leave a pattern of cleat imprints parallel to slope contours) or other method to provide stable areas for seeds to rest.
24. When used, hydromulch shall be applied with grass seed at a rate of 2000 lbs. per acre between April 30 and June 10, or between September 1 and October 1. On slopes steeper than 10 percent, hydroseed and mulch shall be applied with a bonding agent (tackifier). Application rate and methodology to be in accordance with seed supplier recommendations.
25. When used in lieu of hydromulch, dry, loose, weed free straw used as mulch shall be applied at a rate of 4000 lbs. per acre (double the hydromulch application requirement). Anchor straw by working in by hand or with equipment (rollers, cleat trackers, etc.). Mulch shall be spread uniformly immediately following seeding.
26. When conditions are not favorable to germination and establishment of the grass seed, the Contractor shall irrigate the seeded and mulched areas as required to establish the grass cover.
27. Seeding. Recommended erosion control grass seed mix is as follows. Dwarf grass mix (low height, low maintenance) consisting of dwarf perennial ryegrass (80 % by weight), creeping red fescue (20 % by weight). Application rate shall be 100 lbs. per acre minimum.
28. Grass seed shall be fertilized at a rate of 10 lbs. per 1000 S.F with 16- 16-16 slow release type fertilizer. Development areas within 50 feet of water bodies and wetlands must use a non-phosphorous fertilizer.
29. Prior to starting construction contractor shall acquire the services of a DEQ Certified Erosion and Sediment Control Inspector and shall submit an "Action Plan" to DEQ indentifying their names, contact information, training and experience as required in Schedule A.6.b.i-ii of the 1200-C Permit
30. Contractor shall submit "Notice of Termination" to DEQ to end the 1200-C permit coverage once all soil disturbance activities have been completed and final stabilization of exposed soils has occured.

NO.	DATE	DESCRIPTION	BY
		REVISIONS	

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH, DO THIS SHEET, ADJUST SCALES ACCORDINGLY

DSN. JW
DRN. IH
CKD. JW
DATE: 06/22/2022

REVIEW

REGISTERED PROFESSIONAL ENGINEER
OREGON JULY 12, 2005
WILLIAM T. WELLS
RENEWS: 6/30/2022

WESTECH ENGINEERING, INC.
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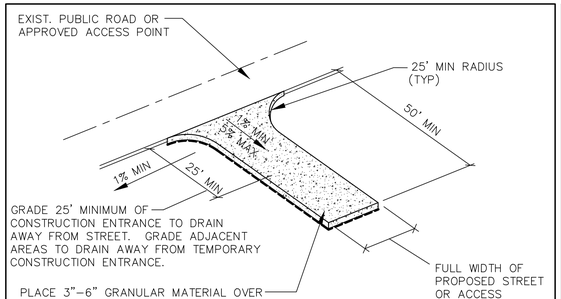
VJ-2 DEVELOPMENT
ELYSIAN SUBDIVISION

EROSION CONTROL NOTES

DRAWING
C1.2

JOB NUMBER
2931.0000.0



DRY WEATHER ACCESS
14–INCH MIN. DEPTH OVER COMPACTED SUBGRADE & FABRIC

WET WEATHER ACCESS
24–INCH MIN. DEPTH OVER UNDISTURBED SUBGRADE & FABRIC

CONSTRUCTION NOTES:

1. THE AREA OF THE CONSTRUCTION ENTRANCE SHALL BE STRIPPED OF ALL TOPSOIL, VEGETATION, ROOTS, AND OTHER NON–COMPACTABLE MATERIAL.
2. SUBGRADE SHALL BE COMPACTED AND PROOFROLLED PRIOR TO PLACEMENT OF GRANULAR MATERIAL. FAILURE TO PASS PROOFROLL WILL REQUIRE USE OF WET WEATHER SECTION.
3. FAILURE OR PUMPING OF THE DRY WEATHER SECTION WILL REQUIRE REMOVAL OF THE GRANULAR MATERIAL AND INSTALLATION OF THE WET WEATHER SECTION.

MAINTENANCE NOTES:

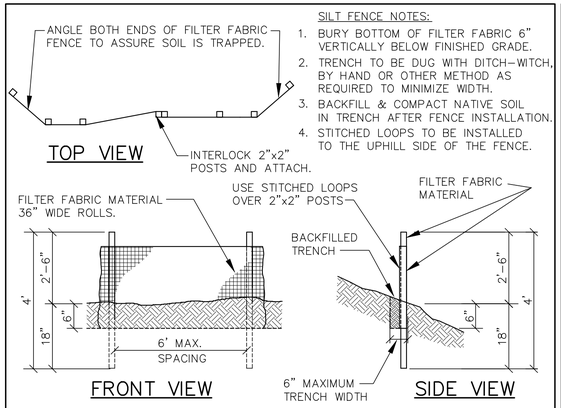
1. THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRACKING OR FLOW OF SEDIMENT ONTO PUBLIC RIGHT–OF–WAY. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH 3"–6" INCH STONE AS CONDITIONS DEMAND, AND REPAIR AND/OR CLEAN–OUT OF STRUCTURES USED TO TRAP SEDIMENT.
2. ALL MATERIALS SPILLED, DROPPED, WASHED OR TRACKED FROM VEHICLES ONTO ROADWAYS OR INTO STORM DRAINS MUST BE REMOVED IMMEDIATELY.
3. ALL TRUCKS TRANSPORTING SATURATED SOILS SHALL BE WELL SEALED. WATER DRIPPAGE FROM TRUCKS MUST BE REDUCED TO 1 GALLON PER HOUR PRIOR TO LEAVING THE SITE.

LAST REVISION DATE:	JO #
MAY 2013	STANDARD

TEMPORARY CONSTRUCTION ENTRANCE

(NTS)

WESTECH ENG.	DETAIL NO.
	6100



SILT FENCE NOTES:

1. BURY BOTTOM OF FILTER FABRIC 6" VERTICALLY BELOW FINISHED GRADE.
2. TRENCH TO BE DUG WITH DITCH–WITCH, BY HAND OR OTHER METHOD AS REQUIRED TO MINIMIZE WIDTH.
3. BACKFILL & COMPACT NATIVE SOIL IN TRENCH AFTER FENCE INSTALLATION.
4. STITCHED LOOPS TO BE INSTALLED TO THE UPHILL SIDE OF THE FENCE.

MAINTENANCE NOTES:

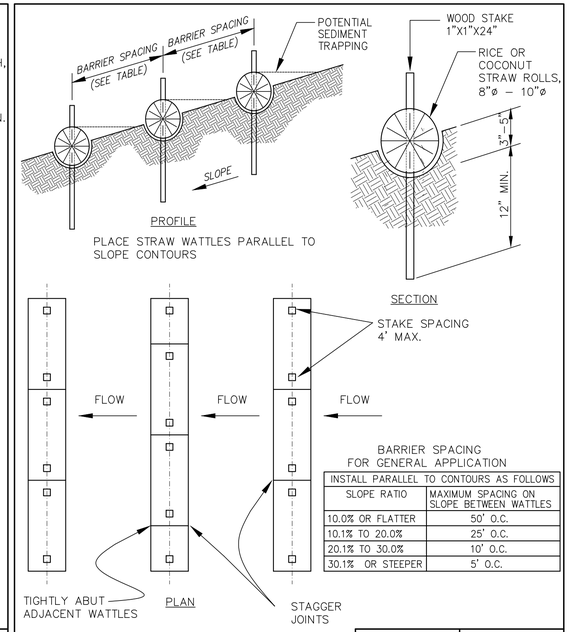
1. SEDIMENT BARRIERS SHALL BE MAINTAINED UNTIL UP–SLOPE AREA IS PERMANENTLY STABILIZED.
2. AT NO TIME SHALL MORE THAN ONE FOOT OF SEDIMENT BE ALLOWED TO ACCUMULATE BEHIND SEDIMENT FENCES OR BIOFILTER BAGS.
3. NEW SEDIMENT BARRIERS SHALL BE INSTALLED UPHILL AS REQUIRED TO CONTROL SEDIMENT TRANSPORT.

LAST REVISION DATE:	JO #
APRIL 2014	STANDARD

SEDIMENT BARRIERS

(NTS)

WESTECH ENG.	DETAIL NO.
	6110



BARRIER SPACING FOR GENERAL APPLICATION

INSTALL PARALLEL TO CONTOURS AS FOLLOWS	
SLOPE RATIO	MAXIMUM SPACING ON SLOPE BETWEEN WATTLES
10.0% OR FLATTER	50' O.C.
10.1% TO 20.0%	25' O.C.
20.1% TO 30.0%	10' O.C.
30.1% OR STEEPER	5' O.C.

NOTES:

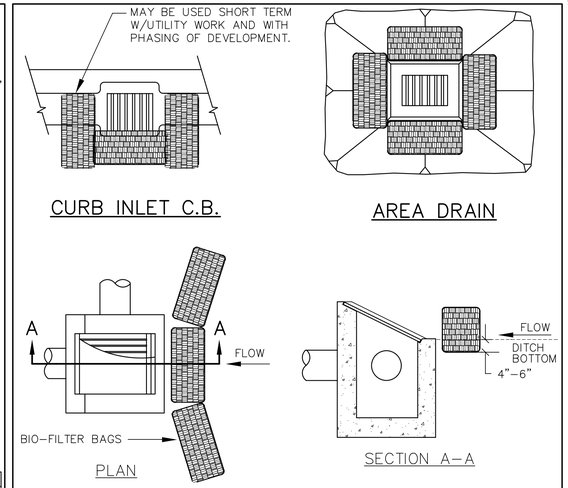
1. ALL MATERIAL SHALL CONFORM TO OSSC (ODOT/APWA) SPECIFICATIONS, CURRENT EDITION.
2. SEDIMENT BARRIERS SHALL BE MAINTAINED UNTIL UP–SLOPE AREA IS PERMANENTLY STABILIZED.
3. AT NO TIME SHALL SEDIMENT BE ALLOWED TO ACCUMULATE ABOVE THE TOP OF THE STRAW WATTLE.
4. NEW SEDIMENT BARRIERS SHALL BE INSTALLED UPHILL AS REQUIRED TO CONTROL SEDIMENT TRANSPORT.

LAST REVISION DATE:	JO #
JUNE 2015	STANDARD

STRAW WATTLE SEDIMENT BARRIER

(NTS)

WESTECH ENG.	DETAIL NO.
	6120



DITCH INLET C.B.

MAINTENANCE NOTES:

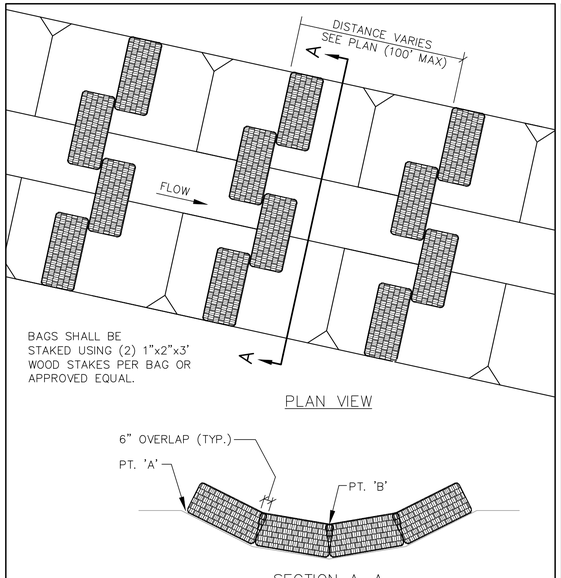
1. SEDIMENT BARRIERS SHALL BE MAINTAINED UNTIL UP–SLOPE AREA IS PERMANENTLY STABILIZED.
2. AT NO TIME SHALL MORE THAN ONE FOOT OF SEDIMENT BE ALLOWED TO ACCUMULATE BEHIND SEDIMENT FENCES OR BIOFILTER BAGS.
3. NEW SEDIMENT BARRIERS SHALL BE INSTALLED UPHILL AS REQUIRED TO CONTROL SEDIMENT TRANSPORT.

LAST REVISION DATE:	JO #
APRIL 2014	STANDARD

INLET SEDIMENT CONTROL

(NTS)

WESTECH ENG.	DETAIL NO.
	6130



MAINTENANCE NOTES:

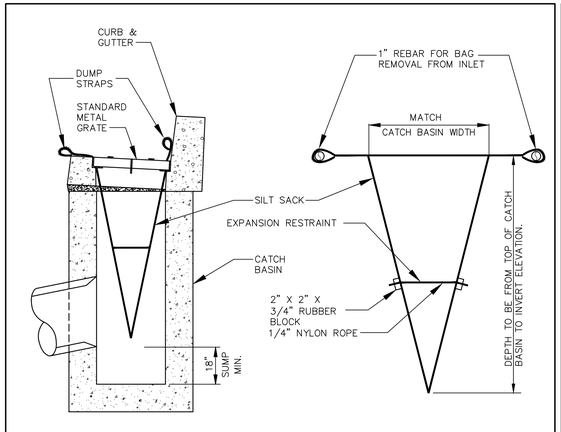
1. SEDIMENT BARRIERS SHALL BE MAINTAINED UNTIL UP–SLOPE AREA IS PERMANENTLY STABILIZED.
2. AT NO TIME SHALL MORE THAN ONE FOOT OF SEDIMENT BE ALLOWED TO ACCUMULATE BEHIND BIOFILTER BAGS.
3. NEW SEDIMENT BARRIERS SHALL BE INSTALLED UPHILL AS REQUIRED TO CONTROL SEDIMENT TRANSPORT.
4. PT. 'A' SHALL BE 6" MIN. HIGHER THAN PT. 'B'.

LAST REVISION DATE:	JO #
APRIL 2014	STANDARD

DITCH AND SWALE EROSION PROTECTION

(NTS)

WESTECH ENG.	DETAIL NO.
	6140



NOTES:

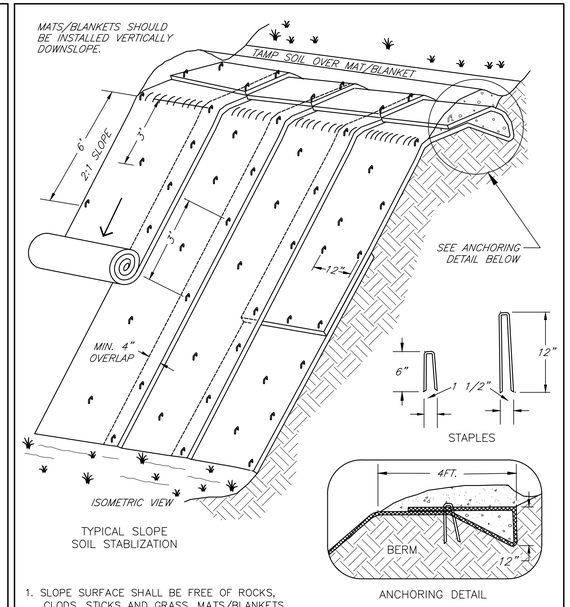
1. EMPTY SILT SACK AS NECESSARY.
2. SILTSACK SEDIMENT CONTROL DEVICE AS MANUFACTURED BY ACF ENVIRONMENTAL AND SUPPLIED BY ACF WEST (503) 771–5115 OR APPROVED EQUAL.

LAST REVISION DATE:	JO #
OCT 2002	STANDARD

SILTSACK INLET DETAIL

(NTS)

WESTECH ENG.	DETAIL NO.
	6150



1. SLOPE SURFACE SHALL BE FREE OF ROCKS, CLODS, STICKS AND GRASS. MATS/BLANKETS SHALL HAVE GOOD SOIL CONTACT.
2. APPLY PERMANENT SEEDING BEFORE PLACING BLANKETS.
3. LAY BLANKETS LOOSELY AND STAKE OR STAPLE TO MATIAIN DIRECT CONTACT WITH THE SOIL.
4. SEE MANUFACTURER'S SPECIFICATIONS FOR MINIMUM STAKING OR STAPLING LAYOUT PATTERN.
5. STAPLE LENGTH AND QUANTITY VARIES DEPENDING ON SOIL DENSITY. USE 6" STAPLES ON COMPACTED SOILS. USE 12" STAPLES ON LOOSE SOILS.

LAST REVISION DATE:	JO #
OCT. 2019	STANDARD

EROSION CONTROL MAT/BLANKET INSTALLATION

(NTS)

WESTECH ENG.	DETAIL NO.
	6180

NO.	DATE	DESCRIPTION REVISIONS	BY
1			

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

DSN. JW
DRN. IH
CKD. JW
DATE: 05/20/2022

REVIEW

REGISTERED PROFESSIONAL ENGINEER
OREGON
JULY 27, 2005
WILLIAM T. WELLS

RENEWAL 6/30/2022

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
Phone: (503) 585–2474 Fax: (503) 585–3986
E–mail: westech@westech–eng.com

VJ–2 DEVELOPMENT
ELYSIAN SUBDIVISION

EROSION CONTROL DETAILS

DRAWING
C1.3

JOB NUMBER
2931.0000.0

LEGEND	
- - - - -	BUILDING FOOTPRINT

Curve Table					
Curve #	Length	Radius	Delta	Chord Direction	Chord Length
C11	95.29	350.00	15.60	S7° 45' 10"E	94.99
C12	94.18	350.00	15.42	S7° 50' 36"E	93.90

● = CONTRACTOR TO SET C/L MONUMENTS. (8"x8" WASHINGTON COUNTY RING & COVER OR EQUAL).

NOTES:
1. 5FT SIDE-YARD SETBACK PROPOSED ON ALL LOTS.

LOT SUMMARY

MIN = 5436 SF
MAX = 8363 SF
AVG = 6294 SF

EXISTING ZONES: R-1

GROSS AREA: 3.79 ACRES

NET AREA: 3.03 ACRES
(W/OUT ROW)

TL: 4 418 TL 204

PHASE II
PHASE I
PHASE BOUNDARY
BUILDING FOOTPRINT
LOT 2 AREA: 6424 S.F.
LOT 1 AREA: 6940 S.F.
LOT 12 AREA: 5974 S.F.
LOT 11 AREA: 6500 S.F.
LOT 3 AREA: 6422 S.F.
LOT 10 AREA: 6500 S.F.
LOT 4 AREA: 6420 S.F.
LOT 9 AREA: 6287 S.F.
LOT 5 AREA: 6267 S.F.
LOT 8 AREA: 5748 S.F.
LOT 6 AREA: 6340 S.F.
LOT : 7 AREA: 6358 S.F.
LOT 13 AREA: 5992 S.F.
LOT 14 AREA: 5473 S.F.
LOT 15 AREA: 5475 S.F.
LOT 16 AREA: 5436 S.F.
LOT 17 AREA: 6365 S.F.
LOT 18 AREA: 8363 S.F.
TRACT A OPEN SPACE AREA=15,086 SF TOTAL AREA=16,925 SF
NW MEADOWS DRIVE
NW FENDLE WAY
EXTG. SAN.
EXTG. 8" WATER
60' B.P.A. EASEMENT PER V. 40, P. 851
30' DEDICATION BY OWNER
30' DEDICATION BY CITY OF MCMINNVILLE
10' PUBLIC STORM EASEMENT
10' PUBLIC SS EASEMENT
10' PUBLIC ACCESS EASEMENT
10' WIDE PEDESTRIAN CONNECTION
PUBLIC UTILITIES AND ACCESS EASEMENT
10' DRAINAGE EASEMENT
6' PUE
10' PUE
4' TALL BLACK VINYL FENCE
12' WIDE GATE
PROTECTED WETLANDS
BENCH
21000
21001
21002
21010
0 15 30 60 (feet)

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NO.	DATE	DESCRIPTION	BY
		REVISIONS	

VERIFY SCALE
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DSN. JW
DRN. AK
CKD. JW
DATE: 05/20/2005

REVIEW

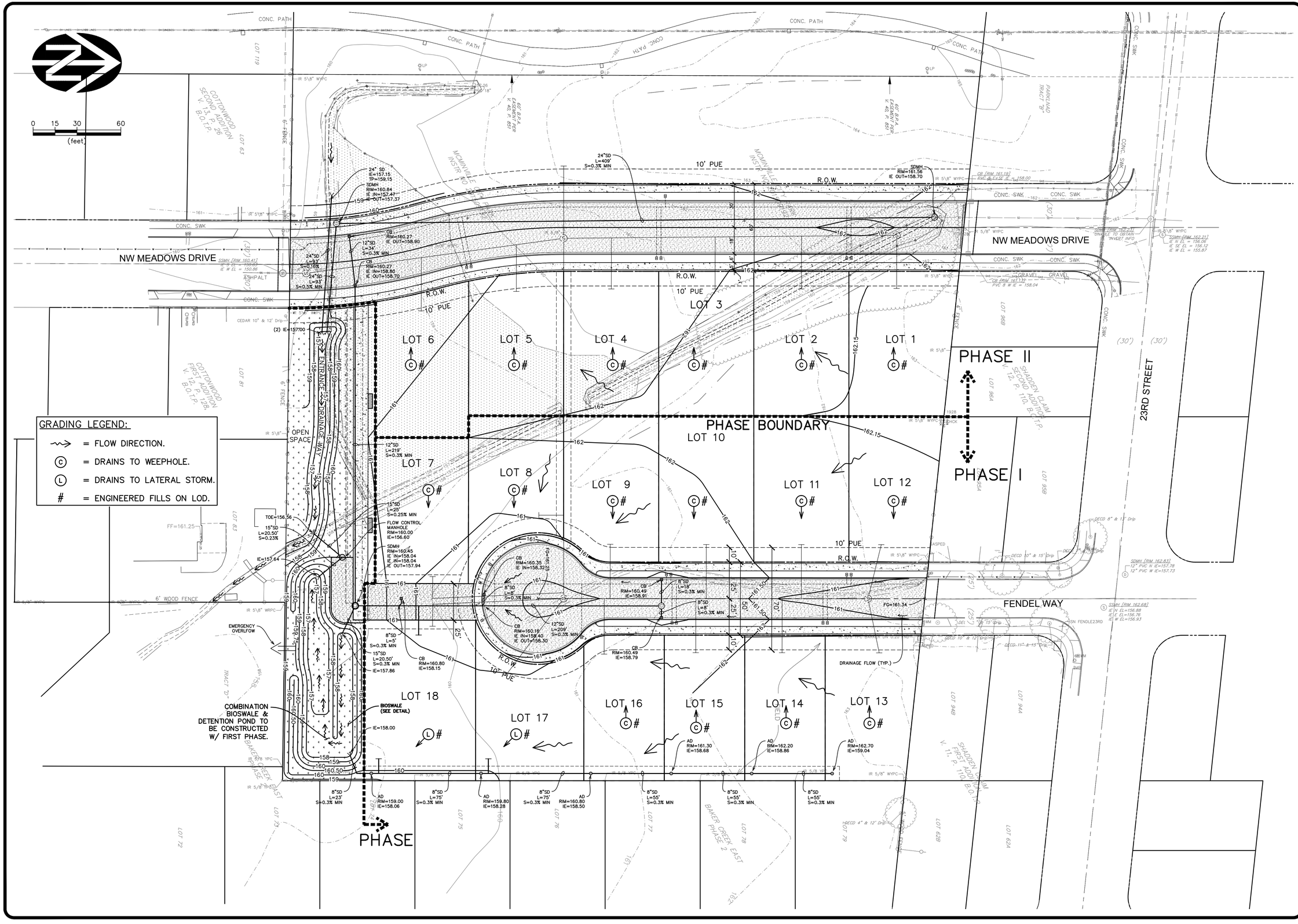
REGISTERED PROFESSIONAL ENGINEER
OREGON JULY 27, 1979 WILLIAM T. WELLS
RENEWS: 6/30/2022

VJ-2 DEVELOPMENT
ELYSIAN SUBDIVISION

OVERALL SUBDIVISION PLAN

DRAWING
C2.0

JOB NUMBER
2931.0000.0



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NO.	DATE	DESCRIPTION	BY
1		REVISIONS	

DSN. JW
DRN. IH/AK
CKD. JW
DATE: 05/20/2022

REVIEW

REGISTERED PROFESSIONAL ENGINEER
OREGON JULY 27, 1976
WILLIAM L. WELLS

RENEWS: 6/30/2022

WESTECH ENGINEERING, INC.
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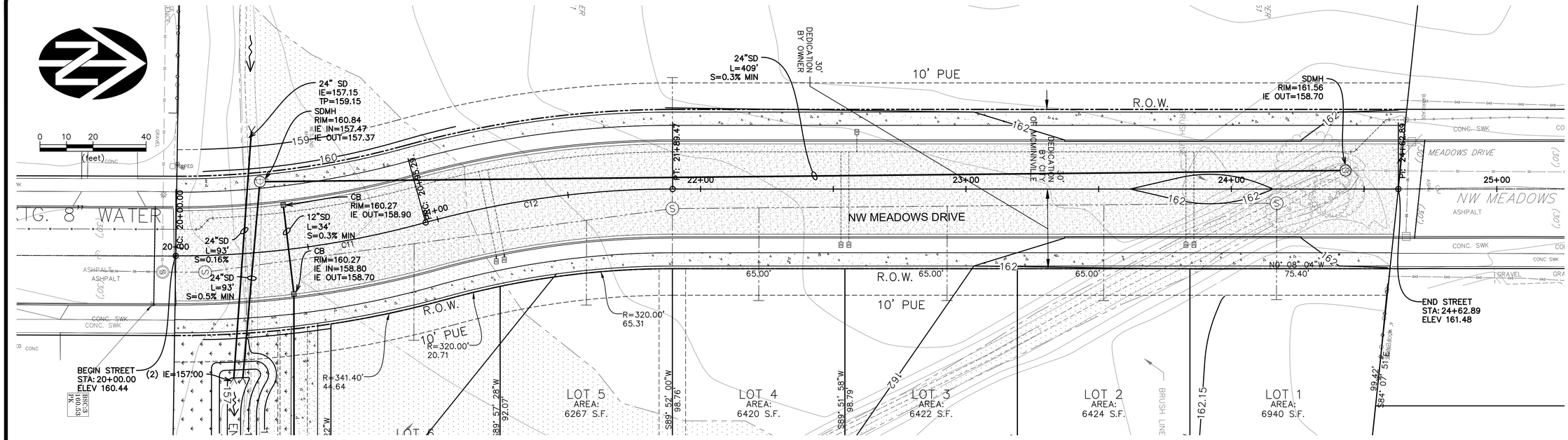
VJ-2 DEVELOPMENT
ELYSIAN SUBDIVISION

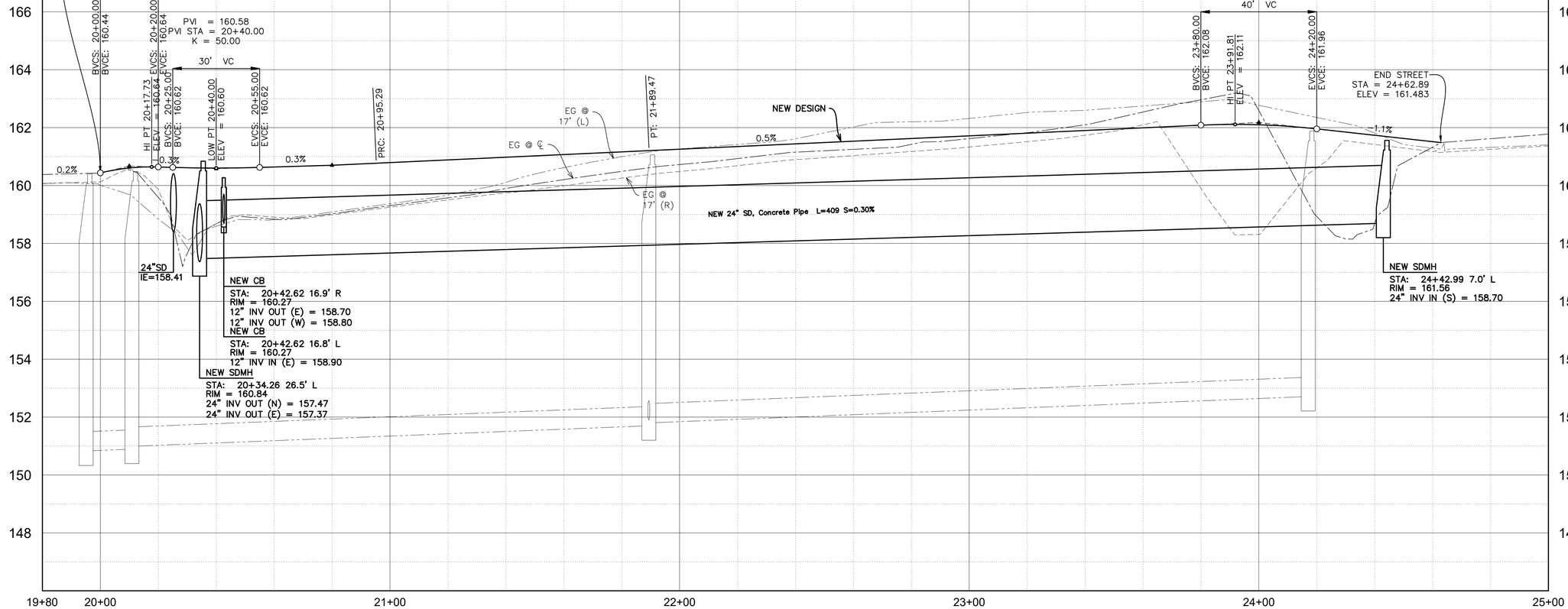
OVERALL GRADING AND DRAINAGE PLAN

DRAWING
C3.0

JOB NUMBER
2931.0000.0



NW MEADOWS DRIVE PLAN STA:20+00 - 25+00



NW MEADOWS DRIVE PROFILE STA:20+00-25+00

NO.	DATE	DESCRIPTION	BY
1		REVISIONS	

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DSN. JW
DRN. AK/IH
CKD. JW
DATE: 05/20/2022

REVIEW

REGISTERED PROFESSIONAL ENGINEER
OREGON
JULY 27, 2007
WILLIAM T. WELLS

RENEWS: 6/30/2022

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
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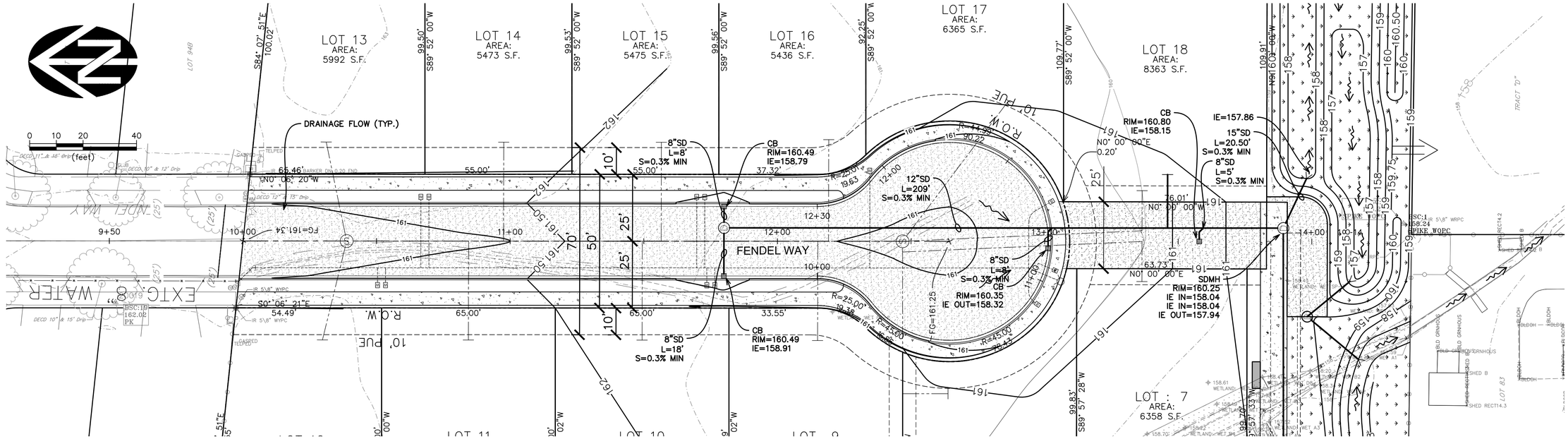
VJ-2 DEVELOPMENT
ELYSIAN SUBDIVISION

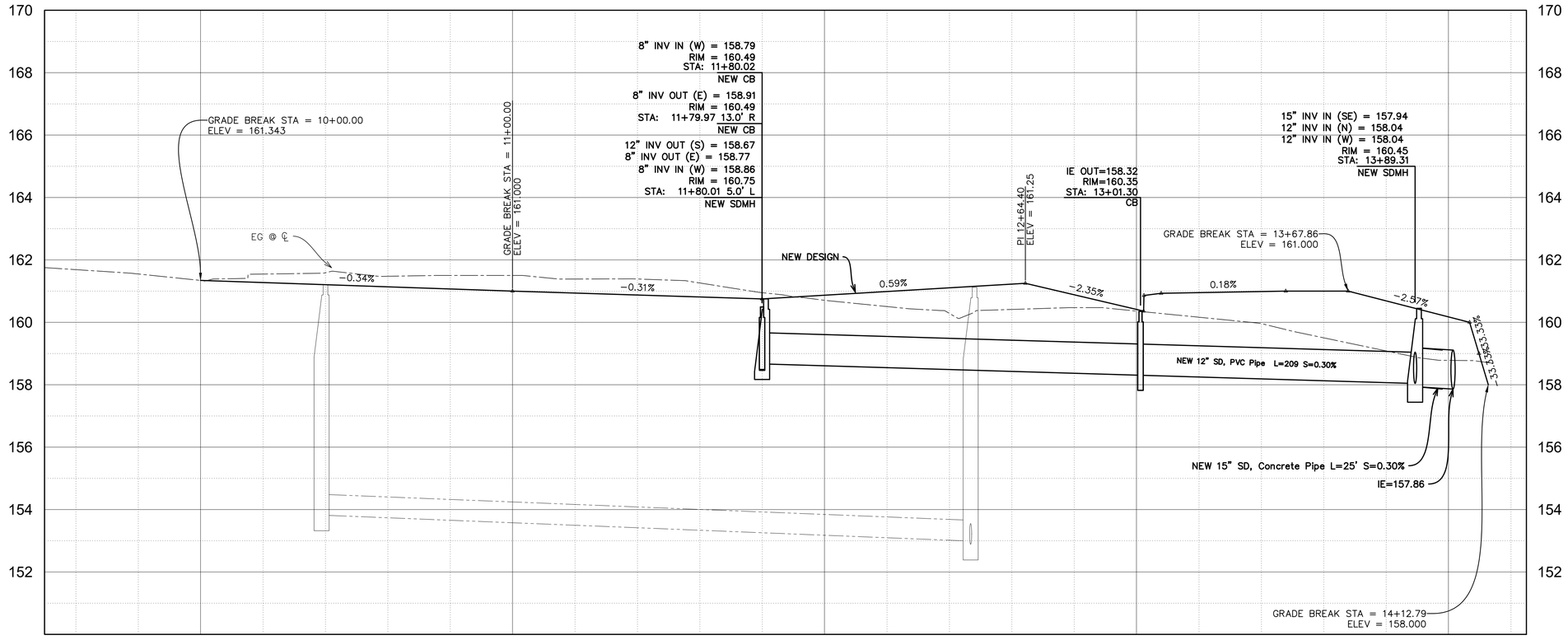
MEADOWS STREET PLAN AND PROFILE

DRAWING
ST-1

JOB NUMBER
2931.0000.0



NW MEADOWS DRIVE PLAN STA:10+00 - 14+14.40



NW MEADOWS DRIVE PROFILE STA:10+00-14+14.40

NO.	DATE	DESCRIPTION	BY
1		REVISIONS	

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DSN. JW
DRN. IH
CKD. JW
DATE: 05/20/2022

REVIEW
REVIEW

REGISTERED PROFESSIONAL ENGINEER
OREGON
JULY 12, 2005
WILLIAM T. WELLS

RENEWS: 6/30/2022

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
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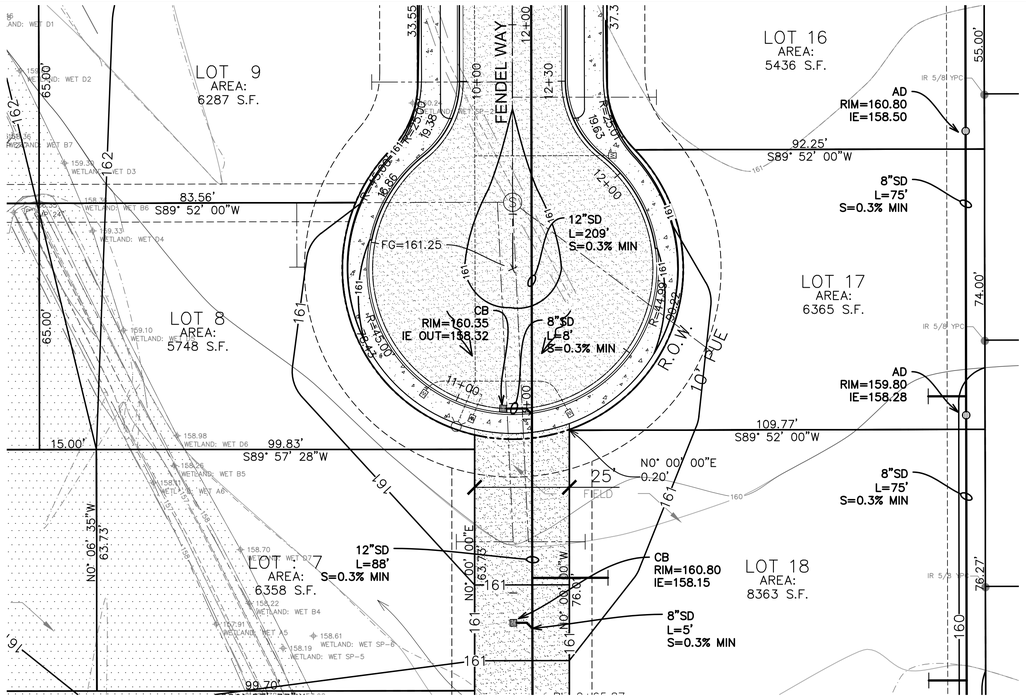
VJ-2 DEVELOPMENT
ELYSIAN SUBDIVISION

FENDEL WAY PLAN AND PROFILE

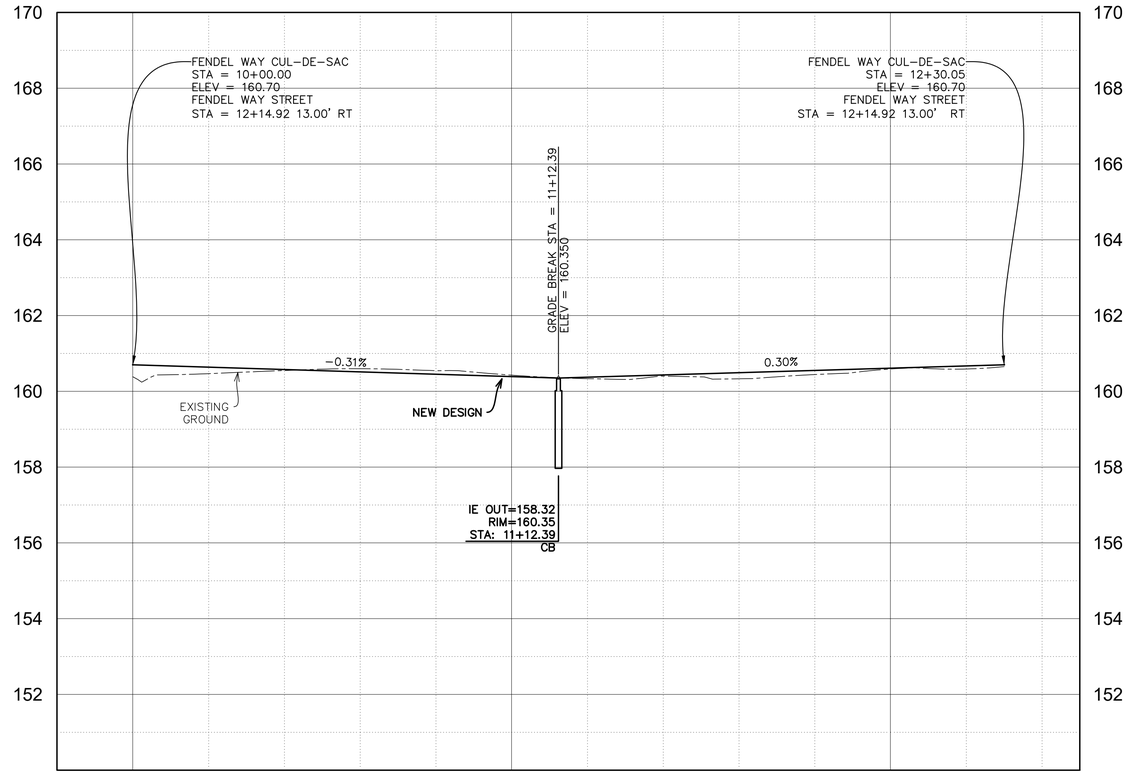
DRAWING
ST-2

JOB NUMBER
2931.0000.0

0 10 20 40
(feet)



FENDEL WAY PLAN STA:10+00 - 12+30.05



FENDEL WAY PROFILE STA:10+00 - 12+30.05

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		REVISIONS	

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0 1"

DSN. JW
DRN. IH
CKD. JW
DATE: 05/20/2022

REVIEW

REGISTERED PROFESSIONAL ENGINEER
OREGON JULY 27, 1978
WILLIAM T. WELLS
RENEWS: 6/30/2022

WESTECH ENGINEERING, INC.
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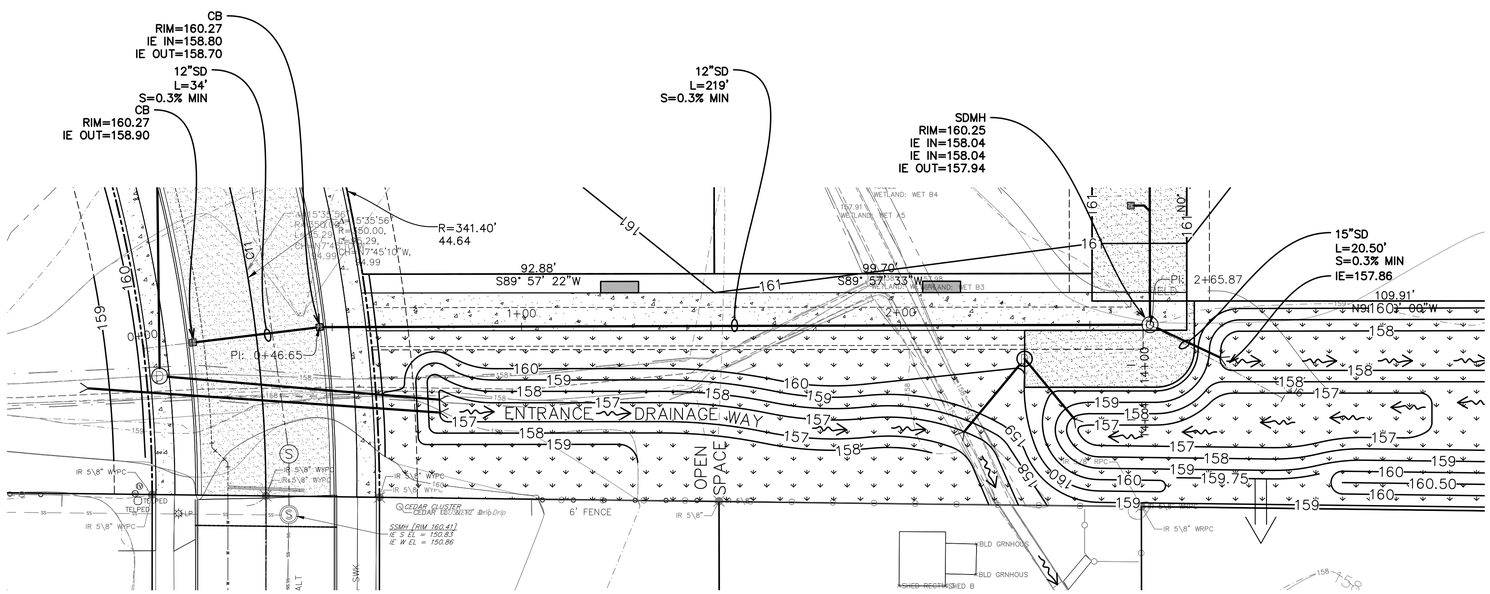
VJ-2 DEVELOPMENT
ELYSIAN SUBDIVISION

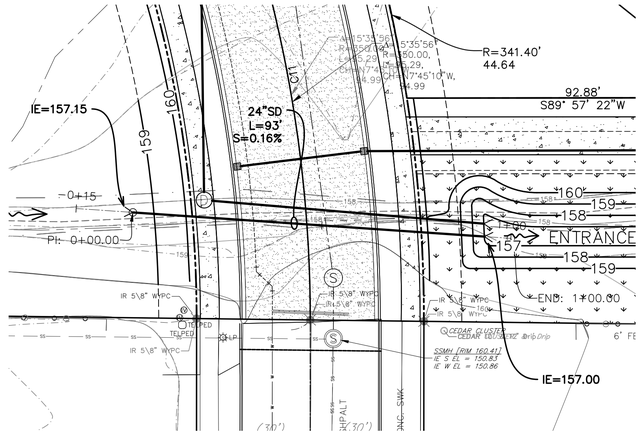
FENDEL WAY CUL-DE-SAC PLAN AND PROFILE

DRAWING
ST-3

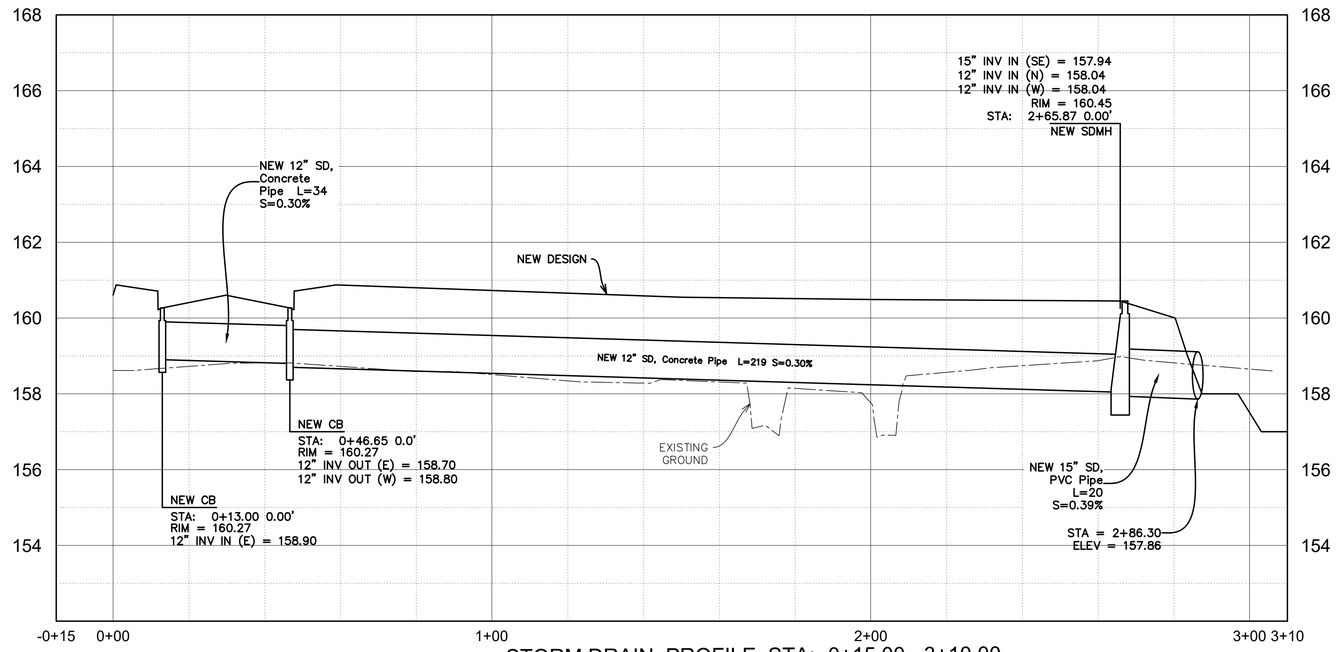
JOB NUMBER
2931.0000.0



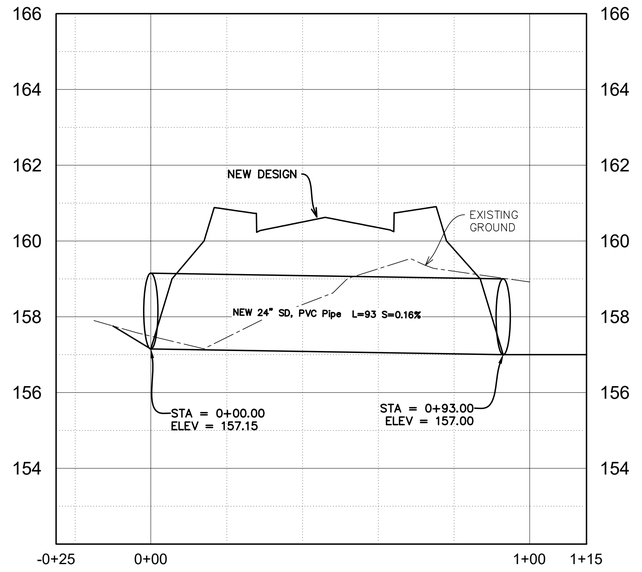
STORM DRAIN PROFILE STA: -0+15.00 - 3+10.00



STORM DRAIN PROFILE STA: -0+25.00 - 1+15.00



STORM DRAIN PROFILE STA: -0+15.00 - 3+10.00



STORM DRAIN PROFILE STA: -0+25.00 - 1+15.00

0 10 20 40
(feet)

NO.	DATE	DESCRIPTION	BY
1		REVISIONS	

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DSN. JW
DRN. IH
CKD. JW
DATE: 05/20/2022

REVIEW

REGISTERED PROFESSIONAL ENGINEER
OREGON
JULY 27, 1976
WILLIAM T. WELLS
RENEWS: 6/30/2022

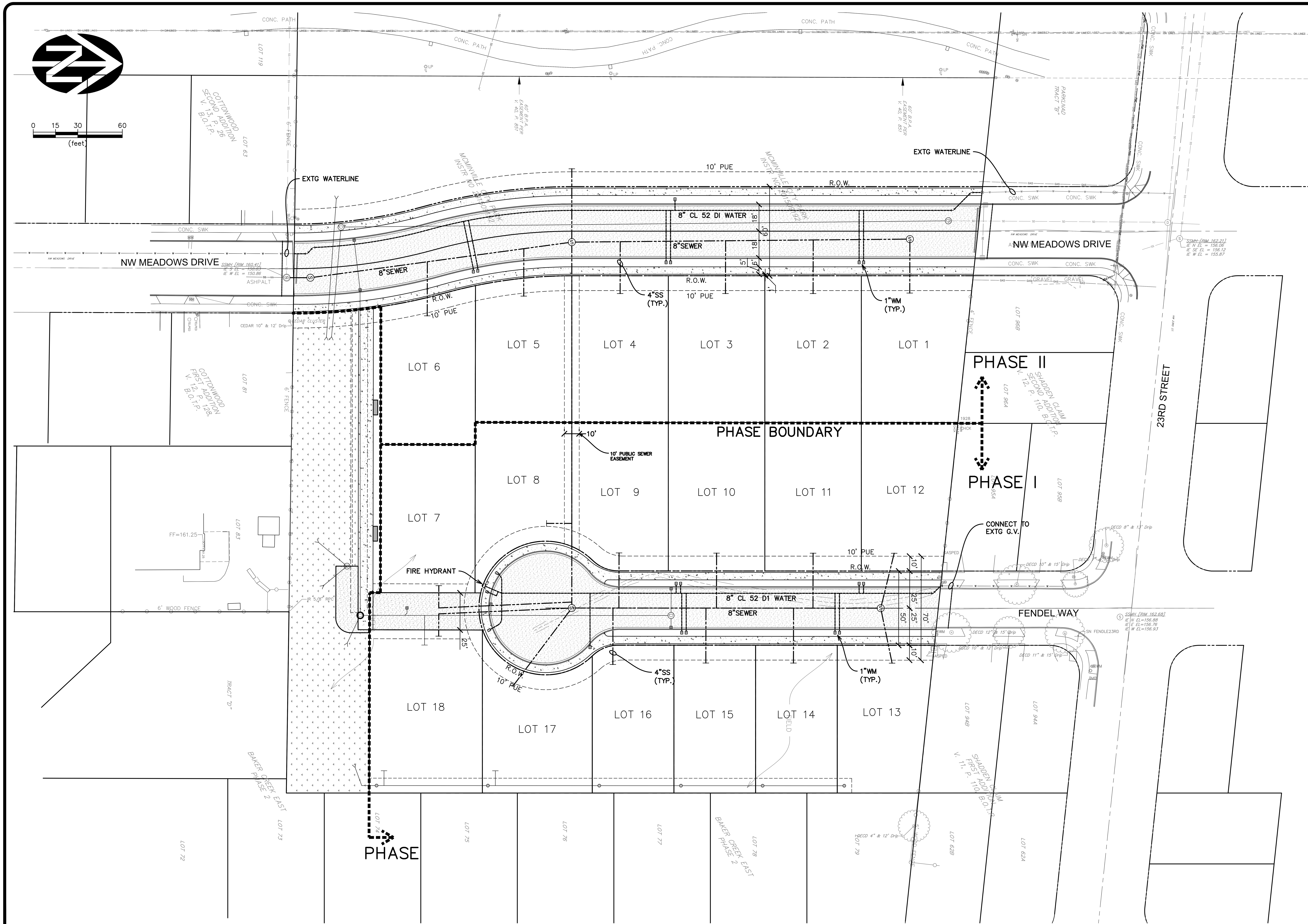
WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

VJ-2 DEVELOPMENT
ELYSIAN SUBDIVISION

STORM DRAIN PLAN & PROFILE

DRAWING
ST-4

JOB NUMBER
2931.0000.0



VERIFY SCALE
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0 1"
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DSN.	JW
DRN.	IH
CKD.	JW
DATE:	06/2008

NO.	DATE	DESCRIPTION	BY
1		REVISIONS	

REGISTERED PROFESSIONAL ENGINEER 61515 OREGON NOV. 12, 2008 WILLIAM J. WELLS
RENEWS: 6/30/2022

REVIEW REVIEW

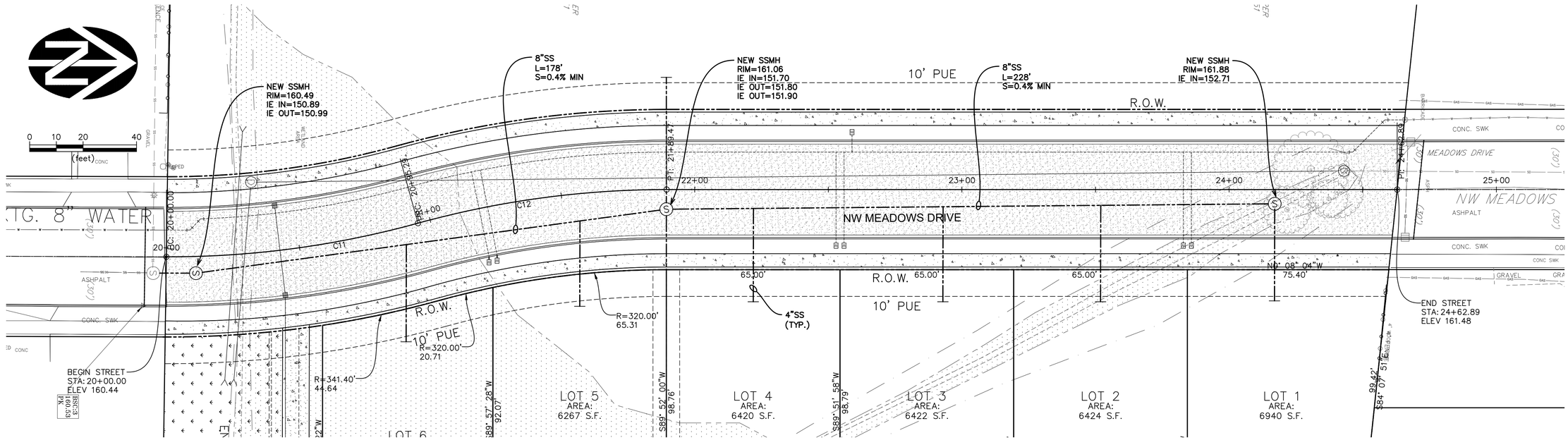
WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

VJ-2 DEVELOPMENT
ELYSIAN SUBDIVISION

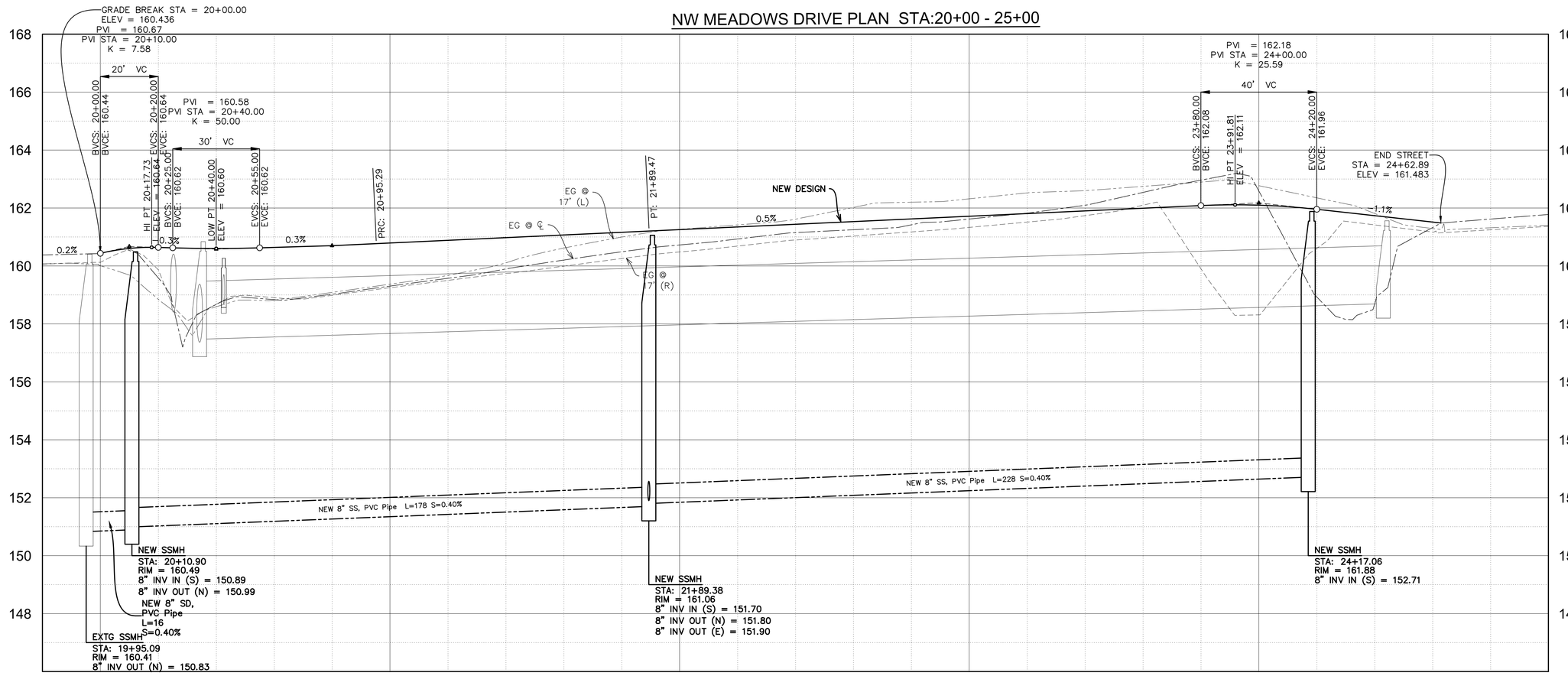
OVERALL UTILITY PLAN

DRAWING
C4.0

JOB NUMBER
2931.0000.0



NW MEADOWS DRIVE PLAN STA:20+00 - 25+00



NW MEADOWS DRIVE PROFILE STA:20+00-25+00

NO.	DESCRIPTION	DATE	BY
1	REVISIONS		

VERIFY SCALE
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0 1"
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DSN. JW
DRN. IH
CKD. JW
DATE: 8/5/2022

REVIEW
REGISTERED PROFESSIONAL ENGINEER
OREGON
JULY 27, 1971
WILLIAM T. WELLS
RENEWS: 6/30/2022

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
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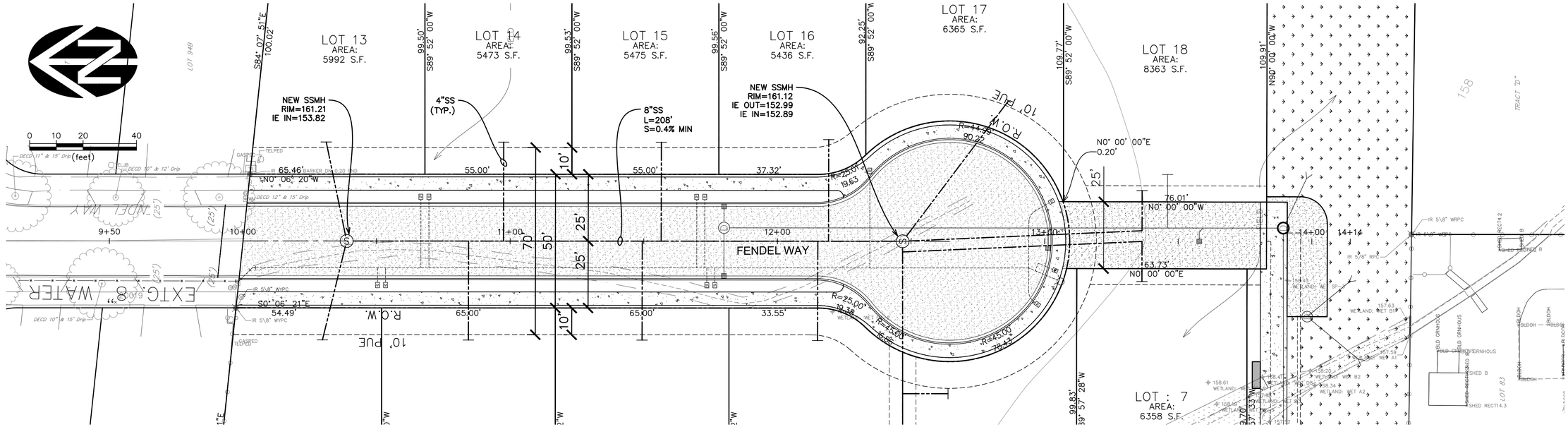
VJ-2 DEVELOPMENT
ELYSIAN SUBDIVISION

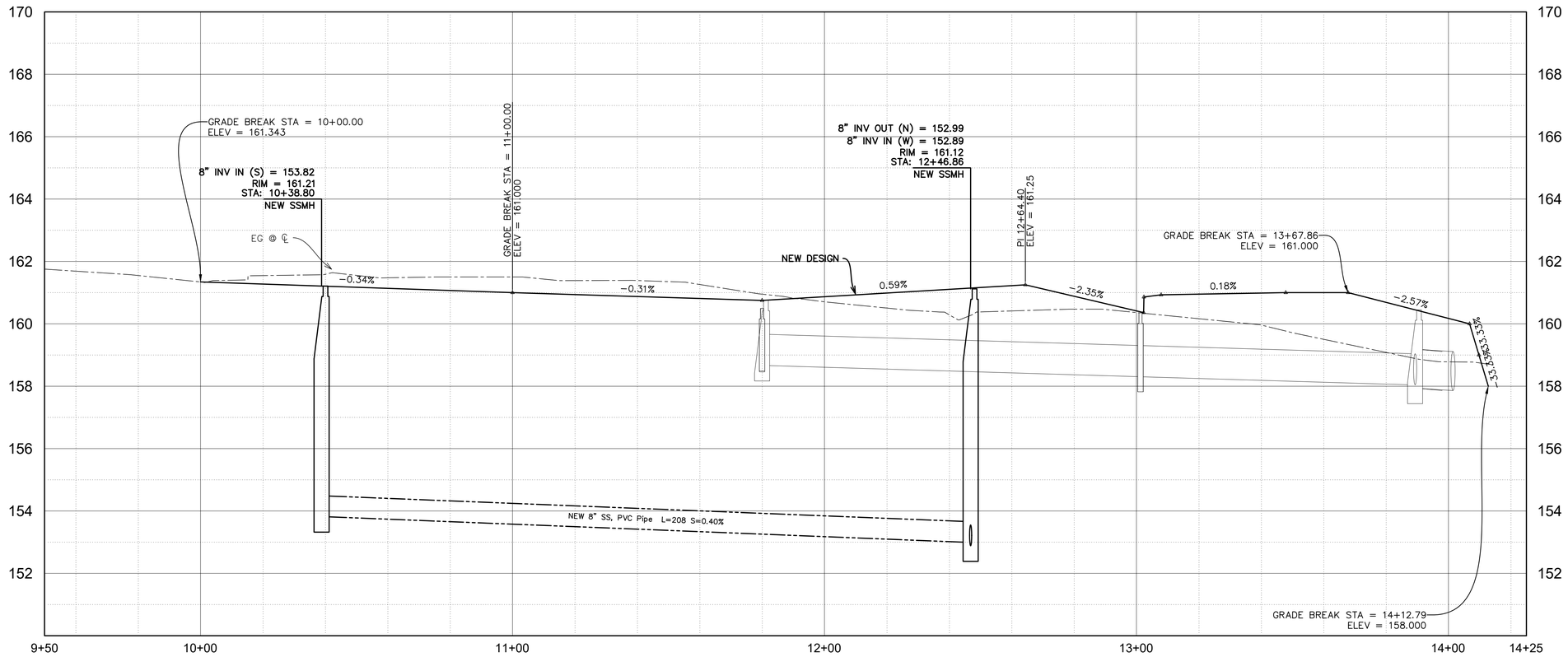
MEADOWS SANITARY SEWER PLAN AND PROFILE

DRAWING
SS-1

JOB NUMBER
2931.0000.0



FENDEL WAY PLAN STA:10+00 - 12+64.40



FENDEL WAY PROFILE H:1"=10' V:1"=1'

NO.	DATE	DESCRIPTION	BY
1		REVISIONS	

VERIFY SCALE
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0 1"

DSN. JW
DRN. IH
CKD. JW
DATE: 8/5/2022

RENEWS: 6/30/2022

REGISTERED PROFESSIONAL ENGINEER
OREGON
JULY 27, 1976
WILLIAM T. WELLS

REVIEW

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
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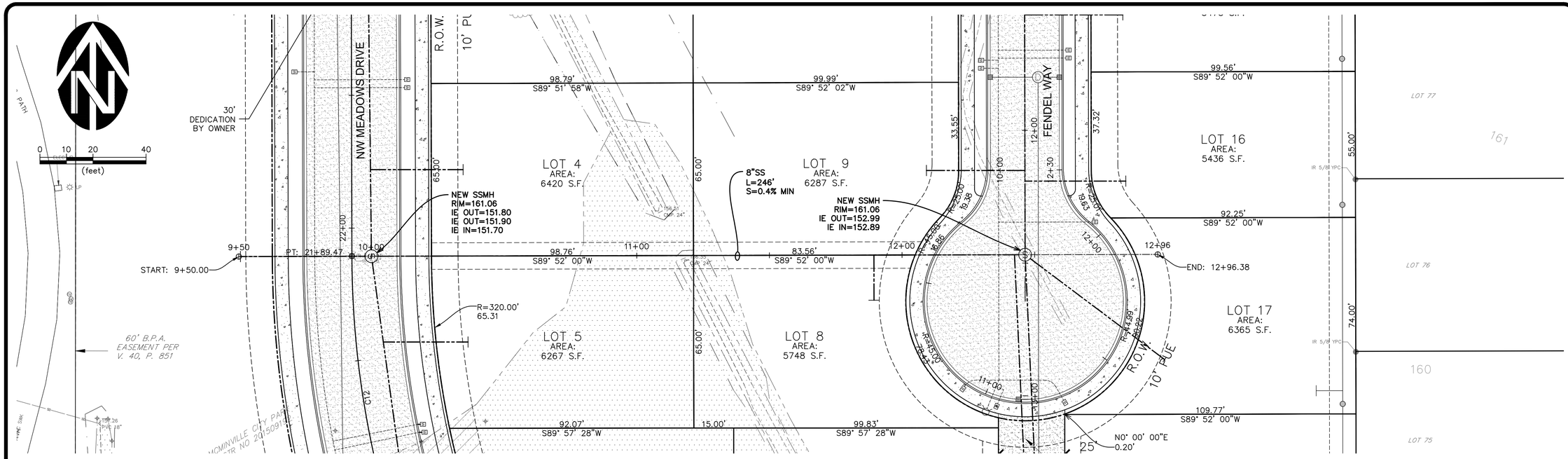
VJ-2 DEVELOPMENT
ELYSIAN SUBDIVISION

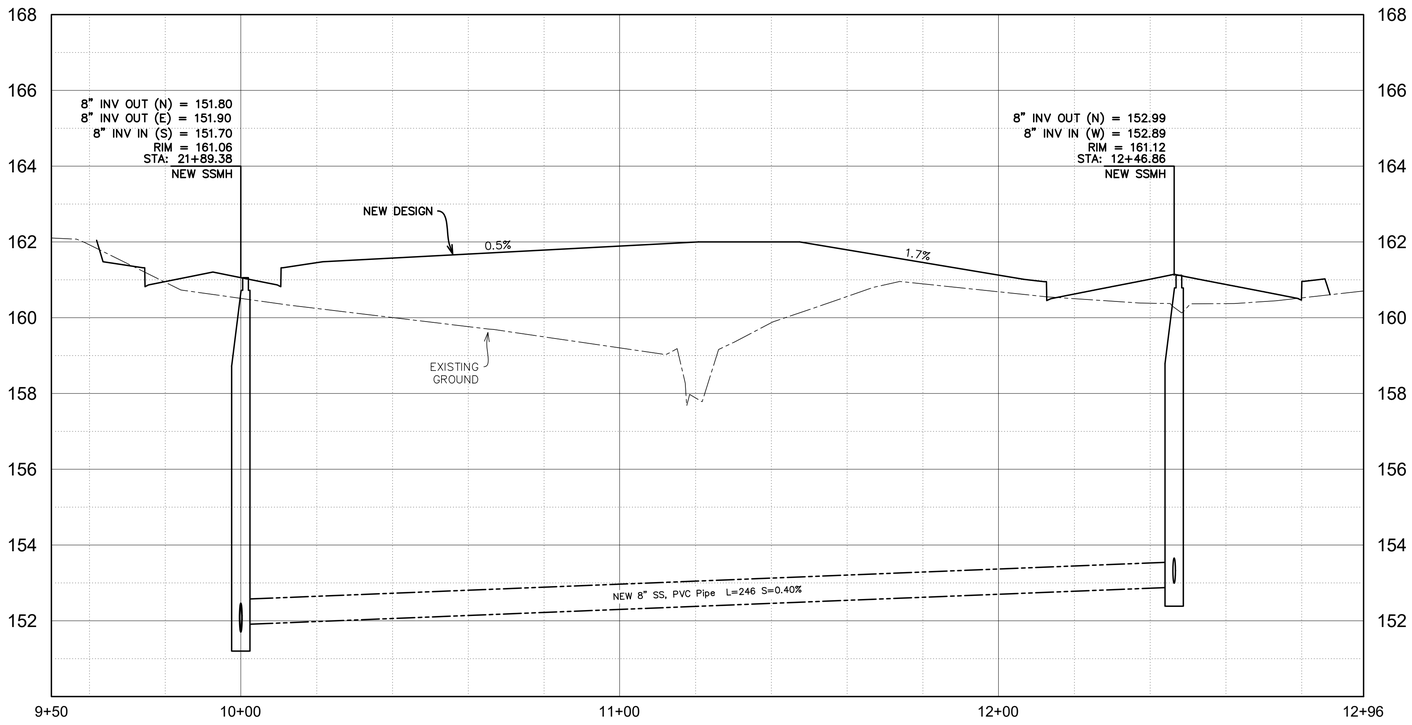
FENDEL WAY SANITARY SEWER PLAN AND PROFILE

DRAWING
SS-2

JOB NUMBER
2931.0000.0



SANITARY SEWER PLAN STA:10+00 - 12+46.38



SANITARY SEWER PROFILE H:1"=10' V:1"=1'

NO.	DATE	REVISIONS	BY
1			

VERIFY SCALE
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DSN. JW
DRN. IH
CKD. JW
DATE: 07/22/2005

REVIEW

REGISTERED PROFESSIONAL ENGINEER
WILLIAM T. WELLS
EXPIRES: 12-31-2022

RENEWS: 6/30/2022

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
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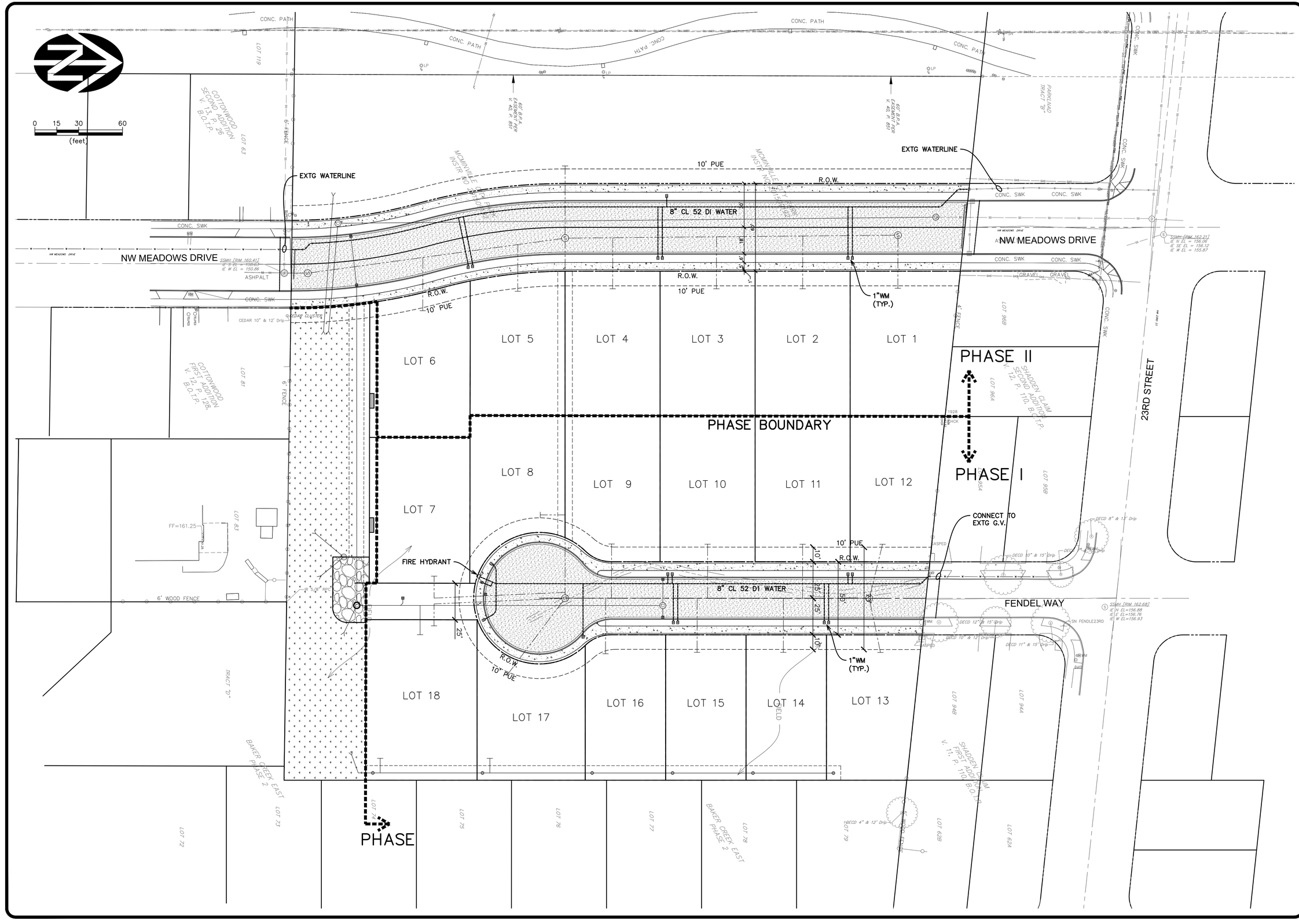
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

VJ-2 DEVELOPMENT
ELYSIAN SUBDIVISION

SANITARY SEWER MEADOWS DRIVE AND FENDEL WAY

DRAWING
SS-3

JOB NUMBER
2931.0000.0



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NO.	DATE	DESCRIPTION	BY
1		REVISIONS	

DSN. JW
DRN. IH
CKD. JW
DATE: 06/22/2022

REVIEW

REGISTERED PROFESSIONAL ENGINEER
OREGON JULY 27, 1979
WILLIAM J. WELLS
RENEWS: 6/30/2022

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
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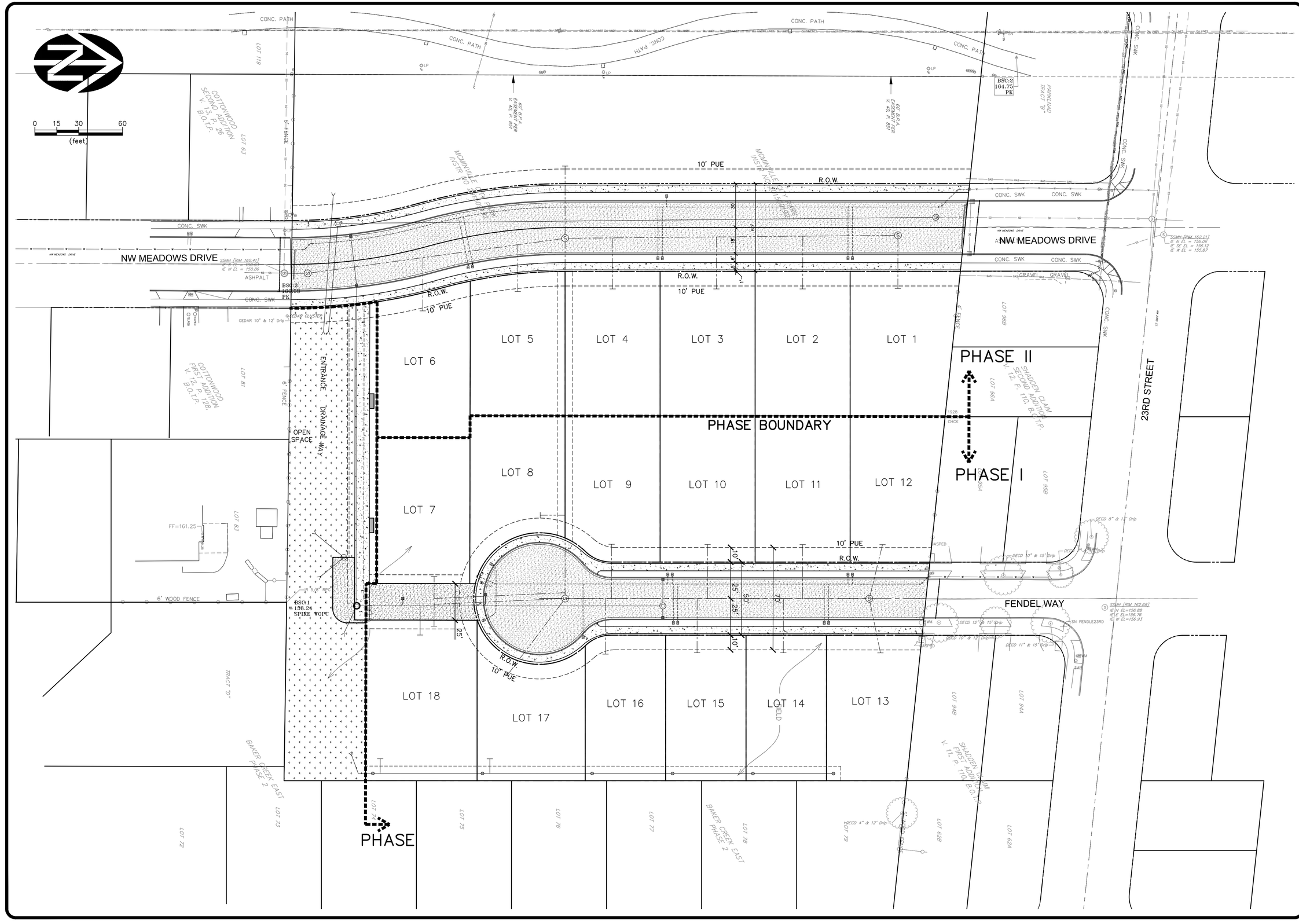
VJ-2 DEVELOPMENT
ELYSIAN SUBDIVISION

OVERALL WATER PLAN

DRAWING
W-1

JOB NUMBER
2931.0000.0



NO.	DATE	DESCRIPTION	BY
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DSN. JW
DRN. IH
CKD. JW
DATE: 8/5/2022

REVIEW

REGISTERED PROFESSIONAL ENGINEER
OREGON JULY 12, 2005
WILLIAM T. WELLS
RENEWS: 6/30/2022

WESTECH ENGINEERING, INC.
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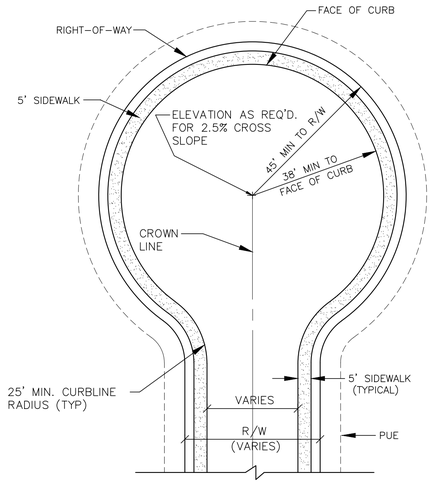
VJ-2 DEVELOPMENT
ELYSIAN SUBDIVISION

MW & L POWER PLAN

DRAWING
UT-1

JOB NUMBER
2931.0000.0



NOTES:

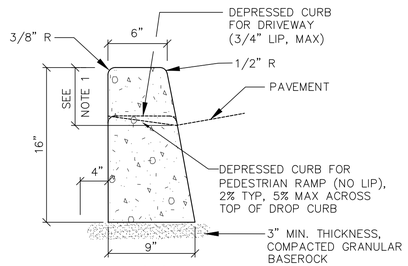
1. 2.5% MIN. CROSS SLOPE REQUIRED FROM CENTER OF BULB TO GUTTER.
2. MAINTAIN CROWN LINE TO CENTER OF CUL-DE-SAC BULB.

LAST REVISION DATE:	JO #
NOV 2013	STANDARD

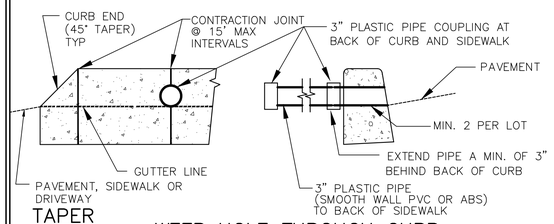
STANDARD CUL-DE-SAC

(NTS)

WESTECH ENG.	DETAIL NO. 2050



TYPE 'C' CURB



TAPER

WEEP HOLE THROUGH CURB

NOTES

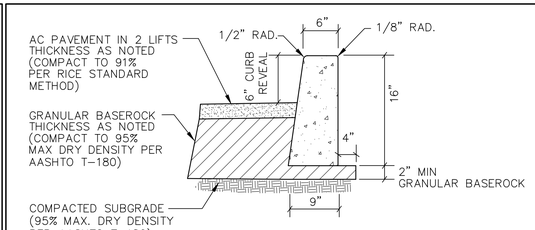
1. 7" CURB EXPOSURE FOR ARTERIAL & COLLECTOR STREETS TYPICAL WHERE TYPE C CURB IS ALLOWED.
   6" EXPOSURE ALL OTHER PUBLIC STREETS, PRIVATE STREETS & PARKING LOTS.
2. A CONTRACTION JOINT SHALL BE PLACED ACROSS SIDEWALK OVER WEEP HOLE PIPE.
3. ALL CONCRETE SHALL BE 3300 PSI @ 28 DAYS.
4. WHERE SIDEWALKS ARE TO BE CONSTRUCTED, EXTEND 3" PIPE TO BACK OF SIDEWALK LOCATION & INSTALL COUPLING AT ALL WEEPHOLE LOCATIONS.
5. INSTALL MIN. 2 WEEP HOLES ON ALL LOTS. ONE TO BE AT LOW POINT OF LOT, 5' FROM P/L. WEEP HOLES IN EXISTING CURBS SHALL BE CORE DRILLED.
6. **UNLESS APPROVED IN WRITING BY AGENCY WITH JURISDICTION, MONOLITHIC CURB & PUBLIC SIDEWALK OR DRIVEWAY APRON PLACEMENT IS NOT PERMITTED (IE. CURB CONCRETE & SIDEWALK OR DRIVEWAY CONCRETE SHALL BE PLACED SEPARATELY).**

LAST REVISION DATE:	JO #
JULY 2017	STANDARD

STANDARD TYPE 'C' CURB

(NTS)

WESTECH ENG.	DETAIL NO. 2110



PAVEMENT & BASEROCK SECTIONS:

1. LIGHT DUTY PAVEMENT
   3" AC PAVEMENT IN 2 LIFTS (1" CLASS 'C' OVER 2" CLASS 'B')
   7" OF 1"-0 GRANULAR BASEROCK
2. HEAVY DUTY PAVEMENT
   3" AC PAVEMENT IN 2 LIFTS (1" CLASS 'C' OVER 2" CLASS 'B')
   12" OF 1"-0 GRANULAR BASEROCK

PAVEMENT/TYPE "C" CURB DETAIL

NTS

NOTES:

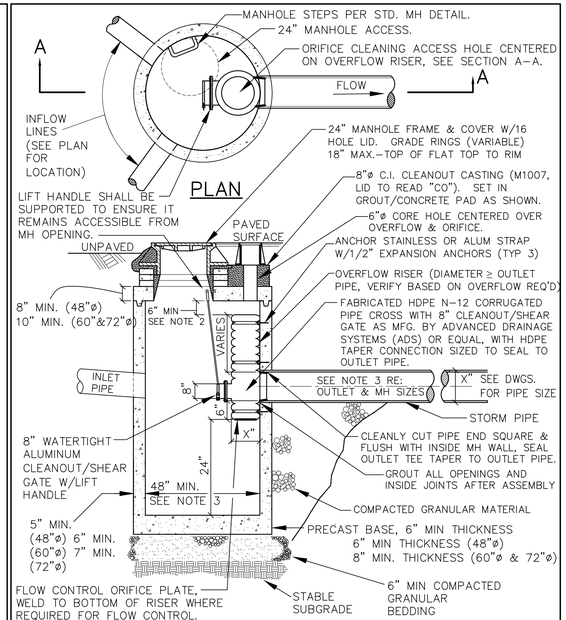
1. SEE GRADING PLAN FOR LOCATION OF LIGHT AND HEAVY DUTY PAVEMENT.
2. DESIGN SUBGRADES SHALL BE COMPACTED AND PROOF-ROLLED PRIOR TO PLACEMENT OF BASEROCK. IF SUBGRADE PASSES PROOF-ROLL BUT FAILS DENSITY TESTING, MIN. 4.5 OZ NON-WOVEN GEOTEXTILE FABRIC SHALL BE PLACED ON SUBGRADE PRIOR TO PLACEMENT OF BASEROCK. FAILURE OF PROOF-ROLL WILL REQUIRE OVEREXCAVATION.
3. IF SUBGRADE FAILS THE PROOF-ROLL, SUBGRADE SHALL BE OVEREXCAVATED TO UNDISTURBED SOIL AND BACKFILLED WITH BASEROCK OVER MIN. 8.0-OZ. NON-WOVEN FABRIC AS REQUIRED TO ALLOW COMPACTION OF UPPER (DESIGN) BASEROCK SECTION AND TO MAINTAIN STRUCTURAL INTEGRITY OF NATIVE SUBGRADE SOILS. TYPICAL MIN. OVEREXCAVATION REQUIRED IS 12-INCHES. NO RUBBER TIRED EQUIPMENT ALLOWED ON SUBGRADE FOLLOWING OVEREXCAVATION.
4. SUBGRADE TO BE PROOFROLLED IMMEDIATELY PRIOR TO PLACING BASEROCK. BASEROCK TO BE PROOFROLLED IMMEDIATELY PRIOR TO PAVING.
5. CONTRACTION JOINTS SHALL BE PLACED AT 15' MIN. INTERVALS AND SHALL EXTEND AT LEAST 50% THROUGH THE CURB SECTION.
6. ALL CONCRETE SHALL BE 3300 PSI @ 28 DAYS.
7. CURBS TO CURE A MINIMUM OF 7 DAYS PRIOR TO PLACING FINAL BASEROCK AND PAVING. USE TYPE 1 OR 1-D CLEAR CURING COMPOUND.

LAST REVISION DATE:	JO #
DEC 1999	X

PAVEMENT AND TYPE 'C' CURB DETAIL

(NTS)

WESTECH ENG.	DETAIL NO. 2390



SECTION A-A

NOTES:

1. PRECAST SECTIONS SHALL CONFORM TO ASTM C-478.
2. DISTANCE FROM TOP OF OVERFLOW TO MH RIM SHALL BE BASED ON OVERFLOW CAPACITY CALC'S BY DESIGN ENGINEER (ASSUME ORIFICE CONTROL).
3. 60" MINIMUM DIA. MANHOLE REQUIRED FOR OUTLET PIPE LARGER THAN 15" OR INLET > 21".
4. ORIFICE CLEANING ACCESS TO BE 6" CORE HOLE THROUGH FLAT-TOP (CENTERED ON OVERFLOW) WITH CI CLEANOUT BOX GROUTED TO SLAB.

LAST REVISION DATE:	
AUG 2014	STANDARD

POLLUTION/FLOW CONTROL MANHOLE W/OVERFLOW

(NTS)

WESTECH ENG.	DETAIL NO. 3200

NO.	DATE	DESCRIPTION	BY
		REVISIONS	

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

DSGN. JW
DRN. IH
CKD. JW
DATE: 8/5/2022

REVIEW

REGISTERED PROFESSIONAL ENGINEER
OREGON JULY 27, 2010 WILLIAM T. WELLS
RENEWS: 6/30/2022

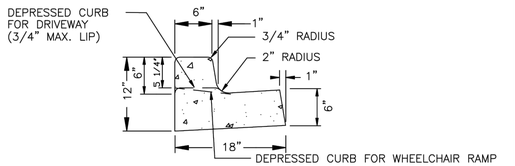
WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

VJ-2 DEVELOPMENT
ELYSIAN SUBDIVISION

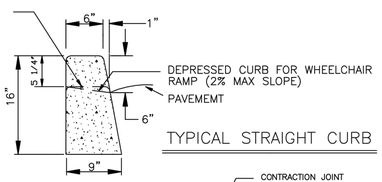
DETAILS

DRAWING
C6.0

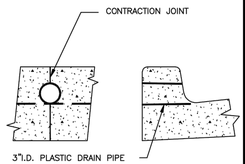
JOB NUMBER
2931.0000.0



TYPICAL CURB & GUTTER



TYPICAL STRAIGHT CURB



WEEP HOLE THROUGH CURB

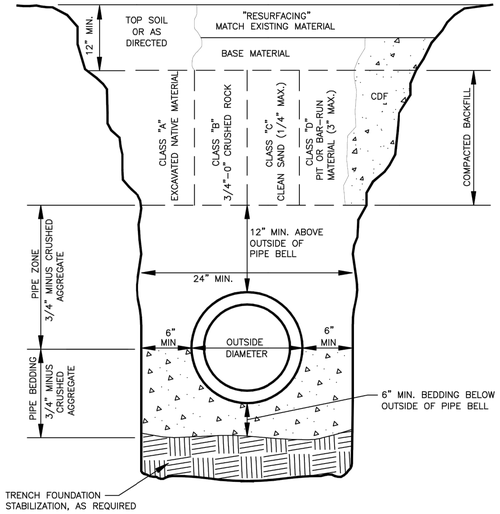
NOTES:

1. ALL RADII SHALL BE 3/4" EXCEPT AS OTHER-WISE SHOWN.
2. ISOLATION JOINTS SHALL BE PLACED ONLY AS SPECIFIED.
3. CONTRACTION JOINTS SHALL BE PLACED AT 15' INTERVALS UNLESS OTHERWISE SPECIFIED, AND SHALL EXTEND AT LEAST 50% THROUGH THE CURB OR CURB & GUTTER.
4. A CONTRACTION JOINT SHALL BE PLACED ALONG AND OVER WEEP HOLE THROUGH THE CURB AND THROUGH THE SIDEWALK.
5. WHEN SIDEWALKS ARE CONSTRUCTED, EXTEND 3" PIPE TO BACK OF SIDEWALK AND INSTALL COUPLING.

City of McMinnville

DETAIL FOR
P.C. CONCRETE
CURB AND GUTTER

DATE: AUGUST 2009 | DRAWING NO. 6

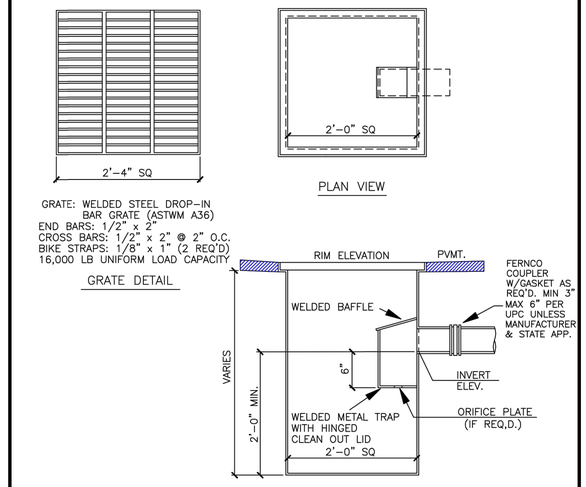


NOTE:
SURFACING OF PAVED AREAS SHALL COMPLY WITH STREET CUT STANDARD DWG. NO. 8.

City of McMinnville

DETAIL FOR
TRENCH BACKFILL
BEDDING & PIPE ZONE

DATE: AUGUST 2009 | DRAWING NO. 9



NOTES:

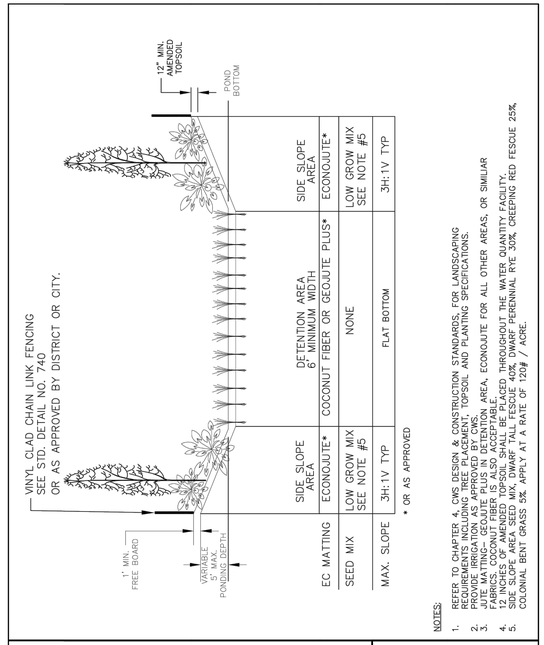
1) SEE CONSTRUCTION DWGS FOR PIPE SIZE, LOCATION AND INVERT ELEVATION.
2) FOR JUNCTION BOX, REPLACE GRATE WITH 3/4" STEEL PLATE, DRILL ONE, 1" LIFTING HOLE, CENTERED IN ONE END OF THE PLATE. WELD SHIMS TO RIM AS REQUIRED TO RAISE PLATE TO RIM ELEVATION.
3) OUTLET: SIZE AS REQ'D. FOR INDICATED PIPE SIZE.

CONSTRUCT BASIN OF WELDED 1/4" STEEL. COAT ALL SURFACES WITH ASPHALTIC PAINT

City of McMinnville

DETAIL FOR
PARKING LOT CATCH BASIN
(LYNCH STYLE)

DATE: AUGUST 2009 | DRAWING NO. 27



NOTES:

1. REFER TO CHAPTER 4, CWS DESIGN & CONSTRUCTION STANDARDS, FOR LANDSCAPING REQUIREMENTS INCLUDING TREE PLACEMENT, TOPSOIL AND PLANTING SPECIFICATIONS. PROVIDE IRRIGATION AS APPROVED BY CWS.
2. JUTE MATTING: GEOJUTE PLUS IN DETENTION AREA, ECONOJUTE FOR ALL OTHER AREAS, OR SIMILAR FABRICS. COCONUT FIBER MATTING IS ALSO ACCEPTABLE.
3. 12 INCHES OF AMENDED TOPSOIL SHALL BE PLACED THROUGHOUT THE WATER QUANTITY FACILITY.
4. SIDE SLOPE AREA SEED MIX, DWARF TALL FESCUE 40% DWARF PERENNIAL RYE 30%, CREEPING RED FESCUE 25%.
5. COLONIAL BENT GRASS 5%. APPLY AT A RATE OF 120# / ACRE.

DETENTION POND

DRAWING NO. 700 | REVISED 10-31-19

CleanWater Services

CONSTRUCTION

1. Detention Pond shall be over-excavated and filled to final grade with 12-inch amended topsoil. Topsoil amendments shall be garden compost, not conventional fertilizer amendments.
2. A biodegradable Erosion Control Matting shall be placed over the topsoil throughout the Detention Pond cross section, fabric shall be held in place in accordance with the manufacturer's installation requirements. Anchor spacing shall be based on 3 fps flow over the fabric.
   a. Pond bottom - high-density jute matting (Geojute Plus or other approved equal)
   b. All other areas - low-density jute matting (Econojute or other approved equal)
3. Plant materials shall be placed in accordance with the plan and plant table as shown on approved plans.
4. The facility shall be deemed acceptable to begin the maintenance period when plant growth and density matches the Engineer's design as shown on the approved plans and all other requirements have been met. The Engineer must certify the facility to be functional, in accordance with the approved plan design to begin the two-year maintenance period..

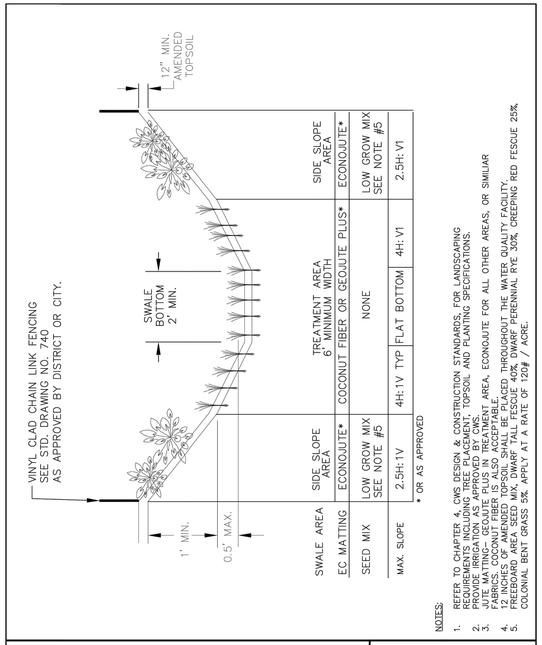
MAINTENANCE

1. The permittee is responsible for the maintenance of this facility for a minimum of two years following construction and acceptance of this facility per Chapter 2.
2. Irrigation is to be provided per separate irrigation plan as approved.
   Note: Irrigation needs are to be met using a temporary irrigation system with a timer during the dry season. Systems should be winterized during the wet season to assure longevity and guard against damage from freezing temperatures. Water source shall be as shown on the approved plans.
3. Engineer or Owner's Representative is required to perform Monitoring and Maintenance of the Site and provide Documentation as required in Appendix A, 2.5 of the Design and Construction Standards. The Approved Plans shall include a Maintenance Schedule per Appendix A, 2.6.e of the Design and Construction Standards.
4. The Facility shall be re-excavated and planted if siltation greater than 3 inches in depth occurs within the two-year maintenance period.

DETENTION POND
CONSTRUCTION & MAINTENANCE NOTES

DETAIL NO. 701 | REVISED 10-31-19

CleanWater Services



NOTES:

1. REFER TO CHAPTER 4, CWS DESIGN & CONSTRUCTION STANDARDS, FOR LANDSCAPING REQUIREMENTS INCLUDING TREE PLACEMENT, TOPSOIL AND PLANTING SPECIFICATIONS. PROVIDE IRRIGATION AS APPROVED BY CWS.
2. JUTE MATTING: GEOJUTE PLUS IN TREATMENT AREA, ECONOJUTE FOR ALL OTHER AREAS, OR SIMILAR FABRICS. COCONUT FIBER IS ALSO ACCEPTABLE.
3. 12 INCHES OF AMENDED TOPSOIL SHALL BE PLACED THROUGHOUT THE WATER QUALITY FACILITY.
4. SIDE SLOPE AREA SEED MIX, DWARF TALL FESCUE 40% DWARF PERENNIAL RYE 30%, CREEPING RED FESCUE 25%.
5. COLONIAL BENT GRASS 5%. APPLY AT A RATE OF 120# / ACRE.

WATER QUALITY SWALE

DRAWING NO. 705 | REVISED 10-31-19

CleanWater Services

CONSTRUCTION

1. Water Quality Facility shall be over-excavated and filled to final grade with 12-inch amended topsoil. Topsoil amendments shall be garden compost, not conventional fertilizer amendments.
2. A biodegradable Erosion Control Matting shall be placed over the topsoil throughout the swale cross section, fabric shall be held in place in accordance with the manufacturer's installation requirements. Anchor spacing shall be based on 3 fps flow over the fabric.
   a. Treatment area - high-density jute matting (Geojute Plus or other approved equal)
   b. All other areas - low-density jute matting (Econojute or other approved equal)
3. Plant materials shall be placed in accordance with the plan and plant table as shown on approved plans.
4. The water quality facility treatment area plantings can be deemed "substantially complete" once active green growth has occurred to an average growth of 3" and plant density is an average of approx. 6 plants (minimum 1-inch plugs or equivalent) per square foot.
5. The facility shall be deemed acceptable to begin the maintenance period when plant growth and density matches the engineer's design as shown on the approved plans and all other requirements have been met. The engineer must certify the facility to be functional, in accordance with the approved plan design to begin the two-year maintenance period.

MAINTENANCE

5. The permittee is responsible for the maintenance of this facility for a minimum of two years following construction and acceptance of this facility per Chapter 2.
6. Irrigation is to be provided per separate irrigation plan as approved.
   Note: Irrigation needs are to be met using a temporary irrigation system with a timer during the dry season. Systems should be winterized during the wet season to assure longevity and guard against damage from freezing temperatures. Water source shall be as shown on the approved plans.
7. Engineer or Owner's Representative is required to perform Monitoring and Maintenance of the Site and provide Documentation as required in Appendix A, 2.5 of the Design and Construction Standards. The Approved Plans shall include a Maintenance Schedule per Appendix A, 2.6.e of the Design and Construction Standards.
8. The facility shall be re-excavated and planted if siltation greater than 3 inches in depth occurs within the two-year maintenance period.

WATER QUALITY SWALE
CONSTRUCTION & MAINTENANCE NOTES

DETAIL NO. 706 | REVISED 10-31-19

CleanWater Services

NO.	DATE	DESCRIPTION	BY
		REVISIONS	

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH, ADJUST SCALES ACCORDINGLY

DSN. JW
DRN. IH
CKD. JW
DATE: 8/5/2008

REVIEW

REGISTERED PROFESSIONAL ENGINEER
OREGON
JULY 27, 1976
WILLIAM T. WELLS

RENEWS: 6/30/2022

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

VJ-2 DEVELOPMENT

ELYSIAN SUBDIVISION

DETAILS

DRAWING
C6.1

JOB NUMBER
2931.0000.0