City of West Linn

Water System Master Plan Update

March 2024

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City of West Linn

March 2024

DRAFT

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Acronyms & Abbreviations

A	
AAGR	Average annual growth rate
AC	Asbestos Cement
ADD	Average daily demand
ALA	American Lifelines Alliance
ASCE	American Society of Civil Engineers
ATS	Automatic transfer switch
AWWA	American Water Works Association
B	
BMI	Backflow Management Inc
C	
cfs	Cubic feet per second
CIP	Capital Improvement Program
City	City of West Linn
CMP	Capital Maintenance Program
CRWS	Clackamas River Water-South
CSZ 10-1	Cascadia Subduction Zone
D	
D/DBPR	Disinfectants and Disinfection Byproducts Rule
DOGAMI	Oregon Department of Geology and Mineral Industries
DSPS	Division Street Pump Station
DWS	Drinking Water Services
DWSPF	Drinking Water Source Protection Fund
DWSRF	Drinking Water State Revolving Fund
E	
EOP	Emergency Operations Plan
EPA	Environmental Protection Agency
ERU	Equivalent residential unit
F	
FEMA	Federal Emergency Management Agency
fps	Feet per second
FY	Fiscal year
G	
GIS	Geographic information system
gpcd	Gallons per capita per day
gpd	Gallons per day
gpm	Gallons per minute
H	
HAA	Halogenic acetic acids

HAA5	Haloacetic acids
HB	House Bill
HGL	Hydraulic grade line
HMI	Human Machine Interface
I	
I-205	Interstate 205
IGA	Intergovernmental Agreement
in/sec	Inches per Second
K	
L	
LCR	Lead and Copper Rule
LF	Linear feet
M	
M9 10-1	Magnitude 9.0
MCL	Maximum contaminant level
MDD	Maximum day demand
MDBP	Microbial and Disinfection Byproducts Rules
MG	Million gallons
MGD	Million gallons per day
MHI	Median Household Income
msl	Mean sea level
N	
NPDWRs	National primary drinking water regulations
NRCS	National Resource Conservation Service
O	
O&M	Operations and maintenance
OAR	Oregon Administrative Rules
ODOT	Oregon Department of Transportation
OHA	Oregon Health Authority
OPSC	Oregon Plumbing Specialty Code
ORS	Oregon Revised Statutes
OWRD	Oregon Water Resources Department
P	
PFAS	Poly-fluoroalkyl substances
PGD	Permanent Ground Deformation
PGV	Peak Ground Velocity
PHD	Peak hour demand
PRV	Pressure reducing valve
psi	Pounds per square inch
PSU PRC	Portland State University Population Research Center
PVC	Polyvinyl chloride

R	
RR	Rate of Repair
RTCR	Revised Total Coliform Rule
RWPC	Regional Water Providers Consortium
RWPS	Raw water pump station
S	
SCADA	Supervisory Control and Data Acquisition
SDC	System Development Charge
SDWA	Safe Drinking Water Act
SDWRLF	Safe Drinking Water Revolving Loan Fund
SFWB	South Fork Water Board
SIPP	Sustainable Infrastructure Planning Project
SOP	Standard operating procedures
SWA	Source Water Assessment
SWP	Source Water Protection
T	
TTHM	Trihalomethane
TVFR	Tualatin Valley Fire and Rescue
U	
UCMR	Unregulated Contaminant Monitoring Rule
UGB	Urban Growth Boundary
V	
VFD	Variable frequency drive
W	
WIFIA	Water Infrastructure Finance and Innovation Act of 2014
WMP	Water Master Plan
WSMP	Water System Master Plan Update
WTP	Water Treatment Plant

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CHAPTER 1

Water System Description

1.1 Purpose

The purpose of this Water System Master Plan Update (WSMP) is to perform an analysis of the City of West Linn's (City's) water system which includes the following.

- Document the water system and improvements performed since the 2008 Water Master Plan.
- Estimate future water demand based on historical and existing demand and projected growth.
- Perform and document a high-level system seismic resilience evaluation.
- Identify current and projected deficiencies and recommend improvements that correct those deficiencies.
- Perform a rate study and update of the City's System Development Charges (SDCs), documented separately.
- Recommend and prioritize a Capital Improvement Program (CIP) and Capital Maintenance Program (CMP).
- Comply with water system master planning requirements for Public Water Systems established under Oregon Administrative Rules (OAR) for Public Water Systems, Chapter 333, Division 61 (OAR 333-061-0060(5)).

This report is divided into twelve chapters, as summarized below.

- **Chapter 1**: Description of the existing system
- **Chapter 2**: Establishes current and existing demand and population growth over the planning period
- **Chapter 3**: Describes the performance criteria used for each component of the water system
- **Chapter 4**, **Chapter 5**, **Chapter 6**, **Chapter 7**: Evaluates the supply, storage, pumping and distribution systems against the performance criteria for current and projected demand and identifies deficiencies and vulnerabilities in the system
- **Chapter 8**: Describes the City's operations and maintenance (O&M) program
- **Chapter 9**: Describes the City's water quality program
- **Chapter 10**: Provides a high level seismic and resilience assessment of the water system
- **Chapter 11**: Evaluates the City's current rate structure and provides recommendations
- **Chapter 12**: Summarizes and prioritizes the recommended CIP and CMP in 5-year increments, including project cost estimates

The planning and analysis efforts presented in this WSMP are intended to provide the City with the information needed to inform long-term water supply and distribution infrastructure decisions.

1.2 System Description and Service Area

The City is located in Clackamas County, southeast of the City of Portland and south of the City of Lake Oswego. The City provides finished water to approximately 28,000 residents through approximately 9,000 residential, commercial, industrial, and municipal service connections. The current service area includes all areas within the existing city limits and a limited number of historical customers located outside the city limits. The study area of this planning effort is the current urban growth boundary (UGB); however, the limited number of customers outside the UGB are included as if they were within it.

Figure 1-1 illustrates the existing water system and pressure zones. **Figure 1-2** illustrates the city limits, UGB and land use for the study area. A schematic of the water system is provided in **Figure 1-3**.

1.3 Supply

The City's primary water supply is from the South Fork Water Board (SFWB). Intake, transmission, treatment, and pumping facilities are located in Oregon City. The City also has an emergency supply connection to the City of Lake Oswego's Water Treatment Plant (WTP), which is located in the northeast section of the City.

1.3.1 South Fork Water Board

The SFWB was established under Oregon Revised Statutes (ORS) 190 by agreement between the cities of West Linn and Oregon City for the purposes of supplying water to the two cities. The SFWB owns and operates water supply facilities consisting of a river intake on the Clackamas River, which includes a raw water pumping station, a WTP located in the Park Place area of Oregon City, finished water storage, finished pumping station, and raw and finished water transmission pipelines. The SFWB supply system is described in further detail below and in **Chapter 4**.

1.3.2 Water Rights

The SFWB holds four water rights in the Clackamas River basin. These rights are the most senior municipal rights on the river and its tributaries except for a small intervening right on the Clackamas River held by the City of Gladstone. The SFWB water rights pre-date the major instream right held by the Oregon Water Resources Department (OWRD). The total permitted withdrawal rate for all the SFWB permits is 116.0 cubic feet per second (cfs) or 74.98 million gallons per day (MGD). The four water rights held by the SFWB are summarized in **Table 1-1**.

Table 1-1 | Water Rights Summary

Permit No.	Certificate	Priority Date	Permitted Production Rate		
			Cubic Feet per Second (cfs)	Gallons per Minute (gpm)	Million Gallons per Day (MGD)
S2257	80417	7/17/1914	6	2,693	3.88
S3778		1/16/1918	20	8,977	12.93
S9982		8/11/1926	30	13,465	19.39
S22581		8/3/1953	60	26,930	38.78
Total			**116**	**52,064**	**74.98**

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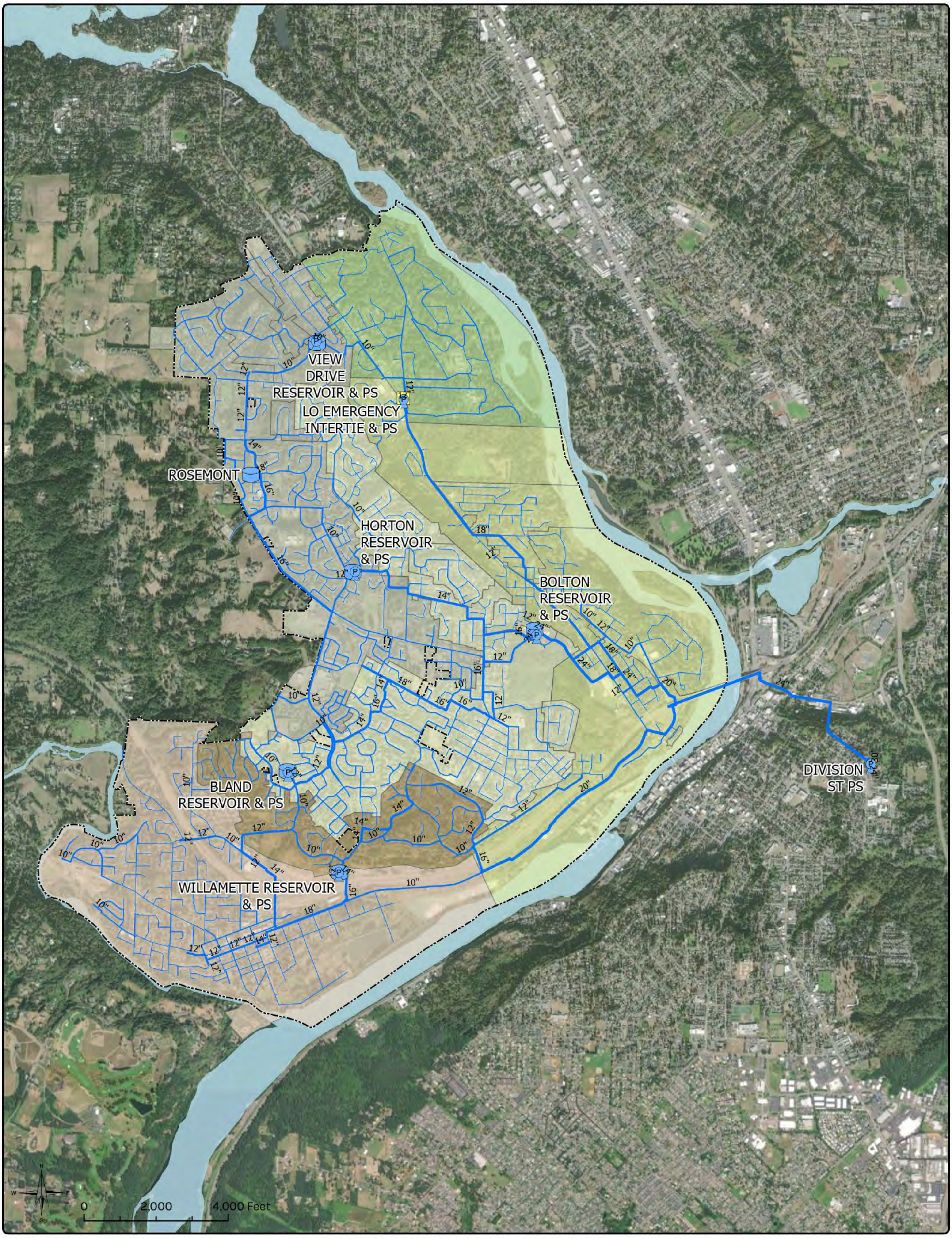


Legend

- ▲ SFWB Intake
- WTP SFWB WTP
- I Emergency Intertie
- P Pump Station
- ⛁ Reservoir

Mains Diameter (in.)

- <6"
- 8"
- 10"
- 12"
- 14-18"
- 20-24"
- 28-42"

Pressure Zone

- Bland
- Bolton
- Horton
- Robinwood
- Rosemont
- Willamette
- City Limits

City of West Linn

consor

Water System Master Plan

Figure 1-1
Existing System

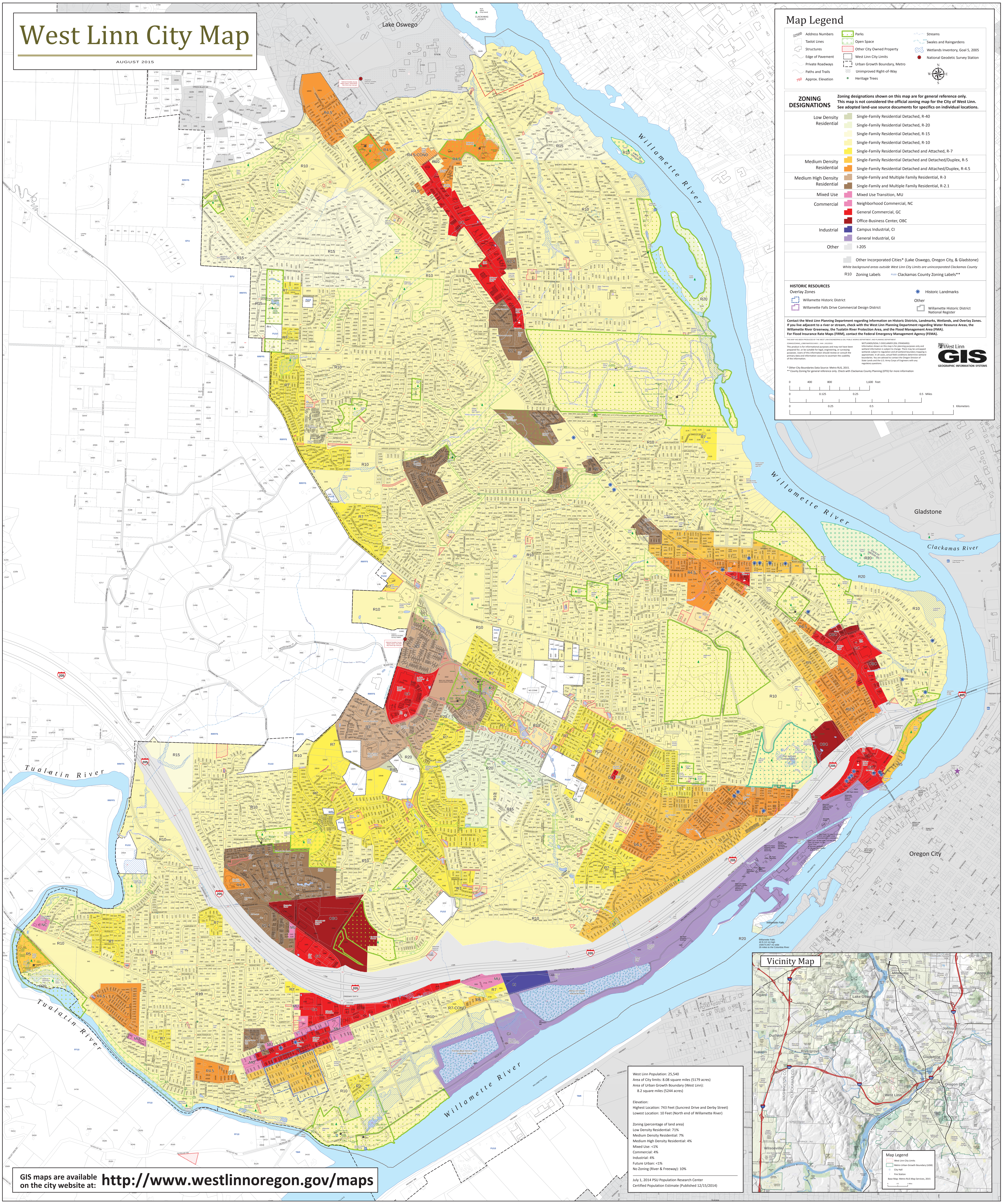
Project No: 22-3537

March 2024

Data Sources: City of West Linn, 2022; World Imagery: Maxar.
Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Disclaimer: Consor and Client make no representations, express or implied, as to the accuracy, completeness and timeliness of the information displayed. This map is not suitable for legal, engineering, or surveying purposes. Notification of any errors is appreciated.

West Linn City Map

AUGUST 2015



Map Legend

22500	Address Numbers
	Taxlot Lines
	Structures
	Edge of Pavement
	Private Roadways
	Paths and Trails
750	Approx. Elevation
	Parks
	Open Space
	Other City Owned Property
	West Linn City Limits
	Urban Growth Boundary, Metro
	Unimproved Right-of-Way
	Heritage Trees
	Streams
	Swales and Raingardens
	Wetlands Inventory, Goal 5, 2005
●	National Geodetic Survey Station

N
W E
S

ZONING DESIGNATIONS

Zoning designations shown on this map are for general reference only. This map is not considered the official zoning map for the City of West Linn. See adopted land-use source documents for specifics on individual locations.

Low Density Residential		Single-Family Residential Detached, R-40
		Single-Family Residential Detached, R-20
		Single-Family Residential Detached, R-15
		Single-Family Residential Detached, R-10
		Single-Family Residential Detached and Attached, R-7
Medium Density Residential		Single-Family Residential Detached and Detached/Duplex, R-5
		Single-Family Residential Detached and Attached/Duplex, R-4.5
Medium High Density Residential		Single-Family and Multiple Family Residential, R-3
		Single-Family and Multiple Family Residential, R-2.1
Mixed Use		Mixed Use Transition, MU
Commercial		Neighborhood Commercial, NC
		General Commercial, GC
		Office-Business Center, OBC
Industrial		Campus Industrial, CI
		General Industrial, GI
Other		I-205

Other Incorporated Cities* (Lake Oswego, Oregon City, & Gladstone)

White background areas outside West Linn City Limits are unincorporated Clackamas County

R10 Zoning Labels FU10 Clackamas County Zoning Labels**

HISTORIC RESOURCES

Overlay Zones

Willamette Historic District

Willamette Falls Drive Commercial Design District

✱ Historic Landmarks

Other

Willamette Historic District National Register

Contact the West Linn Planning Department regarding information on Historic Districts, Landmarks, Wetlands, and Overlay Zones. If you live adjacent to a river or stream, check with the West Linn Planning Department regarding Water Resource Areas, the Willamette River Greenway, the Tualatin River Protection Area, and the Flood Management Area (FMA). For Flood Insurance Rate Maps (FIRM), contact the Federal Emergency Management Agency (FEMA).

THIS MAP HAS BEEN PRODUCED BY THE WEST LINN ENGINEERING & GIS, PUBLIC WORKS DEPARTMENT, AND PLANNING DEPARTMENT

ZONING/ZONING_LOBBYMAP2015.MXD | AHA | 8/12/2015

This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information.

WETLANDS/GOAL 5 DISCLAIMER (DSL STANDARD): Information shown on this map is for planning purposes only and wetland information is subject to change. There may be unmapped wetlands subject to regulation and all wetland boundary mapping is approximate. In all cases, actual field conditions determine wetland boundaries. You are advised to contact the Oregon Division of State Lands and the U.S. Army Corps of Engineers with any regulatory questions.

City of West Linn GIS
GEOGRAPHIC INFORMATION SYSTEMS

* Other City Boundaries Data Source: Metro RLIS, 2015.

** County Zoning for general reference only. Check with Clackamas County Planning (DTD) for more information

0 400 800 1,600 Feet

0 0.125 0.25 0.5 Miles

0 0.25 0.5 1 Kilometers

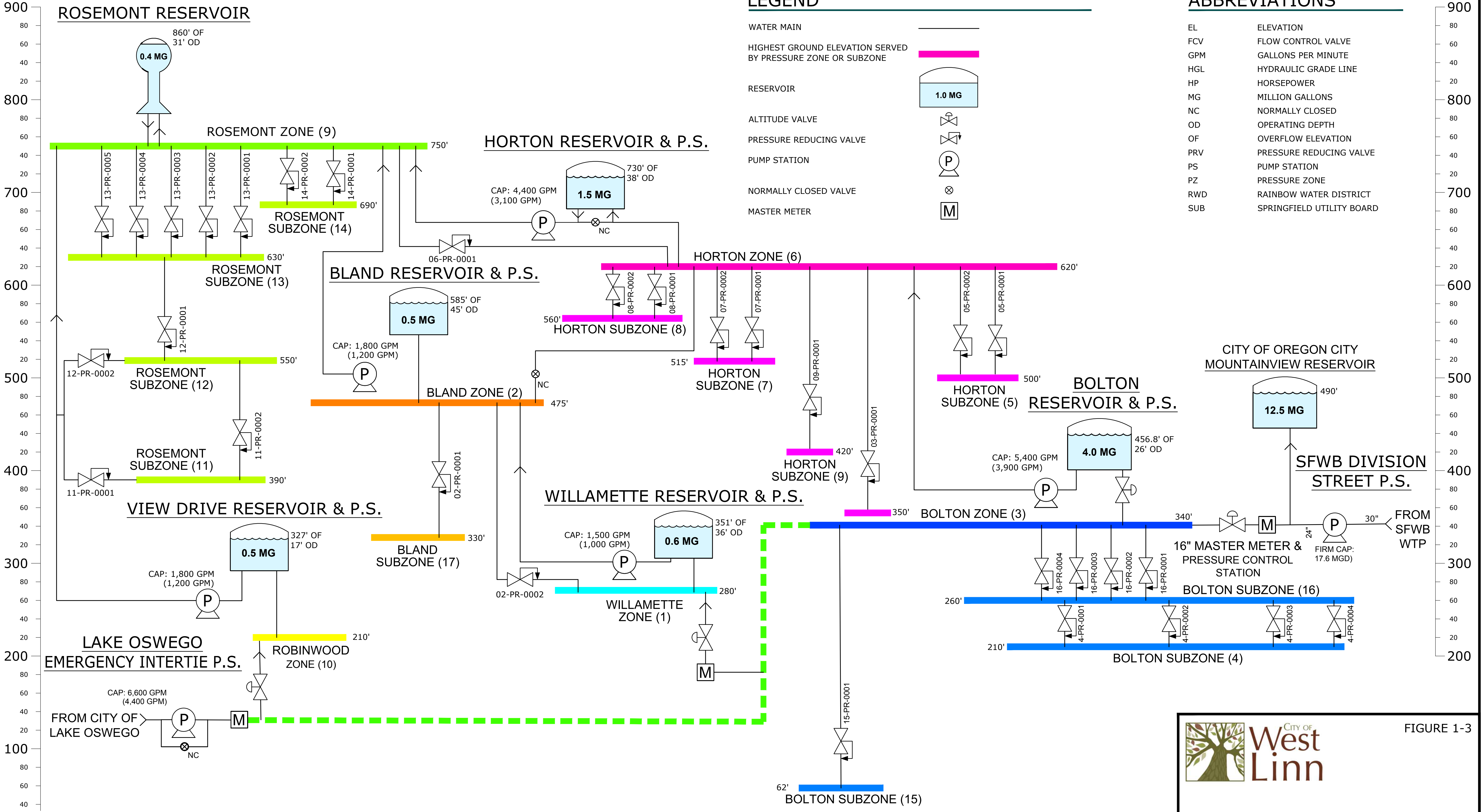
West Linn Population: 25,540
Area of City limits: 8.08 square miles (5179 acres)
Area of Urban Growth Boundary (West Linn):
8.2 square miles (5244 acres)

Elevation:
Highest Location: 743 Feet (Suncrest Drive and Derby Street)
Lowest Location: 10 Feet (North end of Willamette River)

Zoning (percentage of land area)
Low Density Residential: 71%
Medium Density Residential: 7%
Medium High Density Residential: 4%
Mixed Use: <1%
Commercial: 4%
Industrial: 4%
Future Urban: <1%
No Zoning (River & Freeway): 10%

July 1, 2014 PSU Population Research Center
Certified Population Estimate (Published 12/15/2014)

GIS maps are available on the city website at: **http://www.westlinnoregon.gov/maps**



LEGEND

WATER MAIN	—
HIGHEST GROUND ELEVATION SERVED BY PRESSURE ZONE OR SUBZONE	🟪
RESERVOIR	1.0 MG
ALTITUDE VALVE	⋈
PRESSURE REDUCING VALVE	⋈
PUMP STATION	Ⓟ
NORMALLY CLOSED VALVE	⊗
MASTER METER	M

ABBREVIATIONS

EL	ELEVATION
FCV	FLOW CONTROL VALVE
GPM	GALLONS PER MINUTE
HGL	HYDRAULIC GRADE LINE
HP	HORSEPOWER
MG	MILLION GALLONS
NC	NORMALLY CLOSED
OD	OPERATING DEPTH
OF	OVERFLOW ELEVATION
PRV	PRESSURE REDUCING VALVE
PS	PUMP STATION
PZ	PRESSURE ZONE
RWD	RAINBOW WATER DISTRICT
SUB	SPRINGFIELD UTILITY BOARD

FIGURE 1-3

City of West Linn

Water System Master Plan
Existing System Schematic

DECEMBER 2023

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22-3537

G:\PDX_Projects\22\3537 – West Linn – Water System Master Plan\CAD\Figures\223537-OR-FIGURE 1-3.dwg HYDRAULIC PROFILE 12/20/23 11:11 (Matt.Estep)

1.3.3 River Intakes

The SFWB has two raw water intakes located on the Clackamas River. The “new” intake, constructed in 1996, is located at Clackamas River Mile 1.7. This intake is designed and constructed to pass a maximum flow of approximately 82 cfs (53 MGD) and is equipped with fish screens to meet current federal and state regulations. The old intake, which is inoperable, is located approximately 500 feet upstream of the new intake and is no longer maintained or in service.

1.3.4 Raw Water Pump Station

The SFWB raw water pump station (RWPS) is located in the same structure as the “new” river intake and includes five vertical turbine pumps. The current firm capacity, or capacity with the largest pump out of service, is approximately 30.8 MGD. The planned ultimate capacity of the RWPS is approximately 52 MGD.

1.3.5 Raw Water Transmission Main

An existing 42-inch diameter steel raw water transmission main extends approximately 600 feet from the SFWB RWPS where it connects to a 27-inch diameter concrete cylinder pipe main, originally constructed in 1959, that extends to the WTP. The capacity of the existing SFWB raw water transmission main is approximately 22 MGD.

1.3.6 Water Treatment Plant (WTP)

The SFWB WTP is located in the Park Place area of Oregon City on Hunter Avenue, south of the river intake and RWPS. The WTP, constructed in 1958 and upgraded in 1975, 1986, and more recently, has a rated production capacity of approximately 22 MGD. The treatment process includes flocculation, sedimentation, filtration, and chlorination of the raw water for disinfection and chlorine residual.

1.3.7 Finished Water Supply to West Linn

A 30-inch diameter concrete cylinder pipe main transmits water by gravity from the SFWB WTP clearwell to the Division Street Pump Station (DSPS). In 2018, a water leak in the existing 30-inch diameter pipe prompted an emergency repair of the damaged section of pipe. During the emergency repair project, a connection to the existing parallel 42-inch diameter pipe, that extends from the WTP to Oregon City’s Hunter Avenue Pump Station, was made that will provide bypass flow and redundancy if additional repairs are required on the upper portion of the 30-inch main.

The DSPS, located near the intersection of Division Street and Penn Lane in Oregon City, has a current firm pumping capacity of 27.8 MGD. The DSPS pumps treated water to the City of Oregon City Mountainview Reservoir and to the West Linn transmission main through a shared 24-inch diameter transmission line. The City’s connection to the 24-inch transmission main is located near the DSPS, but “downstream” from the Mountain View Reservoir. Operation of the DSPS is controlled by elevations in the Mountainview Reservoir; however, supply to that reservoir is not isolated from the City’s supply. If operation of the DSPS fails, the City continues to receive supply because the Mountainview Reservoir fill pipe basically reverts to a gravity pipe and supply can be diverted from that reservoir to the City’s transmission line.

The City connection at the DSPS includes a pressure control station and 16-inch diameter master meter. The valves can also be operated to maintain a constant flow rate to the City. Operation of the control valves are controlled by elevations in the Bolton Reservoir. All SFWB supply flow to the City is measured at the meter.

The City's 24-inch diameter transmission main extends west, crossing the Willamette River on the Interstate 205 (I-205) Abernathy Bridge where it connects to the City's distribution system. At the time of this WSMP, an Oregon Department of Transportation (ODOT) project is underway to widen and seismically retrofit the I-205 bridge. Approximately 4,000 linear feet (LF) of the City's existing 24-inch diameter pipe will be replaced with a 30-inch diameter, ductile iron transmission main in conjunction with the ODOT project. The section of piping that will be suspended from the I-205 bridge will be constructed to be seismically resilient. Construction is currently expected to be complete mid-2025.

1.3.8 Emergency Interties

In 1984, the City entered into an intergovernmental agreement (IGA) with the City of Lake Oswego and the SFWB to construct, operate, and maintain an intertie between the Lake Oswego and the West Linn/ SFWB system. The purpose of the IGA was to provide an additional source of water to the City or to Lake Oswego during emergency conditions. Emergency water is provided to the City from Lake Oswego only when supplies from the SFWB are interrupted. Mutual consent from Lake Oswego, the City, and SFWB is required to activate the intertie. The IGA was updated in 2003 and a copy is included in Appendix A.

The IGA provided for the construction of an 18-inch, 800-foot long intertie between the City's 18-inch diameter transmission main, located on Highway 43, to Lake Oswego's 24-inch transmission main located at the intersection of Kenthorpe Way and Old River Road. The intertie pump station is located on the City's side of the transmission main near the intersection of Old River Road and Willamette Drive. The pump station is equipped with three 2,200 gallons per minute (gpm) frame mounted end suction centrifugal pumps and has a firm nominal capacity of 6.3 MGD and total capacity of 9.5 MGD. The pump station pumps emergency supply into the Bolton and Robinwood pressure zones. An altitude valve, pressure reducing valve (PRV) and a flow meter are located at the pump station. The City is responsible for the operation, maintenance, and repair of the emergency intertie facilities.

1.3.9 Pressure Zones

The City's existing distribution system is divided into six service levels or pressure zones. The pressure zones are identified as:

- Bolton Pressure Zone
- Horton Pressure Zone
- Rosemont Pressure Zone
- Robinwood Pressure Zone
- Willamette Pressure Zone
- Bland Pressure Zone

The six main pressure zones are defined by ground topography and designated by overflow elevations of water storage facilities or outlet settings of pressure reducing facilities serving the zone. All are served by gravity from a storage facility. Subzones with the main pressure zones are also defined by topography.

The six pressure zones are summarized in **Table 1-2** and described further below. Pressure zones are illustrated in **Figure 1-1** and the hydraulic schematic in **Figure 1-2**.

Table 1-2 | Pressure Zones

Pressure Zone (#)	Subzones	PRVs	Maximum HGL (ft)	Ground Elevations Served (ft)	Minimum Static Service Pressure	Area (acres)	Metered Connections
Bolton (3)	4, 15, 16	04-PR-0001, 2,3,4 15-PR-0001 16-PR-0001, 2, 3, 4	456.8-490[1]	≤ 336	45	1,250	1,379
Horton (6)	5,7,8,9	03-PR-0001 05-PR-0001, 2 06-PR-0001 07-PR-0001,2 08-PR-0001,2	730[2]	350' – 632	42	1,000	2,580
Rosemont (9)	11, 12, 13, 14	11-PR-0001 12-PR-0001, 2 13-PR-0001, 2, 3, 4, 5 14-PR-0001, 2	860[2]	220' – 754	45	860	2,047
Robinwood (10)	None	None	328[2]	≤207	52	560	727
Willamette (1)	None	None	351[2]	100' – 257	40	1,140	1,620
Bland (2)	17	17-PR-0001	585[2]	280' – 490	41	350	667

Notes:

1. HGL range includes the Bolton Reservoir overflow elevation and the overflow elevation of Oregon City's Mountainview Reservoir.
2. HGL based on the overflow elevation of the reservoir serving the pressure zone.

1.3.10 Bolton Pressure Zone

The Bolton Pressure Zone serves lower elevation areas of the City on either side of Willamette Drive (Highway 43) south from Cedar Oak Drive to the mouth of Tanner Creek and encompasses approximately 1,250 acres. The Bolton Pressure Zone and subzones serve customers below an approximate ground elevation of 340 feet above mean sea level (msl). This pressure zone is directly connected to the SFWB transmission main and operates at an approximate hydraulic grade line (HGL) between 456.8 and 490 feet based on the Bolton Reservoir overflow elevation, the overflow elevation of the Mountainview Reservoir and the control valves at the DSPS discharge.

1.3.11 Horton Pressure Zone

The Horton Pressure Zone serves higher elevation areas of the City on the uphill side of I-205 and Willamette Drive and encompasses approximately 1,000 acres. The Horton Pressure Zone and subzones serve customers at ground elevations between 350 and 630 feet above msl. This pressure zone is served from the Horton Reservoir and operates at an HGL of approximately 730 feet.

1.3.12 Rosemont Pressure Zone

The Rosemont Pressure Zone serves the highest elevation areas in the City west of the Horton Pressure Zone, encompassing approximately 950 acres. The Rosemont Pressure Zone and subzones serve customers at ground elevations between 220 feet and 750 feet above msl. This pressure zone is served by the Rosemont Reservoir and operates at an HGL of approximately 860 feet.

1.3.13 Robinwood Pressure Zone

The Robinwood Pressure Zone is located at the northerly end of the City, encompassing approximately 560 acres. The Robinwood Pressure Zone serves customers at ground elevations below 220 feet above msl. The pressure zone is served by the View Drive Reservoir and operates at an HGL of approximately 328 feet.

1.3.14 Willamette Pressure Zone

The Willamette Pressure Zone is located at the southerly end of the City between I-205 and the Tualatin River, encompassing approximately 1,140 acres. The Willamette Pressure Zone serves customers at ground elevations between 100 feet and 280 feet above msl. This pressure zone is served by the Willamette Reservoir and operates at an HGL of approximately 351 feet.

1.3.15 Bland Pressure Zone

The Bland Pressure Zone is located on the north side of I-205 between the Horton and Willamette Pressure Zones and encompasses approximately 350 acres. The Bland Pressure Zone and its subzone serve customers at ground elevations between 280 feet and 475 feet above msl. This pressure zone is served by the Bland Reservoir and operates at an HGL of approximately 585 feet. In 2003, the Bland Pressure Zone was connected to the Horton Pressure Zone with a manually operated intertie to provide supplemental supply to the Bland Pressure Zone during peak demand periods. The intertie can supply approximately 100,000 gallons per day (gpd) to the Bland Pressure Zone.

1.3.16 Pressure Reducing Valves

Subzones of the six main pressure zones described above are served through a series of PRVs. The distribution system includes 31 PRV stations, creating 13 subzones. The PRV stations reduce the pressure from the main pressure zones to acceptable service levels at the lower elevations. Without these automatic reductions in pressure, the lower elevations would have unacceptably high pressures if operated directly off the pressures of the main zone. City staff operates, tests, and maintains the PRV stations on a routine basis. The latest PRV settings report from the City is included in Appendix B. The relative locations of the PRV stations are shown in **Figure 1-3**.

1.4 Pump Stations

The City's water system includes five finished water distribution system pump stations with a sixth located at the City's emergency supply connection with Lake Oswego. All distribution pump stations have flow meters to monitor instantaneous flow and total volume. Pump stations are summarized in **Table 1-3** and a brief description of each of are summarized in the following sections.

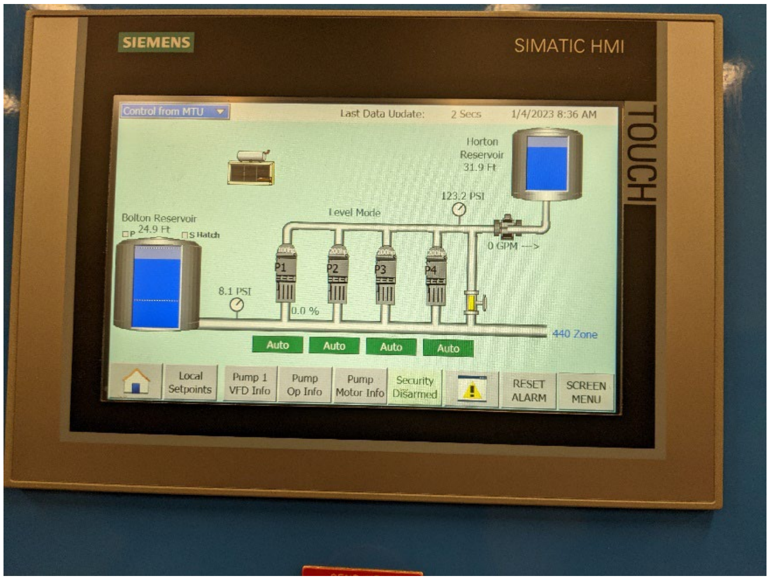
It should be noted that the five distribution pump stations are named after the pressure zone in which they are located, not the pressure zone that they supply. Pump operation is controlled by water levels in the corresponding reservoir, which are described in the reservoir section of this chapter.

1.4.1 Bolton Pump Station

Photo 1-1 | Bolton Pump Station

The Bolton Pump Station, located adjacent to the Bolton Reservoir, was originally constructed in 1999 and upgraded in 2016 during construction of the new Bolton Reservoir. The concrete structure pump station is currently equipped with four 1,500 gpm vertical turbine pumps. One pump is equipped with a variable frequency drive (VFD) and the other three pumps are constant speed. The station pumps water from the Bolton Reservoir to the Horton Pressure Zone through a 14-inch diameter transmission main. The pump station operates in a lead/lag 1/lag 2 configuration. To minimize programming issues, the pump assignments are not rotated. The pumps are controlled by the Supervisory Control and Data Acquisition (SCADA) system with control setpoints based on the water level in the Horton Reservoir. The pump station also includes an emergency standby diesel generator with an automatic transfer switch (ATS) in case of a power failure.

Photo 1-2 | Bolton Pump Station SCADA

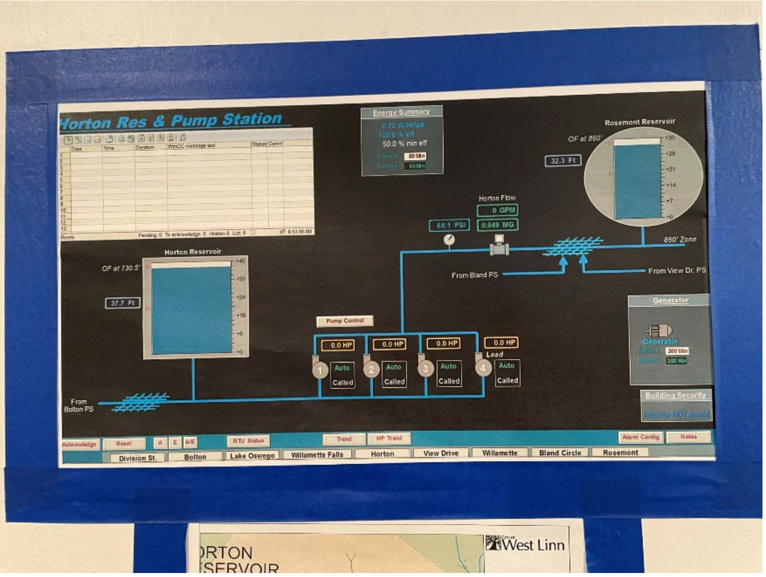


1.4.2 Horton Pump Station

Photo 1-3 | Horton Pump Station

The Horton Pump Station is a concrete and wood frame structure located adjacent to the Horton Reservoir. The Horton Pump Station contains four frame mounted end suction centrifugal pumps. The station pumps water from the Horton Reservoir to the Rosemont Reservoir through Rosemont Pressure Zone distribution piping. The pumps are controlled by the SCADA system with control setpoints based on the water level in the Rosemont Reservoir. Of the three pump stations that pump to the Rosemont Pressure Zone, Horton is the first pump station called to service. A low-level alarm in the Horton Reservoir stops pumping to the Rosemont Pressure Zone. The pump station operates in a lead/lag 1/lag 2 configuration. To minimize programming issues, the pump assignments are not rotated. The pump station also includes an emergency standby diesel generator with an ATS in case of a power failure. The pump station roof is planned to be replaced this year.

Photo 1-4 | Horton Pump Station SCADA

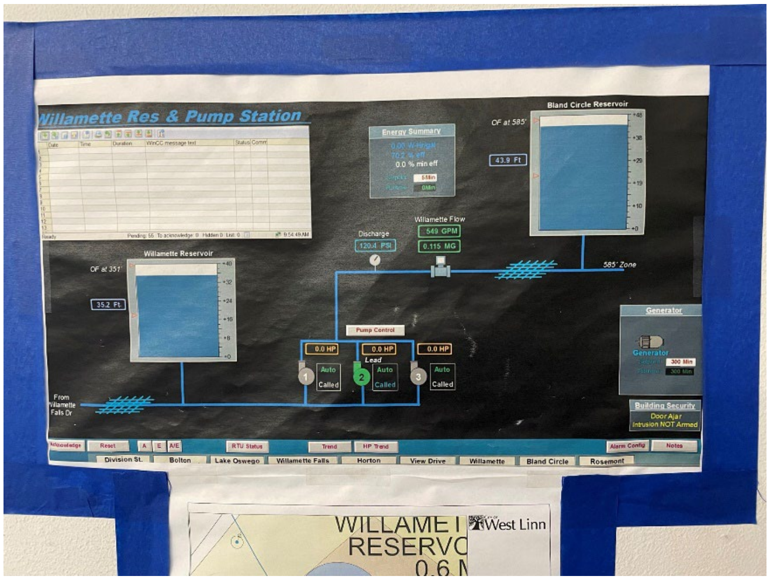


1.4.3 Willamette Pump Station

Photo 1-5 | Willamette Pump Station

The Willamette Pump Station is a concrete structure constructed in 1994 and located adjacent to the Willamette Reservoir. The station contains three 500 gpm can-type vertical turbine pumps. The station pumps water from the Willamette Reservoir to the Bland Pressure Zone. The pump station operates in a lead/lag 1/lag 2 configuration. To minimize programming issues, the pump assignments are not rotated. The pumps are controlled by the SCADA system with control setpoints based on the water level in the Bland Reservoir. The Willamette Reservoir provides suction supply to the pump station through a 16-inch diameter pipe. Piping improvements in a vault outside of the pump station were added to allow it to stay online if the reservoir is taken offline. The pump station also includes an emergency standby diesel generator with an ATS in case of a power failure.

Photo 1-6 | Willamette Pump Station SCADA

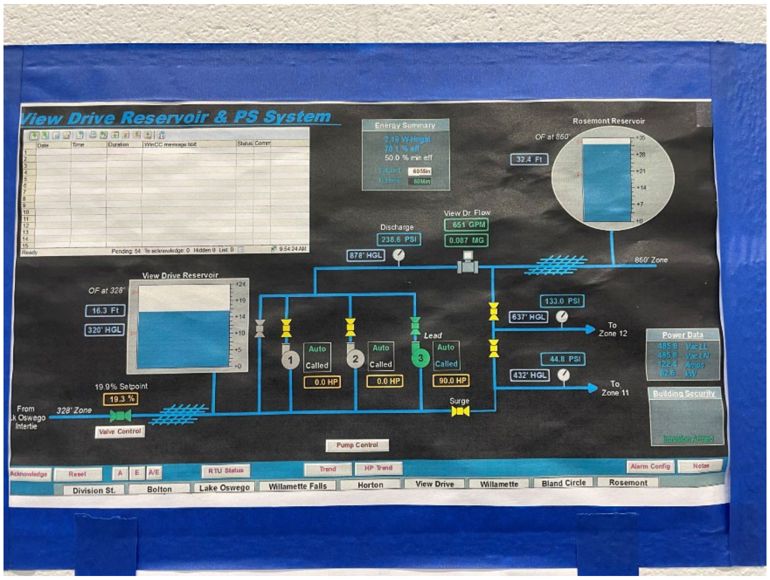


1.4.4 View Drive Pump Station

Photo 1-7 | View Drive Pump Station

The View Drive Pump Station is a concrete structure located at the View Drive Reservoir site. The pump station contains three 600 gpm can-type vertical turbine pumps. It pumps water from the View Drive Reservoir to the Rosemont Pressure Zone and supplies two subzones through PRVs connected to the pump station discharge. Of the three pump stations that pump to the Rosemont Pressure Zone, View Drive is the second pump station called to service. A low-level alarm in the View Drive Reservoir stops pumping to the Rosemont Pressure Zone. The pump station operates in a lead/lag configuration (the third pump is not currently in operation). To minimize programming issues, the pump assignments are not rotated. The pumps are controlled by the SCADA system with setpoints based on the water level in the Rosemont Reservoir. The pump station also includes a manual transfer switch and plug for a portable emergency generator.

Photo 1-8 | Valley View Pump Station SCADA



1.4.5 Bland Pump Station

Photo 1-9 | Bland Pump Station

The Bland Pump Station was constructed in 2015 and is a concrete masonry block structure located at the Bland Reservoir site. The station contains three 600 gpm vertical turbine pumps. The station pumps water from the Bland Reservoir to the Rosemont Pressure Zone. Of the three pump stations that pump to the Rosemont Pressure Zone, Bland is the third pump station called to service. A low-level alarm in the Bland Reservoir stops pumping to the Rosemont Pressure Zone. The pump station operates in a lead/lag configuration. To minimize programming issues, the pump assignments are not rotated. Each pump has a VFD and is controlled by the SCADA system with setpoints based on the water level in the Rosemont Reservoir. The pump station includes manual transfer switch equipment, but the system has not been wired or connected yet.

Photo 1-10 | Bland Pump Station SCADA

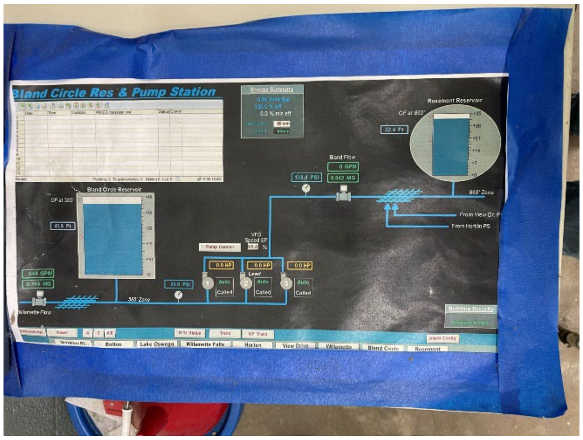


Table 1-3 | Pump Station Summary

Pump Station	From Zone	To Zone	No. of Pumps & Capacity (gpm)	Station Capacity (gpm)	Firm Capacity (gpm)	Pump Type	Emergency Power
Bolton	Bolton	Horton	3 @ 1,500 1@ 900	5,400	3,900	Vertical turbine	Onsite Generator & ATS
Horton	Horton	Rosemont	2 @ 1,300; 2 @ 900	4,400	3,100	Vertical turbine	Onsite Generator & ATS
Willamette	Willamette	Bland	3 @ 500	1,500	1,000	End-suction centrifugal	Onsite Generator & ATS
View Drive	View Drive	Rosemont	3 @ 600	1,800	1,200	Vertical turbine	Portable generator rental is required for emergency power
Bland	Bland	Rosemont	3 @ 600	1,800	1,200	Vertical turbine	Not equipped with emergency power connection

1.5 Storage Reservoirs

The City owns six finished-water storage facilities with a combined storage capacity of 7.5 million gallons (MG). **Table 1-4** provides details of the six reservoirs serving the City. Also presented below is a brief discussion of each reservoir.

Table 1-4 | Reservoir Summary

Reservoir	General Location	Capacity (MG)	Overflow Elevation (ft)	Year Built	Coating Age (yrs) Interior/Exterior	Tank Type	Seismic Code
Bolton	Skyline Drive	4.0	456.8	2017	2017/2017	Prestressed Concrete	Current
Horton	Horton Road & Santa Anita Drive	1.5	730	1974	Unknown/Unknown	Welded Steel	Unknown
Rosemont	Suncrest Drive	0.4	860	1993	2017/2017	Welded Steel	Unknown
Bland Circle	Bland Circle	0.5	585	1980	2009/2009	Welded Steel	Unknown
Willamette	Salamo Road	0.6	351	1970	2003-2008/ 2003-2008	Welded Steel	Unknown
View Drive	View Drive	0.5	328	1967	Unknown/Unknown	Welded Steel	Unknown

Each reservoir and corresponding pressure zone has at least one supply source as illustrated in the schematic, **Figure 1-3**. Operation of the source pump station or PRV is controlled by reservoir setpoints, which may vary depending on the season. **Table 1-5** summarizes the “start” and “stop” control setpoints as reservoir depth.

Table 1-5 | Reservoir Supply Control Setpoints

Reservoir/Zone	Supply Source	Control Setpoints (Reservoir Depth) On Setpoint (feet) – Off Setpoint (feet)		Alarm Setpoints (Reservoir Depth) High/Low (feet)
		Summer	Winter	
Bolton	Control Valves at DSPS	23.5’ - 26.0’	18.5’ - 26.0 ‘	13.5’/7.0’
Horton	Bolton Pump Station	Lead: 33.0’ – 38.0 Lag 1: 31.0’ – 35.0’ Lag 2: 28.0’ – 33.0’ VFD: 27.0’ – 30.0’	Lead: 28.0’ – 38.0’ Lag 1: 26.0’ – 35.0’ Lag 2: 24.0’ – 33.0’ VFD: 18.0’ – 20.0’	39.5’/19.5’
Willamette	WFC PRV	37.0’ - 38.0’	32.0- 38.0’	39.5’/18.0’
View Drive	LO Intertie Pump Station	15.0’ - 17.0’	13.0’ - 17.0’	22.0’/10.0’
Bland	Willamette Pump Station	Lead: 42.0’ – 45.0’ Lag 1: 38.0’ – 41.0’ Lag 2:35.0’ – 40.0’	Lead: 38.0’ – 45.0’ Lag 1: 35.0’ – 41.0’ Lag 2: 32.0’ – 40.0’	45.0’/25.0’
Rosemont	Bland Pump Station	Not Available	Lead: 23’ – 31’ Lag: 20’ – 22’	34.5’/20.0’
	Horton Pump Station	Not Available	Lead: 25’ – 31’ Lag 1: 22’ – 30’ Lag 2: 19’ – 23’	
	View Drive Pump Station	Not Available	Lead: 24’ – 31’ Lag: 21’ – 23’	

1.5.1 Bolton Reservoir

The existing Bolton Reservoir, located on Skyline Drive, is a pre-stressed concrete (AWWA D110) reservoir with a 4 MG capacity that is built to current seismic code. The reservoir was constructed in 2017-2018, replacing the original 1915 built, 2.5 MG Bolton Reservoir. Supply to the Bolton Reservoir is provided by the SFWB DSPS and is controlled by two ball valves installed on the 24-inch transmission line. The Bolton Reservoir provides gravity supply to the Bolton Pressure Zone and suction supply to the Bolton Pump Station.

Photo 1-11 | Bolton Reservoir

1.5.2 Horton Reservoir

The Horton Reservoir, located at the intersection of Horton Road and Santa Anita Drive, is a 1974 built, 1.5 MG ground level welded steel reservoir that is not built to current seismic code. The exterior coating was updated in 2003-2008 but the age and condition of the interior coating is unknown. Supply to the Horton Reservoir is provided by the Bolton Pump Station, which is controlled by the depth of water in the reservoir. The Horton Reservoir provides gravity storage to the Horton Pressure Zone and suction supply to the Horton Pump Station.

Photo 1-12 | Horton Reservoir

1.5.3 Rosemont Reservoir

The Rosemont Reservoir, located on Suncrest Drive, is a 1984 built, 0.4 MG elevated welded steel, spheroid tower that is not built to current seismic code. The interior and exterior coatings were updated in 2016-2017 but have not been inspected since the upgrade. Supply to the Rosemont Reservoir is provided by the Horton Pump Station, View Drive Station, and Bland Pump Station which are controlled by water levels in the reservoir. The Rosemont Reservoir provides gravity supply to the Rosemont Pressure Zone and also to the Horton Zone Pressure Zone through a dedicated PRV.

Photo 1-13 | Rosemont Reservoir

1.5.4 Bland Reservoir

The Bland Reservoir, located on Bland Circle, is a 1980 built, 0.5 MG ground level welded steel reservoir that is not built to current seismic code. The interior and exterior coatings were updated in 2009 but have not been inspected since the upgrade. Supply to the Bland Reservoir is provided by the Willamette Pump Station, which is controlled by water levels in the reservoir. The Bland Reservoir provides gravity supply to the Bland Pressure Zone and suction supply to the Bland Pump Station.

Photo 1-14 | Bland Reservoir

1.5.5 Willamette Reservoir

The Willamette Reservoir, located on Salamo Road, is a 1970 built, 0.6 MG ground level welded steel reservoir that is not built to current seismic code. The interior and exterior coatings were updated in 2003-2008 but have not been inspected since the upgrade. Supply to the Willamette Reservoir is provided by the transmission main from the Bolton Pressure Zone and controlled by an altitude valve. The Willamette Reservoir provides gravity supply to the Willamette Pressure Zone and suction supply to the Willamette Pump Station.

Photo 1-15 | Willamette Reservoir

1.5.6 View Drive Reservoir

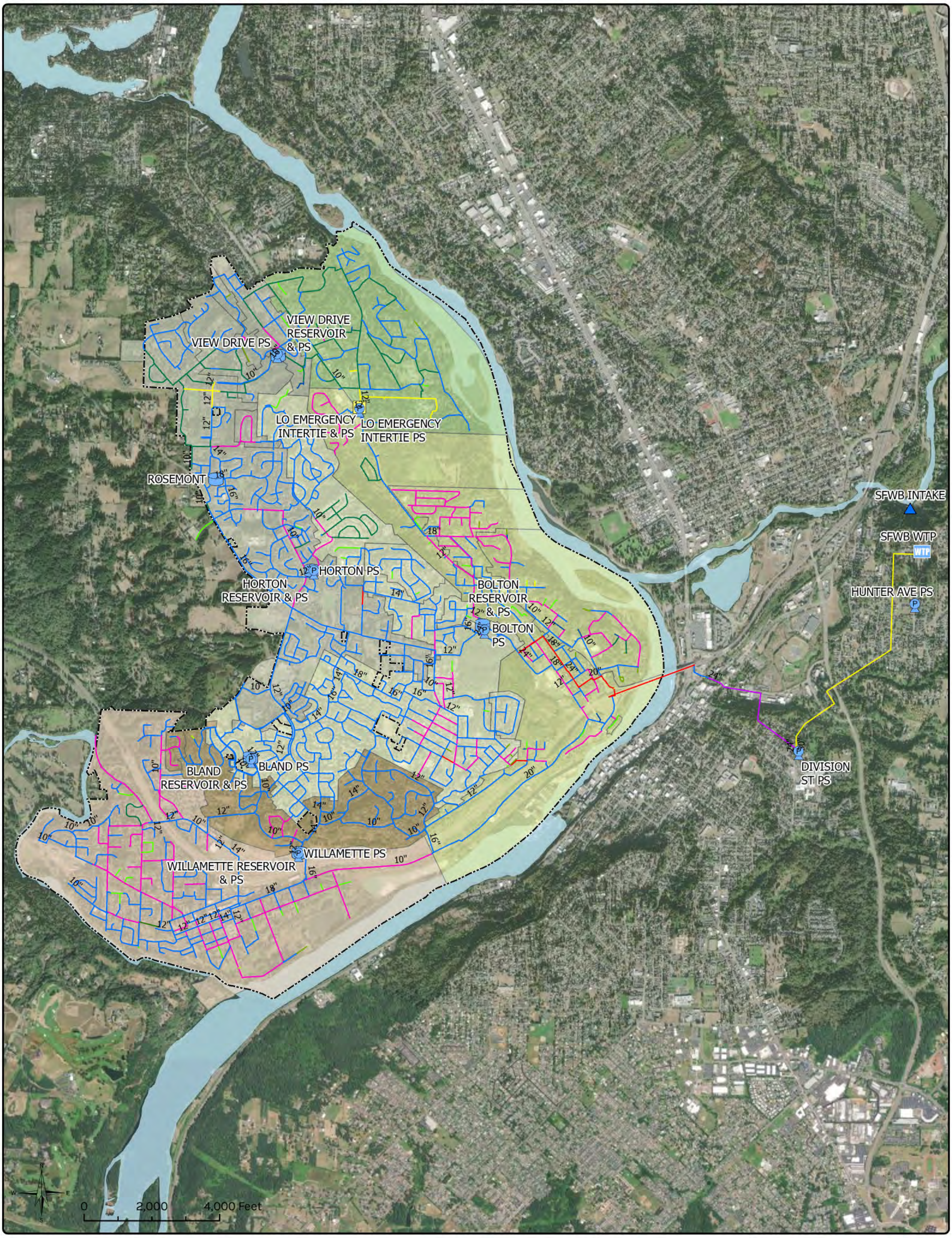
The View Drive Reservoir, located on View Drive, is a 1967 built, 0.5 MG ground level welded steel reservoir that is not built to current seismic code. The age and condition of the exterior and interior coatings are unknown. Supply to the View Drive Reservoir is provided by the transmission main from the Bolton Pressure Zone and controlled by a PRV and altitude valve located near the Lake Oswego Intertie Pump Station. The View Drive Reservoir provides gravity supply to the Robinwood Pressure Zone and suction supply to the View Drive Pump Station.

Photo 1-16 | View Drive Reservoir

1.6 Distribution System

The City's water service area distribution system is composed of various pipe types in sizes up to 24 inches in diameter. The total length of piping in the service area is approximately 120 miles. The pipe types include cast iron, ductile iron, polyvinyl chloride (PVC), steel, asbestos cement (AC), concrete cylinder pipe, copper, and galvanized iron. The oldest piping in the system likely dates back to 1915 when the SFWB was first established.

Based on data from the City's geographic information system (GIS) pipeline database, more than 80 percent of the pipe in the City is ductile iron or cast iron. Approximately 8.8 percent is AC and the remaining 11 percent is PVC, steel, concrete cylinder pipe, copper, polybutylene, and unknown material. **Table 1-6** presents a summary of pipe material, length, and percentage within the distribution system and **Figure 1-4** illustrates the existing pipe material in the system.



Legend

- ▲ SFWB Intake
- WTP SFWB WTP
- I Emergency Intertie
- P Pump Station
- Reservoir

Mains

MATERIAL

- AC
- CAS; CI
- CCP
- CP
- CU
- DIP; DI
- GL
- PB
- PVC
- ST; SP
- WI

Pressure Zone

Zone

- Bland
- Bolton
- Horton
- Robinwood
- Rosemont
- Willamette
- City Limits

City of West Linn

consor

Water System Master Plan

Figure 1-4
Existing Pipe Material

Project No: 22-3537

March 2024

Data Sources: City of West Linn, 2022; World Imagery: Maxar.
Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Disclaimer: Consor and Client make no representations, express or implied, as to the accuracy, completeness and timeliness of the information displayed. This map is not suitable for legal, engineering, or surveying purposes.
Notification of any errors is appreciated.

Table 1-6 | Length of Transmission and Distribution Piping by Diameter and Material

Diameter (in)	Ductile Iron (if)	Galvanized & Steel (lf)	Asbestos Concrete (lf)	Cast Iron (lf)	Other (lf)	Total (miles)	% of Total
Less than 6	25,642	4,205	1,088	10,095	13,795	10.4	8.8%
6	131,292	610	41,488	82,408	5,388	49.4	41.7%
8	159,048	-	8,635	11,248	-	33.9	28.6%
10	27,123	-	4,758	10,533	-	8.0	6.8%
12	25,503	-	-	1,734	-	5.2	4.4%
14	15,268	104	-	-	-	2.9	2.5%
16	10,532	-	-	-	-	2.0	1.7%
18	14,511	2,723	-	-	1,446	3.5	3.0%
20	7,642	1,558	-	-	-	1.7	1.5%
24	806	2,702	-	-	4,194	1.5	1.2%
Total (miles)	79.0	2.3	10.6	22.0	4.7	118.5	100%
% of Total	66.7%	1.9%	8.9%	18.5%	4.0%	100%	

According to billing records, there are approximately 9,400 water meters throughout the water system. Approximately 96 percent of these meters are residential, 5/8 x 3/4-inch meters. Most of the remaining meters are 1-inch, 1½-inch, and 2-inch meters that serve multifamily housing, commercial, and public facilities. Billing records indicate there are 26 3-inch meters and six 6-inch meters. Of the 6-inch meters, three are categorized as "A" (apartments) and three are categorized as "P" (public) and located in the Mary S. Young State Recreational Area.

Meter sizes are typically calculated by the City according to the number of fixtures associated with that meter. Meter classifications are assigned according to the type of use, i.e., residential, commercial, etc. **Table 1-7** summarizes quantities for each meter size and classifications for the system.

Table 1-7 | Summary of Existing Meter Classification and Size

Account Classification	Meter Size							
	5/8"	¾"	1"	1 ½"	2'	3"	6"	Total
Residential	8,138	829	146	8	3	0	0	9,124
Apartments & Multi-Family	67	1	13	18	22	10	3	134
Commercial	59	2	29	38	14	8	0	150
Public	9	1	10	7	15	8	3	53
Total	8,273	833	198	71	54	26	6	**9,461**

1.7 Supervisory Control and Data Acquisition

City staff control and monitor the City's water system facilities through the SCADA system. A SCADA system is a combination of hardware and software that enables process automation by capturing real-time data and providing a Human Machine Interface (HMI) for control. **Figure 1-5** shows a screenshot of the Water System Overview at the HMI.

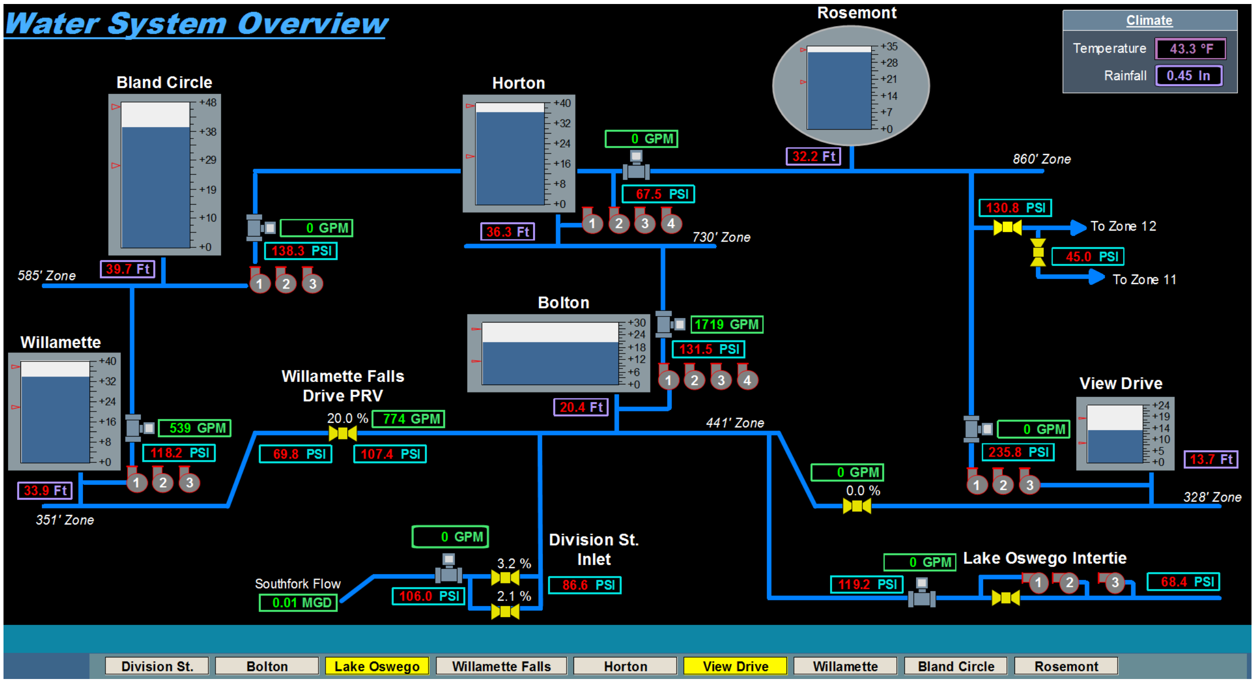


Figure 1-5 | Water System Overview SCADA

Remote telemetry units and programmable logic controllers are connected to pressure transducer sensors and motor controls actuators. Both units have embedded ladder logic control capabilities and are networked to the supervisory computer system through the communication infrastructure. The SCADA HMI at the operations center provides operators with a real time graphical output of operational status of the pump stations, storage levels, flow rate, and system pressures. The HMI is linked to the supervisory computers to provide live data to drive system diagrams, alarm displays, and trending graphs. The HMI also gives the operator the ability to switch a pump on or off or alter sequencing. Building security status and generator run time are also available. **Figure 1-6** shows a typical HMI screen of a reservoir and pump station. **Figure 1-7** shows a PRV.

Figure 1-6 | Bolton Reservoir and Pump Station SCADA

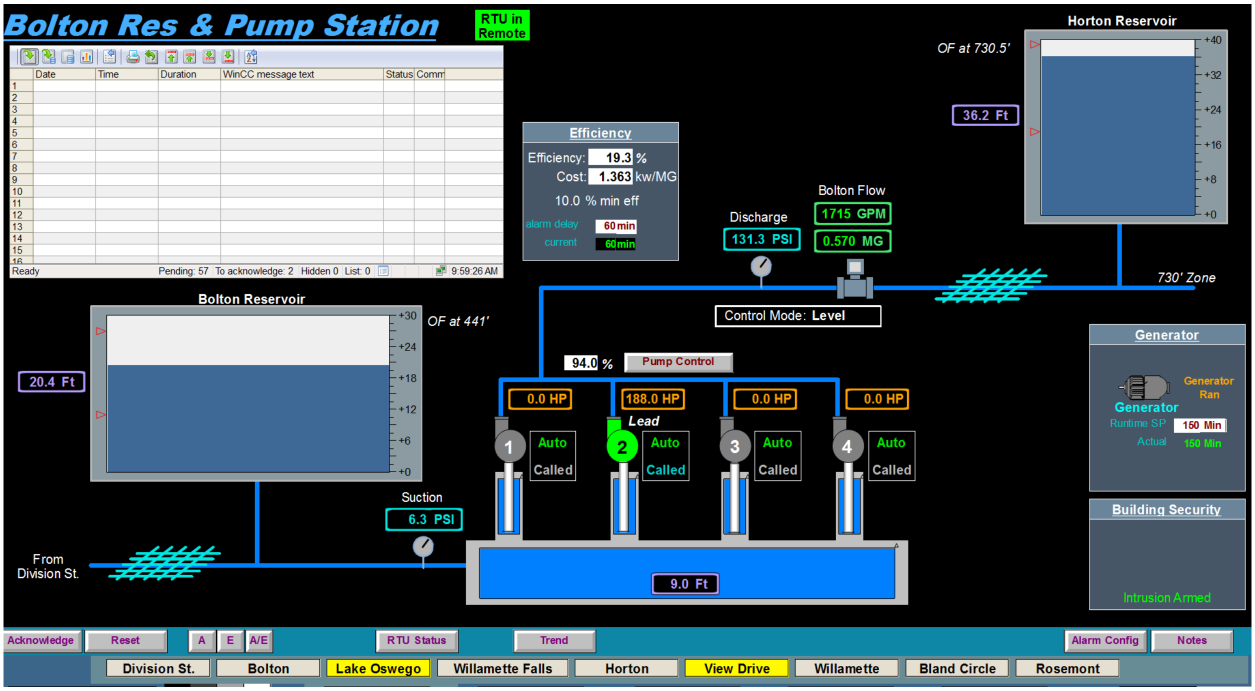
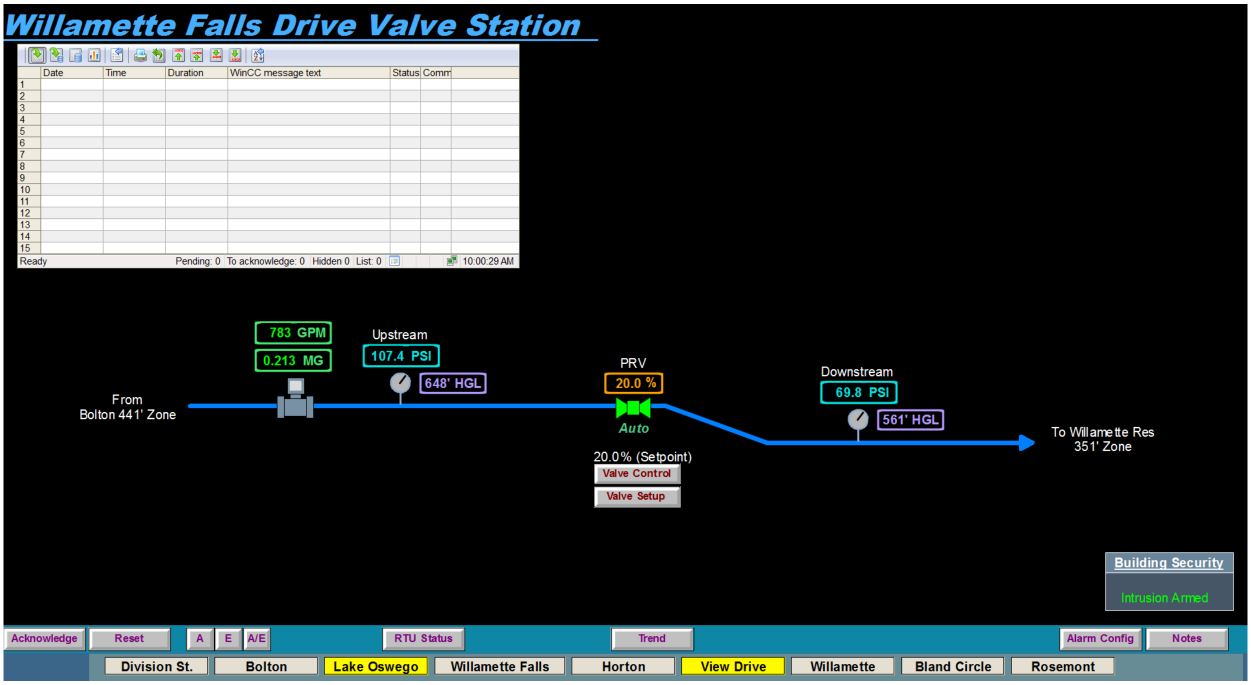


Figure 1-7 | Willamette Falls Drive PRV SCADA



The SCADA system also provides alarm signals when operational conditions require immediate attention. The SCADA system activates a visual alarm at the HMI and initiates an automated sequence of phone calls. These alarm conditions may include:

- Line power outage
- Communication fault

- Pump fault/failure to start
- Reservoir low level condition
- Reservoir high level condition
- High discharge pressure/low suction pressure
- Free chlorine residual exceedance

CHAPTER 2

Planning Data

This chapter evaluates the historical demand of the City's water system and available data on historical population and projected growth rates for the determination of future projected population growth and demand. Water demand forecasts presented in this chapter are used with the performance criteria presented in **Chapter 3** to evaluate the existing water system's capacity to serve current demand and future growth. Demand forecasts are developed from historical water consumption and production records, regional planning data, current land use designations, and previous City water planning efforts.

2.1 Existing and Future Water Service Area

As illustrated in **Figure 1-1**, the City's service area encompasses all areas within the existing city limits and a limited number of historical customers located outside the city limits. The service area is not expected to change over the planning period.

2.2 Planning Period

The planning period for this WSMP is 20 years, through the year 2043, consistent with OAR requirements for WSMPs (OAR 333-061).

2.3 Water Demand Description

Water demand refers to all finished water required by the system including residential, commercial, industrial, and institutional uses. Water demands are described using three water use metrics: average daily demand (ADD), maximum day demand (MDD), and peak hour demand (PHD). Each of these metrics is stated in gallons per unit time such as MGD and in gallons per capita per day (gpcd). The methodology used in this WSMP is described below.

- ADD was calculated as the total demand for a given year divided by 365 days.
- MDD is the largest daily water volume for a given year. In western Oregon, MDD typically occurs each year between June 1st and September 30th.
- PHD is estimated as the largest hour of demand on the peak water use day.

2.3.1 Water Consumption

Water consumption data is obtained from the City's customer billing records and includes all revenue metered uses. This data can be analyzed by geographical location and customer type which is useful for quantifying typical water use for different land uses. However, consumption data does not capture any water loss or unmetered uses and is typically only recorded in monthly totals making it less useful in determining system-wide peak daily demands.

2.3.2 Water Production

The City's total daily water production is the sum of finished water flow measured at the DSPS (SFWB Supply) and at the Emergency Intertie Pump Station (Lake Oswego supply). Total water production is used for analyzing seasonal water demand trends, supply, and storage capacity. Water production includes billed consumption (customer billing records), unmetered uses such as hydrant flushing, and water loss through minor leaks and unregulated use.

2.3.3 Unaccounted For Water

The difference between water production and water consumption is known as unaccounted for water and typically consists of two components:

- Unbilled consumption that can be tracked, such as operational, flushing, and construction use.
- Unbilled water that cannot be tracked, such as firefighting, leaks, main breaks, metering inaccuracies, illegal connections, and other types of unmetered water use.

The City's average unaccounted for water for 2020-2022 was 10.1 percent. This is considered typical for a system of the City's size, infrastructure age, and customer makeup. Due to the relatively low percentage of water loss, the City does not currently have a water loss reduction framework in place. If average water loss were to increase, the City should consider developing a water loss reduction program. A typical water loss reduction program includes annual water audits, replacement of master meters, a meter testing and maintenance program, and leak detection studies to help prioritize main replacement programs. For a system similar to the City's, water loss above 15 percent would typically be considered high water loss.

Table 2-1 shows the historical volume and percentage of water loss.

2.4 Historical Water Demand

System-wide historical production and consumption demand is tabulated in **Table 2-1**. Water consumption was calculated from the City's monthly billing data. Unmetered water use in the City is minimal and not recorded; therefore, it was not included in the consumption analysis. Consumption data from 2020-2022 was used for the consumption analysis.

Water production is calculated as finished water supplied from the SFWB WTP minus the corresponding change in reservoir volumes. Water supplied from the Lake Oswego Emergency Intertie was added to the total when emergency supply conditions were in place. Unmetered water use is included in the production volume.

Table 2-1 | Historical Water Demand

Year	Production Total (MG)	Consumption Total (MG)	Water Loss (MG)	Water Loss (%)
2018	1149	-	-	-
2019	1109	-	-	-
2020	1051	953	97	9.3%
2021	1163	1042	121	10.4%
2022	1041	929	111	10.7%
Average	**1103**	**975**	**110**	**10.1%**

The majority of demand on the City's water system is associated with residential demand. **Table 2-2** summarizes the historical demand by customer classification as a percentage. The allocation of demand among classifications has been relatively consistent and is expected to remain so over the planning period.

Table 2-2 | Historical Demand by Customer Classification by Percentage

Customer Classification	2020	2021	2022
Residential	82.13%	82.16%	81.23%
Multi-Family and Apartments	11.01%	10.39%	11.31%
Commercial	4.40%	4.56%	4.74%
Public	2.46%	2.88%	2.74%

2.4.1 Historical Demand Metrics and Peaking Factors

The historical data presented above was used to calculate the demand metrics and peaking factors that are used later in this chapter to calculate demand projections. Demand projections must factor in water loss and unaccounted for water; therefore, production data is more accurate than consumption data for this purpose.

2.4.1.1 Demand Metrics

System-wide historical demand metrics are tabulated in **Table 2-2**.

- ADD: Calculated by dividing the total annual production demand for each year by 365.
- MDD: The date with the highest production demand was determined for each year.
- PHD: Hourly data from the SFWB DPSP and City SCADA were available and used to determine the maximum hourly production demand for the maximum day. The maximum hourly demand from the maximum day was multiplied by 24 hours.

2.4.1.2 Peaking Factors

The peaking factors, or ratios, of ADD:MDD and MDD:PHD were calculated for each year.

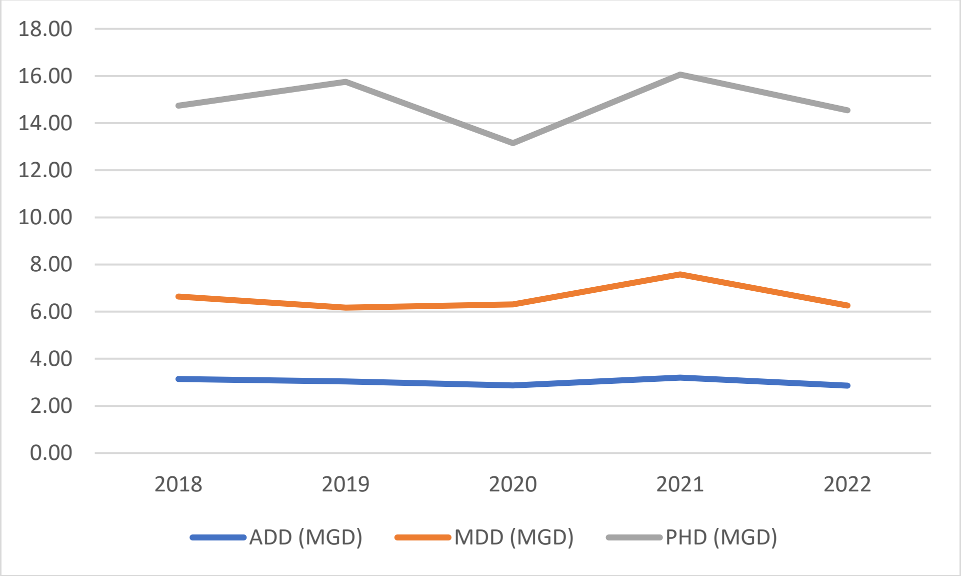
The historic ADD, MDD, PHD, and peaking factors are summarized in **Table 2-3**. **Figure 2-1** illustrates the historical ADD, MDD, and PHD.

In general, peaking factors have stayed relatively consistent and within a narrow range. To provide a more conservative approach to MDD and PHD projections, the maximum peaking factor of 2.37 for ADD:MDD and 2.32 for MDD:PHD were selected future demand projections.

Table 2-3 | Historical ADD, MDD, PHD and Peaking Factors

Year	ADD (MGD)	MDD (MGD)	PHD (MGD)	Peaking Factors	
				ADD:MDD	MDD:PHD
2018	3.14	6.64	14.74	2.11	2.22
2019	3.04	6.17	15.75	2.03	2.23
2020	2.87	6.31	13.15	2.20	2.09
2021	3.20	7.58	16.06	2.37	2.12
2022	2.86	6.26	14.54	2.19	2.32
Max Value	**3.20**	**7.58**	**16.06**	**2.37**	**2.32**

Figure 2-1 | Historical ADD, MDD, and PHD



2.4.2 Historical Water Demand by Pressure Zone, Customer Type, and Land Use

Consumption records provided by the City were used to document average daily water consumption by pressure zone. **Table 2-4** presents ADD, MDD, and PHD by zone, based on the geolocated billing records. The pressure zones with the highest water use (MDD basis) in the system are Horton and Rosemont.

Table 2-4 | Historical ADD, MDD, PHD by Pressure Zone

Pressure Zone	ADD (MGD)	MDD (MGD)	PHD (MGD)	Percentage (%)
Bolton	0.36	0.86	2.00	12.60%
Horton	0.76	1.80	4.16	26.30%
View Drive	0.22	0.53	1.23	7.75%
Rosemont	0.69	1.63	3.78	23.85%
Willamette	0.52	1.24	2.87	18.10%
Bland	0.33	0.78	1.81	11.40%
Total	**2.88**	**6.83**	**15.84**	**100.00%**

Consumption records provided by the City were used to document historical consumption by customer classification. The average total residential consumption for 2020-2022 was 81.84 percent. **Table 2-5** tabulates historical consumption and associated percentages by customer classification.

Table 2-5 | Historical Consumption by Customer Classification

Customer Classification	Billed Consumption					
	2020		2021		2022	
	Gallons	%	Gallons	%	Gallons	%
Residential	775,211,492	81.32%	848,646,392	81.42%	748,022,440	80.48%
Residential (Low Income Disc)	6,452,248	0.68%	6,297,412	0.60%	5,794,756	0.62%
Residential Outside	1,261,128	0.13%	1,496,748	0.14%	1,122,748	0.12%
Multi-Family	4,845,544	0.51%	5,053,488	0.48%	4,575,516	0.49%
Apartments	100,081,652	10.50%	103,295,060	9.91%	100,454,904	10.81%
Commercial	41,965,044	4.40%	47,512,960	4.56%	44,032,516	4.74%
Fire	48,620	0.01%	59,840	0.01%	57,596	0.01%
Public Facility	10,963,436	1.15%	16,520,328	1.58%	16,010,940	1.72%
Compound Meter	12,471,404	1.31%	13,479,708	1.29%	9,370,944	1.01%
Total	**953,300,568**	**100%**	**929,442,360**	**100%**	**2,925,104,864**	**100%**

2.4.3 Historical Per Capita Water Demand

Historical population data was obtained from the Portland State University Population Research Center (PSU PRC). The PSU PRC provides annual population estimates for all Oregon cities. United States Census data and PSU PRC population estimates were used to estimate historical populations for 2010 and later.

The historical population data and corresponding ADD were used to calculate annual per capita usage. The results indicate a downward trend, possibly due to the City's efforts towards a more efficient usage of their source water. It should be noted that the 2008 WSMP chose a conservative rate of 140 gpcd for ADD projections, which proved to be much higher than any recorded demand in subsequent years. For the purpose of this WSMP, it is assumed that per capita demand will continue to trend downwards or stay relatively constant. An ADD demand of 104 gpcd is selected for calculating projected demand.

Table 2-6 | Historical ADD Per Capita

Year	ADD (MGD)	Population*	ADD gpcd
2002	3.5	23,430	149
2003	3.3	23,820	139
2004	3.3	23,970	138
2005	3.0	24,075	125
2006	3.1	24,615	126
2018	3.14	25,830	122
2019	3.04	25,905	117
2020	2.87	27,373	105
2021	3.20	27,452	116
2022	2.86	27,420	104

Note:
*Source of data is Portland State University Population Research Center (PSUPRC).

2.4.4 High Demand Users

The City's consumption billing records indicate the highest demand users are associated with large apartment complexes and are generally located in the same areas within the Willamette and Bland Pressure Zones. **Table 2-7** tabulates the high demand users, number of units, meter size, and 2020-2022 consumption.

Table 2-7 | High Water Demand Customers

Customer Address	Dwelling Units	Meter Size (in)	Customer Classification	Pressure Zone	2020 – 2022 Total Consumption (gal)
4701 Summerlinn Way	96	6	Apartment	Bland	42,511,832
2101 Snowberry Ridge	116	6	Apartment	Willamette	19,111,400
4000 Summerlinn Drive	40	6	Apartment	Bland	17,713,388
400 Springtree	95	6	Apartment	Willamette	15,651,900
3101 Summerlinn Drive	84	6	Apartment	Willamette	13,838,748

2.5 Future Water Demand Forecast

Future system demands are the sum of residential and non-residential projections. The majority of the City's water system serves residential customers. It is been assumed that any growth in commercial or industrial use over the planning period will remain proportional to the residential population. Additionally, unmetered water use in the system is low and assumed to remain proportional to any residential growth. Therefore, no adjustments to the residential per capita demand will be made for commercial, industrial, or unmetered demand when calculating system wide demand over the planning period.

2.5.1 Residential Densification, Housing Choices – HB 2001

In 2019, the Oregon legislature passed House Bill (HB) 2001. HB 2001 is landmark legislation that preempts local zoning regulations by doing away with the exclusively single unit residential zoning within the Portland regional UGB and within cities with a population of at least 25,000 persons elsewhere in the state. For these cities, HB 2001 requires that local zoning allow duplexes on any lot that allows a single unit dwelling as well as triplexes, quadplexes, townhouses and cottage clusters in areas zoned for single unit housing. Development Code amendments complying with HB 2001 were to be adopted by June 2022.

While it's clear that HB 2001 allows for higher density development within areas zoned for single unit homes, it is uncertain what impact the legislation might have on demand for public services. HB 2001 provides some guidance to cities for the purposes of utility planning. For infill areas, HB 2001 allows for a housing capacity increase of one percent over current estimates. In newly developing urban growth areas, HB 2001 allows for a housing capacity increase of three percent. Until the impacts of HB 2001 are better understood, it is assumed that the legislation will have marginal impacts on anticipated development levels, thus the potential increase in population resulting from HB 2001 was not included in the population projections in the analysis for this WSMP.

2.5.2 Future System Wide Growth and Demand

Projected population growth in this WSMP is based on forecasts developed for the City by the Regional Water Providers Consortium (RWPC) in 2019. The RWPC forecast indicates an annual growth rate ranging between 0.31 and 0.73 percent, a 20-year average annual growth rate (AAGR) of 0.51 percent and a total projected 10.5 percent increase in population over the planning period. The historical population developed by the PSU PRC is the basis for projections over the planning period. Future water demands were forecasted at 5, 10, 15, and 20 years for this WSMP. **Table 2-8** and **Table 2-9** summarize and **Figure 2-2** illustrates the historical population (2010-2022) and projected population (2023-2043).

Table 2-8 | Historical Population Growth

Year	Population	Source
2010	25,109	U.S. Census
2018	25,830	PSU PRC certified estimate
2019	25,905	PSU PRC certified estimate
2020	27,373	U.S. Census
2021	27,452	PSU PRC[1] certified estimate
2022	27,420	PSU PRC[1] certified estimate
2023	27,618	

Table 2-9 | Projected Population Growth

Year	Population	5-Year AAGR	Source
2023	27,618	0.68%	Projected AAGR developed from SFWB - West Linn RWPC Forecast (June 2018)
2028	28,556		
2028	28,556	0.59%	
2033	29,395		
2033	29,395	0.42%	
2038	29,991		
2038	29,991	0.35%	
2043	30,516		

Figure 2-2 | Historical and Projected Population Growth

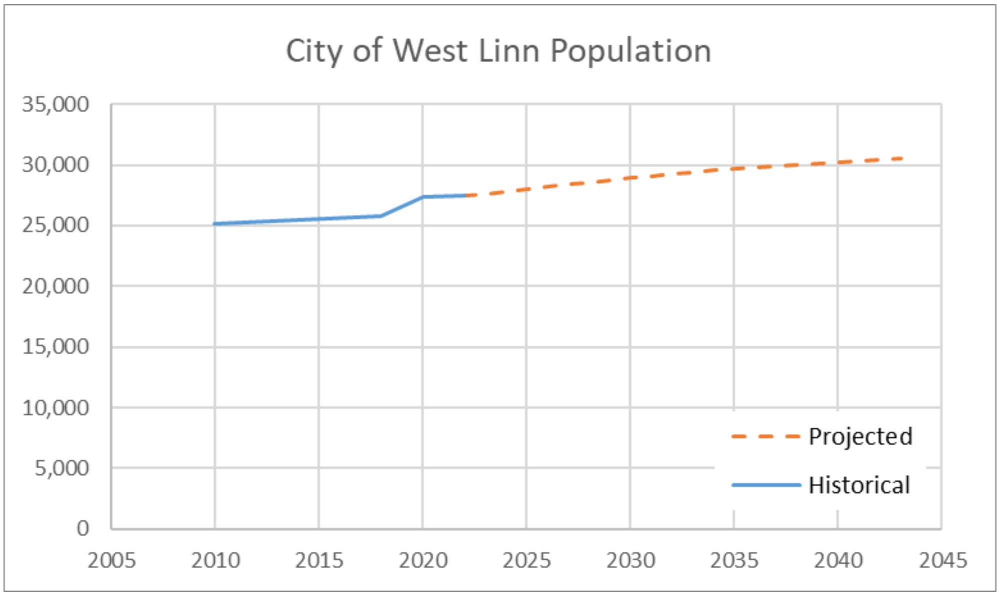


Table 2-10 tabulates the calculated ADD, MDD and PHD over the planning period. This information will be used with the performance criteria to evaluate the existing water system's capacity to serve current demand and future growth.

Table 2-10 | Projected Water Demand Summary

Year	Population	ADD (MGD)[1]	MDD (MGD)[2]	PHD(MGD)[3]
2028	28,556	2.97	7.04	16.33
2033	29,395	3.06	7.25	16.81
2038	29,991	3.12	7.39	17.15
2043	30,516	3.17	7.52	17.45

Notes:
1. Assumed ADD per capita of 104 gpcd per Table 2-4.
2. Peaking factor of 2.37 * ADD
3. Peaking factor of 2.32 * MDD

2.5.3 Projected Water Demand by Pressure Zone

Water demand by pressure zone is used with performance criteria presented in **Chapter 3** to analyze the capacity of water facilities supplying each zone. The projected demand by pressure zone is based on the same percentages indicated in **Table 2-3**.

Table 2-11 | Projected 2043 Water Demand by Zone

Pressure Zone	ADD (MGD)	MDD (MGD)	PHD (MGD)	Percentage (%)
Bolton	0.40	0.95	2.20	12.60%
Horton	0.84	1.97	4.59	26.30%
View Drive	0.24	0.57	1.34	7.75%
Rosemont	0.76	1.80	4.16	23.85%
Willamette	0.58	1.37	3.16	18.10%
Bland	0.35	0.86	2.00	11.40%
Total	**3.17**	**7.52**	**17.45**	**100.00%**

CHAPTER 3

Performance Criteria

3.1 Introduction

This chapter documents the performance criteria used for analysis of the City's water supply and distribution system. Criteria are established for evaluating water supply, distribution system piping, service pressures, and storage and pumping facilities. Recommended water needs for emergency fire suppression are also presented. These criteria are used in conjunction with the water demand forecasts developed in **Chapter 2** to complete the analysis of the City’s water system presented in **Chapters 4, 5, 6** and **7** of this WSMP.

3.2 Performance Criteria

The water distribution system should be capable of operating within certain performance limits under varying customer demand and operational conditions. The recommendations of this plan result from evaluations based on the performance criteria listed in this chapter and summarized in **Table 3-3**. The performance guidelines have been developed through review of City design standards, State requirements, American Water Works Association (AWWA) acceptable practice guidelines, the *Ten States Standards*, the *Washington State Water System Design Manual*, and practices of other water providers in the region.

3.3 Water Supply Performance Criteria

The water supply should be capable of providing adequate peak season (summer) supply firm capacity to meet the future MDD projections. Water supply adequacy is measured based on firm capacity of facilities. For a WTP, this is the total plant capacity with the largest single treatment train out of service. For a pump station, such as the Emergency Intertie, this is the capacity with the largest pump out of service. If the City develops additional supply sources/systems, consideration should be given to the firm capacity of the source/system.

3.4 Transmission Main Performance Criteria

The finished water transmission mains should be capable of passing projected MDD for customers served by the transmission main.

3.5 Distribution Piping Performance Criteria

Water distribution systems are typically separated into pressure zones or service levels to provide service pressures within an acceptable range to all customers. As described in **Chapter 1**, the City’s existing water service area distribution system is divided into six main pressure zones, with multiple pressure-regulated subzones. Pressure zones are usually determined by ground topography and designated by overflow elevations of water storage facilities or outlet settings of pressure reducing facilities serving the zone. Typically, water from a reservoir will serve customers by gravity within a specified range of ground elevations so as to maintain acceptable minimum and maximum water pressures at individual service connections. When it is not feasible or practical to have a separate reservoir serving each pressure zone, pumping facilities or pressure reducing facilities are used to serve customers in different pressure zones from a single reservoir.

Generally, 100 pounds per square inch (psi) is considered the desirable upper static pressure limit and 40 psi the lower limit. Whenever feasible, it is desirable to achieve the 40 psi lower limit at the point of the highest fixture within a given building being served. Conformance to this pressure range may not always be possible or practical due to topographical relief, existing system configurations, and economic considerations. Maximum pressures typically should not exceed 125 psi.

Typically, water distribution mains should be at least 8 inches in diameter and looped to supply minimum fire flows. A minimum 4-inch or 6-inch diameter main may be acceptable in special cases with approval of the City Engineer if no fire hydrant connection is required, there are limited services on the main, the main is dead-ended, and looping or future extension of the main is not anticipated. Potential water quality issues will be considered on a case-by-case basis when sizing pipes for proposed water main improvements identified during distribution system analysis. Velocity in new distribution mains shall be designed not to exceed 8 feet per second (fps).

3.5.1 Normal Service Pressure

Consistent with the criteria used in the City's 2008 WSMP, the acceptable service pressure range under ADD and normal operating conditions is 40 to 100 psi, measured at the customer's water service meter. Where mainline pressures exceed 80 psi, services must be equipped with individual PRVs to maintain their static pressures at no more than 80 psi in compliance with the Oregon Plumbing Specialty Code (OPSC 608.2).

The distribution system should be capable of supplying the PHD while maintaining service pressures of not less than 75 percent of normal system pressures, and not less than 30 psi.

3.5.2 Service Pressure in an Emergency

During a fire flow event or emergency, the minimum service pressure is 20 psi, as required by Oregon Health Authority (OHA) Drinking Water Services (DWS) and OAR 333-061-0025(7). The system should be capable of providing fire flow capacity while simultaneously delivering MDD and maintaining 20 psi throughout the distribution system. The system should meet this criterion with operational, equalizing, and fire storage in the City's reservoirs depleted. **Table 3-1** summarizes the service pressure criteria during various system operation scenarios.

Table 3-1 | Recommended Service Pressure Criteria

Service Pressure Criterion	Pressure (psi)
Normal range, during ADD	40-100
Maximum, without PRV	80
Minimum, during emergency or fire flow	20
Minimum, during PHD	75% of normal, not less than 30

3.6 Fire Flow Performance Criteria

Municipal water distribution systems must provide adequate water for fire suppression, in addition to the domestic demand described in **Chapter 2**. The required fire suppression volume is typically based on building type or land use, as described in the local jurisdictional code.

Fire protection for the City's service area is provided by Tualatin Valley Fire and Rescue (TVFR). TVFR has established guidelines for determining fire flow requirements based on the 2022 Edition of the State of Oregon Fire Code (OFC) and ordinances adopted by TVFR. Appendix B of the OFC makes the following statement:

> "The availability of water is essential for fire fighting operations. The amount of water required to fight a fire depends on many things, including the type of construction, the location of the fire, the contents of the building, response time and the capabilities of the fire department. Limiting the maximum fire flow to 3,000 gallons per minute provides local water purveyors with a predictable and cost-effective method to forecast infrastructure expenditures and can serve to lesson local fire services' apparatus capital expenditures."

3.6.1 Single-Family Residential Fire Flow

The TVFR guidelines specify a minimum fire flow of 1,000 gpm for single-family and two-family dwellings with square footage less than 3,600 square feet. For residential structures larger than 3,600 square feet, TVFR specifies the minimum fire flow requirement at 1,750 gpm. Based on a review of the size of typical residential developments within the City, the performance criteria used in the analysis of the system is based on a single-family residential minimum available fire flow of 1,750 gpm for a duration of 2 hours.

3.6.2 Multi-Family Residential Fire Flow

Discussions with TVFR staff indicate that certain areas designated for medium and high-density residential development should be provided with a minimum available fire flow of 3,000 gpm. This is because the "medium-high density" designation may allow for attached housing units or apartments which constitute a "commercial fire event." Therefore, the performance criteria used in the analysis of the system is based on a multi-family residential minimum available fire flow of 3,000 gpm for a duration of 3 hours.

3.6.3 Commercial, Industrial, and Institutional Fire Flow

The OFC limits maximum fire flow demand to 3,000 gpm unless other conditions are met during development of the building. Previous discussions with TVFR officials indicate that existing buildings may have been constructed prior to current codes; however, available flow capacities of 3,000 gpm are sufficient for planning purposes. Therefore, the performance criteria used in the analysis of the system is based on a minimum available fire flow of 3,000 gpm for a duration of 3 hours.

A summary of the fire flow performance criteria by land use type is summarized in **Table 3-2**.

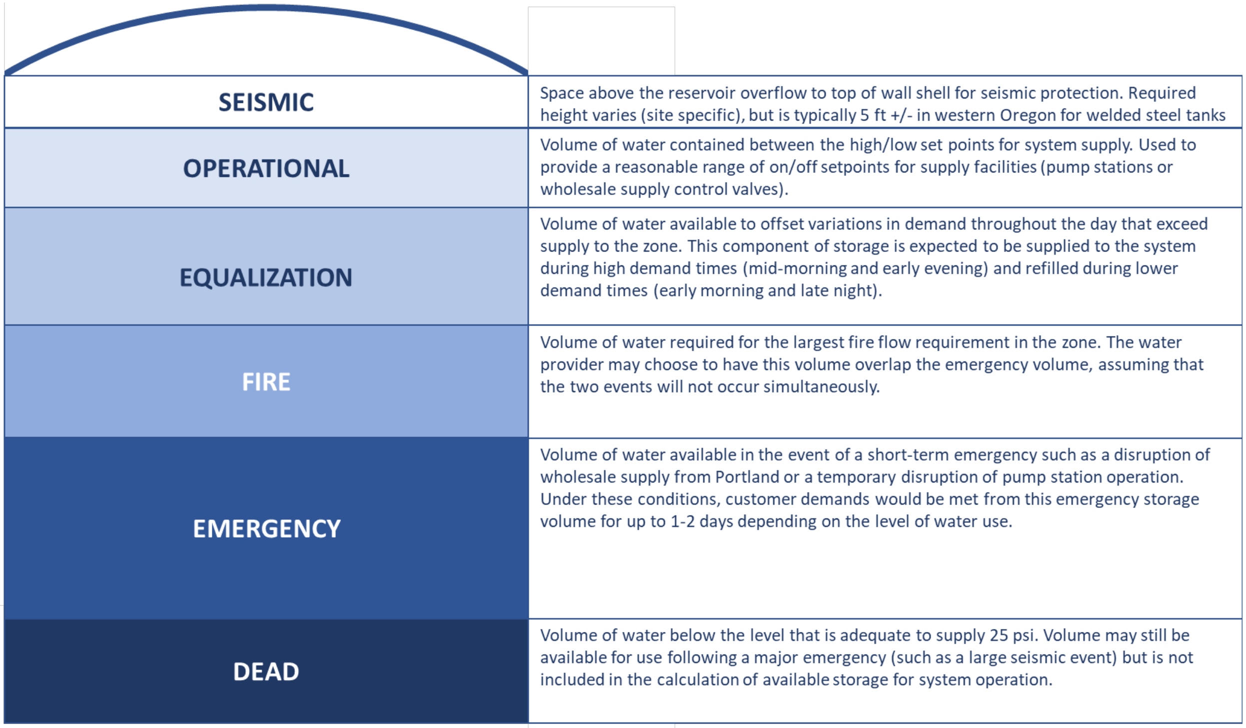
Table 3-2 | Recommended Fire Flow Summary

Land Use Designation	Recommended Available Fire Flow (gpm)	Fire Flow Duration (hours)
Single-Family Residential	1,750	2
Multi-Family Residential	3,000	3
Commercial, Industrial, and Institutional	3,000	3

3.7 Storage Capacity

The City's water storage reservoirs should provide capacity for four purposes: operational storage, equalization storage, fire storage, and standby (emergency) storage. Additionally, dead storage and headroom for seismic sloshing should also be included in storage volume calculations, where tanks have not been constructed to include seismic slosh height. While storage is typically discussed as a volume, limiting factors may actually be based on vertical space in a tank, flow rates, or actual volume of water. Adequate storage capacity for each purpose must be provided for each pressure zone, although the volume may be divided among multiple tanks. **Figure 3-1** provides a visual of the six storage volume components and is followed by a brief discussion of each storage element below, based on the Washington State Water System Design Manual guidelines.

Figure 3-1 | Storage Volumes



SEISMIC	Space above the reservoir overflow to top of wall shell for seismic protection. Required height varies (site specific), but is typically 5 ft +/- in western Oregon for welded steel tanks
OPERATIONAL	Volume of water contained between the high/low set points for system supply. Used to provide a reasonable range of on/off setpoints for supply facilities (pump stations or wholesale supply control valves).
EQUALIZATION	Volume of water available to offset variations in demand throughout the day that exceed supply to the zone. This component of storage is expected to be supplied to the system during high demand times (mid-morning and early evening) and refilled during lower demand times (early morning and late night).
FIRE	Volume of water required for the largest fire flow requirement in the zone. The water provider may choose to have this volume overlap the emergency volume, assuming that the two events will not occur simultaneously.
EMERGENCY	Volume of water available in the event of a short-term emergency such as a disruption of wholesale supply from Portland or a temporary disruption of pump station operation. Under these conditions, customer demands would be met from this emergency storage volume for up to 1-2 days depending on the level of water use.
DEAD	Volume of water below the level that is adequate to supply 25 psi. Volume may still be available for use following a major emergency (such as a large seismic event) but is not included in the calculation of available storage for system operation.

3.7.1 Operational Storage

Operational storage is the volume of water stored between the nominal on/off reservoir level set points for the supplying pump stations or supply valves. Operational storage supplies the water system while the pumps that supply the reservoir are "off". This volume is dedicated to minimizing pump cycling and to align with the pump manufacturer's recommendations for cycling (typically no more than six starts per hour). Operational storage volume, however, does not apply to systems operating under a continuous supply mode. The Bolton, Willamette, and View Drive reservoirs are continuously supplied by the DSPS/Mountainview Reservoir, and therefore, are not required to maintain operational storage.

Operational storage can be varied throughout the year to provide reservoir turnover. For example, winter tank levels are normally set lower than summer levels to allow for continued turnover with lower winter demands. Summer operation setpoints were used for calculating the City's operational storage as the peak demand on storage occurs during the summer season.

3.7.2 Equalization Storage

Equalization storage is required to meet water system demands when zone demands exceed supply delivery capacity due to diurnal fluctuations in water usage. Equalization storage is calculated as:

$$(PHD - Qs) \times 150 \text{ minutes}$$

Where Qs is the total supply available to the zone excluding emergency supply.

Per the Washington State Water System Design Manual guidelines, equalization storage may be eliminated if the supply sources meet or exceed the PHD for the water system.

3.7.3 Fire Suppression Storage

The Washington Water System Design Manual recommends a minimum fire storage volume equal to the maximum fire flow rate and duration. The land-use based fire flow rates described in **Section 3.6** specify the following rates and durations:

- Single Family: 1,750 gpm @ 2 hours
- Multi-Family: 3,000 gpm @ 3 hours
- Commercial, Industrial, and Institutional: 3, 000 gpm @ 3 hours

Water stored for fire suppression is typically provided to meet the single most severe fire flow demand within each pressure zone. The Washington Water System Design Manual allows for consolidation of the emergency and fire suppression storage with the larger of the two volumes being the minimum required storage.

3.7.4 Emergency/Standby Storage

Emergency storage is provided to supply water from storage during emergencies such as supply pipeline failures, equipment failures, power outages, or natural disasters. The amount of emergency storage provided can be highly variable depending upon an assessment of risk and the desired degree of system reliability. The Washington Water System Design Manual recommends the following for calculating the volume of emergency/standby storage.

$SB = (N)(SB_i)(T_d)$
SB = Storage Component
N = Number of ERUKs, based on the ERU_{MDD} value
T_d = Number of days selected to meet water system-determined standard of reliability

3.7.5 Dead Storage and Seismic Volume

Some reservoirs may include two additional, non-usable volumes of air or water. Dead storage is the volume of water at the base of the reservoir that does not provide a minimum 20 psi or exists below the outlet pipe inlet level. Seismic volume is only required in older reservoirs that do not meet current seismic standards. It includes the volume of space between the maximum water surface allowed and the base of the tank roof. This space is maintained as a buffer in the event of a seismic event to minimize forces on the tank caused by sloshing and the resultant uplift. For older reservoirs with inadequate freeboard, this volume of space may require the reservoir to be operated such that the maximum operational level is below the set overflow elevation of the tank.

3.8 Pump Station Capacity

Pumping capacity requirements vary depending on how much storage is available, the number of pumping facilities serving a pressure zone, and the zone's maximum fire flow requirement. Pumping recommendations are based on firm capacity which is defined as a pump station's capacity with the largest pump out of service.

3.8.1 Pump Station Supplying Pressure Zone with Gravity Storage

For pump stations supplying pressure zones with gravity storage available, the station must have adequate firm capacity to supply MDD for the zone.

3.8.2 Standby Power

Standby power facilities are needed for at least one pump station serving each pressure zone, assuming the pump station has adequate total capacity to meet the pressure zone's MDD. Standby power is typically provided in the form of an on-site backup generator sized to operate the pump station at firm capacity with an automatic transfer switch (ATS) and on-site fuel storage.

3.9 Performance Criteria Summary

Table 3-3 summarizes the planning criteria described in the sections above.

Table 3-3 | Performance Criteria Summary

Water System Component	Evaluation Criteria Component	Value	Design Standards/Guideline
Water Supply	Transmission Capacity	MDD[1]	Ten State Standards, Washington Water System Design Manual
	Supply Capacity	Summer: MDD[1] Winter: ADD[1]	
Service Pressure	Normal Range (ADD[1] Conditions)	40-100 psi	Ten State Standards, City Public Works Standards
	Maximum	110 psi system pressure and 80 psi at service with individual PRVs	Oregon Plumbing Specialty Code, Section 608.2
	Minimum, during MDD[1] with Fire Flow	20 psi	OHA Drinking Water Services (DWS) and OAR 333-061-0025(7)
Distribution Mains	Velocity during PHD[1]	Not to exceed 8 fps	AWWA M32, Washington Water System Design Manual
	Minimum Pipe Diameter	8-inch diameter, 6-inch acceptable for short mains without fire service	City Public Works Standards
Storage	Total Available Storage Capacity	Sum of operational, equalization, fire suppression, and emergency storage volumes (does not include seismic or dead storage volumes)	Washington Water System Design Manual and TVFD

Water System Component	Evaluation Criteria Component	Value	Design Standards/Guideline
	Operational	Tank level set points. Does not apply to continuous pumping systems	
	Equalization	(PHD - Qs) * (150 minutes), however, not required if source capacity is larger than PHD.	
	Fire	FFS = (FF)(tm) FFS = Fire Suppression Storage FF = Fire Flow Rate Tm = Duration of fire flow The Emergency and Fire Storage may be consolidated by using the larger volume of the two if the local jurisdiction does not require them to be additive. ➢ Residential Fire Flow: 1.750 gpm X 2 hours ➢ Multi-Family Fire Flow: 3,000 gpm X 3 hours ➢ Commercial, Industrial and Institutional Fire Flow: 3,000 gpm X 3 hours	
	Emergency (Standby)	SB = (N)(SBi)(Td) SB = Storage Component N = Number of ERUKs, based on the ERUMDD value Td = Number of says selected to meet water system-determined standard of reliability	
Pump Stations	Firm Capacity	MDD	Washington Water System Design Manual
	Backup Power	At least one pump station serving each pressure zone	City Policy
Required Fire Flow and Duration	Single-Family Residential	1,750 gpm for 2 hours	2022 Oregon Fire Code, Tualatin Valley Fire & Rescue Fire Code Applications Guide
	Multi-Family Residential	2,000 gpm for 2 hours	
	Commercial, Industrial, and Institutional	3,000 gpm for 3 hours	

Note:

1. ADD: Average daily demand, defined as the average volume of water delivered to the system during a 24-hour period = total annual demand/365 days per year.
   MDD: Maximum day demand, defined as the maximum volume of water delivered to the system during any single day.
   PHD: Peak hour demand, generally the peak hour of MDD. Estimated as 2xMDD.

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CHAPTER 4

Supply Evaluation

4.1 Purpose

This chapter summarizes the analysis of the City's supply capacity against the existing system described below, the demand projections described in Chapter 2 and the performance criteria described in **Chapter 3**. This chapter presents an evaluation of the City's existing supply source, including the intake, raw water pumping, raw water transmission, treatment, finished water pumping and finished water transmission, and emergency supply, against the current and projected 2043 MDD. The results of the analysis serve as the basis for capital improvements and capital maintenance of the supply system as described in the CIP in **Chapter 11**. Unlike the other recommended CIPs in this WSMP, CIPs associated with supply are primarily under the control of the SFWB.

4.2 Existing Water Supply

The City's primary water supply source is the SFWB which was established under ORS 190 by agreement between the City and Oregon City for the purposes of supplying water to both from the lower Clackamas River. The SFWB owns and operates the water supply facilities which consist of a river intake, raw water pumping station, WTP, finished water pumping station, and raw and finished water transmission pipelines. A section of finished water transmission main between the finished water pump station and the City's distribution system, including the Willamette River I-205 Bridge crossing, is owned by the City.

Most of the source supply facilities are owned and operated by the SFWB. Existing capacities and condition assessments for those systems were obtained from the SFWB 2016 Water Master Plan (WMP), which is included in Appendix C . The 2016 SFWB WMP also categorized CIPs into four priorities, some of which are referenced in the evaluations found in this chapter. It should be noted however, that SFWB's prioritization of a project may not be equal to the priority assigned by the City.

1. High Priority Improvements
2. Expansion to 30 MGD
3. Expansion to 40 MGD
4. Expansion to 52 MGD

4.3 Water Demand Projections

Table 4-1 below describes the projected demands on the SFWB system, which includes the City, Oregon City, and Clackamas River Water-South (CRW-S). Information on demand projections for Oregon City and CRWS were obtained from their current WMPs. The following should be noted.

- Some extrapolation of available data was required to align the Oregon City and CRW-S projections with the City's planning period.

- The Oregon City and the CRW-S WMPs that were used as the source of ADD and MDD are more recent than those referenced in the current SFWB WMP.

- Lake Oswego and the North Clackamas County Water Commission use SFWB as an emergency water source, but that demand is not included in **Table 4-1** because they do not share intake, transmission, pumping or treatment facilities with the City, Oregon City, and CRW-S.

Table 4-1 | Source Water Demand Projection Summary

Water Provider	Year and Demand Projection (MGD)									
	2023		2028		2033		2038		2043	
	ADD	MDD	ADD	MDD	ADD	MDD	ADD	MDD	ADD	MDD
Oregon City[1]	4.14	9.64	4.54	10.51	4.94	11.36	5.16	11.94	5.26	12.4
Clackamas River Water-South[2]	1.58	3.79	1.71	4.11	1.85	4.43	2.00	4.74	2.15	5.09
West Linn	2.88	6.83	2.98	7.06	3.06	7.26	3.13	7.41	3.18	7.54
Total	**8.6**	**20.26**	**9.23**	**21.68**	**9.85**	**23.05**	**10.29**	**24.09**	**10.59**	**25.03**

Notes:
1. Source: Oregon City 2012 Water Distribution System Master Plan (Amended 2021), Murray Smith & Assoc., Planning period 2020-2040.
2. Source: Clackamas River Water South System, Water Master Plan, April 2019 Carollo, Planning period 2019-2038.

4.4 Supply Capacity Analysis

The source facilities, current capacities and projected demand are summarized in **Table 4-2**. The capacities of the existing SFWB infrastructure and systems included in **Table 4-2** were taken from the current 2016 SFWB WMP.

Table 4-2 | Supply Capacity Analysis Summary

Supply System Component	Capacity Criteria	Current Capacity (MGD)[1]	Required Capacity of West Linn		Total Required Capacity of Water Providers[2]	
			2023 (MGD)	2043 (MGD)	2023 (MGD)	2043 (MGD)
River Intake	MDD	53.0	6.38	7.54	20.26	25.03
Raw Water Pump Station	MDD (Firm Capacity)	30.0	6.38	7.54	20.26	25.03
Raw Water Transmission	MDD	22.0	6.38	7.54	20.26	25.03
Water Treatment Plant	MDD	22.0	6.38	7.54	20.26	25.03
Finished Water Transmission – SFWB WTP to DSPS	MDD	21.9	6.38	7.54	16.47	19.94
Finished Water Pump Station	MDD (Firm Capacity)	17.6	6.38	7.54	16.47	19.94
Finished Water Transmission – West Linn	MDD	9.5	6.38	7.54	6.38	7.54

Notes:
1. Source: SFWB Water Master Plan Update, September 2016, MWH/CH2MHill, Planning period 2016 – 2036
2. Water providers include City of West Linn, City of Oregon City and Clackamas River Water – South.

4.4.1 Clackamas River Intake

The existing SFWB Clackamas River Intake, constructed in 1996, has a rated capacity of approximately 53 MGD. The required capacity of the intake over the planning period for the entire SFWB service area, including the City, is approximately 25.03 MGD. The existing river intake has adequate capacity to supply all currently projected SFWB demand through the 20-year planning period. Capacity of the finished water transmission main is not a concern.

4.4.2 SFWB Raw Water Pump Station

The existing SFWB RWPS, constructed in 1996, is located in the same structure with the river intake. The RWPS has a current firm capacity of approximately 30.8 MGD after the installation of a fifth 800 horsepower pump in 2005 that provided an additional 10.65 MGD to the original pump configuration. The required capacity of the RWPS over the planning period for the entire SFWB service area, including the City, is approximately 25.03 MGD. The existing RWPS has adequate capacity to supply all currently projected SFWB demand through the 20-year planning period. The City’s projected 2043 raw water pumping demand is approximately 7.54 MGD.

The 2016 SFWB WMP indicates that seismic anchorage is needed. Also, a second primary power source is available to the pump station, but an automatic emergency power source is not available. The 2016 SFWB WMP proposes that a portable generator “could be rented during power outage of both primary supplies.”

Capacity of the RWPS is not a concern to the City, but seismic resiliency and emergency power are concerns.

4.4.3 SFWB Raw Water Transmission

The existing raw water transmission main consists of approximately 600 LF of 42-inch diameter steel main from the existing intake to the abandoned intake. From this point, the original 27-inch diameter concrete-cylinder transmission main continues approximately 1,800 LF to the WTP. The current capacity of the transmission main, based on the capacity of the 27-inch diameter section, is approximately 22 MGD. The required capacity over the planning period for the SFWB service area, however, is approximately 25.03 MGD.

The updated 2016 SFWB WMP describes the existing 27-inch diameter raw water transmission main as follows:

> “….in service over 50 years, has a history of maintenance problems, including failure of the steel wire wrap and pipe wall caused by corrosion and pipe joint leaks possibly attributed to land movement along the pipe located in the steep slope…there is also concern about its vulnerability due to the steep slope in which it is laid. Instability of steep slopes present a greater hazard to a pipeline, especially when construction methods may not have accounted for the instability. Further, if the pipe experiences a break or other type of leak, the leaking water can lead to further damage to the hillside and the pipeline.”

Construction of a new 48-inch diameter raw water transmission main between the newer 42-inch transmission main and the WTP has been categorized as one of six high priority projects in the updated 2016 SFWB CIP. The recommendation in the WMP is to replace the 27-inch diameter pipe with a 42 or 48-inch diameter pipe that would convey the ultimate flow of 52 MGD and meet the requirements of the SFWB service area over the 20-year planning horizon.

The City’s 2008 WMP identified the SFWB raw water transmission piping among the most vulnerable due to its age, general condition, and slope. The SFWB 2010 and 2016 WMPs also identified replacement of the raw water transmission line as a high priority, however, no significant improvements have been made. Any necessary repairs required of the pipeline are considered emergency repairs by SFWB. The raw water transmission line is currently the most vulnerable facility in the City’s source water system.

At the current projected rate of growth of the SFWB service area, the 27-inch diameter transmission main will be at capacity around the year 2025. The City's projected 2043 raw water transmission demand is approximately 7.54 MGD. Capacity and condition of the pipeline are a priority concern for the City.

4.4.4 Water Treatment Plant

The existing SFWB WTP has a nominal capacity of 22 MGD; however, the required capacity over the planning period for the SFWB service area is approximately 25.03 MGD. At the current projected rate of growth of the SFWB service area, the WTP will be at capacity around the year 2025. Many of the concrete structures are not built to current seismic code and much of the critical equipment is not seismically anchored.

Improvements to the WTP, including a new chemical building, electrical upgrades, and other improvements, were categorized as an "Expansion to 30 MGD" project in the updated 2016 SFWB CIP. Additional WTP Improvements, including emergency power source, instrumentation upgrades, and other improvements, were categorized as an "Expansion to 40 MGD" project. Completion of the projects described in the "1" and "2" categories of the 2016 SFWB WMP CIP would increase treatment capacity to 30 MGD and 40 MGD, respectively, and meet the requirements of the SFWB service area over the 20-year planning horizon. The City's projected 2043 treatment demand is approximately 7.54 MGD.

The SFWB WTP meets current demand and water quality requirements and the SFWB CIP includes expansion improvements to meet future demand. The SFWB WTP is not currently equipped with a secondary or emergency power source, but a proposed CIP associated with emergency power at the WTP is classified as 3-Expansion to 40 MGD. A new Chemical Building Project was scheduled for construction in late 2023 but is currently on hold.

At the current projected rate of growth of the SFWB service area, the WTP will be at capacity around the year 2025. Capacity of the WTP is a priority concern for the City.

4.4.5 Finished Water Transmission (SFWB)

The finished water transmission main from the SFWB WTP to the DSPS, is approximately a 1.5 mile, 30-inch diameter, wire wrapped, concrete-cylinder pipe constructed in 1958. Isolation valves were recently installed to the pipeline for maintenance purposes. Inspections in 2016 indicated tension cracking and slope instability; however, the actual condition of the pipe is unknown. A seismic failure is likely in the Abernethy Creek vicinity. An existing finished water line near the WTP is on an active landslide.

The nominal capacity of this transmission main, dictated by the suction pressure requirements of the finished water pump station, is approximately 21.0 MGD. The required capacity of the finished water transmission main to supply the projected future build-out capacity for the entire SFWB service area is approximately 19.94 MGD, and therefore near capacity. Construction of a new finished water transmission main has been categorized as a "2-Expansion to 30 MGD" project in the updated 2016 SFWB CIP. A Pipeline Condition Assessment and Lining Project associated with all raw and finished water piping is also categorized as a High Priority CIP. Completion of the project would increase transmission capacity to 30 MGD, which would meet the requirements of the SFWSB service area over the 20-year planning horizon. The City's projected 2043 finished water transmission demand is approximately 7.54 MGD. Capacity and condition of the pipeline are a priority concern for the City.

4.4.6 Finished Water Pump Station (DSPS)

The DSPS was originally constructed in the lates 1950s with improvements made as recently as 2009. The pump station pumps finished water via a 24-inch diameter discharge main to the City and to the Mountainview Reservoir. The pump station is not built to current seismic code and critical equipment is not seismically anchored. The 2016 SFWB WMP indicates that a second primary power source is available to the pump station, but an automatic emergency power source is not available and a portable generator "could be rented during power outage of both primary supplies."

The firm capacity of the DSPS is 17.6 MGD; however, the required capacity over the planning period for the SFWB service area is approximately 19.94 MGD. It should also be noted that the DSPS capacity is also limited by the size of the existing 30-inch diameter finished water transmission main at approximately 21 MGD.

Construction of a new Finished Water Pump Station has been categorized as a "2-Expansion to 30 MGD" project in the updated 2016 SFWB CIP. Expanding the capacity of the DSPS would require extending the pump station building footprint to accommodate two additional pumps. This would increase the nominal firm capacity of the DSPS over two phases to 24 MGD and 32 MGD, respectively. Adding one additional pump would supply the projected future build-out capacity for the SFWB service area.

The SFWB pumping facilities are adequately sized to meet current demand; however, improvements associated with increased capacity are included in proposed SFWB CIPs. The SFWB pumping facilities are currently equipped with a second primary power source, but they are not equipped with emergency generators or ATSs. The 2016 SFWB WMP proposed renting generators for emergency conditions. The 2016 SFWB WMP also does not indicate the installation of emergency power systems at the pumps stations. Seismic and anchorage upgrades are included in the SFWB CIP.

At the current projected rate of growth in the SFWB service area, the DSPS will be at capacity around the year 2028. Capacity, seismic resiliency, and emergency power at the DSPS are priority concerns for the City.

4.4.7 Finished Water Transmission Main (West Linn)

The configuration of the City's connection to the SFWB transmission line, DSPS, and Mountainview Reservoir is described in more detail in **Section 1.3.5** of **Chapter 1**. What should be noted in this chapter is that failure of the DSPS would not impact the City's supply until levels in the Mountainview Reservoir fell below the Bolton Reservoir fill elevation.

The City's existing 24-inch diameter steel transmission main extends from the DSPS through Oregon City and across the Willamette River as a suspended overcrossing on the I-205 Bridge. A portion of the existing 24-inch diameter steel transmission main will be replaced with a 30-inch diameter ductile iron transmission main in conjunction with an ODOT project. The larger diameter pipe will be installed roughly between 17th and Main on the Oregon City side of the Willamette River to a connection near the I-205 off-ramp on the City's side of the Willamette River. The existing 24-inch diameter piping up to the DSPS and 24-inch piping up to the Bolton Pressure Zone connection are not included in the ODOT project. The anticipated completion date of the ODOT project is mid-2026. Capacity of the finished water transmission main to the City will remain limited by the existing 24-inch diameter piping until that piping is replaced. Flow tests, modeling and analysis in the 2008 WSMP indicate that the nominal capacity of the 24-inch diameter transmission main is approximately 9.5 MGD.

The condition of the two existing flow control ball valves located on the West Linn side of the DSPS/Mountain View Reservoir/West Linn Supply tee are a concern to the City. If either or both valves failed, is it unlikely that they could be repaired and an emergency replacement would be required. The City would most likely have to rely on storage for water supplies during replacement of the valves.

The 2008 WSMP identified the City's Finished Water Transmission Main across the Willamette River I-205 Bridge as having the highest vulnerability in the City's source supply. That section of pipe will be replaced with a 30-inch diameter pipe in 2025-2026; however, the remaining section of 24-inch diameter pipe will limit capacity to 9.5 MGD. The City's 2043 projected demand is 7.54 MGD, so capacity of the finished water transmission main is not a concern.

4.5 Emergency Water Supply

4.5.1 Lake Oswego Intertie

Capacity of the intertie is limited by the pump station which has a firm capacity of 6.3 MGD and total capacity of 9.5 MGD. The original pump station was constructed in 2001 with two 2200 gpm pumps and updated with a third 2200 gpm pump in 2015. The 4400 gpm capacity of the original build met the demand requirements of that time, but room was left for the installation of the third pump at a later date. The existing 6.3 MGD capacity is not actually sized to meet a specific demand, but coincidentally does meet, more or less, the existing demand of 6.38 MGD. It is generally assumed that any future increase in pumping capacity at the pump station will not be allowed by Lake Oswego. The IGA with the City of Lake Oswego says "The Party supplying the water shall endeavor to supply the maximum feasible quantity of water to the other Party……..so long as such actions are not detrimental to the operation of the supplying Party's own water system."

The City's emergency intertie with the City of Lake Oswego provides a reliable backup supply, albeit with limited capacity, to the City in the event of a supply disruption. Capacity is limited by the firm capacity of the intertie pump station at 6.3 MGD. No further expansions of the pump station capacity are planned.

4.5.2 Emergency Treatment Trailers

The SFWB 2016 WMP recommends the purchase of two emergency treatment trailers for use in the weeks following a Cascadia event until the WTP can be brought back online. The purchase was categorized as a High Priority Project in the 2016 CIP. SFWB purchased a trailer in 2019 with a Homeland Security grant and a second trailer in 2020 with capital funds. One trailer is stationed at the Bolton Reservoir and the other is stationed at the SFWB WTP in Oregon City.

4.5.3 Additional Supply Source - Aquifer Storage and Recovery

As part of the supply analysis for the 2008 WMP, a preliminary evaluation for the potential development of aquifer storage and recovery (ASR) as a backup or peaking supply was performed. ASR is the underground storage of treated drinking water that is injected into a suitable aquifer and subsequently recovered from the same well or wells, generally requiring no retreatment other than disinfection. The 2008 preliminary evaluation indicated that ASR may not be feasible for the Willamette and southern Rosemont areas. An ASR evaluation of other locations would require exploratory drilling and testing to evaluate and verify aquifer characteristics, however, the results could indicate that suitable conditions are not present after an initial significant investment was made. Further, verification of ASR feasibility at one location may not be sufficient to show ASR feasibility at another location, requiring additional exploration investment. The 2008 WMP recommended that the City consider ASR development as a future option, but not pursue at present. This WMP proposes the same recommendation which is to reconsider ASR development if conditions change in the City's source capacity and/or reliability.

4.6 Reliability of Supply Summary

Source systems that are owned by the City do not currently pose any capacity limitations that affect current or 2043 projected demands for the City. The source systems with apparent capacity limitations, however, are associated with SFWB pipelines and infrastructure that supply source water to Oregon City and to West Linn. General condition, seismic and emergency power issues that are under the ownership of SFWB also affect the reliability of the City's supply source. SFWB is currently expected to start planning their CIP projects in 2024 so scheduling for that work is unknown at this time.

A summary of the source facilities and their vulnerability to loss of service are described below and summarized in **Table 4-3**:

Table 4-3 | Source Water Vulnerability Summary

Facility	Capacity Limitations	Additional Considerations	SFWB CIP Priority Rating and Projects
SFWB Raw Transmission Main	Current capacity (22 MGD) does not meet 2043 SFWB demand projection (25 MGD).	➢ Aging concrete pipe ➢ Maintenance and failure issues ➢ Slope instability	1 - High Priority (raw water pipeline).
SFWB Raw Water Pump Station	Current capacity (22 MGD) does not meet 2043 SFWB demand projection (25 MGD)	➢ Not equipped with emergency power source	3 – Expansion to 40 MGD (backup generator)
SFWB WTP	Current capacity (22 MGD) does not meet 2043 SFWB demand projection (25 MGD)	➢ Not built to seismic code. equipment not properly anchored ➢ Not equipped with emergency power source	1 - High (new chemical building) 2 - Expansion to 30 MGD (structural upgrades) 3 – Expansion to 40 MGD (backup generator)
SFWB Finished Water Transmission Line	Current capacity (21 MGD does not meet 2043 SFWB demand projection (19.94 MGD)	➢ Aging concrete pipe ➢ Maintenance and failure issues ➢ Slope instability	1 - High Priority (finished water pipeline from Hunter Avenue to Cleveland)
SFWB Division Street Pump Station	Current capacity (17.6) does not meet 2043 SFWB demand projection (19.94 MGD)	➢ Not build to seismic code, equipment not properly anchored ➢ Not equipped with emergency power source	2 - Expansion to 30 MGD (structural upgrades) 4 – Expansion to 52 (backup generator)
West Linn Finished Water Transmission Main	Current capacity (9 MGD) exceeds 2043 projected demand (7.54 MGD)	➢ I-205 Bridge piping to be complete mid-2026 ➢ Capacity remains limited by remaining 24" diameter pipe	N/A
Lake Oswego Emergency Intertie	6.3 MGD firm capacity, 9.5 MGD total capacity	➢ Third pump added in 2015 ➢ Capacity limited by current pump station configuration	N/A

4.7 Summary of Recommended Improvements

A pair of existing ball valves on the supply piping located on the discharge side of the DSPS should be replaced before an emergency repair situation occurs. The recommended supply system improvements are summarized in **Table 4-4** and included in the City's CIP.

The SFWB CIP projects are not currently scheduled but SFWB is in the process of budgeting and scheduling those projects. The City's estimated cost share and/or any required rate increase will have to be coordinated between SFWB, Oregon City and West Linn. The SFWB CIPs are summarized in **Table 4-5** and included in the City's CIP.

Table 4-4 | Summary of Source CIP Projects

Facility	Purpose	Description	Estimated Budget Cost & Schecdule
Finished Water Transmission Main – Valve Replacement	The condition of the flow control valves are suspect and would require an emergency repair if they failed.	Replace the two existing ball valves located on the West Linn side of the tee on the DSPS discharge pipe.	$200,000 FY 2024 – FY 2028

Table 4-5 | Summary of SFWB CIPs

SFWB Project	SFWB CIP Priority Rating and Projects	West Linn Impact and Priority	Estimated Cost Share	Schedule
SFWB Raw Transmission Main	1 - High Priority (raw water pipeline).	Increased capacity is required to meet the projected SFWB 2043 demand of 25 MGD, which is the combined demand from all water providers including West Linn. At the current projected rate of growth of the SFWB service area, capacity will be reached at approximately 2025.	TBD	TBD
SFWB Raw Water Pump Station	3 – Expansion to 40 MGD (backup generator)		TBD	TBD
SFWB WTP	1 - High (new chemical building) 2 - Expansion to 30 MGD (structural upgrades) 3 – Expansion to 40 MGD (backup generator)		TBD	TBD
SFWB Finished Water Transmission Line	1 - High Priority (finished water pipeline from Hunter Avenue to Cleveland)		TBD	TBD
SFWB Division Street Pump Station	2 - Expansion to 30 MGD (structural upgrades) 4 – Expansion to 52 (backup generator)	Increased capacity is required to meet the projected SFWB 2043 demand of 19.94 MGD, which is the combined demand from all water providers including West Linn. At the current projected rate of growth of the SFWB service area, capacity will be reached at approximately 2028.	TBD	TBD

CHAPTER 5

Storage Analysis

5.1 General

This section summarizes the analysis of the City's storage capacity against the existing system described in **Chapter 1,** the demand projections described in Chapter 2 and the performance criteria described in **Chapter 3** of this WSMP. The results of the analysis serve as the basis for capital improvements and capital maintenance of the storage system as described in the CIP in **Chapter 11**.

The storage performance criteria described in **Chapter 3** is summarized in **Table 5-1**.

Table 5-1 | Storage Performance Criteria Summary

Water System Component	Storage Component	Value	Design Standards/Guideline
Storage	Total Available Storage Capacity	Sum of operational, equalization, fire suppression, and emergency storage volumes (does not include seismic or dead storage volumes)	Washington Water System Design Manual
	Operational	Tank level set points. Does not apply to continuous pumping systems	Washington Water System Design Manual
	Equalization	(PHD - Qs) * (150 minutes), however, not required if source capacity is larger than PHD.	Washington Water System Design Manual
	Fire	FFS = (FF)(tm) FFS = Fire Suppression Storage FF = Fire Flow Rate Tm = Duration of fire flow The Emergency and Fire Storage may be consolidated by using the larger volume of the two if the local jurisdiction does not require them to be additive. ➢ Residential Fire Flow: 1,750 gpm X 2 hours ➢ Multi-Family Fire Flow: 3,000 gpm X 3 hours ➢ Commercial, Industrial and Institutional Fire Flow: 3,000 gpm X 3 hours	Washington Water System Design Manual and TVFD
	Emergency (Standby)	SB = (N)(SBi)(Td) SB = Storage Component N = Number of ERUs, based on the ERUMDD value Td = Number of days selected to meet water system-determined standard of reliability	Washington Water System Design Manual
	Seismic Storage	Only required in reservoirs that do not meet seismic code	Washington Water System Design Manual
	Dead Storage	The volume of storage that is not available at the minimum pressure	Washington Water System Design Manual

5.2 Storage Capacity Analysis

In drinking water systems, adequate storage capacity is necessary to ensure the following.

- Equalized demand on supply sources, booster pump stations, and transmission mains
- Stable system flow and service pressures
- Availability of reserve capacity in the distribution system for emergencies
- Reliable "on demand" capacity to meet fire suppression needs

The following section analyzes the total required component storage capacity, pressure zone storage capacity, and system storage capacity for existing conditions and conditions over the planning period.

5.3 Operational Storage Capacity

Operation of the pump stations are controlled by water depth in the reservoirs. The pumps start when depths reach a low setpoint and stop when depths reach a high setpoint. The volume between the two setpoints is the operational volume. The setpoints used by the City also include lead and lag pump configurations, but operational storage is based only on lead pump operation as it is assumed that reservoir levels are typically maintained by the lead pump. The setpoints are designed to minimize pump cycling for the typical demand, which may vary by season. Storage capacity should be based on high demand scenarios, so the summer operational storage volume is being used in this storage analysis. Pressure zones that are subject to continuous pumping, such as Bolton, View Drive, and Willamette are not required to provide operational storage. The Operational storage volume is not expected to increase over the planning period because the operational setpoints are not expected to change with higher demand.

The volume associated with the summer operation setpoints are summarized in **Table 5-2**.

Table 5-2 | Operational Storage Capacity

	Summer Operation		
	Fill Depth(ft)	Stop Depth(ft)	Volume (Mgal)
Bolton	--	--	Not Required
Horton	33	38	0.19
View Drive	--	--	Not Required
Rosemont	25	31	0.09
Willamette	--	--	Not Required
Bland	42	45	0.03
Total			**0.31**

5.4 Equalization Storage Capacity

The Washington State Water System Design Manual only requires equalization storage when source pumping does not meet the PHD. **Table 5-3** compares the source pumping capacity for each reservoir with its allocated PHD.

Table 5-3 | Equalization Storage Capacity

Reservoir	2023		2043	
	PHD (gpm)	Pumping Firm Capacity	PHD (gpm)	Pumping Firm Capacity
Bolton	1,386	SFWB	1,528	SFWB
Horton	2,892	3,900	3,195	3,900
View Drive	852	SFWB	940	SFWB
Rosemont	2,623	5,500	2,898	5,500
Willamette	1,990	SFWB	2,199	SFWB
Bland	1,354	1,000	1,385	1,000

The firm pumping capacity of each reservoir is larger than the PHD for each reservoir, except the Bland Reservoir. The required equalization storage capacity for the Bland Reservoir is as follows.

- 2023: 0.04 MG
- 2043: 0.08 MG

5.5 Fire Suppression Storage Capacity and Emergency Standby Capacity

The Washington State Water System Design Manual allows consolidation of standby and fire suppression storage capacity where the larger of the two volumes is the minimum requirement. This method is acceptable for an analysis of the City's storage system because all reservoirs except Bland have multiple supply sources and multiple failures must occur before the emergency volume is accessed. The City can also implement a temporary curtailment plan to reduce demand during an extended emergency event.

5.6 Fire Suppression Storage Capacity

Each pressure zone was analyzed for the land use with the highest fire flow requirement. Refer to **Figure 1-2** for land use areas and designations. All pressure zones except Horton include commercial land use areas. Land use designations and fire flow requirements are not expected to change over the planning period. **Table 5-4** summarizes the land use and maximum fire flow requirement for each pressure zone.

Table 5-4 | Fire Safety Suppression Storage Capacity (2023 and 2043)

Pressure Zone	Land Use	Flow (gpm)	Duration (hrs)	Total (MG)
Bolton	Commercial	3,000	3	0.54
Horton	Residential	1,750	2	0.21
View Drive	Commercial	3,000	3	0.54
Rosemont	Commercial	3,000	3	0.54
Willamette	Commercial	3,000	3	0.54
Bland	Commercial	3,000	3	0.54

5.7 Emergency/Standby Capacity Storage

The method of calculation described in the Washington State Water System Design Manual for emergency/standby storage requires the determination of an equivalent residential unit (ERU). ERUs are units of measure used to equate non-residential demand and multi-family demand to demand from a single-family residence. ERUs provide a daily volume of demand that can be equated to demand from a single-family residence.

The City's billing records were used to determine the number of units for residential, multifamily, commercial, and public classifications and the GIS database was used to determine the number of meters in each pressure zone. Historical demand was used to determine an average percentage for each classification. Average residential demand between 2020 and 2022 was approximately 82 percent. This percentage and the 2022 MDD of 6.76 MG was used to calculate an ERU of 606 GPD. This ERU was then multiplied by the projected growth in each pressure zone to determine the associated emergency storage. Uniform growth using the AAGRs described in **Chapter 2** was used for the projections. One day of storage was assumed, due to continuous pumping and a reliable source water.

Table 5-5 summarizes the fire flow suppression capacity and emergency/standby storage capacity for each pressure zone and entire system for 2023 and 2043.

Table 5-5 | Fire Flow Suppression Storage Capacity and Emergency/Standby Storage Capacity

Reservoir	2023			2043		
	Fire Flow (Mgal)	Emergency (Mgal)	Required (Mgal)	Fire Flow (Mgal)	Emergency (Mgal)	Required (Mgal)
Bolton	0.54	0.84	0.84	0.54	0.93	0.93
Horton	0.21	1.56	1.56	0.21	1.73	1.73
View Drive	0.54	0.44	0.44	0.54	0.49	0.49
Rosemont	0.54	1.24	1.24	0.54	1.37	1.37
Willamette	0.54	0.98	0.98	0.54	1.09	1.09
Bland	0.54	0.40	0.54	0.54	0.45	0.54
Total			**5.60**			**6.14**

5.8 Seismic Storage Capacity

Without performing a site specific seismic analysis of each reservoir, the seismic storage volume cannot be determined. There are no typical percentages or water levels to base an estimated seismic storage on. The recently designed and constructed Bolton and Rosemont Reservoirs were designed to include seismic considerations, so additional storage is not required. The storage analysis in this WSMP does not include any provisions for seismic storage; however, it should be noted that any required seismic volume could impact current and/or future storage requirements.

5.9 Dead Storage Capacity

The outlet pipe elevation for all reservoirs is generally located at the reservoir floor, so the determination of dead storage is based on maintaining a minimum pressure of 20 psi at the highest elevation in the pressure zone. Therefore, the largest allowable vertical distance between the reservoir floor and the highest service elevation is approximately 46 feet.

As-built drawings are not available for all reservoirs, so the actual elevation of a reservoir floor may have been assumed according to GIS and modeling data. The elevations of the pressure zones are generally known but can also be identified through GIS and modeling data.

The Willamette Reservoir was the only one that indicated a potential for dead storage. Further investigation into the actual elevations of services in the Willamette Pressure Zone reveals that all services are located below the 260-f00t elevation.

Table 5-6 summarizes the reservoir floor elevations, pressure zone high points, and difference in elevation for each reservoir. No dead storage is required for the City's storage system.

Table 5-6 | Dead Storage Capacity Summary

Reservoir	Floor Elevation[1]	Pressure Zone High Point	Change in Elevation	Dead Storage (Mgal)[3]
Bolton	428[1]	340	88	Not required
Horton	695[2]	620	75	Not required
View Drive	310[2]	210	100	Not required
Rosemont	818[1]	750	68	Not required
Willamette	320[2]	260	60	Not required
Bland	545[2]	475	70	Not required

Notes:

1. Reservoir floor elevation is based on as-built drawings.
2. Reservoir floor elevation is based on GIS data.
3. Based on minimum change in elevation to maintain 20 psi of 46 ft

5.10 Summary of Total Storage Capacity Requirements

The individual component storage requirements were combined into the total required storage for each pressure zone. The results indicate a current surplus of approximately 1.5 MG and a projected 2043 surplus of approximately 1.0 MG. It should be noted that this surplus volume does not account for any potential decreases to address seismic storage volume needs.

Table 5-7 and **Table 5-8** summarize the required storage capacity and associated surplus or deficit for each pressure zone and the total system.

Table 5-7 | 2023 Storage Capacity Analysis

Reservoir	Required Storage Capacity (Mgal)						
	Operational	Equalization	Fire/ Emergency	Seismic & Dead	Total Required	Available	Surplus (Deficit)
Bolton	0.00	0.00	0.84	0	0.8	4.0	3.2
Horton	0.19	0.00	1.56	0	1.8	1.5	(0.3)
View Drive	0.00	0.00	0.44	0	0.4	0.5	0.1
Rosemont	0.09	0.00	1.24	0	1.3	0.4	(0.9)
Willamette	0.00	0.00	0.98	0	1.01	0.6	(0.4)
Bland	0.03	0.00	0.54	0	0.6	0.5	(0.1)
Total	**0.31**	**0.04**	**5.60**	**0**	**6.0**	**7.5**	**1.5**

Table 5-8 | 2043 Storage Capacity Analysis

Reservoir	Required Storage Capacity (Mgal)						
	Operational	Equalization	Fire/ Emergency	Seismic & Dead	Required	Available	Surplus (Deficit)
Bolton	0.00	0.00	0.93	0	0.9	4.0	3.1
Horton	0.19	0.00	1.73	0	1.9	1.5	(0.4)
View Drive (Robinwood)	0.00	0.00	0.49	0	0.5	0.5	0.0
Rosemont	0.09	0.00	1.37	0	1.5	0.4	(1.1)
Willamette	0.00	0.00	1.09	0	1.1	0.6	(0.5)
Bland	0.03	0.08	0.54	0	0.7	0.5	(0.2)
Total	**0.31**	**0.08**	**6.14**	**0**	**6.5**	**7.5**	**1.0**

Storage deficiencies in individual pressure zones are not a true indication of storage deficiency for the entire water storage system. Under a system wide evaluation, each calculated deficit in a pressure zone is offset or supplemented by other storage, pumping, or supply systems, as described below.

- Deficits in the Horton Pressure Zone are offset by the 3.2 MG Bolton Reservoir storage surplus and the 3,900 gpm firm capacity of the Bolton Pump Station. Additional gravity storage to the Horton Reservoir is also available from the higher elevation 0.4 MG Rosemont Reservoir through the connecting PRV.

- Deficits in the Bland Pressure Zone are offset by the 1,000 gpm firm capacity of the Willamette Pump Station. Additional gravity storage from the higher elevation 1.5 MG Horton Reservoir is also available through the normally closed isolation valve.

- Deficits in the Willamette Pressure Zone are offset by the reliable SFWB source supply and the Lake Oswego Emergency Intertie. Additional gravity storage is also available from the higher elevation 0.5 MG Bland Reservoir through the connecting PRV and from the 3.2 MG Bolton Reservoir through the altitude valve.

- Deficits in the View Drive Pressure Zone are offset by the reliable SFWB source supply and the Lake Oswego Emergency Intertie. Additional gravity storage is also available from the higher elevation 3.2 MG Bolton Reservoir through the altitude valve.

Under certain emergency conditions, it may be acceptable to consider a reduced level of service for a water system. For example, if a natural disaster were to result in the simultaneous loss of a reservoir and pump station, it may be reasonable to expect the water system to supply ADD and typical fire suppression, rather than MDD and fire suppression. For prolonged emergency situations, the City may also enforce a curtailment plan that would reduce overall demand.

5.11 Reservoir General Condition Analysis

Five of the City's six reservoirs are of welded steel construction. According to the AWWA if tank coatings are well maintained, the anticipated life expectancy of a welded steel tank is more than 30 years. The failure of interior and exterior coatings can lead to steel plate pitting and structural steel deterioration. Coating inspections will examine dry film thickness, lead based paint detection, adhesion tests, and a visual inspection. Reservoirs are recommended to undergo coating inspections every five years. Inspections of the tank interior may require taking the reservoir out of service or a dive inspection.

The age of the coatings on the Horton and View Drive Reservoirs are unknown, so coating condition assessments and rehabilitation should be prioritized for those two reservoirs. Assessment of the remaining reservoirs should be prioritized according to the age of the coatings.

Tank coating inspections may include an evaluation of the following.

Chalking
Chipping
Crevice corrosion
Coating loss
Cathodic protection
Surface corrosion
Organic material growth
Ponding
Pitting
Rust staining
Coating thickness
Wall thickness
Coating adhesion

Additional inspections and condition assessments may include an evaluation of the following.

External ladder
Internal Ladder
Roof safety railings
Roof arrest system
Shell manway access
Silt stops
Vents
Vent screens
Overflow piping
Roof access hatch
Roof drainage
Roof water tightness
Inlet/outlet
Operational level gauge

The OHA prepared a report on physical security for drinking water facilities in 2009 which categorized facilities as low, moderate, and high security and the minimum physical controls associated with each level. Periodic security assessments should be performed, primarily associated with the restriction of access to the site and to tank hatches. A security field evaluation may include the following.

Evidence of past intrusion
Security Gate
Secured Access Hatch
Intrusion Isolation Valves
Perimeter Fencing
Site Surveillance
Secured Vents
Alarms (audible or silent)
Perimeter security
Secured Roof Hatch
Hatch Intrusion Alarms

5.12 Summary of Recommended Improvements

The City's storage system meets the specified performance criteria for normal operation and emergency conditions through reservoir storage, pumping, and redundant systems. However, any additional capacity requirements associated with seismic storage are currently unknown. Seismic assessments of the reservoirs are recommended in Section 10 of this WSMP and included in the Seismic Improvements section of the CIP.

This WSMP recommends a general condition assessment of each reservoir. The general condition assessments have been combined with the seismic assessments and included in the Seismic Improvement section of the CIP.

This WSMP also recommends re-coating the interior and exterior coatings for the Willamette, Horton and View Drive Reservoirs within the 20-year planning horizon. Cost estimates and schedules for the re-coating projects are summarized in Table 5-9 and included in the CMP.

Table 5-9 | Summary of Storage CIP Projects

Reservoir	Project	Estimated Cost	Schedule
Horton	Interior & Exterior Recoating	$1,000,000	FY 2024-FY 2028
Valley Drive	Interior & Exterior Recoating	$500,000	FY 2029-FY 2033
Willamette	Interior & Exterior Recoating	$670,000	FY 2029-FY 2033

CHAPTER 6

Pumping Analysis

6.1 General

This chapter summarizes the analysis of the City's pump stations against the existing system described in **Chapter 1**, the demand projections described in Chapter 2 and the performance criteria described in **Chapter 3**. The results of the analysis serve as the basis for capital improvements and capital maintenance of the pumping system as described in the CIP in **Chapter 12**.

Booster pump operation is controlled by elevation levels in the reservoir. Lead and lag pump starts and stops are controlled by specific elevation setpoints when a pump station is equipped with two or more pumps. In order to minimize programming and operational issues associated with the telemetry system, the City does not currently rotate lead and lag pump operation. However, the setpoints are seasonally adjusted to maximum reservoir storage for the demand associated with that season (storage is higher during the summer).

The storage performance criteria described in **Chapter 3** is summarized in **Table 6-1**.

Table 6-1 | Pumping Performance Criteria Summary

Water System Component	Evaluation Criteria Component	Value	Design Standards/Guideline
Pump Stations	Firm Capacity	MDD	Washington Water System Design Manual
	Backup Power	At least one pump station serving each pressure zone	City Policy

6.2 Pumping Performance Criteria Analysis

Adequate pumping capacity in drinking water systems are necessary to ensure the following.

- System demand and fire suppression demand within individual pressure zones are reliably met.
- System demand and fire suppression demand within the total system are reliably met.
- Storage supplies from higher elevation pressure zones are available to lower pressure zones during emergency conditions.

The following section analyzes the firm pumping capacity and backup power performance criteria for existing conditions and conditions over the planning period.

6.3 Firm Pumping Capacity Analysis

Each pump station meets the firm capacity performance criteria, as described below.

- The firm capacity for the Bolton Pump Station is larger than the current and projected MDD for the discharge pressure zone.

- The firm capacities for the Willamette Pump Station are larger than the current and projected MDD for the discharge pressure zone.
- The combined firm capacities for the Horton, View Drive, and Bland Pump Stations are larger than the current and projected MDD for the Rosemont Pressure Zone.

Table 6-2 summarizes the firm capacity of each pump station against the current and projected MDD allocated to the discharge pressure zone.

Table 6-2 | Pumping Firm Capacity Analysis

Pump Station	Discharge Pressure Zone	Firm Capacity (gpm)		Pressure Zone MDD			
				2023		2043	
				(Mgal)	(gpm)	(Mgal)	(gpm)
Bolton	Horton	3,900		1.8	1,245	2.02	1,400
Willamette	Bland	1,000		0.78	540	0.87	607
Horton	Rosemont	3,100	5,500	1.63	1,133	1.83	1,270
View Drive		1,200					
Bland		1,200					

6.4 Back Up Power Supply

The Bolton, Horton, and Willamette Pump Stations are equipped with onsite standby generators and automatic transfer switches and therefore meet the back-up power supply performance criteria.

The View Drive Pump Station does not have an onsite generator but does have a connection for a portable generator. The City, however, does not currently own a portable generator and would have to rent the equipment. Given that renting a portable generator during an emergency situation could be problematic, this WSMP recommends the purchase of a portable trailer-mounted diesel-powered generator.

The Bland Pump Station does not have an onsite generator or any way to connect a portable one. This WSMP recommends, at a minimum, electrical improvements that would allow the connection of a portable generator and the purchase of a portable trailer-mounted diesel-powered generator. The generator purchase recommended for the View Drive Pump Station could be shared with the Bland Pump Station.

Table 6-3 summarizes current emergency power conditions at the pump stations and their associated pressure zones.

Table 6-3 | Pumping Station Emergency Power

Pump Station	Discharge Pressure Zone	Emergency Power
Bolton	Horton	Meets the performance criteria
Horton	Rosemont	Meets the performance criteria
Willamette	Bland	Meets the performance criteria
View Drive	Rosemont	Deficiencies include a generator and electrical connection
Bland	Rosemont	Deficiencies include a generator, transfer switch and electrical connection

The City's pump stations meet the specified firm capacity performance criteria but do not meet the standby emergency power performance criteria at the Bland and View Drive Pump Stations. The failure of one or both pump stations could impact storage in the Rosemont Reservoir and demand in the Rosemont Pressure Zone. The following options are available to the City.

- Option 1: Purchase one portable trailer-mounted generator sized for use at the Bland and View Drive Pump Stations. Install an ATS and make other electrical improvements at the Bland Pump Station. Provide the necessary electrical improvements at the View Drive Pump Station. Budget Cost = $265,000.
- Option 2: Purchase and install two onsite standby generators each sized specifically for the Bland and View Drive Pump Stations. Provide necessary site improvements, including grading and a concrete pad. Install an ATS and other electrical improvements at the Bland Pump Station. Provide the necessary electrical improvements at the View Drive Pump Station.

Option 1 would allow the Bland and View Drive Pump Stations to meet the emergency power performance criteria at a lower cost and faster schedule than Option 2. Additionally, Option 2 would require site and electrical design and coordination with PGE. The City should keep in mind that use of a portable generator will require access to the generator and the ability to haul it to the pump station during emergency conditions.

Option 1, Emergency Power Improvements, has been included in the CIP at a budget cost of $265,000 for Fiscal Year (FY) 2024-FY 2028.

6.5 Willamette Pump Station Motor Control Center (MCC) Assessment

This WSMP recommends an assessment of the condition, performance and operation of the existing MCCs in the Willamette Pump Station. The assessment would determine if corrective repairs or replacement are required to address pump performance and operational concerns that were identified by City staff. It is recommended that the City proceed with the assessment during FY 2024-FY 2028. A budget cost of $420,000 is included in the CMP for the assessment and improvements. This cost of the improvements, however, should be confirmed during the assessment.

6.6 Demolition of Abandoned View Drive Site Facilities

It is recommended that the abandoned reservoir and pump station on the View Drive site be demolished and removed to improve site aesthetics and reduce the risk associated with failure of aging structures. A budget cost of $250,000 is included in the CMP for FY 2024-FY 2028.

6.7 Site Facilities

The physical condition of the pump stations, including building and site utilities are generally unknown, however, the Horton Pump Station needs a new roof.. A budget cost of $40,000 is included in the CMP for FY 2024-FY 2028.

Summary of Recommended Improvements

The firm capacity of the City's pump stations meet the specified performance criteria for pumping, however, other improvements associated with the pump stations are recommended in the CMP and CIP, as summarized in Table 6-4 below.

Table 6-4 | Summary of Pumping CIP and CMP Projects

Pump Station	CIP Improvements	CMP Improvements
Horton	Portable Generator Budget Cost: $265,000, FY 2024-FY 2028	Horton Roof Replacement Budget Cost: $40,000 FY 2024-FY 2028
Valley View		Demolish Valley Drive Pump Station and Reservoir Budget Cost: $250,000, FY 2024-FY 2028
Willamette	MCC Assessment Budget Cost: $420,000, FY 2024-FY 2028	

CHAPTER 7

Distribution System Analysis

7.1 General

This chapter summarizes the analysis of the City's water distribution system against the existing system described in **Chapter 1**, demand projections described in **Chapter 2**, and the performance criteria described in **Chapter 3** of this WSMP. The results of the analysis serve as the basis for capital improvements and capital maintenance of the distribution system, as described in the CIP in **Chapter 12**.

The distribution system performance criteria are summarized in **Table 7-1**.

Table 7-1 | Distribution System Performance Criteria Summary

Water System Component	Evaluation Criteria	Value	Design Standards/Guideline
Service Pressure	Minimum system pressure under normal conditions (ADD) Maximum system pressure under normal conditions (ADD)	40 psi 100 psi	Ten State Standards, City Public Works Standards
	Maximum	110 psi system pressure and 80 psi at service with individual PRVs	Oregon Plumbing Specialty Code, Section 608.2
	Minimum, during MDD with Fire Flow	20 psi	OHA DWS and OAR 333-061-0025(7)
	Minimum, during PHD	75% of normal, not less than 30 psi	
Distribution Mains	Velocity during PHD1	Not to exceed 8 fps	AWWA M32, Washington Water System Design Manual
	Minimum Pipe Diameter	8-inch diameter, 6-inch acceptable for short mains without fire service	City Public Works Standards
Required Fire Flow and Duration	Single-Family Residential	1,750 gpm for 2 hours	2022 Oregon Fire Code, TVFR Fire Code Applications Guide
	Multi-Family Residential	3,000 gpm for 3 hours	
	Commercial, Industrial, and Institutional	3,000 gpm for 3 hours	

7.2 General Condition of Distribution System

A review of the City's 2020, 2021, and 2022 Leak Repair Reports indicate the majority of reported leaks involving pipe mains were 6-inch and 8-inch diameter cast iron and AC pipes (80 percent) and were located in the Bolton and Rosemount pressure zones (79 percent). Approximately 85 percent of the piping referenced on the leak reports were assessed as fair or poor condition and approximately 60 percent were assessed as needing replacement. Approximately half of the repairs required a shutdown and at least 350 labor hours were allocated to the repair of the reported leaks for that three-year period.

The City's relatively low percentage of water loss does not make a leak detection program economically feasible; however, the City should continue to focus on a systematic replacement of aged and obsolete cast iron and AC water mains.

7.3 Aged and Outdated Piping

Table 1-6 of this WSMP tabulates the type and length of different pipe materials in the City's transmission and distribution system. Based on the City's current GIS database, approximately 29 percent of the City's transmission and distribution piping is comprised of galvanized, steel, cast iron, or AC. Due to risks associated with useful life, health impacts, and ongoing deterioration of these types of piping, it is typically recommended that a water provider replace them with ductile iron or PVC, depending on the application. This WSMP recommends ongoing funding for and replacement of the referenced aged and obsolete piping material until it is completely replaced according to the following prioritization.

- Priority 1: replacement of galvanized/steel piping
- Priority 2: replacement of AC piping
- Priority 3: replacement of cast iron piping

7.3.1 Galvanized/Steel Pipe Replacement

Cost associated with the replacement of approximately 950 LF of galvanized/steel piping 6 inches in diameter or smaller is included in the CMP. Cost associated with the replacement of approximately 6,983 LF of larger diameter galvanized/steel piping is included in the CIP.

An annual budget of $60,000 is included in the CMP for small diameter galvanized/steel pipe replacement over the FY 2024-FY 2028, resulting in a total budget of $300,000. An annual budget of $400,000 is included in CIP M-01 for large diameter steel pipe replacement over the FY 2024-FY 2044 and beyond, resulting in a total budget of $8,250,000. **Figure 7-1** and **Figure 7-2** illustrate the general location and **Table 7-2** tabulates the length of galvanized/steel piping by diameter and pressure zone.

Table 7-2 | Galvanized/Steel Piping Length and Diameter

Pressure Zone	Length (feet)				
	<4-inch	8-inch	18-inch	20-inch	24-inch
Bland					
Bolton	285		2,723	1,558	2,702
Horton	375				
Robinwood	90				
Rosemont					
Willamette	200				
TOTAL	**950**		**2,723**	**1,558**	**2,702**

For the piping that is 4 inches in diameter or less that do not support fire hydrants and will not be looped in the future, it is recommended that replacement of these mains be completed with 4-inch diameter ductile iron piping. Increasing the size of these pipes to anything larger will result in excess unused capacity with no benefit to the distribution system and may result in water quality issues.

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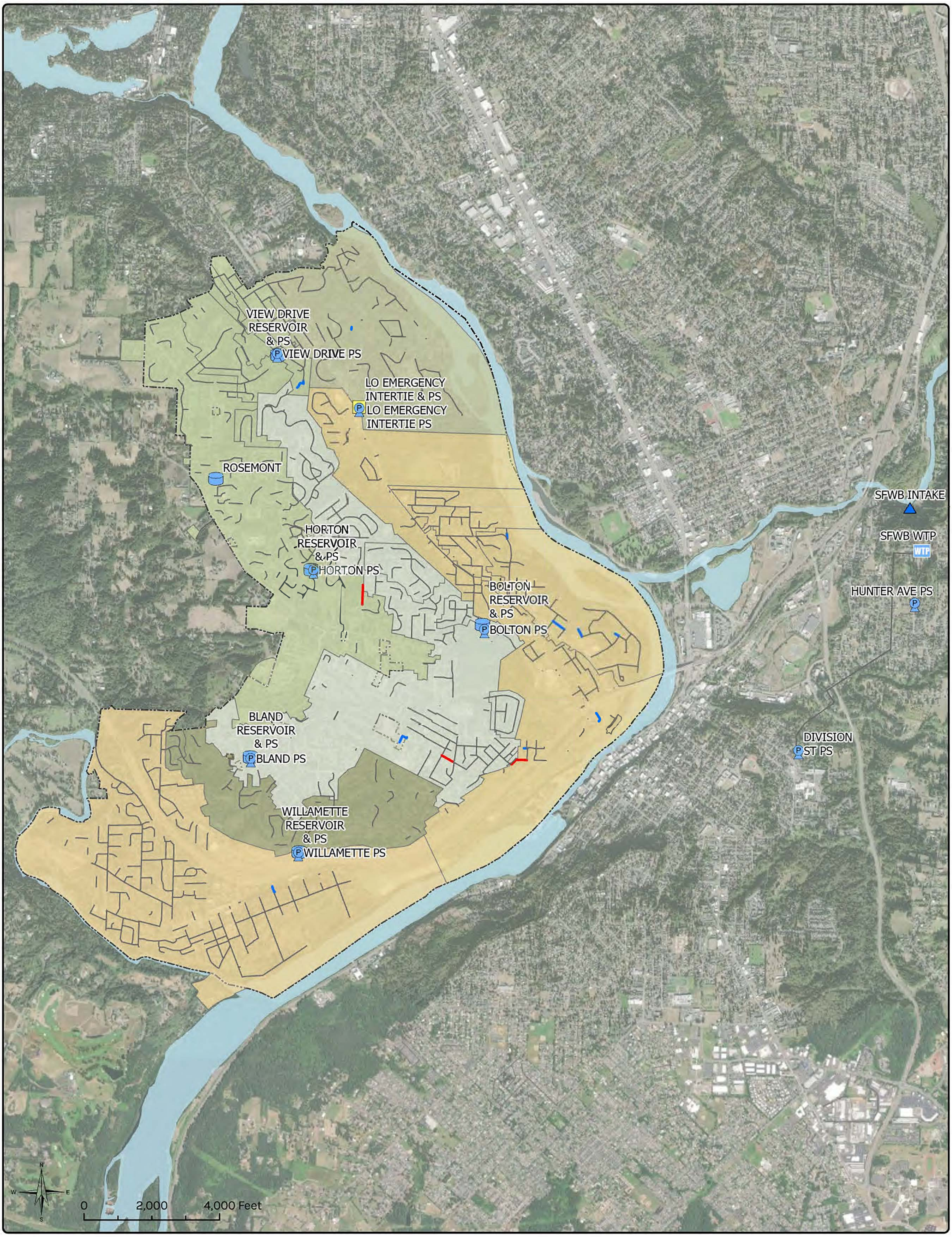

Legend

Mains

Material

- Other 6-inch or less
- Steel 6-inch or less
- Galvanized 6-inch or less
- ▲ SFWB Intake
- WTP SFWB WTP
- Emergency Intertie
- Pump Station
- Reservoir

Pressure Zone

Zone

- Bland
- Bolton
- Horton
- Robinwood
- Rosemont
- Willamette
- City Limits

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Figure 7-1
CMP Priority 1
Galvanized and Steel Pipes

Project No: 22-3537

March 2024

Data Sources: City of West Linn, 2022; World Imagery: Maxar.
Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
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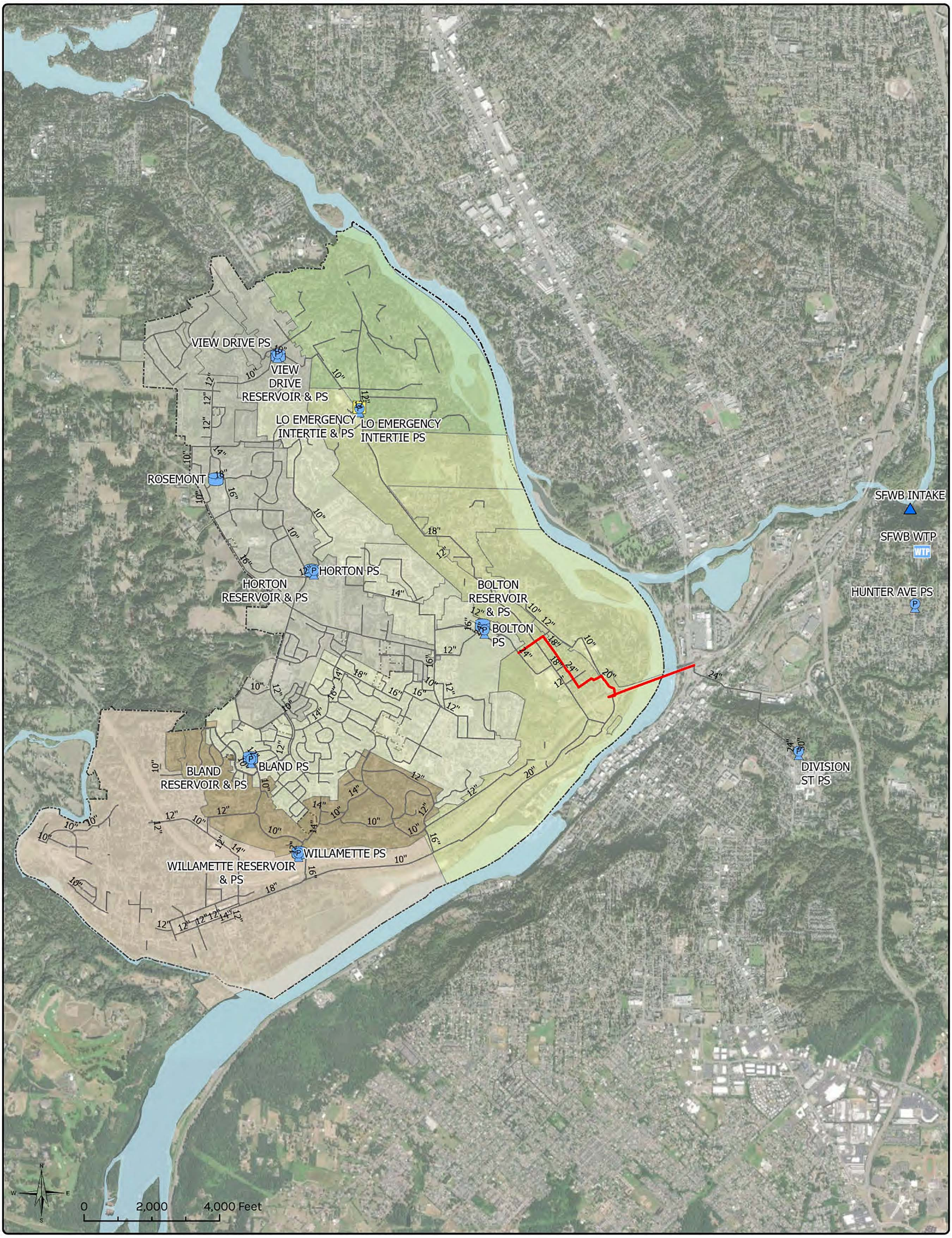

Legend

Mains Material

—	Other
🟥	Steel > 6-inch
🟦	Galvanized > 6-inch
▲	SFWB Intake
WTP	SFWB WTP
I	Emergency Intertie
P	Pump Station
●	Reservoir

Pressure Zone

Zone

▨	Bland
▨	Bolton
▨	Horton
▨	Robinwood
▨	Rosemont
▨	Willamette
┅	City Limits

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Water System Master Plan

Figure 7-2
CIP
Galvanized and Steel Pipes

Project No: 22-3537

March 2024

Data Sources: City of West Linn, 2022; World Imagery: Maxar.
Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl

7.3.2 Asbestos Cement Pipe Replacement

Cost associated with the replacement of approximately 42,525 LF of AC piping is included in the CMP. Aging AC pipe has been shown to have higher occurrences of leaks and failures than other piping materials and special precautions must be taken when working near, tapping into, or connecting to this pipe material. Replacement of AC piping should be considered Priority 2 under the CMP.

Main piping 8-inch diameter and smaller should be replaced with new 8-inch diameter pipes and 10-inch diameter mains should be replaced with 10-inch diameter piping. The minimum size recommended for new and replacement mains to support fire flow requirements as outlined in the State of Oregon Fire Code and as adopted by TVFR is 8-inch diameter. Where a dead-end main is being replaced that does not support a fire hydrant, and no plans for future looping are anticipated, a 6-inch diameter main size may be considered.

An annual budget ranging between $300,000 and $400,000 is included in the CMP for AC pipe replacement over the 20-year planning period and beyond, for a total budget of $16,165,000. **Figure 7-3** illustrates the general location and **Table 7-3** tabulates the total length of AC piping by diameter and pressure zone.

Table 7-3 | AC Piping Length and Diameter – CMP Priority 2

Pressure Zone	Length (feet)		
	4-inch	8-inch	10-inch
Bland			
Bolton		1,860	
Horton		7,530	
Robinwood		10,950	3,315
Rosemont	1,090	9,015	850
Willamette		650	
TOTAL	**1,090**	**30,005**	**4,165**

7.3.3 Cast Iron Pipe Replacement

Cost associated with the replacement of approximately 74,945 feet of cast iron piping is included in the CMP. Replacement of cast iron piping should be considered Priority 3 under the CMP.

Main piping 8-inch diameter and smaller should be replaced with new 8-inch diameter pipes and 10-inch diameter mains should be replaced with 10-inch diameter piping. The minimum size recommended for new and replacement mains to support fire flow requirements as outlined in the State of Oregon Fire Code and as adopted by TVFR is 8-inch diameter. Where a dead-end main is being replaced that does not support a fire hydrant, and no plans for future looping are anticipated, a 6-inch diameter main size may be considered.

An annual budget ranging between $200,000 and $400,000 is included in the CMP for cast iron pipe replacement over the 20-year planning period and beyond, for a total budget of $28,150,000. **Figure 7-4** illustrates the general location and **Table 7-4** tabulates the total length of cast iron piping by diameter and pressure zone.

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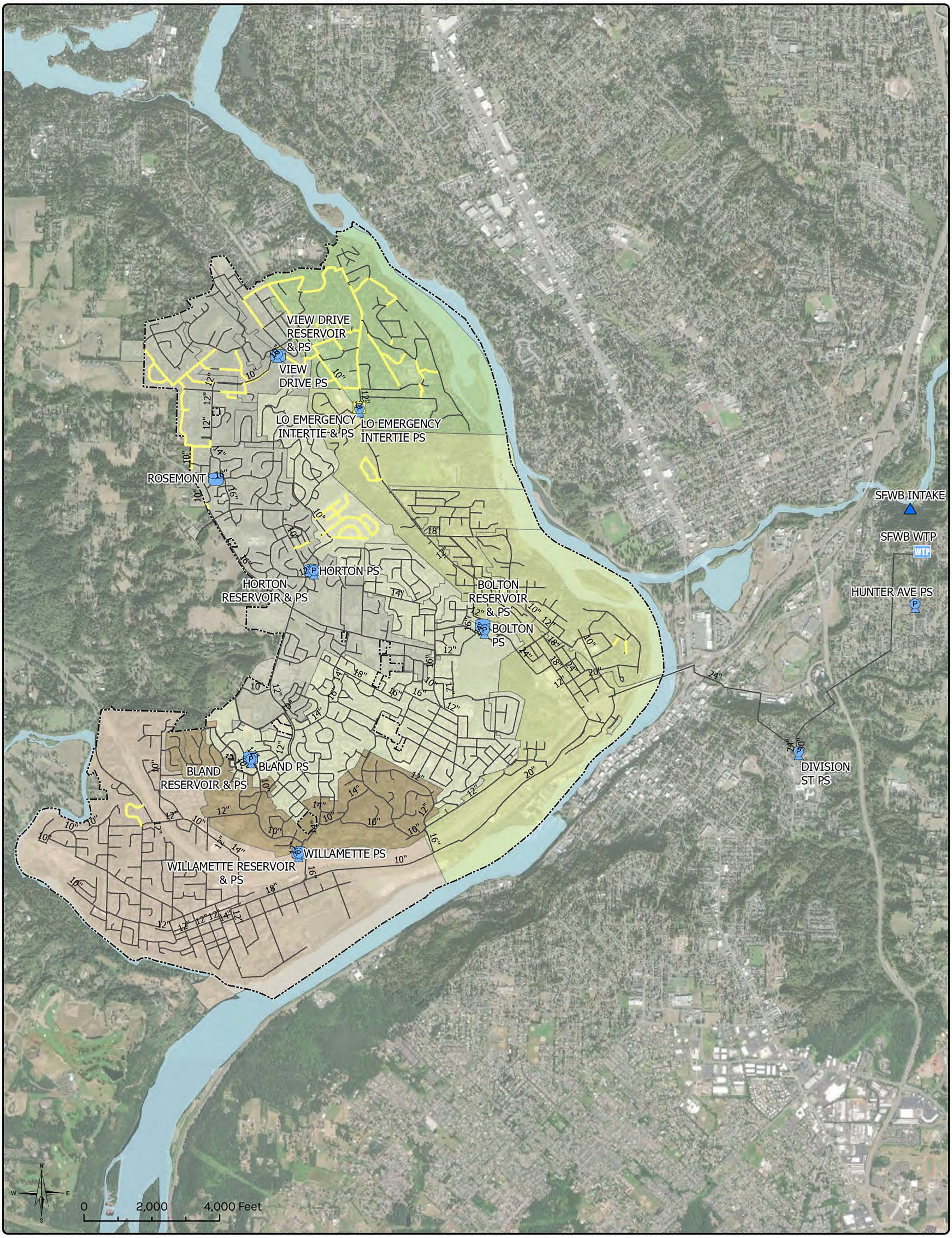

Legend

Mains

Material

- Other
- AC
- ▲ SFWB Intake

- WTP SFWB WTP
- I Emergency Intertie
- P Pump Station
- Reservoir
- ▨ Bland
- ▨ Bolton

- ▨ Horton
- ▨ Robinwood
- ▨ Rosemont
- ▨ Willamette
- ☐ City Limits

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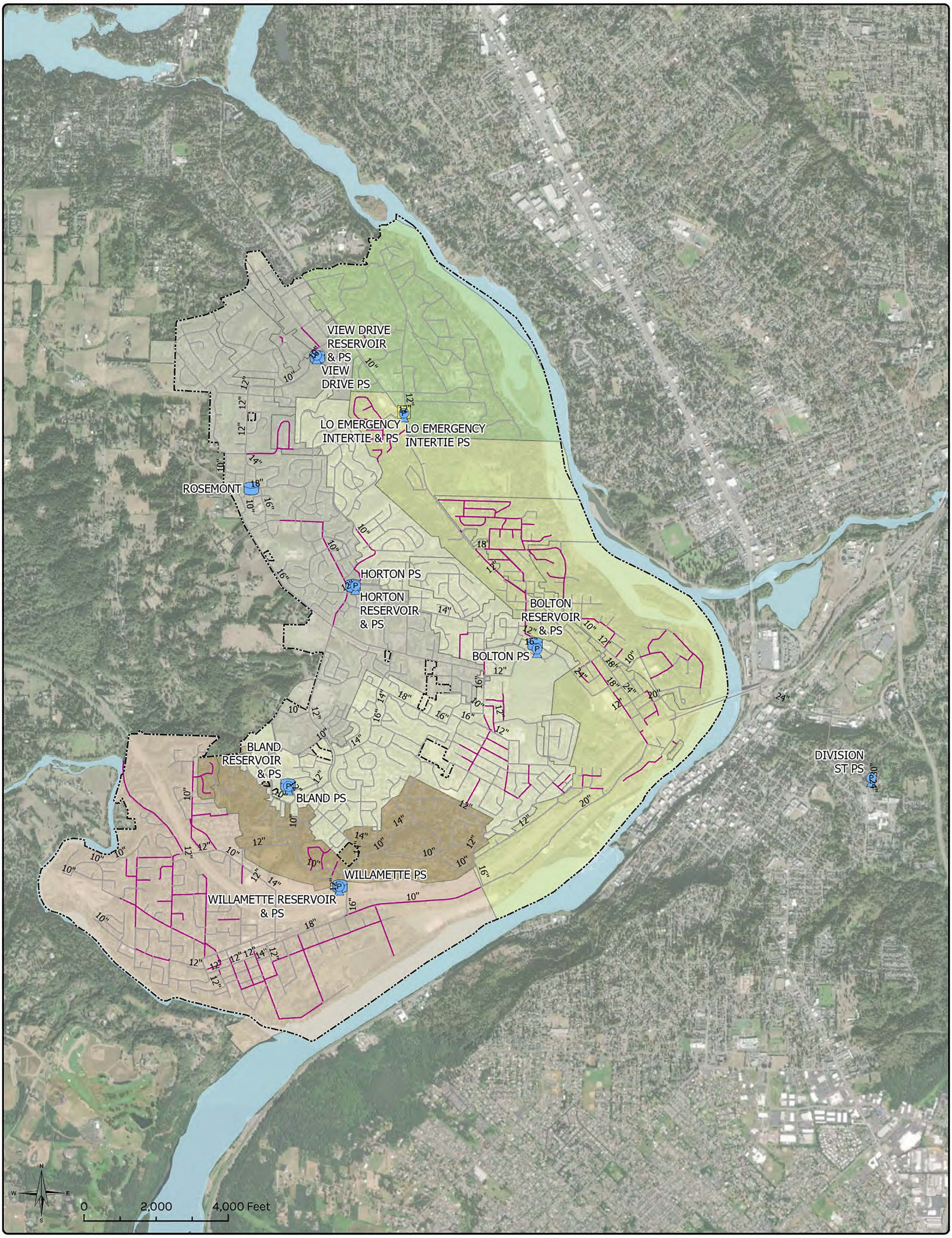
Figure 7-3
CMP Priority 2
AC Pipes

Project No: 22-3537

March 2024

Data Sources: City of West Linn, 2022; World Imagery: Maxar.
Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl



Legend

Mains Material

―	Other
―	CAS; CI
▲	SFWB Intake
WTP	SFWB WTP
I	Emergency Intertie
P	Pump Station
●	Reservoir
▨	Bland
▨	Bolton
▨	Horton
▨	Robinwood
▨	Rosemont
▨	Willamette
⬚	City Limits

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Figure 7-4
CMP Priority 3
Cast Iron Pipes

Project No: 22-3537

March 2024

Data Sources: City of West Linn, 2022; World Imagery: Maxar.
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Table 7-4 | Cast Iron Piping Length and Diameter – CMP Priority 3

Pressure Zone	Pipe Length (feet)				
	4"	6"	8"	10"	12"
Bland	280	3,315			
Bolton	2,810	21,805	3,740		
Horton	1,180	3,750	500	2,150	1,450
Robinwood		450	530	185	
Rosemont	750	1,715	1,435	4,365	
Willamette	2,485	18,220	1,635	2,195	
TOTAL	**7,505**	**49,255**	**7,840**	**8,895**	**1,450**

7.3.4 PRV Station Drainage Improvements

It is recommended that the City complete drainage improvements at existing PRV vaults below a ground elevation of approximately 175 feet to address potential flooding issues. The vaults should be sealed to reduce groundwater infiltration and surface water inflow. Sump pumps should be installed to remove any water that does enter the vault. The intrusion of groundwater impacts the capacity of the piping. An annual budget of $78,000 is included in CMP M-02 over the FY 2024-FY 2028, resulting in a total budget of $390,000.

7.4 Water System Operational Improvements

Improvements associated with the water system’s ability to operate within the performance criteria described in **Chapter 3** are included below.

7.4.1 Willamette Drive/Marylhurst Drive/Lazy River Drive Improvements

Approximately 3,800 LF of sub-standard and/or undersized piping is located in Willamette Drive (Hwy 43) between Arbor Drive and Cedar Oak Drive. Slip lining an abandoned 24-inch welded steel transmission main with 16-inch and 20-inch high-density polyethylene has been proposed as a replacement method. The project would also require reconnecting services, laterals, and hydrants and will include work within the ODOT right-of-way. The project was intended to be built in conjunction with an ODOT sidewalk and paving project but was shelved due to the City’s focus on the I-205 Bridge Project. ODOT’s revisions to their original Hwy 43 scope will now require the City to re-evaluate the tie-in locations for the new feeder pipe to the View Drive Reservoir. Additional potholing and modifications to the 90% design will be required for the project to proceed. A budget of $3,000,000 has been included in the FY 2024-FY 2028 CIP M-03.

7.5 Hydraulic Analysis of Distribution System

A computerized hydraulic model of the distribution system was created for the WSMP using the City’s GIS database. The software used for the model was InfoWater, which is a fully GIS integrated software application commonly used for distribution modeling and management. The model was used as the basis for evaluating the performance of the City’s water system under a variety of demand and fire flow scenarios. The results of the model will determine pressure and flow relationships throughout the distribution system under a variety of hydraulic conditions. The evaluation of the system performance and adequacy is based on the system pressure and fire flow performance criteria described above to identify areas of deficiency and develop recommended system improvements.

All system pipes are shown as "links" between "nodes" which represent pipeline junctions or changes in pipe size. Other system assets, like reservoirs, pump stations, and PRVs are also represented in the model. Each pipe, junction, and asset has a set of attributes or properties that describe the pipe diameter, elevation, or other parameter specific to that asset.

7.5.1 Modeling Calibration, Conditions and Assumptions

A calibrated computer model will provide the most accurate results of the system operation. A new model based on the City's GIS database was created for this WSMP. Calibration was performed during the development of the model with a 5 psi static pressure variance and 10 psi fire flow residual variance. The calibration procedure was reviewed and verified with recent flow test data associated with the City's 24-inch diameter transmission main and determined to be adequate for master planning level analysis of the distribution system.

The distribution system was evaluated under two demand scenarios:

- MDD plus fire flow demand
- PHD

These two scenarios describe what is typically the largest instantaneous demand on a system. Evaluating the system under these conditions helps identify deficiencies in the distribution network and suggest improvements to be included in the Capital Improvements Projects list.

The analysis of the City's water system under existing and future demand was performed to assess the distribution system's ability to provide required demand (ADD, MDD, PHD and fire flow) while maintaining acceptable system pressure for operation of typical customer fixtures and irrigation systems.

Analysis of the system under existing and proposed conditions assumed that all supply necessary to meet the MDD within each pressure zone was provided through the City's existing storage facilities under normal operating conditions.

7.5.2 Service Pressure and Pressure Zone Analysis

Table 7-5 summarizes the highest elevation served and corresponding static pressure in each pressure zone. The performance criteria require a minimum pressure of 40 psi; therefore, the existing pressure zone boundaries are generally adequate to provide the recommended minimum service pressures throughout the water system. PRVs maintain service pressures below the maximum pressure of 100 psi at lower elevations.

Table 7-5 | Pressure Zone Service Pressure Analysis Summary

Pressure Zone	Overflow Elevation (feet)	Highest Elevation in System	
		Elevation (feet)	Static Pressure (psi)
Robinwood	327	207	52
Willamette	351	257	41
Bolton	440	336	45
Bland	585	490	41
Horton	730	632	42
Rosemont	860	754	46

7.5.3 Fire Flow Modeling Criteria

Fire flow requirements are typically much larger than the normal MDD; however, adequate hydraulic capacity must be provided during a fire event at each fire hydrant. The distribution system must be capable of providing the recommended fire flow to a given location while supplying the MDD and maintaining a minimum residual service pressure of 20 psi at all services in the system.

The following assumptions were made while modeling fire flow.

- Reservoir volume was at 75 percent of the full volume.
- Capacity was increased in zones with more than one supply source.
- Fire flow demand was assigned according to the land use/zoning category in the City's GIS.

The scenarios under which the model was evaluated included the following:

A. ADD and resulting pressure conditions
B. MDD and resulting pressure conditions
C. PHD and resulting pressure conditions
D. MDD plus maximum fire flow within each pressure zone with the largest supply out of service

System performance was generally found to be adequate under scenarios A, B, and C. System performance under scenario D, however, was found to be inadequate in multiple locations. The modeling analysis revealed distribution system deficiencies during fire flow events under existing conditions and future conditions in all six of the pressure zones that resulted in unacceptable pressure drops below 20 psi. These areas lack the hydraulic capacity to meet the performance criteria described under scenario D and provide adequate system pressure.

Potential system improvements were systematically input into the model and tested to determine the most effective and economical improvements to address the deficiencies. A cost/benefit approach was used to prioritize improvements such that adequate system pressure at fire flows within 10 percent of the required flow were considered acceptable for this evaluation. These capacity reductions reflect the City and TVFR's preference for on-site fire suppression (sprinklered) systems at developments with higher fire flow requirements than the surrounding and/or adjacent structures. The following guidelines were used to evaluate deficiencies.

- Residential areas that did not provide adequate pressure at a fire flow of 1500 gpm were improved to provide adequate pressure at a fire flow of 1750 gpm.

- Residential areas that did provide adequate pressure at fire flows greater than 1500 were not improved.

- Commercial/institutional/industrial areas that did not provide adequate pressure at a fire flow of 2700 gpm were improved to provide adequate pressure at a fire flow of 3,000 gpm.

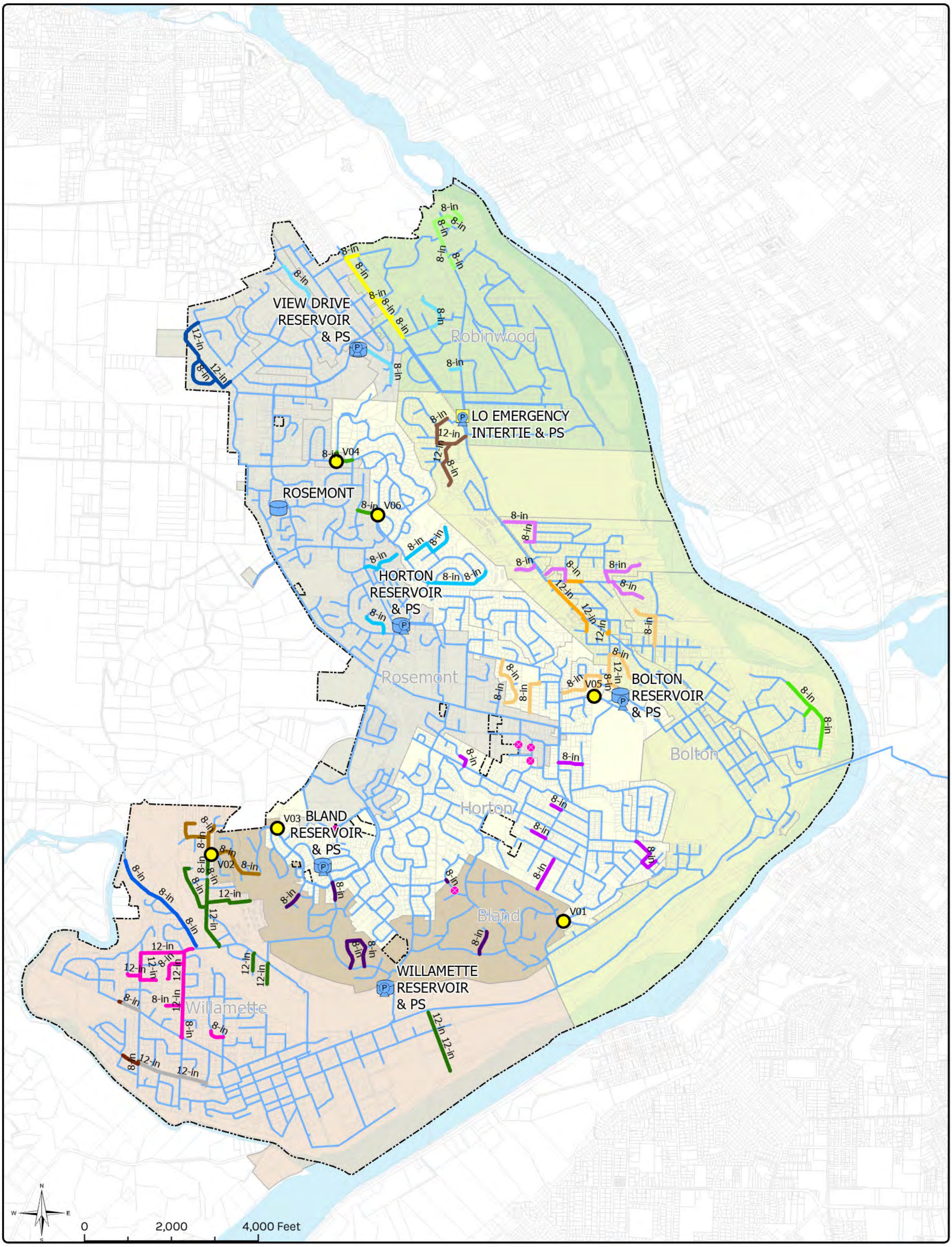
- Commercial/institutional/industrial areas that did provide adequate pressure at a fire flow greater than 2700 gpm were not improved.

Approximately 70,000 LF of piping improvements are recommended to address the modeled deficiencies. The recommended improvements were categorized and prioritized as described in **Table 7-6**.

Table 7-6 | Recommended Distribution System Improvement Prioritization

Priority Category	Description	SDC Allocation Methodology
1	Improvements related to maintaining fire flow pressure and capacity to a large area within a subzone. These improvements typically require the installation of a new PRV between two adjacent pressure zones and impact a large number of services. Installation of a new PRV may also be used to maintain service if an isolation valve must be closed for system maintenance or repairs.	These improvements are intended to address deficiencies in transmission capacity. New mains and the expanded capacity of replacement mains are allocated to growth. These are the highest priority improvements because they provide the broadest benefit to the greatest number of customers.
2	Improvements related to increasing transmission capacity between supply facilities. These improvements typically require an increase in pipe diameter and are located in proximity to reservoirs.	These improvements are intended to address deficiencies in transmission capacity. New mains and the expanded capacity of replacement mains are allocated to growth. These are the highest priority improvements because they provide the broadest benefit to the greatest number of customers.
3	Improvements related to improving fire flow capacities, addressing existing system deficiencies. Conveyance Deficiencies: Areas with hydraulic deficiencies that require an increase in pipe diameter to maintain sufficient pressure and capacity during a fire event. These improvements typically increase conveyance piping diameter to 8 and 12-inch diameters.	These improvements address existing conveyance deficiencies and are therefore allocated to existing customers. If a project must be increased in size to accommodate future needs, then the oversized portion is allocated to growth.
4	Improvements intended to increase system looping and proposed for opportunistic completion with planned developments. Local improvements addressing fire flow capacities for a small number of customers, such as dead-end mains. These improvements are typically dead-end pipes or hydrants that serve a relatively low number of services.	These improvements are required to meet the demands of future development and improve system performance. A number of these projects are anticipated to be required as a condition of development. These improvements address existing deficiencies and are for local system needs. Allocation of these projects is entirely to existing customers.

Some pipe segments with lower priorities were grouped into higher priority CIP projects due to proximity. **Figure 7-5** illustrates the general locations of the recommended distribution system improvements.



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Water System Master Plan

Figure 7-5
Distribution System CIP Improvements

Project No: 22-3537

March 2024

Data Sources: City of West Linn, 2022; .
Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
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7.6 Priority 1 CIPs – New PRV Stations

The model analysis indicates insufficient hydraulic capacity between adjoining subzones. This WSMP recommends the installation of new PRVs, as described below.

7.6.1 V-01 Riverview Drive PRV

Installation of a new PRV with associated piping and valves connecting the Horton (6) and Bland (2) subzones to provide additional hydraulic capacity to the Bland (2) subzone. This improvement will provide additional hydraulic capacity to Bland (2) and improve the reliability of supply to this pressure zone. Additionally, this new PRV will provide the City with more operational control associated with isolation concerns in the Salermo/Green area.

Proposed PRV No.	General Location	Recommended Schedule	Estimated Cost
02-PRV-0001	4176 Riverview Drive	FY 2024-FY 2028	$250,000

7.6.2 V-02 Debok/Killarney PRV

Installation of a new PRV with associated piping and valves completing a loop between the Bland (2) and Willamette (1) subzones to provide additional hydraulic capacity to the Willamette (1) subzone. The PRV and new piping replaces an existing 6-inch diameter pipe. This improvement will provide additional hydraulic capacity to Willamette (1) and improve the reliability of supply to this pressure zone. There is currently one existing PRV between the Bland (2) and Willamette (1) subzones.

Proposed PRV No.	General Location	Recommended Schedule	Estimated Cost
01-PRV-0002	Debok/Killarney Intersection	FY 2024-FY 2028	$250,000

7.6.3 V-03 Bland Circle PRV

Installation of a new PRV with associated piping and valves connecting the Horton (6) and Bland (2) subzones to provide additional hydraulic capacity to the Bland (2) subzone.

Proposed PRV No.	General Location	Recommended Schedule	Estimated Cost
02-PRV-0002	23004 Bland Circle	FY 2024-FY 2028	$250,000

7.6.4 V-04 Carraige Way/Wildwood PRV

Installation of a new 12-inch PRV completing a loop between the Rosemont (14) and Horton (6) subzones to provide additional hydraulic capacity to the Horton (6) subzone. This new PRV requires significantly more new piping, compared to the other PRVs. This improvement will provide additional hydraulic capacity to Horton (6) and improve the reliability of supply to this pressure zone.

Proposed PRV No.	General Location	Recommended Schedule	Estimated Cost
06-PRV-0001	Carraige Way and Wildwood	FY 2029-FY 2033	$500,000

7.6.5 V-05 Firwood/Skyline PRV

Installation of a new PRV with associated piping and valves connecting the Horton (6) and Horton (7) subzones to provide additional hydraulic capacity to the Horton (7) subzone. There are two existing PRVs between the Horton (6) and Horton (7) subzones. This improvement will provide additional hydraulic capacity to Horton (7) and improve the reliability of supply to this pressure zone.

Proposed PRV No.	General Location	Recommended Schedule	Estimated Cost
07-PRV-0003	Firwood and Skyline Intersection	FY 2029-FY 2033	$250,000

7.6.6 V-06 Carriage Way/Hunter Way PRV

Installation of a new PRV with associated piping and valves completing a loop between the Rosemont (9) and Horton (6) subzones to provide additional hydraulic capacity to the Horton (6) subzone. This improvement will provide additional hydraulic capacity to Horton (6) and improve the reliability of supply to this pressure zone.

Proposed PRV No.	General Location	Recommended Schedule	Estimated Cost
06-PRV-0001	Carriage Way and Hunter Way Intersection	FY 2029-FY 2033	$250,000

7.7 Priority 2 CIPs – Transmission/Supply Improvements

The distribution system analysis found that water line improvements are needed to provide improved hydraulic capacity in the transmission piping. **Table 7-7** lists the recommended Priority 2 improvements associated with transmission.

7.8 Priority 3 CIPs – Conveyance Improvements

The distribution system analysis found that water line improvements are needed to provide improved hydraulic capacity in the conveyance piping. **Table 7-8** lists the recommended Priority 3 improvements associated with transmission.

7.9 Priority 4 CIPs – Looping and Dead End Improvements

The distribution system analysis found that water line improvements are needed to provide improved hydraulic capacity at dead ends and hydrants. **Table 7-9** lists the recommended Priority 4 improvements associated with transmission.

Also, two hydrants located in the Horton Pressure Zone do not have sufficient pressure to provide the required fire flow. Increasing the diameter of the laterals to the hydrants will not solve the issue due to the elevation of the hydrants. The recommendation is to install new laterals from the existing hydrants to the adjacent and higher elevation Rosemont Pressure Zone.

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Table 7-7 | Priority 2 CIP Improvements

CIP No.	Description	General Location	Pressure Zone	Existing Diameter (in)	Proposed Diameter (in)	Length	Recommended Schedule	Estimated Cost
D-01	Increase pipe diameter to correct capacity and fire flow deficiencies	19th Street, Blankenship Road, Douglas Drive, Fairview Court, Hillhouse Drive, Michael Drive, Orchard Street, Ostman Road	Willamette	6”	8” and 12”	1,880 ft 8” 4,120 ft 12”	FY 2029-FY 2033	$3,700,000
D-02*	Increase pipe diameter to correct fire flow deficiencies	Dollar Street, Ostman Road, Willamette Falls Drive	Willamette	6” and 8”	8” and 12”	150 ft 8” 450 ft 12”	FY 2029-FY 2033	$360,000
D-03	Increase pipe diameter to correct capacity and fire flow deficiencies and dead ends.	Barnes Circle, Riverknoll Drive, Taylor Drive, Tannler Drive	Bland	4” and 6”	8”	3,000 ft 8”	FY 2029-FY 2033	$1,400,000
D-04	Increase pipe diameter to correct capacity and fire flow deficiencies and dead ends.	Caufield Street, Firwood Street, Hammerle Street, Linn Lane, Parkview Terrace, Rosepark Drive, Failing Street, Bridgeview Drive, Evergreen Drive	Bolton	6”	8”	6,800 ft 8”	FY 2034-FY 2044	$3,250,000
D-05	Increase pipe diameter to correct capacity and dead ends	Debok Road, Tamariosk Drive, Troy Court, Wisteria Court, Killarney Drive	Willamette and Bland	6”	8”	2,700 ft 8”	FY 2034-FY 2044	$1,200,000
							TOTAL PRIORITY 2 CIP IMPROVEMENTS	$9,910,000

Note:
*D-02 improvements are adjacent to the 2024 Waterline Improvements that are currently scheduled for design and construction in 2024.

Table 7-8 | Priority 3 CIP Improvements

CIP No.	Description	General Location	Pressure Zone	Existing Diameter (in)	Proposed Diameter (in)	Length	Recommended Schedule	Estimated Cost
D-06	Increase pipe diameter to correct capacity and fire flow deficiencies	Bella Street, River Street	Bolton	4”	8”	2,100 ft 8”	FY 2034-FY 2044	$945,000
D-07	Increase pipe diameter to correct capacity and fire flow deficiencies	Arbor Drive, Lazy River Drive, Shady Hollow Way, Willamette Drive	Robinwood	4” and 6”	8”	2,770 ft 8”	FY 2034-FY 2044	$1,260,000
D-08	Increase pipe diameter to correct capacity and fire flow deficiencies and dead ends	13th Street, 4th Street, Blankenship Road, Debok Road, I205 Fwy, Margery Street, Village Park Place, Virginia Lane, Alder Street, Barclay Street, Willamette Drive	Willamette and Bolton	6”	8” and 12”	1,860 ft 8” 5,000 ft 12”	FY 2034-FY 2044	$4,235,000
D-09	Increase pipe diameter to correct capacity and fire flow deficiencies	Barlow Street, Willamette Drive, Dillow Drive	Bolton	6”	8” and 12”	400 ft 8” 1,550 ft 12”	FY 2034-FY 2044	$1,235,000
D-10	Increase pipe diameter to correct capacity and fire flow deficiencies	Chow Mein Lane, Cottonwood Court, Hidden Springs Road, Robin Circle, Wilderness Drive	Bolton	6” and 8”	8” and 12”	1,050 ft 8” 1,530 ft 12”	FY 2034-FY 2044	$1,515,000
							TOTAL PRIORITY 3 CIP IMPROVEMENTS	$9,190,000

Table 7-9 | Priority 4 CIP Improvements

CIP No.	Description	General Location	Pressure Zone	Existing Diameter (in)	Proposed Diameter (in)	Length (ft)	Recommended Schedule	Estimated Cost
D-11	Improve capacity at dead ends.	Cambridge Street, Falls View Avenue, Knox Street, Riverview Avenue, Roxbury Drive, Sussex Street, Walden Street, Warwick Street	Horton	4” and 6”	8”	3,400	Beyond 20-Yr Planning Period	$1,550,000
D-12	Improve capacity at dead ends.	Pimlico Drive, Jolie Pointe Road, Larson Avenue, Lowell Avenue, Magone Lane, Maple Terrace, Mark Lane, Tulane Street, Dillow Drive, Willamette View Court	Bolton	4” and 6”	8”	4,650	Beyond 20-Yr Planning Period	$2,200,000
D-13	Improve capacity at dead ends.	Apollo Road, Athena Road, Bronco Court, Palomino Circle, Palomino Way, Sorrel Way, Club House Circle, Club House Court, Conestoga Lane	Horton and Rosemont	6”	8”	5,600	Beyond 20-Yr Planning Period	$2,110,000
D-14	Improve capacity at dead ends.	Johnson Road	Willamette	6”	8”	2,630	Beyond 20-Yr Planning Period	$1,197,000
D-15	Improve capacity at dead ends.	Marylhurst Circle, Troon Drive	Rosemont	4” and 8”	8”	3,260	Beyond 20-Yr Planning Period	$1,980,000
D-16	Improve capacity at dead ends.	Old River Drive, Old River Landing, River Edge Lane, River Woods Place	Robinwood	6”	8”	2,130	Beyond 20-Yr Planning Period	$970,000
D-17	Improve capacity at dead ends.	Fairview Way, Old River Drive, Kantara Way, Rydman Court, Hillside Court, Hillside Drive	Robinwood and Rosemont	6”	8”	3,420	Beyond 20-Yr Planning Period	$1,600,000
D-18	Improve capacity at fire hydrants by connecting an existing hydrant to an adjacent and higher pressure zone.	Weatherhill Road	Horton and Rosemont	N/A	8”	300 ft 8”	Beyond 20-Yr Planning Period	$150,000
D-19	Improve capacity at fire hydrants by connecting an existing hydrant to an adjacent and higher pressure zone.	Ireland Land, Coho Lane	Horton and Rosemont	N/A	8”	300 ft 8”	Beyond 20-Yr Planning Period	$150,000
							TOTAL PRIORITY 4 CIP IMPROVEMENTS	$11,907,000

7.10 Summary of Recommended Improvements

The City's distribution system does not meet the specified performance criteria for system pressure and fire flow in several areas. The distribution system also has outdated and aged pipe materials and associated infrastructure that requires updating. Isolated operational issues within the system should also be corrected with the improvements described in this chapter.

This WSMP recommends a combination of Capital Maintenance and Capital Improvements to adequately address the recommended improvements for the distribution system. **Table 7-10** and **Table 7-11** summarize the recommended CMP and CIP distribution system projects.

Table 7-10 | Summary of Distribution CMP Projects

Project Description	Estimated Annual Cost	Proposed Schedule	Total Estimated Cost
Replace small diameter galvanized/steel pipe with ductile iron	$60,000	FY 2024-FY 2028	$300,000
Replace asbestos cement pipe with ductile iron	$300,000 - $400,000	FY 2024-2044, BEYOND	$16,165,000
Replace cast iron pipe with ductile iron	$200,000 - $400,000	FY 2024-2044, BEYOND	$28,150,000

Table 7-11 | Summary of Distribution CIP Projects

Priority	CIP No.	Project Description	Proposed Schedule	Estimated Cost
1	M-01	Replace large diameter galvanized/steel pipe with ductile iron	FY 2024-FY 2044, Beyond	$8,250,000
1	M-02	PRV Station Drainage Improvements	FY 2024-FY 2028	$390,000
1	M-03	Willamette/Marylhurst/Lazy River Drive Improvements	FY 2024-FY 2028	$3,000,000
3	M-04	Water Master Plan	FY 2034-FY 2044	$300,000
1	V-01	Install PRV Station at Riverview Drive connecting the Horton (6) and Bland (2) subzones	FY 2024-FY 2028	$250,000
1	V-02	Install PRV Station at Debok/Killarny connecting the Horton (6) and Bland (2) subzones	FY 2024-FY 2028	$250,000
1	V-03	Install PRV Station at Bland Circle connecting the Horton (6) and Bland (2) subzones	FY 2024-FY 2028	$250,000
1	V-04	Install PRV Station at Carriage Way/Wildwood connecting the Rosemont (14) and Horton (6) subzones	FY 2029-FY 2033	$500,000
1	V-05	Install PRV Station at Firwood/Skyline connecting the Horton (6) and Horton (7) subzones	FY 2029-FY 2033	$250,000
1	V-06	Install a PRV station at Carriage Way/Hunter completing a loop between the Rosemont (9)/ Horton (6) subzones	FY 2029-FY 2033	$250,000
2	D-01	Increase 6,000 feet pipe from 6-inch diameter to 8-inch and 12-inch diameter in Willamette Pressure Zone to correct capacity and fire flow deficiencies.	FY 2029-FY 2033	$3,700,000
2	D-02	Increase 600 feet pipe from 6 and 8-inch diameter to 8 and 12-inch diameter in Willamette Pressure Zone to correct capacity and fire flow deficiencies.	FY 2029-FY 2033	$360,000
2	D-03	Increase 3,000 feet pipe from 4 and 6-inch diameter to 8-inch diameter in Bland Pressure Zone to correct capacity and fire flow deficiencies.	FY 2029-FY 2033	$1,400,000

Priority	CIP No.	Project Description	Proposed Schedule	Estimated Cost
2	D-04	Increase 6,800 feet pipe from 6-inch diameter to 8-inch diameter in Bolton Pressure Zone to correct capacity and fire flow deficiencies	FY 2034-FY 2044	$3,250,000
2	D-05	Increase 2,700 feet pipe from 6-inch diameter to 8-inch diameter in Willamette and Bland Pressure Zones to correct capacity and fire flow deficiencies	FY 2034-FY 2044	$1,200,000
3	D-06	Increase 2,100 feet pipe from 4-inch diameter to 8-inch diameter in Bolton Pressure Zone to correct capacity and fire flow deficiencies	FY 2034-FY 2044	$945,000
3	D-07	Increase 2,770 feet pipe from 4 and 6-inch diameter to 8-inch diameter in Robinwood Pressure Zone to correct capacity and fire flow deficiencies	FY 2034-FY 2044	$1,260,000
3	D-08	Increase 6,860 feet pipe from 6-inch diameter to 8 and 12-inch diameter in Willamette and Bland Pressure Zones to correct capacity and fire flow deficiencies	FY 2034-FY 2044	$4,235,000
3	D-09	Increase 1,950 feet pipe from 6-inch diameter to 8 and 12-inch diameter in Bolton Pressure Zone to correct capacity and fire flow deficiencies	FY 2034-FY 2044	$1,235,000
3	D-10	Increase 2,580 feet pipe from 6 and 8-inch diameter to 8 and 12-inch diameter in Bolton Pressure Zone to correct capacity and fire flow deficiencies	FY 2034-FY 2044	$1,515,000
4	D-11	Install 3,400 feet of 8-inch diameter pipe to increase capacity at dead ends in the Horton Pressure Zone.	Beyond	$1,550,000
4	D-12	Install 4,650 feet of 8-inch diameter pipe to increase capacity at dead ends in the Bolton Pressure Zone.	Beyond	$2,200,000
4	D-13	Install 5,600 feet of 8-inch diameter pipe to increase capacity at dead ends in the Horton and Rosemont Pressure Zones.	Beyond	$2,110,000
4	D-14	Install 2,630 feet of 8-inch diameter pipe to increase capacity at dead ends in the Willamette Pressure Zone.	Beyond	$1,197,000
4	D-15	Install 3,260 feet of 8-inch diameter pipe to increase capacity at dead ends in the Rosemont Pressure Zone.	Beyond	$1,980,000
4	D-16	Install 2,130 feet of 8-inch diameter pipe to increase capacity at dead ends in the Robinwood Pressure Zone.	Beyond	$970,000
4	D-17	Install 3,420 feet of 8-inch diameter pipe to increase capacity at dead ends in the Robinwood and Rosemont Pressure Zones.	Beyond	$1,600,000
4	D-18	Install 300 feet of 8-inch diameter pipe to increase capacity to fire hydrant in the Horton Pressure Zone.	Beyond	$150,000
4	D-19	Install 300 feet of 8-inch diameter pipe to increase capacity to fire hydrant in the Horton Pressure Zone.	Beyond	$150,000

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CHAPTER 8

Operations and Maintenance

8.1 Purpose

This chapter describes the operational control capabilities of, and basic procedures for, the City’s water system.

8.2 Regulatory Requirements

Outlined in OAR 333-061-0065 are the following requirements for O&M of key water system components.

- **Service Continuity** must be maintained to ensure continuous production and delivery of potable water through:
    - Operation of all phases and components of the system in the manner for which they were designed
    - Prompt repair of leaks and broken or malfunctioning equipment
    - Maintenance of proper equipment, tools, and parts to make repairs to the system
    - Procedures to ensure safe drinking water during emergencies
- **Personnel** responsible for operations shall have:
    - Competence
    - Knowledge about all functions of the particular facility being addressed
    - The training and experience necessary to ensure continuous delivery of water
    - Certification as required
- **Operating Manuals** must be maintained and reviewed at least every five years and include:
    - Source O&M
    - Water treatment O&M
    - Reservoir O&M
    - Distribution system O&M
    - Written protocols describing the operational decisions on-site operators are allowed to make
- The following **Documents and Records** shall be retained by the water supplier and shall be available when the system is inspected or upon request by the OHA.
    - As-built plans and specifications of the entire system and other documents necessary for system O&M
    - Current operating manuals
    - A current master plan

  - Data showing production capabilities
  - Number, type, and location of service connections
  - Raw water quality, both chemical and microbiological
  - All chemicals and dosage rates used in the treatment of water
  - Maintenance records
  - Sampling and analysis for regulatory compliance with the maximum contaminant levels (MCLs)
  - Residual disinfectant measurements
  - Cross connection control and backflow prevention device testing
  - Customer complaints pertaining to water quality and follow-up action
  - Fluoridation records

8.3 Cross Connection Control Program

According to the OHA DWS regulations, the City must perform annual testing of the backflow prevention assemblies no later than July 1st of each year. The purpose of the program is to protect the water supply and distribution system from contamination or pollution due to any existing or potential cross connections and to comply with the OAR Chapter 222, Division 61, Sections 333—061-0070, 0071, 0072, 0073 and 0074. The City has provided a list of certified backflow assembly tests on their website.

The cross-connection control program applies to every premise and property served by the City's water system. It regulates cross connections and specifies backflow prevention assembly requirements for new construction, retrofitting, irrigation, and double check detector assemblies for fire systems. It also specifies annual testing, maintenance, and repairs.

8.4 Service Continuity

The City provides continuous production and delivery of water through the following.

- Operation of equipment and systems as designed, and optimized for efficiency
- Prompt repair to equipment and piping through the use of best management practices and standard operating procedures (SOPs)
- Routine maintenance to equipment and piping in accordance with the CMP
- An IGA with Lake Oswego for the Emergency Intertie connection and pump station and the City's Emergency Operations Plan (EOP)

The City's EOP was updated in 2017 and describes how the City will organize and respond to emergencies and disasters in the community. The City has adopted the National Incident Management System, including the Incident Command System, and the National Response Framework. A copy of the EOP is included in Appendix D.

The City has also developed an Emergency Procedure for Contamination of the Water Distribution System, which is described in Section 11 of the O&M Manual.

8.5 Personnel

Per OAR Chapter 333, all personnel directly involved with the operation of a public water system are required to be certified by the state. All water department field personnel must be certified in one of the three categories listed below.

- Water Treatment Operator
- Water Distribution Operator
- Operator-in-Training

Certification level requirements should be developed in consultation with OHA. Education and experience requirements for each operator grade are also determined by OHA.

Figure 8-1 summarizes the City's organizational structure. **Table 8-1** lists operations staff and their certifications.

Figure 8-1 | Organizational Structure

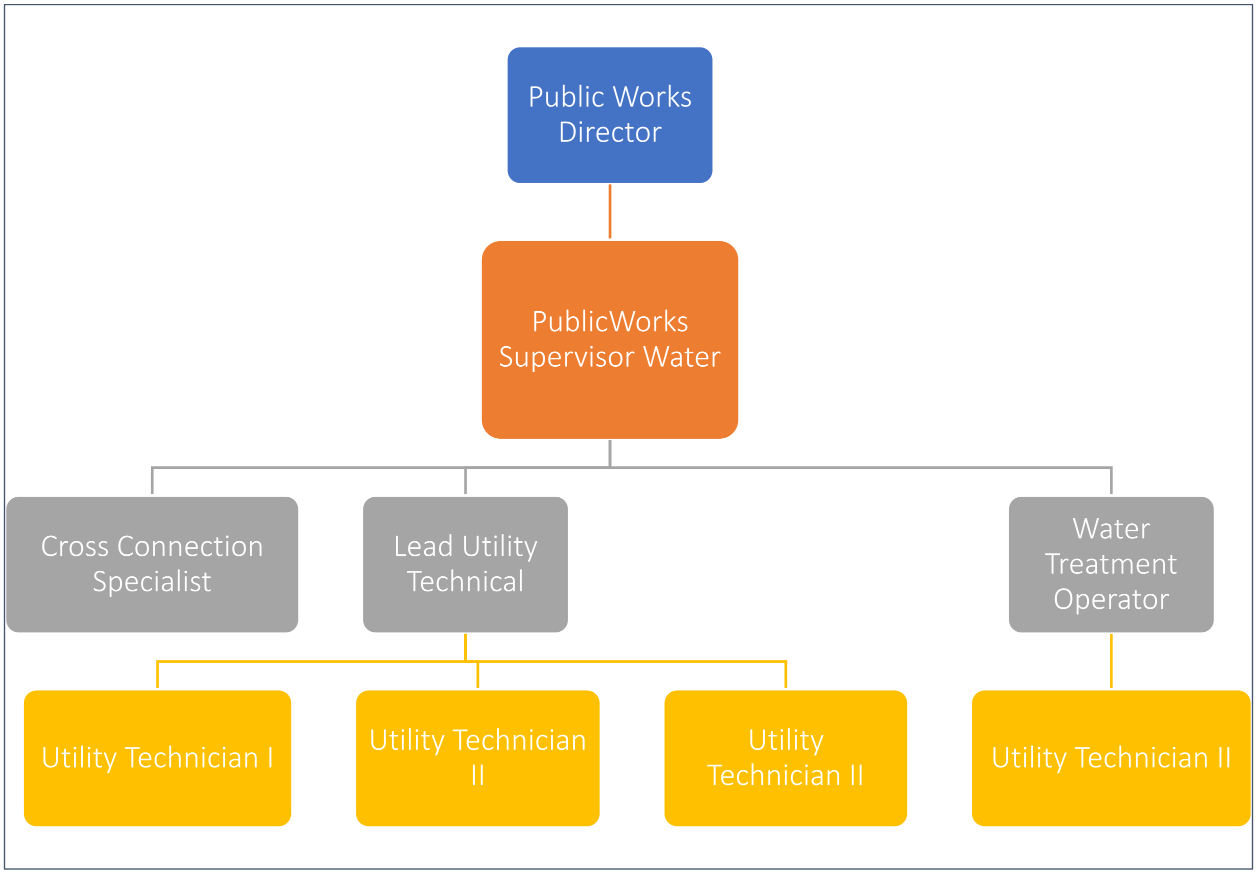

Table 8-1 | Water System Operations Staff and Certifications ***City to complete Table 8-1.***

Staff	Operator Certification Grade/Type
XXXXXXX	Distribution Level III / CCS
XXXXXXX	Treatment II and Distribution II
XXXXXXX	Distribution Level I
XXXXXXX	Distribution Level I
XXXXXXX	Distribution Level I
	Distribution Level 1
	Distribution Level 1
	Distribution Level II / CCS / Backflow

8.6 Operations and Maintenance

The City maintains an O&M Manual which was reviewed by OHA in 2020. The next review will take place in 2025. The City also maintains a hard copy set of O&Ms for major equipment.

The City does not currently have a formal preventive maintenance program. It is generally recommended that public works departments conduct an annual O&M review to critique plant operation, review operating costs, and make recommendations for more efficient operation.

8.7 Standard Operating Procedures

The City maintains a list of SOPs in Section 12 of the O&M Manual. They include the following.

- Fire Hydrant Installation
- Water Main Repair & Service Repair
    - Best Management Practices for Cutting into or Repairing a Water Main
    - Public Notice Procedure for Loss of Pressure
    - Drinking Water Warning Letter
    - Locate Request Form
    - Best Management Practices for Service Outages Due to Reduced Pressure Events
- 1-1/2-inch & 2-inch Water Service Installation
- Blow-Off Assembly Installation
- Air Release Valve Installation
- How To Determine a Leak is on Customer Side or City Side
- Water Meter Replacement
- Sample Station Installation
- Obtaining & Tracking New Backflow Customers
- New Water Main Installation

- Water Quality Duties During New Main Installation
- Water Works Math Formulas

As required under OAR 333-061-0065, the Water Division is required to maintain an inventory of replacement parts and equipment on hand to ensure continuity of service. When this inventory is used during routine maintenance, replacements are ordered and placed into storage. The water operations supervisor is responsible for maintaining the list of parts and reordering the inventory. A list of contacts is maintained in case parts or equipment are required immediately. A review of inventory is performed annually.

A summary of inventory groups and suggested storage protocol are described below.

- Maintenance equipment used in response to a mechanical or electrical equipment failure is stored at the Public Works Facility.
- Spare parts for general maintenance repairs are stored at the Public Works Facility.

8.8 Recordkeeping

The City maintains water system records in compliance with OAR 333-061-0040. **Table 8-2** summarizes these records and the minimum retention period. The City also maintains the additional records described in **Table 8-3**.

Table 8-2 | OAR 333-061-0040 Recordkeeping Requirements

Record	Minimum Retention Period
Microbiological analysis	5 years
Chemical analysis	10 years
Secondary contaminants	10 years
Turbidity	10 years
Radioactive substances	10 years
Monitoring plans	10 years
Records of action to correct non-compliance items	3 years
Sanitary surveys	10 years
Variances or permits	5 years
Residual disinfectant measurements	2 years
Sampling data and reports	12 years
Documentation of corrective action	10 years
Public notices	3 years
Cryptosporidium reporting	3 years
Initial distribution system evaluation reports	10 years
Records associated with invalidation of E. coli positive samples	5 years
40/30 Certification to EPA	10 years
Coliform investigation and documentation	5 years

Table 8-3 | Additional Records Maintained by the City of West Linn Water Division

Record	Minimum Retention Period	Frequency
Pump station hours and master meter usage	3 years	Logged weekly. Checked against average residential usage. Used to monitor pump flow, pump efficiency, water consumption, and to detect large leaks.
Manager's report	7 years	Statement of profit and loss with budget comparison, water system income statement, water system balance sheet including assets, debts, and operating revenues and expenses.
Field logs	3 years	Daily. Document field activities.
Pump hour sheets	3 years	Completed weekly as part of pump inspection.
Work Orders	Utility discretion	Generated as needed to direct system component maintenance. Part of computerized utility management program.
Chlorine residual monitoring	3 years	Monthly. Maintained at City Office
Lead and copper	As long as operational	As scheduled. Maintained in Public Works building
TTHM/HAA monitoring[1]	As long as operational	Quarterly. Maintained at Public Works building
Asbestos	As long as operational	Every 9 years. Maintained at Public Works building
Other water quality records	As long as operational	As scheduled. Maintained at Public Works building
Source meter readings	7 years	Summarized monthly. Maintained at Public Works building
Pumping power usage	7 years	Recorded Monthly. Maintained at City Hall
Service meter reading	7 years	Recorded Monthly. Maintained at City Hall
Meter read quality control	7 years	Monthly. Random sampling of meter reads. Maintained at City Hall

Note:

1. TTHM = trihalomethane
   HAA = halogenic acetic acids
   (THM and HAA are both types of disinfection byproducts)

CHAPTER 9

Water Quality and Water Conservation

9.1 Purpose

As a public drinking water system, the City must follow state and federal regulations associated with water quality sampling, monitoring and reporting. Water quality standards regulate source water, water treatment and distribution system water quality. This chapter identifies relevant rules and the City's compliance status with those rules.

Within the State of Oregon, the OHA DWS rules for water quality standards and monitoring are adopted directly from the Environmental Protection Agency (EPA). The DWS is required to adopt rules that are at least as stringent as federal rules. To date, DWS has not elected to implement more stringent water quality or monitoring requirements.

The City must adhere to the following four water quality rules.

- Disinfectants/Disinfection Byproducts Rule (DBPR)
- Revised Total Coliform Rule (RTCR)
- Lead and Copper Rule (LCR)
- Unregulated Contaminant Monitoring Rule (UCMR)

The City maintains a sampling plan which describes the sampling protocol, reporting process, SOPs for positive sample response, boil water notice, and public notifications. The City currently uses Alexin Analytical in Tigard for sample analysis.

9.1.1 Wholesale Provider Regulatory Issues

As the source water provider, the SFWB is responsible for sampling, monitoring, and compliance with numerous water quality regulations that do not need to be addressed directly by the City. As the wholesale water provider to the City, the SFWB is responsible for meeting these regulatory requirements. SFWB's cost to meet these requirements is passed on to the City and Oregon City through water rates.

These include:

- Synthetic Organic Chemicals and Inorganic Chemicals
- Volatile Organic Compounds
- Arsenic
- Sulfate
- Fluoride
- Radon/Radionuclides
- Groundwater Rule

- Surface Water Treatment Rule and Supplementary Rules:
    - Interim Enhanced Surface Water Treatment Rule
    - Long Term 1 Enhanced Surface Water Treatment Rule
    - Long Term 2 Enhanced Surface Water Treatment Rule

9.2 Disinfectants/Disinfection Byproducts Rule

The Stage 1 and Stage 2 D/DBPRs are part of the suite of Microbial and Disinfection Byproducts Rules (MDBPs). MDBPs are a series of interrelated regulations that address risks from microbial pathogens and disinfectants/disinfection byproducts.

- The Stage 1 D/DBPR reduces drinking water exposure to disinfection byproducts. Stage 1 established maximum residual disinfection levels for chemical disinfectants and MCLs for byproducts.

- The Stage 2 D/DBPR strengthens public health protection by tightening compliance monitoring requirements for Trihalomethanes (TTHM) and Haloacetic acids (HAA5). The rule targets public water systems with the greatest risk. Stage 2 sampling is the final EPA rule intended to continue to reduce potential cancer and reproductive and developmental health risks associated with disinfection by-products. The rule targets community water systems with the greatest risk and builds incrementally on the Stage 1 rule. Stage 2 required providers to identify locations with high disinfection byproduct concentrations, which were then used as sampling sites for Stage 2 compliance monitoring. D/DBPR regulations require the MCL to be calculated on the locational running annual average of samples taken quarterly.

The Stage 2 D/DBPR also requires each system to determine if they have exceeded an operational evaluation level, which is identified using their compliance monitoring results. The operational evaluation level provides an early warning of possible future MCL violations, which allows the system to take proactive steps to remain in compliance. A system that exceeds an operational evaluation level is required to review their operational practices and submit a report to their state that identifies actions that may be taken to mitigate future high disinfection byproduct levels, particularly those that may jeopardize their compliance with the MCLs.

The D/DBPR applies to community water systems and non-transient non-community systems, including those serving fewer than 10,000 people that add a disinfectant to the drinking water during any part of the treatment process. Systems that purchase disinfected water, such as the City, are included in this rule.

Disinfectants are added to drinking water to kill harmful pathogens. At low levels, these disinfectants keep our water safe and do not affect human health. At higher concentrations (such as typical concentrations in swimming pool water), exposure could lead to nausea, vomiting, and diarrhea. Disinfection byproducts occur when disinfectants react with usually non-harmful nutrients in the water to produce contaminants. When these precursors are not present, there is nothing for the disinfectants to react with and so disinfection byproducts are not formed. Therefore, it is important to monitor the precursors and the resultant contaminants. Because these byproducts change in concentration with time, sample site locations must represent the maximum water age in the distribution system.

The EPA standards for the residual disinfectant concentration in the water entering the distribution system cannot be less than 0.2 mg/L for more than 4 hours (40 CFR 141.72(a)(3) and (b)(2)). The residual disinfectant concentration in the distribution system cannot be undetectable in more than five percent of the samples each month for any two consecutive months that the system serves water to the public (40 CFR 141.72(a)(4) and (b)(3)).

9.2.1 Compliance

The City began Stage 2 sampling in October 2013. Sampling occurs at four sites every quarter, with quarterly reports submitted to the OHA.

9.3 Revised Total Coliform Rule (RTCR)

The RTCR identifies provisions for monitoring of total coliform as an indicator of bacteriological quality. Most coliforms are not disease causing. Rather, their presence indicates the sanitary conditions of the water and are one of the easiest indicator species to monitor. Total coliforms include both environmental and fecal coliforms. Both types are important to measure as both can indicate the presence of pathogens, although fecal coliforms are generally more concerning. E. coli bacteria is used to indicate fecal coliforms, as it is one of the major species of fecal coliforms that does not reproduce in the absence of fecal matter.

9.3.1 Compliance

Under the RTCR, all surface water and groundwater systems must have a monitoring plan that identifies a prescribed number of monitoring locations based on population. The number of required sample sites is based on the type of source water and population served.

A quantity of 15 routine samples are collected on the 2nd and 4th Tuesday of each month for a total of 30 samples per month. Samples results are reported electronically to OHA by Alexin Analytical and the City emails a quarterly reports to OHA.

If a total coliform sample exceeds the MCL, at least three repeat samples must be collected within 24 hours of learning of the exceedance. The repeat samples are collected as follows.

- One repeat sample must be collected from the same tap as the original sample.
- One repeat sample must be collected from within five service connections upstream.
- One repeat sample must be collected within five service connections downstream.

The City's sampling plan includes 17 primary routine sampling sites. Each primary site also has two repeat sites associated with it. The repeat sites are located in the same pressure zone as the primary site. **Table 9-1** summarizes the quantity of primary sites in each pressure zone.

Table 9-1 | Distribution of Primary Sample Sites by Pressure Zone

Pressure Zone & Subzone	Primary Sample Sites (No.)	Pressure Zone & Subzone	Primary Sample Sites (No.)
Horton Subzone6	4	Robinwood Subzone 10	2
Rosemont Subzone 9	4	Bolton Subzone 4	1
Rosemont Subzone 13	1	Willamette Subzone 1	3
Rosemont Subzone 11	1	Bolton Subzone 3	1

9.4 Lead and Copper Rule

The LCR was first established in 1991 to limit lead and copper exposure. Revisions were made to the rule in 2000, 2007, 2016, and 2021. The latest revisions alter how utilities implement corrosion control treatment, conduct compliance sampling, manage lead service lines, and communicate with customers. The revisions expanded the responsibility associated with privately owned service lines, sampling protocol, service line inventory, and full lead service line replacement requirements. They also expanded public outreach and education needs through more frequent customer contact and annual service line notification letters. The EPA's Guidance for Developing and Maintaining a Service Line Inventory provides essential information to help water systems comply with the LCR revisions requirement to prepare and maintain an inventory of service line materials by October 16, 2024. The guidance document includes:

- Best practices for inventory development and communicating information to the public.
- A template for water systems, states, and Tribes to use or adapt to create their own inventory.
- Case studies on developing, reviewing, and communicating about inventories.
- Prioritization of inventory development in disadvantaged communities and where children live and play.
- Science-based testing protocols to find more sources of lead in drinking water.
- Trigger level to jumpstart mitigation earlier and in more communities.
- Directions for more and complete lead service line replacements.
- Testing requirements for schools and childcare facilities.
- Requirements to identify and make public the locations of lead service lines.

Compliance with the LCR requires that samples at the customer's tap must not exceed the following action levels.

- Lead - 0.015 mg/L detected in the 90th percentile of all samples
- Copper -1.3 mg/L detected in the 90th percentile of all samples

The most common sources of lead in a water system are pipes, faucets, and plumbing fixtures. Therefore, testing within the distribution system, rather than just at the water source, is important. Water samples at the customer's tap are required to be taken at high-risk locations, which are defined as homes with the following conditions.

- Lead solder installed after 1982
- Lead service lines
- Lead interior piping

If action levels are exceeded for either lead or copper, there are additional requirements including source monitoring, public education, and corrosion control studies.

9.4.1 Compliance

The 2022 LCR revisions did not significantly impact the City's compliance. The most significant change is the requirement to complete the lead service line inventory by October 16, 2024.

After 2015, the City was placed on a reduced sampling schedule because no action levels were triggered over the previous three years. Sampling is now required every three years, with the next sampling event scheduled for 2024.

9.5 Unregulated Contaminant Monitoring Rule

The Safe Drinking Water Act (SDWA) requires that, once every five years, the EPA issue a list of unregulated contaminants to be monitored by public water systems. These contaminants may be present in drinking water but are not yet subject to EPA drinking water standards. Under the UCMR, the EPA collects nationally representative drinking water occurrence data to support future regulatory determinations and, as appropriate, assist in the development of national primary drinking water regulations (NPDWRs). For each UCMR cycle, the EPA establishes a new list of contaminants for monitoring, specifies which systems are required to monitor, identifies the sampling locations, and defines the analytical methods to be used. The program began in 1996 with Rule 1. Rule 5 was implemented in December 2021. UCMR 5 was expanded to include 29 poly-fluoroalkyl substance (PFAS) contaminants. Unlike some of the earlier rules, UCMR 5 applies to all public water systems that serve more than 3,300 people.

The OHA conducted a PFAS drinking water monitoring project in 2021 at select public water systems in Oregon identified as at risk due to their proximity to a known or suspected PFAS use or contamination site. The purpose of the sampling project was to make sure customers are not being exposed to potentially harmful PFAS chemicals in their drinking water. The analysis was paid for through an EPA grant.

9.5.1 Compliance

The City has previously participated under UCMR 3 in 2015 and UCMR 4 in 2020 and will be participating in UCMR 5. The City will collect 29 samples during a 12-month period between January 2023 and December 2025.

9.6 Other Constituents

The City also tests water quality samples for turbidity, nitrate, chloride, iron, sulfate, total dissolved solids, zinc, and asbestos. Asbestos is tested every nine years, with the most recent test performed in 2020. The next asbestos test is scheduled for 2029.

9.7 Compliance Summary

The City has not exceeded any MCLs or been subjected to any enforcement. **Table 9-2** below summarizes the monitoring schedule for regulated substances.

Table 9-2 | West Linn Water Quality Compliance Summary

Requirement	Sampling Quantity and Frequency	Exceedance or Violations
D/DBR	4 quarterly (chlorine residual samples are taken daily)	None
RTCR	30 monthly	None
LCR	1, every 3 years (next test scheduled for 2024)	Copper: None Lead: Last exceedance in 2009
UCMR	Testing to be performed over 12-month period between 2023 and 2025.	N/A

9.8 Cross Connection Control Program

The City maintains a very active Cross Connection Control Program. As of January 1, 2020, there are a total of 4,384 testable backflow prevention assembly devices. Backflow Management Inc (BMI) manages the customer notification and data entry portion of the program. An Annual Summary Report - Cross Connection/Backflow Prevention is prepared by the Cross Connection Specialist and sent to the State Drinking Water Program by the last business day in March each year.

The backflow prevention devices for the City, as of Jan 1, 2020, are broken down into three categories:

- 212 Commercial
- 72 City owned
- 4100 Residential

In March of each year BMI sends out a reminder for irrigation system owners to have their backflow devices tested by the 1st of July. Two more notices are then sent out: one in April and a final notice at the end of July. In general, the City maintains an 85 percent compliance rate. New backflow devices are typically discovered through locate requests and Building Department plumbing permits. The City's building code requires that a backflow prevention device be required on all 1.5-inch or larger water services.

9.9 Water Conservation

The City is not required by the state to develop a formal Water Management and Conservation Plan as it does not have any active municipal water rights. As a member of the RWPC, the City actively participates in regional water conservation program development and implementation. Comprised of 25 water providers and the Metro Regional Government, the RWPC provides a forum for collaboration on water supply, resource management, emergency preparedness, and conservation issues affecting the region. The current Regional Water Supply Plan describes the region's water supply strategy and recognizes that water conservation plays a key role in meeting future water needs. The updated plan evaluated regional source options while reflecting the actions and plans of the individual members. The plan also updated water demand forecasts and continued to emphasize opportunities for regional conservation programs where economies of scale and regionally-consistent conservation messages and benefits can be achieved. The RWPC's conservation objectives are to:

- Plan and implement regional programs and events focused on reducing peak summer water use.

- Effectively encourage customers to visit and utilize the web site at www.regionalh2o.org.

- Integrate consistent conservation messages into the daily lives of customers.
- Develop and implement effective monitoring and reporting techniques to verify program effectiveness.
- Invite stakeholder participation in conservation program development.
- Seek economies of scale by working together.
- Foster public awareness of the RWPC's collaborative efforts.

The RWPC's conservation plan contains a variety of programs and outreach opportunities which include:

- Summer marketing campaign
- Education programs
- Regional events
- Landscape industry partnerships
- A web site (www.regionalh20.org)
- Informational materials (brochures, kits and water-saving devices)

Given the City's participation in RWPC, further City-specific public education and outreach programs are not likely to offer cost-effective water conservation results.

9.10 Leak Prevention and Detection

Water loss prevention and leak detection programs are typically economical when annual water losses regularly exceed 10 percent. Given that the estimated percentage of unaccounted-for water is below this level, the City does not currently have and is not planning for implementation of a comprehensive on-going leak detection program within the distribution system. However, the City regularly replaces leaking water meters, provides guidance and troubleshooting on the customer side of the meter, and encourages residents to take advantage of the leak detection program through the RWPC.

Additionally, the City has actively replaced aging water mains systematically with a focus on existing asbestos cement pipe and associated service lines to reduce water loss and excessive main breaks. The continuation of this program as a key element of the City's water system capital budget is recommended to maintain current low levels of water loss.

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CHAPTER 10

Seismic Resilience Evaluation

10.1 Introduction

This chapter addresses the seismic risk assessment and mitigation planning required by the OHA for WMPs. Water utilities located fully or partially within areas identified as VII to X, for moderate to very heavy damage potential, are required to include a seismic risk assessment and mitigation plan in their WMP. According to the State of Oregon Department of Geology's Map of Earthquake and Tsunami Damage Potential for a Simulated Magnitude 9.0 (M9) Cascadia Earthquake, the City is located within an area categorized as VII – Moderate for damage potential. The requirements of the plan include the following:

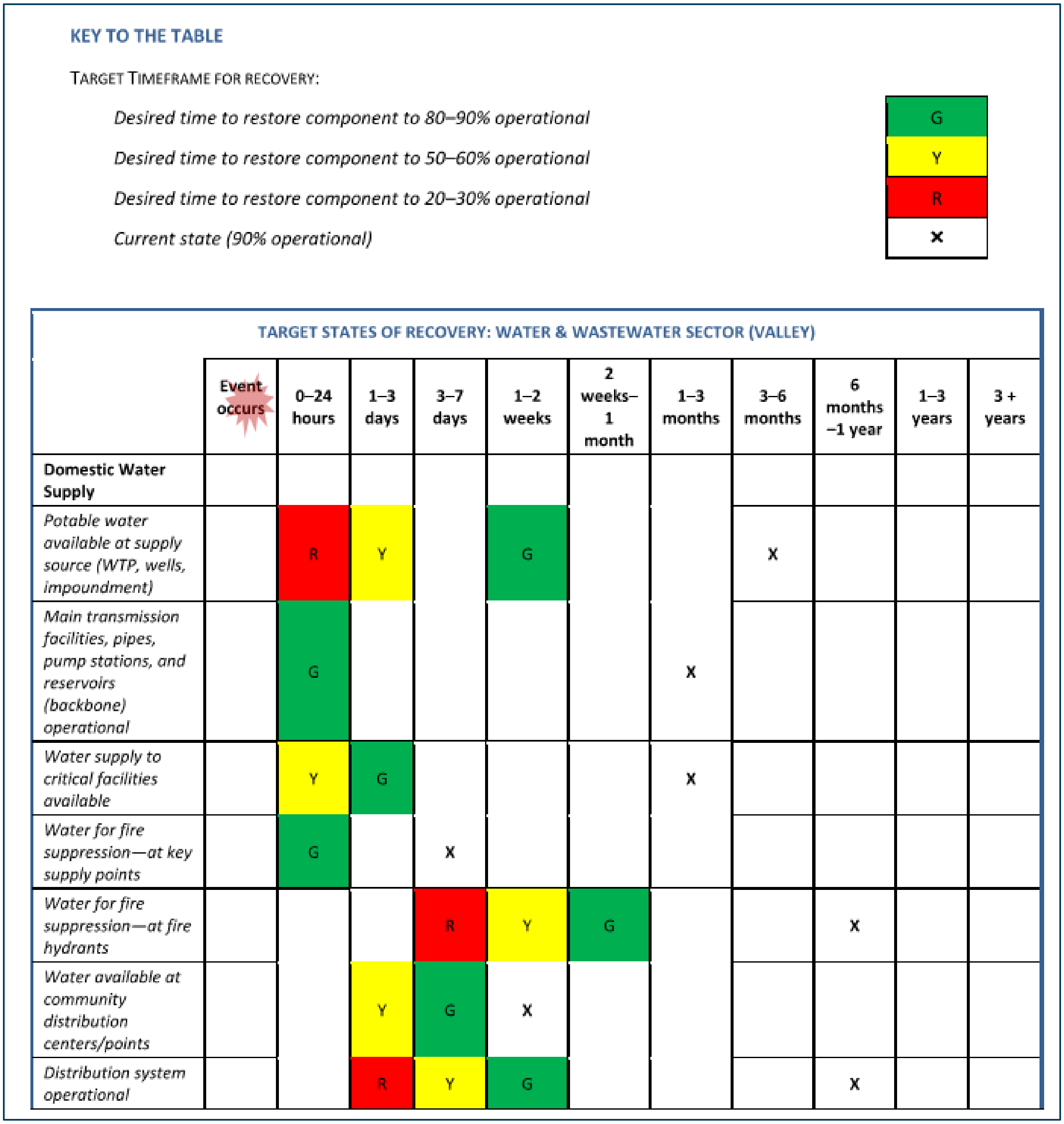
- Identification of critical facilities associated with the supply of fire suppression, health and emergency response and community drinking water supply points
- Identification and evaluation of the likelihood and consequence of seismic failures at the critical facilities
- The mitigation plan shall encompass a 50-year planning horizon and include recommendations to minimize water loss from each critical facility, capital improvements, or recommendations for further study or analysis.

The objective of the mitigation plan is to provide the City with the knowledge and resources to maintain service, or return to service, within a prescribed timeframe following a M9 Cascadia Subduction Zone (CSZ) event.

Chapter 8 of *The Oregon Resilience Plan for Reducing Risk and Improving Recover for the Next Cascadia Earthquake and Tsunami* includes a table that describes target states of recovery for different regions within the State. **Figure 10-1** describes the target state of recovery for water systems in the area including the City.

Building codes change over time, sometimes due to seismic deficiencies discovered in older codes. No requirement currently exists that requires a city to upgrade facilities to keep up with the changes; however, revisions should be noted when assessing seismic vulnerabilities. There are no existing federal or state regulatory requirements associated with seismic retrofitting for potable water facilities. General guidelines for a seismic evaluation of existing buildings and reservoirs are to use the American Society of Civil Engineers (ASCE) 41-17, *Seismic Evaluation and Retrofit of Existing Buildings*.

Figure 10-1 | Target State of Recovery for Water Systems (Valley)



KEY TO THE TABLE

TARGET TIMEFRAME FOR RECOVERY:

Desired time to restore component to 80–90% operational	G
Desired time to restore component to 50–60% operational	Y
Desired time to restore component to 20–30% operational	R
Current state (90% operational)	X

TARGET STATES OF RECOVERY: WATER & WASTEWATER SECTOR (VALLEY)

	Event occurs	0–24 hours	1–3 days	3–7 days	1–2 weeks	2 weeks–1 month	1–3 months	3–6 months	6 months –1 year	1–3 years	3 + years
Domestic Water Supply											
Potable water available at supply source (WTP, wells, impoundment)		R	Y		G			X			
Main transmission facilities, pipes, pump stations, and reservoirs (backbone) operational		G					X				
Water supply to critical facilities available		Y	G				X				
Water for fire suppression—at key supply points		G		X							
Water for fire suppression—at fire hydrants				R	Y	G			X		
Water available at community distribution centers/points			Y	G	X						
Distribution system operational			R	Y	G				X		

10.2 Critical Facilities and Water System Backbone

A water system backbone of key supply, storage, pumping, and distribution facilities was identified based on typical system operations. Key City water facilities and their critical supply and distribution functions are summarized in **Table 10-1** and illustrated on **Figure 10-2** Water System Backbone Map.

Key water facilities were prioritized according to age, condition, metered connections served, capacity, and operational restrictions. The priority list is summarized in **Table 10-1**.

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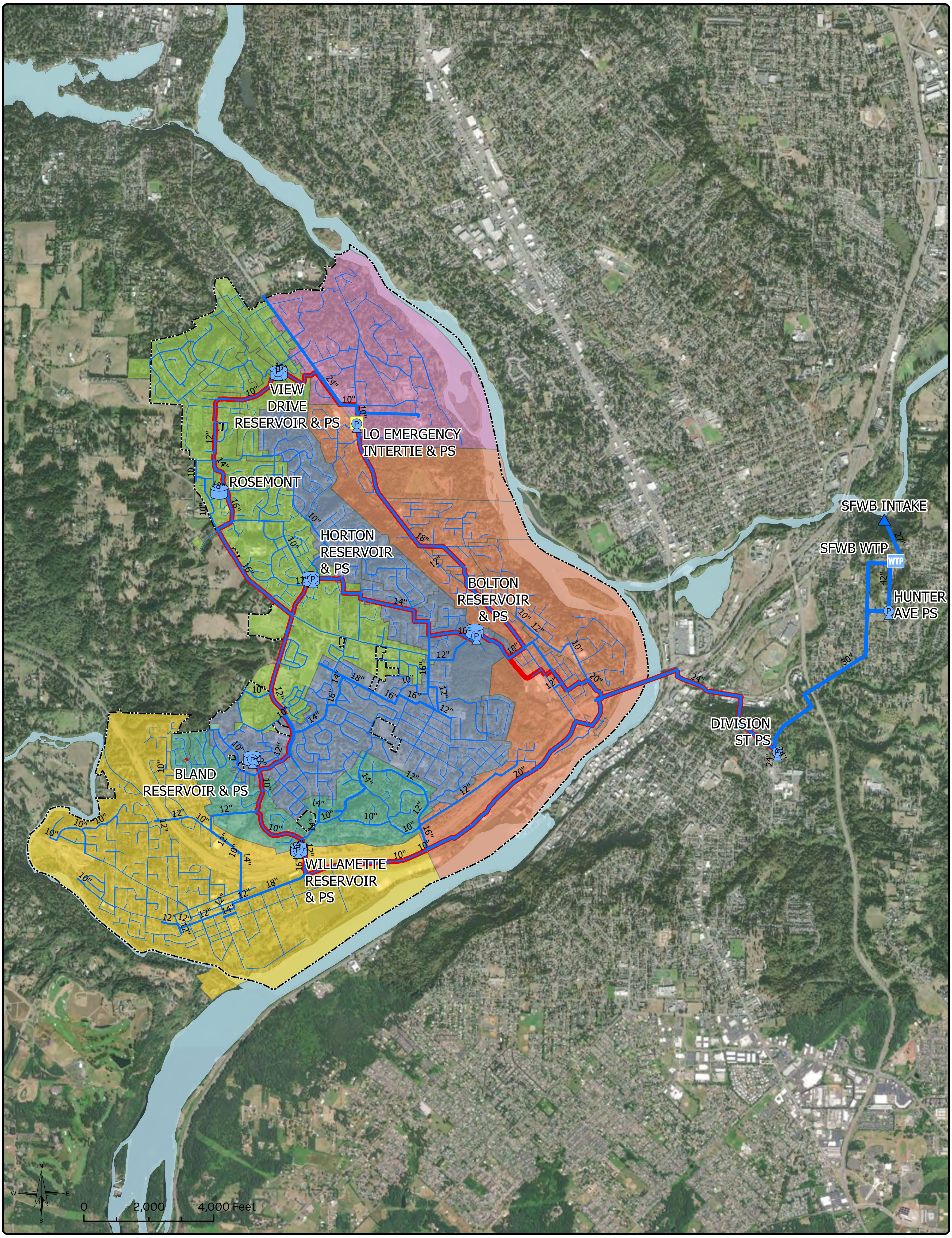

Legend

▲ SFWB Intake

WTP SFWB WTP

I Emergency Intertie

P Pump Station

Reservoir

Mains

Diameter (in.)

<6"

8"

10"

12"

14-18"

20-24"

28-42"

Backbone

Pressure Zone

Bland

Bolton

Horton

Robinwood

Rosemont

Willamette

City Limits

CITY OF West Linn

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Water System Master Plan

Figure 10-2
Water System Backbone Map

Project No: 22-3537

November, 2023

Data Sources: City of West Linn, 2022; World Imagery: Maxar.
Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Disclaimer: Consor and Client make no representations, express or implied, as to the accuracy, completeness and timeliness of the information displayed. This map is not suitable for legal, engineering, or surveying purposes.
Notification of any errors is appreciated.

Table 10-1 | Key Water System Facilities and Mitigation Prioritization

Priority	Facility Name	Year Built	Critical Functions (Metered Connections Served)
1	Rosemont Reservoir	1993	Gravity supply to Rosemont Pressure Zone (2,047) Supplemental gravity supply to Horton Pressure Zone (2,580)
2	View Drive Reservoir	1967	Gravity supply to Robinwood Pressure Zone (727) Pumped supply to Rosemont Pressure Zone (2,047)
3	Willamette Reservoir	1970	Gravity supply to Willamette Pressure Zone (1,620) Pumped supply to Bland Pressure Zone (667)
4	Horton Reservoir	1974	Gravity supply to Horton Pressure Zone (2,580) Pumped supply to Rosemont Pressure Zone (2,047) Supplemental gravity supply to Bland Reservoir (667)
5	Bland Reservoir	1980	Gravity supply to Bland Pressure Zone (667) Pumped supply to Rosemont Pressure Zone (2,047)
6	Horton Pump Station	1974	Pumped supply to Rosemont Pressure Zone (2,047)
7	Willamette Pump Station	1994	Pumped supply to Bland Pressure Zone (667)
8	View Drive Pump Station	1967	Pumped supply to Rosemont Pressure Zone (2,047)
9	Bland Pump Station	2015	Pumped supply to Rosemont Pressure Zone (2,047)
10	Bolton Reservoir	2017	Gravity supply to Bolton Pressure Zone (1,379) Pumped supply to Horton Pressure Zone (2,580)
11	Bolton Pump Station	2000	Pumped supply to Horton Pressure Zone (2,580)

10.3 Geotechnical and Seismic Hazard Evaluation

A high-level analysis of the local geotechnical conditions and seismic hazards was performed by Delve Underground. A map of the City's critical facilities and system backbone was provided to Delve to overlay against the existing conditions and hazards. Seismic hazards were evaluated based on existing M9 CSZ earthquake hazard maps published for the Portland Metro region by the Oregon Department of Geology and Mineral Industries (DOGAMI) (Madin and Burns, 2012). Subsurface conditions were obtained through ODOT boring logs, OWRD well logs, and other site-specific subsurface investigations. The results of the analysis were published in a Technical Memorandum, which is summarized below and included in **Appendix E**.

10.3.1 Seismicity and Seismic Hazard

Three primary sources of seismicity are located within the City area:

- Shallow crustal faults within the North American plate
- CSZ intraplate faults within the subducting Juan de Fuca plate
- CSZ megathrust events generated along the boundary between the subducting Juan de Fuca plate and the overriding North American plate

Of those three sources, CSZ megathrust events are considered to have the most potential for damage due to the anticipated magnitude and duration of ground shaking. Recent studies indicate that the CSZ can potentially generate earthquakes with magnitudes ranging between 8.0 and 9.2. The magnitude of a CSZ earthquake depends on the rupture length along the subduction zone. A full rupture will likely generate mega-magnitude 9.0 and above earthquake events, and a partial rupture will likely cause large-magnitude 8.0 to 8.5 earthquakes.

These earthquake events are estimated to recur approximately every 500 years for the mega-magnitude full rupture events (9.0-9.2) and every 200 to 300 years for the large-magnitude partial rupture events (8.0-8.5). Based on documentation of historic earthquakes, the probability of a future occurrence is high because the area is "past due." The CSZ earthquake with a magnitude greater than 8.5 (similar to recent events in Japan, Chile, and Indonesia) has an estimated 16 to 22 percent probability of occurring off the Oregon Coast in the next 50 years (Goldfinger and others, 2016).

For the purposes of this evaluation, seismic hazards to the water system are assessed under a CSZ M9 earthquake as this is regarded as the greatest threat to the region. CSZ events may result in severe ground shaking, liquefaction settlement, lateral spreading, and/or seismic-induced landslides with the potential to damage pipelines, reservoirs, pump stations, etc.

The likelihood and magnitude of four seismic hazard sources were analyzed by Delve:

- strong ground shaking
- liquefaction settlement
- liquefaction-induced lateral spreading
- landslides

10.3.1.1 Peak Ground Velocity

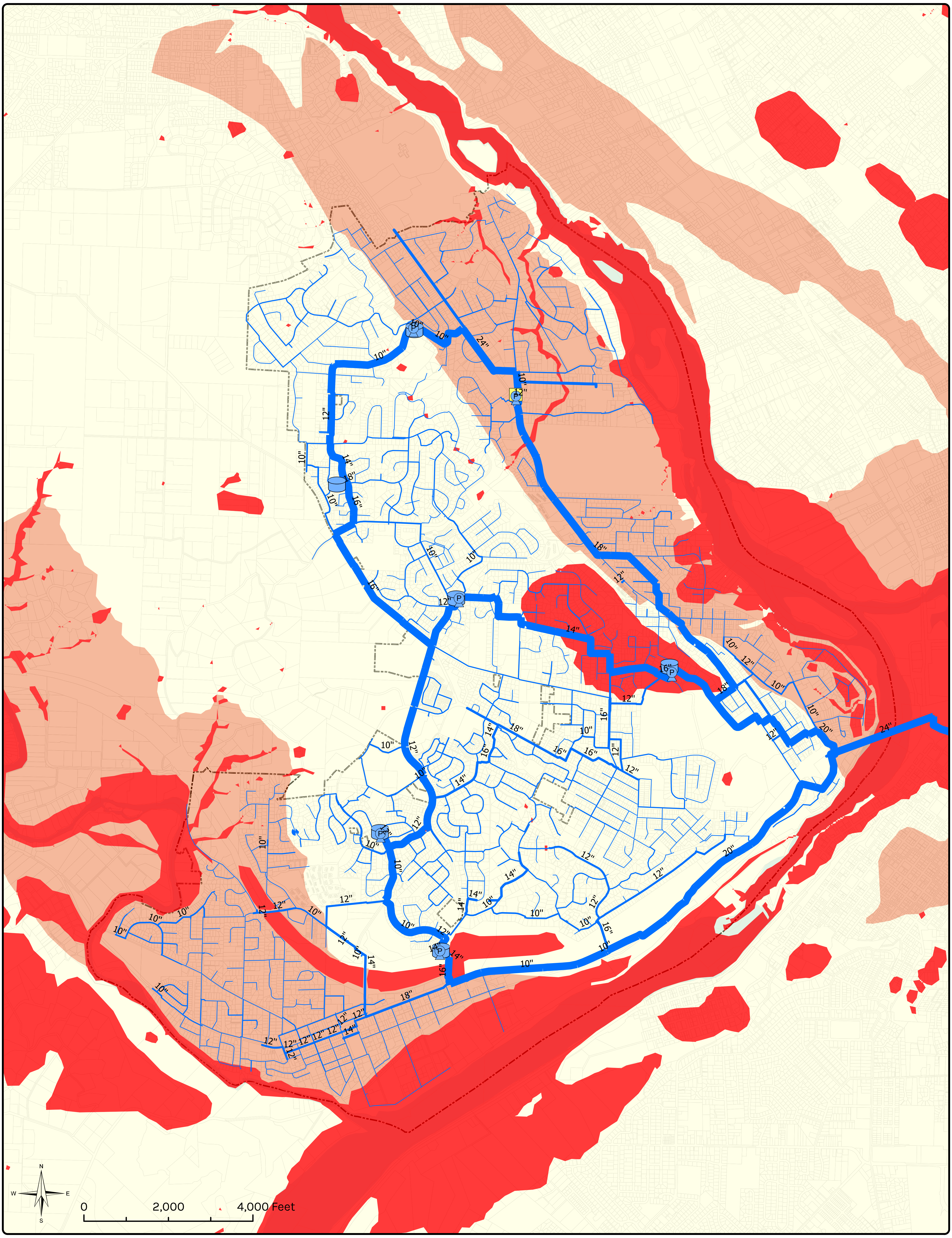
The intensity or rate of ground shaking is known as peak ground velocity (PGV) and is expressed as inches per second (in/sec). The PGV is dependent on the magnitude of the event, the distance from the seismic source, and the ground material through which the seismic waves pass. This extreme shaking can damage pipelines if the pipe material and joints are not strong enough to withstand the transient ground deformations. Damage from ground shaking can occur even when there is no permanent ground deformation (PGD).

The Peak Ground Velocity Hazard map (**Figure 10-3**) illustrates the estimated peak ground velocity levels relative to the location of the water system backbone, reservoirs, and pump stations. The highest range of velocities typically occurs in less consolidated soils such as landslide deposits, recent alluvial deposits, and smaller drainages. The highest estimated PGVs within the City range from 12-16 in/sec and are located in these areas of less consolidated soils.

10.3.1.2 Liquefaction Settlement

Liquefaction occurs when saturated soil experiences enough shaking that it loses its shear strength and transforms from a solid into a nearly liquid state. The results of soil liquefaction include loss of bearing capacity, loss of soil materials through sand boils or flow, flotation of buried chambers and pipes, and post-liquefaction reconsolidation (ground settlement). The assessed liquefaction hazard for the City is quantified as a magnitude of post-liquefaction settlement.

The Liquefaction Induced Ground Deformation Hazard map (**Figure 10-4**) illustrates low, moderate, and high hazard levels expressed in PGD in inches. The location of the water system backbone, reservoirs, and pump stations are shown relative to the liquefaction hazards.



Legend

PGV (in/s)

🟨	8
🟧	9 - 11
🟥	12 - 16

Mains

—	<6"
—	8"
—	10"
—	12"
—	14-18"
—	20-24"
—	28-42"

Backbone

▬	Backbone

City Limits

▭	City Limits

City of West Linn

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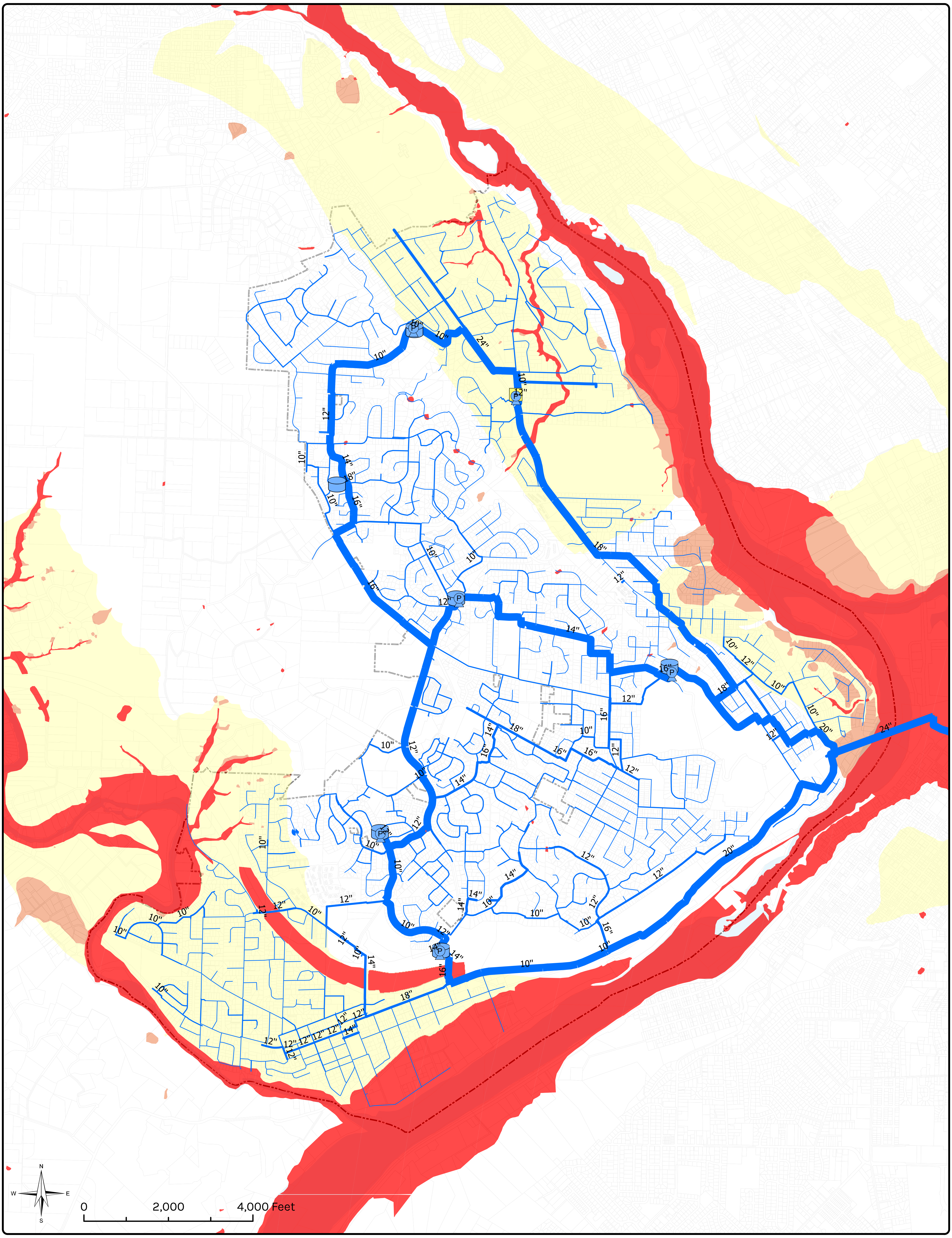
Water System Master Plan

Figure 10-3
Peak Ground Velocity

Project No: 22-3537

February 2024

Data Sources: City of West Linn, 2022; .
Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl



Legend

Liquefaction (in)

- 0
- 🟨 1 - 12
- 🟧 13 - 48
- 🟥 49 - 96

Mains

- <6"
- 8"
- 10"
- 12"
- 14-18"
- 20-24"
- 28-42"

Backbone

- Backbone

City Limits

- City Limits

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Water System Master Plan

Figure 10-4
Liquefaction Deformation

Project No: 22-3537

February 2024

Data Sources: City of West Linn, 2022; .
Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl

The liquefaction hazard varies significantly with the highest-level hazards located around the confluence of the east bank of the Willamette River and at the confluence with the Clackamas River. ODOT boring logs support this assumption through indications of very low blow counts in sand and silt substrate.

The areas with moderate to high liquefaction hazard levels are summarized below:

- The backbone pipelines connecting to the Willamette River Crossing on I-205, and notably on the east side, have a high liquification hazard level due to alluvial deposits, which may be poorly consolidated and of low strength.
- The backbone pipeline along Highway 43, Lake Oswego Emergency Intertie and Pump Station, and area north of Mary S. Young Park have a moderate liquefaction hazard level. Borings in this area indicate more shallow sand and silt deposits than areas further south. Creek crossings in the area have an increased hazard level.

10.3.1.3 Liquefaction-Induced Lateral Spreading

Liquefaction-induced ground deformation generally consists of post-liquefaction settlement (vertical movement) and lateral spreading (horizontal movement). Lateral spreading typically occurs along river/creek banks and other sloped areas. The lateral movement and loss of support breaks the overlying non-liquefied soil “crust” into blocks that progressively move downslope in response to the ground accelerations. The potential for lateral spreading depends on the liquefaction potential of the soil, the seismic horizontal loading, the residual shear strength of the soil, and the topography.

Figure 10-4 illustrates the PGD (in inches), relative to the location of the water system backbone, reservoirs, and pump stations.

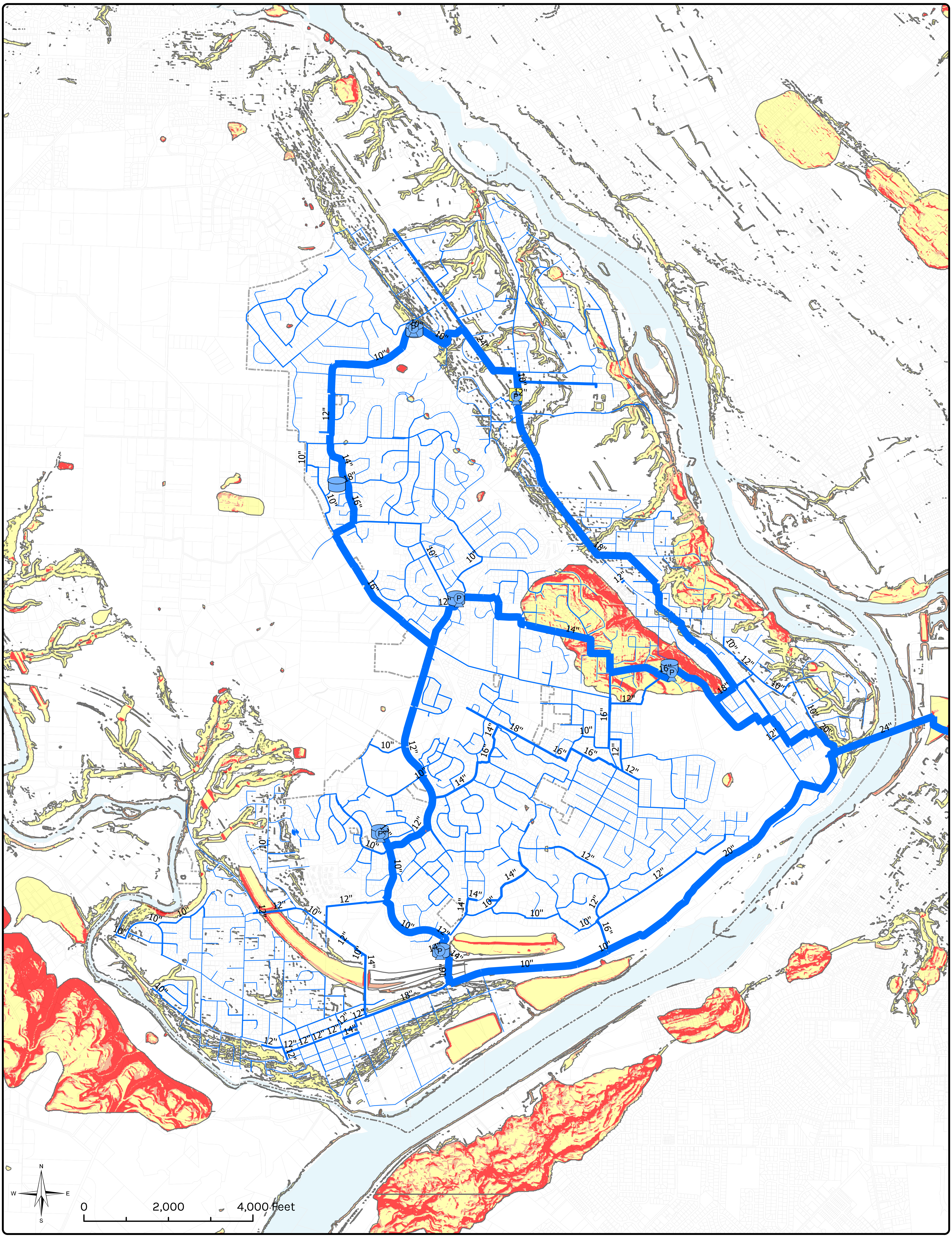
The areas with moderate to high liquefaction induced ground deformation hazard levels are summarized below.

- For the high liquefaction hazard area at the east bank side of the Willamette River Crossing, the liquefaction induced ground deformation will mainly consist of lateral spreading movement with magnitude on the order of 3 to 4 feet or greater.
- For the backbone pipeline along Highway 43 and the Lake Oswego Emergency Intertie and Pump Station, north of Mary S. Young Park, the liquefaction induced ground deformation will mainly consist of post-liquefaction settlement with magnitude generally less than 12 inches.

10.3.1.4 Landslide

Landslides can occur due to the added load created by an earthquake induced inertial force on a slope. Landslide ground movement can be extremely damaging to pipelines.

The Seismic Landslide Hazard map (**Figure 10-5**) illustrates the PGD, expressed in feet, relative to the location of the water system backbone, reservoirs, and pump stations.



Legend

Landslide PGD (ft)

☐	0
🟨	1 - 5
🟧	6 - 15
🟥	16 - 25

Mains

- <6"
- 8"
- 10"
- 12"
- 14-18"
- 20-24"
- 28-42"

Backbone

- Backbone

City Limits

- City Limits

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Water System Master Plan

Figure 10-5
Landslide Displacement

Project No: 22-3537 February 2024

Data Sources: City of West Linn, 2022; .
Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Disclaimer: Consor and Client make no representations, express or implied, as to the accuracy, completeness and timeliness of the information displayed. This map is not suitable for legal, engineering, or surveying purposes. Notification of any errors is appreciated.

The only seismic landslide hazard that intersects with the backbone pipeline or storage facilities is near the Bolton Reservoir, Pump Station, and nearby pipelines, which are located within a prehistorical landslide zone. Most of the area is subject to potential landslide hazards of up to 5 feet deformation. However, the slopes directly below the reservoir have potentially 25 feet of deformation. Grading and subsurface improvements were made under the reservoir footprint to mitigate these hazards. However, the adjacent pipelines are still vulnerable to landslide ground deformation.

The Willamette Reservoir, Pump Station and adjacent pipelines are located on a moderate slope just to the west of the I-205 landslide. They are within 100 feet, but do not intersect the landslide.

10.3.1.5 Seismic Hazard Findings Summary

The Delve technical memorandum concluded that most of the critical facilities and backbone pipe sections are within relatively low seismic hazard areas; however, several locations have a higher seismic hazard potential. Delve recommends additional evaluations to further characterize the hazard and develop mitigation strategies. **Table 10-2** lists four areas of higher seismic hazard potential and recommended evaluations.

Table 10-2 | Seismic Hazard Summary and Recommendations

Location	Comments	Recommendation
Willamette River Crossing Area	Moderate to high liquefaction hazard and ground deformation are anticipated in this area	Seismic hazards study and pipe resiliency evaluations should be conducted, especially for the pipe sections connected to the crossing. NOTE: The current ODOT I-205 Pipeline Crossing Project has performed this study and the appropriate measures have been included in the design and construction of the crossing improvements. No additional evaluation or project will be included in the CIP for this location.
Prehistoric landslide zone near Bolton Reservoir	Moderate to high seismic landslide hazards and ground deformation. Although the hazard has likely been mitigated by ground improvements during construction of the reservoir, the pipelines within the landslide zone are still vulnerable for seismic landslide hazard	NOTE: Ground improvements at the reservoir site were made in accordance with recommendations made by a Geotechnical Investigation and Site-Specific Seismic Hazard Study performed by GRI. The adjacent piping, however, should be further evaluated and will be included in the CIP.
Hwy 43 and west of Mary S. Young Park	Low to moderate liquefaction hazard and ground deformation	Seismic hazards study and pipe resiliency evaluations should be conducted. Note: This evaluation will be included in the CIP.
I-205 Crossing south of Willamette Reservoir	Low to moderate liquefaction hazard and ground deformation DOGAMI seismic landslide hazard mapping shows no hazard at the reservoir. However, it is very close to the I-205 landslide.	Slope Stability, seismic hazard study and pipe resiliency evaluations should be conducted. Note: This evaluation will be included in the CIP.

Recommended CIP projects and their estimated cost and schedule are summarized at the end of this chapter.

10.4 Structural Evaluation of Storage and Pumping Facilities

This WSMP recommends the City perform a structural seismic analyses of the Horton, View Drive, Willamette, and Bland Reservoirs to assess the current seismic risk at each site, determine if the current level of seismic restraint is adequate, and develop recommended improvements, as needed, to meet current seismic code requirements. The Bolton reservoir was built to current seismic code and does not require an assessment.

Table 10-3 summarizes the estimated cost and recommended schedule for the structural seismic assessments and rehabilitation. It should be noted, however, that the rehabilitation budget may require adjustment based on recommendations made in the assessment. This WSMP recommends scheduling the Seismic Analyses for FY 2024 – FY 2-2029 and the Seismic Rehabilitations for FY 2034 – FY 2044.

Table 10-3 | Recommended Seismic Analyses and Rehabilitation CIP

Reservoir	Priority	Seismic Analysis Budget Cost	Seismic Rehabilitation Budget Cost
Horton	1	$60,000	$750,000
Valley View	1	$60,000	$750,000
Willamette	2	$60,000	$750,000
Bland	2	$60,000	$750,000
Rosemont	3	$60,000	$750,000
Bolton	3	Not required*	

Note:

*Not required unless changes are made to the seismic code.

10.5 Pipe Fragility Analysis

Pipeline fragility describes the likelihood of pipeline damage following an earthquake by estimating the necessary rate of repair per 1,000 feet of pipeline. The estimated rate of repair is based on the pipe material, installation, and surrounding ground conditions. While the actual location of pipeline damage cannot be predicted, pipeline fragility analysis provides a measure of the expected severity of damage to the water system backbone overall and may identify areas of relatively higher risk where mitigation efforts should be focused first.

10.5.1 Analysis Method

This analysis estimated the rates of repair (RR) for the all of the City's water mains. The pipeline fragility was evaluated using water mains data provided by the City, seismic geohazards described earlier in this chapter, and the Seismic Fragility Formulations for Water Systems guidelines developed by the American Lifelines Alliance (ALA, 2001). The ALA is a partnership between the Federal Emergency Management Agency (FEMA) and the ASCE.

The ALA guidelines present damage algorithms used to calculate RR per 1,000 LF of pipe. They are based on empirical evidence catalogued after major earthquakes such as the 1989 Loma Prieta Earthquake in the San Francisco Bay area and the 1995 Great Hanshin earthquake in Hyogoken-Nanbu (Kobe), Japan. The guidelines recommend using two pipe vulnerability algorithms, each of which address a different seismic hazard:

1. RR = K1 * 0.00187 * PGV

This algorithm estimates a RR per 1,000 LF of pipe due to seismic wave propagation or ground shaking. The magnitude of ground shaking is represented by PGV, described earlier in this chapter.

2. RR = K2 * 1.06 * PDG$^{0.319}$

This function estimates a RR per 1,000 LF of pipe due to PGD. PGD can be the result of landslide or lateral spreading due to soil liquefaction, described earlier in this chapter.

In the pipe vulnerability algorithms above, K1 and K2 are empirical fragility constants which are used to scale the RR for different pipe diameters, pipe materials, and joint types. K1 generally represents the strength and flexibility of the pipe material to withstand ground shaking. K2 generally represents the strength and flexibility of the pipe joint to resist separation during ground deformation. A larger K value correlates with higher material or joint vulnerability.

10.5.2 Pipe Installation and Materials (K Value Selection)

The ALA seismic fragility guidelines provide a range of K values which scale estimated RR for different pipe materials and joint types. K values are estimated based on empirical damage evidence from previous earthquakes. Thus, the influence of some variables, such as pipe diameter, are inconclusive based on the currently available historical water main damage data. Selected K values for the City's water system mains are summarized in **Table 10-4** based on the ALA guidelines.

Generally, K1 represents the pipe material. The RR for some material types are also influenced by pipe diameter and soil corrosivity. Large diameter, defined as 16-inch diameter and greater, welded steel or concrete cylinder mains show lower damage rates in previous seismic events than smaller diameter mains of the same material. This may be attributed to higher quality control during construction, fewer bends and lateral connections than smaller mains, or lower soil loads as a function of pipe strength for the same depth of cover. The City's water system mapping data includes diameter for all pipes and material for most pipes.

Soil corrosivity also influences K1 values for cast iron and steel pipes. If these pipes are installed in corrosive soils, anticipated damage rates would be higher. Based on soil survey data from the National Resource Conservation Service (NRCS), soil corrosivity is moderate throughout the City's water service area. Soil corrosivity may not be an issue for a specific main if corrosion protection measures, such as an impressed current system, are in place.

Generally, K2 represents the pipe joint and is selected based on joint type and pipe material. Joint type information was not available for City's water system mains but is assumed based on pipe material and common construction methods at the time of pipe installation. The City's water system mapping data includes installation dates for most pipes.

Table 10-4 | Pipe Fragility K Values

Pipe Material:		Installation Date	Assumed Joint Type	Diameter	K1	K2
City Abbr.	Assumed					
AC	Asbestos Cement	All	Cement	All	1.0	1.0
CAS/CI	Cast Iron	All	Cement	Large	1.0	1.0
CAS/CI	Cast Iron	<1970	Cement	Small	1.4	1.0
CAS/CI	Cast Iron	>=1970	Rubber Gasket	All	0.8	0.8
CCP/CP	Concrete w/Steel Cylinder	All	Rubber Gasket	All	0.8	0.7
DIP/DI	Ductile Iron	All	Rubber Gasket	All	0.5	0.5
UNK	Unknown	All	All	All	1.0	1.0
SP/STL	Steel	All	Lap – Arc Welded	Large	0.15	0.15
PVC	Polyvinyl Chloride	All	Rubber Gasket	Small	0.5	0.8

Notes:

1. Small = 4- to 12-inch diameter
2. Large = 16-inch diameter and greater

10.5.3 Pipe Fragility Seismic Hazard Values

A composite pipe fragility RR per 1,000 LF of pipe was calculated by summing the estimated repair rates for the following seismic hazards:

- strong ground shaking, expressed as PGV
- settlement due to liquefaction, expressed as PGD
- seismic-induced landslide movement, expressed as PGD

Relative potential hazard levels for each of these three hazards are shown in **Figure 10-3**, **Figure 10-4**, and **Figure 10-5** as PGV and PGD. Each hazard is expected to cause damage and RRs are estimated separately. As summarized in **Section 10.3**, the four areas of higher seismic hazard potential are the Willamette River crossing area, around the Bolton Reservoir, HWY 43 and west of Mary S. Young Park, and the I-205 crossing south of the Willamette Reservoir.

10.5.4 Pipe Fragility Findings

Buried pipeline damage caused by ground failure (liquefaction and lateral spreading) will be significantly more severe than damage caused by ground shaking. Empirical data used to develop the ALA's pipe fragility analysis method reveals RRs two orders of magnitude higher for damage caused by ground failure. The Hazus methodology used by FEMA to assess potential earthquake damage to buried pipelines also supports this conclusion. For pipeline repairs caused by ground failure, Hazus assigns 80 percent of the repairs as "breaks" and 20 percent as "leaks". For ground shaking, 20 percent are considered breaks and 80 percent leaks.

The RR estimated by the pipeline fragility algorithms are for main lines. These equations do not account for breaks to service lines up to or beyond the customer meter. Depending on the location and severity of damage to service lines, the water utility may need to address some of these locations for proper operation of the main lines. ALA guidelines recommend 20 percent be added to calculated RR to account for damage to services that could require the City to address for system operations.

The estimated RRs for ground shaking, liquefaction-induced ground deformation, and landslide-induced ground deformation are calculated using different seismic hazard values, as described in previous sections. The three RRs for pipeline segments were added together to provide an estimated composite RR. These composite RRs for the water system mains are illustrated on **Figure 10-6**. This evaluation provides RR estimates as general guidance for prioritizing seismic mitigation efforts within the distribution system. The City's backbone system, as described earlier in this chapter, is the first priority for the City to begin restoring water service to its customers after a major seismic event. Seismic mitigation efforts should prioritize these pipelines. As seen in **Figure 10-6**, backbone pipelines at higher seismic hazard potential are the crossing of the Willamette River and extending east towards the DSPS, near the Bolton Reservoir, the I-205 crossing south of Willamette Reservoir, and Highway 43 and west of Mary S. Young Park. It should be noted that the ALA recommended K1 and K2 values are for pipelines installed without seismic design specific to the local geologic conditions. The crossing of the Willamette River is currently being upgraded including seismic retrofits and the pipeline crossing the bridge is being improved for seismic resilience. Existing pipelines extending from the crossing are still a priority for future seismic improvements. Additionally, the backbone pipeline extending southeast from the Bolton Reservoir was improved as part of the Bolton Reservoir improvements.

10.6 Design Standards for Seismic Resilience

Oregon Structural Specialty and Mechanical Specialty Codes will dictate that all new water facility construction meet current earthquake standards which are based on an M9 event. Suggestions for City design and construction standards are described in more detail below.

10.6.1 Pipelines

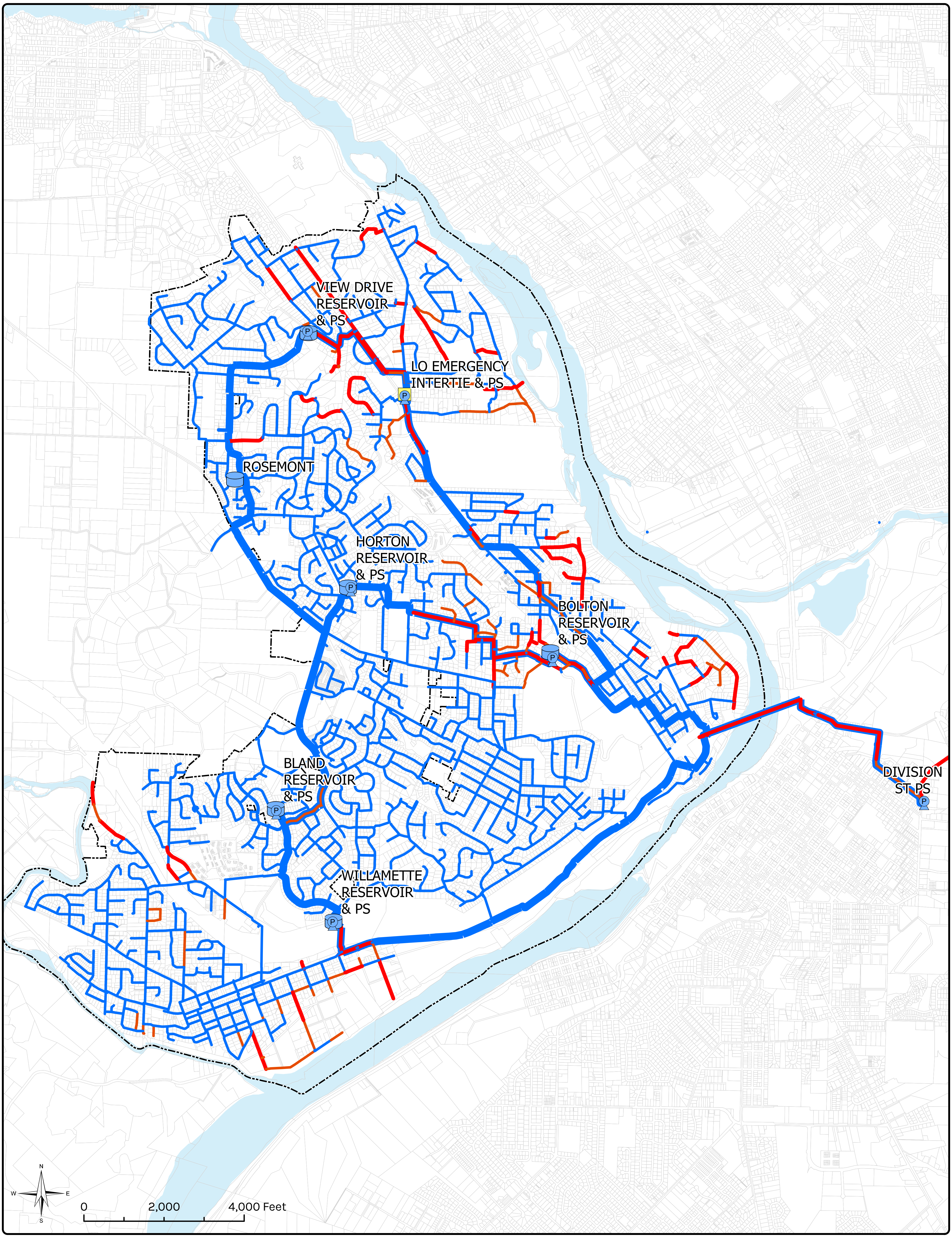
Based on the seismic vulnerability of the City water system, restrained-joint ductile iron pipe provides the best balance of cost, performance and life cycle. Fully restrained ductile iron pipe reduces the risk of separation at standard push-on joints and allows limited deflection as a result of ground shaking and ground deformation. Furthermore, ductile iron is a piping material that City crews are familiar with and stock adequate supplies to respond to leaks and main breaks.

For pipes larger than 24-inch diameter, the City should consider double lap welded steel as a preferred pipe material. The selection of piping material, lining and coating system, and other design parameters should be made on a case-by-case basis with adequate consideration of specific alignment seismic hazards, hydraulics, performance and life-cycle expectations, soil considerations, etc.

10.6.2 Reservoirs

It is assumed that future reservoir structures will be designed to meet earthquake standards consistent with current Structural and Mechanical Specialty codes. There are two key design considerations associated with reservoir configuration and connections to the distribution system:

- Pipe to reservoir connections
- Automated isolation valves



Legend

Comp_RR (/1000LF)

- 🟦 0 - 3
- 🟧 3 - 5
- 🟥 5 - 11

Backbone

- 🟦 Backbone

City Limits

- ⬚ City Limits

City of West Linn

consor

Water System Master Plan

Figure 10-6
Composite Repair Rate

Project No: 22-3537

February 2024

Data Sources: City of West Linn, 2022; .
Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl

10.6.2.1 Pipe to Reservoir Connections

At each distribution or transmission piping connection to the reservoir, significant stress can be placed on the pipe as a result of the difference in response to ground motion and deformation by the pipe and reservoir foundation. To minimize the risk of pipe breakage at this location, it is recommended that a flexible expansion joint be installed at this interface. Flexible expansion joints must be capable of allowing axial expansion/contraction and differential movement that results in a vertical or horizontal offset.

10.6.2.2 Automated Isolation Valves

Automated isolation valving with seismic valve actuators should be considered at all reservoir piping connections. There are several considerations to be weighed in determining whether to use an automatic shut-off valve at each reservoir as summarized in **Table 10-5**.

Table 10-5 | Automatic Shut-off Valve Considerations at Reservoirs

If a seismic valve actuator is used for automatic shut-off at reservoirs:	YES	NO
Water Available for Fire Suppression Immediately After Event?		✓
Reservoir Water Volume Preserved for Use During Recovery?	✓	
Requires Maintenance of Batteries for Valve Actuation?	✓	
Vulnerable to Accidental Closure due to False Alarm?	✓	

The City should consider the specific performance objectives of each reservoir associated with a seismic event and the anticipated response and recovery period to determine whether the installation of seismically actuated valves is warranted. Pump Stations

Similar to reservoir structures, pipe connections at the pump station building present specific vulnerability as a result of differential movement and settlement. To minimize the risk of pipe breakage at this location, it is recommended that a flexible expansion joint be installed at this interface. Flexible expansion joints must be capable of allowing axial expansion/contraction and differential movement that results in a vertical or horizontal offset.

Standby power should also be provided, in the form of a standby generator, at all critical (Tier 1) pump station facilities. The standby generator should be equipped with on-site fuel storage for at least 24 hours of operation. While a significantly greater volume of fuel will likely be required to sustain operation of the generator through the recovery period following a seismic event, storage of greater volumes of fuel present complications and are likely not economically feasible.

10.7 Next Step

This initial seismic evaluation demonstrates that there are risks to the City's water system during a seismic event. It is recommended that the City:

- continue coordination with emergency managers to refine understanding of post-disaster water needs which will inform water facility performance goals and design choices.

- pursue a more detailed analysis of vulnerable facilities to develop a 50-year seismic CIP consistent with the Oregon Resilience Plan.

10.8 Summary of Recommended Improvements

This WSMP recommends the City perform a seismic analyses of the Horton, View Drive, Willamette, Rosemont, and Bland Reservoirs to assess the current seismic risk at each site, determine if the current level of seismic restraint is adequate, and develop recommended improvements as needed to meet current seismic code requirements. The Bolton reservoir was built to current seismic code and does not require an assessment. This WSMP also recommends completion of the relevant seismic rehabilitation improvements to the five reservoirs. **Table 10-6** summarizes the estimated cost and recommended priority and schedule for the reservoir seismic assessments and rehabilitation. It should be noted, however, that the rehabilitation budget may need an adjustment after completion of the assessments.

Table 10-7 summarizes the recommended CIP projects associated with seismic assessment and rehabilitation.

Table 10-6 | Seismic Recommendations

Structure Name	Recommendation
Bland Reservoir and Pump Station	Perform subsurface investigation to confirm shallow basalt bedrock condition
Division St. Pump Station	Perform subsurface investigation, site-specific stability and liquefaction analysis to confirm the low seismic liquefaction potential
Horton Reservoir and Pump Station	Perform subsurface investigation, site-specific stability, and liquefaction analysis
Lake Oswego Intertie and Pump Station	Perform subsurface investigation, site-specific stability, and liquefaction analysis
View Drive Reservoir and Pump Station	Perform subsurface investigation to confirm shallow basalt bedrock condition
Willamette Reservoir and Pump Station	Perform subsurface investigation to confirm shallow basalt bedrock condition. Perform slope stability evaluation.
Willamette River Crossing and Vicinity Pipeline	Perform subsurface investigation, site-specific stability, and liquefaction analysis

Table 10-7 | Recommended Seismic Assessment and Rehabilitation CIP Projects

Reservoir	Priority	Seismic Analysis		Seismic Rehabilitation	
		Budget Cost	Schedule	Budget Cost	Schedule
Rosemont	1	$60,000	FY 2024 – FY 2028	$750,000	FY 2034– FY 2044
Valley View	2	$60,000	FY 2024 – FY 2028	$750,000	FY 2034– FY 2044
Willamette	3	$60,000	FY 2024 – FY 2028	$750,000	FY 2034– FY 2044
Horton	4	$60,000	FY 2024 – FY 2028	$750,000	FY 2034– FY 2044
Bland	5	$60,000	FY 2024 – FY 2028	$750,000	FY 2034– FY 2044
Bolton	N/A*				

Note:
*Not required, unless changes are made to the seismic code.

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CHAPTER 11

Rate Study and Financing Options *(Pending Completion of Rate Study)*

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CHAPTER 12

CIP, CMP, Cost Allocations, and Financing Options

12.1 General

This chapter summarizes the recommended water system improvements that are described in previous chapters. The recommended improvements will correct system deficiencies associated with the performance criteria described in **Chapter 3** for the existing and future demand described in **Chapter 2**.

All recommended improvements are located within the City's existing UGB and are intended to serve existing development and planned growth that occurs within that area. Project cost estimates are presented for all recommended improvements and annual budgets are presented which support on-going programs.

The improvements are divided into the following two categories.

- Capital Maintenance Plan: Projects included in the CMP are generally associated with maintenance and are intended to improve the reliability or performance of the system. CMP projects typically do not quality for SDCs, however, there are exceptions. The total cost of a CMP project may be annualized over multiple years in the form of an annual budget.

- Capital Improvement Plan: Projects included in the CIP are generally associated with improvements that correct system deficiencies to meet current or future demand. Projects that also increase system capacity may be eligible for SDCs.

12.1.1 System Development Charges

. SDCs and eligibility are also discussed in more detail in **Chapter 11**.

12.1.2 Prioritization and Scheduling

The priority given to each project is described and assigned in the relevant chapter of this WSMP. Improvements recommended for construction during FY 2024-FY 2028 are considered short-term projects, projects identified for construction during FY 2029-2044 are considered medium-term projects and those beyond the 20-year planning horizon are considered long-term improvements.

12.2 Cost Estimating Data

An estimated project cost has been developed for each recommended CMP and CIP project. The American Association of Cost Engineers classifies cost estimates depending on project definition, end usage, and other factors. The cost estimates presented in this document are considered Class 5 with an end usage being a study or feasibility evaluation and an expected accuracy range of -30 percent to +50 percent. As the projects are better defined the accuracy level of the estimates can be narrowed. The estimated planning level cost for each project includes construction, engineering, and contingencies and are presented in 2024 dollars. Since construction costs change periodically, an indexing method to adjust present estimates in the future is useful. The Engineering News Record Construction Cost Index is commonly used for this purpose.

12.3 Capital Maintenance Program

Based on the analyses of the source, storage, pumping, transmission, and distribution facilities presented in previous chapters, several improvements were identified for inclusion to the City's water system CMP. Projects included in the CMP are recommended for major maintenance and replacement of existing facilities. The proposed CMP projects are generally considered maintenance and do not provide expanded capacity to the system. As such, there is no SDC allocation for these projects. **Table 12-1** summarizes the estimated total cost and recommended schedule over the 20-year study period for the recommended CMP projects.

12.4 Capital Improvement Program

Based on the analysis of the water system's source, storage, pumping, transmission, and distribution facilities presented in previous sections, a list of recommended improvements for each category has been developed for inclusion in the CIP. **Table 12-1** summarizes the estimated total cost and recommended schedule over the 20-year study period for the recommended CIP projects.

Table 12-1 | Recommended CMP and CIP Budget and Schedule Summary

Project No.	Project Description	CIP Schedule and Project Cost Summary (2024 Dollars)				
		FY 2024 FY 2028	FY 2029 FY 2033	FY 2034 FY 2044)	Beyond	Total
S.1	Replace two flow control ball valves on DSPS discharge to West Linn	$200,000				$200,000
	Source Subtotal	**$200,000**				**$200,000**
R.1	Horton Interior & Exterior Coating	$1,000,000				$1,000,000
R.2	Valley View Interior & Exterior Coating		$500,000			$500,000
R.3	Willamette Interior & Exterior Coating		$670,000			$670,000
R.4	Reservoir Seismic Analysis (Willamette, Horton, View Drive, Bland, Rosemont)	$300,000				$300,000
R.5	Willamette Reservoir Seismic Rehabilitation			$750,00		$750,000
5.6	Horton Reservoir Seismic Rehabilitation			$750,00		$750,000
R.7	Valley View Reservoir Seismic Rehabilitation			$750,00		$750,000
R.8	Bland Reservoir Seismic Rehabilitation			$750,00		$750,000
R.9	Rosemont Reservoir Seismic Rehabilitation			$750,00		$750,000
	Seismic Subtotal	**$1,300,000**	**$1,170,000**	**$3,750,000**		**$6,220,000**
P.1	Willamette Pump Station MCC Assessment	$420,000				$420,000
P.2	200 kW standby generator Bland/Valley Drive Pump Stations	$265,000				$265,000
P.3	Horton Pump Station Roof Replacement	$40,000				$40,000
P.4	Demolish Valley View Pump Station & Reservoir	$250,000				$250,000
	Pump Station Subtotal	**$975,000**				**$975,000**
M-01	Replace large diameter galvanized/steel pipe with ductile iron	$2,000,000	$2,000,000	$2,000,000	$2,250,000	$8,250,000
M-02	PRV Station Drainage Improvements	$390,000				$390,000
M-03	Willamette/Marylhurst/Lazy River Drive Improvements	$3,000,000				$3,000,000
M-04	Water Master Plan			$300,000		$300,000
	Operations Subtotal	**$5,390,000**	**$2,000,000**	**$2,300,000**	**$2,250,000**	**$11,940,000**
CMP-01	Replace small diameter galvanized/steel pipe with ductile iron	$300,000				$300,000
CMP-02	Replace asbestos cement pipe with ductile iron	$2,000,000	$1,500,000	$4,000,000	$8,665,000	$16,165,000
CMP-03	Replace cast iron pipe with ductile iron	$2,000,000	$2,000,000	$2,000,000	$22,150,000	$28,150,000
	CMP Subtotal	**$4,300,000**	**$3,500,000**	**$6,000,000**	**$30,815,000**	**$44,605,000**
V-01	Riverview Drive PRV Station	$250,000				$250,000
V-02	Debok/Killarny PRV Station	$250,000				$250,000
V-03	Bland Circle PRV Station	$250,000				$250,000
V-04	Carriage Way/Wildwood PRV Station		$500,000			$500,000
V-05	Firwood/Skyline PRV Station		$250,000			$250,000
V-06	Carriage Way/Hunter PRV Station		$250,000			$250,000
D-01	6,000 ft 8” and 12” diameter in Willamette Pressure Zone		$3,700,000			$3,700,000
D-02	600 ft 8” and 12” diameter in Willamette Pressure Zone.		$360,000			$360,000
D-03	3,000 ft 8” diameter in Bland Pressure Zone.		$1,400,000			$1,400,000
D-04	6,800 ft 8” diameter in Bolton Pressure Zone			$3,250,000		$3,250,000
D-05	2,700 ft 8” diameter in Willamette and Bland Pressure Zones			$1,200,000		$1,200,000
D-06	2,100 ft 8” diameter in Bolton Pressure Zone			$945,000		$945,000
D-07	2,770 ft 8” diameter in Robinwood Pressure Zone			$1,260,000		$1,260,000
D-08	6,860 ft 8” and 12” diameter in Willamette and Bland Pressure Zones			$4,235,000		$4,235,000
D-09	1,950 ft 8” and 12” diameter in Bolton Pressure Zone			$1,235,000		$1,235,000
D-10	2,580 ft 8” and 12” diameter in Bolton Pressure Zone			$1,515,000		$1,515,000
D-11	3,400 ft 8” diameter pipe to increase capacity at dead ends in the Horton Pressure Zone.				$1,550,000	$1,550,000
D-12	4,650 ft 8” diameter pipe to increase capacity at dead ends in the Bolton Pressure Zone.				$2,200,000	$2,200,000
D-13	5,600 ft 8” diameter pipe to increase capacity at dead ends in the Horton and Rosemont Pressure Zones.				$2,110,000	$2,110,000
D-14	2,630 ft 8” diameter pipe to increase capacity at dead ends in the Willamette Pressure Zone.				$1,197,000	$1,197,000
D-15	3,260 ft 8” diameter pipe to increase capacity at dead ends in the Rosemont Pressure Zone.				$1,980,000	$1,980,000
D-16	2,130 ft 8” diameter pipe to increase capacity at dead ends in the Robinwood Pressure Zone.				$970,000	$970,000
D-17	3,420 ft 8” diameter pipe to increase capacity at dead ends in the Robinwood and Rosemont Pressure Zones.				$1,600,000	$1,600,000
D-18	300 ft 8” diameter pipe to increase capacity to fire hydrant in the Horton Pressure Zone.				$150,000	$150,000
D-19	300 ft 8” diameter pipe to increase capacity to fire hydrant in the Horton Pressure Zone.				$150,000	$150,000
	Distribution Subtotal	**$750,000**	**$6,460,000**	**$13,640,000**	**$11,907,000**	**$32,757,000**
	CIP & CMP Total	$12,915,000	$13,130,000	$25,690,000	$14,157,000	$96,287,000
	Planning Period Estimated Annual Budget	$2.6M	$2.6M	$2.6M		

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APPENDIX A
LAKE OSWEGO
EMERGENCY INTERTIE IGA

consor

INTERGOVERNMENTAL
COOPERATIVE AGREEMENT
FOR
WATER SYSTEM INTERTIE
BETWEEN THE
SOUTH FORK WATER BOARD, THE CITY OF LAKE OSWEGO
AND THE CITY OF WEST LINN

This Agreement is made and entered into by and between the South Fork Water Board, an intergovernmental entity created pursuant to ORS Chapter 190, serving as a water supply agency and jointly owned and operated by the Cities of Oregon City and West Linn, hereinafter referred to as "Board;" the City of Lake Oswego, an Oregon municipal corporation, hereinafter referred to as "Lake Oswego;" and the City of West Linn, an Oregon municipal corporation, hereinafter referred to as "West Linn," all hereinafter collectively referred to as the "Parties."

RECITALS

The Parties agree upon the following recitals:

1. WHEREAS, the Parties hereto entered into an intergovernmental cooperative agreement in 1984 to provide for the construction, operation and maintenance of an emergency water system intertie between the water supply system of the Board and West Linn and the water supply system of Lake Oswego; and

2. WHEREAS, the facilities as described in the 1984 agreement, which are located near the intersection of Old River Road and Kenthorpe Way in West Linn, were constructed and the intertie became operable in that same year; and

3. WHEREAS, the intertie has been utilized periodically since 1984 during emergencies to provide emergency water supply between the Parties; and

4. WHEREAS, the planning for the 1984 intertie contemplated future construction of an intertie water pump station in the vicinity of original intertie; and

5. WHEREAS, West Linn has constructed the previously contemplated pump station on Old River Road near its intersection with Kenthorpe Way; and

6. WHEREAS, the pump station was constructed in conjunction with a scheduled shutdown and reconstruction of West Linn's finished water transmission main that is located on the Interstate 205 Bridge; and

7. WHEREAS, this transmission main supplies all of the water to West Linn from the South Fork Water Board; and

8. WHEREAS, the pump station was needed to provide for automatic and unattended operation of the intertie over an extended period of time to provide water supply to West Linn from Lake Oswego during the shutdown of West Linn's transmission main; and

9. WHEREAS, the shutdown of the transmission main commenced in the fall of 2001 and was completed by spring of 2002; and

10. WHEREAS, the intertie pump station and appurtenant facilities provide benefit to all of the Parties to this agreement; and

11. WHEREAS, all of the Parties agree to contribute to the cost of the pump station and appurtenant facilities; and

12. WHEREAS, the Parties desire that this agreement supersede and replace the 1984 agreement; and

13. WHEREAS, the Parties acknowledge that they have authority to execute this cooperative intergovernmental agreement pursuant to the terms of their respective municipal charters and pursuant to ORS 190.010,

NOW THEREFORE, in consideration of the mutual covenants and agreements contained herein, it is agreed by and between the Parties hereto as follows:

1. "Water Supply Facilities" Defined. As used herein, the term "water supply facilities" means river intakes, raw and finished water pumping facilities, water treatment facilities, water storage facilities, and all other infrastructure used in conjunction with the appropriation, treatment, storage or transmission of the Parties' water.

2. "Emergency Condition" Defined. An "emergency condition" is an occurrence created by a failure of the water supply facilities of the Board, Lake Oswego or West Linn, or the occurrence of an event which jeopardizes the Parties' water quality, whereby insufficient supply to any of the water customers of the Parties could threaten the health or safety of those customers. Such failure includes failure or interruption in the operation of river intakes, raw and finished water pumping facilities, water treatment facilities, raw and finished water pipelines, reservoirs, and appurtenant facilities. Emergency conditions shall not include situations involving loss of water pressure or diminution in water volume in a water distribution system during periods of high demand if the system remains in a normal operational mode, and shall not include scheduled repairs or maintenance.

3. Utilization of Water Intertie.

Emergency Conditions. Utilization of the water intertie under emergency conditions, as defined in paragraph 2 above, may be accomplished by the mutual consent of the executive officers of each of the Parties, or their designees.

Non-Emergency Conditions Less Than TwoWeeks. Sporadic use of the intertie for routine maintenance and repair may be accomplished by the mutual consent of the executive officers of each of the parties or their designees.

Non-Emergency Conditions Greater Than Two Weeks. Prolonged use of the intertie for routine maintenance and repair may be accomplished by the mutual consent of the parties provided Lake Oswego gives notice to West Linn at least one month advance notice so that the West Linn governing body may approve the action by resolution.

4. Location and Description of Water System Intertie. The location of the water system intertie is in the vicinity of the intersection of Kenthorpe Way and Old River Road in West Linn. The intersystem connection that was established and constructed in 1984 under the above-referenced prior agreement consists of an 18-inch intertie main approximately 800 feet in length and related appurtenances that are located on Old River Road between Mapleton Drive and Kenthorpe Way. This pipeline connects West Linn's 18-inch diameter transmission main located on Highway 43 to Lake Oswego's 24-inch diameter transmission main located at the intersection of Kenthorpe Way and Old River Road. West Linn has constructed an intertie booster pump station on property located on the west side of Old River Road between Kenthorpe Way and Mapleton Drive. The property is located between Old River Road and Highway 43. The project is described by plans and specifications prepared by Murray, Smith & Associates, Inc. entitled "Contract Documents for Emergency Intertie Water Pump Station" dated November 2000. The pump station connects to, and utilizes, the 18-inch intertie main on Old River Road. The pump station allows the intertie to be used on a continuous and automatically controlled basis in both directions of supply, i.e. Board and West Linn to Lake Oswego and Lake Oswego to West Linn and Board. The pump station includes flow, pressure control, metering and telemetry facilities, and a connection for providing emergency power supply. The pump station, along with the facilities and appurtenances associated with it, as well as the facilities previously constructed in 1984, constitute the water system intertie that is the subject of this agreement.

5. Prorating of Project Costs. West Linn, as the project owner, undertook and completed the water system intertie pump station project. West Linn has maintained accurate cost accounting records relating to the project. The Board agreed to contribute $100,000.00 to the project cost, which shall be payable in accordance with a payment schedule not to exceed two years. Lake Oswego agreed to contribute to the project a sum equal to 50% of the project cost of the facilities that benefit Lake Oswego, but not to exceed $65,000. These facilities are defined as the piping, valves, vaults, metering, instrumentation and control systems, and appurtenant facilities that are used to provide water supply to Lake Oswego from West Linn and the Board. The estimated project cost of these facilities which benefit Lake Oswego is $130,000. "Project cost" as used in this paragraph is defined as the final construction cost of the facilities plus the prorated share of the engineering costs for project which include pre-design, design, bidding and award, construction

management, permits and approvals, operation and maintenance manuals, and intertie operating plan. Project costs do not include property acquisition costs, contractor claims, litigation costs or other extraordinary costs related to the project. Upon completion of the project, West Linn will provide documentation to Lake Oswego for the project costs incurred. Lake Oswego agrees to pay West Linn its contribution toward the cost of such facilities in accordance with a payment schedule not to exceed two years from the date of this agreement.

6. Title to Intertie Facilities. The title to the water system intertie facilities as described above in Paragraph 4 and the obligation to insure them shall be in the name of West Linn. Title to the property occupied by the intertie pump station will be in the name of West Linn.

7. Method of Water Supply Through Intertie. Supply to Lake Oswego from the Board and West Linn will be by gravity through the piping, metering, flow and pressure control facilities associated with the intertie pump station. Supply to West Linn and the Board from Lake Oswego will be accomplished by pumping from Lake Oswego's water system through the intertie pump station into West Linn's system. Instrumentation, control and telemetry systems will be installed in the station and the station will be under the primary control of West Linn. Lake Oswego has installed additional instrumentation, control and telemetry systems that will provide for pump station status indication and additional control functions. West Linn will prepare an operating plan for the intertie pump station and appurtenant facilities and provide copies of same to the Board and Lake Oswego.

8. Quantity of Water to be Supplied. Upon agreement between the parties to make use of the intertie pursuant to Paragraph 3 of this Agreement, the Party supplying water shall endeavor to supply the maximum feasible quantity of water to the other Party, and take all reasonable actions necessary to accomplish the same, so long as such actions are not detrimental to the operation of the supplying Party's own water system.

9. Cost of Water Provided. The Parties agree to pay for all water provided through the intertie at the rate then being paid by West Linn to South Fork for wholesale water. The volume of water delivered shall be measured by the meter installed at the intertie pump station. The Parties shall have the right at any time to review rates for water supplied and make such adjustments to the cost of water provided, as they deem necessary and by mutual agreement of all Parties. In the event it is necessary for a Party supplying water through the intertie to obtain additional water from a water provider not party to this agreement, the water rate charged to the Party receiving water under this agreement shall be the water rate charged to the supplying Party by the non-party water provider. The Parties further agree that water utilized for periodic testing and exercising of the facilities will be furnished between the Parties without cost. In addition to the rate charged for water, the Parties by mutual agreement reserve the right to impose wheeling charges.

10. Operation and Maintenance Costs. The Parties agree that West Linn, as the owner of the intertie facilities, will be responsible for and will pay for the normal day-to-day operation and maintenance costs of the facilities.

11. Repairs, Renewals, Replacements, Upgrading and Modifications. The Parties agree that West Linn, as the owner of the intertie facilities, will be responsible for scheduling, contracting for and implementing any repairs, renewals, replacements, upgrading and modifications that may be required in the future to maintain or increase the function of the facilities.

a) Cost of Repairs: West Linn shall be responsible for the cost of all repairs, except that Lake Oswego agrees to pay 50% of the cost of any repairs necessary to those facilities which benefit Lake Oswego. Those facilities are defined as the piping, valves, vaults, metering, instrumentation and control systems, and appurtenant facilities that are used to provide water to Lake Oswego from West Linn and the Board.

b) Cost of Capital Improvements: The cost of any capital improvements or improvements which increase the function of the facilities will be shared in an equitable manner, based upon the benefit to be derived from each Party from each particular project.

12. Access to Water System Intertie Facilities. The Parties and their employees shall have access to the water system intertie facilities.

13. Agreement Not to Resell Water Without Consent. The Parties agree that they will not resell water supplied under the terms of this agreement without prior written consent of all Parties.

14. Supersedes Prior Agreement. The Parties agree that this agreement supersedes and replaces the prior agreement executed in March and April, 1984.

15. Amendment Provisions. The terms of this agreement may be amended by mutual agreement of the Parties. Any amendments shall be in writing, shall refer specifically to this agreement, and shall be executed by the Parties.

16. Termination of Agreement. This agreement shall continue in effect until terminated by the parties with written notice of such intent to terminate provided to the other Parties. Notice to terminate must be provided at least 36 months prior to the effective date of termination. Termination of this agreement shall not affect the ownership status of the water system intertie facilities hereinabove described.

17. Written Notice Addresses. All written notices required under this agreement shall be sent to:

South Fork Water Board:
General Manager
South Fork Water Board
15962 S. Hunter Avenue
Oregon City, Oregon 97045

City of Lake Oswego:	City Manager City of Lake Oswego P.O. Box 369 Lake Oswego, Oregon 97034
City of West Linn:	City Manager City of West Linn 22500 Salamo Road West Linn, Oregon 97068

18. Dispute Resolution: If a dispute arises between the parties regarding this Agreement, the Parties shall attempt to resolve the dispute through the following steps:

Step One (Negotiation)

The Manager or other persons designated by each of the disputing Parties will negotiate on behalf of the entity they represent. The nature of the dispute shall be reduced to writing and shall be presented to each Manager, who shall then meet and attempt to resolve the issue. If the dispute is resolved at this step, there shall be a written determination of such resolution, signed by each Manager and ratified by their respective Board or Council, which shall then be binding upon the Parties.

Step Two (Mediation)

If the dispute cannot be resolved within thirty (30) days at Step One, the parties shall submit the matter to non-binding mediation. The Parties shall attempt to agree on a mediator. If they cannot agree, the parties shall request a list of five (5) mediators from the Presiding Judge of Clackamas County Circuit Court. The Parties will attempt to mutually agree on a mediator from the list provided, but if they cannot agree, the mediator will be selected by the Presiding Judge of Clackamas County Circuit Court. The cost of mediator shall be borne equally between the Parties, but each Party shall otherwise be responsible for its own costs and fees therefore. If the issue is resolved at this step, a written determination of such resolution shall be signed by each Manager and ratified by their respective Board or Council.

Step Three (Arbitration)

If the Parties are unsuccessful at Steps One and Two, the dispute shall be resolved by binding arbitration proceedings pursuant to ORS Chapter 36. The Parties shall follow the same process as in Step Two for the selection of the arbitrator. Upon breach of this agreement, the nondefaulting Parties shall be entitled to all legal or equitable remedies available, including injunctive relief, declaratory judgment, specific performance and termination. The prevailing Party(ies) in Step Three shall be entitled to reasonable attorney fees and costs which have been incurred during the Step Three process, as may be awarded by the arbitrator.

IN WITNESS WHEREOF, the Parties have set their hands and affixed their seals as of the date and year hereinabove written.

Board has acted in this matter pursuant to Resolution No. 03-04 adopted on the 20th day of November, 2003.

Lake Oswego has acted in this matter pursuant to Resolution No. 03-45 adopted by the City Council on the 21st day of October, 2003.

West Linn has acted in this matter pursuant to Resolution No. 03-12 adopted by its City Council on the 3rd day of December, 2003.

South Fork Water Board,
by and through its officials

By: Alice Norris
Alice Norris, Vice Chair

APPROVED AS TO FORM

By Peggy Hennessy
Peggy Hennessy, Attorney

City of Lake Oswego,
by and through its city officials

By: Judie Hammerstad
Judie Hammerstad, Mayor

By Jane McGarvin
~~Robyn Christie, City Recorder~~
Jane McGarvin, Deputy City Recorder

APPROVED AS TO FORM

By
David Powell, City Attorney

City of West Linn,
by and through its city officials

By:
David Dodds, Mayor

APPROVED AS TO FORM

By
Tim Ramis, City Attorney

Attest:
Nancy L. Davis (Administrative Assistant)

APPENDIX B
PRV SETTINGS

STATION NUMBER	VALVE TYPE	ZONE BEING FED BY	ADDRESS	GROUND ELEVATION	PIPE ELEVATION	UPSTREAM PRESSURE	VALVE #1 SIZE	VALVE #1 SETTING	VALVE #2 SIZE	VALVE #2 SETTING	CRL SETTING	LAST REBUILD DATE	NOTES
1-1	Altitude valve	Bolton	3901 Willamette Falls Dr.			107	10	70				Dec '12	Installed new 2006, PRV backup
2-1	PSI Reducing	Bland	1526 Killarney Dr	296.7	293.7	132	6	50	2	55	100	April '10	W/CRL for pressure sustaining
2-2	PSI Reducing	Bland	Greene St and Summertinn Dr		240	130	10	25	4	30			installed new Jan 99. for fire flow into the Willamette Zone #1
3-1	PSI Reducing	Horton	1775 Sunset Ave			169	2	65					Installed, rebuilt 2" Aug 2012 with main replacement
4-1	PSI Reducing	Bolton	22250 Willamette Fals Dr (Astro)	121.5	116	158	6	66	2	76		May '07	
4-2	PSI Reducing	Bolton	5789 Broadway (Web)	191.7	186.2	130	6	30	2	40		May '07	small device off to stop humming May '07
4-3	PSI Reducing	Bolton	Buck and Failing	176.6	170.4	95	4	37	2	47		May '07	
4-4	PSI Reducing	Bolton	Dillow and Larson	178.2	173	92	4	41	1.5	51		May '07	
5-1	PSI Reducing	Horton	Clark St and Windsor Ter	440.7	434.7	120	6	59	2	64		April '10	
5-2	PSI Reducing	Horton	2450 Oregon City Blvd	481	476.5	100	6	40	2	45		April '10	
6-1	PSI Reducing	Rosemont	Weatherhill and Salamo Rd	631.7	624.7	95	10	25	3	30			set psi 2/7/06 to supplement fire flows
6-2	PSI Reducing	Horton	6001 Skyline Dr				2						REMOVED
7-1	PSI Reducing	Horton	6206 Bridgeview Dr. (Summit)	498.5	492.5	110	6	38	3	43		April '10	
7-2	PSI Reducing	Horton	5109 Firwood Dr (Skyline)			112	6		2				Installed new 2/8/2005
8-1	PSI Reducing	Horton	4300 Horton Rd (Sahallie Park)	490.4	484.9	108	6	72	2	77		April '10	
8-2	PSI Reducing	Horton	6598 Appollo Rd	500.5	494.5	100	6	70	2	75		April '10	
9-1	PSI Reducing	Horton	1810 Wildwood Pl	464 est.	460	110	2	43					installed new 2/5/2004
11-1	PSI Reducing	Rosemont	View Dr PS				8		2				installed new Oct 06
11-2	PSI Reducing	Rosemont	18040 Upper Midhill Dr		273.8	135	6	60	2	65		Dec '12	added 2" 11/05
12-1	PSI Reducing	Rosemont	1842 Marylhurst Dr		495 approx.	98	6	50	2	55	75	Dec '12	installed new Sept 05
12-2	PSI Reducing	Rosemont	View Dr PS				8		2				installed new Oct 06
13-1	PSI Reducing	Rosemont	2248 Valley View Dr.	597.4	592.4	112	6	53	2	58		April '09	
13-2	PSI Reducing	Rosemont	2222 Hillcrest	608.6	603.8	108	6	48	2	53		April '09	
13-3	PSI Reducing	Rosemont	1275 Marylhurst Dr	606	612.7	105	6	47	2	52		April '09	
13-4	PSI Reducing	Rosemont	1350 Stonehaven Dr.	555.4	551.4	132	6	71	2	76		April '09	
13-5	PSI Reducing	Rosemont	1347 Troon Dr	569	580.1	120	6	63	2	68		April '09	removed small device to stop humming
14-1	PSI Reducing	Rosemont	1925 Carriage Wy	666	661.5	90	6	50	2	55		April '10	
14-2	PSI Reducing	Rosemont	19700 Derby St (Lexington)		647.5	90	6	45	2	50		April '10	
15-1	PSI Reducing	Bolton	5083 Territorial Dr			160	1.5	60				Dec '12	
16-1	PSI Reducing	Bolton	Buck ard Davenport		231.9	105	6	60	2	65		Dec '12	
16-2	PSI Reducing	Bolton	Barclay ard Willamette Dr		225.8	110	6	59	2	64		Dec '12	
16-3	PSI Reducing	Bolton	Lowry and Dillow Dr		204.8	120	6	70	2	75		Dec '12	
16-4	PSI Reducing	Bolton	Mark Ln. ard Willamette Dr.		245.6	100	6	65	2	70		Dec '12	
	Surge Release	Bolton	Old Bolton Pum Station				3	173				May '03	163 psi with 2,3,4 and 6 running
	Surge Release	Horton	Horton Pump Station				6	92				May '03	82 psi with all pumps running
	Surge Release	Willamette	Willamette PS				6		2.5	145		May '03	136 psi with all pumps running/6" valve is psi reducing
	Surge Release	Bolton	L.O. Intertie				8						Vents to LO system
	Surge Release	Robinwood	L.O. Intertie				6						Vents to atmosphere
	Surge Release	Rosemont	View Dr. PS				3						
	Surge Release	Rosemont	View Dr. PS				2.5						
	Altitude valve	Bolton	L.O. Intertie				10						
	Surge Release	Bolton	Clackamas County Shops				6	210				Dec. 12	Vents to atmosphere
	Pump Control		Bolton PS				3-8"						
	Pump Control		Horton PS				4-6"						
	Pump Control		Willamette PS				3-6"						
	Pump Control		L.O. Intertie				2-10"						
	Pump Control		View Dr PS				3-6"						
	PSI Reducing	L.O.	L.O. Intertie				2-10"						On the inlet side of the pumps
	Altitude valve	Bolton/L.O.	L.O. Intertie				12						Valve that regulates flow between WL and LO

APPENDIX C

2016 SOUTH FORK WATER BOARD MASTER PLAN

consor

Water Master Plan
Final Draft

MWH®
now
part of
Stantec

ch2m℠

Submitted to:

South Fork Water Board
September 2016

South Fork Water Board Master Plan

Prepared for

South Fork Water Board

November 3, 2016

MWH®

ch2m℠

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Figures

Acronyms and Abbreviations

AAGR	average annual growth rate
ADD	average day demand
BAT	best available treatment
°C	degrees Celsius
CECs	contaminants of emerging concern
cfs	cubic feet per second
CIP	capital improvements plan
CRW-S	Clackamas River Water-South
CRW	Clackamas River Water
CT	concentration x time
DSL	Oregon Division of State Lands
DSPS	Division Street Pump Station
EDCs	endocrine disruptors
ENR CCI Seattle August 2016—10596	Seattle Engineering News and Record Construction Cost Index
EPA	U.S. Environmental Protection Agency
°F	degrees Fahrenheit
FEMA	U.S. Federal Emergency Management Agency
GAC	granular activated carbon
gpcd	gallons per capita per day
gpd	gallons per day
gpm	gallons per minute
HABs	harmful algal blooms
HMI	human-machine interface
hp	horsepower
IGA	intergovernmental agreement
kVA	kilovolt-ampere
LPMF	low-pressure membrane filtration
LT2ESWTR	Long Term 2 Enhanced Surface Water Treatment Rule
MCE	maximum considered earthquake
MCLs	maximum contaminant levels
MDD	maximum day demand
MG	million gallons

mgd	million gallons per day
mg/L	milligrams per liter
MMD	monthly maximum demand
NC	Normally closed
NCCWC	North Clackamas County Water Commission
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity unit
O&M	operation and maintenance
ODFW	Oregon Department of Fish and Wildlife
OHA	Oregon Health Authority
ORP	Oregon Resilience Plan
PAC	powdered activated carbon
PCU	platinum color unit
PGE	Portland General Electric
ppb	parts per billion
PPCPs	pharmaceuticals and personal care products
PRC	Portland State University Population Research Center
RWPC	Regional Water Providers Consortium
RWPS	Clackamas River Intake/Raw Water Pump Station
SCADA	supervisory control and data acquisition
SDC	system development charge
SFWB	South Fork Water Board
T&O	taste and odor
TOC	total organic carbon
UASI	Urban Area Security Initiative
UCMR	Unregulated Contaminants Monitoring Rule
UCMR-3	Unregulated Contaminants Monitoring Rule, third-round
UCMR-4	Unregulated Contaminants Monitoring Rule, fourth-round
UFW	unaccounted-for water
USACE	U.S. Army Corps of Engineers
UV	ultraviolet
VFD	variable frequency drive
WTP	water treatment plant

Executive Summary

Introduction

The South Fork Water Board (SFWB) was formed in 1915 with the purpose of providing high-quality and safe potable drinking water to the growing populations of the City of Oregon City (Oregon City) and the City of West Linn (West Linn). The first SFWB supply project was construction of a gravity pipeline from the South Fork of the Clackamas River. Today, SFWB serves water to more than 65,000 people and owns and operates regional supply facilities including an intake on the Clackamas River, a raw water supply line, a surface water treatment plant (WTP), finished water transmission lines, a finished water pump station, and finished water storage facilities.

The primary objective of this master plan update is to evaluate the water supply system and update a 20-year capital improvement plan (CIP). A water system master plan, in accordance with Oregon Administrative Rule 333-061-0060, at a minimum provides a 20-year planning horizon for a water purveyor. The plan includes an analysis of the existing facilities with respect to the current and projected water demand on the municipality, the current and anticipated rules and regulations governing potable water supplies, and the age and physical condition of the conveyance and treatment facilities.

This report constitutes an update to SFWB’s most recent master planning effort, the 2004 Water Master Plan (2004 WMP). The previous plan provided a CIP for SFWB to follow as the demand for water from the growing populations of Oregon City and West Linn entailed improvements to SFWB’s conveyance and treatment facilities. MWH and CH2M updated the Water Master Plan in 2010. Again, SFWB selected MWH and CH2M to update the master plan in 2016 with a special emphasis on providing priority upgrades related to capacity and seismic deficiencies.

Report Organization

This report is organized into the following sections:

- Section 1—Population and Water Demand Projections
- Section 2—Evaluation of Water Treatment Plant
- Section 3—Evaluation of Existing Water Supply and Transmission Facilities
- Section 4—Evaluation of System Reliability
- Section 5 – Evaluation of an Alternate Water Supply
- Section 6—Seismic Resiliency Recommendations
- Section 7—Capital Improvement Plan

Summary of Findings

The summary of findings includes a projected water demand forecast, a summary of capacity for SFWB components, a discussion of alternatives considered, and the recommended CIP.

Projected Water Demand Forecast

The water demand forecast is shown in Table ES-1. The demand projections show that SFWB will use all of its water rights within a 50-year planning horizon if other commitments to water purveyors and industrial growth projections are realized. The results also show that the current SFWB customer demand is approaching the existing capacity of many of the system components, as discussed below.

Table ES-1. Water Use and Demand Forecast for SFWB (mgd)

	Year							
	2008	2010	2016	2021	2026	2031	2036	2066
Oregon City[a]	9.6	9.8	10.7	11.5	12.4	13.4	14.4	22.5
Oregon City[b]	9.6	9.9	11.9	13.8	15.9	18.5	21.4	42.9
West Linn	8.1	8.3	8.7	9.0	9.4	9.8	10.1	10.1
CRW-S[c]	2.8	2.4	4.0	3.6	1.7	0.9	1.0	1.0
CRW-S[d]	2.8	2.4	4.1	4.4	4.7	5.0	5.2	7.3
NCCWC	12	12	12	12	12	12	12	12
Lake Oswego	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Total[b, d, e]	20.5	20.6	24.7	27.2	30	33.3	36.7	60.3

[a] Assumes an Oregon City growth rate equal to 1.5%.
[b] Assumes an Oregon City growth rate equal to 3%.
[c] Assumes CRW-S creates a backbone distribution.
[d] Assumes SFWB continues to supply CRW-S.
[e] Includes Oregon City, West Linn, and CRW-S.

Evaluation of Existing Facilities

Much of SFWB's system is configured with a capacity of approximately 22 to 23 million gallons per day (mgd). Since that time, the intake, raw water pump station (RWPS) and parts of the WTP have been expanded. The existing demand is approaching the capacity of many of the supply components including the raw water transmission line, the WTP, the finished water transmission line, and the Division Street Pump Station (DSPS). The demand forecast discussed in Section 1 for SFWB shows that the system will require expansion soon.

Seismic Resiliency Recommendations

In February 2013, the Oregon Seismic Safety Policy Advisory Commission published recommendations for water and wastewater treatment plants in the Oregon Resilience Plan (ORP). The ORP provides recommendations on policy to protect citizens during and after a Cascadia tsunami and earthquake. A specific task group was created to assess water and wastewater system vulnerabilities.

Given the size and inherent vulnerability of most water and wastewater systems, it was assumed that costs of seismic mitigation would exceed the resources of most providers' 50-year CIPs. Therefore, to provide water to critical areas and establish wastewater service to protect public health and safety as soon as possible following the seismic event, a phased approach to system recovery was developed. The phased approach is built upon having hardened backbone elements of the water and wastewater systems. The backbone system would consist of key supply, treatment, transmission, distribution, and collection elements that, over the 50-year timeframe, have been upgraded, retrofitted, or rebuilt to withstand a Cascadia subduction zone earthquake.

The backbone water system would be capable of supplying key community needs, including fire suppression, health and emergency response, and community drinking water distribution points, while damage to the larger (non-backbone) system is being addressed.

The proposed approach—each community establishes a backbone water system—does not alleviate critical water concerns following a Cascadia subduction zone earthquake. Large portions of the water distribution system will remain vulnerable and presumably inoperable. Table ES-2 shows how phased improvements enhance seismic resiliency.

Table ES-2. Phased Resiliency Improvements

Phase	1 Highest Priority Projects	2 Expansion to 30 mgd	3 Expansion to 40 mgd	4 Expansion to 52 mgd
Projects	New chemical building SCADA upgrades Pipeline condition assessment Raw water pipeline Emergency treatment trailers Finished water pipeline from Hunter Avenue to Cleveland	New sedimentation basin Rapid mix system Structural upgrades Filter improvements Electrical upgrades Miscellaneous plant Plant piping improvements Finished water piping	RWPS improvements Two new flocculation/ sedimentation basins Plant piping Ozone system Backup generator Miscellaneous Electrical Mechanical dewatering	WTP expansion Raw water pumps Division street pumps
Impact on Level of Service	No expansion of capacity Improves operational control	Improves ability to meet future growth needs	Improves ability to meet future growth needs Improves taste and odor	Meets future water supply needs for full water right
Impact on System Resiliency & Reliability	Emergency treatment New raw water line Eliminates known problem area on finished water line	Resiliency goals for water plant and pipelines met	Adds resiliency for raw water pumps and backup power at WTP	Meets goals of ORP
Impact on Regulatory Compliance & Water Quality	Better monitoring and control Meets chemical storage requirements	Some improved organics removal with filter improvements	Meets known future drinking water quality regulations for the Clackamas supply	Meets known future drinking water, chemical, and sludge regulations.

Recommended Capital Improvement Plan

The CIP includes projects that can be categorizes into three phases:

1. High priority projects that need to be constructed immediately
2. Expansion of the supply capacity to 30 mgd
3. Expansion of the supply capacity to 40 mgd

SECTION 1

Water Demand Projections

This section discusses the historical population and water demand information for the City of Oregon City (Oregon City), the City of West Linn (West Linn), and the south portion of Clackamas River Water (CRW-S) that served by South Fork Water Board (SFWB). Forecasts of future population and water demands were obtained from each entity's master plan and planned capital improvements. These projections are used for facilities and capital improvement planning for SFWB. A discussion about future demands in CRW-S is presented in Section 1.5.

1.1 Definition of Terms

The following definitions are used in the master plan:

Production:	The total quantity of water produced and supplied to the SFWB system as potable water. The units for production include million gallons per day (mgd) and gallons per minute (gpm).
Demand:	The total quantity of water delivered through end-user meters for a given period of time to meet the various required uses. The various uses are residential, commercial, and industrial as well as firefighting, system losses, unaccounted-for uses, and miscellaneous uses. The units for demand include mgd and gpm and, when expressed in per capita use, gallons per capita per day (gpcd).
Unaccounted-for water:	The difference between the total amount of water produced by the water treatment plant (WTP) and the total amount of water billed to customers.

The different levels of water demand used in this analysis are designated as average day demand (ADD), maximum day demand (MDD), and monthly maximum demand (MMD).

Average day demand:	The total volume of water delivered to the system in 1 year, divided by 365 days.
Maximum day demand:	The maximum volume of water delivered to the system in any single day of the year, divided by 1 day.
Monthly maximum demand:	The total volume of water delivered to the system in the maximum usage month during the year, divided by the total of days in the month.

1.2 Population

Historical population data and population projections were gathered from various Oregon City and West Linn sources. This information, in addition to water use trends, serves as the basis for analyzing the existing SFWB facilities and for planning capital improvements.

1.2.1 Existing Population

Historical population estimates for Oregon City and West Linn were obtained from annual population estimates by the Portland State University Population Research Center (PRC) research data. The PRC creates population estimates each year, as of July 1, and publishes those estimates the following spring after review. The population estimates from the PRC provided the most up-to-date estimates and are shown in Table 1-1.

Table 1-1. Historical Population Summary—Cities of Oregon City and West Linn

	Oregon City		West Linn	
Calendar Year	**Population**	**Annual Growth Rate (%)**	**Population**	**Annual Growth Rate (%)**
2006	29,540	1.99%	24,180	0.44%
2007	30,060	1.76%	24,180	0.00%
2008	30,405	1.15%	24,400	0.91%
2009	30,710	1.00%	24,400	0.00%
2010	31,995	4.18%	25,150	3.07%
2011	32,220	0.70%	25,250	0.40%
2012	32,500	0.87%	25,370	0.48%
2013	33,390	2.74%	25,425	0.22%
2014	33,760	1.11%	25,540	0.45%
2015	33,940	0.53%	25,605	0.25%

Source: Portland State University Population Research Center.

1.2.2 Population Projections

Population forecasts for each city were based on existing sources and population projections presented in the cities' master plans. The *Oregon City Water Distribution System Master Plan* (2012 Oregon City master plan) (West Yost Associates) was adopted in 2012 and the *City of West Linn Water System Master Plan* (2008 West Linn master plan) (Murray, Smith, and Associates [MSA]) was adopted in 2008. These water system master plans for both Oregon City and West Linn provided 20-year population growth projections and estimated annual growth percentages.

1.2.2.1 Population Projections for Oregon City

It is anticipated that the region will grow at an annual average rate between 1.14 and 1.3 percent (West Yost Associates, 2012). In the 2012 Oregon City master plan, two growth rates were studied to project the population to the year 2030: 1.5 percent and 3.0 percent. For this SFWB master plan update, growth rates for the cities were extended to 2036, using both growth rates for Oregon City.

Table 1-2 summarizes the population projections for Oregon City used in the SFWB water master plan update.

1.2.2.2 Population Projections for West Linn

In the 2008 West Linn master plan, an average annual growth rate (AAGR) of 0.8 percent was assumed for population estimates. Assuming a constant growth of 0.8 percent, West Linn is projected to reach a saturated development population of 30,931 people (as described in the 2008 West Linn master plan) before the year 2036. For this master plan, the population will be held constant at 30,931 once it is reached.

Table 1-2 summarizes the population projections for West Linn used in the SFWB master plan update.

Table 1-2. Population Projections—Cities of Oregon City and West Linn

	Year				
	2016	**2021**	**2026**	**2031**	**2036**
Oregon City					
1.5% growth rate	33,745	36,353	39,162	42,189	45,449
3% growth rate	37,394	43,350	50,255	58,259	67,538
West Linn					
0.8% growth rate	26,646	27,729	28,856	30,028	30,931

Source: Oregon City (2012) and West Linn (2008) master plans.

1.3 Historical Water Demand

The historical water use information, current population estimates, and future population projections form the basis for projecting future water demands. Historical use and current population data are used to estimate per capita usage rates, and then these values are used with population projections to estimate future water use. This information was acquired for the south region of CRW (Clackamas River Water-South [CRW-S]), a wholesale customer of SFWB, in addition to Oregon City and West Linn.

Historical water demands for Oregon City, West Linn, and CRW-S were obtained from SFWB meters. Production data for SFWB were obtained from plant staff. Tables 1-3, 1-4, 1-5, and 1-6 summarize the demand data for Oregon City, West Linn, CRW-S, and SFWB, respectively. Average day and maximum day data are shown.

Table 1-3. Historical Water Demand Summary—City of Oregon City

Total Demands (mgd)							Per Capita Demands (gpcd)		
Calendar Year	**Estimated Population Served**	**Average Daily Demand (ADD)**	**Monthly Maximum Demand (MMD)**	**Maximum Day Demand (MDD)***	**MMD/ADD**	**MDD/ADD**	**ADD**	**MMD**	**MDD**
2011	32,220	3.47	6.08	7.97	1.76	2.3	108	189	247
2012	32,500	3.55	6.48	8.16	1.83	2.3	109	199	251
2013	33,390	3.65	6.74	8.40	1.85	2.3	109	202	252
2014	33,760	3.67	6.85	8.45	1.86	2.3	109	203	250
2015	33,940	3.83	7.06	8.81	1.84	2.3	113	208	260

*Incorporates a 2.33 maximum day peaking factor 1-3 from the 2012 Oregon City master plan.
Source: South Fork Water Board treatment plant production summaries. Note the estimated population served is less than the projected population from the water master plan, and reflects populations provided by PRC in 2016.

Table 1-4. Historical Water Demand Summary—City of West Linn

Total Demands (mgd)							Per Capita Demands (gpcd)		
Calendar Year	**Estimated Population Served**	**Average Daily Demand (ADD)**	**Monthly Maximum Demand (MMD)**	**Maximum Day Demand (MDD)***	**MMD/ADD**	**MDD/ADD**	**ADD**	**MMD**	**MDD**
2011	25,250	2.55	5.04	5.89	1.98	2.31	101	200	233
2012	25,370	2.75	5.40	6.35	1.96	2.31	108	213	250
2013	25,425	2.79	5.15	6.45	1.85	2.31	110	203	254
2014	25,540	2.82	5.46	6.52	1.93	2.31	111	214	255
2015	25,605	3.01	5.89	6.94	1.96	2.31	117	230	271

*Incorporates a 2.31 maximum day peaking factor calculated from the 2008 West Linn master plan.
Source: SFWB WTP production summaries.

Table 1-5. Historical Water Demand Summary—Clackamas River Water-South

Total Demands (mgd)			
Calendar Year	**Average Daily Demand (ADD)**	**Monthly Maximum Demand (MMD)**	**MMD/ADD**
2011	1.20	2.37	1.98
2012	1.27	2.47	1.94
2013	1.54	3.30	2.14
2014	1.61	2.82	1.75
2015	1.69	3.45	2.04

Source: SFWB WTP production summaries.

Table 1-6. Production Summary—SFWB WTP
mgd

Calendar Year	Average Daily Production (to meet ADD)	Monthly Maximum Daily Production (to meet MMD)	Maximum Day Production (to meet MDD)	MMD/ADD Ratio	MDD/ADD Ratio
2011	7.49	13.45	15.91	1.80	2.13
2012	7.92	14.47	18.00	1.83	2.27
2013	8.28	15.20	17.08	1.84	2.06
2014	8.37	14.61	17.07	1.75	2.04
2015	8.89	16.81	20.28	1.89	2.28

Source: SFWB WTP production summaries.

SFWB occasionally supplies emergency water during the winter months to the North Clackamas County Water Commission (NCCWC). The intergovernmental agreement (IGA) between SFWB and the NCCWC allows for the delivery of an MDD of 12 mgd between October 1 and April 30 of each year. The master meter is read once monthly to determine total demand. SFWB also has an agreement to provide up to 5.6 mgd in emergency supply to the City of Lake Oswego provided through the emergency intertie with the West Linn distribution system.

1.4 Unaccounted-for Water

Unaccounted-for water (UFW) in the SFWB water system is the difference between the total amount of water produced at the WTP and the total amount of water billed to wholesale customers. UFW results from leakage losses, meter discrepancies, operation and maintenance (O&M) uses, and unmetered miscellaneous uses.

The average UFW in the SFWB water system has varied between 3 and 5 percent between 2011 and 2015 with an average just below 4 percent. Because the SFWB transmission system facilities are limited, leakage would be expected to be low. Table 1-7 presents historical UFW for the SFWB system.

Table 1-7. SFWB—Unaccounted-for Water

Calendar Year	Delivered Water from WTP (MG)	Master Meter Demand (MG)	% UFW
2011	2,732	2,633	3.76
2012	2,897	2,763	4.85
2013	3,022	2,915	3.66
2014	3,054	2,959	3.22
2015	3,244	3,115	4.15
Average:			3.93

Source: SFWB WTP production summaries and master meter records.

MG = million gallons.

1.5 Water Demand Projections

The water demand projections developed in this section are used for planning the expansion and upgrade of the SFWB water supply system. Future water demand was projected based on the estimated per capita use and future population projections for Oregon City and West Linn. It is assumed that the rate of increase in water use for institutional, commercial, and other users will follow a similar pattern as for the residential population. This assumption provides a conservative projection of future water needs of each city based on the best information available and without knowledge of the elimination or addition of specific large water users. Therefore, projections for future water use for West Linn and Oregon City will be based on the rate of increase of the permanent residential population. For CRW-S, demands were projected based on planned capital improvement projects reported by CRW. These improvements are intended to reduce demand from SFWB as described in Section 1.5.3.

Figure 1-1 shows the ADD over the planning period. Figure 1-2 shows the MDD projection over the planning period assuming completion of the CRW South Backbone project. These figure do not include a potential 12 mgd water demand for emergency supplies to Lake Oswego and North Clackamas County Water Commission as described below.

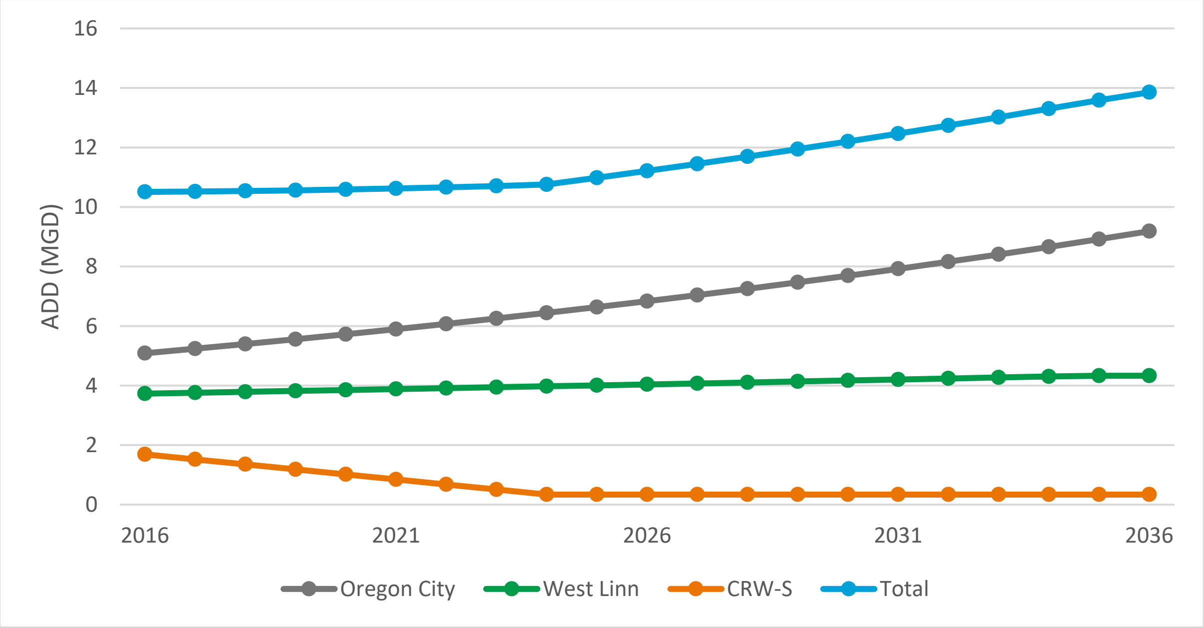

Figure 1-1. SFWB ADD Water Demand Projections 2016 – 2036
Assumes completion of the CRW-South Backbone Project

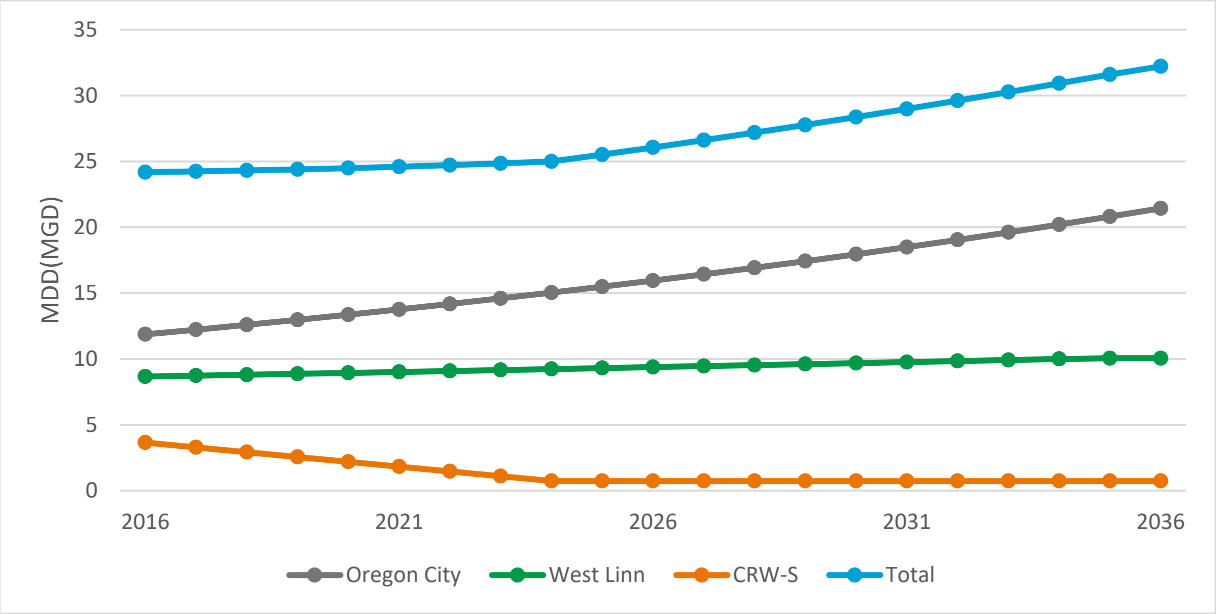

Figure 1-2. SFWB MDD Water Demand Projections 2016 – 2036
Assumes completion of the CRW-South Backbone Project.

1.5.1 Oregon City

According the 2012 Oregon City master plan, projected per capita ADD is 136 gpcd. MDD was calculated using a historical peaking factor of 2.33 (also from the 2012 master plan). To arrive at the forecast demand for each study year, the population projections at the higher growth rate in Table 1-2 were multiplied by the corresponding per-capita ADD value. The ADD value was then multiplied by the 2.33

historical factor to estimate MDD. The ADD and MDD forecasts for Oregon City are summarized in Tables 1-8 and 1-9, respectively.

1.5.2 West Linn

West Linn's per capita ADD and MDD were determined by both averaging historical information and by using the values stated in the 2008 West Linn master plan. The 2008 West Linn master plan recommends using an estimated ADD of 140 gpcd and a MDD of 325 gpcd. These updated values are used in the demand projections shown in Tables 1-8 and 1-9.

1.5.3 CRW-S

The demand projections for CRW-S, as shown in Table 1-8, are based on the maximum historic ADD use, as shown in Table 1-5. The MDD reflected in Table 1-9 was determined by analysis of historic MDD/ADD ratios, known as the MDD peaking factor, for Oregon City and West Linn. This method to estimate MDD was necessary because MDD data were not available for CRW-S. Growth for this area was estimated to be the same as Clackamas County from data provided by the PRC.

CRW intends to serve 80 percent of its south area from its own WTP. Starting in 2017, CRW projects to reduce its consumption from SFWB by 10 percent annually until only 20 percent of its water is supplied by SFWB. Tables 1-8 and 1-9 provide demands with and without this project.

1.5.4 North Clackamas County Water Commission

In accordance with the IGA with NCCWC, a projected NCCWC emergency demand of 12 mgd may be required for a period of time.

1.5.5 Lake Oswego

In accordance with the IGA with Lake Oswego, a projected Lake Oswego emergency demand of 5.6 mgd may be required for a period of time.

Table 1-8. SFWB Average Day Demand Projections

	Year					
	2016	**2021**	**2026**	**2031**	**2036**	**2066**
Oregon City[a]	4.6	4.9	5.3	5.7	6.2	9.6
Oregon City[b]	5.1	5.9	6.8	7.9	9.2	18.4
West Linn	3.7	3.9	4.0	4.2	4.3	4.3
CRW-S[c]	1.8	1.7	0.8	0.4	0.5	0.5
CRW-S[d]	1.9	2.0	2.2	2.3	2.4	3.4
Total[b, d]	10.5	11.1	11.4	12.7	14.1	26.1

[a] Assumes an Oregon City growth rate equal to 1.5%.
[b] Assumes an Oregon City growth rate equal to 3%.
[c] Assumes CRW-S creates a backbone distribution.
[d] Assumes SFWB continues to supply CRW-S.

Table 1-9. SFWB MDD Demand Projections

	Year					
	2016	2021	2026	2031	2036	2066
Oregon City[a]	10.7	11.5	12.4	13.4	14.4	22.5
Oregon City[b]	11.9	13.8	15.9	18.5	21.4	42.9
West Linn	8.7	9.0	9.4	9.8	10.1	10.1
CRW-S[c]	4.0	3.6	1.7	0.9	1.0	1.0
CRW-S[d]	4.1	4.4	4.7	5.0	5.2	7.3
NCCWC	12	12	12	12	12	12
Lake Oswego	5.6	5.6	5.6	5.6	5.6	5.6
Total[b, d, e]	24.7	27.2	30	33.3	36.7	60.3

[a] Assumes an Oregon City growth rate equal to 1.5%.
[b] Assumes an Oregon City growth rate equal to 3%.
[c] Assumes CRW-S creates a backbone distribution.
[d] Assumes SFWB continues to supply CRW-S.
[e] Includes Oregon City, West Linn, and CRW-S.

SECTION 2

Evaluation of Water Treatment Plant

This section summarizes information pertinent to the SFWB WTP with respect to improvements that should be included in the overall capital improvements plan (CIP). An aerial photo of the WTP is presented in Figure 2-1.

Figure 2-1. SFWB WTP Aerial Photograph

The SFWB WTP and various components of the supply system (27-inch-diameter raw water pipeline, 30-inch-diameter finished water pipeline and the Division Street Pump Station [DSPS]) were constructed in the late 1950s and originally went on line in 1959. Various improvements and upgrades have been made at the WTP since original construction, including the addition of the two backwash/solids drying ponds and associated transfer pump station in 1978, a new Clackamas River intake and Raw Water Pump Station (RWPS) in 1996, and a new 2.0 MG Clear Well 3 in 2009.

2.1 Introduction and Background

A detailed WTP facility Plan was completed in 2010 as part of the master planning process for the SFWB system (MWH/CH2M HILL, 2010a). The facility plan was prepared for three primary purposes:

- Assess the remaining useful life of the plant systems and then develop an incremental plant improvements/expansion plan for ultimate build-out to 52 mgd
- Develop a CIP for the plant improvements over the 20-year planning horizon, which was used to help determine updated system development charges (SDCs) for the SFWB system

- Recommend a 40 mgd WTP site layout, which was used for the land-use application to be submitted to the Oregon City Planning Department

The recommended WTP site layout for the 40 mgd condition, as presented in the facility plan, was approved by the Oregon City Planning Department in 2011. Figure 2-2 presents a 3D rendering of the site layout, which was presented to the Planning Department. A copy of the City's approval document is included in Appendix A.

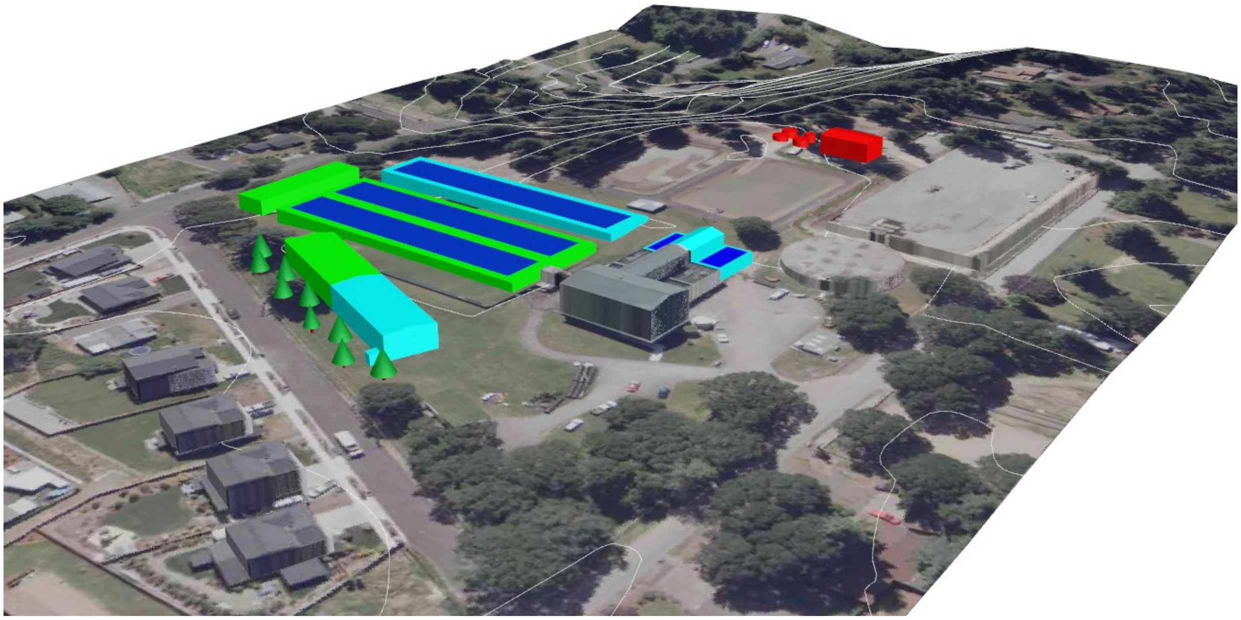

Figure 2-2. SFWB WTP Proposed 40 mgd Site Layout

The proposed plant improvement schedule from the master plan indicated that an expansion to 30 mgd, from the existing 22 mgd capacity, was to be ready for service by 2015. This was due to maximum day WTP production exceeding 20 mgd in 2006–2008. The expansion program was not completed because increases in system demands did not materialize as anticipated in the 2010 SFWB master plan (MWH/CH2M HILL, 2010b). The uncertainty about whether CRW would remain as a wholesale customer also led to a deferral of the plant's capacity expansion.

This SFWB master plan update reviews previous recommendations made in 2010 and provides updates and adjustments as required. This section addresses the recommended adjustments to the WTP CIP program based on recent information and changes that have occurred since 2010. Where possible and logical, this SFWB master plan update refers to information provided in the 2010 SFWB WTP facility plan rather than repeat it in this report. New information is presented herein to support the updated CIP program.

2.2 WTP Capacity Requirements

As noted above, the WTP capacity remains at 22 mgd since a capacity expansion to 30 mgd (as recommended in the 2010 SFWB master plan update) was not completed. The 27-inch-diameter raw water pipeline from the Clackamas River intake and RWPS to the WTP also has a 22 mgd capacity. An expansion of the WTP capacity to 30 mgd, including a new 42-inch-diameter raw water pipeline (sized for ultimate 52 mgd capacity), is still the next logical improvement, but the timing for this depends on the actual demands on the facility.

Section 1 of this report documents the future demand projections for Oregon City and West Linn, and also addresses the CRW customer topic. Based on this information and assuming that CRW remains as a wholesale customer, the estimated timing for expanded plant capacity is as follows:

- Expand WTP to 30 mgd—operational by summer 2022
- Expand WTP to 40 mgd—operational by summer 2034

If SFWB decides to exclude CRW from future demand projections, then the timing for the estimated plant expansions can be deferred by 5 years or longer.

There are a couple of near-term WTP improvement projects that SFWB should consider prior to beginning the initial plant expansion project. These improvements are discussed at the end of this Section 2.

2.3 Historical Plant Performance

Since 2010, the WTP has continued to produce high quality water that has met all Federal and Oregon Health Authority (OHA) drinking water regulations. No major modifications to the WTP infrastructure or processes have been made since 2010. Chemical additions at the WTP and compliance monitoring sample locations have remained in the same locations as documented in the 2010 WTP facility plan (Figure 2-3).

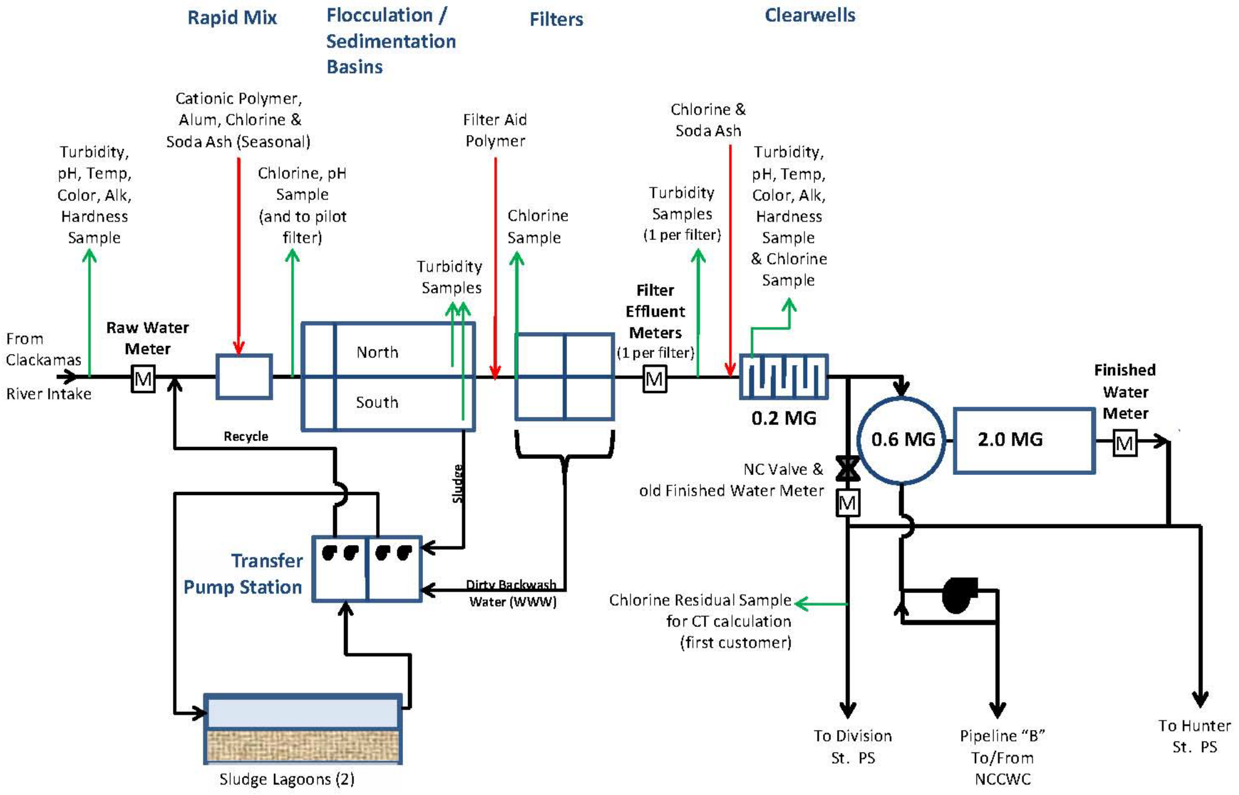

Figure 2-3. SFWB WTP Sampling Locations and Chemical Addition Points

The 2010 WTP facility plan reviewed WTP data from 2003 through 2009. This update summarizes and focuses on data from 2010 through 2015. Data in electronic format were made available by SFWB WTP staff. As part of the WTP performance review, there was a focus on selected raw and finished water quality parameters, chemical usage data, flocculation/sedimentation basin performance, and overall filter performance indicators, to see if any significant changes have been observed since 2010.

2.3.1 Historical WTP Production

Figure 2-4 and Table 2-1 summarize recent WTP Production. Data from 2009 are shown to provide context for demands “pre-recession.” It is suspected that increases in water production stalled from 2010 through 2012 due to the economic climate and reduction in demand from CRW, but production has started to increase steadily again over the past 4 years. The 2015 peak day production of 20.3 mgd is near the WTP’s maximum production capacity, so if demands are anticipated to increase as detailed in Section 1, expansion may be necessary in the near future.

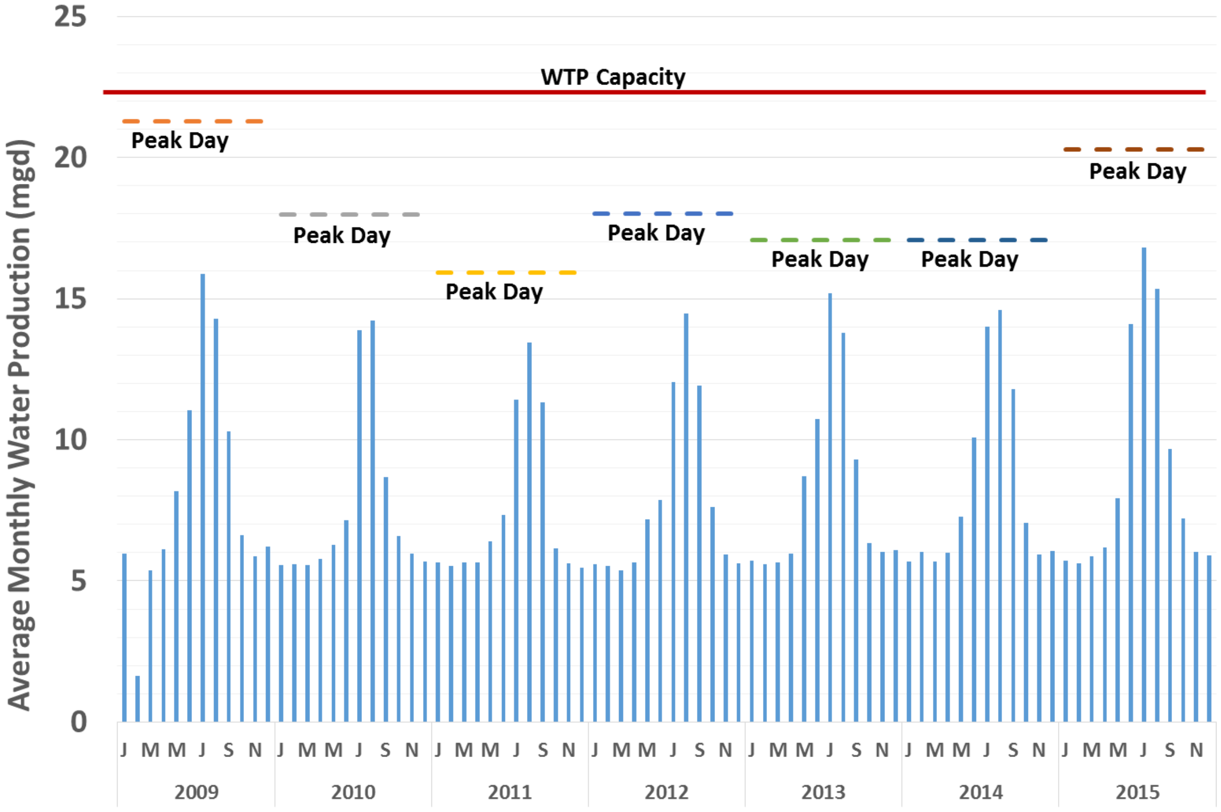

Figure 2-4. Monthly Summary of SFWB WTP Production (2009–2015)

Table 2-1. SFWB WTP Production Summary (2009–2015)
in mgd

				Minimum Monthly Average		Maximum Monthly Average		Maximum Weekly Average		Maximum Daily	
Year	**Annual Average**	**Peak Season^{a} Average**	**Off Season^{b} Average**	**Month**	**Value**	**Month**	**Value**	**Dates**	**Value**	**Date**	**Value**
2009^{c}	8.2	12.9	5.8	Mar	5.4	Jul	15.9	07/27–08/02	19.1	7/30	21.3
2010	7.6	11.0	5.9	Jan	5.5	Aug	14.2	08/12–08/18	16.1	7/10	18.0
2011	7.5	10.9	5.8	Dec	5.5	Aug	13.4	09/05–09/11	14.7	8/21	15.9
2012	7.9	11.6	6.1	Mar	5.4	Aug	14.5	08/11–08/17	16.2	8/16	18.0
2013	8.3	12.3	6.3	Feb	5.6	Jul	15.2	07/22–07/28	15.8	7/1	17.1
2014	8.4	12.6	6.2	Mar	5.7	Aug	14.6	08/05–08/11	15.3	8/10	17.1
2015	8.9	14.0	6.3	Feb	5.6	Jul	16.8	07/02–07/08	18.4	7/6	20.3

Table 2-1. SFWB WTP Production Summary (2009–2015)
in mgd

				Minimum Monthly Average		Maximum Monthly Average		Maximum Weekly Average		Maximum Daily	
Year	**Annual Average**	**Peak Season[a] Average**	**Off Season[b] Average**	**Month**	**Value**	**Month**	**Value**	**Dates**	**Value**	**Date**	**Value**

[a] Peak season is June through September.

[b] Off season is October through May.

[c] Plant was shut down periodically in February 2009 due to 2 MG clear well construction. Annual average plant production was lower than normal.

2.3.2 Review of Raw and Finished Water Quality

The Clackamas River raw water supply is typical of western Cascade surface supplies with generally low levels of dissolved minerals and low turbidities except during rainfall and snowmelt events. The main parameters of interest with respect to treatment performance and regulatory compliance include:

- Turbidity
- Color
- Temperature
- pH
- Alkalinity
- Hardness

Figure 2-4 presents the maximum daily raw water turbidity since January 2010. The highest turbidity periods occurred during the wet weather months and the lowest turbidity periods occurred during the warmer, drier months. Annual average raw water turbidities are around 6 nephelometric turbidity units (NTU). Minimum turbidities have been as low as 1 NTU during summer months and are generally less than 10 NTU during the winter months, except during heavy rainfall and snowmelt events. Almost every fall/winter, there has been at least one event when the raw water turbidity has exceeded 100 NTU and coincides with heavy rain, sometimes coupled with significant snowmelt. The duration of these high turbidity events is usually 2 days, but can last as long as 1 week, depending on rainfall and river flows. The maximum recorded turbidity at the SFWB WTP since 2010 was 480 NTU on December 7, 2015.

Also presented in average daily plant effluent (finished water) turbidities are presented in Figure 2-5. The plant finished water turbidity has consistently been less than 0.15 NTU. The settled water turbidities are typically at or below 2.0 NTU, except when river turbidities are elevated.

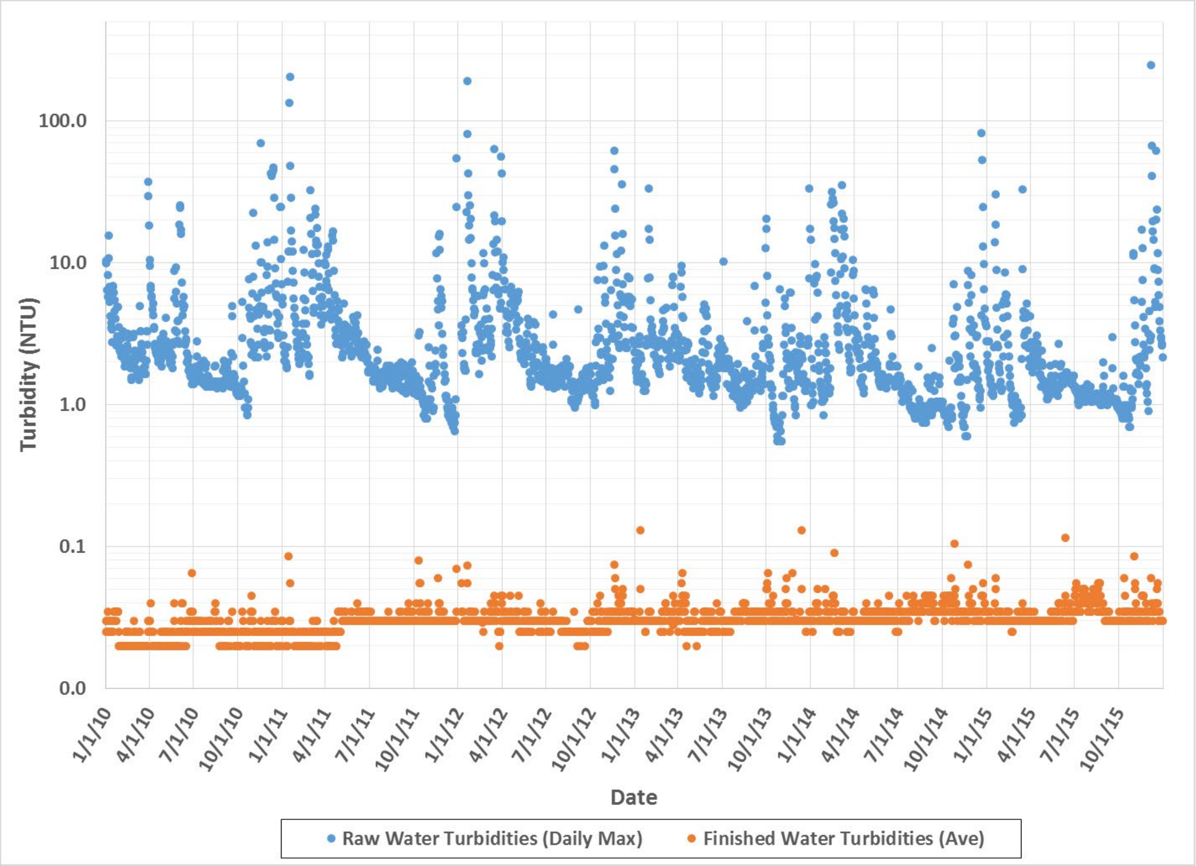

Figure 2-5. Raw Water and Plant Finished Water Turbidities (2010–2015)

Figure 2-6 presents daily average color in the raw water since January 2010. The color appears to follow trends in turbidity and is therefore mostly attributable to suspended particulates (apparent color). There is a relatively-low level of dissolved (true) color in the Clackamas River supply. The finished water color is almost always less than 2 platinum color units (PCU).

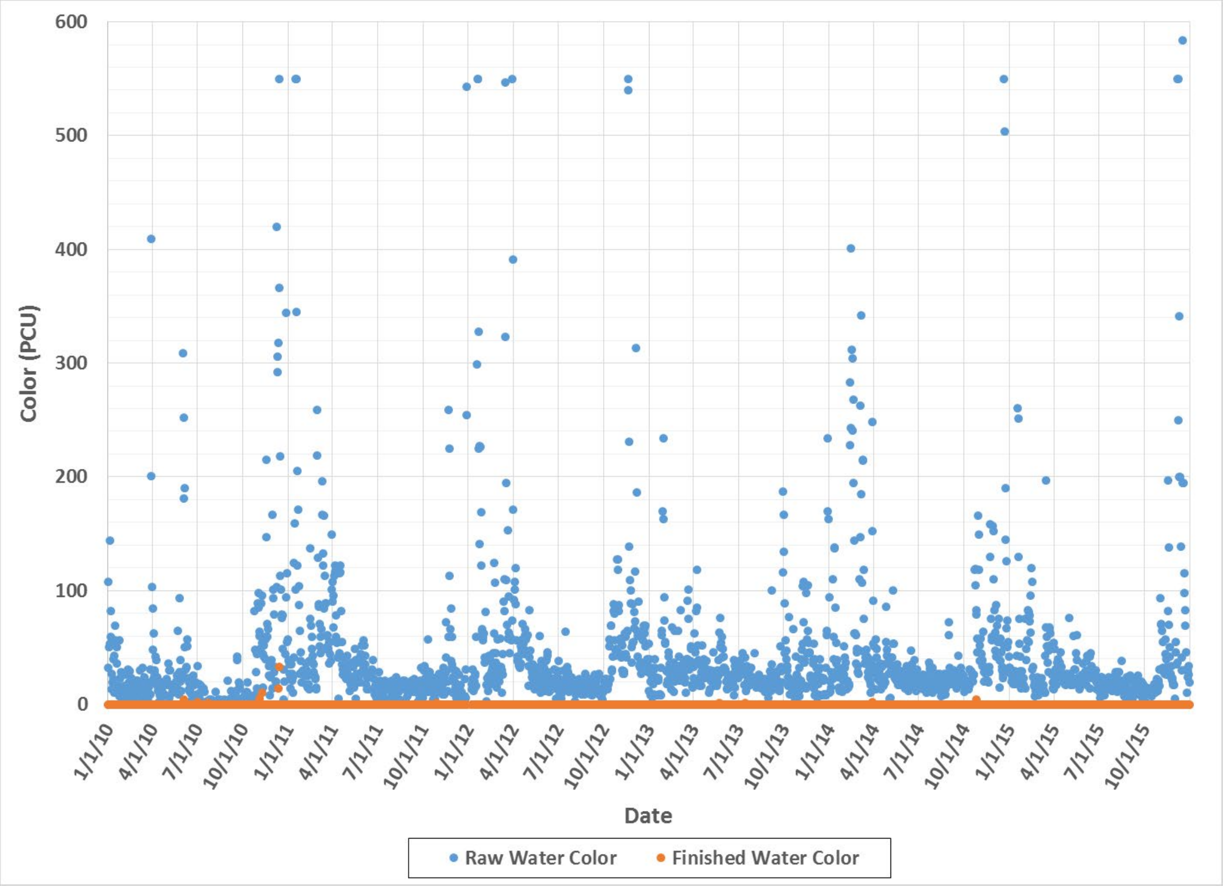

Figure 2-6. Raw Water Color (2010–2015)

Temperature plays an important role in water treatment because it affects the rate of chemical reactions (including disinfection and formation of disinfection byproducts), floc formation and settling, and filter performance. Higher temperature water typically requires lower chemical doses and offers better floc formation, settling, filtration, and disinfection characteristics. Rising water temperature increases optimal filter backwash rates due to the decreased viscosity of the warmer water.

The average daily temperature of the raw water entering the WTP varies by season, as shown in Figure 2-7. Since January 2010, wintertime (October to May) average temperatures were approximately 47.1 degrees Fahrenheit (°F) (8.4 degrees Celsius [°C]) and summertime (June to September) average temperatures were approximately 63.7°F (17.6°C). The minimum observed temperature was 34.7°F (1.5°C) on multiple winter days. The maximum observed temperature was 78.8°F (26°C) on multiple days in July 2015. **This high temperature corresponded with record low river flows experienced during summer 2015.** The water temperature has consistently been greater than 15°C during July and August when peak water demands and maximum plant production coincide.

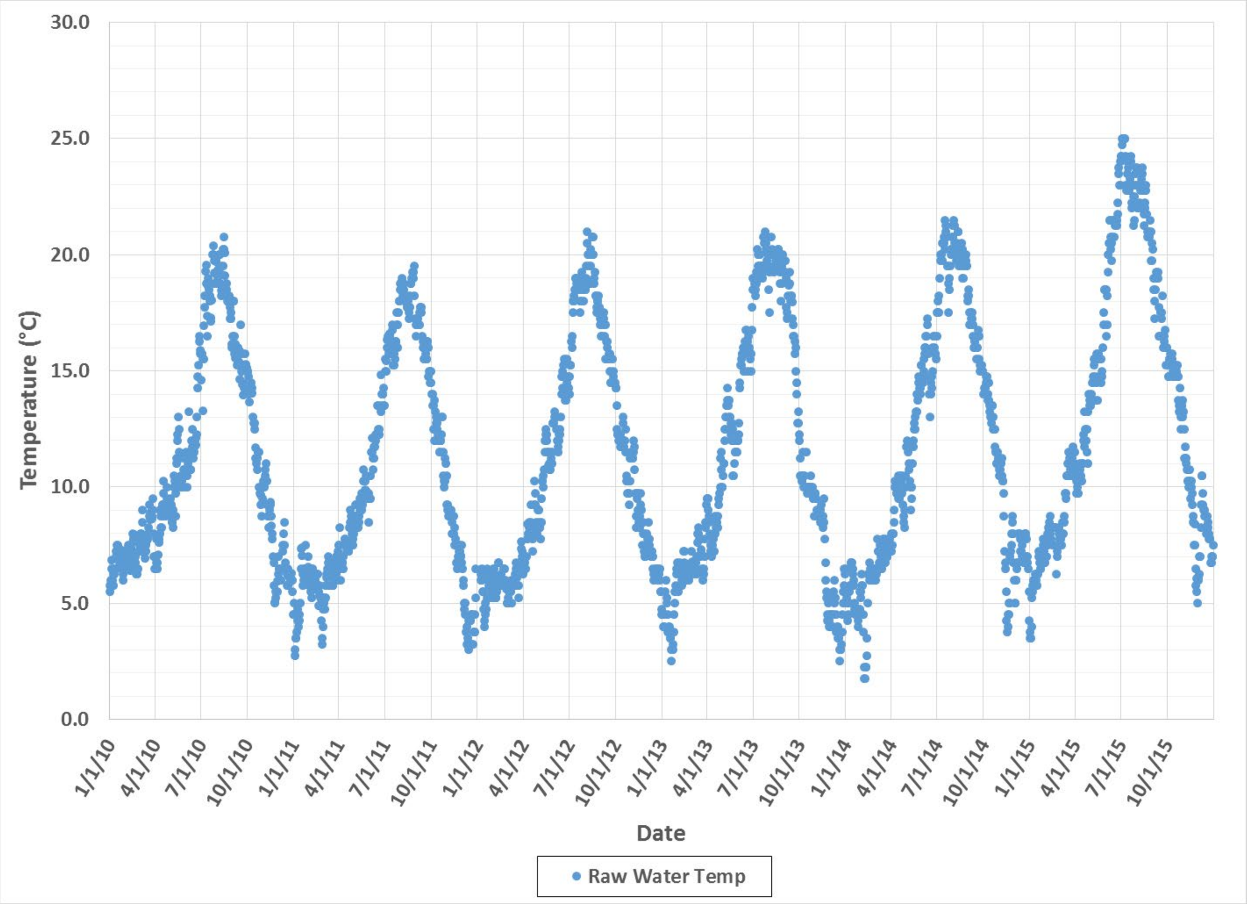

Figure 2-7. Raw Water Temperature (2010–2015)

pH is a measure of the acidic or basic nature of a water sample and can also be indicative of whether or not a water is corrosive. A pH of 7.0 represents neutral conditions, and pH values in excess of this are normally considered acceptable for corrosion control. pH values less than 7.0 usually indicate corrosiveness, which can lead to leaching of toxic metals into the water system and degradation of conveyance facilities. pH is also important in water treatment because of its impacts on coagulation performance and chemical disinfection. The addition of certain treatment chemicals alters the pH. Alum used at the WTP depresses the pH, but low-strength sodium hypochlorite solution does not increase the pH very much. Soda ash is used to increase the pH of the finished water, and is sometimes added to the raw water to improve coagulation (during high turbidity, high alum dose events). Figure 2-8 presents the historical raw water and plant effluent (finished water) pH values since January 2010.

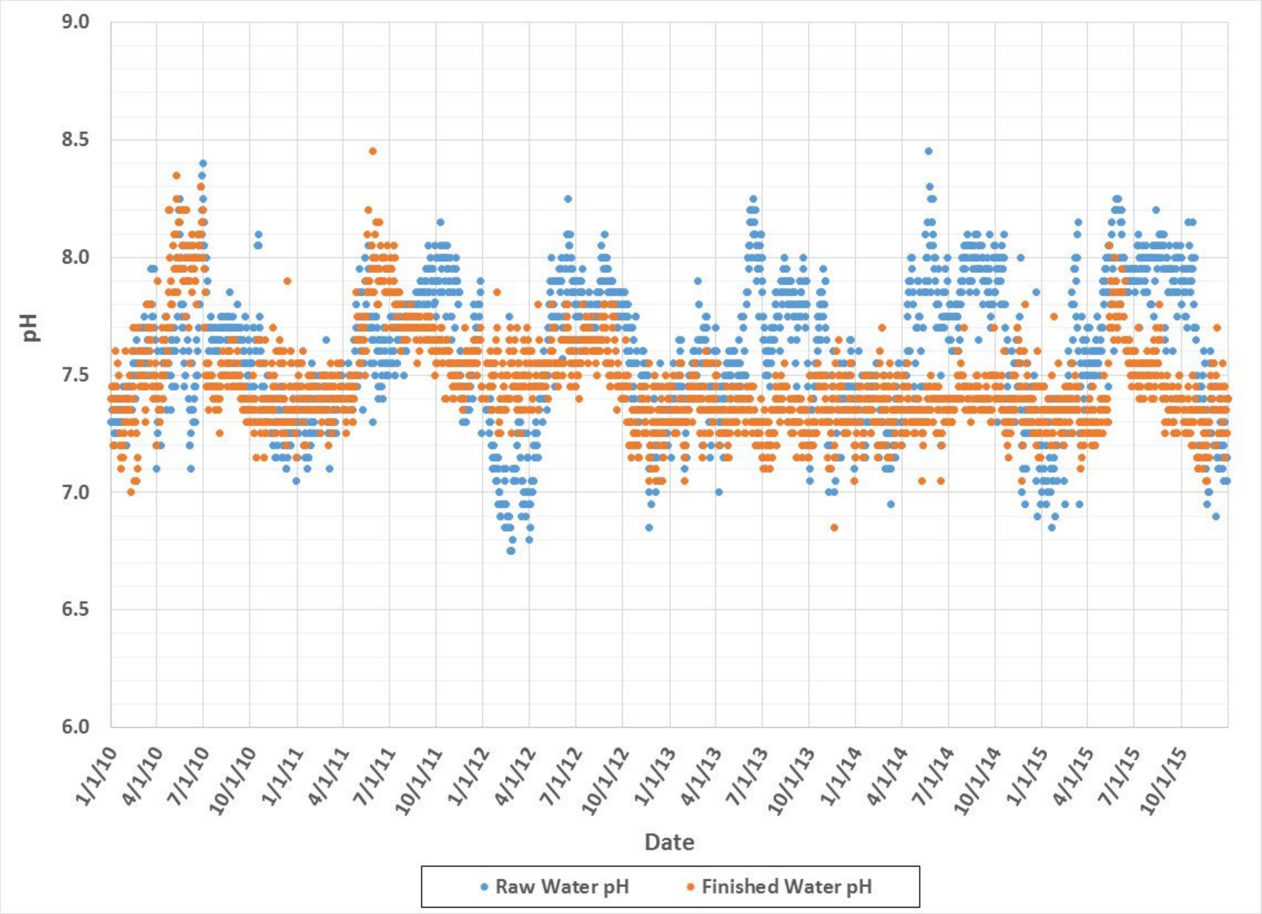

Figure 2-8. Raw Water and Finished Water Average Daily pH (2010–2015)

The raw water pH varies seasonally and is usually lowest during the winter months, when alkalinity is also at its lowest. The raw water pH rarely is less than 7.0. The raw water pH is higher during the summer months and can sometimes exceed 8.0 during diurnal swings, presumably due to algal activity. Since 2008, the plant has been adding more soda ash to maintain a higher finished water pH compared to historical operations. This and increased chlorine residual in the distribution system has allowed SFWB to be below the lead and copper action levels and conduct reduced monitoring.

Alkalinity is important in water treatment because of its impact on coagulation performance as well as its impact on corrosivity and pH stability. Alkalinity above 20 milligrams per liter (mg/L) as calcium carbonate ($CaCO_3$) is generally considered adequate for alum coagulation and for improved pH stability in the distribution system. Alkalinity can also impact total organic carbon (TOC) removal requirements, depending on raw water organic concentrations.

The alkalinity of the Clackamas River water varies seasonally as depicted in Figure 2-9. The raw water alkalinity can be as low as 10 to 15 mg/L during winter periods and can be as high as 30 to 35 mg/L during the summer. When the alkalinity is low and river turbidities are high, the addition of soda ash is required to maintain a proper coagulation pH due to the high alum dose required.

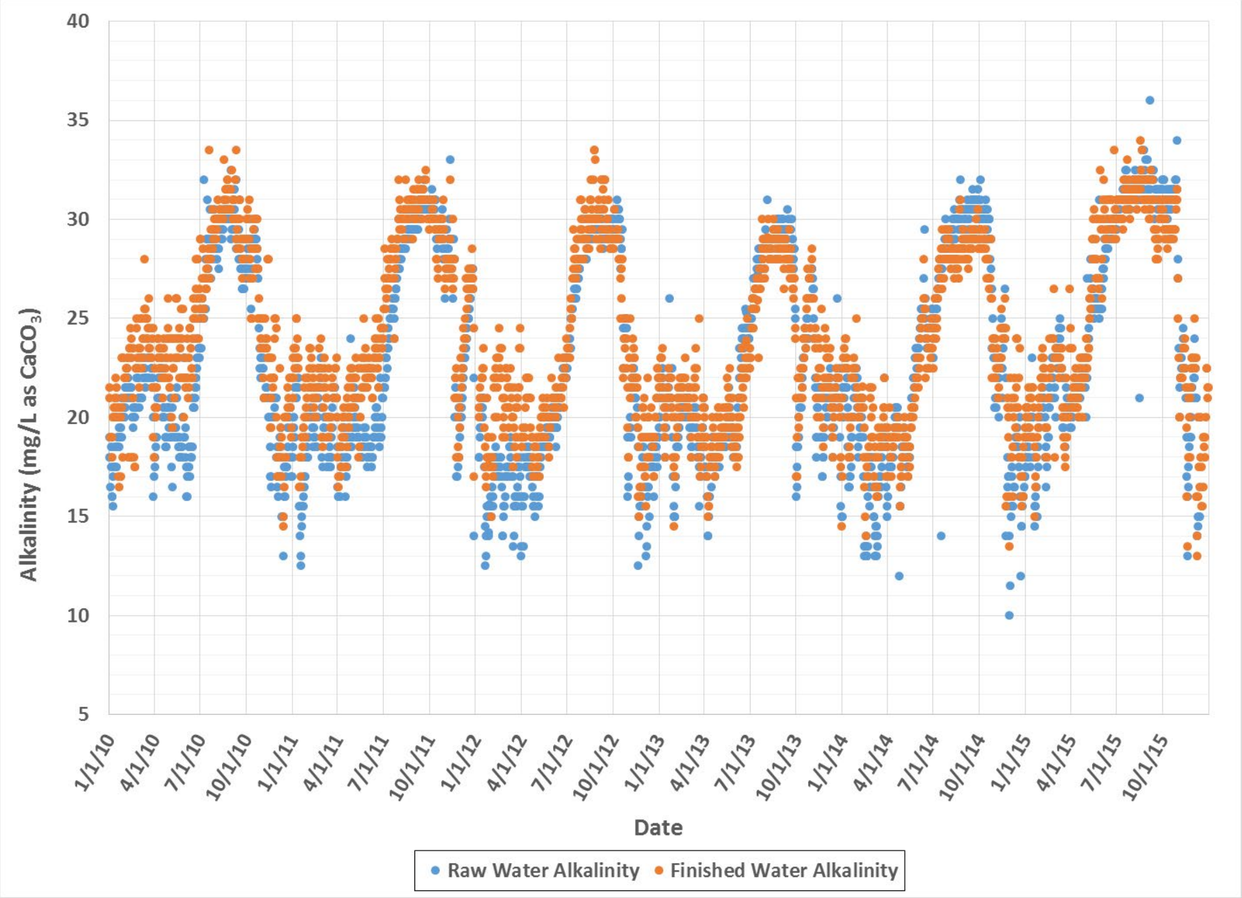

Figure 2-9. Raw Water and Plant Finished Water Alkalinity (2010–2015)

Hardness is a measure of the calcium and magnesium concentrations in water. These two minerals can often precipitate and produce scale (such as calcium carbonate) at high enough concentrations and under the right pH and alkalinity conditions.

Raw water and finished water hardness is measured daily, as presented in Figure 2-10. The hardness varies by season, generally ranging from 10 to 25 mg/L as $CaCO_3$, with the highest values observed during summer and early fall. The raw and finished water hardness are generally equal, since the plant treatment processes do not add or remove appreciable amounts of calcium or magnesium.

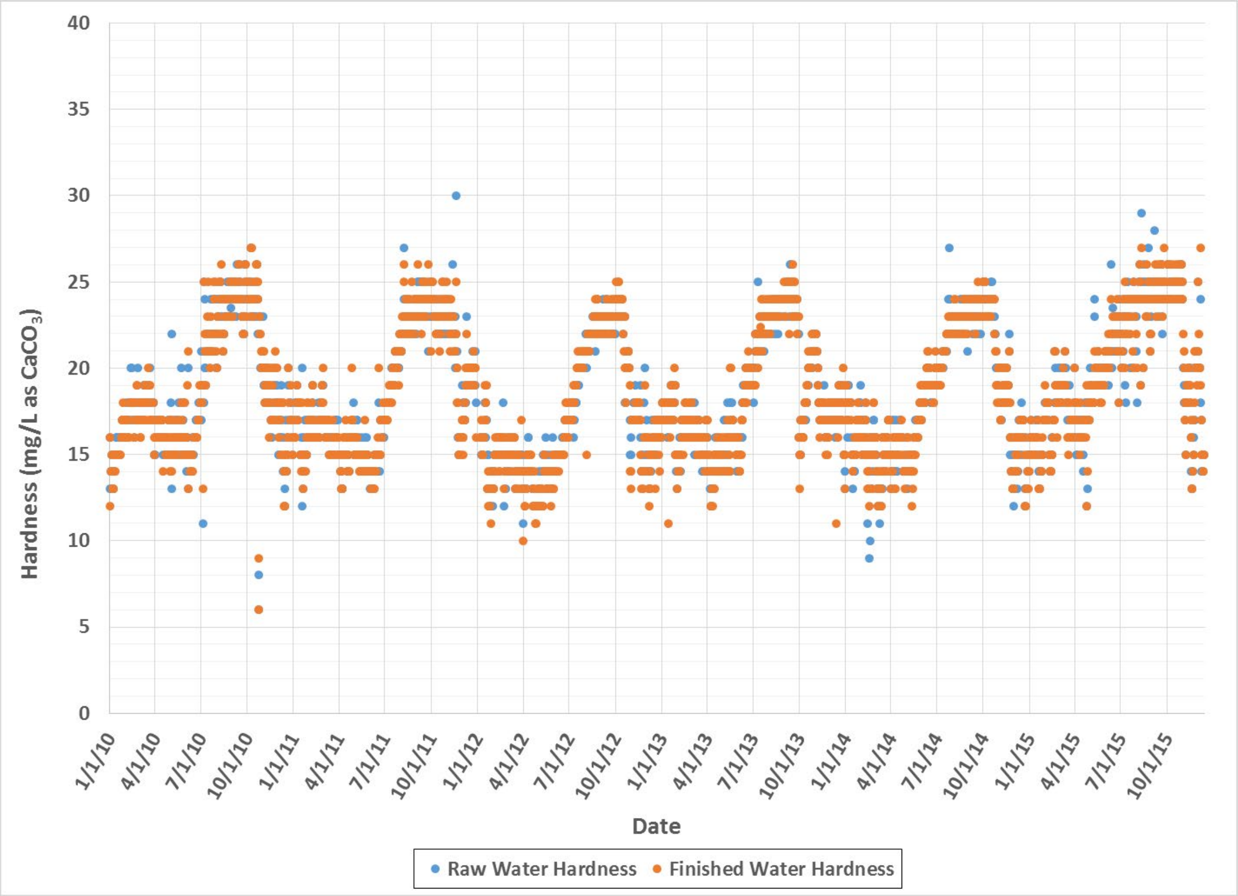

Figure 2-10. Raw Water and Plant Finished Water Hardness (2010–2015)

2.3.3 WTP Operational Costs

The major costs to operate and maintain a typical water treatment and supply system include labor, power, chemicals, equipment and materials maintenance and replacement, and residuals disposal. SFWB currently does not have to pay for offsite solids disposal. Table 2-2 is a summary of annual O&M costs, based on recent historical costs and the budget for 2014/2015 fiscal year. These costs include power and maintenance for the Clackamas River intake and RWPS and the DSPS. The annual power costs for pumping the raw and finished water represent the bulk of the total SFWB system power costs.

Table 2-2. SFWB 2014/2015 Fiscal Year WTP Costs

Category	Current Budgeted Amount
Labor	$1,100,000
Power	$710,000
Chemicals	$140,000
Equipment Maintenance	$40,000
Vehicles and Maintenance	$30,000
Other Annual Costs*	$680,000
Total	$2,700,000

*These are mostly administrative and not directly related to WTP operations.

The total 2014/2015 operating budget for SFWB was approximately $2,700,000 exclusive of various debt payments for prior construction projects and contingency funds. This annual cost results in a unit cost of approximately $870/MG of treated water produced based on an annual average production of 8.5 mgd.

2.4 Regulatory Review

2.4.1 Regulatory and Water Quality Issues

The 2010 WTP facility plan provided an in-depth review of regulatory requirements for municipal drinking water systems and the WTP's historical compliance. As stated above, the SFWB WTP has continued to consistently meet all existing primary and secondary water quality regulations. While there are no major regulatory issues of concern at this time, there are some regulatory and water quality issues that SFWB should consider as part of future plant expansions and improvements:

1. Ensure that the plant continues to be rated as "complete conventional filtration," or its equivalent, to minimize the *Giardia* inactivation (concentration x time [CT]) requirements.
2. Verify that the WTP continues to fall into Bin #1 classification per the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR), which will minimize/avoid the need for additional *Cryptosporidium* inactivation/removal requirements:
    - Under LT2ESWTR, the first round of sampling required the WTP to test raw water monthly, for *Cryptosporidium*, *E.coli,* and turbidity from 2007 through 2009, and determined Bin #1 classification.
    - Per OHA requirements, the WTP has started the second round of LT2ESWTR monthly sampling for *Cryptosporidium*, *E.coli,* and turbidity, which will be completed in 2018.
    - Upon conclusion of the second round of sampling, OHA will affirm SFWB's Bin classification.

3. Focus on producing a consistent finished water pH and alkalinity to continue complying with the Lead and Copper Rule, especially considering the increased awareness about this subject due to the circumstances in Flint, Michigan, and elsewhere in the country:
    - In order to assist the WTP in producing consistent finished water quality with optimal corrosion control characteristics, it is recommended that provisions for a carbon dioxide (CO_2) feed system be included in near-term improvements. This will provide a means to control both pH and alkalinity versus existing practices that can only control pH.
4. Consider treatment process modifications to reduce/eliminate earthy and musty tastes and odors that can occur in the Clackamas River during late summer and early fall due to algal activity.
5. Consider treatment process alternatives that can remove trace organics and contaminants of emerging concern (CECs) that may be present in the Clackamas River, and/or that may become a regulatory requirement in the future (includes algal toxins, herbicides, and pesticides).

The biggest impacts to the plant processes, facility layouts, space requirements, and costs will come from decisions to implement taste and odor control, and/or control of CECs.

2.4.2 Emerging Contaminants

The presence of a multitude of CECs in water supplies throughout the United States and elsewhere has been documented in numerous papers and presentations. The impacts of CECs have yet to be fully understood in the drinking water community, but it is clear that the drinking water regulations will change in the future as more data are gathered via the U.S. Environmental Protection Agency (EPA) Unregulated Contaminants Monitoring Rule (UCMR) program efforts, including the recently-completed third-round (UCMR-3) and the upcoming fourth-round (UCMR-4). The potential presence of CECs in the Clackamas River also needs to be better understood.

As part of UCMR-3, Oregon City and West Linn were required to perform testing for List 1 contaminants at the entry points of their distribution systems (SFWB's connection to each City) and at a point considered to have the maximum residence time. Table 2-3 summarizes preliminary results from testing and relates them to what has been observed on the regional (Oregon and Washington) level.

Table 2-3. Comparative Preliminary UCMR-3 Testing Results from Pacific Northwest and Oregon City/West Linn

List 1 Contaminants	Method Reporting Limit	Number of Results in OR/WA	Number of Detects in OR/WA	% Detects in OR/WA	Range of Detects in OR/WA (ųg/L)	Range of Detects in Oregon City/ West Linn (µg/L)
1,1-dichloroethane	0.03	850	1	0.1%	0.036	-
1,2,3-trichloropropane	0.03	850	-	-	-	-
1,3-butadiene	0.1	850	-	-	-	-
1,4-dioxane	0.07	858	12	1.4%	0.07–0.28	-
bromomethane	0.2	850	-	-	-	-
chlorate	20	1,517	750	49.4%	20–3,000	34–71
chloromethane	0.2	850	7	0.8%	0.2–2.2	-
chromium	0.2	1,515	648	42.8%	0.2–55	0.2–0.28
chromium-6	0.03	1,517	1,205	79.4%	0.03–4.0	0.065–0.23
cobalt	1	1,518	2	0.1%	1.8–1.9	-
Halon 1011	0.06	850	3	0.4%	0.087–1.0	-

Table 2-3. Comparative Preliminary UCMR-3 Testing Results from Pacific Northwest and Oregon City/West Linn

List 1 Contaminants	Method Reporting Limit	Number of Results in OR/WA	Number of Detects in OR/WA	% Detects in OR/WA	Range of Detects in OR/WA (ųg/L)	Range of Detects in Oregon City/ West Linn (µg/L)
HCFC-22	0.08	850	13	1.5%	0.088–0.67	-
manganese	1	127	60	47.2%	1–820	
molybdenum	1	1,518	274	18.1%	1–13	-
PFBS	0.09	866	-	-	-	-
PFHpA	0.01	866	3	0.3%	0.013–0.026	-
PFHxS	0.03	866	2	0.2%	0.20–0.24	-
PFNA	0.02	866	2	0.2%	0.027–0.028	-
PFOA	0.02	866	5	0.6%	0.02–0.03	-
PFOS	0.04	866	2	0.2%	0.51–0.60	-
strontium	0.3	1,514	1,509	99.7%	0.9–531	29–54
vanadium	0.2	1,518	1,270	83.7%	0.2–41.9	1.0–2.1

µg/L = micrograms per liter.
OR = Oregon.
WA = Washington.

While there were detects for chromium/chromium-6, chlorate, strontium, and vanadium, the concentrations were well below current health reference levels, and were found commonly by other surface water systems throughout Washington and Oregon.

The proposed UCMR-4 list was published in December 2015, and includes:

- 10 algal toxins
- 2 metals
- 8 pesticides and 1 pesticide manufacturing byproduct
- 3 bromated haloacetic acid groups
- 3 alcohols
- 3 additional semi-volatile chemicals

The topic of algal toxins resulting from harmful algal blooms (HABs) of blue-green algae has been long-studied and monitored in the Pacific Northwest. Portland General Electric (PGE) and the Clackamas River Providers routinely monitor for blue-green algae activity in the watershed. Throughout the summer of 2015, over 40 samples were taken and analyzed for four commonly-found algal toxins resulting from HABs. Over 95 percent of the samples returned with non-detectable levels of algal toxins, but there were six low-level detects (< 1 parts per billion [ppb]) of Anatoxin-a and one of Microcystin-LR. Of the seven detects, five were at the North Fork Reservoir and two were at the Lake Oswego raw water intake. The OHA health advisory guidelines for cyanotoxins[1] in Oregon recreational waters are:

- Anatoxin-A < 20 ppb
- Cylindrospermopsin < 20 ppb
- Saxitoxin < 10 ppb
- Microcystin < 10 ppb

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[1] Public Health Advisory Guidelines for Harmful Algae Blooms in Freshwater Bodies. Oregon Health Authority - Public Health Division Center for Health Protection. May 2016.

The levels of algal toxins and algal cells recently observed in the Clackamas River can be handled by the SFWB WTP processes. However, long-term planning should incorporate additional barriers for algal toxins and other CECs to ensure SFWB will be able to continue to provide high quality drinking water for its customers. It should be noted that while the use of free chlorine is effective to oxidize most cyanotoxins, it is relatively ineffective on Anatoxin-a. One of best available treatment (BAT) technologies for Anatoxin-a and other cyanotoxins is ozonation. Other highly effective treatment technologies include activated carbon (powdered and granular), and enhanced ultraviolet (UV) irradiation with addition of peroxide (or chlorine).

2.5 Evaluation of Existing WTP Facilities

The major WTP facilities and structures include the following:

- 27-inch-diameter raw water pipeline from the intake.
- 30-inch-diameter finished water transmission pipeline to DSPS.
- 24-inch-diameter “Pipeline B,” which is an intertie with the NCCWC WTP and Pump Station.
- Pipeline “B” Pump Station.
- 42-inch-diameter finished water transmission pipeline to Oregon City and CRW-S via Hunter Street Pump Station.
- Raw water magnetic flowmeter.
- Finished water magnetic flowmeter.
- Operations building (headhouse).
- One pumped diffusion rapid mixer.
- Two flocculation/sedimentation basins, each with baffled hydraulic flocculation using wooden baffle walls.
- 42-inch-diameter settled water pipeline.
- Four dual cell, gravity, constant-rate filters, each containing approximately 38 inches of dual media.
- A backwash supply pump.
- 0.2 MG “under-filter” clear well, 0.6 MG circular, concrete treated water reservoir, and a new 2 MG concrete, rectangular reservoir. This finished water storage system is capable of meeting the current and future disinfection (CT) requirements of the WTP for the full 52 mgd capacity during summer months when highest demands are experienced.
- Chemical storage and feed systems for liquid sodium hypochlorite (using an onsite generation system with stored salt in a brine solution), liquid alum, liquid cationic polymer, dry soda ash and dry polymer for a filter aid.
- Two washwater/sludge lagoons with a transfer pump station and decant recycle pumps; the recycle flow is returned to the rapid mix influent box.
- 8-inch-diameter recycled water pipeline from sludge lagoons.
- 8-inch-diameter sludge pipeline from sedimentation basins.

Also included in the operations building are the supervisory control and data acquisition (SCADA) control and monitoring system, a water quality laboratory for treatment process monitoring and control, an office/administrative space, and a conference room.

Chapter 5 of the 2010 WTP facility plan reviewed all of the plant systems, structures, and functions and determined that all structural, mechanical, electrical, and control systems were in good-to-moderate condition, and have significant remaining useful life. Some minor repairs and improvements should be made as part of the plant capacity expansion to 30 mgd. The existing electrical system is considered "at capacity" and any new power loads will require an upgrade to the existing PGE power supply system. A second power supply/feed may be appropriate to serve the new systems to be added as part of the expansion to 30 mgd.

Currently, not much has changed since the detailed inspections and evaluations were conducted in 2009/2010, except that now everything is 6 to 7 years older. Recent developments in regional seismic risk analysis suggest that the SFWB WTP is more at risk of catastrophic failure from a severe earthquake, such as from the Cascadia Subduction Zone.

Even though many of the existing WTP structures and systems are almost 59 years old, the major process structures have significant remaining useful life as follows:

- Flocculation/sedimentation basins = 15 to 30 years
- Granular media filters, headhouse, and Clear Well 1 = 30 to 50 years
- Filter backwash/solids drying ponds and transfer pump station = 15 to 30 years
- Clear Well 2 = 30 to 50 years
- Clear Well 3 = 75 to 100 years

The four items should be given serious consideration by the Board as improvement plans and costs are being developed include:

1. The SCADA and control systems are outdated
2. The liquid alum storage system is old/failing
3. The liquid sodium hypochlorite storage system is susceptible to leakage and to violations of the plant's National Pollutant Discharge Elimination System (NPDES) permit
4. A new carbon dioxide storage and feed system to provide treatment and water quality benefits

The aging liquid alum storage tank has had numerous leaks and is now considered at the end of its useful life. The "make-shift" spill containment around the tank is inadequate and cannot be expected to serve a long life. The tank needs to be replaced with a new storage system that meets all current health and safety codes.

The sodium hypochlorite system is over 15 years old, is located in the front of the plant, and is atop an old pipeline that used to drain waste washwater and sludge back to the Clackamas River. If the liquid hypochlorite tank were to fail or be damaged, the liquid contents would enter the pipeline and then discharge to the river, which could cause a variety of problems, including potential fish kills. The minimal containment system is inadequate for spill/leak control.

The addition of a CO_2 system will allow the WTP to precisely control its finished water pH and alkalinity on a daily basis to provide optimal corrosion control. CO_2 can also help improve coagulation with alum (especially during the summer months when raw water pH experiences diurnal swings), which will lower alum usage and lower solids production. As such, the use of CO_2 can reduce overall treatment costs.

These three chemical system issues – alum, sodium hypochlorite, CO_2 – suggest that the Board consider construction of a new Chemical Building as presented in the 2010 WTP facility plan. It was anticipated then that the new Chemical Building would be constructed as part of the 30 mgd plant expansion, but the expansion was not completed, as explained above. The Board may choose to accelerate the new Chemical Building in advance of the plant expansion project to address the three chemical system issues. The Chemical Building is recommended as a high priority project by this master plan update.

2.6 Review of Alternative Treatment Trains

The SFWB WTP is a conventional granular media filtration plant that has successfully treated Clackamas River water for almost 59 years. The plant's recent historical performance has demonstrated its ability to treat water to potable standards over a wide range of water quality conditions. The plant produces high-quality treated water at a very reasonable cost and has been demonstrated to be simple and reliable to operate. Because the SFWB WTP has conventional flocculation/sedimentation basins, it is better equipped to handle the seasonally-variable raw water turbidity compared to other neighboring municipal WTPs that treat water from the lower Clackamas River.

2.6.1 Treatment Processes

The 2010 WTP facility plan evaluated alternative treatment process technologies to expand/upgrade the existing plant. The plan recommended the continued use of granular media filtration instead of newer filtration technologies such as low-pressure membrane filtration (LPMF) due to the following considerations:

- The existing process structures have significant remaining useful life
- The existing plant has a long history of successful performance using granular media filtration
- There are no significant proposed changes to drinking water regulations that would suggest using a different primary treatment process train

Additionally, it was demonstrated that converting the existing plant to LPMF would be very expensive compared to remaining a conventional filtration plant. Therefore, it was recommended that plant expansions should continue to use clarification ahead of granular media filters. This will be a less-costly and more-prudent approach than installing a new LPMF system.

Significant water quality and regulatory issues that would possibly require enhanced treatment relate to the potential presence of trace organic compounds in the Clackamas River supply, including:

- Taste and odor (T&O) compounds produced from algal activity
- Algal toxins
- CECs, such as pharmaceuticals and personal care products (PPCPs), endocrine disruptors (EDCs), and other related compounds

The Clackamas River experiences infrequent, seasonal T&O events (caused by the presence of methylisoborneol [MIB] and/or geosmin) that have caused customer complaints. These events usually occur in August and September when temperatures are warm, river flows are low, and the potential for algal growth is at its highest. SFWB does not have treatment processes that can effectively remove the low-concentration and problematic T&O compounds including MIB and geosmin. A strong oxidizer, such as chlorine dioxide or ozone, and/or an adsorbent such as granular activated carbon (GAC) or powdered activated carbon (PAC), is required to remove these compounds.

As noted above, there have been reported cases of elevated concentrations of algal toxins in Pacific Northwest surface water supplies, including limited detects in the Clackamas River. There is the potential for PPCPs, EDCs, and related compounds to be present in any surface water supply that receives discharges from wastewater treatment plants, stormwater from urban and agricultural areas, and/or is close to high concentrations of human activity. These compounds are not currently regulated in municipal drinking water standards, but there is the potential for future maximum contaminant levels (MCLs) to be established.

Therefore, it was recommended in 2010 - and is recommended in this update – that SFWB modify its conventional treatment process in the future to address these trace organic compounds including:

- Installation of GAC filter media (to replace the anthracite media) to adsorb T&O and other organic compounds
- Installation of intermediate ozonation to oxidize/alter organic compounds

A process flow schematic and photographic examples for an ozone system and its components are shown in Figures 2-12 and 2-13.

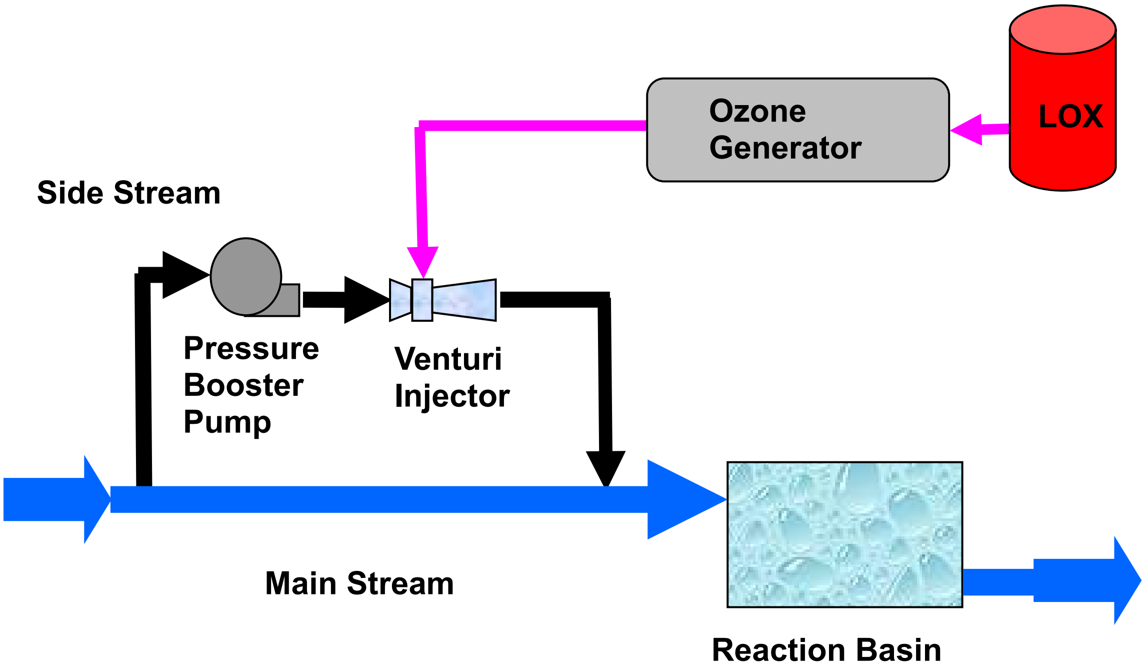
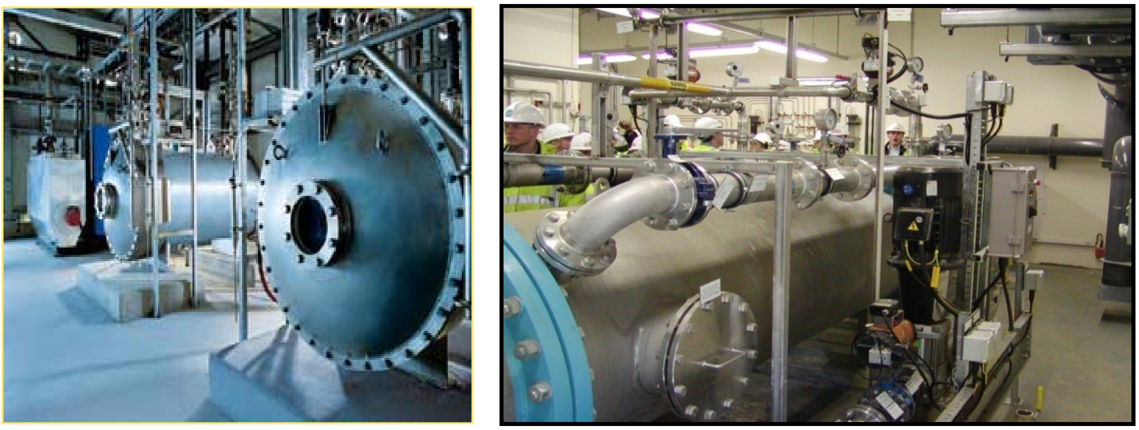
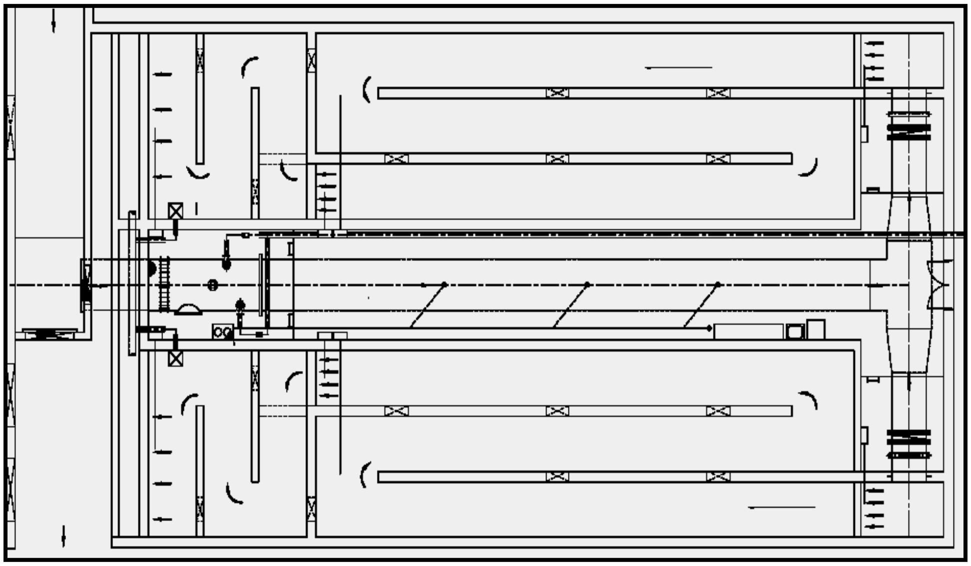


Figure 2-12. Schematic of an Ozone Injection System



Ozone Generators **Sidestream Ozone Injector**



Ozone Contact Basin Plan View

Figure 2-13. Photographs and Graphic of Ozone System Components

The recently upgraded and expanded Lake Oswego-Tigard WTP (38 mgd) includes intermediate ozonation and GAC filter media to address multiple water quality challenges that can occur in the Clackamas River. The 15 mgd Willamette River WTP in Wilsonville (commissioned in 2002) also uses intermediate ozonation and GAC filter media, and a planned expansion to 60 mgd for the Willamette River Supply Partners will continue to use these processes for optimized control of a number of organic contaminants.

There are no apparent reasons to deviate from the major recommendations of the 2010 WTP facility plan. Continued use of conventional clarification, supplemented with intermediate ozonation and GAC filter media, is still the recommended treatment process train for expansion and upgrades to the SFWB WTP.

2.6.2 Solids Handling Processes

The 2010 WTP facility plan recommended significant upgrades to the plant's solids handling and dewatering systems as part of the 20-year improvement program. Currently, solids produced by the plant, which consist primarily of suspended solids/turbidity removed from the Clackamas River supply, are dried in one of the two onsite backwash clarification ponds and then spread on the southeast part of the plant property. This is a low-cost disposal method because the dried solids are relatively inert and nonhazardous. However, the plant cannot continue to dispose of solids this way for the long-term, when greater volumes of solids are produced as a result of treating more water as the service area's water demands increase. Therefore, the SFWB needs to prepare to haul the dried solids offsite for disposal at a landfill or at another legal disposal site.

In order to achieve a high-solids content material that can be legally hauled and disposed of, a new solids dewatering technology should be added at the WTP. The current technology (drying ponds) would be very space intensive to achieve the required high-solids content for future conditions. The 2010 WTP facility plan recommended preparing for the addition of thickeners and mechanical dewatering equipment to be housed inside a new building. This approach helps minimize the required footprint for new facilities. Of the alternative solids dewatering equipment evaluated, it was suggested that SFWB consider the use of centrifuges. Figure 2-14 includes example photographs of a centrifuge and a thickener.

Figure 2-14. Example Photographs of a Centrifuge Dewatering Unit (left) and an Empty Gravity Thickener (right)

Since 2010, there have been advances in solids dewatering technologies for alum-based solids and use of screw presses may present lower capital and O&M costs compared to centrifuges. Screw presses have recently been installed at the Lake Oswego-Tigard WTP and at the Green River Filtration Facility in Tacoma, Washington. Figure 2-15 includes example photographs of a screw press. An overall solids handling process flow schematic is presented in Figure 2-16. As dewatering technology will continue to advance, and opportunities may develop that will allow beneficial use of the solids besides landfilling, SFWB intends to implement the best available technology when the project is needed.

Figure 2-15. Screw Press Photographs

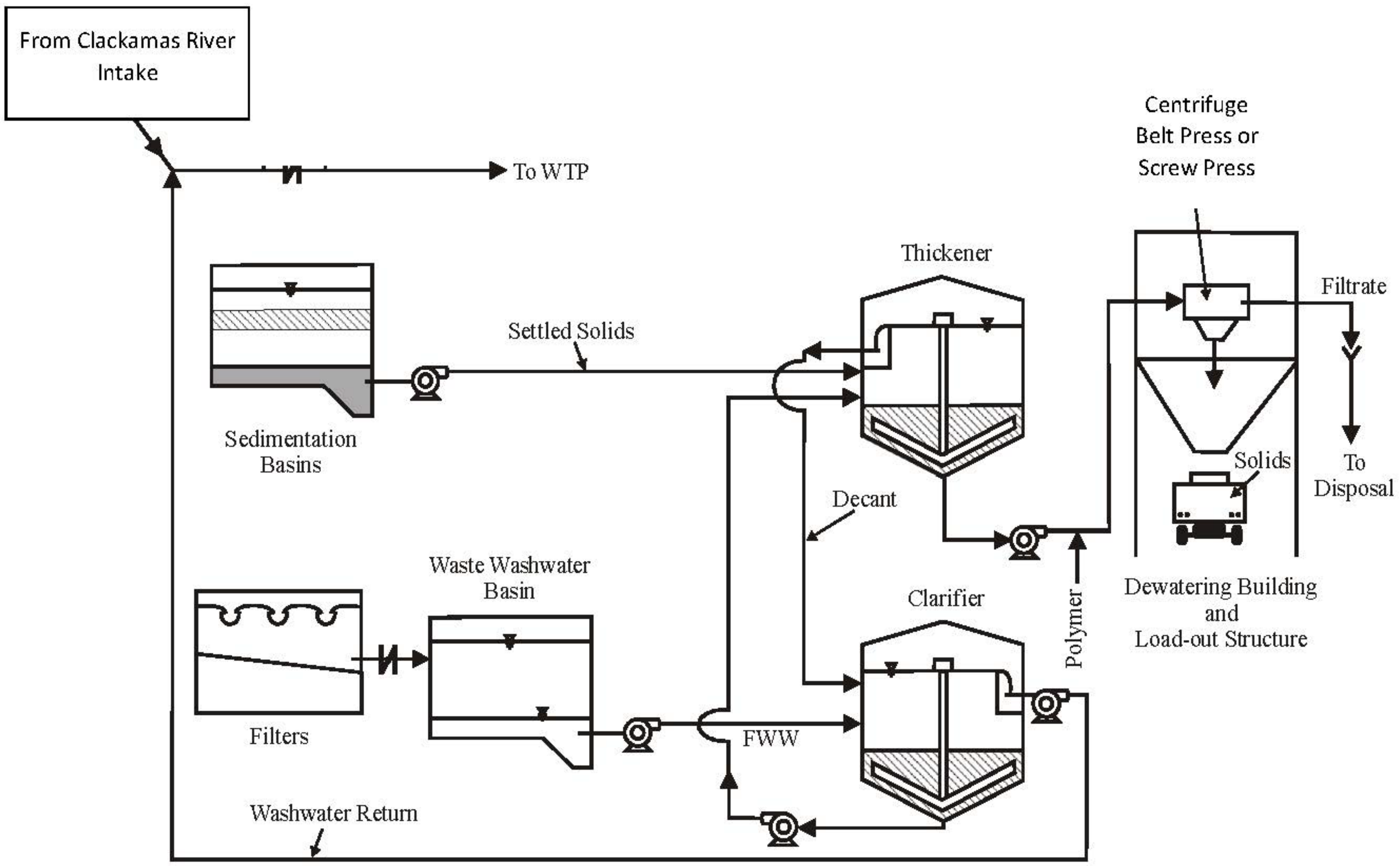


Figure 2-16. Solids Handling Diagram for Mechanical Dewatering System

2.7 Recommended WTP Expansion Layouts

Figures 2-17 and 2-18 indicate the recommended site layouts for expansion of the SFWB WTP to 30 mgd and 40 mgd, respectively. These are similar layouts prepared for the 2010 WTP facility plan, but intermediate ozonation has been accelerated from the 40 mgd layout to the 30 mgd layout. This change was made at the direction of the Board at the July 2016 meeting. Both of these expansions were recommended in the 2010 plan to be completed within the 20-year CIP. The 40 mgd site layout is what was used for the site master plan that was approved by the Oregon City Planning Department in 2011.

Figure 2-19 presents a potential site layout for expansion of the SFWB WTP to the ultimate 52 mgd capacity. This master plan update anticipates that this plant expansion will occur after the 20-year planning horizon. Because an expansion to 52 mgd was outside the 20-year planning horizon, it was not included as part of the Conditional Land Use approval by Oregon City in 2011.

Other significant improvements/upgrades to the plant that are recommended in the 20-year CIP, and are included in the plant layouts, are as follows:

- A new chemical storage/feed building to remove chemicals from the existing headhouse area
- A new, second power supply for the plant to serve additional electrical loads and to provide redundancy
- A standby diesel generator to allow continued production of treated water during an extended power outage

Due to the recent challenges with the existing liquid alum storage tank and the sodium hypochlorite systems, and the recommendation to add a new CO_2 storage and feed system, it is reasonable for SFWB to consider constructing a new Chemical Building within the next few years as a stand-alone project, prior to initiating the 30 mgd capacity expansion project.

Capital costs for potential use of solar power (panel technology) are not included in the CIP. Installation of this equipment could potentially be funded by others that would capture financial benefits flowing from the investment.

2.8 Cost Estimate Summaries

Tables 2-4 through 2-6 present the estimated project costs for the recommended plant improvements over the 20-year planning period, which incrementally takes the plant to 40 mgd capacity. Table 2-7 shows the improvement projects that would bring the WTP to its ultimate 52 mgd capacity, but because the improvements will occur outside the 20-year planning period, detailed costs are not included.

Cost estimates were prepared using CH2M's Parametric Cost Estimating System (CPES) and represent Class 5 cost estimates (accuracy +100%, -50%) as defined by the American Association of Cost Engineers (AACE) International Classification System. Project costs include construction costs and an allowance for administrative, engineering, and other project-related costs.

The total estimated project costs for all plant improvements through 2036 is $54.4 million in 2016 dollars. Cost estimates are provided in 2016 dollars at an *Engineering News and Record* Construction Cost Index for Seattle (ENR CCI Seattle August 2016) value of10596.

Table 2-4. Expansion of SFWB WTP to 30 mgd

(With New Flocculation/Sedimentation Basin, Two New Filters, New Ozone System, and New Chemical Building.)[a]

Class 5 Estimate —Project Cost Opinion

Project Construction Components	2016 Cost Opinion
1. Rapid mix/flowmeter vault (connects to new 42" raw water pipe)	$480,000
2. 30" coagulated water pipe to new flocculation/sedimentation basin	$120,000
3. Re-route 8" recycle pipe to upstream of rapid mix vault	$20,000
4. Structural/cosmetic improvements to existing flocculation/sedimentation basins	$120,000
5. Structural/cosmetic improvements to existing headhouse	$120,000
6. New 10 mgd flocculation/sedimentation basin (with sludge collectors)	$3,310,000
7. 36" settled water pipe to ozone basin and filters	$120,000
8. Intermediate ozonation system (1,000 ppd) including contactor and generator/building[b]	$4,820,000
9. Two new filters (896 square feet each, with GAC/sand dual media + air scour)	$3,920,000
10. Modify four existing filters (with GAC/sand dual media + air scour)	$600,000
11. New Chemical Building (alum, cat poly, NaOCl, soda ash/NaOH, CO_2)	$1,800,000
12. Modify headhouse lower level for workshop and storage	$120,000
13. Miscellaneous yard piping	$120,000
14. Site work	$120,000
15. New plant electrical service (located near new Chemical Building)	$240,000
16. Electrical and instrumentation upgrades and modifications	$240,000
Subtotal of Estimated Construction Cost Opinion	**$15,470,000**
Engineering, Construction Management Services, and Administration @ 20%	$3,090,000
Contingencies @ 20%	$3,090,000
Project Cost Opinion	**$21,650,000**

[a] No improvements to backwash ponds or transfer pump station or other solids handling components. Does not include solar panel/sustainable energy improvements.

[b] Assumes that gravity flow from the basins through the new ozone contactors to the filters can be maintained.

ppd = pounds per day.

Table 2-5. Expansion of SFWB WTP to 40 mgd*

(With Two New Flocculation/Sedimentation Basins, and Standby Power)

Class 5 Estimate —Project Cost Opinion

Project Construction Components	**2016 Cost Opinion**
1. Demolish old flocculation/sedimentation basins	$240,000
2. 36” coagulated water pipe to new flocculation/sedimentation basins	$180,000
3. Two new 15 mgd flocculation/sedimentation basins (with plate settlers and sludge collectors)	$6,930,000
4. 42” settled water pipe to filters	$180,000
5. 300 kW diesel generator (inside building) and related electrical modifications	$360,000
6. Miscellaneous yard piping	$120,000
7. Site work	$120,000
8. Electrical and instrumentation upgrades and modifications	$240,000
Subtotal of Estimated Construction Cost Opinion	**$8,370,000**
Engineering, Construction Management Services, and Administration @ 20%	$1,670,000
Contingencies @ 20%	$1,670,000
Project Cost Opinion	**$11,710,000**

*Expandable to 52 mgd. Does not include replacement of GAC/sand media for six filters—this is considered an O&M expense. Does not include solar panel/sustainable energy improvements.

kW = kilowatt.

Table 2-6. New Mechanical Dewatering System at SFWB WTP (for 40 mgd)[a]

(Use Existing Backwash Ponds for Washwater Solids Dewatering)

Class 5 Estimate —Project Cost Opinion

Project Construction Components	**2016 Cost Opinion**
1. Three centrifuges, feed pumps, polymer systems, and other mechanical systems	$1,810,000
2. Two-story centrifuge building (includes HVAC systems, built for addition of future equipment)	$1,810,000
3. Two 25-foot-diameter thickeners	$720,000
4. Thickened sludge pump station	$360,000
5. One 100,000-gallon thickened solids holding tank, mixers, and support systems	$300,000
6. Re-line existing backwash ponds and replace transfer pumps	$360,000
7. Yard piping	$120,000
8. Site work	$120,000
9. Electrical and instrumentation for mechanical dewatering systems (15%)	$900,000
Subtotal of Estimated Construction Cost Opinion	**$6,980,000**

Table 2-6. New Mechanical Dewatering System at SFWB WTP (for 40 mgd)[a]
(Use Existing Backwash Ponds for Washwater Solids Dewatering)
Class 5 Estimate —Project Cost Opinion

Project Construction Components	2016 Cost Opinion
Engineering, Construction Management Services, and Administration @ 20%	$1,396,000
Contingencies @ 20%	$1,396,000
Project Cost Opinion	**$9,772,000**

[a]Expandable to 52 mgd.

Table 2-7. Expansion of SFWB WTP to 52 mgd
(Upgrade Flocculation/Sedimentation Basins, Upgrade Ozone System, Two New Filters, Upgrade Mechanical Dewatering)
List of Project Components Required for Expansion to 52 mgd

Project Construction Components	2016 Cost Opinion
1. Additional plate settlers to flocculation/sedimentation basins	
2. Two new filters (896 square feet each, with GAC/sand dual media + air scour)	
3. New ozone generator including miscellaneous system upgrades	
4. Dewatering system upgrade	
5. Miscellaneous yard piping	
6. Site work	
7. Electrical and instrumentation upgrades and modifications	
Project Cost Opinion	$12,000,000

2.9 Next Steps

Assuming that the Board decides that the plant should have the expanded 30 mgd capacity available by the summer of 2022, the preliminary design of the expansion project should begin not later than early 2018 to allow adequate time for planning, design, and construction. The proposed new 42-inch-diameter raw water pipeline should be completed prior to 2018, and planning and design should be integrated with the plant’s influent flow control design element.

Should the Board decide to proceed with construction of the new Chemical Building prior to construction of the 30 mgd plant expansion, as recommended, the design should begin in 2017 to allow completion of construction by the end of 2018.

Evaluation of Existing Water Supply and Transmission Facilities

This section presents an evaluation of the existing SFWB water supply and conveyance facilities.

3.1 Flow Demarcations for Analyzing Facilities

Flow demarcations are presented as the basis for analyzing the existing and future functions of the SFWB conveyance and supply facilities. The flow demarcations provide planning goals for future conveyance system and supply capacities. The estimated maximum withdrawal from the Clackamas River from both current and anticipated water use permits and certificates is 80 cubic feet per second (cfs), or 52 mgd. This value is used as the basis for judging individual components of the system. Since it is unlikely that SFWB would expand all of its facilities to 52 mgd in one step, interim levels of 30 mgd and 40 mgd are used for judging the need for system improvements. Table 3-1 summarizes the flow demarcations for this master plan.

Table 3-1. Flow Demarcations for Existing Facilities Evaluation

Flow Demarcation (mgd)	**Capacity Limitation**
30 mgd	Expansion Capacity
40 mgd	Expansion Capacity
52 mgd	Water Use Permits Maximum Withdrawal

mgd = million gallons per day.

3.2 Evaluation of Existing Facilities

The following subsections present the results of an evaluation of SFWB's existing conveyance facilities. The evaluated facilities include the river intake, the vacated river intake, the RWPS, the raw water transmission main, the DSPS, the finished water transmission main, finished water storage, and metering facilities. Figure 3-1 shows the locations of the SFWB water facilities and the conveyance system layout. Figure 3-2 shows the system schematically.

3.2.1 River Intake

The existing raw water intake, located at Clackamas River Mile 1.7, diverts water from the river to the raw water pumping station. The intake and the RWPS were constructed in 1996, and the intake is equipped with fish screens to prevent the entrance of juvenile fish, trash, and debris into the intake pumps. The approximate gross area of the fish screen is 205 square feet. It was designed to pass a maximum flow of 82 cfs (52 mgd) while meeting the regulatory requirements for juvenile fish passage as mandated by the National Oceanic and Atmospheric Administration Fisheries (NOAA Fisheries) and the Oregon Department of Fish and Wildlife (ODFW) at the time of design. NOAA Fisheries and ODFW required that the maximum uniform approach velocity of water through an active (self-cleaning) intake is 0.4 feet per second, with a slot size of not more than 1.75 millimeters.

The river intake should be capable of withdrawing the MDD from the Clackamas River, at a minimum. Since the river intake, based on current federal and state regulations, has been constructed to operate at a 52 mgd capacity, no improvements to or modifications of the facility are anticipated through the

52 mgd flow limit. If more stringent fish passage or fish protection regulations are adopted by NOAA Fisheries or ODFW in the future, these regulations could limit the withdrawal capacity of the existing intake structure. It is recommended that SFWB continue its current practice of periodically reviewing the updated NOAA Fisheries and ODFW regulations and assessing their impact. No changes to the current rule are proposed at this time.

3.2.2 Vacated River Intake

SFWB currently owns the intake and intake RWPS that was used before the new intake was constructed in 1996. This old intake is located 500 feet upstream of the 1996 intake and is no longer maintained or in service. The old intake is currently being maintained by SFWB as an emergency standby facility as a backup to the new intake.

Three public agencies established requirements for removal from the river of the old intake and RWPS once the new intake and raw water pumps station were constructed and in use. The three agencies, the Oregon Division of State Lands (DSL), the U.S. Army Corps of Engineers (USACE), and the City of Oregon City, included the requirement as a condition of approval for the construction permit from each agency. Table 3-2 summarizes the requirements.

Table 3-2. Agency Requirements for the Removal of the Vacated Intake*

Agency	Document Reference	Timeframe
Oregon Division of State Lands	Permit Condition No. 9	After the water rights have been transferred to the new intake structure
United States Army Corps of Engineers	Construction Permit	No time requirement
City of Oregon City	Conditional Use Permit Final Order—Condition No. 20	SFWB issued letter stating 30 days after new intake is in operation removal of the old intake needed to commence
City of Oregon City	City Ordinance No. 96-1000 Approved January 17, 1996	Allowed for temporary increase in floodway elevation until old intake is removed

*Summarized from the discussion in the 1997 *Water Master Plan* (Montgomery Watson, 1997).

The old intake's value as a backup facility is only as an emergency pumping station for short durations. Without fish screening meeting the current requirements, it is unlikely that the facility would be allowed to operate for long periods of time. If the current intake or pump station were damaged, emergency pumping facilities could be staged at the current intake location.

SFWB's updated CIP includes a capital project to remove the old intake and RWPS from the Clackamas River as part of the new Raw Water Line Project. As SFWB plans for the removal of the facility, it is recommended to consult with the agencies mentioned in Table 3-2 regarding permitting requirements. Besides the three public agencies listed in Table 3-2, SFWB will also need to consult with the State Historic Preservation Office.

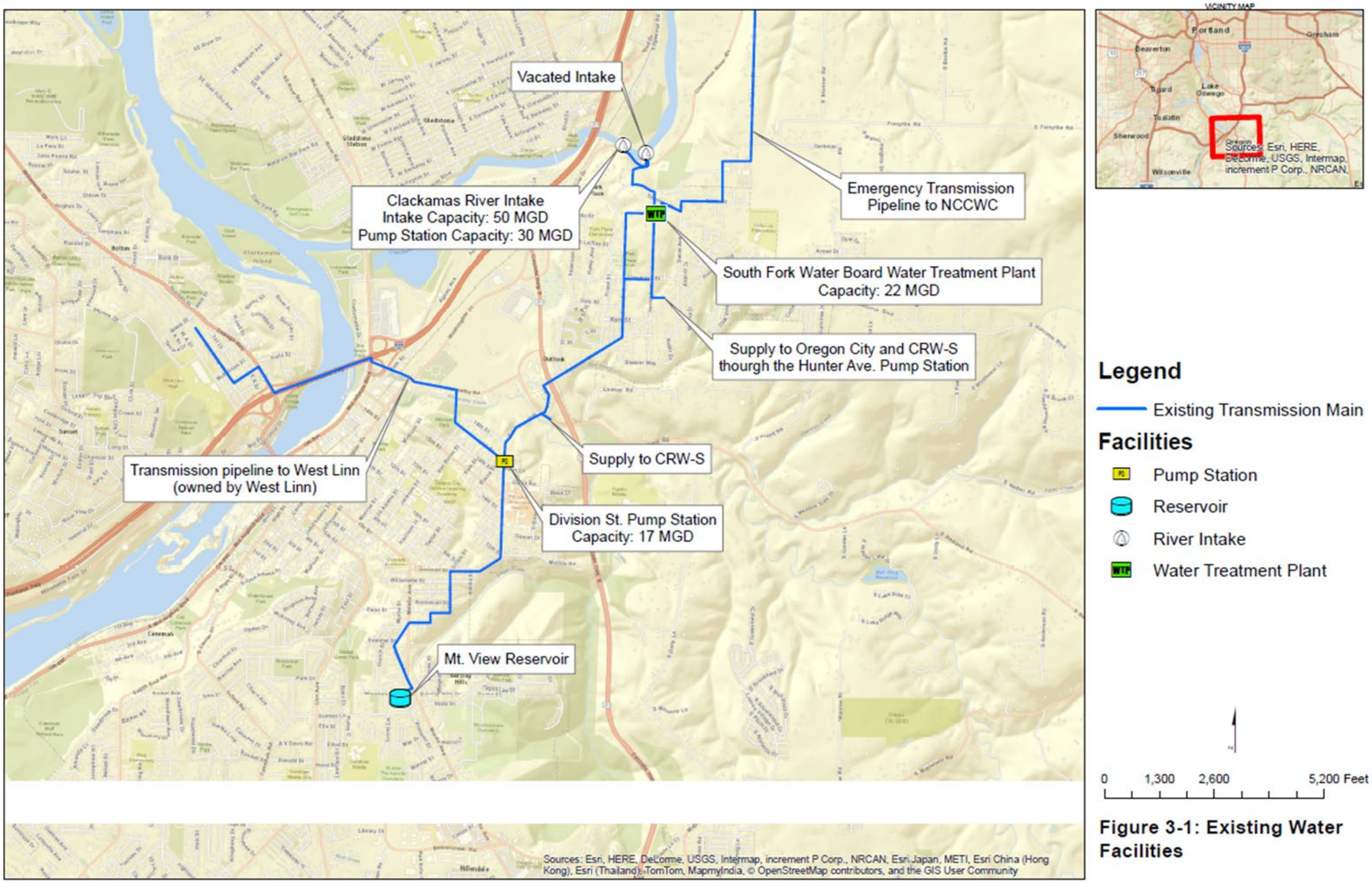


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Figure 3-1: Existing Water Facilities

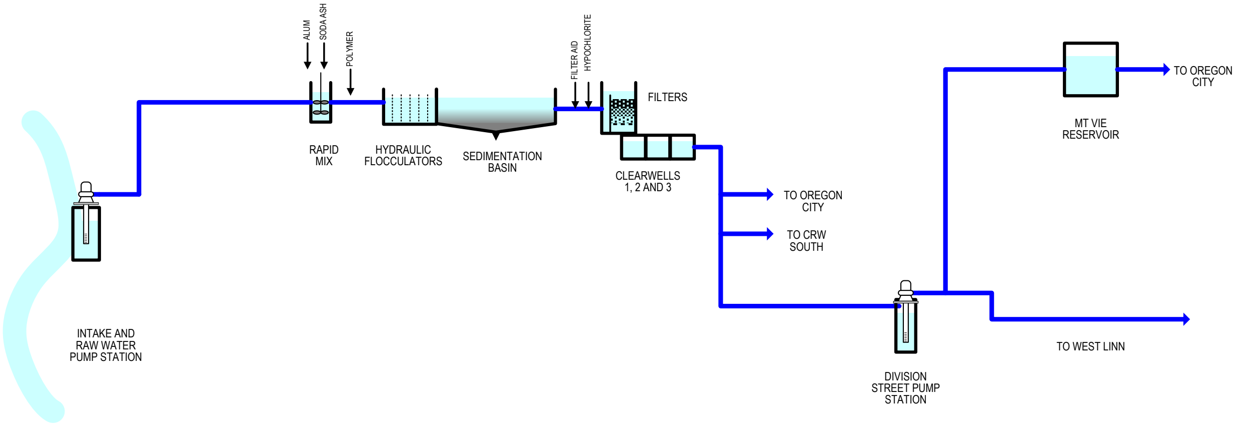

Figure 3-2. Schematic Diagram of South Fork Water Board Supply System

3.2.3 Raw Water Pump Station

The RWPS is contained in the same structure with the river intake. The current firm capacity (the capacity with the largest pump not in service) of the RWPS is approximately 30.8 mgd during low river level conditions. The RWPS can be modified to provide a firm capacity equal to the maximum flow rate of 52 mgd. A 52 mgd capacity could be achieved with additional pumps and modifications to the pump station piping and electrical systems.

The RWPS currently contains the following equipment:

- Two identical constant-speed vertical-turbine pumps, each of approximately 10.65 mgd capacity and driven by an 800 horsepower (hp) electric motor
- One vertical-turbine pump, with a 10.65 mgd capacity, driven by an 800 hp electric motor with variable frequency drive (VFD)
- Two identical constant-speed vertical-turbine pumps, each of approximately 4.75 mgd capacity driven by a 400 hp motor
- A hydropneumatic tank to protect the pump discharge piping from pressure surges caused by the starting and stopping of the pumps from normal operation and during unplanned power failure
- A 3,000-kilovolt-ampere (kVA) primary transformer
- A 3,000-kVA spare transformer (located at the DSPS) in case of emergency failure of the primary transformer
- A manually switched dual primary power supply to the station transformer

The primary and secondary power supplies are provided through two PGE substations and they provide a highly reliable power supply for the facility.

3.2.3.1 Expansion of the RWPS

As future demands increase, the two smaller pumps will need to be exchanged for larger capacity pumps. Two phases are summarized in Table 3-3 for expansion of the RWPS to 40 mgd and eventually to 52 mgd.

Table 3-3. Raw Water Pump Station Expansion Options (mgd)[a]

	Pump Number					Firm Capacity[a]	Total Capacity[b]
	1	2	3	4	5	(mgd)	(mgd)
Current station configuration (30 mgd)	10.65	10.65	4.75	4.75	10.65	30.8	41.5
40 mgd Expansion (Phase 1)—Replace Pumps 3 and 4with a larger pumps	10.65	10.65	15.4	15.4	10.65	47.4	62.8
52 mgd Expansion (Phase 2)—Replace Pump 2 with a larger pump	10.65	15.4	15.4	15.4	10.65	52.1	67.5

[a] The values listed for each pump number represent the pump capacity in mgd.

[b] Firm and total capacities assume a new raw water transmission line is constructed.

As the WTP capacity is increased to 40 mgd, the capacity of the RWPS should be expanded. This will require the addition of two 15.4 mgd pumps in place of the existing 4.75 mgd pumps.

Expansion to provide a firm capacity of 52 mgd will require the addition of a third 15.4 mgd pump in place of one of the 10.65 mgd pumps.

The continued use of variable speed drives on future pumps should be considered. A variable speed pump, operated with the proper control strategy, would provide the ability to target a delivery flow rate to the WTP and the ability to incrementally adjust the flow to a targeted rate. This could minimize problems associated with a sudden increase or decrease in flow through the treatment plant.

A factor influencing the expansion of the RWPS beyond its current capacity is the flow limitation of the existing 27-inch-diameter raw water transmission main, as discussed below. The 27-inch-diameter transmission main is limited to a maximum flow of 22 mgd, and a new pipe will be needed to move higher flow rates to the WTP.

3.2.4 Raw Water Transmission Main

The raw water transmission main connecting the RWPS to the WTP consists primarily of the original pipeline constructed with the vacated intake, with a short pipeline built with the RWPS connecting it to the original pipeline. The original transmission main, approximately 1,800 feet in length from the old intake to the WTP, was constructed in 1959 of 27-inch-diameter steel wire wrapped concrete-cylinder pipe. This main runs south from the old intake up a steep grade between South Clackamas River Drive and Forsythe Road, past Forsythe Road to South Thurman Street, turns southeast and runs along South Thurman Street to Hunter Avenue, turns southerly along Hunter Avenue, and terminates at the WTP. Connected to this main where it crosses South Clackamas River Drive is the newer 42-inch-diameter steel water main that runs approximately 840 feet along Clackamas River Road from the RWPS. This steel transmission main was installed in 1996 with the construction of the current intake and RWPS.

The 27-inch-diameter raw water transmission main, in service over 50 years, has a history of maintenance problems, including failure of the steel wire wrap and pipe wall caused by corrosion and pipe joint leaks possibly attributed to land movement along the pipe located in the steep slope between Clackamas River Drive and the top of the bluff. Replacement of the 27-inch-diameter pipeline with either a 42-inch- or a 48-inch-diameter steel pipeline was recommended as a high priority capital improvement in 2010 SFWB master plan update (CH2M HILL, 2010b).

In addition to the maintenance issues of the old transmission main, there is concern about its vulnerability due to the steep slope in which it is laid. Instability of steep slopes present a greater hazard to a pipeline, especially when construction methods may not have accounted for the instability. Further, if the pipe experiences a break or other type of leak, the leaking water can lead to further damage to the hillside and the pipeline. Further discussion about the reliability of this pipeline is presented in Section 4.

Another concern is that increasing water demands could soon outstrip the capacity of the pipeline. The practical capacity of the 27-inch-diameter pipeline is estimated to be 22 mgd. If water demand increases as projected in Section 1, then the capacity of the pipeline needs to be increased in short order.

Therefore, planning for the construction of a new raw water transmission main in the near future is recommended. A new raw water transmission main should be sized to convey the ultimate flow of 52 mgd, which would require the pipeline to be 42- or 48-inch-diameter. The new main could connect to the end of existing 42-inch-diameter main east of the raw water intake with an alignment to the WTP similar to the 27-inch-diameter main. Alternatively, the new pipeline could follow a route to the west of the existing pipeline connecting the RWPS to the WTP. To determine the alignment and total length of the new transmission main, an alignment study is needed for different alternatives, which evaluates geotechnical issues, such as slope stability, alternative construction methods, costs of construction, and maintenance considerations.

A capital project to evaluate alternative alignments, design, and construct a new raw water transmission main is included in the updated CIP. For capital planning purposes, it is assumed that the new main will be constructed of 48-inch-diameter steel for a total length of 1,800 feet.

3.2.5 WTP Drain

A pipeline from the WTP to the Clackamas River discharges WTP overflow and drains portions of the WTP as necessary for routine maintenance or plant modifications. The pipeline originally drained the plant washwater and sludge before the sludge lagoons were constructed. This pipeline parallels the 27-inch-diameter raw water transmission main with approximately 12 feet of separation, according to SFWB construction record drawings, and was constructed at the same time as the transmission main. From the WTP to Forsythe Road, the drain line is a 30-inch-diameter concrete cylinder pipe. Downstream of Forsythe Road along the slope to the South Clackamas River Drive and beyond to the discharge in the Clackamas River, the pipeline is 18-inch-diameter concrete cylinder pipe.

With an ultimate plant flow of 52 mgd, the drain line may not adequately convey an emergency plant overflow for an extended period of time. Because SFWB has reported no problems with the drain line, from a capacity perspective, the line should continue to serve SFWB through the projected population build-out of both Oregon City and West Linn. However, the 2010 SFWB master plan update (CH2M HILL, 2010b), recommended that the 18-inch-diameter portion of the drain line located on the steep slope adjacent to the raw water transmission main be evaluated for risks associated with the potential for landslide or land movement along the slope.

3.2.6 Finished Water Transmission Mains

Two finished water transmission mains convey water from the WTP to two booster pump stations that serve SFWB customers. A 30-inch-diameter finished water transmission pipeline conveys water from the WTP to SFWB's DSPS. Water is conveyed to Oregon City's Hunter Avenue Pump Station via a 42-inch-diameter finished water transmission pipeline. The finished water transmission system is shown schematically in Figure 3-3.

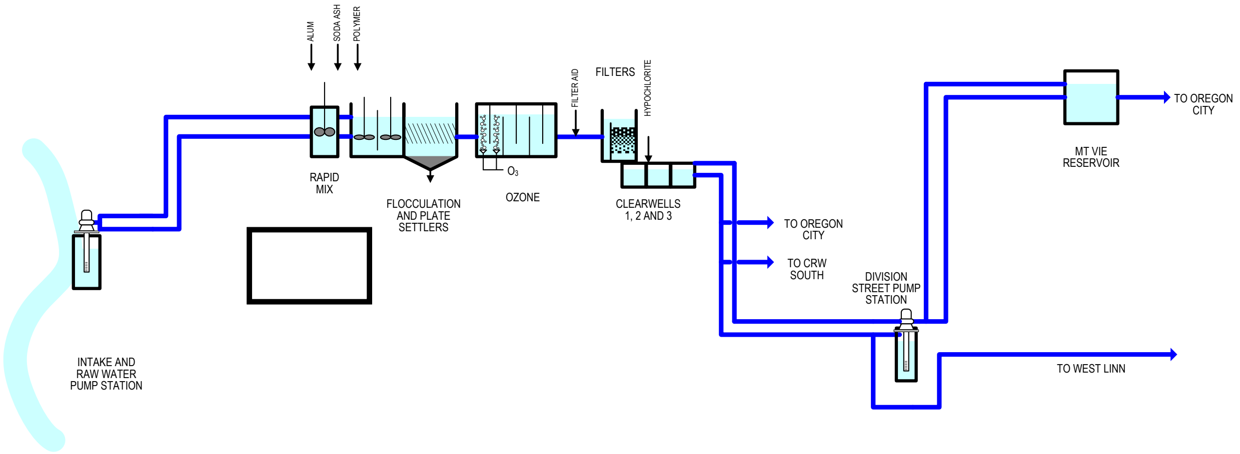

Figure 3-3. Schematic Diagram of SFWB Proposed Finished Water Transmission System

CRW = Clackamas River Water; FWTL = finished water transmission line; OC = Oregon City

3.2.6.1 WTP to the DSPS 30-Inch-Diameter Finished Water Transmission Main

Finished water is conveyed from the WTP to the DSPS via a 30-inch-diameter concrete-cylinder transmission pipeline. This pipeline, constructed in 1958 at the same time as the WTP, is approximately 8,400 feet in length. The transmission main has performed well during its service life with few maintenance problems and no known pipe failures. SFWB installed four isolation valves along the transmission main to allow isolation of segments of the pipeline during maintenance or repair.

There are two service connections off of the 30-inch-diameter raw water transmission main serving distribution systems between the WTP and DSPS. One service connection located near the intersection of Cleveland Street and Hiram Road serves the Park Place area of Oregon City. Fire suppression flow in addition to normal residential and commercial demand is served from this gravity connection. The other service connection at the intersection of Redland Road and Anchor Way, serves CRW-S via the Holly Lane and Redland Pump Stations.

Table 3-4 presents a summary of projected demands to be conveyed through the transmission main. The projected demands listed for Oregon City reflect the higher values shown in Table 1-9, less the demand for the portion of Oregon City served by the Barlow Crest Reservoir through the Hunter Avenue Pump Station. The current and 2030 projected MDDs for the area of Oregon City served through the Hunter Avenue Pump Station are 0.51 mgd and 2.43 mgd, respectively. The projected demands for West Linn are taken from Table 1-9. The combined demand from CRW-S's Holly Lane and Redland Pump Stations at the service connection is estimated as the peak demand of both pump stations: 2,550 gpm or 3.67 mgd. The demand for CRW-S that is wheeled through the DSPS and Oregon City's Mountain View Reservoir is shown as 0.47 mgd. The demands for CRW-S are assumed to remain constant through 2030, consistent with the assumptions stated in Section 1.

The capacity of the 30-inch-diameter finished water transmission main is approximately 21.9 mgd. This flow limitation primarily causes suction side pressure reductions at the DSPS. Flow rates in excess of 21.9 mgd may cause pump cavitation as a result of head loss in the existing 30-inch-diameter finished water transmission line.

Table 3-4. Projected Demands Served Through Finished Water Transmission Main (mgd)

	Year					
Demand Source	**2016**	**2021**	**2026**	**2031**	**2036**	**2066**
Oregon City MDD, excluding Barlow Crest Reservoir Zone[a]	10.9	12.7	14.6	17.0	19.6	39.3
West Linn MDD	8.7	9	9.4	9.8	10.1	10.1
CRW-S MDD through Redland Road and Anchor Way Service Connection[b]	3.6	3.9	4.1	4.4	4.7	6.5
CRW-S MDD Wheeled through Oregon City's DSPS and Mountain View Reservoir[c]	0.5	0.5	0.5	0.6	0.6	0.8
Finished Water Transmission Main Demand Projection						
Finished Water Transmission Main Total Demand with Service to CRW-S through Oregon City	20.1	22.2	24.5	27.3	30.3	50.3

[a] Excludes the current and projected demands as documented in Oregon City's 2013 *Water Distribution Master Plan* (West Yost Associates, 2013) for the portion of Oregon City served by the Barlow Crest Reservoir and the Hunter Avenue Pump Station.

[b] Assumes CRW system is not constructed

[c] Assumes no change in demand from the current use for CRW-S.

As shown in Table 3-4, more capacity for finished water transmission will be needed before 2021. This improvement can be primarily accomplished by connecting a 42-inch-diameter finished water transmission line from the WTP to the DSPS. The transmission improvements can be completed over time, with the first segment connecting the existing 42-inch-diameter pipeline on Hunter Avenue to the existing 30-inch-diameter finished water transmission line. Improvements that provide additional transmission capacity to the DSPS are described below in Section 3.2.6.2.

3.2.6.2 WTP to Hunter Avenue Pump Station: 42-Inch Finished Water Transmission Main

In 2000, a 42-inch-diameter transmission main was installed from the WTP to and in conjunction with construction of Oregon City's Hunter Avenue Pump Station. The main connects to the 30-inch-diameter finished water transmission pipeline downstream of the plant effluent meter and extends south about 2,000 feet within the Hunter Avenue right-of-way to the Hunter Avenue Pump Station. The firm capacity of the pump station is 1,800 gpm (2.6 mgd) and the pump station is the only demand served from the pipeline, leaving capacity available for additional finished water transmission.

Extension of the 42-inch-diameter main will become necessary as the capacity of the 30-inch-diameter main is reached due to increasing demand from Oregon City and West Linn or if industrial demands are added to the system. If CRW-S continues to be served from the Redland Road and Anchor Way connection at the current flow rates in addition to water pumped through the DSPS to the Mountain View Reservoir, the capacity of the 30-inch-diameter finished water transmission main could be reached by 2021, as described in the previous section. Extending the 42-inch-diameter main from the Hunter Avenue Pump Station to Redland Road and Anchor Way will provide additional flows for the service area, and the service connection for CRW-S would be connected to the new main. The new main would extend south along Hunter Avenue, then would run southwest along Holcomb Road and parallel the 30-inch-diameter finished water main to the CRW-S service connection for an approximate total distance of 4,500 feet.

This pipeline would provide adequate finished water transmission through both the 20-year and the 50-year planning horizons.

3.2.7 Division Street Pump Station

The DSPS is located in Oregon City north of the intersection of 16th Street and Division Street. The pump station is supplied water from the 30-inch-diameter WTP to DSPS transmission main and water is pumped via a 24-inch-diameter transmission main to the Mountain View Reservoir and via a 24-inch-diameter supply transmission main to West Linn. The operation of the DSPS is controlled through the WTP SCADA system by the water level in the Mountain View Reservoir. The pump station was upgraded in 1996 and has a current firm capacity of approximately 17.6 mgd. Capacity limitations in the 30-inch finished water transmission main can limit the pump station capacity.

The DSPS currently has the following features and contains the following equipment:

- The pump station building is reinforced-concrete construction
- The pump station site, owned by SFWB, is approximately 0.29 acre
- Three identical vertical-turbine pumps, 5,500-gpm (8 mgd) nominal capacity, each driven by a 600 hp electric motor. One of these pumps has a variable frequency drive.
- A 24-inch sonic flow meter on the discharge header
- Two hydropneumatic tanks—one connected to the suction header and the other connected to the discharge header—to protect the piping from pressure surges caused by the starting and stopping of pumps from normal operation and during unplanned power failure
- A normally-closed transfer valve that connects the suction and discharge headers and that allows the backfeeding of Mountain View Reservoir water to the WTP clear well
- A 3,000-kVA primary transformer located onsite as part of an electrical substation with capacity to supply power for pumping rates over 50 mgd
- A 3,000-kVA spare transformer available for use as a backup transformer for the DSPS or the RWPS
- A secondary power supply system allowing for pump station expansion to approximately 32 mgd

The primary and secondary power supplies are provided from two PGE substations and they provide a highly reliable power supply for the facility.

A pressure control station is located across Division Street from the pump station on the West Linn supply transmission main. The station limits the pressure on the supply main when the pump station is operating to prevent high pressures in West Linn's gravity system.

3.2.7.1 Expansion of the DSPS

The DSPS supplies water to meet the demands of the growing population of Oregon City, West Linn, and CRW-S. Table 3-5 shows the current demands served by the DSPS and the future demands projected to the year 2023 to be served by an expanded facility. The components of current and projected flows shown in the table are described as follows:

- Oregon City MDD—the total MDD for Oregon City as projected in Section 1.
- Oregon City MDD through the Hiram Avenue and Cleveland Street Service Connection—a portion of Oregon City's demand that is served directly from the WTP to DSPS transmission main. This demand is subtracted from the total Oregon City current and projected demands.
- Oregon City MDD through the Hunter Avenue Pump Station—a portion of Oregon City's demand that is served through the 42-inch-diameter transmission main and the Hunter Avenue Pump Station. This demand is subtracted from the total Oregon City current and projected demands.

- CRW-S MDD wheeled through Oregon City's DSPS and Mountain View Reservoir—a portion of the total CRW-S demand that is wheeled through Oregon City's upper distribution system pressure zones.
- West Linn MDD—the total MDD for Oregon City as projected in Section 1.

Table 3-5. Projected Demands Served through the Division Street Pump Station (mgd)

	Year					
Demand Component	**2016**	**2021**	**2026**	**2031**	**2036**	**2066**
Oregon City MDD, except Barlow Crest Zone	10.9	12.7	14.6	17.0	19.6	39.3
Oregon City MDD through the Hiram Avenue and Cleveland Street Service Connection[a]	(0.3)	(0.3)	(0.4)	(0.4)	(0.5)	(1.0)
Oregon City MDD through the Hunter Avenue Pump Station[a]	(0.8)	(0.9)	(1.0)	(1.2)	(1.4)	(2.7)
CRW-S MDD Wheeled through Oregon City's DSPS and Mountain View Reservoir[b]	0.5	0.5	0.5	0.6	0.6	0.8
West Linn MDD	8.7	9	9.4	9.8	10.1	10.1
Division Street Pump Station Demands						
Demand through Division Street Pump Station with Service to CRW-S[c]	19.0	21.0	23.1	25.7	28.5	46.6

Current demands supplied through the DSPS exceed its firm capacity of 17.6 mgd. Expansion of the facility will be necessary to increase firm capacity for current and anticipated future demands.

Expanding the capacity of the DSPS would entail extending the pump station building to the east. This would provide room to add two additional nominal 8-mgd pumps, the same size as the existing pumps and increase the nominal firm capacity in two phases to 24 mgd and 32 mgd, respectively. The 1996 upgrade to the facility provided the discharge piping and electrical system with sufficient capacity to allow expansion to 32-mgd.

The projected demand through the pump station is estimated to be 28.5 mgd by 2036, as shown in Table 3-5. By adding another pump, the station could supply the projected demand for Oregon City, West Linn, and CRW-S through the year 2036.

The ability to expand the firm capacity of the DSPS beyond the current capacity is limited by pressure on the suction side of the DSPS. As discussed in the previous section, the capacity of the 30-inch-diameter transmission main is estimated to be 21.9 mgd, beyond which it adversely affects pump station performance. Any demand placed on the transmission main beyond the 21.9 mgd capacity, such as an increase in demand from CRW-S, from Oregon City at the Hiram Avenue and Cleveland Street service connection, or from an expansion to the DSPS, will require an extension of the 42-inch-diameter transmission main to increase the conveyance capacity to the DSPS.

Expansion of the DSPS from the current capacity will also require a new transmission main between the pump station and the Mountain View Reservoir. The new main would parallel the existing 24-inch-diameter transmission pipeline that currently serves the reservoir and would increase the conveyance capacity from the DSPS. The DSPS to Mountain View Reservoir transmission main is discussed in the next section. Expansion of the pump station and adding transmission capacity to meet with project demands is included in the CIP.

3.2.8 Finished Water Transmission Main—DSPS to the Mountain View Reservoir

The transmission main that delivers finished water from the DSPS to Oregon City's Mountain View Reservoir is a 24-inch-diameter concrete-cylinder pipeline. The pipeline is approximately 7,800 feet in length and was constructed in 1959 This main has served SFWB well with few maintenance problems reported by SFWB staff.

The transmission main has a capacity from DSPS to the Mountain View Reservoir of 18 mgd under the current pumping head. With the 1996 upgrades to the pump station, the transmission main experiences 100 feet of head at the Mountain View Reservoir and 400 feet of head at the pump station. With this pressure, the working pressure limit of the pipeline is being approached. Basically, any increase in the DSPS capacity, with or without service to CRW-S, will exceed the capacity of the DSPS to Mountain View Reservoir transmission pipeline. As mentioned in the previous section, expanding the capacity of the DSPS to 28 mgd is needed.

A new transmission main, parallel to the existing main, to increase conveyance capacity to the Mountain View Reservoir will need to be constructed when the capacity of the DSPS is expanded. Paralleling the 7,800 feet of existing 24-inch-diameter main with a new 30-inch-diameter main and using the pipelines in combination would allow an ultimate flow from the DSPS of 32 mgd at peak day. For the purpose of this analysis, it is assumed that the transmission line will need to be expanded to allow West Linn to store water in Mountain View Reservoir, when needed.

Capital projects to conduct a condition assessment of the existing transmission main and to provide a second transmission main from the DSPS the Mountain View Reservoir are included in the CIP.

3.3 Storage

Finished water storage is generally provided by a municipal water agency to ensure a continuous water supply under varying operating and demand conditions. The storage, usually contained in reservoirs and tanks, needed by a municipality is commonly accounted for by adding the following functional components.

3.3.1 Operational Storage

Operational storage is the volume of water used to supply a water system when the source of supply, such as a WTP or pump station, under normal operating conditions is reduced or removed from service. The SFWB WTP is commonly operated during the night or weekend when the power costs are lowest (off-peak). When the plant is taken off line during peak power periods or for backwashing or facility maintenance, water is supplied from the operational storage. This storage is provided by the WTP clear wells and the Mountain View Reservoir. The Park Place area of Oregon City depends on the WTP clear wells for operational water storage. Operational storage for the City of West Linn and other areas of Oregon City are served from operational storage within each City's distribution system and not from SFWB's clear well.

In 2009, SFWB completed a new 2 MG clear well, which when added to the existing clear wells provides a total clear well capacity of 3.2 MG. The current average day demand for the Park Place area is less than 0.1 mgd. The 2030 average day demand for the Park Place area is estimated to be less than 0.5 mgd; therefore, no additional operational storage is recommended at this time for this service area.

3.3.2 Equalization Storage

Equalization storage is provided when the source of supply cannot keep pace with the water system demands. This might occur during the time of day when demand exceeds the MDD capacity of the treatment plant, pump stations, or transmission pipelines. Equalization storage is the responsibility of each city and CRW to provide in their distribution reservoirs. The storage evaluation for SFWB does not include equalization storage.

3.3.3 Fire Suppression Storage

The purpose of this storage component is to provide a volume of water always available for fighting fires. Fire suppression storage is the responsibility of each city and CRW to provide in their distribution reservoirs and is often a requirement of municipal insurance. Therefore, the storage evaluation for SFWB does not include fire suppression storage.

3.3.4 Emergency Storage

Emergency storage, also referred to as standby storage, supplies water during emergency events, such as power outages, equipment failure, source contamination, or during periods of unanticipated very high demand. The requirements for emergency storage vary from system to system and typically depend on a risk assessment that evaluates the reliability of the water system, the number of alternate or backup sources of supply, and the types of water use in a system.

It was determined in the 1997 WMP that SFWB had an obligation to provide emergency storage in an effort to provide a reliable supply. Since then, both Oregon City and West Linn have undertaken improvements for their individual water systems. Besides providing equalization and fire-suppression storage, it is the policy of both Oregon City and West Linn to provide adequate emergency storage for their distribution systems to mitigate the loss of water supply. Since there is no clear policy directive for emergency storage, storage is evaluated for only the Park Place area. The clear well volume is capable of providing fire flow storage for a typical residential demand of 1,000 gpm for 60 minutes (60,000 gallons), or a commercial fire demand of 3,000 gpm for 120 minutes (360,000 gallons). The total clear well capacity at the WTP of 3.2 MG adequately covers the emergency storage need for the Park Place area. No hydraulic modeling was conducted to evaluate the impact of the fire flows on the distribution system, since this area is within the Oregon City distribution system.

3.3.5 Storage Requirements for SFWB

No additional storage facilities are required for SFWB for the 20 year planning period to 2036. The addition of new industrial demands or other developments could impact this evaluation, and the need for additional storage should be re-evaluated with the next water master plan update.

3.4 Metering Facilities

Table 3-6 provides a summary of the revenue meters used by SFWB. SFWB meters water supplied to Oregon City and West Linn through seven revenue meters. Six of these meters are owned by SFWB and one is owned by Oregon City. Water is metered to Oregon City through six revenue meters and through one revenue meter to West Linn. Water is metered to CRW-S through five revenue meters that are owned by Oregon City, and one meter owned by SFWB.

Table 3-6. SFWB Revenue Meters

Owner	Municipality Served	Location	Diameter and Type
SFWB	Oregon City	Cleveland and Hiram Roads	10-inch turbine
SFWB	CRW-S	Redland Road and Anchor Way	8-inch and 2x4-inch compound
SFWB	West Linn	17th and Division Street	16-inch magnetic
SFWB	Oregon City	16th and Division Street	8-inch and 2x4-inch compound

Table 3-6. SFWB Revenue Meters

Owner	Municipality Served	Location	Diameter and Type
SFWB	Oregon City	Mountain View Pump Station	16-inch turbine
SFWB	Oregon City	Mountain View Pump Station	6-inch propeller
SFWB	Oregon City	Mountain View Street	10-inch turbine
Oregon City	Oregon City	Hunter Avenue Pump Station	10-inch turbine
Oregon City	CRW-S	Leland and Meyers Roads	3x6-inch compound
Oregon City	CRW-S	South End and Impala Roads	6- and 2-inch turbine
Oregon City	CRW-S	Barlow Crest Pump Station	6-inch turbine
Oregon City	CRW-S	Barlow Crest Reservoir	8- and 2-inch turbine
Oregon City	CRW-S	Swan Avenue and Forsythe Roads	6- and 2-inch turbine

Two emergency water supply interties are metered by SFWB. West Linn owns a 12-inch magnetic meter that is used to measure flow both directions through their intertie with the City of Lake Oswego. SFWB also owns the meter that measures flow through Pipeline B that conveys emergency supply from the WTP to the NCCWC.

In addition to the revenue meters and emergency supply meters, SFWB meters water that is conveyed through the WTP and the DSPS. Raw water is measured entering the plant through a 20-inch magnetic meter. Additionally, a 20-inch magnetic meter measures finished water leaving the plant. Water is measured leaving the DSPS through a 24-inch magnetic meter.

SFWB could acquire ownership of the revenue metering facilities currently owned by Oregon City. SFWB would assume responsibility to operate, maintain, and read the meters. In addition, it is recommended that SFWB begin a revenue meter testing, calibrating, and improvement program for all meters owned by SFWB. These recommendations should be considered by SFWB as demands increase and distribution and metering improvements are needed.

SFWB WTP staff has expressed interest in converting the existing meters to include automated reading capabilities. This would allow field measurements of the water meters electronically by quickly passing a recording device over a meter sensor located at the meter vault. The readings are recorded and can be downloaded by the operator and automatically recorded in electronic spreadsheets or other database software. Automated reading saves time spent manually reading meters and helps eliminate human error associated with manual reading. As part of the SFWB's updated CIP, a capital project is included to add Touch Read capabilities to the seven revenue meters owned by SFWB.

SECTION 4

Evaluation of System Reliability

4.1 Introduction

This section of the report examines the reliability of each SFWB supply component and makes recommendations for emergency operation if required. The analysis includes the raw water intake, RWPS, WTP, finished water transmission, DSPS, and transmission to Oregon City's Mountain View Reservoir and the City of West Linn's Bolton Reservoir. A summary of the reliability analysis is provided in Table 4-1.

Table 4-1. Summary of Reliability Analysis for SFWB System Components

Component	Current Condition	Multiple, Isolatable Components	Emergency Power Available	Mitigated with Emergency Response Plan
Raw Water Intake	Good structural condition	Yes, three screens can be isolated	Not applicable	Emergency intake at new or old intake facility
Raw Water Pump Station	Good structural condition, some seismic anchoring needed	Yes, five pumps can be isolated	Yes, dual primary power supply available, and a spare primary transformer kept at Division St. Pump Station	Portable generator could be rented during power outage of both primary supplies, emergency pumps could be placed in service
Raw Water Transmission	59-year-old pipeline has a history of breaks, unstable slopes, and is at capacity	No	Not applicable	Emergency repairs required when breaks occur
Water Treatment Plant	59-year-old plant is generally in adequate condition, some seismic upgrades recommended	Yes, multiple treatment trains and spare parts are maintained onsite	No	Yes, emergency response plan is annually reviewed by staff
Finished Water Transmission from WTP to DSPS	59-year-old pipeline has a some leaks, but no major breaks have occurred	No, a single transmission line from the WTP to the DSPS exists, although a 42-inch ductile iron pipe has been extended to the Hunter Avenue Pump Station	Not applicable	Emergency repairs required when breaks occur
Operational and Emergency Storage	2 MG currently provided in Mountain View Reservoir will diminish over time; reservoir in good condition	No	Not Applicable	West Linn has emergency connection to Lake Oswego, but Oregon City has no additional source of supply

Table 4-1. Summary of Reliability Analysis for SFWB System Components

Component	Current Condition	Multiple, Isolatable Components	Emergency Power Available	Mitigated with Emergency Response Plan
Division Street Pump Station	59-year-old facility generally in good condition, some seismic anchoring recommended	Yes, three pumps can be isolated for repair	Yes, second primary power supply and a second primary transformer available	Portable generator could be rented during power outage of both primary supplies, emergency pumps could be placed in service
Finished Water Transmission from DSPS to Mountain View Reservoir	59-year-old pipeline, but no major breaks have occurred	No, a single transmission line from the DSPS to Mountain View Reservoir exists	Not applicable	Emergency repairs required when breaks occur
Finished Water Transmission from DSPS to Bolton Reservoir	The condition of the City of West Linn's transmission main not evaluated in this water master plan	No, a single transmission line from the DSPS to the Bolton Reservoir exists, including an above-ground bridge crossing	Not applicable	Emergency Connection with Lake Oswego could be used

4.2 Raw Water Intake and Pump Station

The intake structure and RWPS, constructed in 1996, is a rectangular, conventionally reinforced concrete structure. The concrete is in good condition with a few visible cracks, which are likely due to initial construction shrinkage and initial settlement of the structure as it was put in service.

The intake structure includes three separate screen systems that can be isolated and repaired in case of damage to one of the screens.

The pump station has multiple pumps that can be isolated for repair or replacement. There are a few large electrical control units in the pump station that appear to be anchored at the base only. These tall, slender units pose an overturning or falling risk during a seismic event. It is recommended that the units be seismically braced and anchored to the structure to reduce the overturning risk.

The vertical turbine pumps' riser pipes from the wet well, which is at river level, to the discharge head at the motors are laterally unsupported their full length. It is recommended that these pipes be evaluated and seismically anchored and braced to avoid damage to the pipes and pumps during a seismic event.

Backup power for the pump station is provided by a second primary power supply to the site with a manual switch. A second primary transformer can be moved from the DSPS to the RWPS if required.

If an emergency situation occurs that takes the entire pump station and intake out of service, temporary emergency intake and pumping would be required. The old intake is not suitable for use, but does provide a second location to pump water from on an emergency basis.

4.3 Raw Water Transmission

The raw water transmission line has a limited capacity and a history of breaks. Part of the line is located in an area of unstable slopes. This pipeline is the only source of supply for the SFWB WTP and should be replaced. It is recommended to complete a routing study along with the new Raw Water Pipeline Construction.

4.4 Water Treatment Plant

The WTP is in generally good structural condition, includes multiple treatment trains, emergency power is not available however, and an emergency response plan that staff reviews annually.

A site walk-through to collect information for structural condition assessment was conducted by engineering staff from CH2M HILL on June 13, 2016. During the time of the site visit, the existing hydraulic facilities were in operation and were not visually inspected on the interior surfaces. Many of the plant structures are fully or partially buried and only the exposed exterior portions of the structures were inspected. A complete structural assessment of the WTP and the two other offsite facilities should be conducted to determine the viability of their continued use for the next 20 to 50 years.

4.4.1 Observations

Some of the existing WTP facilities are nearly59 years old. In general, the hydraulic tanks and building structures are in reasonable operating condition. Many of the older tanks have minor cracks, some signs of calcification and efflorescence (a white powdery substance leaching out of the cracks), and some minor rust staining from top-mounted handrails and similar metal appurtenances. Any significant cracking is noted in the discussion below for each tank, building, or pond. No significant active leakage was noted in the exposed portions of the hydraulic tanks or ponds.

Historically, building codes have been written using expected 50-year useful lives, which provide a basis for an industry standard target life span. However, it appears that the inspected facilities of the WTP should be structurally sound for an additional 20 years or more beyond their original 50-year design life if the excellent ongoing maintenance continues, the initial coatings and repairs indicated below are applied and performed, and the recommendations of this assessment are implemented. At the end of these extra 20 years, additional injections, coatings, and similar life cycle related upgrades might be needed to further extend the useful life of these facilities.

4.4.1.1 Site Piping and Utilities

If a site is sensitive to seismic-induced movement or settlement, the risk of dislocating or shearing buried piping and buried or overhead utilities is always present for both hydraulic structures and buildings. Piping connections to the new Clear Well 3 and the new piping into existing Clear Wells 1 and 2 at the WTP site were designed to reduce risk of pipe distress during the initial piping/structure settlements and any future anticipated settlements. Other older existing piping and utilities were probably not specifically detailed to mitigate damage due to this relative movement.

However, the WTP site is not founded on liquefiable soils and all of the settlement to date is due to content settlement (CH2M HILL, 2007). Only nominal to minor future seismic settlements are anticipated, so risks to piping and utility connections to structures are low to moderate.

4.4.1.2 Sludge Drying Beds

The sludge drying beds are earth-supported, asphalt-lined shallow basins and are not considered a structure. These shallow types of earthwork based ponds are susceptible to ground motion during seismic events. They also serve as surge basins for the filter backwash so they are generally partially full of water. They may lose contents and/or sustain damage, but are generally repairable or replaceable after an event.

4.4.1.3 Seismic Anchorage and Bracing of Mechanical, Electrical, and Architectural Components

The site visit identified many mechanical, electrical, and architectural equipment and components that were not anchored adequately to prevent life safety risks during a seismic event. These items included motor control centers, tall electrical cabinets, small tanks, tile cladding, and other code identified items that are recommended to prevent ground movement induced overturning or sliding within a structure or mounted outside. It is recommended that these be anchored during regular maintenance activities as soon as possible.

4.4.1.4 Clear Well 1/Filters/Headhouse

This multiple-use structure is a partially buried, rectangular, conventionally reinforced combined concrete building and hydraulic structure built in 1957. Clear Well 1 is below grade, adjacent and attached to the two-story filter areas. The two hydraulic below -grade structures have common walls. The first level of the multi-story filters is below grade with a filter pipe gallery between two sets of filters. The headhouse area, including a loading dock and storage areas, is above Clear Well 1. Clear Well 1 is rectangular, with intermediate walls and provides approximately a 250,000 gallons of volume at 12 feet of depth. The exposed concrete appears to be in good condition with a few visible, non-leaking cracks on the exterior of the filters.

The interior walls of the currently occupied headhouse, which includes the facility controls area, are lined with clay tiles. The existing drawings indicate that the tiles were detailed to be anchored at regular intervals to the concrete walls for lateral and vertical support. Brick veneer is also present in some interior as well as exterior areas and also detailed to be anchored. A few of the nonstructural tile-lined partition walls appear to lack top of wall connections and are shown as cantilevered from the wall base. These walls could overturn during seismic induced motions if they are truly unsupported at the top of wall.

The unsupported partition walls may present a falling hazard to building occupants during a seismic event, and the existing top of wall anchorage adequacy should be further investigated. Where required, modifications should be made to these interior walls to mitigate the risks to occupants since no connection appears to have been provided. However, in some locations, cross wall action may supply the required load path.

The tile and brick veneer anchorage shown on the drawings is typical for that era. These anchors are often non-galvanized and were not shaped to resist lateral buckling/pullout during a seismic event. Since the interior space is conditioned, corrosion of the anchors as well as deterioration of the tile backing mortar is of less concern than for the exterior veneer, which has been exposed to the weather. Plant safety plans for exiting after an event should include moving away from the building perimeter fall area (usually the height of the building). Consider anchoring veneer immediately above exits if this condition exists.

The pipe gallery and storage areas contain many different storage tanks, pipes, and mechanical equipment. Much of the piping in the gallery appears to lack adequate seismic anchorage and bracing. It is recommended that anchorage of the equipment, tanks, and pipes is reviewed against current building code requirements. Provide anchorage and bracing where required.

The guardrail in the building interior and on the perimeter of the filters is in good condition.

Photos of the filters exterior and pipe gallery are provided in Figures 4-1 and 4-2, respectively.

Figure 4-1. Filters Exterior South Wall

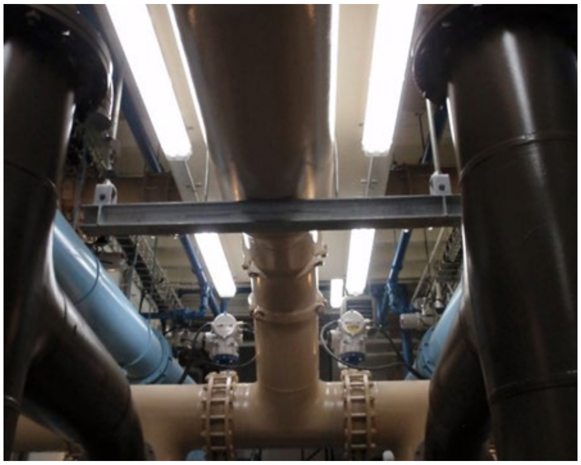

Figure 4-2. Filters Pipe Gallery

4.4.1.5 Administration Area

The administration building is located in the same structure with Clear Well 1, filters, and headhouse. It is adjacent to the headhouse area. The recent expansion of the administration area, completed in 2005, consists of plywood shear walls and a plywood diaphragm above prefabricated wood trusses. The light wood framing is attached to the concrete roof diaphragm above the loading and headhouse area. This area is of recent construction, and this light weight addition appears to meet the intent of recent code detailing and connections, although it may not be designed for the current maximum considered earthquake (MCE) level design forces. Light wood structures are typically at low seismic risk.

4.4.1.6 Flocculation/Sedimentation Basins

The two flocculation/sedimentation basins were constructed the same time as the filters and Clear Well 1. The basin structure is a partially buried, rectangular, conventionally reinforced concrete system. The exterior concrete was in good-to-moderate condition, but with many visible cracks and some signs of weathering of the concrete paste near the top of the walls. Many of the cracks showed signs of calcification and efflorescence, with a few of them showing signs of water seepage. A photo of the flocculation/sedimentation basin south wall is provided in Figure 4-3.

The guardrail anchorage at the southwest wall has caused rust staining and local cracking and spalling of the concrete wall due to corrosion of the anchorage material. A photo of the guardrail anchorage corrosion is provided in Figure 4-4. The embed type handrail connections on the perimeter have gone through numerous freeze-thaw cycles, which have induced the concrete spalling. The handrail should be removed, the embed removed or filled, the concrete repaired, and the handrail replaced with top-mounted, post-installed anchor type connections. If mitigation is not done, the local concrete will continue to deteriorate. Some local rebar corrosion may have already begun. Repair of the concrete including removal and replacement of the deteriorated post anchorage is estimated to cost about $2,500 per post location if only the base plate and anchorage are replaced versus the complete handrail system.

Figure 4-3. Flocculation/Sedimentation Basin South Wall

Figure 4-4. Guardrail Anchorage Corrosion

The entire concrete surface on the interior of the basins shows signs of corrosion and loss of cement paste, leaving the aggregates exposed. A photo of the basin interior wall is provided in Figure 4-5. The plant staff indicated that the concrete is still hard, rather than soft. The concrete should be further evaluated and the surface repaired and coated as required to avoid any further deterioration of the concrete. Loss of aggregate will impair the structure’s water holding ability. A recent estimate of concrete repair systems for this type of condition showed a coating repair life expectancy of about 25 to 30 years. Costs, including any crack injection required, would be up to $10.00 to $12.00 dollars per square foot of exposed surface area.

The concrete at the anchorage of the launder troughs in the basin was in poor condition in most locations. A photo of the launder trough anchorage is provided in Figure 4-6. Anchorage failure was evident by local cracking and spalling of the concrete at the weir anchors. It is recommended that the concrete be locally repaired at these locations and the weir trough anchorage be detailed to avoid similar concrete failures. Repair costs could range from $3,000 to $5,000 for each end of each trough.

Figure 4-5. Flocculation/Sedimentation Basin Interior Wall

Figure 4-6. Launder Trough Anchorage

4.4.1.7 Transfer Pump Station

The transfer pump station, located adjacent to the two backwash/solids drying ponds, is a light gage prefabricated steel building. The structure is of recent construction and appears to be in good condition. Drawings were not available, but it was constructed in 1978. There is a large electrical controls unit that appears to be anchored at the base only. This tall, slender unit poses an overturning or falling risk during a seismic event. It is recommended that this unit be seismically braced and anchored to the structure to negate the overturning risk.

4.4.1.8 Sludge Drying Beds

The sludge drying beds are earth-supported, asphalt-lined shallow basins constructed in 1959 and are not considered structures. They were not inspected during the time of walkthrough. Pond structures are not usually addressed by codes unless they are deep enough to be considered dams. Maintenance and ongoing upgrades are the key to longevity.

4.4.1.9 Clear Well 2

Clear Well 2, constructed in 1978, is a buried, circular, conventionally reinforced concrete water holding basin with approximately 625,000 gallon capacity at a 12-foot water level. The basin was in operation during the time of the walk through and was not inspected. However, it was examined during the recent pipe installation and appeared to be in moderately good condition considering its age.

4.4.1.10 Clear Well 3

Clear Well 3, constructed in 2009, is a buried, rectangular, conventionally reinforced concrete water holding basin with 2 MG volume. The basin was in operation during the time of the walk-through. It is new and was deemed unnecessary to inspect. Water leakage tests and final inspection of the entire structure were performed before backfilling and filling.

4.5 Finished Water Transmission Pipeline from WTP to Division Street Pump Station

Finished water is conveyed from the WTP to the DSPS via a 30-inch-diameter concrete-cylinder transmission pipeline. This pipeline, constructed in 1958 at the same time as the WTP and the Division Street Pump Station, is approximately 8,400 feet in length. The transmission main has performed well during its service life with few maintenance problems and no known pipe failures. Recently, an improvement project involving the installation of four isolation valves along the transmission main was completed, allowing isolation of segments of the pipeline during maintenance or repair.

CH2M performed a visual inspection of a portion of the pipeline route in February 2016. The inspection included the portion of the 30-inch pipe route running west from the WTP to the unimproved section of Hiram Avenue, then south to the beginning of the paved portion of Hiram Avenue. This north-south section of the pipeline parallels a City of Oregon City 8-inch diameter sanitary sewer pipeline, which is believed to be located approximately 10 feet to the west of the SFWB pipeline. Saturated soft soil was observed along the majority of the alignment walked. Seepage of water originating from the ground was observed in many locations along the alignment, but these seeps were more concentrated along the northern half of the alignment walked. The seeps were generally observed to be east of (upslope) from the alignment of the 30-inch pipeline. Along approximately the northern third of the alignment, flowing water believed to be from multiple groundwater seepage sources, was collecting and running down the surface near the alignment of the storm sewer and FW pipeline. Signs of erosion, in the form of a small ditch or gully, was also observed along portions of the pipeline alignment.

In addition to the signs of seepage, trees with bent trunks, which can be indicative of past and potentially ongoing slope movement, were observed in a number of locations on the hillslope east of the pipeline route.

A tension crack was observed in the area directly above the topsoil and aggregate processing facility located east of the intersection of Forsythe Road and Front Avenue where a near vertical excavated slope extends up to a location about 15 feet from the City's sanitary sewer pipeline. The excavated slope in this area is estimated to be between 50 and 60 feet high. The tension crack extended along the excavated slope for a distance of about 20 to 30 feet and had a maximum width of about 3 inches. The tension crack is an initial sign of slope instability. It was observed that additional slope failures back to the tension cracks are likely and could continue to progress toward the finished water line and the sanitary sewer over time.

In 2000, a segment of 42-inch-diameter transmission main was constructed from the WTP in conjunction with the construction of Oregon City's Hunter Avenue Pump Station. The main connects to the 30-inch-diameter WTP effluent pipeline downstream of the plant effluent meter and extends south within the Hunter Avenue right-of-way about 2,000 feet to the Hunter Avenue Pump Station. The firm capacity of the pump station is 1,800 gpm (2.6 mgd) and is currently the only demand served from the pipeline. The two pipelines are not currently interconnected.

4.6 Division Street Pump Station (DSPS)

The pump station, constructed in 1959 (designed and built simultaneously with the original WTP) is a rectangular, conventionally reinforced concrete structure with minor areas of masonry infill. The concrete is in good condition without appreciable visible cracks. No major structural modifications appear to have been made since the original construction. There are a few large electrical control units that appear to be anchored at the base only. These tall, slender units pose an overturning or falling risk during a seismic event. It is recommended that the units be seismically braced and anchored to the structure to negate the overturning risk. Photos of the exterior and interior of the DSPS are provided in Figures 4-7 and 4-8, respectively.

Figure 4-7. DSPS Exterior Wall Corner

Figure 4-8. DSPS Interior

4.7 Finished Water Transmission from DSPS to Mountain View Reservoir

The transmission main that delivers finished water from the DSPS to Oregon City's Mountain View Reservoir is a 24-inch-diameter concrete-cylinder pipeline. The pipeline is approximately 7,800 feet in length and was constructed in 1959. This main has served SFWB well with few maintenance problems reported by SFWB staff. However, the pipeline comprises a single source of supply to the City of Oregon City. The City does not have an emergency intertie with another water purveyor, although parts of the City are fed from SFWB in locations other than from this transmission line.

4.8 Finished Water Transmission from DSPS to Bolton Reservoir

The condition of the finished water transmission line was not evaluated as part of this water master plan since the line is owned by the City of West Linn and not by SFWB. However, the 2008 West Linn master plan describes the vulnerability risk of the single transmission line, including the bridge crossing over the Willamette River and recommends an under-river crossing be constructed to mitigate this risk.

4.9 SCADA System

4.9.1 Background

The SFWB SCADA system includes seven PLCs, five radios, two HMI computers and associated networking as shown in Figure 4-9.

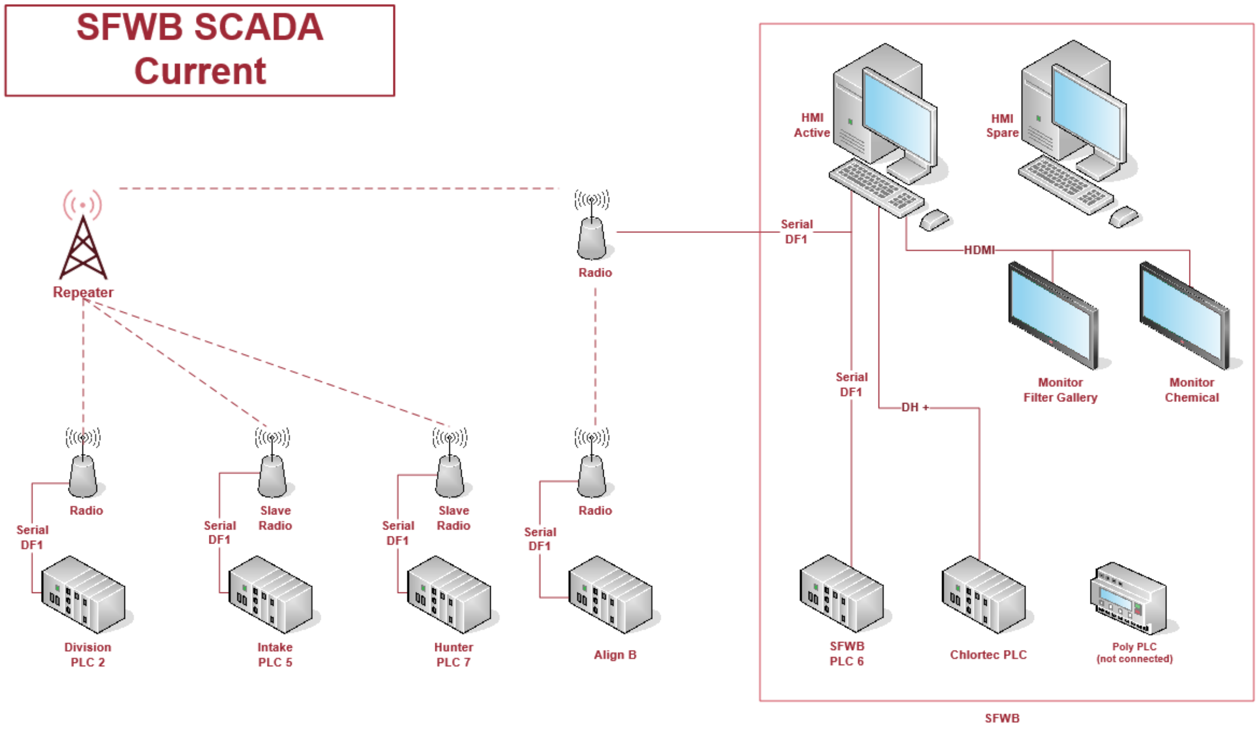

Figure 4-9 – SFWB Existing SCADA System

CH2M assessed the system recently and noted opportunities for improvements regarding the programming, controllers, radios and method of communication. Recommendations for the system included:

- PLC upgrade to replace obsolete controllers and use newer programming language
- Improved networking using Ethernet in place of serial communications
- Efficient Programming to improve system response time and add diagnostics
- Data concentrator for more secure communication and diagnostics
- HMI Nodes both operating for increased availability

4.9.2 Interim Improvements

Replace SFWB PLC

The existing SFWB PLC 6 could be replaced by an Allen Bradley CompactLogix PLC. This is a current model that uses Ethernet communication and RSLogix 5000 programming software. An L32 model also provides a serial port which could connect to the existing radio.

The new PLC could provide a data concentrating function, eliminating the need for the HMI computers to poll remote stations through the radios. This will improved speed and allow both HMI computers to function simultaneously. In the future, this PLC would continue to function as the main processor for the plant even if the radios were replaced.

PLC Programming

The new Compactlogix PLC would be re-programmed to provide polling of the remote units. This would allow the HMIs to function more reliably and eliminate missing data when communications were unsuccessful. Even if the radios were slow to respond, data from the previous read would be visible in the PLC registers. Diagnostic information could be added to monitor and alarm when the communications were not operating properly.

HMI PLC Programming

The existing HMI screens will be retained but the communication configuration will be modified to read and write data through the master PLC. Further improvements can be added in the future including updated HMI screens and remote access.

The revised system would look like this:

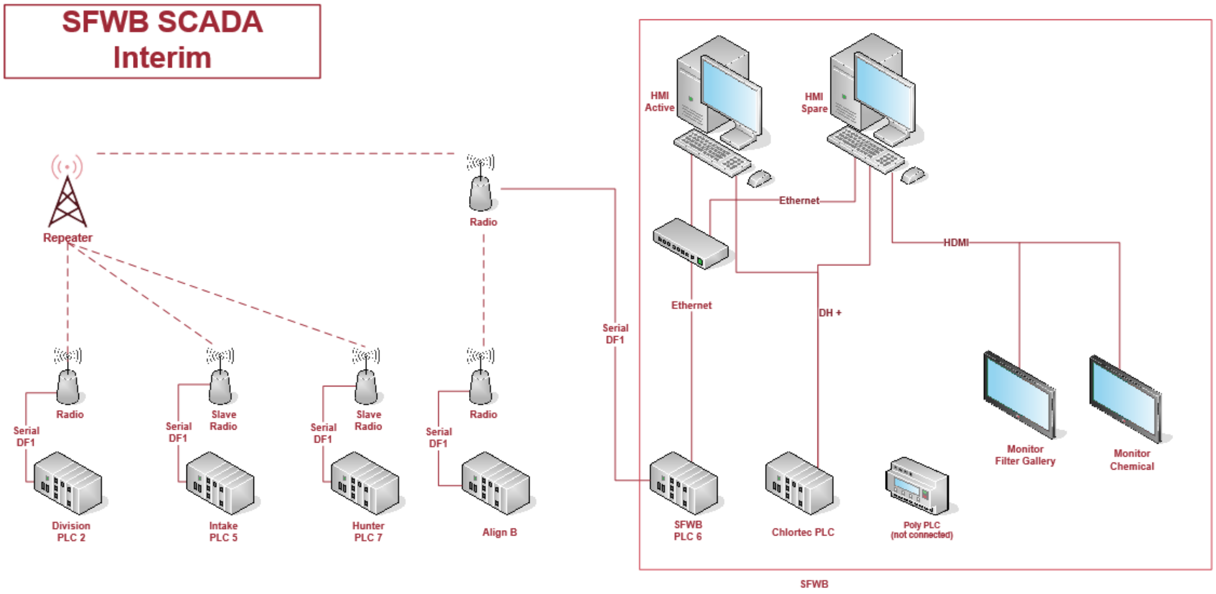

Figure 4-10: SFWB Interim SCADA Improvements

4.9.3 Interim Improvements

Engineering and programming tasks required to perform this work are as follows;

- Engineering
    - Specify and order replacement PLC
    - Provide design assistance for SFWB panel modifications
- Modify SFWB PLC program
    - Convert from RSLogix 500 to RSLogix 5000
    - Add serial polling and data concentrator functions
- Modify HMI Program
    - Update communication addresses
    - Add Ethernet driver

Installation and wiring tasks also required to perform this work are as follows;

- Install new SFWB PLC with associated panel modifications
- Provide Ethernet cabling between PLCs and HMI computers

4.9.4 Long-Term Improvements

Long term improvements include replacing the remaining PLCs, the communications network and the instruments. In addition, the Master Meters are planned to be monitored through the SCADA system.

SECTION 5

Evaluation of Alternative Water Supply

5.1 Introduction

This section briefly discusses three alternative water supplies; the existing Clackamas River supply, groundwater and a Willamette River supply.

5.2 Existing Clackamas River Supply

The Clackamas River surface water supply provides adequate capacity for SFWB for the foreseeable future. The supply provides SFWB with senior water rights dating from 1914 to 1953. The Clackamas River is subject to instream flow requirements, which previous analysis has indicated can be met 98 percent of the time. The supply is subject to curtailment under low flow conditions. The river is home to some threatened and listed species of fish that are protected by the Endangered Species Act, including Chinook salmon (threatened), steelhead trout (threatened), and Coho salmon (listed).

SFWB has capacity to divert up to 52 mgd of water to beneficial use in the current river intake, but additional capital investment is required to increase the capacity of the RWPS, raw water transmission, WTP, finished water transmission, and finished water storage to supply the entire amount.

The water quality of the Clackamas River supply is similar to many northwest surface supplies, including very soft, low mineral content, and slightly-above-neutral pH. The water quality has few taste and odor issues, but does have some upstream potential sources of contaminants, and could be subject to spills. The existing WTP processes are fairly adaptable to removing most of the treatment concerns for this supply.

5.3 Groundwater Supply

CRW and the City of West Linn have both conducted investigations into groundwater and the potentials for aquifer storage and recovery in the West Linn and Oregon City areas. The results of both of those studies have indicated that there is very little potential for additional groundwater development of a significant capacity to meet future demands projected over the current system capacity.

5.4 Willamette River Supply

A number of utilities have investigated the potential for using the Willamette River Supply as a secondary water source, include Eugene Water and Electric Board, McMinnville Power and Water, CRW, Sunrise Water, North Clackamas County Water, and a number of Washington County water suppliers. These suppliers considered the Willamette River as a potential location to diversify their water supply in the event a prolonged event impacted their main source or sources. The SFWB has a water treatment plant that could likely treat the water from the Willamette River, especially after the addition of ozone and filter modifications discussed in Section 2.

5.5 Conclusion

The existing water supply provides many benefits to SFWB including existing capacity at the intake and senior water rights for the supply. Previous investigations into groundwater and aquifer storage and recovery have indicated that the prospect for significant volumes of water is low. SFWB should continue to use the Clackamas River for supply and improve the reliability and resiliency of the water supply system. Because the SFWB needs to upgrade nearly the entire backbone of its system, including raw water transmission, the WTP, and finished water transmission, an investment in making these facilities robust and reliable is the most prudent course of action.

SECTION 6

Seismic Resiliency Recommendations

6.1 Introduction

In February 2013, the Oregon Seismic Safety Policy Advisory Commission published recommendations for water and wastewater treatment plants in the Oregon Resilience Plan (ORP). The ORP provides recommendations on policy to protect citizens during and after a Cascadia subduction zone tsunami and earthquake. A specific task group was created to assess water and wastewater system vulnerabilities.

This master plan update recommends establishing a water system backbone that can withstand a Cascadia event and support fire suppression, health and emergency response, and drinking water distribution points.

6.2 Resilience Goals, Objectives, and Scope

The Water and Wastewater Task Group identified performance goals for the time required to restore water and wastewater service to affected communities. This effort consisted of (1) developing a phased approach to water system upgrades before a Cascadia subduction zone earthquake and to recovery after, (2) defining categories or groups of functional characteristics of systems, and (3) identifying resilience goals for each category.

6.3 Phased Approach

Given the size and inherent vulnerability of most water and wastewater systems, it was assumed that costs of seismic mitigation would exceed the resources of most providers' 50-year CIPs. Therefore, to provide water to critical areas and to protect public health and safety as soon as possible following the seismic event, a phased approach to system recovery was developed in the ORP. The phased approach is built upon having hardened backbone elements of the water and wastewater systems. The backbone system would consist of key supply, treatment, transmission, distribution, and collection elements that, over the 50-year timeframe, have been upgraded, retrofitted, or rebuilt to withstand a Cascadia subduction zone earthquake.

The backbone water system would be capable of supplying key community needs, including fire suppression, health and emergency response, and community drinking water distribution points, while damage to the larger (non-backbone) system is being addressed.

The proposed approach—each community establishes a backbone water system—does not alleviate critical water concerns following a Cascadia subduction zone earthquake. Large portions of the water distribution system will remain vulnerable and presumably inoperable. SFWB's Facilities represent a large part of this potentially reliable backbone system for the cities of Oregon City and West Linn.

6.4 Functional Categories of Water Systems

Using the professional judgment of group members, the Water and Wastewater Task Group established categories of water and wastewater infrastructure based on functional characteristics of the systems. These categories also reflected the proposed backbone structure to accommodate phased recovery of the systems. The categories of system functions for water infrastructure are described below.

6.5 Domestic Water Supply

6.5.1 Potable Water Available at Supply Source

This category represents the initial point of the water supply system. Given the age, geotechnical vulnerability, and complexity of many treatment plants, the ORP assumed systems recover the facilities in phases and investments would be dedicated to seismically hardening the treatment processes.

Communities with more resilient storage may consider longer recovery timeframes for the supply source, as they could rely on stored water in lieu of producing more treated water.

6.5.2 Main Transmission Facilities, Pipes, Pump Stations, and Reservoirs Operational

This category refers to the backbone system discussed above. The intent is to be able to convey water from resilient storage and treatment plants to key distribution points as soon as possible following the event. Manual operation of valves—to isolate the backbone system from damaged areas of the system and minimize water loss—accounts for some of the delay in implementation.

6.5.3 Water Supply to Critical Facilities Available

This category assumes critical facilities will be nearly fully operational due to onsite water storage or the capacity of the local supply. Critical facilities, such as hospitals and first-aid facilities, command and control centers, and industries essential to recovery and restoration efforts, should be identified for individual communities.

6.5.4 Water for Fire Suppression at Key Supply Points

Thorough planning efforts, involving fire officials and emergency responders, should identify key supply points for reliable access to water for fire suppression. These areas should be included in the backbone system.

6.5.5 Water for Fire Suppression at Fire Hydrants

Water will be available at fire hydrants when leaks and breaks in the distribution system have been repaired. Communities in heavily damaged areas will likely not be able to rely on fire hydrants until the majority of the distribution system is operational. Until that benchmark can be reached, communities would have to rely on the key fire-suppression supply points and fire-suppression strategies described above.

6.5.6 Water Available at Community Distribution Centers/Points

As in the case of fire hydrants, the distribution of water to individual homes and neighborhoods may not be possible given damage to the distribution system. If community distribution centers/points are provided at strategic locations along the hardened backbone, people can have access to potable water soon after the event. Such issues as the logistics of staffing and setting up a distribution center and of identifying containers were also considered during the development of the target recovery timeframes for this category.

6.5.7 Distribution System Operational

In order to provide water throughout the community (including fire hydrants), the distribution system would need to be operational. Through vulnerability assessment, material stockpiles, supply identification, and workforce planning, communities would be able to target anticipated repairs as part of their comprehensive response and recovery efforts.

For this project, our team focused on resiliency of the SFWB backbone system as well as providing community points for water supply with emergency treatment trailers. To identify hazards, the team examined slope stability, earthquake, liquefaction, and peak ground acceleration hazards (See Figures 6-1, 6-2, 6-3, and 6-4), as well as an examination of the condition and resiliency of major facilities.

6.6 Intake and Raw Water Pumping

The intake and raw water pumping facility resiliency is summarized in Table 6-1. The facility is in good condition, has multiple units and a secondary power supply; however, it was constructed prior to current building codes and could likely use seismic equipment anchors and a structural review.

Table 6-1. Resiliency of Intake and Raw Water Pumping

Facility	Condition	Resiliency
52 mgd intake and screen capacity, 30.8 mgd pumping capacity	Good condition	Multiple units, newest facility, but designed before current seismic standards; secondary power available

A photo of the SFWB Clackamas River intake and RWPS is provided in Figure 6-5.

Figure 6-5. SFWB's Intake and RWPS Is in Good Condition and Has a Secondary Power Supply

6.6.1 Raw Water Pipeline

The raw water pipeline resiliency is summarized in Table 6-2. The line is 59 years old, located on a stable, but very steep slope, and would be difficult to repair if a failure occurred. The pipeline route is shown in Figure 6-6.

Table 6-2. Raw Water Pipeline Resiliency

Facility	Condition	Resiliency
Raw water line: lower portion was replaced with welded steel pipe when the new intake was constructed. Upper portion is 27-inch-diameter concrete-cylinder pipe installed in 1958.	Upper portion is more than 59 years old, history of failure of wire wrapping. Geotechnical report found generally good conditions. The slope is very steep, but little liquefiable soils.	This line would be very difficult to repair quickly if it failed, because of the steep slopes along the pathway.

Figure 6-6. SFWB Raw Water Pipeline Route

6.6.2 Water Treatment Plant

The resiliency of the WTP is summarized in Table 6-3. The headhouse and filter building and sedimentation basins are 59 years old. The building has useful life left, and some structural improvements can be made. The sedimentation basins are a concern for a Cascadia subduction event. Chemical feed systems should be replaced and upgraded in the proposed new Chemical Building. Photos of the WTP are provided in Figures 6-7 through 6-16.

SECTION 6

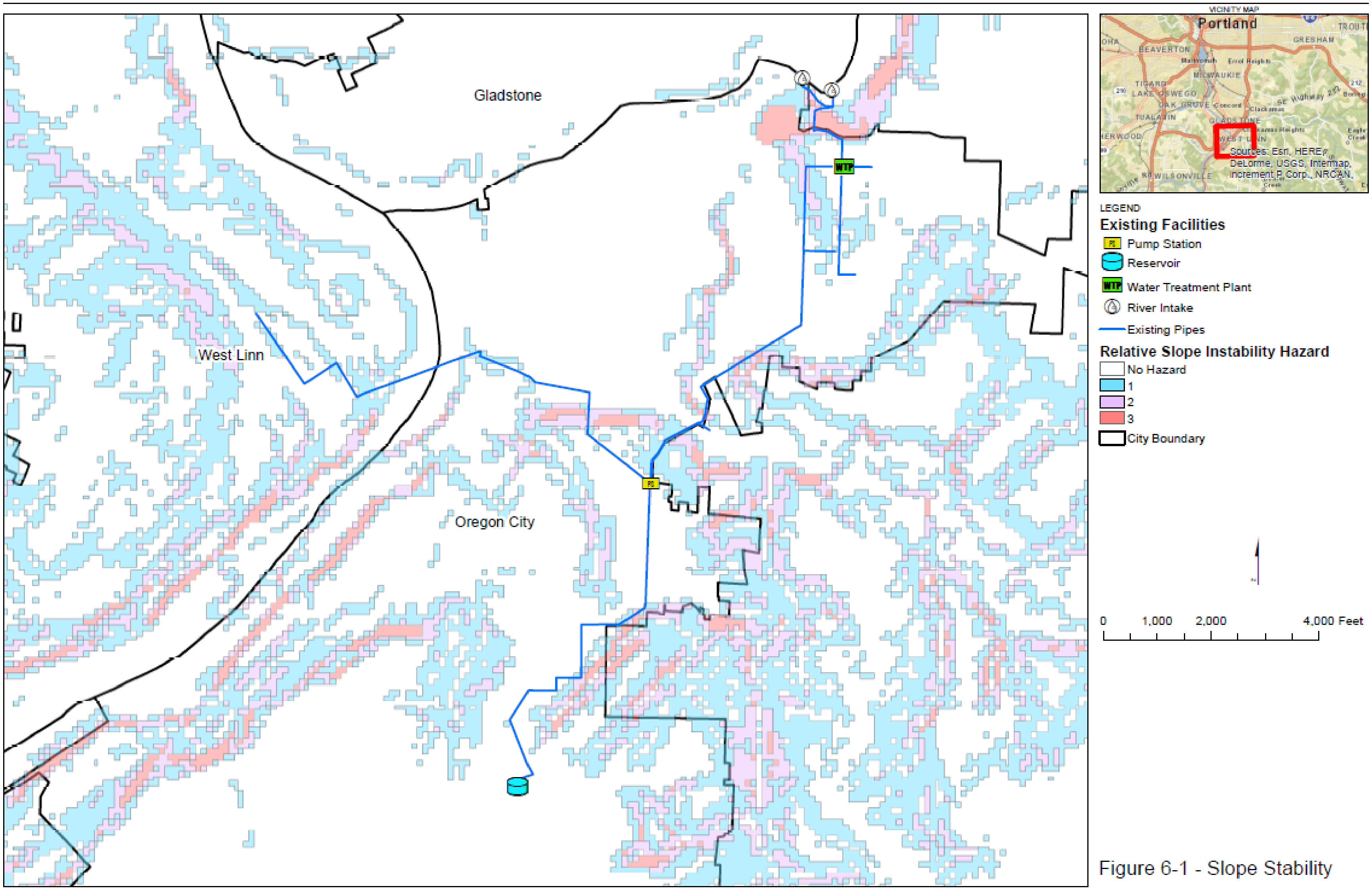

Figure 6-1 - Slope Stability

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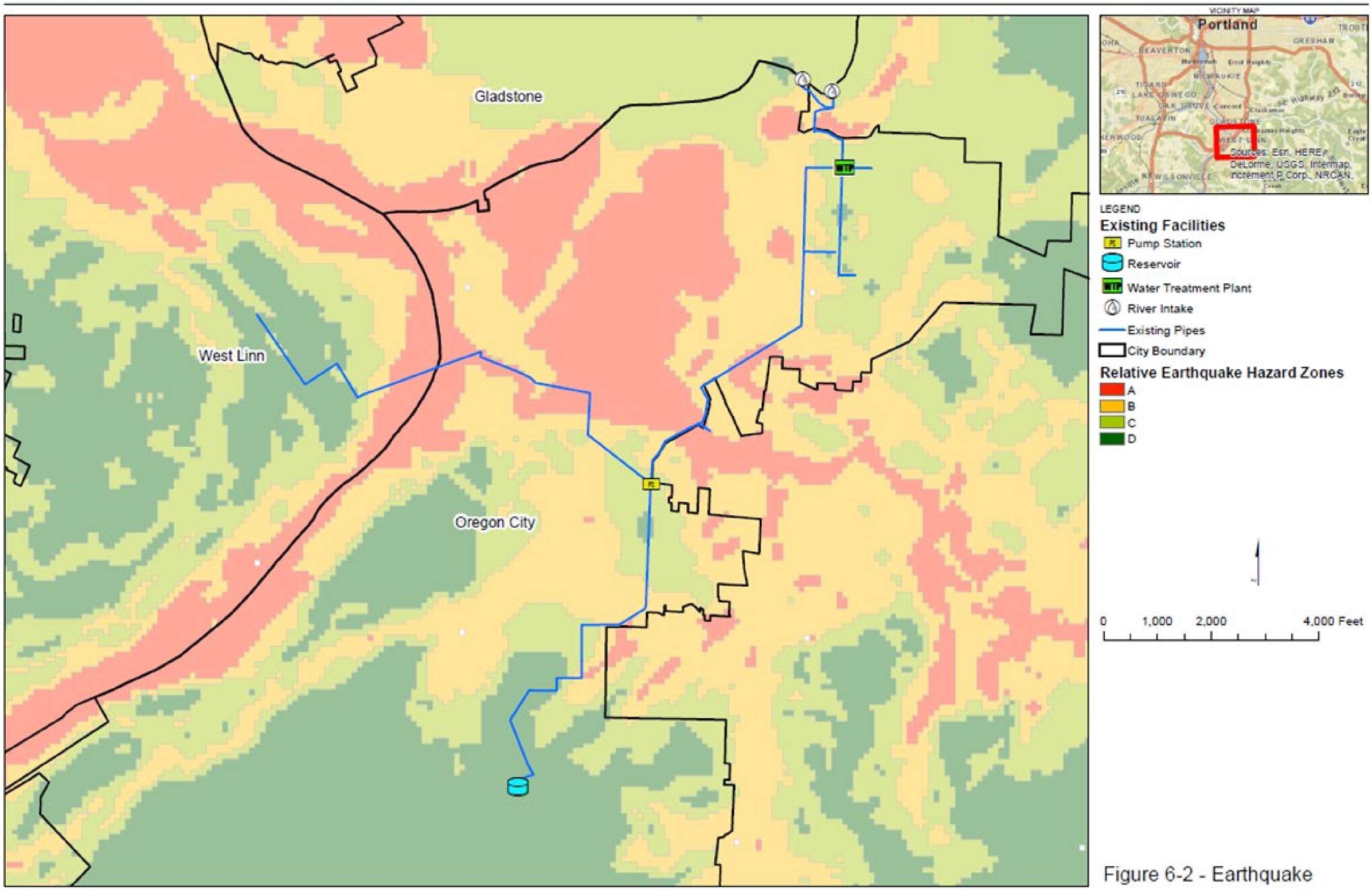

Figure 6-2 - Earthquake

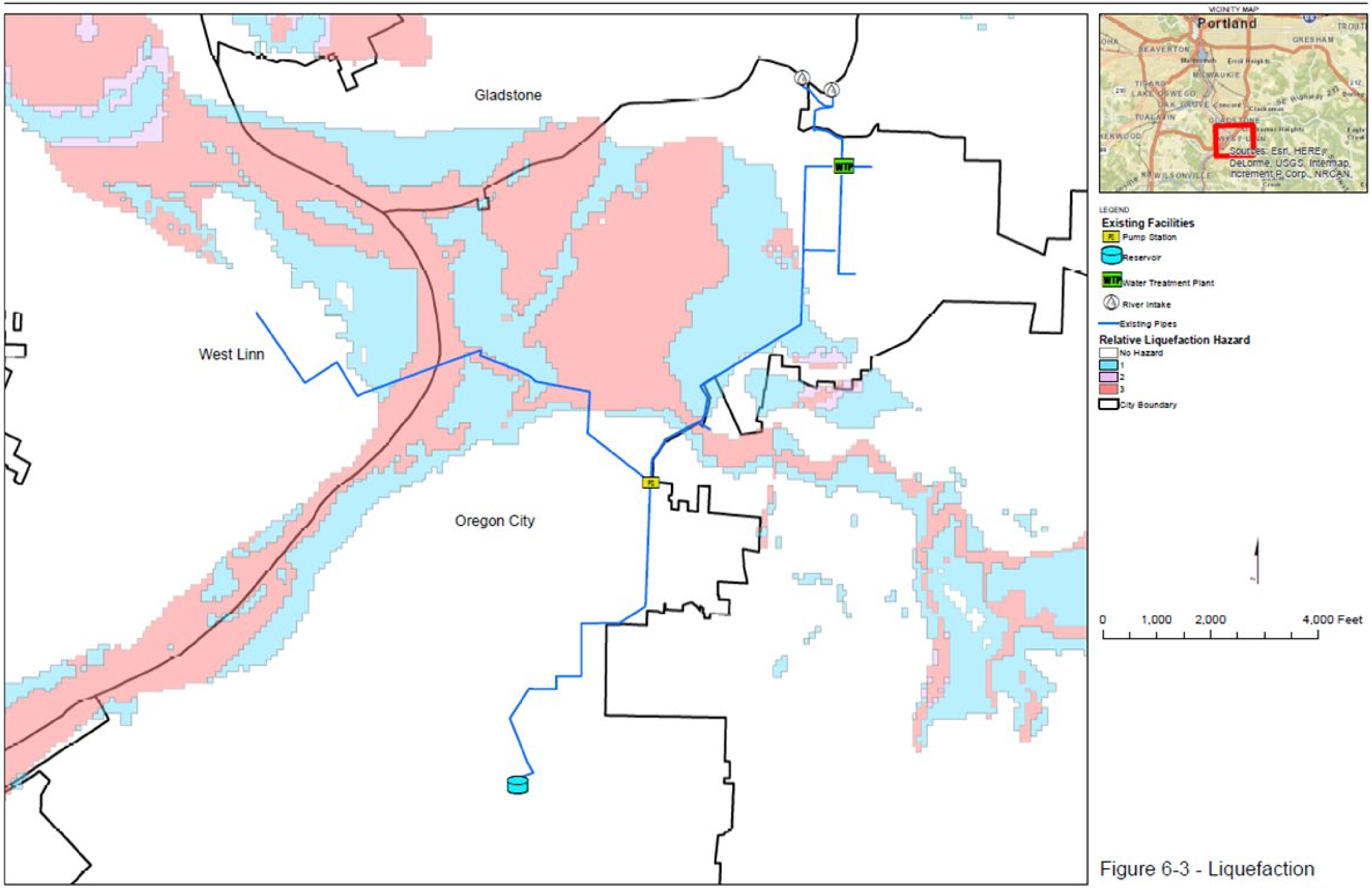

Figure 6-3 - Liquefaction

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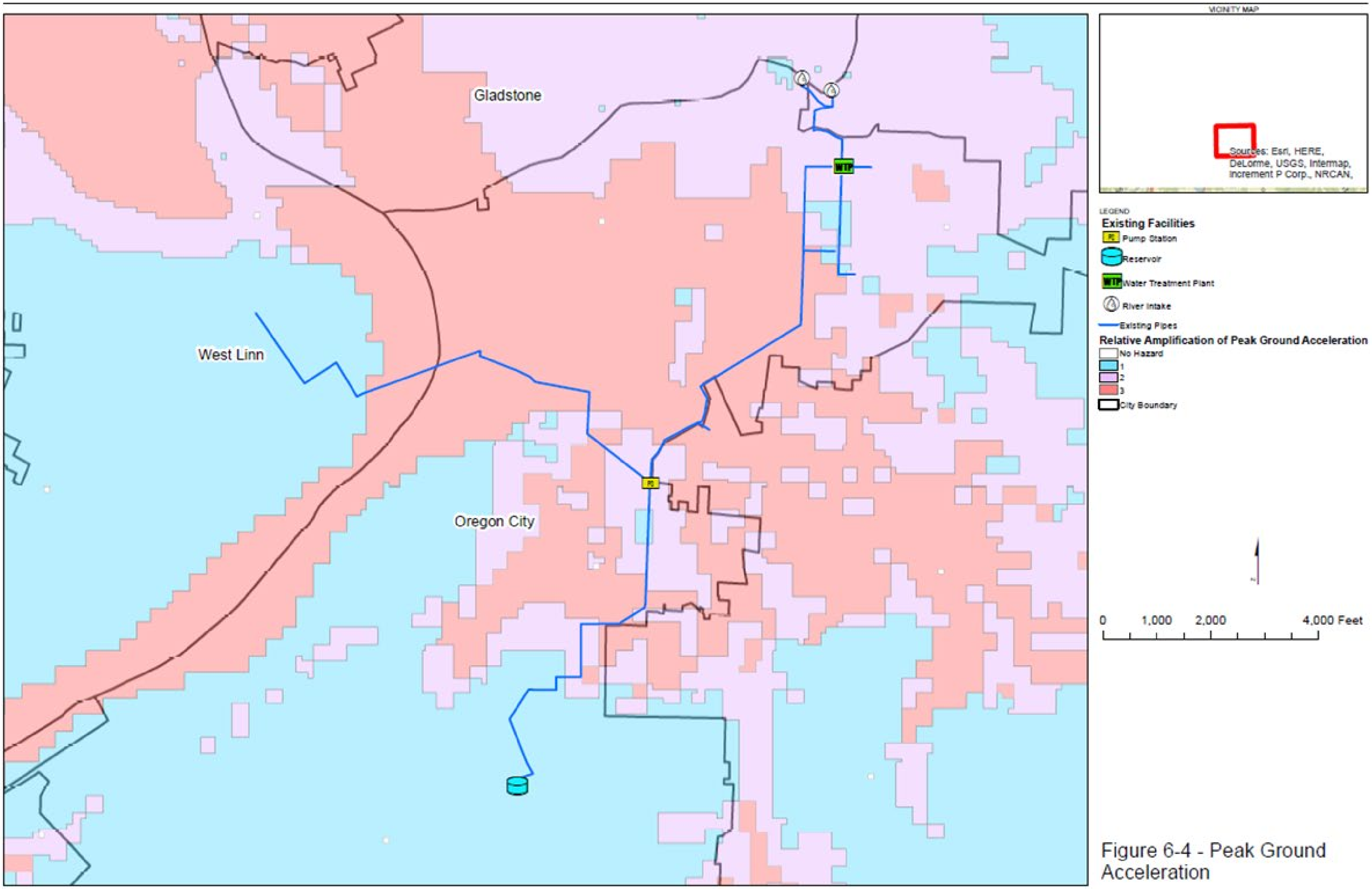

Figure 6-4 - Peak Ground Acceleration

Table 6-3. Resiliency of the Water Treatment Plant

Facility	Condition	Resiliency
Sedimentation basins	59 years old, some structural issues, cracking.	Likely fail during subduction event.
Headhouse and filters	59 years old, some minor structural issues.	Not designed to current structural code, but generally good concrete construction.
Clear wells	Three separate clear wells that vary in age from 59 years old to 7 years old.	The oldest clear well was constructed under the existing filters, and likely poses the biggest concern.
Chemical feed systems	Aging equipment, limited storage areas, some containment issues.	Equipment not seismically anchored.
Meeting facilities	Security and Americans with Disabilities Act compliance.	New meeting location would likely be needed.
Treatment Issues	T&O, algal toxins health advisory, emerging contaminants could be future issues.	Robust treatment process.
Solids disposal	Disposal regulations may change.	May see minor disruption.

Figure 6-7. Hydraulic Flocculators

Figure 6-8. Sedimentation Basin

Figure 6-9. Sedimentation Basins Concrete

Figure 6-10. Filter

Figure 6-11. SCADA Panel

Figure 6-12. Filter Controls

Figure 6-13. Alum Tank

Figure 6-14. Hypochlorite Feed System

Figure 6-15. Polymer Storage

Figure 6-16. Hypochlorite Tanks

6.7 Finished Water Transmission

The resiliency of the finished water transmission pipeline system is summarized in Table 6-4. The pipeline is 59 years old and is of concern for a seismic event. The slope stability and potential for failure is greatest along Abernethy Creek. A condition assessment of the pipeline is recommended. Routes and areas of concern are shown in Figure 6-17.

Table 6.4. Finished Water Transmission Resiliency

Facility	Condition	Resiliency
Finished water line near plant is on an active landslide. Areas of slope hazard, and liquefiable soils identified near Abernethy Creek. All transmission line is constructed of wire-wrapped, concrete-cylinder pipe.	59 year-old concrete-cylinder pipe. One pipe failure known, specific condition of pipe is unknown.	Pipeline would likely fail in a seismic event, especially near Abernethy Creek.

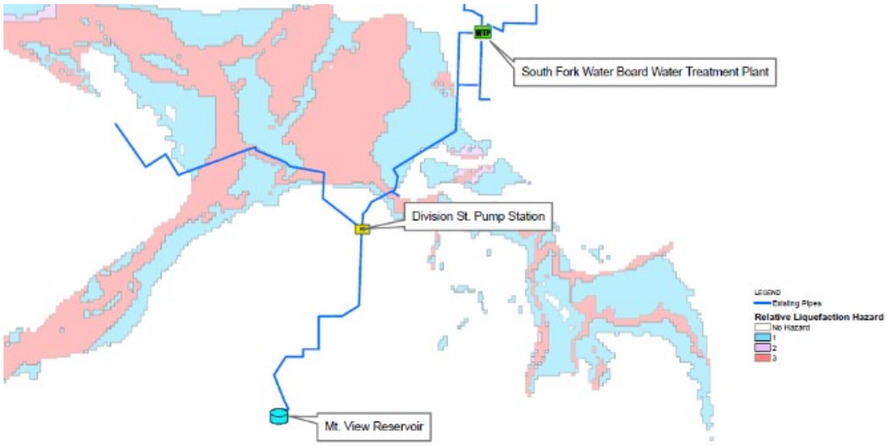

Figure 6-17. Finished Water Transmission Routes and Areas of Concern

6.7.1 Division Street Pump Station

The resiliency of the DSPS is summarized in Table 6-5. The pump station is in good condition, and was upgraded in 2005. A structural review and equipment anchoring are recommended.

Table 6-5. Division Street Pump Station Resiliency

Facility	Condition	Resiliency
The building is 59 years old, but equipment was rehabilitated in the 1990s.	Equipment is well maintained and in good condition.	Multiple units, backup power available. Equipment is not seismically anchored.

6.8 Emergency Drinking Water Treatment

Minimum drinking water requirements and information on similar equipment recently acquired in Oregon are summarized to support the future equipment procurement process, if SFWB decides to proceed. The cities that own SFWB (Oregon City and West Linn) may have differing perspectives on the need for emergency water treatment equipment, considering their physical separation and adjoining water systems. A decision would have to be made as to whether each City would have its own treatment unit, and what the source(s) of water should be for each City.

Three key per capita requirements are shown in Table 6-6 based on studies of "average" adults in "average" conditions. Actual needs vary by person and condition and increase greatly with hot weather and strenuous activity. The longer the emergency water supply interruption, the greater the needed per capita replacement capacity.

For an interruption only affecting a single water provider in the Portland area, nearby water systems and retail entities would be able to provide some short-term emergency support, and some affected customers would have the ability to temporarily relocate some or all of their household to unaffected areas. This would reduce the per capita water needs. For a large regional disaster, neighboring communities would be assumed to have limited or no surplus drinking water available and highway infrastructure would be assumed to be disrupted. The requirements listed in Table 6-6 are approximate. The value of 1 gallon per day per person is widely used for disaster planning. 1 to 2 gallons per day per person appears to be the appropriate capacity for sizing emergency equipment for the SFWB service area situation.

Table 6-6. Key Minimum Drinking Water Requirements

Gallons per Capita per Day	Gallons per Day Required for SFWB Service Area	Description for Average Adults in Average Conditions
0.5*	38,000	Minimum recommended for drinking only. Will need more during hot weather or strenuous work. Not sustainable for an extended duration without increased sanitary and health concerns.
11*	76,000	Allows for drinking and cooking. May need more during hot weather or strenuous work.
22*	152,000	Allows for drinking, cooking, allowance for hot weather and strenuous work and minimizing diseases.

Notes:

Illness, pregnancy also requires more water.

Historical wintertime water production from the SFWB WTP is ~79 gpcd (6.0 mgd) for Oregon City, West Linn, and CRW-South service areas

Current service population is approximately 76,000 (35,000 for Oregon City, 26,000 for West Linn, and 15,000 for CRW-S)

*Howard and Bartram, 2003, see text.

6.9 Oregon Emergency Water Treatment Trailers

There are four emergency water treatment trailers in Oregon owned by utilities: three in the Portland area, and one in Grants Pass. The City of Salem is currently planning construction of a trailer, and the Eugene Water and Electric Board has emergency water storage trailers (without treatment) that can be rapidly filled and deployed in an emergency.

The Regional Water Providers Consortium (RWPC) is a collection of Portland area water providers who jointly participate in regional planning, amongst other activities. A few years ago, the RWPC identified a need for emergency water treatment units in the Portland region as part of a regional disaster mitigation strategy. These units, while independently procured (as summarized in Table 6-7) are intended as regional emergency assets. As such, their capacities were selected to accommodate a manageable size of equipment trailer as opposed to supplying a target population or capacity. Photos of the equipment are included as Figures 6-18 and 6-19. Some key features are as follows:

- Up to 30,000 gpd capacity/per trailer, depending on raw water quality.
- Has raw water piping and pumping, although the unit must be located fairly close to the raw water source.
- Has treated water tank/bladder and a distribution tap, although additional distribution taps may be desirable to provide for faster distribution.
- Runs on electrical power with diesel-powered raw water pumps.

Table 6-7. Portland Area Treatment Unit Procurement

	Vendor	Cost	Date
Hillsboro	Global Remediation Solutions LLC	~$80,000	October 2014
Clackamas River Water	Global Remediation Solutions LLC	$80,000	May 2013
Lake Oswego	Tempest Environmental Unit	~$120,000	March 2012

The City of Grants Pass most recently procured an emergency treatment trailer, for a total project cost of approximately $150,000 and with an approximate capacity of 35,000 gpd. Detailed information can be obtained from Jason Canady, Public Works Director.

Figure 6-18. Selected Photos from Clackamas River Water's Emergency Water Treatment Trailer

Figure 6-19. Selected Photos from Lake Oswego's Emergency Water Treatment Trailer

6.10 Summary of Information Provided by RWPC

The following summarizes information provided by Rebecca Geisen, Portland Water Bureau:

Procurement:

- Three units purchased in the Portland Metro Area: Clackamas River Water, City of Lake Oswego, and City of Hillsboro.
- Funded by Urban Area Security Initiative (UASI) grants administered through Portland Water Bureau.
- Expected that SFWB would need to independently procure.
- Lake Oswego was first to procure. RWPC went through a laundry list of needed features and Kari Duncan and Kim Swan prepared specifications based on U.S. Federal Emergency Management Agency (FEMA) guidelines, etc.
- Prices have come down: when originally looking at these trailer units approximately 5 years ago, they were $200,000 to 300,000; now they are under $100,000.

Trailer Units:

- Up to 30,000 gpd each, depending on raw water quality, and equipped with LPMF technology.
- Have raw water piping and pumping.
- Have treated water tank/bladder and distribution tap.
- Run on electrical power for lights and finished water pump; raw water pumps are diesel powered.
- Otherwise, complete units (no other equipment procurement needed to operate).
- The GE Home Spring membrane filters are not OHA approved, so the unit cannot be connected to the distribution system except for an actual emergency. Baker City wanted to use a unit to take their WTP offline for some work and OHA said no. (CRW and Hillsboro reported that the GE Home Spring filters are no longer produced because that division of the company was sold to Pentair.)
- There is a different filter unit that is approved in California. Rebecca Geisen did not know of anyone currently trying to get approvals from OHA.

Other Portland Region Equipment:

- Nine water distribution manifolds (Figure 6-20) have been assembled. These are portable units that can be used to connect to a working distribution system, or to fill sanitary bags. The bags can then be distributed to areas of need.
- There are about 250,000 sanitary bags distributed over several providers.
  - 6 quart.
  - Sanitary - no need for further disinfection before use.
  - 7-year shelf life.
  - Approximately $1 per bag. Originally purchased with UASI grant money.

Other Treatment Systems:

- There are off-the-shelf treatment units available and in use. These tend to be more expensive.
  - National Guard has units

  - Portland Fire has prefabricated skid-mounted units

- Smaller systems have been procured for local emergency responders and Portland Water Bureau staff in emergencies:
  - 2 gpm via ceramic filtration (2,000 gpd maximum—probably less in practice)
- Approximately $3,500

Figure 6-20. Photos of Distribution System Manifolds

6.11 Summary of Comments—Procured Water Treatment Equipment

Water system staff comments and feedback on the procured systems are summarized below. Based on these general comments, it is recommended that SFWB anticipate reviewing and improving the equipment procurement specification, if the Board decides to acquire one or more units. The comments about the Global Remediation Solutions Trailers (procured by CRW and Hillsboro) are as follows:

1. First trailers by this firm. Operational layout could be improved. Might consider laying out the equipment in the specification.
2. No turbidimeters, chlorine analyzers. Limited instrumentation.
3. Manual filter backwashing required.
4. No O&M or troubleshooting guide/manual.
5. Limited spare parts/extra filters—unit may not fully operate for extended duration.
6. Concern about keeping membrane filters preserved properly after put into service.
7. No training included.
8. With the lack of OHA approval, the units are anticipated to be operated under a boil-water condition. OHA approved filtration is desirable.
9. Some of the equipment fasteners may need to be strengthened to allow for reliable transport, accounting for jarring and vibration.

6.12 Phased Improvements

Phasing of improvements to include resiliency improvements is recommended in development of the CIP, discussed in Section 7. Four phases have been developed as follows:

1. High Priority Improvements
2. Expansion to 30 mgd
3. Expansion to 40 mgd

4. Expansion to 52 mgd

With each phase of improvements, resiliency of the SFWB system is increased, as shown in Table 6-8.

Table 6-8. Phased Resiliency Improvements

Phase	1 Highest Priority Projects	2 Expansion to 30 mgd	3 Expansion to 40 mgd	4 Expansion to 52 mgd
Projects	New chemical building SCADA upgrades Pipeline condition assessment Raw water pipeline Emergency treatment trailers Finished water pipeline Hunter Avenue to Cleveland	New sedimentation basin Ozone System Rapid mix system Structural upgrades Filter improvements Electrical upgrades Miscellaneous plant Plant piping improvements Finished water piping	RWPS improvements Two new flocculation/ sedimentation basins Plant piping Backup generator Miscellaneous Electrical Mechanical dewatering	WTP expansion Raw water pumps Division street pumps
Impact on Level of Service	No expansion of capacity Improves operational control	Improves ability to meet future growth needs	Improves ability to meet future growth needs Improves taste and odor	Meets future water supply needs for full water right
Impact on System Resiliency & Reliability	Emergency treatment New raw water line Eliminates known problem area on finished water line	Resiliency goals for water plant and pipelines partially met	Adds resiliency for raw water pumps and backup power at WTP	Meets goals of ORP
Impact on Regulatory Compliance & Water Quality	Better monitoring and control Meets chemical storage requirements	Some improved organics removal with filter improvements	Meets known future drinking water quality regulations for the Clackamas supply	Meets known future drinking water, chemical, and sludge regulations.

SECTION 7

Capital Improvement Plan

7.1 Introduction

Current supply capacities for SFWB are summarized in Table 7-1. Much of the SFWB system was originally configured with a capacity of 20 to 25 mgd. The existing demand is approaching the capacity of many of the supply components, other than the raw water intake and pump station. The demand forecast for SFWB shows that the system will require expansion to 30 mgd soon, which will enable SFWB to meet demands through 2036.

Table 7-1. Existing Capacity Evaluation for SFWB

SFWB Component	**Current Capacity**	**Current Demand**
Clackamas River Intake	52 mgd	22 mgd
Raw Water Pump Station	30.8 mgd Firm capacity[a]	22 mgd
Raw Water Transmission	22 mgd	22 mgd
WTP—Rapid Mix	22 mgd	22 mgd
WTP—Flocculation and Sedimentation	22 mgd	22 mgd
WTP—Filters	30 mgd	22 mgd
WTP—Clear Wells	52 mgd	22 mgd
Finished Water Transmission—WTP to DSPS	21.9 mgd	20 mgd
Finished Water Transmission – WTP to Hunter Ave PS		0.51 mgd
DSPS	17.6 mgd Firm capacity	17 mgd
Operational Storage	2.8 MG	0.1 MG
Emergency Storage	2.8 MG	0.4 MG
Finished Water Transmission—DSPS to Mountain View Reservoir	17.6 mgd	16.9 mgd
Finished Water Transmission—DSPS to Bolton Reservoir	10 mgd	8.1 mgd

[a] Assumes increased raw water transmission capacity.

7.2 Capital Improvement Plan

The CIP includes projects that can be categorized into four phases:

1. High Priority Improvements
2. Expansion to 30 mgd
3. Expansion to 40 mgd
4. Expansion to 52 mgd

The recommended CIP includes the high priority projects being constructed in the next 2 years and expansion of the supply and treatment system to 30 mgd over the next 5-year period. An expansion to 40 mgd will be needed in approximately 2031, assuming additional demands included in the demand projections materialize. Capacity expansion time frames are shown in Figure 7-1.

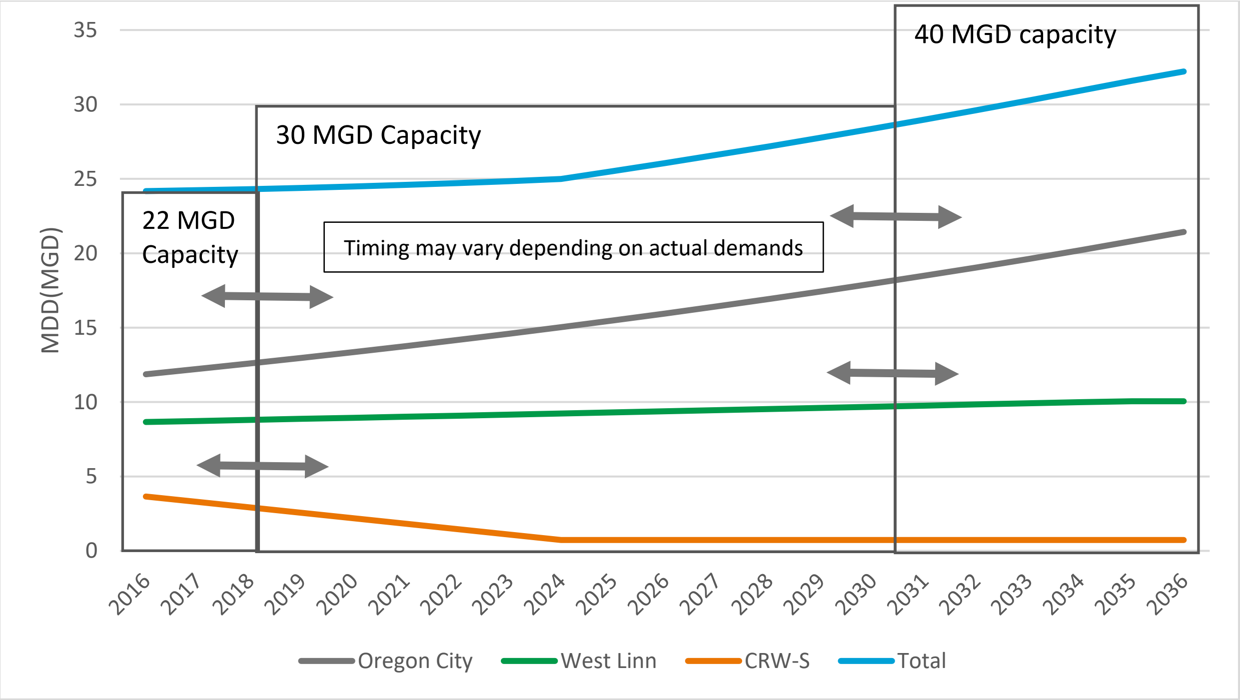

Figure 7-1. Capacity Expansion Timeframes

OC = Oregon City; WL = West Linn

This section contains a summary of the capital improvements developed in the preceding sections for the SFWB WTP and water conveyance system. The improvements were developed to serve existing 2015 and projected build-out demands for the cities of West Linn and Oregon City as well as the current demand of CRW-S. It should be noted that the level of detail provided in the CIP is intended to supply a general description of the project along with a Class 5 cost estimate, as defined by the AACE International Classification System. Project-specific details will need to be verified through the design process. Cost estimates are included in this section for budget planning purposes.

7.3 Capital Improvement Plan Summary

The CIP was developed from the analysis completed in this update to the water master plan for the next 20-year period based on the demand projections included in Section 1. Each improvement has been identified in Table 7-1 and has been assigned to one of three categories: high priority improvements, 30 mgd system upgrades and 40 mgd system upgrades. The schedule for the system improvements is largely dependent on the water demand for SFWB; however, since the peak day demand has already nearly reach the capacity of the WTP, it is recommended that the 30 mgd improvements be completed within the next 5-years. The raw water transmission line should also be replaced in the next 2 years. Figure 7-3 provides a graphical summary of the CIP.

7.4 High Priority Projects

SFWB identified six high priority projects. These projects should be completed during the 2017 and 2018 fiscal years:

1. **New Chemical Building**: Alum, polymer, sodium hypochlorite, and soda ash will be consolidated into a new building at SFWB. New pump skids with redundancy and piping will be installed. This building will also accommodate an ADA-accessible meeting room.
2. **SCADA Upgrades**: Improve field devices, controllers, communication programming, paging system, human-machine interface (HMI) hardware and software, and other SCADA components. This project could include conversion to automated meter reading for the master meters.
3. **Pipeline Condition Assessment and Lining**: Assess all transmission piping for condition and structural deficiencies. For CIP planning we have assumed that all of the raw water piping and finished water piping will require a structural liner installed inside of the existing piping. If the condition assessment is favorable, the entire amount of the lining ($7,000,000) may not be needed.
4. **Raw Water Pipeline**: Water demand is at capacity of the existing 27-inch-diameter raw water transmission main, and the pipe is located in a steep slope area leading to concerns about instability. This improvement includes the design and construction of a new 42- or 48-inch-diameter raw water transmission main from the RWPS to the WTP. This main would be capable of conveying the 52 mgd ultimate flow. For planning purposes and until an alignment study is completed for the new main, 1,800 feet of steel water main is assumed to be constructed. Demolition of the old intake is included in this project.
5. **Emergency Treatment Trailers**: Provide two emergency treatment trailers for use in the weeks following a Cascadia event. Utilize the trailers as points for water distribution until the WTP can be brought back online.
6. **Finished Water Pipeline Hunter Avenue to Cleveland**: This project will provide additional capacity and resiliency for the finished water transmission pipeline that is directly across the street from the WTP and located on an active land slide.

7.5 30 mgd Demand System Upgrades

Capital improvements identified to bring the conveyance and treatment capacity to 30 mgd are described below. Expansion would be preceded by 2 years of piloting and design, and construction is estimated to take 2 years. The new finished water transmission pipeline would be built in segments over the 6 years following the WTP expansion. The 30 mgd improvements are as follows:

1. **WTP Expansion**: Primary elements of the plant upgrades are a rapid mix vault; new 10 mgd flocculation and sedimentation basin; ozone system, two new GAC filters; structural and cosmetic improvements to the existing flocculation, sedimentation basin, and headhouse; miscellaneous yard piping and site work; new plant electrical service; and upgrades to instrumentation and controls.
2. **Finished Water Transmission Pipeline**: Upgrade finished water transmission pipeline between the WTP and Mountain View Reservoir to provide sufficient future capacity. Expansion of the DSPS is included in this project.
3. **Sustainable Energy**: SFWB intends to implement sustainable energy as part of the project, potentially solar panels located on the new sedimentation basins. A capital budget has not been added to the project, since the Board intends to pursue grant funding for this aspect of the project.

7.6 40 mgd Demand System Upgrades

Capital improvements identified to bring the conveyance and treatment capacity to 40 mgd are described below. These improvements are in addition to those described previously for the 30 mgd capacity. The improvements are as follows:

1. **WTP Expansion**: The major components of the expansion include two new 15 mgd flocculation and sedimentation basins, expand ozone system, two new filters, three centrifuges, two-story centrifuge building, two 25-foot diameter thickeners, thickened sludge pump station, electrical modifications, and electrical and instrumentation for mechanical dewatering system.
2. **Sustainable Energy**: SFWB intends to implement sustainable energy as part of the project, potentially solar panels located on the new sedimentation basins. A capital budget has not been added to the project, since the Board intends to pursue grant funding for this aspect of the project.

7.7 Cost Estimate Summary

The cost estimates developed for the proposed improvements are Class 5 estimates as defined by the AACE International Classification System, and should be updated for specific project conditions when implementation is imminent. The estimates are based on CH2M's CPES cost estimating system and are expressed in 2016 dollars. An ENR CCI Seattle August 2016 value of 10596. A 20 percent construction contingency and a 20 percent allowance for legal, engineering, and administrative costs are included in each estimate. Detailed cost estimates should be developed during the design phase for each improvement project.

7.8 20-Year Capital Improvement Plan

The CIP presented in Table 7-2 (provided at the end of this section) shows individual projects, project purpose, estimated costs, and the projected phasing. The actual growth in demand should be monitored, and available funding should be evaluated to determine the actual schedule of implementation.

7.9 System Development Charges

SDCs will be revised based on the adopted CIP and included in the final version of the Water Master Plan. Table 7-3 shows the costs included in the Rates and those funded by SDCs from the CIP.

Table 7-3. CIP Funding by Rates and SDCs

SFWB Component	Rate Funding	SDC Funding
High Priority Projects		
New Chemical Building	846,154	1,153,846
SCADA Upgrades	105,769	144,231
Pipeline Condition Assessment & Lining	7,600,000	-
Raw Water Pipeline	-	2,810,000
Emergency Treatment Trailers	126,923	173,077
Finished Water Pipeline on Cleveland St	-	900,000
30 MGD Expansion	568,098	34,489,902
40 MGD Expansion	426,462	21,063,538
Total	**$9,673,406**	**$60,734,594**

Table 7-1. South Fork Water Board, 2016 Water Master Plan, Capital Improvement Plan

Project	2016 Cost	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030	FY 2031	FY 2032	FY 2033	FY 2034	FY 2035	FY 2036	% Rates	% SDCs
High Priority Projects	**13,860,000**	**3,292,000**	**3,568,000**	-	-	-	-	-	-	-	-	-	-	**3,500,000**	**3,500,000**	-	-	-	-	-	-		
H-1 New Chemical Building	2,000,000	2,000,000																				42%	58%
H-2 SCADA Upgrades	250,000	250,000																				42%	58%
H-3 Pipeline Condition Assessment & Lining	7,600,000		600,000											3,500,000	3,500,000							100%	0%
H-4 Raw Water Pipeline	2,810,000	562,000	2,248,000																			0%	100%
H-5 Emergency Treatment Trailers	300,000	300,000																				42%	58%
H-6 Finished Water Pipeline on Hunter Ave to Cleveland	900,000	180,000	720,000																			0%	100%
30 MGD Expansion	**13,860,000**	**3,292,000**	**3,568,000**	-	-	-	-	-	-	-	-	-	-	**3,500,000**	**3,500,000**	-	-	-	-	-	-		
30 – 1a Rapid Mix/Flowmeter Vault (connects to new 42” RW pipe)	672,000			67,200	67,200	268,800	268,800															0%	100%
30 – 1b 30” Coagulated Water pipe to new Floc/Sed Basin	168,000			16,800	16,800	67,200	67,200															0%	100%
30-1c Intermediate Ozonation System (1,000 ppd) incl. contactor and generator/bldg**	6,748,000															674,800	674,800	2,699,200	2,699,200			0%	100%
30-1d Re-route 8” recycle pipe to upstream of Rapid Mix Vault	28,000			2,800	2,800	11,200	11,200															0%	100%
30-1e Structural/cosmetic improvements to existing floc/sed basins	168,000			16,800	16,800	67,200	67,200															42%	58%
30-1f Structural/cosmetic improvements to existing Headhouse	168,000			16,800	16,800	67,200	67,200															42%	58%
30-1g New 10 MGD Floc/Sed Basin (with sludge collectors)	4,634,000			463,400	463,400	1,853,600	1,853,600															0%	100%
30-1h 36” Settled Water pipe to filters	168,000			16,800	16,800	67,200	67,200															0%	100%
30-1j Two new filters (896sf each, with GAC/sand dual media + air scour)	5,488,000			548,800	548,800	2,195,200	2,195,200															0%	100%
30-1k Modify 4 existing filters with GAC/sand dual media + air scour)	840,000			84,000	84,000	336,000	336,000															42%	58%
30-1l Modify Headhouse lower level for Workshop and Storage	168,000			16,800	16,800	67,200	67,200															42%	58%
30-1m Misc. Yard Piping	168,000			16,800	16,800	67,200	67,200															0%	100%
30-1n Site Work	168,000			16,800	16,800	67,200	67,200															0%	100%
30-1o New Plant Electrical Service (located near New Chemical Building)	336,000			33,600	33,600	134,400	134,400															0%	100%
30-1p Electrical and Instrumentation upgrades and modifications	336,000			33,600	33,600	134,400	134,400															0%	100%
30-2 Finished Water Transmission Pine	14,800,000							1,480,000	1,480,000	2,960,000	2,960,000	2,960,000	2,960,000									0%	100%
Expansion to 40 MGD	**21,490,000**															**2,149,000**	**2,149,000**	**8,596,000**	**8,596,000**				
40-1a Demolish Existing/Older Floc/Sed Basins	336,000															33,600	33,600	134,400	134,400			0%	100%
40-1b 36” Coagulated Water pipe to new Floc/Sed Basins	252,000															25,200	25,200	100,800	100,800			0%	100%
40-1c 2 New 15 MGD Floc/Sed Basin (with plate settlers and sludge collectors)	9,702,000															970,200	970,200	3,880,800	3,880,800			0%	100%
40-1d 42”” Settled Water pipe to filters	252,000															25,200	25,200	100,800	100,800			0%	100%
40-1e 300 kW Diesel Generator (inside bldg) and related electrical modifications	504,000															50,400	50,400	201,600	201,600			42%	58%
40-1f Misc. Yard Piping	168,000															16,800	16,800	67,200	67,200			0%	100%
40-1g Site Work	168,000															16,800	16,800	67,200	67,200			0%	100%
40-1h Electrical and Instrumentation upgrades and modifications	336,000															33,600	33,600	134,400	134,400			0%	100%
40-1i Three centrifuges, feed pumps, polymer systems and other mechanical systems	2,534,000															253,400	253,400	1,013,600	1,013,600			0%	100%
40-1j Two-story centrifuge building (includes HVAC systems, built for addition of future equipment)	2,534,000															253,400	253,400	1,013,600	1,013,600			0%	100%
40-1k Two 25-foot diameter thickeners	1,008,000															100,800	100,800	403,200	403,200			0%	100%
40-1l Thickened sludge pump station	504,000															50,400	50,400	201,600	201,600			0%	100%
40-1m One 100,000-gal thickened solids holding tank, mixers and support systems	420,000															42,000	42,000	168,000	168,000			0%	100%
40-1n Install automated sludge collectors in 2 existing floc/sed basins**	672,000															67,200	67,200	268,800	268,800			0%	100%
40-1o Re-line existing BW ponds and replace transfer pumps	504,000															50,400	50,400	201,600	201,600			42%	58%
40-1p Yard Piping	168,000															16,800	16,800	67,200	67,200			0%	100%
40-1q Site Work	168,000															16,800	16,800	67,200	67,200			0%	100%
40-1r Electrical and Instrumentation for mechanical dewatering systems (15%)	1,260,000															126,000	126,000	504,000	504,000			0%	100%
Total by Fiscal Year	**69,908,000**	**2,792,000**	**3,568,000**	**1,351,000**	**1,351,000**	**5,404,000**	**5,404,000**	**1,480,000**	**1,480,000**	**2,960,000**	**2,960,000**	**2,960,000**	**2,960,000**	**3,500,000**	**3,500,000**	**2,823,800**	**2,823,800**	**11,295,200**	**11,295,200**	**-**	**-**		

SECTION 8

References

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Appendix A
Oregon City WTP Facility Plan Approval Document

Appendix B
SDC Methodology

Contact:

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www.ch2m.com

APPENDIX D
CITY OF WEST LINN
EMERGENCY OPERATIONS PLAN

1009551.0001.02-B4852

City of West Linn, Clackamas County, Oregon
Emergency Operations Plan

Prepared for:

City of West Linn,
Clackamas County, Oregon

Prepared by:

ecology and environment, inc.
Global Environmental Specialists

City of West Linn
Clackamas County, Oregon
EMERGENCY OPERATIONS PLAN

2017 Update

Prepared for:

City of West Linn
22500 Salamo Road
West Linn, OR 97068

Prepared by:

ecology and environment, inc.
Global Environmental Specialists

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Immediate Action Checklist

Use the following Immediate Action Checklist to initiate the City of West Linn's response to and support of an emergency incident. If you are not qualified to implement this plan, dial 9-1-1 and ask for assistance.

1. **Receive alert of incident.**
    - Alerts should be directed to the City Emergency Manager.
    - If the City Emergency Manager is not available, alerts should be directed to the Police Chief or Fire Chief.
    - Alerts may be received through 9-1-1 dispatch, responding agencies, the on-scene Incident Commander, the public, or other sources.
    - If you are the first person receiving notification of the incident, call 9-1-1 and provide as much detail as possible.
2. **Determine need to implement the City's Emergency Management Organization.**
    - The City Emergency Manager should determine, in coordination with the on-scene Incident Commander, what level of support is needed from the City for the incident. This may range from the City Emergency Manager being on stand-by to full activation of the City Emergency Operations Center.
    - Identify key personnel who will be needed to support City emergency operations, including staffing of the City Emergency Operations Center, if activated.
3. **Notify key City personnel and response partners.**
    - The City Emergency Manager will notify key personnel to staff the City Emergency Operations Center based on incident needs.
    - Notify appropriate emergency response agencies.
    - *See the City Emergency Contact List maintained by the City Emergency Manager.*
4. **Activate the City Emergency Operations Center as appropriate.**
    - The City will utilize the Incident Command System in managing the City Emergency Operations Center.
    - Primary Emergency Operations Center Location: West Linn Police Department, 1800 8th Avenue, West Linn, OR
    - Alternate Emergency Operations Center Location: West Linn City Hall, 22500 Salamo Road, West Linn, OR 97068
    - *See Section 5.4 of this plan for information on Emergency Operations Center operations.*
5. **Establish communications with the on-scene Incident Commander.**
    - Identify primary and back-up means to stay in contact with the on-scene Incident Commander.
    - The on-scene Incident Commander may assign a radio frequency that the City Emergency Operations Center can use to communicate with the scene.
    - *See Emergency Support Function Annex 2 - Communications of this plan for more information on communications systems.*

6. **Identify key incident needs, in coordination with the on-scene Incident Commander.**
    - Consider coordination of the following, as required by the incident:
        - Protective action measures, including evacuation and shelter-in-place;
        - Shelter and housing needs for displaced individuals;
        - Emergency public information and coordination with the media;
        - Provisions for access and functional needs populations, including unaccompanied children;
        - Provisions for animals in disaster.
7. **Inform the County and Oregon Emergency Response System of Emergency Operations Center activation and request support as needed.**
    - Clackamas County Disaster Management: 503-655-8378
    - Oregon Emergency Response System: 800-452-0311
    - If there is an oil or chemical spill to report, responsible parties should call the National Response Center at 800-424-8802.
8. **Declare a state of emergency for the City, as appropriate.**
    - If the incident has overwhelmed or threatens to overwhelm the City's resources to respond, the City should declare a state of emergency.
    - A declaration may be made by the City Council or City Manager. A declaration made by the City Manager should be ratified by Council as soon as practicable.
    - The declaration should be submitted to Clackamas County Disaster Management
    - *See Section 1.7 of this plan for information on the disaster declaration process. See Appendix A for a sample disaster declaration form.*

Preface

This Emergency Operations Plan is an all-hazard plan that describes how the City of West Linn will organize and respond to emergencies and disasters in the community. It is based on, and is compatible with, federal, State of Oregon, and other applicable laws, regulations, plans, and policies, including Presidential Policy Directive 8, the National Response Framework, Oregon Office of Emergency Management plans, and Clackamas County Emergency Operations Plan.

Response to emergency or disaster conditions in order to maximize the safety of the public and minimize property damage is a primary responsibility of government. It is the goal of the City of West Linn that responses to such conditions are conducted in the most organized, efficient, and effective manner possible. To aid in accomplishing this goal, the City of West Linn has, in addition to promulgating this plan, formally adopted the principles of the National Incident Management System, including the Incident Command System and the National Response Framework.

Consisting of a Basic Plan and annexes, this Emergency Operations Plan is aligned with the Clackamas County Emergency Operations Plan and provides a framework for coordinated response and recovery activities during a large-scale emergency. The plan describes how various agencies and organizations in the City of West Linn will coordinate resources and activities with other federal, state, local, community- and faith-based organizations, and private-sector partners.

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Letter of Promulgation

To All Recipients:

Promulgated herewith is the Emergency Operations Plan for the City of West Linn. This plan supersedes any previous plans. It provides a framework within which the City can plan and perform its emergency functions during a disaster or national emergency.

This Emergency Operations Plan attempts to be all-inclusive in combining the following five mission areas of emergency management to ensure that the City is prepared to prevent, protect against, mitigate the effects of, respond to, and recover from the hazards and threats that pose the greatest risk to the City:

- **Prevention:** activities necessary to avoid, prevent, or stop a threatened or actual act of terrorism;
- **Protection:** activities necessary to secure the City against acts of terrorism and natural or human-caused disasters;
- **Mitigation**: activities that reduce loss of life and property by lessening the impact of disasters;
- **Response**: activities necessary to save lives, protect property and the environment, and meet basic human needs after an incident has occurred; and
- **Recovery**: activities necessary to assist the community in recovering effectively from a disaster.

This plan has been reviewed by the Emergency Manager and approved by the City Council. It will be revised and updated as required. All recipients are requested to advise the Emergency Manager of any changes that might result in its improvement or increase its usefulness. Plan changes will be transmitted to all addressees on the distribution list.

Russ Axelrod, Mayor	Brenda Perry, Council President
Teri Cummings, Councilor	Bob Martin, Councilor
Richard Sakelik, Councilor	DATE

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Plan Administration

The West Linn Emergency Operations Plan, including appendices and annexes, will be reviewed and updated on an annual basis or as needed after an incident or exercise. The plan will be formally re-promulgated by the West Linn City Council once every five years.

Record of Plan Changes

All updates and revisions to the plan will be tracked and recorded in the following table. This process will ensure the most recent version of the plan is disseminated and implemented by emergency response personnel.

Date	Change No.	Department	Summary of Change
2010	Original Release		Original Release
2012	2012-001		Update and bring overall information and formatting in line with EOPs throughout the State of Oregon
2017	2017-001		Update information and bring overall information and formatting in line with the County EOP.

Plan Distribution List

Copies of this plan have been provided to the following jurisdictions, agencies, and persons electronically, unless otherwise noted. Future updates will be provided electronically and recipients are responsible for updating their copy of the EOP when changes are received. The West Linn Emergency Manager is ultimately responsible for all plan updates. Updates should be provided to the Emergency Manager at any time.

Date	Hard Copies	Jurisdiction/Agency/Person
		City Attorney
		City Building Director
	1	City Emergency Manager
	1	City Emergency Operations Center
		City Finance Director
		City Human Resources Director
		City Information Services Director
	1	City Manager
		City Mayor and City Councilors
		City Parks and Recreation Director
		City Planning Director
		City Police Chief
	1	City Public Works Director
		City Recorder
	1	Clackamas County Emergency Management
	1	Oregon Emergency Management
	1	Tualatin Valley Fire and Rescue Emergency Manager
		Clackamas County Department of Disaster Management
		Washington County Emergency Management Cooperative
		Multnomah County Office of Emergency Management
		Oregon Military Department, Office of Emergency Management

Emergency Operations Plan Review Assignments

The following table contains basic plan and annex assignments for corrections and/or changes. Changes will be forwarded to the Emergency Manager for revision and dissemination of the plan. Responsibility for the maintenance of these specific annexes lies with those listed below. This does not preclude other departments and agencies with a vital interest in the annex from providing input to the document; such input is, in fact, encouraged.

Section/Annex	Responsible Party
Basic Plan	City Emergency Manager
Emergency Support Function (ESF) Annexes	
ESF 1 – Transportation	City Public Works Department
ESF 2 – Communications	City Police Department Information Technology Department
ESF 3 – Public Works	City Public Works Department
ESF 4 – Firefighting	City Police Department
ESF 5 – Information & Planning	City Police Department City Manager's Office (Citizen Engagement Coordinator)
ESF 6 – Mass Care	City Police Department
ESF 7 – Resource Support	City Finance Department
ESF 8 – Health & Medical	City Police Department
ESF 9 – Search & Rescue	City Police Department
ESF 10 – Hazardous Materials Response	City Police Department
ESF 11 – Food & Water	City Finance Department
ESF 12 – Energy	City Public Works Department
ESF 13 – Military Support	City Police Department
ESF 14 – Public Information	City Manager's Office (Citizen Engagement Coordinator)
ESF 15 – Volunteer & Donations Management	City Manager's Office
ESF 16 – Law Enforcement	City Police Department
ESF 17 – Agriculture and Animal Protection	City Parks and Recreation Department City Manager's Office
ESF 18 – Business and Industry	City Manager's Office

Section/Annex	Responsible Party
Support Annexes (SA)	
SA 1 – Continuity of Service	City Emergency Manager
Incident Annexes (IA)	
IA 1 – Incident Annex	City Emergency Manager

Basic Plan

Basic Plan Table of Contents

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1 Introduction

This section establishes the framework within which this Emergency Operations Plan (EOP) exists and how it fits into existing plans. Additionally, the section outlines federal, state, county, and city emergency management authorities pertaining to the community's roles and responsibilities.

1.1 General

The City of West Linn's (City's) emergency management mission is to ensure that the City is prepared for a disaster by ensuring coordination of protection, prevention, mitigation, response, and recovery activities that increase the City's capabilities to minimize loss of life and reduce impacts from disasters.

Emergencies are handled effectively in the City every day. These "routine" emergencies are managed by emergency responders as part of their day-to-day responsibilities and are the most common emergency management activities that the City encounters. For the most part, this type of emergency is handled by individual responders or a team of responders who work together regularly to save lives, contain threats, and minimize damage. While the principles described in this EOP can also be applied to these daily responses, the plan is primarily designed to offer guidance for larger or more complex incidents related to a broad spectrum of hazards that exceed the response capability and/or resources of front line responders.

No plan can anticipate all the situations and conditions that may arise during emergencies, and on-scene Incident Commanders must have the discretion to act as they see fit based on the specific circumstances of the incident at hand. It is imperative, however, that all jurisdictions and response agencies have a plan that provides general guidance and a common framework for preparing for, responding to, and recovering from emergencies and disasters. This plan promulgates such a framework within the City that will bring a combination of technical capabilities and resources, plus the judgment and expertise of its emergency response personnel, department directors, and other key stakeholders to bear on any incident. This EOP provides the foundation and guidance for use of National Incident Management System (NIMS) principles necessary to effectively manage incidents within or affecting the City.

1.1.1 Whole Community Planning

Every person who lives or works in the City (including vulnerable populations) shares responsibility for minimizing the impact of disasters on the community. This includes all emergency management partners, both traditional and nontraditional, such as volunteer-, faith-, and community-based organizations; the private sector; and the public, including survivors of an incident. These individual responsibilities include hazard awareness, knowledge of appropriate protective actions, taking proactive steps to mitigate the impact of anticipated hazards, and preparations for personal and family safety, as well as the self-sufficiency of neighborhoods. To the greatest extent possible, the City will assist its residents in carrying out this responsibility by providing preparedness information, as well as emergency public information and critical public services during a disaster. However, a major emergency is likely to damage the City's critical infrastructure and reduce the workforce available to continue essential government services. Knowledgeable residents, who are prepared to take care of themselves and their families, and to assist neighbors in the early phases of an emergency, can make a significant contribution towards community survival and resiliency.

1.2 Purpose and Scope

1.2.1 Purpose

The primary purpose of the EOP is to outline the City's all-hazard approach to emergency operations in order to protect the safety, health, and welfare of its residents and visitors throughout all emergency management mission areas. Through this EOP, the City designates NIMS and the Incident Command System (ICS) as the frameworks within which all emergency management activities will be conducted.

1.2.2 Scope

The EOP is implemented whenever the City must respond to an emergency incident or planned event whose size or complexity is beyond that normally handled by routine operations. Such occurrences may include natural, technological, or human-caused disasters and may impact unincorporated areas of Clackamas County County), incorporated municipalities, or a combination thereof. This plan is intended to guide the City's emergency operations while complementing and supporting the emergency response plans and procedures of responding agencies, other local governments, special districts, and other public, nonprofit/volunteer, and private-sector entities.

A community's emergency management infrastructure is a complex network of relationships. The EOP establishes roles, responsibilities, and relationships among agencies and organizations involved in emergency operations, thereby facilitating multi-agency and multi-jurisdiction coordination. Using this framework, City departments and agencies that operate under this plan are expected to develop and keep current lines of succession and standard operating procedures (SOPs) that describe how emergency tasks will be performed. Training and equipment necessary for response operations should be maintained by City departments and agencies.

The primary users of this plan are elected officials, department heads and their senior staff members, emergency management staff, coordinating response agencies, and other stakeholders that support emergency operations. The general public is also welcome to review non-sensitive parts of this plan to better understand how the City manages emergency operations.

1.3 Plan Implementation

Once promulgated by the City Council, this EOP is in effect and may be implemented in whole or in part to respond to:

- Incidents in or affecting the City;
- Health emergencies in or affecting the City; and/or
- Non-routine life-safety issues in or affecting the City.

An emergency declaration is not required in order to implement the EOP or activate the Emergency Operations Center (EOC). The Emergency Manager may implement the EOP as deemed appropriate for the situation or at the request of an on-scene Incident Commander.

1.4 Plan Organization

EOP Basic Plan

The Basic Plan provides a framework for emergency operations and information regarding the City's emergency management structure. It serves as the primary document outlining roles and responsibilities of City departments and partners during an incident.

Emergency Support Function Annexes (ESFs)

The ESFs focus on critical tasks, capabilities, and resources provided by emergency response agencies for the City throughout all phases of an emergency. The ESFs, which supplement the information in the Basic Plan, are:

- ESF 1 – Transportation
- ESF 2 – Communications
- ESF 3 – Public Works
- ESF 4 – Firefighting
- ESF 5 – Information & Planning
- ESF 6 – Mass Care
- ESF 7 – Resource Support
- ESF 8 – Health & Medical
- ESF 9 – Search & Rescue
- ESF 10 – Hazardous Materials Response
- ESF 11 – Food & Water
- ESF 12 – Energy
- ESF 13 – Military Support
- ESF 14 – Public Information
- ESF 15 – Volunteer & Donations Management
- ESF 16 – Law Enforcement
- ESF 17 – Agriculture and Animal Protection
- ESF 18 – Business and Industry

Support Annexes (SA)

SAs describe functions that do not fit within the scope of the 18 ESF annexes and identify how the City's departments and agencies, the County, the private sector, volunteer organizations, and nongovernmental organizations coordinate to execute common support functions required during an incident. The actions described in the City's SA are not limited to particular types of events but are overarching in nature and applicable to nearly every type of incident. The City has one SA:

- SA 1 – Continuity of Service

Incident Annex (IA)

While this EOP has been developed as an all-hazards planning document, some hazards may require unique considerations. To that end, the IA supplements the Basic Plan to identify critical tasks particular to specific natural, technological, and human-caused hazards identified in the most current Hazard Identification and Vulnerability Assessment. Hazards covered in the IA include:

- Earthquake
- Major Fire
- Public Health
- Severe Weather
- Volcano
- Hazardous Materials
- Transportation Accidents (including air, rail, and road)
- Terrorism
- Utility Failure

1.5 Relationship to Other Plans

1.5.1 Federal Plans

The following federal plans guide emergency preparedness, response and recovery at the federal level and provide support and guidance for state and local operations:

- **Presidential Policy Directive 8.** Describes the nation's approach to preparing for the threats and hazards that pose the greatest risk to the security of the United States.
- **National Preparedness Goal.** Describes the nation's security and resilience posture through identifying key mission areas and core capabilities that are necessary to deal with great risks, using an integrated, layered, and all-of-Nation approach as its foundation.
- **National Preparedness System.** Provides guidance, programs, processes, and systems that support each component of the National Preparedness System to enable a collaborative, whole community approach to national preparedness that engages individuals, families, communities, private and nonprofit sectors, faith-based organizations, and all levels of government.
- **National Incident Management System.** Provides a consistent nationwide framework and comprehensive approach to enable government at all levels, the private sector, and nongovernmental organizations to work together to prepare for, prevent, respond to, recover from, and mitigate the effects of incidents regardless of their cause, size, location, or complexity.
- **National Planning Frameworks.** The National Planning Frameworks, one for each preparedness mission area, describe how the whole community works together to achieve the National Preparedness Goal:
    - Prevention
    - Protection
    - Mitigation
    - Response
    - Disaster Recovery

1.5.2 State Plans

The following plans of the State of Oregon (the State) guide emergency preparedness, response, and recovery at the state level and provide support and guidance for local operations:

- **Cascadia Subduction Zone Catastrophic Operations Plan**. Describes the roles and responsibilities of State agencies in addressing emergency response and recovery missions in a coordinated manner with local, tribal, and federal agencies after a catastrophic earthquake and tsunami.
    - **Cascadia Playbook**. A cross-cutting emergency management tool for the State that supports various existing plans and efforts for the first 14 days of a catastrophic incident.
- **Debris Management Plan**. Provides a framework for State agencies and municipalities to facilitate and coordinate the evaluation, removal, collection, and disposal of debris following a disaster.

- **Emergency Alert System Plan.** This plan, mandated by the Federal Communications Commission, outlines the organization and implementation of the State of Oregon Emergency Alert System (EAS). It is the guideline for State broadcasters and cable television operators, and state and local entities authorized to use the EAS, to determine the distribution of the President's message, mandated and optional monitoring assignments, and participation by the National Weather Service and local and State emergency agencies.
- **Emergency Management Plan.** The State Emergency Management Plan consists of four volumes:
    - ***Volume I: Oregon Natural Hazards Mitigation Plan.*** Identifies and prioritizes potential actions throughout Oregon that would reduce the State's vulnerability to natural hazards. In addition, the plan satisfies the requirements of the Federal Emergency Management Agency (FEMA) to ensure that Oregon is eligible to receive hazard mitigation and disaster assistance funds from the federal government.
    - ***Volume II: State of Oregon Preparedness Plan*** *(in development).* Includes the plans and guidance necessary for the State to prepare for the effects of a disaster including guidance and requirements for the State's training and exercise program.
    - ***Volume III: State of Oregon Emergency Operations Plan*****.** Establishes the procedures by which the State coordinates response to an emergency, including processes for resource requests from local and tribal partners, established roles and responsibilities for State agencies, and procedures for activation and operation of the State Emergency Coordination Center (ECC). The plan identifies 18 ESF annexes that serve as the mechanism for response support to local and tribal partners.
    - ***Volume IV: State of Oregon Recovery Plan.*** Establishes a State Recovery Organization and describes how the State will coordinate short-term, intermediate, and long-term recovery activities. The plan identifies seven State Recovery Functions that serve as the delivery mechanism for recovery support local and tribal partners.
- **Mount Hood Coordination Plan.** Outlines how various agencies will coordinate their actions to minimize the loss of life and damage to property before, during, and after hazardous geologic events at the Mount Hood volcano.
- **Oregon Resilience Plan.** This plan summarizes the science of Cascadia Subduction Zone earthquakes and estimates their impacts; it then provides detailed analysis of the current vulnerability of the State's buildings and business community and its transportation, energy, communication, and water/wastewater systems.
- **State Fire Marshal Fire Service Mobilization Plan**. This plan establishes operating procedures for the most practical utilization of State resources during all-hazard emergencies that are beyond the capabilities of local resources.

1.5.3 County Plans

The City relies on the County for many critical services during an emergency, so it is vital for the City to be familiar with the County's plans and how they link with the City's emergency plans. Copies of these plans can be found in the County EOC Library.

- **Community Wildfire Protection Plan.** The County's Community Wildfire Protection Plan improves upon historical fire planning efforts by providing a more localized and accurate approach for determining wildfire hazards and implementing best practices for wildfire protection. The plan balances wildfire protection with sustainable ecological management and economic activities throughout the County.
- **Continuity of Operations (COOP) Plan.** The Clackamas County Continuity of Operations Plan identifies mission-essential functions of each department, division and office of County government, and the means by which these services will be maintained during major emergencies and disasters.
- **Debris Management Plan.** The Debris Management Plan guides the County in coordinating clearance, removal, and disposal of disaster debris.
- **Emergency Operations Plan.** This plan establishes the procedures by which the County coordinates response to an emergency, including processes for requesting resources and procedures for activating and operating the County EOC.
- **Natural Hazards Mitigation Plan.** The Natural Hazards Mitigation Plan creates a framework for risk-based decision making to reduce deaths and injuries, property damage, and economic impact from future disasters. Mitigation plans form the foundation for a community's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage. Hazard mitigation is sustained action taken to reduce or eliminate long-term risk to people and their property from hazards.
- **Public Health Emergency Preparedness Program.** The County Health, Housing, and Human Services Department (H3S) is responsible for developing plans to address how public health personnel plan for, respond to, and recover from all hazards that may impact public health, including communicable disease, pandemic scenarios, chemical incidents, radiological incidents, and bioterrorism. The department maintains guidelines for public health personnel responding to a public health incident in the County.

1.5.4 City Plans

Similar to the County's plan, the City EOP is part of a suite of plans that address various elements of the City's emergency management program. While the EOP is focused on short-term recovery, other plans address the City's approach to mitigation, continuity, and other aspects of emergency management. These plans, listed below, work in concert with the City EOP:

- **Natural Hazard Mitigation Plan (NHMP).** The City's NHMP can be found on the City's website at http://westlinnoregon.gov/planning/natural-hazards-mitigation-plan . The NHMP includes resources and information to assist the City's residents, public- and private-sector organizations, and others interested in participating in planning for natural hazards. The mitigation plan provides a list of activities that may assist the City in reducing risk and preventing loss from future natural hazard events. West Linn has developed this plan as an addendum to the Clackamas County Natural Hazards Mitigation Plan in an effort to take a more regional approach to planning for natural hazard scenarios.

- **Debris Management Plan.** An annex to the County's Debris Management Plan, the City's Debris Management Plan guides the City in coordinating clearance, removal, and disposal of disaster debris.
- **Water Master Plan.** This plan is a comprehensive analysis of the City's water system to identify system deficiencies, future water distribution system supply requirements, and facility improvement recommendations.
- **Transportation System Plan.** This plan provides a snapshot of the existing transportation system, immediate changes, and future plans to upgrade and enhance the system.
- **Sanitary Sewer Master Plan.** This plan summarizes the City's sanitary sewer assets and needs and provides a plan to assess future wastewater flows corresponding to forecasted growth.
- **Surface Water Management Plan.** This plan outlines the preferred surface water management strategy in a given location, including flooding from sewers, drains, groundwater, and runoff from land, small water courses, and ditches that occurs as a result of heavy rainfall.

1.5.5 Support Agency Plans

The City is supported by a number of partner agencies. To the greatest extent possible, the City encourages support agencies to design their plans to complement the City EOP, and the City will seek to engage support agencies in the EOP update process to ensure appropriate linkages. The following plans support and work in coordination with the City EOP:

- Tualatin Valley Fire and Rescue EOP;
- Northwest Area Contingency Plan; and
- Portland Dispatch Center Consortium Intergovernmental Agency (LOCOM)

1.6 Authorities

1.6.1 Legal Authorities

In the context of this EOP, a disaster or major emergency is characterized as an incident requiring the coordinated response of all government levels to save the lives and protect the property of a large portion of the population. This plan is issued by the West Linn City Council pursuant to the provisions of the West Linn Municipal Code 2.700 through 2.750, and in accordance with, and under the provisions of, Oregon Revised Statutes (ORS) Chapter 401, which establishes authority for the highest elected official of the City Council to declare a state of emergency.

The City conducts all emergency management functions in a manner consistent with NIMS. Procedures supporting NIMS implementation and training for the City will be developed and formalized by the City's Emergency Management Organization (EMO).

As approved by the City Manager, the Police Department has been identified as the lead agency in the EMO. A pre-designated Police Captain, given the collateral title of Emergency Manager, has authority and responsibility for the organization, administration, and operations of the EMO. The Emergency Manager may delegate any of these activities to designees as appropriate.

Appendix B sets forth the federal, state, and local legal authorities upon which the organizational and operational concepts of this EOP are based.

1.6.2 Mutual Aid and Intergovernmental Agreements

State law (ORS 402.010 and 402.015) authorizes local governments to enter into Cooperative Assistance Agreements with public and private agencies in accordance with their needs (e.g., the Omnibus Mutual Aid Agreement). Personnel, supplies, and services may be used by a requesting agency if the granting agency cooperates and extends such services. However, without a mutual aid pact, both parties must be aware that State statutes do not provide umbrella protection, except in the case of fire suppression pursuant to ORS 476 (the Oregon State Emergency Conflagration Act).

Copies of the following mutual aid agreements can be accessed through the Emergency Manager:

- Managing Oregon Resources Efficiently Intergovernmental Agreement;
- Oregon Public Works Emergency Response Cooperative Assistance Agreement;
- Mutual Aid and Assistance Agreement for the Provision of Emergency Services Related to Water and Wastewater Utilities;
- Intergovernmental Cooperative Agreement for Water System Intertie between the South Fork Water Board, the City of Lake Oswego, and the City of West Linn; and
- Intergovernmental Agreement between Clackamas County Disaster Management (CCDM), Clackamas County Communications (C-COM), and the City of West Linn

During an emergency situation, a local declaration may be necessary to activate these agreements and allocate appropriate resources.

1.7 Emergency Powers

1.7.1 General

Based on local ordinances and State statutes, a local declaration by the City Council allows for flexibility in managing resources under emergency conditions, such as:

- Diverting funds and resources to emergency operations to meet immediate needs;
- Authorizing implementation of local emergency plans and implementing extraordinary protective measures;
- Receiving resources from organizations and individuals initiated through mutual aid and cooperative assistance agreement channels;
- Providing specific legal protection for actions initiated under emergency conditions;
- Setting the stage for requesting State and/or federal assistance to augment local resources and capabilities; and

- Raising public awareness and encouraging the community to become involved in protecting its resources.

The City Attorney should review and advise City officials on possible liabilities arising from disaster operations, including the exercising of any or all of the above powers.

1.7.2 City Disaster Declaration Process

In the context of the City EOP, a disaster or major emergency is characterized as an incident requiring the coordinated response of all government levels to save the lives and protect the property of a large portion of the population. In accordance with ORS 401.025 and the West Linn Municipal Code 2.700, "Emergency Planning," the responsibility for emergency management and direction and control in a time of disaster belongs to the City Manager or designee. Policy decisions are the responsibility of the City Council.

When an emergency or disaster arises, and it is determined that conditions have progressed or will progress beyond the staffing, equipment, or other resource capacities of the City, a declaration of emergency should be considered.

A declaration of a state of emergency within the City of West Linn may be issued by the Mayor (or Council President when the Mayor is absent or otherwise unable to perform the functions of Mayor as provided in the City Charter); or the City Manager or designee if the nature of the emergency requires immediate action to be taken and it is not reasonably practical for the Mayor to issue the declaration of emergency prior to the time immediate action must be taken.

Upon that declaration, the City Manager or designee is empowered to assume centralized control of and have authority over all departments and other offices of the City in order to implement the purpose of this code. Any declaration of emergency by the City Manager or designee shall be subject to review and revision by the Mayor. All declarations of emergency shall be subject to review and revision by the City Council. A state of emergency shall be terminated by the City Council when the emergency situation ceases to exist.

A declaration shall:

- Describe the nature of the emergency;
- Designate the geographic boundaries of the area where the emergency exists, as well as the portion of the affected area lying within the City's boundaries;
- Estimate the number of individuals at risk, injured, or killed;
- Describe the actual or likely damage caused by the emergency;
- State the type of assistance or resources required to respond to the emergency;
- Estimate the length of time during which the designated area will remain in an emergency status; and
- State the specific regulations or emergency measures imposed as a result of the declaration of emergency.

The declaration of emergency will be written based on the best information available at the time. It may be amended, based on additional information or changes in the situation. The City Attorney may be consulted to review the declaration for legality or sufficiency of emergency measures and emergency powers invoked within the document. If county, state, or federal assistance is needed, the declaration must also state that all appropriate and available local resources have been expended, are nearing depletion, or are projected to be inadequate and that mutual aid agreements have been initiated, as well as contain a specific request for the type(s) of assistance required.

Should the City EOC be activated at the time of the declaration, EOC Command and General Staff may have the following responsibilities in the declaration process:

- **EOC Incident Commander or Emergency Manager**: Present the package to City Council.
- **Operations**: Identify necessary resources and outline any special powers needed to respond to the emergency. Assist in the initial damage assessment (IDA).
- **Planning**: Provide situation and resource summaries; conduct a windshield survey, IDA, and preliminary damage assessment (PDA).
- **Logistics**: Compile resource requests.
- **Finance**: Track incident costs, assist in the PDA, and coordinate damage survey activities.

See Appendix A for sample Declaration of Emergency forms.

1.7.3 County Declaration Process

Clackamas County Code 6.03 restricts the Board of County Commissioners' (BCC's) authority to declare an emergency for the unincorporated areas of the County unless one or more cities have asked to be included in the declaration. County and city officials must coordinate emergency declarations closely when incidents cross city/county boundaries to ensure inclusion for anticipated needs.

An Emergency Declaration grants the BCC the authority to exercise any or all of the emergency measures included in Clackamas County Code, Section 6.03. If circumstances prohibit timely action by the BCC, the Chair or other commissioner may declare a state of emergency and seek approval of a majority of the BCC at the first available opportunity.

The BCC may declare an emergency when the need arises for:

- Centralizing control of the County's assets under the Chair; authorizing implementation of extraordinary emergency protective measures;
- Providing specific legal protection for actions initiated under emergency conditions; or
- Setting the stage for requesting State and/or federal assistance to augment local resources and capabilities.

When a major emergency or disaster occurs and a locality has responded to the best of its ability and is, or will be, overwhelmed by the magnitude of the damage, the community requests assistance from the State. The Governor, after examining the situation, may direct that the assistance provisions in the State's emergency plan be executed and direct the use of State resources, as appropriate to the situation. If it is evident that the situation is, or will be, beyond the combined capabilities of local and State resources, the Governor may request that the

President declare that a major emergency or disaster exists in the State, under the authority of the Stafford Act.

1.7.4 State Assistance

The Oregon Office of Emergency Management (OEM) Operations Officer coordinates with the agencies represented in the State ECC to determine the best way to support local government requests. ORS 401.165(6) provides that the County will transmit declaration requests submitted by a city to OEM. If a city is divided between two counties, the city emergency declaration is submitted to the county in which the majority of the city is located.

The State Operations Officer evaluates resource requests based on the goals and priorities established by the Director. Agency representatives keep the Operations Officer informed of resources assigned, resources available for commitment, and the status of assigned missions.

State resources are provided to the County or City EMO or to the on-scene Incident Commander as agreed by the entities concerned. The OEM Director makes final decisions in cases of conflicting interest such as competing resource requests or priority questions.

1.7.5 Federal Assistance

FEMA provides resources, coordination, planning, training, and funding to support state and local jurisdictions when requested by the Governor.

In the event that the capabilities of the State are not sufficient to meet the requirements as determined by the Governor, federal assistance may be requested. OEM coordinates all requests for federal assistance through the State ECC. FEMA coordinates the Governor's Presidential request for assistance in accordance with the National Response Framework.

1.8 Continuity of Government

1.8.1 Lines of Succession

Table 1-1 presents the policy and operational lines of succession during an emergency for the City. Order of succession guidelines for emergency coordination and emergency policy and governance are kept within the vital records packet at the City EOC.

Table 1-1 City Lines of Succession

Emergency Coordination	Emergency Policy and Governance
1. City Manager 2. City Emergency Manager 3. Incident Commander	1. Mayor 2. City Council (in order of succession) 3. City Manager 4. City Police Chief 5. City Public Works Director

Each City department is responsible for pre-identifying staff patterns showing a line of succession in management's absence. All employees must be trained on the protocols and contingency plans required to maintain leadership within the department. The Emergency Manager or designee identified above will provide guidance and direction to department heads to maintain continuity operations during an emergency. Individual department heads within West Linn are responsible for developing and implementing COOP plans to ensure continued delivery of vital services during an emergency.

1.8.2 Preservation of Vital Records

The City has developed a vital records packet for use during emergency events. This packet contains records essential to executing emergency functions, including this EOP, emergency operating records essential to the continued function of the City EMO, the current call-down list, a vital records inventory, necessary keys or access codes, a list of primary and alternate facilities, and the City’s COOP plan.

Each City department must provide for the protection, accessibility, and recovery of the agency's vital records, systems, and equipment. These are rights and interests records, systems, and equipment that, if irretrievable, lost, or damaged, would materially impair the agency's ability to conduct business or carry out essential functions. Each agency should have a maintenance program for the preservation and quality assurance of data and systems. The program should take into account the cost of protecting or reconstructing records weighed against the necessity of the information for achieving the agency mission.

1.9 Administration and Logistics

1.9.1 Request, Allocation, and Distribution of Resources

Resource requests and emergency/disaster declarations must be submitted by the City EOC to Clackamas County Disaster Management (CCDM) according to provisions outlined under ORS Chapter 401. CCDM processes assistance requests to the State.

The City Manager or EOC Incident Commander (if activated) is responsible for the direction and control of the City’s resources during an emergency and for requesting any additional resources required for emergency operations.

1.9.1.1 Conflagration

In the case of emergencies involving fires threatening life and structures, the Emergency Conflagration Act (ORS 476.510) can be invoked by the Governor through the Office of State Fire Marshal. This act allows the State Fire Marshal to mobilize and fund fire resources throughout the State during emergency situations.

When, in the judgment of the Tualatin Valley Fire and Rescue (TVF&R) Incident Commander or County Fire Defense Board Chief, an emergency is beyond the control of local fire suppression resources, including primary mutual aid, the Fire Defense Board Chief shall report the conditions of the emergency to the State Fire Marshal Office and/or request mobilization of support for the department/district. After verifying the need for mobilized support, the State Fire Marshal shall, if appropriate, request authorization from the governor to invoke the Emergency Conflagration Act.

The TVF&R Incident Commander is responsible for:

- Contacting the Fire Defense Board Chief to request that the Conflagration Act be invoked;
- Participating in incident conference call;
- Providing local geographic information system capabilities or maps;
- Working with the Incident Management Team (IMT) to locate a base camp; and
- Maintaining communications with the IMT throughout the deployment to assist with emergency management and other local issues.

The Fire Defense Board Chief is responsible for:

- Notifying the State Fire Marshal via the Oregon Emergency Response System;
- Providing the following information to the Oregon State Fire Marshal Duty Officer of Chief Deputy:
    - Incident name
    - Contact information
    - Type and location of incident
    - Situation description
    - Confirmation that local and mutual aid resources are depleted.
    - Incident Commander information
    - Weather information
    - What resources are being requested
- Participating in incident conference call.

Requests for conflagration should be made when a significant threat exists, e.g.:

- Life threatening situations (firefighter or public safety):
    - Evacuations currently taking place
    - Advisory evacuations
    - Evacuation plans in place
    - Road, highway, or freeway closure
- Real property threatened:
    - Number of structures, commercial, and/or residents
    - Number of subdivisions
    - Population affected
    - Historical significant cultural resources
    - Natural resources, such as crops, grazing, timber, watershed
    - Critical infrastructure, such as major power lines
- High damage potential:
    - Long-term or short-term damage potential
    - Plausible impacts on community
    - Fuel type; fire size and growth potential
    - Political situations
    - Severity, extreme behavior, and fuel conditions

Source: Fire Service Mobilization Plan, 2013

1.9.2 Financial Management

During an emergency, the City is likely to find it necessary to redirect its funds to effectively respond to the incident. Although the authority to adjust department budgets and funding priorities rests with the City Council, emergency procurement authority is delegated to each department director. Tracking the expenditures related to an incident is the responsibility of the Finance Section, which will be staffed by the Finance Department.

If an incident in the City requires major redirection of the City's fiscal resources, the following general procedures will be followed.

- The City Manager will meet in emergency session to decide how to respond to the emergency funding needs.
- The City Manager will declare a state of emergency and request assistance through the County.
- The Mayor and City Council will be advised of such actions as soon as practical.
- To facilitate tracking of financial resources committed to the incident and provide the necessary documentation, a discrete charge code for incident-related personnel time, losses, and purchases will be established by the Finance Section. In addition, copies of expense records and supporting documentation should be maintained for filing FEMA Public Assistance reimbursement requests.

The City Human Resources Director will support procurement issues related to personnel, both volunteer and paid.

1.9.3 Legal Support and Liability Issues

Liability issues and potential concerns among government agencies, private entities, and other response partners and across jurisdictions are addressed in existing mutual aid agreements and other formal memoranda established for the City and its surrounding areas.

The City Attorney will address legal services, including:

- Advising City officials regarding the emergency powers of local government and necessary procedures for invocation of measures to:
    - Implement wage, price, and rent controls
    - Establish rationing of critical resources
    - Establish curfews
    - Restrict or deny access
    - Specify routes of egress
    - Limit or restrict use of water or other utilities
    - Remove debris from publicly or privately owned property
- Reviewing and advising City officials in determining how the City can pursue critical objectives while minimizing potential exposure;
- Preparing and recommending local legislation to implement emergency powers when required;
- Advising City officials and department heads regarding record keeping requirements and other documentation necessary for exercising emergency powers; and

- Thoroughly reviewing and maintaining familiarity with current ORS 401 provisions as they apply to County or City government in disaster events.

1.9.4 Reporting and Documentation

Proper documentation and reporting during an emergency is critical for the City to receive proper reimbursement for emergency expenditures and to maintain a historical record of the incident. City staff will maintain thorough and accurate documentation throughout the course of an incident or event. Incident documentation should include, but is not limited to:

- Incident and damage assessment reports;
- Incident Command logs;
- Cost recovery forms; and
- Incident critiques and After Action Reports (AARs)

All documentation related to the City's emergency management program will be maintained in accordance with Oregon's public records and meetings law (ORS 192), subject to applicable exemptions such as for "Public Safety Plans," as appropriate.

1.10 Safety of Employees and Family

All department heads (or designees) are responsible for the safety of employees. Employees should attempt to contact their supervisors and managers within the first 24 hours following an incident. Emergency 9-1-1 should only be utilized if emergency assistance is needed. Agencies and departments with developed COOP plans will establish alternate facilities and staff locations, as applicable. Notification procedures for employee duty assignments will follow the required procedures established by each agency and department.

During biological incidents or public health emergencies such as influenza pandemics, maintaining a resilient workforce is essential to performing the overall response activities required to protect the City and surrounding community from significant impacts to human lives and the economy. Thus, personnel should be provided with tools to protect themselves and their families while they provide health and medical services during a pandemic or other type of public health emergency.

Currently, plans formally addressing the safety and protection of medical personnel and response staff during a biological incident and/or contagious outbreak have not been developed. Safety precautions and personal protective equipment decisions will be specific to the type of incident and will require just-in-time training among the first responder community and other support staff to implement appropriate procedures.

If necessary, the Oregon Occupational Safety and Health Administration, in coordination with the Oregon Health Authority (OHA), may provide assistance and guidance on worker safety and health issues. Information about emergency procedures and critical tasks involved in a biological emergency incident or disease outbreak is presented in ESF 8 of the County EOP.

While all City agencies and employees are expected to contribute to emergency response and recovery efforts of the community, employees' first responsibility is to their own and their families' safety. Each employee is expected to develop family emergency plans to facilitate family safety and self-sufficiency, which in turn will enable employees to meet their responsibilities to the County and its residents as rapidly as possible.

Processes that support employees and their families during emergency situations or disasters should be further developed through ongoing COOP planning.

2

Situation and Planning Assumptions

This section of the EOP builds on the scope of discussion in Section 1 by profiling the City's risk environment, identifying specific planning considerations, and describing the assumptions underlying this plan. This section ensures that, while taking an all-hazards approach to emergency management, the plan is tailored to the unique risks faced by the City.

2.1 Situation

The City is exposed to many hazards that have the potential to disrupt the community, cause damage, and create casualties. Natural hazards to which the City may be exposed include droughts, floods, wildfires, and winter storms. The threat of a technological or human-caused chemical, biological, radiological, nuclear, or explosive incident is present as well. Other disaster situations could develop from hazardous material accidents, health-related incidents, conflagrations, major transportation accidents, or acts of terrorism.

2.1.1 Community Profile

The City is located in Clackamas County, Oregon, within the southern bounds of the Portland metropolitan area. It is bordered on the east and divided to the southwest by the Willamette River, bordered on the south by the Tualatin River, and bordered on the north by the city of Lake Oswego. To its southeast, across the Willamette, lies the city of Oregon City, while adjacent to its southern and western borders are rural areas of unincorporated Clackamas County. The city of Portland proper is located roughly 8 miles to the north.

As of the 2010 Census, there were 25,109 people and 10,035 housing units in the City. The racial makeup of the City was 91 percent White, 4 percent Asian, and 4 percent of Hispanic or Latino origin. Other ethnic groups (African American, American Indian and Alaska Native, and Native Hawaiian and Other Pacific Islanders accounted for less than 1 percent each). Approximately 3 percent of the population reported themselves as multiracial or multiethnic.

While approximately 10 percent of the population speaks a language other than English, most are bilingual. Only 3 percent of the population reported speaking English "less than very well."

Out of the 9,523 households, 3,557 (37 percent) of these households were families with children under the age of 18. The average household size was 2.6, and the average family size was three people. The age demographics for the City show that 28 percent of the population was 19 or under and 11 percent were 65 years of age or older.

The median household income in the City is $80,391. Approximately 3 percent of families and 4 percent of the population were below the poverty line.

According to the 2011–2015 American Community Survey 5-Year Estimates, the majority of City residents are employed in the following industries:

- Educational services, healthcare, and social assistance sectors;
- Professional, scientific, management, administrative, and waste management services sectors;
- Retail trade;
- Manufacturing; and
- Financial, insurance, and real estate sectors.

2.1.1.6 Community Events

Increases in traffic and strain on public safety services may occur during community events. Special Event Plans are developed for large community events within the City, such as the following:

- 789 Jam Dances (April, May, and June) – Willamette Christian Church, 3153 S. Brandywine Dr.;
- Daddy Daughter Dance (June) – Adult Community Center, 1180 Rosemont Rd.;
- West Linn Street Dance (July) – 13th and Willamette Falls Drive;
- Old Time Fair (July) – Willamette Park, 1100 12th St.;
- Music in the Park (Thursdays in July and August) – Tanner Creek Park, 3456 Parker Rd.;
- Movies in the Park (July & August);
- Art Festivals (August and September) – Mary S. Young Park, 19900 Willamette Dr.;
- Oktoberfest (September);
- Haunted Trail (October) – Mary S. Young Park, 19900 Willamette Dr.;
- Holiday Tree Lighting (December) – West Linn City Hall, 22500 Salamo Rd.; and
- Holiday Parade (December) – Willamette Falls Dr.

It is also important to note that rush hour on Interstate 205 adds a strain to transportation infrastructure in the area.

Figure 2-1 Map of West Linn

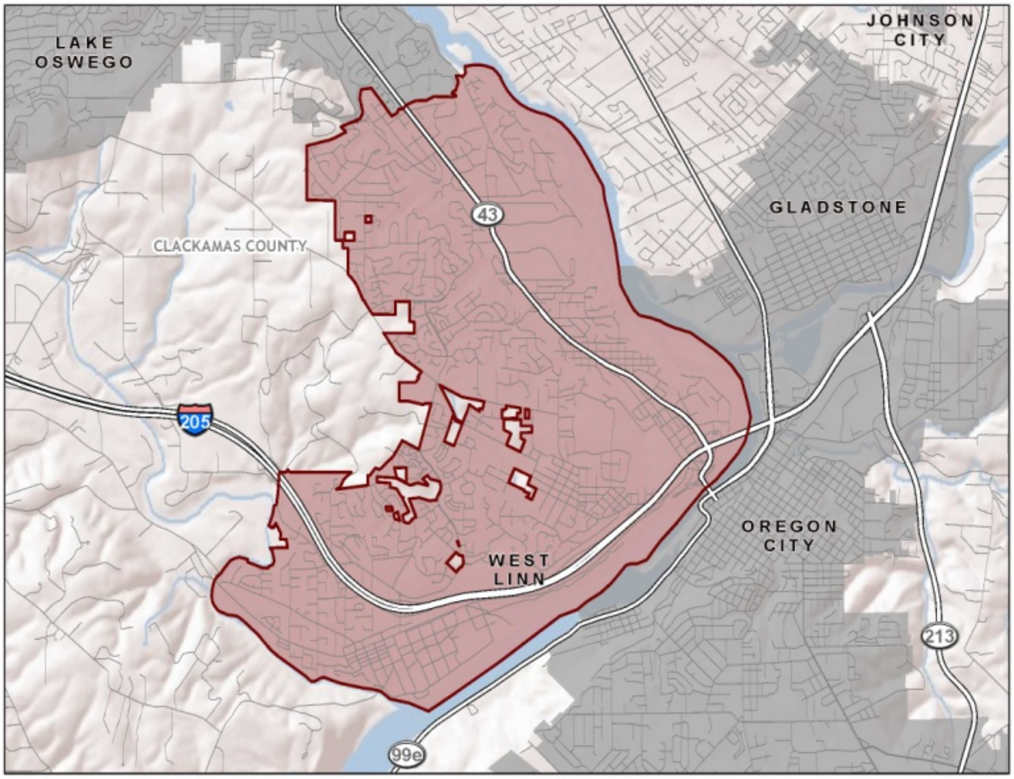
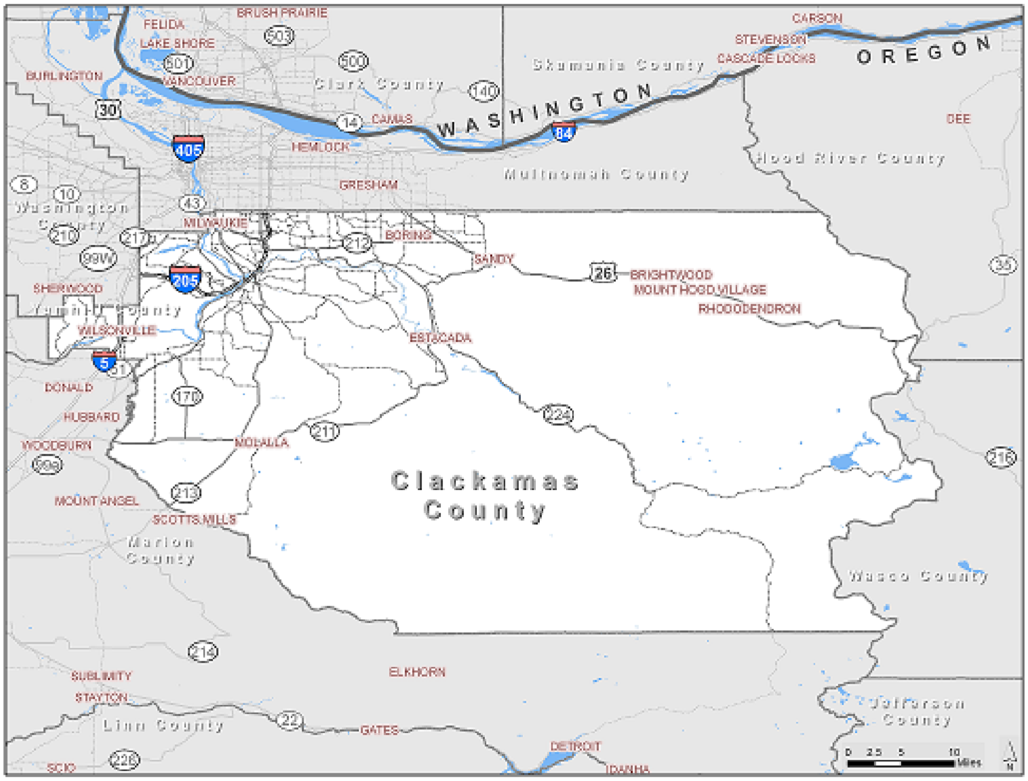


Figure 2-2 Map of Clackamas County



2.1.2 Threat/Hazard Identification

Table 2-1 identifies the hazards and threats most likely to impact the City based on the community's vulnerability and the resulting potential impacts of the hazard or threat.

Table 2-1 Identified Threats/Hazards

Natural *Result from acts of nature*	**Technological** *Result from accidents or failure of systems and structures*	**Human-Caused/ Adversarial Threats** *Result from intentional actions of an adversary*
• Drought • Earthquake • Flooding • Landslide • Severe Storm (Wind, Winter, and Extreme Heat) • Volcanic Eruption • Wildfire	• Airplane Crash • Communications System Failure • Dam Failure • Fuel Line Explosion • Hazmat Release (Fixed Facility) • Hazmat Release (Transportation) • Information Technology Disruption • Liquid Fuel Supply Disruption • Power Failure • Sewer Treatment Failure • Train Derailment • Water Supply Disruption	• Civil Disturbance/ Protest/Demonstration • Public Health Emergency • Riot • Sabotage • School Violence • Sports/Public Event Disturbance • Terrorism (including, but not limited to, Bomb, Intentional Hazardous Materials Release, Active Shooter, Animal/Eco-terrorism)

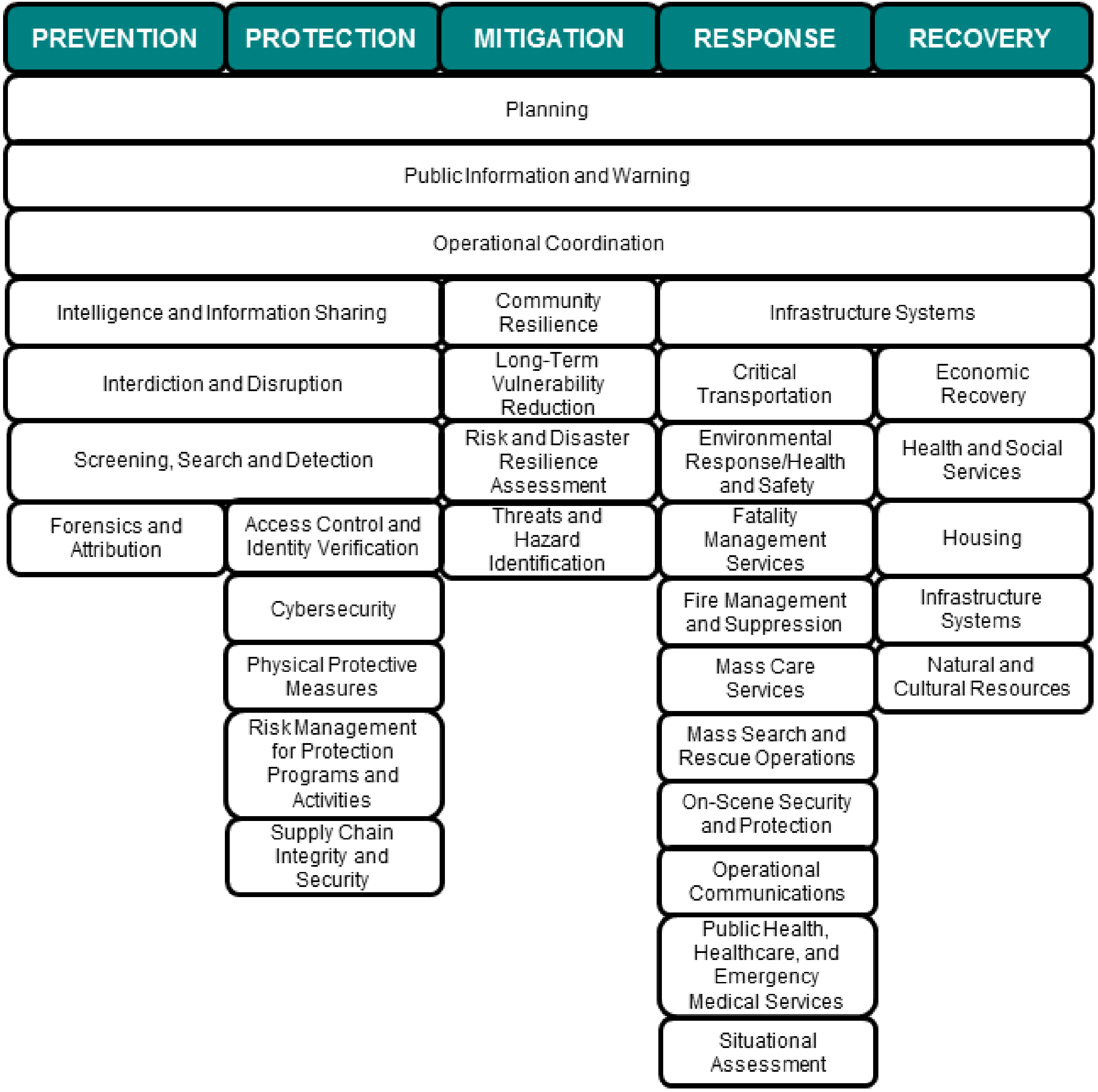
See the City Hazard Analysis and Natural Hazard Mitigation Plan for more information regarding hazards for the area.

2.1.3 Capability Assessment

The availability of the City's physical and staff resources may limit its capability to conduct short- and long-term response actions on an independent basis. City response capabilities are also limited during periods when essential staff are on vacation, sick, or under furlough due to budgetary constraints.

The City has not defined its core capabilities in accordance with the National Preparedness Goal or undertaken a formal capabilities assessment to date. Should an assessment be conducted in the future, it will help emergency responders evaluate, coordinate, and enhance the cohesiveness of their emergency response plans. A community capability assessment is a low impact systematic approach to evaluate the City's emergency plan and capability to respond to hazards.

Figure 2-3 Core Capabilities List



2.1.4 Protection of Critical Infrastructure and Key Resources

Critical infrastructure and key resources (CIKR) support the delivery of critical and essential services that help ensure the security, health, and economic vitality of the City. CIKR includes the assets, systems, networks, and functions that provide vital services to cities, states, regions, and, sometimes, the nation, disruption to which could significantly impact vital services, produce cascading effects, and result in large-scale human suffering, property destruction, economic loss, and damage to public confidence and morale.

Key facilities that should be considered in infrastructure protection planning include:

- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic, and/or water-reactive materials;
- Government facilities, such as departments, agencies, and administrative offices;
- Hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a hazard even;
- Police stations, fire stations, vehicle and equipment storage facilities, and EOCs that are needed for disaster response before, during, and after hazard events;
- Public and private utilities and infrastructure that are vital to maintaining or restoring normal services to areas damaged by hazard events; and
- Communications and cyber systems, assets and networks such as secure City servers and fiber optic communications lines.

See the City Bridge Assessment for information regarding the ability of bridges within the City to withstand earthquake stress.

2.2 Assumptions

This EOP is based on the following assumptions and limitations:

- Essential City services will be maintained as long as conditions permit.
- An emergency will require prompt and effective response and recovery operations by City emergency services, disaster relief, volunteer organizations, and the private sector.
- All emergency response staff are trained and experienced in operating under the NIMS/ICS protocol.
- Each responding city and county agency will utilize existing directives and procedures in responding to major emergencies and disasters.
- Environmental, technological, and civil emergencies may be of a magnitude and severity that require state and federal assistance.
- County support of City emergency operations will be based on the principle of self-help. The City will be responsible for utilizing all available local resources, along with initiating mutual aid and cooperative assistance agreements before requesting assistance from the County.
- Considering shortages of time, space, equipment, supplies, and personnel during a catastrophic disaster, self-sufficiency will be necessary for the first hours or days following the event.
- Local emergency planning efforts focus on accommodating residents while preparing for changes in population trends throughout the year. However, significant increases to the local population may introduce challenges in meeting the needs of non-residents and other travelers during an emergency or disaster.
- All or part of the City may be affected by environmental and technological emergencies.
- The United States Department of Homeland Security provides information regarding threat conditions across the United States and identifies possible targets.

- A terrorist-related incident or attack may occur without warning. In the event of such an attack, the City could be subject to radioactive fallout or other hazard related to weapons of mass destruction. In accordance with national nuclear civil protection policy, two options have been developed to counteract such a threat: population protection and shelter-in-place programs.
- Outside assistance will be available in most major emergency/disaster situations that affect the City. Although this plan defines procedures for coordinating such assistance, it is essential for the City to be prepared to carry out disaster response and short-term actions on an independent basis.
- Control over City resources will remain at the City level even though the Governor has the legal authority to assume control in a State-declared emergency.
- City communication and work centers may be destroyed or rendered inoperable during a disaster. Normal operations can be disrupted during a general emergency; however, the City can still operate effectively if public officials, first responders, employees, volunteers, and residents are:
    - Familiar with established policies and procedures
    - Assigned pre-designated tasks
    - Provided with assembly instructions
    - Formally trained in the duties, roles, and responsibilities required of them during emergency operations

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3 Roles and Responsibilities

Agencies within the community have varying day-to-day operations and will continue to do so during emergency operations. This section assigns responsibilities specific to a disaster or emergency situation to specific departments and agencies.

3.1 General

Local and county agencies and response partners may have various roles and responsibilities throughout an emergency's duration. Therefore, it is particularly important that the local command structure be established to support response and recovery efforts and maintain a significant amount of flexibility to expand and contract as the situation changes. Typical duties and roles may also vary depending on the incident's size and severity of impacts, as well as the availability of local resources. Thus, it is imperative to develop and maintain depth of qualified staff within the command structure and response community.

CCDM is responsible for emergency management planning and operations for the area of the County lying outside the limits of the incorporated municipalities. The mayor or other designated official (pursuant to city charter or ordinance) of each incorporated city is responsible for emergency management planning and operations for that jurisdiction. Responsibilities may be shared with CCDM under mutual agreement.

Most City departments have emergency functions that are similar to their normal duties. Each department is responsible for developing and maintaining its own procedures for carrying out these functions during an emergency. Specific responsibilities are outlined below, as well as in individual annexes.

3.2 Emergency Management Organization

The City does not have an office or division of emergency management services separate from its existing departments. The Police Training/Emergency Specialist serves as the Emergency Manager and may, depending on the size or type of incident, delegate the authority to lead response and recovery actions to other City staff. On a day-to-day basis, this authority is delegated to the Fire, Police, and Public Works Departments for incidents over which those departments would be the lead agencies. H3S is delegated direction and control during health epidemic emergencies. All departments have the power to establish control of such an incident through an on-scene ICS. Operational control of the scene shall remain with the lead agency as Incident Commander or in Unified Command.

Additionally, some authority to act in the event of an emergency may already be delegated by ordinance or by practice. As a result, the organizational structure for the City's emergency management program can vary with the location, size, and impact of the incident.

For the purposes of this plan, the structure will be referred to generally as the City EMO. Roles and responsibilities of individual staff and agencies are described throughout the plan to further clarify the City's emergency management structure.

The EMO for the City is divided into two general groups—the Executive Group and Emergency Response Agencies—organized by function.

3.2.1 Executive Group

The Executive Group may include representation from each City department during an event. The Executive Group is responsible for the activities conducted within its jurisdiction. The members of the group include both elected and appointed executives with legal responsibilities.

Key general responsibilities for local elected and appointed officials include:

- Establishing strong working relationships with local jurisdictional leaders and core private-sector organizations, voluntary agencies, and community partners;
- Leading and encouraging local leaders to focus on preparedness by participating in planning, training, and exercises;
- Supporting staff participation in local mitigation efforts within the jurisdiction, including the private sector, as appropriate;
- Understanding and implementing laws and regulations that support emergency management and response;
- Ensuring that local emergency plans take into account the needs of:
    - The jurisdiction, including persons, property, and structures
    - Vulnerable populations, including unaccompanied children and those with service animals
    - Individuals with household pets
- Leading and encouraging all City residents (including vulnerable populations) to take preparedness actions; and
- Encouraging residents to participate in volunteer organizations and training courses.

3.2.1.1 City Council

The ultimate responsibility for policy, budget, and political direction for the City's government is borne by the City Council. During emergencies, this responsibility includes encouraging community involvement and assistance, issuing policy statements as needed to support actions and activities of recovery and response efforts, and providing the political contact needed for visiting state and federal officials. Additionally, the council will provide elected liaison with the community and other jurisdictions. In the event that declaration of emergency is needed, the Mayor (or designee) will initiate and terminate the state of emergency through a declaration ratified by the council.

General responsibilities of the City Council include:

- Establishing emergency management authority by City ordinance;
- Adopting an EOP and other emergency management–related resolutions;

- Declaring a state of emergency and providing support to the on-scene Incident Commander in requesting assistance through the County;
- Acting as liaison to the community during activation of the EOC;
- Acting on emergency funding needs; and
- Attending Public Information Officer (PIO) briefings.

3.2.1.2 City Manager

The City Manager is responsible for continuity of government, overall direction of City emergency operations, and dissemination of public information, including the following tasks:

- Ensuring that all City departments develop, maintain, and exercise their respective service annexes to this plan.
- Supporting the overall preparedness program in terms of its budgetary and organizational requirements.
- Implementing the policies and decisions of the governing body.
- Ensuring that plans are in place to protect and preserve City records.

3.2.1.3 Emergency Manager

The Emergency Manager has the day-to-day authority and responsibility for overseeing emergency management programs and activities. The Emergency Manager works with the Executive Group to ensure that there are unified objectives with regard to the City’s emergency plans and activities, including coordinating all aspects of the City’s capabilities. The Emergency Manager coordinates all components of the local emergency management program, including assessing the availability and readiness of local resources most likely required during an incident and identifying and correcting any shortfalls. In particular, the Emergency Manager is responsible for:

- Serving as staff advisor to the City Council for emergency matters;
- Coordinating the planning and general preparedness activities of the government and maintenance of this plan;
- Analyzing the emergency skills required and arranging the training necessary to provide those skills;
- Preparing and maintaining a resource inventory (including call-down lists);
- Ensuring the operational capability of the City EOC;
- Activating the City EOC;
- Keeping the governing body apprised of the City’s preparedness status and anticipated needs;
- Serving as day-to-day liaison between the City and CCDM; and
- Maintaining liaison with organized emergency volunteer groups and private agencies.

3.2.1.4 City Department Heads

Department and agency heads collaborate with the Executive Group during development of local emergency plans and provide key response resources. City department and agency heads and their staffs develop, plan, and train to learn internal policies and procedures for meeting response and recovery needs safely. They also make staff available to participate in interagency training and exercise to develop and maintain the necessary capabilities, as well as clearly reinforce preparedness expectations. Department and agency heads not assigned a specific function in this plan will be prepared to make their resources available for emergency duty at the direction of the City Manager.

3.2.2 Responsibilities of All Departments

Individual departments are an integral part of the emergency organization. While some departments' staff comprises emergency response personnel, the majority of City departments focus on supporting emergency response personnel and/or the continuity of services they provide to the public. Organizationally, they are a component that provides support and communication for responders.

All City departments are responsible for:

- Supporting EOC operations to ensure that the City is providing for the safety and protection of the residents it serves;
- Establishing, in writing, an ongoing line of succession and/or delegation of authority for each department; this document must be made known to department employees, and a copy must be filed with the City Council and Emergency Manager;
- Developing alert and notification procedures for department personnel;
- Developing operating guidelines to implement assigned duties specified by this plan;
- Tracking incident-related costs incurred by the department, in coordination with the EOC Finance Section if activated, and submitting expenditure reports in accordance with financial management practices. Incident-related costs may occur during response or recovery phases and may include personnel overtime, equipment used/expended, and contracts initiated;
- Ensuring that vehicles and other equipment are equipped and ready, in accordance with SOPs;
- Notifying the Emergency Manager of resource shortfalls;
- Identifying essential functions and developing procedures for maintaining and/or reestablishing services provided to the public and other City departments;
- Assigning personnel to the EOC, as charged by this plan;
- Developing and implementing procedures for protecting vital records, materials, and facilities;
- Promoting family preparedness among employees;
- Ensuring that staff complete required training (including required NIMS and ICS training);
- Dedicating staff time to participation in training exercises; and
- Preparing and maintaining supporting SOPs and annexes (including incorporation of NIMS components, principles, and policies).

3.2.3 Responsibilities by Function

This group includes services required for an effective emergency management program, of which response is a key element. These agencies include fire departments/districts, law enforcement, emergency medical service (EMS) providers, and public health, environmental health, and public works departments. Departments or agencies assigned as primary may only be responsible for coordinating with other primary or supporting agencies to ensure continuity.

- **Primary City Agency(s):** Identify lead agencies for emergency functions based on the agency's coordinating responsibilities, authority, functional expertise, resources, and capabilities in managing incident activities. Primary agencies may not be responsible for all elements of a function, and will coordinate with supporting agencies.
- **Supporting City Agency(s):** Identify agencies with substantial support roles during major incidents.

3.2.3.1 Transportation

Primary City Agency: Public Works Department
Supporting City Agencies: Police Department, Parks and Recreation Department
County Agency: Department of Transportation and Development (DTD)
Community Partners: TVF&R, mutual aid partners
Primary State Agency: Oregon Department of Transportation (ODOT)
Primary Federal Agency: Department of Transportation

Transportation-related responsibilities include:

- Monitoring and reporting the status of and any damage to the City's transportation system and infrastructure;
- Identifying temporary alternative transportation solutions that can be implemented by others when the City's systems or infrastructure are damaged, unavailable, or overwhelmed;
- Coordinating the restoration and recovery of the City's transportation systems and infrastructure; and
- Coordinating support of emergency operations activities among transportation stakeholders within the City's authorities and resources limitations.

See ESF 1 for more details.

3.2.3.2 Communications

Primary City Agency: Police Department, Information Technology Department
Supporting City Agencies: None at this time.
County Agency: C-COM, CCDM
Community Partners: LOCOM, Washington County Consolidated Communications Agency, West Linn Amateur Radio Emergency Services (ARES) (in development), Verizon
Primary State Agency: Department of Administrative Services
Primary Federal Agency: Department of Homeland Security

Alert and Warning

Responsibilities related to alert and warning include:

- Monitoring emergency communications networks;
- Disseminating emergency alerts, as requested by the on-scene Incident Commander, EOC Incident Commander, or PIO; and
- Receiving and disseminating warning information to the public and key County and City officials.

Communication Systems

Communication-related responsibilities include:

- Establishing and maintaining emergency communications systems;
- Coordinating the use of all public and private communication systems necessary during emergencies;
- Managing and coordinating all emergency communication within the EOC, once activated; and
- Managing and coordinating all emergency notifications to departments and officials (e.g., during transition to continuity facilities or succession notification).

See ESF 2 for more details.

3.2.3.3 Public Works

Primary City Agency: Public Works Department
Supporting City Agencies: Building Department, Parks and Recreation Department, Finance Department
County Agency: DTD
Community Partners: Mutual aid partners, local contractors (e.g., tree removal)
Primary State Agency: ODOT
Primary Federal Agency: Department of Defense/United States Army Corps of Engineers, Department of Homeland Security

Responsibilities related to public works include:

- Conducting pre- and post-incident assessments of public works and infrastructure;
- Executing emergency contract support for life-saving and life-sustaining services;
- Coordinating repair of damaged public infrastructure and critical facilities;

- Coordinating repair and restoration of the City's critical infrastructure; and
- Coordinating disaster debris management activities.

See ESF 3 for more details.

3.2.3.4 Firefighting

Primary City Agency: Police Department (primary response agency listed under community partners)
Supporting City Agencies: Public Works Department
County Agency: Fire Defense Board
Community Partners: TVF&R (primary response), mutual aid partners
Primary State Agency: Oregon Department of Forestry, Oregon State Fire Marshal (OSFM)
Primary Federal Agency: United States Department of Agriculture/Fire Service

Responsibilities related to fire service include:

- Providing fire prevention, fire suppression, and emergency medical aid to prevent loss of life, loss of property, and damage to the environment;
- Performing life-safety inspections and recommendations for activated emergency shelters;
- Disseminating warnings as necessary in a major emergency/disaster and assisting in evacuation; and
- Designating a coordinator/liaison to participate in all phases of the City and/or County's emergency management program, when necessary or as requested.

See ESF 4 for more details.

3.2.3.5 Information and Planning

Primary City Agency: City Police Department, City Manager's Office (Citizen Engagement Coordinator)
Supporting City Agencies: All other City departments
County Agency: CCDM
Community Partners: West Linn Tidings, Oregonian, Tualatin Valley Community TV
Primary State Agency: OEM
Primary Federal Agency: Department of Homeland Security/FEMA

The following activities are necessary for the City to compile, analyze, and coordinate overall information planning activities during a disaster:

- Providing a centralized location for the receipt and dissemination of incident information;
- Coordinating with City departments, community partners, and County agencies;
- Collecting, processing, analyzing, and disseminating information to guide response and recovery activities;
- Collecting and aggregate damage assessment data; and
- Coordinating incident planning in the EOC, including development of information products.

See Chapter 5 – Command and Control as well as ESF 5 for more details.

3.2.3.6 Mass Care

Primary City Agency: Police Department
Supporting City Agencies: City Manager's Office, Finance Department
County Agency: H3S
Community Partners: TVF&R, American Medical Response, American Red Cross, community- and faith-based organizations, West Linn-Wilsonville School District
Primary State Agency: Department of Human Services (DHS)
Primary Federal Agency: Health and Human Services

The City relies on the support of the County to provide shelter and mass care services and has adopted the procedures outlined in the County EOP. H3S, with support from the Oregon Trail Chapter of the American Red Cross, is responsible for ensuring that the mass care needs of the affected population are met, including sheltering, feeding, providing first aid, and reuniting families. Relevant operations are detailed in the County EOP, ESF 6 – Mass Care and ESF 11 – Food and Water. Responsibilities related to mass care include:

- Maintaining and implementing procedures for care and shelter of displaced residents and visitors;
- Maintaining and implementing procedures for the care and shelter of animals in an emergency;
- Coordinating support with other City and County departments, relief agencies, and volunteer groups;
- Designating a coordinator/liaison to participate in all phases of the County's emergency management program, when necessary or as requested;
- Providing emergency counseling for disaster victims and emergency response personnel suffering from behavioral and emotional disturbances;
- Coordinating with faith-based organizations and other volunteer agencies;
- Identifying emergency feeding sites (coordinating with the Red Cross and Salvation Army);
- Identifying sources of clothing for disaster victims (may coordinate with the Red Cross, Salvation Army, or other disaster relief organizations);
- Securing sources of emergency food supplies (with the Red Cross and Salvation Army);
- Coordinating operation of shelter facilities operated by the City or County, local volunteers, or organized disaster relief agencies such as the Red Cross; and
- Coordinating special care requirements for sheltered groups such as unaccompanied children and the elderly.

See ESF 6 for more details.

3.2.3.7 Resource Support

Primary City Agency: Finance Department
Supporting City Agencies: Manager's Office
County Agency: CCDM
Community Partners: TVF&R, local faith-based organizations, volunteer organizations
Primary State Agency: Department of Administrative Services
Primary Federal Agency: Department of Homeland Security/FEMA

Responsibilities related to resource support include:

- Establishing procedures for employing temporary personnel for disaster operations;
- Establishing and maintaining a staffing reserve, in cooperation with law enforcement;
- Coordinating deployment of reserve personnel to City departments requiring augmentation;
- Establishing emergency purchasing procedures and/or a disaster contingency fund; and
- Maintaining records of emergency-related expenditures for purchases and personnel.

Individual department directors will be responsible for managing resources within their departments and coordinating any requests for additional resources with the City EOC. The Emergency Manager will be responsible for establishing priorities if major shortages occur in critical resources; otherwise, the EOC will allocate such resources as additional staffing, materials, services and supplies needed for emergency and recovery operations.

See ESF 7 for more details.

3.2.3.8 Health and Medical

Health Services

Primary City Agency: City Police Department
Supporting City Agencies: None at this time.
County Agency: H3S
Community Partners: TVF&R, local hospitals and clinics, emergency medical response agencies, Red Cross, mutual aid partners
Primary State Agency: OHA
Primary Federal Agency: Health and Human Services

The City relies on the County to provide public health and human services. Relevant operations are detailed in the County EOP, ESF 6 – Mass Care and ESF 8 – Health and Medical.

Responsibilities related to public health include:

- Coordinating with hospitals, clinics, nursing homes/care centers, and behavioral health organizations for adequate provision of public health, medical, and behavioral health services, including making provisions for populations with disabilities and access or functional needs (DAFN);
- Coordinating public health surveillance;

- Coordinating mass prophylaxis and delivery and distribution set-up of the Strategic National Stockpile, if needed;
- Coordinating mass fatality operations with the Medical Examiner and Funeral Directors to provide identification and disposal of the dead;
- Coordinating isolation and/or quarantine actions, as needed and permitted;
- Coordinating dissemination of public health information; and
- Designating a coordinator/liaison to participate in all phases of the County's emergency management program, when necessary or as requested.

See ESF 8 for more details.

Medical Services

Primary City Agency: Police Department (primary response agency is TVF&R)
Supporting City Agencies: None at this time.
County Agency: H3S
Community Partners: TVR&F, local ambulance service agencies, hospitals and clinics
Primary State Agency: OHA
Primary Federal Agency: Health and Human Services

EMS-related responsibilities include:

- Providing emergency medical care and transport;
- Coordinating EMS resources; and
- Requesting additional EMS assets as necessary.

See ESF 8 for more details.

3.2.3.9 Search and Rescue

Primary City Agency: Police Department
Supporting City Agencies: Public Works Department, Parks and Recreation
County Agency: County Sheriff's Office (primary)
Community Partners: Mutual aid partners, TVF&R, Red Cross, EMS agencies
Primary State Agency: OEM, OSFM
Primary Federal Agency: Department of Defense, Department of Homeland Security/FEMA and United States Coast Guard

Responsibilities related to search and rescue include:

- Coordinating available resources to search for and rescue persons lost outdoors;
- Performing specialized rescue (e.g., water, high-angle, structural collapse), as needed and practical;
- Cooperating with and extending assistance to surrounding jurisdictions, on request and as resources allow; and
- Establishing and monitoring training standards for certification of search and rescue personnel.

See ESF 9 for more details.

3.2.3.10 Hazardous Materials Response

Hazardous Materials Response

Primary City Agency: Police Department
Supporting City Agencies: Public Works Department, City Manager's Office
County Agency: Fire Defense Board
Community Partners: TVF&R (primary), mutual aid partners, Red Cross, private industry, EMS agencies
Primary State Agency: OEM, OSFM Regional Hazardous Materials Team No. 3 (Primary)
Primary Federal Agency: Department of Defense, Department of Homeland Security/FEMA and United States Coast Guard

Responsibilities related to oil and hazardous materials include:

- Conducting oil and hazardous materials response (chemical, biological, etc.);
- Providing remote consultation, as needed;
- Assessing the potential health effects of a hazardous materials release;
- Identifying the needs for hazardous materials incident support from regional and state agencies;
- Recommending protective actions related to hazardous materials; and
- Conducting environmental short- and long-term cleanup.

Radiological Protection

Primary City Agency: Police Department
Supporting City Agencies: Public Works Department
County Agency: OHA, Radiation Protection Services
Community Partners: TVF&R
Primary State Agency: OHA, Radiation Protection Services, OSFM Regional Hazardous Materials Team No. 3
Primary Federal Agency: United States Environmental Protection Agency

Responsibilities related to radiological protection include:

- Providing localized radiological monitoring and reporting network, when necessary;
- Securing initial and refresher training for instructors and monitors;
- Providing input to the statewide monitoring and reporting system from incident scenes, as necessary;
- Under fallout conditions, providing City and County officials and department heads with information regarding fallout rates, fallout projections, and allowable doses provided by the State Radiation Protection Services or federal government; and
- Providing monitoring services and advice at the scenes of accidents involving radioactive materials.

See ESF 10 for more details.

3.2.3.11 Food and Water

Primary City Agency: Finance Department
Supporting City Agencies: City Manager's Office, Public Works Department (Water Division)
County Agency: CCDM, H3S
Community Partners: Red Cross, Salvation Army, community- and faith-based organizations
Primary State Agency: DHS
Primary Federal Agency: Department of Homeland Security/FEMA

Responsibilities related to food and water include:

- Assessing of food and water needs for the community;
- Identifying food and water resources;
- Storing of food and water resource;
- Monitoring the collection and sorting of all food and water supplies and establishing procedures to ensure that they are safe for consumption; and
- Coordinating transportation of food and water resources to the community.

See ESF 11 for more details.

3.2.3.12 Energy

Primary City Agency: Public Works Department
Supporting City Agencies: Parks and Recreation, Information Technology Department
County Agency: CCDM
Community Partners: Public and private utilities (Portland General Electric, NW Natural)
Primary State Agency: Oregon Public Utility Commission
Primary Federal Agency: Department of Energy

Responsibilities related to energy include:

- Coordinating with local utilities to restore and repair damaged infrastructure and accompanying systems;
- Coordinating with local utilities to reduce the risk of physical or cyber attack on lifeline utility systems; and
- Coordinating temporary emergency power generation capabilities to support critical facilities until permanent restoration is accomplished. Critical facilities may include primary and alternate EOCs, hospitals/critical care facilities, designated shelters, government offices/facilities, water/sewage systems, and other essential community services.

See ESF 12 for more details.

3.2.3.13 Military Support

Primary City Agency: City Police Department
Supporting City Agencies: None at this time.
County Agency: Sheriff's Office
Community Partners: None at this time.
Primary State Agency: Oregon Military Department
Primary Federal Agency: Department of Defense

Responsibilities related to military support include:

- Working with the Oregon Military Department when it is necessary for them to:
    - Coordinate, employ, and control Oregon National Guard forces and military resources in order to assist civil authorities with the protection of life and property, and to maintain peace, order, and public safety
    - Mobilize and stage personnel and equipment to restore/preserve law and order and provide support to other ESFs respectively as directed by the State ECC and within Oregon National Guard capabilities
- Coordinate with the active federal military to ensure mutual support during federal disaster relief operations.

See ESF 13 for more details.

3.2.3.14 Public Information

Primary City Agency: City Manager's Office (Citizen Engagement Coordinator)
Supporting City Agencies: Police Department
County Agency: Public and Governmental Affairs
Community Partners: West Linn Tiding, West Linn ARES (in development)
Primary State Agency: OEM
Primary Federal Agency: Department of Homeland Security/FEMA

Responsibilities related to public information include:

- Conducting ongoing hazard awareness and public education programs;
- Compiling and preparing emergency information for the public in the event of emergency;
- Coordinating with other agencies to ensure consistency of education and emergency information;
- Arranging for media representatives to receive regular briefings on the City's status during extended emergency situations;
- Securing printed and photographic documentation of the disaster situation;
- Handling unscheduled inquiries from the media and the public;
- Being aware of non-English-speaking and/or bilingual population centers within the City and County and preparing training and news releases accordingly;
- Monitoring the media and correcting misinformation; and
- Overseeing and providing information to call-takers who receive requests for assistance from the public.

See ESF 14 for more details.

3.2.3.15 Volunteer and Donation Management

Primary City Agency: City Manager's Office
Supporting City Agencies: Police Department, Library Department
County Agency: CCDM, H3S
Community Partners: Red Cross, community- and faith-based organizations
Primary State Agency: OEM
Primary Federal Agency: FEMA

Responsibilities related to volunteer and donations management include:

- Coordinating the identification and vetting of volunteer resources;
- Matching volunteer resources and donations with the unmet needs of the community;
- Maintaining a donations management system to ensure the effective utilization of donated cash, goods, and services;
- Providing guidance to personnel coordinating the management of undesignated cash donations, unsolicited goods, and emergent volunteers;
- Directing unaffiliated volunteers to and coordinating with government-sponsored/organized volunteer organizations such as Community Emergency Response Teams (CERTs), Red Cross, Fire Corps, Medical Reserve Corps, Volunteers in Police Services, and volunteers associated with the faith-based community in completing their assigned tasks.

See ESF 15 for more details.

3.2.3.16 Law Enforcement Services

Primary City Agency: Police Department
Supporting City Agencies: Public Works Department
County Agency: Sheriff's Office
Community Partners: TVF&R, mutual aid partners
Primary State Agency: Oregon State Police (OSP)
Primary Federal Agency: Department of Justice

Responsibilities related to law enforcement include:

- Protecting life and property and preserving order;
- Providing law enforcement and criminal investigation;
- Providing traffic control, crowd control, and site security;
- Isolating damaged areas; and
- Providing damage reconnaissance and reporting.

See ESF 16 for more details.

3.2.3.17 Agriculture and Animal Protection

Primary City Agency: Parks and Recreation Department, City Manager's Office
Supporting City Agencies: Police Department
County Agency: CCDM, H3S
Community Partners: Local veterinarians, local animal organizations
Primary State Agency: Oregon Department of Agriculture
Primary Federal Agency: United States Department of Agriculture

Responsibilities related to agriculture and animal protection include:

- Conducting animal and plant disease and pest response;
- Coordinating animal/veterinary/wildlife response during a disaster, including:
  - Capturing/rescuing animals that have escaped confinement or been displaced from their natural habitat
  - Providing emergency care to injured animals
  - Providing humane care, handling, and sheltering to animals (including service animals, pets, and livestock)
- Protecting the State's natural resources from the impacts of a disaster.

See ESF 17 for more details.

3.2.3.18 Business and Industry

Primary City Agency: City Manager's Office
Supporting City Agencies: Community Development
County Agency: Business and Community Services (BCS)
Community Partners: Chamber of Commerce, Rotary Club, Clackamas County Business Alliance, area businesses and industry
Primary State Agency: Oregon Business Development Department
Primary Federal Agency: Small Business Administration

Responsibilities related to business and industry include:

- Coordinating with business and industry partners to facilitate private-sector support to response and recovery operations;
- Identifying short-term recovery assistance to business and industry partners;
- Facilitating communication between business and industry partners and the local, tribal, and State EMOs; and
- Providing economic damage assessments for impacted areas.

See ESF 18 for more details.

3.2.3.19 Recovery

Primary City Agency: City Manager's Office
Supporting City Agencies: All other departments
County Agency: CCDM, BCS, DTD
Community Partners: Clackamas County Business Alliance
Primary State Agency: OEM
Primary Federal Agency: Department of Homeland Security

Recovery-related responsibilities include:

- Directing emergency recovery in times of disaster by providing leadership in coordinating private and governmental-sector emergency recovery efforts;
- Participating with County and State partners to conduct damage assessments; identifying and facilitating availability and use of recovery funding;
- Accessing recovery and mitigation grant and insurance programs;
- Providing outreach, public education, and community involvement in recovery planning;
- Coordinating logistics management and resource support, providing assistance as needed;
- Locating, purchasing, and coordinating delivery of resources necessary during or after an incident in the City; and
- Ensuring accurate documentation of the recovery effort to secure federal reimbursement of funds.

3.2.3.20 Evacuation and Population Protection

Primary City Agency: Police Department
Supporting City Agencies: Public Works Department
County Agency: Sheriff's Office
Community Partners: TVF&R, mutual aid partners
Primary State Agency: OSP
Primary Federal Agency: Department of Homeland Security

Responsibilities related to evacuation and population protection include:

- Defining responsibilities of City departments and private-sector groups;
- Identifying high-hazard areas and corresponding numbers of potential evacuees;
- Coordinating evacuation planning, including:
  - Movement control
  - Health and medical requirements
  - Transportation needs
  - Emergency Public Information materials
  - Shelter and reception location
- Developing procedures for sheltering in place;
- Confirming and managing locations of staging areas and pick-up points for evacuees requiring public transportation;
- Providing guidance on commuting arrangements for essential workers during the evacuation period;

- Assisting with control and safety measures in the evacuated area and reassigning personnel during the evacuation period;
- Conducting evacuation in accordance with City policy; and
- If an evacuation is instituted, notifying the Red Cross (1-888-680-1455).

3.2.3.21 Damage Assessment

Primary City Agency: Public Works Department
Supporting City Agencies: Police Department, Building Department
County Agency: DTD
Community Partners: TVF&R, CERT
Primary State Agency: OEM
Primary Federal Agency: Department of Homeland Security/FEMA

Responsibilities related to damage assessment include:

- Establishing a damage assessment team from among City departments with assessment capabilities and responsibilities;
- Training and providing damage plotting team members to the EOC;
- Assisting in reporting and compiling information regarding deaths, injuries, and dollar damage to tax-supported facilities and to private property;
- Assisting in determining the geographic extent of the damaged area; and
- Evaluating the effect of damage on the City's economic index, tax base, bond ratings, insurance ratings, etc. for use in long-range recovery planning.

3.2.2.22 Coordination with Special Facilities

Primary City Agency: City Manager's Office
Supporting City Agencies: All other departments
County Agency: CCDM, H3S
Community Partners: None at this time
Primary State Agency: OEM
Primary Federal Agency: None at this time

Responsibilities related to coordination with special facilities (e.g., schools, care facilities, correctional institutions) include:

- Establishing strong working relationships with local jurisdictional leaders and core private-sector organizations, voluntary agencies, and community partners;
- Encouraging staff preparedness by participating in planning, training, and exercises;
- Educating staff, students, clients, etc. on facility emergency plans and procedures and the need for individual and/or family emergency planning; and
- Preparing and maintaining emergency plans and SOPs.

3.2.3.24 Other Agency Responsibilities

Other City department and agency heads not assigned a specific function in this plan will be prepared to make their resources (including personnel) available for emergency duty at the direction of the City Manager.

3.3 Local and Regional Response Partners

The City's emergency organization is supported by a number of outside organizations, including the County, service organizations, and the private sector.

3.3.1 Private Sector

Private-sector organizations play a key role before, during, and after an incident. First, they must provide for the welfare and protection of their employees in the workplace. In addition, the City and County must work seamlessly with businesses that provide water, power, communication networks, transportation, medical care, security, and numerous other services upon which both response and recovery are particularly dependent. Essential private-sector responsibilities include:

- Planning for the protection of employees, infrastructure, and facilities;
- Planning for the protection of information and the continuity of business operations;
- Planning for, responding to, and recovering from incidents that impact private-sector infrastructure and facilities;
- Collaborating with emergency management personnel before an incident occurs to ascertain what assistance may be necessary and how private-sector organizations can help;
- Developing and exercising emergency plans before an incident occurs;
- Where appropriate, establishing mutual aid and assistance agreements to provide specific response capabilities; and
- Providing assistance (including volunteers) to support local emergency management and public awareness during response and throughout the recovery process.

3.3.2 Nongovernmental and Faith-Based Organizations

Nongovernmental and faith-based organizations play enormously important roles before, during, and after an incident. In the City, nongovernmental/faith-based organizations such as the Red Cross provide sheltering, emergency food supplies, counseling services, and other vital support services to support response and promote the recovery of disaster victims. Nongovernmental and faith-based organizations also collaborate with responders, governments at all levels, and other agencies and organizations.

The roles of nongovernmental and faith-based organizations in an emergency may include:

- Training and managing volunteer resources;
- Identifying shelter locations and needed supplies;
- Providing critical emergency services to those in need, such as cleaning supplies, clothing, food, shelter, and assistance with post-emergency cleanup; and
- Identifying those whose needs have not been met and helping to coordinate assistance.

3.3.3 Individuals and Households

Although not formally a part of the City's emergency operations, individuals and households play an important role in the overall emergency management strategy. Community members can contribute by:

- Reducing hazards in their homes;
- Preparing emergency supply kits and household emergency plans that consider all members of the household, including children and pets;
- Monitoring emergency communications carefully;
- Volunteering with established organizations;
- Enrolling in emergency response training courses; and
- Encouraging children to participate in preparedness activities.

3.4 County Response Partners

County departments and agencies are assigned emergency response tasks based on their statutory responsibilities and functional expertise.

See the County EOP for details on the County's EMO and detailed roles and responsibilities for County departments.

3.5 State Response Partners

Under the provisions of ORS 401.035, the Governor has broad responsibilities for the direction and control of all emergency activities in a State-declared emergency. The administrator of OEM is delegated authority by ORS 401.052 to 401.092 to coordinate all activities and organizations for emergency management within the State and to coordinate in emergency matters with other states and the federal government.

Under the direction and control of department heads, agencies of State government represent the State emergency operations organization. Responsibility for conducting ESFs is assigned by the Governor to the department best suited to carry out each function applicable to the emergency situation. Some State agencies may call upon their federal counterparts to provide additional support and resources following established procedures and policies for each agency.

See the State EOP for details on the State's emergency management organization and detailed roles and responsibilities for State departments.

3.6 Federal Response Partners

Federal response partners are typically requested by OEM in the event that the State's resources become limited or specialized services are needed. In most instances, federal resources become available following a formal declaration of emergency by the Governor. Thus, procedures and policies for allocating and coordinating resources at the federal level follow the Oregon Emergency Management Plan and, if necessary, the National Response Framework.

See the National Response Framework for details on the federal government's EMO and detailed roles and responsibilities for federal departments.

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4 Concept of Operations

This section of the EOP states the community's response and recovery priorities, provides concepts to guide the Community through the phases of emergency operations, and provides a guide for multi-jurisdictional coordination and incident command.

4.1 General

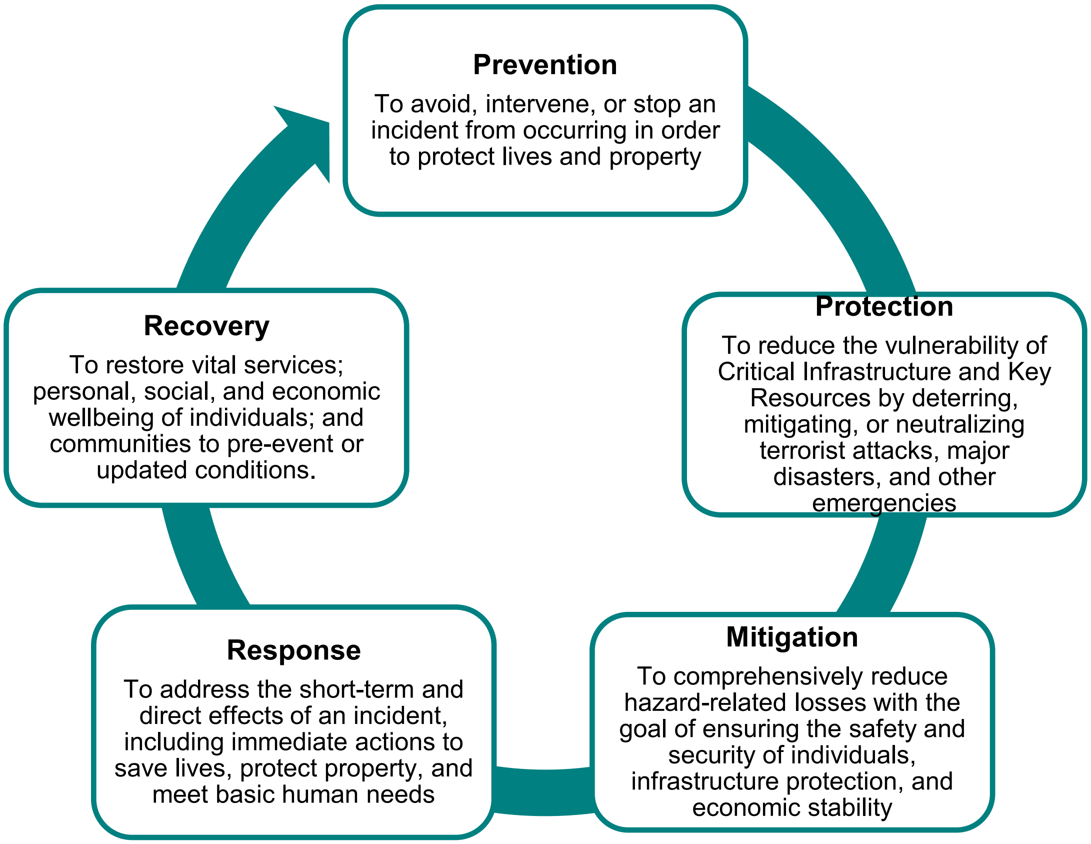
Primary roles involved during the initial emergency response will focus on first responders, such as fire services, police services, and the public works department. Depending on the type of incident, initial response also may include hospitals, local public health departments, and hazardous material teams. In all emergencies, saving and protecting human lives is the top priority of the City and emergency response personnel.

The City is responsible for emergency management and protecting life and property of individuals within this jurisdiction. This EOP will be used when the City or individual emergency response agencies are reaching or have exceeded their capabilities to respond to an emergency. It may also be used during non-routine incidents or pre-planned events where City resources are limited and/or have been expended.

4.2 Emergency Management Mission Areas

This plan adheres to the emergency management principle of all-hazards planning, which is based on the fact that most responsibilities and functions performed during an emergency are not hazard-specific. The focus of this EOP is response and short-term recovery actions. Nevertheless, this plan both impacts and is informed by activities conducted before and after emergency operations take place and is designed to assist the City in the following five mission areas:

Figure 4-1 Emergency Management Mission Areas



4.3 Response and Recovery Priorities

4.3.1 Response

Response activities within the City are undertaken immediately after an incident. The City's response priorities are defined below:

1. **Lifesaving/Protection of Property:** This is a focus on efforts to save lives of persons. It may include prevention or mitigation of major property damage if results of such damage would likely present an immediate danger to human life.
2. **Incident Stabilization:** This is a focus on protection of mobile response resources, isolation of the impacted area, and containment (if possible) of the incident.
3. **Property Conservation:** This is a focus on the protection of public facilities essential to life safety/emergency response, protection of the environment whenever public safety is threatened, and protection of private property.

4.3.2 Recovery

Recovery activities will begin as soon as conditions permit following an incident. It is the responsibility of all levels of government to assist the public and private sectors with recovery from disaster. A widespread disaster will impact the ability of businesses to function, disrupt employment, interrupt government services, and impact tax revenues within the City. This EOP is not a recovery plan; however, the City recognizes that response and recovery activities often take place concurrently until the life safety and emergency protective actions are completed.

Recovery operations are the actions taken to restore vital services, help residents resume self-sufficiency, and help communities return to pre-event or “new normal” conditions. Short-term recovery involves the restoration of critical services such as communications, water supply, sewage service, emergency medical capabilities, and electricity, as well as garbage and debris removal. These functions must occur early in the emergency response to support the life, health, and safety of the population and to support other emergency operations. The City’s recovery priorities for CIKR are defined below:

1. **Initial Damage Assessment and Human Impact Assessment:** Determine structure impacts to the City and assess unmet human needs.
2. **Debris Removal:** Coordinate debris clearance, collection, and removal.
3. **Infrastructure Restoration:** Facilitate restoration of CIKR.

4.4 Incident Levels

Incident levels assist local, county, and state response agencies in recognizing the degree of intensity and potential impact of a particular situation. Emergency situations within the City will not always fit neatly into these levels, and any incident has the potential to intensify or expand to a higher level. Special circumstances or external pressures may warrant outside assistance for relatively minor incidents.

4.4.1 Level 1

A Level 1 incident is a minor and localized incident that is quickly resolved within existing City resources or limited outside help. A Level 1 incident has little or no impact on personnel or normal operations outside the locally affected area. Level 1 incidents do not require activation of this EOP or the EOC. Impacted emergency response personnel coordinate directly with their individual departments and each other to resolve the incident.

Examples of Level 1 incidents include small chemical spill, small fire, limited duration power failure, and normal fire and police response requests.

4.4.2 Level 2

A Level 2 incident is a major event or threat that requires response by more than one department or response agency due to special or unusual characteristics, or that is beyond the scope of available local resources. Level 2 incidents may require partial implementation of this EOP and the EOC.

Examples of Level 2 incidents include large or multiple structure fires, structural collapse, significant hazardous materials release, extended power or utility outage, severe flooding, multi-fatality incident, or an external emergency that may affect the City’s response agencies or operations.

4.4.3 Level 3

A Level 3 incident is a major disaster or imminent threat involving the coordinated response of local, regional, state, and federal resources to save lives and protect the property of a large portion of the population. The effects of the emergency are wide-ranging and complex and may require sheltering or relocation of the affected population. Under such conditions, this EOP will be implemented and the EOC will be activated.

Examples of Level 3 incidents include major explosion, major hazardous materials release, major earthquake, or terrorism incident.

4.4.4 NIMS Incident Levels

While the City uses incident levels that are consistent with the County and State EOPs, incident types at the federal level are based on the five levels of complexity that ascend from relatively minor incidents (Type 5, e.g., vehicle fire) to a major disaster (Type 1) resulting in high impact on the City and requiring national response resources (source: U.S. Fire Administration).

During an incident,

- Where federal agencies are involved in response and recovery operations (Type 3); or
- Where national resources are impacted (such as waters of the United States), requiring response from federal agencies,

Incident levels identified in this EOP will transition to the NIMS incident levels. Refer to Table 4-1 for further information on NIMS incident levels.

Table 4-1 NIMS Incident Levels

Type 5	▪ The incident can be handled with one or two single resources with up to six personnel. ▪ Command and General Staff positions (other than the Incident Commander) are not activated. ▪ No written Incident Action Plan (IAP) is required. ▪ The incident is contained within the first operational period and often within an hour to a few hours after resources arrive on scene. ▪ Examples include a vehicle fire, an injured person, or a police traffic stop.
Type 4	▪ Command and General Staff functions are activated only if needed. ▪ Several resources are required in order to mitigate the incident. ▪ The incident is usually limited to one operational period in the control phase. ▪ The agency administrator may have briefings and ensure that the complexity analysis and delegation of authority are updated. ▪ No written IAP is required, but a documented operational briefing will be completed for all incoming resources. ▪ The agency administrator develops operational plans, including objectives and priorities.

Table 4-1 NIMS Incident Levels

Type 3	■ When capabilities exceed initial attack, the appropriate ICS positions should be added to match the complexity of the incident. ■ Some or all Command and General Staff positions may be activated, as well as Division/Group Supervisor and/or Unit Leader level positions. ■ A Type 3 Incident Management Team or Incident Command organization manages initial action incidents with a significant number of resources, an extended attack incident until containment/control is achieved, or an expanding incident until transition to a Type 1 or 2 team. ■ The incident may extend into multiple operational periods. ■ A written IAP may be required for each operational period.
Type 2	■ The incident extends beyond the capabilities for local control and is expected to extend into multiple operational periods. A Type 2 incident may require the response of resources out of area, including regional and/or national resources, to effectively manage the Operations, Command, and General Staffing. ■ Most or all of the Command and General Staff positions are filled. ■ A written IAP is required for each operational period. ■ Many of the functional units are needed and staffed. ■ Operations personnel normally do not exceed 200 per operational period, and total incident personnel do not exceed 500 (guidelines only). ■ The agency administrator is responsible for the incident complexity analysis, agency administrator briefings, and the written delegation of authority.
Type 1	■ A Type 1 incident is the most complex, requiring national resources to safely and effectively manage and operate. ■ All Command and General Staff positions are activated. ■ Operations personnel often exceed 500 per operational period, and total personnel will usually exceed 1,000. ■ Branches need to be established. ■ The agency administrator will hold briefings and ensure that the complexity analysis and delegation of authority are updated. ■ Use of resource advisors at the incident base is recommended. ■ There is a high impact on the local jurisdiction, requiring additional staff for office administrative and support functions.

4.5 Incident Management

4.5.1 Activation

When an emergency situation arises and it is determined that the normal organization and functions of City government are insufficient to effectively meet response requirements, the Emergency Manager will activate and implement all or part of this EOP. In addition, the Emergency Manager may partially or fully activate and staff the City EOC based on an emergency's type, size, severity, and anticipated duration. Concurrently, all involved City emergency services will implement their respective plans, procedures, and processes and will provide the City EOC with the following information:

- Operational status;
- Readiness and availability of resources;
- Changing conditions and status of resources (personnel, equipment, facilities, supplies, etc.); and
- Significant concerns and issues dealing with potential or actual loss of life or property

Refer to the immediate actions checklist (at the beginning of this EOP) for further information on initial actions to be taken by the Emergency Manager (or designee) upon implementation of all or part of this EOP.

4.5.2 Alert and Warning

Warnings, emergency information and notifications, or disaster reports received by City personnel will be relayed to the Emergency Manager and the Dispatch Center. City response personnel will communicate and receive notifications using communications media such as landline and cellular telephones, internet/email, and radio throughout the duration of response activities as long as these resources are available. Emergency notification procedures are established among the response community, and call-down lists are updated and maintained by each agency. External partners will be notified and coordinated through the City EOC as appropriate.

4.5.3 Communications

The ability of responders from different agencies and disciplines to work together depends greatly on their ability to communicate with each other. Plain language is essential to first responder and public safety, and will be used by all City personnel during emergencies. The use of common terminology enables emergency responders, EOC personnel, and City staff, as well as personnel from neighboring jurisdictions, the County, or the State to communicate clearly with each other and effectively coordinate response activities, regardless of an incident's size, scope, or complexity.

Through the County, a public warning and broadcast system has been established for the City to provide emergency information and instructions during a pending or actual emergency incident or disaster.

See ESF 2 – Communications for more information.

4.5.3.1 Interoperability

Interoperability is the ability of public and private agencies, departments, and other organizations to operate and communicate effectively together through the use of systems, personnel, and equipment. In recognition that successful emergency management and incident response operations require the continuous flow of critical information among jurisdictions, disciplines, organizations, and agencies, interoperability plans or procedures should be developed that include training and exercises, SOPs, new technology, and considerations of individual agency governance, as well as consideration of use within a stressful and often chaotic context of a major response. Interoperable voice, data, or video-on-demand communications systems allow emergency management/response personnel to communicate within and across agencies and jurisdictions in real time, when needed, and when authorized.

4.5.4 Situational Awareness and Intelligence Gathering

Situational awareness and intelligence gathering are necessary to maintain a common operating picture among response agencies and provide the basis for emergency alert and warning (when an incident alert is not received by an outside agency). Situational awareness is the ongoing process of collecting, analyzing, and sharing information across agencies, intergovernmental levels, and the private sector. Intelligence gathering is the collecting of security and operational information, such as collection of severe weather forecasts from the National Weather Service. Intelligence gathering may also be used to detect, prevent, apprehend, and prosecute criminals planning terrorist incidents.

On a day-to-day basis, and during Level 1 and 2 incidents when the EOC is not fully activated, the City, primary agencies, and supporting response agencies will:

- Be aware of their surroundings and identify and report potential threats and dangerous situations;
- Share and evaluate information from multiple sources;
- Integrate communications and reporting activities among responding agencies;
- Monitor threats and hazards; and
- Share forecasting of incident severity and needs.

If activated, the EOC Planning Section Chief will lead situational awareness and intelligence gathering activities and functions, unless otherwise designated. If a criminal or terrorist incident is suspected, the City Police Department will notify the Oregon Terrorism Information Threat Assessment Network Fusion Center (OTFC) through the County Sheriff's Office. During a terrorist incident, the OTFC will support situational awareness and intelligence-gathering functions.

See ESF 5 – Information and Planning for more information.

4.5.5 Resource Management

When the EOC is activated, the Logistics and Planning Sections have primary responsibility for coordinating the resource management effort and have authority under emergency conditions to establish priorities for the assignment and use of all City resources. In a situation where resource allocations are in dispute, the City Manager has the final allocation authority. City resources will be allocated according to the following guidelines:

- Deploy resources according to the following priorities:
    1. Protection of life
    2. Protection of responding resources
    3. Protection of public facilities
    4. Protection of private property
- Distribute resources so that the most benefit is provided for the amount of resources expended;
- Coordinate resident appeals for assistance through the PIO at the EOC or Joint Information Center (JIC). Use local media to provide residents with information about where to make these requests;

- Activate mutual aid agreements as necessary to supplement local resources; and
- When all local resources are committed or expended, issue a request to the County for county, state, and federal resources through an emergency declaration.

See ESF 7 – Resource Management for more information.

4.5.5.1 Resource Typing

Resource typing is a method of standardizing equipment requests and managing resources during an incident in accordance with NIMS. A resource typed list can increase the usefulness of the tools requested during an emergency and may reduce costs by eliminating orders for equipment that are inaccurate or inappropriate for the situation. At this time, the City has not implemented resource typing. Should resource typing be implemented, response personnel and support staff will train and exercise using resource typing lists to become familiar with the standard terminology for commonly requested resources.

4.5.5.2 Credentialing of Personnel

At this time, the City has not implemented a formalized credentialing program. Should one be implemented, the program will be developed with technical assistance from OEM and provide for documenting personnel and authenticating and verifying their qualifications.

4.5.6 Emergency Public Information

Emergency public information involves developing, coordinating, and disseminating information to the public, coordinating officials, and incident management and responders under all hazard conditions. To ensure that appropriate information is distributed to all populations within the community, the EMO will seek to develop public and private partnerships with fixed and mobile service providers, local officials and state agencies, representatives DAFN populations such as non-English-speakers and the disabled community, staff from nonprofit emergency support organizations, representatives from fixed facilities, third-party emergency alert and telephone notification vendors, and broadcasters. These partnerships help inform overall guidance of emergency public information message development, standards of practice, and evaluation tools, and help refine public information plans and procedures.

The PIO is a member of the Command Staff responsible for interfacing with the public, media, and other agencies during all emergency mission phases. During an emergency, the PIO gathers, verifies, coordinates, and disseminates accurate, accessible, and timely information and is an important link between the EMO and the community. The information the PIO provides to a community can call people to action, educate and inform, change behavior and attitudes, create a positive impression of the City’s EMO, and prepare the community for an emergency.

4.6.7.1 Methods of Public Information Dissemination

Clear, accurate, and consistent information must be disseminated to the public during an emergency for the public to take appropriate protective actions. The information must be distributed in a variety of methods to ensure accessibility and comprehensive penetration of the message. Methods of public information dissemination include the following:

- **Press releases** – A press release is a prepared written news release that uses current data and information.
- **Media briefing or conference** – A briefing is an exchange of information on a single topic and typically includes a question-and-answer period, whereas a conference is a gathering of media where reporters expect to be able to ask questions on a variety of topics.
- **Print Media** – Print media, including newspapers and magazines, allow PIOs to disseminate public information such as detailed information, background, and input from subject matter experts.
- **Radio** – In addition to warnings issued by the EAS, radio allows PIOs to release audio clips and sound bites to the public.
- **Television** – PIOs may utilize television to disseminate visuals, sound bites, and graphics to the public.
- **Internet** – The internet is a dynamic communication conduit that includes webpages, rich site summary (RSS) feeds, and email and can be used as a strategic path for sharing information during an emergency.
- **Newsletters/Mailers** – Information sent directly to the public can provide details on events and activities as well as background information on the City's emergency management programs.
- **Social Media** – Web-based platforms may be used for alerting the public in sudden onset and rapidly developing disasters, direct communication with large groups of constituents, building situational awareness, fostering transparency and accountability, obtaining feedback, and responding quickly to rumors and misinformation. Common types of social media are:
    - Blogs
    - Social networking (e.g., Twitter, Facebook, LinkedIn, NextDoor)
    - Media sharing (e.g., YouTube, Flickr, Pinterest, Instagram)
    - Wiki
    - Communications Applications (FlashAlert, YourGov)
- **Call Center** – May be used as a way to divert unnecessary calls away from the 9-1-1 system, gather information to increase situational awareness of the incident, and disseminate emergency public information.
- **Reverse 9-1-1** – May be used to send out emergency communications to residents.

Each distribution method has strengths and weaknesses. The PIO must determine the best methods of media distribution to reach all populations within the City and must ensure that the weakness of each system is covered by the strength of another. Additionally, the PIO must ensure that all communications are accurate, consistent, and coordinated to avoid public confusion. Pre-planning, message maps, easily adapted messages to be recorded, and the creation of partnerships can assist the PIO in determining what message formats and dissemination methods will be the most accessible to the population of the City.

4.5.7 Disabled, Access and Functional Needs Populations

Access to emergency services shall not be denied on the grounds of color, national origin, sex, age, sexual orientation, or functional needs. DAFN populations (also referred to as vulnerable populations and special needs populations) are members of the community who experience physical, mental, or medical care needs and who may require assistance before, during, and after an emergency incident after exhausting their usual resources and support network.

Examples of DAFN individuals include, but are not limited to:

- Individuals who are deaf or hard of hearing;
- Individuals with limited English proficiency;
- Children and the elderly;
- Individuals without vehicles;
- Individuals with special dietary needs; and
- Individuals who experience physical disabilities

DAFN persons in the City have the primary responsibility for minimizing the impact of disasters through personal preparedness activities. To the greatest extent possible, the Emergency Manager will assist them in carrying out this responsibility by providing preparedness information, emergency public information, and critical public services in an accessible manner.

4.5.8 Children and Disasters

Planning and preparing for the unique needs of children is of utmost concern to the City and, whenever possible, the City will consider preparedness, evacuation, shelter operations, and public outreach and education activities that identify issues particular to children.

Individuals with children have the primary responsibility for minimizing the impact of disasters to themselves and their children through personal preparedness activities. To the greatest extent possible, the Emergency Manager will assist in carrying out this responsibility by providing preparedness information, emergency public information, and critical public services.

4.5.9 Animals in Disaster

While the protection of human life is paramount, the need to care for domestic livestock and/or companion animals plays into decisions made by people affected by disasters. Preparing for the care of animals during a disaster is the responsibility of owners. However, the City may coordinate with local animal owners, veterinarians, and animal advocacy groups and charities sponsored by private organizations to address animal-related issues that arise during an emergency. If local resources are insufficient to meet the needs of animals during a disaster, the City may request assistance through CCDM.

4.5.10 Demobilization

As the emergency situation progresses and the immediate response subsides, a transition period will occur during which emergency responders will hand responsibility for emergency coordination to agencies involved with short- and long-term recovery operations.

The following issues will be considered when demobilizing:

- Identification of surplus resources and probable resource release times;

- Demobilization priorities as established by the on-scene Incident Commander and/or EOC Incident Commander;
- Released or demobilized response resources as approved by the on-scene Incident Commander and/or EOC Incident Commander; and
- Repair and maintenance of equipment, if necessary.

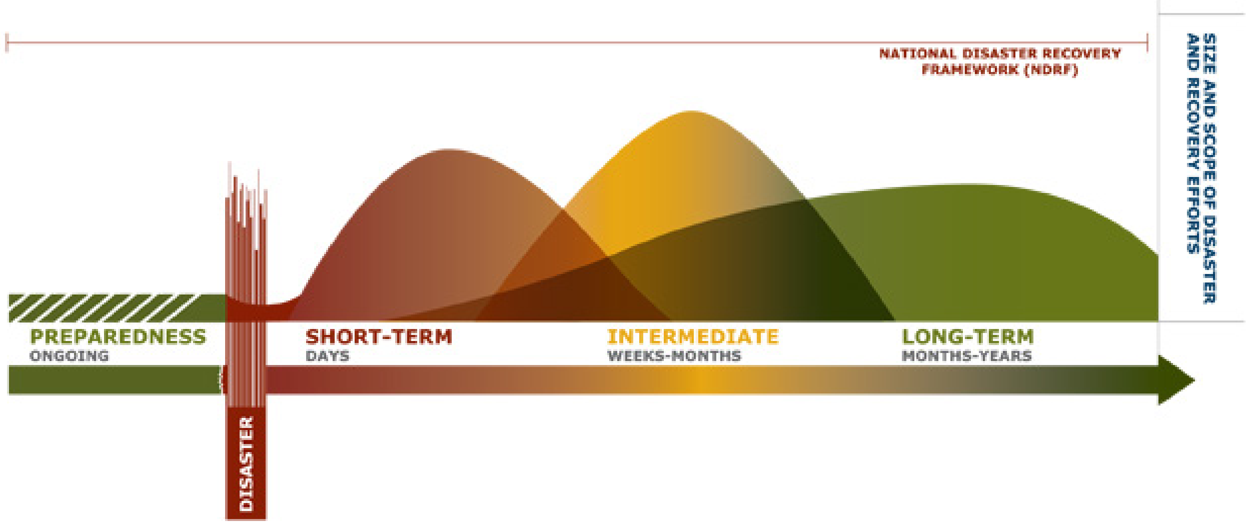
The City Manager, with advice from EOC Incident Commander and/or on-scene Incident Commander, will determine when a state of emergency no longer exists, emergency operations can be terminated, and normal City functions can be restored.

4.6 Transition to Recovery

Once immediate response activities have been completed, the City will turn toward recovery to restore government function and community services. Certain recovery activities may begin prior to the completion of all response activities. For example, restoration of lifeline utilities may commence while emergency sheltering is still ongoing.

It is the responsibility of all levels of government to assist the public and private sectors with recovery from disaster. A widespread disaster may disrupt employment, interrupt government services, impact the ability of businesses to function, and impact tax revenues within the City. This EOP is not a recovery plan; however, the City recognizes that response and recovery activities often take place concurrently until life safety and emergency protective actions are completed.

Figure 4-2 Disaster Recovery Continuum



Source: National Disaster Recovery Framework

Short-term recovery operations take place in the days to weeks following an incident and focus on stabilizing activities. This phase of recovery involves restoring vital services to the community and providing for the basic needs of the public, such as bringing necessary lifeline systems (e.g., power, communication, water and sewage, disposal of solid and hazardous wastes, or removal of debris) to an acceptable standard while providing for basic human needs (e.g., food, clothing, and shelter). Once stability is achieved, the City can concentrate on intermediate and long-term recovery efforts, which focus on restoring the community to a “new normal” or improved state.

Intermediate recovery operations take place in the weeks to months following an incident and focus on rebuilding activities. This phase of recovery involves repairing damaged infrastructure and buildings, providing financial, social, and psychological support to community members, and mitigating future risks.

Long-term recovery operations take place in the months to years following an incident and focus on revitalizing activities. This phase of recovery addresses complete redevelopment and revitalization of the impacted area, continued rebuilding activities, and a focus of building self-sufficiency, sustainability, and resilience.

During the recovery period, the City will review and implement mitigation measures, collect lessons learned and share them within the emergency response community, and reassess this EOP, including annexes, to identify deficiencies and take corrective actions. Resources to restore or upgrade damaged areas may be available if the City demonstrates that extra repairs will mitigate or lessen the chances of, or damages caused by, another similar disaster in the future.

5

Command and Control

This section of the EOP highlights the setting in which the EOC exists. It details the location, capabilities, and policies of the EOC. Additionally, this section outlines a process for establishing operations within the EOC, including activation, EOC procedures, and deactivation.

5.1 General

The ultimate responsibility for command and control of City departments and resources lies with the City Manager. The Emergency Manager will maintain direction and control of the City EMO, unless otherwise delegated. City emergency operations, both on scene and in the City EOC, will be conducted in a manner consistent with NIMS, including use of ICS.

During a City-declared disaster, control is not relinquished to county or state authority but remains at the local level for the duration of the event

5.2 On-Scene Incident Management

Initial response to an incident will be managed by the responding agency (i.e., Public Works Department, TVF&R, and/or Police Department), who will assign an on-scene Incident Commander. The on-scene Incident Commander is responsible for performing or directing such duties as enforcing emergency measures and designating emergency areas. During the initial response, the on-scene Incident Commander may establish an Incident Command Post and may assume the responsibilities of Command Staff until delegated. The on-scene Incident Commander will notify the Emergency Manager and request activation of the City EOC, as appropriate. The on-scene Incident Commander may also establish an on-scene Unified Command structure with City, County, and State leads.

5.3 Emergency Operations Center Support to On-Scene Operations

Depending on the type and size of incident, or at the request of the on-scene Incident Commander, the City may activate the EOC and assign an EOC Incident Commander. The EOC and EOC Incident Commander support on-scene operations and coordinate City resources. The request will be submitted to the Emergency Manager, who will determine whether to activate the City EOC and will assume, or designate, the role of EOC Incident Commander. In most instances, the on-scene Incident Commander will retain tactical control over the incident, relying on the City EOC for resource coordination, communications, and public information support. In a more complex incident, Unified Command may be established at the EOC to ensure proper coordination of resources across agencies. Outside assistance from neighboring jurisdictions or from private contractors will be requested and used as an adjunct to existing City services, and then only when a situation threatens to expand beyond the City’s response capabilities.

Upon activation of the City EOC, the EOC Incident Commander is empowered to assume executive control over all departments, divisions, and offices of the City during a state of emergency. If appropriate, the on-scene Incident Commander or EOC Incident Commander may request that the City Manager declare a state of emergency.

5.4 Emergency Operations Center

The EOC supports incident response activities, including tracking, management, and allocation of appropriate resources and personnel, and may also serve as a Multi-Agency Coordination Center, if needed. The EOC will be activated upon notification of a possible or actual emergency. During large-scale emergencies, the EOC may become the City's seat of government for the duration of the crisis.

5.4.1 Emergency Operations Center Activation

During emergency operations, and upon activation of the EOC, EOC staff will assemble and exercise direction and control, as outlined below.

- The EOC will be activated by the Emergency Manager, who may assume or designate the role of EOC Incident Commander. While the on-scene Incident Commander retains tactical control of the incident, the EOC Incident Commander assumes responsibility for coordinating and prioritizing the City's resources in support of emergency operations.
- The EOC Incident Commander will determine the level of staffing required and will alert the appropriate personnel, agencies, and organizations.
- Emergency operations will be conducted by City departments, augmented as required by trained reserves, volunteer groups, forces supplied through mutual aid agreements, and private contractors. County, state, and federal support will be requested if the situation dictates.
- Communications equipment in the EOC will be used to receive information, disseminate instructions and notifications, and coordinate emergency operations.
- The on-scene Incident Commander may establish a command post at the scene to maintain close contact and coordinate resources with the EOC.
- Department heads and organization leaders are responsible for assigned emergency functions, as outlined in the ESFs.
- The EOC may, as appropriate, operate on a 24-hour basis.
- The Emergency Manager will immediately notify the CCDM upon activation of the City EOC. Periodic updates will be issued to the County for the duration of the City EOC's activation.

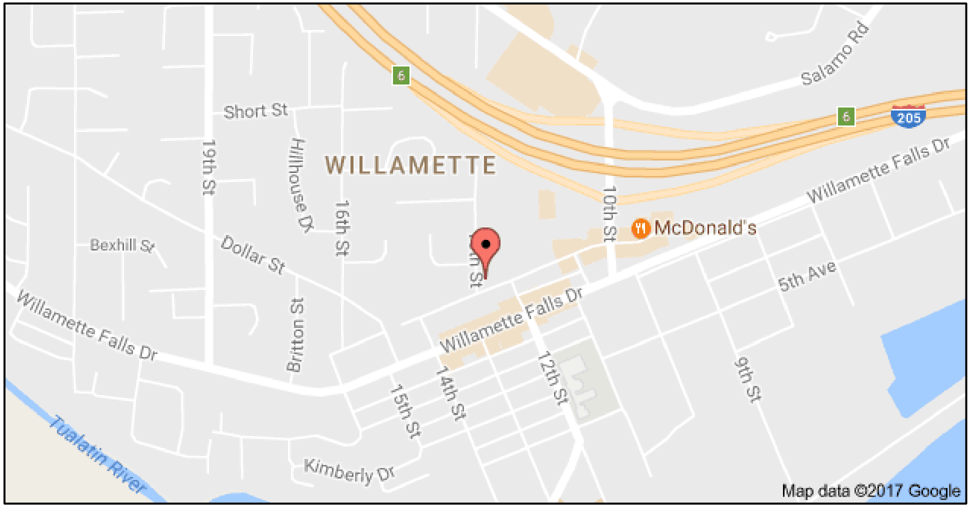
See Appendix C – Incident Action Planning Cycle for more information on the activities that go on during an operational period and the development of an IAP.

5.4.2 Emergency Operations Center Location

The **primary location** for the City EOC is:

West Linn Police Department
1800 8th Avenue, West Linn, OR 97068

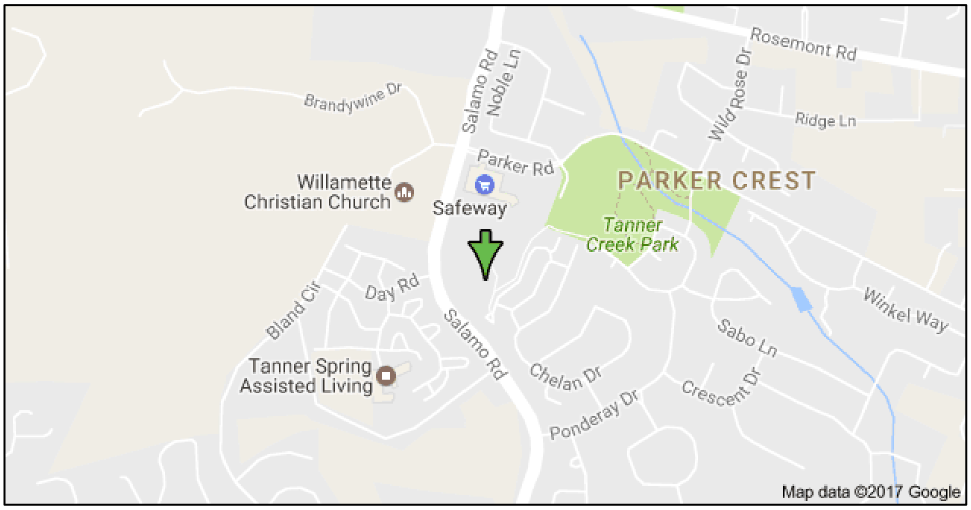
Figure 5-1 Primary EOC Location



If necessary, the **alternate location** for the City EOC is:

West Linn City Hall
22500 Salamo Rd, West Linn, OR 97068

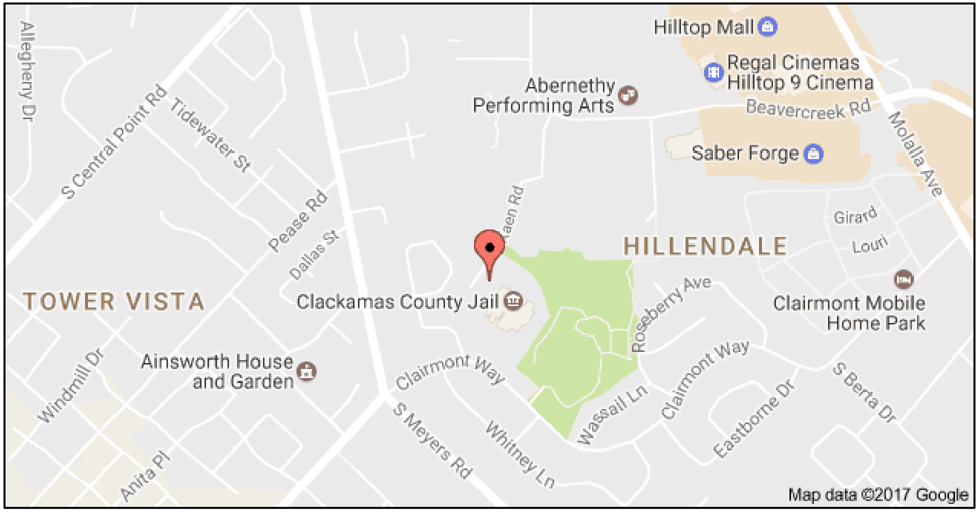
Figure 5-2 Alternate EOC Location



The **County EOC** is located at:

Clackamas County Disaster Management
2200 Kaen Road, Oregon City, OR

Figure 5-3 County EOC Location



The location of the EOC can change as required by the needs of the incident. Coordination and control of the City's emergency resources will take place from the EOC as long as environmental and incident conditions allow. However, if conditions require relocation of the EOC, then the EOC Incident Commander will designate an alternate facility. The EOC Incident Commander may request the use of the County EOC or County facilities from CCDM.

5.4.3 Emergency Operations Center Staffing

Depending on the incident type, City departments will provide staff to the EOC. The City may receive assistance from CCDM to support the EOC. At any time, if the incident expands or contracts, changes in jurisdiction or discipline, or becomes more or less complex, the on-scene Incident Commander or EOC Incident Commander may change to meet the needs of the incident. In the event that local staffing resources are not adequate to maintain the City EOC, the City may request support from the State via the County.

City departments involved in emergency response and personnel assigned to Command and General Staff (if previously designated) are required to report to the EOC upon activation. Personnel assigned to the EOC have the authority to make the decisions associated with their Command and General Staff positions.

Due to limited personnel and resources available in the City, it is imperative that all primary and alternate EOC staff be trained on ICS functions outside their areas of expertise. Regularly exercising ICS, including sub-functions and liaison roles, with volunteers and other support staff will improve overall EOC operation efficiency.

5.4.4 Access and Security

During an emergency, access to the City EOC will be limited to designated emergency operations personnel due to the large volume of incoming and outgoing sensitive information. The EOC Incident Commander may allow access on an individual, case-by-case basis. Appropriate security measures will be in place to identify personnel who are authorized to be present.

5.4.5 Deactivation

Each incident will be evaluated to determine the need for continued operation of the EOC after the emergency response phase of the incident has been completed. This decision is made by the on-scene Incident Commander, EOC Incident Commander, and Emergency Manager (if different than the EOC Incident Commander).

During the initial phase of the recovery period for a major disaster, it may be desirable to continue to operate the City EOC during the day with limited staffing to facilitate dissemination of public and local government disaster relief information. This alternative should be weighed against the option of immediately requiring staff to manage recovery operations as part of their daily responsibilities.

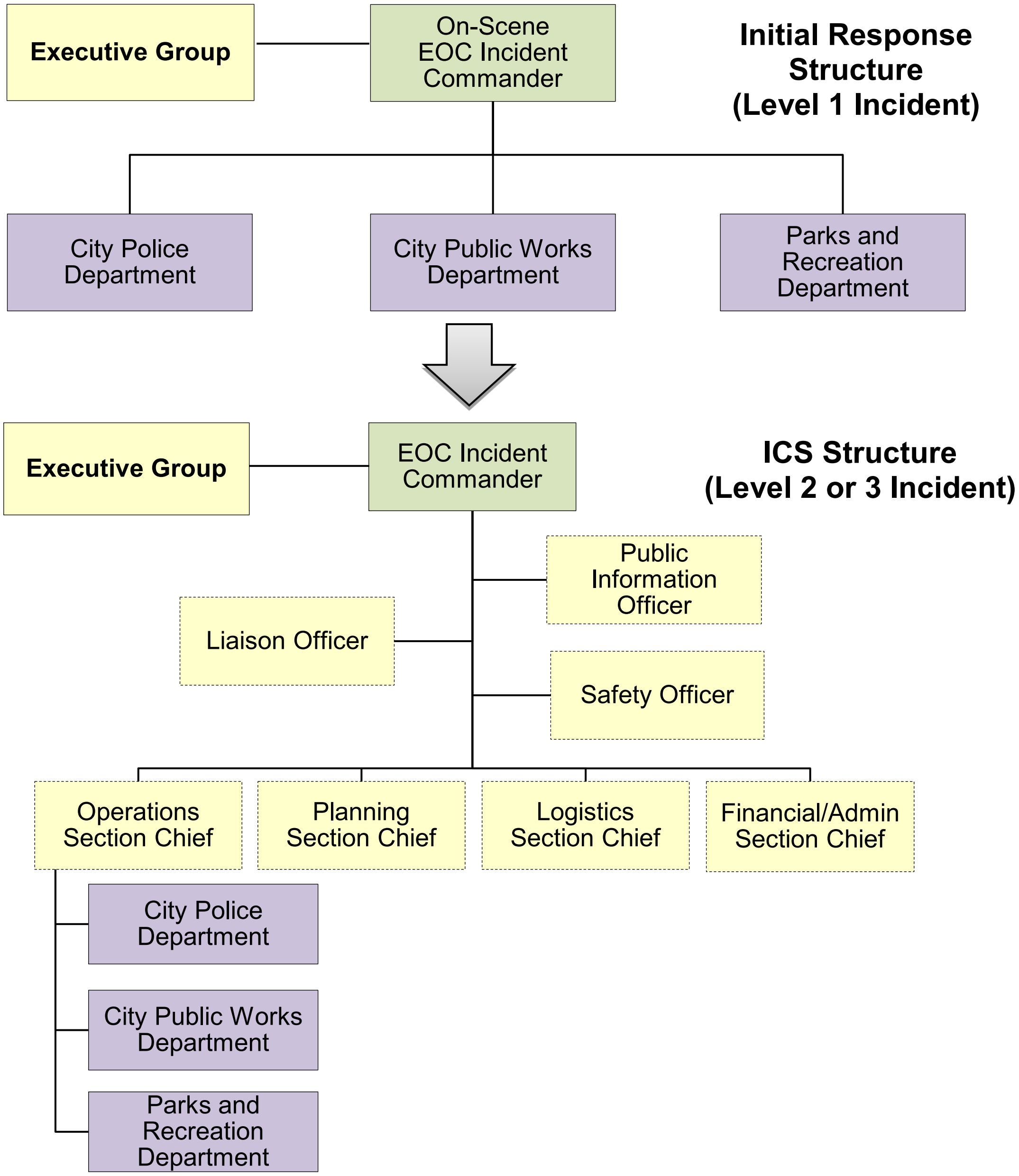
The City Manager has the final approval authority for activation and closure of the EOC. Once the decision has been made to limit hours/staff or close the EOC, notification must be disseminated to the same agencies that were notified it was activated. If necessary, the EOC may also be re-opened and emergency operations re-initiated at any time. As with initial activation, re-activation of the EOC would occur at the direction of the Emergency Manager.

5.5 Incident Command System

ICS is a standardized, flexible, scalable, all-hazard incident management system designed to be utilized from the time an incident occurs until the need for management and operations no longer exists. The City will utilize ICS to manage resources and activities during an emergency response, in order to communicate with other responding agencies using common terminology and operating procedures (Figure 5-4).

The City ICS structure can be expanded or contracted, depending on the incident's changing conditions. During a large-scale (Level 3) incident, it can be staffed and operated by qualified personnel from any emergency service agency, including personnel from a variety of disciplines. The City ICS structure can also be utilized for lower level emergencies such as a minor incident involving a single emergency response agency (Level 1). The City has established an EMO, supporting EOC activation and ICS operational procedures, and position checklists. Copies of the EOC position checklists and ICS forms can be found in the EOC.

Figure 5-4 Example of a Scalable Command Structure for the City



5.5.1 Emergency Operations Center Incident Commander

The EOC Incident Commander is responsible for operation of the EOC when it is activated and has overall responsibility for coordinating resources in support of emergency operations. In general, the EOC Incident Commander is responsible for:

- Maintaining EOC operations in accordance with the principles of ICS and NIMS;
- Approving and supporting implementation of an IAP;
- Coordinating activities supporting emergency operations;
- Approving release of information through the PIO;

- Performing the duties of the following Command Staff if no one is assigned to the position:
  - Safety Officer
  - PIO
  - Liaison Officer
- At any time, if the incident expands or contracts, changes in jurisdiction or discipline, or becomes more or less complex, the EOC Incident Commander may change to meet the needs of the incident.

5.5.2 Emergency Operations Center Command Staff

5.5.2.1 Safety Officer

The Safety Officer is responsible for the safety of emergency response personnel, EOC Command and General Staff, and their operations. The Safety Officer's responsibilities include:

- Identifying initial hazards, determining personal protective equipment requirements, and defining decontamination areas;
- Implementing site and access control measures;
- Monitoring and assessing the health and safety of response personnel and support staff;
- Preparing and implementing a site Health and Safety Plan and updating the EOC Incident Commander, on-scene Incident Command, and Operations Chiefs as necessary regarding safety issues or concerns; and
- Exercising emergency authority to prevent or stop unsafe acts.

5.5.2.2 Public Information Officer

The PIO will coordinate the City's public information network, including local, County, regional, and State agencies; political officials; and other emergency management stakeholders. The PIO's duties include:

- Developing and coordinating release of information to incident personnel, media, and the general public;
- Coordinating information sharing among the public information network through the use of a Joint Information System (JIS) and, if applicable, participating in a JIC;
- Implementing information clearance processes with the EOC Incident Commander; and
- Conducting and/or managing media briefings and implementing media-monitoring activities.

5.5.2.3 Liaison Officer

Specific liaison roles may be incorporated into the command structure established at the City and/or County EOC, depending on the type of emergency incident that has occurred. Liaisons represent entities and organizations such as hospitals, school districts, public works/utility companies, and volunteer services such as the Red Cross. Responsibilities typically associated with a liaison role include:

- Serving as the contact point for local government officials, agency or tribal representatives, and stakeholders;
- Coordinating information and incident updates among interagency contacts, including the public information network; and
- Providing resource status updates and limitations among personnel, capabilities, equipment, and facilities to the EOC Incident Commander, government officials, and stakeholders.

The annexes attached to this plan contain general guidelines for City staff, volunteer organizations, neighboring jurisdictions, County officials and departments, and other response agency staff to carry out assigned Command Staff responsibilities at the City EOC, as well as at EOCs of the County and neighboring jurisdictions.

5.5.3 Emergency Operations Center General Staff

5.5.3.1 Operations Section Chief

The Operations Section Chief position is typically filled by the lead agency managing response activities for a specific type of incident. The Operations Section is organized into functional units representing agencies involved in tactical operations.

The Operations Chief is responsible for:

- Developing and coordinating tactical operations to carry out the IAP, including:
  - Managing field response activities
  - Directing implementation of unit operational plans
  - Requesting resources as needed
- Managing and incorporating community partners and stakeholders (private entities, companies, and nongovernmental organizations) into response operations.

The following agencies and organizations are typically included in the Operations Section:

- **Fire Services** - emergencies dealing with fire, earthquake with rescue, or hazardous materials.
- **Law Enforcement** - incident(s) involving civil disorder/disturbance, significant security/public safety concerns, transportation-related accidents, and/or criminal investigations.
- **Public Health Officials** - contamination issues, disease outbreaks, and/or emergency incidents posing threats to human, animal, and environmental health.
- **Public Works** - incidents resulting in major utility disruptions, damage to critical infrastructure, and building collapse.
- **Private entities, companies, and nongovernmental organizations** may also support the Operations Section. Examples of support these organizations may provide include:
  - Grass roots social media support for situational awareness, as well as identifying and connecting resources to residents in need
  - Non-hazardous debris clearance collection and disposal

5.5.3.2 Planning Section Chief

The Planning Section is responsible for forecasting the needs of the response as well as implementing appropriate procedures and processes. This section is typically supported by four primary units: Resources, Situation, Documentation, and Demobilization. The Planning Chief is responsible for:

- Collecting and evaluating information, and distributing incident information through status summaries:
    - For terrorist incidents, liaise with the OTFC
- Maintaining resource status;
- Preparing and disseminating the IAP, including developing alternatives for tactical operations; and
- Conducting planning meetings.

5.5.3.3 Logistics Section Chief

The Logistics Section is typically supported by the units responsible for supplies, food, communications, medical services, facilities, and ground support. Depending on the incident's type and size, these units can be divided into two branches: Service and Support. The Logistics Chief is responsible for:

- Managing various resources to meet the needs of incident personnel, such as transportation-related equipment, EOC staff support services, supplies, facilities, and personnel;
- Coordinating with the Planning Section to estimate future support and resource requirements; and
- Assisting with development and preparation of the IAP.

5.5.3.4 Finance/Administration

The Finance/Administration Section is activated for large-scale or incidents that require emergency funding or use of specialized services and equipment that are not within the City's resources. Potential units assigned to this section include Compensation/Claims, Procurement, Cost, and Time. Conversely, during some incidents, responding agencies may not require outside assistance, or relatively minor finance or administrative operations are otherwise required. In these instances, the Finance/Administration section can be staffed by a technical specialist in the Planning Section. The Finance and Administration Chief is responsible for:

- Monitoring costs related to the incident;
- Maintaining accounting, procurement, and personnel time records; and
- Conducting cost analyses.

5.5.4 Unified Command

Unified Command allows all agencies with jurisdictional authority or functional responsibility for the incident to jointly provide management direction to an incident through a common set of incident objectives and strategies and a single IAP. Each participating agency maintains its individual authority, responsibility, and accountability.

Table 5-1 compares a single Incident Commander and Unified Command.

Table 5-1 Comparison of Single Incident Commander and Unified Commander

Single Incident Commander	Unified Command
The Incident Commander is solely responsible (within the confines of his or her authority) for establishing incident objectives and strategies. The Incident Commander is directly responsible for ensuring that all functional areas activities are directed toward accomplishment of the strategy.	The individuals designated by their jurisdictional and organizational authorities (or by departments within a single jurisdiction) must jointly determine objectives, strategies, plans, resource allocations, and priorities and work together to execute integrated incident operations and maximize the use of assigned resources.

Source: ICS-300: Intermediate ICS for Expanding Incident Student Manual.

5.5.5 Area Command

An Area Command is a management structure established to oversee the organization of multiple incidents handled by separate ICS organizations, or very large incidents that involves multiple ICS organizations. Area Command is activated only if necessary, depending on the complexity of the incident and span-of-control, and does not have operational responsibilities. If activated, the Area Command:

- Sets overall incident-related priorities:
    - De-conflicts incident management objectives with other ICS organizations and established policies
    - Allocates critical resources according to incident-related priorities
    - Identifies critical resource needs and reports them to the EOCs
- Conducts oversight:
    - Ensures proper management and effective communications and provides for personnel accountability and a safe operating environment
    - Ensures that short-term emergency recovery is coordinated to assist in the transition to full recovery operations

5.5.6 Multi-Agency Coordination

In the event that the City is coordinating a response with other jurisdictions or agencies with authority over the incident, it may choose to implement a Multi-Agency Coordination Group (MAC Group). Typically, administrators/ executives, or their appointed representatives, who are authorized to commit agency resources and funds are brought together to form MAC Groups. Other names for MAC Groups include “multiagency committees” and “emergency management committees.” A MAC Group can provide coordinated decision making and resource allocation among cooperating agencies and may establish the priorities among incidents, harmonize agency policies, and provide strategic guidance and direction to support incident management activities.

6

Plan Development, Maintenance, and Implementation

This section of the EOP outlines the plan development process, prescribes plan maintenance and improvement processes, and provides plan training and exercise requirements.

6.1 Plan Review and Maintenance

At a minimum, this EOP will be formally reviewed and re-promulgated every five years to comply with State requirements. This review will be coordinated by the Emergency Manager and will include participation by members from each of the departments assigned as lead agencies in this EOP and its supporting annexes. This review will:

- Verify contact information;
- Review the status of resources noted in the plan; and
- Evaluate the procedures outlined in the plan to ensure their continued viability.

In addition, lead agencies will review the annexes and appendices assigned to their respective departments. A more frequent schedule for plan review and revision may be necessary.

Recommended changes should be forwarded to:

Emergency Manager
Police Department
1800 9th Avenue
West Linn, OR 97068

6.2 Training Program

To assist with training and preparing essential response staff and supporting personnel to incorporate ICS/NIMS concepts in all facets of an emergency, each agency and department is responsible for ensuring that critical staff are identified and trained at a level that enables effective execution of existing response plans, procedures, and policies.

The Emergency Manager coordinates training for City personnel and encourages them to participate in training sessions hosted by other agencies, organizations, and jurisdictions throughout the region.

Current training and operational requirements set forth under NIMS have been adopted and implemented by the City (see minimum training requirements in Table 6-1). The Emergency Manager maintains records and lists of training received by City personnel. Training requirements apply to all first responders and disaster workers, including first-line supervisors, middle management, and Command and General Staff, as well as:

- EMS personnel;
- Firefighters;
- Law enforcement personnel;
- Public works/utility personnel;
- Skilled support personnel;
- Other emergency management response personnel; and
- Support/volunteer personnel at all levels.

Table 6-1 Minimum Training Requirements

Emergency Personnel	Training Required
Direct role in emergency management or emergency response	ICS-100b IS-700a
First-line supervisors, mid-level management, and Command and General Staff	ICS-100b, -200a IS-700a
Supervisory role in expanding incidents or a management role in an EOC	ICS-100b, -200a, -300 IS-700a
Management capacity in an Area Command situation or EOC	ICS-100b, -200a, -300, -400 IS-700a, -701a
PIOs	IS-702a
Resource management	IS-703a
Communication or incident information systems	IS-701a
Development of mutual aid agreements and/or mutual aid operational plans	IS 706
Planning	IS-800b

Additional information about training requirements can be found on the OEM website at http://www.oregon.gov/OMD/OEM/plans_train/docs/nims/nims_who_takes_what.pdf. Independent study courses can be found at http://training.fema.gov/IS/crslist.asp.

6.3 Exercise Program

The City will conduct exercises throughout the year to test and evaluate this EOP. The City will coordinate with agencies; organizations (nonprofit, for profit, and volunteer); neighboring jurisdictions; and State and federal government to participate in joint exercises. These exercises will consist of a variety of tabletop exercises, drills, functional exercises, and full-scale exercises.

As appropriate, the City will use Homeland Security Exercise and Evaluation Program procedures and tools to develop, conduct, and evaluate these exercises. Information about this program can be found at http://hseep.dhs.gov.

The Emergency Manager will work with other City/County departments and agencies to identify and implement corrective actions and mitigation measures, based on exercises conducted through Emergency Management.

6.4 Event Critique and After Action Reporting

To document and track lessons learned from exercises, the Emergency Manager will conduct a review, or “hot wash, exercise participants after each exercise. The Emergency Manager will also coordinate an AAR, which will describe the objectives of the exercise, document the results of the evaluation, and improve the City’s readiness.

Reviews and AARs will also be facilitated after an actual disaster. All agencies involved in the emergency response will participate in the AAR. The AAR following an incident should describe actions taken, identify equipment shortcomings and strengths, and recommend ways to improve operational readiness. Recommendations may include future exercise events and programs. The Emergency Manager will ensure that equipment, training, and planning shortfalls identified following an incident are addressed by the City’s EMO.

6.5 Community Outreach and Preparedness Education

The City will educate the public about threats, disasters, and what to do when an emergency occurs. The City maintains an active community preparedness program and recognizes that individual preparedness and education are vital components of the City’s overall readiness.

Information about the City’s public education programs, hazard and mitigation information, and other emergency management and emergency services can be found on the City’s website.

6.6 Funding and Sustainment

It is a priority of the City to fund and maintain an EMO that ensures the City’s ability to respond to and recover from disasters. The Emergency Manager will work with City Council and community stakeholders to:

- Identify funding sources for emergency management programs, personnel, and equipment;
- Ensure that the council is informed of progress toward building emergency response and recovery capabilities and is aware of gaps to be addressed; and
- Leverage partnerships with local, regional, and State partners to maximize use of scarce resources.

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A

Sample Disaster Declaration Forms

DECLARATION OF STATE OF EMERGENCY

To: Clackamas County Disaster Management

From: ____, City of West Linn, Oregon

At ________________ (military time) on __________________________ (full date), a/an
____ (emergency incident or event type)
occurred in the City of West Linn within the geographic boundaries of __________________
____ threatening life and property.

The current situation and conditions are:

Deaths: __________________
Injuries: __________________
Population at risk: __________________

The current emergency conditions or threats are:

____

____

An initial estimate of the damage and impacts is: _____________________________________.

The following specific assistance is being requested: ___________________________________

____

Actions that have been taken and resources that have been committed by the City of West Linn:

____

____

I do hereby declare that a State of Emergency now exists in the City of West Linn and that the City of West Linn has expended or will shortly expend its necessary and available resources. I respectfully request that Clackamas County provide assistance, consider the City of West Linn an "Emergency Area" as provided for in ORS 401, and, as appropriate, request support from State agencies and/or the federal government.

Signed: ____

Title: __________________________ Date & Time: __________________________________

This request may be passed to the County via radio, telephone, or fax. The original signed document must be sent to Clackamas County Disaster Management, with a copy placed in the final incident package.

B

Legal Authorities

Table B-1 Legal Authorities

Federal

- Federal Emergency Management Agency (FEMA) Policy
  - Crisis Response and Disaster Resilience 2030 (January 2012)
  - FDOC 104-008-1: A Whole Community Approach to Emergency Management (December 2011)
  - FEMA Administrator’s Intent (2015-2019)
  - FEMA Incident Management and Support Keystone (January 2011)
  - FEMA Publication: 1 The Federal Emergency Management Agency (November 2010)
  - FEMA Strategic Plan 2011-2014
  - National Disaster Housing Strategy (January 2009)
  - National Disaster Recovery Framework (September 2011)
  - National Incident Management System (December 2008)
  - National Preparedness Goal (September 2011)
  - National Response Framework (January 2008)
- Executive Order 13347, July 2004, Individuals with Disabilities in Emergency Preparedness
- Homeland Security Presidential Directive 5: Management of Domestic Incidents (2003)
- Pet Evacuation and Transportation Standards Act of 2006, Public Law 109-308, 2006
- Presidential Policy Directive 8: National Preparedness (2008)
- Public Law 107-296 The Homeland Security Act of 2002
- Public Law 109-295 The Post-Katrina Emergency Management Reform Act (2007)
- Public Law 93-288 Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended (last amended April 2013)

State of Oregon

- Oregon Administrative Rules Chapter 104 Oregon Military Department, Office of Emergency Management
- Oregon Revised Statutes (ORS) 279B.080 Emergency Procurements
- ORS 294.481 Authorization to Receive Grants or Borrow or Expend Moneys to Respond to Public Emergency
- ORS 401 Emergency Management and Services
- ORS 402 Emergency Mutual Assistance Agreements
- ORS 403 Public Safety Communications System
- ORS 404 Search and Rescue
- ORS 431 State and Local Administration and Enforcement of Health Laws
- ORS 433 Disease and Condition Control; Mass Gatherings; Indoor Air
- ORS 476 State Fire Marshal; Protection From Fire Generally
- ORS 477 Fire Protection of Forests and Vegetation
- State of Oregon Emergency Operations Plan

Table B-1 Legal Authorities

County
— Code Section 6.03 Emergency Regulations — Resolution 2005-26, February 2005 – Adoption of NIMS/ICS — Board Order #2008-154, September 2008 – Local Public Health Administrator designation
City
— Adoption of the National Incident Management System, Resolution No. 05-24, August 2005. — Emergency Planning, Ordinance No. 1459, August 2000. — Community Development Code, Emergency Planning, Chapter 2.700 through 2.750.

C

Incident Action Planning Cycle

An Incident Action Plan is the vehicle by which Incident Command communicates their expectations and provides collaboration and participation among all levels of incident management. A complete Incident Action Plan facilitates successful incident operations and provides a basis for evaluating performance in achieving incident objectives. The Planning "P" in Figure C-1 is a guide to the process and steps involved in planning for an incident. The leg of the "P" describes the initial response period whereas the top of the leg of the "P" is the beginning of the first operational planning period cycle.

An Incident Action Plan should be comprised of the items listed in Table C-1, along with pertinent information on each item.

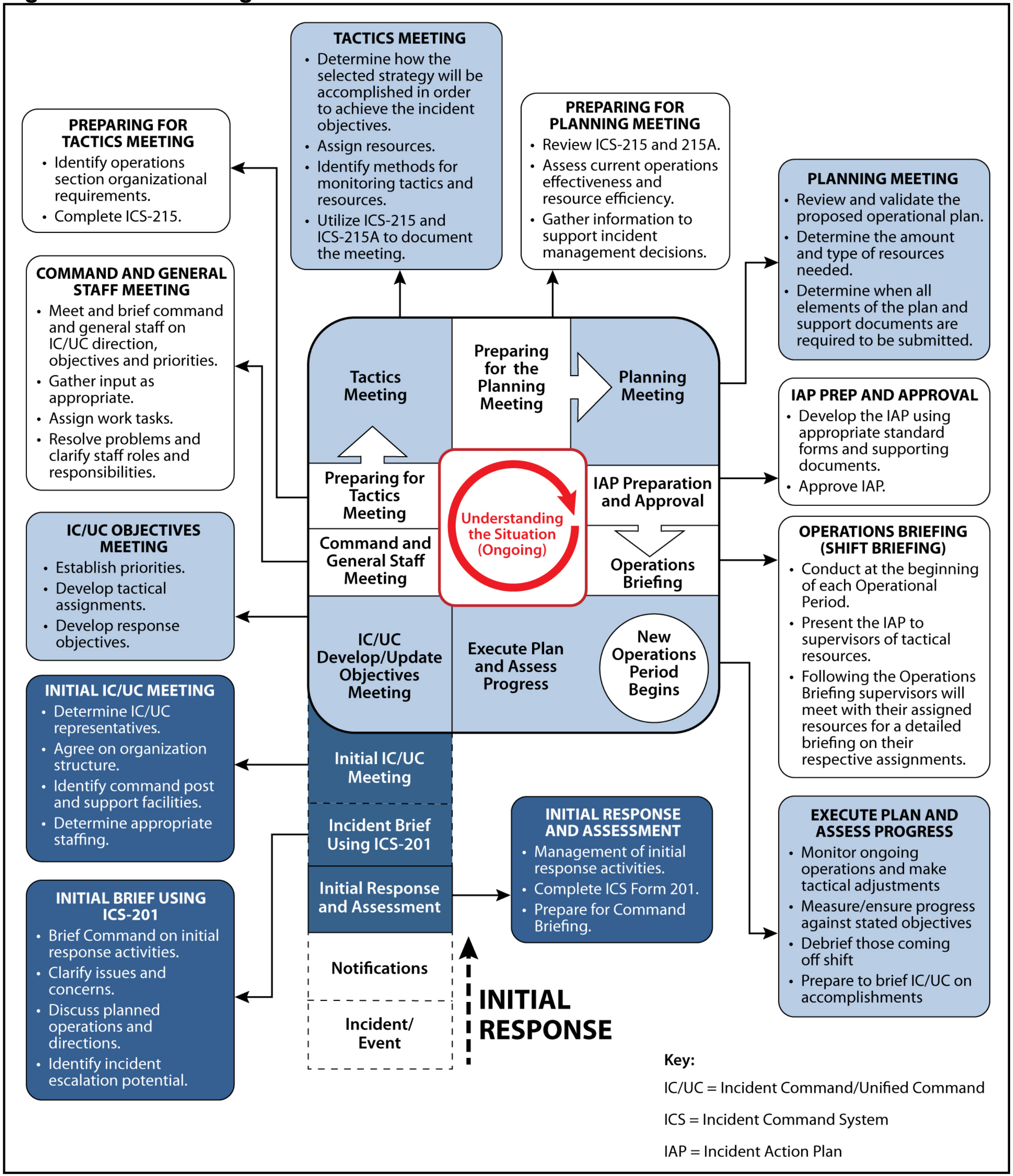
Table C-1 Incident Action Plan Components and Sequence of Assembly

Order	FEMA-ICS Form	Title	Required	Prepared By
1	200	Cover Sheet	Always	Planning Support Unit Leader
2	202	Incident Objectives	Always	Situation Unit Leader
3	205	Incident Radio Communications Plan	As the incident requires – Radio Use	Communications Unit Leader
4	205A	Incident Telephone Communications Plan	Always	Resource Unit Leader
5	207	Incident Organization Chart	Always	Resource Unit Leader
6		Incident Map	Always	Situation Unit Leader /GIS Unit
7	204	Assignment List	Always	Resource Unit Leader
8	220	Air Operations Summary	As the incident requires – Air Ops	Operations Section Chief/Air Operations Branch
9	206	Medical Plan	Always	Safety Officer
10	230	Meeting Schedule	Always	Situation Unit Leader
11	213	General Message	Optional	Any Message Originator
12	Other components as needed		Optional	Planning Support

For more information, see FEMA's Incident Action Planning Guide, June 2012

Appendix C. Incident Action Planning Cycle

Figure C-1 Planning “P”



TACTICS MEETING
- Determine how the selected strategy will be accomplished in order to achieve the incident objectives.
- Assign resources.
- Identify methods for monitoring tactics and resources.
- Utilize ICS-215 and ICS-215A to document the meeting.

PREPARING FOR TACTICS MEETING
- Identify operations section organizational requirements.
- Complete ICS-215.

PREPARING FOR PLANNING MEETING
- Review ICS-215 and 215A.
- Assess current operations effectiveness and resource efficiency.
- Gather information to support incident management decisions.

PLANNING MEETING
- Review and validate the proposed operational plan.
- Determine the amount and type of resources needed.
- Determine when all elements of the plan and support documents are required to be submitted.

COMMAND AND GENERAL STAFF MEETING
- Meet and brief command and general staff on IC/UC direction, objectives and priorities.
- Gather input as appropriate.
- Assign work tasks.
- Resolve problems and clarify staff roles and responsibilities.

IAP PREP AND APPROVAL
- Develop the IAP using appropriate standard forms and supporting documents.
- Approve IAP.

IC/UC OBJECTIVES MEETING
- Establish priorities.
- Develop tactical assignments.
- Develop response objectives.

OPERATIONS BRIEFING (SHIFT BRIEFING)
- Conduct at the beginning of each Operational Period.
- Present the IAP to supervisors of tactical resources.
- Following the Operations Briefing supervisors will meet with their assigned resources for a detailed briefing on their respective assignments.

INITIAL IC/UC MEETING
- Determine IC/UC representatives.
- Agree on organization structure.
- Identify command post and support facilities.
- Determine appropriate staffing.

INITIAL RESPONSE AND ASSESSMENT
- Management of initial response activities.
- Complete ICS Form 201.
- Prepare for Command Briefing.

EXECUTE PLAN AND ASSESS PROGRESS
- Monitor ongoing operations and make tactical adjustments
- Measure/ensure progress against stated objectives
- Debrief those coming off shift
- Prepare to brief IC/UC on accomplishments

INITIAL BRIEF USING ICS-201
- Brief Command on initial response activities.
- Clarify issues and concerns.
- Discuss planned operations and directions.
- Identify incident escalation potential.

Key:

IC/UC = Incident Command/Unified Command

ICS = Incident Command System

IAP = Incident Action Plan

02:1009551.0001.02\Incident response flow diagram.ai-6/6/17-GRA

D References

Federal

- Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288) as amended, April 2013. Accessed on 20 December 2013 at: http://www.fema.gov/robert-t-stafford-disaster-relief-and-emergency-assistance-act-public-law-93-288-amended
- Homeland Security Act of 2002 (Public Law 107-296). Accessed on 20 December 2013 at: http://www.dhs.gov/key-dhs-laws
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- Presidential Policy Directive/PPD-8: National Preparedness. Accessed on 20 December 2013 at: http://www.dhs.gov/presidential-policy-directive-8-national-preparedness

FEMA Policy

- The Federal Emergency Management Agency Publication 1: The Federal Emergency Management Agency, November 2010. Accessed on 20 December 2013 at: http://www.fema.gov/media-library/assets/documents/25272
- A Whole Community Approach to Emergency Management: Principles, Themes, and Pathways for Action, FDOC 104-008-1, December 2011. Accessed on 20 December 2013 at: http://www.emd.wa.gov/about/documents/FEMA_Whole_Community.pdf
- FEMA Incident Management and Support Keystone, January 2011. Accessed on 20 December 2013 at: http://www.fema.gov/media-library/assets/documents/26688
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- National Disaster Housing Strategy, January 2009. Accessed on 20 December 2013 at: http://www.fema.gov/media-library/assets/documents/24600
- Developing and Maintaining Emergency Operations Plans, Comprehensive Preparedness Guide (CPG) 101, Version 2.0, November 2010. Accessed on 20 December 2013 at: http://www.fema.gov/media-library/assets/documents/25975
- Incident Action Planning Guide, January 2012. Accessed on 31 March 2014 at http://www.fema.gov/media-library-data/20130726-1822-25045-1815/incident_action_planning_guide_1_26_2012.pdf

State

- State of Oregon Emergency Operations Plan, as revised November 2013. Accessed on 20 December 2013 at: http://www.oregon.gov/OMD/OEM/Pages/plans_train/EOP.aspx
- Oregon State Fire Marshal, Fire Service Mobilization Plan. 2013. Accessed on 20 December 2013 at: http://www.oregon.gov/osp/SFM/docs/2013MobPlan.pdf
- Emergency Declaration Guidelines for Local Elected and Appointed Officials. September 2011. Accessed on 20 December 2013 at: http://www.oregon.gov/OMD/OEM/docs/library/ea_officials_guide_sept_2011.pdf
- Oregon Revised Statutes (ORS) 2011 Edition. Chapters 401 through 404. Accessed on 20 December 2013 at: https://www.oregonlegislature.gov/bills_laws/Pages/ORS.aspx
- Oregon Administrative Rules 104: Oregon Military Department. Accessed on 20 December 2013 at: http://arcweb.sos.state.or.us/pages/rules/oars_100/oar_104/104_tofc.html

County

- Board Order #2008-154, September 2008
- Emergency Operations Plan, 2011
- Natural Hazard Mitigation Plan, 2013
- Community Wildfire Protection Plan, 2012
- Mt. Hood Coordination Plan, 2013
- Damage Assessment Plan
- Debris Management Plan, 2015
- Resolution 2005-26, February 2005
- Code Section 6.03

City

- Natural Hazard Mitigation Plan, 2013
- Debris Management Plan, 2016
- All other Public Laws or Executive Orders enacted or to be enacted which pertain to emergencies/disasters.

E

Acronyms and Glossary

Acronyms

AAR	After Action Report
ARES	Amateur Radio Emergency Services
BCC	Board of County Commissioners
CAMEO	Computer Aided Management of Emergency Operations
CBRNE	chemical, biological, radiological, nuclear, and explosive
CCDM	Clackamas County Disaster Management
C-COM	Clackamas County Communications
CDC	Centers for Disease Control and Prevention
CERT	Community Emergency Response Teams
CIKR	critical infrastructure and key resources
City	City of West Linn
COOP	Continuity of Operations
County	Clackamas County
DAFN	Disabilities and access and functional needs
DHS	Oregon Department of Human Services
DOT	United States Department of Transportation
DTD	Clackamas County Department of Transportation and Development
EAS	National Emergency Alert System
ECC	Emergency Coordination Center
EMO	Emergency Management Organization
EMP	State of Oregon Emergency Management Plan
EMS	Emergency Medical Services
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
ESF	Emergency Support Function
FEMA	Federal Emergency Management Agency

FSA	Farm Service Agency
GIS	geographical information system
Guard	Oregon National Guard
H3S	Clackamas County Health, Housing, and Human Services Department
HazMat Team	Hazardous Materials Team
IA	Incident Annex
IAP	Incident Action Plan
ICS	Incident Command System
IGA	Intergovernmental Agreement
IDA	initial damage assessment
IMT	Incident Management Team
JIC	Joint Information Center
JIS	Joint Information System
LOCOM	Lake Oswego Communications
MAC Group	Multi-Agency Coordination
MHz	megahertz
MOU	memorandum of understanding
NAWAS	National Warning System
NHMP	Natural Hazard Mitigation Plan
NIMS	National Incident Management System
NRC	National Response Center
ODA	Oregon Department of Agriculture
ODOT	Oregon Department of Transportation
OEM	Office of Emergency Management
OERS	Oregon Emergency Response System
ORS	Oregon Revised Statutes
ORWARN	Oregon Water/Wastewater Agency Response Network
OSFM	Oregon State Fire Marshal
OSHA	United States Occupational Safety and Health Administration
OTFC	Oregon Terrorism Information Threat Assessment Network Fusion Center
PDA	preliminary damage assistance
PGE	Portland General Electric Company

PIO	Public Information Officer
SA	Support Annex
SAD	State Active Duty
SAR	search and rescue
SDS	safety data sheet
SNS	Strategic National Stockpile
SOP	Standard Operating Procedure
State	State of Oregon
TDD	telecommunication device for the deaf
TTY	teletype
TVF&R	Tualatin Valley Fire and Rescue
USAR	urban search and rescue
USCG	United States Coast Guard
USDA	United States Department of Agriculture
USGS	United States Geological Survey
VHF	very high frequency
VOIP	voice-over internet protocol

Glossary of Key Terms

Accessible: Having the legally required features and/or qualities that ensure easy entrance, participation, and usability of places, programs, services, and activities by individuals with a wide variety of disabilities.

Acquisition Procedures: A process used to obtain resources to support operational requirements.

Agency: A division of government with a specific function offering a particular kind of assistance. In the Incident Command System, agencies are defined either as jurisdictional (having statutory responsibility for incident management) or as assisting or cooperating (providing resources or other assistance). Governmental organizations are most often in charge of an incident, though in certain circumstances private-sector organizations may be included. Additionally, nongovernmental organizations may be included to provide support.

Agency Administrator/Executive: The official responsible for administering policy for an agency or jurisdiction. An Agency Administrator/Executive (or other public official with jurisdictional responsibility for the incident) usually makes the decision to establish an Area Command.

Agency Dispatch: The agency or jurisdictional facility from which resources are sent to incidents.

Agency Representative: A person assigned by a primary, assisting, or cooperating Federal, State, tribal, or local government agency, or nongovernmental or private organization, that has been delegated authority to make decisions affecting that agency's or organization's participation in incident management activities following appropriate consultation with the leadership of that agency.

All-Hazards: Describing an incident, natural or manmade, that warrants action to protect life, property, environment, and public health or safety, and to minimize disruptions of government, social, or economic activities.

Allocated Resource: Resource dispatched to an incident.

Area Command: An organization established to oversee the management of multiple incidents that are each being handled by a separate Incident Command System organization or to oversee the management of a very large or evolving incident that has multiple Incident Management Teams engaged. An Agency Administrator/Executive or other public official with jurisdictional responsibility for the incident usually makes the decision to establish an Area Command. An Area Command is activated only if necessary, depending on the complexity of the incident and incident management span-of-control considerations.

Assessment: The process of acquiring, collecting, processing, examining, analyzing, evaluating, monitoring, and interpreting the data, information, evidence, objects, measurements, images, sound, etc., whether tangible or intangible, to provide a basis for decision-making.

Assigned Resource: Resource checked in and assigned work tasks on an incident.

Assignment: Task given to a personnel resource to perform within a given operational period that is based on operational objectives defined in the Incident Action Plan.

Assistant: Title for subordinates of principal Command Staff positions. The title indicates a level of technical capability, qualifications, and responsibility subordinate to the primary positions. Assistants may also be assigned to Unit Leaders.

Assisting Agency: An agency or organization providing personnel, services, or other resources to the agency with direct responsibility for incident management. See Supporting Agency.

Available Resource: Resource assigned to an incident, checked in, and available for a mission assignment, normally located in a Staging Area.

Badging: The assignment of physical incident-specific credentials to establish legitimacy and limit access to various incident sites.

Branch: The organizational level having functional or geographical responsibility for major aspects of incident operations. A Branch is organizationally situated between the Section Chief and the Division or Group in the Operations Section, and between the Section and Units in the Logistics Section. Branches are identified by the use of Roman numerals or by functional area.

Cache: A predetermined complement of tools, equipment, and/or supplies stored in a designated location, available for incident use.

Camp: A geographical site within the general incident area (separate from the Incident Base) that is equipped and staffed to provide sleeping, food, water, and sanitary services to incident personnel.

Categorizing Resources: The process of organizing resources by category, kind, and type, including size, capacity, capability, skill, and other characteristics. This makes the resource ordering and dispatch process within and across organizations and agencies, and between governmental and nongovernmental entities, more efficient, and ensures that the resources received are appropriate to their needs.

Certifying Personnel: The process of authoritatively attesting that individuals meet professional standards for the training, experience, and performance required for key incident management functions.

Chain of Command: The orderly line of authority within the ranks of the incident management organization.

Check-In: The process through which resources first report to an incident. All responders, regardless of agency affiliation, must report in to receive an assignment in accordance with the procedures established by the Incident Commander.

Chief: The Incident Command System title for individuals responsible for management of functional Sections: Operations, Planning, Logistics, Finance/Administration, and Intelligence/Investigations (if established as a separate Section).

Command: The act of directing, ordering, or controlling by virtue of explicit statutory, regulatory, or delegated authority.

Command Staff: The staff who report directly to the Incident Commander, including the Public Information Officer, Safety Officer, Liaison Officer, and other positions as required. They may have an assistant or assistants, as needed.

Common Operating Picture: An overview of an incident by all relevant parties that provides incident information enabling the Incident Commander/Unified Command and any supporting agencies and organizations to make effective, consistent, and timely decisions.

Common Terminology: Normally used words and phrases-avoiding the use of different words/phrases for same concepts-to ensure consistency and to allow diverse incident management and support organizations to work together across a wide variety of incident management functions and hazard scenarios.

Communications: The process of transmission of information through verbal, written, or symbolic means.

Communications/Dispatch Center: Agency or interagency dispatch centers, 911 call centers, emergency control or command dispatch centers, or any naming convention given to the facility and staff that handles emergency calls from the public and communication with emergency management/response personnel. The center can serve as a primary coordination and support element of the Multiagency Coordination System(s) (MACS) for an incident until other elements of the MACS are formally established.

Complex: Two or more individual incidents located in the same general area and assigned to a single Incident Commander or to Unified Command.

Comprehensive Preparedness Guide 101: A guide designed to assist jurisdictions with developing operations plans. It promotes a common understanding of the fundamentals of planning and decision-making to help emergency planners examine a hazard and produce integrated, coordinated, and synchronized plans.

Continuity of Government: A coordinated effort within the Federal Government's executive branch to ensure that National Essential Functions continue to be performed during a catastrophic emergency (as defined in National Security Presidential Directive 51/Homeland Security Presidential Directive 20).

Continuity of Operations: An effort within individual organizations to ensure that Primary Mission Essential Functions continue to be performed during a wide range of emergencies.

Cooperating Agency: An agency supplying assistance other than direct operational or support functions or resources to the incident management effort.

Coordinate: To advance an analysis and exchange of information systematically among principals who have or may have a need to know certain information to carry out specific incident management responsibilities.

Corrective Actions: The implementation of procedures that are based on lessons learned from actual incidents or from training and exercises.

Credentialing: The authentication and verification of the certification and identity of designated incident managers and emergency responders.

Critical Infrastructure: Assets, systems, and networks, whether physical or virtual, so vital to the United States that the incapacitation or destruction of such assets, systems, or networks would have a debilitating impact on security, national economic security, national public health or safety, or any combination of those matters.

Delegation of Authority: A statement provided to the Incident Commander by the Agency Executive delegating authority and assigning responsibility. The delegation of authority can include objectives, priorities, expectations, constraints, and other considerations or guidelines, as needed. Many agencies require written delegation of authority to be given to the Incident Commander prior to assuming command on larger incidents. (Also known as Letter of Expectation.)

Demobilization: The orderly, safe, and efficient return of an incident resource to its original location and status.

Department Operations Center (DOC): An Emergency Operations Center (EOC) specific to a single department or agency. The focus of a DOC is on internal agency incident management and response. DOCs are often linked to and, in most cases, are physically represented in a combined agency EOC by authorized agent(s) for the department or agency.

Deputy: A fully qualified individual who, in the absence of a superior, can be delegated the authority to manage a functional operation or to perform a specific task. In some cases a deputy can act as relief for a superior, and therefore must be fully qualified in the position. Deputies generally can be assigned to the Incident Commander, General Staff, and Branch Directors.

Director: The Incident Command System title for individuals responsible for supervision of a Branch.

Dispatch: The ordered movement of a resource or resources to an assigned operational mission, or an administrative move from one location to another.

Division: The organizational level having responsibility for operations within a defined geographic area. Divisions are established when the number of resources exceeds the manageable span of control of the Section Chief. See Group.

Emergency: Any incident, whether natural or manmade, that requires responsive action to protect life or property. Under the Robert T. Stafford Disaster Relief and Emergency Assistance Act, an emergency means any occasion or instance for which, in the determination of the President, Federal assistance is needed to supplement State and local efforts and capabilities to save lives and to protect property and public health and safety, or to lessen or avert the threat of a catastrophe in any part of the United States.

Emergency Management Assistance Compact (EMAC): A congressionally ratified organization that provides form and structure to interstate mutual aid. Through EMAC, a disaster-affected State can request and receive assistance from other member States quickly and efficiently, resolving two key issues up front: liability and reimbursement.

Emergency Management/Response Personnel: Includes Federal, State, territorial, tribal, substate regional, and local governments, nongovernmental organizations, private sector-organizations, critical infrastructure owners and operators, and all other organizations and individuals who assume an emergency management role. (Also known as emergency responder.)

Emergency Operations Center (EOC): The physical location at which the coordination of information and resources to support incident management (on-scene operations) activities normally takes place. An EOC may be a temporary facility or may be located in a more central or permanently established facility, perhaps at a higher level of organization within a jurisdiction. EOCs may be organized by major functional disciplines (e.g., fire, law enforcement, medical services), by jurisdiction (e.g., Federal, State, regional, tribal, city, county), or by some combination thereof.

Emergency Operations Plan: An ongoing plan for responding to a wide variety of potential hazards.

Emergency Public Information: Information that is disseminated primarily in anticipation of or during an emergency. In addition to providing situational information to the public, it frequently provides directive actions required to be taken by the general public.

Evacuation: The organized, phased, and supervised withdrawal, dispersal, or removal of civilians from dangerous or potentially dangerous areas, and their reception and care in safe areas.

Event: See Planned Event.

Federal: Of or pertaining to the Federal Government of the United States of America.

Field Operations Guide: Durable pocket or desk guides that contain essential information required to perform specific assignments or functions.

Finance/Administration Section: The Incident Command System Section responsible for all administrative and financial considerations surrounding an incident.

Function: The five major activities in the Incident Command System: Command, Operations, Planning, Logistics, and Finance/Administration. A sixth function, Intelligence/Investigations, may be established, if required, to meet incident management needs. The term function is also used when describing the activity involved (e.g., the planning function).

General Staff: A group of incident management personnel organized according to function and reporting to the Incident Commander. The General Staff normally consists of the Operations Section Chief, Planning Section Chief, Logistics Section Chief, and Finance/Administration Section Chief. An Intelligence/Investigations Chief may be established, if required, to meet incident management needs.

Group: An organizational subdivision established to divide the incident management structure into functional areas of operation. Groups are composed of resources assembled to perform a special function not necessarily within a single geographic division. See Division.

Hazard: Something that is potentially dangerous or harmful, often the root cause of an unwanted outcome.

Incident: An occurrence, natural or manmade, that requires a response to protect life or property. Incidents can, for example, include major disasters, emergencies, terrorist attacks, terrorist threats, civil unrest, wildland and urban fires, floods, hazardous materials spills, nuclear accidents, aircraft accidents, earthquakes, hurricanes, tornadoes, tropical storms, tsunamis, war-related disasters, public health and medical emergencies, and other occurrences requiring an emergency response.

Incident Action Plan: An oral or written plan containing general objectives reflecting the overall strategy for managing an incident. It may include the identification of operational resources and assignments. It may also include attachments that provide direction and important information for management of the incident during one or more operational periods.

Incident Base: The location at which primary Logistics functions for an incident are coordinated and administered. There is only one Base per incident. (Incident name or other designator will be added to the term Base.) The Incident Command Post may be co-located with the Incident Base.

Incident Command: The Incident Command System organizational element responsible for overall management of the incident and consisting of the Incident Commander (either single or unified command structure) and any assigned supporting staff.

Incident Commander (IC): The individual responsible for all incident activities, including the development of strategies and tactics and the ordering and release of resources. The IC has overall authority and responsibility for conducting incident operations and is responsible for the management of all incident operations at the incident site.

Incident Command Post (ICP): The field location where the primary functions are performed. The ICP may be co-located with the Incident Base or other incident facilities.

Incident Command System (ICS): A standardized on-scene emergency management construct specifically designed to provide an integrated organizational structure that reflects the complexity and demands of single or multiple incidents, without being hindered by jurisdictional boundaries. ICS is the combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure, designed to aid in the management of resources during incidents. It is used for all kinds of emergencies and is applicable to small as well as large and complex incidents. ICS is used by various jurisdictions and functional agencies, both public and private, to organize field-level incident management operations.

Incident Management: The broad spectrum of activities and organizations providing effective and efficient operations, coordination, and support applied at all levels of government, utilizing both governmental and nongovernmental resources to plan for, respond to, and recover from an incident, regardless of cause, size, or complexity.

Incident Management Team (IMT): An Incident Commander and the appropriate Command and General Staff personnel assigned to an incident. The level of training and experience of the IMT members, coupled with the identified formal response requirements and responsibilities of the IMT, are factors in determining "type," or level, of IMT.

Incident Objectives: Statements of guidance and direction needed to select appropriate strategy(s) and the tactical direction of resources. Incident objectives are based on realistic expectations of what can be accomplished when all allocated resources have been effectively deployed. Incident objectives must be achievable and measurable, yet flexible enough to allow strategic and tactical alternatives.

Information Management: The collection, organization, and control over the structure, processing, and delivery of information from one or more sources and distribution to one or more audiences who have a stake in that information.

Integrated Planning System: A system designed to provide common processes for developing and integrating plans for the Federal Government to establish a comprehensive approach to national planning in accordance with the Homeland Security Management System as outlined in the National Strategy for Homeland Security.

Intelligence/Investigations: An organizational subset within ICS. Intelligence gathered within the Intelligence/Investigations function is information that either leads to the detection, prevention, apprehension, and prosecution of criminal activities-or the individual(s) involved-including terrorist incidents or information that leads to determination of the cause of a given incident (regardless of the source) such as a public health event or fire with unknown origins. This is different from the normal operational and situational intelligence gathered and reported by the Planning Section.

Interoperability: Ability of systems, personnel, and equipment to provide and receive functionality, data, information and/or services to and from other systems, personnel, and equipment, between both public and private agencies, departments, and other organizations, in a manner enabling them to operate effectively together. Allows emergency management/response personnel and their affiliated organizations to communicate within and across agencies and jurisdictions via voice, data, or video-on-demand, in real time, when needed, and when authorized.

Job Aid: Checklist or other visual aid intended to ensure that specific steps of completing a task or assignment are accomplished.

Joint Field Office (JFO): The primary Federal incident management field structure. The JFO is a temporary Federal facility that provides a central location for the coordination of Federal, State, tribal, and local governments and private-sector and nongovernmental organizations with primary responsibility for response and recovery. The JFO structure is organized, staffed, and managed in a manner consistent with National Incident Management System principles. Although the JFO uses an Incident Command System structure, the JFO does not manage on-scene operations. Instead, the JFO focuses on providing support to on-scene efforts and conducting broader support operations that may extend beyond the incident site.

Joint Information Center (JIC): A facility established to coordinate all incident-related public information activities. It is the central point of contact for all news media. Public information officials from all participating agencies should co-locate at the JIC.

Joint Information System (JIS): A structure that integrates incident information and public affairs into a cohesive organization designed to provide consistent, coordinated, accurate, accessible, timely, and complete information during crisis or incident operations. The mission of the JIS is to provide a structure and system for developing and delivering coordinated interagency messages; developing, recommending, and executing public information plans and strategies on behalf of the Incident Commander (IC); advising the IC concerning public affairs issues that could affect a response effort; and controlling rumors and inaccurate information that could undermine public confidence in the emergency response effort.

Jurisdiction: A range or sphere of authority. Public agencies have jurisdiction at an incident related to their legal responsibilities and authority. Jurisdictional authority at an incident can be political or geographical (e.g., Federal, State, tribal, local boundary lines) or functional (e.g., law enforcement, public health).

Jurisdictional Agency: The agency having jurisdiction and responsibility for a specific geographical area, or a mandated function.

Key Resource: Any publicly or privately controlled resource essential to the minimal operations of the economy and government.

Letter of Expectation: See Delegation of Authority.

Liaison: A form of communication for establishing and maintaining mutual understanding and cooperation.

Liaison Officer: A member of the Command Staff responsible for coordinating with representatives from cooperating and assisting agencies or organizations.

Local Government: Public entities responsible for the security and welfare of a designated area as established by law. A county, municipality, city, town, township, local public authority, school district, special district, intrastate district, council of governments (regardless of whether the council of governments is incorporated as a nonprofit corporation under State law), regional or interstate government entity, or agency or instrumentality of a local government; an Indian tribe or authorized tribal entity, or in Alaska a Native Village or Alaska Regional Native Corporation; a rural community, unincorporated town or village, or other public entity. See Section 2 (10), Homeland Security Act of 2002, Pub. L. 107-296, 116 Stat. 2135 (2002).

Logistics: The process and procedure for providing resources and other services to support incident management.

Logistics Section: The Incident Command System Section responsible for providing facilities, services, and material support for the incident.

Management by Objectives: A management approach that involves a five-step process for achieving the incident goal. The Management by Objectives approach includes the following: establishing overarching incident objectives; developing strategies based on overarching incident objectives; developing and issuing assignments, plans, procedures, and protocols; establishing specific, measurable tactics or tasks for various incident-management functional activities and directing efforts to attain them, in support of defined strategies; and documenting results to measure performance and facilitate corrective action.

Manager: Individual within an Incident Command System organizational unit who is assigned specific managerial responsibilities (e.g., Staging Area Manager or Camp Manager).

Mitigation: Activities providing a critical foundation in the effort to reduce the loss of life and property from natural and/or manmade disasters by avoiding or lessening the impact of a disaster and providing value to the public by creating safer communities. Mitigation seeks to fix the cycle of disaster damage, reconstruction, and repeated damage. These activities or actions, in most cases, will have a long-term sustained effect.

Mobilization: The process and procedures used by all organizations-Federal, State, tribal, and local-for activating, assembling, and transporting all resources that have been requested to respond to or support an incident.

Mobilization Guide: Reference document used by organizations outlining agreements, processes, and procedures used by all participating agencies/organizations for activating, assembling, and transporting resources.

Multiagency Coordination (MAC) Group: A group of administrators or executives, or their appointed representatives, who are typically authorized to commit agency resources and funds. A MAC Group can provide coordinated decision-making and resource allocation among cooperating agencies, and may establish the priorities among incidents, harmonize agency policies, and provide strategic guidance and direction to support incident management activities. MAC Groups may also be known as multiagency committees, emergency management committees, or as otherwise defined by the Multiagency Coordination System.

Multiagency Coordination System (MACS): A system that provides the architecture to support coordination for incident prioritization, critical resource allocation, communications systems integration, and information coordination. MACS assist agencies and organizations responding to an incident. The elements of a MACS include facilities, equipment, personnel, procedures, and communications. Two of the most commonly used elements are Emergency Operations Centers and MAC Groups.

Multijurisdictional Incident: An incident requiring action from multiple agencies that each have jurisdiction to manage certain aspects of an incident. In the Incident Command System, these incidents will be managed under Unified Command.

Mutual Aid Agreement or Assistance Agreement: Written or oral agreement between and among agencies/organizations and/or jurisdictions that provides a mechanism to quickly obtain emergency assistance in the form of personnel, equipment, materials, and other associated services. The primary objective is to facilitate rapid, short-term deployment of emergency support prior to, during, and/or after an incident.

National: Of a nationwide character, including the Federal, State, tribal, and local aspects of governance and policy.

National Essential Functions: A subset of government functions that are necessary to lead and sustain the Nation during a catastrophic emergency and that, therefore, must be supported through continuity of operations and continuity of government capabilities.

National Incident Management System: A set of principles that provides a systematic, proactive approach guiding government agencies at all levels, nongovernmental organizations, and the private sector to work seamlessly to prevent, protect against, respond to, recover from, and mitigate the effects of incidents, regardless of cause, size, location, or complexity, in order to reduce the loss of life or property and harm to the environment.

National Response Framework: A guide to how the Nation conducts all-hazards response.

Nongovernmental Organization (NGO): An entity with an association that is based on interests of its members, individuals, or institutions. It is not created by a government, but it may work cooperatively with government. Such organizations serve a public purpose, not a private benefit. Examples of NGOs include faith-based charity organizations and the American Red Cross. NGOs, including voluntary and faith-based groups, provide relief services to sustain life, reduce physical and emotional distress, and promote the recovery of disaster victims. Often these groups provide specialized services that help individuals with disabilities. NGOs and voluntary organizations play a major role in assisting emergency managers before, during, and after an emergency.

Officer: The Incident Command System title for a person responsible for one of the Command Staff positions of Safety, Liaison, and Public Information.

Operational Period: The time scheduled for executing a given set of operation actions, as specified in the Incident Action Plan. Operational periods can be of various lengths, although usually they last 12 to 24 hours.

Operations Section: The Incident Command System (ICS) Section responsible for all tactical incident operations and implementation of the Incident Action Plan. In ICS, the Operations Section normally includes subordinate Branches, Divisions, and/or Groups.

Organization: Any association or group of persons with like objectives. Examples include, but are not limited to, governmental departments and agencies, nongovernmental organizations, and the private sector.

Personal Responsibility: The obligation to be accountable for one's actions.

Personnel Accountability: The ability to account for the location and welfare of incident personnel. It is accomplished when supervisors ensure that Incident Command System principles and processes are functional and that personnel are working within established incident management guidelines.

Plain Language: Communication that can be understood by the intended audience and meets the purpose of the communicator. For the purpose of the National Incident Management System, plain language is designed to eliminate or limit the use of codes and acronyms, as appropriate, during incident response involving more than a single agency.

Planned Event: A scheduled nonemergency activity (e.g., sporting event, concert, parade, etc.).

Planning Meeting: A meeting held as needed before and throughout the duration of an incident to select specific strategies and tactics for incident control operations and for service and support planning. For larger incidents, the Planning Meeting is a major element in the development of the Incident Action Plan.

Planning Section: The Incident Command System Section responsible for the collection, evaluation, and dissemination of operational information related to the incident, and for the preparation and documentation of the Incident Action Plan. This Section also maintains information on the current and forecasted situation and on the status of resources assigned to the incident.

Portability: An approach that facilitates the interaction of systems that are normally distinct. Portability of radio technologies, protocols, and frequencies among emergency management/response personnel will allow for the successful and efficient integration, transport, and deployment of communications systems when necessary. Portability includes the standardized assignment of radio channels across jurisdictions, which allows responders to participate in an incident outside their jurisdiction and still use familiar equipment.

Pre-Positioned Resource: A resource moved to an area near the expected incident site in response to anticipated resource needs.

Preparedness: A continuous cycle of planning, organizing, training, equipping, exercising, evaluating, and taking corrective action in an effort to ensure effective coordination during incident response. Within the National Incident Management System, preparedness focuses on the following elements: planning; procedures and protocols; training and exercises; personnel qualification and certification; and equipment certification.

Preparedness Organization: An organization that provides coordination for emergency management and incident response activities before a potential incident. These organizations range from groups of individuals to small committees to large standing organizations that represent a wide variety of committees, planning groups, and other organizations (e.g., Citizen Corps, Local Emergency Planning Committees, Critical Infrastructure Sector Coordinating Councils).

Prevention: Actions to avoid an incident or to intervene to stop an incident from occurring. Prevention involves actions to protect lives and property. It involves applying intelligence and other information to a range of activities that may include such countermeasures as deterrence operations; heightened inspections; improved surveillance and security operations; investigations to determine the full nature and source of the threat; public health and agricultural surveillance and testing processes; immunizations, isolation, or quarantine; and, as appropriate, specific law enforcement operations aimed at deterring, preempting, interdicting, or disrupting illegal activity and apprehending potential perpetrators and bringing them to justice.

Primary Mission Essential Functions: Government functions that must be performed in order to support or implement the performance of National Essential Functions before, during, and in the aftermath of an emergency.

Private Sector: Organizations and individuals that are not part of any governmental structure. The private sector includes for-profit and not-for-profit organizations, formal and informal structures, commerce, and industry.

Protocol: A set of established guidelines for actions (which may be designated by individuals, teams, functions, or capabilities) under various specified conditions.

Public Information: Processes, procedures, and systems for communicating timely, accurate, and accessible information on an incident's cause, size, and current situation; resources committed; and other matters of general interest to the public, responders, and additional stakeholders (both directly affected and indirectly affected).

Public Information Officer: A member of the Command Staff responsible for interfacing with the public and media and/or with other agencies with incident-related information requirements.

Publications Management: Subsystem that manages the development, publication control, publication supply, and distribution of National Incident Management System materials.

Recovery: The development, coordination, and execution of service- and site-restoration plans; the reconstitution of government operations and services; individual, private-sector, nongovernmental, and public assistance programs to provide housing and to promote restoration; long-term care and treatment of affected persons; additional measures for social, political, environmental, and economic restoration; evaluation of the incident to identify lessons learned; post incident reporting; and development of initiatives to mitigate the effects of future incidents.

Recovery Plan: A plan developed to restore an affected area or community.

Reimbursement: A mechanism to recoup funds expended for incident-specific activities.

Resource Management: A system for identifying available resources at all jurisdictional levels to enable timely, efficient, and unimpeded access to resources needed to prepare for, respond to, or recover from an incident. Resource management under the National Incident Management System includes mutual aid agreements and assistance agreements; the use of special Federal, State, tribal, and local teams; and resource mobilization protocols.

Resource Tracking: A standardized, integrated process conducted prior to, during, and after an incident by all emergency management/response personnel and their associated organizations.

Resources: Personnel and major items of equipment, supplies, and facilities available or potentially available for assignment to incident operations and for which status is maintained. Resources are described by kind and type and may be used in operational support or supervisory capacities at an incident or at an Emergency Operations Center.

Response: Activities that address the short-term, direct effects of an incident. Response includes immediate actions to save lives, protect property, and meet basic human needs. Response also includes the execution of emergency operations plans and of mitigation activities designed to limit the loss of life, personal injury, property damage, and other unfavorable outcomes. As indicated by the situation, response activities include applying intelligence and other information to lessen the effects or consequences of an incident; increased security operations; continuing investigations into nature and source of the threat; ongoing public health and agricultural surveillance and testing processes; immunizations, isolation, or quarantine; and specific law enforcement operations aimed at preempting, interdicting, or disrupting illegal activity, and apprehending actual perpetrators and bringing them to justice.

Retrograde: To return resources back to their original location.

Safety Officer: A member of the Command Staff responsible for monitoring incident operations and advising the Incident Commander on all matters relating to operational safety, including the health and safety of emergency responder personnel.

Section: The Incident Command System organizational level having responsibility for a major functional area of incident management (e.g., Operations, Planning, Logistics, Finance/Administration, and Intelligence/Investigations (if established). The Section is organizationally situated between the Branch and the Incident Command.

Single Resource: An individual, a piece of equipment and its personnel complement, or a crew/team of individuals with an identified work supervisor that can be used on an incident.

Situation Report: Confirmed or verified information regarding the specific details relating to an incident.

Span of Control: The number of resources for which a supervisor is responsible, usually expressed as the ratio of supervisors to individuals. (Under the National Incident Management System, an appropriate span of control is between 1:3 and 1:7, with optimal being 1:5, or between 1:8 and 1:10 for many large-scale law enforcement operations.)

Special Needs Population: A population whose members may have additional needs before, during, and after an incident in functional areas, including but not limited to: maintaining independence, communication, transportation, supervision, and medical care. Individuals in need of additional response assistance may include those who have disabilities; who live in institutionalized settings; who are elderly; who are children; who are from diverse cultures, who have limited English proficiency, or who are non-English-speaking; or who are transportation disadvantaged.

Staging Area: Temporary location for available resources. A Staging Area can be any location in which personnel, supplies, and equipment can be temporarily housed or parked while awaiting operational assignment.

Standard Operating Guidelines: A set of instructions having the force of a directive, covering those features of operations which lend themselves to a definite or standardized procedure without loss of effectiveness.

Standard Operating Procedure: A complete reference document or an operations manual that provides the purpose, authorities, duration, and details for the preferred method of performing a single function or a number of interrelated functions in a uniform manner.

State: When capitalized, refers to any State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, and any possession of the United States. See Section 2 (14), Homeland Security Act of 2002, Pub. L. 107-296, 116 Stat. 2135 (2002).

Status Report: Information specifically related to the status of resources (e.g., the availability or assignment of resources).

Strategy: The general plan or direction selected to accomplish incident objectives.

Strike Team: A set number of resources of the same kind and type that have an established minimum number of personnel, common communications, and a leader.

Substate Region: A grouping of jurisdictions, counties, and/or localities within a State brought together for specified purposes (e.g., homeland security, education, public health), usually containing a governance structure.

Supervisor: The Incident Command System title for an individual responsible for a Division or Group.

Supporting Agency: An agency that provides support and/or resource assistance to another agency. See Assisting Agency.

Supporting Technology: Any technology that may be used to support the National Incident Management System, such as orthophoto mapping, remote automatic weather stations, infrared technology, or communications.

System: Any combination of facilities, equipment, personnel, processes, procedures, and communications integrated for a specific purpose.

Tactics: The deployment and directing of resources on an incident to accomplish the objectives designated by strategy.

Task Force: Any combination of resources assembled to support a specific mission or operational need. All resource elements within a Task Force must have common communications and a designated leader.

Technical Specialist: Person with special skills that can be used anywhere within the Incident Command System organization. No minimum qualifications are prescribed, as technical specialists normally perform the same duties during an incident that they perform in their everyday jobs, and they are typically certified in their fields or professions.

Technology Standards: Conditions, guidelines, or characteristics that may be required to facilitate the interoperability and compatibility of major systems across jurisdictional, geographic, and functional lines.

Technology Support: Assistance that facilitates incident operations and sustains the research and development programs that underpin the long-term investment in the Nation's future incident management capabilities.

Terrorism: As defined in the Homeland Security Act of 2002, activity that involves an act that is dangerous to human life or potentially destructive of critical infrastructure or key resources; is a violation of the criminal laws of the United States or of any State or other subdivision of the United States; and appears to be intended to intimidate or coerce a civilian population, to influence the policy of a government by intimidation or coercion, or to affect the conduct of a government by mass destruction, assassination, or kidnapping.

Threat: Natural or manmade occurrence, individual, entity, or action that has or indicates the potential to harm life, information, operations, the environment, and/or property.

Tools: Those instruments and capabilities that allow for the professional performance of tasks, such as information systems, agreements, doctrine, capabilities, and legislative authorities.

Tribal: Referring to any Indian tribe, band, nation, or other organized group or community, including any Alaskan Native Village as defined in or established pursuant to the Alaskan Native Claims Settlement Act (85 Stat. 688) 43 U.S.C.A. and 1601 et seq., that is recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians.

Type: An Incident Command System resource classification that refers to capability. Type 1 is generally considered to be more capable than Types 2, 3, or 4, respectively, because of size, power, capacity, or (in the case of Incident Management Teams) experience and qualifications.

Unified Approach: The integration of resource management, communications and information management, and command and management in order to form an effective system.

Unified Area Command: Version of command established when incidents under an Area Command are multijurisdictional. See Area Command.

Unified Command (UC): An Incident Command System application used when more than one agency has incident jurisdiction or when incidents cross political jurisdictions. Agencies work together through the designated members of the UC, often the senior persons from agencies and/or disciplines participating in the UC, to establish a common set of objectives and strategies and a single Incident Action Plan.

Unit: The organizational element with functional responsibility for a specific incident planning, logistics, or finance/administration activity.

Unit Leader: The individual in charge of managing Units within an Incident Command System (ICS) functional Section. The Unit can be staffed by a number of support personnel providing a wide range of services. Some of the support positions are pre-established within ICS (e.g., Base/Camp Manager), but many others will be assigned as technical specialists.

Unity of Command: An Incident Command System principle stating that each individual involved in incident operations will be assigned to only one supervisor.

Vital Records: The essential agency records that are needed to meet operational responsibilities under national security emergencies or other emergency or disaster conditions (emergency operating records), or to protect the legal and financial rights of the government and those affected by government activities (legal and financial rights records).

Volunteer: For purposes of the National Incident Management System, any individual accepted to perform services by the lead agency (which has authority to accept volunteer services) when the individual performs services without promise, expectation, or receipt of compensation for services performed. See 16 U.S.C. 742f(c) and 29 CFR 553.10

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Emergency Support Function Annexes

ESF 0 – Overview

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1 General

Emergency Support Functions (ESFs) focus on critical tasks, capabilities, and resources provided by emergency response agencies for the City throughout all phases of an emergency.

ESF	Purpose
1 – Transportation	Describes how the City will coordinate transportation needs during a major emergency or disaster, including assessing damage to and restoring and maintaining transportation networks—specifically, roads and bridges.
2 – Communication	Describes how the City will provide for, support, and enhance the requisite technology (hardware and software) for emergency communications systems; alert, warning, and notification systems; and redundant communications systems during all phases of the emergency management cycle, including response and recovery operations.
3 – Public Works	Describes how the City will provide the resources (human, technical, equipment, facilities, materials, and supplies) to support emergency public works needs during a major emergency or disaster.
4 – Firefighting	Describes how the City will detect and suppress urban, rural, and wildland fires resulting from, or occurring coincidentally with, a significant disaster condition or incident.
5 – Information & Planning	Describes how the County will support incident information and planning needs to develop and maintain a common operating picture to support response and recovery activities.
6 – Mass Care	Describes how the County will support the efforts of the City to address the mass care, emergency assistance, temporary housing, and human services needs of people impacted by disasters.
7 – Resource Support	Describes how the City will provide logistical and resource support during emergencies, as well as financial tracking and records management of overall costs of the County's response.
8 – Health & Medical	Intended to create awareness regarding the County's coordination of public health and medical aspects of emergencies that exceed routine response capabilities and/or are related to a declared state of public health emergency.
9 – Search & Rescue	Describes how the City will coordinate deployment of resources in both urban and non-urban search and rescue during a major disaster or incident.
10 – Hazardous Materials	Outlines roles and responsibilities in responding effectively to a hazardous materials release or threatened release, and provides a framework for response and mitigation activities to prevent or minimize injuries, environmental impact, and property damage.
11 – Food & Water	Describes how the City will identify food and water (including ice) needs in the aftermath of a disaster or emergency, obtain these resources, and transport them to the impacted area.

ESF	Purpose
12 – Energy	Describes how the City will coordinate plans, procedures, and resources to support response to and recovery from shortages and disruptions in the supply and delivery of energy during a major disaster or incident.
13 – Military Support	Intended to create awareness regarding the State's coordination of military support to civil authorities in times of emergency.
14 – Public Information	Describes how the City will disseminate information to the public and other partners during times of emergency (e.g., evacuation/ shelter-in-place orders, water boil notices, emergency sheltering information, situational awareness notifications, etc.).
15 – Volunteer & Donations Management	Describes how the City will coordinate with community and faith-based organizations to effectively coordinate the activities/ management of pre-identified and established affiliated volunteers and solicited donations as well as managing spontaneous and/or unaffiliated volunteers as well as unsolicited donations (physical and monetary)
16 – Law Enforcement	Describes how the City will support law enforcement activities during a time of emergency.
17 – Agriculture & Animal Protection	Describes how the City will coordinate an effective and humane response involving animal and agricultural issues, and work to protect the City's natural resources.
18 – Business & Industry	Describes how the City will provide immediate and short-term assistance to local private-sector entities; stabilize the local economy; and effectively utilize local private-sector assets in response operations following a large-scale incident.

2 Roles and Responsibilities

The City has identified primary and supporting agencies and community partners in each ESF to ensure that ESF-related activities are performed in an efficient and effective manner during all phases of the emergency management cycle. Individual ESFs do not relieve tasked agencies of the responsibility for emergency planning, and agency plans should adequately provide for the capability to implement their assigned tasks.

- **Primary City Agency(s)** – City agency(s) may be assigned as primary based on their responsibilities, authority, functional expertise, resources, and capabilities in managing incident activities. Primary agencies may not be responsible for all elements of a function, and will work with supporting agencies to manage capabilities and resources to support ESF-related activities.
- **Supporting City Agency(s)** – City agency(s) may be assigned as supporting if they may have a substantial support role during incidents based on their capabilities and resources.
- **Community Partners** – Community partners may be assigned tasks if they meet one or more of the following criteria: the organization's self-defined mission includes emergency response (e.g., disaster relief nonprofit organizations); the organization receives formalized tasking by governmental agencies (e.g., American Red Cross); the

organization's jurisdictional authority, or resources and capabilities may make them suitable to the response.

Roles and responsibilities for County, State, and federal agencies are identified in the County and State Emergency Operations Plans and National Response Framework, respectively.

3 ESF Representative Actions

It is not necessary to activate all functions and their associated roles and responsibilities in every emergency or disaster. However, in the event that a particular ESF is activated (e.g., public works in a flooding event, food and water in a major earthquake event), the representative responsible for the function is responsible for the following actions (not an all-inclusive list).

3.1 Activation and Initial Actions

- Report to the Emergency Operations Center (EOC) Incident Commander, Section Chief, Branch Coordinator, or other assigned supervisor with required identification.
- Become familiar with available job resources (e.g., plans, equipment, and staff) and EOC plans and forms.
- Review the EOC organization and staffing chart and understand your role in working with the various branches and sections.
- Equip your work station with necessary equipment and supplies and test the functionality of all equipment.
- Obtain situation report(s), the EOC Action Plan, and/or briefings from EOC and/or field personnel.

3.2 Initial Operational Periods

- Obtain a briefing from the person you are replacing.
- Attend meetings and briefings, as appropriate.
- Establish and maintain your position log with chronological documentation.
- Follow procedures for transferring responsibilities to replacements.
- Follow staff accountability and check-in/-out procedures when temporarily leaving your assigned work station.

3.3 Final Operational Periods

- Complete and submit all required documentation.
- Ensure that all materials are returned to their proper storage location and file requests for replacement of resources that are expended or inoperative.
- Follow check-out procedures.
- Share lessons learned at After-Action Conferences to contribute to the After-Action Report and inform future activations.

3.4 Keys to Success

3.4.1 Information Management

Information management is getting the right information to the right people, in the right form, at the right time. It includes receiving, sorting, prioritizing, and delivering information.

- The EOC information management role for ESF Leads and agency representatives includes:
  - Filtering information for what is accurate, distill that information to what is useful, and push it to the appropriate people within the EOC or agency, contributing to a common operating picture
  - Serving as a conduit of information to and from agencies
  - Supplying accurate, appropriate, and up-to-date information to the Situation Report.

3.4.2 Resource Management

Resource management is getting the right resources to the right place, at the right time. The resource request process is at its core and supports coordinated management of resource requests by local, state, and federal partners. Resources include equipment, supplies, and personnel.

The EOC Resource Management support role for ESF Leads and agency representatives includes the following:

- Coordinate the contribution of resources from an agency to the response and recovery.
- Request resources from other sources and agencies.
- Keep the lines of communication open and provide specific information about what an agency can and cannot provide. The more specific and timely the information held by the Logistics Section is, the more efficiently it will support the request.

ESF 1 – Transportation

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ESF 1 Tasked Agencies	
Primary City Agency	Public Works Department (includes Engineering & GIS)
Supporting City Agency	Police Department Parks and Recreation Department
Community Partners	Mutual aid partners Canby Ferry Boat or Barge Companies
County Agency	Transportation and Development
State Agency	Oregon Department of Transportation (ODOT)
Federal Agency	Department of Transportation

1 Introduction

1.1 Purpose

Emergency Support Function (ESF) 1 describes how the City will coordinate transportation needs during a major emergency or disaster, including assessing damage to and restoring and maintaining transportation networks—specifically, roads and bridges.

1.2 Scope

ESF 1 includes the following activities:

- Coordinate and/or support damage assessment activities, including the dissemination of pertinent data regarding any impacts to the transportation infrastructure contained within the City’s jurisdictional boundaries.
- Coordinate the repair and restoration of the City’s transportation network.
- Maintain undamaged, repaired, and/or restored infrastructure as necessary to ensure that additional hazards do not occur.
- Monitor, control, and coordinate vehicular traffic flow.
- Provide resources to support transportation of evacuees, personnel, equipment, and materials and supplies.
- Provide maps for all modes of transportation.
- Prioritize and initiate emergency work tasks to clear debris and obstructions from, and make emergency repairs to, the transportation infrastructure.

1.3 Policies and Authorities

City, County, and State departments with transportation resources and support operations are responsible for assessing and restoring transportation systems under their control. Priorities shall be determined and coordinated by the Emergency Operations Center (EOC), when activated.

The City is a signatory on the Managing Oregon Resources Efficiently Intergovernmental Agreement, which promotes cost-effective and efficient use of public resources among public agencies in Oregon.

2 Situation and Assumptions

2.1 Situation

The City is faced with a number of hazards that may cause disruption to transportation systems and require support. The following considerations should be taken into account when planning for and implementing ESF 1 activities:

- A major emergency or disaster may severely damage transportation infrastructure.
- The movement of people, equipment, and supplies may be much less efficient in emergency conditions than under normal circumstances.
- Many transportation activities may be disrupted or hindered by damaged transportation infrastructure.
- In anticipation of or reaction to a disaster, evacuations that overwhelm standard routes may require resources beyond the capabilities of the City.
- Some communities have limited means of ingress and egress, and an emergency or disaster that disrupts key roads/bridges may limit or prevent access to the community.

Effective emergency transportation involves citywide and regional travel and requires close coordination with neighboring cities, the County, ODOT, and other public and private providers of transportation services and equipment. Transportation operations may require road closures, restrictions, detours, removal of debris, and/or construction of temporary roads or bridges.

2.2 Assumptions

ESF 1 is based on the following planning assumptions:

- The City's transportation infrastructure will likely sustain damage during a large-scale incident, thus impacting the effectiveness and efficiency of response and recovery.
- Disaster operations and/or hazardous conditions may require the City to divert traffic away from damaged, isolated, or evacuated areas or implement other traffic control methods.
- Response operations, especially during initial operational periods, may exhaust the City's transportation capabilities, thus requiring assistance from neighboring jurisdictions and/or State and federal government.
- Rapid initial and ongoing damage assessments of impacted areas will assist in the determination of response priorities and transportation demands.

3 Roles and Responsibilities of Tasked Agencies

See Appendix B for a checklist of responsibilities for tasked agencies by phase of emergency management.

4 Concept of Operations

4.1 General

Emergency transportation operations involve:

- Identification of areas impacted and people at risk.

- Identification, designation, and maintenance of access and egress routes.
- Arrangements to obtain additional emergency transportation resources, with highest priority given to resources needed for protection of life.
- Designation of transportation bases, staging areas, and refueling and repair facilities.
- Coordination with neighboring jurisdictions to ensure that transportation priorities and routes are consistent and coordinated.

4.2 Emergency Transportation and Evacuation Routes

The Public Works Department, with support from the County and ODOT, maintains transportation infrastructure, manages emergency transportation routes, identifies road hazards, and implements road closures. Mapping capabilities and equipment may be provided through the City's Geographic Information Systems (GIS) division and other partners. Staff and resources are assigned to support emergency evacuation and essential transportation routes.

4.3 Disabilities, and Access and Functional Needs

Provision of transportation-related activities will take into account populations with disabilities and access and functional needs (DAFN). The needs of the DAFN population shall be identified and planned for as directed by policy makers and according to State and federal regulations and guidance.

The County Department of Health, Housing, and Human Services and individual hospitals/ medical care facilities support evacuation procedures established for medical care facilities, coordinate resources needed for distribution of medical supplies/equipment to points of dispensing sites, and manages medical response operations within the identified emergency transportation routes.

4.4 Coordination with Other ESFs

The following ESFs support transportation-related activities:

- **ESF 3 – Public Works:** Support in maintenance, assessment, and restoration of the transportation network, including debris clearance.
- **ESF 16 – Law Enforcement:** Assist in traffic control and escort of emergency supplies.

5 ESF Annex Development and Maintenance

The Public Works Department will be responsible for coordinating regular review and maintenance of this annex. Each primary and supporting agency will be responsible for developing plans and procedures that address assigned tasks. Clackamas County Disaster Management staff will assist as requested.

6 Appendices

- Appendix A – ESF 1 Resources
- Appendix B – ESF 1 Responsibilities by Phase of Emergency Management

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Appendix A ESF 1 Resources

The following resources provide additional information regarding ESF 1 and transportation-related issues at the local, state, and federal level:

City

- Emergency Operations Plan
    - ESF 3 – Public Works
- Mutual Aid/Resource Sharing Agreements
- Emergency Transportation Routes

County

- Emergency Operations Plan
    - ESF 3 – Public Works
    - SA A – Evacuation
- Mutual Aid/Resource Sharing Agreements
- Regional Emergency Transportation Routes

State

- Emergency Operations Plan
    - ESF 1 – Transportation
- Department of Transportation Emergency Operations Plan
- State Aviation Resources for Disaster Assistance Plan

Federal

- National Response Framework
    - ESF 1 – Transportation
- Homeland Security Presidential Directives
    - No. 7: Identification of and Prioritization for Protection of Critical Infrastructure

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Appendix B ESF 1 Responsibilities by Phase of Emergency Management

The following checklist identifies key roles and responsibilities for ESF 1 – Transportation. It is broken out by phase of emergency management to inform tasked agencies of what activities they might be expected to perform before, during, and after an emergency to support the City's transportation concerns. All tasked agencies should maintain agency-specific plans and procedures that allow them to effectively accomplish these tasks.

Preparedness

Preparedness activities take place **before** an emergency occurs and include plans or preparations to save lives and help response and recovery operations. Preparedness roles and responsibilities for ESF 1 include the following:

All Tasked Agencies

- ☐ Develop plans and procedures for ESF 1 activities, as appropriate.
- ☐ Participate in ESF 1–related trainings and exercises as appropriate.
- ☐ Coordinate regular review and update of the ESF 1 annex with supporting agencies.
- ☐ Facilitate collaborative planning to ensure the City's capability to support ESF 1 activities.
- ☐ Develop and maintain one or more emergency/disaster transportation plans that address the following activities:
    - Providing for logistics and resource transportation needs
    - Conducting and/or facilitating damage assessments of City-owned/maintained transportation infrastructure

Emergency Manager

- ☐ Maintain operational capacity of the City EOC to support transportation activities.
- ☐ Ensure that staff are identified and adequately trained to fulfill their various City EOC positions.
- ☐ Maintain a list of transportation resources and capabilities.
- ☐ Identify transportation needs to support emergency response.

Response

Response activities take place **during** an emergency and include actions taken to save lives and prevent further property damage in an emergency situation. Response roles and responsibilities for ESF 1 include the following:

All Tasked Agencies

- ☐ Provide situational updates to the City EOC as required to maintain situational awareness and establish a common operating picture.
- ☐ Provide a representative to the City EOC, when requested, to support ESF 1 activities.

Public Works Department

- ☐ Coordinate all transportation-related missions in support of the City EOC.

- ☐ Coordinate fuel supply, vehicle support, and vehicle maintenance during an emergency.
- ☐ Prioritize response activities in support of developing the EOC Action Plan.
- ☐ Work with other agencies as needed to determine the usable portions of the City transportation system, including roads, bridges, and transit systems.
- ☐ Provide transportation-related public information and mapping support to the EOC during response and recovery activities.
- ☐ Clear and establish lifeline routes.
- ☐ Coordinate transportation of responders and resources to affected areas.
- ☐ Provide barriers and signage to aid missions.
- ☐ Provide personnel on scene to assist with road closures, traffic redirection, and other activities in coordination with the Police Department.
- ☐ Support damage assessment of transportation routes.
- ☐ Coordinate with the EOC Planning Section to identify unmet needs, including response vehicles, boats, engineering, fuel, and repair assistance.
- ☐ Establish a Transportation Branch in the City EOC if needed.
- ☐ Track the use of transportation resources through the EOC Finance Section.

Police Department

- ☐ Provide traffic control and evacuation assistance.
- ☐ Provide security escorts for movement of commodities into affected areas.

Tualatin Valley Fire and Rescue

- ☐ Provide evacuation assistance.
- ☐ Support identification of DAFN populations that need transportation support.

Recovery

Recovery activities take place **after** an emergency occurs and include actions to return to normal or even safer conditions following an emergency. Recovery roles and responsibilities for ESF 1 include the following:

All Tasked Agencies

- ☐ Demobilize response activities.
- ☐ Maintain incident documentation to support public and individual assistance processes.
- ☐ Participate in all after-action activities and take corrective action as appropriate.
- ☐ Provide support to recovery planning.

Public Works Department

- ☐ Coordinate and/or facilitate pre- and post-damage assessment activities.
- ☐ Continue to monitor and restore transportation systems in support of recovery.
- ☐ Develop financial estimates of damages and losses to transportation infrastructure.
- ☐ Compile and keep all documentation collected relating to ESF 1–related response activities.
- ☐ Coordinate all after-action activities and take corrective action as appropriate.

Mitigation

Mitigation activities take place **before and after** an emergency occurs and includes activities that prevent an emergency, reduce the chance of an emergency happening, or reduce the damaging effects of unavoidable emergencies. Mitigation roles and responsibilities for ESF 1 include the following:

All Tasked Agencies

- ☐ Participate in the hazard/vulnerability identification and analysis process.
- ☐ Take steps to correct deficiencies identified during the hazard/vulnerability identification and analysis process as appropriate.

Public Works Department

- ☐ Regularly inspect streets, public roadways, and rights-of-way for deterioration and make necessary repairs to keep them in good condition.
- ☐ Keep equipment in operating condition.

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ESF 2 – Communication

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ESF 2 Tasked Agencies	
Primary City Agency	Police Department Information Technology Department
Supporting City Agency	City Manager's Office
Community Partners	Lake Oswego Communications (LOCOM) – primary 911 Center West Linn Amateur Radio Emergency Services (ARES) – in development Verizon Washington County Consolidated Communications Agency – backup 9-1-1 Center
County Agency	Clackamas County Communications (CCOM) Technology Services Department
State Agency	Oregon Department of Administrative Services
Federal Agency	Department of Homeland Security

1 Introduction

1.1 Purpose

Emergency Support Function (ESF) 2 describes how the City will provide for, support, and enhance the requisite technology (hardware and software) for emergency communications systems; alert, warning, and notification systems; and redundant communications systems during all phases of the emergency management cycle, including response and recovery operations.

1.2 Scope

ESF 2 includes the following activities:

- Maintain a reliable alert, warning, and notification system.
- Establish and maintain an effective communications system, including City-owned and commercially leased systems, for use in a disaster.
- Coordinate the provision of redundant and temporary communications as required. Impacts to cellular services, external internet connectivity, local phone services, etc. are dependent upon the vendor services the City utilizes.
- Monitor and report on the overall status of the City's communications infrastructure during a disaster.
- Maintain the City's critical information technology infrastructure, including, but not limited to, the provision of cybersecurity measures.

1.3 Policies and Authorities

- The National Warning System (NAWAS) is the primary method of communicating alert and warning messages from national authorities to state authorities and between state authorities and local authorities or warning points. NAWAS messages are received through LOCOM.
- The Emergency Alert System (EAS) is the primary method of communicating alert and warning messages to the public.

- The City uses a 9-1-1 reverse communication emergency notification system to send notifications to the public over the phone (landline). In addition, individuals have the option of adding cell phones, voice over internet protocol (VOIP), and email through an online registration.

2 Situation and Assumptions

2.1 Situation

The City is faced with a number of hazards that may require communications support. Certain considerations should be taken into account when planning for and implementing ESF 2 activities, including the following:

- For the purposes of this document, “communication” is defined as the transference of information and may involve the representation, transfer, interpretation, and processing of data among persons, places, and machines. The term may also refer to the transmission, emission, or reception of signs, signals, writing, images, and sounds or intelligence of any nature by wire, radio, optical, or other electromagnetic system.
- An emergency can disrupt or even destroy communications systems by damaging antennas, repeaters, power supplies, or other components. During hazard conditions, access to, and functionality of, communications equipment and infrastructure may be limited and prevent the timely restoration of services.
- The distribution of accurate and timely information is a critical component of any effective emergency response.
- A large-scale incident may result in a surge of user requests for access to the local telecommunications infrastructure (e.g., jammed cell and landline phone switches, high-speed internet bandwidth degradation, etc.).
- During emergencies, heavy demand for communication services can quickly exceed the capacity of existing systems, limiting user access or shutting them down entirely.
- Response agencies often maintain and operate their own radio systems and may use different frequencies, potentially hindering timely and effective response/coordination unless interoperable communication systems are in place.
- Protection/restoration of emergency communications is one of the highest priorities in an emergency. Priority communications include emergency 9-1-1 calls and dispatch, interoperable communications among responders and supporting agencies, Emergency Operations Center (EOC) contact with field units, and communications with the public and media.
- LOCOM is the 24/7 Warning Point for the City.

2.2 Assumptions

ESF 2 is based on the following planning assumptions:

- To the extent possible, operational local telecommunication capabilities will be utilized to support response operations even in a diminished capacity.
- Local first responders have identified frequencies to be utilized for operational coordination, direction, and control communications.

- The loss of some or all telephone service and the internet may reduce or eliminate the effectiveness of the EOC and/or other City offices.
- Large-scale incidents may require extensive coordination of inter- and intra-community communications.
- If electronic emergency information systems are not available, redundant incident management documentation protocols may be required (e.g., paper logs may be used to record events, communications and messages, damage assessments, situation reports, resources utilized, staff hours expended, etc.)
- Adequate communications are vital for effective and efficient warning, response, and recovery operations.

3 Roles and Responsibilities of Tasked Agencies

See Appendix B for a checklist of responsibilities for tasked agencies by phase of emergency management.

4 Concept of Operations

4.1 General

When communication-related activities are staffed in the EOC, the communication representative will be responsible for the following:

- Serve as a liaison with supporting agencies and community partners.
- Provide a primary entry point for situational information related to communication.
- Share situation status updates related to communication to inform development of Situation Reports.
- Participate in, and provide communication-specific reports for, EOC briefings.
- Assist in development and communication of communication-related actions to tasked agencies.
- Monitor ongoing communication-related actions.
- Share communication-related information with the Public Information Officer to ensure consistent public messaging.
- Coordinate communication-related staffing to ensure that the function can be staffed across operational periods.

4.2 Warning Systems

4.2.1 Emergency Notifications

- Wireless 9-1-1 calls may be answered by any 9-1-1 center in the region and are transferred to the appropriate dispatching center.
- Emergency messages may be received via radio, telephone, or the Law Enforcement Data System and will be distributed according to departmental procedures.
- Messages that affect the overall emergency preparedness of the City, such as information about the movement of hazardous materials or weather alerts will be distributed to the Emergency Manager and appropriate response agencies. It is the responsibility of the Emergency Manager or Incident Commander to determine what further notifications should be made and actions taken in response to the message.

- The EOC becomes the primary coordination point for incident response, amateur radio, and satellite telephone communications.
- The City uses a variety of communication tools to provide situation information to residents, including:
    - Twitter
    - Facebook
    - FlashAlert
    - City Website
    - NextDoor
    - YourGov
    - 9-1-1 reverse communications

4.2.2 Employee Notification

The City may notify employees using:

- Phone-based systems—group voice mail, paging networks, faxes, employee information line, and communication notification technology;
- Computer network systems;
- Department notification procedures—each department is responsible for establishing and maintaining internal emergency communications;
- Instant messaging/texting;
- Web pages; and
- Social media.

4.2.3 Public Notification

4.2.3.1 Reverse 9-1-1

Reverse 9-1-1 is a reverse call emergency notification system utilized by the City to inform residents and business owners of local emergencies that may impact them.

Direction of these assets shall be the responsibility of the Incident Command through the Law Enforcement Branch Director, with input and support from the Planning, Logistics, and Operations Sections.

4.2.3.2 Emergency Alert System

The City uses EAS when a life-threatening hazard requires immediate protective action, with participating broadcast stations and cable operators transmitting the emergency alert over their networks. EAS messages may not exceed two minutes and are designed to provide a brief, initial warning to be followed by more detailed information. The Clackamas County EAS Plan can be activated by the City Manager, Emergency Manager, or Incident Commander.

Citizens are encouraged to monitor local radio and television broadcasts for emergency information. The North American Oceanic and Atmospheric Administration Weather Alert Net also provides effective emergency warning for weather-related hazards.

4.2.3.3 National Warning System

NAWAS is a government-to-government warning system that connects the National Warning Center at Colorado Springs to each state and, in turn, to the designated warning points in each county.

4.3 Response Systems

The City uses a variety of emergency response communications systems, including the following:

- Cell phones, land-line telephones, pagers, voicemail, and fax;
- Computer networks, Intranet, Internet, and email;
- Radio voice and data nets (very high frequency [VHF], 800 megahertz [MHz], mobile data communications, and both alpha-numeric and two-way pagers);
- Instant messaging/texting;
- Mobile or hand-held public address systems that are available on most marked police vehicles and most fire vehicles and may be used for alert and warning; and
- Door-to-door alert, which may be necessary in the event of a rapidly emerging incident that poses a clear threat to public safety. Residents will be directed to temporary shelter depending on the weather and the expected duration of the emergency.

The City is working on developing both satellite phone and amateur radio emergency services capability.

4.3.1 Amateur Radio Emergency Services

HAM radio is a critical element of emergency communications, particularly since other communications systems may be unavailable or overloaded in an emergency. ARES volunteers are federally licensed and registered as emergency service workers and provide emergency voice and data communications.

Once developed, the West Linn ARES will be led by an Emergency Coordinator working directly with the Emergency Manager to identify requirements, capabilities, and protocols for emergency operations. ARES provides a robust, reliable communication network throughout the City until usual communications channels and services can be restored. The ARES incident-specific emergency communications plan becomes an integral part of the EOC Action Plan.

ARES operations are conducted in accordance with the Oregon State Amateur Radio Communications Plan.

4.4 Interoperability

The core emergency communications system throughout the City is an 800 MHz radio system.

4.5 Disabilities, and Access and Functional Needs

Provision of communication-related activities will take into account populations with disabilities and access and functional needs (DAFN). The needs of the DAFN population shall be identified and planned for as directed by policy makers and according to State and federal regulations and guidance.

4.6 Coordination with Other ESFs

The following ESFs support communication-related activities:

- **All ESFs:** Support interoperable and redundant communications systems to ensure that responding agencies can communicate with each other and the EOC.

5 ESF Annex Development and Maintenance

The Police Department and Information and Technology Department will be responsible for coordinating regular review and maintenance of this annex. Each primary and supporting agency will be responsible for developing plans and procedures that address assigned tasks as well as testing equipment, backup EOC sites, and overall coordination of technical and communication requirements with the EOC and LOCOM.

6 Appendices

- Appendix A – ESF 2 Resources
- Appendix B – ESF 2 Responsibilities by Phase of Emergency Management

Appendix A ESF 2 Resources

The following resources provide additional information regarding ESF 2 and communications related issues at the local, state, and federal level:

City

- Emergency Operations Plan
  - ESF 14 – Public Information
- Intergovernmental Agreement with LOCOM

County

- Emergency Operations Plan
  - ESF 2 – Communications
  - ESF 14 – Public Information
- County Communications Interoperability Plan
- Regional Tactical Interoperable Communications Plan
- Clackamas County Disaster Communications Toolkit

State

- Emergency Operations Plan
  - ESF 2 – Communications
  - ESF 14 – Public Information
- Emergency Alert System Plan

Federal

- National Response Framework
  - ESF 2 – Communications
  - ESF 15 – External Affairs
- National Emergency Communications Plan
- Executive Order 13636, Improving Critical Infrastructure Cybersecurity

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Appendix B ESF 2 Responsibilities by Phase of Emergency Management

The following checklist identifies key roles and responsibilities for ESF 2 – Communications. It is broken out by phase of emergency management to inform tasked agencies of what activities they might be expected to perform before, during, and after an emergency to support the City's communications concerns. All tasked agencies should maintain agency-specific plans and procedures that allow them to effectively accomplish these tasks.

Preparedness

Preparedness activities take place **before** an emergency occurs and include plans or preparations to save lives and help response and recovery operations. Preparedness roles and responsibilities for ESF 2 include the following:

All Tasked Agencies

- ☐ Develop plans and procedures for ESF 2 activities, as appropriate.
- ☐ Participate in ESF 2–related trainings and exercises as appropriate.
- ☐ Maintain interoperable and redundant communications equipment.

Police Department

- ☐ Ensure that mobile data computers are tied into the computer-aided dispatch system for efficient communication.
- ☐ Coordinate regular review and update of the ESF 2 annex with supporting agencies.
- ☐ Facilitate collaborative planning to ensure the City's capability to support ESF 2 activities.
- ☐ Dispatch siren-equipped mobile units to key locations to provide supplemental sound coverage.
- ☐ Develop robust plans for the following communications sub-capabilities:
    - *Alert and Warning*
        - Manage and coordinate all incident notifications to City staff, elected officials, and other outside agencies as appropriate (e.g., during transition to continuity facilities or succession notification)
        - Engage in routine intelligence gathering and situational awareness activities.
    - *Communications Systems*
        - Establish and maintain emergency communications systems.
        - Coordinate the use of all public and private communication systems necessary during emergencies.
        - Manage and coordinate all emergency communications within the EOC, once activated.
        - Maintain operational capacity of the City EOC to support communications activities.
        - Ensure that staff are identified and adequately trained to fulfill their delegated function within the County EOC, including the use of specialized and alternate communications technology and any associated equipment, software, etc.

LOCOM

- ☐ Serve as the 24/7 City Warning Point.
- ☐ Provide dispatch services for the City before, during, and after an emergency.
- ☐ Maintain emergency contact lists.
- ☐ Maintain and operate emergency alert and notification systems for the City.
- ☐ Issue all warnings through the warning point.

Information Technology Department

- ☐ Ensure availability of telephone, computer, computer networks, and geographic information systems (GIS).
- ☐ Coordinate with telephone service providers.
- ☐ Serve as the radio frequency coordination point.
- ☐ Evaluate and recommend improvements to EOC communications capability.

Response

Response activities take place **during** an emergency and include actions taken to save lives and prevent further property damage in an emergency situation. Response roles and responsibilities for ESF 2 include the following:

All Tasked Agencies

- ☐ Provide situational updates to the City and County EOCs as required to maintain situational awareness and foster a common operating picture.
- ☐ Provide a representative to the County EOC, when requested, to support ESF 2 activities.
- ☐ Use established common response communications language (i.e., plain English) to ensure that information dissemination is timely, clear, acknowledged, and understood by all receivers.
- ☐ Monitor status of the County's communication infrastructure during or following any disaster.
- ☐ Coordinate and assign resources necessary to respond to an incident that impacts the communications infrastructure.
- ☐ Establish or confirm communications methods.
- ☐ When necessary, coordinate provision of a temporary or interim communications capability as required.

Police Department

- ☐ Support tactical communications needs of emergency responders.
- ☐ Coordinate with EOC staff and other Public Service Answering Points to link with on-scene personnel.
- ☐ Operate Reverse 9-1-1.
- ☐ Provide staffing for the EOC Communications Unit, as appropriate.
- ☐ Activate and implement alert, warning, and notification systems as required to effectively notify appropriate stakeholders, including first responders.
- ☐ Establish communications with local response partners.
- ☐ Provide staffing for door-to-door warning if necessary.

- ☐ Develop and maintain hazard-specific warning procedures covering warning receipt, verification, and dissemination.

LOCOM

- ☐ Conduct call-taking/emergency dispatch services as long as conditions allow.
- ☐ Coordinate technical support for operation of 9-1-1 call-taking and computer-aided dispatch.

Emergency Manager

- ☐ Activate the EOC.
- ☐ Coordinate the following core EOC activities:
    - Compile and submit situational intelligence information regarding the operational status of the County's communications infrastructure and then utilize the findings to prepare operational status and situation reports for stakeholders to foster a common operational picture. See *ESF 5 – Information and Planning* for more information.
    - Facilitate the resource requesting process (i.e., compiling resource requests, filling resource requests locally or through existing agreements, forwarding unmet resource requests to the Oregon Emergency Coordination Center, and coordinating the staging and distribution of assets as they arrive). *See ESF 7 – Resource Support for more information.*
- ☐ Coordinate with the EOC Planning Section to identify unmet needs.
- ☐ Establish a Communications Branch in the County EOC if needed.
- ☐ Track the use of communication equipment and resources through the EOC Finance Section.
- ☐ Be a point of contact for ARES.

Information Technology

- ☐ Support and troubleshoot any/all technical problems as required to support incident operations.
- ☐ Set up EOC voice and data equipment systems; provide technical and networking support.
- ☐ Provide EOC Incident Commander with timely assessment of damage or degradation of telephone and network assets.
- ☐ Provide staffing for EOC Communications Unit

City Manager's Office

- ☐ Provide employees, the public, and the media with accurate and timely incident information.
- ☐ Ensure that DAFN individuals receive alert and warning messages and emergency public information in a format they can use.
- ☐ Activate and staff the Joint Information Center (JIC) and operate the Joint Information System (JIS).
- ☐ Coordinate public information with other agencies/jurisdictions.

Tualatin Valley Fire and Rescue

- ☐ Provide additional siren-equipped mobile units where necessary to provide sound coverage.
- ☐ Provide mobile public address units if necessary.
- ☐ Provide staffing for door-to-door warning if necessary.

ARES

- ☐ Augment City communications capabilities through use of amateur radio operators and systems.
- ☐ Develop and maintain an Emergency Communications Plan.
- ☐ Provide trained personnel and equipment.

Recovery

Recovery activities take place **after** an emergency occurs and include actions to return to a normal or an even safer situation following an emergency. Recovery roles and responsibilities for ESF 2 include the following:

All Tasked Agencies

- ☐ Demobilize response activities.
- ☐ Maintain incident documentation to support public and individual assistance processes.
- ☐ Prepare to support recovery operations by identifying community needs.

Emergency Manager

- ☐ Compile and keep all documentation relating to the management of communication equipment and software.
- ☐ Coordinate all after-action activities and take corrective actions as appropriate.

Mitigation

Mitigation activities take place **before and after** an emergency occurs and includes activities that prevent an emergency, reduce the chance of an emergency happening, or reduce the damaging effects of unavoidable emergencies. Mitigation roles and responsibilities for ESF 2 include the following:

All Tasked Agencies

- ☐ Participate in the hazard/vulnerability identification and analysis process.
- ☐ Take steps to correct deficiencies identified during the hazard/vulnerability identification and analysis process as appropriate.

ESF 3 – Public Works

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ESF 3 Tasked Agencies	
Primary City Agency	Public Works Department
Supporting City Agency	Building Department Parks and Recreation Department Finance Department
Community Partners	Mutual aid partners, local contractors (e.g., tree removal)
County Agency	Department of Transportation and Development
State Agency	Oregon Department of Transportation
Federal Agency	Department of Defense/U.S. Army Corps of Engineers Department of Homeland Security

1 Introduction

1.1 Purpose

Emergency Support Function (ESF) 3 describes how the City will provide the resources (human, technical, equipment, facilities, materials, and supplies) to support emergency public works needs during a major emergency or disaster.

1.2 Scope

ESF 3 includes the following activities:

- Monitor, assess, restore, and repair hazard impacts to the City's public works infrastructure.
- Determine the levels of damage to the following systems: transportation, public water supplies and facilities, electrical, natural gas, sewage, hazardous materials, and hazardous waste sites (generation, distribution, collection, storage, and disposal).
- Close or repair damaged segments of public works infrastructure.
- Coordinate repair and restoration of damaged public systems (e.g., water, electrical, natural gas, sanitary sewage, storm water collection, generating, distribution systems, dams, levees, water control structures).
- Provide for inspection and repair of essential facilities.
- Maintain undamaged or repaired public works infrastructure to ensure that additional hazards do not occur.
- Demolish or stabilize damaged structures (public and private) to facilitate search and rescue and/or protect the public's health and safety.
- Coordinate disaster debris management activities, including clearance of debris from public works infrastructure and development and initiation of emergency collection, sorting, and disposal routes and sites for debris cleared from public and private property.
- Prioritize and initiate recovery efforts to restore, repair, and mitigate the impact of the public works and engineering needs listed above.
- Provide technical assistance to the response team with respect to flooding, water management, structure integrity assessment, and impact assessments of infrastructure.

1.3 Policies and Authorities

The following policies and authorities are currently in place:

- Managing Oregon Resources Efficiently Intergovernmental Agreement; and
- Oregon Public Works Emergency Response Cooperative Assistance Agreement.

2 Situation and Assumptions

2.1 Situation

The City is faced with a number of hazards that may require public works support. Considerations that should be taken into account when planning for and implementing ESF 3 activities include, but are not limited to, the following:

- Access to potable water and effective wastewater management plays a significant role in maintaining the health and safety of the public.
- A significant disaster or emergency situation may overwhelm local assessment and engineering capacity.
- Unsafe and unknown conditions may persist throughout a community as weakened or destroyed structures, homes, public buildings, roads, and bridges await assessment from engineers and emergency personnel.
- Debris may make transportation routes impassable, and local standardized equipment may not be capable of removing it, thus making it difficult or impossible to reach public works infrastructure or get necessary equipment to sites in need of repair/restoration.
- Local equipment used for repair and removal may have been damaged or inadequate for the disaster or emergency event.
- Local personnel may have personal safety and health concerns following a disaster or emergency event, making it impossible for them to perform their duties.

2.2 Assumptions

ESF 3 is based on the following planning assumptions:

- A major emergency or disaster may cause extensive damage to property and infrastructure. Structures may be destroyed or severely weakened. Homes, public buildings, bridges, and other facilities may have to be reinforced or demolished to ensure safety. Debris may make streets and highways impassable. Public utilities may be damaged or partially or fully inoperable.
- Each public works agency will utilize its existing directives and procedures in responding to major emergencies/disasters while working within the framework of their applicable emergency operations plans (EOPs).
- Access to disaster-impacted public works infrastructure may depend on either the repair (permanent or temporary) of transportation routes or the establishment of ad-hoc alternatives.
- Interdepartmental liaison activities and requests for additional public works and engineering resources may be coordinated through the City Public Works Department’s designated resource coordinator, who may be stationed at the City’s Emergency Operations Center (EOC) during the response to a major disaster.

- In many locations, debris clearance and emergency road repairs will be given top priority to support immediate life-saving emergency response activities.
- Damage to public works infrastructure may result in a public health emergency (e.g., lack of potable water, damage to wastewater systems).
- Damage assessment of the disaster area will be required to determine potential work load.
- Assistance may be needed to clear debris, perform damage assessments and structural evaluations, make emergency repairs to essential public facilities, reduce hazards by stabilizing or demolishing structures, and provide emergency water for human health needs and firefighting.
- Debris may include many different types of materials, including hazardous materials that require specialized equipment and personnel to remove.
- Following disasters that cause significant debris, existing disposal sites may not provide effective debris management solutions because of capacity limitations and their need to provide continuous waste management operations for day-to-day debris generation.
- Local contractors will be utilized by public works agencies in supplementing emergency response and recovery capabilities.

3 Roles and Responsibilities of Tasked Agencies

See Appendix B for a checklist of responsibilities for tasked agencies by phase of emergency management.

4 Concept of Operations

4.1 General

When public works–related activities are staffed in the EOC, the public works representative will be responsible for the following:

- Serve as a liaison with supporting agencies and community partners.
- Provide a primary entry point for situational information related to public works.
- Share situation status updates related to public works to inform development of Situation Reports.
- Participate in, and provide public works–specific reports for, EOC briefings.
- Assist in developing public works–related actions and communicating them to tasked agencies.
- Monitor ongoing public works–related actions.
- Share public works–related information with the Public Information Officer to ensure consistent public messaging.
- Coordinate public works–related staffing to ensure that the function can be staffed across operational periods and into short-term recovery.

4.2 Pre-Disaster Operations

During the mitigation and preparedness phases, the Public Works Department should develop internal emergency procedures to handle daily situations while also preparing for larger-scale events. This includes developing and maintaining emergency call-out lists, contributing to and participating in the development and exercise of their jurisdictions' EOPs for major emergencies and disasters. Pre-disaster planning should include the development of mutual aid agreements and documentation of conditions, including photographic documentation of facilities, major culverts, bridges, etc. for Federal Emergency Management Agency reimbursement purposes.

4.3 Disaster Response

Public works response will include all activities performed to restore vital lifeline systems to the community, focusing on critical bridges, roads, potable water systems, and wastewater systems throughout the City. Protection of life will be the priority, which in many response situations will mean that Public Works will be providing direct support to police and fire units in rescue, evacuation, and traffic control.

4.4 Debris Management

The City will follow procedures as outlined in its Debris Management Plan, which is an annex to the County's Debris Management Plan, including:

- Coordinating debris collection and removal;
- Providing debris management instructions to the public; and
- Identifying temporary storage trash collection and storage sites as well as final landfill sites.

4.5 Contractors

The Public Works Department will use local contractors to supplement its emergency response capabilities, escalating unmet needs through the County EOC and/or mutual aid partners.

4.6 Disabilities, and Access and Functional Needs

Provision of public works–related activities will take into account populations with disabilities and access and functional needs (DAFN). The needs of the DAFN population shall be identified and planned for as directed by policy makers and according to State and federal regulations and guidance.

4.7 Coordination with Other ESFs

The following ESFs support public works–related activities:

- **ESF 1 – Transportation**. Identify impacts to the City's transportation infrastructure and develop priorities for repair and restoration.
- **ESF 10 – Hazardous Materials.** Identify impacts to hazardous materials and hazardous waste sites and develop priorities for repair and restoration.
- **ESF 12 – Energy.** Identify impacts to the City's energy infrastructure and develop priorities for repair and restoration.
- **ESF 13 – Military Support.** Provide public works support, including debris management, as resources allow.

5 ESF Annex Development and Maintenance

The Public Works Department will be responsible for coordinating regular review and maintenance of this annex. Each primary and supporting agency will be responsible for developing plans and procedures that address assigned tasks.

6 Appendices

- Appendix A – ESF 3 Resources
- Appendix B – ESF 3 Responsibilities by Phase of Emergency Management

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Appendix A ESF 3 Resources

The following resources provide additional information regarding ESF 3 and public works–related issues at the local, state, and federal level:

City

- Emergency Operations Plan
    - ESF 1 – Transportation
    - ESF 10 – Hazardous Materials
    - ESF 12 – Energy
    - ESF 13 – Military Support
- Debris Management Plan

County

- Emergency Operations Plan
    - ESF 1 – Transportation
    - ESF 10 – Hazardous Materials
    - ESF 12 – Energy
    - ESF 13 – Military Support
- Debris Management Plan
- Damage Assessment Plan

State

- State of Oregon Emergency Operations Plan
    - ESF 3 – Public Works

Federal

- National Response Framework
    - ESF 3 – Public Works
- National Infrastructure Protection Plan
- Response Federal Interagency Operational Plan

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Appendix B ESF 3 Responsibilities by Phase of Emergency Management

The following checklist identifies key roles and responsibilities for ESF 3 – Public Works. It is broken out by phase of emergency management to inform tasked agencies of what activities they might be expected to perform before, during, and after an emergency to support the public works function. All tasked agencies should maintain agency-specific plans and procedures that allow them to effectively accomplish these tasks.

Preparedness

Preparedness activities take place **before** an emergency occurs and include plans or preparations to save lives and to help response and recovery operations. Preparedness roles and responsibilities for ESF 3 include the following:

All Tasked Agencies

- ☐ Develop plans and procedures for ESF 3 activities, as appropriate.
- ☐ Participate in ESF 3–related trainings and exercises as appropriate.

Public Works Department

- ☐ Develop and maintain an emergency notification list of departmental personnel.
- ☐ Develop and maintain operating procedures for disaster response, including evacuation transportation requirements.
- ☐ Provide appropriate training to personnel on the general concept of disaster response and self-preservation techniques and for utilization of the Incident Command System (ICS) in disaster procedures for damage assessment.
- ☐ Ensure that employees fully understand their obligations as emergency responders to report to work as soon as possible in the event of a major emergency or disaster.
- ☐ Ensure that employees are aware of the need for a family preparedness plan that will assist them and their families in dealing with the results of all hazards.
- ☐ Designate an emergency management program liaison that will be responsible for the department's mitigation and preparedness activities, including participating in the development, maintenance, and exercise of the EOP.
- ☐ Designate a public works resource coordinator who will serve as a member of the City's EOC staff whenever the EOC is activated, for the purpose of training, exercising, or coordinating an actual response by the City government to a major emergency or disaster. This coordinator shall also be responsible for developing and maintaining a working knowledge of resources available to Public Works through other local, State, and federal agencies for disaster response. This position will also work with utility companies, the Oregon Department of Transportation, and the U.S. Army Corps of Engineers.
- ☐ Participate in training exercises to test the EOP.

Emergency Manager

- ☐ Maintain operational capacity of the City EOC to support public works activities.
- ☐ Ensure that staff are identified and adequately trained in the City EOC to include the tracking of public works resources.

Response

Response activities take place **during** an emergency and include actions taken to save lives and prevent further property damage in an emergency situation. Response roles and responsibilities for ESF 3 include the following:

All Tasked Agencies

- ☐ Provide a representative to operate from the EOC or other command location to ensure coordination with other agencies, as necessary.

Public Works Department

- ☐ Immediately recall off-duty personnel.
- ☐ Relocate equipment as necessary.
- ☐ Inspect bridges and report any damage to bridges or other infrastructure immediately following the occurrence of a natural hazard such as earthquake or flood.
- ☐ Clear debris from roads, streets, culverts, and streams endangering bridges and other structures and coordinate with the EOC in matters of debris disposal.
- ☐ Perform temporary repairs of arterial routes and bridges.
- ☐ Coordinate restoration of public facilities, roads, and bridges.
- ☐ Demolish unsafe public works structures.
- ☐ Furnish equipment and operators to assist fire and police in rescue operations.
- ☐ Support traffic control measures and provide signing for detours, shelters, routes, security, trespassing, etc.
- ☐ Ensure that public works emergency response activities and emergency public information are coordinated with the EOC, when it is operational.
- ☐ Keep other City departments informed of public works–related aspects of the emergency or disaster.
- ☐ Prioritize response activities in support of developing the EOC Action Plan.
- ☐ Support public messaging related to ESF 3 activities.
- ☐ Report suspicious devices found on infrastructure to Incident Command.
- ☐ Provide personnel and equipment to support emergency operations.
- ☐ Establish a Public Works Branch in the City EOC if needed.
- ☐ Provide damage assessment information to the City EOC, as applicable.
- ☐ Notify regulatory agency(s), as appropriate.

Building Department

- ☐ Conduct damage assessment.
- ☐ Work to stabilize damaged public and private structures to facilitate search and rescue and/or protect public health and safety.
- ☐ Identify and label uninhabitable/unsafe structures.
- ☐ Work with Public Works to implement closures and repair transportation infrastructure.
- ☐ Work with utilities to repair and restore operations (power, gas, telecommunications, water, wastewater, and stormwater systems).
- ☐ Prioritize efforts to restore, repair, and mitigate damage to City infrastructure.

Parks and Recreation Department

- ☐ Conduct damage assessment.
- ☐ Work with Public Works to implement closures and repair transportation infrastructure.
- ☐ Report suspicious devices found on infrastructure to Incident Command.
- ☐ Provide personnel and equipment to support emergency operations.

Finance Department

- ☐ Document personnel and other costs related to the emergency or disaster response for possible federal disaster assistance reimbursement.

Emergency Manager

- ☐ Regularly brief City Council on the developing situation.
- ☐ Collect resource requirement information from all City departments.
- ☐ Evaluate the situation and determine whether the EOP should be implemented.
- ☐ Assess developing conditions, and evaluate their potential impact.
- ☐ Research sources of needed resources.
- ☐ Establish and maintain contact with the County; provide updates on conditions.
- ☐ Consider activating the EOC.
- ☐ Document actions taken and costs incurred.
- ☐ Facilitate post-incident analysis.

Recovery Phase

Recovery activities take place **after** an emergency occurs and include actions to return to normal or even safer conditions following an emergency. Recovery roles and responsibilities for ESF 3 include the following:

All Tasked Agencies

- ☐ Demobilize response activities.
- ☐ Provide support to recovery planning.
- ☐ Maintain incident documentation to support any applicable public and/or individual assistance claims. Continue to repair infrastructure and buildings on a priority basis.

Public Works Department

- ☐ Continue necessary response operations.
- ☐ Assist other agencies with recovery operations and damage assessment, as appropriate.
- ☐ Return the focus of service to maintenance of the City’s infrastructure as soon as possible, releasing personnel and equipment for return to normal operations.

Emergency Manager

- ☐ Coordinate all after-action activities and take corrective actions as appropriate.

Mitigation

Mitigation activities take place **before and after** an emergency occurs and include activities that prevent an emergency, reduce the chance of an emergency happening, or reduce the damaging effects of unavoidable emergencies. Mitigation roles and responsibilities for ESF 3 include the following:

All Tasked Agencies

- ☐ Participate in the hazard/vulnerability identification and analysis process.
- ☐ Take steps to correct deficiencies identified during the hazard/vulnerability identification and analysis process as appropriate.

ESF 4 – Firefighting

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ESF 4 Tasked Agencies	
Primary City Agency	Police Department
Supporting City Agency	Public Works Department
Community Partners	Tualatin Valley Fire and Rescue (TVF&R) (primary response for firefighting) Mutual aid partners
County Agency	Clackamas County Disaster Management
State Agency	Oregon Department of Forestry, Oregon State Fire Marshal
Federal Agency	U.S. Department of Agriculture /Fire Service, Bureau of Land Management

1 Introduction

1.1 Purpose

Emergency Support Function (ESF) 4 describes how the City will detect and suppress urban, rural, and wildland fires resulting from, or occurring coincidentally with, a significant disaster condition or incident.

1.2 Scope

ESF 4 includes the following activities:

- Coordinate support for firefighting activities, including detection of fires on State and private lands.
- Provide personnel, equipment, and supplies in support of all agencies involved in rural and urban and wildland firefighting operations.

1.3 Policies and Authorities

The following legal authorities and policies are related to firefighting:

- Nothing in this ESF establishes mandatory standards or requirements. Tasks and activities will be accomplished to the extent that finances, programs, resources and staffing are available, as determined by City Council. There shall be no liability for failure to accomplish specific tasks and activities, and the decision to allocate resources for implementation of this ESF shall be a discretionary budgeting decision within the meaning of Oregon Revised Statutes 477.
- The City and its employees, while complying with the provisions of the ESF, shall not be liable for death, injury, or loss of property except in cases of willful misconduct, gross negligence, or bad faith.
- The U.S. Forest Service and the Bureau of Land Management have the authority to manage fire suppression and control on federal land.
- The Oregon Department of Forestry has the authority to manage and suppress fire on State land.
- The Oregon Department of Transportation has the authority to close State highways impeded by smoke as a matter of public safety.

- TVF&R and the Police Department have the authority to order evacuations, enforce perimeters, and request additional resources.

2 Situation and Assumptions

2.1 Situation

The City is faced with a number of hazards that may require firefighting support. The following considerations should be taken into account when planning for and implementing ESF 4 activities:

- Fires are often a secondary hazard after a large scale disaster such as an earthquake. These hazards often overwhelm a community's response capabilities and can exacerbate already dangerous situations as resources become overstretched.
- Dealing with fires involving hazardous materials may require the use of specialized equipment and training.
- Fire personnel are trained in the Incident Command System (ICS)/National Incident Management System (NIMS), so they often have a high level of understanding of the command structure during an incident.
- Fire agencies have a major role in responding to terrorist/chemical, biological, radiological, nuclear, or explosive (CBRNE) incidents, which may also require assistance from a regional hazardous materials team and/or Explosive Disposal Unit. A terrorism incident may involve one or more CBRNE hazards, including improvised explosive devices and the combination of these devices or other explosives with radiological materials to create a "dirty bomb." The potential for mass casualties, mass fatalities, and significant property damage during CBRNE incidents is very high.

2.2 Assumptions

ESF 4 is based on the following planning assumptions:

- Urban, rural, and wildland fires will be significant secondary hazards after a major, widespread disaster such as an earthquake.
- In a disaster, some firefighting resources may become scarce or damaged. Assistance from mutual aid agreements, neighboring jurisdictions, and State and federal resources may be relied upon.
- Telephone communications may be interrupted.
- Wheeled-vehicle access may be hampered by road or bridge failures, landslides, etc., making conventional travel to the fire locations extremely difficult or impossible. Aerial attack by air tankers, helicopters, and smoke jumpers may be needed in these situations.
- Wildland firefighting techniques may have to be applied to rural and urban fire situations, particularly where water systems are inoperative. Aerial delivery of fire retardants or water for structural protection may be essential. In the case of multiple fires, firebreaks may be cleared, and burning-out and backfiring techniques may be used.
- Efficient and effective mutual aid among partners requires the use of the ICS together with compatible firefighting equipment and communications.

3 Roles and Responsibilities of Tasked Agencies

See Appendix B for a checklist of responsibilities for tasked agencies by phase of emergency management.

4 Concept of Operations

4.1 General

TVF&R provides fire and emergency medical services (EMS) in the city and is routinely dispatched by Lake Oswego Communications (LOCOM) to handle emergencies. TVF&R shares resources using automatic mutual aid and also exchanges resources with other fire agencies in the region. The first fire responder unit to arrive at the incident location assumes On-Scene Command responsibility.

When On-Scene Command requests, the City will activate its Emergency Operations Center (EOC). TVF&R will send a representative to the City EOC to coordinate fire resources. The City EOC provides support to On-Scene Command and the Fire Chief, activating the EOC if requested or needed to coordinate emergency operations with cities, special districts, regional partners, and State agencies.

In addition to fire services, TVF&R will provide initial EMS response, including Advanced Life Support, and will advise LOCOM of additional EMS needs.

The EOC or Fire Incident Command may request resource assistance whenever available resources (including mutual aid) will be insufficient to meet incident needs. EOC Command coordinates the recommendation for a Declaration of Emergency and request for County/State assistance with the Fire Chief.

See ESF 10 – Hazardous Materials for more information on hazardous materials incidents.

4.2 Disabilities, and Access and Functional Needs

Provision of firefighting-related activities will take into account populations with disabilities and access and functional needs (DAFN). The needs of the DAFN population shall be identified and planned for as directed by policy makers and according to State and federal regulations and guidance.

4.3 Coordination with Other ESFs

The following ESFs support firefighting-related activities:

- **ESF 1 – Transportation.** Assist in movement of firefighting resources and personnel to the incident.
- **ESF 6 – Mass Care.** Provide mass care support for residents displaced by a fire incident.
- **ESF 10 – Hazardous Materials.** Provide technical support for fire incidents that involve hazardous materials.

5 ESF Annex Development and Maintenance

The Police Department, in conjunction with TVF&R, will be responsible for ensuring regular review and maintenance of this annex. Each primary and supporting agency will be responsible for developing plans and procedures that address assigned tasks.

6 Appendices

- Appendix A – ESF 4 Resources
- Appendix B – ESF 4 Actions by Phase of Emergency Management

Appendix A ESF 4 Resources

The following resources provide additional information regarding ESF 4 firefighting-related issues at the local, state, and federal level:

City

- Emergency Operations Plan
  - ESF 10 – Hazardous Materials

County

- Emergency Operations Plan
  - ESF 10 – Hazardous Materials
- Clackamas Fire Resource Management Plan (zone map)
- Community Wildfire Protection Plan
- Regional Mutual Aid/Resource Sharing Agreements

State

- Emergency Operations Plan
  - ESF 4 – Firefighting
- Oregon Fire Service Mobilization Plan
- Conflagration Act

Federal

- National Response Framework
  - ESF 4 – Firefighting

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Appendix B ESF 4 Responsibilities by Phase of Emergency Management

The following checklist identifies key roles and responsibilities for ESF 4 – Fire Services. It is broken out by phase of emergency management to inform tasked agencies of what activities they might be expected to perform before, during, and after an emergency to support the fire services function. All tasked agencies should maintain agency-specific plans and procedures that allow them to effectively accomplish these tasks.

Preparedness

Preparedness activities take place **before** an emergency occurs and include plans or preparations to save lives and to help response and recovery operations. Preparedness roles and responsibilities for ESF 4 include the following:

All Tasked Agencies

- ☐ Develop plans and procedures for ESF 4 activities, as appropriate.
- ☐ Participate in ESF 4-related trainings and exercises as appropriate.
- ☐ Appoint a representative to assist in the City EOC when requested.
- ☐ Establish criteria for relocating fire operations in the event that present facilities must be evacuated.
- ☐ Establish communication links with law enforcement agencies for coordinating warning and evacuation confirmation functions.
- ☐ Develop procedures and protocols for coordinating protective action communications with the at-risk population on scene.

TVF&R

- ☐ Conduct hazard evaluations

Mutual Aid Partners

- ☐ Establish procedures for coordinating all public information releases through the City PIO.

Response

Response activities take place **during** an emergency and include actions taken to save lives and prevent further property damage in an emergency situation. Response roles and responsibilities for ESF 4 include the following:

All Tasked Agencies

- ☐ Provide situational updates to the City EOC as required to maintain situational awareness and foster a common operating picture.

TVF&R

- ☐ Conduct response operations related to fire prevention, fire suppression, fire investigation, site security, search and rescue, and emergency medical aid to prevent loss of life, loss of property, and damage to the environment.
- ☐ Initiate mutual aid contingency plans, as required based upon resource availability.
- ☐ Provide on-scene incident management.
- ☐ Coordinate ambulance services, as appropriate.
- ☐ Integrate on-scene and EOC PIO activities.
- ☐ Conduct CBRNE detection, monitoring, response, and decontamination operations in collaboration with law enforcement.
- ☐ Size up situations and notify LOCOM as appropriate.
- ☐ Issue and implement evacuation notices, if necessary.
- ☐ Conduct damage assessment.
- ☐ Issue road closure notices, if necessary
- ☐ Conduct cost recovery actions

Police Department

- ☐ Assist in warning the public of evacuations, traffic routing and/or traffic control, and site security, when possible.
- ☐ Assist On-Scene Command.
- ☐ Coordinate warning and evacuation.
- ☐ Provide traffic and crowd control.
- ☐ Issue and/or enforce road closure notices, if necessary
- ☐ Integrate the law enforcement PIO into on-scene PIO activities.
- ☐ Take the lead in terrorism/CBRNE events in detection and crime scene management.
- ☐ Implement enforcement against responsible party.
- ☐ Coordinate radio communications.
- ☐ Fill resource requests, monitor emergency communications, and record incident benchmarks.
- ☐ Conduct notifications as per requests from the field.
- ☐ Track units’ time (dispatch and arrival).

Public Works

- ☐ Provide signs, barriers, equipment, and personnel to assist in traffic and crowd control.
- ☐ Provide heavy equipment as requested.
- ☐ Support water supply.
- ☐ Provide mechanical service of equipment
- ☐ Coordinate fuel, as necessary.

Private Ambulances

- ☐ Conduct EMS.
- ☐ Transport injured persons.
- ☐ Conduct triage tasks.

Non-governmental and Faith-based Organizations

- ☐ Shelter, feed, and clothe evacuated persons.

- ☐ Provide food to fire crews.

Mutual Aid-Partners

- ☐ Respond to calls for support under established agreements, including, but not limited to, fire, rescue/extrication, emergency medical assistance, hazardous material response, and evacuation.
- ☐ Support emergency operations as defined in agency emergency operations procedures or as requested by the EOC, such as damage assessment.

Recovery

Recovery activities take place **after** an emergency occurs and include actions to return to a normal or an even safer situation following an emergency. Recovery roles and responsibilities for ESF 4 include:

All Tasked Agencies

- ☐ Demobilize any communication staging areas, mobile communication centers, and/or other applicable response operations according to established plans, policies, and procedures and return to normal day-to-day activities.
- ☐ Keep detailed records of expenses in case there is potential for federal and State reimbursement assistance.
- ☐ Participate in all after-action activities and take corrective actions as appropriate.

Mitigation

Mitigation activities take place **before and after** an emergency occurs and includes activities that prevent an emergency, reduce the chance of an emergency happening, or reduce the damaging effects of unavoidable emergencies. Mitigation roles and responsibilities for ESF 4 include the following:

All Tasked Agencies

- ☐ Participate in the hazard/vulnerability identification and analysis process.
- ☐ Take steps to correct deficiencies identified during the hazard/vulnerability identification and analysis process as appropriate.

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ESF 5 – Information and Planning

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ESF 5 Tasked Agencies	
Primary City Agency	Police Department (Emergency Manager) City Manager's Office (Citizen Engagement Coordinator)
Supporting City Agency	All remaining departments, divisions, and agencies.
Community Partners	West Linn Tidings, Oregonian, Tualatin Valley Community TV
County Agency	Clackamas County Disaster Management
State Agency	Oregon Office of Emergency Management
Federal Agency	Department of Homeland Security/Federal Emergency Management Agency (FEMA)

1 Introduction

1.1 Purpose

Emergency Support Function (ESF) 5 describes how the City will support incident information and planning needs to develop and maintain a common operating picture to support response and recovery activities.

1.2 Scope

ESF 5 includes the following activities:

- Serve as a hub for the receipt and dissemination of emergency management–related information.
- Collect, process, analyze, and disseminate information to guide response and recovery activities.
- Coordinate with on-scene incident commanders and County, State, regional, and private-sector emergency management organizations (EMOs) to facilitate the flow of situational information.
- Collect and aggregate situational awareness and track local declarations.
- Coordinate incident planning and support in the Emergency Operations Center (EOC), including development of information products for public information, notification, and messaging.

1.3 Policies and Authorities

The following policies and authorities are currently in place:

- Emergency Code Resolution;
- Resolution 2012-15 Adopting an Emergency Operations Plan;
- West Linn Municipal Code 2.700 – 2.750, Emergency Planning; and
- Social Media Policy.

2 Situation and Assumptions

2.1 Situation

The City government, as outlined in Oregon Revised Statutes 401, is responsible for preparing and maintaining an Emergency Operations Plan (EOP) and an emergency operations facility, including trained staff. Using the City's all-hazards risk assessment as a point of reference, the City implements a comprehensive emergency management program that provides both a proactive approach to managing risk and a strategic ability to react when incidents occur.

The City is faced with a number of hazards that may require information and planning support. The following considerations should be taken into account when planning for and implementing ESF 5 activities:

- The administration and logistics for emergency response and recovery operations will be provided by emergency services and support agencies that routinely manage these procedures during non-emergency operations. These agencies will be coordinated using established procedures expedited for administrative assistance and logistics support during emergency operations.
- The information and planning function provides the methodologies and procedures required by field operations and the EOC during a major emergency or disaster.
- During major emergencies or disasters, communication can be hampered due to the loss of telecommunication infrastructure requiring that procedures exist to capture and coordinate information and resources needed to effectively respond.

2.2 Assumptions

ESF 5 is based on the following planning assumptions:

- There will be an immediate and continuing need to collect, process, and disseminate situational information and to identify urgent response requirements before, during, and immediately following a major emergency or disaster in order to plan for continuing response, recovery, and mitigation activities.
- Assessment of damage impacts and EOC operations may be delayed due to minimal staffing.
- During the early stages of an incident, information may be scarce, vague, or incomplete, and the need to verify this information may challenge response support.
- Normal forms of communications may be severely delayed or interrupted during the early phases of an emergency or disaster.
- Transportation to affected areas may be cut off due to weather conditions or damage to roads, bridges, and other transportation means.

3 Roles and Responsibilities of Tasked Agencies

See Appendix B for a checklist of responsibilities for tasked agencies by phase of emergency management.

4 Concept of Operations

4.1 General

The City has established this EOP in accordance with the National Incident Management System and has designated an Emergency Manager. The Emergency Manager is responsible for the development and training of an EMO capable of managing the response and recovery of a major emergency in accordance with the provisions of this plan. The EMO functions as a team. Oregon Revised Statutes 401.305 and 401.335 and the City resolutions affirm the City's responsibility and authority to direct activities which will allow it to mitigate, prepare for, respond to, and recover from emergencies or major disasters. The EOP may be activated at the discretion of the Emergency Manager.

Day-to-day supervision of the EMO is the responsibility of the Emergency Manager. If the EOC is activated, the Emergency Manager or designee has the responsibility for organization, supervision, and operation of the EOC as the EOC Incident Commander.

Some emergencies may require a self-triggered response. In the event of an emergency in which telephone service is interrupted, members of the Operations and General Staff should ensure the safety of their families and then report to the EOC.

The City Manager has the authority to involve any or all City personnel in the response to a disaster or other emergency incident. The declaration of an emergency nullifies leaves and vacations as deemed necessary by the Mayor or City Council.

Emergency contact information for the EMO and EOC staff will be maintained by the City Emergency Manager.

4.2 Developing Incident and Planning Objectives

Objectives are the backbone for conducting all planning, response and recovery activities. The first step in developing good objectives is to understand the priorities:

- Priorities define overarching requirements, i.e., what to accomplish in order of importance.
- Objectives must be based on incident priorities.
- The priorities guide the precedence by which objectives are addressed.
- Initial priorities may be driven in part by the delegation of authority.
- Every plan, incident, response and recovery situation always has its priorities. Priorities should be built based on the whole community's core capabilities.

The next step in developing good objectives consists of the following:

- Frame the problem – what are the essential elements of the issue to be addressed?
- Use the objective to describe what is to be accomplished—*what* and *where*, if possible, but not *how* or *by whom*.
- Provide enough detail to make the objective meaningful.
- Allow the necessary flexibility—ensure that the objective and its results can be used as a metric.

- Ask, “is the objective attainable?” Determine whether the objective can be met with available resources.
- Ask, finally, “what is the objective’s priority when compared to other identified issues?” Order the objectives based on the order of priority or urgency.

Adapted from FEMA’s Incident Action Planning Guide.

4.3 Geographic Information System Mapping and Data Management

Mapping capabilities and equipment may be provided through the City Public Works Department, Geographic Information Systems (GIS) Division and other partners.

4.4 Incident Management Software

The City utilizes WebEOC incident management software to help gather, analyze, and disseminate information in the EOC. Information Technology is responsible for training EOC staff on the use of software, and a User’s Manual is maintained in the City EOC.

4.5 Oregon Fusion Center

If a criminal or terrorist incident is suspected, the Police Department will notify the Oregon Terrorism Information Threat Assessment Network Fusion Center (OTFC). During a terrorist incident, the OTFC will support situational awareness and intelligence gathering functions.

4.6 Disabilities, and Access and Functional Needs

Provision of information and planning–related activities will take into account populations with disabilities, and access and functional needs (DAFN). The needs of the DAFN population shall be identified and planned for as directed by policy makers and according to State and federal regulations and guidance.

4.7 Coordination with Other ESFs

The following ESFs support information and planning–related activities:

- **All ESFs.** All functions will provide situation status updates to ESF 5 to guide incident action planning activities.

5 ESF Annex Development and Maintenance

The Emergency Manager will be responsible for coordinating regular review and maintenance of this annex. Each primary and supporting agency will be responsible for developing plans and procedures that address assigned tasks.

6 Appendices

- Appendix A – ESF 5 Resources
- Appendix B – ESF 5 Responsibilities by Phase of Emergency Management

Appendix A ESF 5 Resources

City

- Local Mutual Aid/Resource Sharing Agreements
- EOC General Actions and Position Specific Checklists

County

- Emergency Operations Plan
  - ESF 5 – Information and Planning
- Local Mutual Aid/ Resource Sharing Agreements
- EOC General Actions and Position Specific Checklists

State

- Emergency Operations Plan
  - ESF 5 – Information and Planning

Federal

- National Response Framework
  - ESF 5 – Information and Planning
- US Department of Homeland Security, FEMA Region X- 2011 Emergency Communications Plan, State of Oregon Annex

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Appendix B ESF 5 Responsibilities by Phase of Emergency Management

The following checklist identifies key roles and responsibilities for ESF 5 – Information and Planning. It is broken out by phase of emergency management to inform tasked agencies of what activities they might be expected to perform before, during, and after an emergency to support the information and planning function. All tasked agencies should maintain agency-specific plans and procedures that allow them to effectively accomplish these tasks.

Preparedness

Preparedness activities take place **before** an emergency and include plans or preparations made to save lives and to help response and recovery operations. Preparedness roles and responsibilities for ESF 5 include the following:

All Tasked Agencies

- ☐ Maintain an inventory of personnel and resources available to support emergency operations.
- ☐ Maintain department-specific data, statistics, and plans that may inform incident planning and damage assessment activities.
- ☐ Develop plans and procedures for ESF 5 activities, as appropriate.
- ☐ Identify deficiencies in emergency plans and execute appropriate corrective action recommendations.
- ☐ Maintain continuity of operations for lines of succession.
- ☐ Participate in ESF 5-related trainings and exercises as appropriate.

Emergency Manager

- ☐ Coordinate regular review and update of the ESF 5 annex with supporting agencies.
- ☐ Facilitate collaborative planning to ensure the City’s capability to support ESF 5 activities.
- ☐ Establish and maintain systems for incident data management and information sharing.
- ☐ Maintain operational capacity of the City EOC to support information and planning activities.
- ☐ Establish standardized reporting processes and prepare standardized reporting formats and forms.
- ☐ Ensure program compliance with local, State, and federal regulations.
- ☐ Facilitate regular review and promulgation of the EOP.
- ☐ Establish and maintain the EOC staffing roster and facilitate training and exercises for EOC staff.
- ☐ Train, advise, and assist the City Manager and City Council in the performance of emergency duties.
- ☐ Train, exercise and coordinate City plans, including continuity of operations.
- ☐ Establish and maintain primary and alternate EOC facility capability.
- ☐ Coordinate emergency management activities on an interagency, interdepartmental, and intergovernmental basis.
- ☐ Coordinate City homeland security and emergency management program grants.

- ☐ Maintain a collaborative emergency management program with cities and special districts.
- ☐ Coordinate public preparedness and outreach efforts.
- ☐ Develop and maintain standard operating procedures and other procedures necessary to support agencies that operate in the EOC.
- ☐ Coordinate the use of GIS capabilities to support emergency management functions.
- ☐ Maintain and update needed computer data programs, including maps, critical facility information, evacuation studies, demographics, and other critical City data.
- ☐ Establish and maintain contact with the chief elected and appointed officials or municipal/town emergency management officials.
- ☐ Develop/maintain memorandums of understanding and mutual aid agreements.
- ☐ Provide outreach and training for mutual aid agreements.
- ☐ Identify deficiencies in plans; identify and execute appropriate corrective action recommendations.

Response

Response activities take place **during** an emergency and include actions taken to save lives and prevent further property damage in an emergency situation. Response roles and responsibilities for ESF 5 include the following:

All Tasked Agencies

- ☐ Assess the status of and impacts to agency-specific systems, infrastructure, customers, etc.
- ☐ Provide situational updates to the City EOC, if activated, as required to maintain situational awareness and establish a common operating picture.
- ☐ Provide a representative to the City EOC, when requested, to support ESF 5 activities.
- ☐ Support emergency response operations.
- ☐ Ensure that agency-specific data are entered into any utilized incident management software.

Emergency Manager

- ☐ Activate the City EOC and establish operational objectives and priorities through the development of EOC Action Plans and short-term recovery priorities.
- ☐ Monitor incident status.
- ☐ Coordinate incident resources.
- ☐ Coordinate public information, alert and warning.
- ☐ Liaise with all partners and stakeholders.

Recovery

Recovery activities take place **after** an emergency occurs and include actions to return to a normal or an even safer situation following an emergency. Recovery roles and responsibilities for ESF 5 include the following:

All Tasked Agencies

- ☐ Continue to provide situation status updates as requested by the Emergency Manager or the City EOC, if activated.
- ☐ Maintain incident documentation to support public and individual assistance processes.
- ☐ Support major emergency or disaster recovery operations.
- ☐ Participate in the damage assessment process and disaster recovery process, as appropriate.
- ☐ Provide technical assistance and resources to support recovery activities upon request.
- ☐ Track disaster-related expenditures.
- ☐ Participate in all after-action activities and take corrective actions as appropriate.

Emergency Manager

- ☐ Facilitate long-term recovery planning, policy discussions, and implementation strategies.
- ☐ Collect and collate information for a Citywide Initial Damage Assessment report.
- ☐ Identify department-specific roles in recovery and coordinate public education and community involvement.
- ☐ Monitor recovery efforts through field personnel and coordinating agencies.
- ☐ Develop short-, intermediate-, and long-term recovery plans and coordinate recovery.
- ☐ Conduct an after-action critique of the overall response and recovery efforts.

Mitigation

Mitigation activities take place **before and after** an emergency occurs and include activities that prevent an emergency, reduce the chance of an emergency happening, or reduce the damaging effects of unavoidable emergencies. Mitigation roles and responsibilities for ESF 5 include the following:

All Tasked Agencies

- ☐ Participate in the hazard mitigation planning process for the City.
- ☐ Provide agency and incident data to inform development of mitigation projects to reduce hazard vulnerability.

Emergency Manager

- ☐ Administer the local natural hazard mitigation program.
- ☐ Implement and administer federal and State disaster mitigation programs.
- ☐ Identify potential mitigation opportunities based on an analysis of damage assessment information, along with City, County, State, and federal mitigation priorities.
- ☐ Coordinate and participate in the City/local hazard mitigation planning team.
- ☐ Through the local hazard mitigation planning team, coordinate the development, implementation, and maintenance of the City Hazard Mitigation Plan.
- ☐ Provide information and limited assistance to incorporated cities in developing and maintaining their mitigation plans.
- ☐ Apply for funding through federal and State pre- and post-disaster mitigation grant programs for prioritized mitigation projects identified in the City Hazard Mitigation Plan.

☐ Upon grant approval, implement and administer federal and State pre- and post-disaster mitigation funds.
☐ Provide education and awareness regarding mitigation to the jurisdictions within the City and the public sector, including businesses, private nonprofit groups, and the general public.
☐ Update the City Hazard Analysis.

ESF 6 – Mass Care

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ESF 6 Tasked Agencies	
Primary City Agency	Police Department
Supporting City Agency	City Manager's Office Finance Department Public Works Department
Community Partners	Tualatin Valley Fire and Rescue American Medical Response West Linn-Wilsonville School District American Red Cross Community and faith-based organizations
County Agency	Department of Health, Housing, and Human Services (H3S)
State Agency	Department of Human Services
Federal Agency	Department of Health and Human Services

1 Introduction

1.1 Purpose

Emergency Support Function (ESF) 6 describes how Clackamas County will support the efforts of the City and nongovernmental organizations to address the mass care, emergency assistance, temporary housing, and human services needs of people impacted by disasters.

1.2 Scope

ESF 6 includes the following a:

- Mass care:
  - Sheltering for the general population and populations with disabilities, and access and functional needs (DAFN)
- Collecting and providing information on those affected by the disaster to family members;
- Family reunification;
- Housing:
  - Providing short-term housing solutions for those affected by the disaster. It may include rental assistance, repairs, loans, manufactured housing, semi-permanent and permanent construction, referrals, identification and provision of accessible housing, and access to other sources of housing assistance.
- Human services:
  - Assist as able in disaster unemployment insurance
  - Disaster legal services
  - Veterans' support
  - Services for DAFN populations
  - Other needs for assistance as they arise

The following are not covered in this ESF:

- Medical sheltering is addressed in ESF 8;
- Animal sheltering is addressed in ESF 17:
  - Feeding operations
  - Emergency first aid
  - Bulk distribution of emergency relief items

1.3 Policies and Authorities

The following policies and authorities are currently in place:

- All appropriate governmental and volunteer agency resources will be used as available.
- All services will be provided without regard to economic status or racial, religious, political, ethnic, or other affiliation.
- Tracking of displaced residents will be accomplished by the American Red Cross Disaster Welfare Inquiry procedures.

2 Situation and Assumptions

2.1 Situation

The City is faced with a variety of hazards that may impact large numbers of persons requiring mass care, personal emergency assistance, short-term housing, and other types of human services as part of response and recovery actions. The following considerations should be taken into account when planning for and implementing ESF 6 activities:

- Hazards may affect widespread areas, and emergency care personnel in unaffected neighboring communities may be overwhelmed with victims from neighboring communities.
- Evacuees may contribute to the scarcity of resources, as an influx of evacuees can increase the population of a receiving community during a significant disaster or emergency event.
- Mass care needs may range from emergency sheltering operations for a limited number of visitors and citizens to more intermediate and long-term housing.
- In accordance with the Red Cross's organizational documents and charter, ratified by the United States Congress on January 5, 1907, as well as the Disaster Relief Act of 1974, the Red Cross (national organization and local chapters) provides an array of mass care services to emergency and disaster victims routinely under its own authority. Furthermore, the Red Cross is tasked as the primary agency responsible for federally supported Mass Care Services per the National Response Framework (ESF 6) despite being a nongovernmental organization.
- Disaster conditions are likely to require evacuation and care of domestic animals and livestock. Animals (with the exception of service animals) are not allowed in public shelters.
- The diverse nature of the City will be reflected by shelter populations and will likely include a significant number of DAFN persons (e.g., elderly, persons with language barriers, physical challenges, or other limiting medical or mental health conditions)

and/or persons who are vulnerable to becoming marginalized or those with specialized needs (e.g., students, inmates, registered sex-offenders, the indigent, persons with chemical dependency concerns, etc.)

2.2 Assumptions

ESF 6 is based on the following planning assumptions:

- Widespread damages may necessitate the relocation of victims and the need for mass care operations.
- Some victims will go to shelters, while others will find shelter with friends and relatives. Some may stay with or near their damaged homes.
- Shelters may have to be opened with little notice. Local government personnel will have to manage and coordinate shelter and mass care activities. They may be supported by Red Cross personnel, if available, and assume responsibility for managing such shelters.
- The demand for shelters may prove to be higher than what is available.
- Volunteer and faith-based organizations may open shelters. Some of these organizations and groups may coordinate their efforts with the City, County, and Red Cross, while others may operate these facilities independently.
- Public and private services will be continued during mass care operations. However, for an incident that requires a large-scale shelter and mass care operation, normal activities at schools, community centers, places of worship, and other facilities used as shelters may have to be curtailed.
- Emergency operations for most human services organizations (mass care, individual assistance, sheltering, special medical needs, and access and functional needs) will be an extension of normal programs and services.

3 Roles and Responsibilities of Tasked Agencies

See Appendix B for a checklist of responsibilities for tasked agencies by phase of emergency management.

4 Concept of Operations

4.1 General

On-Scene Command will request the 9-1-1 Center to notify H3S and the Red Cross whenever it appears that a major emergency or disaster has displaced or will displace a significant number of people.

Command will determine the at-risk area, estimate the number of people involved, and identify any critical needs. The H3S and Red Cross, if involved, will use this information to coordinate shelter activation with potential providers. The Oregon Trail Chapter of the American Red Cross may assign a Liaison to the City or County Emergency Operations Center (EOC) to coordinate reception, shelter, and mass care activities.

If the Red Cross takes on the sheltering responsibility, EOC staff will help coordinate shelter support throughout the City, including logistics, security, communications, transportation, public health, behavioral health, and social services.

On-Scene Command will determine whether evacuees have been exposed to chemical, biological, radiological, nuclear, or explosive agents or other hazardous materials and will manage decontamination operations prior to victims leaving the incident scene if exposure has occurred, or provide transport to a healthcare facility where the evacuee may be decontaminated.

The City will seek the assistance of or provide support to the Red Cross and other similar agencies in implementing this section of the EOP. A liaison from the Red Cross will be requested in the City EOC to help coordinate the emergency housing, sheltering and feeding activities; however, depending on the size and scope of the disaster, this coordination may occur at the County EOC through the City EOC liaison at that location.

It is not the intent of the City to supplant the Red Cross as the primary provider and coordinator of emergency housing, sheltering, and feeding services; however, the City is not relieved of its obligation for the welfare of its residents in times of emergency, as outlined in Chapter 401 of the Oregon Revised Statutes.

Shelter/lodging facility managers will be responsible for the operation of their individual facilities. The primary communications link between shelter facilities and the EOC will be telephone. If telephones cannot be used or are overloaded, law enforcement personnel will provide radio assistance. Shelter facility managers should arrange for persons in their facility to monitor prescribed communication sources for guidance and announcements.

4.2 Shelters and Mass Care Facilities

The Red Cross may have agreements in place for use of specific shelters that can be activated by alerting the local chapter. This information will be available to the City EOC during a major emergency or disaster. The Red Cross may assist in the registration of evacuees and, as applicable, will coordinate information with appropriate government agencies of evacuees who are housed in Red Cross-supported shelters.

The following options for temporary shelter during an incident are available to the City:

- Pre-determined sheltering sites and supplies available through the Red Cross;
- General purpose tents available through the Oregon National Guard and requested by the City from Clackamas County Disaster Management (CCDM) to the Oregon Office of Emergency Management.
- Tents and other resources available via the fire cache located at the Redmond Air Center, requested by the City from CCDM.
- If a Presidential declaration has been made, temporary buildings or offices requested through the Federal Coordinating Officer.

Services will be provided through the coordinated efforts of City staff, CCDM, the Red Cross, Salvation Army, other state-supported agencies, volunteer agencies, and mutual-aid agreements with various support groups. Law enforcement agencies will provide security at shelter facilities where possible and also support back-up communications if needed.

4.3 Feeding

Food is provided to victims through a combination of fixed sites, mobile feeding units, and bulk distribution. Feeding operations are based on nutritional standards and should include meeting requirements of victims with special dietary needs, if possible. The Red Cross will coordinate all mass feeding and other services needed at open Red Cross shelters.

4.4 Bulk Distribution

Emergency relief items to meet urgent needs are distributed via established sites within the affected area. Distribution of food, water, and ice requirements through federal, State, local, and non-governmental organizations is coordinated at these sites. The following agencies and organizations are involved in supporting and managing bulk distribution:

- City Emergency Manager;
- City Police Department;
- City Public Works Department;
- Red Cross;
- Salvation Army;
- Private-sector partners;
- Faith-based organizations; and
- Disaster assistance personnel, paid, and volunteer staff

See ESF 11 – Food and Water for additional details.

4.5 Housing

All housing needs identified during and following emergency incidents or disasters impacting the City will be coordinated through the Police Department, in cooperation with the County, via the City and County EOCs. Liaisons will be assigned to the command staff in order to manage and coordinate resources and activities with regional, State, federal, and private-sector entities. In some disaster situations, the federal government may be requested to provide emergency housing. Disaster victims will be encouraged to obtain housing with family or friends or in commercial facilities.

4.6 Crisis Counseling and Mental Health

The following agencies and organizations are involved with providing crisis counseling and mental health support to victims and families, the first responder community, and special needs populations:

- County H3S;
- Area hospitals;
- Northwest Human Services;
- County and regional volunteer organizations; and
- Local nursing homes and care facilities.

H3S will coordinate mental health services to the general public. Specific concerns within the first responder community can also be addressed through the Police Chaplaincy and the Oregon Office of the State Fire Marshal, which coordinate mental health and crisis counseling services for first responders.

See ESF 8 – Health and Medical for additional details.

4.7 Disabilities, and Access and Functional Needs

Provision of mass care–related activities will take into account DAFN populations. The needs of the DAFN population shall be identified and planned for as directed by policy makers and according to State and federal regulations and guidance.

A formal registry for DAFN populations has not been developed to date. Community emergency response and recovery planning to provide special needs services to residents of the City have not been formalized or finalized among the various first responder agencies and volunteer organizations supporting this jurisdiction.

Agencies and organizations involved in managing, transporting, and communicating with DAFN populations during an emergency and pertaining to mass care include the following:

- City Emergency Manager;
- Area hospitals;
- Private clinics and care facilities;
- Red Cross and other volunteer agencies;
- School district; and
- Local radio stations serving the City and surrounding areas.

4.7.1 Sheltering Service and Companion Animals

The City, the Red Cross, and other organizations or groups providing Sheltering and Mass Care will comply with the Americans with Disability Act requirements for Service Animals, with the facility owners' limitations, and with County and State of Oregon Health Code requirements.

The County Animal Rescue Emergency Shelter, will, when called upon, establish a companion pet shelter and will attempt to coordinate site selection with the Red Cross; however, some agreements already in place may have the companion pet shelter at a location away from the Red Cross shelter(s).

4.7.2 Nursing Homes and Residential Care Facilities

Nursing homes and residential care facilities are required to have disaster and emergency plans in place to ensure the transfer of clients to appropriate facilities.

4.7.3 Shelter Categories

- **Category 1: Hospitalization –** Category 1 comprises persons who require recurring professional medical care, special medical equipment, and/or continual medical surveillance. Examples include persons who are dependent on ventilators, IVs, or oxygen supplementation; those with chest pain or shortness of breath; and others requiring the intensity of services provided at a hospital or skilled nursing facility.
- **Category 2: Special Needs Shelter –** Category 2 includes persons who require some medical surveillance and/or special assistance. These are individuals whose age, frailty, mobility, or functional or medical disabilities make them particularly vulnerable in disaster situations. They may have medical impairments but have been able to maintain some independence prior to the disaster or emergency situation. Examples are those with mental illness, severely reduced mobility, or medical impairment that does not preclude activities with some assistance.

- **Category 3: General Shelter –** Category 3 includes persons who are independent prior to the disaster or special emergency or who may have pre-existing health problems that do not impede activities of daily living. Examples are persons with prostheses or hearing or speech impediments, wheelchair users with no medical needs, or those with controlled diseases such as diabetes, muscular dystrophy, or epilepsy.

4.8 Care of Response Personnel and EOC Staff

Arrangements for the feeding and sheltering of EOC staff are the responsibility of the Logistics Section. As space allows, EOC staff will sleep and eat near the EOC. Sleeping areas may also be set up in other facilities.

Response personnel will be released to their homes or stations to sleep. If necessary, space may be arranged in a shelter. This shelter should be different than the one used for disaster victims or evacuees.

Families of response personnel may be sheltered together in the event of an extended incident involving a major shelter operation. This will facilitate keeping families informed and improve the morale of response personnel.

4.9 Coordination with Other ESFs

The following ESFs support mass care–related activities:

- **ESF 8 – Health and Medical.** Coordinate health inspections of mass care facilities; coordinate sheltering of populations with medical needs.
- **ESF 11 – Food and Water.** Coordinate food and water to support mass care operations.
- **ESF 14 – Public Information.** Inform the public about mass care operations.
- **ESF 15 – Volunteers and Donations Management.** Coordinate volunteers and donated goods to support mass care operations.
- **ESF 16 – Law Enforcement.** Provide security for mass care facilities.
- **ESF 17 – Agriculture and Animal Protection.** Provide care and shelter for animals, including service animals, pets, and livestock.

5 ESF Annex Development and Maintenance

The Police Department will be responsible for coordinating regular review and maintenance of this annex. Each primary and supporting agency will be responsible for developing plans and procedures that address assigned tasks.

6 Appendices

- Appendix A – ESF 6 Resources
- Appendix B – ESF 6 Responsibilities by Phase of Emergency Management

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Appendix A ESF 6 Resources

The following resources provide additional information regarding ESF 6 and mass care-related issues at the local, state, and federal level:

City

- None at this time.

County

- Emergency Shelter Listing (For Official Use Only)
- Clackamas County Emergency Plan for People with Access and Functional Needs
- Urban Area Security Initiative Region Pets Sheltering Plan

State

- Emergency Operations Plan
    - ESF 6 – Mass Care

Federal

- National Response Framework
    - ESF 6 – Mass Care, Emergency Assistance, Temporary Housing, and Human Services

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Appendix B ESF 6 Responsibilities by Phase of Emergency Management

The following checklist identifies key roles and responsibilities for ESF 6 – Mass Care. It is broken out by phase of emergency management to inform tasked agencies of what activities they might be expected to perform before, during, and after an emergency to support Mass Care function. All tasked agencies should maintain agency-specific plans and procedures that allow them to effectively accomplish these tasks.

Preparedness

Preparedness activities take place **before** an emergency occurs and include plans or preparations to save lives and help response and recovery operations. Preparedness roles and responsibilities for ESF 6 include the following:

All Tasked Agencies

- ☐ Develop plans and procedures for ESF 6 activities, as appropriate.
- ☐ Participate in ESF 6-related trainings and exercises as appropriate.

Police Department

- ☐ Coordinate regular review and update of the ESF 6 annex with supporting agencies.
- ☐ Facilitate collaborative planning to ensure the City's capability to support ESF 6 activities.
- ☐ Liaise with the County to ensure that a Mass Care Plan is developed and maintained.
- ☐ Coordinate pre-incident public health inspections of shelters and verify sanitary conditions as required.
- ☐ Identify local government's authority, responsibility, and role in providing long-term or temporary emergency housing for disaster victims.
- ☐ Coordinate emergency preparedness planning and exercise activities with the Red Cross.

Red Cross

- ☐ Develop and maintain plans, procedures, and policies for establishing, managing, and operating a feeding and sheltering system to meet the needs created by a major disaster.
- ☐ Develop and maintain memorandums of understanding (MOUs) with local governments to define and clarify roles and responsibilities in preparing for and responding to disasters.
- ☐ Participate in the annual training exercises conducted by Emergency Management to test the Emergency Operations Plan.

Response

Response activities take place **during** an emergency and include actions taken to save lives and prevent further property damage in an emergency situation. Response roles and responsibilities for ESF 6 include the following:

All Tasked Agencies

☐ Provide situational updates to the City EOC as required to maintain situational awareness and establish a common operating picture.
☐ Provide a representative to the City EOC, when requested, to support ESF 6 activities.

Police Department

☐ Assess the situation and make appropriate notifications to activate and staff the EOC, including notification of the Red Cross, if it is determined that a representative is needed to coordinate emergency food and shelter.
☐ Establish a communications link with affected jurisdictions, volunteer agencies, and the public and ensure that they are kept informed of available shelters.
☐ Assist in the coordination of logistics to support operations and ensure that the provisions of MOUs are implemented, as necessary.
☐ Activate the EOC.
☐ Coordinate with the EOC Planning Section to identify unmet needs.
☐ Establish a Mass Care Branch in the City EOC if needed.
☐ Facilitate the emergency declaration process.
☐ Assist in multi-agency/jurisdictional and resource coordination.
☐ Track the use of Mass Care resources through the EOC Finance Section.
☐ Coordinate security at shelters, reception centers, and food/water distribution centers.
☐ Provide traffic and crowd control.

Red Cross

☐ Implement the response actions outlined in MOUs with the City, as necessary.
☐ Evaluate the direct or indirect effects of the hazard on available shelter resources.
☐ Provide specific resource requirements, including feeding support, clothing and bedding supplies, emergency registration of people, and trained shelter management volunteers.
☐ Coordinate activities with voluntary organizations active in disaster, the faith-based organizations, other social service agencies, local, State, and federal government in the provision of emergency food and shelter.

City Manager’s Office (Citizen Engagement Coordinator)

☐ Provide staff for the Public Information Officer and Joint Information Centers.
☐ Develop and coordinate a Joint Information System.
☐ Collaborate with the Red Cross and H3S to produce timely, clear, and concise messages on shelter and mass care operations and food/water options.
☐ Provide access information on health, social, and medical services.
☐ Provide the public with updated information on shelter locations and systems for locating family, friends and pets.

Public Works

☐ Coordinate garbage and recycling services for shelters and food/water distribution centers.
☐ Assist with transportation options and resources.
☐ Provide building inspection for structural safety and sheltering sites.
☐ Provide updated mapping to assist in directing people to shelters safely.

Recovery

Recovery activities take place **after** an emergency occurs and include actions to return to a normal or an even safer situation following an emergency. Recovery roles and responsibilities for ESF 6 include the following:

All Tasked Agencies

☐ Demobilize response activities.
☐ Maintain incident documentation to support public and individual assistance processes.

Police Department

☐ Coordinate with local, State, and federal agencies in damage assessment and cost recovery activities as well as identifying long-term temporary emergency housing options.
☐ Ensure that necessary communication activities are accomplished in informing the public of disaster recovery activities, including information on long-term temporary emergency housing assistance.
☐ Continue to assist in restoration of normal services and operations, as appropriate.
☐ Conduct an after action debriefing/evaluation on the overall effectiveness of the City’s efforts in providing emergency food and shelter.

Red Cross

☐ Assist the City in determining post-emergency needs for long-term emergency temporary housing, as requested.
☐ Prepare a report on the condition of shelter facilities and make arrangements for returning them to normal use.
☐ Compile a record of emergency expenditures.
☐ Critique the provision of shelters for people displaced from their place of residence and institute reforms as required.

Mitigation

Mitigation activities take place **before and after** an emergency occurs and includes activities that prevent an emergency, reduce the chance of an emergency happening, or reduce the damaging effects of unavoidable emergencies. Mitigation roles and responsibilities for ESF 6 include the following:

All Tasked Agencies

- ☐ Participate in the hazard/vulnerability identification and analysis process.
- ☐ Take steps towards correcting deficiencies identified during the hazard/vulnerability identification and analysis process as appropriate.

ESF 7 – Resource Support

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ESF 7 Tasked Agencies	
Primary City Agency	Finance Department
Supporting City Agency	City Manager's Office
Community Partners	Tualatin Valley Fire and Rescue Local faith-based organizations Volunteer organizations
County Agency	Finance Department
State Agency	Department of Administrative Services
Federal Agency	Department of Homeland Security/Federal Emergency Management Agency

1 Introduction

1.1 Purpose

Emergency Support Function (ESF) 7 describes how the City will provide logistical and resource support during emergencies, as well as provide financial tracking and records management of overall costs of the City's response.

1.2 Scope

Activities encompassed within the scope of ESF 7 include:

- Coordinate the procurement and provision of City and private-sector resources during a disaster.
- Receive and coordinate response to resource requests from City departments and local response partners.
- Provide logistical and resource support for needs not specifically addressed in other ESFs.
- Monitor and track available and committed resources involved in the incident.
- Monitor and document mutual aid and the financial costs of providing resources, including costs of using City resources, purchasing or contracting goods and services, transportation, and above normal staffing.

1.3 Policies and Authorities

The following policies and agreements are currently in place:

- None at this time.

2 Situation and Assumptions

2.1 Situation

The City is faced with a number of hazards that may require resource support. The following considerations should be taken into account when planning for and implementing ESF 7 activities:

- Upon request, ESF 7 provides the resource support needed to maintain the response capacity of the City and local response partners.
- Equipment and supplies are provided from current stocks or, if necessary, from commercial sources, using locally available sources when possible. ESF 7 does not stockpile supplies.
- During response operations, acquisition of these resources may be supported by preexisting memorandums of understanding, memorandums of agreement, and interagency agreements and contracts.

2.2 Assumptions

ESF 7 is based on the following planning assumptions:

- Local and tribal partners will exhaust local and mutual aid resource support mechanisms prior to requesting support from the City. A request may be made to the City if exhaustion of local resources is imminent.
- Normal forms of communications may be severely interrupted during the early phases of an emergency or disaster.
- Transportation to affected areas may be cut off due to weather conditions or damage to roads, bridges, airports, and other transportation means.
- Donated goods and supplies will be managed and utilized as necessary.
- The management and logistics of resource support is highly situational and requires flexibility and adaptability.
- Local governments will expend resources and implement mutual aid agreements under their own authority.

3 Roles and Responsibilities of Tasked Agencies

See Appendix B for a checklist of responsibilities for tasked agencies by phase of emergency management.

4 Concept of Operations

4.1 General

Efficient resource management is one of the pre-requisites for effective incident management. This includes knowing: 1) what resources are available and their capabilities and/or inventory; 2) how to access those resources; 3) how to allocate resources to satisfy incident priorities; and 4) anticipating what resources are or may become critical during an incident.

The City will meet initial resource requirements using locally owned, contracted and mutual aid resources. If additional resources are required, the City will request County assistance, normally through an Emergency Declaration.

4.2 Resource Allocation Priorities

The resource prioritization concept is to “do the most good for the most people” in order to alleviate disaster impacts on residents and public entities.

During emergencies, resources are allocated according to the following priorities:

1. Preserving life.
2. Stabilizing the incident/containing the hazard.
3. Protecting critical infrastructure, property, and the environment.

4.3 Sourcing Resources

Resources are normally obtained and used in the following sequence:

1. Resources owned or employed by the City.
2. Mutual aid agreements.
3. Contractors, commercial sources, and private industry.
4. Volunteer groups or agencies.
5. State resources.
6. Federal resources.

4.4 Mutual Aid

Mutual aid is an important component of incident resource management and can take several forms, outlined in the following sections.

4.4.1 Automatic Mutual Aid

Day-to-day incident response agencies (fire, law enforcement, emergency medical services) have pre-coordinated mutual aid arrangements embodied in Lake Oswego Communications Dispatch Protocols. When an on-scene response agency needs additional resources, they simply request them through dispatch and assume automatic approval to the extent that the protocols allow. Automatic mutual aid is normally discipline-specific and has no provision for reimbursement of lender expenses.

Fire agencies have several discipline-specific mutual aid processes in place beyond automatic mutual aid, including district-to-district, fire defense board to fire defense board, and state-level conflagration and mobilization agreements. Conflagration mutual aid is closely managed by the Fire Marshal, and participant costs are reimbursed by the State. Fire mobilization plan participation is more loosely managed, is voluntary, and costs are not reimbursed by the State.

Law enforcement automatic mutual aid is less formally structured and does not normally include reimbursement.

4.5 Emergency Operations Center Resource Management

All four EOC sections (Operations, Planning, Logistics, and Finance) collaborate on managing incident resources.

- The Operations Section identifies resource needs and directs staging and deployment of assigned resources.
- The Planning Section helps Operations anticipate resource needs and tracks available resource status and capabilities.
- The Logistics Section, in collaboration with Operations, confirms resource needs and coordinates acquisition, reception, and allocation. Logistics also manages volunteer resources and is the point of contact for donations management.

- The Finance Section coordinates funding sources and tracks costs; negotiates emergency contracts/agreements using emergency procurement procedures; and advises EOC Command, the City Manager, and the City Council regarding the ongoing financial impact of the emergency.

4.6 Disabilities, and Access and Functional Needs

Provision of resource support–related activities will take into account populations with disabilities, and access and functional needs (DAFN). The needs of the DAFN population shall be identified and planned for as directed by policy makers and according to State and federal regulations and guidance.

4.7 Coordination with Other ESFs

The following ESFs support resource support–related activities:

- **ESF 11 – Food and Water.** Identify and procure food and water resources to support identified needs.
- **ESF 15 – Volunteers and Donations Management.** Coordinate provision of donated goods and services.

5 ESF Annex Development and Maintenance

The Finance Department will be responsible for coordinating regular review and maintenance of this annex. Each primary and supporting agency will be responsible for developing plans and procedures that address assigned tasks.

6 Appendices

- Appendix A – ESF 7 Resources
- Appendix B – ESF 7 Responsibilities by Phase of Emergency Management

Appendix A ESF 7 Resources

The following resources provide additional information regarding ESF 7-related issues at the local, state, and federal level:

City

- Intra-County Omnibus Mutual Aid Agreement

County

- Intra-County Omnibus Mutual Aid Agreement
- Inter-County Omnibus Mutual Aid Agreement
- Intra-State Mutual Assistance Compact Statute
- Volunteer Reception Center Plan
- Information and Referral Directory

State

- Emergency Operations Plan
    - ESF 7 – Resource Support

Federal

- National Response Framework
    - ESF 7 – Resource Support
- NIMS Resource Typing Guides

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Appendix B ESF 7 Responsibilities by Phase of Emergency Management

The following checklist identifies key roles and responsibilities for ESF 7 – Resource Support. It is broken out by phase of emergency management to inform tasked agencies of what activities they might be expected to perform before, during, and after an emergency to support the Resource Support function. All tasked agencies should maintain agency-specific plans and procedures that allow them to effectively accomplish these tasks.

Preparedness

Preparedness activities take place **before** an emergency occurs and include plans or preparations to save lives and to help response and recovery operations. Preparedness roles and responsibilities for ESF 7 include the following:

All Tasked Agencies

- ☐ Develop operational plans for ESF 7 activities.
- ☐ Participate in ESF 7-related trainings and exercises as appropriate.

Finance Department

- ☐ Coordinate regular review and update of the ESF 7 annex with supporting agencies.
- ☐ Facilitate collaborative planning to ensure the City’s capability to support ESF 7 activities.
- ☐ Develop and maintain a Resource Support Plan for the City that includes procedures for addressing:
    - o Resource requesting
    - o Resource staging
    - o Resource tracking
    - o Resource demobilization
- ☐ Develop plans for the establishment of logistic staging areas for internal and external response personnel, equipment, and supplies.
- ☐ Estimate logistical requirements (e.g., personnel, supplies and equipment, facilities, and communications) during the planning process and through exercise.

Response

Response activities take place **during** an emergency and include actions taken to save lives and prevent further property damage in an emergency situation. Response roles and responsibilities for ESF 7 include the following:

All Tasked Agencies

- ☐ Provide situational updates to the City EOC as required to maintain situational awareness and establish a common operating picture.
- ☐ Provide a representative to the City EOC, when requested, to support ESF 7 activities.

Finance Department

- ☐ Establish an incident cost code to capture all incident-related costs.
- ☐ Provide staff for EOC Finance and Logistics Sections.
- ☐ Implement emergency procurement procedures.
- ☐ Assist in identifying and acquiring resources to meet emergency needs.
- ☐ Coordinate purchasing/acquisition with requesting departments or agencies.
- ☐ Train departments in expenditure tracking and record-keeping procedures.
- ☐ Locate and coordinate use of available space for disaster management and emergency response activities.
- ☐ Provide cost and budget information to Section Chiefs, Command, and City Manager.
- ☐ Collect and collate initial damage reports and create an Initial Damage Report for the State.
- ☐ Coordinate City information for the public assistance process.

Recovery

Recovery activities take place **after** an emergency occurs and includes actions to return to a normal or even safer situation following an emergency. Recovery roles and responsibilities for ESF 7 include the following:

All Tasked Agencies

- ☐ Demobilize response activities.
- ☐ Maintain incident documentation to support public and individual assistance processes.

Finance Department

- ☐ Compile and keep all documentation collected relating to the management of resources requested and/or utilized as part of response operations.
- ☐ Coordinate all after-action activities and take corrective actions as appropriate.

Mitigation

Mitigation activities take place **before and after** an emergency occurs and include activities that prevent an emergency, reduce the chance of an emergency happening, or reduce the damaging effects of unavoidable emergencies. Mitigation roles and responsibilities for ESF 7 include the following:

All Tasked Agencies

- ☐ Participate in the hazard/vulnerability identification and analysis process.
- ☐ Take steps to correct deficiencies identified during the hazard/vulnerability identification and analysis process as appropriate.

ESF 8 – Health and Medical

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ESF 8 Tasked Agencies	
Primary City Agency	Police Department
Supporting City Agency	None at this time.
Community Partners	Tualatin Valley Fire and Rescue Area Hospitals and Clinics American Medical Response/Emergency Medical Services (EMS) Agencies American Red Cross Mutual aid partners
County Agency	Department of Health, Housing, and Human Services (H3S) (Public Health Division) Clackamas County Disaster Management (CCDM) (Medical Examiner)
State Agency	Oregon Health Authority
Federal Agency	Health and Human Services

1 Introduction

Emergency Support Function (ESF) 8 informs the City of how the County will work to protect and promote the health of its residents during a time of emergency.

1.1 Purpose

ESF 8 provides awareness level information to the City by describing how the County will coordinate plans, procedures, and resources to support health and medical care during a time of emergency and/or a developing potential health and medical situation.

1.2 Scope

ESF 8 includes the following activities:

- Support local assessment and identification of public health and medical needs in the City and implement plans to address those needs.
- Coordinate and support stabilization of the public health and medical system in the City.
- Support sheltering of persons with medical needs.
- Monitor and coordinate resources to support care and movement of persons with medical needs in impacted areas.
- Support monitoring, investigating, and controlling potential or known threats and impacts to human health through surveillance, delivery of medical countermeasures, and non-medical interventions.
- Support monitoring, investigating, and controlling potential or known threats to human health of environmental origin.
- Develop, disseminate, and coordinate accurate and timely public health and medical information.
- Monitor the need for and coordinate resources to support fatality management services.
- Monitor the need for and coordinate resources to support disaster behavioral health services.
- Support responder safety and health needs.

- Provide public health and medical technical assistance and support.

1.3 Policies and Authorities

The following policies and agreements are currently in place for the County:

- Clackamas County, the Local Public Health Authority, operates under Oregon Revised Statutes (ORS) Chapter 624. The Clackamas Board of County Commissioners serves as the Board of Health and will be notified and convened during a public health emergency. Many of the duties under ORS Chapter 624 are delegated to the Public Health Director within the Department of Health, H3S/Public Health Division.

2 Situation and Assumptions

2.1 Situation

The City is faced with a number of hazards that may require health and medical support. The County will take these considerations into account when implementing ESF 8:

- Hazards may result in mass casualties or fatalities; disruption of food and/or water distribution and utility services; loss of water supply, wastewater, and solid waste disposal services; and other situations that could create potential health hazards or serious health risks.
- One of the primary concerns of public health officials is disease control. This involves the prevention, detection, and control of disease-causing agents; maintaining safe water and food sources; and continuation of wastewater disposal under disaster conditions.
- Disaster and mass-casualty incidents take many forms. Proper emergency medical response must be structured to provide optimum resource application without total abandonment of day-to-day responsibilities.
- Large-scale morgue and remains disposal is a significant issue for communities of any size.
- Traditional public health measures will likely to be taken in these instances. These measures include epidemiological investigations to determine the source and nature of the disease or agent

2.2 Assumptions

ESF 8 is based on the following assumptions:

- H3S will perform the functions in support of health and medical services during a major emergency or disaster.
- Emergencies and disasters may occur without warning at any time of day or night and may cause mass casualties.
- Emergency health and medical services should be an extension of normal duties. Health/ medical care will be adjusted to the size and type of disaster.
- A large-scale emergency is likely to overwhelm the local health system and severely impact the availability of staff, bed capacity, medical supplies, and equipment. Some emergencies may require hospitals to set up alternate care sites or mobile hospitals.

- Use of nuclear, chemical, or biological weapons of mass destruction could produce a large number of injuries requiring specialized treatment that could overwhelm the local and State health and medical system.
- Public and private medical, health, and mortuary services resources will be available for use during emergency situations; however, local resources may be adversely impacted by the emergency.
- Hospitals, nursing homes, ambulatory care centers, pharmacies, and other facilities for medical/health care and those with disabilities, and access and functional needs (DAFN) may be damaged or destroyed in major emergency situations.
- If hospitals and nursing homes are damaged, it may be necessary to relocate significant numbers of patients to other comparable facilities elsewhere.
- Health and medical facilities that survive emergency situations with little or no damage may be unable to operate normally because of a lack of utilities or because staff are unable to report for duty as a result of personal injuries or damage to communications and transportation systems.
- Medical and health care facilities that remain in operation and have the necessary utilities and staff could be overwhelmed by the “walking wounded” and seriously injured victims transported to facilities in the aftermath of a disaster.
- Uninjured persons who require frequent medications such as insulin and anti-hypertensive drugs, or regular medical treatment such as dialysis, may have difficulty obtaining these medications and treatments in the aftermath of an emergency situation due to damage to pharmacies and treatment facilities and disruptions caused by loss of utilities and damage to transportation systems.
- The Federal Strategic National Stockpile (SNS) can supply pharmaceuticals, medical supplies and equipment during emergencies through its 12-hour Push Packs, vendor-managed inventory, or buying power. The Governor, or Oregon Public Health Division administrator, requests assets from the Centers for Disease Control and Prevention (CDC)
- In a major catastrophic event (including, but not limited to, epidemics, pandemics, and bioterrorism attacks), medical resources may be insufficient to meet demand, specialized equipment and/or treatment materials may be unavailable, and transportation assets may also be restricted due to contamination. No emergency plan can ensure the provision of adequate resources in such circumstances.
- Disruption of sanitation services and facilities, loss of power, and the concentration of people in shelters may increase the potential for disease and injury.
- Damage to chemical plants, sewer lines and water distribution systems, and secondary hazards such as fires could result in toxic environmental and public health hazards that pose a threat to response personnel and the general public. This includes exposure to hazardous chemicals, biological and/or radiological substances, contaminated water supplies, crops, livestock, and food products.
- The public may require guidance on how to avoid health hazards caused by the disaster or arising from its effects.
- The damage and destruction caused by a natural or technological event may produce urgent needs for mental health crisis counseling for victims and emergency responders.
- Emergency responders, victims, and others affected by emergency situations may experience stress, anxiety, and other physical and psychological symptoms that may

adversely affect their daily lives. In some cases, disaster mental health services may be needed during response operations.

3 Roles and Responsibilities of Tasked Agencies

See Appendix B for a checklist of responsibilities for tasked agencies by phase of emergency management.

4 Concept of Operations

4.1 General

The City does not have the capabilities or resources to support public health or medical emergencies. It therefore looks to the County for support and direction. However, the City should maintain situational awareness and communication with the County.

H3S/Public Health Division maintains 24-hour coverage in support of potential public health or medical emergencies and works in coordination with CCDM. In the event of an incident, the level of ESF 8 activation will depend on the magnitude of the emergency or disaster. H3S will coordinate the initial response to most public health and medical emergencies affecting the City and County as a whole.

Public health and medical operations will be executed as outlined in the Clackamas County Emergency Operations Plan (EOP), ESF 8 – Public Health and Medical Services.

4.2 Disabilities, Access and Functional Needs

Provision of public health and medical related activities will take into account DAFN populations. The needs of DAFN populations shall be identified and planned for as directed by policy makers and according to State and federal regulations and guidance.

4.3 Coordination with the County

To minimize duplication of specialized duties, the City acknowledges that the Public Health Officer of H3S is responsible for ensuring the provision of public health/mental health services required to cope with disasters in any urban or rural area, and coordinating other medical services as required. During an emergency, the H3S Director will be incorporated into the City's Emergency Management Organization and will coordinate the provision of public health and medical services for the City. The Emergency Manager will liaise with H3S to provide local agency support of public health and medical service support functions. Procedures as outlined in ESF 8 – Public Health and Medical Services of the County EOP are incorporated into the City EOP.

4.4 Coordination with Other ESFs

The following ESFs support health and medical–related activities:

- **ESF 1 – Transportation.** Support transportation of medical resources to impacted areas.
- **ESF 6 – Mass Care.** Coordinate with ESF 8 for health and medical support to shelter operations.

- **ESF 9 – Search and Rescue.** Coordinate medical care for disaster victims.
- **ESF 10 – Hazardous Materials.** Provide for decontamination and medical care for disaster victims contaminated by hazardous materials.
- **ESF 11 – Food and Water.** Provide for the safety of the food and water supply.

5 ESF Annex Development and Maintenance

The Police Department is responsible for ensuring regular review and revision of this annex.

6 Appendices

- Appendix A – ESF 8 Resources
- Appendix B – ESF 8 Responsibilities by Phase of Emergency Management

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Appendix A ESF 8 Resources

The following resources provide additional information regarding ESF 8–related issues at the local, state, and federal level:

City

- None at this time.

County

- Ambulance Services Contingency Plan
- EMS Mass Casualty Incident Protocol
- Mass Fatality Plan
- Medical Countermeasures Plan
- Medical Reserve Corps Volunteer Handbook
- Pandemic Influenza Plan

State

- Emergency Operations Plan
  - ESF 8 – Health and Medical
- Oregon SNS Plan

Federal

- National Response Framework
  - ESF 8 – Public Health and Medical Services
- NIMS Implementation Objectives for Healthcare Facilities
- Hospital Incident Command System
- Homeland Security Presidential Policy Directive No. 21
- The National Health Security Strategy
- Centers for Disease Control
  - CDC Public Health Capabilities
  - CDC Healthcare Capabilities
- Health and Human Services Assistant Secretary for Preparedness and Response Hospital Preparedness Program
  - Tier 2 Healthcare Coalition Guide
- National Response Team Biological and Chemical Quick Reference Guides
- National SNS Plan

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Appendix B ESF 8 Responsibilities by Phase of Emergency Management

This appendix describes general roles and responsibilities in support of ESF 8. Specific activities will vary depending on the type of event, length of the warning period, resources available, and duration of the incident.

Preparedness

Preparedness activities take place **before** an emergency occurs and include plans or preparations to save lives and to help response and recovery operations. Preparedness roles and responsibilities for ESF 8 include:

All Tasked Agencies

- ☐ Develop plans and procedures for ESF 8 activities, as appropriate.
- ☐ Participate in ESF 8–related trainings and exercises as appropriate.
- ☐ Work with local, regional, and State agencies to align planning efforts (e.g., identifying duplicate vendor agreements, mutual aid agreements, common point of dispensation planning, etc.).

Police Department

- ☐ Coordinate regular review and update of the ESF 8 annex with supporting agencies.
- ☐ Build awareness related to the County’s emergency public health plans and other tools.

Emergency Medical Services

- ☐ Develop and maintain emergency plans and other tools that includes procedures for addressing pre-hospital emergency medical services activities, including:
  - Mass casualty incident response
  - Patient decontamination

Medical Examiner

- ☐ Develop and maintain emergency plans and other tools that include procedures for mass fatality incident response.

Area Hospitals and Clinics

- ☐ Develop and maintain emergency plans and other tools that include procedures for addressing:
  - Facility bed tracking
  - Healthcare system surge capacity
  - Healthcare facility evacuation
  - Alternate care facilities
  - Crisis standards of care
  - Medical special needs sheltering

Response

Response activities take place **during** an emergency and include actions taken to save lives and prevent further property damage in an emergency situation. Response roles and responsibilities for ESF 8 include the following:

All Tasked Agencies

☐ Provide situational updates to the City Emergency Operations Center (EOC) as required to maintain situational awareness and establish a common operating picture.
☐ Provide a representative to the City EOC, when requested, to support ESF 8 activities.

Police Department

☐ Coordinate with local, regional, State and federal public health agencies.
☐ Coordinate with the CCDM/Medical Examiner and funeral directors in determining proper disposition of deceased persons.
☐ Manage on-scene operations, activate the Mass Casualty Incident Protocol, as needed, and notify CCDM/Medical Examiner when fatalities are involved.
☐ Work with the Sheriff’s Office to coordinate investigations of potentially deliberate health impacts, enforce mandatory health actions, and conduct on-scene operations in cooperation with health and fire agencies, including crime investigations; security, traffic, and crowd control; and assistance with death determinations.

Emergency Medical Services

☐ Provide EMS first response, extrication, triage, treatment, and transport of patients.

Hospitals

☐ Respond to a major health emergency by activating their EOCs and operating under their hospital emergency Incident Command System (ICS).
☐ Coordinate with the County EOC/Public Health staff and to share critical information regarding presenting symptoms, capabilities, security, resources, decontamination requirements, operations, and surge capacity.

Private Clinics

☐ Report suspected communicable diseases to the H3S/Public Health Division on an ongoing basis. The H3S/Public Health Division may contact private clinics to collect and share information during public health or medical emergencies.
☐ May provide services or resources to their clients, such as vaccines or medications, in the event of an outbreak, public health, or medical emergency.

American Medical Response

☐ Provide triage, treatment, and patient ambulance transport.
☐ Work closely with other emergency responders to coordinate care and transport of victims.

American Red Cross

☐ Provide and manage shelter and mass care operations for citizens who are victims of disaster, as well as feeding and support services for emergency responders.

- ☐ Activate and manage shelters for disaster victims, including feeding, health, and behavioral health services, and provide disaster relief assistance to individuals and families affected by the disaster, feeding operations for emergency workers, and response to inquiries from concerned family members outside the disaster area.
- ☐ Coordinate with the EOC regarding non-Red Cross shelters and shelters for pets.

Recovery

Recovery activities take place **after** an emergency occurs and include actions to return to a normal or an even safer situation following an emergency. Recovery roles and responsibilities for ESF 8 include the following:

All Tasked Agencies

- ☐ Demobilize response activities.
- ☐ Maintain incident documentation to support public and individual assistance processes.

Police Department

- ☐ Compile and keep all documentation collected relating to the management of activities related to the emergency provision of public health and medical services.

Mitigation

Mitigation activities take place **before and after** an emergency occurs and includes activities that prevent an emergency, reduce the chance of an emergency happening, or reduce the damaging effects of unavoidable emergencies. Mitigation roles and responsibilities for ESF 8 include the following:

All Tasked Agencies

- ☐ Participate in the hazard/vulnerability identification and analysis process.
- ☐ Take steps to correct deficiencies identified during the hazard/vulnerability identification and analysis process as appropriate.

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ESF 9 – Search and Rescue

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ESF 9 Tasked Agencies	
Primary City Agency	Police Department (County Sheriff Primary)
Supporting City Agency	Public Works Department Parks and Recreation Department
Community Partners	Tualatin Valley Fire and Rescue Mutual Aid Partners American Red Cross Emergency Medical Service Agencies
County Agency	County Sheriff's Office (CCSO) (Search and Rescue)
State Agency	Oregon Office of Emergency Management Oregon State Fire Marshal
Federal Agency	Department of Defense Department of Homeland Security/Federal Emergency Management Agency United States Coast Guard

1 Introduction

1.1 Purpose

Emergency Support Function (ESF) 9 describes search and rescue (SAR) resources in both urban and non-urban SAR efforts during a major disaster or incident. The CCSO has primary responsibilities for search and rescue activities within the County, including within City limits. Tualatin Valley Fire and Rescue (TVF&R) and the Police Department will support the CCSO in providing emergency SAR services for the City.

1.2 Scope

ESF 9 includes the following activities:

- SAR includes searching for, rescuing, or recovering persons lost, injured, or killed outdoors, including ground and marine locations; coordinated by the CCSO in accordance with the Clackamas County Search and Rescue Plan (Oregon Revised Statutes [ORS] 401.560).
- Urban search and rescue (USAR) includes searching for, rescuing, or recovering victims trapped in collapsed structures, in natural or human-caused disasters, and in operations that require specialized personnel and/or equipment; USAR is coordinated by the Local Fire Chief/State Fire Marshal/Office of Emergency Management (ORS 401.638; 401.639 and Oregon USAR Operations Manual).

1.3 Policies and Authorities

The following policies and agreements are currently in place:

- Clackamas County Water Rescue Consortium (through TVF&R and/or CCSO)

- Provisions in Oregon State law for SAR can be found in ORS 404 and include the following key provisions:
  - ORS 404.110. Delegation of SAR authority to the CCSO
  - ORS 404.115. Restriction of access to the SAR area
  - ORS 404.120. Requirement for each county to adopt an SAR plan
  - ORS 404.125. Provisions for critique of an SAR incident
  - ORS 404.130. Assignment of an SAR incident number
  - ORS 404.300–404.325. Provisions regarding equipment and signaling devices
  - ORS 404.350. Rescue of companion animals

2 Situation and Assumptions

2.1 Situation

The City is faced with a number of hazards that may require SAR support. The following considerations should be taken into account when planning for and implementing ESF 9 activities:

- A major disaster or emergency situation may result in large numbers of displaced, stranded, lost, or trapped individuals needing prompt rescue and medical attention.
- The first 72 hours of an SAR operation are the most critical in terms of reducing the mortality rate of an incident and therefore SAR efforts must begin as soon as possible.
- SAR personnel often need to be trained to deal with extreme or dangerous terrain for operations in remote areas. Similarly, they may need to work in dangerous conditions such as partially collapsed structures or areas with hazardous materials. These situations often require specialized skills that may not be available in a particular community, and experts may need to be brought in from other areas.
- Strict SAR procedures related to health and safety may be implemented to avoid rescuers becoming victims themselves.
- Volunteer SAR personnel are familiar with the Incident Command System (ICS) and National Incident Management System (NIMS) organization and have completed the basic training in both.

2.2 Assumptions

ESF 9 is based on the following planning assumptions:

- The need for SAR operations will increase as population and recreational opportunities continue to grow.
- Operations may be overwhelmed during emergencies and disasters. Local SAR efforts may require technical assistance from other agencies.
- Access to impacted locations may be limited due to steep or rocky terrain, water, structural barriers, or debris. Some areas may only be accessible by aircraft or boat, and fortification of structures may need to occur before any rescue operations can begin.
- Rapid assessment of impacted areas and lost individuals will assist in the determination of response priorities.
- Local residents and unaffiliated volunteers may initiate activities to assist in SAR operations and will require coordination and direction.

3 Roles and Responsibilities of Tasked Agencies

See Appendix B for a checklist of responsibilities for tasked agencies by phase of emergency management.

4 Concept of Operations

4.1 General

Individuals at the incident scene may have initiated rescue operations prior to the arrival of the SAR or USAR team. On-Scene Command manages the incident situation to minimize risk of injury to volunteer rescuers and victims. On-Scene Command requests that the 9-1-1 center activate the SAR/USAR team as soon as the need for their services is recognized.

On-Scene Command at SAR/USAR incidents creates a unified command structure when USAR operations are part of chemical, biological, radiological, nuclear, and explosive (CBRNE) incident response or when SAR operations involve multiple agencies/jurisdictions (such as joint water rescue operations).

4.2 Disabilities, and Access and Functional Needs

Provision of SAR-related activities will take into account populations with disabilities, and access and functional needs (DAFN). The needs of the DAFN population shall be identified and planned for as directed by policy makers and according to State and federal regulations and guidance.

4.3 Coordination with Other ESFs

The following ESFs support SAR-related activities:

- **ESF 4 – Firefighting.** Provide resources to support SAR operations.
- **ESF 8 – Health and Medical.** Coordinate emergency medical services for disaster victims.
- **ESF 16 – Law Enforcement.** Provide resources to support SAR operations.

5 ESF Annex Development and Maintenance

The Police Department will be responsible for coordinating regular review and maintenance of this annex. Each primary and supporting agency will be responsible for developing plans and procedures that address assigned tasks.

6 Appendices

- Appendix A – ESF 9 Resources
- Appendix B – ESF 9 Responsibilities by Phase of Emergency Management

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Appendix A ESF 9 Resources

The following resources provide additional information regarding ESF 9 and SAR-related issues at the local, state, and federal level:

City

- None at this time.

County

- Emergency Operations Plan
  - ESF 9 – Search and Rescue
- Search and Rescue Plan
- Clackamas Fire District #1 Urban Search and Rescue Plan
- Tualatin Valley Fire & Rescue Urban Search and Rescue Plan

State

- Emergency Operations Plan
  - ESF – 9 Search and Rescue

Federal

- National Response Framework
  - ESF 9 – Search and Rescue

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Appendix B ESF 9 Responsibilities by Phase of Emergency Management

The following checklist identifies key roles and responsibilities for ESF 9 – Search and Rescue. It is broken out by phase of emergency management to inform tasked agencies of what activities they might be expected to perform before, during, and after an emergency to support the SAR function. All tasked agencies should maintain agency-specific plans and procedures that allow them to effectively accomplish these tasks.

Preparedness

Preparedness activities take place **before** an emergency occurs and include plans or preparations to save lives and to help response and recovery operations. Preparedness roles and responsibilities for ESF 9 include:

All Tasked Agencies

- ☐ Develop plans and procedures for ESF 9 activities, as appropriate.
- ☐ Participate in ESF 9-related trainings and exercises as appropriate.

Police Department

- ☐ Coordinate regular review and update of the ESF 9 annex with supporting agencies.

Response

Response activities take place **during** an emergency and include actions taken to save lives and prevent further property damage in an emergency situation. Response roles and responsibilities for ESF 9 include the following:

All Tasked Agencies

- ☐ Provide situational updates to the City Emergency Operations Center (EOC) as required to maintain situational awareness and establish a common operating picture.
- ☐ Provide a representative to the City EOC, when requested, to support ESF 9 activities.

Police Department

- ☐ Coordinate SAR support with the CCSO.
- ☐ Establish unified On-Scene Command for incidents involving multiple agencies or jurisdictions.
- ☐ Provide traffic and crowd control at rescue scenes.
- ☐ Participate in Joint Information Center (JIC)/Joint Information System (JIS) activities.

TVF&R

- ☐ Coordinate USAR support with the Fire Defense Board Chief/CCDM/EOC Command.
- ☐ Coordinate access to the USAR equipment cache.
- ☐ Coordinate SAR response operations as required for the following types of specialty rescue:
    - o Urban/Structural Rescue

    - Specialty rescue (swift water, high angle, etc.)
- ☐ Establish unified On-Scene Command for CBRNE incidents.

Emergency Medical Services

- ☐ Assist with care and transport of persons with injuries received in SAR operations.

Public Works

- ☐ Provide heavy equipment and operators to assist in rescue operations.
- ☐ Provide signs, barriers, equipment, and personnel to assist in traffic and crowd control.
- ☐ Provide technical engineering advice to on-scene personnel.

American Red Cross

- ☐ Provide and manage shelter and mass care operations for victims and feeding and support services for emergency responders.
- ☐ Provide a liaison to On-Scene/EOC Command to coordinate support activities.

Recovery

Recovery activities take place **after** an emergency occurs and include actions to return to a normal or even safer situation following an emergency. Recovery roles and responsibilities for ESF 9 include the following:

All Tasked Agencies

- ☐ Demobilize response activities.
- ☐ Maintain incident documentation to support public and individual assistance processes.

TVF&R

- ☐ Compile and keep all documentation collected relating to the management of SAR operations and the assets utilized during SAR-related activities.
- ☐ Coordinate all after-action activities and take corrective actions as appropriate.

Mitigation

Mitigation activities take place **before and after** an emergency occurs and includes activities that prevent an emergency, reduce the chance of an emergency happening, or reduce the damaging effects of unavoidable emergencies. Mitigation roles and responsibilities for ESF 9 include the following:

All Tasked Agencies

- ☐ Participate in the hazard/vulnerability identification and analysis process.
- ☐ Take steps to correct deficiencies identified during the hazard/vulnerability identification and analysis process as appropriate.

ESF 10 –Hazardous Materials

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ESF 10 Tasked Agencies	
Primary City Agency	Police Department
Supporting City Agency	Public Works Department City Manager's Office
Community Partners	Tualatin Valley Fire and Rescue (primary) American Red Cross Mutual Aid Partners Private Industry (including Chemical Transportation Emergency Center [CHEMTREC] and local businesses) Emergency Medical Service Agencies
County Agency	Fire Defense Board
State Agency	Department of Environmental Quality, Oregon State Fire Marshal (OSFM) Regional Hazardous Materials Team (HazMat Team) No. 3
Federal Agency	Environmental Protection Agency (EPA)

1 Introduction

1.1 Purpose

Emergency Support Function (ESF) 10 outlines roles and responsibilities in responding effectively to a hazardous materials release or threatened release, and provides a framework for response and mitigation activities to prevent or minimize injuries, environmental impact, and property damage.

1.2 Scope

Hazardous materials incidents may occur during the manufacture, use, storage, or transport of hazardous materials, or they may be deliberately caused by vandalism, sabotage, or terrorism.

1.3 Policies and Authorities

The following policies and agreements are currently in place:

- Hazardous materials are discussed in Oregon Revised Statutes (ORS) Chapter 453.

2 Situation and Assumptions

2.1 Situation

Substances classified as hazardous materials are used, stored, and transported in the City every day. The west side of the City houses industrial facilities, and the east side of the City has auto body shops. Unknown quantities of hazardous materials are transported through the City by road, air, and pipeline.

Tualatin Valley Fire and Rescue (TVF&R) manages routine hazardous materials incidents in the City with local and mutual aid resources. The Clackamas County Fire Defense Board coordinates fire resources during a major emergency or disaster.

The party responsible for the hazardous materials is also responsible for cleanup and disposal of any spill or release. The following government agencies provide oversight and confirmation that cleanup and disposal are conducted safely according to applicable laws and regulations:

- Incidents on State or federal property: the government agency having jurisdiction;
- Incidents involving nuclear/radioactive materials: the Oregon Departments of Energy and Human Services;
- Incidents involving military weapons/materials: United States Departments of Defense or Energy; and
- Incidents involving spills in waterways: the EPA, United States Coast Guard (USCG), or the Oregon Department of Environmental Quality

A hazardous materials incident involving a credible threat or a confirmed deliberate or terrorist/ chemical, biological, radiological, nuclear, or explosive act involves multiple agencies, jurisdictions, and levels of government.

2.2 Assumptions

ESF 10 is based on the following planning assumptions:

- A natural or technological disaster could result in one or more situations in which hazardous materials are released into the environment.
- Fixed facilities (chemical plants, tank farms, laboratories, and industries operating hazardous waste sites that produce, generate, use, store, or dispose of hazardous materials) could be damaged so that existing spill control apparatus and containment measures are not effective.
- Hazardous materials that are transported may be involved in railroad accidents, highway collisions, waterway accidents, or airline incidents.
- Damage to, or rupture of, pipelines transporting materials that are hazardous if improperly released will present serious problems.
- Emergency exemptions may be needed for disposal of contaminated materials.
- Laboratories responsible for analyzing hazardous material samples may be damaged or destroyed in a disaster.

3 Roles and Responsibilities of Tasked Agencies

See Appendix B for a checklist of responsibilities for tasked agencies by phase of emergency management.

4 Concept of Operations

4.1 General

The City Emergency Operations Plan (EOP) has been developed to be consistent with the EOPs of Clackamas County and the State of Oregon. It describes the typical roles and responsibilities of responders. It identifies command functions and provides guidelines for coordinating local, State, federal, industry, and volunteer resources.

The City will normally assume the lead role during the emergency phases of a hazardous materials incident. State and federal agencies shall provide technical support during the emergency phases of an incident. The county can be called for assistance after local resources are exhausted. Cleanup is the responsibility of the spiller. Local, State, and federal agencies shall coordinate recovery activities.

4.2 Levels of Response

For the purposed of emergency planning, training and response, the following four categories have been defined to deal with hazardous materials incidents:

4.2.1 Level 1 Emergency

A Level 1 emergency is an incident that is out of the ordinary and involves release of little or no hazardous material. Public health and safety are not immediately threatened; however, the potential may exist for the incident to escalate (e.g., gasoline or diesel spill under 42 gallons, containers have fallen but are not damaged or leaking). A hazardous materials incident classified as a Level 1 emergency may be handled within the normal organization and procedures of an emergency response agency and does not require implementation of this plan or notification of the Oregon Emergency Response System (OERS).

4.2.2 Level 2 Emergency

A Level 2 emergency is an incident resulting in a localized release of hazardous materials. The health and safety of people and emergency workers in the immediate area may be threatened if protective actions are not taken. A probable environmental impact exists (e.g., gasoline or diesel in excess of 42 gallons, leak of any quantity of unknown contents). A hazardous materials incident classified as a Level 2 emergency has special or unique characteristics requiring resources outside the normal emergency organization of the City or response by more than one emergency response agency and may require partial implementation of this plan.

4.2.3 Level 3 Emergency

A Level 3 emergency is an incident resulting in a large release of hazardous materials creating a serious threat to public health and safety of the environment. Such incidents may require relocation or sheltering of the affected population. A hazardous materials incident classified as a Level 3 emergency requires the coordinated response of all resources at all levels of government to save lives and protect property and will require implementation of this plan. Level 3 incidents may result in an emergency declaration at the local, state, and federal level.

4.2.4 Security Incident

A hazardous materials incident classified as a security incident involves threatened or actual sabotage or demonstration of civil disobedience that, if carried out, may result in a release. These may include blockage of a shipment of hazardous materials or threatened or actual sabotage to the shipment. A security incident will primarily involve the law enforcement community in taking whatever steps are required to avoid a threat to the population. State and federal assistance will likely be required to abate the threat.

4.3 Basic Priorities

- **Life Safety**. In all hazardous incidents, the primary concern is life safety, starting with the life safety of the emergency responders.
- **Protecting the Environment**. Protection of the environment should be considered ahead of protecting property and equipment because property and equipment can be replaced.
- **Protecting Property and Equipment**. While protecting property and equipment is important, this should be done after protecting life and the environment.

4.4 Information Sources

4.4.1 Chemical Transportation Emergency Center (800-424-9300)

CHEMTREC provides 24- hour immediate advice by telephone with data on 350,000 chemicals. When CHEMTREC's Operations Center receives a call, a CHEMTREC Emergency Service Specialists (ESS):

- Gathers information about the incident, including the caller's name, organization, callback phone number, fax number, location and nature of the incident, the type and amount of product(s) involved, shipper, consignee, carrier, type of container, and other details.
- Provides the caller with immediate technical emergency response information concerning the product(s) involved. Information is obtained from several sources, including the manufacturer's product-specific Safety Data Sheet (SDS), a product specialist from the manufacturer or shipper, and/or other technical sources and computer databases.
- Quickly relays details of the incident to the shipper or manufacturer of the product. The carrier (railroad, trucking company, etc.) may also be notified, as appropriate. The shipper is put in contact with the incident scene to provide further technical advice and assistance, which may include sending personnel to the scene. CHEMTREC also provides important support to medical professionals treating victims of exposure.
- Sends a written report of the incident via fax and/or email to the shipper or shipper-designated compliance organization (in cases where the shipper is registered with CHEMTREC).

4.4.2 National Response Center (800-424-8802)

The NRC, which is operated by the USCG, receives reports from spillers and acts as the notification, communications, technical assistance, and coordination center for the National Response Team. The NRC is a single access point for accessing all federal agencies involved with hazardous materials. It is the contact point for accessing the Pacific Strike Team, a specially trained and equipped HazMat Team with expertise in handling water-related spills.

4.4.3 Oregon State Fire Marshal's Hazardous Substance Employer Survey

The OSFM can be reached through OERS. The OSFM maintains information from the State's Hazardous Substance Employer Survey, which annually inventories all businesses in the State for chemicals that are being manufactured, stored, and used at their locations. While this is good information, not all businesses have complied with regulations that require data to be sent to the State. Oregon Regional Response Teams will have this information available on their onboard computers.

The OSFM provides an updated list of companies that have reported Extremely Hazardous Substances in TVF&R's area of coverage on an annual basis, which is available through TVF&R.

4.4.4 Oregon Poison Control Center

The Oregon Poison Control Center provides:

- 24-hour service (503-494-8968 or 800-452-7165) with expertise on hazardous materials exposure;
- A toxicologist available for consultation on chemical-related health issues;
- Familiarity with Regional HazMat Teams and their level of training;
- Excellent follow-up capability for patient treatment and care;
- The ability to get information on trade secrets in a timely manner; and
- Recommendations on decontamination procedures.

4.4.5 Safety Data Sheets

Safety data sheets (SDSs) are required by the United States Occupational Safety and Health Administration (OSHA) as the primary communications link between chemical manufacturers and users. They summarize the hazards of particular substances that may be anticipated in an emergency situation.

SDSs are a good source of information, but definitive answers on toxicity and treatment for exposed victims should be sought from the Poison Control Center.

4.4.6 Printed Resources

There are many different guidebooks to cross reference, starting with the United States Department of Transportation (DOT). Emergency Response Guidebook. Responders should use multiple sources as quickly as they can. The DOT Guidebook is only useful for the first few minutes of an incident until more detailed information can be obtained from technical resources.

4.4.7 Computer Aided Management of Emergency Operations

Computer Aided Management of Emergency Operations (CAMEO) is a collection of 22 integrated programs and databases developed by the National Oceanic and Atmospheric Administration for persons dealing with hazardous materials. CAMEO also has a plume-modeling program to visualize vapor dispersion patterns. Most HazMat Teams have CAMEO installed in their vehicles.

4.5 Training Levels

Per OSHA 29 Code of Federal Regulations 1910.120, City employees shall not work outside their scope of training, knowledge, and skill level.

- Individuals who are likely to witness or discover a hazardous substance release will be trained to the First Responder Awareness level. This group should include Police Officers and Public Works field personnel.
- Individuals that respond to releases will be trained to the First Responder Operations level. This includes TVF&R personnel.

- The TVF&R will have personnel trained to the On-Scene Incident Commander level. Personnel trained to this level will respond and take command of a hazardous materials incident as soon as possible. Note: the first arriving unit will take command until personnel trained to the On-Scene Incident Commander level arrive.

4.6 Disabilities, and Access and Functional Needs

Provision of hazardous materials–related activities will take into account populations with disabilities, and access and functional needs (DAFN). The needs of the DAFN population shall be identified and planned for as directed by policy makers and according to state and federal regulations and guidance.

4.7 Coordination with Other ESFs

The following ESFs support hazardous materials–related activities:

- **ESF 4 – Firefighting.** Provide specialized resources to support hazardous materials operations.
- **ESF 8 – Health and Medical.** Provide emergency first aid to contaminated victims.
- **ESF 16 – Law Enforcement.** Provide specialized resources to support hazardous materials operations.

5 ESF Annex Development and Maintenance

The Police Department will ensure that this annex and supporting plans and documents are reviewed and updated at least every two years or when changes occur, such as lessons learned from exercises or actual incidents.

6 Appendices

- Appendix A – ESF 10 Resources
- Appendix B – ESF 10 Responsibilities by Phase of Emergency Management
- Appendix C – City Operational Guidelines

Appendix A ESF 10 Resources

The following resources provide additional information regarding ESF 10 and hazardous materials–related issues at the local, state, and federal level:

City

- None at this time.

County

- Emergency Operations Center (EOC) Library
  - Fire Resource Management Plan (needs to be updated)
  - Companies Reporting Extremely Hazardous Substances (available on CD)
  - 2008 US DOT Emergency Response Guidebook
  - National Institute for Occupational Safety and Health Pocket Guide to Chemical Hazards

State

- Emergency Operations Plan
  - ESF 10 – Hazardous Materials

Federal

- National Response Framework
  - ESF 10 – Oil and Hazardous Materials
- Northwest Area Contingency Plan
- National Contingency Plan

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Appendix B ESF 10 Responsibilities by Phase of Emergency Management

The following checklist identifies key roles and responsibilities for ESF 10 – Hazardous Materials. It is broken out by phase of emergency management to inform tasked agencies of what activities they might be expected to perform before, during, and after an emergency to support the hazardous materials function. All tasked agencies should maintain agency-specific plans and procedures that allow them to effectively accomplish these tasks.

Preparedness

Preparedness activities take place **before** an emergency occurs and include plans or preparations to save lives and to help response and recovery operations. Preparedness roles and responsibilities for ESF 10 include the following:

All Tasked Agencies

- ☐ Develop operational plans for ESF 10 activities.
- ☐ Participate in ESF 10-related trainings and exercises as appropriate.

Police Department

- ☐ Coordinate regular review and update of the ESF 10 annex with supporting agencies.
- ☐ Facilitate collaborative planning to ensure the City’s capability to support ESF 10 activities.
- ☐ Ensure that staff are identified and adequately trained to fulfill the finance function in the City EOC to include assets utilized during a hazardous response.

TVF&R

- ☐ Participate in updating this annex with the City.
- ☐ Facilitate collaborative planning to ensure City capability to support ESF 10 activities.
- ☐ Develop and maintain a Hazardous Materials Response Plan.
- ☐ Ensure that staff are identified and adequately trained to fulfill the finance function in the City EOC to include assets utilized during a hazardous response.

Response

Response activities take place **during** an emergency and include actions taken to save lives and prevent further property damage in an emergency situation. Response roles and responsibilities for ESF 10 include:

All Tasked Agencies

- ☐ Provide situational updates to the City EOC as required to maintain situational awareness and establish a common operating picture.
- ☐ Provide a representative to the City EOC, when requested, to support ESF 10 activities.

Police Department

- ☐ Attempt to identify material, if first on scene.

- ☐ Provide law enforcement personnel to staff EOC positions.
- ☐ Coordinate law enforcement response activities, including traffic control, crowd control, and evacuation.
- ☐ Analyze law enforcement resource needs and request assistance through the EOC.
- ☐ Provide explosive disposal unit expertise.
- ☐ Provide/coordinate security for shelters, critical facilities, Point of Dispensation (POD) locations, and feeding centers.
- ☐ Enforce mandatory public health and safety actions.

TVF&R

- ☐ Attempt to identify the material(s) involved, if first on scene, and determine appropriate protective measures and notifications.
- ☐ Command firefighting forces and coordinate other responding support forces; tactical units remain under the command of the responding command officers.
- ☐ Coordinate decontamination and urban search and rescue operations.
- ☐ Ensure that OERS is notified.
- ☐ Assist in warning, evacuation, traffic control, and staging; coordinate evacuation operations requiring specialized personal protective equipment and hazardous materials operations level training.

Public Works Department

- ☐ Attempt to identify material, if first on scene.
- ☐ Provide personnel to staff EOC positions.
- ☐ Support decontamination, containment, urban search and rescue, evacuation, and debris removal operations as appropriate.
- ☐ Attempt to identify the source and route/speed of travel if a substance enters storm drains.
- ☐ Provide damming and absorbent materials.
- ☐ Provide signs, barriers, equipment, and personnel to assist in traffic and crowd control; assist in road closures.
- ☐ Coordinate transportation routes and resources with adjacent cities and the Oregon Department of Transportation.
- ☐ Monitor the condition of, and amount of traffic on, emergency transportation routes and implement emergency repairs to streets and bridges as necessary to support emergency operations and restore essential traffic flow.
- ☐ Conduct preliminary assessment of wastewater and drainage systems and damage to structures, streets, and utilities; conduct emergency repairs as appropriate.
- ☐ Provide public works support for emergency operations as necessary, including heavy equipment and skilled equipment operators.

City Manager’s Office (Citizen Engagement Coordinator)

- ☐ Staff the EOC Public Information Officer (PIO) position.
- ☐ Develop general and agent-specific information for media and public, including exposure control and self-protection measures, and locations and hours for PODs and other prophylaxis/treatment facilities.
- ☐ Ensure that updated information is distributed regarding incident status, evacuation routes and detours, traffic conditions, transportation options for those who need assistance,

shelter locations and updates, and systems for locating family, friends, and pets, and other information needed for public safety and welfare.

- ☐ Work with local, County, State, regional, and federal jurisdictions' PIOs, and with responder groups to provide information to public and employees.
- ☐ Gather, prepare, and obtain On-Scene and/or EOC Command approval for release of all communications sent to media, jurisdictions, and employees.

Emergency Medical Service

- ☐ Provide triage, treatment, and patient ambulance transport.
- ☐ Work closely with other emergency responders to coordinate care and transport of victims.

American Red Cross

- ☐ Provide and manage shelter and mass care operations for victims of disaster, and feeding and support services for emergency responders.
- ☐ Manage inquiries from concerned family members outside the disaster area.
- ☐ Coordinate with CCDM and the EOC regarding non-Red Cross shelters and shelters for pets.

Private Industry

- ☐ Be familiar with state and local government hazardous materials planning.
- ☐ Respond to emergencies, as required by law.
- ☐ Coordinate cleanup and site restoration, when required to do so by law.
- ☐ Provide expertise and resources to local government and/or state government to help mitigate the effects of a hazardous materials incident.
- ☐ Provide resources, equipment, and knowledge of the removal and disposal of contamination.

Recovery

Recovery activities take place **after** an emergency occurs and include actions to return to a normal or an even safer situation following an emergency. Recovery roles and responsibilities for ESF 10 include the following:

All Tasked Agencies

- ☐ Demobilize response activities.
- ☐ Maintain incident documentation to support public and individual assistance processes.

TVF&R

- ☐ Compile and keep all documentation relating to the management of hazardous materials response operations.
- ☐ Coordinate all after-action activities and take corrective actions as appropriate.

Mitigation

Mitigation activities take place **before and after** an emergency occurs and includes activities that prevent an emergency, reduce the chance of an emergency happening, or reduce the damaging effects of unavoidable emergencies. Mitigation roles and responsibilities for ESF 10 include the following:

All Tasked Agencies

- ☐ Participate in the hazard/vulnerability identification and analysis process.
- ☐ Take steps to correct deficiencies identified during the hazard/vulnerability identification and analysis process as appropriate.

Appendix C City Operational Guidelines

INITIAL RESPONDERS

Size-up/Identification

- Approach from up-wind, up-stream, and up-grade.
- Observe from safe distance.
- Use binoculars.
- Examine shipping papers or ID numbers
- Examine placards/labels.
- Interview driver, conductors, dock manager, etc.
- Refer to the DOT Guidebook or Fire Fighters' Handbook of Hazardous Materials. Use of at least three texts is preferable.
- Position apparatus pointing away from incident.
- Determine routes of egress if emergency develops.
- Communicate these routes to all involved personnel.

Isolate A - Avoid Contact with Materials, Fumes, Dust, etc.

- Eliminate or avoid ignition sources (no smoking or use of highway flares).
- Determine if a larger evacuation is necessary to keep people away from chemicals.
- Establish a control line at a safe distance from the incident.

Rescue Injured Person if Prudent

- It may be necessary to delay rescue to identify hazards.
- Identify all people who might have been injured or exposed.

Notification and Technical Help

- Alert dispatch operators or 9-1-1 to begin notifications:
    - State agencies: OERS (1-800-452-0311)
    - Federal agencies: NRC (1-800-424-8802)
    - Industry: CHEMTREC (1-800-424-9300)
    - Emergency Medical Advice: Poison Control Center (1-800--452-7165 or 225-8968)

Useful Information

The following information may be useful when reporting the spill:

- Caller's name, title, and organization;
- Callback number at scene;
- Dispatch center phone number;
- Description of incident and actions taken;
- Type and number of injuries/exposures;
- Hazards involved (health, environment)
- Materials involved, including:
    - Name of the products(s), preferably a trade name

  - Carrier and trailer or car number
  - Container type
  - UN, NA (placard) or STCC number of the products
  - Points of origin and destination
  - Names of consignee and shipper
- Type or description and number of containers/packages;
- Specific information you need right away (SDS, medical help, etc.)
- Size or amount of release; and
- Location, time, weather at the scene.

Establish Incident Command

- Determine who is the Incident Commander.
- Transmit size-up to responding crews and Lake Oswego Communications.
- Set up field command post at safe location.
- Tell the dispatcher the exact location of command post.
- Establish communications with off-scene help.
- Pass command as appropriate.
- Brief the new commander.

INCIDENT COMMANDER

Establish Incident Command

- Clearly identify yourself as the commander.
- Make sure command post is at a safe location.
- Establish unified command, if appropriate, with agencies on scene.
- Identify the lead State agency, if any.

Determine the Hazard

- Check placards, shipping, etc.
- Use reference books and off-scene help (e.g., OERS, CHEMTREC, DOT Guidebook).
- Determine downwind, downstream and downslope exposures.
- Identify ignition sources.
- Determine wind speed and direction.
- Use available detection equipment.
- HazMat Teams have some testing equipment if product unknown.

Notification and Technical Help

- Regional HazMat Teams: OERS (1-800-452-0311)
- State agencies: OERS (1-800-452-0311)
- Federal agencies: NRC (1-800-424-8802)
- Industry: CHEMTREC (1-800-424-9300)
- OSHA Hazardous Communications data (1-503-378-3272)
- Emergency medical advice: (Poison Control Center (1-800-452-7165)

Assign Team Responsibilities

- Evacuation/shelter-in-place

- Rescue
- Traffic and crowd control
- Containment
- Fire suppression
- Public information
- Communications
- Safety officer
- Emergency medical

Evaluate Control Line and Revise if Necessary

- Use tape, rope, fire-hose, etc. to mark the control line.
- Leave a margin of error.

Decontamination

- Assign a decontamination team and officer.
- Check people and equipment for contamination.
- Set up decontamination procedures.

Establish Staging Area for Medical Treatment

- See ESF 8 – Public Health and Medical Services.

EVACUATION/SHELTER-IN-PLACE

Determine Danger Area

- Determine size of spill.
- Determine plume direction.
- Identify people and facilities in danger area.

Decide Between Evacuation or Shelter-in-place – Which Will Best Reduce Exposure

Begin Warning and /or Evacuation Procedures for those nearest the spill site. Work outwards from spill site.

- Inform evacuees to lock doors and take small valuables and necessary medication.
- Provide information on the safest evacuation route.

Notify Those Who Need to Know

- Law enforcement agencies
- Emergency Management (city, county, state)
- Red Cross
- County Health Officer
- Local TV and radio
- Dispatchers
- Other emergency relief organizations
- Transportation companies

TRAFFIC CONTROL AND LAW ENFORCEMENT

- Obtain guidance from the Incident Commander on the need for an exclusion perimeter, and the distances.
- Establish a perimeter, using rope, barricades, vehicles, etc. (avoid flares if there is any indication that combustible/flammable chemicals are present.)
- Reroute pedestrians and vehicles around the perimeter—keep onlookers, news media and others from the excluded area.
- Request additional assistance as needed.
- Be prepared, at the request of the Incident Commander, to remove persons hindering emergency operations.

PUBLIC INFORMATION

What to Do First

- Report to the field command post. Find the Incident Commander. Work with Incident Commander to develop press statements.
- Set up a press briefing area away from the command post. Issue public information from the press area only. Do not talk to reporters away from the press area.

Work with State PIO

- Communicate with the PIO from the lead State agency. Agree with the State PIO before issuing updates. The State PIO will help provide information about health effects, environmental effects, state resources, etc.
- Set times for updates with the State PIO and with on-scene press

What to Tell Reporters

- They will want to know:
    - Who had the accident?
    - Who has been injured?
    - Who is the Incident Commander (name, rank, who he/she works for, etc.)?
    - What material is involved?
    - What are the public safety or health hazards?
    - What is the estimated loss?
    - Where did the accident occur?
    - When did it occur?
    - How did it occur?
- Describe response actions. (Work with the State PIO to describe health effects). Do not tell more than you know. Do not try to keep things from the press. (Except names of injured or dead before notification of families).
- Take notes about response actions and who you told what. The notes will help you later.

NOTE: The media may be helpful in issuing emergency public announcements.

MEDICAL SERVICE/HEALTH OFFICER

- At the incident scene:
  - Be aware of dangers
  - Take proper precautions to protect yourself when handling casualties
  - Coordinate actions with the incident commander
  - Coordinate support activities as required with response agencies present
- Confirm health hazard.
- Investigate toxic levels of materials involved.
- Seek antidote options.
- Confirm evacuation area perimeters (includes establishment of triage areas as required).
- Coordinate with hospitals involved. Advise them as to the probability of people self-referring themselves to hospitals.
- Determine whether any etiological agents are involved.
- Coordinate with the Reception and Care Coordinator regarding medical services required by evacuees.
- Decontaminate personnel/equipment as required, e.g.:
  - Hospital
  - Ambulance
- Help question/examine responding personnel on state of health. Treat as required.
- Work with the State Health Division and Department of Environmental Quality to address environmental health/sanitation impacts.
- Note: News releases are to be made by an authorized PIO. Check with the Incident Commander

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ESF 11 – Food and Water

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ESF 11 Tasked Agencies	
Primary City Agency	Finance Department
Supporting City Agency	Police Department Public Works Department (Water Division)
Community Partners	American Red Cross Salvation Army Community and faith-based organizations
County Agency	Clackamas County Disaster Management (CCDM)
State Agency	Department of Human Services
Federal Agency	Department of Homeland Security/Federal Emergency Management Agency

1 Introduction

1.1 Purpose

Emergency Support Function (ESF) 11 describes how the City will identify food and water (including ice) needs in the aftermath of a disaster or emergency, obtain these resources, and transport them to the impacted area.

1.2 Scope

ESF 11 includes the following activities:

- Assessment of food and water needs for areas impacted by disaster;
- Identification of food and water resources;
- Storage of food and water resources;
- Monitoring the collection and sorting of all food and water supplies and establishing procedures to ensure that they are safe for consumption; and
- Coordinating transportation of food and water resources to impacted areas.

1.3 Policies and Authorities

None at this time.

2 Situation and Assumptions

2.1 Situation

The City is faced with a number of hazards that may impact the availability of food and water for affected communities. The following considerations should be taken into account when planning for and implementing ESF 11 activities:

- A significant emergency or disaster may severely diminish food and water stores in a community.
- Communities without electricity for extended periods will lose the ability to refrigerate goods, and household and supermarket supplies requiring cooling will spoil.

- Individuals and families will have varying emergency food and water supplies on hand.
- The heat of summer may exacerbate any existing issues as ambient air temperature will increase the rate of spoilage and the need to use ice.
- Damage to freshwater supplies and wastewater treatment systems may increase the risk of infection due to waterborne illness and increase the demand for bottled water locally.
- Special needs populations may have special dietary restrictions on food and the preparation of meals.

2.2 Assumptions

ESF 11 is based on the following planning assumptions:

- The need for fresh food and water will likely overwhelm the City's local supply if electricity is not available for three or more days.
- Damage projection models will be used to calculate the number of people affected in order to assess the amount of emergency food and water needed to meet anticipated demand.
- The City will look to the County, State, and United States Department of Agriculture (USDA), for guidance on quantity usage tables related to disaster food distribution.

3 Roles and Responsibilities of Tasked Agencies

See Appendix B for a checklist of responsibilities for tasked agencies by phase of emergency management.

4 Concept of Operations

4.1 General

When food and water–related activities are staffed in the Emergency Operations Center (EOC), the appointed ESF 11 representative will be responsible for the following:

- Serve as a liaison with supporting agencies and community partners.
- Provide a primary entry point for situational information related to food and water.
- Share situation status updates related to food and water to inform development of the Situation Report.
- Participate in, and provide food and water-specific reports for, EOC briefings.
- Assist in development and communication of food and water–related actions to tasked agencies.
- Monitor ongoing food and water–related actions.
- Share food and water–related information with ESF 14 – Public Information, to ensure consistent public messaging.
- Coordinate food and water–related staffing to ensure the function can be staffed across operational periods.

4.2 Disabilities, Access and Functional Needs

Provision of food and water–related activities will take into account populations with disabilities and access and functional needs (DAFN). The needs of the DAFN population shall be identified and planned for as directed by policy makers and according to state and federal regulations and guidance.

4.3 Coordination with Other ESFs

The following ESFs support food and water–related activities:

- **ESF 3 – Public Works.** Coordinate repair and restoration of the drinking water system within the City.
- **ESF 6 – Mass Care.** Coordinate distribution of food and water supplies to impacted populations.
- **ESF 7 – Resource Support.** Identify food and water resources and coordinate staging of resources for distribution. Assist in transportation of food and water supplies to impacted areas.
- **ESF 8 – Health and Medical.** Ensure that proper procedures are in place to ensure food and water safety.
- **ESF 15 – Volunteers and Donations Management.** Coordinate donated food and water supplies. Assist in the transportation of food and water supplies to impacted areas.
- **ESF 17 – Agriculture and Animal Protection.** Ensure the security of the City’s food system.
- **ESF 18 – Business and Industry.** Coordinate with private-sector partners to support ESF 11 activities.

5 ESF Annex Development and Maintenance

The Finance Department will be responsible for coordinating regular review and maintenance of this annex. Each primary and supporting agency will be responsible for developing plans and procedures that address assigned tasks.

6 Appendices

- Appendix A – ESF 11 Resources
- Appendix B – ESF 11 Responsibilities by Phase of Emergency Management

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Appendix A ESF 11 Resources

The following resources provide additional information regarding ESF 11–related issues at the local, state, and federal level:

City

- None at this time.

County

- None at this time.

State

- Emergency Operations Plan
  - ESF 11 – Food and Water

Federal

- National Response Framework
  - ESF 6 – Mass Care
- Food and Nutrition Service USDA Foods Program Disaster Manual (https://www.fns.usda.gov/sites/default/files/FDDDisasterManual.pdf)

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Appendix B ESF 11 Responsibilities by Phase of Emergency Management

The following checklist identifies key roles and responsibilities for ESF 11 – Food and Water. It is broken out by phase of emergency management to inform tasked agencies of what activities they might be expected to perform before, during, and after an emergency to support the food and water function. All tasked agencies should maintain agency-specific plans and procedures that allow them to effectively accomplish these tasks.

Preparedness

Preparedness activities take place **before** an emergency occurs and include plans or preparations to save lives and to help response and recovery operations. Preparedness roles and responsibilities for ESF 11 include the following:

All Tasked Agencies

☐ Develop operational plans for ESF 11 activities.
☐ Participate in ESF 11–related trainings and exercises as appropriate.
☐ Work with local, regional, and State agencies to align planning efforts (e.g., identifying duplicate vendor agreements, mutual aid agreements, common point of dispensation [POD] planning, etc.).

Finance Department

☐ Coordinate regular review and update of the ESF 11 annex with supporting agencies.
☐ Facilitate collaborative planning to ensure the City's capability to support ESF 11 activities.
☐ Develop and maintain an Emergency Food and Water Plan for the City that includes procedures for addressing:
  - Procuring food and water consumables
  - Transporting food and water consumables to and from the warehouse/staging area
  - Documenting the amounts food and water consumables provided to PODs and monitoring inventory status
  - Providing for the sustenance needs of persons with dietary restrictions (e.g., infants, diabetic persons, renal patients, hypertensive patients, liquid diets, vegetarians, persons with cultural sensitivities, etc.)

Police Department

☐ Maintain the operational capacity of the City EOC and help ensure that staff are identified and adequately trained to fulfill the food and water function in the City EOC to include tracking and use of assets utilized during food and water operations and activities.

Response

Response activities take place **during** an emergency and include actions taken to save lives and prevent further property damage in an emergency situation. Response roles and responsibilities for ESF 11include the following:

All Tasked Agencies

☐ Provide situational updates to the City EOC as required to maintain situational awareness and establish a common operating picture.
☐ Provide a representative to the City EOC, when requested, to support ESF 11activities.

Finance Department

☐ Coordinate with the EOC Planning Section to identify unmet needs.
☐ Establish a Food and Water Branch in the City EOC if needed.
☐ Coordinate with community and faith-based partners to facilitate the distribution of donated relief supplies.
☐ Track the use of food and water resources through the EOC Finance Section.
☐ Through the State Emergency Coordination Center, request support for volunteers and donations activities in coordination with ESF 15 – Volunteers and Donations.
☐ Provide necessary inspections for food and water safety. Work with County and State agencies regarding the inspections and safety.

Public Works Department (Water Division)

☐ Work with the Public Information Officer and/or other ESF 14 representatives to craft public messaging surrounding the safety of the City's food and water supply (e.g., boil notices).

American Red Cross

☐ Assist in distribution of food and water supplies in coordination with mass care and shelter operations.

Recovery

Recovery activities take place **after** an emergency occurs and include actions to return to a normal or an even safer situation following an emergency. Recovery roles and responsibilities for ESF 11 include the following:

All Tasked Agencies

☐ Demobilize response activities.
☐ Maintain incident documentation to support public and individual assistance processes.

Finance Department

☐ Compile and keep all documentation relating to the management of emergency provision of food and water.
☐ Coordinate all after-action activities and take corrective actions as appropriate.

Mitigation

Mitigation activities take place **before and after** an emergency occurs and include activities that prevent an emergency, reduce the chance of an emergency happening, or reduce the damaging effects of unavoidable emergencies. Mitigation roles and responsibilities for ESF 11 include the following:

All Tasked Agencies

☐ Participate in the hazard mitigation planning process for the City.
☐ Provide agency and incident data to inform development of mitigation projects to reduce hazard vulnerability.

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ESF 12 – Energy

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ESF 12 Tasked Agencies	
Primary City Agency	Public Works Department
Supporting City Agency	Parks and Recreation Department Information Technology Department
Community Partners	Public/Private Utilities (Portland General Electric Company [PGE], NW Natural)
County Agency	Clackamas County Disaster Management
State Agency	Oregon Department of Energy Public Utility Commission
Federal Agency	Department of Energy

1 Introduction

1.1 Purpose

Emergency Support Function (ESF) 12 describes how the City will coordinate plans, procedures, and resources to support response to and recovery from shortages and disruptions in the supply and delivery of energy during a major disaster or incident.

1.2 Scope

ESF 12 includes the following activities:

- Coordinate with utilities operating in the City to ensure that the integrity of the supply systems is maintained during emergency situations and that any damages that may be incurred are repaired and services restored in an efficient and expedient manner afterward.
- Monitor and coordinate the availability of electric generating capacity and reserves, the availability and supply of natural gas, and the supply of generation fuels.
- Monitor and coordinate the restoration of utilities for normal community functioning.
- Coordinate with private-sector providers of energy and transportation fuels such as propane, fuel oil, diesel fuel, and gasoline.
- Assist City departments and agencies in obtaining fuel for transportation, communications, emergency operations, and other critical functions.
- Help energy suppliers and utilities obtain equipment, specialized labor, and transportation to repair or restore energy systems.

1.3 Policies and Authorities

The following policies and agreements are currently in place:

- It is the policy of the City that all utilities, whether publicly or privately owned, be prepared to respond to needs caused by an emergency or disaster. The Public Works Department may establish liaison with such utility providers to coordinate disaster and emergency needs and services.
- The City is a member of Oregon Water/Wastewater Agency Response Network (ORWARN), which is composed of member utilities providing voluntary emergency

assistance to each other. ORWARN facilitates rapid and short-term deployment of emergency services in the form of personnel, equipment, and materials.

2 Situation and Assumptions

2.1 Situation

The City is faced with a number of hazards that may require the rapid assessment, repair, and support of energy-related services. The following considerations should be taken into account when planning for and implementing ESF 12 activities:

- Emergencies, both natural and human-caused, can have significant effects on public and privately owned utilities in a community. The ability to quickly restore damaged water, power, natural gas, telephone, and sewer systems is essential to minimizing a disaster's impacts on the safety, public and environmental health, and economy of the area.
- The electrical power industry is organized into a network of public and private generation and distribution facilities. Through such networks, the electrical power industry has developed a capability to provide, reroute, and restore power under even the most extreme circumstances.
- A major disaster could destroy or disrupt all or a portion of the City's energy and utility systems.

2.2 Assumptions

ESF 12 is based on the following planning assumptions:

- A major disaster could destroy or damage portions of a region's energy and utility systems and disrupt local petroleum supplies.
- Widespread and possibly prolonged electric power failures could occur in a major disaster.
- The City's transportation and telecommunications infrastructures will be affected.
- Delays in the production, refining, and delivery of petroleum-based products may occur as a result of transportation infrastructure problems and loss of commercial power.
- There may be extensive distribution failure in water, wastewater, and gas utilities. These may take hours, days, or even weeks to repair.
- There may be panic hoarding of fuel in areas served by severed pipelines or by individuals from neighboring jurisdictions where shortages have occurred.
- Natural gas lines may break, causing fire, danger of explosion, or health hazards such as inhalation of toxic substances.
- Water pressure may be low, hampering firefighting and impairing sewer system function.
- City departments, under an emergency proclamation, may require the authority to enter private property to evaluate and shut off utilities that jeopardize public and private property or threaten public health, safety, or the environment. It is preferred that City agencies coordinate with utilities as needed to evaluate shut off.

3 Roles and Responsibilities of Tasked Agencies

See Appendix B for a checklist of responsibilities for tasked agencies by phase of emergency management.

4 Concept of Operations

4.1 General

Utility failures generally occur with little or no warning. Fortunately, they will likely be isolated to a portion of the City. If an incident involves a City utility, i.e., water or sanitary sewer, Public Works responsibilities cover all phases of the planning process, including the development and maintenance of the Department's standard operating procedures. For other utility failures, such as natural gas, electrical power, and telephone service, the planning responsibility includes coordination with the utility(s) affected, as well as evacuation and shelter planning for the affected population.

4.2 Utilities

Utility providers for the City include:

- PGE;
- NW Natural; and
- City of West Linn (water, sewer, surface water)

4.3 Repair and Restoration

If utility problems are created as a result of the disaster, the Public Works Department will coordinate with local utilities to repair and prioritize the restoration of vital utility services. If required, the Public Works Department will coordinate safety inspections with local utilities before the general public is allowed to return to impacted areas.

4.4 Disabilities, and Access and Functional Needs

Provision of ESF 12–related activities will take into account populations with disabilities, and access and functional needs (DAFN). The needs of the DAFN population shall be identified and planned for as directed by policy makers and according to State and federal regulations and guidance.

4.5 Coordination with Other ESFs

The following ESFs support ESF 12–related activities:

- **ESF 1 – Transportation:** Identify impacts to the City’s transportation infrastructure and develop priorities for repair and restoration.
- **ESF 2 – Communications:** Identify impacts to the City’s communication infrastructure and develop priorities for repair and restoration.
- **ESF 14 – Public Information:** Provide situation status updates and subject matter expertise to inform development of public messaging.
- **ESF 18 – Business and Industry:** Coordinate with private sector-partners to support ESF 12 activities.

5 ESF Annex Development and Maintenance

The Public Works Department will be responsible for coordinating regular review and maintenance of this annex. Each primary and supporting agency will be responsible for developing plans and procedures that address assigned tasks.

6 Appendices

- Appendix A – ESF 12 Resources
- Appendix B – ESF 12 Responsibilities by Phase of Emergency Management

Appendix A ESF 12 Resources

The following resources provide additional information regarding ESF 12– and energy-related issues at the local, state, and federal level:

City

- Water System Emergency Response Plan

County

- Emergency Operations Plan
    - ESF 12 – Energy

State

- Emergency Operations Plan
    - ESF 12 – Energy
- Energy Assurance Plan
- Oregon Resiliency Plan

Federal

- National Response Framework
    - ESF 12 – Energy

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Appendix B ESF 12 Responsibilities by Phase of Emergency Management

The following checklist identifies key roles and responsibilities for ESF 12 – Energy. It is broken out by phase of emergency management to inform tasked agencies of what activities they might be expected to perform before, during, and after an emergency to support the volunteers and donations function. All tasked agencies should maintain agency-specific plans and procedures that allow them to effectively accomplish these tasks.

Preparedness

Preparedness activities take place before an emergency occurs and include plans or preparations to save lives and to help response and recovery operations. Preparedness roles and responsibilities for ESF 12 include the following:

All Tasked Agencies

- ☐ Develop operational plans for ESF 12 activities.
- ☐ Participate in ESF 12-related trainings and exercises as appropriate.

Public Works Department

- ☐ Maintain liaison with local utilities, including the ability to contact them on a 24-hour day basis.
- ☐ Work to pre-identify DAFN populations that require energy-related support, including home dialysis and oxygen patients as well as healthcare facilities for priority restoration.
- ☐ Coordinate regular review and update of the ESF 12 annex with supporting agencies.
- ☐ Facilitate collaborative planning to ensure the City capability to support ESF 12 activities.
- ☐ Procure and maintain sources of backup power and fuel, including emergency generators.
- ☐ Pre-identify public works and debris clearance priorities that will support restoration of lifeline utilities.
- ☐ Maintain and control water.

Other Utility Providers

- ☐ Develop response and restoration plans to ensure lifeline utilities are restored as quickly as possible after a disruption.
- ☐ Establish an emergency management organization that is able to establish communication with the City Emergency Operations Center (EOC).

Response

Response activities take place during an emergency and include actions taken to save lives and prevent further property damage in an emergency situation. Response roles and responsibilities for ESF 12 include the following:

All Tasked Agencies

- ☐ Provide situational updates to the City EOC, as required, to maintain situational awareness and foster a common operating picture.
- ☐ Provide a representative to the City EOC, when requested, to support ESF 12 activities.

Public Works Department

- ☐ Coordinate with area utility partners to facilitate the efficient restoration of lifeline utilities.
- ☐ Monitor the status of lifeline utilities and provide situation status updates to the City Public Information Officer to inform public messaging.
- ☐ Assist City and community partners with obtaining fuel in support of emergency operations.
- ☐ Request support for energy-related activities through the County EOC.
- ☐ Coordinate public works and debris clearance activities to support restoration of lifeline utilities.
- ☐ Ensure that appropriate backup power sources and fuel supplies are available to support City emergency operations.
- ☐ Perform damage assessment on systems and identify problems or shortfalls in water supply. Report findings to the EOC.
- ☐ Regulate water and utility usage in times of shortage, as appropriate, ensuring that priority use is set to meet immediate and essential emergency needs.
- ☐ Within available means, protect existing water supplies and restore damaged systems.
- ☐ Prepare appropriate disaster assistance forms for submission to appropriate State and federal agencies.

Information Technology Department

- ☐ Support backup power sources and systems at the EOC.

Other Utility Providers

- ☐ Continue to operate in the tradition of self-help and inter-service mutual aid before calling for area, regional, or State assistance.
- ☐ Comply with the prevailing priority systems relating to curtailment of customer demands or loads, restoration of services, and provision of emergency services for other utilities and systems.
- ☐ In conjunction with the EOC Operations Section, determine priorities among users if adequate utility supply is not available to meet all essential needs.
- ☐ Assess the affected areas to determine operational priorities and emergency repair procedures with utility field personnel.
- ☐ Repair and restore lifeline utilities.
- ☐ Report the status of utility systems to the City EOC.
- ☐ Provide information necessary for compiling damage and operational capability reports.

Recovery

Recovery activities take place **after** an emergency occurs and include actions to return to a normal or an even safer situation following an emergency. Recovery roles and responsibilities for ESF 12 include the following:

All Tasked Agencies

- ☐ Demobilize response activities.
- ☐ Maintain incident documentation to support public and individual assistance processes.
- ☐ Participate in all after-action activities and take corrective actions as appropriate.

Mitigation

Mitigation activities take place **before and after** an emergency occurs and activities that prevent an emergency, reduce the chance of an emergency happening, or reduce the damaging effects of unavoidable emergencies. Mitigation roles and responsibilities for ESF 12 include the following:

All Tasked Agencies

- ☐ Participate in the hazard mitigation planning process for the City.
- ☐ Provide agency and incident data to inform development of mitigation projects to reduce hazard vulnerability.

Public Works Department

- ☐ Identify potential areas for mitigation strategy.
- ☐ Conduct repair and restoration activities in a manner that reduces the likelihood and severity of future damages and enhance community resiliency.

Other Utility Providers

- ☐ Conduct repair and restoration activities in a manner that reduces the likelihood and severity of future damages and enhances community resiliency.

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ESF 13 – Military Support

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ESF 13 Tasked Agencies	
Primary City Agency	Police Department
Supporting City Agency	None at this time
Community Partners	None at this time
County Agency	Clackamas County Department of Disaster Management
State Agency	Oregon Military Department
Federal Agency	Department of Defense

1 Introduction

1.1 Purpose

Emergency Support Function (ESF) 13 is intended to create awareness regarding the State's coordination of military support to civil authorities in times of emergency.

See the State of Oregon's ESF 13 – Military Support for more information.

1.2 Scope

ESF 13 activities include awareness of Oregon National Guard (Guard) forces and military resources that may be called in to assist civil authorities with the protection of life and property and to maintain peace, order, and public safety.

1.3 Policies and Authorities

None at this time.

2 Situation and Assumptions

2.1 Situation

The City is faced with a number of hazards that may require support to civil authorities by the Guard. The following considerations should be taken into account when planning for and implementing ESF 13 activities:

- A significant disaster or emergency event may result in widespread damage to existing civil infrastructure and displace great numbers of people, thus requiring a rapid, self-contained, self-sufficient deployment of skilled personnel and equipment.
- The National Guard is the only U.S. military force that operates across both State and federal responses, leveraging State Active Duty (SAD), Full-Time National Guard Duty (Title 32), and Active Duty (Title 10) personnel. While SAD, Title 32, and Title 10 are different statuses and roles, they provide mutually supporting capability.
- When Army National Guard units are not under federal control, the Governor is the commander-in-chief of the State of Oregon. The Guard is supervised by the Adjutant General of the State who also serves as the Director or Commanding General of the State military forces.

- The Governor can activate National Guard personnel to SAD in response to natural or man-made disasters or Homeland Defense missions.

2.2 Assumptions

ESF 13 is based on the following planning assumptions:

- Guard assets are available for State missions. It is understood that the federal wartime mission of all Department of Defense assets takes priority over State missions. If the Guard is federalized, it will not be available for State tasking.
- Post-disaster impact/needs assessments are an ongoing process as needs cannot be fully determined in the initial response phase of a major disaster.

3 Roles and Responsibilities of Tasked Agencies

See Appendix B for a checklist of responsibilities for tasked agencies by phase of emergency management.

4 Concept of Operations

4.1 General

The Oregon Military Department is the headquarters for the Army and the Air National Guard and supervises all matters pertaining to personnel administration, support, and logistical support of the Guard, State Defense Force, Oregon Office of Emergency Management, and all State-owned or leased armories, posts, camps, military reservations and rifle ranges.

Guard units are trained and equipped to aid in providing law enforcement, medical care, traffic control, firefighting support, resource distribution, potable water transportation, mass feeding of disaster victims, aerial surveillance of a disaster area, and limited electric power from portable generators, as well as establishing communications networks with fixed and mobile radios. The Guard may also assist in search and rescue, lifesaving, and air ambulance missions.

In peacetime, the Guard is under the command of the Governor, with its active command and administration vested in the Adjutant General. When directed by the Governor through a declaration of a state of emergency, the Guard may be placed in Active Duty status, with the State bearing financial responsibility for the committed forces, including wages, fuel, equipment maintenance, and other expenses.

It is the policy of the Governor and the Adjutant General to mobilize only Guard resources that are necessary to respond to the emergency situation.

The Oregon Military Department operates a Joint Operations Center that controls the response activities of all Guard units. The Oregon Military Department maintains a presence in the State Emergency Coordination Center (ECC) whenever the ECC is activated.

Emergency management restrictions on using Guard resources include the following:

- No State agency or local jurisdiction may employ Guard assets without approval of the State ECC. The exception to this rule is that area Commanders may render immediate aid to save lives and protect property under circumstances outlined in National Guard Regulation 500-1, Military Support to Civil Authorities.

- In general terms, Guard assets may be deployed under the following conditions:
    - The situation is beyond the control of local authorities, and formal assistance has been requested through the declaration process.
    - Requested resources are not available from commercial sources and are deployed to supplement, not replace, local efforts.
    - Assistance is limited to tasks that the Guard can accomplish more effectively or efficiently than another State agency.
- Guard resources specifically requested by State agencies or local jurisdictions will generally be provided on a cost-reimbursable basis.

4.2 Coordination with Other ESFs

The following ESFs support ESF 13–related activities:

- **ESF 1 – Transportation.** Assist in transportation of military personnel to impacted areas.
- **ESF 2 – Communications.** Augment communications resources.
- **ESF 3 – Public Works.** Assist in damage assessment, debris management, and infrastructure restoration.
- **ESF 10 – Hazardous Materials.** Provide support for chemical, biological, radiological, nuclear, and explosive incidents.
- **ESF 16 – Law Enforcement.** Provide support for law enforcement agencies.

5 ESF Annex Development and Maintenance

The Police Department will be responsible for coordinating regular review and maintenance of this annex. Each primary and supporting agency will be responsible for developing plans and procedures that address assigned tasks.

6 Appendices

- Appendix A – ESF 13 Resources
    - Attachment 1 – Military Support Overview
- Appendix B – ESF 13 Responsibilities by Phase of Emergency Management

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Appendix A ESF 13 Resources

The following resources provide additional information regarding ESF 13 and military support related issues at the local, state, and federal level:

City

- None at this time.

County

- None at this time.

State

- Emergency Operations Plan
  - ESF 13 – Military Support

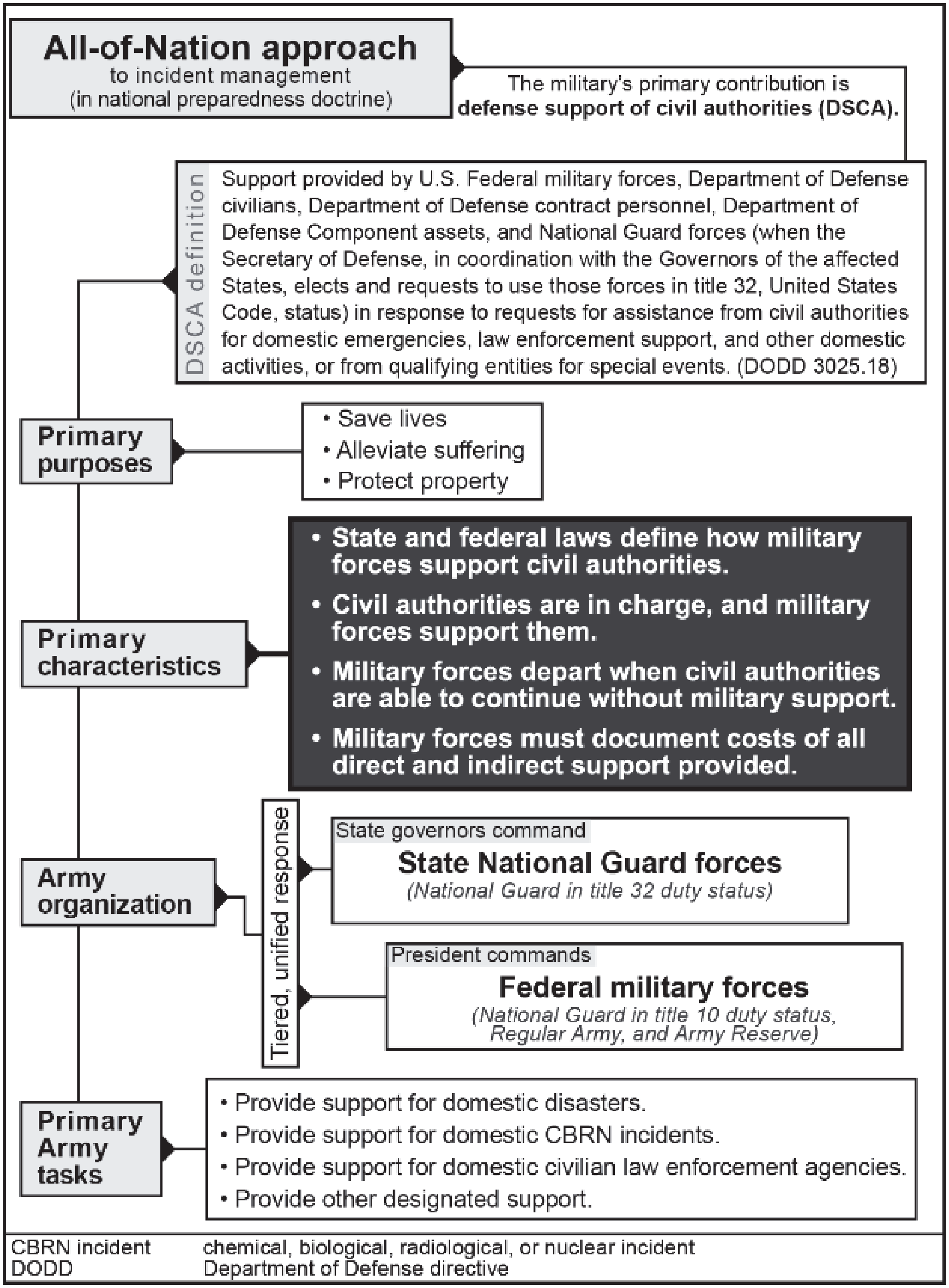
Federal

- Legislation
  - Posse Comitatus Act (Title 18, U.S. Code, Section 1385)
- National Response Framework
- National Incident Management System

Nonprofit Non-Governmental Organization

- National Emergency Management Association
  - State Emergency Management Agency Handbook

Appendix A, Attachment 1 Military Support Overview



All-of-Nation approach
to incident management
(in national preparedness doctrine)

The military's primary contribution is **defense support of civil authorities (DSCA).**

DSCA definition

Support provided by U.S. Federal military forces, Department of Defense civilians, Department of Defense contract personnel, Department of Defense Component assets, and National Guard forces (when the Secretary of Defense, in coordination with the Governors of the affected States, elects and requests to use those forces in title 32, United States Code, status) in response to requests for assistance from civil authorities for domestic emergencies, law enforcement support, and other domestic activities, or from qualifying entities for special events. (DODD 3025.18)

Primary purposes

- Save lives
- Alleviate suffering
- Protect property

Primary characteristics

- **State and federal laws define how military forces support civil authorities.**
- **Civil authorities are in charge, and military forces support them.**
- **Military forces depart when civil authorities are able to continue without military support.**
- **Military forces must document costs of all direct and indirect support provided.**

Army organization

Tiered, unified response

State governors command
State National Guard forces
(National Guard in title 32 duty status)

President commands
Federal military forces
(National Guard in title 10 duty status, Regular Army, and Army Reserve)

Primary Army tasks

- Provide support for domestic disasters.
- Provide support for domestic CBRN incidents.
- Provide support for domestic civilian law enforcement agencies.
- Provide other designated support.

CBRN incident	chemical, biological, radiological, or nuclear incident
DODD	Department of Defense directive

Appendix B ESF 13 Responsibilities by Phase of Emergency Management

The following checklist identifies key roles and responsibilities for ESF 13 – Military Support. It is broken out by phase of emergency management to inform tasked agencies of what activities they might be expected to perform before, during, and after an emergency to support the volunteers and donations function. All tasked agencies should maintain agency-specific plans and procedures that allow them to effectively accomplish these tasks.

Preparedness

Preparedness activities take place before an emergency occurs and include plans or preparations to save lives and help response and recovery operations. Preparedness roles and responsibilities for ESF 13 include the following:

All Tasked Agencies

☐ Develop operational plans for ESF 13 activities.
☐ Participate in ESF 13–related trainings and exercises as appropriate.

Emergency Manager

☐ Maintain operational capacity of the City Emergency Operations Center (EOC) to support the integration, direction, and control of the Guard during emergency response operations.

Response

Response activities take place during an emergency and include actions taken to save lives and prevent further property damage in an emergency situation. Response roles and responsibilities for ESF 13 include:

All Tasked Agencies

☐ Provide situational updates to the City EOC, as required, to maintain situational awareness and foster a common operating picture.
☐ Provide a representative to the City EOC, when requested, to support ESF 13 activities.

Police Department

☐ Coordinate with the EOC Planning Section to determine the operational status and posture of National Guard assets.
☐ Establish a Military Support Branch in the City EOC if needed.
☐ Request support for military-related activities through the State ECC.

Oregon Military Department

- ☐ Work in concert with local emergency management and other local level officials to maintain local level operational control of incident response activities.

Recovery

Recovery activities take place **after** an emergency occurs and include actions to return to a normal or an even safer situation following an emergency. Recovery roles and responsibilities for ESF 13 include the following:

All Tasked Agencies

- ☐ Demobilize response activities.
- ☐ Participate in all after-action activities and corrective actions as appropriate.

Mitigation

Mitigation activities take place **before and after** an emergency occurs and include activities that prevent an emergency, reduce the chance of an emergency happening, or reduce the damaging effects of unavoidable emergencies. Mitigation roles and responsibilities for ESF 13 include the following:

All Tasked Agencies

- ☐ Participate in the hazard mitigation planning process for the City.
- ☐ Provide agency and incident data to inform development of mitigation projects to reduce hazard vulnerability.

ESF 14 – Public Information

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ESF 14 Tasked Agencies	
Primary City Agency	City Manager's Office (Citizen Engagement Coordinator)
Supporting City Agency	Police Department All other departments
Community Partners	Lake Oswego Communications (LOCOM) West Linn Tiding (newspaper) West Linn Amateur Radio Emergency Services (in development)
County Agency	Public and Governmental Affairs
State Agency	Oregon Office of Emergency Management
Federal Agency	Department of Homeland Security/Federal Emergency Management Agency (FEMA)

1 Introduction

1.1 Purpose

Emergency Support Function (ESF) 14 describes how the City will disseminate information to the public and other partners during times of emergency (e.g., evacuation/shelter-in-place orders, water boil notices, emergency sheltering information, situational awareness notifications, etc.).

1.2 Scope

ESF 14 includes the following activities:

- Support City departments in the timely and accurate dissemination of information to the public, media, and private sector.
- Support the development of consistent and accurate messaging.

1.3 Policies and Authorities

None at this time.

2 Situation and Assumptions

2.1 Situation

The City is faced with a number of hazards that may require the dissemination of information to the public and other partners. The following considerations should be taken into account when planning for and implementing ESF 14 activities:

- The ability to disseminate information to the public during a disaster can be hampered by a variety of things, including power outages and damage to telecommunication infrastructure.
- Providing information to the public during a disaster or emergency event can be crucial in reducing the mortality rate and avoiding panic situations. It can also reduce the effect of secondary threats or cascading impacts so that the public is able to take preventative measures.

- The Emergency Alert System (EAS) is the principal method for disseminating emergency warnings and providing instruction to the public. This system relies on telecommunication infrastructure, which can be damaged or destroyed during a large scale emergency.
- Social media and online communications tools may also be used for public communications.

During emergencies, the City Manager’s Office, specifically the Citizen Engagement Coordinator, is responsible for the City Public Information Officer (PIO) function and coordinates with On-Scene Command and the Emergency Operations Center (EOC) staff to deliver timely and accurate emergency public information to inform the community, minimize confusion, recommend protective measures, and quell rumors.

The City will use all available communication methods to provide timely and consistent information to City officials and employees, individuals with disabilities, and others with access and functional needs, residents, and neighboring jurisdictions.

The Citizen Engagement Coordinator will partner with print and electronic media to get emergency information to its target audience. Electronic media enable rapid public notification of impending threats and recommended protective actions. Print media provide more detailed information for slowly developing threats and extended emergency response and recovery activities.

2.2 Assumptions

ESF 14 is based on the following planning assumptions:

- Emergencies and disasters may occur without warning at any time of day or night and may cause mass casualties.
- A public education and information program will help save lives and property during emergencies and disasters if the public knows how to prepare for them.
- In an emergency situation, the public will demand information about the emergency and the protective actions being taken.
- Local print and broadcast media will cooperate in broadcasting, publishing, and posting on the web detailed disaster-related instructions for the public.
- Normal means of communications in the affected areas may be either destroyed or largely incapacitated; therefore, only limited and incomplete information is anticipated from the disaster area until communications can be restored.
- Responding agencies will provide information to reduce public concerns about the incident and response activities.
- Sufficient numbers of trained support personnel will be available to help coordinate public information and interface with the media and appropriate agencies.
- Demands for information from media outside the jurisdiction will be significantly increased in a disaster.
- Rumors often abound, and information is usually sketchy at best. It may be hours before officials know the facts. Rumor control procedures will be directed by the designated City PIOs and will help keep incorrect information from affecting emergency response activities.

- The City PIOs maintain a listing of media contacts and EAS networks and rely on those contacts and networks for the dissemination of emergency public information.
- In a major emergency or disaster, a Joint Information Center (JIC) may be set up to help facilitate the information flow between agencies and the general public.
- Information is one of the first casualties of a disaster. The lack of information or contradictory information may cause confusion. The public may accept as valid rumors, hearsay, and inaccurate information that may cause unnecessary fear and confusion.

3 Roles and Responsibilities of Tasked Agencies

See Appendix B for a checklist of responsibilities for tasked agencies by phase of emergency management.

4 Concept of Operations

4.1 General

Until the EOC is opened, the PIO on scene provides information to the media, with the approval of the Incident Commander. Once the EOC is activated, PIO functions are directed from the EOC. The on-scene PIO will continue to provide information regarding response activities.

The PIO in the EOC will be the Lead PIO. Under the command and management structure of the Incident Command System (ICS), the Lead PIO is part of the Command Staff supporting the Incident Command structure. The PIO works directly for the Incident Commander and also coordinates public information support for the City Manager, Mayor, and City Council.

PIOs working on the incident handle all media and public inquiries, emergency public information and warnings, rumor monitoring and response, media monitoring, and other functions required to coordinate, clear with appropriate authorities, and disseminate accurate and timely information related to the incident.

In the event of a major disaster or complex incident involving multiple agencies, the Incident Commander may decide to activate a JIC. To adequately staff the JIC, the City may call on PIOs from other City departments, surrounding local jurisdictions, State agencies, and other trained non-emergency preparedness staff. PIO representatives from each participating jurisdiction, agency, and organization jointly staff the JIC, working as a team to conduct a coordinated, consistent public information program. To assist with this effort, the City will follow guidelines in the Portland Urban Area Regional Emergency Public Information Concept of Operations Plan.

4.2 Joint Information System

Providing timely and accurate public information during a major emergency or disaster of any nature is critical to the overall response efforts. A Joint Information System (JIS) will be implemented in conjunction with ICS, and a local and/or regional JIC will be established under Unified Command. During a regional or statewide emergency, the City will ensure that procedures are coordinated with those implemented by County, State and regional PIOs.

Depending on the size and nature of an incident, the JIC may be co-located with an existing EOC/command post or could be designated as an independent facility. A lead PIO, representing the lead agency for the response, will be assigned to the incident and will maintain the following responsibilities:

- Coordinate information-sharing among the larger PIO network;
- Develop and distribute materials to the general public and media partners;
- Implement information clearance processes set by EOC Command; and
- Schedule media briefings in a designated location away from the EOC and other emergency operations.

4.3 Working with the Media

4.3.1 Media Briefing Facilities

During a major emergency or disaster, media briefing areas may be established in a facility that is capable of handling them. The media briefing area should always be coordinated with the EOC Incident Command and placed some distance away from the incident location and separated from the EOC to keep critical activities free from media interference.

4.3.2 Media Access to the Scene

- The PIO will allow escorted media access to the EOC only under limited, controlled circumstances and only with the prior approval of the Incident Commander. Before being admitted to the EOC, media representatives shall display appropriate identification and shall be escorted by a member of the Public Information staff at all times.
- In cooperation with the EOC and the Safety Officer, the on-scene Incident Commander may allow media representatives restricted access to the scene, accompanied by a member of the Public Information staff. This should be done with consideration for the safety of media personnel, the impact on response, and the wishes and concerns of the victims.
- If it is not safe or practical to admit all media representatives to the scene, a media “pool” may be created, in which media representatives select one camera crew to take video footage for all. If even such controlled access is impractical, a “staged” photo opportunity to tape response vehicles or support activities may satisfy the media’s need for video footage.
- Response personnel must be protected from unwanted media intrusion. Off-shift personnel should be provided uninterrupted rest. It may be necessary to provide security to facilities where response personnel are housed and disconnect the telephones to ensure privacy. The media may be allowed access to response personnel, at the discretion of the on-scene Incident Commander, only if such an interview does not interfere with response efforts.
- Victims and families should be provided access to public officials without having to face media, as appropriate.
- When an incident takes place on private property, access will be coordinated with the owners of the site, if possible.
- If the situation should get out of control, law enforcement officials have the authority to arrest and remove members of the press (and any other unauthorized persons) who are interfering with the safe management of the incident or whose actions represent a threat to the safety of themselves, responders, or the public.

- Response personnel will not comment on the incident without the consent of the Incident Commander. Inquiries should be directed to the designated PIO, with approval of the EOC Command and the department of jurisdiction.

4.4 Dissemination of Ongoing Emergency Public Information

The PIO is responsible for:

- Collecting, coordinating, and disseminating emergency information;
- Advising on-scene and EOC Command on information and media issues;
- Advising City officials;
- Responding to media and public inquiries;
- Using an established JIS structure and procedures to coordinate incident information; and
- Staffing the JIC based on incident-specific needs.

A Public Inquiry Center, which is a single telephone number for the public to call for emergency information, may be activated to assist in preventing or correcting public misinformation about an incident. This line is staffed by call-takers trained to handle public calls and be knowledgeable about current incident status.

The PIO may also utilize social media and online or mobile application-based communication tools. As with all communications, the PIO needs to review and approve all social media messages. The City currently uses Twitter, Facebook, Instagram, Nextdoor, and FlashAlert.

4.5 Training Recommendations for PIOs

During an emergency or disaster, PIOs must be able to assemble information quickly, organize it, and use it to develop effective messages for release to the public. They must understand the ICS and how they work together to coordinate information for the public through a JIS and JIC. To ensure that PIOs possess the needed skills and background to perform these critical duties, the City recommends that all PIOs complete the following training in order to qualify for JIC duty:

- FEMA Introduction to Incident Command System training IS-100
- FEMA National Incident Management System (NIMS) and Introduction training IS-700
- FEMA National Incident Management (NIMS) Public Information Systems training IS-702

4.6 Portland Metropolitan Region Emergency Public Information

In the Portland Metropolitan Region, PIOs will use the Portland Metropolitan Region Emergency Public Information Concept of Operations Plan to conduct and coordinate crisis communications during emergency response and other situations in which multiple organizations need to collaborate to provide timely, useful, and accurate information to the public and other stakeholders.

- The plan provides implementing procedures for the operation of a regional JIS in the event of a disaster.
- The plan guides all city, county, and special district crisis communications within the Portland urban area, comprising all local jurisdictions within and including Clackamas, Clark, Columbia, Multnomah, and Washington Counties.

- The procedures contained in the plan apply to major disasters that start within the Portland urban area, as well as disasters that start elsewhere and impact the region to the extent that the coordination of emergency public information is necessary.

Refer to the Portland Metropolitan Region Emergency Public Information Concept of Operations Plan for more information. See ESF 5 – Information and Planning for further information on PIO responsibilities

4.7 Disabilities, and Access and Functional Needs Populations

The PIO coordinates information outreach activities to the disabled and access and functional needs (DAFN) populations with agencies/organizations that have an ongoing relationship with these groups and service their functional needs on a day-to-day basis. These organizations assist in disseminating alert and warning and ongoing emergency information to the elderly, hearing or vision impaired, non-English-speaking, homeless, and citizens with physical or mental challenges, or homebound or with other access or functional needs. LOCOM has teletype/ telecommunication device for the deaf (TTY/TDD) capability, text to 9-1-1, and access to language line services for communicating with non-English-speaking individuals on a one at a time basis (not a wholesale notification method).

4.8 Coordination with Other ESFs

The following ESFs support ESF 14–related activities:

- **All ESFs.** All functions will provide situation status updates and subject matter expertise to inform development of public messaging as well as disseminate approved messaging.

5 ESF Annex Development and Maintenance

The City Manager’s Office will be responsible for coordinating regular review and maintenance of this annex. Each primary and supporting agency will be responsible for developing plans and procedures that address assigned tasks.

6 Appendices

- Appendix A – ESF 14 Resources
- Appendix B – ESF 14 Responsibilities by Phase of Emergency Management

Appendix A ESF 14 Resources

The following resources provide additional information regarding ESF 14 public information related issues at the local, state, and federal level:

City

- City Communications Plan

County

- Emergency Operations Plan
    - ESF 2 – Communications
- PIO Handbook/JIS Plan (For Official Use Only)
- EAS Activation Protocol (For Official Use Only)
- Clackamas County Communications (C-COM)/Clackamas County Disaster Management (CCDM) Community Alerting System Policy

State

- Emergency Operations Plan
    - ESF 2 – Communications
    - ESF 14 – Public Information

Federal

- National Response Framework
    - ESF 2 – Communications
    - ESF 15 – External Affairs
- Federal Integrated Public Alert and Warning System

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Appendix B ESF 14 Responsibilities by Phase of Emergency Management

The following checklist identifies key roles and responsibilities for ESF 14 – Public Information. It is broken out by phase of emergency management to inform tasked agencies of what activities they might be expected to perform before, during, and after an emergency to support the volunteers and donations function. All tasked agencies should maintain agency-specific plans and procedures that allow them to effectively accomplish these tasks.

Preparedness

Preparedness activities take place before an emergency occurs and include plans or preparations made to save lives and to help response and recovery operations. Preparedness roles and responsibilities for ESF 14 include the following:

All Tasked Agencies

- ☐ Develop operational plans for ESF 14 activities.
- ☐ Participate in ESF 14-related trainings and exercises as appropriate.

City Manager’s Office/Citizen Engagement Coordinator

- ☐ Coordinate regular review and update of the ESF 14 annex with supporting agencies.
- ☐ Participate in required trainings and exercises to develop the skillsets required to effectively serve as the jurisdiction’s PIO.
- ☐ Coordinate and operate a JIC to support the coordination of public messaging among multiple response partners.
- ☐ Maintain a media contact roster.
- ☐ Facilitate collaborative planning to ensure the City’s capability to support ESF 14 activities.
- ☐ Develop pre-scripted warning messages for known hazards.
- ☐ Develop methods for distribution of materials to the public, including materials for non-English-speaking groups, if appropriate.
- ☐ Establish and maintain systems to support public information.

Response

Response activities take place during an emergency and include actions taken to save lives and prevent further property damage in an emergency situation. Response roles and responsibilities for ESF 14 include the following:

All Tasked Agencies

- ☐ Provide situational updates to the City EOC, as required, to allow for the development of timely and accurate public messaging.
- ☐ Provide a representative to the City EOC, when requested, to support ESF 14 activities.

City Manager’s Office/ Citizen Engagement Coordinator

- ☐ Serve as the lead/EOC PIO.

- ☐ Advise On-Scene and EOC Command regarding all public information issues.
- ☐ Coordinate timely, consistent information with participating agencies and jurisdictions.
- ☐ Provide staff for field PIO and JIC activities.
- ☐ Provide public information support for the City Manager and City Council, as directed by the Incident Commander.
- ☐ Develop and operate the JIS.
- ☐ Prepare and obtain EOC Command approval for all incident information releases sent to media, employees, and city and regional partners.
- ☐ Keep employees and the public updated on incident status.

LOCOM

- ☐ Provide Public Safety Answering Point back-up services to C-COM.
- ☐ Back up C-COM as the County Warning Point.
- ☐ Operate the Code Red community notification system for the LOCOM areas that contract for those services.

Police Department

- ☐ Participate in on-scene PIO and EOC JIC activities.
- ☐ Assist in disseminating emergency public information.
- ☐ Collaborate with PIO staff to develop and disseminate alert and warning messages.

City Manager and City Council

- ☐ Coordinate preparation for media interviews and press conferences with the Incident Commander and PIO.

City Employees

- ☐ Refer all requests for incident information to the PIO.
- ☐ Do not offer personal opinions, conjecture, or off-the-record comments regarding any aspect of the incident or related activities.

Recovery

Recovery activities take place **after** an emergency occurs and include actions to return to a normal or an even safer situation following an emergency. Recovery roles and responsibilities for ESF 14 include the following:

All Tasked Agencies

- ☐ Demobilize response activities.
- ☐ Maintain incident documentation to support public and individual assistance processes.
- ☐ Participate in all after-action activities and take corrective actions as appropriate.

Mitigation

Mitigation activities take place **before and after** an emergency occurs and activities that prevent an emergency, reduce the chance of an emergency happening, or reduce the damaging effects of unavoidable emergencies. Mitigation roles and responsibilities for ESF 14 include the following:

All Tasked Agencies

- ☐ Participate in the hazard mitigation planning process for the City.
- ☐ Provide agency and incident data to inform development of mitigation projects to reduce hazard vulnerability.

CCDM

- ☐ Conduct public education programs as an ongoing activity.

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ESF 15 – Volunteers and Donations Management

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ESF 15 Tasked Agencies	
Primary City Agency	Parks Department
Supporting City Agency	Police Department Library Department City Attorney Finance Department Human Resources
Community Partners	American Red Cross Local faith-based organizations
County Agency	Clackamas County Disaster Management
State Agency	Oregon Office of Emergency Management
Federal Agency	Federal Emergency Management Agency

1 Introduction

1.1 Purpose

Emergency Support Function (ESF) 15 describes how the City will coordinate with community and faith-based organizations to:

- Effectively coordinate the activities/management of pre-identified and established affiliated volunteers and solicited donations.
- Coordinate with community and faith-based groups to manage spontaneous and/or unaffiliated volunteers, as well as unsolicited donations (physical and monetary).

1.2 Scope

ESF 15 includes the following activities:

- Coordinate the disaster response activities of volunteers affiliated with City-recognized community and faith-based groups.
- Coordinate and/or provide guidance on the management and/or utilization of solicited donations (physical and monetary) received by City-recognized community and faith-based groups.
- Manage spontaneous/unaffiliated volunteers and unsolicited donations and refer them to appropriate City-recognized community and faith-based groups.
- Provide guidance to community and faith-based groups engaged in the management of spontaneous/unaffiliated volunteers and/or unsolicited donations as requested.

This annex does not supersede the plans, policies, or procedures of voluntary organizations, nor does it affect donations or volunteer assistance offered directly to voluntary agency partners. This annex also does not address organized volunteer resources that have been pre-vetted to support a specific function.

1.3 Policies and Authorities

None at this time.

2 Situation and Assumptions

2.1 Situation

The City is faced with a number of hazards that may require coordination of volunteers and donations to support response and recovery activities. The City is also supported by numerous community and faith-based partners who are able to assist facilitating volunteer support and donations management to address unmet needs. The following considerations should be taken into account when planning for the coordination and management of volunteers and donations:

- During large-scale incidents, a surge of spontaneous/unaffiliated volunteers and/or unsolicited donations may jam distribution channels, overwhelm City government and volunteer agencies, and hamper the City’s response operations.
- Despite good intentions, during a disaster spontaneous/unaffiliated volunteers and unsolicited donations are often underutilized and are often problematic for established response agencies.
- The lack of an organized system to manage physical donations (i.e., receiving, sorting, prioritizing, and distributing) has the potential to severely reduce the effectiveness of the City’s response operations.
- Careful planning reduces problems associated with spontaneous, unaffiliated volunteers.
- The timely release of information to the public regarding needs and collection points is essential to the management of donated goods and services.
- Coordinating the efforts of multiple volunteer agencies is necessary to avoid duplication of effort and redundancy in the provision of services.
- Reducing the potential for unethical management of monetary donations will be important in a disaster.

2.2 Assumptions

ESF 15 is based on the following planning assumptions:

- The arrival of spontaneous/unaffiliated volunteers is expected.
- Donations of unsolicited, non-useful, and unwanted goods can be expected.
- The City is responsible for coordinating response activities within its borders, including the management of volunteers and donations.
- Many community and faith-based organizations are experienced in managing volunteers and donations and have the capacity to receive, process, and deliver goods and services to the affected population; therefore, the City will look to those organizations to implement their existing plans, policies, and procedures to assist the City managing volunteers and donations.

3 Roles and Responsibilities of Tasked Agencies

See Appendix B for a checklist of responsibilities for tasked agencies by phase of emergency management.

4 Concept of Operations

4.1 General

All ESF 15–related activities will be performed in a manner that is consistent with the National Incident Management System and the Robert T. Stafford Disaster Relief and Emergency Assistance Act.

Requests for assistance with volunteer and donations management will first be issued in accordance with established mutual aid agreements and once those resources have been exhausted, a request may be forwarded to the County Emergency Operations Center EOC.

4.2 Disabilities, and Access and Functional Needs

Provision of ESF 15–related activities will take into account populations with disabilities, and access and functional needs (DAFN). The needs of the DAFN population shall be identified and planned for as directed by policy makers and according to State and federal regulations and guidance.

4.3 Coordination with Other ESFs

The following ESFs support ESF 15–related activities:

- **ESF 1 – Transportation:** Coordinate transportation of donated goods and volunteers to impacted areas.
- **ESF 6 – Mass Care:** Identify unmet community needs and coordinate distribution of goods and services to impacted populations.
- **ESF 7 – Resource Support:** Identify resource needs and coordinate with ESF 15 to address them.
- **ESF 8 – Health and Medical:** Coordinate healthcare volunteer (e.g., Medical Reserve Corps.) support.
- **ESF 11 – Food and Water:** Coordinate donations of food and water supplies.
- **ESF 14 – Public Information:** Inform the public of how to effectively support response and recovery through volunteering and donations**.**

5 ESF Annex Development and Maintenance

The City Manager’s Office will be responsible for coordinating regular review and maintenance of this annex. Each primary and supporting agency will be responsible for developing plans and procedures that address assigned tasks.

6 Appendices

- Appendix A – ESF 15 Resources
- Appendix B – ESF 15 Responsibilities by Phase of Emergency Management

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Appendix A ESF 15 Resources

The following resources provide additional information regarding ESF 15 volunteer and donations–related issues at the local, state, and federal level:

City

- None at this time.

County

- None at this time.

State

- Emergency Operations Plan
  - ESF 15 – Volunteers and Donations

Federal

- National Response Framework

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Appendix B ESF 15 Responsibilities by Phase of Emergency Management

The following checklist identifies key roles and responsibilities for ESF 15 – Volunteers and Donations. It is broken out by phase of emergency management to inform tasked agencies of what activities they might be expected to perform before, during, and after an emergency to support the volunteers and donations function. All tasked agencies should maintain agency-specific plans and procedures that allow them to effectively accomplish these tasks.

Preparedness

Preparedness activities take place **before** an emergency occurs and include plans or preparations to save lives and to help response and recovery operations. Preparedness roles and responsibilities for ESF 15 include the following:

All Tasked Agencies

- ☐ Develop operational plans for ESF 15 activities.
- ☐ Participate in ESF 15–related trainings and exercises as appropriate.

Parks Department

- ☐ Coordinate regular review and update of the ESF 15 annex with supporting agencies.
- ☐ Facilitate collaborative planning to ensure the City's capability to support ESF 15 activities.
- ☐ Develop and maintain a Volunteers and Donations Plan for the City that includes procedures for addressing:
  - o Spontaneous/unaffiliated volunteers
  - o Unsolicited donations (physical and monetary)
  - o Coordination with community and faith-based partners

Police Department

- ☐ Maintain the operational capacity of the City EOC to support volunteers and donations activities.
- ☐ Facilitate, in coordination with citizen emergency preparedness organizations (e.g., Map Your Neighborhood), the recruitment, training, and equipping of a cadre of disaster relief volunteers.

Finance Department

- ☐ Establish financial protocols for the management of monetary donations.
- ☐ Ensure that staff are identified and adequately trained to fulfill the finance function in the City EOC to include tracking of volunteers and donations, including monetary gifts.

City Attorney

- ☐ Advise on the legal implications and liability issues arising from volunteer and donations management.

Community and Faith-Based Organizations

- ☐ Maintain an inventory of available volunteer and material resources to support response and recovery activities.

Response

Response activities take place **during** an emergency and include actions taken to save lives and prevent further property damage in an emergency situation. Response roles and responsibilities for ESF 15 include the following:

All Tasked Agencies

- ☐ Provide situational updates to the City EOC as required to maintain situational awareness and establish a common operating picture.
- ☐ Provide a representative to the City EOC, when requested, to support ESF 15 activities.

Parks Department

- ☐ Coordinate with the EOC Planning Section to identify unmet needs.
- ☐ Establish a Volunteers and Donations Branch in the City EOC if needed.
- ☐ Designate a Volunteer Manager and coordinate establishment of a volunteer reception center or facility to facilitate the receiving, registering, and referral of spontaneous/unaffiliated volunteers.
- ☐ Designate a Donations Manager and coordinate establishment of donations reception points/staging areas, as needed.
- ☐ Coordinate with community and faith-based partners to facilitate the matching of volunteers and donations with unmet needs.
- ☐ Coordinate with community and faith-based partners to facilitate the distribution of donated relief supplies.
- ☐ Track the use of volunteers and donated resources through the EOC Finance Section.
- ☐ Communicate information to the public about how to volunteer and/or donate through the Public Information Officer.
- ☐ Request support for volunteers and donations activities through the County EOC.

Finance Department

- ☐ Manage the receipt and use of unsolicited and/or undesignated monetary donations in accordance with City, State, and federal statute.

Police Department

- ☐ Activate volunteers and coordinate resources with the EOC.
- ☐ Coordinate off-duty officers who live in the community but work in other jurisdictions.

Library Department

- ☐ Activate volunteers and coordinate resources with the EOC.

Community and Faith-Based Organizations

- ☐ Assist with the delivery of food, shelter, fuel, clothing, transportation, financial assistance, victim registration and inquiry, and other essential services.

Recovery

Recovery activities take place **after** an emergency occurs and include actions to return to a normal or an even safer situation following an emergency. Recovery roles and responsibilities for ESF 15 include the following:

All Tasked Agencies

- ☐ Demobilize response activities.
- ☐ Maintain incident documentation to support public and individual assistance processes.
- ☐ Participate in all after-action activities and take corrective actions as appropriate.

Human Resources

- ☐ Coordinate the demobilization of the volunteer reception center.
- ☐ Coordinate the demobilization of any donations reception points/staging areas, etc.
- ☐ Compile and keep all documentation relating to the management of spontaneous volunteers and unsolicited donations.
- ☐ Coordinate the disposition of unused donations.
- ☐ Coordinate all after-action activities and take corrective actions as appropriate.

Community and Faith-Based Organizations

- ☐ Distribute surplus items through existing charitable networks.

Mitigation

Mitigation activities take place **before and after** an emergency occurs and include activities that prevent an emergency, reduce the chance of an emergency happening, or reduce the damaging effects of unavoidable emergencies. Mitigation roles and responsibilities for ESF 15 include the following:

All Tasked Agencies

- ☐ Participate in the hazard mitigation planning process for the City.
- ☐ Provide agency and incident data to inform development of mitigation projects to reduce hazard vulnerability.
- ☐ Conduct public information campaigns, and continuously remind and encourage citizens, to:
    - o Join recognized community and faith-based organizations’ cadre of disaster volunteers before a disaster strikes.
    - o Contribute financial/monetary donations rather than physical donations unless otherwise requested.
    - o Give charitable donations directly to disaster relief organizations rather than to the City.

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ESF 16 – Law Enforcement

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ESF 16 Tasked Agencies	
Primary City Agency	Police Department
Supporting City Agency	Public Works Department
Community Partners	Mutual aid partners Tualatin Valley Fire and Rescue (TVF&R)
County Agency	Clackamas County Sheriff's Office
State Agency	Oregon State Police
Federal Agency	Department of Justice

1 Introduction

1.1 Purpose

Emergency Support Function (ESF) 16 describes how the City will support law enforcement activities during a time of emergency.

1.2 Scope

ESF 16 includes the following activities:

- Facilitate damage assessment of law enforcement facilities.
- Provide for the protection of life and property, traffic control, crowd control, communications, emergency first aid, site security, and security for vital City facilities and critical infrastructure.
- Provide access control/site security to support local efforts to control access to incident sites, critical facilities, and/or critical infrastructure.
- Secure and escort key emergency resources and assets when deployed.
- Assist in the facilitation of evacuation operations.

Military support to local law enforcement agencies is addressed in ESF 13 – Military Support.

1.3 Policies and Authorities

None at this time.

2 Situation and Assumptions

2.1 Situation

The City is faced with a number of hazards that may require law enforcement support. The following considerations should be taken into account when planning for and implementing ESF 16 activities:

- Routine law enforcement emergencies are managed by the respective jurisdictional agency using internal and mutual aid resources. Law enforcement response priorities are to protect the safety of emergency responders, the public, and critical infrastructure and facilities; perform investigations; and arrest and detain perpetrators.

- Significant disasters and emergency situations have the ability to damage infrastructure and lifelines, overwhelming local abilities to meet basic human needs and enforce law and order.
- Law enforcement may be faced with tremendous challenge in meeting the increased need for public assistance and aid and maintaining community security. This is often exacerbated by the presence of personnel unfamiliar with the area and local customs.
- Emergency situations may lead to increased 9-1-1 call volume, injuries and fatalities of civilians, rescue requests, looting, and violent crime.
- Local law enforcement professionals may be preoccupied with securing their own family's situation and unable to fulfill their required functions during an event. This can also lead to increased mental fatigue and stress.
- The concentration of people in public shelters and other mass gathering spots may require law enforcement personnel to maintain security. Additional security may be required to prevent looting or other crimes and unlawful entry to areas or buildings in evacuated areas or to control crowds at incident locations.
- A health emergency may require security at hospitals, shelters, pharmaceutical supply sites, dispensing sites, morgues, or other health care facilities.
- Civil disturbances and terrorist incidents may involve large angry crowds, explosives, and weapons of mass destruction, bomb threats, arson, kidnapping, or assassination threats or attempts. All incidents of this type may require resources that greatly exceed those available to the City on a day-to-day basis. The Terrorism Response and Recovery Plan is available in the Emergency Operations Center (EOC) library (controlled access).
- Routine law enforcement activities not directly related to life safety may have to be curtailed in a major emergency. Private security organizations may be used to supplement local law enforcement capabilities.

2.2 Assumptions

ESF 16 is based on the following planning assumptions:

- General law enforcement problems are compounded by disaster-related community disruption, restriction of movement, impacted communications and facilities, and a shortage of law-enforcement resources.
- Generally, law enforcement within the disaster/emergency area remains the responsibility of local authorities along established jurisdictional boundaries, unless State assistance is requested or required by statute.
- The capabilities of local law enforcement agencies may be quickly exceeded. Supplemental assistance should be requested through local and State emergency management and mutual aid agreements.
- The availability of resources will have a profound effect on agencies' abilities to perform tasked activities.

3 Roles and Responsibilities of Tasked Agencies

See Appendix B for a checklist of responsibilities for tasked agencies by phase of emergency management.

4 Concept of Operations

4.1 General

Law enforcement emergency operations will be an extension of the normal responsibilities of the Police Department. All responding law enforcement agencies have the responsibility to ensure operational capabilities. The Police Department is responsible for coordinating law enforcement services, including the following tasks:

- Assess the situation, determine its impact on law enforcement operations, and identify additional resource needs.
- Secure the area to prevent additional injury or damage.
- Provide traffic and crowd control.
- Evaluate the credibility of intelligence information.
- Investigate crime scenes.
- Coordinate warning and evacuation/shelter-in-place operations.
- Provide security for evacuated areas, critical facilities, and resources.
- Provide situation reports to the EOC.
- Enforce mandatory health measures.
- Report road damage or blockage to EOC Damage Assessment Unit or Clackamas County Communications.
- Establish traffic control points to divert traffic from damaged or overloaded roads.
- Deny entry to evacuated or dangerous areas by unauthorized persons.
- Provide additional security, if necessary, for:
  - Transportation and sheltering of prisoners from the jail and youth from Juvenile Department programs.
  - Public shelters or other mass care facilities.
  - Critical facilities such as field medical operations, health and medical providers, point-of-dispensing operations (including escorting Strategic National Stockpile supplies), chain-of-custody environmental samples, utility installations, food distribution centers, storage locations, distribution sites, and government offices.
- Coordinate with the District Attorney and presiding judge(s) when incidents impact the arrest, prosecution, incarceration, or release of prisoners, or delay due process.

When the need for multiple agency response becomes apparent or several jurisdictions become involved, Incident Command may transition from field operations to the EOC. If appropriate, a Unified Command will be established. EOC activities will be determined by the Incident Commander and may include: 1) identifying incident objectives and priorities; 2) assigning, monitoring, and coordinating incident resources, and 3) determining the need for additional resources.

4.2 Disabilities, and Access and Functional Needs

Provision of ESF 16–related activities will take into account populations with disabilities, and access and functional needs (DAFN). The needs of the DAFN population shall be identified and planned for as directed by policy makers and according to State and federal regulations and guidance.

4.3 Coordination with Other ESFs

The following ESFs support ESF 16–related activities:

- **ESF 1 – Transportation.** Support clearance of emergency transportation routes.
- **ESF 3 – Public Works.** Support crowd and traffic control operations.
- **ESF 13 – Military Support.** Augment civilian law enforcement operations as needed.

5 ESF Annex Development and Maintenance

The Police Department will be responsible for coordinating regular review and maintenance of this annex. Each primary and supporting agency will be responsible for developing plans and procedures that address assigned tasks.

6 Appendices

- Appendix A – ESF 16 Resources
- Appendix B – ESF 16 Responsibilities by Phase of Emergency Management

Appendix A ESF 16 Resources

The following resources provide additional information regarding ESF 16 and law enforcement–related issues at the local, state, and federal level:

City

- None at this time.

County

- Emergency Operations Plan
  - ESF 16 – Law Enforcement
- Technical Interoperable Communications Plan
- Regional CBRNE Response Plan

State

- Emergency Operations Plan
  - ESF 16 – Law Enforcement

Federal

- National Response Framework
  - ESF 13 – Public Safety
- Terrorism Incident Law Enforcement and Investigation Annex (https://www.fema.gov/media-library/assets/documents/25560)

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Appendix B ESF 16 Responsibilities by Phase of Emergency Management

The following checklist identifies key roles and responsibilities for ESF 16 – Law Enforcement. It is broken out by phase of emergency management to inform tasked agencies of what activities they might be expected to perform before, during, and after an emergency to support the law enforcement function. All tasked agencies should maintain agency-specific plans and procedures that allow them to effectively accomplish these tasks.

Preparedness

Preparedness activities take place **before** an emergency occurs and include plans or preparations to save lives and to help response and recovery operations. Preparedness roles and responsibilities for ESF 16 include the following:

All Tasked Agencies

- ☐ Develop operational plans for ESF 16 activities.
- ☐ Participate in ESF 16–related trainings and exercises as appropriate.

Police Department

- ☐ Coordinate regular review and update of the ESF 16 annex with supporting agencies.
- ☐ Facilitate collaborative planning to ensure the City's capability to support ESF 16 activities.
- ☐ Ensure the availability of necessary equipment to support law enforcement activities.
- ☐ Coordinate and maintain liaison with support agencies and state and federal law enforcement agencies.

Response

Response activities take place **during** an emergency and include actions taken to save lives and prevent further property damage in an emergency situation. Response roles and responsibilities for ESF 16 include the following:

All Tasked Agencies

- ☐ Provide situational updates to the City EOC as required to maintain situational awareness and establish a common operating picture.
- ☐ Provide a representative to the City EOC, when requested, to support ESF 16 activities.

Police Department

- ☐ Serve as a member of Unified Command.
- ☐ Provide staff to support EOC operations.
- ☐ Advise the City Manager, City Council, and Emergency Management Executive Committee on law enforcement aspects of the emergency and the need for an emergency declaration.
- ☐ Provide for safety of personnel and their families prior to reporting to their duty station.

- ☐ Provide traffic and crowd control, security to critical facilities and supplies, and control access to hazardous or evacuated areas.
- ☐ Provide security for special populations affected by the emergency.
- ☐ Assist with the dissemination of warnings and notifications as time and resources allow.
- ☐ Coordinate criminal investigations and provide guidance to responders on preserving crime scenes.
- ☐ Coordinate law enforcement agencies responding from outside the jurisdiction.
- ☐ Recall active duty personnel and active volunteer personnel.
- ☐ Relocate equipment as necessary.
- ☐ If applicable, coordinate with the TVF&R to establish formal exclusion zones to protect the public from hazardous materials.

TVF&R

- ☐ Coordinate fire response with law enforcement.
- ☐ Serve as a member of Unified Command.
- ☐ Provide staff to support EOC operations.
- ☐ Provide triage and first aid after the scene is secure.
- ☐ Assist in warning, evacuation, traffic control, and staging as needed.

Public Works

- ☐ Serve as a member of Unified Command.
- ☐ Provide signs, barriers, equipment, and personnel to assist in traffic control.
- ☐ Assist in road closures.
- ☐ Coordinate with the Sheriff and other agencies.
- ☐ Coordinate transportation routes and resources with adjacent cities, counties, and the Oregon Department of Transportation.
- ☐ Monitor condition and traffic on emergency transportation routes.

Recovery

Recovery activities take place **after** an emergency occurs and include actions to return to a normal or an even safer situation following an emergency. Recovery roles and responsibilities for ESF 16 include the following:

All Tasked Agencies

- ☐ Demobilize response activities.
- ☐ Maintain incident documentation to support public and individual assistance processes.

CCDM

- ☐ Compile and keep all documentation relating to the management of law enforcement operations and the assets utilized.
- ☐ Coordinate all after-action activities and implement corrective actions as appropriate.

Mitigation

Mitigation activities take place **before and after** an emergency occurs and includes activities that prevent an emergency, reduce the chance of an emergency happening, or reduce the damaging effects of unavoidable emergencies. Mitigation roles and responsibilities for ESF 16 include:

All Tasked Agencies

- ☐ Participate in the hazard/vulnerability identification and analysis process.
- ☐ Take steps to correct deficiencies identified during the hazard/vulnerability identification and analysis process as appropriate.

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ESF 17 – Agriculture and Animal Protection

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ESF 17 Tasked Agencies	
Primary City Agency	Parks and Recreation City Manager's Office
Supporting City Agency	Police Department
Community Partners	Local veterinarians and animal organizations
County Agency	Clackamas County Disaster Management (CCDM)
State Agency	Oregon Department of Agriculture (ODA)
Federal Agency	U.S. Department of Agriculture

1 Introduction

1.1 Purpose

Emergency Support Function (ESF) 17 is intended to create awareness regarding the County's coordination of effective and humane responses involving animal and agricultural issues, and work to protect natural resources, including those within the City.

1.2 Scope

Activities encompassed within the scope of ESF 17 include awareness of County resources that may be called in to assist in an animal and agricultural issue within the City.

1.3 Policies and Authorities

The Oregon Department of Agriculture (ODA), in accordance with Oregon State law, specifically Oregon Revised Statutes, Chapter 596 (Disease Control Generally) and Oregon Administrative Rules 603 Division 11, has the authority to:

- Declare an animal health emergency.
- Impose restrictions on importations of animals, articles, and means of conveyance.
- Quarantine animals, herds/flocks, parts of the State, and the entire State; create quarantine and isolation areas.
- Stop the movement of animals.
- Require the destruction of animals, animal products, and materials.
- Specify the method for destruction and disposal of animals, products, and materials.
- Indemnify owners for animals destroyed.
- Employ deputy state veterinarians and livestock inspectors.

Farm Service Agency (FSA) programs are administered through the U.S. Department of Agriculture (USDA) and are subsequently activated by the U.S. Secretary of Agriculture in support of a natural hazard event, such as drought. These include the:

- Noninsured Assistance Program;
- Emergency Conservation Program;
- Emergency Conservation Reserve Program Haying and Grazing Assistance; and
- Emergency loans.

Not all FSA programs require a disaster declaration prior to activation.

The FSA has local offices throughout the State, including in Oregon City, that are often co-located with the Natural Resources Conservation Service and/or the local soil and water conservation district office. More information about programs administered by the FSA can be accessed via the following website: http://disaster.fsa.usda.gov/fsa.asp

2 Situation and Assumptions

2.1 Situation

The City is faced with a number of hazards that may result in impacts to agriculture or natural resources, as well as potentially impacting animals. The following considerations should be taken into account when planning for and implementing ESF 17 activities:

- Numerous plant and animal diseases exist that could impact communities through natural, accidental, or intentional introduction.
- Drought and other severe weather may impact agriculture and animals throughout the City.
- Vulnerability of animals during disasters or emergencies can have impacts at both individual and commercial levels, with the potential for long-range effects on the local and State economy.
- An emergency may cause or be caused by the spread of a contagious disease through the food and water supply systems or from animals to people.
- Some animal diseases are very contagious (such as foot and mouth disease) and would be very difficult to identify, isolate, control, and eradicate. In addition, many agents are zoonotic, affecting both animals and people.
- Some plant diseases are highly infectious to other plants and can be very difficult to identify, isolate, control, and eradicate.
- Any displacement or evacuation of people from their homes may cause household pets and livestock to be placed at risk for food, shelter, and care. Local general population shelters are likely inadequately prepared for pets or livestock.

2.2 Assumptions

ESF 17 is based on the following planning assumptions:

- The owners of pets and livestock, when notified of an impending emergency, will take reasonable steps to shelter and protect their animals.
- Livestock, wildlife, birds, and crops may be affected by a disease or insect outbreak. Plants and animals may die of such an outbreak or need to be destroyed/depopulated.
- Agricultural production capability and/or value may become severely limited. This could greatly impact the economic stability and viability of a community or region.
- The time between the reporting of a disease and its identification as an emergency is critical. A highly contagious disease could spread rapidly through a region via vectors, markets, product movement, and fomites (people, vehicles, etc.).
- A community's resources would be rapidly depleted if the outbreak involved multiple facilities or large areas.

- Aggressive and proactive actions by local, State, and (possibly) federal authorities will be required in order to stop a highly contagious disease.
- Some land owners, individuals, or groups may strenuously object to depopulation of animals or destruction of plants. Some people may not consider the threat of the disease spread valid and may take actions counterproductive to control and eradication efforts.
- First responders may not be familiar with the special conditions of an animal or plant health emergency. These include quarantine, isolation, security and bio-security precautions, personal protective equipment, decontamination, etc.
- Volunteers will want to help and can make a significant contribution to response efforts.

3 Roles and Responsibilities of Tasked Agencies

See Appendix B for a checklist of responsibilities for tasked agencies by phase of emergency management and County Emergency Operations Plan (EOP), ESF 17 – Agriculture and Animal Protection for County-level roles and responsibilities

4 Concept of Operations

4.1 General

CCDM and other County departments and organizations will coordinate and/or provide the agriculture and natural resources services they are equipped to and then coordinate with other emergency response partners, especially the ODA and USDA, for emergencies that affect the local agricultural food supply, animal and plant health, and the well-being of animals in the County. If the provided services still are not adequate, the County can declare a state of emergency in accordance with the declaration requirements in the EOP Basic Plan. If the County Emergency Operations Center (EOC) is activated, agriculture and natural resources services will be coordinated through the EOC.

4.2 Agricultural Food Supply

The County will coordinate with its emergency response partners regarding the safety and viability of locally grown food (including items grown in private gardens) potentially affected by an emergency event (such as drought, flooding, a terrorist act involving hazardous or radioactive materials, etc.). This will entail coordinating with the ODA, USDA, County Health, Housing, and Human Services Department, and others regarding the safety of the local food supply and, for a national emergency, the safety of the national food supply, in order to inform and protect persons in the County.

4.3 Animal and Plant Diseases and Health

Domestic animals, wild animals, plants, and the timber industry could be vulnerable to the spread of animal or plant diseases related to an emergency. The County has procedures and policies specific to managing disease control and the health of certain animals and plants affected by an emergency, which are referenced in Clackamas County's ESF 8 – Public Health and Medical Services. Important elements to consider include the identification and control of animal and plant diseases associated with or exacerbated by an emergency; isolation or quarantine of animals; and the disposition of animals killed by the emergency or required to be destroyed as a result of the emergency.

The County will coordinate with emergency response partners for related information and services. With support from the Oregon Department of Human Services, the County will be the principal point of contact for an outbreak of a highly infectious/contagious animal or zoonotic (capable of being transmitted from animals to people) disease posing potential impacts to human health.

ODA in particular has broad expertise with animal and plant diseases and health, including the authority to:

- Declare an animal health emergency;
- Impose restrictions on importations of animals, articles, and means of conveyance;
- Quarantine animals, herds, parts of the State, and the entire State and create quarantine areas;
- Stop the movement of animals; and
- Require the destruction of animals, animal products, and materials.

Animal quarantine measures will be implemented through the County Public Health Department and do not require a court order.

4.4 Care and Assistance for Animals

The County recognizes that care and concern for domestic animals might delay and affect emergency actions necessary for the well being of humans. Planning for animals in disasters should address care and assistance for livestock, household pets, other domestic animals that are not household pets (e.g., horses), and wild animals affected by an emergency. This includes concerns such as sheltering them, evacuating them, and aiding injured or displaced animals. The County will coordinate with local emergency response partners to accomplish this, including CCDM (which might open animal evacuation shelters, for instance, at a local school), local veterinarians, ODA (for livestock and other domestic animals that are not pets), and Oregon Department of Fish and Wildlife (for wild animals).

Persons in the City and County have the primary responsibility for the health and welfare of their livestock, household pets, and other domestic animals and will be encouraged to provide for their care in an emergency to the extent possible. This is best handled by public information campaigns as part of emergency preparedness.

Additional information is provided in the County's EOP, SA 3 – Animals in Disaster.

4.5 Natural and Cultural Resources and Historic Properties

Local soil and water conservation districts and other State and federal organizations will take the lead in assessing threats to natural resources from an emergency, including water quality, air quality, forest land, fishing, wildlife, soil quality, and others. The County will coordinate with the State Historic Preservation Office and others regarding impacts to cultural resources and historic properties owned or managed by the county.

Important emergency response entities will include County and State Forestry Departments, local soil and water conservation districts, Oregon Department of Environmental Quality, Oregon Department of Fish and Wildlife, and tribal organizations.

4.6 Disabilities, and Access and Functional Needs

Provision of ESF 17–related activities will take into account populations with disabilities, and access and functional needs (DAFN). The needs of the DAFN population shall be identified and planned for as directed by policy makers and according to State and federal regulations and guidance.

4.7 Coordination with Other ESFs

The following ESFs support ESF 17–related activities:

- **ESF 3 – Public Works.** Protect historical structures.
- **ESF 6 – Mass Care.** Coordinate shelter operations for persons with service animals.
- **ESF 8 – Health and Medical.** Assist in zoonotic disease surveillance and response; regulate food safety at restaurants.
- **ESF 10 – Hazardous Materials.** Coordinate cleanup of hazardous materials incidents that impact natural resources.
- **ESF 11 – Food and Water.** Assess the status of the food supply; coordinate food and water resources for animal shelter operations.
- **ESF 15 – Volunteers and Donations.** Coordinate volunteers and donated goods to support animal shelter operations.
- **ESF 16 – Law Enforcement.** Support enforcement of animal quarantine measures.

5 ESF Annex Development and Maintenance

The Parks and Recreation Department will be responsible for coordinating regular review and maintenance of this annex. Each primary and supporting agency will be responsible for developing plans and procedures that address assigned tasks.

6 Appendices

- Appendix A – ESF 17 Resources
- Appendix B – ESF 17 Responsibilities by Phase of Emergency Management

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Appendix A ESF 17 Resources

The following resources provide additional information regarding ESF 17 and agriculture and animal protection related issues at the local, state, and federal level:

City

- None at this time.

County

- Emergency Operations Plan
  - SA 3 – Animals in Disaster

State

- Emergency Operations Plan
  - ESF 17 – Agriculture and Animal Protection
- Oregon Animal Disease Emergency Management Plan

Federal

- National Response Framework
  - ESF 11 – Agriculture and Natural Resources

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Appendix B ESF 17 Responsibilities by Phase of Emergency Management

The following checklist identifies key roles and responsibilities for ESF 17 – Agriculture and Animal Protection. It is broken out by phase of emergency management to inform tasked agencies of what activities they might be expected to perform before, during, and after an emergency to support the volunteers and donations function. All tasked agencies should maintain agency-specific plans and procedures that allow them to effectively accomplish these tasks.

Preparedness

Preparedness activities take place before an emergency occurs and include plans or preparations made to save lives and to help response and recovery operations. Preparedness roles and responsibilities for ESF 17 include the following:

All Tasked Agencies

- ☐ Develop operational plans for ESF 17 activities.
- ☐ Participate in ESF 17-related trainings and exercises as appropriate.

Parks and Recreation Department

- ☐ Coordinate regular review and update of the ESF 18 annex with supporting agencies.
- ☐ Facilitate collaborative planning to ensure capability to support ESF 18 activities.
- ☐ Maintain awareness of County-level plans related to agriculture and animal protection.
- ☐ Identify pet boarding facilities and private organizations that may provide emergency shelters for animals.

Area Farmers and Agribusiness

- ☐ Report potential or actual breaches of agricultural safety or threats to the food supply immediately.

Response

Response activities take place during an emergency and include actions taken to save lives and prevent further property damage in an emergency situation. Response roles and responsibilities for ESF 17 include the following:

All Tasked Agencies

- ☐ Provide situational updates to the City and/or County EOC, as required, to maintain situational awareness and foster a common operating picture.
- ☐ Provide a representative to the City EOC, when requested, to support ESF 17 activities.

Parks and Recreation Department

- ☐ Maintain awareness of the County's actions, recommendations, and activities during an agriculture and animal protection emergency.
- ☐ Advise City Council, the City Manager, and the Emergency Management Executive Committee of the status of the situation.

Area Farmers and Agribusiness

- ☐ Assess the impact of the emergency on agriculture.
- ☐ Report the status of agricultural operations and impacts to the County EOC.

Area Veterinarians

- ☐ Provide animal care and veterinary capabilities.

Recovery

Recovery activities take place **after** an emergency occurs and include actions to return to a normal or an even safer situation following an emergency. Recovery roles and responsibilities for ESF 17 include the following:

All Tasked Agencies

- ☐ Demobilize response activities.
- ☐ Maintain incident documentation to support public and individual assistance processes.
- ☐ Participate in all after-action activities and take corrective actions as appropriate.

Mitigation

Mitigation activities take place **before and after** an emergency occurs and include activities that prevent an emergency, reduce the chance of an emergency happening, or reduce the damaging effects of unavoidable emergencies. Mitigation roles and responsibilities for ESF 17 include the following:

All Tasked Agencies

- ☐ Participate in the hazard mitigation planning process for the City.
- ☐ Provide agency and incident data to inform development of mitigation projects to reduce hazard vulnerability.

Farmers and Agribusiness

- ☐ Conduct agriculture restoration activities in a manner to reduce the likelihood and severity of future damages and enhance community resiliency.

ESF 18 – Business and Industry

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ESF 18 Tasked Agencies	
Primary City Agency	City Manager's Office
Supporting City Agency	Community Development Department
Community Partners	Chamber of Commerce Rotary Club Area Businesses and Industry
County Agency	Business and Economic Development
State Agency	Business Oregon
Federal Agency	Small Business Administration

1 Introduction

1.1 Purpose

Emergency Support Function (ESF) 18 describes how the City will provide immediate and short-term assistance to local private-sector entities, stabilize the local economy, and effectively utilize local private-sector assets in response operations following a large-scale incident.

1.2 Scope

ESF 18 includes the following activities:

- Fostering solid partnerships among private- (business and industry) and public- (local, regional, state, federal) sector emergency management organizations (EMOs) throughout all phases of the emergency management cycle;
- Identifying and addressing any private-sector resource/capability shortfalls with the potential to destabilize the local economy if left unmet/unaddressed;
- Identifying, coordinating, mobilizing, tracking, and demobilizing resources owned and operated by the private sector that are utilized during incident response operations; and
- Helping conduct initial economic damage assessments for impacted areas.

The following activities are outside the scope of this function and are not included in this ESF:

- Developing and/or implementing private-sector Business Continuity Plans/Continuity of Operations Plans; and
- Developing and/or implementing plans to identify and thwart terrorist plots targeting facilities federally defined as critical infrastructure or a key resource (CIKR).

Private-sector entities providing critical/essential services (private utilities, hospitals, etc.) and/or operating a CIKR-designated facility are specifically addressed within an appropriate corresponding ESF Annex (e.g., privately owned hospitals are addressed in ESF 8 – Health and Medical; privately owned power/electricity utility companies are addressed in ESF 12 – Energy; etc.).

1.3 Policies and Authorities

None at this time.

2 Situation and Assumptions

2.1 Situation

The City is faced with a number of hazards, each with the potential to significantly impact its economic stability. Incidents significantly impacting the local economy will likely require the City to support the resource/capability needs of critical private-sector partners and coordinate the utilization of privately owned and operated assets utilized as part of response operations. The following planning considerations should be made in preparing for the processes by which the City will coordinate with private-sector partners to stabilize the local economy following a large-scale incident. Large-scale incidents may result in extensive damage to privately owned property (commercial and residential), and may:

- Reduce or suspend local private-sector business operations, thereby:
  - Destabilizing the overall local economy
  - Delaying the individual citizen’s ability to regain normalcy and autonomy
- Overwhelm the City’s capacity to conduct damage assessment activities.
- Delay or hamper the community’s ability to transition from incident response operations to incident recovery operations.

2.2 Assumptions

ESF 18 is based on the following planning assumptions:

- Research affirms the correlation between the efficacy of a local jurisdiction’s response/ recovery operations and the strength of relationships between the public and private-sectors (public-private partnerships).
- The successful implementation of all activities included within the scope of this function is predicated upon trust between public and private-sector entities, and a willingness to redefine the nature of existing relationships.
- Historical data show the nation’s economy to be relatively stable (despite the occasional poor performance of one or more “economic indicators”); therefore, this ESF assumes that the City will likely mobilize and initiate ESF 18 activities in the context of a stable economy.
- Private-sector entities are responsible for and will provide for the means to repair, restore, and secure, self-owned and/or operated properties with damage resulting from a hazard’s impacts.
- Some private-sector entities may routinely conduct disaster preparedness activities, and have either developed/or will develop the necessary disaster preparedness plans to ensure the safety of staff, customers/clients, and guests; sustain business operations and provide continuity of services; and augment the City’s response operations with pre-identified resources and assets.
- Private-sector entities pre-identified as owning and/or operating potentially useful response equipment are responsible for addressing matters related to maintenance, safety, and training.

3 Roles and Responsibilities of Tasked Agencies

See Appendix B for a checklist of responsibilities for tasked agencies by phase of emergency management.

4 Concept of Operations

4.1 General

All ESF 18–related activities will be performed in a manner that is consistent with the National Incident Management System and the Robert T. Stafford Disaster Relief and Emergency Assistance Act.

- In accordance with the Basic Plan and this ESF Annex, Business and Economic Development is responsible for coordinating ESF 18–related activities. Plans and procedures developed by the primary and supporting agencies provide the framework for carrying out those activities.
- Requests for assistance with business and industry will first be issued in accordance with mutual aid agreements, if established, and once those resources have been exhausted, a request may be forwarded to the County Emergency Operations Center (EOC).
- The City EOC will provide guidance for the coordination of business and industry resources.

4.2 Disabilities, and Access and Functional Needs Populations

Provision of ESF 18–related activities will take into account populations with disabilities, and access and functional needs (DAFN). The needs of the DAFN population shall be identified and planned for as directed by policy makers and according to State and federal regulations and guidance.

4.3 Coordination with Other ESFs

The following ESFs support ESF 18–related activities:

- **ESF 2 – Communications.** Coordinate with private-sector telecommunications providers.
- **ESF 3 – Public Works.** Coordinate with private-sector infrastructure partners.
- **ESF 8 – Health and Medical.** Coordinate with private-sector healthcare providers.
- **ESF 10 – Hazardous Materials.** Coordinate with private-sector partners that handle, store, or transport hazardous materials.
- **ESF 11 – Food and Water.** Coordinate with private-sector partners that may provide food and water resources.
- **ESF 12 – Energy.** Coordinate with private-sector energy utilities.
- **ESF 17 – Agriculture and Animal Protection.** Coordinate with agriculture and agribusiness industry partners.

5 ESF Annex Development and Maintenance

The City Manager's Office will be responsible for coordinating regular review and maintenance of this annex. Each primary and supporting agency will be responsible for developing plans and procedures that address assigned tasks.

6 Appendices

- Appendix A – ESF 18 Resources
- Appendix B – ESF 18 Responsibilities by Phase of Emergency Management

Appendix A ESF 18 Resources

The following resources provide additional information regarding ESF 18 and business and industry–related issues at the local, state, and federal level:

City

- None at this time.

County

- Emergency Operations Plan
  - ESF 18 – Business and Industry

State

- Emergency Operations Plan
  - ESF 18 – Business and Industry

Federal

- Federal Emergency Management Agency
  - National Response Framework
- US Small Business Administration

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Appendix B ESF 18 Responsibilities by Phase of Emergency Management

The following checklist identifies key roles and responsibilities for ESF 18 – Business and Industry. It is broken out by phase of emergency management to inform tasked agencies of what activities they might be expected to perform before, during, and after an emergency to support the volunteers and donations function. All tasked agencies should maintain agency-specific plans and procedures that allow for them to effectively accomplish these tasks.

Preparedness

Preparedness activities take place before an emergency occurs and include plans or preparations to save lives and to help response and recovery operations. Preparedness roles and responsibilities for ESF 18 include the following:

All Tasked Agencies

- ☐ Develop operational plans for ESF 18 activities.
- ☐ Participate in ESF 18–related trainings and exercises as appropriate.

City Manager's Office

- ☐ Coordinate regular review and update of the ESF 18 annex with supporting agencies.
- ☐ Facilitate collaborative planning to ensure the City's capability to support ESF 18 activities.
- ☐ Maintain operational capacity of the City EOC to support business and industry–related activities.
- ☐ Provide private-sector partners with vetted, pertinent, and useful preparedness information or EMOs throughout all phases of the emergency management cycle.
- ☐ Promote policies that encourage community-wide emergency preparedness, including business and industry partners.

Chamber of Commerce with Area Businesses and Industry

- ☐ Establish an emergency management organization to facilitate interaction, communication, and coordination with local, tribal, and State partners.
- ☐ Develop, validate, exercise, and implement security and business continuity plans to ensure their capability to deliver goods and services. Plans should include procedures to:
    - Determine the impact of an incident on the business involved, as well as forecast cascading effects of interdependencies between sectors.
    - Facilitate a shared situational awareness with local, tribal, and State EMOs.
    - Coordinate and set priorities for incident management support and response, and the rationing or prioritizing of the delivery of goods and services after an incident.
    - Inform State decision-makers to help determine appropriate recovery and reconstitution measures, particularly in cases where they may result in indemnity, liability, or business losses for the private sector.
    - Support local, tribal, and State partners to obtain goods and services necessary for the restoration and recovery of impacted business and industry on a priority basis.
- ☐ Conduct assessments of, and develop contingency plans for, supply chain disruption.

- ☐ Maintain business interruption insurance.
- ☐ Coordinate plans for security and continuity/contingency programs with local, tribal, and State partners.

Response

Response activities take place during an emergency and include actions taken to save lives and prevent further property damage in an emergency situation. Response roles and responsibilities for ESF 18 include the following:

All Tasked Agencies

- ☐ Provide situational updates to the City EOC, as required, to maintain situational awareness and a foster a common operating picture.
- ☐ Provide a representative to the City EOC, when requested, to support ESF 18 activities.

City Manager's Office

- ☐ Coordinate with the EOC Planning Section to determine the impacts to the City's business community.
- ☐ Establish a Liaison Officer in the City EOC if needed to reach out to business and industry partners.
- ☐ Coordinate with business and industry partners around opportunities for private-sector support to response operations.
- ☐ Request support for business and industry–related activities through the State Emergency Coordination Center.

Chamber of Commerce with Area Businesses and Industry

- ☐ Assess the impact of the emergency on business.
- ☐ Provide goods and services through contractual arrangements or government purchases, or, where appropriate, mutual support agreements with impacted communities.
- ☐ Utilize existing agreements and contracts to obtain needed resources.
- ☐ Implement business continuity plans.
- ☐ Report status of business operations and impacts to the City EOC.

Recovery

Recovery activities take place **after** an emergency occurs and include actions to return to a normal or an even safer situation following an emergency. Recovery roles and responsibilities for ESF 18 include the following:

All Tasked Agencies

- ☐ Demobilize response activities.
- ☐ Maintain incident documentation to support public and individual assistance processes.
- ☐ Participate in all after-action activities and take corrective actions as appropriate.

Mitigation

Mitigation activities take place **before and after** an emergency occurs and include activities that prevent an emergency, reduce the chance of an emergency happening, or reduce the damaging effects of unavoidable emergencies. Mitigation roles and responsibilities for ESF 18 include the following:

All Tasked Agencies

- ☐ Participate in the hazard mitigation planning process for the City.
- ☐ Provide agency and incident data to inform development of mitigation projects to reduce hazard vulnerability.

Chamber of Commerce with Area Businesses and Industry

- ☐ Conduct business restoration activities in a manner to reduce the likelihood and severity of future damages and enhance community resiliency.

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Support Annex

SA 1 – Continuity of Service

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1 Description

A continuity of service emergency is defined as any situation in which the loss or reassignment of personnel resources threatens the City's ability to provide mandated services. Any number of scenarios may require major reorganization of City personnel resources. Strikes may result in large numbers of employees being absent from the workplace; the long-term recovery demands of a major disaster may require that personnel be assigned to incident management, leaving their day-to-day duties uncovered. Some services are required by law, others by City policy and internal priorities. It is the City's policy that normal services be continued as long as possible under all circumstances.

The loss or reassignment of a major portion of the City's personnel resources is considered an emergency under the City's Emergency Operations Plan (EOP). This continuity of service plan is designed to assist City departments in meeting their service commitments while allowing maximum flexibility to meet the needs of the emergency.

2 Continuity of Service Planning

The City Manager's Office is the lead agency for continuity of service emergencies. The City Manager may assume the role of Incident Commander in the event of a strike, or form part of a Unified Command structure if continuity of service issues arise as the result of a technological or natural disaster. Other departments will support the response effort as directed by the Incident Commander.

3 General Guidelines

3.1 Service Priorities

The services provided by City departments can be classified into three tiers, based on their level of importance to the community:

- Tier I Services – Services that must be performed to maintain public health and safety.
- Tier II Services – Services that should be performed to avoid major inconvenience or financial loss to the City or its citizens, and/or that are critical to the function of the individual department.
- Tier III Services – Routine services that can be delayed for a short time (one month or less) without serious consequences.

3.2 Coordination

The Incident Command System (ICS) may be activated to respond to the loss or reassignment of personnel resources. The ICS organization may be activated to manage the reorganization process as its only strategic goal (such as for a strike) or as part of the overall response to a major emergency (such as would follow an earthquake).

4 Levels of Activation

Continuity of service issues may arise with a long warning period, such as for a strike, or as an immediate critical need. The following levels may be used as a guideline for initiating planning efforts.

4.1 Level I

Level I activities require continuity of service planning for a single department. Continuity planning at this level is the responsibility of the affected department, with assistance as needed from the Human Resources Department, and will not require activation of the City EOP.

4.2 Level II

Level II activities require continuity of service planning for two or more departments. Activation of the City EOP at Level II is at the discretion of the affected departments and the City Manager.

4.3 Level III

Level III activities involve the loss or immediate reassignment of a major portion of the workforce. At this level, the City EOP is activated under the direction of the City Manager and/or Unified Command organization.

5 Incident Command Staff Responsibilities

Because issues relating to continuity of service differ significantly from normal emergency response activities, the following checklist is provided in addition to the position-specific checklists found in the Emergency Operations Center (EOC).

5.1 Command/Command Staff

- ■ Assess the impact of the emergency on the ability of a department or the City as a whole to continue normal services.
- ■ Reassign department or City resources as necessary to meet the needs of the emergency.
- ■ Activate ICS organizational elements as needed to manage the incident.
- ■ Prioritize service delivery by department.
- ■ Identify resource shortfall; determine sources for additional assistance.
- ■ Authorize procurement of personnel resources as needed to maintain priority services.
- ■ Establish and maintain cost accounting mechanisms.
- ■ Confirm public information policy and process.

5.1.1 Information Officer

- ■ Receive briefing from Command.
- ■ Determine responsibilities of the Information function regarding:
    - Recruitment
    - Discussion of contract negotiations
- ■ Obtain approval from Command for press releases.
- ■ Staff the function appropriately.

5.1.2 Liaison Officer

- Obtain briefing from Command.
- Determine responsibility for continuity of service analysis (in the event of a strike, Operations may be responsible for this activity).
- Establish and maintain contact with directors of impacted departments.
- Conduct continuity of service analysis as assigned. Determine as needed:
  - Status of priority service delivery by department
  - Availability of additional resources
  - Special resource needs
  - Special resource qualifications
  - Contract issues that may affect the use of department resources.
- Determine resource ordering process.
- Staff the function appropriately (this may require a representative from each impacted department).

5.2 Operations Section

The description below includes all department directors in the Operations organization, and each will complete the tasks described below.

- Determine services that are required by law, City policy, or department priorities.
- Assess the impact of an emergency on departments’ priority service delivery.
- Determine whether there is a resource shortfall.
- Perform emergency callback of City personnel as needed (police records may assist in this task).
- Activate mutual aid assistance as necessary.
- Identify the need for temporary hires or reassignment of personnel from other departments. Consider:
  - Task assignments
  - Personnel class required
  - Special qualifications needed
  - Approximate duration of assignment (if known)
  - Potential source (if known).
  - Date/time/reporting location
  - Person to whom the resource should report
- Obtain approval for temporary hires from Command.
- Place requests for temporary hires with Logistics.
- Monitor use of reassigned or temporary-hire personnel. Release as soon as possible.

5.3 Planning Section

See the Basic Plan and position-specific checklists in the EOC for more information.

5.4 Logistics Section

See the Basic Plan and position-specific checklists in the EOC for more information.

5.5 Finance Section

Finance Section responsibilities include coordination with the City's insurance carriers, assisting the Safety Officer, as requested and other duties as described Basic Plan.

See the Basic Plan and position-specific checklists in the EOC for more information.

6 Department Responsibilities

6.1 All Departments

- Determine services that are required by law, City policy, or department priorities (Tier I and II services).
- Conduct department continuity of service analysis.
- Determine need for additional resources. Consider emergency callback of all department employees.
- Activate volunteers, department reserves, and/or existing consulting contracts as appropriate.
- Activate mutual aid resources as necessary.
- Request additional resources according to established procedures.

6.2 Administration

- Establish and maintain contact with the Mayor and City Council.
- If a strike is anticipated, request the City Attorney's Office to develop a city strike policy.
- Direct all City departments to complete continuity of service analysis. Include:
  - Timelines
  - Format for the information
- Tier I and II services required by law may include:
  - Support to Mayor and City Council
  - Recording services
  - Emergency documentation
  - Mediation services
  - Liaison between emergency organization and Mayor and City Council

6.3 Human Resources

- Assume command.
- Staff the incident management organization as needed.
- Assign personnel to the negotiation process as needed.
- Tier I and II services required by law may include:
  - Recruitment
  - Compensation and benefits administration
  - Labor relations
- Establish/confirm the resource ordering process.
- Assign personnel to Logistics (Supply Unit) as needed.
- Assist the City Manager's Office and/or lead agency as requested.

6.4 Finance Department

- Staff the Incident Command organization as needed.
- Tier I and II services required by law may include:
    - Risk management
    - Time/payroll processing
    - Liquor licensing
    - Service billings (includes installment financing)
    - Process payments (includes rents, bond/tax payments)
    - Customer service – open/close accounts
    - City lien processing
    - Sewer collection
    - City banking and deposit functions
    - Staffing the Finance Section as required
    - Oversee operations-related purchasing
- Review the City's insurance policies for covered losses. Assist in collection of funds from policies.
- Establish/confirm resource ordering process.
- Assign personnel to Logistics (Supply Unit) as needed.
- Assist the City Manager's Office and/or lead agency as requested.

6.5 Tualatin Valley Fire and Rescue

- Tier I and II services required by law may include:
    - Fire suppression
    - High hazard/public occupancy inspections
    - Fire code enforcement
    - Arson investigation
    - Hazardous materials response
    - Emergency medical services
    - Plan review
    - Emergency response
- Assist Administration and/or lead agency as requested.

6.6 Police Department

- Tier I and II services required by law may include:
    - Confirmation of out of County warrants
    - Entry of stolen/recovered vehicles
    - Entry of missing/returned persons
    - Assignment of case numbers
    - Validate computer entries
    - Entry of part 1, UCR crime data
    - Street patrol
    - Criminal investigation
    - Operations-related support services

  - Emergency response
- Assist Administration and/or lead agency as requested.

6.7 Planning and Building Department

- Tier I and II services required by law may include:
  - Building safety inspections
  - Emergency or critical facility permit review
  - General building permit review and inspection
  - Public notices
  - Development permits
  - Construction plan review (public facilities)
  - Commercial building permit review (public facilities)
  - Public facility permit issuance
- Assist Administration and/or lead agency as requested.

6.8 Engineering

- Tier I and II services required by law may include:
  - Building safety inspections
  - Emergency or critical facility permit review
  - General building permit review and inspection
  - Public notices
  - Development permits
  - Construction plan review (public facilities)
  - Commercial building permit review (public facilities)
  - Public facility permit issuance
  - Map services
  - Capital improvements
- Assist Administration and/or lead agency as requested.

6.9 Public Works

- Tier I and II services required by law may include:
  - Water quality sampling (state and federal mandates)
  - Back/flow cross connection
  - Underground utility line locates
  - Water/sewer line and service repairs
  - Reservoir and pump station repairs
  - Park equipment repair
  - Garbage/litter pickup
  - Mowing
  - Street signing/striping
  - Catch basin maintenance
  - Flood response
  - Snow removal/sanding

- Assist Administration and/or lead agency as requested.

6.10 City Attorney

- Tier I and II services required by law may include:
    - Legal support to the Mayor and City Council
    - Legal support to incident management organization
    - Ongoing litigation
- Assist Finance and/or lead agency as requested.

6.11 Municipal Court

- Assist Administration and/or lead agency as requested.

6.12 Parks Department

- Assist Administration and/or lead agency as requested.

6.13 Library

- Assist Administration and/or lead agency as requested.

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Incident Annex

Incident Annex

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Table of Contents

1 Hazard Descriptions

This annex includes the following incidents, as well as action items and information specific to the incident type.

- Natural Hazards:
    - Earthquake
    - Major Fire
    - Public Health Incident
    - Severe Weather (including thunderstorm and lightning, tornado, windstorm, hailstorm, severe winter storm, landslides, generalized flooding, and drought)
    - Volcano
- Human-Caused and Technological:
    - Hazardous Materials
    - Transportation Accidents (including air, rail, and roads)
    - Terrorism
    - Utility Failure

1.1 Earthquake

An earthquake of 5 or greater on the Richter Scale may or may not cause widespread damage, but it is a situation that may warrant activation of the Emergency Operations Center (EOC) to better coordinate the flow of information and damage assessment needs.

Initially, the lead agencies for earthquake response will be the Police Department and Tualatin Valley Fire & Rescue (TVF&R). As the initial assessment to determine the extent of damage, injury, and loss of life has been accomplished, the EOC's Operations Section lead may be transitioned to TVF&R.

As emergency response transitions from rescuing casualties to restoring critical services, the Public Works Department may be expected to assume the role of lead department in the Operations Section for the City's earthquake response. The Public Works Department's efforts in the response and early recovery phase of the disaster will likely concentrate on reestablishment of public infrastructure facilities.

See the City Natural Hazard Mitigation Plan for more information.

1.2 Major Fire

A major fire is an instance of uncontrolled burning that may involve grasslands, brush, or woodlands, as well as multiple structures. There is an increasing vulnerability to such fires, due to the increasing number of homes in fire-prone areas. The costs of fighting the wildland fires today, including using heavy equipment, helicopters, office and communications equipment, and feeding and housing responders, can be very high. Fuel, slope, weather, and development are key components in wildfire hazard identification.

The lead agency for major fire response will be the TVF&R, with support from the Police Department to control traffic.

See the City Natural Hazard Mitigation Plan for more information.

1.3 Public Health

For the purpose of this annex, the following incidents are included under public health:

- Endemic and pandemic outbreaks
- Contamination concerns
- Biological- and chemical-terrorism

Each public health incident may have its own characteristics, including interaction with other hazards identified in this annex. For example, water contamination could be the result of massive flooding.

The nature of the public health incident will determine agency involvement, but it is anticipated that County Health, Housing, and Human Services (H3S) will serve as the lead agency in this type of event.

1.4 Severe Weather

For the purpose of this annex, the following individual hazards are included under severe weather:

- Flooding (generalized)
- Hailstorm
- Landslides
- Severe winter storm
- Thunderstorm and lightning
- Tornado
- Windstorm
- Drought – areas that may experience impacts

Each weather hazard will have its own characteristics, including time of year it is most likely to occur, severity, and associated risk; however, many hazards are interrelated. For example, wind is a factor in thunderstorms and severe winter storms and hailstorms and rain can contribute to landslides.

The nature of the severe weather will determine agency involvement, but the Public Works Department will be heavily involved in leading operations.

See the City Natural Hazard Mitigation Plan for more information.

1.5 Volcano

Oregon’s vulnerability to volcanic emergencies varies across the State. The Cascade Mountains, which separate Western Oregon from Central Oregon, pose the greatest threat of volcanic activity. Regions that include the Cascade Mountains are most vulnerable to the effects of a volcanic event. Within the State of Oregon, there are several specific volcanoes that may pose a threat of eruption, most notably Mount Hood, which most recently erupted about 200 years ago, and the Three Sisters and Mt. Jefferson, which have not erupted for about 15,000 years but are not considered extinct.

Initially, the lead agencies for volcano response will be the police and TVF&R. As the initial assessment to determine the extent of damage, injury, and loss of life has been accomplished, the EOC’s Operations Section lead may be transitioned solely to TVF&R. As emergency response transitions from rescuing casualties to restoring critical services, the Public Works Department may be expected to assume the role of lead department in the Operations Section for the City’s volcano response. Public Works Department efforts in this response and early recovery phase of the disaster will likely concentrate on reestablishment of public infrastructure facilities.

See the City Natural Hazard Mitigation Plan for more information.

1.6 Hazardous Materials

Hazardous materials are stored, used, and transported using roads, rail lines, pipelines, or flight paths. Numerous industries and businesses use chemicals that pose a threat to their own private property and employees. In addition, in some instances where a hazardous materials plume is released, it may affect neighboring businesses and communities.

The lead agency for hazardous materials response will be Oregon State Fire Marshal Hazmat Teams, with support from the Police Department to control traffic.

1.7 Transportation Accidents (Including Air, Rail, and Road)

The Federal Aviation Administration and National Transportation Safety Board (NTSB) have the authority and responsibility to investigate all accidents involving aircraft. It is NTSB policy to be on the scene of a major accident as soon as possible. In minor aircraft accidents, the Federal Aviation Administration may respond to the scene instead of the NTSB. The Department of Defense has the authority to investigate any accident involving military aircraft.

Motor vehicle accidents that occur on roadways within the City would not normally constitute a major emergency under the EOP, unless hazardous materials or mass casualties/fatalities complicate the incident. The Police Department and TVF&R will assume initial command if the transportation accident involves a fire and/or casualties and to secure the incident site.

1.8 Terrorism

This annex can be applied to incidents involving weapons of mass destruction and chemical, biological, radiological, nuclear, and explosive (CBRNE) materials.

The Police Department has the lead role in terrorism crisis management within the City, and the County Sheriff’s Office maintains authority in unincorporated segments of the County. The lead agencies for the State and federal government are Oregon State Police and the Federal Bureau of Investigation (FBI).

The laws of the United States assign primary authority to state and local governments to respond to the consequences of terrorism; the federal government provides assistance as required. The City and County EOCs typically will be activated and have the lead role in terrorism consequence management for most types of terrorist incidents, but H3S will be assigned the lead local role in terrorism consequence management for incidents involving biological agents. The Oregon Office of Emergency Management and Federal Emergency Management Agency (FEMA) are the State and federal consequence management leads, respectively.

1.9 Utility Failure

A utility failure causing a disruption to the normal operations of electricity, water, wastewater, gas, internet, and telephone services can happen at any time. While these shortages may result from natural or human causes, the severity of the incident must be measured by how seriously the shortage amount and duration impacts life and property.

The type of utility will determine agency involvement, but the Public Works Department will be heavily involved in leading operations. Involvement from utility companies will be required to ensure service restoration.

2 Pre-Incident Actions

2.1 General

The following pre-incident action items are appropriate to most incidents; however, the actions should be evaluated for appropriateness in any given situation and do not replace common sense or standard operating procedures (SOPs).

- Determine the key stakeholders that should be notified of the arising situation.
- Consider limited activation of the EOC.
- Conduct pre-incident planning for protective actions (e.g., sheltering-in-place, evacuation, activation of warming shelters).
- Identify and review established evacuation routes and alternate routes for areas vulnerable to the incident.
- Prepare public information materials to inform residents and businesses of protective measures. Utilize multiple media types, including print, television, radio, and social media.
- Identify and review existing agreements for mutual support and identify additional community partners, including local contractors, vendors, and private organizations that may be able to assist.
- Anticipate potential unmet needs or resource shortfalls and identify strategies for meeting those needs.
- Identify and review procedures for registering mutual aid and other first responders as they arrive on the scene and receive deployment orders.
- Identify and review existing SOPs and agency-specific protocols specific to the incident. Ensure that copies of all documents are available to response personnel as necessary.
- Ensure that all departments are notified to provide situational awareness to the Emergency Manager and/or the EOC if activated.
- Prepare disaster declaration materials if appropriate. Brief key leadership.
- Conduct just-in-time training based on incident requirements.

2.2 Earthquake

In addition to the pre-incident actions listed in Section 2.1, the following action items may be appropriate:

- Monitor the Pacific Northwest Seismic Network (https://www.pnsn.org/).
- Identify potential protective measures, including:
    - Pre-identified evacuation routes and alternate routes for areas vulnerable to earthquakes to ensure accuracy
    - Appropriate infrastructure protection measures in landslide-prone areas

- Evaluate current resources and identify potential needs and shortfalls (e.g., bridge-free evacuation routes, assembly sites, viable shelter locations).

2.3 Major Fire

In addition to the pre-incident actions listed in Section 2.1, the following action items may be appropriate:

- Monitor updated fire danger ratings detailing weather trends, fuel types, and likely fire characteristics.
- Identify potential protective measures, including:
  - Pre-identified evacuation routes and alternate routes for areas vulnerable to the fire
  - Relocating equipment and personnel out of vulnerable areas
- Evaluate current resources and identify potential needs and shortfalls (e.g., water sources, equipment, personnel).

2.4 Public Health

In addition to the pre-incident actions listed in Section 2.1, the following action items may be appropriate:

- Coordinate with H3S to monitor and report the presence of contagious infection within the City.
- Identify potential protective measures, including:
  - Encouraging personnel to obtain vaccinations
  - Encouraging work-from-home options
  - Encouraging personnel to wear N95 face masks or respirators, as appropriate
- Evaluate current resources and identify potential needs and shortfalls (e.g., medical supplies and equipment, personnel).
- Engage with public health organizations to ensure the presence of adequate supplies and medical equipment.
- Identify and review drinking water quality plans.
- Identify and review wastewater and sewage disposal plans.

2.5 Severe Weather

In addition to the pre-incident actions listed in Section 2.1, the following action items may be appropriate:

- Monitor weather reports (http://www.weather.gov/, http://www.spc.noaa.gov/).
- Identify potential protective measures, including:
  - Reviewing pre-identified cooling center locations
  - Reviewing pre-identified warming center locations
  - For precipitation and flooding, identifying areas that will likely need sandbagging to protect residents and property
- Evaluate current resources and identify potential needs and shortfalls (e.g., cooling centers, warming centers, alternative water sources, sandbags).

- Participate in severe weather preparedness activities, seeking an understanding of interactions with participating agencies in a severe weather scenario.

2.5.1 Flooding

In addition to the pre-incident actions listed in Section 2.1 and 2.5, the following action items may be appropriate:

- Monitor expected rainfall and river, creek, and tributary levels.
- Identify potential protective measures, including:
  - Pre-identified evacuation routes and alternate routes for areas vulnerable to flooding
  - Appropriate infrastructure protection measures in landslide/flood-prone areas
- Evaluate current resources and identify potential needs and shortfalls (e.g., sandbags, equipment, clear evacuation routes, assembly sites, shelter locations, road closure signage, evacuation route signage).
- Become familiar with flood-prone areas and the challenges they face.
- Ensure that sandbags and other necessary equipment and supplies are prepared and ready to use.

2.5.2 Drought

In addition to the pre-incident actions listed in Section 2.1 and 2.5, the following action items may be appropriate:

- Monitor rainfall, weather, crop and livestock conditions, and water availability.
- Identify potential protective measures, including:
  - Alternative sources of drinking water
  - Working with the local water service provider to implement water conservation efforts
  - Working with local farmers to implement herd management strategies
- Evaluate current resources and identify potential needs and shortfalls (e.g., potable water, water for agricultural needs, financial support, firefighting).
- Pre-designate alternative sources of drinking water in case of drought or other water shortage event.

2.6 Volcano

In addition to the pre-incident actions listed in Section 2.1, the following action items may be appropriate:

- Monitor volcanic activity and wind direction.
- Identify potential protective measures, including:
  - Pre-identified evacuation routes and alternate routes for areas vulnerable to projected ashfall areas
  - Implementing shelter-in-place plans
  - Identifying traffic control needs
- Identify potential resource needs (e.g., ash removal equipment, masks, shelters).

2.7 Transportation Accident (Including Air, Rail, and Road)

In addition to the pre-incident actions listed in Section 2.1, the following action items may be appropriate:

- Monitor weather reports for severe weather that may make it challenging for drivers, pilots, and rail operators to see and/or control their vehicles, aircraft, and railcars (e.g., excessive rainfall, fog, snow, ice).
- Identify potential protective measures, including:
  - Assessing the City's transportation infrastructure (e.g., roads, bridges, and traffic control devices) and implementing an emergency transportation route plan
  - Closure of roads or bridges that are experiencing flooding or icy conditions
- Evaluate current resources and identify potential needs and shortfalls (e.g., traffic management supplies, personnel, mass fatality and mass casualty needs).
- Ensure that City personnel are aware they should not attempt to remove accident-related debris from the accident area except as necessary to facilitate fire suppression, rescue, and emergency medical care.

2.8 Terrorism

In addition to the pre-incident actions listed in Section 2.1, the following action items may be appropriate:

- Monitor social media and other avenues for potential terrorism-related threats.
- Identify potential protective measures, including:
  - Shelter-in-place resources and activities
  - Pre-identified evacuation routes and alternate routes for potential targets of terrorist activity
- Evaluate current resources and identify potential needs and shortfalls (e.g., personnel trained in hazardous materials response, shelter-in-place supplies, police services).
- Ensure that City personnel have a basic awareness of hazardous materials response and whom to contact.

2.9 Utility Failure

In addition to the pre-incident actions listed in Section 2.1, the following action items may be appropriate:

- Monitor severe weather reports that may affect utilities (e.g., high winds, drought, flooding).
- Identify potential protective measures, including:
  - Removal of tree branches or trees from power line areas
  - Coordination with schools, daycare centers, nursing homes, rest homes, hospitals, etc. in proper precautions and emergency actions prior to a utility failure
  - Confirming emergency contact information for each utility that provides service in the area
  - Checking emergency generators to ensure they are in working condition and adequate fuel

  - Review of hazard information for vital facilities and the impact of a major utility failure on one or more of those facilities.
  - Coordination with utilities to procure and produce information for distribution to the public (e.g., What to Do When the Lights Go Out).
- ■ Evaluate current resources and identify potential needs and shortfalls (e.g., generators, equipment for clearing roads of debris, personnel).

3 Response Phase Actions

3.1 General

The following response action items are appropriate to most incidents; however, the actions should be evaluated for appropriateness in any given situation and do not replace common sense or SOPs.

- ■ Activate local warning/alert systems as appropriate.
- ■ Provide Just in Time training as appropriate.
- ■ Assist the EOC Safety Officer in ensuring actions are taken to protect personnel and emergency equipment from possible damage by the incident.
- ■ Conduct EOC operations in accordance with the Incident Action Planning process. See https://goo.gl/FaMF8T for more information.
- ■ Activate mutual aid as needed, including placing backup teams on standby.
- ■ Ensure that all required notifications have been completed. Consider the following:
  - Local, regional, State, and federal agencies/entities that may be able to mobilize resources to support local response efforts
  - Mutual aid partners
  - Private-sector partners with whom existing contracts are in place
  - Adjacent jurisdiction EOCs
  - Agency operations centers
- ■ Coordinate resource access, deployment, and storage in the operational area and track resources as they are dispatched and/or used.
- ■ Determine the need for an emergency/disaster declaration and submit as needed.
- ■ Facilitate public information through the Public Information Officer (PIO) with approval by the EOC Incident Commander.
- ■ If appropriate, establish and/or participate in a Joint Information Center and designate a lead PIO for the City.
- ■ Maintain incident documentation, including financial records for potential reimbursement.
- ■ Develop appropriate reports to maintain situational awareness, including, but not limited to:
  - Damage assessment
  - Repair and restoration of essential services and vital systems needed
  - Injuries and deaths
  - Major equipment damage accrued during response activities
- ■ Develop and deliver situation reports (recurring action at regular intervals). *[ICS Form 209 – Incident Status Summary]*

- Develop and regularly update the Incident Action Plan (recurring action). *[ICS Form 202 – Incident Objectives, ICS Form 203 – Organization Assignment List, ICS Form 205 – Incident Radio Communications Plan, ICS Form 206 – Medical Plan, ICS 208 – Safety Message, Incident Map]*

3.2 Earthquake

In addition to the response actions listed in Section 3.1, the following action items may be appropriate:

- Continue to monitor the Pacific Northwest Seismic Network for aftershocks.
- Monitor secondary hazards associated with earthquakes (e.g., ruptured utility lines, hazardous spills, fires, building collapses).
- Implement protective measures (e.g., evacuation, stand up assembly areas, activate shelters, traffic control, search and rescue).
- Coordinate debris management activities (e.g., clear right-of-way, establish temporary debris storage sites).
- Identify transportation resources to move people and equipment as necessary.

3.3 Major Fire

In addition to the response actions listed in Section 3.1, the following action items may be appropriate:

- Continue to monitor weather reports, including wind, expected rainfall, and thunderstorm reports.
- Monitor secondary hazard associated with fires (e.g., public health, erosion, landslides, introduction of invasive species, changes in water quality).
- Implement protective actions (e.g., evacuations, relocation of equipment and personnel).
- Coordinate debris management activities (e.g., clear right-of-way, establish temporary debris storage sites).

3.4 Public Health

In addition to the response actions listed in Section 3.1, the following action items may be appropriate:

- Continue to coordinate with H3S to monitor and report the presence of public health incidents within the City.
- Implement protective measures, in coordination with H3S, to minimize the spread of disease (e.g., wash hands frequently, wear mask, vaccination, work from home).
- Establish access control to quarantine areas through local law enforcement agencies.
- Collect and report vital statistics to H3S or the County EOC if activated, including injuries and/or deaths due to the public health emergency.
- Coordinate with the County to plan for transportation of mass casualties to suitable care facilities and mass fatalities to suitable emergency morgue facilities.
- Coordinate with H3S to ensure that public information being released is appropriate and in line with their messaging.

3.5 Severe Weather

In addition to the response actions listed in Section 3.1, the following action items may be appropriate:

- Continue to monitor weather reports and models to project potential damage and determine the affected areas.
- Monitor secondary hazards associated with severe weather (e.g., landslides, agricultural water needs, transportation infrastructure damage).
- Implement protective measures (e.g., activate warming or cooling centers, provide sandbag materials and equipment, traffic control measures).
- Coordinate debris management activities (e.g., clear right-of-way, establish temporary debris storage sites).

3.5.1 Flooding

In addition to the response actions listed in Sections 3.1 and 3.5, the following action items may be appropriate:

- Continue to monitor expected rainfall and river, creek, and tributary levels.
- Monitor secondary hazards associated with flooding (e.g., landslides, infrastructure damage, soil erosion and land degradation, epidemic diseases, poisoning, unhygienic conditions, sedimentation, traffic accidents, water pollution, waterlogging/salinity).
- Implement protective measures, including:
  - Coordinating debris removal from necessary areas (e.g., storm drains, bridge viaducts, main arterial routes, public right-of-ways, dams).
  - Activating law enforcement resources (e.g., curfew enforcement, road closures, security).
  - Establishing infrastructure protection measures in landslide/flood prone areas.
- Identify resource needs (e.g., sandbags, equipment, assembly sites, shelters) and request additional support through mutual aid, private contractors, and the County.
- Activate search and rescue operations as necessary.

3.5.2 Drought

In addition to the response actions listed in Sections 3.1 and 3.5, the following action items may be appropriate:

- Continue to monitor rainfall, temperatures, crop conditions, and water availability.
- Monitor secondary hazards associated with drought (e.g., wildfires, economic).
- Implement protective measures (e.g., water conservation efforts, voluntary or mandatory water use restrictions, herd management strategies).
- Work with the PIO and local extension office to provide information and advice to affected farmers via media releases and increase drought education and outreach to the general public.
- Identify resource needs (e.g., potable water, support to farmers).

3.6 Volcano

In addition to the response actions listed in Section 3.1, the following action items may be appropriate:

- Continue to monitor volcanic activity and wind direction to project potential spread of ash, fires, and/or gases.
- Monitor secondary hazards associated with volcanic activity (e.g., ground deformation, lahars, landslides, building roof collapses).
- Implement protective measures (e.g., evacuations, shelter-in-place, traffic control, promote wearing masks, promote staying indoors, open shelters).
- Identify resource needs (e.g., ash removal equipment, masks, fire suppression equipment).
- Work with the PIO to provide information to the public regarding health protective measures and appropriate ash removal methods.

3.7 Hazardous Materials

In addition to the response actions listed in Section 3.1, the following action items may be appropriate:

- Monitor current and forecasted weather to project a potential spread of hazardous materials plume (recurring action).
- Activate the Regional Hazardous Materials Team through the Oregon Emergency Response System at 1-800-452-0311 for technical assistance.
- Determine the type, scope, and extent of the hazardous materials incident (recurring action). Verify reports and obtain estimates of the area that may be affected. [ICS Form 209: Status Summary]
    - Notify 9-1-1 dispatch, supporting agencies, adjacent jurisdictions, and liaisons of the situation.
    - Assess the type, severity, and size of the incident. If possible, characterize the hazardous material(s) of concern and determine appropriate personal protection equipment requirements.
    - Ensure that a health and safety plan is developed by the designated Safety Officer, including monitoring first responders in accordance with applicable guidance.
- Ensure that proper containment methods have been implemented by first responders until hazardous materials response teams arrive.
- Establish a safe zone and determine a location for on-site staging and decontamination. Reevaluate as the situation changes.
- Provide support for implementation of applicable Geographic Response Plans established by the Oregon Department of Environmental Quality to guide activities throughout the duration of the incident.
- Support access control to the incident site through local law enforcement agencies.
- If applicable, establish immediate gross decontamination capability for victims.
- Notify agencies that support hazardous materials response.
- Ensure that all required hazardous notifications have been completed.

REQUIRED NOTIFICATIONS

- Contact the Oregon Department of Transportation (ODOT) for incidents occurring on State highways.
- Notify appropriate key stakeholders and partners for incidents that pose an actual or potential threat to State parks, recreational areas, historical sites, environmental sensitive areas, tourist routes, or other designated areas.
- If agricultural areas and livestock are potentially exposed or impacted, notify local extension services (Oregon State University), the Oregon Department of Agriculture, and the State Veterinarian.

- Coordinate with the responsible party (if known) and the Oregon Department of Environmental Quality on using private contractors for clean-up.

3.8 Transportation Accidents (including air, rail, and road)

In addition to the response actions listed in Section 3.1, the following action items may be appropriate:

- Continue to monitor weather reports for severe weather.
- Conduct a scene assessment to determine appropriate level of emergency medical, transportation, and hazardous materials response. Based on the location of the accident, mass casualty, and/or evacuation procedures may be required. [ICS Form 209: Status Summary]
- Implement protective measures (e.g., road/bridge closures, alternate routes).
- Identify resources needed to support the incident (traffic management supplies, personnel, mass fatality and mass casualty support).
- Secure the crash site to maintain integrity of the accident site (after fire suppression and victim rescue operations are completed).
- Ensure that all required notifications have been completed.

REQUIRED NOTIFICATIONS

- Aircraft accident:
    - Federal Aviation Administration
    - Contact the NTSB prior to removing deceased victims or moving aircraft wreckage. (Safety Office, 425-227-2000, 24 hours)
    - ODOT (State highways)
- Railroad accident:
    - Prior to removing any victims or wreckage, the Incident Commander or EOC Manager should contact the railroad company's emergency response center, as well as the NTSB.
- State highway accident: ODOT
- Appropriate key stakeholder and partners for incidents that pose an actual or potential threat to State parks, recreational areas, historical sites, environmental sensitive areas, tourist routes, or other designated areas.
- If agricultural areas and livestock are potentially exposed or impacted, notify local extension services (Oregon State University), Oregon Department of Agriculture, and the State Veterinarian.

- Coordinate the collection, storage, and disposition of all human remains and their personal effects from the accident site.
- Coordinate provision of up-to-date information to friends and family of victims (if not already being handled by another agency). Consideration should be given to keeping the friends and family of the victims in a central location, protected from the press, and where information can be provided to them as it becomes available.
  - Allow the rail company, airline, or agency affected by the accident to confirm casualties and to notify the next of kin via their usual protocol.
- Support the removal of debris in coordination with, or under the direction of, investigating agencies such as the Transportation Security Administration, NTSB, and FBI.
- Coordinate with the American Red Cross to provide shelter and family referral services through the EOC.

3.9 Terrorism

In addition to the response actions listed in Section 3.1, the following action items may be appropriate:

- Continue to work with County, State, and FBI resources to monitor and address terrorist activities.
- Mobilize appropriate emergency personnel and first responders. When necessary, send fire services, emergency medical services, hazardous materials, law enforcement, public health, and others to the site. Determine responder activities and establish non-contaminated areas prior to mobilizing resources.
- Ensure that all required notifications have been completed.

REQUIRED NOTIFICATIONS

- Notification to the Oregon State Police and the FBI is required for all terrorism incidents.
- If an incident occurs on State highways, ensure that ODOT has been notified.
- Appropriate key stakeholders and partners for incidents that pose an actual or potential threat to State parks, recreational areas, historical sites, environmentally sensitive areas, tourist routes, or other designated areas.
- If agricultural areas and livestock are potentially exposed or impacted, notify local extension services (Oregon State University), Oregon Department of Agriculture, and the State Veterinarian.

- Activate and participate in Unified Command. Unified Command may consist of City, County, regional, State, and federal crisis management and consequence management agencies.
- Evaluate the safety of emergency personnel. Initiate development of a site- and agent-specific health and safety plan.
- Implement protective actions (e.g., evacuations, sheltering). *Refer to the United States Department of Transportation Emergency Response Guidebook to determine the appropriate evacuation distance from the source.*
- Activate public notification and advisory procedures.

- Clear the immediate area and notify appropriate first responders if an explosive device is found.
  - Be cognizant of any secondary devices that may be on site.
  - Be cognizant that CBRNE agents may be present.
- Control and investigate the crime scene and collect evidence, photographs, and video recordings.

See Section 3.6 for hazardous materials–specific information.

3.10 Utility Failure

In addition to the response actions listed in Section 3.1, the following action items may be appropriate:

- Continue to monitor severe weather reports that may affect utilities.
- Monitor secondary hazards associated with utility failure (e.g., traffic accidents due to signals being out, public health concerns, communication difficulties, heating and cooling difficulties).
- Implement protective measures (e.g., utilize backup generators, clear debris from roads).
- Identify the following:
  - General boundary of the affected area
  - Extent of utility disruption
  - Immediate needs of response forces or utilities
  - Estimated time of repair or duration of outage
  - Estimated population affected
- Coordinate with the Red Cross to open shelters as appropriate.
- Establish communication with and request a liaison from the utility as appropriate.

4 Recovery/Demobilization Phase Actions

Recovery/demobilization actions begin once the threat to public safety has been eliminated. The following recovery action items are appropriate to most incidents; however, the actions should be evaluated for appropriateness in any given situation and do not replace common sense or SOPs.

- Coordinate the transition from response to recovery.
- Continue to monitor incident-specific secondary hazards.
- Coordinate with the Red Cross to determine how long shelter operations will be continued, if activated during the incident.
- Implement intermediate and long-term recovery activities.
- Develop a strategy for transitioning the coordination and communication mechanisms for ongoing recovery efforts (e.g., role of the EOC, situational awareness updates, and communications protocols).
- Consider long-term environmental impacts and remediation needs and implement actions accordingly.
- Develop a Demobilization Plan to assist in an orderly demobilization of emergency operation. [ICS Form 221 – Demobilization Plan]
- Deactivate/demobilize the EOC, agency operations centers, and command posts.

- Conduct post-incident debriefing(s) to identify success stories and opportunities for improvement. Develop an After Action Report based on these debriefings.
- Develop recommendations and correct any deficiencies reflected in the After Action Report regarding changes in planning, zoning, and building codes/ordinances to lessen the impact of future emergencies related to this type of incident.
- Revise any applicable emergency response plans based on the success stories and/or lessons learned during the response.

5 Resources

5.1 Earthquake

- Cascadia Playbook https://www.oregon.gov/OMD/OEM/Pages/Cascadia_Playbook.aspx
- United States Geological Survey (USGS) Earthquake Hazards Program https://earthquake.usgs.gov/
- Catalog of FEMA Earthquake Resources https://www.fema.gov/media-library-data/1394506756491-eac042da03e84513b9d034c7debcd6f8/FEMA_P-736B_Final_508.pdf
- Resident Guidance from FEMA https://www.ready.gov/earthquakes
- County EOP, Incident Annex (IA) 2 – Geologic Emergencies
- State of Oregon EOP, IA 2 – Earthquake
- Oregon Resilience Plan

5.2 Major Fire

- Fire Agency List by County http://www.oregon.gov/osp/SFM/docs/FireAgencyListCounty.pdf
- United States Forest Service Wildland Fire Assessment System, Fire Danger Rating http://www.wfas.net/index.php/fire-danger-rating-fire-potential--danger-32
- Resident Guidance from FEMA https://www.ready.gov/wildfires
- County EOP, IA 1 – Weather Emergencies
- State of Oregon EOP
  - Emergency Support Function (ESF) 4 – Firefighting
  - IA 5 – Wildland Fire

5.3 Public Health

- Oregon’s Health Security, Preparedness, and Response Program https://public.health.oregon.gov/Preparedness/Pages/index.aspx
- Cities Readiness Initiative http://www.crinorthwest.org/preptalk.html
- Resident Guidance from FEMA
  - Pandemic https://www.ready.gov/pandemic
  - Chemical Threats https://www.ready.gov/chemical-threats
  - Biological Threats https://www.ready.gov/biological-threats
- County EOP
  - ESF 8 – Health and Medical
  - Support Annex (SA) 4 – Public Health

- State of Oregon EOP, ESF 8 – Health and Medical

5.4 Severe Weather

- North American Oceanic and Atmospheric Administration's National Climatic Data Center http://www.ncdc.noaa.gov/
- United State Drought Monitor, updated weekly http://droughtmonitor.unl.edu/Home.aspx
- Resident Guidance from FEMA
    - Severe Weather https://www.ready.gov/severe-weather
    - Drought https://www.ready.gov/drought
    - Floods https://www.ready.gov/floods
    - Snowstorms and Extreme Cold https://www.ready.gov/winter-weather
    - Thunderstorms and Lightening https://www.ready.gov/thunderstorms-lightning
    - Extreme Heat https://www.ready.gov/heat
- County EOP, IA 1 – Weather Emergencies
- State of Oregon EOP
    - IA 1 – Drought
    - IA 3 – Flood
    - IA 7 – Severe Weather

5.5 Volcano

- Mount Hood Coordination Plan, June 2013, https://www.oregon.gov/OMD/OEM/plans_train/Earthquake/volcano_plan_mt-hood.pdf
- U.S. Geological Survey Volcano Hazards Program, http://volcanoes.usgs.gov/index.html
- Resident Guidance from FEMA https://www.ready.gov/volcanoes
- County EOP, IA 2 – Geologic Emergencies
- State of Oregon IA 6 – Volcano http://www.oregon.gov/OMD/OEM/plans_train/docs/eop/eop_ia_6_volcano.pdf

5.6 Hazardous Materials

- Northwest Area Contingency Plan http://www.rrt10nwac.com/nwacp/
- Pipeline and Hazardous Materials Safety Administration http://www.phmsa.dot.gov/hazmat
- Resident Guidance from FEMA https://www.ready.gov/hazardous-materials-incidents
- County EOP
    - ESF 10 – Hazardous Materials Response
- State of Oregon Emergency Operations Plan, ESF 10 – Hazardous Materials http://www.oregon.gov/OMD/OEM/plans_train/docs/eop/OR_EOP_2015_ESF_10_hazmat.pdf

5.7 Transportation Accidents (including air, rail, and road)

- Oregon Department of Transportation Trip Check https://tripcheck.com
- County Airport and Heliport Directory https://www.oregon.gov/OMD/OEM/Pages/plans_train/Disaster-Aviation-Annex.aspx#County_Airport_and_Heliport_Directory

- Individual airport emergency response plans
- Individual railroad emergency response plans
- State of Oregon Disaster Aviation Annex https://www.oregon.gov/OMD/OEM/Pages/plans_train/Disaster-Aviation-Annex.aspx

5.8 Terrorism

- County EOP, IA 3 – Terrorism
- State of Oregon EOP
    - IA 8 – Terrorism https://www.oregon.gov/OMD/OEM/plans_train/docs/eop/eop_ia_8_terrorism.pdf
    - IA 10 – Cyber Security https://www.oregon.gov/OMD/OEM/plans_train/docs/eop/eop_ia_10_cyber.pdf

5.9 Utility Failure

- State of Oregon EOP, ESF 12 – Energy
- Electrical company emergency response plans
- Natural gas company emergency response plans
- Cell phone company emergency response plans
- Telecommunications company emergency response plans

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APPENDIX E
SEISMIC HAZARD ASSESSMENT TECHNICAL MEMORANDUM, DELVE UNDERGROUND

consor

Technical Memorandum

To:	Brian Ginter, PE Consor North America, Inc.	Project:	West Linn Seismic Hazard Study
From:	Wolfe Lang, PE Devin Todd Roth, PE	cc:	
Date:	12/15/2023	Job No.:	6432.0
Subject:	Seismic Hazards Evaluation		

1.0 Introduction

The City of West Linn (City) has contracted with Consor North America (Consor) to provide a Water Master Plan Update. Consor has retained Delve Underground (formerly known as McMillen Jacobs Associates) to study and evaluate geotechnical and seismic hazards for the backbone West Linn Water System (Project). The backbone of the West Linn Water System is composed of critical water distribution pipelines and facilities, and was developed by Consor as part of the Water System Master Plan Project, a map of the backbone of the West Linn Water System is included in Attachment A.

This memorandum presents the results of our evaluation. Delve Underground completed the following tasks in accordance with our scope of work:

1. Perform a background information review and site reconnaissance, with the following tasks:

    a. Compile and review existing local and regional geologic publications and maps,

    b. Review seismic hazard maps for a Cascadia Subduction Zone (CSZ) 9.0 magnitude earthquake in the vicinity of the backbone,

    c. Subsurface data, including Oregon Water Resources Department (OWRD) well logs and available geotechnical boring information,

    d. Foundation design drawings of the critical facilities of the City's water system,

    e. Attend a site visit of critical facilities of the City's water system to visually examine the condition of slopes and other geologic features near the critical facilities.

2. Evaluate seismic and geotechnical hazards from a 9.0 magnitude Cascadia Subduction Zone event and the potential foundation performances at critical facilities.

    a. Prepare seismic hazard maps for the ground shaking, seismic liquefaction, lateral spreading, and seism landslides hazards. Using the background information from the previous task, verify and update maps illustrating geotechnical issues and seismic hazards in the Project area.

    b. Develop this memorandum to summarize the results of our information review and evaluations, including maps of geologic and geotechnical data.

Delve Underground completed these tasks for the pipelines and critical facilities identified as part of the backbone of the West Linn Water System as shown on figures 1 through 5 and summarized in Table 2. In the following sections we present the results of the information review, evaluation of seismic and geotechnical hazards, and recommendations.

2.0 Background Information Review and Site Reconnaissance

Delve Underground reviewed background information and performed a site reconnaissance at the backbone reservoir and pump station facilities. We reviewed mapped seismic hazards, geologic and seismic hazard literature, and available subsurface data.

2.1 Geologic Information Review

The Portland basin is a structural depression created by complex folding and faulting of the basement rocks, a sequence of middle Miocene age, about 17 to 6 million years ago, lava flows of the Columbia River Basalt Group (CRBG). An extensive sedimentary fill has then accumulated in the basin and overlies the CRBG basement (Trimble, 1963; Tolan and Beeson, 1984). The Tertiary sedimentary units include up to 1,300 feet of the Sandy River Mudstone, which directly overlies the CRBG, and 100 to 350 feet of sandstone and conglomerate of the Troutdale Formation, which overlies the Sandy River Mudstone (Pratt et al., 2001).

Unconsolidated sediments at the top of the basin fill sequence consist primarily of catastrophic flood sediment deposited near the end of the last ice age, between 15,300 and 12,800 radiocarbon years ago (Mullineaux et. al., 1978; Waitt, 1987; Allen et al., 2009). Forty or more catastrophic floods occurred at intervals of several decades on the Columbia River system. The flood waters swept across the Portland basin and deposited tremendous loads of sediment. Boulders, cobbles, and gravels were deposited near the mouth of the Columbia River Gorge and along the main channel of the Columbia River, while great cobble and gravel bars stretched westward across the Portland basin, grading to thick blankets of micaceous sand. Within the Portland basin, the flood deposits mantle the Troutdale Formation at elevations below about 350 feet above mean sea level. The flood deposits generally consist of unconsolidated gravel topped by fine sand and silt and range from a few feet to more than 200 feet thick.

During the late Pliocene epoch, fluvial conglomerate, volcaniclastic sandstone, siltstone and debris flow deposits, originating in the Cascade Range, were deposited in a broad fan in the Boring Hills area at the southern margin of the Portland Basin (Tolan and Beeson, 1984). These deposits, the Springwater Formation, interfingered with the late Troutdale Formation sediments. Deposition of the Springwater Formation continued into the Pleistocene (Madin, 1994).

During the Holocene epoch (the last 10,000 years), minor alluvial deposits accumulated along the several creeks and streams that drain the area. These young alluvial sediments are largely reworked from older materials in the Boring Hills and from the catastrophic flood deposits on the basin floor. Other active geologic processes include soil creep and land sliding.

2.1.1 Geological Units and Descriptions

The Geologic Map (Figure 1) depicts the mapped surficial geologic units in the backbone system vicinity and is derived from the Oregon Geologic Data Compilation Release 7 (OGDC-7), prepared by the Oregon Department of Geology and Mineral Industries (DOGAMI). The geologic units are described in simplified terms on the Geologic Map, based on their geotechnical properties, from oldest to most recent, as described in Geologic Map of Quaternary Units in the Willamette Valley, Oregon (O’Conner, 2001).

The Basalt layer is part of the Columbia River Basalt Group (Tcr), it is composed of lava flows of dart gray to black locally deeply weathered, deposited around 15 million years ago. Areas mapped as Basalt may include small areas of unmapped alluvium, colluvium, loess, and landslide debris, especially near steep slopes and water channels.

The Sedimentary Rocks layer is primarily composed of the Troutdale Formation (QTt) deposited 4 to 1 million years ago. It may be composed of sand, gravel, sandstone, conglomerate, siltstone, or mudstone in the project area.

The Coarse-Grained Sediments layer is composed of Coarse Missoula Flood Deposits (Qfc). These deposits include unconsolidated boulders, cobbles, and sandy gravel fans left by Missoula Floods as they spilled through the Oregon City gap.

The Fine-Grained Sediments layer is primarily composed of Main Body of fine-grained Missoula Flood Deposits, (Qff_2). These deposits include stratified silt and clay with minor sand with sparse pebbles and boulders exotic to the Willamette Valley and form mantles over foothills, up to altitudes of 120 meters.

The Alluvial Deposits layer is primarily composed of Floodplain deposits, (Qalc). These deposits are composed of unconsolidated silt, sand, and gravel of the Willamette River and Clackamas River. The layer is typically less than 12,000 years old.

Two landslide deposits are mapped close to the backbone (Figure 1). The Bolton Landside is classified as a pre-historic, deep landslide. The I-205 Landslide deposits are classified as a recent, deep landslide. Localized unmapped landslide deposits may be present across the area, especially near steep basalt slopes.

2.2 Seismic Hazards Review

Delve Underground reviewed seismic hazards in the vicinity of the Project. The City of West Linn, Oregon, is located near an active tectonic plate boundary called the Cascadia Subduction Zone (CSZ). Recent earthquakes in Japan, New Zealand, Chile and elsewhere, and an increased understanding of the CSZ, have increased the recognition of the earthquake hazard in Oregon. In 2011, Oregon legislature passed a resolution directing the Oregon Seismic Safety Policy Advisory Commission to prepare the Oregon Resilience Plan (ORP). The purpose of the ORP is to set policy direction for protecting lives and maintaining economic and commercial activity following a magnitude 9.0 CSZ earthquake (Oregon Resilience Plan 2013). The ORP was accompanied by a report mapping seismic hazards driven by a CSZ event, *Open File Report O-13-06* (Madin 2013), with a geographical information system (GIS) database of seismic hazards.

Subsequently DOGAMI updated and refined the mapped hazards in *Open File Report O-18-02* (Bauer 2018) for Clackamas, Multnomah, and Washington Counties.

Off the coast of the Pacific Northwest the Juan de Fuca oceanic plate is subducting beneath the North American crustal plate. This tectonic regime has resulted in seismicity in the Pacific Northwest occurring from three primary sources:

- Shallow crustal faults within the North American plate.
- CSZ intraplate faults within the subducting Juan de Fuca plate.
- CSZ megathrust events generated along the boundary between the subducting Juan de Fuca plate and the overriding North American plate.

Among these three sources, CSZ megathrust events are considered as having the most hazard potential due to the anticipated magnitude and duration of associated ground shaking. Recent studies indicate that the CSZ can potentially generate large earthquakes with magnitudes ranging from 8.0 to 9.2, depending on rupture length. The recurrence intervals for CSZ events are estimated at approximately 500 years for the mega-magnitude full rupture events (magnitude 9.0 to 9.2) and 200 to 300 years for the large-magnitude partial rupture events (magnitude 8.0 to 8.5). Goldfinger et al. (2016) completed research on prehistoric recurrence based on the investigation of ocean sediments. The research indicates the region is “past due”, thus, future occurrence is anticipated. For example, over the next 50 years, the CSZ earthquake has an estimated probability of occurrence on the order of 16 to 22 percent.

Results of a CSZ event may include hazards such as severe ground shaking, liquefaction settlement, lateral spreading, and/or seismic-induced landslides. These hazards have the potential to damage facilities (i.e., pipelines, reservoirs, pump stations, treatment plants) through either permanent ground deformation (PGD) or intense shaking. Our analysis of these seismic hazards is based on DOGAMI hazard maps and publicly available geotechnical information for the area.

2.3 Subsurface Information Review

Delve Underground reviewed data from geotechnical records provided by the City and other available sources. Table 1: Subsurface Data lists the well logs and geotechnical borings logs that we reviewed, with hazard interpretations and sources.

Consor provided subsurface information for two facilities, Rosemont Reservoir and Bolton Reservoir. The report titled Supplemental Subsurface Investigation; New Site of the 0.4 MG… Rosemont Reservoir Subsurface, L.R. Squire Associates Inc., 1988, of the Rosemont Subsurface investigations includes 5 geotechnical boring logs performed at the site in 1987 to support the construction of the 0.4 million gallon waterspheroid tank called Rosemont Reservoir. This report is included as Attachment B. The report titled Geotechnical Investigation and Site Specific-Seismic Hazard Study; 4-MG Bolton Reservoir, GRI, 2015, is an investigation of subsurface materials and conditions at the site of the Bolton Reservoir site for use in designing the reservoir. This report is included as Attachment C.

2.4 Site Reconnaissance

On January 4th, 2023 Wolfe Lang, PE, GE from Delve Underground conducted a geotechnical reconnaissance of critical facilities in the City's backbone. Facilities visited include:

- Bolton Reservoir
- Norton Reservoir
- Rosemont Reservoir
- Bland Reservoir
- Willamette Reservoir
- View Drive Reservoir

During the reconnaissance, Delve Underground noted site conditions, exposed soil and rock conditions, site topography, proximity to bodies of water, and constructed features. Selected photographs from the site visits are provided in Appendix 4.

3.0 Geotechnical and Seismic Hazard Evaluation and Mapping

As discussed in section 1.02.2 Seismic Hazards Review, a CSZ event may include hazards such as severe ground shaking, liquefaction settlement, lateral spreading, and/or seismic-induced landslides. These hazards have the potential to damage facilities (i.e., pipelines, reservoirs, pump stations, treatment plants) through either permanent ground deformation (PGD) or intense shaking. Our analysis of these seismic hazards is based on DOGAMI hazard maps published as *Open File Report O-18-02* "Earthquake Regional Impact Analysis for Clackmas, Multnomah, and Washington Counties, Oregon" (Bauer 2018) and publicly available geotechnical information for the area.

Delve Underground prepared maps (Figures 2 – 5) of seismic peak ground velocity, liquefaction hazard, liquefaction lateral spreading, and seismic landslide hazards in the project area. Many factors drive seismic liquefaction hazards, including material composition and strength, groundwater, slope, intensity of seismic loading (shaking), as well as the degree to which these factors coincide in the same location.

3.1 Peak Ground Velocity

The intensity of ground shaking at a site is known as peak ground velocity (PGV). The magnitude of PGV is dependent on the magnitude and distance from the seismic source, and the ground material through which seismic waves pass. The rapid and extreme shaking during an earthquake can cause transient stress and strain in pipelines that can be damaging if the pipe material and joints are not strong enough to withstand the transient ground deformations. Damage from ground shaking occurs even when there is no permanent ground deformation.

The Peak Ground Velocity Map (Figure 2) shows estimated PGV ranges for a CSZ 9.0 event in the area of West Linn. Variations in PGV are primarily driven by ground material, with the highest velocities occurring in less consolidated soils. In the project area, the highest range of PGV of 12 to 16 inches per second occurs in landslide deposits, recent alluvial deposits, and smaller drainages.

3.2 Seismic Liquefaction

Liquefaction is a phenomenon in which ground shaking from an earthquake transforms soil from a solid state to a viscous fluid state. Soils that are susceptible to liquefaction are generally sands and non-plastic to low-plastic silts that are saturated (below groundwater level). Silts and silty soils with a plasticity index less than 7 are generally considered to be susceptible to liquefaction. The results of soil liquefaction include loss of shear strength, loss of soil materials through sand boils or flow, flotation of buried chambers/pipes, and post-liquefaction reconsolidation (settlement).

The Liquefaction Hazard Map (Figure 3) shows the location of the water system backbone compared to seismic liquefaction hazards. Within the study area, the seismic liquefaction hazard in a CSV 9.0 event ranges from none to high. The highest hazards occur around the confluence of the east bank of the Willamette River, especially at the confluence with the Clackamas Rivers. ODOT boring logs record low to very low blow counts in sand and silt at several locations.

Intact Basalt and Troutdale Formation soils are not liquefiable, however unmapped small areas of varying soil conditions may exist within these zones. Coarse Grained Sediments typically have a low liquefaction hazard due to the presence of gravels and cobbles. Fine Grained Sediments and Alluvial deposits have a low to high liquefaction hazard where low strength silts and sands occur below the water table.

Based on the review of well logs CLAC_75426 and CLAC_77648 we have reduced the liquefaction hazard level to none in that area.

Areas with moderate to high liquefaction hazard level

- The backbone pipelines connecting to the Willamette River Crossing on I-205, especially on the east bank have a high liquefaction hazard because they are in Alluvial Deposits, which may be poorly consolidated and low strength.

- The backbone pipeline along Highway 43 and the LO Emergency Intertie and Pumpstation, north of Mary S. Young Park have a moderate liquefaction hazard level. Borings in this area show more shallow sand and silt deposits than further south. Creeks crossing the area have an increased hazard.

3.3 Liquefaction Induced Ground Deformation

Liquefaction induced ground deformations generally consist of two components – post-liquefaction settlement (vertical) and lateral spreading movement (horizontal). Lateral spreading generally occurs along river/creek banks and within sloping ground areas. The lateral movement and loss of support of the liquefied soil breaks the overlying non-liquefied soil "crust" into blocks that progressively move downslope or toward a free face in response to the earthquake generated ground accelerations. Each cycle of loading from the earthquake incrementally pushes these blocks downslope. The potential and magnitude of lateral spreading depends on the liquefaction potential of the soil, the magnitude and duration of earthquake ground accelerations, the site topography, and the post-liquefaction strength of the soil. Lateral spreading can result in both vertical and horizontal components of PGD, but for discussion purposes and this screening-level of analysis, the reported estimates of PGD can be considered horizontal.

The Liquefaction Induced Ground Deformation Map (Figure 4) shows the location of the water system backbone compared to seismic liquefaction lateral spread hazards. Within the study area, we used geotechnical boring logs and historic well logs to confirm that the liquefaction lateral spreading estimates presented by DOGAMI are reasonable for this area.

For the high liquefaction hazard area at Willamette River Crossing and on the east bank, the liquefaction induced ground deformation will mainly consist of lateral spreading movement with magnitude on the order of 3 to 4 feet or greater.

For the backbone pipeline along Highway 43 and the LO Emergency Intertie and Pumpstation, north of Mary S. Young Park, the seismic ground deformation will mainly consist of post-liquefaction settlement with magnitude generally less than 12 inches.

A site-specific lateral spreading study should be performed to characterize the hazard and develop mitigation strategies.

3.4 Seismic Landslide

Earthquake induced landslides can occur on slopes due to the inertial force from an earthquake adding load to a slope. The ground movement due to landslides can be extremely large and damaging to pipelines and other structures.

The Seismic Landslide PGD map (Figure 5) shows the estimated levels of seismic landslide PGD in the vicinity of the Project. The only seismic landslide hazard that intersects the backbone or storage facilities is around the Bolton Reservoir and Pumpstation, and the nearby pipelines. This area is located within a prehistorical landslide zone with landslide deposit and landslide scarps near the upslope boundaries. Most of this area is subject to a potential landslide hazard of up to 5 feet deformation, but the slopes directly below the reservoir have up to 25 feet of deformation. The subsurface conditions of the landslide and other seismic hazards are discussed in *Geotechnical Investigation and Site Specific-Seismic Hazard Study; 4-MG Bolton Reservoir*, GRI, 2015. (Attachment C). We understand that ground improvements had been made under the reservoir footprint to mitigate the landslide hazards. However, the nearby backbone pipelines are still subject to the seismic landslide hazard, and may be vulnerable under the potential landslide ground deformation. The Willamette Reservoir and Pumpstation are located on a moderate slope just to the west of the I-205 Landslide. The landslide does not intersect the reservoir or backbone pipelines, but does pass within 100 feet.

3.5 Critical Facilities

The backbone of the West Linn Water System includes 6 reservoirs, 7 pump stations, 1 emergency intertie. Additionally, the backbone crosses the Willamette River on the I-205 bridge. Table 2 summarizes subsurface information, conditions, hazard levels, and concerns for these sites.

3.6 Conclusions and Recommendations

Based on review of the available hazard mapping and subsurface data, there are a wide range of seismic hazards in the vicinity of the backbone of the West Linn Water System. . In our opinion, most of the critical facilities and backbone pipe sections are within low seismic hazard areas. However, the following locations/areas have relatively high seismic hazard potentials and additional evaluations will be needed to characterize the hazard and develop mitigation strategies:

- Willamette River Crossing area: moderate to high liquefaction hazard and ground deformation are anticipated in this area. Seismic hazards study and pipe resiliency evaluations should be conducted, especially for the pipe sections connected to the crossing;

- Prehistorical landslide zone near Bolton Reservoir: moderate to high seismic landslide hazards and ground deformation. Although, this hazard has likely been mitigated by ground improvements under the reservoir, the pipelines within the landslide zone are still vulnerable for seismic landslide hazard;

- HWY 43 near and west of Mary S Young Park: low to moderate liquefaction hazard and ground deformation. Seismic hazards study and pipe resiliency evaluations should be conducted;

- I 205 Crossing south of Willamette Reservoir: low to moderate liquefaction hazard and ground deformation. DOGAMI seismic landslide hazard mapping shows no hazard at the reservoir, however it is very close to the I-205 Landslide. Slope stability, seismic hazards study and pipe resiliency evaluations should be conducted.

4.0 References

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Tables

1. List of Subsurface data
2. Table of Seismic Hazards

Table 1. Subsurface Data

Log Name	Estimated Liquefaction Hazard[1]	Comment	Source
CLAC_3869	None	Shallow Clay; not liquefiable	OWRD Well Log[2]
CLAC_71767	Low	Potentially liquefiable	OWRD Well Log[2]
CLAC_74494	Moderate	potentially liquefiable SILTY SAND 10 - 30 ft	OWRD Well Log[2]
CLAC_74495	Moderate	potentially liquefiable SILTY SAND 10 - 35 ft	OWRD Well Log[2]
CLAC_77780	Moderate	Potentially liquefiable SILTY SAND	OWRD Well Log[2]
CLAC_75664	Moderate	Potentially liquefiable SILTY SAND	OWRD Well Log[2]
CLAC_75293	None	Not liquefiable	OWRD Well Log[2]
CLAC_75246	Low	Potentially liquefiable SILTY SAND	OWRD Well Log[2]
CLAC_77648	None to Low	Very Low Liquefaction Potential. IF soils become silty/sandy below end of boring at 17 ft bgs	OWRD Well Log[2]
CLAC_64930	Medium	Potentially liquefiable wet silt	OWRD Well Log[2]
CLAC_75427	Low to moderate	Very low Liquefaction potential in Gravel/Silt/Cobbles, depending on ratios of these materials	OWRD Well Log[2]
13 Borings	None	Shallow basalt, not liquefiable	ODOT 217-09724 (24017)[3]
4 Borings	None	Very shallow basalt, not liquefiable	ODOT 209-09704 (24011)[3]
4 Borings	None	Shallow basalt and rocky clay, not liquefiable	ODOT 208-09703 (24003)[3]
4 Borings	High	Silts and Sands with low blow counts, low plasticity, high liquefaction potential	ODOT 19119 (60612)[3]
B-1	Medium	Potentially liquefiable silts	LOTWP FWP 2[4]
B-66	Medium	Potentially liquefiable silts, medium stiff	LOTWP FWP 1[4]
B-65	Medium	Potentially liquefiable soft silts	LOTWP FWP 1[4]
B-3	Medium	Potentially liquefiable silts, medium stiff	LOTWP FWP 1[4]
B-4	Medium	Potentially liquefiable silts, medium stiff	LOTWP FWP 1[4]
B-5	Medium	Potentially liquefiable silts, medium stiff	LOTWP FWP 1[4]
5 Borings	None	Shallow basalt, not liquefiable	Rosemont Subsurf.[5]
7 borings	None	[1]Landslide debris, potential seismic landslide hazard	Bolton Reservoir Seismic Study[6]

1 – Based on presence of low blow count sands and low-plasticity silts. Liquefaction estimates assumes saturated soil and groundwater at the surface.

2 – Oregon Water Resources Department Well Logs, Appendix 1

3 – Willamette River Crossing, I-205 Bridge Boring Logs, Appendix 2

4 – Lake Oswego Water Treatment Plant, Finished Water Pipeline Boring Logs, Appendix 3

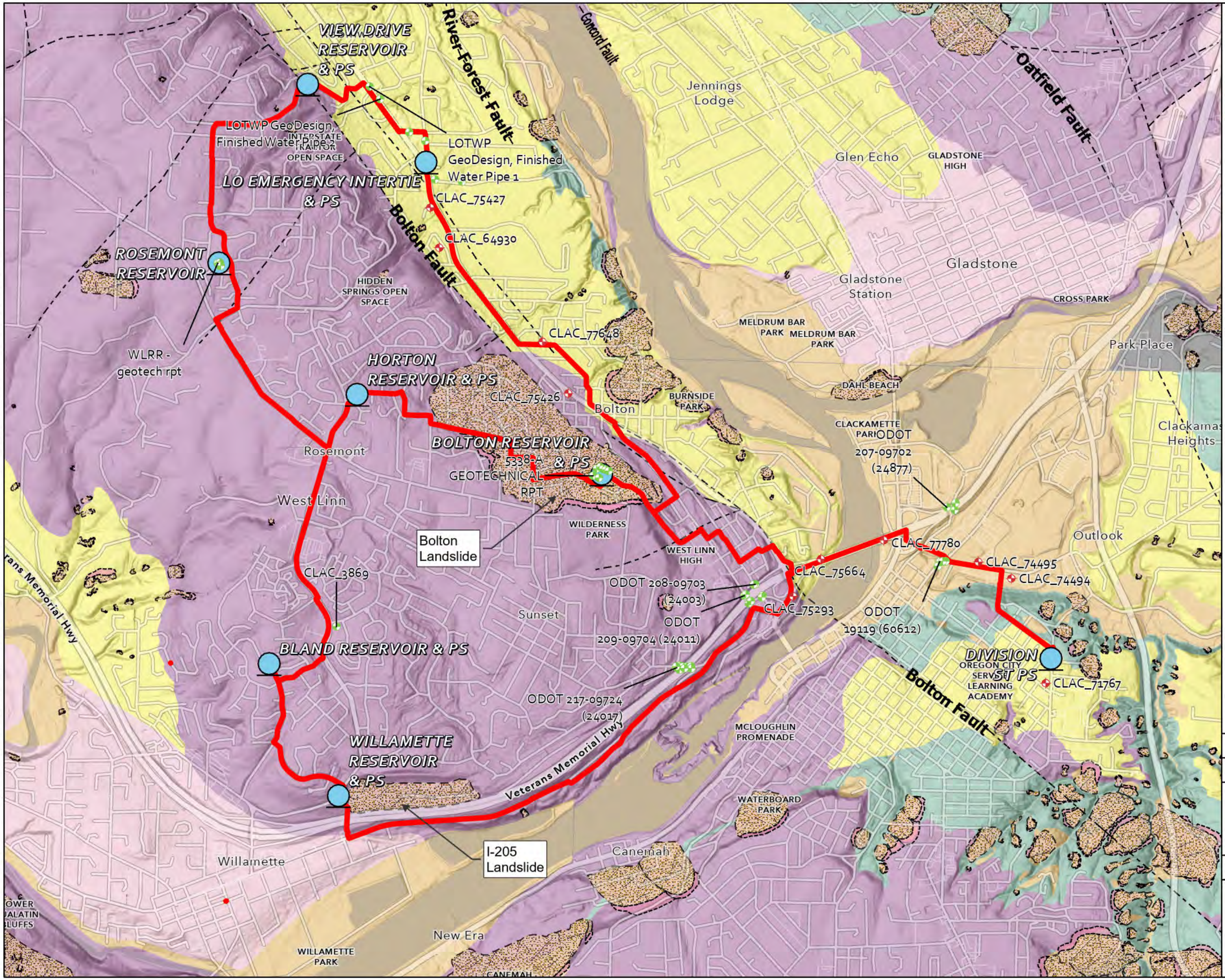
5 – Rosemont Subsurface Investigation, Attachment B

6 – Bolton Reservoir Seismic Study, Attachment C

Table 2. Preliminary Seismic Hazard Evaluation for Critical Facilities

Structure Name	**Available or Nearby Geotechnical Information**	**Mapped Seismic Hazards and Levels**	**Anticipated Subsurface Conditions and Site Topography**	**Preliminary Geotechnical Seismic Concerns & Issues**	**Recommendations/Notes**
Bland Reservoir and Pumpstation	CLAC_3869	Liquefaction and landslide hazards are not anticipated at this site.	Shallow basalt.	Isolated steep slopes along hillside. Lack of subsurface information.	Perform subsurface investigation to confirm shallow basalt bedrock condition.
Bolton Reservoir, Pumpstation and Vicinity Pipeline	*Geotechnical Investigation and Site Specific-Seismic Hazard Study; 4-MG Bolton Reservoir*, GRI, 2015. (Attachment C)	Site sits on the mapped landslide deposits, and over the Bolton Fault. Surrounding area includes high landslide hazards due to steep slopes and nearby existing slide mass. Liquefaction hazards are not anticipated at this site.	Located above steep slopes consisting of landslide debris.	Isolated steep slopes located adjacent to existing structures. Located within a large mapped landslide.	See 2015 GRI report. We understand ground improvements had been constructed at the reservoir site to mitigate the landslide hazard.
Division St Pumpstation	CLAC_71767		Fine Grained Sediments	Located within Fine-grained Flood deposit has a low liquefaction potential Lack of subsurface information.	Perform subsurface investigation, site-specific stability, and liquefaction analyses to confirm the low seismic liquefaction potential
Horton Reservoir and Pumpstation	No geotechnical data available.	Liquefaction and landslide hazards are not anticipated at this site.	Shallow basalt.	Very steep slopes located adjacent to site. Historic landslides located adjacent to property. Lack of subsurface information.	Perform subsurface investigation, site-specific stability, and liquefaction analyses.
Lake Oswego (LO) Emergency Intertie and Pumpstation	LOWTP FWP 1, LOWTP FWP2	Low to moderate liquefaction hazard	Potentially liquefiable flood deposits		Perform subsurface investigation, site-specific stability, and liquefaction analyses.
Rosemont Reservoir and Pumpstation	*Supplemental Subsurface Investigation; New Site of the 0.4 MG… Rosemont Reservoir Subsurface*, L.R. Squire Associates Inc., 1988. (Attachment B)	Liquefaction and landslide hazards are not anticipated at this site.	Shallow basalt.		
View Drive Reservoir and Pumpstation	No geotechnical data available.	Liquefaction and landslide hazards are not anticipated at this site.	Shallow basalt.		This site is close to the boundary of basalt and fine-grained sediments. Perform subsurface investigation to confirm shallow basalt bedrock condition.
Willamette Reservoir and Pumpstation	No geotechnical data available.	Liquefaction and landslide hazards are not anticipated at this site.	Shallow basalt.	The site is very close to the I-205 Landslide and located on a moderate slope.	Perform subsurface investigation to confirm shallow basalt bedrock condition. Perform slope stability evaluation.
Willamette River Crossing (I-205) and Vinity Pipeline	ODOT 207-09702, ODOT208-09703, CLAC_75293, CLAC)75664, CLAC_77780	High liquefaction and lateral spreading hazards on east bank of Willamette River, Moderate to High liquefaction and lateral spreading hazards on west bank of Willamette River.	Recent alluvial deposits of the Willamette and Clackamas Rivers		Perform subsurface investigation, site-specific stability, and liquefaction analyses.

Figures



EXPLANATION

- Geotechnical Boring
- ORWD Well Log
- Backbone Sites
- Backbone Alignment
- Fault

Geologic Units

🟫	Alluvial Deposits
🟨	Fine Grained Sediments
▢	Coarse Grained Sediments
🟩	Sedimentary Rocks
🟪	Basalt
⬛	Other geology
▨	Landslide Headscarp Flanks
▨	Landslide Deposits

Coordinate System: NAD 1983 2011 StatePlane Oregon North FIPS 3601 Ft Intl; Map Units: Foot

CONSOR/CITY OF WEST LINN

WEST LINN SEISMIC HAZARD STUDY

GEOLOGY MAP

WEST LINN, OR

DATE: DEC 2023 • PROJECT: 6432.0

DELVE underground

FIGURE

1

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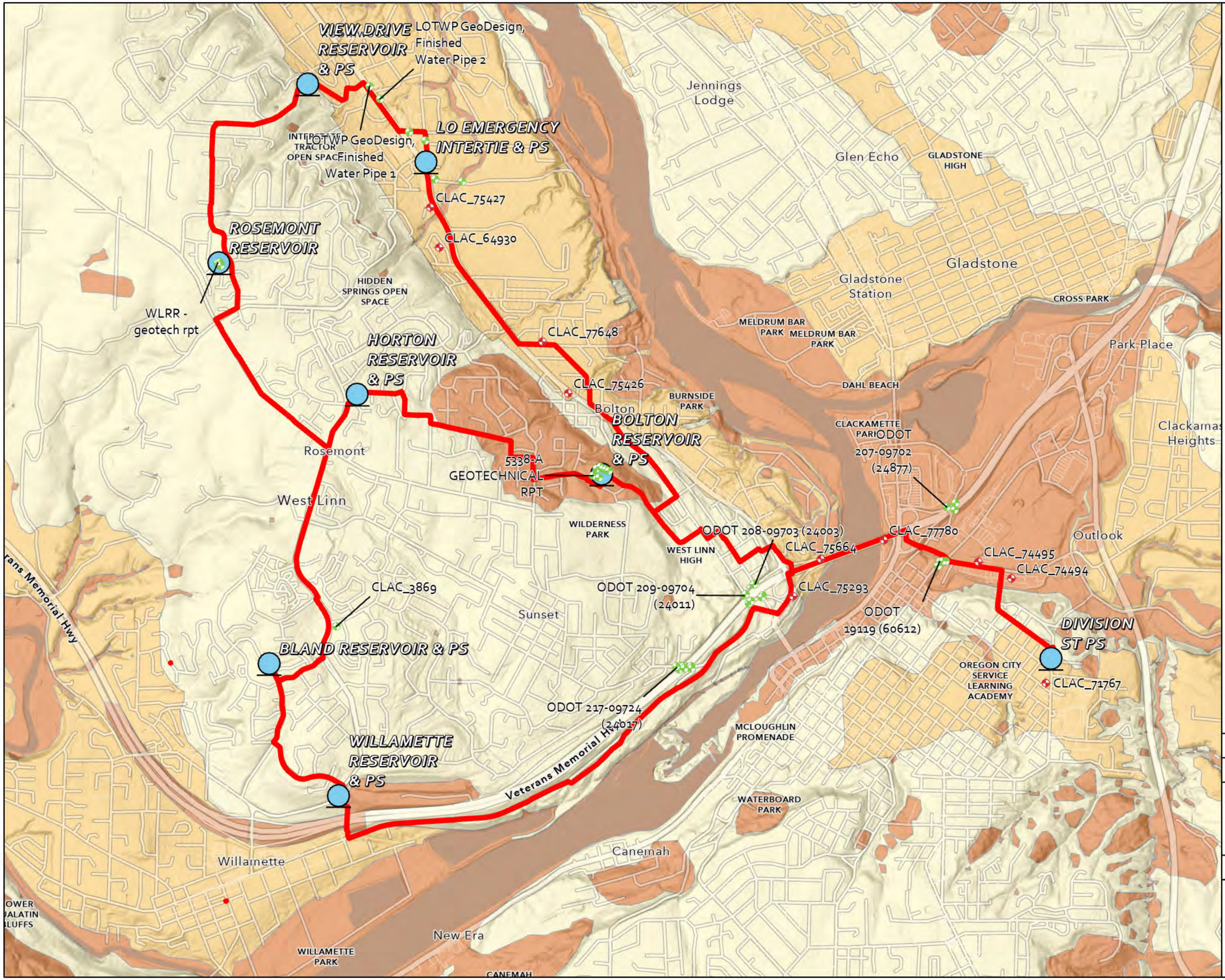

EXPLANATION

- Geotechnical Boring
- ORWD Well Log
- Backbone Sites
- Backbone Alignment

CSZ 9.0 PGV (in/sec)

- 8
- 9 - 11
- 12 - 16

1 inch = 2,000 feet

0 1,000 2,000 4,000 Feet

Coordinate System: NAD 1983 2011 StatePlane Oregon North FIPS 3601 Ft Intl; Map Units: Foot

CONSOR/CITY OF WEST LINN

WEST LINN SEISMIC HAZARD STUDY

PEAK GROUND VELOCITY MAP

WEST LINN, OR

DATE: DEC 2023 • PROJECT: 6432.0

DELVE underground

FIGURE

2

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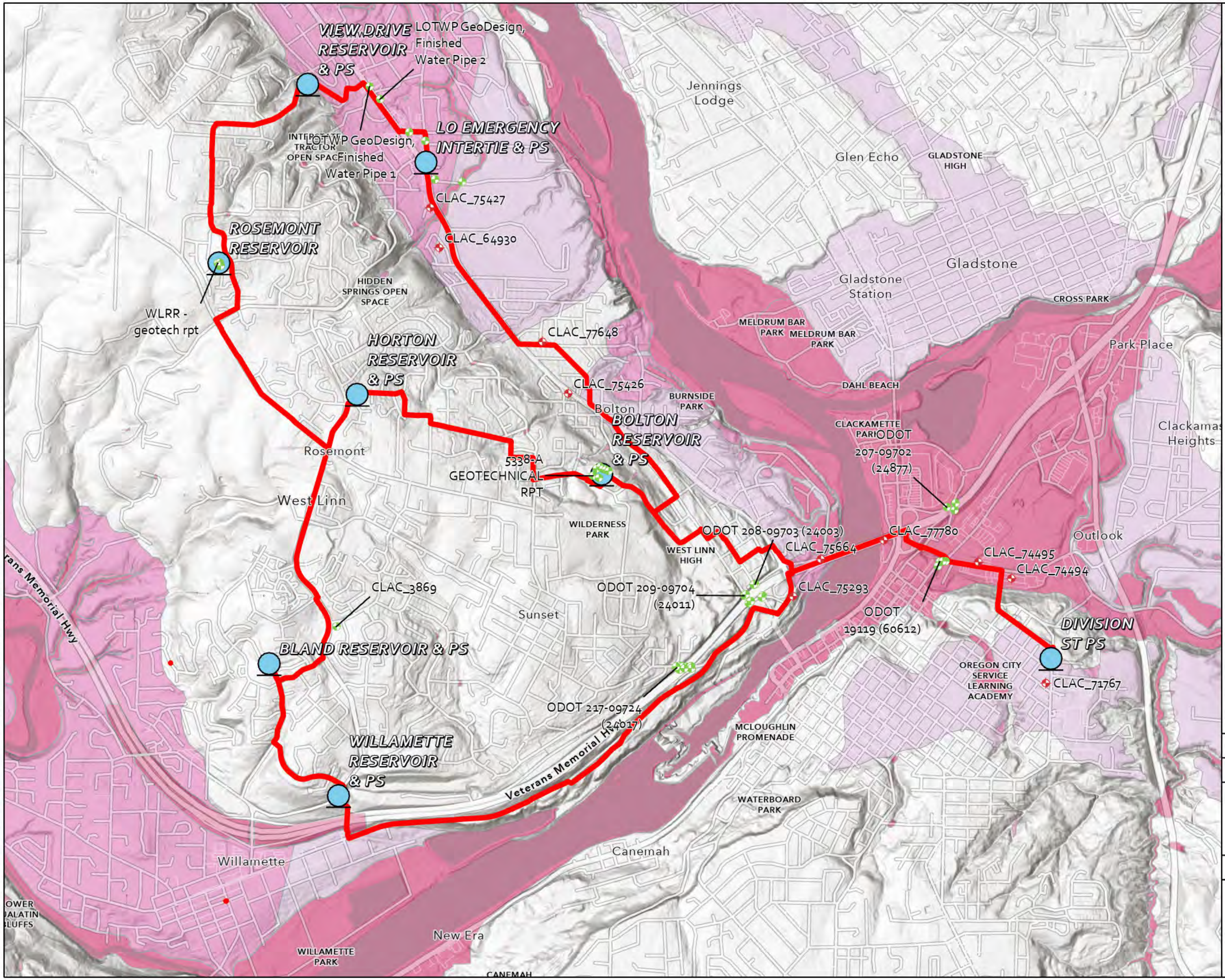

EXPLANATION

- ● Backbone Sites
- ▬ Backbone Alignment
- ● Geotechnical Boring
- ● ORWD Well Log

Liquefaction Hazard Level

Hazard Level

- None
- ▨ Low
- ▨ Moderate
- ▨ High

1 inch = 2,000 feet

0 1,000 2,000 4,000 Feet

Coordinate System: NAD 1983 2011 StatePlane Oregon North FIPS 3601 Ft Intl; Map Units: Foot

CONSOR/CITY OF WEST LINN

WEST LINN SEISMIC HAZARD STUDY

LIQUEFACTION HAZARD MAP

WEST LINN, OR

DATE: DEC 2023 • PROJECT: 6432.0

DELVE underground

FIGURE

3

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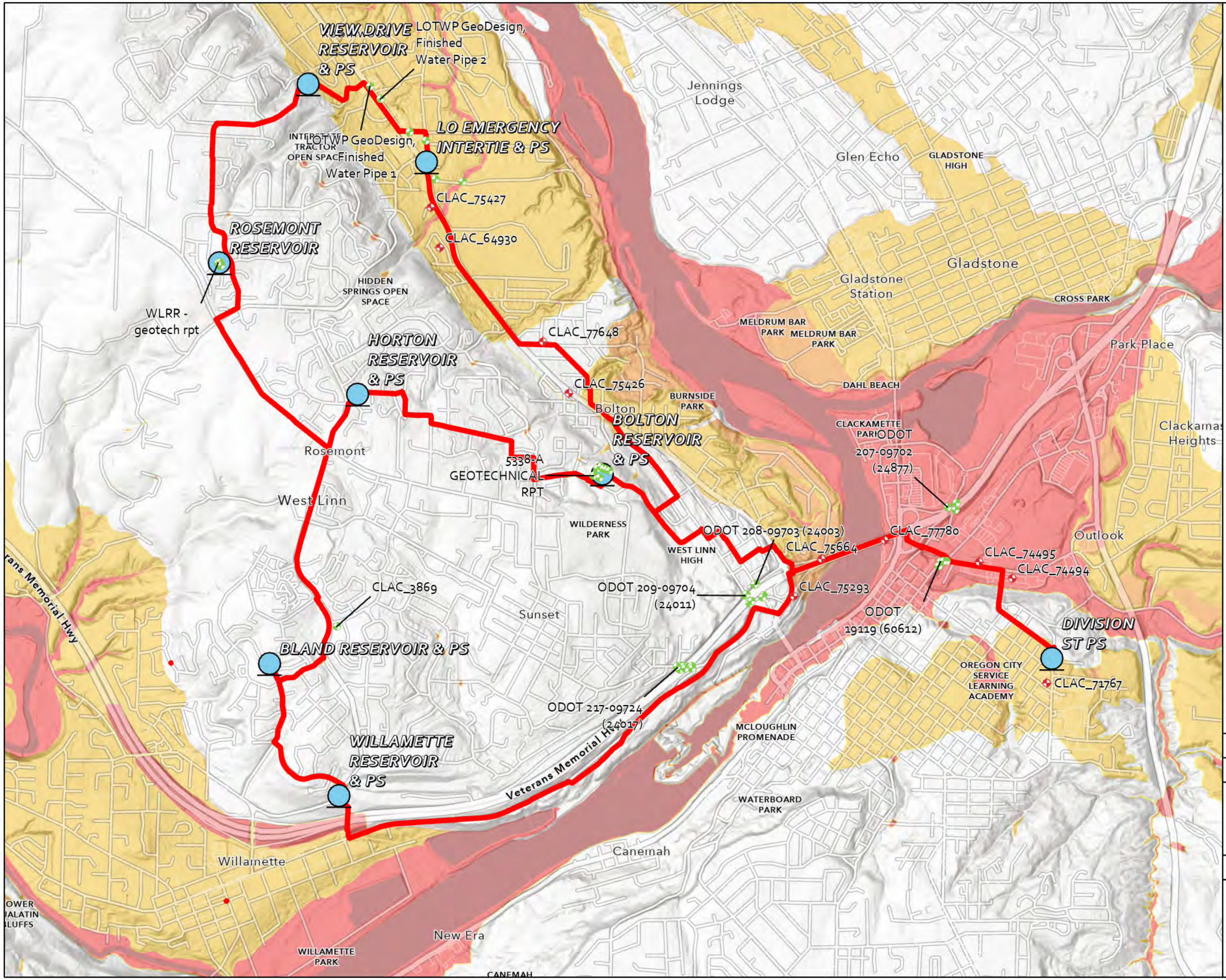

EXPLANATION

- Geotechnical Boring
- ORWD Well Log
- Backbone Sites
- Backbone Alignment

Liquefaction Induced Ground Deformation

Peak Ground Deformation (PGD) - inches

- 0
- 1 - 12
- 13 - 48
- 49 - 96

1 inch = 2,000 feet

0 1,000 2,000 4,000 Feet

Coordinate System: NAD 1983 2011 StatePlane Oregon North FIPS 3601 Ft Intl; Map Units: Foot

CONSOR/CITY OF WEST LINN

WEST LINN SEISMIC HAZARD STUDY

LIQUEFACTION INDUCED GROUND DEFORMATION

WEST LINN, OR

DATE: DEC 2023 • PROJECT: 6432.0

DELVE underground

FIGURE

4

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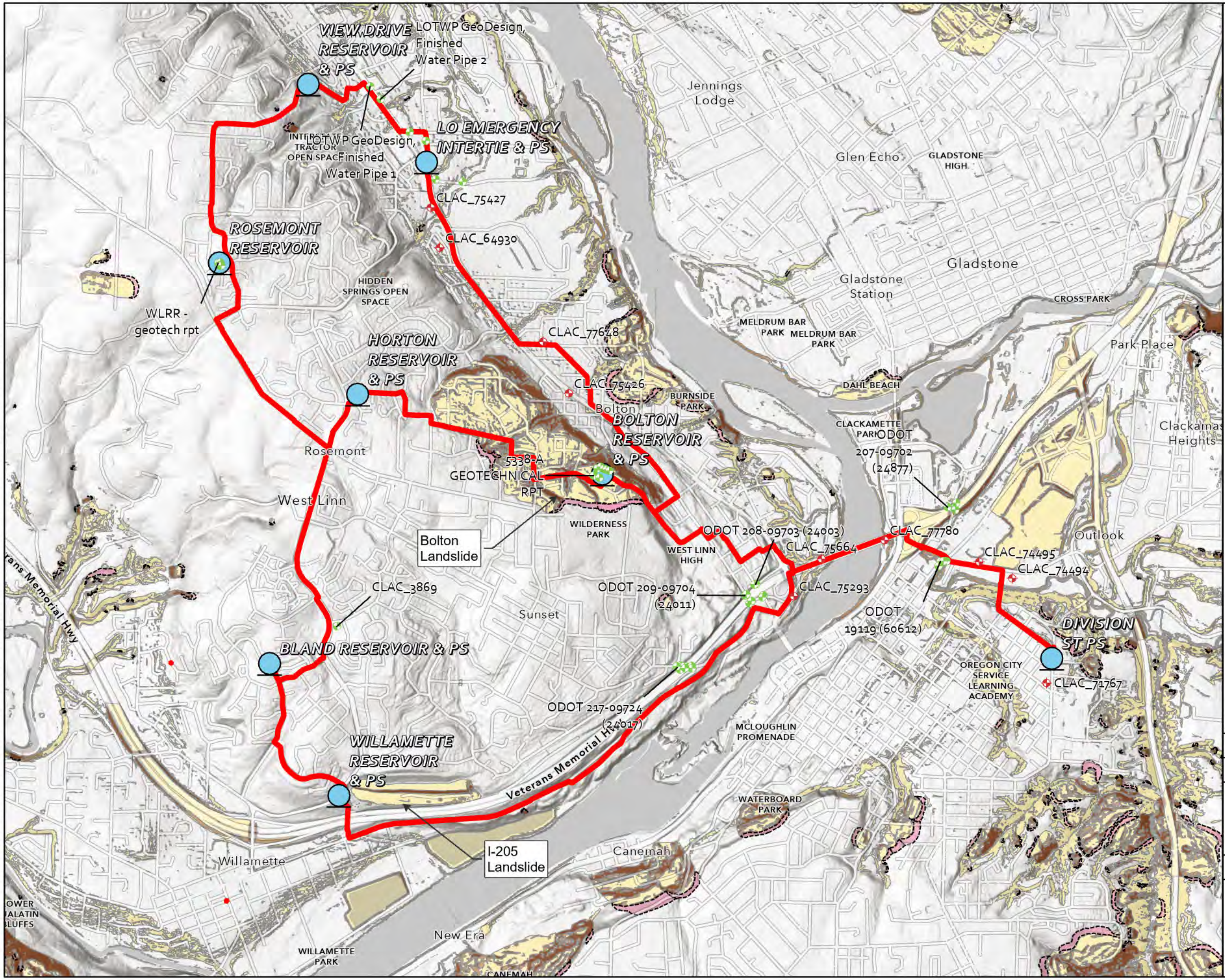


EXPLANATION

- Geotechnical Boring
- ORWD Well Log
- Backbone Sites
- Backbone Alignment
- Landslide Headscarp Flanks

Seismic Landslide Hazard

Peak Ground Deformation (ft)

- 0
- 1 - 5
- 6 - 15
- 16 - 25

1 inch = 2,000 feet

0 1,000 2,000 4,000 Feet

Coordinate System: NAD 1983 2011 StatePlane Oregon North FIPS 3601 Ft Intl; Map Units: Foot

CONSOR/CITY OF WEST LINN

WEST LINN SEISMIC HAZARD STUDY

SEISMIC LANDSLIDE MAP

WEST LINN, OR

DATE: DEC 2023 • PROJECT: 6432.0

DELVE underground

FIGURE

5

Path: G:\projects\6432.0\6432.0 West Linn Seismic Hazard Study\6432.0 West Linn Seismic Hazard Study.aprx User: Roth Date Saved: 12/13/2023 5:08 PM

Appendices

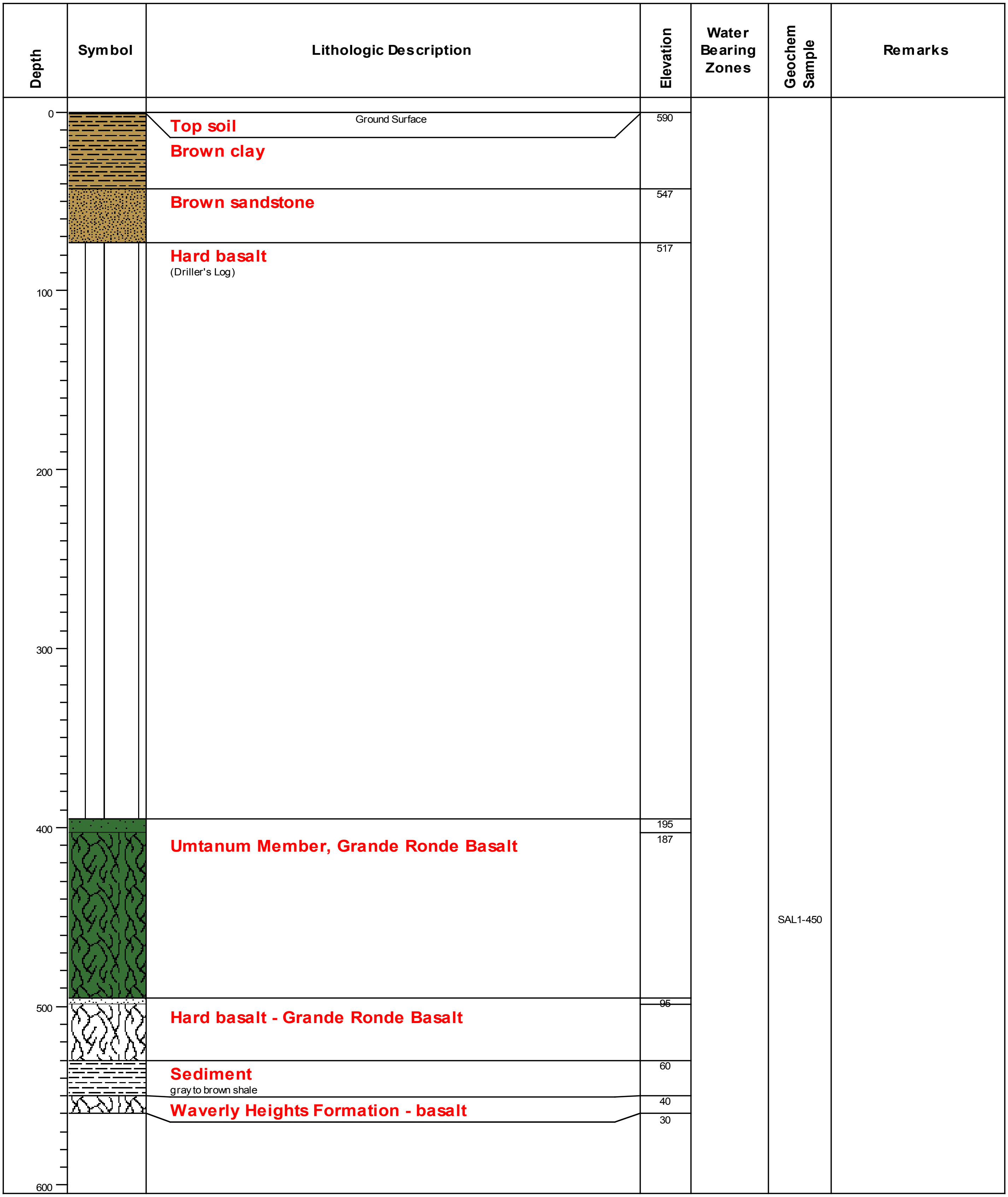
1. OWRD Well Logs
2. I 205 Geotechnical Boring Information
3. Lake Oswego Water Treatment Plant Finished Water Pipeline Boring Logs
4. Site Reconnaissance Photos

Appendix 1 OWRD Well Logs

Geologic Log For Site CLAC 3869

NWIS Site ID: 452131122384001
OWRD Log ID: CLAC 3869
Well location: 02S/01E-35AAC1
Depth drilled, in feet below land surface: 560
Land surface altitude, in feet above Nation Geodetic Vertical Datum of 1929: 585

Logged by: M. H. Beeson
Date drilled: 09/19/1988



Lithologic Description	Elevation	Geochem Sample
Top soil	590	
Brown clay		
Brown sandstone	547	
Hard basalt (Driller's Log)	517	
	195	
Umtanum Member, Grande Ronde Basalt	187	SAL1-450
Hard basalt - Grande Ronde Basalt	95	
Sediment gray to brown shale	60	
Waverly Heights Formation - basalt	40	
	30	

CLAC 64930

07-21-2008

STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-0035)

(1) OWNER/PROJECT

Hole Number B1
First Name Dave Last Name Grant
Company
Address 3963 Mapleton Drive
City West Linn State OR Zip 97068

(2) TYPE OF WORK

☒ New ☐ Deepening ☒ Abandonment
☐ Alteration (repair/recondition)

(3) CONSTRUCTION

☐ Rotary Air ☒ Hand Auger ☐ Hollow stem auger
☐ Rotary Mud ☐ Cable ☐ Push Probe
☐ Other

(4) TYPE OF HOLE:

● Uncased Temporary ○ Cased Permanet
○ Uncased Permanent ○ Slope Stablity
○ Other
Other:

(5) USE OF HOLE

Environmental Investigation

(6) BORE HOLE CONSTRUCTION

Special Standard ☐ (Attach copy)
Depth of Completed Hole 16.80 ft.

BORE HOLE			SEAL				
Dia	From	To	Material	From	To	Amt	sacks/ lbs
.25	0	16.8	Bentonite Chips	.5	16.8	75	P

Backfill placed from .5 ft. to 16.8 ft. Material Bentonite chips
Filter pack from ft. to ft. Material Size

(7) CASING/SCREEN

Casing	Screen	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐

(8) WELL TESTS

○ Pump ○ Bailer ○ Air ○ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration(hr)

Temperature °F Lab analysis ☐ Yes By
Supervising Geologist/Engineer
Water quality concerns? ☐ Yes (describe below)

From	To	Description	Amount	Units

(9) LOCATION OF HOLE (legal description)

County Clackamas Twp 2.00 S N/S Range 1.00 E E/W WM
Sec 24 NW 1/4 of the SW 1/4 Tax Lot 201
Tax Map Number Lot
Lat ° ' " or DMS or DD
Long ° ' " or DMS or DD
● Street address of hole ○ Nearest address
3963 Mapleton Drive, West Linn, OR 97068

(10) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
Completed Well			☐	

Flowing Artesian? ☐
WATER BEARING ZONES
Depth water was first found 15.40

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
					☐	
					☐	
					☐	
					☐	
					☐	

(11) SUBSURFACE LOG

Ground Elevation

Material	From	To
Sample tube closed	0	8.7
Moist silt, moderate contamination	8.7	15.4
Wet silt, moderate contamination	15.4	16.8

Date Started 11-06-2007 Completed 11-06-2007

(12) ABANDONMENT LOG:

Material	From	To	Amt	sacks/ lbs
Other	0	.5	0	
Bentonite Chips	.5	16.8	75	P

Date Started 11-06-2007 Completed 11-06-2007

Professional Certification (to be signed by an Oregon licensed water or monitoring well constructor, or Oregon registered geologist or civil engineer).

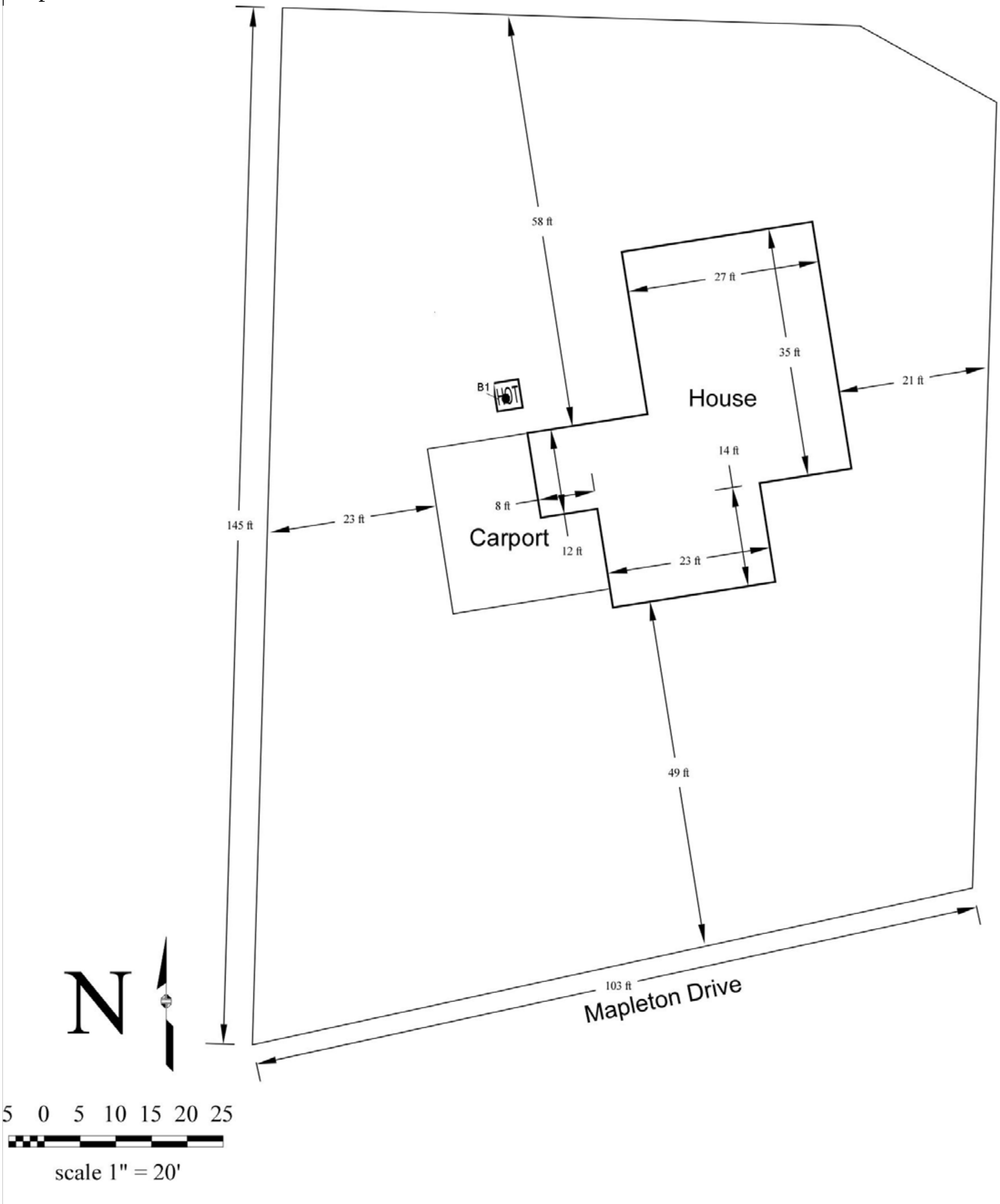
I accept responsibility for the construction, deepening, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License/Registration Number G1796 Date
Electronically Submitted
First Name Kevin R. Last Name Knapp
Affiliation EcoTech, LLC

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

Form Version: 0.36

Map of Hole



ECOTECH	EcoTech • P.O. Box 11630 Portland, OR 97211	07-513	Grant	10/07
	Site Plan	3963 Mapleton Drive West Linn OR 97068		

CLAC 71767

Page 1 of 2

STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-0035)

11/13/2015

(1) OWNER/PROJECT

Hole Number B2

PROJECT NAME/NBR: 4-846/PROVIDENCE-63-01

First Name
Last Name
Company PROVIDENCE REAL ESTATE DEPT
Address 4400 NE HALSEY ST, BLDG 2 STE 190
City PORTLAND State OR Zip 97213

(2) TYPE OF WORK

☒ New ☐ Deepening ☒ Abandonment
☐ Alteration (repair/recondition)

(3) CONSTRUCTION

☐ Rotary Air ☐ Hand Auger ☐ Hollow stem auger
☒ Rotary Mud ☐ Cable ☐ Push Probe
☐ Other

(4) TYPE OF HOLE:

● Uncased Temporary ○ Cased Permanent
○ Uncased Permanent ○ Slope Stablity
○ Other
Other:

(5) USE OF HOLE

GEOTECHNICAL

(6) BORE HOLE CONSTRUCTION

Special Standard ☐ (Attach copy)

Depth of Completed Hole 45.00 ft.

BORE HOLE			SEAL				sacks/
Dia	From	To	Material	From	To	Amt	lbs
4	0	45	Bentonite Chips	0	15	3	S
			Bentonite Grout	15	45	1	S

Backfill placed from ft. to ft. Material
Filter pack from ft. to ft. Material Size

(7) CASING/SCREEN

Casing	Screen	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐

(8) WELL TESTS

○ Pump ○ Bailer ○ Air ○ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration(hr)

Temperature °F Lab analysis ☐ Yes By
Supervising Geologist/Engineer
Water quality concerns? ☐ Yes (describe below) TDS amount

From	To	Description	Amount	Units

(9) LOCATION OF HOLE (legal description)

County CLACKAMAS Twp 2.00 S N/S Range 2.00 E E/W WM
Sec 32 NW 1/4 of the NE 1/4 Tax Lot 2300
Tax Map Number Lot
Lat ° ' " or 45.35713889 DMS or DD
Long ° ' " or -122.58880556 DMS or DD
● Street address of hole ○ Nearest address
1505 DIVISION ST OREGON CITY, OR 97045

(10) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
Completed Well			☐	

Flowing Artesian? ☐
WATER BEARING ZONES
Depth water was first found

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
					☐	
					☐	
					☐	
					☐	
					☐	

(11) SUBSURFACE LOG

Ground Elevation

Material	From	To
AC/Base Rock	0	1
Brown Silt Clay	1	16
Gray Med Clay	16	38
Tan Soft Clay	38	42
Gray Stiff Clay	42	45

Date Started 11/10/2015 Completed 11/10/2015

(12) ABANDONMENT LOG:

Material	From	To	Amt	sacks/ lbs
Bentonite Chips	0	15	3	S
Bentonite Grout	15	45	1	S

Date Started 11/10/2015 Completed 11/10/2015

Professional Certification (to be signed by an Oregon licensed water or monitoring well constructor, Oregon registered geologist or professional engineer).

I accept responsibility for the construction, deepening, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License/Registration Number 1772 Date 11/13/2015

First Name WILLIAM 'BRAD' Last Name WRIGHT
Affiliation WESTERN STATES SOIL CONSERVATION INC.

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

Form Version:

GEOTECHNICAL HOLE REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

CLAC 71767

11/13/2015

Map of Hole

CLAC 74494

STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-0035)

10/17/2018

(1) OWNER/PROJECT

Hole Number B-6

PROJECT NAME/NBR: 306-18-1181

First Name Last Name
Company CLACKAMAS COUNTY
Address 150 BEAVERCREEK RD.
City OREGON CITY State OR Zip 97045

(2) TYPE OF WORK

☒ New ☐ Deepening ☒ Abandonment
☐ Alteration (repair/recondition)

(3) CONSTRUCTION

☐ Rotary Air ☐ Hand Auger ☐ Hollow stem auger
☐ Rotary Mud ☐ Cable ☒ Push Probe
☐ Other

(4) TYPE OF HOLE:

● Uncased Temporary ○ Cased Permanent
○ Uncased Permanent ○ Slope Stablity
○ Other
Other:

(5) USE OF HOLE

SOIL AND WATER SAMPELING

(6) BORE HOLE CONSTRUCTION

Special Standard ☐ (Attach copy)

Depth of Completed Hole 30.00 ft.

BORE HOLE			SEAL				
Dia	From	To	Material	From	To	Amt	sacks/ lbs
2.25	0	30	Other	0	1	0.25	S
			Bentonite Chips	1	30	1.25	S

Backfill placed from 0 ft. to 30 ft. Material BETONITE CHIPS
Filter pack from ft. to ft. Material Size

(7) CASING/SCREEN

Casing	Screen	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐

(8) WELL TESTS

○ Pump ○ Bailer ○ Air ○ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration(hr)

Temperature 55 °F Lab analysis ☐ Yes By
Supervising Geologist/Engineer
Water quality concerns? ☐ Yes (describe below) TDS amount 100 ppm

From	To	Description	Amount	Units

(9) LOCATION OF HOLE (legal description)

County CLACKAMAS Twp 2.00 S N/S Range 2.00 E E/W WM
Sec 29 SE 1/4 of the SW 1/4 Tax Lot 100
Tax Map Number Lot
Lat ° ' " or DMS or DD
Long ° ' " or DMS or DD
● Street address of hole ○ Nearest address

902 ABERNETHY ROAD,
OREGON CITY, OR, 97045

(10) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
Completed Well	9/28/2018		☐	19.4

Flowing Artesian? ☐
WATER BEARING ZONES
Depth water was first found

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
9/28/2018	19.4	30			☐	19.4
					☐	
					☐	
					☐	
					☐	

(11) SUBSURFACE LOG

Ground Elevation

Material	From	To
Silty Gravel	0	10
SILTY SANDS	10	30

Date Started 9/28/2018 Completed 9/28/2018

(12) ABANDONMENT LOG:

Material	From	To	Amt	sacks/ lbs
Other	0	1	0.25	S
Bentonite Chips	1	30	1.25	S

Date Started 9/28/2018 Completed 9/28/2018

Professional Certification (to be signed by an Oregon licensed water or monitoring well constructor, Oregon registered geologist or professional engineer).

I accept responsibility for the construction, deepening, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License/Registration Number 10670 Date 10/17/2018
First Name STEVEN Last Name EDDINS
Affiliation STEVENEDDINS

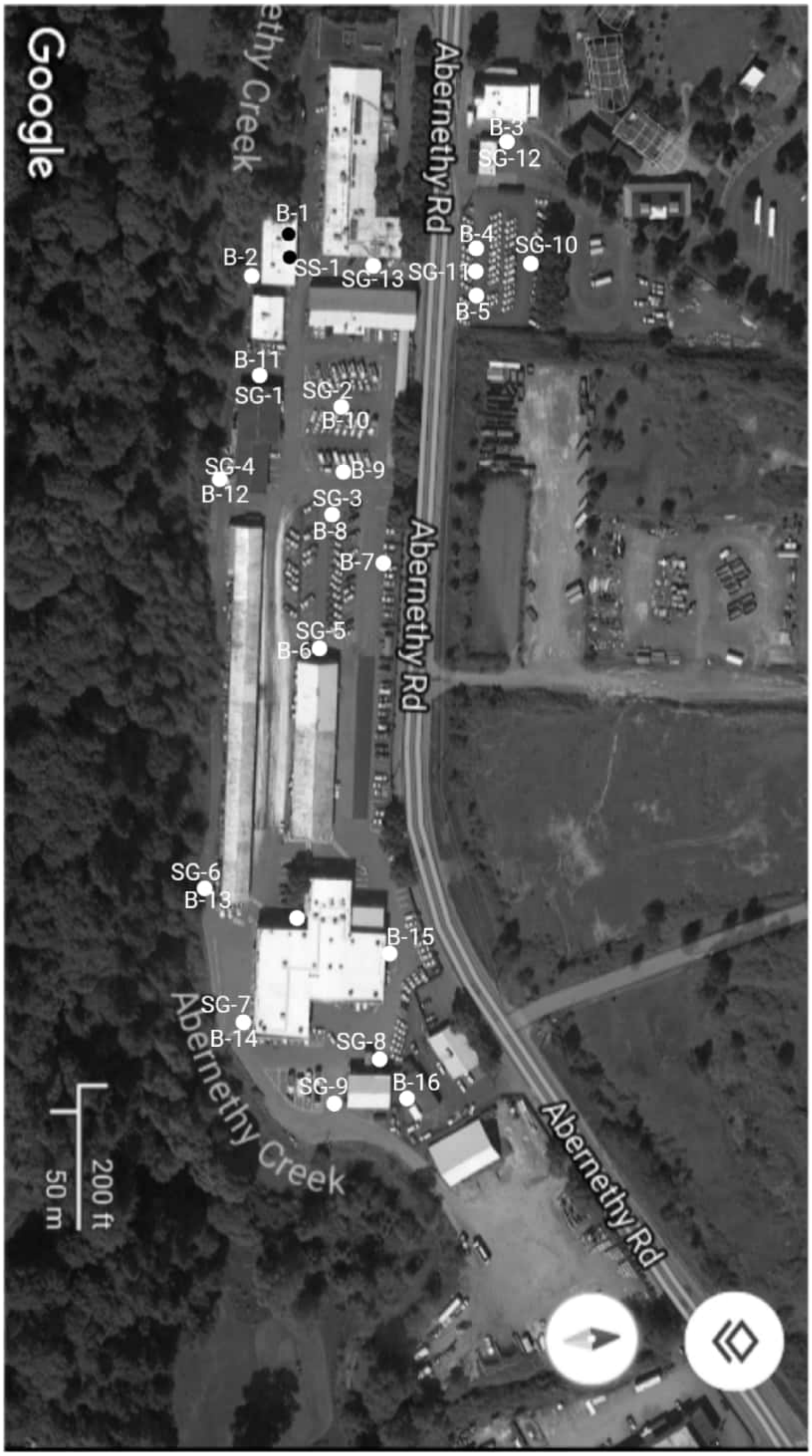
ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK
Form Version:

GEOTECHNICAL HOLE REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

CLAC 74494

10/17/2018

Map of Hole



902 Abernethy Rd,
Oregon City, OR
97045

CLAC 74495

STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-0035)

10/17/2018

(1) OWNER/PROJECT

Hole Number B-3

PROJECT NAME/NBR: 306-18-1181

First Name ________ Last Name ________

Company CLACKAMAS COUNTY

Address 150 BEAVERCREEK RD.

City OREGON CITY State OR Zip 97045

(2) TYPE OF WORK

☒ New ☐ Deepening ☒ Abandonment

☐ Alteration (repair/recondition)

(3) CONSTRUCTION

☐ Rotary Air ☐ Hand Auger ☐ Hollow stem auger

☐ Rotary Mud ☐ Cable ☒ Push Probe

☐ Other ________

(4) TYPE OF HOLE:

● Uncased Temporary ○ Cased Permanent

○ Uncased Permanent ○ Slope Stablity

○ Other

Other: ________

(5) USE OF HOLE

SOIL AND WATER SAMPELING

(6) BORE HOLE CONSTRUCTION

Special Standard ☐ (Attach copy)

Depth of Completed Hole 35.00 ft.

BORE HOLE

Dia	From	To
2.25	0	35

SEAL

Material	From	To	Amt	sacks/ lbs
Other	0	1	0.25	S
Bentonite Chips	1	35	1.5	S

Backfill placed from 0 ft. to 35 ft. Material BETONITE CHIPS

Filter pack from ____ ft. to ____ ft. Material ____ Size ____

(7) CASING/SCREEN

Casing	Screen	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐

(8) WELL TESTS

○ Pump ○ Bailer ○ Air ○ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration(hr)

Temperature 55 °F Lab analysis ☐ Yes By ________

Supervising Geologist/Engineer ________

Water quality concerns? ☐ Yes (describe below) TDS amount 100 ppm

From	To	Description	Amount	Units

(9) LOCATION OF HOLE (legal description)

County CLACKAMAS Twp 2.00 S N/S Range 2.00 E E/W WM

Sec 29 SE 1/4 of the SW 1/4 Tax Lot 2700

Tax Map Number ________ Lot ________

Lat ____° ____' ____" or ________ DMS or DD

Long ____° ____' ____" or ________ DMS or DD

● Street address of hole ○ Nearest address

902 ABERNETHY ROAD,
OREGON CITY, OR, 97045

(10) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
Completed Well	9/27/2018		☐	32.5

Flowing Artesian? ☐

WATER BEARING ZONES

Depth water was first found ________

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
9/27/2018	19.4	35			☐	32.5
					☐	
					☐	
					☐	
					☐	

(11) SUBSURFACE LOG

Ground Elevation ________

Material	From	To
Silty Gravel	0	10
SILTY SANDS	10	35

Date Started 9/27/2018 Completed 9/27/2018

(12) ABANDONMENT LOG:

Material	From	To	Amt	sacks/ lbs
Other	0	1	0.25	S
Bentonite Chips	1	35	1.5	S

Date Started 9/27/2018 Completed 9/27/2018

Professional Certification (to be signed by an Oregon licensed water or monitoring well constructor, Oregon registered geologist or professional engineer).

I accept responsibility for the construction, deepening, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License/Registration Number 10670 Date 10/17/2018

First Name STEVEN Last Name EDDINS

Affiliation STEVENEDDINS

ORIGINAL - WATER RESOURCES DEPARTMENT

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

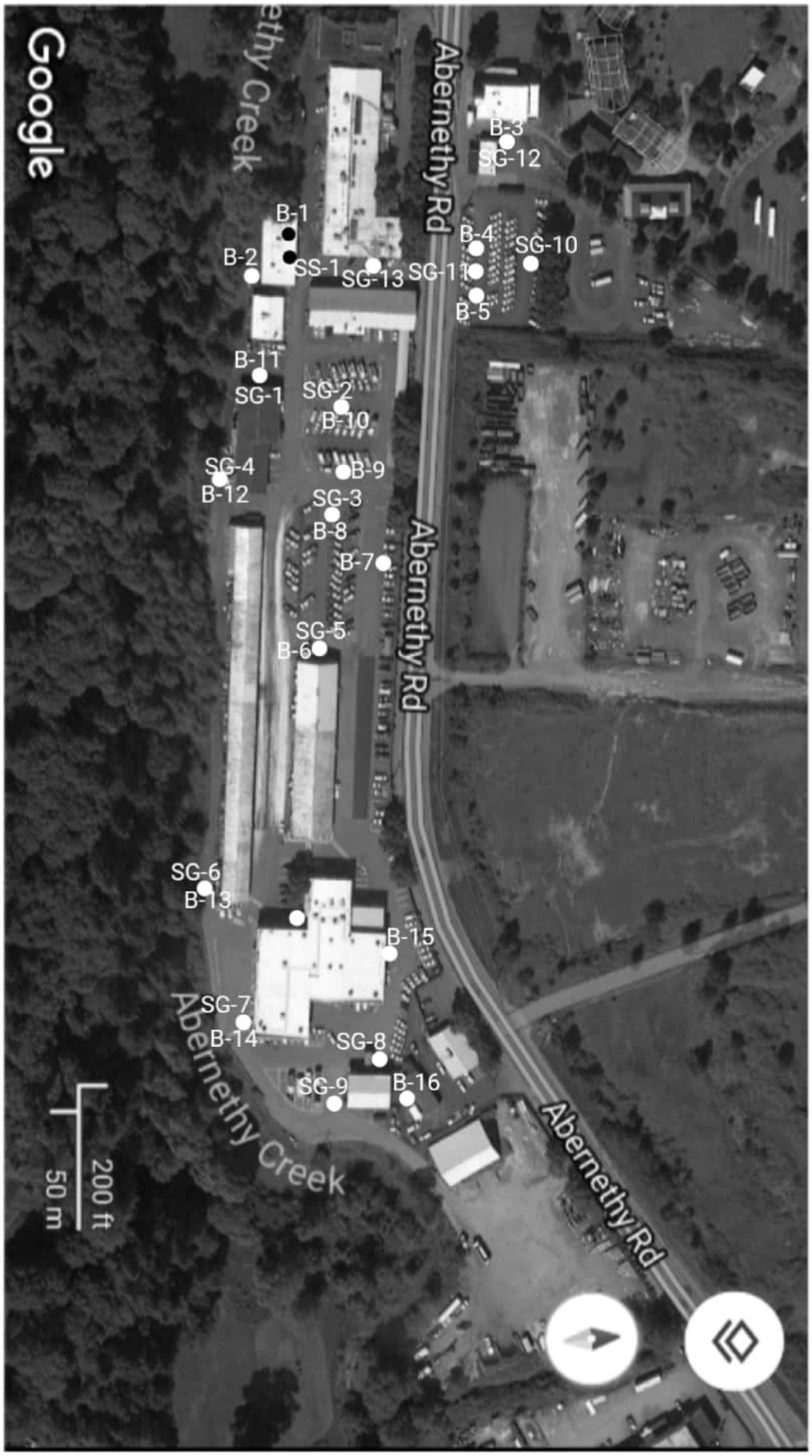
Form Version:

GEOTECHNICAL HOLE REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

CLAC 74495

10/17/2018

Map of Hole



902 Abernethy Rd,
Oregon City, OR
97045

CLAC 75426

Page 1 of 2

STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-0035)

11/25/2019

(1) OWNER/PROJECT

Hole Number B7

PROJECT NAME/NBR: WEST LINN

First Name
Last Name
Company CITY OF WEST LINN
Address 22500 SALAMO ROAD
City WEST LINN State OR Zip 97068

(2) TYPE OF WORK

☒ New ☐ Deepening ☒ Abandonment
☐ Alteration (repair/recondition)

(3) CONSTRUCTION

☐ Rotary Air ☐ Hand Auger ☐ Hollow stem auger
☒ Rotary Mud ☐ Cable ☐ Push Probe
☐ Other

(4) TYPE OF HOLE:

● Uncased Temporary ○ Cased Permanent
○ Uncased Permanent ○ Slope Stablity
○ Other
Other:

(5) USE OF HOLE

GEOTECHNICAL SOIL

(6) BORE HOLE CONSTRUCTION

Special Standard ☐ (Attach copy)

Depth of Completed Hole 40.00 ft.

BORE HOLE			SEAL				
Dia	From	To	Material	From	To	Amt	sacks/ lbs
4.87	0	40	Bentonite Chips	0	40	7	S

Backfill placed from ft. to ft. Material
Filter pack from ft. to ft. Material Size

(7) CASING/SCREEN

Casing	Screen	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐

(8) WELL TESTS

○ Pump ○ Bailer ○ Air ○ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration(hr)

Temperature °F Lab analysis ☐ Yes By
Supervising Geologist/Engineer
Water quality concerns? ☐ Yes (describe below) TDS amount

From	To	Description	Amount	Units

(9) LOCATION OF HOLE (legal description)

County CLACKAMAS Twp 2.00 S N/S Range 1.00 E E/W WM
Sec 25 NW 1/4 of the NE 1/4 Tax Lot ROADS
Tax Map Number Lot
Lat ° ' " or 45.37274444 DMS or DD
Long ° ' " or -122.62754444 DMS or DD
○ Street address of hole ● Nearest address
WILLAMETTE FALLS DR, WEST LINN, OR

(10) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
Completed Well			☐	

Flowing Artesian? ☐
WATER BEARING ZONES
Depth water was first found

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
					☐	
					☐	
					☐	
					☐	
					☐	

(11) SUBSURFACE LOG

Ground Elevation

Material	From	To
Gravels cobbles and silt	0	4
Clay silt	4	7
Sandy silt and some gravels	7	25
Weathered rock with trace clay	25	40

Date Started 11/13/2019 Completed 11/13/2019

(12) ABANDONMENT LOG:

Material	From	To	Amt	sacks/ lbs
Bentonite Chips	0	40	7	S

Date Started 11/13/2019 Completed 11/13/2019

Professional Certification (to be signed by an Oregon licensed water or monitoring well constructor, Oregon registered geologist or professional engineer).

I accept responsibility for the construction, deepening, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License/Registration Number 10607 Date 11/25/2019
First Name ADONIS Last Name PABLO
Affiliation WESTERN STATES

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

Form Version:

GEOTECHNICAL HOLE REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

CLAC 75426

11/25/2019

Map of Hole

CLAC 75664

STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-0035)

3/9/2020

(1) OWNER/PROJECT

Hole Number B2

PROJECT NAME/NBR: I-205

First Name
Last Name
Company ODOT REGION 1
Address 123 NW FLANDERS
City PORTLAND State OR Zip 97209

(2) TYPE OF WORK

☒ New ☐ Deepening ☒ Abandonment
☐ Alteration (repair/recondition)

(3) CONSTRUCTION

☐ Rotary Air ☐ Hand Auger ☐ Hollow stem auger
☒ Rotary Mud ☐ Cable ☐ Push Probe
☒ Other HQ3 CORE

(4) TYPE OF HOLE:

● Uncased Temporary ○ Cased Permanent
○ Uncased Permanent ○ Slope Stablity
○ Other
Other:

(5) USE OF HOLE

GEOTECHNICAL SOIL & ROCK

(6) BORE HOLE CONSTRUCTION

Special Standard ☐ (Attach copy)

Depth of Completed Hole 160.00 ft.

BORE HOLE			SEAL				sacks/
Dia	From	To	Material	From	To	Amt	lbs
5	0	140	Bentonite Chips	0	10	2	S
4	140	160	Bentonite Grout	10	160	6	S

Backfill placed from ft. to ft. Material
Filter pack from ft. to ft. Material Size

(7) CASING/SCREEN

Casing	Screen	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐

(8) WELL TESTS

○ Pump ○ Bailer ○ Air ○ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration(hr)

Temperature °F Lab analysis ☐ Yes By
Supervising Geologist/Engineer
Water quality concerns? ☐ Yes (describe below) TDS amount

From	To	Description	Amount	Units

(9) LOCATION OF HOLE (legal description)

County CLACKAMAS Twp 2.00 S N/S Range 2.00 E E/W WM
Sec 30 SW 1/4 of the SE 1/4 Tax Lot ROW
Tax Map Number Lot
Lat ° ' " or 45.36379444 DMS or DD
Long ° ' " or -122.60701944 DMS or DD
○ Street address of hole ● Nearest address

5350 RIVER ST WEST LINN

(10) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
Completed Well			☐	

Flowing Artesian? ☐
WATER BEARING ZONES
Depth water was first found

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
					☐	
					☐	
					☐	
					☐	
					☐	

(11) SUBSURFACE LOG

Ground Elevation

Material	From	To
Sand and gravels	0	5
Sandy Silt	5	85
Brown Clay	85	105
Decomposed Rock	105	138
Basalt	138	160

Date Started 1/30/2020 Completed 2/3/2020

(12) ABANDONMENT LOG:

Material	From	To	Amt	sacks/ lbs
Bentonite Chips	0	10	2	S
Bentonite Grout	10	160	6	S

Date Started 2/3/2020 Completed 2/3/2020

Professional Certification (to be signed by an Oregon licensed water or monitoring well constructor, Oregon registered geologist or professional engineer).

I accept responsibility for the construction, deepening, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License/Registration Number 10591 Date 3/9/2020
First Name JEFF Last Name CRISMAN
Affiliation WESTERN STATES SOIL CONSERVATION, INC.

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

Form Version:

GEOTECHNICAL HOLE REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

CLAC 75664

3/9/2020

Map of Hole

CLAC 77780

STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-0035)

3/6/2023

(1) OWNER/PROJECT

Hole Number 3A

PROJECT NAME/NBR: OREGON CITY OR 1 30

First Name Last Name
Company ODOT
Address 3930 FAIRVIEW INDUSTRIAL DRIVE SE
City SALEM State OR Zip 97302

(2) TYPE OF WORK

☒ New ☐ Deepening ☒ Abandonment
☐ Alteration (repair/recondition)

(3) CONSTRUCTION

☐ Rotary Air ☐ Hand Auger ☐ Hollow stem auger
☐ Rotary Mud ☐ Cable ☐ Push Probe
☒ Other SONIC

(4) TYPE OF HOLE:

● Uncased Temporary ○ Cased Permanent
○ Uncased Permanent ○ Slope Stablity
○ Other
Other:

(5) USE OF HOLE

GEOTECHNICAL SOIL

(6) BORE HOLE CONSTRUCTION

Special Standard ☐ (Attach copy)
Depth of Completed Hole 211.60 ft.

BORE HOLE			SEAL				
Dia	From	To	Material	From	To	Amt	sacks/ lbs
6	0	211.6					

Backfill placed from ft. to ft. Material
Filter pack from ft. to ft. Material Size

(7) CASING/SCREEN

Casing	Screen	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐

(8) WELL TESTS

○ Pump ○ Bailer ○ Air ○ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration(hr)

Temperature °F Lab analysis ☐ Yes By
Supervising Geologist/Engineer
Water quality concerns? ☐ Yes (describe below) TDS amount

From	To	Description	Amount	Units

(9) LOCATION OF HOLE (legal description)

County CLACKAMAS Twp 2.00 S N/S Range 2.00 E E/W WM
Sec 30 NE 1/4 of the SE 1/4 Tax Lot ROW
Tax Map Number Lot
Lat ° ' " or 45.36494722 DMS or DD
Long ° ' " or -122.60202778 DMS or DD
○ Street address of hole ● Nearest address

AGNES AVE

(10) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
Completed Well			☐	

Flowing Artesian? ☐
WATER BEARING ZONES
Depth water was first found

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
					☐	
					☐	
					☐	
					☐	
					☐	

(11) SUBSURFACE LOG

Ground Elevation

Material	From	To
no recovery fill	0	8
Silty gravel w some sand (alluvium)	8	34.5
Silt w some sand (alluvium)	34.5	167
Clay w some sand trace gravels multicolo	167	173
Columbia River basalt	173	211.6

Date Started 1/31/2023 Completed 2/9/2023

(12) ABANDONMENT LOG:

Material	From	To	Amt	sacks/ lbs
Bentonite Chips	0	10	3	S
Bentonite Grout	10	211.6	11	S

Date Started 2/9/2023 Completed 2/9/2023

Professional Certification (to be signed by an Oregon licensed water or monitoring well constructor, Oregon registered geologist or professional engineer).

I accept responsibility for the construction, deepening, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License/Registration Number 10708 Date 3/6/2023
First Name JOE Last Name BOHACH
Affiliation WESTERN STATES

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

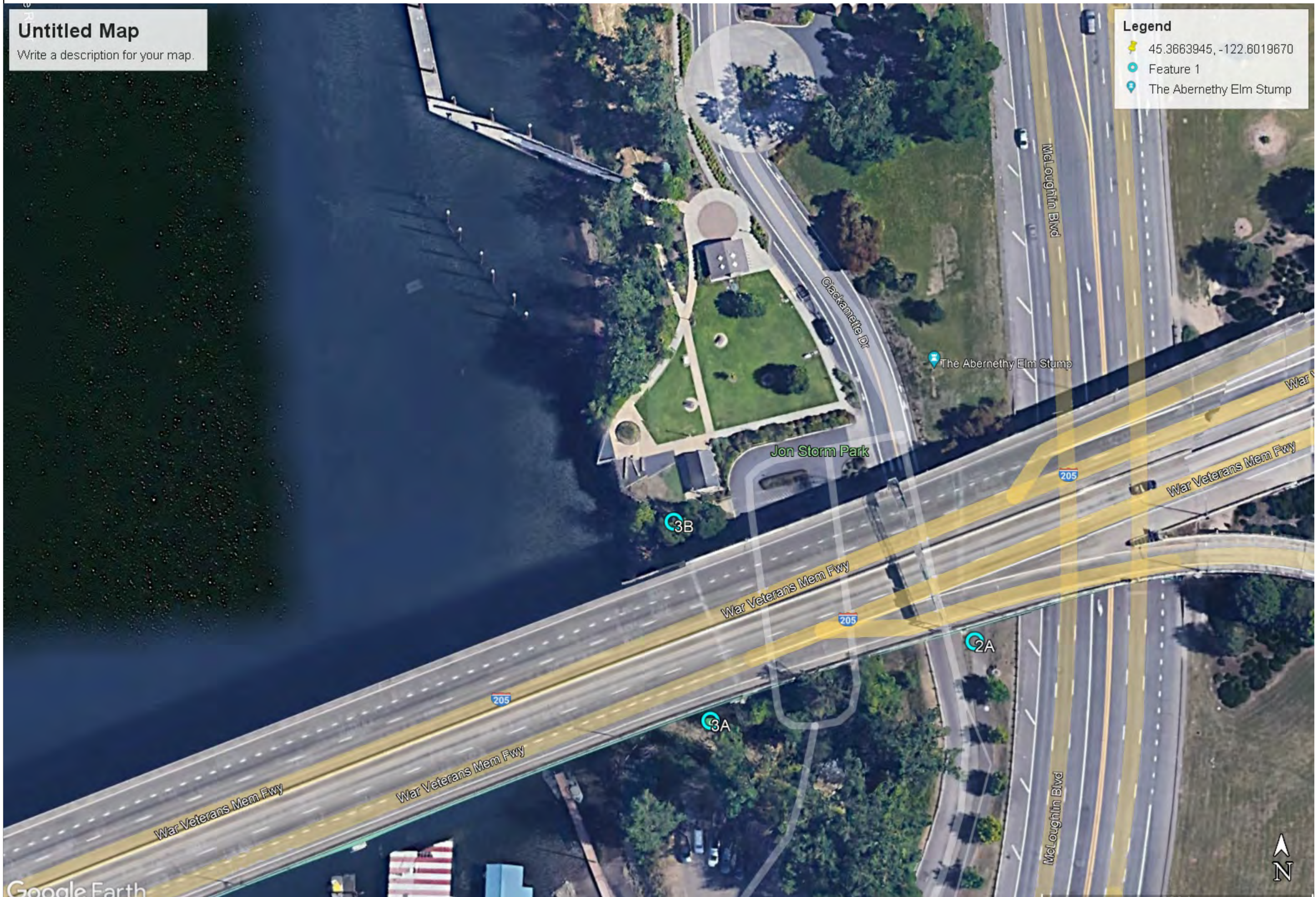
Form Version:

GEOTECHNICAL HOLE REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

CLAC 77780

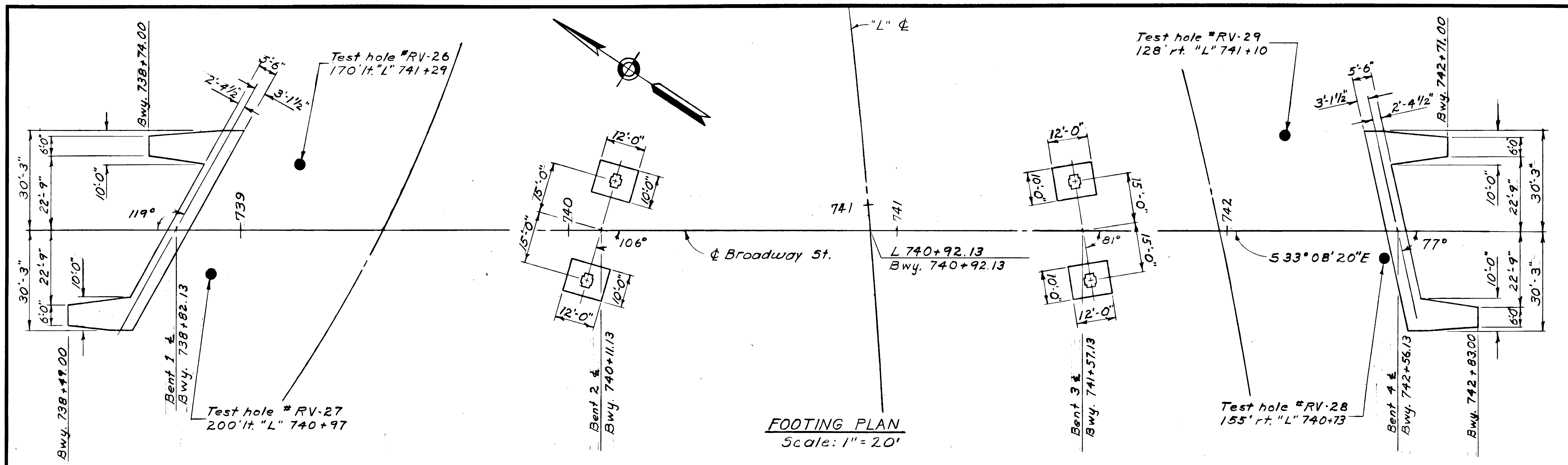
3/6/2023

Map of Hole

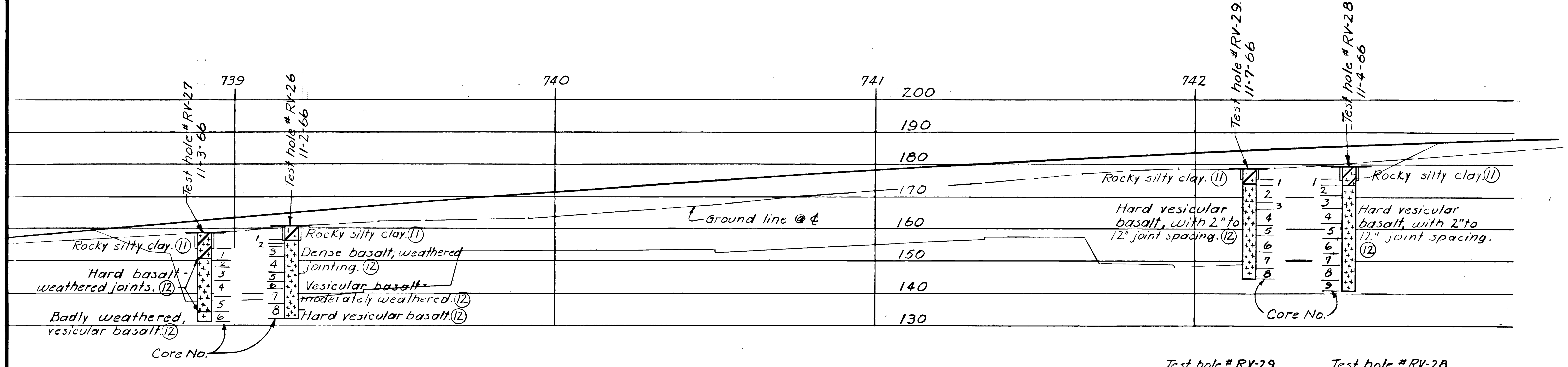


Appendix 2 I205 Geotechnical Boring Information

REVIEWED 4-18-68 JEB
DESIGN ENGR. SEC.



FOOTING PLAN
Scale: 1"=20'



FOUNDATION DATA
Scale: 1"=20'

Test hole #RV-27

Core No.	% Rec.
1	23
2	95
3	93
4	96
5	100
6	75

Test hole #RV-26

Core No.	% Rec.
1	100
2	82
3	80
4	96
5	59
6	64
7	100
8	100

Core Recovery Record

Test hole #RV-29

Core No.	% Rec.
1	42
2	100
3	100
4	98
5	100
6	"
7	"
8	"

Test hole #RV-28

Core No.	% Rec.
1	35
2	100
3	92
4	100
5	"
6	"
7	"
8	"
9	"

Core Recovery Record

Foundation data shown on this drawing, in some instances, is a consolidation of and a revision in terminology from the original field drilling logs. The original field drilling logs are available for review in the office of the Bridge Engineer in Salem.

LEGEND OF MATERIALS

①	Gravels and cobbles
②	Sand
③	Silty gravels, gravel-sand-silt mixture.
④	Silty sands, sand-silt mixtures.
⑤	Clayey gravels, gravel-sand-clay mixture.
⑥	Clayey sands, sand-clay mixtures.
⑦	Silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts.
⑧	Loam — near equal proportions of sand, silt and clay.
⑨	Sandstone
⑩	Shales
⑪	Clays — silty clays.
⑫	Basalt rock - broken, solid, weathered, lava, etc.
⑬	
⑭	

REDUCED FOR BIDDING PLANS
JUN 24 1968

DATE	REVISION
3-31-71	As Constructed

APPROVED: Ivan V. Merchant
BRIDGE ENGINEER

DESIGNED ...... CHECKED ——
DRAWN MAC CALC. BOOK ......

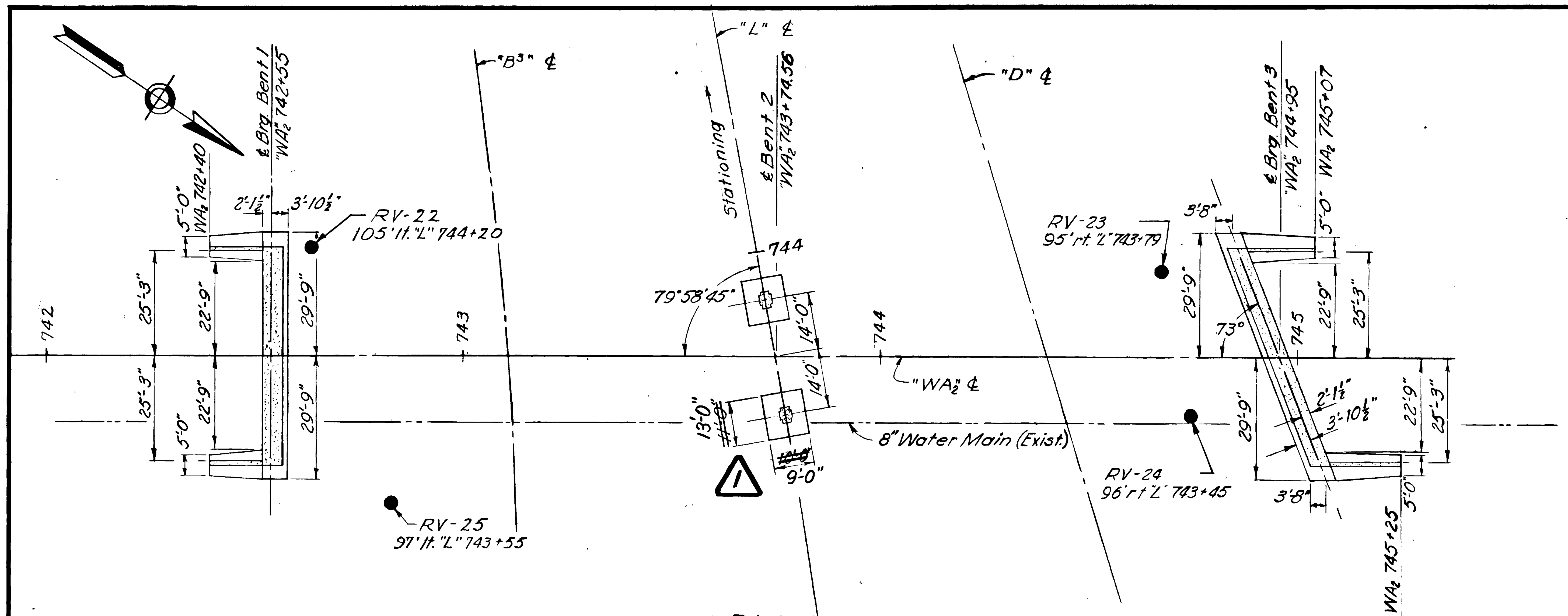
OREGON STATE HIGHWAY DEPARTMENT
BRIDGE DIVISION

EAST PORTLAND FREEWAY
UNDERCROSSING OF BROADWAY STREET

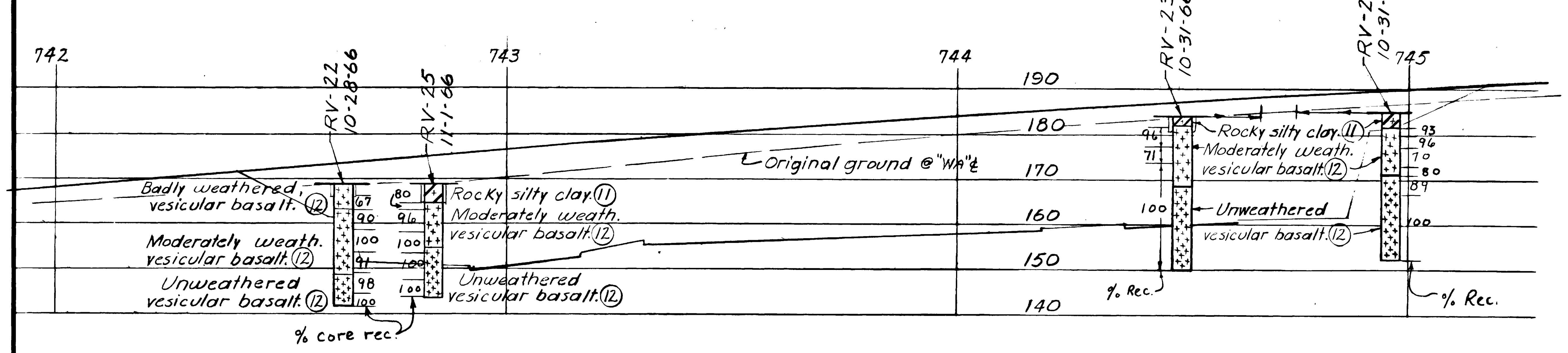
FOUNDATION DATA

DATE 10-31-67 SHEET 2 OF 15
BRIDGE NO. 9703 DRAWING NO. 24003

REVIEWED
DESIGN ENGR. SECTION



PLAN
Scale: 1" = 20'



FOUNDATION DATA
Scale: 1" = 20'

Note: Ground water not recorded.

Foundation data shown on this drawing, in some instances, is a consolidation of and a revision in terminology from the original field drilling logs. The original field drilling logs are available for review in the office of the Bridge Engineer in Salem.

LEGEND OF MATERIALS

- ① Gravels and cobbles
- ② Sand
- ③ Silty gravels, gravel-sand-silt mixture.
- ④ Silty sands, sand-silt mixtures.
- ⑤ Clayey gravels, gravel-sand-clay mixture.
- ⑥ Clayey sands, sand-clay mixtures.
- ⑦ Silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts.
- ⑧ Loam — near equal proportions of sand, silt and clay.
- ⑨ Sandstone
- ⑩ Shales
- ⑪ Clays — silty clays.
- ⑫ Basalt rock - broken, solid, weathered, lava, etc.
- ⑬
- ⑭

REDUCED FOR BIDDING PLANS
JUN 24 1968

	DATE	REVISION
1	8-1-68	FOOTING DIMENSION
2	3-31-71	As Constructed

APPROVED:
Ivan D. Merchant
BRIDGE ENGINEER

DESIGNED JEC
CHECKED RLM
DRAWN MAC
CALC. BOOK 1127

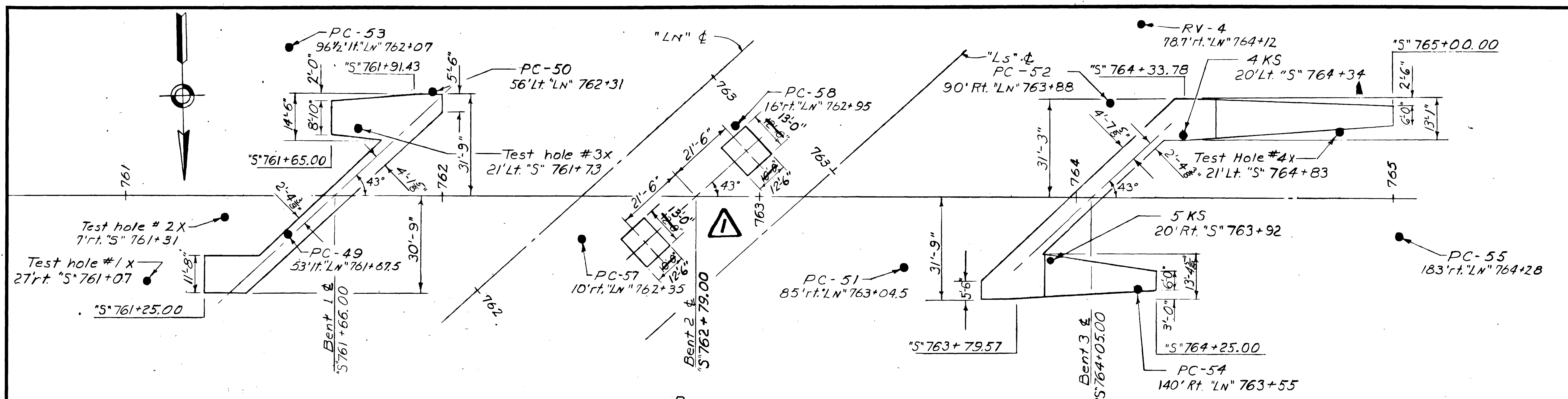
OREGON STATE HIGHWAY DEPARTMENT
BRIDGE DIVISION

EAST PORTLAND FREEWAY
UNDERCROSSING OF WEST "A" STREET

FOUNDATION DATA

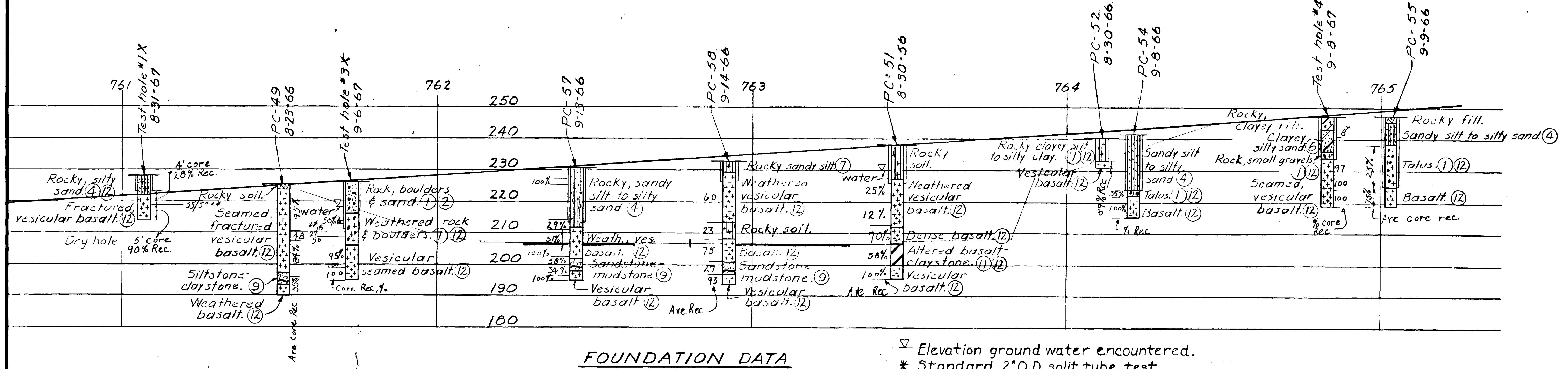
DATE 4-18-68
SHEET 2 OF 13
BRIDGE NO. 9704
DRAWING NO. 24011

RELEASED DESIGN SEC 4-18-68 JEB



PLAN

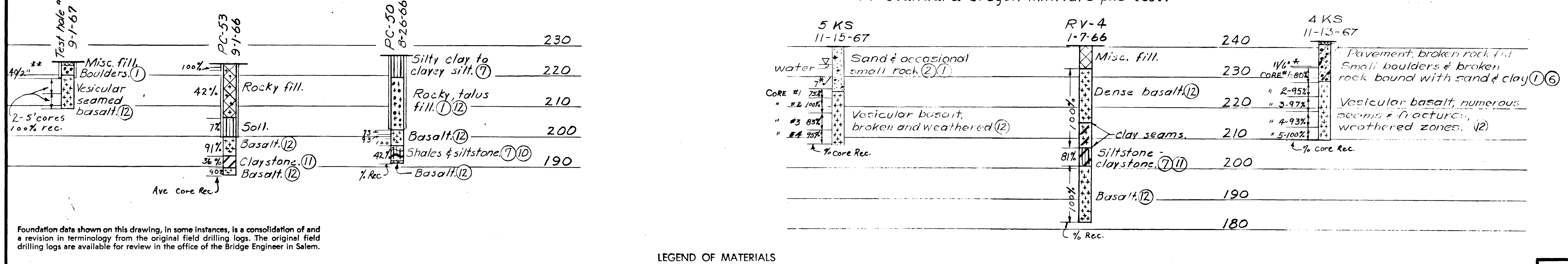
Scale: 1" = 20'-0"



FOUNDATION DATA

Scale: 1" = 20'

▽ Elevation ground water encountered.
* Standard 2" O.D. split tube test.
** Standard Oregon miniture pile test.



Foundation data shown on this drawing, in some instances, is a consolidation of and a revision in terminology from the original field drilling logs. The original field drilling logs are available for review in the office of the Bridge Engineer in Salem.

LEGEND OF MATERIALS

①	▨	Gravels and cobbles
②	▨	Sand
③	▨	Silty gravels, gravel-sand-silt mixture.
④	▨	Silty sands, sand-silt mixtures.
⑤	▨	Clayey gravels, gravel-sand-clay mixture.
⑥	▨	Clayey sands, sand-clay mixtures.
⑦	▨	Silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts.
⑧	▨	Loam — near equal proportions of sand, silt and clay.
⑨	▨	Sandstone
⑩	▨	Shales
⑪	▨	Clays — silty clays.
⑫	▨	Basalt rock - broken, solid, weathered, lava, etc.
⑬	☐	
⑭	☐	

DATE	REVISION
△1 8-1-68	FOOTING DIMENSIONS
△2 3-31-71	As Constructed

APPROVED: Ivan D. Merchant
BRIDGE ENGINEER

DESIGNED ....
CHECKED ....
DRAWN MAC
CALC. BOOK ....

OREGON STATE HIGHWAY DEPARTMENT
BRIDGE DIVISION

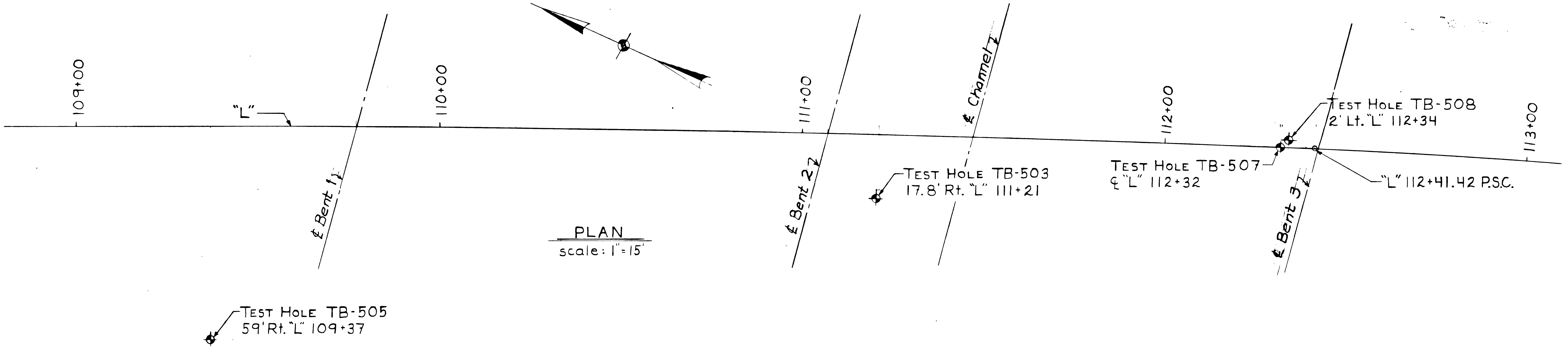
EAST PORTLAND FREEWAY
UNDERCROSSING OF SUNSET AVENUE

FOUNDATION DATA

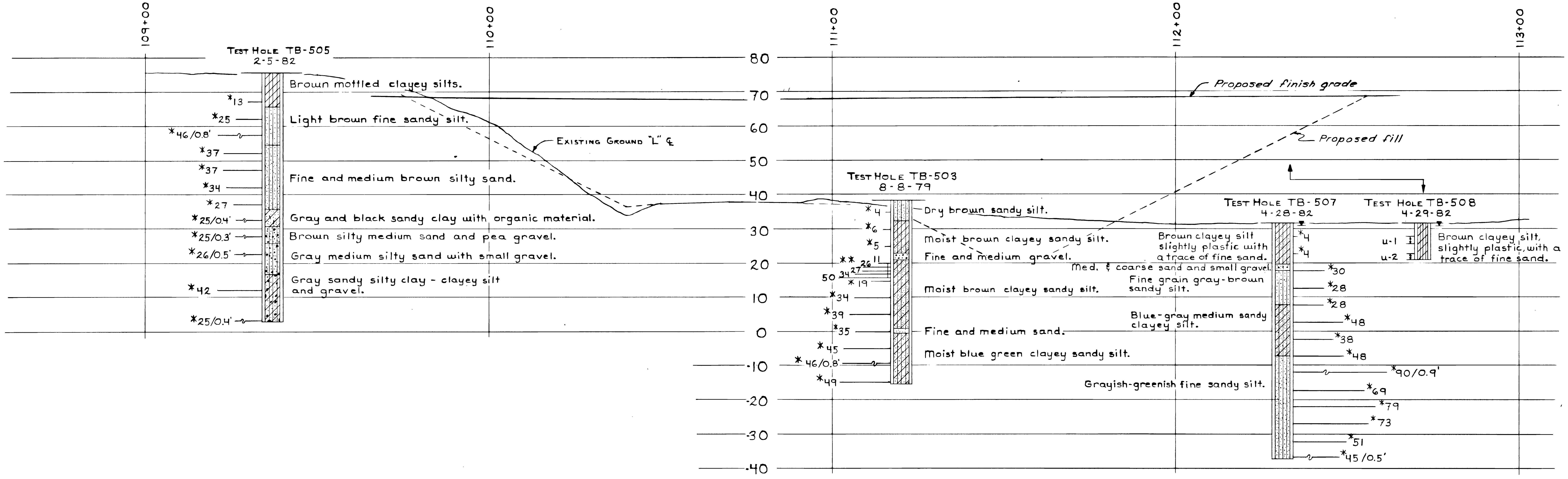
DATE ....
SHEET 2 OF 16
BRIDGE NO. 9724
DRAWING NO. 24017

REDUCED FOR BIDDING PLANS
JUN 24 1968

EUGENE DIETZGEN CO.



PLAN
scale: 1"=15'



FOUNDATION DATA

scale: 1"=15'

LEGEND OF MATERIALS

- ▨ Gravels, cobbles and boulders.
- ▨ Silts.
- ▨ Silty gravels, gravel-silt mixture.
- ▨ Clayey gravel, gravel-clay mixture.
- ▨ Silty clay.
- ▨ Shale.
- ▨ Basalt rock, broken, solid, weathered, lava.
- ▨ Sand.
- ▨ Clays.
- ▨ Silty sand, sand-silt mixture.
- ▨ Clayey sand, sand-clay mixture.
- ▨ Sand-silt-clay mixture, near equal proportions.
- ▨ Sandstone.

▼ Elevation ground water encountered.
* Standard Penetration test.
** Oregon Miniature Pile test.
RQD = Rock Quality Designation
U = Undisturbed Sample
C = Core Sample

Foundation data shown on this drawing, in some instances, is a consolidation of and a revision in terminology from the original field drilling logs. The original field drilling logs are available for review through the office of the Structural Design Engineer in Salem.

APPROVED: Walter J. Hart
STRUCTURAL DESIGN ENGINEER
DESIGNED
DRAWN G. Thommen
CHECKED J.D.
REVIEWED
REVIEWED
CALC. BOOK

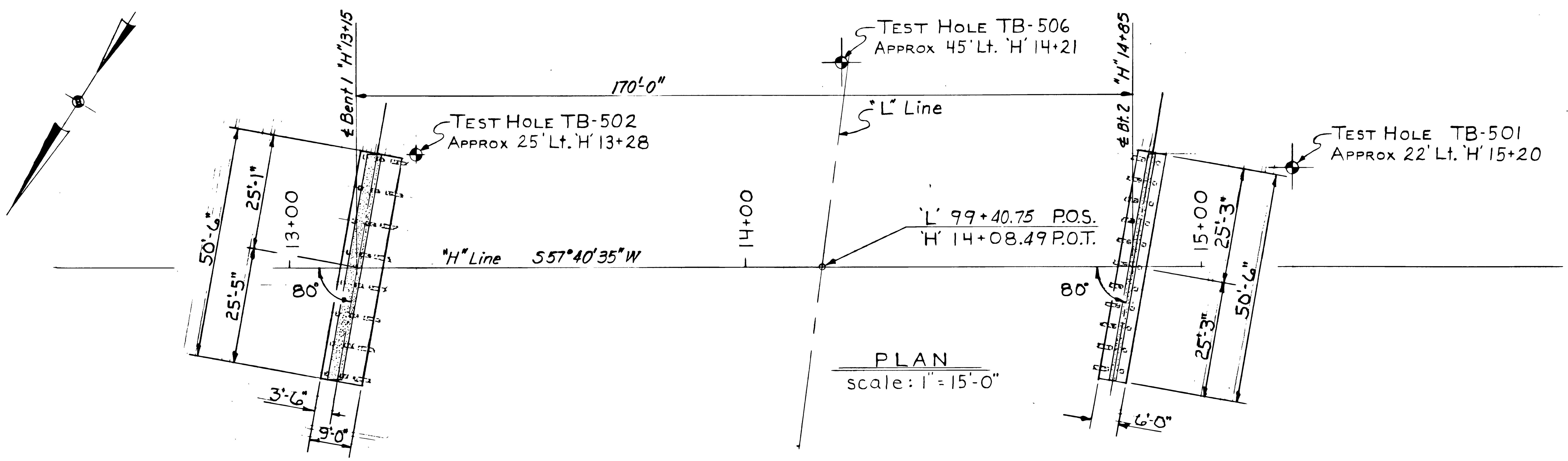
DATE	REVISION
2/13/85	"As Constructed"

OREGON DEPARTMENT OF TRANSPORTATION
STRUCTURAL DESIGN SECTION

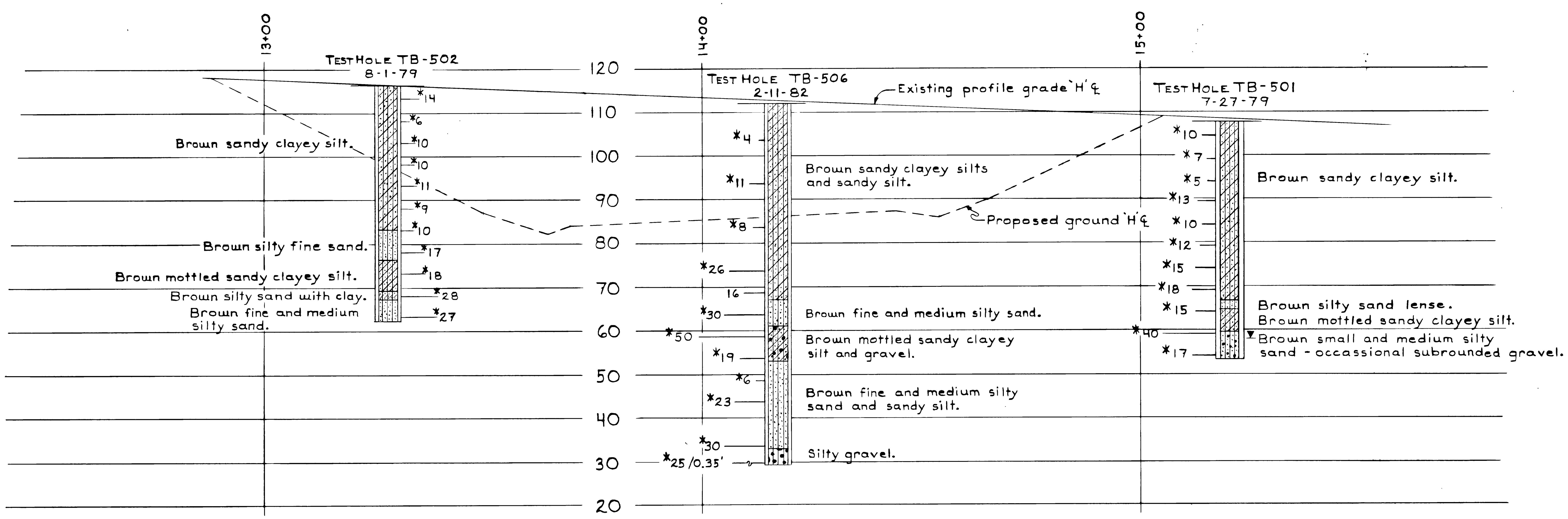
REDLAND RD. O'XING
PARK PLACE - CLACKAMAS COMM. COLLEGE
CASCADE HIGHWAY — CLACKAMAS COUNTY

FOUNDATION DATA

DATE May 1982
BRIDGE NO. 16522
SHEET 2 OF 19
DRAWING NO. 37338



PLAN
scale: 1" = 15'-0"



FOUNDATION DATA
scale: 1" = 15'

LEGEND OF MATERIALS

- ▨ Gravels, cobbles and boulders.
- ▨ Sand.
- ▨ Silts.
- ▨ Clays
- ▨ Silty gravels, gravel-silt mixture.
- ▨ Silty sand, sand-silt mixture.
- ▨ Clayey gravel, gravel-clay mixture.
- ▨ Clayey sand, sand-clay mixture.
- ▨ Silty clay.
- ▨ Sand-silt-clay mixture, near equal proportions.
- ▨ Shale.
- ▨ Sandstone.
- ▨ Basalt rock, broken, solid, weathered, lava.

▼ Elevation ground water encountered.
✱ Standard Penetration test.
✱✱ Oregon Miniature Pile test.
RQD = Rock Quality Designation
U = Undisturbed Sample
C = Core Sample

Foundation data shown on this drawing, in some instances, is a consolidation of and a revision in terminology from the original field drilling logs. The original field drilling logs are available for review through the office of the Structural Design Engineer in Salem.

APPROVED: Walter J Hart
STRUCTURAL DESIGN ENGINEER
DESIGNED
DRAWN GRT
CHECKED
REVIEWED
REVIEWED
CALC. BOOK 1917

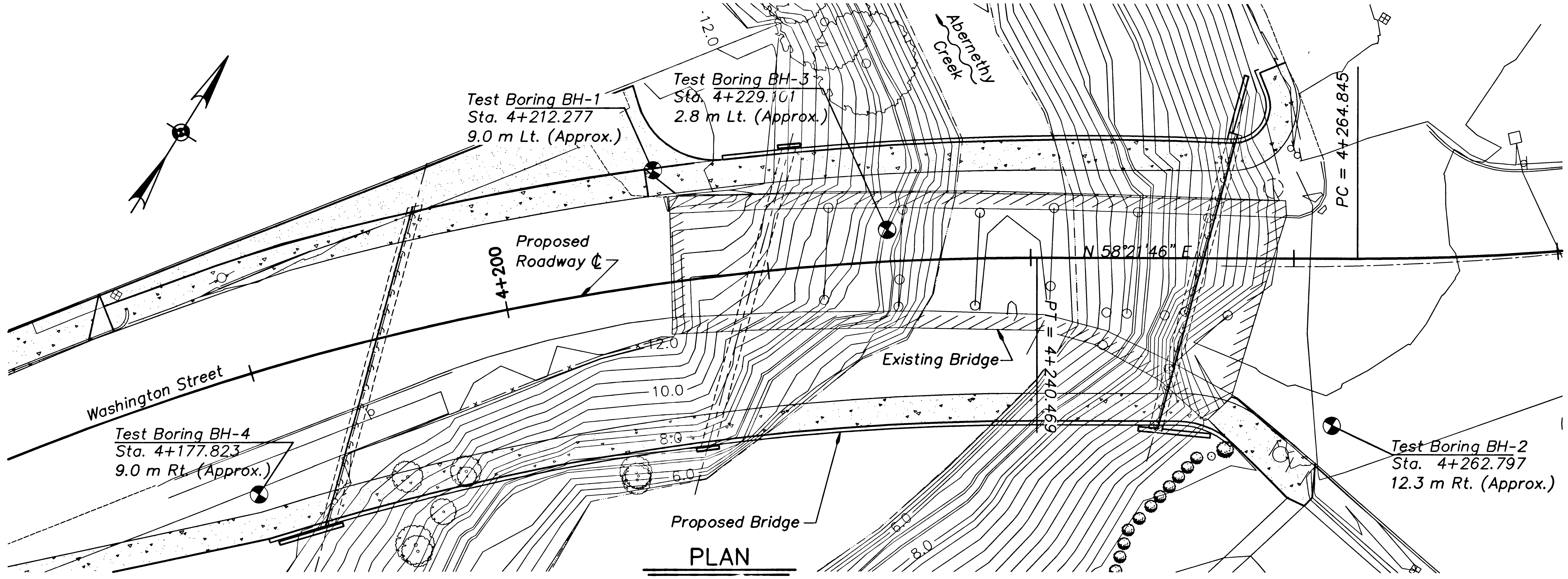
DATE	REVISION
2/13/85	"As Constructed"

OREGON DEPARTMENT OF TRANSPORTATION
STRUCTURAL DESIGN SECTION

HOLCOMB BLVD. U'XING
PARK PLACE - CLACKAMAS COMM. COLLEGE
CASCADE HIGHWAY — CLACKAMAS COUNTY

FOUNDATION DATA

DATE April 1982
BRIDGE NO. 16523
SHEET 2 OF 16
DRAWING NO. 37329



PLAN

Scale: 1:200

LEGEND OF MATERIALS

▨ Sandy GRAVEL
▨ GRAVEL
▥ SILT
▨ SAND
■ ASPHALT
▨ Clayey SILT
▥ Sandy SILT/Silty Sand

Ⓐ Crushed GRAVEL; grey, damp to dry, 25 mm minus, (base rock).

Ⓑ Sandy SILT with some gravel; brown, low plasticity, moist, soft, fine to medium sand, sub-rounded gravel.

Ⓒ SAND with trace silt and fine roots; brown, dry grading to moist, loose to medium dense, fine to medium, (alluvium).

Ⓓ SAND with some silt; grey, moist to wet, loose to medium dense, medium to coarse sand, slightly micaceous, (alluvium).

Ⓔ SILT with trace to some sand, (ML); grey, wet, low to medium plasticity, very soft, fine sand, slightly micaceous, (alluvium).

Ⓕ GRAVEL; grey, wet, dense to very dense, sub-rounded, occasional cobbles, (Troutdale Formation).

Ⓖ SILT with trace clay, (MH); green-grey, medium plasticity, damp to moist, hard, micaceous, blocky structure, Troutdale Formation).

Relatively Undisturbed Sample

14 Standard Penetration Test.
N value.

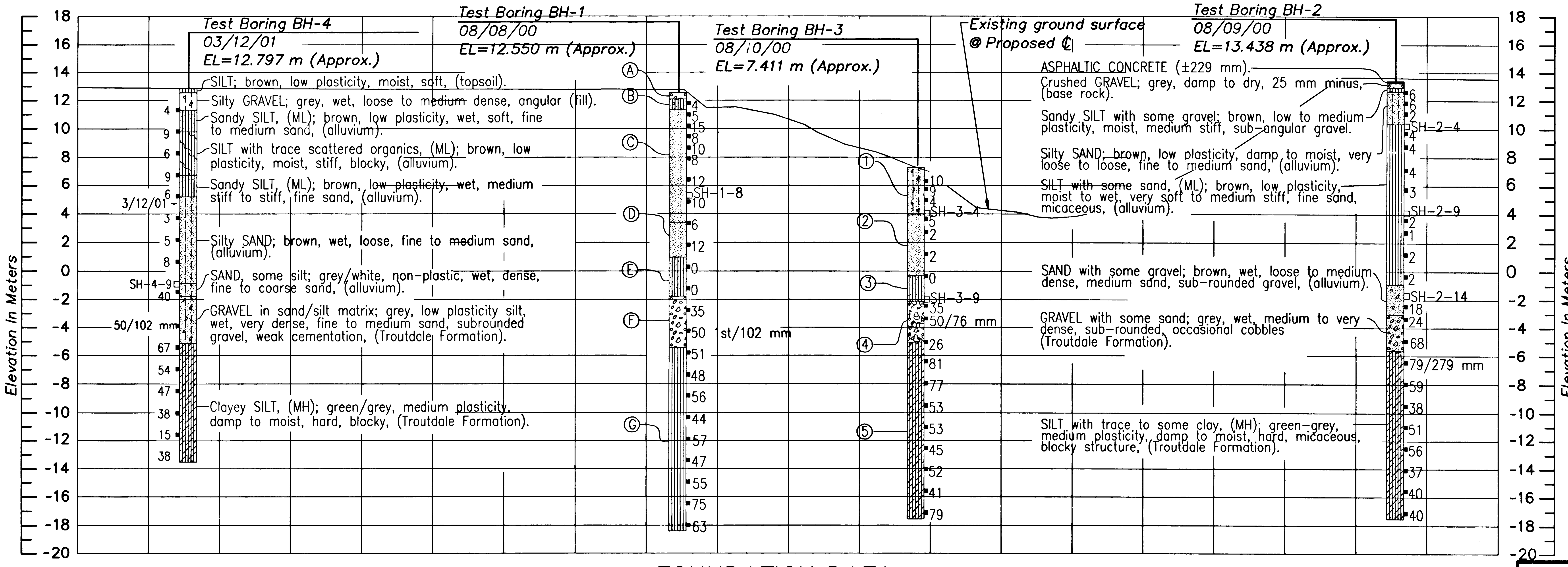
① Silty SAND with some gravel; brown, slightly iron-stained, non-plastic, damp to wet, loose to very loose, fine sand, micaceous, (alluvium).

② SAND; grey, wet, very loose to loose, fine to medium sand, (alluvium).

③ SILT with trace to some sand, (ML); grey, low plasticity, wet, very soft to medium stiff, fine sand, (alluvium).

④ GRAVEL and COBBLES; grey, wet, dense to very dense, sub-rounded, occasional cobbles, (Troutdale Formation).

⑤ SILT with some clay and trace sand, (MH); green-grey, medium plasticity, damp, micaceous, blocky structure, (Troutdale Formation).



FOUNDATION DATA

Scale: 1:200

City Br. No. 05C09

Foundation data shown on this drawing may be a consolidation of information and/or revision in terminology from the Soils and Geological Exploration Logs. The Soils and Exploration Logs used in compiling this drawing are available upon request.

All dimensions are in millimeters (mm) and all elevations in meters (m) except as noted.

METRIC

FOUNDATION ENGINEERING, INC.
PROFESSIONAL GEOTECHNICAL SERVICES
820 NW CORNELL AVENUE
CORVALLIS OR, 97330-4517
BUS. 541 757-7645 FAX 541 757-7650

DAVID EVANS AND ASSOCIATES, INC.
530 Center Street NE, Suite 605
Salem, OR. 97301-3756
BUS. (503) 361-8635

DRAFTED: G. Haffner
CHECKED: M. McCracken, P.E.
REVIEWED: D. Running, P.E.

DESIGNER
Melvin J McCracken
JULY 14, 1998
EXPIRES: 12/31/02

OREGON DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING SECTION

BRIDGE NO. 19119
DATE Feb. 2002

ABERNETHY CREEK (WASHINGTON ST.) BRIDGE

FOUNDATION DATA SHEET

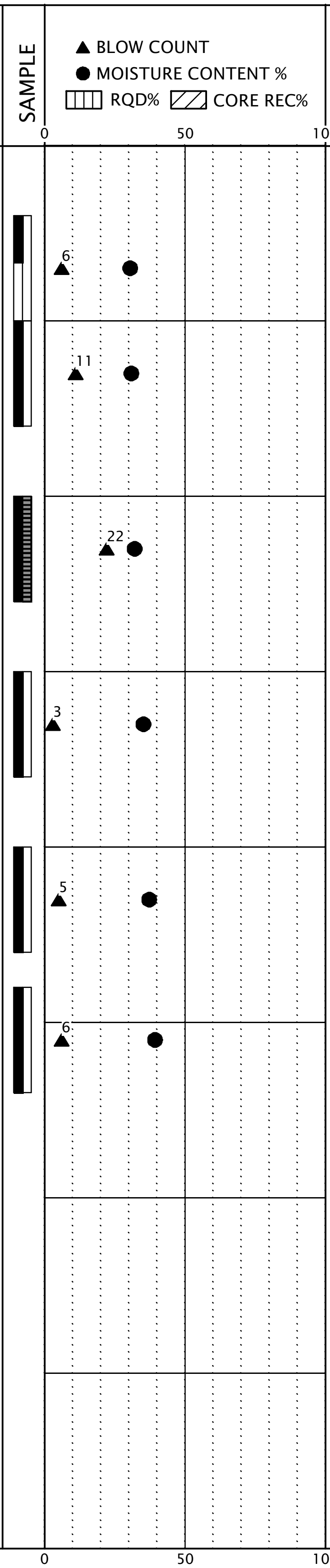
SHEET 2 OF 25

DRAWING NO. 60612

Xrefs: Fndbdr.dwg afnd_det.dwg abernethy_bm.dwg

Appendix 3 Lake Oswego Water Treatment Plant Finished Water Pipeline Boring Logs

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	INSTALLATION AND COMMENTS
0.0	ASPHALT CONCRETE (3 inches).	167.4		
	Medium stiff, orange mottled gray-brown SILT with fine sand (ML), minor clay; moist (alluvium).	167.1 0.3		
2.5	becomes stiff, sandy at 2.5 feet			
5.0			DD DS	DD = 85 pcf
7.5	becomes soft at 7.5 feet			
10.0	Loose, brown, fine to medium, silty SAND (SM); wet (alluvium).	157.4 10.0		⊻ 10.0 feet, during drilling
	with dark orange mottles at 12.0 feet			
12.5	gray, decreasing silt; interbeds of sandy SILT (ML) at 12.8 feet			
	Exploration completed at a depth of 13.5 feet.	153.9 13.5		
15.0				
17.5				
20.0				



DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: VCL

COMPLETED: 08/24/10

BORING METHOD: hollow-stem auger (see report text)

BORING BIT DIAMETER: 8-inch

GEODESIGN INC

15575 SW Sequoia Parkway - Suite 100
Portland OR 97224
Off 503.968.8787 Fax 503.968.3068

BROWNCALD-49-05-02

FEBRUARY 2011

BORING FWP-3

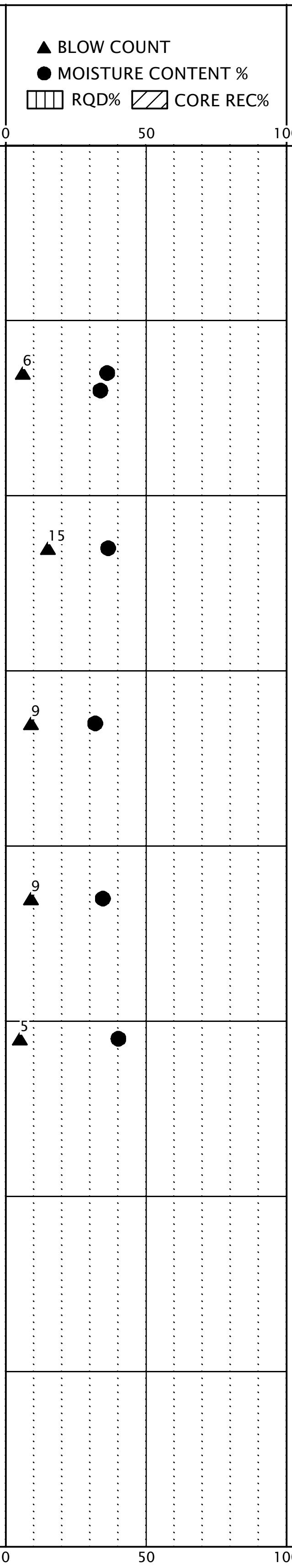
FINISHED WATER PIPELINE
CLACKAMAS COUNTY, OR

FIGURE A-3

BORING LOG BROWNCALD-49-05-02-REPORT.GPJ GEODESIGN.GDT PRINT DATE: 2/4/11:KT

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	INSTALLATION AND COMMENTS
0.0	ASPHALT CONCRETE (10 inches).	178.9		
	AGGREGATE BASE (8 inches).	178.1 0.8		Large chunk of concrete, moved hole to avoid excess tool wear
	Abandoned ss concrete pipe. Soft, gray mottled brown SILT (ML), minor clay, trace sand; moist, medium plasticity (alluvium).	177.4 1.5		
2.5	becomes medium stiff; low plasticity at 3.5 feet			
5.0	becomes stiff, brown with gray-orange mottles; low to medium plasticity at 5.0 feet		DD	DD = 83 pcf
7.5	grades to gray with brown mottles, with sand, trace clay at 7.0 feet		ATT	LL = 37% PL = 32%
10.0	becomes medium stiff; wet, nonplastic at 10.0 feet		DD	DD = 88 pcf
12.5				
	Exploration completed at a depth of 13.5 feet.	165.4 13.5		
15.0				
17.5				
20.0				

▽ 11.5 feet, during drilling



DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: CLR

COMPLETED: 07/22/10

BORING METHOD: hollow-stem auger (see report text)

BORING BIT DIAMETER: 4 1/4-inch ID

GEODESIGN INC

15575 SW Sequoia Parkway - Suite 100
Portland OR 97224
Off 503.968.8787 Fax 503.968.3068

BROWNCALD-49-05-02

FEBRUARY 2011

BORING FWP-4

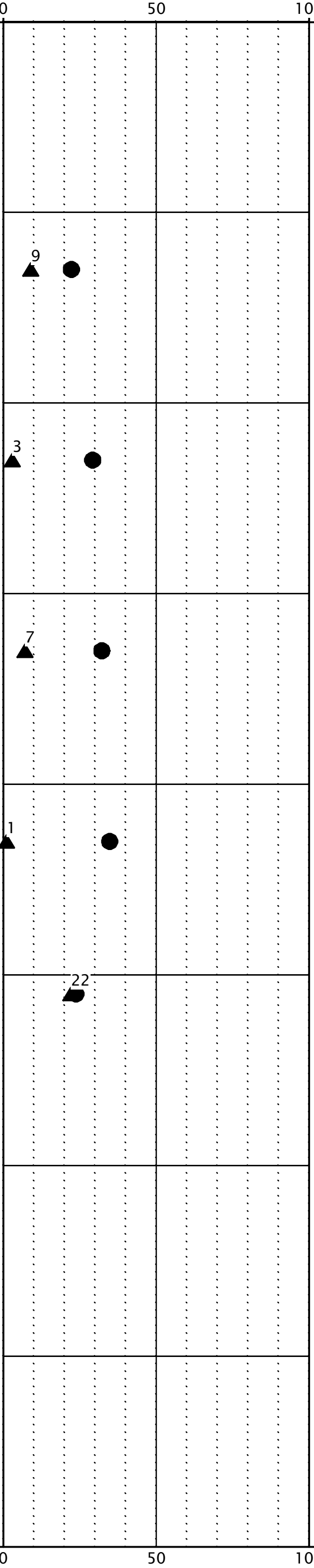
FINISHED WATER PIPELINE
CLACKAMAS COUNTY, OR

FIGURE A-4

BORING LOG BROWNCALD-49-05-02-REPORT.GPJ GEODESIGN.GDT PRINT DATE: 2/4/11:KT

BORING FWP-5

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC%	INSTALLATION AND COMMENTS
0.0		ASPHALT CONCRETE (7 inches).	178.5				
		AGGREGATE BASE (7 inches).	177.9 0.6				
		Medium stiff, gray mottled brown SILT (ML), minor clay, trace sand and organics; moist, low to medium plasticity (alluvium).	177.3 1.2				
2.5				DD		9	DD = 99 pcf
5.0		Soft, brown mottled orange-gray CLAY (CL); moist (alluvium).	173.5 5.0	ATT		3	LL = 37% PL = 24%
7.5		becomes medium stiff at 7.5 feet		DD		7	DD = 84 pcf
10.0		becomes very soft at 10.0 feet				1	
		Stiff, brown mottled gray SILT with gravel (ML), minor clay, trace sand; moist, low to medium plasticity (alluvium).	167.5 11.0				
12.5						22	
		Exploration completed at a depth of 13.5 feet.	165.0 13.5				
15.0							
17.5							
20.0							



DRILLED BY: Western States Soil Conservation, Inc.   LOGGED BY: CLR   COMPLETED: 07/22/10

BORING METHOD: hollow-stem auger (see report text)   BORING BIT DIAMETER: 4 1/4-inch ID

GEODESIGN INC

15575 SW Sequoia Parkway - Suite 100
Portland OR 97224
Off 503.968.8787 Fax 503.968.3068

BROWNCALD-49-05-02

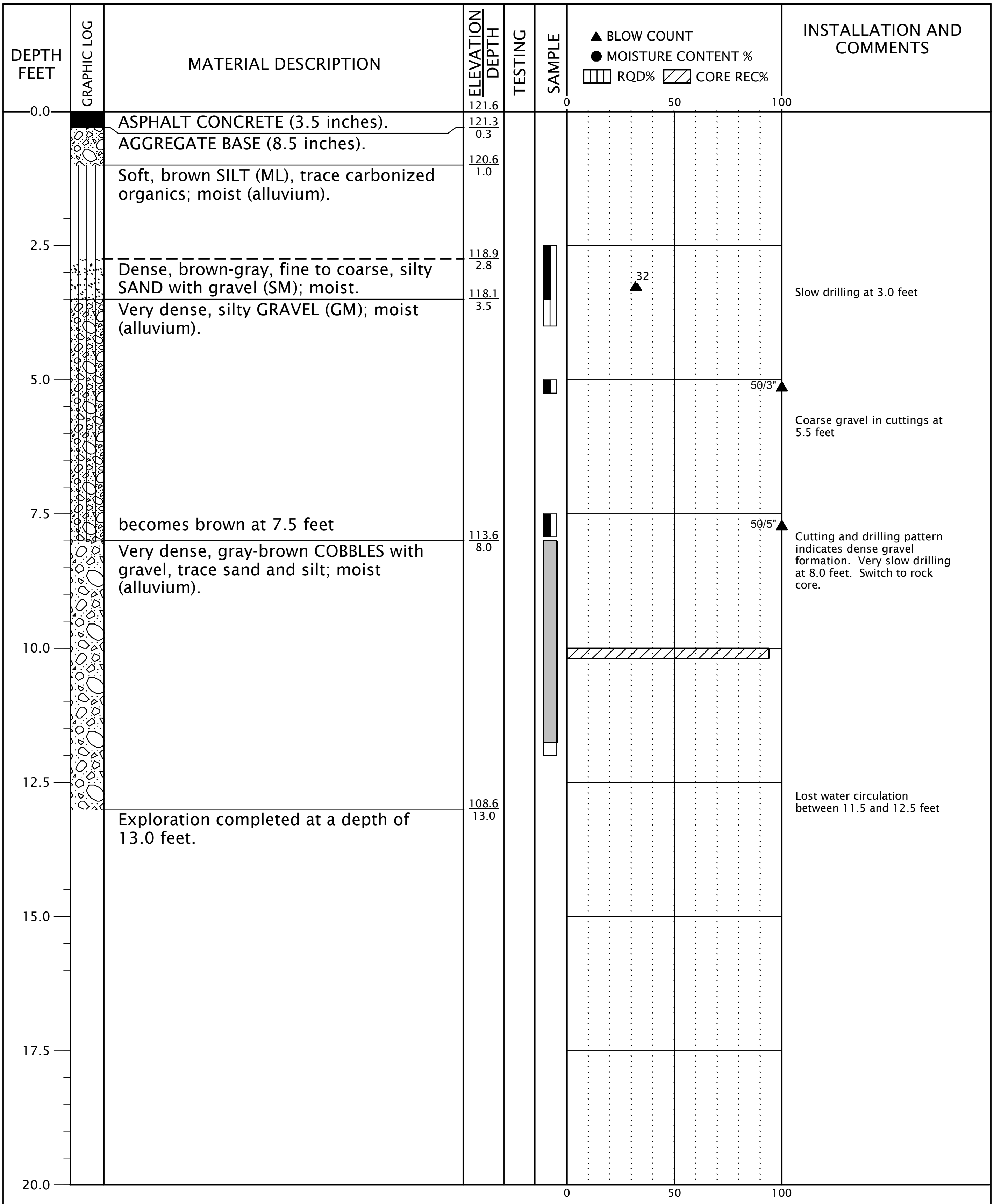
FEBRUARY 2011

BORING FWP-5

FINISHED WATER PIPELINE
CLACKAMAS COUNTY, OR

FIGURE A-5

BORING LOG BROWNCALD-49-05-02-REPORT.GPJ GEODESIGN.GDT PRINT DATE: 2/4/11:KT



ELEVATION / DEPTH	MATERIAL DESCRIPTION	INSTALLATION AND COMMENTS
121.6		
121.3 / 0.3	ASPHALT CONCRETE (3.5 inches).	
120.6 / 1.0	AGGREGATE BASE (8.5 inches).	
	Soft, brown SILT (ML), trace carbonized organics; moist (alluvium).	
118.9 / 2.8	Dense, brown-gray, fine to coarse, silty SAND with gravel (SM); moist.	Slow drilling at 3.0 feet
118.1 / 3.5	Very dense, silty GRAVEL (GM); moist (alluvium).	Coarse gravel in cuttings at 5.5 feet
	becomes brown at 7.5 feet	Cutting and drilling pattern indicates dense gravel formation. Very slow drilling at 8.0 feet. Switch to rock core.
113.6 / 8.0	Very dense, gray-brown COBBLES with gravel, trace sand and silt; moist (alluvium).	Lost water circulation between 11.5 and 12.5 feet
108.6 / 13.0	Exploration completed at a depth of 13.0 feet.	

DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: NAK COMPLETED: 10/23/10

BORING METHOD: hollow-stem auger and HQ rock coring (see report text) BORING BIT DIAMETER: 8-inch

GEODESIGN INC
15575 SW Sequoia Parkway - Suite 100
Portland OR 97224
Off 503.968.8787 Fax 503.968.3068

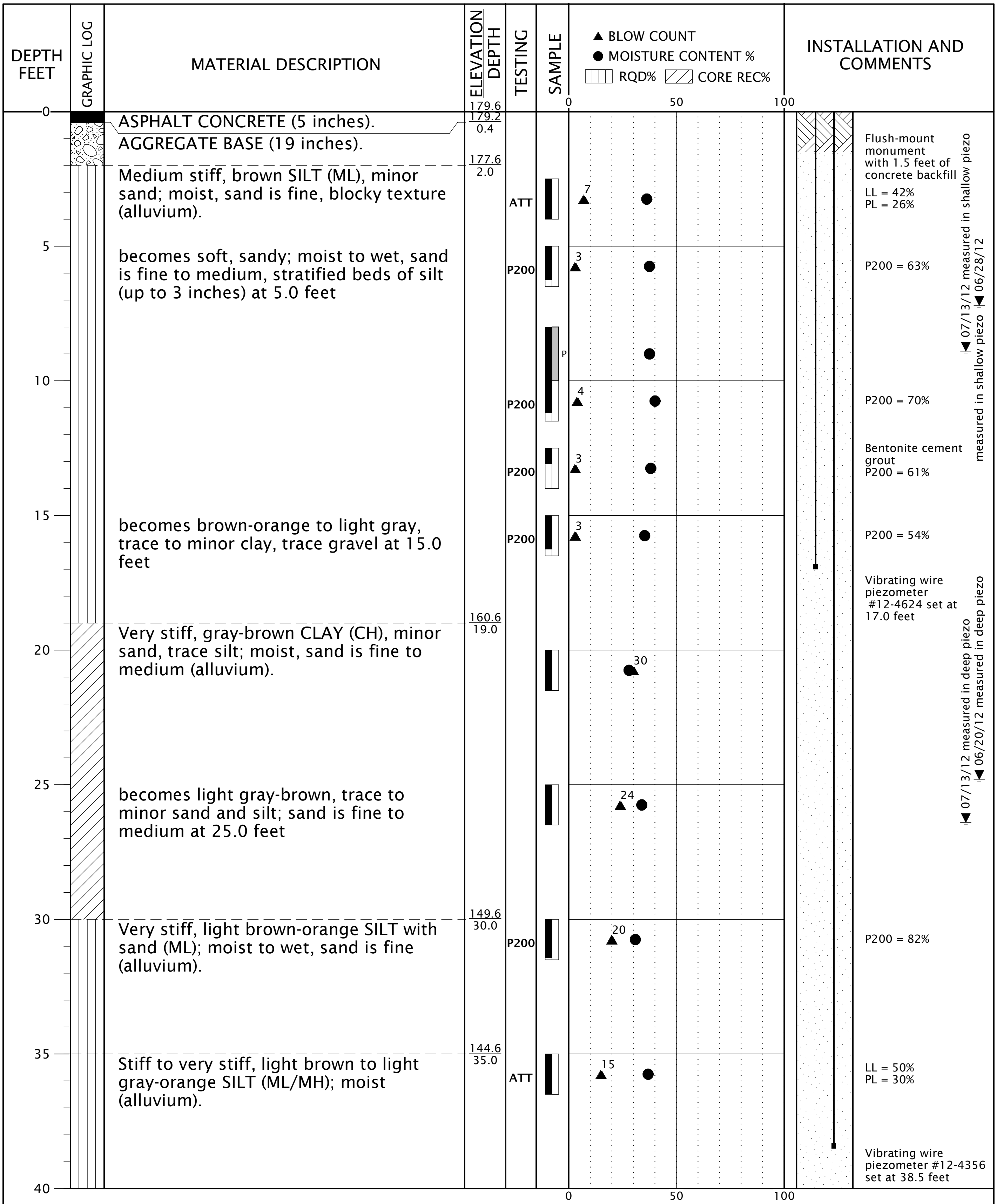
BROWNCALD-49-05-02

FEBRUARY 2011

BORING FWP-80A

FINISHED WATER PIPELINE
CLACKAMAS COUNTY, OR

FIGURE A-66



DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	BLOW COUNT	INSTALLATION AND COMMENTS
0	ASPHALT CONCRETE (5 inches).	179.6 179.2 0.4			Flush-mount monument with 1.5 feet of concrete backfill
	AGGREGATE BASE (19 inches).	177.6 2.0			
	Medium stiff, brown SILT (ML), minor sand; moist, sand is fine, blocky texture (alluvium).		ATT	7	LL = 42% PL = 26%
5	becomes soft, sandy; moist to wet, sand is fine to medium, stratified beds of silt (up to 3 inches) at 5.0 feet		P200	3	P200 = 63%
10			P200	4	P200 = 70%
			P200	3	Bentonite cement grout P200 = 61%
15	becomes brown-orange to light gray, trace to minor clay, trace gravel at 15.0 feet		P200	3	P200 = 54%
					Vibrating wire piezometer #12-4624 set at 17.0 feet
	Very stiff, gray-brown CLAY (CH), minor sand, trace silt; moist, sand is fine to medium (alluvium).	160.6 19.0		30	
25	becomes light gray-brown, trace to minor sand and silt; sand is fine to medium at 25.0 feet			24	
30	Very stiff, light brown-orange SILT with sand (ML); moist to wet, sand is fine (alluvium).	149.6 30.0	P200	20	P200 = 82%
35	Stiff to very stiff, light brown to light gray-orange SILT (ML/MH); moist (alluvium).	144.6 35.0	ATT	15	LL = 50% PL = 30%
40					Vibrating wire piezometer #12-4356 set at 38.5 feet

▼ 07/13/12 measured in shallow piezo

▼ 06/28/12 measured in shallow piezo

▼ 07/13/12 measured in deep piezo

▼ 06/20/12 measured in deep piezo

DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: JGH

COMPLETED: 06/20/12

BORING METHOD: mud rotary (see report text)

BORING BIT DIAMETER: tricone 4 7/8-inch/drag bit 3 7/8-inch

GEODESIGN INC

15575 SW Sequoia Parkway - Suite 100
Portland OR 97224
Off 503.968.8787 Fax 503.968.3068

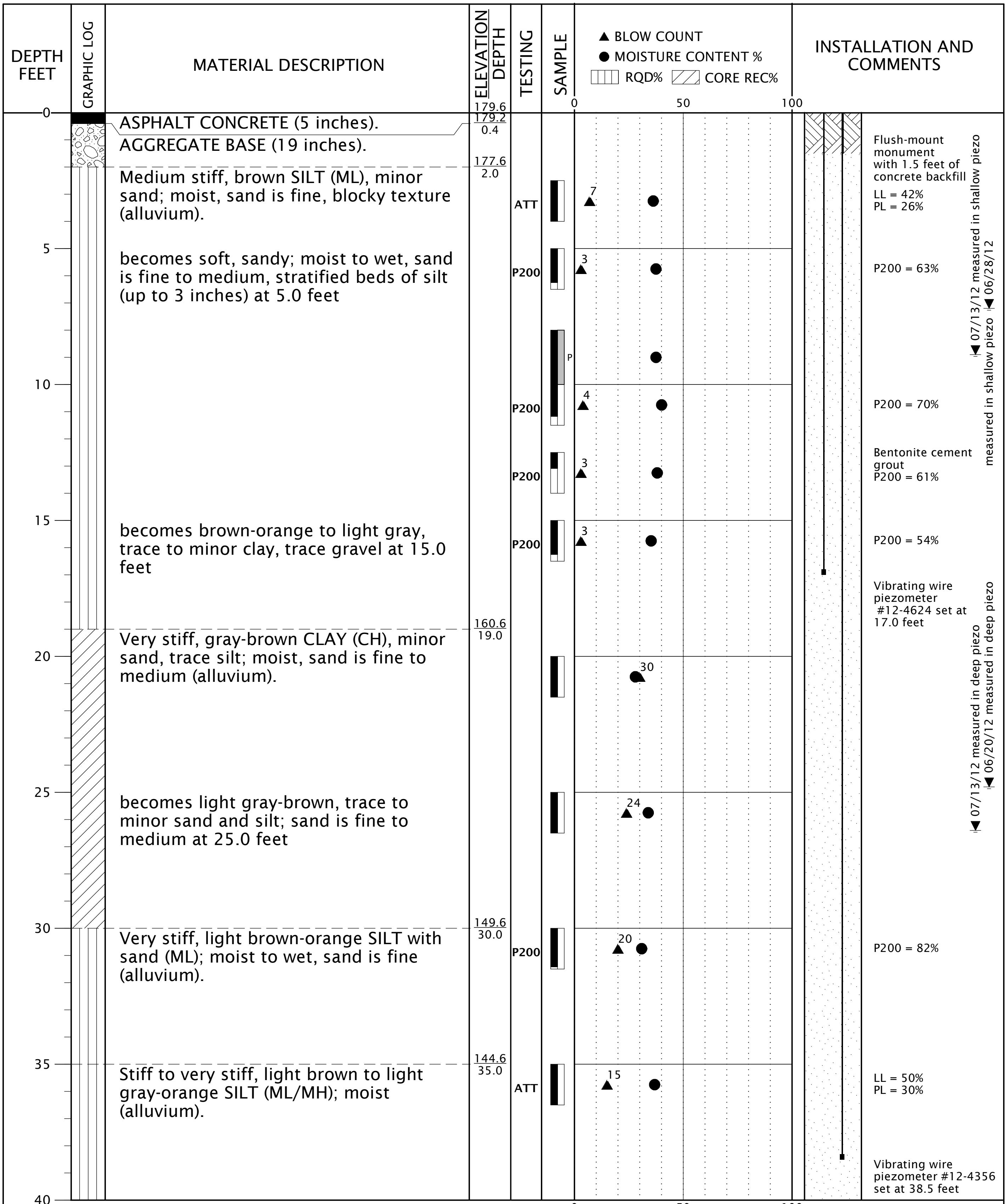
BROWNCALD-49-22

AUGUST 2012

BORING B-1

HWY 43 SEISMIC HAZARD EXPLORATIONS
CLACKAMAS COUNTY, OR

FIGURE A-1



▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC%

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	BLOW COUNT	INSTALLATION AND COMMENTS
0	ASPHALT CONCRETE (5 inches).	179.6			
	AGGREGATE BASE (19 inches).	179.2 0.4			Flush-mount monument with 1.5 feet of concrete backfill
	Medium stiff, brown SILT (ML), minor sand; moist, sand is fine, blocky texture (alluvium).	177.6 2.0	ATT	7	LL = 42% PL = 26%
5	becomes soft, sandy; moist to wet, sand is fine to medium, stratified beds of silt (up to 3 inches) at 5.0 feet		P200	3	P200 = 63%
				P	
10			P200	4	P200 = 70%
			P200	3	Bentonite cement grout P200 = 61%
15	becomes brown-orange to light gray, trace to minor clay, trace gravel at 15.0 feet		P200	3	P200 = 54%
					Vibrating wire piezometer #12-4624 set at 17.0 feet
20	Very stiff, gray-brown CLAY (CH), minor sand, trace silt; moist, sand is fine to medium (alluvium).	160.6 19.0		30	
25	becomes light gray-brown, trace to minor sand and silt; sand is fine to medium at 25.0 feet			24	
30	Very stiff, light brown-orange SILT with sand (ML); moist to wet, sand is fine (alluvium).	149.6 30.0	P200	20	P200 = 82%
35	Stiff to very stiff, light brown to light gray-orange SILT (ML/MH); moist (alluvium).	144.6 35.0	ATT	15	LL = 50% PL = 30%
					Vibrating wire piezometer #12-4356 set at 38.5 feet
40					

▼ 07/13/12 measured in shallow piezo

▼ 06/28/12 measured in shallow piezo

▼ 07/13/12 measured in deep piezo

▼ 06/20/12 measured in deep piezo

DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: JGH COMPLETED: 06/20/12

BORING METHOD: mud rotary (see report text) BORING BIT DIAMETER: tricone 4 7/8-inch/drag bit 3 7/8-inch

GEODESIGN INC

15575 SW Sequoia Parkway - Suite 100
Portland OR 97224
Off 503.968.8787 Fax 503.968.3068

BROWNCALD-49-22

AUGUST 2012

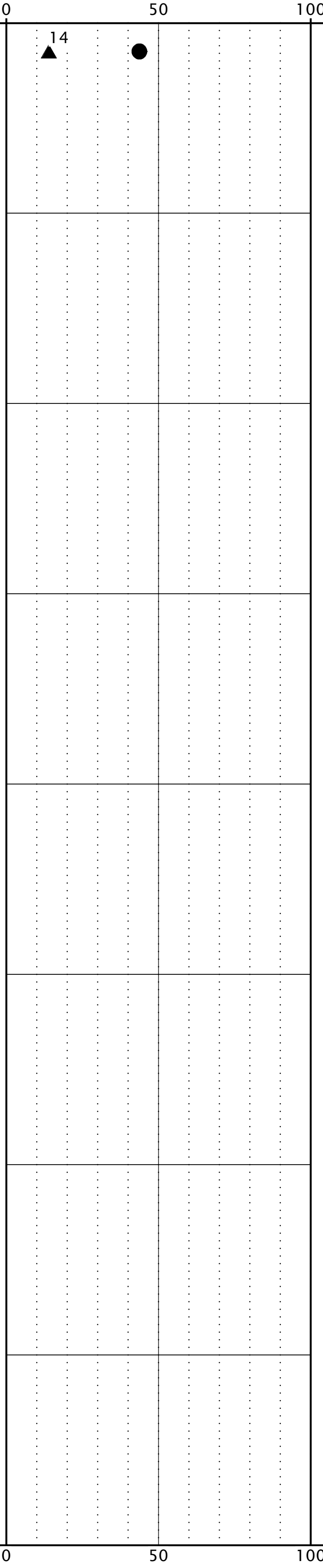
BORING B-1

HWY 43 SEISMIC HAZARD EXPLORATIONS
CLACKAMAS COUNTY, OR

FIGURE A-1

BORING LOG BROWNCALD-49-22-B1_8.GPJ GEODESIGN.GDT PRINT DATE: 8/2/12:KT

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC%	INSTALLATION AND COMMENTS
40	▥	Stiff, brown-orange SILT (ML), some clay; moist (alluvium).	139.6 40.0	ATT	▮	14	LL = 49% PL = 26%
		Exploration completed at a depth of 41.5 feet.	138.1 41.5				
45							
50							
55							
60							
65							
70							
75							
80							



DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: JGH

COMPLETED: 06/20/12

BORING METHOD: mud rotary (see report text)

BORING BIT DIAMETER: tricone 4 7/8-inch/drag bit 3 7/8-inch

GEODESIGN INC

15575 SW Sequoia Parkway - Suite 100
Portland OR 97224
Off 503.968.8787 Fax 503.968.3068

BROWNCALD-49-22

AUGUST 2012

BORING B-1
(continued)

HWY 43 SEISMIC HAZARD EXPLORATIONS
CLACKAMAS COUNTY, OR

FIGURE A-1

BORING LOG BROWNCALD-49-22-B1_8.GPJ GEODESIGN.GDT PRINT DATE: 8/2/12:KT

Appendix 4 Site Reconnaisance Photos

Photo 1: Bolton Reservoir.

Photo 2: Steep slope south of Bolton Reservoir.

Photo 3: Horton Reservoir.

Photo 4: Rosemount Reservoir.

	CITY OF WEST LINN WATER SYSTEM MASTER PLAN STUDY SEISMIC HAZARDS EVALUATION TECHNICAL MEMORANDUM SELECTED PHOTOGRAPHS JANUARY 4TH, 2023	DEC 2023 SHEET 2

Photo 5: Bland Reservoir.

Photo 6: Willamette Reservoir.

Photo 7: Steep slope south of Wilamette Reservoir.

Photo 8: View Drive Reservoir.

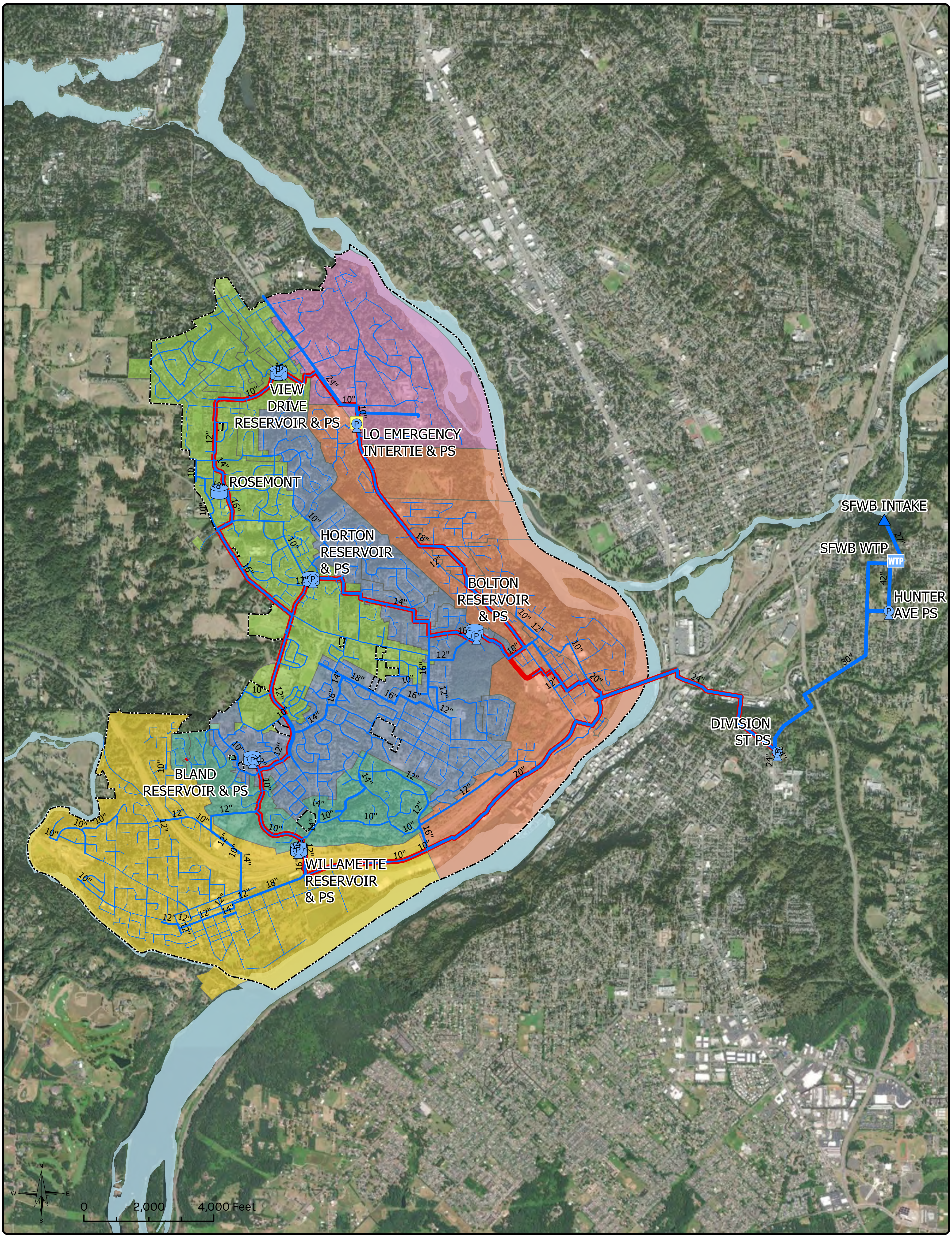
DELVE underground	CITY OF WEST LINN WATER SYSTEM MASTER PLAN STUDY SEISMIC HAZARDS EVALUATION TECHNICAL MEMORANDUM SELECTED PHOTOGRAPHS JANUARY 4TH, 2023	DEC 2023 SHEET 4

Attachments

A. West Linn Water System Backbone, Consor, 2023.
B. Supplemental Subsurface Investigation; New Site of the 0.4 MG… Rosemont Reservoir Subsurface, L.R. Squire Associates Inc., 1988.
C. Geotechnical Investigation and Site Specific-Seismic Hazard Study; 4-MG Bolton Reservoir, GRI, 2015.

Attachment A– West Linn Water System Backbone

G:\PDX_Projects\22\3537 - West Linn - Water System Master Plan\GIS\MXD_APRX\Existing System_DJW.aprx 11/8/2023 12:33 PM DJW



Legend

▲	SFWB Intake
WTP	SFWB WTP
I	Emergency Intertie
P	Pump Station
⛁	Reservoir

Mains
Diameter (in.)

- <6"
- 8"
- 10"
- 12"
- 14-18"
- 20-24"
- 28-42"
- Backbone

Pressure Zone

- Bland
- Bolton
- Horton
- Robinwood
- Rosemont
- Willamette
- City Limits

CITY OF West Linn

consor

Water System Master Plan

Figure 1-1
Existing System

Project No: 22-3537

November, 2023

Data Sources: City of West Linn, 2022; World Imagery: Maxar.
Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Disclaimer: Consor and Client make no representations, express or implied, as to the accuracy, completeness and timeliness of the information displayed. This map is not suitable for legal, engineering, or surveying purposes.
Notification of any errors is appreciated.

Attachment B – [Rosemont] Supplemental Subsurface Investigation; New Site of the 0.4 MG Rosemont Reservoir Subsurface, L.R. Squire Associates Inc., 1988.

L. R. SQUIER ASSOCIATES INC.

SUBSURFACE INVESTIGATION

LRS

L. R. SQUIER ASSOCIATES INC.
geotechnical consultants

4255 oak ridge road
p.o. box 1317

lake oswego, oregon 97034
tel. (503) 635-4419

87175
March 30, 1988

Murray, Smith & Associates, Inc.
121 S.W. Salmon Street, Suite 1110
Portland, Oregon 97204

RECEIVE
APR - 1 1988
MURRAY, SMITH & ASSOCIATES, I

Attn: Mr. David Leibbrandt, P.E.

Re: Supplemental Subsurface Investigation;
New Site of the 0.4 MG Waterspheroid Tank
(Rosemont Reservoir); City of West Linn

Dear David:

In accordance with your authorization, we have completed additional subsurface explorations at the new location of the 0.4 mg. waterspheroid tank off Sunset Drive in the City of West Linn. The new reservoir site is approximately 45 feet north and 15 feet west of the originally proposed site. A foundation investigation consisting of three drilled borings, a laboratory test program, and engineering studies was conducted at the original reservoir location and the results were presented in our letter report dated January 12, 1988. The purpose of this investigation is to evaluate the subsurface conditions at the new tank location and to reaffirm the conclusions and recommendations contained in our previous report.

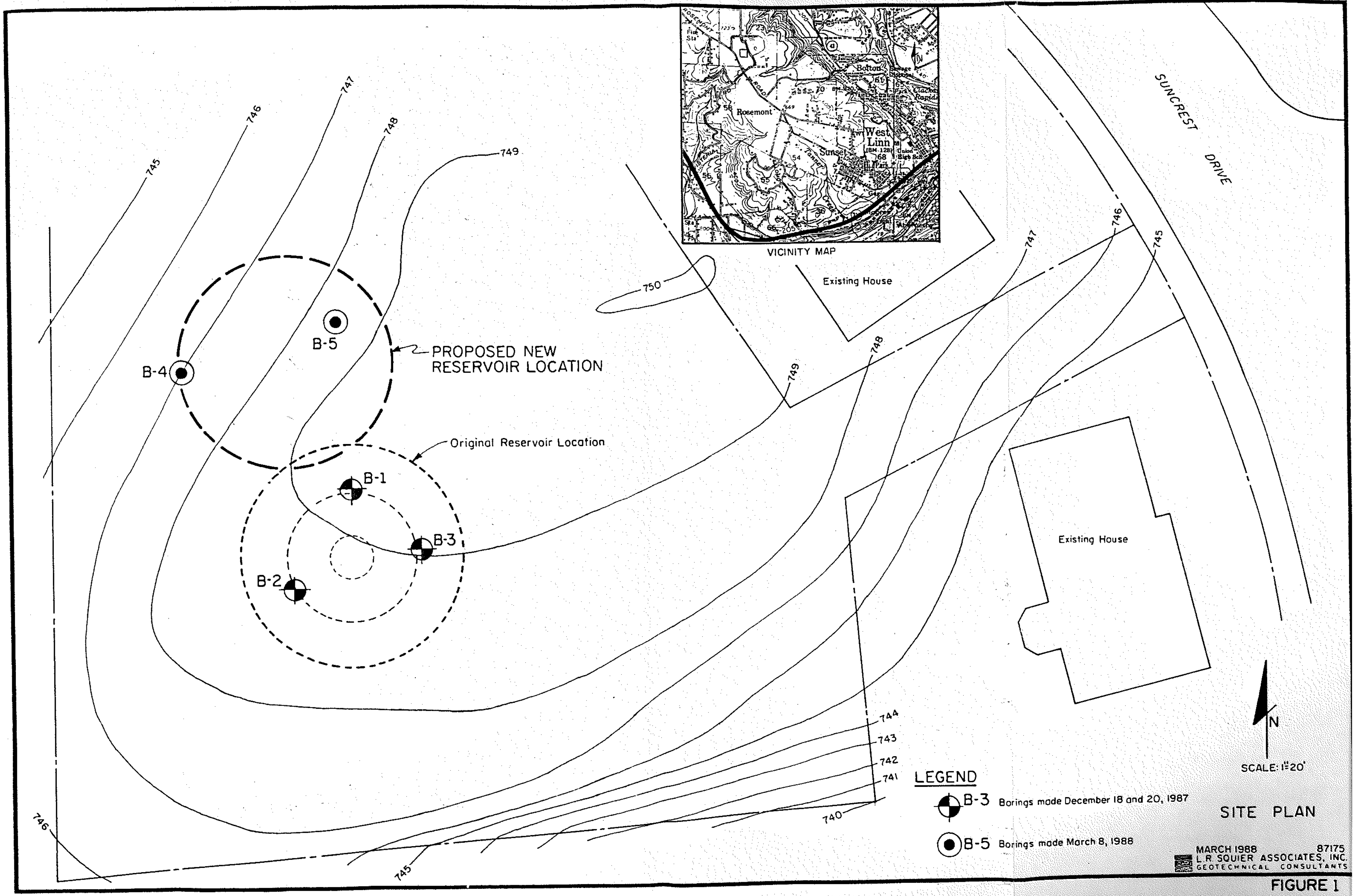
The supplemental subsurface investigation consisted of the completion of two drilled borings designated B-4 and B-5 at the location shown on Figure 1. The borings were made to depths of 18 and 20.2 feet with a truck-mounted CME Model 55 drill rig provided and operated by Geo-Tech Explorations, Inc. of Beaverton. The borings were made on March 8, 1988. Drilling and sampling techniques were similar to those described in our previous letter report. Descriptive logs of the borings are presented on Figures 2 and 3. Laboratory tests on soil and rock samples consisted of visual identification and moisture determination. Criteria used to describe the various samples obtained from the borings is outlined in our previous letter report.

The borings encountered residual soils overlying basalt that has been weathered to varying degrees. The subsurface conditions and materials are similar to those disclosed underlying the original reservoir site. Based on this information it is our opinion that the recommendations and conclusions presented in our soils report can be used without modification to found the reservoir on the relocated site.

Very truly yours,
L.R. Squier Associates, Inc.

by Scott V Mills
Scott V. Mills, P.E.
Project Engineer

SVM/LRS/es
Enclosures

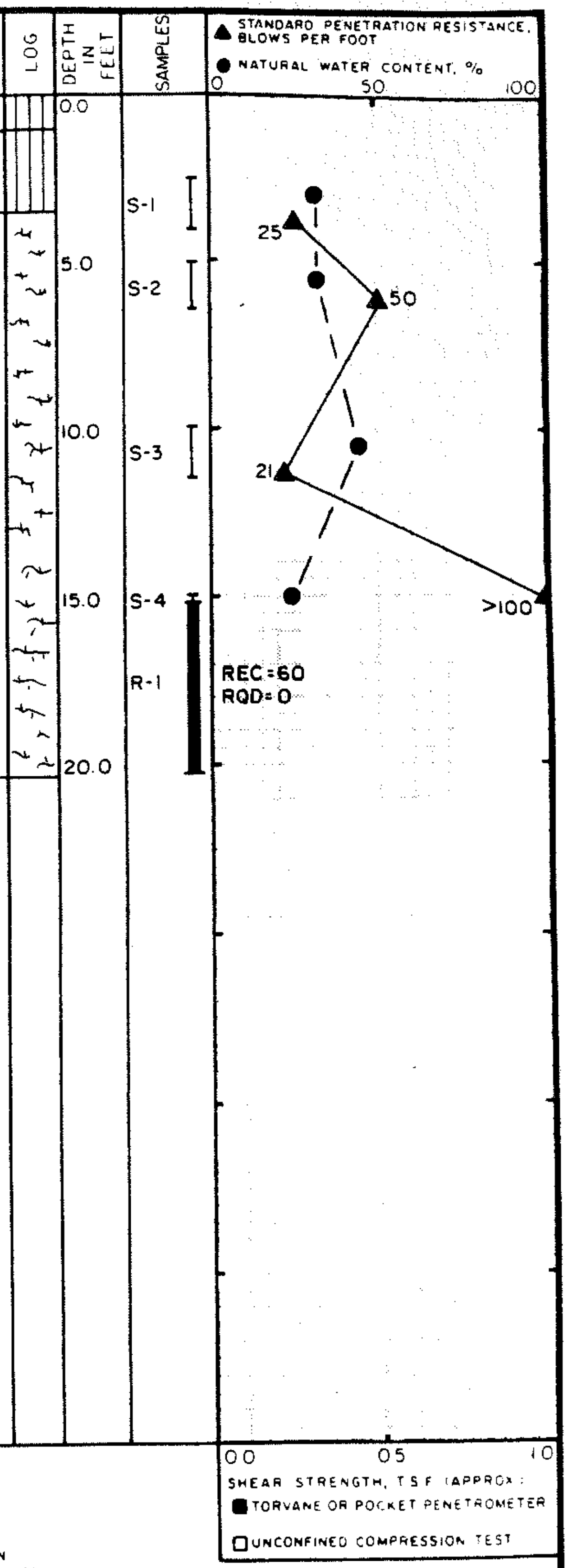


SITE PLAN

MARCH 1988 87175
L.R SQUIER ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

FIGURE 1

GROUND WATER	DEPTH IN FEET	SURFACE ELEVATION IN FEET: CLASSIFICATION OF MATERIAL
	0.0	TOPSOIL: Medium stiff brown SILT with trace clay, scattered to numerous organic material (fine grass, roots); moist
	1.0	Very stiff brown SILT with some sand, scattered gravel-sized basalt fragments (residual soil)
	3.5	Extremely soft to very soft (R0-R1) BASALT, sandy texture, very severe to severe weathering, frequent moderately weathered basalt fragments; moist grades to soft (R2) with moderately severe weathering. Basalt fragments(4in. minus)
	20.2	BOTTOM OF BORING (3/8/88)



LEGEND

- I : 2.0" O.D. SPLIT SPOON SAMPLE
- [I] : 3.0" O.D. THIN-WALLED SAMPLE
- * : SAMPLE NOT RECOVERED
- ☒ : GRAB SAMPLE DRILL CUTTINGS
- ▮ - CORE ROCK SAMPLE

REC= RECOVERY,%
RQD= ROCK QUALITY DESIGNATION,%

IMPERVIOUS SEAL
P.V.C. PIPE
▽ GROUND WATER LEVEL AS MEASURED ON DATE SHOWN (MAY VARY WITH TIME OF YEAR)
SLOTTED END

ATTERBERG LIMITS
LIQUID LIMIT
NATURAL WATER CONTENT
PLASTIC LIMIT

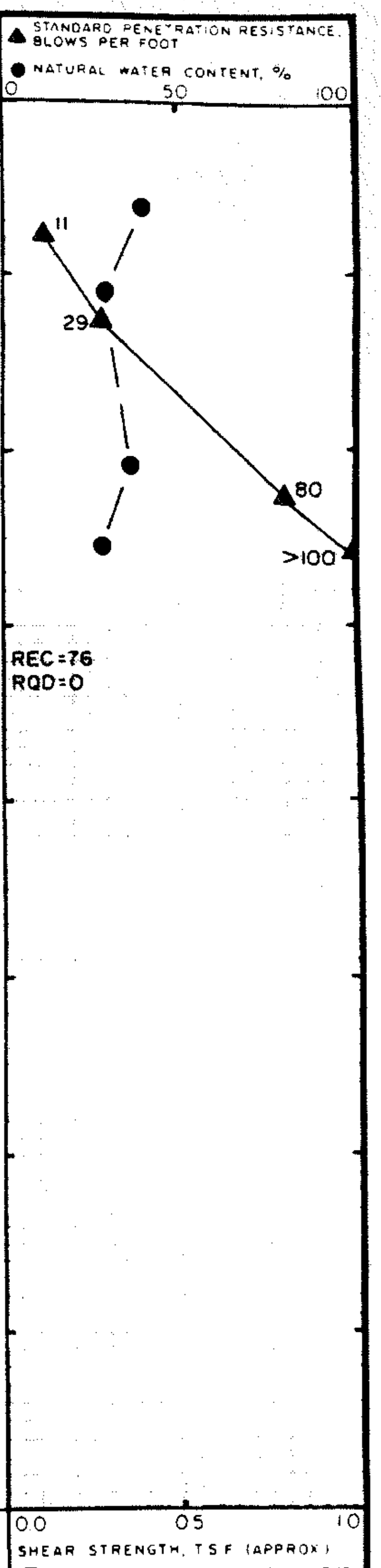
NOTE
Lines representing the interface between soil/rock units of differing description are approximate only and may indicate gradual transition

LOG
BORING B-4

MARCH 1988 87175
L.R. SQUIER ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

FIGURE 2

GROUND WATER	DEPTH IN FEET	SURFACE ELEVATION IN FEET: CLASSIFICATION OF MATERIAL	LOG	DEPTH IN FEET	SAMPLES
	0.0	TOPSOIL: Medium stiff brown SILT with some clay, scattered to numerous organics (fine grass roots)		0.0	
	0.9	Stiff brown SILT with some sand; moist (residual soil)		5.0	S-1 S-2
	6.5	Extremely soft to soft (R0 to R2) BASALT, sandy texture, very close joint spacing, very severe to severe weathering, frequent moderately weathered basalt fragments (4-inch minus)		10.0 15.0	S-3 S-4 R-1
	18.0	BOTTOM OF BORING (3/8/88)			



■ TORVANE OR POCKET PENETROMETER

☐ UNCONFINED COMPRESSION TEST

LEGEND

- I = 2.0" O.D. SPLIT SPOON SAMPLE
- II = 3.0" O.D. THIN-WALLED SAMPLE
- * = SAMPLE NOT RECOVERED
- ☒ = GRAB SAMPLE DRILL CUTTINGS
- ▮ = CORE ROCK SAMPLE

REC= RECOVERY,%

RQD= ROCK QUALITY DESIGNATION,%

IMPERVIOUS SEAL

P.V.C. PIPE

▽ GROUND WATER LEVEL AS MEASURED ON DATE SHOWN (MAY VARY WITH TIME OF YEAR)

SLOTTED END

ATTERBERG LIMITS

LIQUID LIMIT

NATURAL WATER CONTENT

PLASTIC LIMIT

NOTE
Lines representing the interface between soil/rock units of differing description are approximate only and may indicate gradual transition

LOG
BORING B-5

MARCH 1988 87175

L.R. SQUIER ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

FIGURE 3

LRS

L. R. SQUIER ASSOCIATES INC.
geotechnical consultants

4255 oak ridge road
p.o. box 1317

lake oswego, oregon 97034
tel. (503) 635-4419

87175
January 12, 1988

Murray, Smith & Associates, Inc.
121 S.W. Salmon Street, Suite 1110
Portland, Oregon 97204

Attn: Mr. Philip H. Smith, P.E.
Vice President

Re: Foundation Investigation, 0.4 MG Waterspheroid Tank (Rosemont Reservoir), City of West Linn

Dear Phil:

In accordance with your authorization, we have completed a foundation investigation for the proposed reservoir to be located off Suncrest Drive in the City of West Linn, Oregon (refer, Vicinity Map, Figure 1). The foundation investigation consisted of three drilled borings, a laboratory test program, and engineering studies. Descriptions of the field exploration and laboratory test programs and the results of these phases of work are presented in this report. Also, presented are conclusions and recommendations pertaining to the design and construction of the foundation for the proposed reservoir.

We understand that the proposed project will include a new 0.4 MG pedestal-type reservoir tank. The diameter of the sphere will be 51.5 feet, and it will stand about 110 feet above the existing ground surface. Approximate foundation loads provided by you are presented in the following table:

COMPLETE SERVICES IN SOIL & ROCK MECHANICS FOUNDATION ENGINEERING & ENGINEERING GEOLOGY

FOUNDATION LOADS

Component	Load(kips)
Dead Load (water + structure)	3730.0
Live Load (snow)	20.0
Total Load	3750.0

The location of the proposed reservoir with respect to property boundaries, adjacent structures, and surface contours is shown on Figure 1. The site is situated at the top of a ridge with the ground sloping, generally, downward to the northwest, southeast and southwest, from elevation 750 to elevation 738 feet at the northwest corner of the site. The elevation at the ground surface at the tank location is approximately 749 feet. At the time of the field investigation, the site was covered with ankle-high grass and weeds and scattered saplings. Residential housing borders the site to the northeast and south.

The site is located in the Columbia River basalt geologic unit on the steep eastern flank of the Tualatin mountains. This steep east-facing slope has been reported to be the fault scarp of a major northwest trending geologic fault. No recent activity is known for the fault and it is not considered to be earthquake producing. In this area of West Linn near-surface soils generally consist of wind deposited silt and/or residual soils. The residual soils have been derived from the chemical decomposition of basalt rock. The basalt is severely weathered, becoming moderately weathered at depth.

<u>Seismicity</u>. West Linn is located within the Portland Area physiographic province. A physiographic province is an area of relatively consistent geologic structure and geomor-

phology. This physiographic province historically has experienced a significant number of earthquakes. About three dozen earthquakes ranging in intensity from "felt" to intensity VII (on the Modified Mercalli Scale of I to XII) have been recorded in the Portland area during the period of 1841 to 1980. About three dozen other earthquakes have been documented within a 100 mile radius. This latter group includes the strong Olympia Earthquake of 1949. That earthquake had an observed magnitude of 7.1 (unified scale).

The greatest earthquake on record in the Portland area occurred in 1962. It had an intensity of VII and an average observed magnitude of 5.0. An intensity VII seismic event is defined as follows: damage negligible in buildings of good design and construction, slight to moderate in well-built ordinary structures, considerable in poorly built or badly designed structures, and some chimneys broken. A United States Coast and Geodetic Survey strong motion seismograph in the greater Portland area recorded a maximum ground acceleration of 0.16 times that of gravity. This seismograph was embedded in bedrock.

The rate of seismic energy released in the Portland area has been reported to be equivalent to approximately one magnitude 5.7 earthquake each decade. This same rate of energy release if stored for a period of 100 years and released at once would produce an earthquake in the order of magnitude 6.0. This evidence indicates that the Portland area should be considered one of active seismicity. However, the seismicity of the Portland region is not comparable to that of the Puget Sound region to the north, nor the very active seismic zones of California and western Nevada.

The selection of a design earthquake is based on a statistical analysis of historic data tempered with judgment, considering the geologic setting of the area. The International Conference of Building Officials has adopted a seismic risk map of the United States and has included it in the Uniform Building Code. The West Linn area is located within seismic Zone 2, that is, moderate damage potential, corresponding to a maximum intensity of VII. This is consistent with the data presented above.

The American Water Works Association (AWWA) standard for welded steel tanks for water storage also describes a means to estimate earthquake forces for pedestal-type elevated tanks. The lateral earthquake force is expressed by the following formula:

$$V = Z\ K\ C\ S\ W$$

The terms in this formula are defined in the AWWA standard. The coefficients S and Z are site and seismic zone related parameters. For West Linn, in Zone 2, the AWWA standard recommends Z=3/8. The value of S is a function of the ratio of the fundamental period of the structure to the characteristic site period, T_s, which is a function of the subsurface profile and the shear wave velocities through materials in that profile. For this site, the estimated characteristic site period is much less than 0.5 seconds; however, the Uniform Building Code states the T_s should not be taken as less than 0.5 seconds.

Field Explorations

To confirm the subsurface conditions and provide detailed data for foundation design studies, three borings, designated B-1 through B-3, were made on the site at locations shown on Figure 1. The borings were made to depths between 18.0 and 25.1 feet with a truck-mounted CME Model 55 drill rig provided and operated by Geo-Tech Explorations, Inc., of Beaverton. The borings were made on December 18 and 20, 1987. The borings were advanced with rotary drilling techniques using bentonite mud. When coreable rock was encountered, a Nx core barrel, with a split inner sleeve and diamond bit, was used to obtain samples. A representative from our firm located the general areas for the drilling and sampling and maintained a detailed descriptive log of each exploration.

Both disturbed and undisturbed soil samples were obtained in the borings. The disturbed samples were obtained with a standard 2-inch diameter spit-spoon sampler. During the taking of the samples the Standard Penetration Test was performed by driving the split-spoon sampler 18 inches with a 140 pound weight dropped 30 inches per blow. The number of blows required to drive the sampler the final 12 inches is defined as the standard penetration resistance. The standard penetration resistance, or N-value, provides a measure of the relative density of cohesionless soils (such as sands and gravels) or the consistency of cohesive soils (such as clayey silts and clays). Disturbed samples were classified and representative portions saved in sealed glass jars.

An undisturbed sample was obtained in a 3-inch O.D. Shelby tube. The Shelby tube was pushed into the soil using the hydraulic feed on the drill rig. Since the sample was pushed and not driven, a relatively undisturbed sample was obtained, suitable for strength and consolidation testing, as necessary. All the samples, both the disturbed and undisturbed, were returned to our laboratory for check classification and laboratory testing.

An observation well was installed in boring B-1 upon completion of drilling to permit the measurement of ground water levels. The observation well consisted of a 1/2-inch I.D. plastic riser pipe with narrow slots sawn at the bottom.

After inserting the riser pipe, clean pea gravel was placed around the pipe and a surface plug of relatively impervious soil was placed in the hole. Ground water enters the slotted pipe and rises to a static level inside the riser pipe. The level of water can be measured by lowering a probe inside the pipe.

The logs of borings are presented on Figures 2 through 4. The logs present a description of the types of soils and rock encountered and the depth where the soils/rock change in composition, and/or characteristics although the changes may be gradual. Further to the right the number, depth and types of samples that were obtained during drilling are shown. Ground water information is shown on the log of boring B-1, along with the date of the observation.

Laboratory Tests

Initially, soil and rock samples were classified visually in the field. Consistency, color, relative moisture, degree of plasticity, peculiar odors and other distinguishing characteristics of the soil were noted. The hardness, joint characteristics, degree of weathering and other pertinent characteristics of rock quality were recorded. Afterwards, the samples were re-examined in the laboratory, various standard classification tests were conducted, and the field classifications were modified where necessary. The soils were classified in accordance with the Unified Soil Classification System with certain other terminology, such as th relative density or consistency of the soil deposits, in general accordance with engineering practice. In determining the soil type (that is, gravel, sand, silt, or clay) the term that best described the major portion of the sample was used.

Natural water contents were determined for each sample and the results are presented on the boring logs, Figures 2 through 4. Pocket penetration strength tests were conducted on the undisturbed soil sample. Results of the pocket penetration test are summarized on Figure 2. The dry unit weight of sample S-1 from boring B-1 was 100 lbs./cu.ft.

Discussion of Subsurface Conditions

The field explorations disclosed that relatively uniform subsurface conditions exist beneath the site of the proposed reservoir. The borings encountered residual soils overlying basalt that has been weathered to varying degrees. Below approximately a 10 inch root zone and topsoil layer, the site is underlain by stiff to very stiff brown silt with varying amounts of sand and clay. At between 3.5 and 4.5 feet below the existing ground surface the explorations encountered severely weathered basalt bedrock. Although classified as rock, the texture and certain physical characteristics of the materials are more like soil than rock.

The hardness description of the weathered basalt, as presented in the Boring Logs, Figures 2 through 4, is in terms of rock hardness. Rock hardness for the unit ranges from extremely soft to soft, generally increasing in hardness with depth. Angular rock fragments ranging up to 4 inches in size make up to 40 percent of this unit below a depth of approximately 15 feet. The rock fragments are contained in a brown clayey sandy silt matrix. The original rock fabric, including joints and fractures, is apparent in this unit.

Ground water was not encountered during drilling nor was ground water detected in the observation well January 7, 1988, approximately two weeks after drilling. It is unlikely, due to the proximity of the site near the top of the hill, that ground water will be encountered near the surface of the site, even during the rainy season. Further, due to the fine-grained nature of the soil, it is expected that the downward percolation of surface water will be relatively slow.

Conclusions and Recommendations

General. The field explorations confirmed that the site is mantled by 3.5 to 4.5 feet of stiff to very stiff brown silt, which in turn is underlain by severely weathered basalt. Information obtained from this investigation indicates that the proposed pedestal-type reservoir may be supported on a conventional ring wall footing embedded in the weathered basalt. Uplift loads due to seismic and wind loadings may be resisted by the dead weight of the ring wall footing and a wedge of soil directly above the footing. The ring wall footing will likely be embedded from 5 to 10 feet below the existing ground surface in order to provide sufficient uplift resistance, with respect to the relatively high overturning moments of the reservoir.

A second scheme was briefly considered. It would involve using soil anchors along the ring wall to resist the design uplift loads. However, due to the variable nature of the weathered basalt, the design capacities of each anchor would be uncertain and, hence, this alternative was not considered practical.

Earthwork. Based on information obtained from the explorations, basalt will be encountered during excavation of the ring wall footing. However, the basalt is severely weathered and it is anticipated that general excavation can be satisfactorily accomplished with a moderate- to large-sized backhoe. Although relatively competent in-place, the weathered basalt is susceptible to disturbance from construction activity. Therefore, care should be taken to minimize any disturbance. In this regard, excavation of the weathered basalt should be accomplished using a backhoe equipped with a smooth bucket. The excavation should be conducted so that equipment traffic is kept off of the exposed excavation bottom at all times. A 12-inch granular pad consisting of 1-inch minus crushed rock should be placed immediately following excavation to subgrade elevation. Care should be taken to remove any soft or loose soils from the bottom of the excavation prior to placement of the crushed rock. The granular pad should adequately protect the subgrade from softening due to foot and other light traffic. The crushed rock should be relatively clean with less than 5 percent fines passing the No. 200 sieve (wet sieve analysis). Compaction of the granular pad should be at least 95 percent of the material's maximum dry density in accordance with ASTM D698. In our opinion, temporary cut slopes should be constructed no greater than 1H:1V.

Structural fill will be installed from the ring wall footing to the ground surface. The upper brown silt and weathered basalt are moisture sensitive and presently wet of optimum moisture for acceptable compaction. Therefore, we recommend that any structural fill consist of relatively clean granular material consisting of sand, sand and gravel, or crushed rock with maximum aggregate size in the order of 3 inches and with no more than 5 percent, by weight, passing the No. 200 sieve (wet sieve analysis). The structural fill should be placed in lifts not exceeding 9 inches thick (measured loose). The fill should be brought up on both sides of the ring wall footing in such a manner as to avoid adverse differential lateral earth pressures on the wall. Each lift should be uniformly compacted with a suitable compactor to at least 95 percent of the standard maximum dry density (ASTM D698).

Foundations. The proposed reservoir can be founded on a conventional ring wall spread footing established at least 5 feet below the existing ground surface. The width and embedment of the footing should be designed in accordance with the requirements of an allowable bearing pressure, lateral and uplift resistance, as discussed below. We recommend an allowable bearing pressure of 4000 lbs./sq.ft. for dead load and wind live load conditions. This allowable pressure may be increased by one-third for seismic loading conditions. The estimated total and differential settlements along the ring wall are expected to be on the order of 1/2 and 1/4 inch, respectively.

Resistance to Sliding-Foundation. Resistance to sliding of the tank foundation due to earthquake and wind loads may be obtained by friction between the base of the ring wall footing and the supporting soils, combined with passive earth pressure on the embedded portions of the footing. The total sliding resistance between the footing and supporting soils may be taken as the total contact pressure times 0.4. Additional lateral resistance, if required, can be provided by passive soil resistance against the face of the embedded ring wall. An equivalent fluid pressure of 150 lbs./cu.ft. may be adopted in the calculation of lateral resistance, provided that the backfill is granular and is compacted as recommended in the foregoing paragraphs. The factor of safety for determining the required lateral resistance should not be less than 1.5.

Uplift Resistance. Uplift loads due to overturning may be resisted by the mass dead weight of the concrete ring wall footing and the weight of the soil occupying a wedge shape area directly above the ring wall footing, as shown on Figure 5. The depth of embedment and width of the ring wall footing should be calculated on the basis of the weight required to resist the uplift load times a suitable factor of safety. We recommend that the factor of safety be at least 1.5 to resist uplift loads, with the combined wind and earthquake loadings having at least a factor of safety of 1.1 with respect to overturning.

Limitations

The scope of the investigation presented herein is limited to an investigation of the subsurface conditions for suitably founding the proposed reservoir. This report has been prepared to aid you in the evaluation of the site and to assist you in the design of the facilities. Our description of the project represents our understanding of the significant aspects of the project relevant to the design and construction of earthwork, foundations and similar. In the event that any changes in the basic design or location of the structure, as outlined in this report, are planned, we should be given the opportunity to review the changes and to modify or reaffirm in writing the conclusions and recommendations of this report.

The analyses and recommendations represented in this report are based on the data obtained from the borings made at the locations indicated on the Site Plan and from other information discussed herein. This report is based on the assumption that the subsurface conditions everywhere are not significantly different from those disclosed by the borings. However, variations in soil conditions may exist between the boring locations and, also, general ground water levels may fluctuate from time to time. The nature and extent of the variations may not become evident until construction. If subsurface conditions different from those encountered in the explorations are observed or encountered during construction or appear to be present beneath or beyond excavations, we should be advised at once so that we can observe and review these conditions and reconsider our recommendations where necessary.

Construction Monitoring

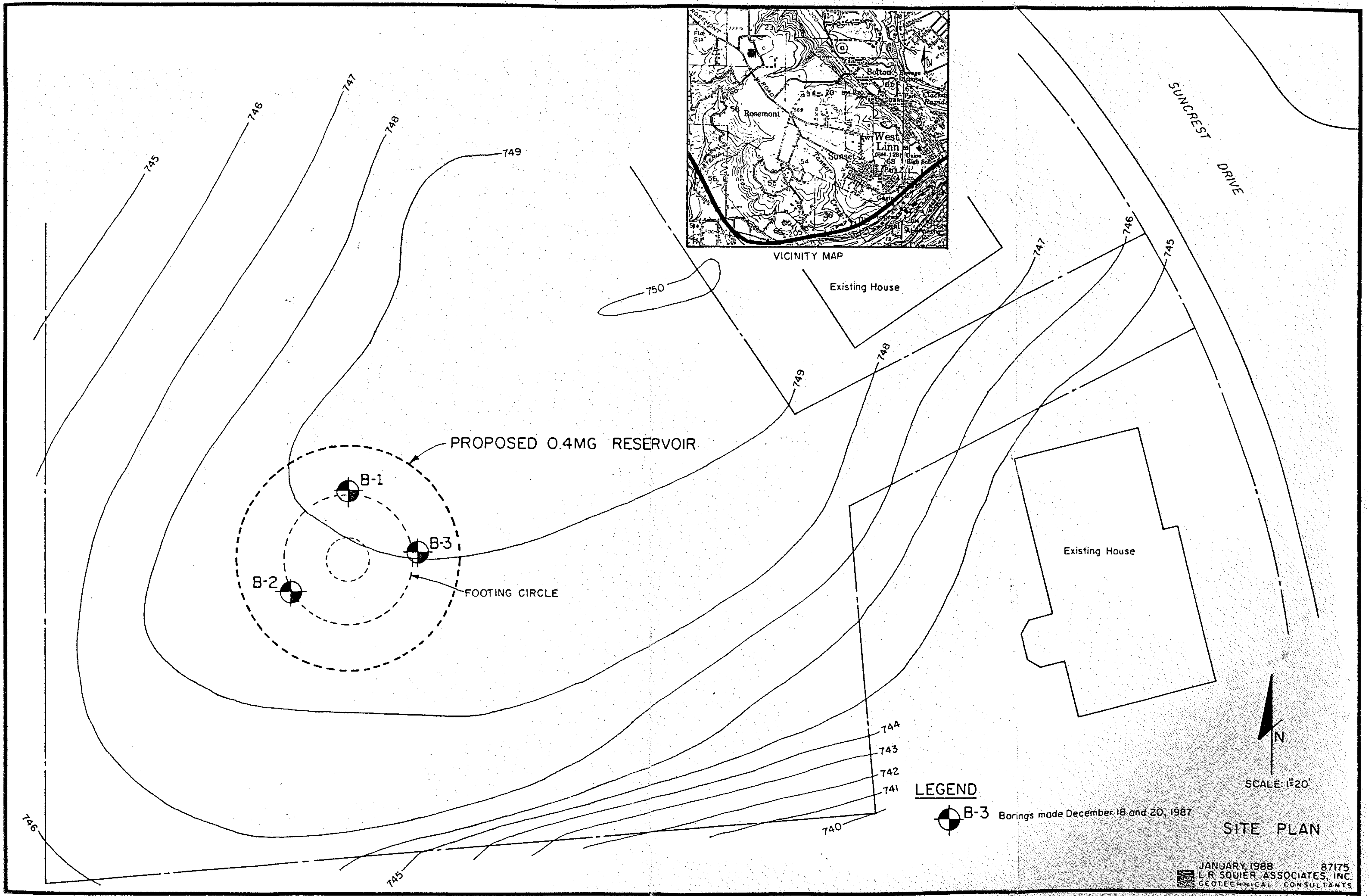
We should be retained to review the project plans and specifications to determine if they are in substantial conformance with the conclusions and recommendations contained in our report, and to determine if they are compatible with site geotechnical conditions. Moreover, we recommend that material gradation and all construction operations relating to earthwork, and compaction be observed and tested by us to determine if the work is proceeding in accordance with the intent of the design concepts, specifications and/or recommendations, and to allow for design changes in the event that subsurface conditions differ from those anticipated. Unless we have the opportunity during construction to confirm our assumptions, interpretations and analyses, we cannot be held responsible for the applicability of our conclusions and recommendations to subsurface conditions that are different from those anticipated.

Very truly yours,
L.R. Squier Associates, Inc.

by
Scott V. Mills, P.E.
Project Engineer

REGISTERED PROFESSIONAL ENGINEER
#13701
OREGON
JULY 16, 1987
SCOTT V. MILLS

SVM/LRS/es
Enclosures

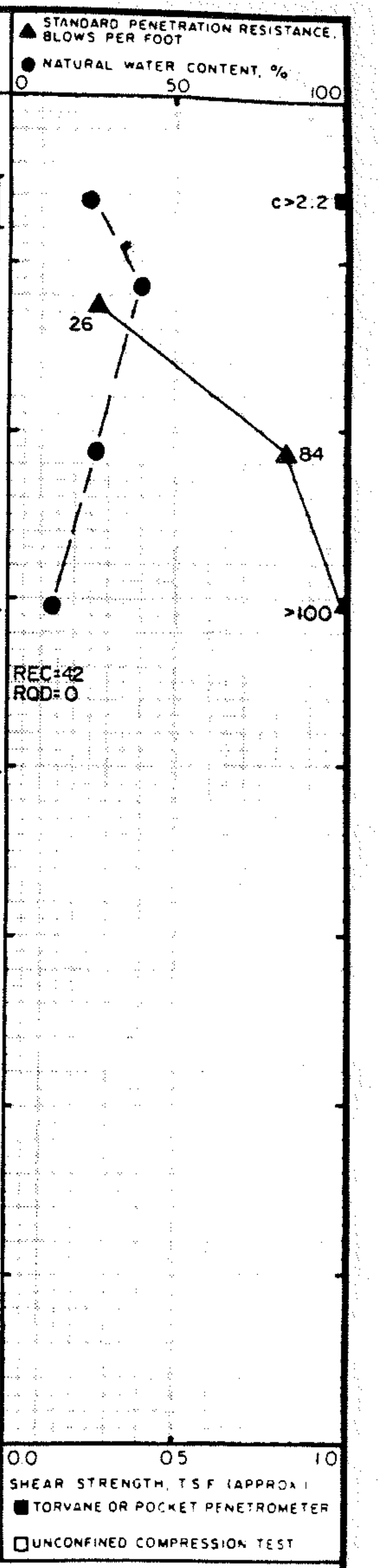


SITE PLAN

JANUARY, 1988 87175
L.R SQUIER ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

FIGURE 1

GROUND WATER	DEPTH IN FEET	SURFACE ELEVATION IN FEET: CLASSIFICATION OF MATERIAL	DEPTH IN FEET	SAMPLES
	0.0	TOPSOIL/ROOT ZONE: Medium stiff brown SILT with numerous roots (grass)	0.0	
	0.8	Stiff to very stiff brown SILT with some sand (residual soil) POWELL SILT LOAM GROUP C K=.37		S-1
	4.5	Extremely soft to very soft (R0 to R1) gray BASALT, sandy texture, very close joint spacing, very severe to severe weathering, frequent moderately weathered basalt fragments 4in. minus	5.0	S-2
			10.0	S-3
		grades to soft (R2) and moderately severe weathering	15.0	S-4
				R-1
	20.2	BOTTOM OF BORING (12/18/87) No ground water observed on 1/7/88	20.0	



LEGEND

- I : 2.0" O.D. SPLIT SPOON SAMPLE
- II : 3.0" O.D. THIN-WALLED SAMPLE
- * : SAMPLE NOT RECOVERED
- ⊠ : GRAB SAMPLE DRILL CUTTINGS
- ▌ - CORE ROCK SAMPLE
- REC: RECOVERY, %
- RQD: ROCK QUALITY DESIGNATION, %

IMPERVIOUS SEAL
P.V.C. PIPE
▽ GROUND WATER LEVEL AS MEASURED ON DATE SHOWN (MAY VARY WITH TIME OF YEAR)
SLOTTED END

ATTERBERG LIMITS
LIQUID LIMIT
NATURAL WATER CONTENT
PLASTIC LIMIT

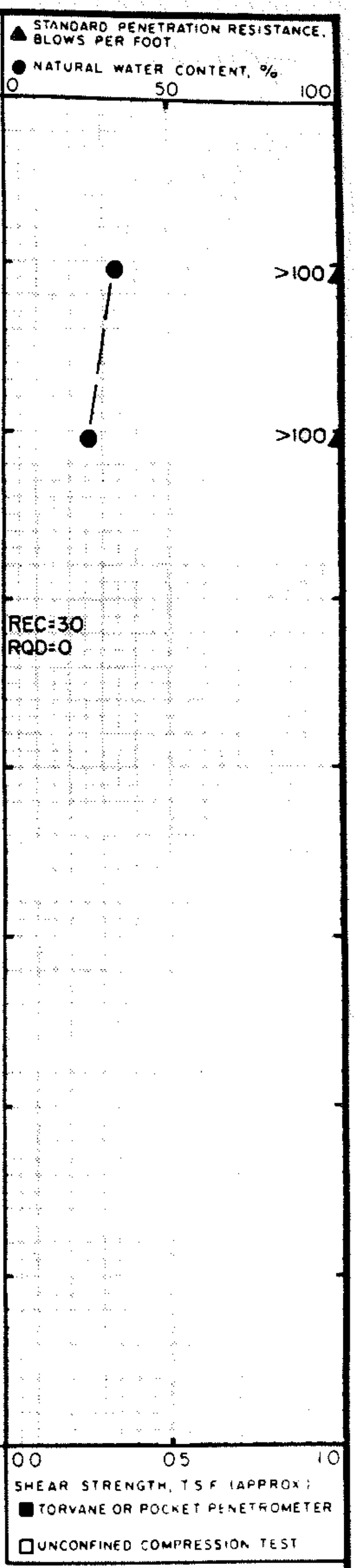
NOTE
Lines representing the interface between soil/rock units of differing description are approximate only and may indicate gradual transition

LOG
BORING B-1

JANUARY, 1988 87175
L.R. SQUIER ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

FIGURE 2

GROUND WATER	DEPTH IN FEET	SURFACE ELEVATION IN FEET: CLASSIFICATION OF MATERIAL	DEPTH IN FEET	SAMPLES
	0.0	TOPSOIL/ROOT ZONE: Medium stiff brown SILT with some sand, numerous roots (grass)	0.0	
	0.8	Stiff to very stiff brown SILT with some sand and clay (residual soil)		
	3.5	Extremely soft to very soft (R0 to R1) gray BASALT, very severely to severely weathered, very close joint spacing with brown clayey silt joint filling, frequent moderately weathered basalt fragments, 4in. minus	5.0	S-1 I
			10.0	S-2 I
		grades to soft (R2) and moderately severe weathering	15.0	R-1
	18.0	BOTTOM OF BORING (12/18/87)		



LEGEND

I = 2.0" O.D. SPLIT SPOON SAMPLE

Ī = 3.0" O.D. THIN-WALLED SAMPLE

* = SAMPLE NOT RECOVERED

☒ = GRAB SAMPLE DRILL CUTTINGS

▌ = CORE ROCK SAMPLE

REC = RECOVERY, %

RQD = ROCK QUALITY DESIGNATION, %

IMPERVIOUS SEAL

PVC PIPE

∇ GROUND WATER LEVEL AS MEASURED ON DATE SHOWN (MAY VARY WITH TIME OF YEAR)

SLOTTED END

ATTERBERG LIMITS

LIQUID LIMIT

NATURAL WATER CONTENT

PLASTIC LIMIT

NOTE:
Lines representing the interface between soil/rock units of differing description are approximate only and may indicate gradual transition

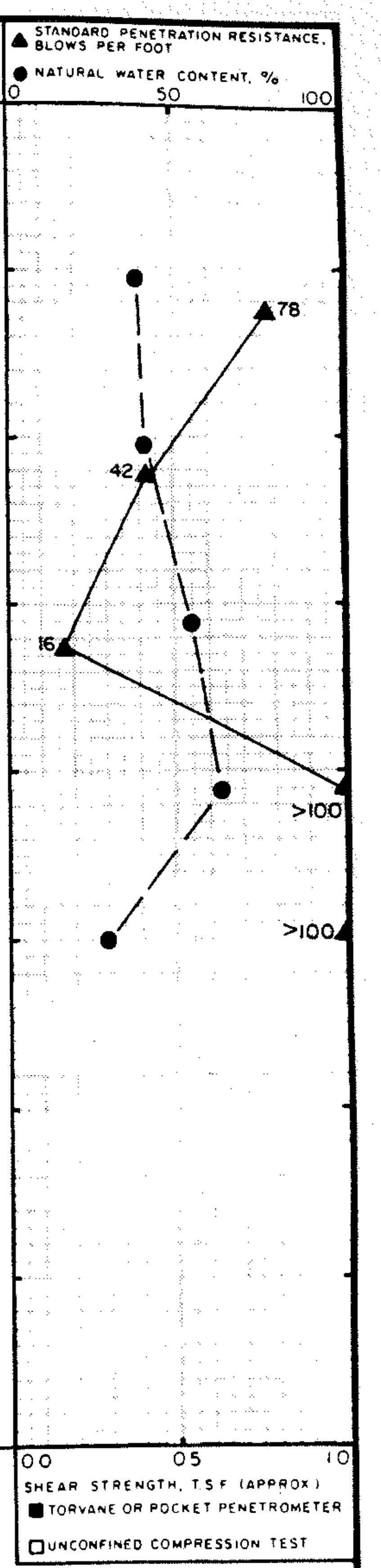
LOG
BORING B-2

JANUARY 1988 87175

L.R. SQUIER ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

FIGURE 3

GROUND WATER	DEPTH IN FEET	SURFACE ELEVATION IN FEET CLASSIFICATION OF MATERIAL	LOG	DEPTH IN FEET	SAMPLES
	0.0	TOPSOIL/ROOT ZONE: Medium stiff brown SILT with some sand, numerous roots (grass)		0.0	
	0.7	Stiff to very stiff brown SILT with some sand (residual soil)			
	3.5	Extremely soft to very soft (R0 to R1) gray BASALT, very severely to severely weathered, very close jointing with brown silt joint filling, frequent moderately weathered basalt fragments, 4in. minus		5.0	S-1 I
				10.0	S-2 I
				15.0	S-3 I
		grades to soft (R2) gray BASALT, severe to moderately severe weathering		20.0	S-4 I
				25.0	S-5 I
	25.1	BOTTOM OF BORING (12/20/87)			



LEGEND

I : 2.0" O.D. SPLIT SPOON SAMPLE

II : 3.0" O.D. THIN-WALLED SAMPLE

* : SAMPLE NOT RECOVERED

☒ : GRAB SAMPLE DRILL CUTTINGS

▮ : CORE ROCK SAMPLE

REC: RECOVERY, %

RQD: ROCK QUALITY DESIGNATION, %

IMPERVIOUS SEAL

PVC PIPE

▽ GROUND WATER LEVEL AS MEASURED ON DATE SHOWN (MAY VARY WITH TIME OF YEAR)

SLOTTED END

ATTERBERG LIMITS

LIQUID LIMIT

NATURAL WATER CONTENT

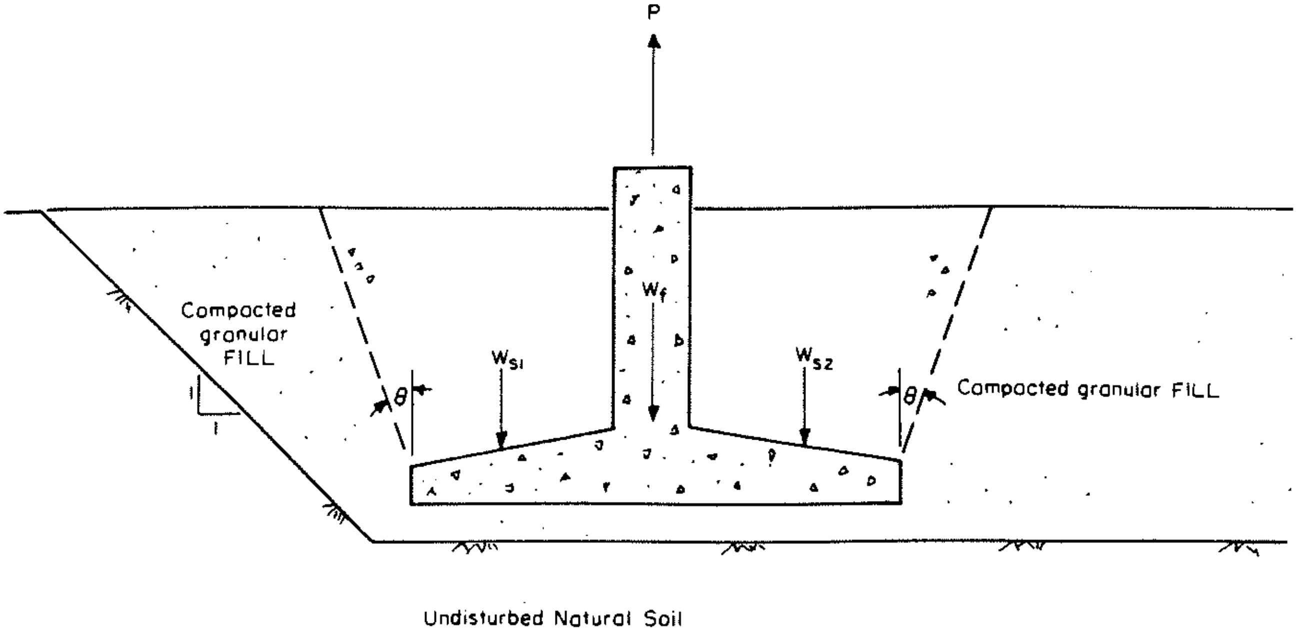
PLASTIC LIMIT

NOTE:
Lines representing the interface between soil/rock units of differing description are approximate only and may indicate gradual transition

LOG
BORING B-3

JANUARY, 1987 87175
L.R. SQUIER ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

FIGURE 4



Where:

W_s = Weight of soil wedge on side of footing defined by $\theta = 20°$

W_f = Weight of footing

P = Uplift load

FS = 1.5 (minimum Factor of Safety)

therefore:

$$1.5P = W_{s1} + W_{s2} + W_f$$

UPLIFT RESISTANCE ON RINGWALL FOOTING

JANUARY, 1988 87175
L.R. SQUIER ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

FIGURE 5

Attachment C – [Bolton] Geotechnical Investigation and Site Specific-Seismic Hazard Study; 4-MG Bolton Reservoir, GRI, 2015.

GRI
9750 SW Nimbus Avenue
Beaverton, OR 97008-7172
p | 503-641-3478 f | 503-644-8034

January 23, 2015 5338-A GEOTECHNICAL RPT

Murray, Smith & Associates, Inc.
121 SW Salmon Street, Suite 900
Portland, OR 97204

DRAFT

Attention: Tom Boland, PE

SUBJECT: Geotechnical Investigation and Site-Specific Seismic Hazard Study
4-MG Bolton Reservoir
West Linn, Oregon

At your request, GRI has conducted a geotechnical investigation and site-specific seismic hazard study for the above-referenced project in West Linn, Oregon. The general location of the site is shown on the Vicinity Map, Figure 1. The purpose of this investigation was to evaluate subsurface materials and conditions at the site and develop geotechnical recommendations for use in design and construction of the reservoir. The investigation included a review of available geotechnical information for the site and vicinity, subsurface explorations, laboratory testing, and engineering and seismic analyses. This report describes the work accomplished and provides our conclusions and recommendations for design and construction of the proposed reservoir.

Because the reservoir is considered an essential facility in accordance with the 2014 Oregon Structural Specialty Code (OSSC), our investigation included a site-specific seismic hazard study.

GRI completed a preliminary geotechnical evaluation of the site to support the conceptual siting analysis. The results of our evaluation are summarized in our August 31, 2012, report to Murray, Smith & Associates, Inc. entitled, "Preliminary Geotechnical Evaluation for Conceptual Siting Analysis, 4-MG Bolton Reservoir, West Linn, Oregon."

PROJECT DESCRIPTION

As currently proposed, the existing 2.5-million gallon (MG) concrete reservoir will be replaced with a partially embedded 4-MG concrete reservoir established in a cut up to 30 ft deep. The approximate location of the proposed tank with respect to the existing reservoir and site topography is shown on the Site Plan, Figure 2. The new reservoir will consist of a partially embedded, American Water Works Association (AWWA) D110-13 Type I wire-wound, circular, pre-stressed concrete tank with an inside diameter of about 168 ft. The January 12, 2015, pre-design report by Peterson Structural Engineers (PSE) indicates the floor of the new reservoir will be established at approximate elevation 425 ft (NAVD 88) and overflow at approximate elevation 451 ft with 2 ft of freeboard. The reservoir foundation was originally designed to be a 24-in.-thick reinforced concrete mat slab. The 9-in.-thick reinforced concrete roof will be supported by a 12-in.-thick core wall and 24-in. diameter columns on approximately 20-ft center-to-center spacing. The tank will be backfilled to elevation 442 and 445 ft on the north and south side, respectively, and will support a 15-ft-wide gravel service road.

As shown on Figure 2, the new reservoir will be established toward the southwest portion of the site, and the northern side of the reservoir will be about 50 ft farther south than the existing reservoir to reduce the risk of potential local slope instability along the north side of the site. The top of the slope along the north side of the site will be flattened by removing soil to improve the overall stability of the slope.

Based on our experience with similar projects, the amount of differential settlement that can be tolerated across the footprint of a concrete reservoir is small, and limiting differential settlement will be critical to the performance of the reservoir. Possibly poor quality fill and localized zones of soft, compressible soil in the basalt have been disclosed by recent exploration. To reduce the risk of undesirable settlement beneath the reservoir, ground improvement, such as rammed aggregate piers overlain with several feet of compacted crushed rock, is planned to limit settlement to acceptable levels. Ground improvement is also required to improve the factor of safety for the seismic slope stability.

The excavation necessary for construction of the new reservoir is anticipated to extend to approximately 30 ft below existing grades. As currently planned, the side slopes of the excavation will be sloped at up to 1H:1V where space allows. However, we anticipate a shoring system constructed from the top-down, such as a tied-back soldier pile wall or possibly a soil-nail wall, may be necessary to retain the temporary excavation next to the existing pump station to the southeast and along the west side of the reservoir footprint near the properly line. We anticipate the shoring walls could have a total retained height of up to 30 ft.

The project will also include construction of new piping, a valve vault, landscaping, and a gravel access road. The 18-in.-diameter inlet/outlet line in Skyline Circle will be replaced with a 24-in.-diameter line, and the existing 8-in.-diameter PVC main north of the reservoir will be replaced with an 8-in.-diameter ductile iron line. A new overflow line will be constructed at a location that has not yet been determined.

SITE DESCRIPTION

Topography and Surface Conditions

As shown on the Site Plan, Figure 2, and the Site Map, Figure 3, the reservoir site is located northeast of Skyline Drive on a relatively flat bench at about elevation 445 to 450 ft (NAVD 88). Land use in the area surrounding the existing reservoir consists of forested undeveloped land to the south and residential to the west, north, and east. The ground surface north of the reservoir slopes downward at about 25° to the northeast to residences along Caufield Street and is vegetated with mature trees and brush.

GEOLOGY

Geologic Setting

The site is located on the eastern flank of the Tualatin Mountains, a topographic upland that separates the Portland Basin to the northeast from the Tualatin Basin to the west and the Willamette Valley to the south. Geologic mapping completed for the area indicates the site is located in the vicinity of the contact between the Miocene Wanapum Basalt and the Grande Ronde Basalt units of the Columbia River Basalt Group (Madin, 2009). Where fresh and unweathered, these basalt units are typically a light to dark gray, dense volcanic rock. However, the Wanapum-Grande Ronde boundary is characterized in places by an erosional unconformity or an interbed that varies from non-marine sediments to a thick relic soil, and is referred to as the Vantage Horizon (Beeson et al., 1985). The Vantage Horizon originated during a period of erosion and soil development that occurred between volcanic flow events. Large-scale landslides are known to occur where the Vantage Horizon daylights at or near the ground surface. The reservoir site and other areas of the Tualatin Mountain upland are capped by deposits of fine-grained, windblown silt, referred to as Portland Hills Silt. Quaternary alluvial deposits associated with the Willamette River and the Ice Age Missoula Floods (about 15,000 to 20,000 years ago) are present northeast of the site, north of Highway 43. A geologic map and cross section of the project area are provided on Figure 4.

Faults

General. Several geologic faults are located in the project area. Two northeast-trending unnamed normal faults are mapped near the site (Yeats et al., 1991). These faults, which are bedrock faults in the Columbia River Basalt, do not have historic seismicity and are not considered by U.S. Geological Survey (USGS) to contribute to the seismic hazard at the site. The surface trace of the Bolton Fault is located about 900 ft northeast of the site, the Oatfield Fault is about 2.5 miles northeast of the site, and the Portland Hills Fault is about 3 miles northeast of the site (Schlicker and Finlayson, 1979; Personius et al., 2002). These faults do not have historic seismicity, but the USGS considers each of these faults to contribute to the overall seismic hazard at the site.

Bolton Fault. The northwest-trending Bolton Fault is responsible for the straight, abrupt front of the hills west of Highway 43 between Lake Oswego and West Linn. The Bolton Fault does not appear to have moved since the time of the Missoula Floods, about 15,000 to 20,000 thousand years ago (DOGAMI, 2009). This fault is located about 900 ft northeast of the site. USGS considers the structure a southwest-dipping reverse fault with down-to-the-northeast separation of up to 200 m (600 ft) in Miocene volcanic rocks (Personius et al., 2002). No fault scarps in surficial deposits or other unequivocal evidence of Quaternary displacement has been described in the literature. The USGS classifies the fault as Class B until further studies are conducted (Personius et al., 2002). Class A faults generally have a slip rate greater than 5 mm/yr and well constrained paleoseismic data. Class B faults include all other faults lacking paleoseismic data necessary to constrain the recurrence intervals of large events (Petersen et al., 1996).

An online Department of Geology and Mineral Industries (DOGAMI) mapping viewer (DOGAMI HazVue, accessed January 8, 2015) places the closest point of the surface trace of the Bolton Fault about 900 ft northeast of the existing reservoir (distance measured from northeast corner of existing reservoir to the trace mapped at intersection of Highway 43 and Buck Street). Other published DOGAMI maps show the surface trace of the Bolton Fault generally coincident with the relatively linear eastern slope toe of the Tualatin Mountains upland, or about 900 ft northeast of the existing reservoir (Schlicker and Finlayson, 1979, scale 1:24,000; Burns et al., 1997, scale 1:100,000). However, it should be noted that the available geologic resolution and confidence to locate the Bolton Fault with about 500 ft at scales of 1:24,000 and 1:100,000 is low. Yeats et al. (1991) and Madin (2009) map two strands of the Bolton Fault near the site, see Figure 4. Their mapping shows one strand along the abrupt topographic escarpment, and another buried strand is concealed beneath Quaternary alluvial deposits near Highway 43.

Canby 133 Ancient Landslide

DOGAMI is the state agency responsible for geologic hazard mapping in Oregon. DOGAMI has indicated in its statewide landslide hazard database that Bolton Reservoir is located on a prehistoric (>150 yrs), deep-seated (>15 ft deep), translational rock landslide, referred to as Canby 133. Figure 5 shows the limits of the landslide from the state database. Mapping of landslide deposits are based, in part, on light detection and ranging (lidar) derived elevation data and interpretation of surface topography typical of landslide features. Canby 133 was mapped using lidar and a method protocol outlined by DOGAMI (2009) with a "moderate" level of confidence. The confidence ranking (low, moderate, and high) is based on desktop analysis. Bill Burns with DOGAMI was contacted regarding this feature and recalls they did a vehicle-based reconnaissance from public roads to map this feature, but he was not aware of other data (i.e., reports, borings, or anecdotal stories of ground movement) about the feature. Mr. Burns indicated unpublished DOGAMI field mapping from 2004 also indicates the area is a landslide. This information suggests the Bolton Reservoir site is located on a very large, old or "ancient" landslide.

As part of the Murray, Smith & Associates, Inc. (MSA) team, Cornforth Consultants, Inc. (2014) completed a seismic landslide evaluation for the planned reservoir. The evaluation was performed to identify any signs of landslide activity near the reservoir and to provide opinions on potential impacts of seismic landslide displacements on proposed improvements at the site. Their geotechnical reconnaissance of the ancient landslide around Bolton Reservoir did not identify signs of active movement, especially along the margins, where differential movement would be greatest. They also concluded the ancient landslide is likely to move feet rather than tens of feet during a large earthquake.

The mapped northeast boundary of the Canby 133 landslide near the site is essentially coincident with the prominent straight and abrupt topographic escarpment associated with the Bolton Fault. In our opinion, this indicates the Bolton Fault cross-cuts the toe of the Canby 133 landslide. Therefore, the Canby 133 landslide is likely on the order of at least 15,000 to 20,000 years old.

SLOPE STABILITY

Previous Reports

Three geotechnical engineering reports prepared for the Bolton Reservoir site in 1972, 1988, and 1998, were provided to GRI. The first report was prepared by Northwest Testing Laboratories (NTL) for the City of West Linn (City) in 1972 (NTL, 1972). The report provided the results of a soil and foundation investigation and recommendations for enlarging the reservoir. The report concluded the slope east of the site could accommodate the additional load of the reservoir.

L.R. Squier Associates, Inc. prepared a geologic reconnaissance report for the City in 1988 (L.R. Squier, 1988). The purpose of the report was to evaluate the slope northeast of the reservoir for a planned residential development, where there were concerns of slope stability. The report concluded that steep slopes, weak and locally thin soils, soil creep, and groundwater seepage from springs suggested a high risk for slope instability, and a comprehensive geotechnical investigation was recommended.

In the 1970s, a small earth flow landslide occurred along the steeply sloping wooded area northeast of the reservoir. Large ground cracks occurred north of the reservoir in 1996 following heavy rainfall. Landslide Technology conducted an investigation into the stability of the steep slope area in 1997 (Landslide Technology, 1998). The investigation included a reconnaissance, subsurface explorations, laboratory testing, installation of an open-pipe piezometer and inclinometer casing. Based on the results of the investigation, the report provided an approach for repair of the small earth flow failure.

Site Reconnaissance

A reconnaissance of the site and surrounding area was conducted by a registered geologist and a certified engineering geologist from GRI in June 2012 and January 2015. The following description of the site is a summary of the observations made during the reconnaissance activities. Private properties located immediately northwest and southeast of the site were not accessed, but observed from the public right of way for features of significance. To the northeast, the ground slopes downward at approximately 25° toward Caufield Street. The slope northeast of the reservoir site is wooded with predominantly deciduous trees and occasional conifer tree, and springs. The ground surface is generally covered by English ivy, ferns, and blackberries. Several springs and flowing water were also observed along Caufield Street and originated from the slope above. A concrete manhole and pipe valve were observed along the slope near the northern property boundary. The valve appeared to be rusted through and was leaking water. No indications of recent slope instability were observed along the northeast slope during the site reconnaissance. The surrounding neighborhood was also examined from the public right of way for indications of slope movement (cracked and separated sidewalks or curbs). The reconnaissance did not disclose obvious indications of relatively recent movement, such as cracked streets, sidewalks, or curbs. Limited interviews with City maintenance personnel did not disclose reports of broken or sheared underground utilities.

The slope failure that occurred along the northeast side of the existing reservoir in 1996 and investigated by Landslide Technologies has not been repaired and is covered with vegetation as observed during our January 2015 reconnaissance. Most of the remainder of the slope along the north side of the reservoir has the same general appearance and inclination of the slope adjacent to the landslide. The existing reservoir was fully covered with a liner and could not be examined. However, cracking is present along portions of the north side of the reservoir flatwork and ring wall, particularly in the northwest corner. As with previous observations in 2012, whether the flatwork and ring wall cracking is due to slope movement or fill settlement could not be ascertained.

Inclinometer

In June 2012 and November 2014, GRI monitored the inclinometer that was installed by Landslide Technologies in 1997 at the approximate location shown on Figure 2 during their evaluation of local instability at the northeast corner of the site. An inclinometer casing consists of a plastic pipe with a pair of orthogonal slots, or grooves, that permit a calibrated instrument to be lowered to the bottom of the casing. When the ground surrounding the casing moves, the casing distorts above the zone of movement, and the orientation of the casing changes. The orientation of the casing is measured by lowering the calibrated instrument to the bottom of the casing and reading the instrument at 2-ft intervals as it is withdrawn. The zone and rate of movement can be determined by comparing the results of successive sets of readings. The inclinometer was installed east of the proposed tank footprint to provide long-term monitoring of the site with respect to potential slope movement.

GRI obtained the baseline measurements collected by Landslide Technologies in 1997 and compared those data with measurements obtained from the inclinometer in June 2012 and November 2014. The readings indicate very small creep-type slope movements have occurred since the inclinometer casing was installed in 1997. The measurements indicate cumulative horizontal movement of 1 and 1.25 in. at the ground surface between the 1997 base line reading and the readings by GRI in June 2012 and November

2014, respectively. The majority of the movement occurred in the upper approximately 10 to 12 ft of the soil profile and was less than about 0.25 in. below this depth. The movement detected in the inclinometer gradually decreases with depth, to no obvious movement at a depth of about 40 ft. Indications of obvious movement at the ground surface, such as ground cracks or settlement, have not been observed during our recent visits to the site.

In our opinion, information provided in the report by Landslide Technology and monitoring of the inclinometer indicate the slope instability that occurred in 1996 is likely related in part to the presence of fill soil placed along the northern slope during the original construction of the reservoir. As part of the reservoir replacement project, soil will be removed from the top of the slope to improve local stability, which may impact the existing inclinometer and piezometer installed by Landslide Technology. We recommend preserving the slope inclinometer and piezometer for future monitoring. In this regard, the upper portion of the inclinometer and piezometer may need to be removed followed by a new inclinometer base line reading. GRI should participate closely with any field modifications to the inclinometer and piezometer casing.

SUBSURFACE CONDITIONS

General

Subsurface materials and conditions at the site were evaluated by GRI on June 15, 2012, with one boring, designated B-1, and on October 27 through 29, 2014, with two borings, designated B-2 and B-3. The locations of the borings are shown on Figure 2. The borings were advanced to depths rof about 76 to 90 ft. The field and laboratory programs completed for this study are discussed in detail in Appendix A. Logs of the borings are provided on Figures 1A through 3A. The terms and symbols used to describe the soil and rock encountered in the borings are defined in Tables 1A and 2A and the attached legend.

In addition to the borings completed by GRI, Landslide Technology (1998) and Northwest Testing Laboratories (1972) completed borings at the locations shown on Figure 2. Logs of the previously drilled borings are provided in Appendix B.

The explorations indicate the reservoir site is mantled with a variable thickness of silty and clayey manmade fill, underlain by native silty and clayey soils, which are in turn underlain by basalt of the Columbia River Basalt Group. The relative consistency of the silty and clayey fill and native soil is generally medium stiff to stiff. The native soil is underlain by extremely soft (R0), predominantly decomposed to decomposed basalt (Wanapum Basalt). The basalt has generally weathered to the consistency of medium stiff to hard soil. Localized zones in the decomposed basalt have weathered to the consistency of soft, silty and clayey soil. The soft soil-like zones were encountered locally between depths of about 20 and 40 ft below the ground surface. The basalt transitions to generally fresh to moderately weathered, medium hard to hard (R3 to R4) basalt at depths of about 55 to 60 ft below the ground surface. The Wanapum Basalt transitions to the Vantage Horizon of the Grande Ronde Basalt at a depth of about 79 and 71 ft below the ground surface in GRI borings B-2 and B-3, respectively. The zone between the two basalt formations is called the Vantage Horizon and consists of moderately weathered, very soft to medium hard (R1 to R3) basalt. GRI borings B-2 and B-3 did not disclose indications of soft soil and/or shear zones within the Vantage Horizon. The transition from soil-like weathered basalt to relatively intact medium hard to hard basalt at a depth of about 55 to 60 ft is interpreted to be the lower boundary of material within the mass of the very large, presently inactive, ancient/prehistoric, deep-seated landslide.

Groundwater

An observation standpipe piezometer was installed in GRI borings B-2 and B-3 to a depth of 90 and 48 ft, respectively, to monitor groundwater levels at the site. As discussed previously, Landslide Technology installed a standpipe piezometer to a depth of 40 ft in a boring at the northeast corner of the site. On November 18, 2014, groundwater levels in standpipe piezometers installed GRI borings B-2 and B-3, and Landslide Technology boring LT-1P were measured at depths of about 23, 42, and 19 ft, respectively, below the ground surface. On January 7, 2015, the groundwater level in borings B-2, B-3 and LT-1P was about 23, 41, and 19 ft, respectively, below the ground surface. We anticipate the regional groundwater level is significantly deeper, and the groundwater levels measured in the standpipes are perched within the soil and rock. It is expected that perched groundwater in the soil could approach the ground surface locally during periods of prolonged or intense precipitation that are common during the wet, fall through spring months and will likely drop to depths greater than 20 ft during typical dry, summer and early fall months.

CONCLUSIONS AND RECOMMENDATIONS

General

The new reservoir will be constructed toward the southwest portion of the site in a cut up to 30 ft deep and will have a finished floor at about elevation 425 ft and an overflow at elevation 451 ft with 2 ft of freeboard. The sides of the new reservoir will be backfilled to within about 5 to 10 ft of the top of the reservoir. To provide satisfactory seismic slope stability for the new reservoir and limit differential static settlements, ground improvement will be completed beneath the new tank, and soil will be removed along the crest of the slope along the north side of the site. Drainage will be installed around and beneath the reservoir to manage subsurface water, and new inlet/outlet and overflow piping will be installed.

The reservoir site is mantled with a variable thickness of relatively stiff, silty and clayey manmade fill that is underlain by relatively stiff, native silty and clayey soils, which are in turn underlain by basalt. The basalt has generally weathered to the consistency of medium stiff to hard soil to depths of about 55 to 60 ft. However, localized zones in the decomposed basalt between depths of about 20 to 40 ft have weathered to the consistency of soft, silty and clayey soil. Soft to hard (R2 to R4) basalt underlies the decomposed basalt at depths of 55 to 60 ft. The groundwater level at the site may approach the ground surface during periods of prolonged or intense precipitation that are common during the wet, fall through spring months.

As previously discussed, the reservoir site is located on a very large, ancient landslide. However, reconnaissances by GRI as part of this study and during our 2012 study did not disclose indications of recent landslide movement. A reconnaissance recently completed by Cornforth Consultants (December 2014) also did not identify signs of active movement. It is our opinion the risk of significant future movement of the large, ancient landslide is low. It is expected that the greatest risk of significant movement of the large landslide would be during and/or following a large seismic event. Because the reservoir site is located within the middle of this large translational landslide mass and away from the margins, the risk of significant differential movement within the footprint of the new reservoir following the design-level earthquake is expected to be low. The planned ground improvement beneath the reservoir, removal of soil at the top of the slope along the north side of the site, and the gravel pad and subdrainage system around and beneath the reservoir will improve local factors of safety as they relate to potential reservoir instability. In our opinion, the new reservoir, as planned, will not adversely affect the existing site slope stability. Slope stability analyses and discussion are provided in the Slope Stability Analyses section in this report.

In our opinion, the proposed reservoir can be supported on spread footings and a reinforced floor slab system underlain by a granular base course section underlain by improved ground. We anticipate overall site grading can be accomplished with conventional construction equipment. The major geotechnical considerations with construction of the planned reservoir are the moisture-sensitive nature of the soil and decomposed basalt and potential for shallow, perched groundwater. The following sections of this report provide our conclusions and recommendations for design and construction of the reservoir.

Seismic Considerations

We anticipate the new reservoir will be designed in accordance with the AWWA D110-13 standard entitled, *Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks*, and the 2012 International Building Code (IBC) with 2014 Oregon Structural Specialty Code (OSSC) modifications. The 2012 IBC evaluates seismic loading in accordance with the American Society of Civil Engineers (ASCE) 7-10 document entitled, *Minimum Design Loads for Buildings and Other Structure*.. We anticipate seismic design of the new reservoir will be completed in accordance with the 2012 IBC and ASCE 7-10 documents.

The reservoir is considered an essential facility by Oregon Revised Statute (ORS) 455.447, and GRI has completed a site-specific seismic hazard study in accordance with the 2012 IBC with 2014 OSSC modifications. The results of this study are provided in Appendix B and indicate IBC Site Class D, or a stiff soil site, is appropriate for design of the new reservoir. The IBC design methodology uses two spectral response coefficients, S_S and S_1, corresponding to periods of 0.2 and 1.0 second, to develop the MCE_R earthquake spectrum. The S_S and S_1 coefficients for the site located at the approximate latitude/longitude coordinates of 45.37° N and 122.63° W are 0.95 and 0.41 g, respectively. We recommend using the code-based F_a and F_v factors of 1.12 and 1.59, respectively, for Site Class D conditions to estimate the ground surface response spectrum. The design spectrum is based on a damping ratio of 5%. To evaluate sloshing at a damping ratio of 0.5%, the design spectrum for Site Class D can be multiplied by a factor of 1.5.

Based on preliminary evaluations, there is some risk of seismically induced soil strength loss in relatively thin zones in the decomposed basalt that have weathered to the consistency of soft soil that were encountered locally between depths of about 25 to 40 ft below the existing ground surface. In our opinion, the risk of significant post-earthquake settlement due to soil strength loss in these isolated layers is low. However, the presence of these layers presents a risk of seismic slope instability. A discussion of slope stability and alternatives to reduce the risk of instability are provided below.

The risk of damage by tsunami and/or seiche at the site is absent due to the elevation of the site. In our opinion, the risk of liquefaction-induced lateral spreading and ground deformation at the site is very low. As previously discussed, the surface trace of the Bolton Fault is about 900 ft northeast of the site. Unless occurring on a previously unmapped or unknown fault, it is our opinion the risk of ground rupture at the site is low. In our opinion, there is a risk of seismically induced localized slope instability at the site; however, we anticipate the proposed ground improvement program discussed in the following sections will be completed to reduce the risk of seismic slope instability to an acceptable level. Additional discussion of local faults and other seismic considerations is provided in Appendix C.

Slope Stability Analyses

As discussed previously, the silty and clayey soil that mantles the site is relatively stiff, and the underlying decomposed basalt typically has a consistency comparable medium stiff to hard soil. However, localized zones in the decomposed basalt have weathered to soft, silty and clayey soil between depths of about 20 to 40 ft below the ground surface. It is possible that these soft zones in the decomposed basalt could extend laterally beneath the site and present a potential risk for localized slope instability, particularly during the design-level earthquake.

Slope stability analyses were completed to evaluate the potential risk of local slope instability affecting the new reservoir. The location of the assumed critical cross section used to develop the slope stability models is shown on Figure 2 and is oriented in a general south-north direction through the center of the planned reservoir, where the side of the reservoir is closest to the slope along the north side of the site. Models were developed to evaluate slope stability for the proposed reservoir (without and with ground improvement) and the existing reservoir. The stability models developed are shown on the Slope Stability Models, Figures 6 through 9. The slope stability models were analyzed with the aid of the computer software SLOPE/W by GeoSlope International of Calgary, Alberta, Canada. The groundwater level and locations/boundaries of soil and rock units and associated physical properties used in the models are provided on the aforementioned figures. The new reservoir was assumed to have a reinforced-concrete bottom thickness of 24 in. underlain by a 3-ft-thick crushed rock base course/drainage section. A horizontal pseudo-static coefficient of 0.22 (k_h) for the design-level earthquake, which is equal to about half of the design-level PGA (required by the 2014 OSSC), was used to evaluate the seismic factor of safety values. A residual internal angle of friction of 21° and 0 psi cohesion were used to model potential soft zones that may be present in the decomposed basalt layer, based on torsional ring shear residual strength testing of a sample of soft, clayey silt obtained from within the decomposed basalt at a depth of about 35 ft in boring B-2. The results of this testing are provided in Appendix A.

For the configurations and assumptions described above, and as shown on Figures 6 through 9, a factor of safety against local slope instability for seismic conditions was first computed for potential failure surfaces that could extend laterally beneath the new and existing reservoir. The computed factor of safety against instability is defined as the ratio of the forces (or moments) tending to resist failure to the forces (or moments) tending to cause failure. Computed factors of safety less than 1.0 represent potentially unstable conditions. Based on site geometry and subsurface conditions, it is assumed the most likely mode of failure will consist of translational block-type failures. As shown on Figure 6, the results of the modeling indicate a local seismic factor of safety of 1.0 for a potential slip surface that extends through potential soft zones in the silt and decomposed basalt beneath the new reservoir. A minimum factor of safety of 1.1 against seismic slope instability is typically used for design. To improve the local seismic factor of safety, ground improvement was assumed to be completed beneath the reservoir extending to an average depth of about 20 ft below the base of the reservoir and through potential soft zones observed in the borings to the top of the harder decomposed basalt. For the purpose of analysis, it is assumed the ground improvement will likely consists of rammed aggregate piers (Geopiers or similar) with a 30% replacement ratio. The replacement ratio is the area of improved ground (aggregate piers) relative to the total area. It is further assumed the aggregate piers will have an effective stress internal angle of friction of at least 45°, resulting in the improved zone having an equivalent average effective stress internal angle of friction of 29°. As shown on Figures 7 and 8, the ground improvement zone in the model was assumed to extend 10 and 20 ft horizontally beyond the south and north side of the reservoir, respectively. As shown on Figure 7, a minimum seismic factor of safety of 1.1 against instability was computed for slip surfaces extending from south to north under the reservoir, assuming completion of ground improvement. As shown on Figure 8, the seismic factors of safety for potential slip surfaces on the sloping ground along the north side of the site that could potentially extend under the reservoir are greater than 1.5, assuming ground improvement is completed. For comparison purposes, a slope stability model for the existing reservoir was also developed and is shown on Figure 9. The minimum seismic factor of safety against instability computed for a potential slip surface extending south to north under the existing reservoir is about 0.7 and is notably lower than for the planned reservoir constructed either without or with ground improvement. The primary reasons the new reservoir has a greater factor of safety than the existing reservoir, even without ground improvement, are the new reservoir will be set back a greater distance from the slope along the north side of the site, the drainage layers beneath and around the new reservoir will maintain a lower local groundwater level, and there will be an overall net decrease in gravity loads since the new reservoir will replace a significant amount of heavier excavated soil.

The results of our stability analysis indicate ground improvement will be necessary beneath the new reservoir to achieve a satisfactory seismic factor of safety against local instability that could affect the new reservoir. A discussion of recommended ground improvement is provided in the next section. Additionally, the top of the slope along the north side of the site should be flattened as much as practical by removal of soil. The planned flattening of the top of the slope along the north side of the site will lower the soil loads and improve the overall stability of the sloping ground north of the reservoir and, consequently, will reduce the risk of relatively shallow failures like those that occurred at the northeast corner of the site in the 1970s and in 1996. We recommend the subsurface drains under and around the reservoir, and surface drainage, be collected and discharged to an appropriate off-site location.

In our opinion, the measures discussed above will provide a satisfactory factor of safety against local instability affecting the new reservoir, but will not mitigate potential movements of the ancient large slide mass. Due to the large size of the landslide and potential deep failure surfaces, mitigation measures to improve the stability of the large landslide mass are likely not practical or cost effective. As discussed previously, obvious indications of recent movement of the large landslide mass were not observed during site reconnaissances completed by GRI and Cornforth Consultants, nor have there been reports of potential movements of the large landslide. Based on the available information, the risk of significant movement of the large landslide within the design life of the reservoir is expected to be low and would most likely occur during/following a large seismic event. It is expected that if movement of the large landslide mass occurs, the ground supporting the reservoir will tend to “raft” along with the greater landslide mass and the risk of significant differential movements beneath the reservoir will be reduced. In addition, the proposed ground improvement will strengthen the ground beneath the reservoir, which will further reduce the risk of significant differential movements.

Ground Improvement

As discussed in the previous section, ground improvement will be required beneath the new reservoir to improve seismic slope stability and limit static differential settlement. We anticipate the ground improvement will need to extend to depths of about 20 to 25 ft beneath the base of the new reservoir and through potential soft zones in the decomposed basalt to the top of harder basalt. Based on the subsurface conditions, site constraints, and cost, we anticipate rammed aggregate piers (RAP) or similar ground improvement methods would be a practical alternative for this project. The RAPs provide a dense/stiff vertical element with significant shearing resistance and will effectively increase the shear resistance within the zone that is being treated. RAPs also attract vertical loads from the overlying structure and distributes the load to the denser and stiffer layers beneath, thereby reducing total and differential settlement, which is an important consideration for large concrete water reservoirs. RAPs can also significantly reduce the risk of potential liquefaction-induced settlement by strengthening the zone being treated; however, the risk of liquefaction at this site is considered low.

RAPs are typically constructed by augering a shaft, typically 30 in. in diameter, to the bottom of the zone requiring improvement and backfilling the shaft with aggregate (crushed rock) that is compacted with a tamping ram in approximate 1-ft-thick lifts. RAPs are typically constructed using large hydraulic excavators equipped with augers and tampers. Augered RAP installation is generally limited to depths of 20 to 25 ft. An alternative method for RAP construction is installation using a hollow mandrel that is vibrated to the required depth instead of augered. Following insertion to the required depth, the mandrel is retracted as aggregate is placed in the bottom of the hole through the center of the mandrel. The mandrel is typically raised about 3 ft as the aggregate is placed and then driven back down about 2 ft to form a 1-ft-thick layer of compacted aggregate. Vibrated RAP methods can be used to construct RAPs to depths of up to 40 ft if conditions are favorable. Advantages of the vibratory RAP method are reduced spoils generation and it can be used in soft or loose soils below groundwater that may cave without casing.

To achieve the minimum required local seismic factor of safety, we recommend a minimum replacement ratio of about 30% (the ratio is the area of aggregate piers relative to the total area) using RAPs or comparable methods of ground improvement. For preliminary design purposes, it would be reasonable to assume the ground improvement footprint will be essentially square and need to extend at least 10 ft beyond the south half of the reservoir and 20 ft beyond the north half of the reservoir. The north side of the square treatment area should be parallel to the face of the slope north of the reservoir, which may require greater amounts of excavation than needed to construct the reservoir. It may be possible to limit the amount of excavation in the corner areas of the treatment area by using vibratory RAPs installed at or near existing grade. To provide adequate support for the RAP installation equipment and minimize the risk of subgrade disturbance, we recommend placing a minimum 18-in.-thick working blanket of compacted crushed rock over the reservoir subgrade. A greater thickness of crushed rock may be required if the subgrade is particularly soft. In this regard, the subgrade conditions should be evaluated by GRI before placing the working blanket. It is expected the working blanket will remain as part of the base course section beneath the reservoir. Recommendations for base course are discuss in the Foundation Support, Settlement, and Subdrainage section of this report.

As discussed above, construction of the RAPs using either a tamping foot or a vibrating mandrel to compact the aggregate backfill will result in ground vibrations. Based on our experience with similar projects that included RAP installation, vibrations from construction of RAPs typically decrease significantly over relatively short distances. Based on previous experience we do not anticipate adjacent residences will be subjected to vibrations in excess of currently acceptable construction levels. However, in our opinion, it would be prudent to install vibration instrumentation along the property lines of the site to monitor potential vibrations from construction equipment. Modifications can be made to construction procedures to reduce excessive vibrations, if necessary. Pre- and post-surveys of adjacent structures/residences should also be completed as part of the vibration monitoring program.

Site Preparation

Vegetation, roots, and other deleterious materials will not be suitable for use as structural fill; therefore, it will be necessary to remove surface organics prior to excavating soils that will be used later for structural fill. The ground surface in areas to receive new fills should also be stripped. Strippings may be used for landscaping purposes or should be removed from the site. We anticipate stripping to a depth of about 3 to 4 in. will be required in areas of lawn. Deeper stripping and grubbing will be required to remove brush and tree stumps where present. With the exception of backfilling around the new reservoir, we anticipate most soil that is excavated to complete the project will be removed from the site. However, stripped areas to receive structural fill should be evaluated by a qualified geotechnical engineer. Excavation spoils should not be stockpiled during construction within 75 ft of the slope along the north side of the site. The planned locations of soil stockpiles should be evaluated by GRI.

All concrete, piping, and other structural elements associated with the existing reservoir should be removed within the footprint of the new reservoir. Soft, loose, or otherwise unsuitable materials beneath the existing reservoir and within the footprint of the new reservoir should also be removed.

The fine-grained soils and decomposed basalt that mantle the site are sensitive to moisture content and are easily disturbed and softened by construction activity during wet conditions. In Addition, groundwater and site drainage, which are important for maintaining satisfactory slope stability during construction, will be more straightforward to manage during dry conditions. Therefore, we recommend as much site preparation and earthwork as practical be accomplished during the dry, summer months. It has been our experience that the moisture content of the upper approximate 2 to 3 ft of the silt will decrease during warm, dry weather. However, the moisture content of the soil below this depth tends to remain relatively unchanged and well above the optimum moisture content for compaction. As a result, the contractor must employ working procedures that prevent disturbance and softening of the subgrade soils. For this reason, excavation within the final 2 to 3 ft of subgrades should be accomplished with a trackhoe equipped with a smooth-edge bucket. It may be necessary to construct granular haul roads and work pads to provide access during wet conditions to minimize subgrade disturbance during construction. In general, a minimum 18- to 24-in. thickness of relatively clean, fragmental rock having a nominal maximum size of 4 to 6 in. would be required to support heavy construction traffic and protect the silt subgrade during wet ground conditions. If the subgrade is particularly soft, it may be prudent to place a geotextile fabric (AMOCO 2002, or equivalent) on the subgrade as a separation membrane prior to placing and compacting the granular work pad.

Excavation

General. Construction of the new reservoir will require an excavation of about 30 ft below existing site grades. The finished floor of the reservoir will be at about elevation 425 ft, and the bottom of the excavation will be at least 3 ft lower to accommodate the granular base course and subdrainage section. We anticipate the soils within the zone of excavation can be readily excavated with conventional excavation equipment, such as a large hydraulic trackhoe. The finished subgrade should be completed with a smooth-edge bucket as previously discussed. We anticipate significant portions of the reservoir will be established in the underlying predominantly decomposed to decomposed basalt. The borings made for this investigation indicate the basalt within the planned depth of excavation has a relative consistency comparable to medium stiff to stiff, fine-grained soil. Although not encountered in the borings, it is possible that zones of harder basalt and/or cobble- to boulder-size pieces of relatively hard basalt could be present within the depth of the excavation. The contractor should have means and methods available to accommodate excavation of potentially harder rock.

Cut Slopes. We recommend the temporary cut slopes made to construct the reservoir be no steeper than 1H:1V. However, flatter slopes maybe necessary to maintain an acceptable level of stability depending on the actual conditions exposed during construction, particularly in locations of groundwater seepage, if encountered in excavations. In this regard, temporary excavation slopes should be evaluated by a qualified geotechnical engineer at the time of construction.

Temporary slopes should be covered with plastic sheeting to reduce erosion during wet weather. In addition, excavation spoils and construction materials should not be stockpiled within 15 ft of the top of the temporary cut slope. The temporary excavation slopes should be evaluated on a daily basis by a knowledgeable person for obvious indications of slope instability such as sloughing, slumping, or ground cracks. Any indications of instability should be reported promptly to GRI for our evaluation. To minimize the risk of instability of temporary cut slopes, we recommend backfilling the reservoir excavation as soon as practical.

Depending on the time of year, perched groundwater may be present within the depth of excavation required to construct the reservoir. We anticipate that seepage, if encountered, can be controlled by pumping from sumps. A ditch should be installed at the top of the cut slopes to direct surface runoff away from the excavation. Water removed from the excavation should not be discharged on or near the top of the slope on the north site.

If temporary excavation slopes extend below the groundwater table or perched groundwater, a 6- to 12-in.-thick layer of relatively clean, well-graded crushed rock placed on the slopes may be required to reduce the risk of running soil conditions.

Permanent cut slopes following final grading, if present, should be no steeper than 2H:1V. Flatter cut slopes may be required if soft and/or wet ground conditions are encountered, which may also require installation of drainage. Permanent excavation slopes should be evaluated by a qualified geotechnical engineer at the time of construction so modifications can be made if necessary.

Temporary Shoring

As discussed previously, the side slopes of the excavation for the reservoir will be sloped at up to 1H:1V where space allows. However, we anticipate a shoring system constructed top-down, such as a tied-back soldier pile wall or possibly a soil-nail wall, may be necessary to retain the sides of the temporary excavation next to the existing pump station southeast of the planned reservoir and along the west side of the reservoir footprint near the properly line. The shoring could have a retained height of up to 30 ft. GRI can provide more detailed design and construction criteria for practical types of top-down shoring once detailed grading plans become available.

Structural Fill

As currently planned, backfill will be placed to within about 5 to 10 ft of the top of the reservoir. It is anticipated the backfill will consist of soil and/or decomposed basalt removed from excavations made during construction. With the exception of the tank backfill, no other significant fills are planned.

Excluding the surface strippings, excavation spoils approved by the geotechnical engineer may be used to backfill the reservoir. However, the fine-grained and decomposed basalt excavation spoils will be sensitive to moisture content and can only be placed and compacted during dry weather. Our investigation indicates the natural moisture content of the excavated materials will typically be in the range from 35 to 50%. In this regard, we anticipate the excavation spoils will require significant moisture conditioning and frequent field evaluations to confirm the material is being adequately compacted. If wet conditions prevent proper moisture conditioning of the excavation spoils, material used to construct structural backfills should consist of relatively clean, granular materials, such as sand, sandy gravel, or crushed rock. The maximum particle size of granular material placed against structures should be limited to not more than 1½ in. in diameter unless approved by the designer. A drainage blanket should be placed between common backfill and the side of embedded structures as discussed in the Lateral and Vertical Earth Pressures section of this report.

The structural backfill should be placed in horizontal lifts and compacted to at least 95% of the maximum dry density as determined by ASTM D 698 (standard Proctor). Fill placed within 5 ft of the reservoir should be compacted to 93 to 95% of the maximum dry density as determined by ASTM D 698 (standard Proctor) with small, light-weight compactors to avoid overcompaction and prevent the development of excessive lateral pressures. Appropriate lift thickness will depend on the type of compaction equipment used and the type of material being placed. For hand-operated or small compactors, we recommend a maximum loose lift thickness of 8 in. For moderate- to heavy-weight compactors, we recommend a maximum loose lift thickness of 12 in.

Finished fill slopes can be slightly overbuilt and then trimmed back to final grade using a trackhoe with a smooth-edge bucket. A qualified geotechnical engineer should review the proposed placement of any fill and evaluate the subgrade prior to fill placement. The proposed compaction equipment should be reviewed by the design team prior to fill placement to evaluate loads on embedded walls.

Landscape fill should be compacted to at least 90% of the maximum dry density as determined by ASTM D 698. The moisture content of soils placed in landscaped areas is generally not critical, provided construction equipment can effectively handle the material. Landscape fill should be no steeper than 3H:1V.

Foundation Support, Settlement, and Subdrainage

Based on information provided by PSE, the new reservoir foundation will consist of a 24-in.-thick, reinforced mat slab. In our opinion, a mat slab is a suitable foundation system for accommodating potential deformations that may occur as a result of the design-level seismic event. The reservoir was preliminary designed to consist of a 9-in.-thick roof slab supported by a 24-in.-diameter, reinforced concrete interior columns placed on a 20.5-ft center-to-center spacing that are cast directly into the mat slab (i.e., no spread footings on the top of the mat slab). The 12-in.-thick reservoir wall will also be cast directly into the mat slab. The maximum service (unfactored) loads are 90 kips for columns and 5.1 kips/ft for the wall, which do not include the weight of the water. A full reservoir of water will impose a uniform pressure of approximately 1,600 psf across the mat slab. Real bearing pressures of about 4,500 to 5,000 psf are estimated beneath the mat slab near column and wall locations for a full reservoir of water as the reservoir is currently configured.

To provide adequate support for the mat slab and assumed loading, we recommend the mat slab be underlain by a minimum 3-ft thickness of compacted crushed rock placed directly over the RAPs. The minimum 18-in.-thick working blanket placed for support of the RAP installation equipment can be considered part of the required base course section. However, it should be expected that the upper portion of the working blanket will be contaminated with soil and need to be removed. The amount of removal should be evaluated by the geotechnical engineer following RAP construction. Following removal, we recommend placing a subgrade geotextile prior to placing of remaining general granular base course and/or the assumed 2-ft-thick granular drainage layer discussed below.

General granular base course placed beneath the reservoir, including the RAP working blanket up to the bottom of the drainage layer, should consist of well-graded crushed rock with a maximum particle size of up to 1 1/2-in. meeting the requirements for Dense-Graded Aggregate as specified in Section 02630.10 of the Oregon Department of Transportation (ODOT) 2008 Standard Specifications for Highway Construction. The well-graded crushed rock should only be placed on firm, undisturbed subgrade that has been evaluated by a qualified geotechnical engineer. Soft or otherwise unsuitable materials that are identified at subgrade elevation should be overexcavated and replaced with granular structural fill. Other types of general granular material proposed by the contractor may be used with the approval of the design team. Materials used to construct drainage blankets should consist of open-graded, angular crushed rock with a maximum size of up to 1 1/2 in., with not more than about 2% passing the No. 200 sieve (washed analysis). Crushed rock of 3/4- to 1 1/2-in. gradation (drain rock) is commonly available and is suitable for this purpose. Open-graded rock (drain rock) placed on silty soil (where present) should be separated by a non-woven geotextile, such as Mirafi 140N or similar. All crushed rock placed beneath the reservoir should be compacted as structural fill using vibratory compaction equipment. The relative density of the well-graded compacted crushed rock should be at least 95% of the maximum dry density as determined by ASTM D 698 (standard Proctor). To protect the native subgrade soil, the initial lift of crushed rock base should be at least 12 in. thick. The drain rock cannot be density tested, but should be compacted until well keyed. The base course section (general granular base course plus drainage layer) should extend horizontally at least one-half the total thickness of the crushed rock section beyond the limits of the perimeter footing, or 1½ ft for a 3-ft thickness of crushed rock.

RAP systems are typically designed by the RAP contractor to meet performance criteria developed by the reservoir designer. Based on similar reservoir projects with similar subsurface conditions, we anticipate RAPs installed to the harder decomposed basalt at depth of about 20 to 25 ft below the reservoir will limit total settlements (static condition) of the reservoir to about ¾ to 1¼ in. when full of water and about one-half to two-thirds this amount near the edge of the reservoir, depending somewhat on the amount of fill placed on the sides of the reservoir. Further, we anticipate it should be feasible to limit differential settlements occurring between the edges of footings to a point on the floor slab halfway between any adjacent footings to a range of about ¼ to ½ in. We do not anticipate any significant deformations will occur in the RAP-treated zone following the design-level earthquake.

For a subgrade prepared as discussed above and with the RAP-treated zone beneath the reservoir, we anticipate the mat slab for the reservoir can be designed to impose an allowable soil bearing pressure of up to 5,000 psf to limit settlements to the range of values discussed previously. We assume the 5,000 psf allowable bearing pressure will be used as performance criteria for the RAPs. This value applies to the total of dead load plus frequently and/or permanently applied live loads and can be increased by one-third for the total of all loads; dead, live, and wind or seismic. The allowable bearing pressure(s) and estimated settlements will need to be verified during design by the RAP designer

To address the actual deformation of the floor slab, we recommend analyzing the floor slab as a plate on an elastic foundation using a coefficient of subgrade reaction, k, of 100 pci. This value assumes the floor slab will be underlain by the aforementioned base course section above the RAP zone.

As discussed previously, the sides of the reservoir will be backfilled. Figure 2 indicates the backfill will extend up to about elevation 442 and 445 ft (17 to 20 ft thick) on the north and south side of the reservoir, respectively. We estimate these fills could induce up to ¾ to 1 in. of settlement around the perimeter of the reservoir and should occur relatively quickly as the fill is placed. In our opinion, placement of the fill around the reservoir will not induce significant downdrag loads on the walls of the reservoir or settlement under the edge of the reservoir, assuming RAPs are installed beyond the edge of the reservoir as discussed previously.

Lateral loads (seismic, soil, etc.) can be resisted partially or completely by frictional forces developed between the base of the mat foundation and underlying crushed rock. The total frictional resistance between the mat slab and the underlying material is the normal force times the coefficient of friction between the crushed rock and the base of the reservoir. We recommend a value of 0.45 for the coefficient of friction between mass concrete cast directly on angular, granular structural fill. If a synthetic membrane, such as HDPE, is placed between the concrete and the underlying crushed rock, we recommend using a coefficient of friction of 0.30. If additional lateral resistance is required, passive earth pressures against embedded foundations and the reservoir walls can be computed on the basis of an equivalent fluid having a unit weight of 225 pcf for limiting lateral deflections to ¼ to ½ in. and 300 pcf for larger deflections. These design passive earth pressures values would be applicable only if the backfill for the foundations or walls is placed as compacted structural fill where the backfill is horizontal. In areas where the backfill is sloped downward at 2H:1V these values should be reduced to about half. The coefficient of friction values provided above are also applicable for the frictional interaction of backfill soils against walls.

We anticipate perched groundwater could approach the ground surface and the bottom of the floor slab during periods of prolonged precipitation common from late fall through early spring. To limit hydrostatic forces on walls due to high groundwater and provide drainage for potential leakage through the reservoir floor slab, we recommend installing subdrainage beneath the floor slab of the new reservoir. We anticipate the reservoir will be underlain by a minimum 2-ft-thick layer of aforementioned open-graded crushed rock (drain rock) that will include 6-in.-diameter PVC drain pipes installed radially from the center of the reservoir in the lower part of the drainage layer outward to collection pipes at the perimeter of the reservoir. We recommend the radial drain pipes be spaced no greater than about 40 ft apart at the perimeter of the reservoir. The subdrainage section can be considered part of the recommended minimum 3-ft thickness of compacted crushed rock base course beneath the reservoir. The top 2 to 3 in. of the open-graded rock can be substituted with relatively clean 3/4-in.-minus crushed rock to facilitate leveling and placement of concrete.

Lateral Earth Pressures for Reservoir and Vaults

As discussed previously, the walls of the reservoir will be backfilled to within about 5 to 10 ft of the top of the reservoir. In addition, a valve vault embedded about 10 ft below site grades will also be constructed to service the new reservoir. Drainage will be provided on the sides and bottom of the reservoir to limit the risk of hydrostatic conditions from developing. We anticipate drainage will also be provided around valve vault. Lateral earth pressure and drainage recommendations for design of the reservoir and vault are provided below.

Design lateral earth pressures on embedded walls depend on the backfill geometry, drainage condition behind the wall, and the ability of the wall to yield by either translation or rotation away from the backfill. The two possible conditions regarding the ability of a wall to yield include the at-rest and the active earth pressure cases. The at-rest earth pressure case is applicable to a wall that is considered to be relatively rigid and unable to yield. The active earth pressure case is applicable to a wall that is capable of yielding slightly away from the backfill by either sliding or rotating about its base. A conventional cantilevered retaining wall is an example of a wall that develops the active earth pressure case by yielding. The walls of the new reservoir and valve vault will be braced at the top and bottom by the roof and floor and should be considered to be non-yielding. Yielding and non-yielding walls can be designed on the basis of a hydrostatic pressure based on an equivalent fluid having a unit weight of 35 and 55 pcf, respectively. In addition, it is assumed the backfill is fully drained and the surface of backfill is flat behind the wall.

We recommend using a distribution of 15 pcf to account for seismic earth pressures, with the resultant applied at 1/3H from the base of the structure, where H is the overall height of the soil retained. The seismic pressure should be added to the static earth pressures. Horizontal pressures due to surcharge loads, such as wheel loads associated with traffic on the backfill behind the walls, can be estimated using the guidelines provided on Figure 10. Transient surcharge loads, such as wheel loads, do not need to be included in the seismic loading case.

The backfill behind embedded walls must be fully drained for use of the aforementioned equivalent fluid values. The drainage system should consist of a minimum 2-ft-wide zone of free-draining granular fill adjacent to the embedded walls. The granular material used for the drainage layer behind embedded walls should conform to our previous recommendations for free-draining structural fill material. A 4- to 6-in.-diameter, rigid, perforated drain pipe should be provided near the bottom of the embedded wall. A non-woven geotextile, such as Mirafi 140N (or similar), is recommended between the free-draining backfill and the general wall backfill to reduce the risk of contamination of the wall drain system. Recommendations regarding placement of backfill behind embedded walls are provided in the Structural Fill section of this report.

Utilities

The project will include replacing the existing 18-in.-diameter inlet/outlet line in Skyline Circle with a 24-in.-diameter line and the existing 8-in.-diameter PVC main north of the reservoir with an 8-in.-diameter ductile iron line. A new overflow line will also be constructed and extend northward from the north side of the reservoir down the slope north of the site; the discharge location has not yet been determined. We anticipate subsurface drainage from the reservoir will likely be conveyed in piping to a point downslope of the reservoir.

We anticipate the maximum depth of trenches for installation of the piping will be 4 to 6 ft below the finished ground surface except where it connects to the new reservoir. Depending on the time of year, groundwater seepage could be encountered in utility excavations, which could create the potential for running soil conditions and unstable trench sidewalls. All excavation sidewalls should be properly sloped or shored to conform to applicable local, state, or federal regulations. Some overexcavation of the trench bottom may also be necessary to permit installation of stabilization/drainage material if wet ground conditions are encountered. To provide a relatively dry working base and facilitate dewatering, a drainage/stabilization layer consisting of a 12- to 18-in. thickness of open-graded crushed rock (drain rock) containing less than 2% passing the No. 200 sieve (washed analysis) may be appropriate. However, the need for a stabilization layer should be evaluated based on actual conditions. We anticipate that seepage, where encountered, can be controlled by pumping from sumps in the trench excavation.

Utility trenches beneath or near pavement, the reservoir foundation, sidewalks, slabs, other structures, should be backfilled with well-graded crushed rock with a maximum particle size of up to $1^1/_2$-in. and meeting the requirements for Dense-Graded Aggregate as specified in Section 02630.10 of the ODOT 2008 Standard Specifications for Highway Construction. The crushed rock backfill should be compacted to at least 95% of the maximum dry density as determined by ASTM D 698 in the upper 4 ft of the trench and at least 92% of this density below this depth. The use of trackhoe-mounted vibratory plate compactors is usually most efficient for compaction of trench backfill. Lift thicknesses should be evaluated on the basis of field density tests; however, particular care should be taken when operating hoe-mounted compactors to prevent damage to the newly placed utilities. Flooding or jetting to compact the trench backfill should not be permitted.

Due to slope stability considerations, the backfill placed in utility trenches on the sloping ground north of the reservoir should be compacted to at least 92% maximum dry density as determined by ASTM D 698. In addition, it would also be prudent to install a 4-in.-diameter perforated drain pipe in the granular pipe bedding to collect any groundwater that may be intercepted during wet conditions. The perforated drain pipes should be discharged into a stormwater system and not discharge directly onto the slope.

Utility pipes should be underlain by a minimum 6-in. thickness of good-quality bedding material. We recommend the bedding material and any pipe zone backfill consist of relatively clean, granular material such as 3/4- or 1-in.-minus crushed rock. Material conforming to ODOT specifications for dense-graded aggregate would be suitable for this purpose. The bottom of the excavation should be thoroughly cleaned to remove loose materials before installing the bedding material.

Design Review and Construction Services

We welcome the opportunity to review and discuss construction plans and specifications for this project as they are being developed. In addition, GRI should be retained to review all geotechnical-related portions of the plans and specifications to evaluate whether they are in conformance with the recommendations provided in our report. In addition, to observe compliance with the intent of our recommendations, design concepts, and the plans and specifications, we are of the opinion that all construction operations dealing with earthwork and foundations should be observed by a GRI representative. Our construction-phase services will allow for timely design changes if site conditions are encountered that are different from those described in this report. If we do not have the opportunity to confirm our interpretations, assumptions, and analyses during construction, we cannot be responsible for the application of our recommendations to subsurface conditions that are different from those described in this report.

Submitted for GRI,

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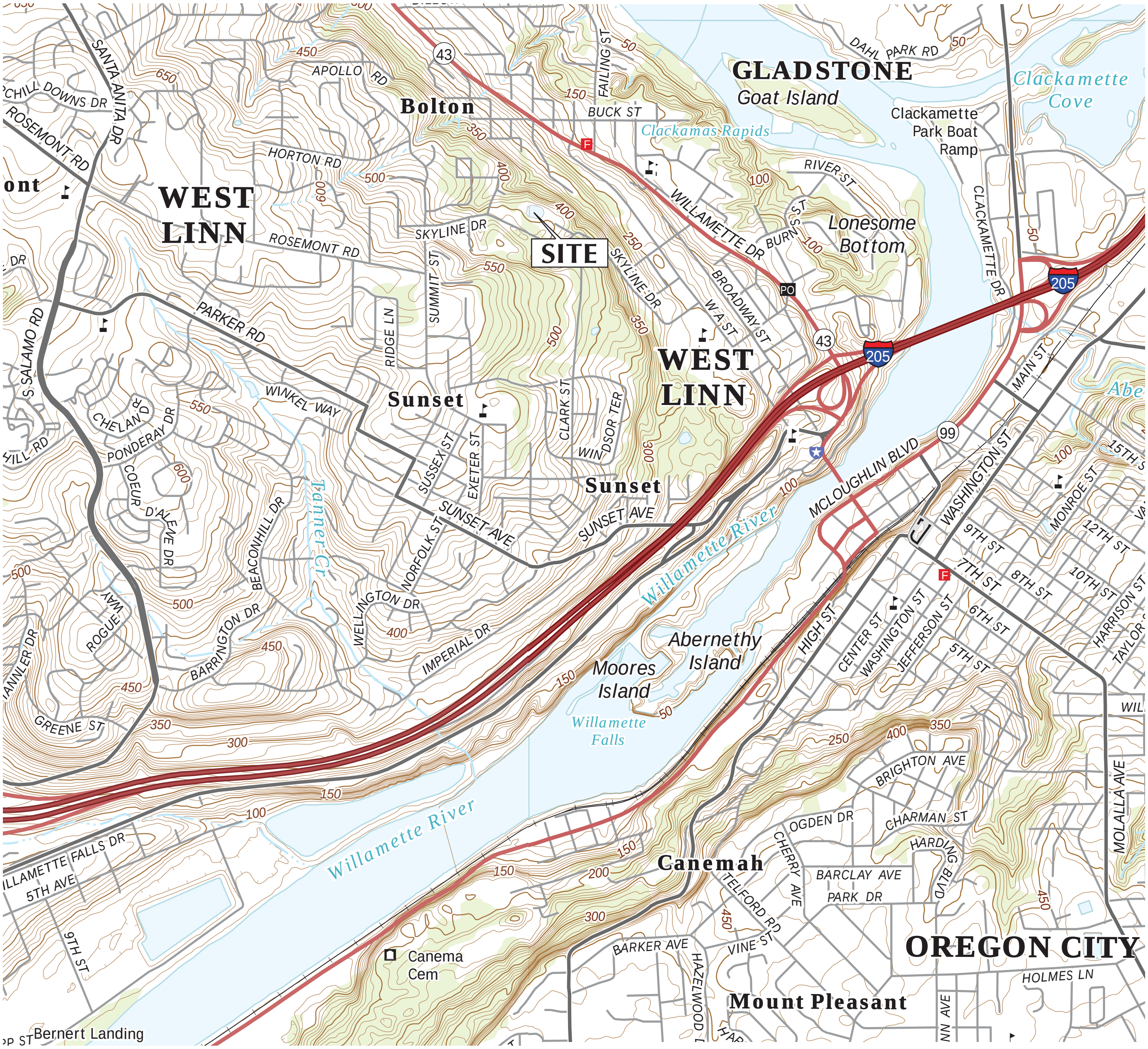
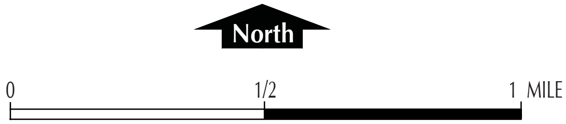


USGS TOPOGRAPHIC MAP
OREGON CITY, OREG. (2014)



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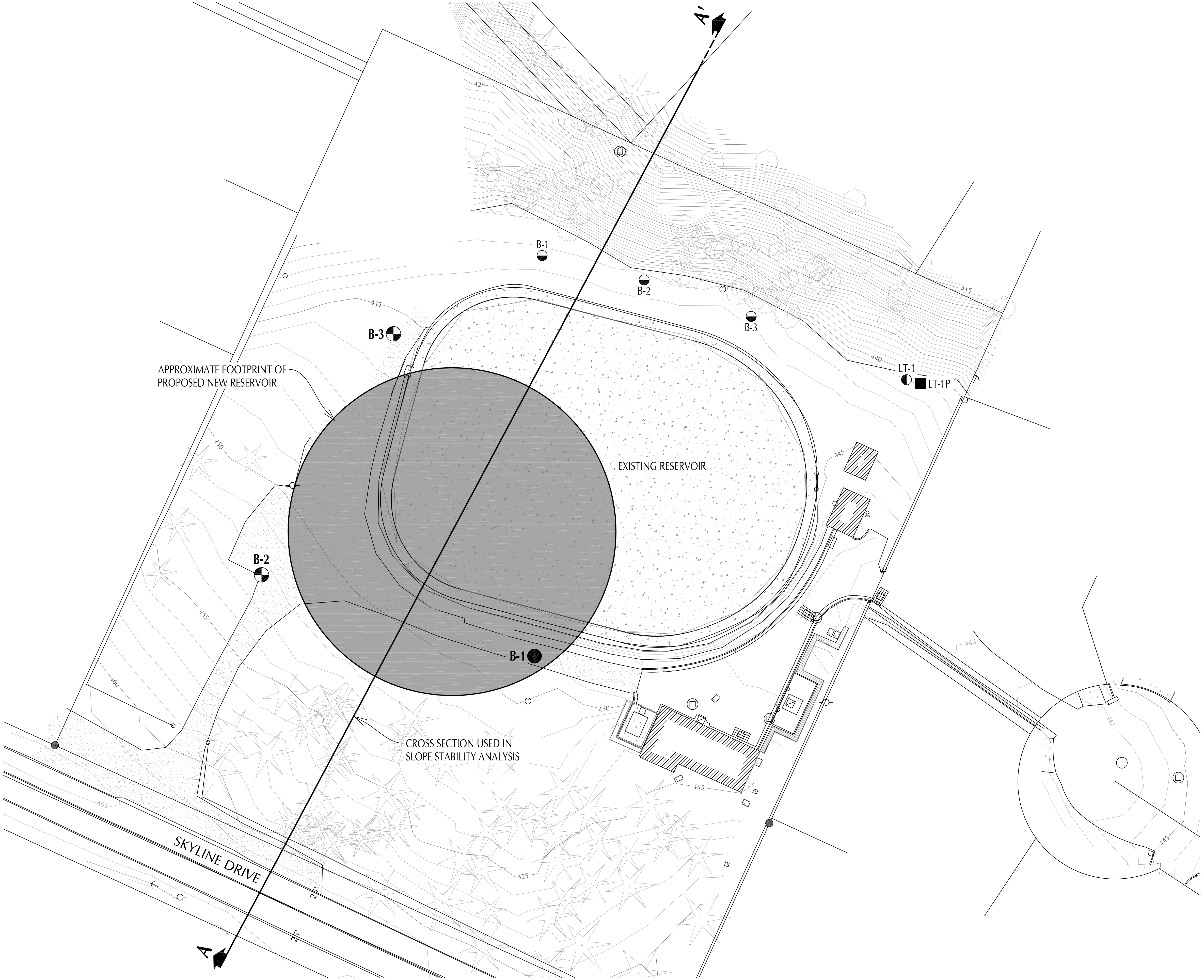
BOLTON RESERVOIR

VICINITY MAP

JAN. 2015 | JOB NO. 5338-A | FIG. 1



⊕ BORING MADE BY GRI
(NOVEMBER 27 - 29, 2014)

● BORING MADE BY GRI
(JUNE 15, 2012)

◐ BORING AND INCLINOMETER MADE / INSTALLED BY
LANDSLIDE TECHNOLOGY
(1997)

■ STANDPIPE INSTALLED BY LANDSLIDE TECHNOLOGY
(1997)

◒ BORING MADE BY NORTHWEST TESTING LABORATORIES
(1972)

ELEVATION DATUM NAVD 88

SITE PLAN FROM FILE BY MURRAY, SMITH & ASSOCIATES, INC.

North

0 50 100 FT

GRI

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BOLTON RESERVOIR

SITE PLAN

JAN. 2015 JOB NO. 5338-A FIG. 2

SITE MAP FROM AERIAL PHOTO BY BING IMAGE (UNDATED)

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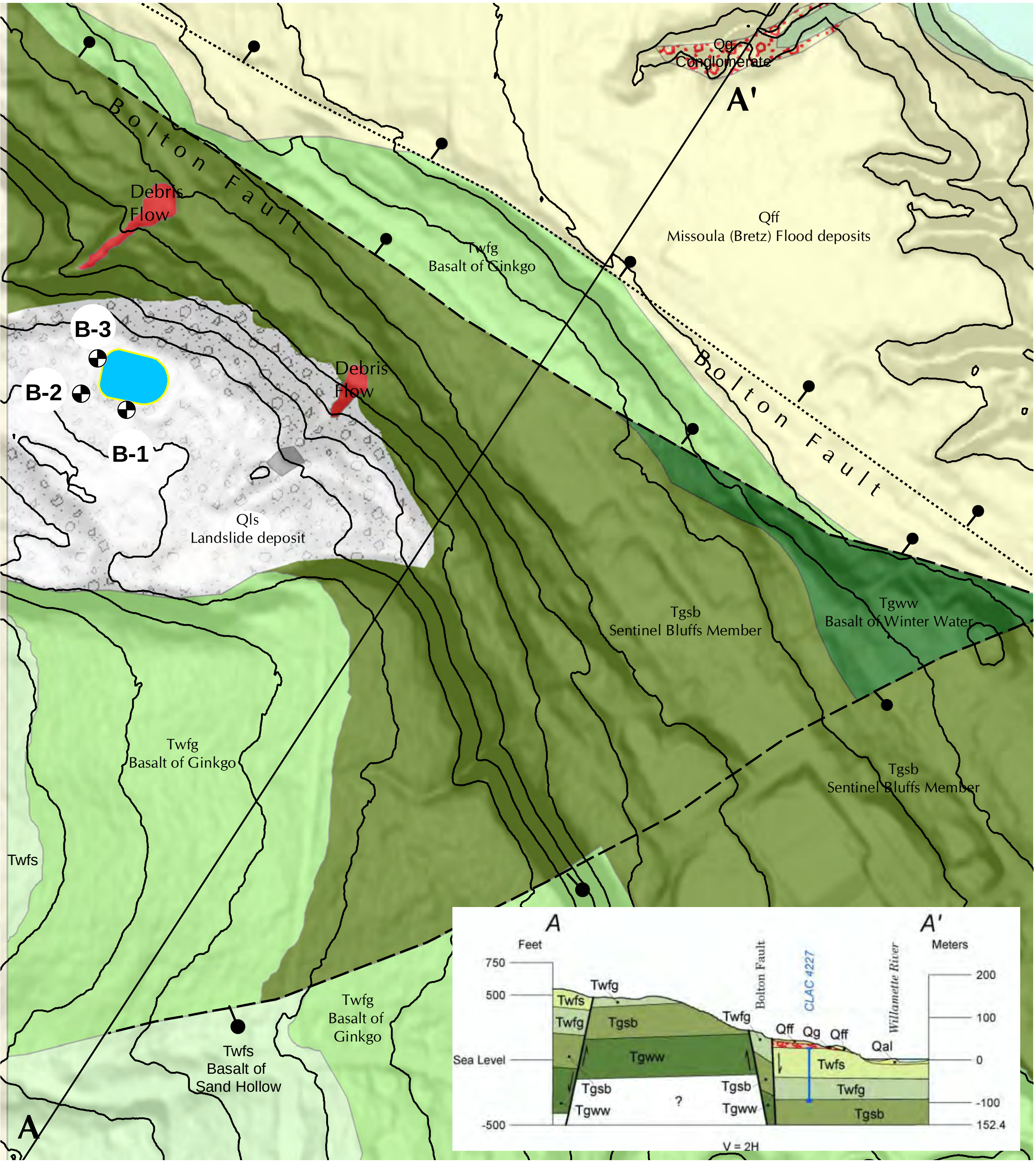
BOLTON RESERVOIR

SITE MAP

JAN. 2015 JOB NO. 5338-A FIG. 3



C:\Data\5338-Bolton\5338_Bolton_Fig4.mxd

Source Madin (2009)

◐ Borings by GRI (2012, 2014)

🟦 Bolton Reservoir

North

0 300 600 Ft

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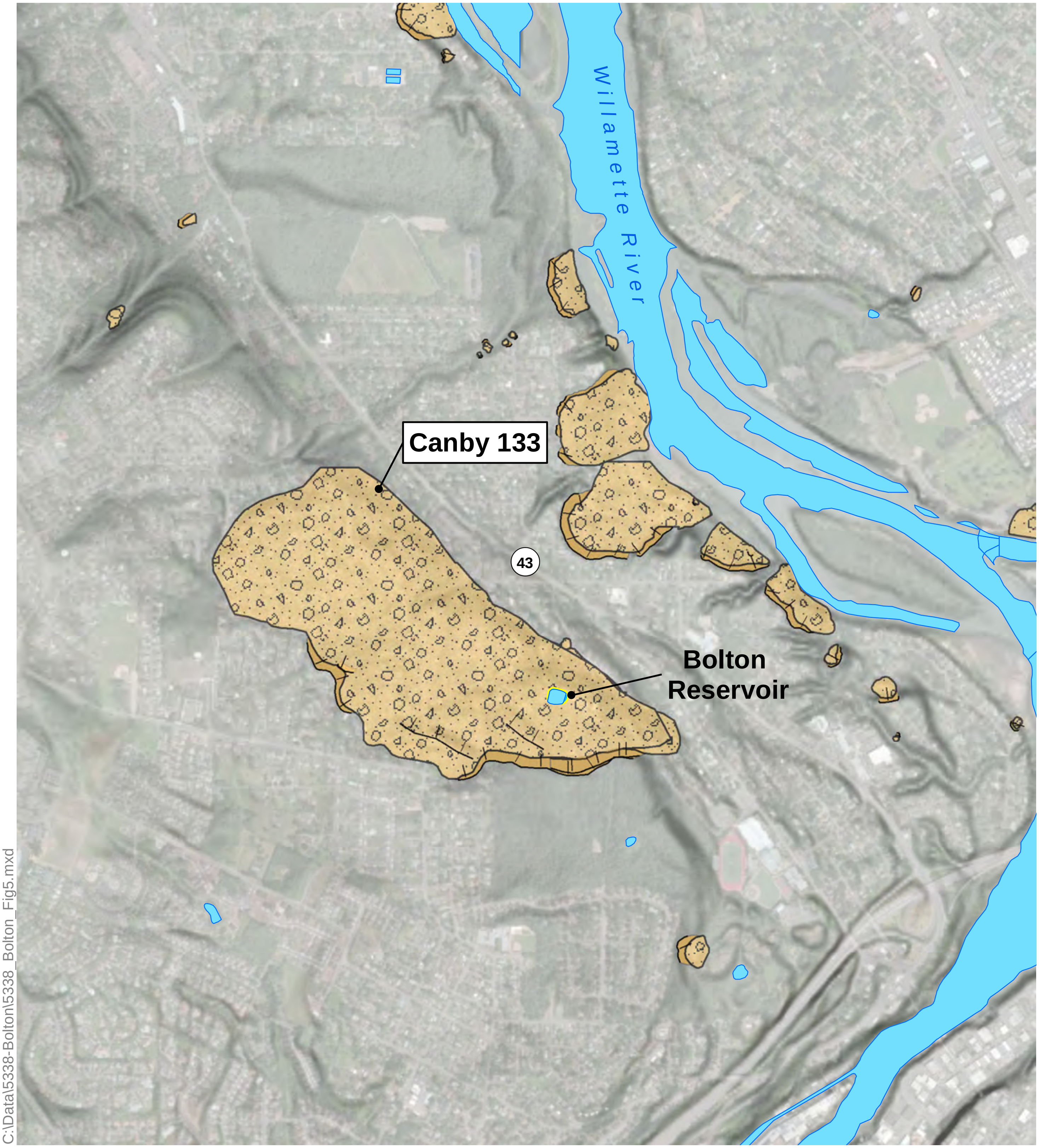
BOLTON RESERVOIR

GEOLOGIC MAP AND CROSS SECTION

JAN. 2015 JOB NO. 5338-A FIG.4



C:\Data\5338-Bolton\5338_Bolton_Fig5.mxd

- 🟦 Bolton Reservoir
- ┬ Landslide Headscarp
- ▨ Landslide Deposit
- 🟫 Landslide Scarp Flank

North

0 1,000 2,000 Ft

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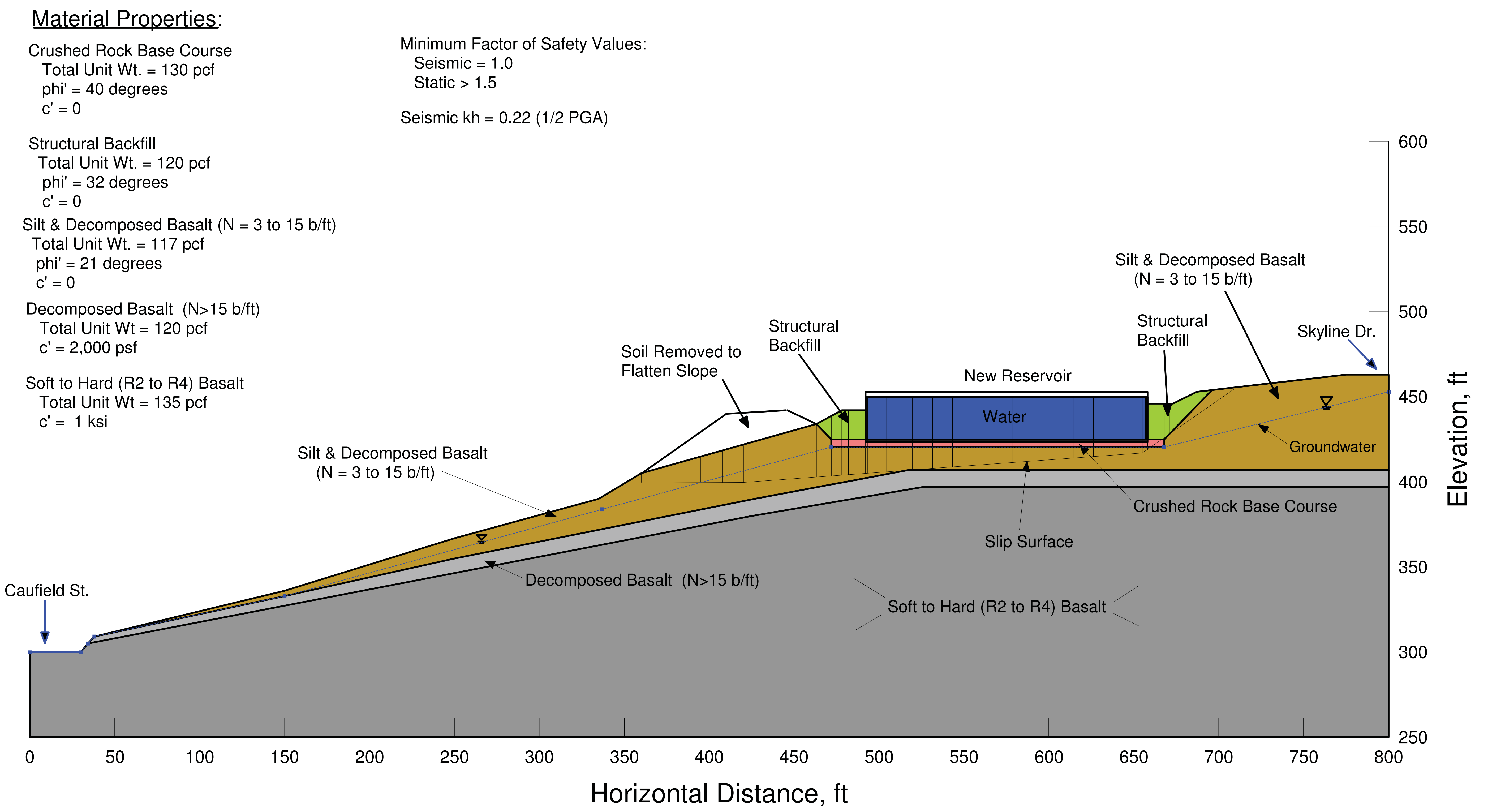
BOLTON RESERVOIR

STATEWIDE LANDSLIDE INFORMATION DATABASE OF OREGON VERSION 3 (SLIDO 3.2) 2014

JAN. 2015 JOB NO. 5338-A FIG.5



Material Properties:

Crushed Rock Base Course
Total Unit Wt. = 130 pcf
phi' = 40 degrees
c' = 0

Structural Backfill
Total Unit Wt. = 120 pcf
phi' = 32 degrees
c' = 0

Silt & Decomposed Basalt (N = 3 to 15 b/ft)
Total Unit Wt. = 117 pcf
phi' = 21 degrees
c' = 0

Decomposed Basalt (N>15 b/ft)
Total Unit Wt = 120 pcf
c' = 2,000 psf

Soft to Hard (R2 to R4) Basalt
Total Unit Wt = 135 pcf
c' = 1 ksi

Minimum Factor of Safety Values:
Seismic = 1.0
Static > 1.5

Seismic kh = 0.22 (1/2 PGA)

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BOLTON RESERVOIR

SLOPE STABILITY MODEL

(NEW RESERVOIR WITHOUT GROUND IMPROVEMENT)

JAN. 2015 JOB NO. 5338-A FIG. 6

Material Properties:

Crushed Rock Base Course
Total Unit Wt. = 130 pcf
phi' = 40 degrees
c' = 0

Structural Backfill
Total Unit Wt. = 120 pcf
phi' = 32 degrees
c' = 0

Improved Ground
Total Unit Wt. = 122 pcf
phi' = 29 degrees
c' = 0

Silt & Decomposed Basalt (N = 3 to 15 b/ft)
Total Unit Wt. = 117 pcf
phi' = 21 degrees
c' = 0

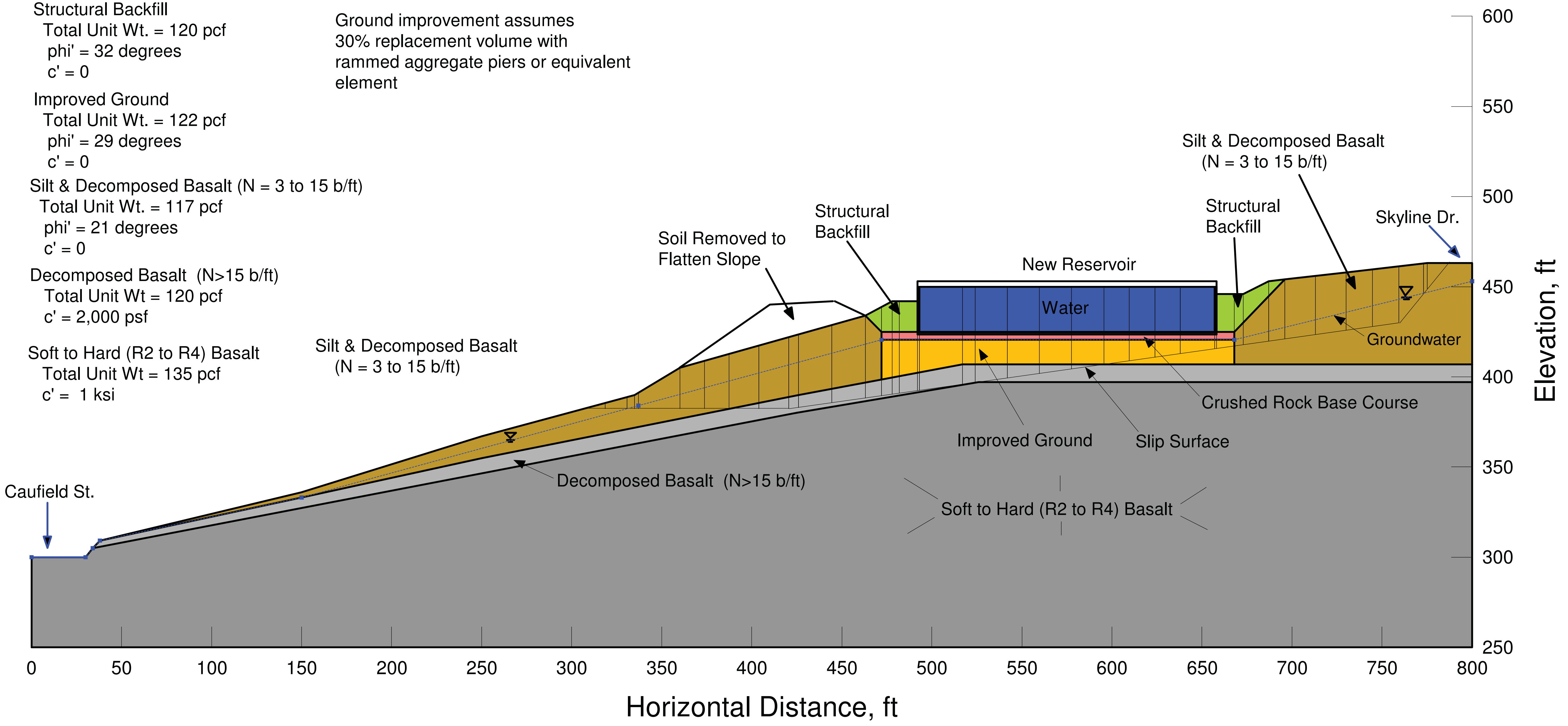
Decomposed Basalt (N>15 b/ft)
Total Unit Wt = 120 pcf
c' = 2,000 psf

Soft to Hard (R2 to R4) Basalt
Total Unit Wt = 135 pcf
c' = 1 ksi

Minimum Factor of Safety Values:
Seismic = 1.1
Static > 1.5

Seismic kh = 0.22 (1/2 PGA)

Ground improvement assumes 30% replacement volume with rammed aggregate piers or equivalent element



GRI

MURRAY, SMITH & ASSOCIATES, INC.
BOLTON RESERVOIR

SLOPE STABILITY MODEL

(NEW RESERVOIR WITH GROUND IMPROVEMENT)

JAN. 2015 JOB NO. 5338-A FIG. 7

Material Properties:

Crushed Rock Base Course
Total Unit Wt. = 130 pcf
phi' = 40 degrees
c' = 0

Structural Backfill
Total Unit Wt. = 120 pcf
phi' = 32 degrees
c' = 0

Improved Ground
Total Unit Wt. = 122 pcf
phi' = 29 degrees
c' = 0

Silt & Decomposed Basalt (N = 3 to 15 b/ft)
Total Unit Wt. = 117 pcf
phi' = 21 degrees
c' = 0

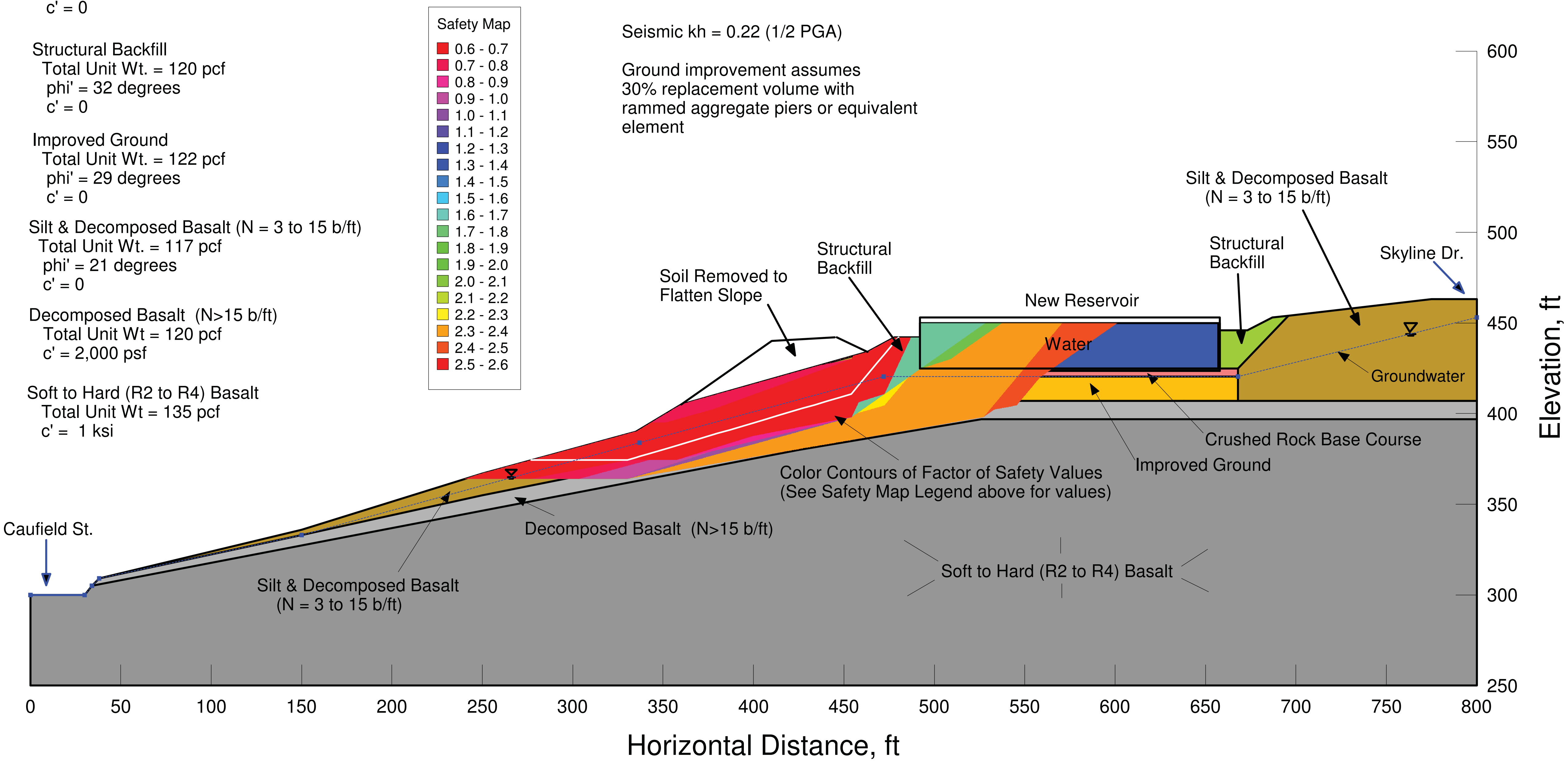
Decomposed Basalt (N>15 b/ft)
Total Unit Wt = 120 pcf
c' = 2,000 psf

Soft to Hard (R2 to R4) Basalt
Total Unit Wt = 135 pcf
c' = 1 ksi

Minimum Factor of Safety Values
at New Reservoir Foundation:
Seismic > 1.5
Static > 1.5

Seismic kh = 0.22 (1/2 PGA)

Ground improvement assumes
30% replacement volume with
rammed aggregate piers or equivalent
element



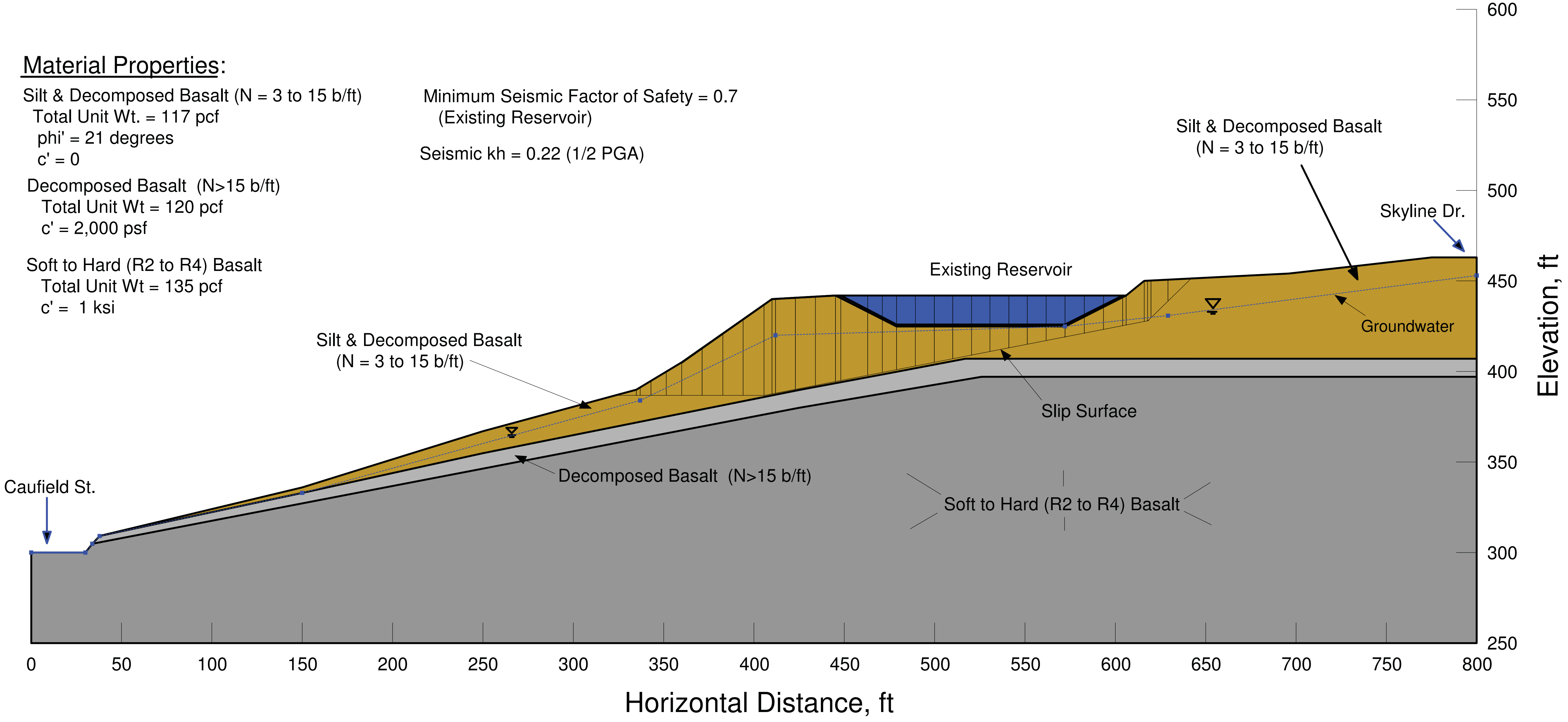
GRI

MURRAY, SMITH & ASSOCIATES, INC.
BOLTON RESERVOIR

SLOPE STABILITY MODEL

(NEW RESERVOIR WITH GROUND IMPROVEMENT, NORTH SLOPE)

JAN. 2015 JOB NO. 5338-A FIG. 8



Material Properties:

Silt & Decomposed Basalt (N = 3 to 15 b/ft)
Total Unit Wt. = 117 pcf
phi' = 21 degrees
c' = 0

Decomposed Basalt (N>15 b/ft)
Total Unit Wt = 120 pcf
c' = 2,000 psf

Soft to Hard (R2 to R4) Basalt
Total Unit Wt = 135 pcf
c' = 1 ksi

Minimum Seismic Factor of Safety = 0.7
(Existing Reservoir)

Seismic kh = 0.22 (1/2 PGA)

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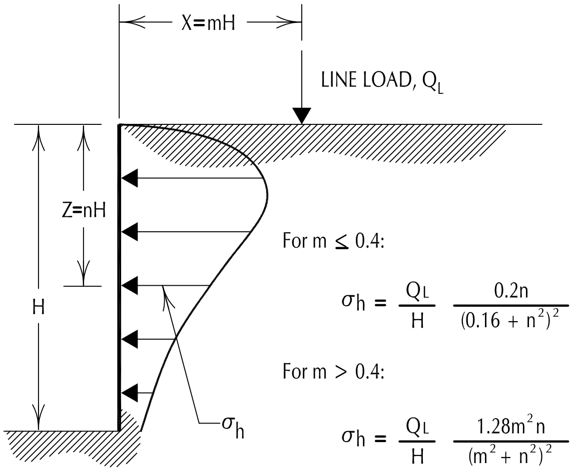
BOLTON RESERVOIR

SLOPE STABILITY MODEL

(EXISTING RESERVOIR)

JAN. 2015 | JOB NO. 5338-A | FIG. 9



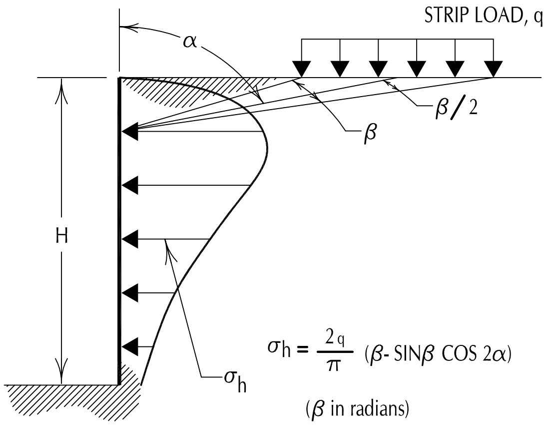
For m ≤ 0.4:

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

For m > 0.4:

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

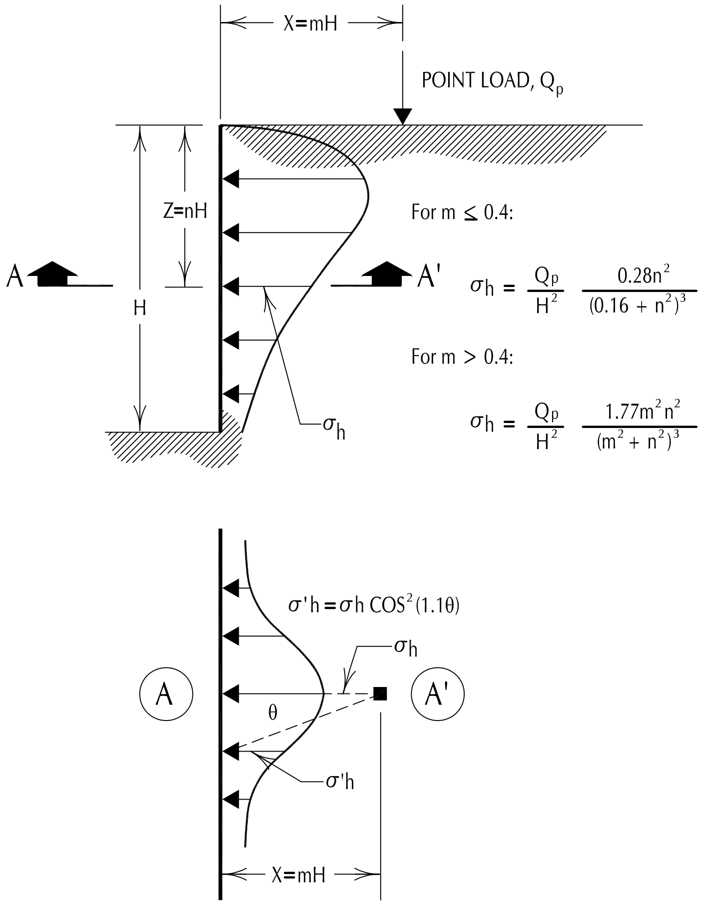
LINE LOAD PARALLEL TO WALL



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

(β in radians)

STRIP LOAD PARALLEL TO WALL



For m ≤ 0.4:

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

For m > 0.4:

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

DISTRIBUTION OF HORIZONTAL PRESSURES

VERTICAL POINT LOAD

NOTES:

1. THESE GUIDELINES APPLY TO RIGID WALLS WITH POISSON'S RATIO ASSUMED TO BE 0.5 FOR BACKFILL MATERIALS.
2. LATERAL PRESSURES FROM ANY COMBINATION OF ABOVE LOADS MAY BE DETERMINED BY THE PRINCIPLE OF SUPERPOSITION.

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BOLTON RESERVOIR

SURCHARGE-INDUCED LATERAL PRESSURE

JAN. 2015 JOB NO. 5338-A FIG. 10

APPENDIX A

Field Explorations and Laboratory Testing

APPENDIX A

FIELD EXPLORATIONS AND LABORATORY TESTING

FIELD EXPLORATIONS

General

Subsurface materials and conditions at the site were evaluated by GRI on June 15, 2012, with one boring designated B-1, and on October 27 through 29, 2014, with two borings, designated B-2 and B-3. The locations of the borings are shown on Figure 2. All explorations were observed by a certified engineering geologist from GRI.

The borings were advanced to depths ranging from 76 to 90 ft with mud-rotary drilling methods using CME 75 track- and truck-mounted drill rigs provided and operated by Western States Soil Conservation, Inc., of Hubbard, Oregon. Disturbed and undisturbed samples were obtained from the borings at about 2.5- to 5-ft intervals of depth. Disturbed samples were obtained using a standard split-spoon sampler. At the time of sampling, the Standard Penetration Test was conducted. This test consists of driving a standard split-spoon sampler into the soil a distance of 18 in. using a 140-lb hammer dropped 30 in. The number of blows required to drive the sampler the last 12 in. is known as the Standard Penetration Resistance, or N-value. The N-values provide a measure of the relative density of granular soils and the relative consistency of cohesive soils. The soil and rock samples obtained in the split-spoon sampler were carefully examined in the field, and representative portions were saved in airtight jars for further examination and physical testing in our laboratory. In addition, relatively undisturbed Shelby tube samples of soil and decomposed rock were collected and returned to our laboratory for further evaluation and testing. Below a depth of about 64and 60 ft in boring B-1 and B-2, respectively, and 55 ft in boring B-3 wireline coring methods were used to obtain continuous samples of rock. The rock cores were placed in core boxes and returned to our laboratory for further evaluation.

Logs of the borings are provided on Figures 1A through 3A. Each log presents a descriptive summary of the various types of materials encountered in the boring and notes the depth where the materials and/or characteristics of the materials change. To the right of the descriptive summary, the numbers and types of samples taken during the drilling operation are indicated. Farther to the right, N-values are shown graphically, along with the natural moisture contents, Torvane shear strength values, Atterberg limits, and percentage of material passing the No. 200 sieve. The terms and symbols used to describe the soil and rock encountered in the borings are defined in Tables 1A and 2A and the attached legend.

Observation Standpipe

An observation standpipe piezometer was installed in boring B-2 and B-3 to depths of about 90 and 48 ft, respectively. The standpipes consist of a 1-in.-I.D. plastic pipe slotted below a depth of 60 and 17 ft in boring B-2 and B-3, respectively. Each boring was flushed with clean water prior to installing the pipe, and the annular space around the pipe was backfilled with Colorado Sand to about 1 ft above the slotted zone. The remaining portion of the hole was backfilled with a seal consisting of bentonite. The top of the standpipe is protected with a flush-mounted monument. Groundwater enters through the slots and rises to a static level, which is measured with an electrical probe lowered inside the pipe.

LABORATORY TESTING

General

The samples obtained from the borings were examined in our laboratory, where the physical characteristics of the samples were noted, and the field classifications were modified where necessary. At the time of classification, the natural moisture content of each sample was determined. Additional tests included determinations of Torvane shear strengths, undisturbed unit weights, one-dimensional consolidation testing, washed sieve analysis, Atterberg limits, drained residual torsional shear strength, and grain-size analysis.

Natural Moisture Contents

Natural moisture content determinations were made in conformance with ASTM D 2216. The results are summarized on the Boring Logs, Figures 1A through 3A.

Torvane Shear Strength

The approximate undrained shear strength of the fine-grained soils obtained in the Shelby tubes was measured using the Torvane shear device. The Torvane is a hand-held apparatus with vanes that are inserted into the soil. The torque required to fail the soil in undrained shear around the vanes is measured using a calibrated spring. The torque measurements have been correlated to the undrained shear strength of various fine-grained soils. The results of the Torvane shear strength testing are shown on Figures 1A through 3A.

Undisturbed Unit Weight

The dry unit weight, or dry density, of undisturbed soil samples was determined in the laboratory in substantial conformance with ASTM D 2937. The unit weight determinations are summarized below.

SUMMARY OF UNIT WEIGHT DETERMINATIONS

Boring	Sample	Approximate Depth, ft	Soil Type	Moisture Content, %	Dry Unit Weight, pcf
B-1	S-2	8.2	Clayey SILT, some fine- to medium-grained sand, brown, stiff (Landslide Debris)	40	81.7
	S-5	16.2	Clayey SILT, some fine- to medium-grained sand, brown, stiff (Landslide Debris)	31	94.3
	S-10	35.7	Clayey SILT, trace sand- to gravel-size fragments of extremely soft (R0), predominantly decomposed basalt, stiff to very stiff (Landslide Debris)	37	88.0
B-2	S-4	11.3	SILT, some clay to clayey, trace to some fine-grained sand, red-brown, black manganese staining, medium stiff (Landslide Debris)	35	87.8
	S-8	21.2	Clayey SILT, trace to some fine-grained sand, brown to red-brown, stiff (Landslide Debris)	27	101.5
	S-11	31.3	BASALT, gray-brown, decomposed, extremely soft (R0), manganese oxide mineralization, relic rock structure, consistency of medium stiff soil (Wanapum Basalt; Landslide Debris)	44	80.0
	S-14	37.8	BASALT, gray-brown to red-brown, decomposed, extremely soft (R0), manganese oxide mineralization, relic rock structure, consistency of soft to hard soil (Wanapum Basalt; Landslide Debris)	43	76.0

Boring	Sample	Approximate Depth, ft	Soil Type	Moisture Content, %	Dry Unit Weight, pcf
B-2	S-16	46.8	BASALT, gray-brown to red-brown, decomposed, extremely soft (R0), manganese oxide mineralization, relic rock structure, consistency of soft to hard soil (Wanapum Basalt; Landslide Debris)	39	84.0
B-3	S-6	15.8	BASALT, gray-brown to red-brown, decomposed, extremely soft (R0), secondary mineralization, relic rock structure, consistency of soft to hard soil (Wanapum Basalt; Landslide Debris)	49	76.0
	S-10	26.0	BASALT, gray-brown to red-brown, decomposed, extremely soft (R0), secondary mineralization, relic rock structure, consistency of soft to hard soil (Wanapum Basalt; Landslide Debris)	52	68.0

One-Dimensional Consolidation Testing

Two, one-dimensional consolidation test was performed in conformance with ASTM D 2435 on relatively undisturbed samples from borings B-1 and B-2 at a depth of about 16.5 and 37.3 ft, respectively. The test provides data on the compressibility of the underlying fine-grained soils and decomposed rock, necessary for settlement studies. The test results are summarized on Figures 4A and 5A in the form of a curve showing percent strain versus applied effective stress. The initial dry unit weight and moisture content of the samples are also shown on the figures.

Washed-Sieve Analysis

Washed sieve analyses were performed using selected soil samples to assist in classification of the soils. The test is performed by taking a sample of known dry weight and washing it over a No. 200 sieve. The material retained on the sieve is oven-dried and weighed. The percentage of material passing the No. 200 sieve is then calculated. The results are tabulated below and shown on Figures 2A and 3A.

SUMMARY OF WASHED SIEVE ANALYSES

Boring	Sample	Depth, ft	Percent Passing No. 200 Sieve	Description
B-2	S-6	15.0	90	Clayey SILT, some fine-grained sand, brown to reddish-brown, stiff (Landslide Debris)
	S-7	17.5	90	Clayey SILT, some fine-grained sand, brown to reddish-brown, stiff (Landslide Debris
	S-9	22.0	85	Clayey SILT, some fine-grained sand, brown to reddish-brown, stiff (Landslide Debris)
B-3	S-4	10.0	82	Clayey SILT, some fine-grained sand, brown (Landslide Debris)

Atterberg Limits

Atterberg limits determinations were performed by GRI on representative samples in conformance with ASTM D 4318. The results of the tests completed by GRI are summarized on Figure 6A Atterberg limits testing were also performed by Cooper Testing Laboratory of Palo Alto, California, on a representative sample decomposed basalt from a depth of 35 ft in boring B-2 that was used to perform the drained residual torsional shear strength test discussed below. The results of the Atterberg limit test by Cooper Testing Laboratory are shown on Figure 7A.

Drained Residual Torsional Shear Strength

The drained residual torsional shear strength test of a representative sample of decomposed basalt from a depth of 35 ft in boring B-2 was completed in conformance with ASTM D 6467 by Cooper Testing Laboratory. The results of the test are summarized on Figure 8A.

Grain Size Analysis

Grain size analysis was completed by Cooper Testing Laboratory of Palo Alto, California on representative sample decomposed basalt from a depth of 35 ft in boring B-2 that was used to perform the drained residual torsional shear strength test discussed above in conformance with ASTM D 422. The results of the test are shown on Figure 9A.

Table 1A

GUIDELINES FOR CLASSIFICATION OF SOIL

Description of Relative Density for Granular Soil

Relative Density	Standard Penetration Resistance (N-values) blows per foot
very loose	0 - 4
loose	4 - 10
medium dense	10 - 30
dense	30 - 50
very dense	over 50

Description of Consistency for Fine-Grained (Cohesive) Soils

Consistency	Standard Penetration Resistance (N-values) blows per foot	Torvane or Undrained Shear Strength, tsf
very soft	0 - 2	less than 0.125
soft	2 - 4	0.125 - 0.25
medium stiff	4 - 8	0.25 - 0.50
stiff	8 - 15	0.50 - 1.0
very stiff	15 - 30	1.0 - 2.0
hard	over 30	over 2.0

Grain-Size Classification

Boulders:
- >12 in.

Cobbles:
- 3 - 12 in.

Gravel:
- $^{1}/_{4}$ - $^{3}/_{4}$ in. (fine)
- $^{3}/_{4}$ - 3 in. (coarse)

Sand:
- No. 200 - No. 40 sieve (fine)
- No. 40 - No. 10 sieve (medium)
- No. 10 - No. 4 sieve (coarse)

Silt/Clay:
- pass No. 200 sieve

Modifier for Subclassification

	Primary Constituent SAND or GRAVEL	Primary Constituent SILT or CLAY
Adjective	**Percentage of Other Material (by weight)**	
trace:	5 - 15 (sand, gravel)	5 - 15 (sand, gravel)
some:	15 - 30 (sand, gravel)	15 - 30 (sand, gravel)
sandy, gravelly:	30 - 50 (sand, gravel)	30 - 50 (sand, gravel)
trace:	<5 (silt, clay)	*Relationship of clay and silt determined by plasticity index test*
some:	5 - 12 (silt, clay)	
silty, clayey:	12 - 50 (silt, clay)	

Table 2A: GUIDELINES FOR CLASSIFICATION OF ROCK

RELATIVE ROCK WEATHERING SCALE

Term	Field Identification
Fresh	Crystals are bright. Discontinuities may show some minor surface staining. No discoloration in rock fabric.
Slightly Weathered	Rock mass is generally fresh. Discontinuities are stained and may contain clay. Some discoloration in rock fabric. Decomposition extends up to 1 in. into rock.
Moderately Weathered	Rock mass is decomposed 50% or less. Significant portions of rock show discoloration and weathering effects. Crystals are dull and show visible chemical alteration. Discontinuities are stained and may contain secondary mineral deposits.
Predominantly Decomposed	Rock mass is more than 50% decomposed. Rock can be excavated with geologist's pick. All discontinuities exhibit secondary mineralization. Complete discoloration of rock fabric. Surface of core is friable and usually pitted due to washing out of highly altered minerals by drilling water.
Decomposed	Rock mass is completely decomposed. Original rock "fabric" may be evident. May be reduced to soil with hand pressure.

RELATIVE ROCK HARDNESS SCALE

Term	Hardness Designation	Field Identification	Approximate Unconfined Compressive Strength
Extremely Soft	R0	Can be indented with difficulty by thumbnail. May be moldable or friable with finger pressure.	$<$ 100 psi
Very Soft	R1	Crumbles under firm blows with point of a geology pick. Can be peeled by a pocket knife and scratched with fingernail.	100 - 1,000 psi
Soft	R2	Can be peeled by a pocket knife with difficulty. Cannot be scratched with fingernail. Shallow indentation made by firm blow of geology pick.	1,000 - 4,000 psi
Medium Hard	R3	Can be scratched by knife or pick. Specimen can be fractured with a single firm blow of hammer/geology pick.	4,000 - 8,000 psi
Hard	R4	Can be scratched with knife or pick only with difficulty. Several hard hammer blows required to fracture specimen.	8,000 - 16,000 psi
Very Hard	R5	Cannot be scratched by knife or sharp pick. Specimen requires many blows of hammer to fracture or chip. Hammer rebounds after impact.	$>$ 16,000 psi

RQD AND ROCK QUALITY

Relation of RQD and Rock Quality

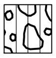
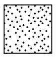
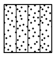
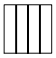
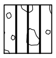
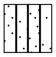
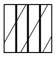
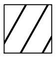
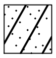
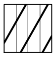
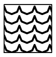
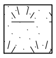
RQD (Rock Quality Designation), %	Description of Rock Quality
0 - 25	Very Poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

Terminology for Planar Surface

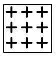
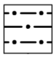
Bedding	Joints and Fractures	Spacing
Laminated	Very Close	$<$ 2 in.
Thin	Close	2 in. – 12 in.
Medium	Moderately Close	12 in. – 36 in.
Thick	Wide	36 in. – 10 ft
Massive	Very Wide	$>$ 10 ft

BORING AND TEST PIT LOG LEGEND

SOIL SYMBOLS

Symbol	Typical Description
	GRAVEL; clean to some silt, clay, and sand
	Sandy GRAVEL; clean to some silt and clay
	Silty GRAVEL; up to some clay and sand
	Clayey GRAVEL; up to some silt and sand
	SAND; clean to some silt, clay, and gravel
	Gravelly SAND; clean to some silt and clay
	Silty SAND; up to some clay and gravel
	Clayey SAND; up to some silt and gravel
	SILT; up to some clay, sand, and gravel
	Gravelly SILT; up to some clay and sand
	Sandy SILT; up to some clay and gravel
	Clayey SILT; up to some sand and gravel
	CLAY; up to some silt, sand, and gravel
	Gravelly CLAY; up to some silt and sand
	Sandy CLAY; up to some silt and gravel
	Silty CLAY; up to some sand and gravel
	PEAT
	LANDSCAPE MATERIALS

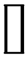
BEDROCK SYMBOLS

Symbol	Typical Description
	BASALT
	SILTSTONE
	SANDSTONE

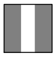
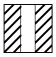
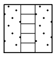
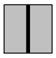
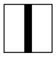
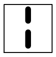
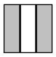
SURFACE MATERIAL SYMBOLS

Symbol	Typical Description
■	Asphaltic-concrete PAVEMENT
▒	Portland cement concrete PAVEMENT
	Crushed rock BASE COURSE

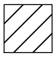
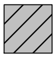
SAMPLER SYMBOLS

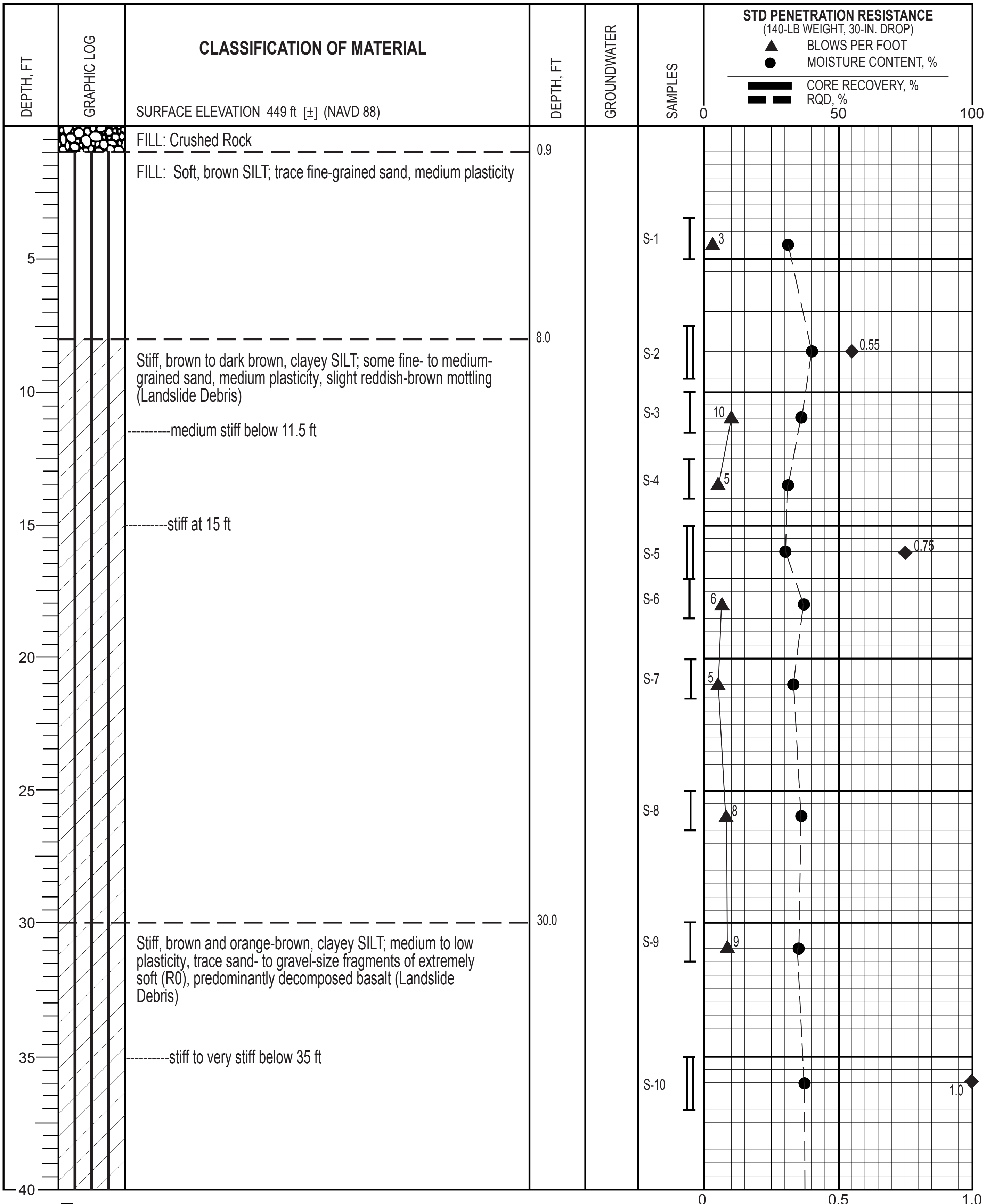
Symbol	Sampler Description
	2.0-in. O.D. split-spoon sampler and Standard Penetration Test with recovery (ASTM D1586)
	Shelby tube sampler with recovery (ASTM D1587)
	3.0-in. O.D. split-spoon sampler with recovery (ASTM D3550)
	Grab Sample
	Rock core sample interval
	Sonic core sample interval
	Geoprobe sample interval

INSTALLATION SYMBOLS

Symbol	Symbol Description
	Flush-mount monument set in concrete
	Concrete, well casing shown where applicable
	Bentonite seal, well casing shown where applicable
	Filter pack, machine-slotted well casing shown where applicable
	Grout, vibrating-wire transducer cable shown where applicable
Ⓟ	Vibrating-wire pressure transducer
	1-in.-diameter solid PVC
	1-in.-diameter hand-slotted PVC
	Grout, inclinometer casing shown where applicable

FIELD MEASUREMENTS

Symbol	Typical Description
▽	Groundwater level during drilling and date measured
▼	Groundwater level after drilling and date measured
	Rock core recovery
	Rock quality designation (RQD)



CLASSIFICATION OF MATERIAL

SURFACE ELEVATION 449 ft [±] (NAVD 88)

FILL: Crushed Rock — 0.9

FILL: Soft, brown SILT; trace fine-grained sand, medium plasticity — 8.0

Stiff, brown to dark brown, clayey SILT; some fine- to medium-grained sand, medium plasticity, slight reddish-brown mottling (Landslide Debris)

----------medium stiff below 11.5 ft

---------stiff at 15 ft

— 30.0

Stiff, brown and orange-brown, clayey SILT; medium to low plasticity, trace sand- to gravel-size fragments of extremely soft (R0), predominantly decomposed basalt (Landslide Debris)

---------stiff to very stiff below 35 ft

I 2-IN.-OD SPLIT-SPOON SAMPLER
II 3-IN.-OD THIN-WALLED SAMPLER
G GRAB SAMPLE OF DRILL CUTTINGS
▌ NX CORE RUN
|—SLOTTED PVC PIPE
▼ Water Level (date)

◆ TORVANE SHEAR STRENGTH, TSF
☐ PERCENT PASSING NO. 200 SIEVE (WASHED)
* NO RECOVERY

Liquid Limit
Moisture Content
Plastic Limit

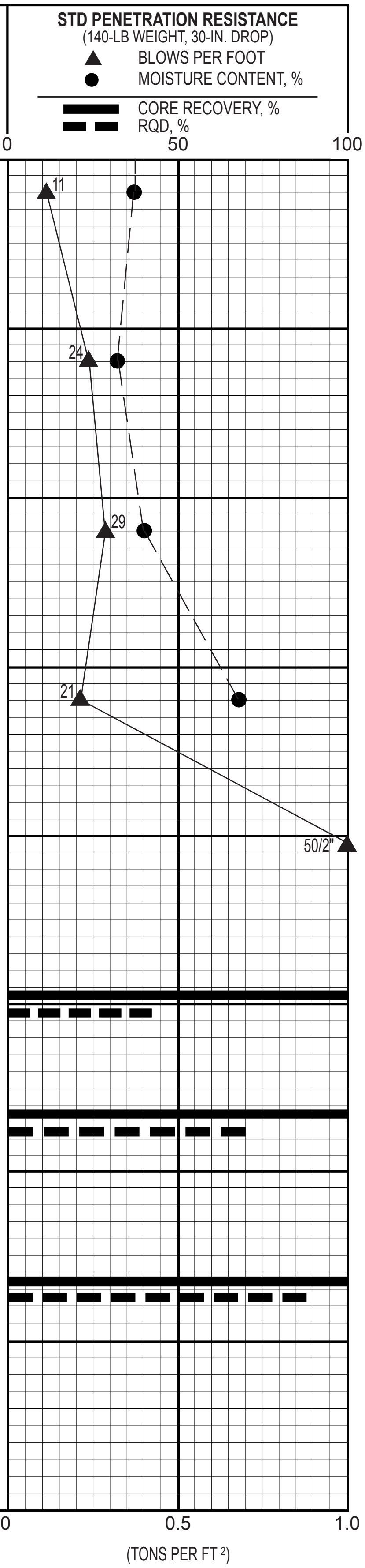
GRI

BORING B-1

JAN. 2015 JOB. NO. 5338-A FIG. 1A

SURFACE ELEVATION 449 ft [±] (NAVD 88)

DEPTH, FT	CLASSIFICATION OF MATERIAL	DEPTH, FT	GROUNDWATER	SAMPLES
40	Stiff, brown and orange-brown, clayey SILT; medium to low plasticity, trace sand- to gravel-size fragments of extremely soft (R0), predominantly decomposed basalt (Landslide Debris)			S-11
45	Very stiff, red, clayey SILT; trace yellowish-white and black, sand-size fragments of predominantly decomposed basalt, relic rock structure (Landslide Debris)	45.0		S-12
50	Very stiff, gray, clayey SILT; medium to high plasticity, some coarse-grained sand- to fine gravel-size fragments of extremely soft (R0), predominantly decomposed basalt (Landslide Debris)	51.0		S-13 S-14
60	Soft to medium hard (R2 to R3), gray and reddish-brown BASALT; coarse-grained sand- to gravel-size fragments of slightly weathered rock (Wanapum Basalt)	60.0		S-15
65	Hard, gray BASALT; vesicular, close to moderately close fractures, fresh to slightly weathered (Wanapum Basalt)	64.0		RUN 1 RUN 2 RUN 3
75	(6/15/2012)	76.0		
80				



I 2-IN.-OD SPLIT-SPOON SAMPLER

II 3-IN.-OD THIN-WALLED SAMPLER

G GRAB SAMPLE OF DRILL CUTTINGS

▌ NX CORE RUN

SLOTTED PVC PIPE

▼ Water Level (date)

◆ TORVANE SHEAR STRENGTH, TSF

☐ PERCENT PASSING NO. 200 SIEVE (WASHED)

* NO RECOVERY

Liquid Limit
Moisture Content
Plastic Limit

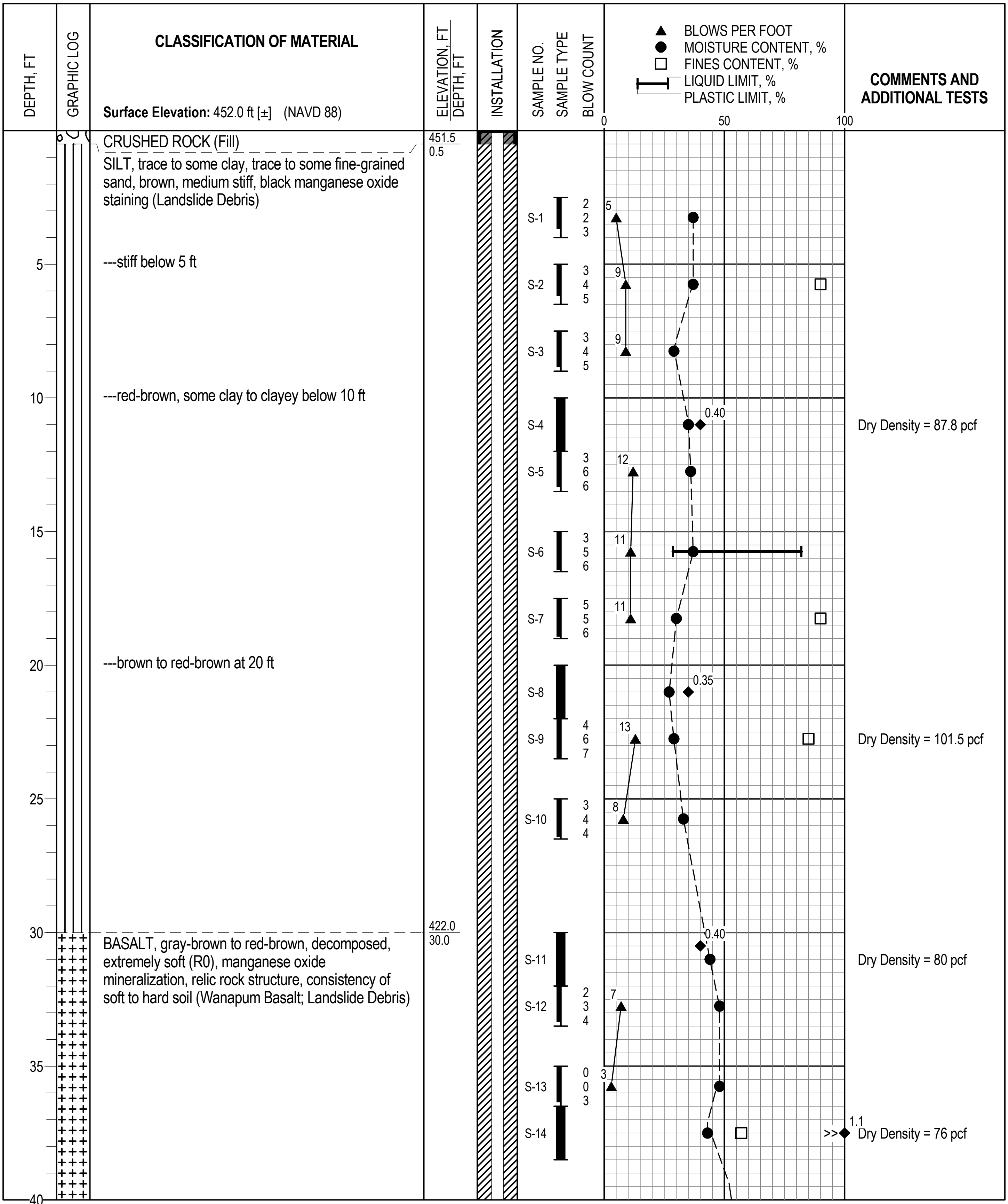
GRI

BORING B-1 (cont.)

JAN. 2015 JOB. NO. 5338-A FIG. 1A

CLASSIFICATION OF MATERIAL

Surface Elevation: 452.0 ft [±] (NAVD 88)



Elevation, ft / Depth, ft	Classification of Material
451.5 / 0.5	CRUSHED ROCK (Fill)
	SILT, trace to some clay, trace to some fine-grained sand, brown, medium stiff, black manganese oxide staining (Landslide Debris)
	---stiff below 5 ft
	---red-brown, some clay to clayey below 10 ft
	---brown to red-brown at 20 ft
422.0 / 30.0	BASALT, gray-brown to red-brown, decomposed, extremely soft (R0), manganese oxide mineralization, relic rock structure, consistency of soft to hard soil (Wanapum Basalt; Landslide Debris)

Sample No.	Blow Count	Blows per Foot	Torvane Shear Strength, TSF	Comments and Additional Tests
S-1	2 2 3	5		
S-2	3 4 5	9		
S-3	3 4 5	9		
S-4			0.40	Dry Density = 87.8 pcf
S-5	3 6 6	12		
S-6	3 5 6	11		
S-7	5 5 6	11		
S-8			0.35	
S-9	4 6 7	13		Dry Density = 101.5 pcf
S-10	3 4 4	8		
S-11			0.40	Dry Density = 80 pcf
S-12	2 3 4	7		
S-13	0 0 3	3		
S-14			>>1.1	Dry Density = 76 pcf

(CONTINUED NEXT PAGE)

Logged By: M. Marshall
Drilled by: Western States Soil Conservation, Inc.
Date Started: 10/27/14
Coordinates: Not Available
Drilling Method: Mud Rotary
Equipment: CME 75 HT Truck-Mounted Drill Rig
Hole Diameter: 3.875 in.
Hammer Type: Auto Hammer
Weight: 140 lb
Drop: 30 in.
Energy Ratio: 71.7 %
Note: See Legend for Explanation of Symbols

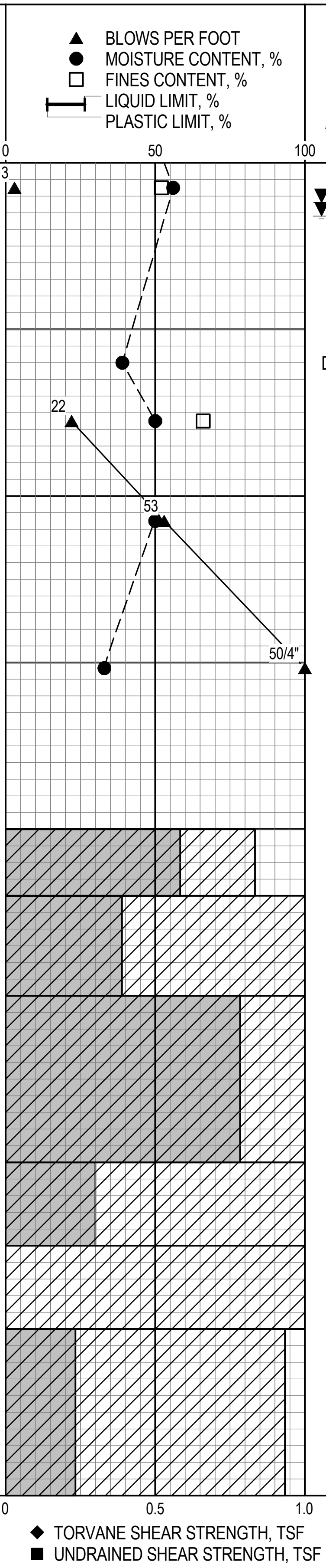
GRI

BORING B-2

JAN. 2015   JOB NO. 5338-A   FIG. 2A

Surface Elevation: 452.0 ft [±] (NAVD 88)

DEPTH, FT	CLASSIFICATION OF MATERIAL	ELEVATION, FT / DEPTH, FT	SAMPLE NO.	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
	BASALT, gray-brown to red-brown, decomposed, extremely soft (R0), manganese oxide mineralization, relic rock structure, consistency of soft to hard soil (Wanapum Basalt; Landslide Debris)		S-15	1 1 2	41.2 ft (1/7/15) 41.6 ft (11/18/14)
45			S-16		Dry Density = 84 pcf
			S-17	6 11 11	
50			S-18	23 23 30	
55	Gravel- to boulder-size fragments of BASALT, gray, decomposed to moderately weathered, soft to medium hard (R2 to R3) (Wanapum Basalt)	397.0 55.0	S-19	50/4"	
60	BASALT, some vesicles, gray, fresh, hard (R4), close joints (Wanapum Basalt)	392.0 60.0	R-1		
			R-2		
65			R-3		
70	---some vesicles below 70 ft		R-4		
			R-5		
75			R-6		
		373.0 79.0			
80					



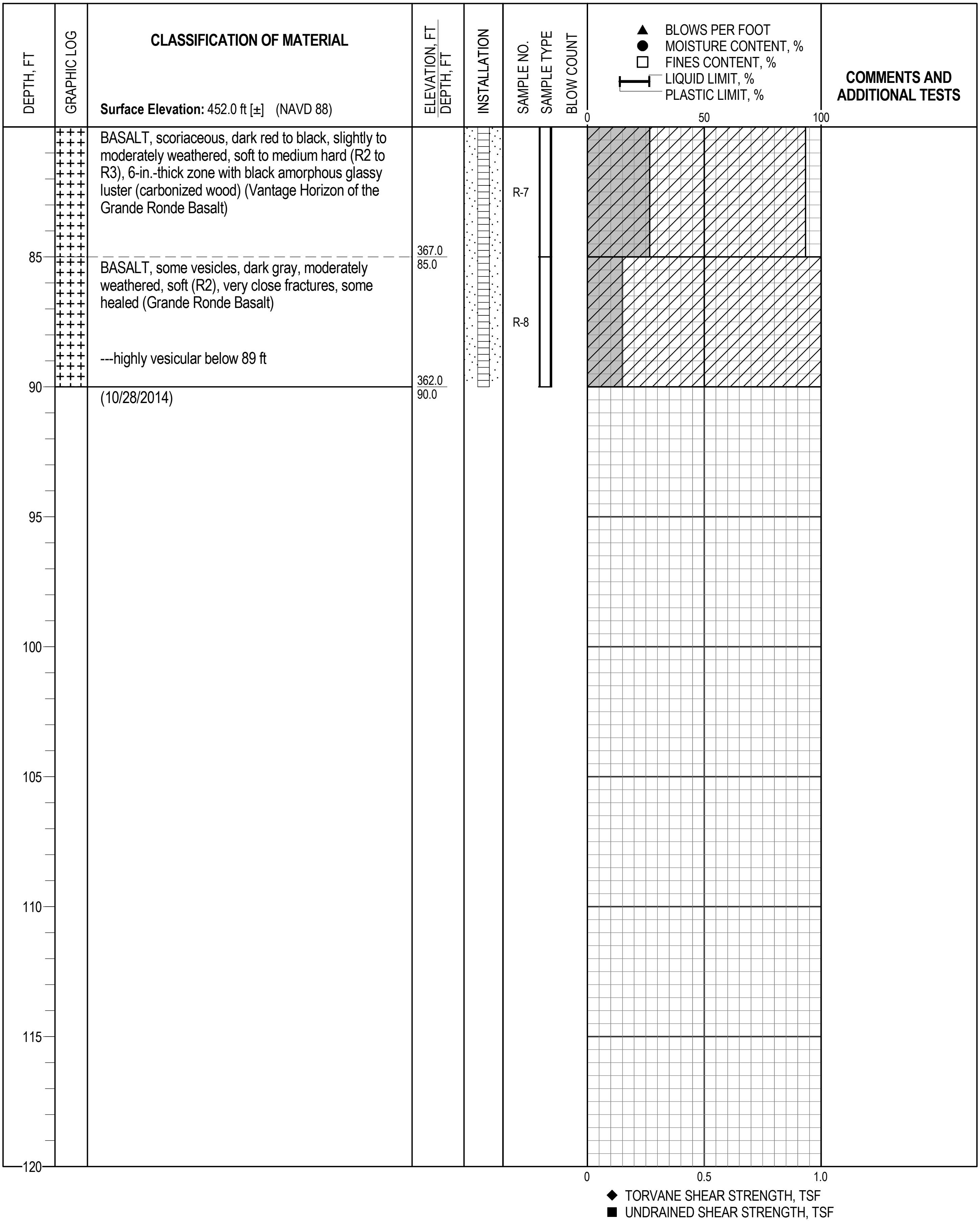
(CONTINUED NEXT PAGE)

GRI BORING LOG GRI DATA TEMPLATE.GDT 1/16/15

GRI

BORING B-2

JAN. 2015 JOB NO. 5338-A FIG. 2A



CLASSIFICATION OF MATERIAL

Surface Elevation: 452.0 ft [±] (NAVD 88)

COMMENTS AND ADDITIONAL TESTS

BASALT, scoriaceous, dark red to black, slightly to moderately weathered, soft to medium hard (R2 to R3), 6-in.-thick zone with black amorphous glassy luster (carbonized wood) (Vantage Horizon of the Grande Ronde Basalt)

367.0 / 85.0

BASALT, some vesicles, dark gray, moderately weathered, soft (R2), very close fractures, some healed (Grande Ronde Basalt)

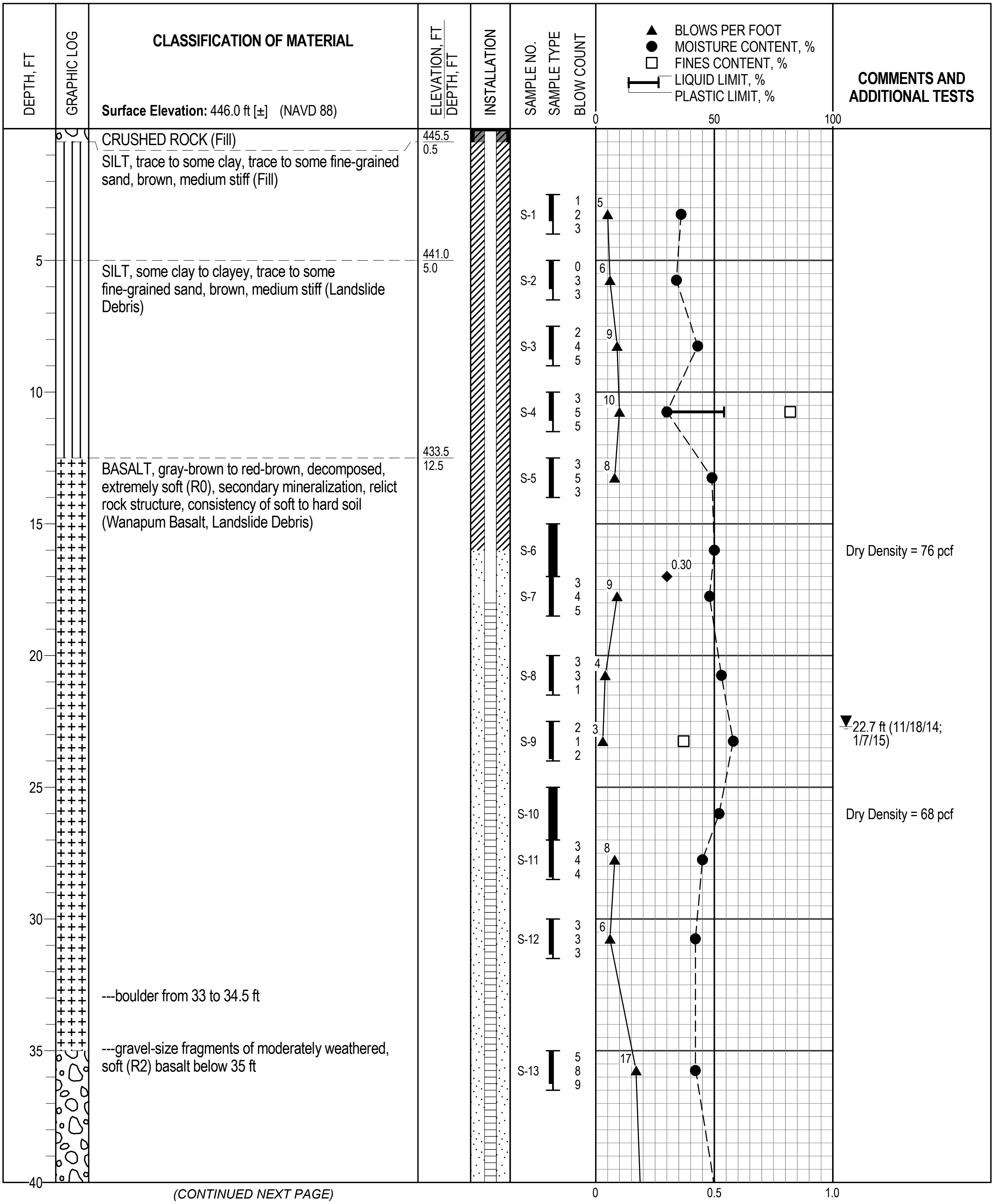
---highly vesicular below 89 ft

362.0 / 90.0

(10/28/2014)

BORING B-2

JAN. 2015 JOB NO. 5338-A FIG. 2A



Surface Elevation: 446.0 ft [±] (NAVD 88)

CRUSHED ROCK (Fill)

SILT, trace to some clay, trace to some fine-grained sand, brown, medium stiff (Fill)

SILT, some clay to clayey, trace to some fine-grained sand, brown, medium stiff (Landslide Debris)

BASALT, gray-brown to red-brown, decomposed, extremely soft (R0), secondary mineralization, relict rock structure, consistency of soft to hard soil (Wanapum Basalt, Landslide Debris)

---boulder from 33 to 34.5 ft

---gravel-size fragments of moderately weathered, soft (R2) basalt below 35 ft

Dry Density = 76 pcf

▼22.7 ft (11/18/14; 1/7/15)

Dry Density = 68 pcf

(CONTINUED NEXT PAGE)

◆ TORVANE SHEAR STRENGTH, TSF
■ UNDRAINED SHEAR STRENGTH, TSF

Logged By: M. Marshall
Drilled by: Western States Soil Conservation, Inc.
Date Started: 10/28/14
Coordinates: Not Available
Drilling Method: Mud Rotary
Equipment: CME 75 HT Truck-Mounted Drill Rig
Hole Diameter: 3.875 in.
Hammer Type: Auto Hammer
Weight: 140 lb
Drop: 30 in.
Energy Ratio: 71.7 %
Note: See Legend for Explanation of Symbols

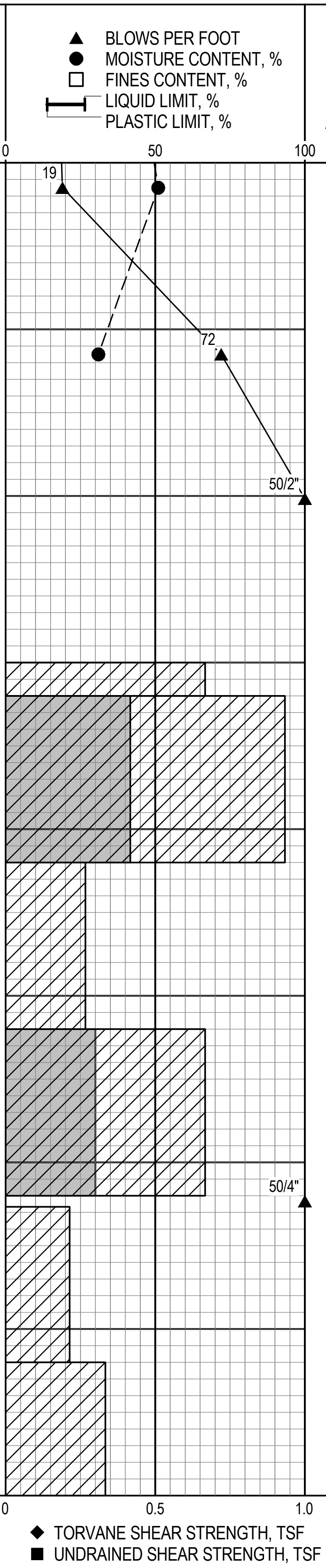
GRI

BORING B-3

JAN. 2015 JOB NO. 5338-A FIG. 3A

DEPTH, FT	CLASSIFICATION OF MATERIAL **Surface Elevation:** 446.0 ft [±] (NAVD 88)	ELEVATION, FT DEPTH, FT	INSTALLATION	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
	BASALT, light brown, decomposed to moderately weathered, extremely soft to soft (R0 to R2), secondary mineralization, relict rock structure, consistency of soft to hard soil (Wanapum Basalt, Landslide Debris)			S-14		4 10 9	
45				S-15		20 32 40	
50	Gravel- to boulder-size fragments of BASALT, gray, slightly to moderately weathered, medium hard to hard (R3 to R4) (Wanapum Basalt)	396.0 50.0		S-16		50/2"	
55	BASALT, gray, slightly weathered, medium hard to hard (R3 to R4), close joints, black carbonized wood within near-vertical (80°) closed fractures, some with chilled margin (Wanapum Basalt)	391.0 55.0		R-1			
				R-2			
60							
				R-3			
65	---some vesicles, fresh to slightly weathered, hard (R4), several closed near-vertical fractures, iron and manganese oxide staining along joints below 65 ft						
				R-4			
70							
	BASALT, highly vesicular, red-brown, moderately weathered, soft to very soft (R2 to R1), secondary mineralization (Vantage Horizon of the Grande Ronde Basalt)	375.0 71.0		S-17		50/4"	
				R-5			
75							
				R-6			
80							

(CONTINUED NEXT PAGE)



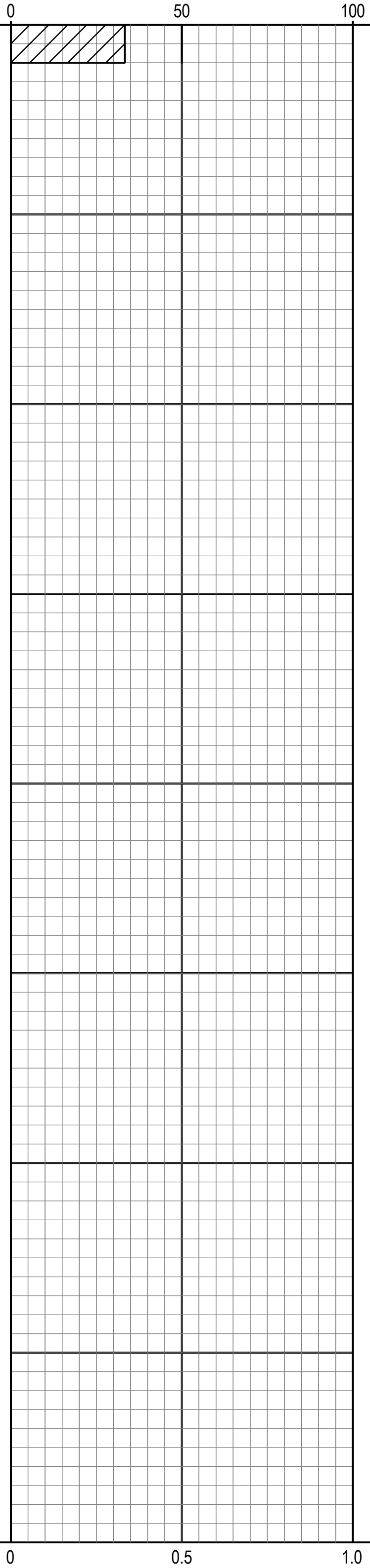
GRI

BORING B-3

JAN. 2015 JOB NO. 5338-A FIG. 3A

DEPTH, FT	GRAPHIC LOG	CLASSIFICATION OF MATERIAL **Surface Elevation:** 446.0 ft [±] (NAVD 88)	ELEVATION, FT / DEPTH, FT	INSTALLATION	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
	+++	BASALT, highly vesicular, red-brown, moderately weathered, soft to very soft (R2 to R1), secondary mineralization (Vantage Horizon of the Grande Ronde Basalt) (10/29/2014)	365.0 81.0			▯		
85								
90								
95								
100								
105								
110								
115								
120								

▲ BLOWS PER FOOT
● MOISTURE CONTENT, %
☐ FINES CONTENT, %
LIQUID LIMIT, %
PLASTIC LIMIT, %



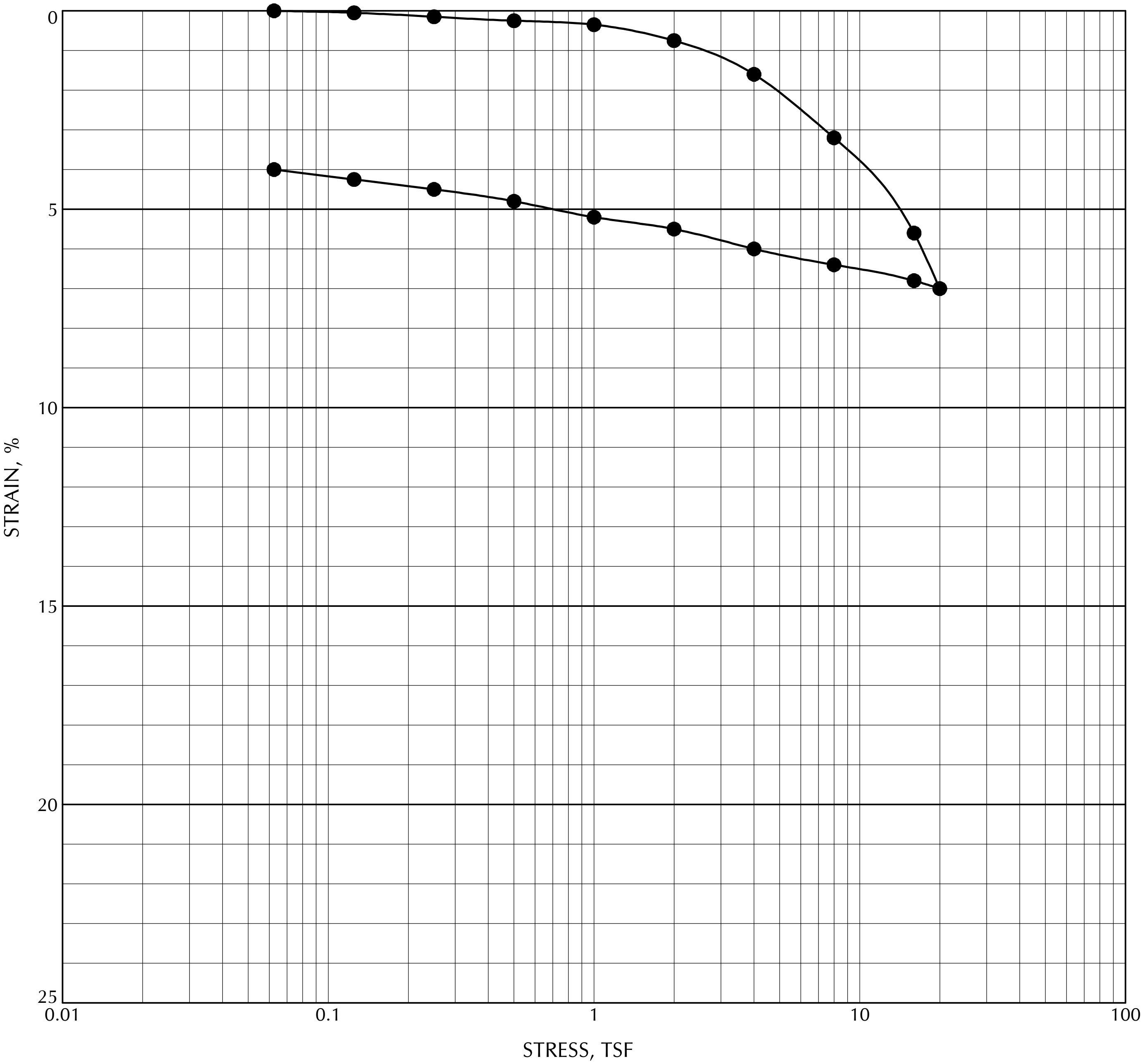
◆ TORVANE SHEAR STRENGTH, TSF
■ UNDRAINED SHEAR STRENGTH, TSF

GRI BORING LOG GRI DATA TEMPLATE.GDT 1/16/15

GRI

BORING B-3

JAN. 2015 JOB NO. 5338-A FIG. 3A

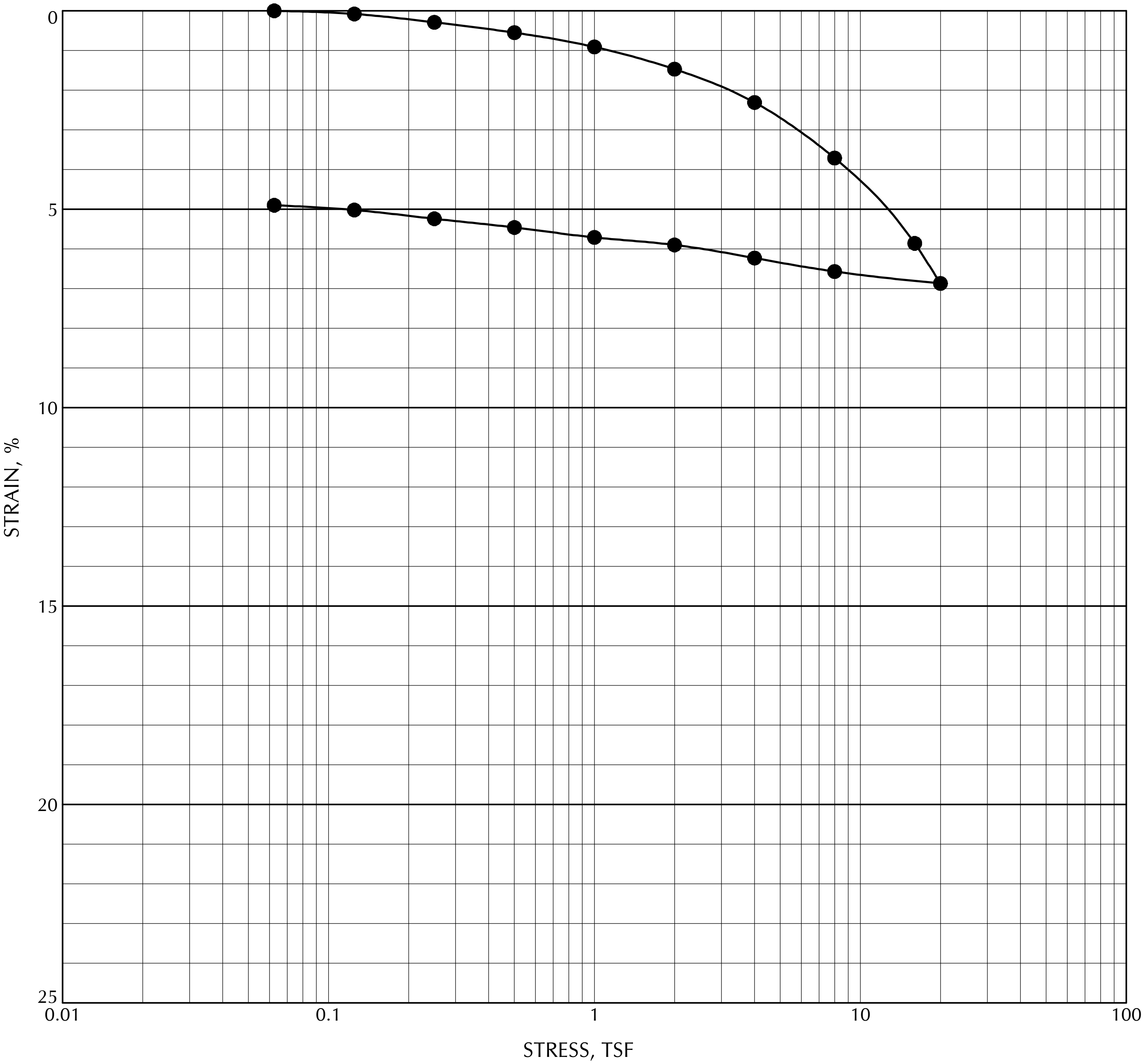


	Location	Sample	Depth, ft	Classification	Initial γ_d, pcf	Initial MC, %
●	B-1	S-5	16.5	Clayey SILT, some fine- to medium-grained sand, brown, medium stiff (Landslide Debris)	89	33

CONSOL STRAIN GRI-0 TO 25-1 PER PAGE GRI DATA TEMPLATE.GDT 1/16/15

GRI

CONSOLIDATION TEST



	Location	Sample	Depth, ft	Classification	Initial γ_d, pcf	Initial MC, %
●	B-2	S-14	37.3	BASALT, gray-brown to red-brown, decomposed, extremely soft (R0), manganese oxide mineralization, relic rock structure, consistency of soft to hard soil (Wanapum Basalt; Landslide Debris)	80	43

GRI

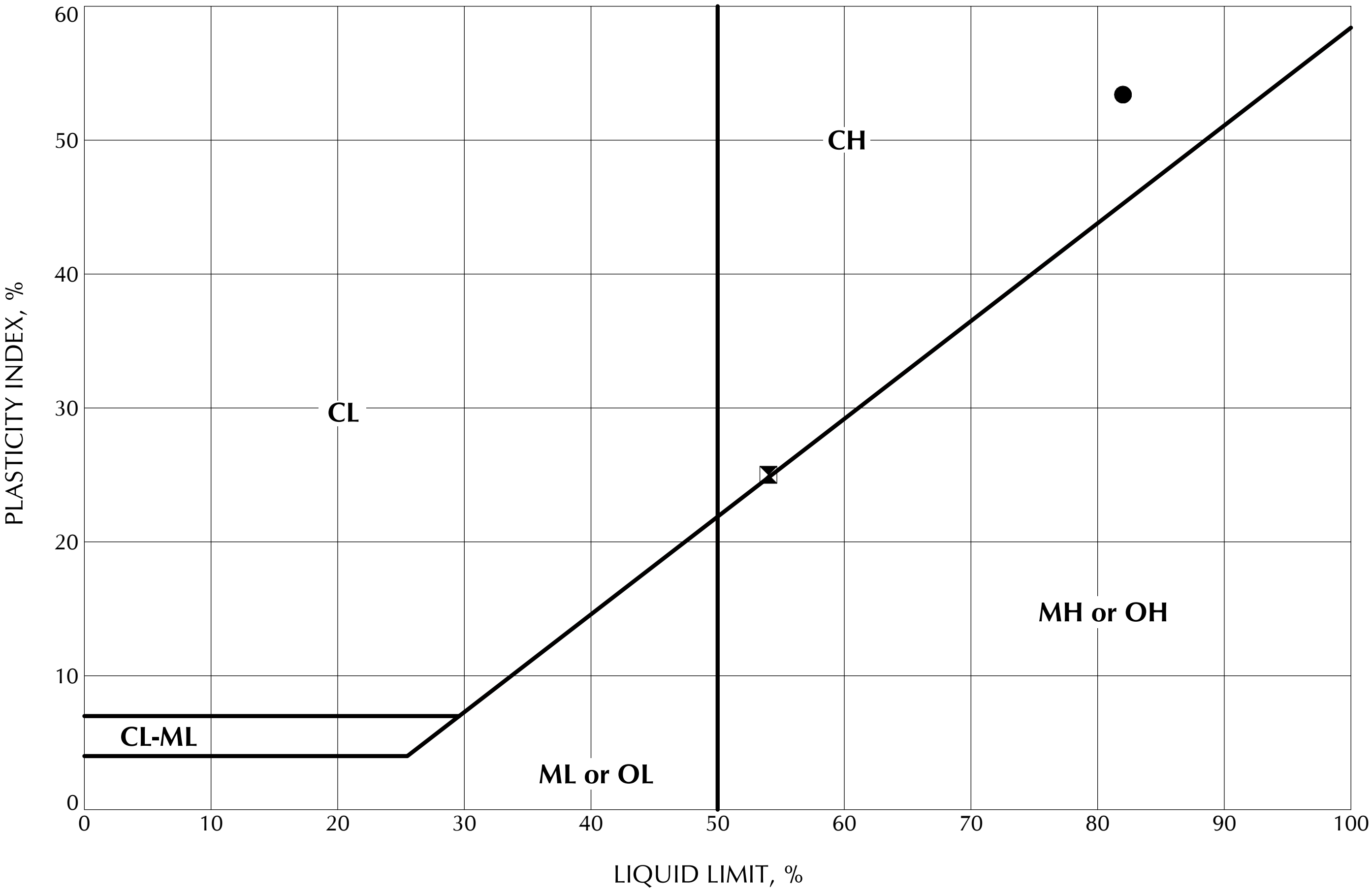
CONSOLIDATION TEST

JAN. 2015 JOB NO. 5338-A FIG. 5A

CONSOL STRAIN GRI-0 TO 25-1 PER PAGE GRI DATA TEMPLATE.GDT 1/16/15

GROUP SYMBOL	UNIFIED SOIL CLASSIFICATION FINE-GRAINED SOIL GROUPS
OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
ML	INORGANIC CLAYEY SILTS TO VERY FINE SANDS OF SLIGHT PLASTICITY
CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY

GROUP SYMBOL	UNIFIED SOIL CLASSIFICATION FINE-GRAINED SOIL GROUPS
OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
MH	INORGANIC SILTS AND CLAYEY SILT
CH	INORGANIC CLAYS OF HIGH PLASTICITY



	Location	Sample	Depth, ft	Classification	LL	PL	PI	MC, %
●	B-2	S-6	15.0	SILT, some clay to clayey, trace to some fine-grained sand, red-brown (Landslide Debris)	82	29	53	37
⧗	B-3	S-4	10.0	SILT, some clay to clayey, trace to some fine-grained sand, brown (Landslide Debris)	54	29	25	30

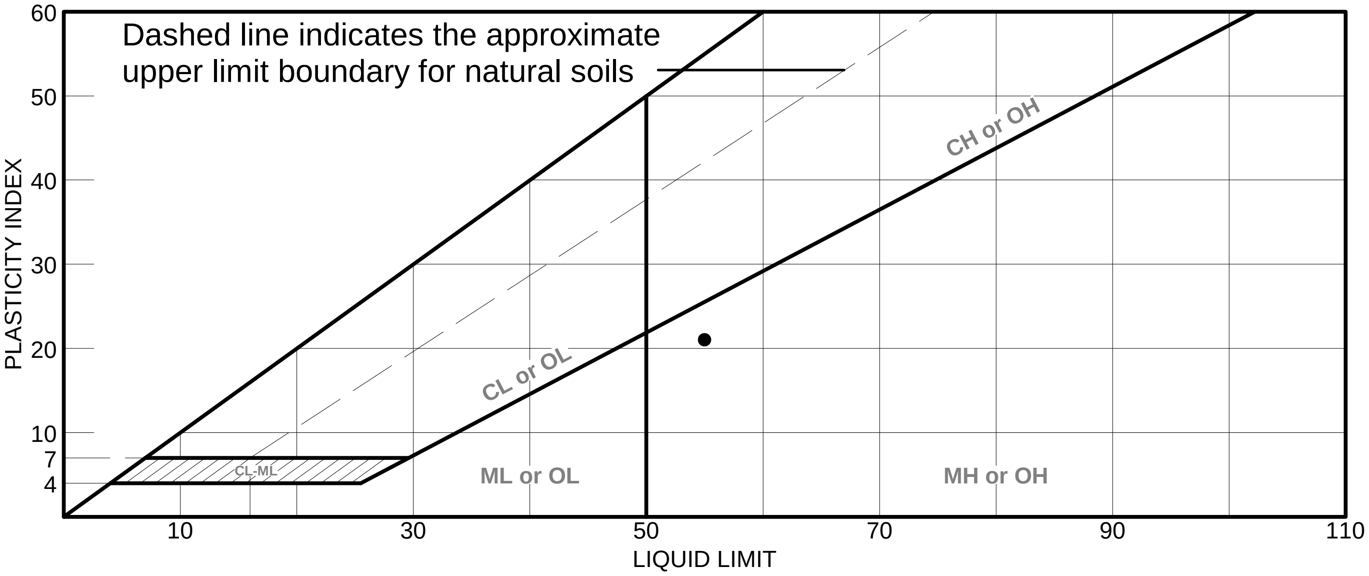
GRI

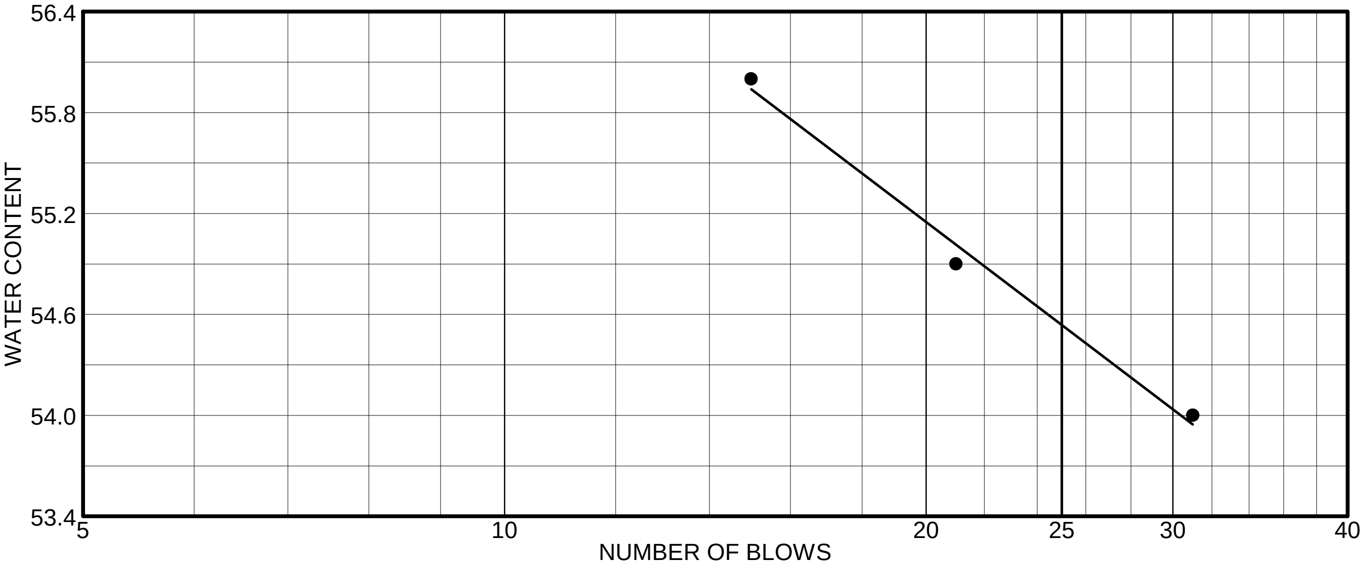
PLASTICITY CHART

JAN. 2015 JOB NO. 5338-A FIG. 6A

ATTERBERG-PLASTICITY 2 PER PAGE GRI DATA TEMPLATE.GDT 1/16/15

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Strong Brown Sandy Elastic SILT	55	34	21	87.2	60.1	MH

Project No. 823-005 **Client:** GRI

Project: Bolton Reservoir - 5338-A

● **Source:** B-2 **Sample No.:** S-13 **Elev./Depth:** 35'

Remarks:

●

LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure

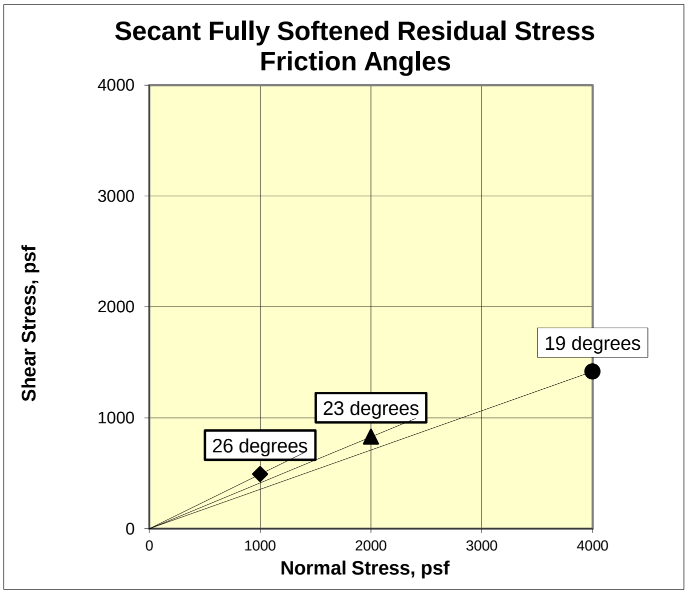
Drained Residual Torsional Shear Strength
(ASTM D6467)

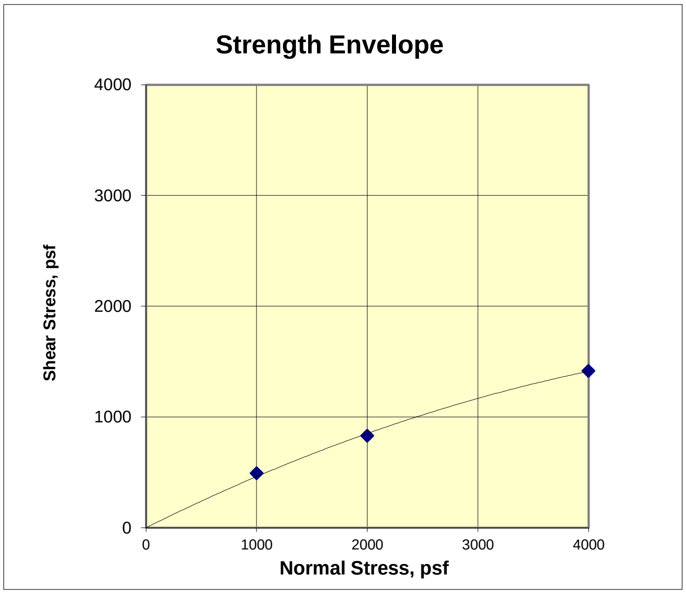
CTL Job No.:	823-005	**Boring:**	B-2	**Date:**	12/9/2014	**Clay, %:**	29.2
Client:	GRI	**Sample:**	S-13	**By:**	PJ	**LL:**	55
Project Name:	Bolton Reservoir	**Depth (ft):**	35	**Checked:**	DC	**PL:**	34
Project Number:	5338-A	**Test Type:**	Fully Softened Residual				

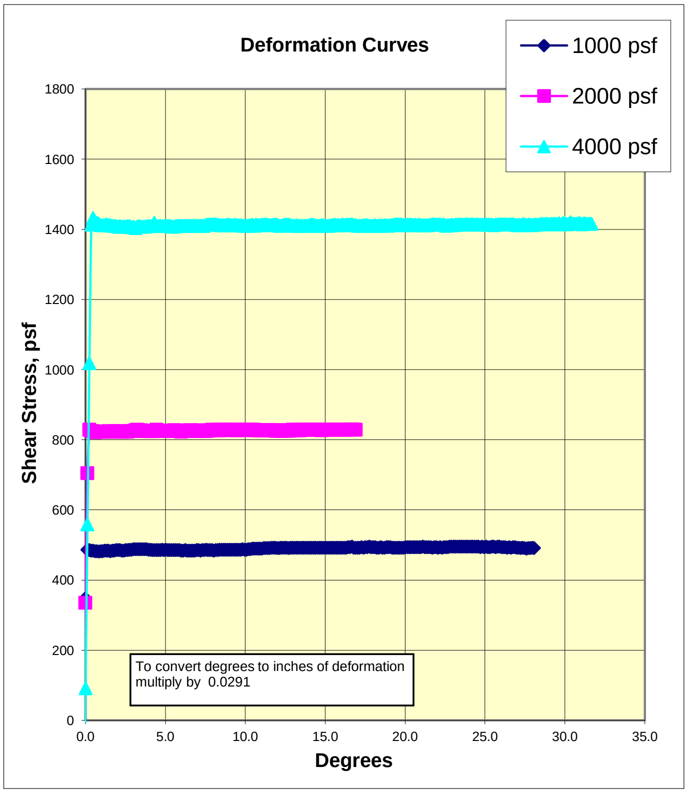
Soil Type: Strong Brown Sandy Elastic SILT

Normal Stress, psf:	1000	2000	4000
Secant Phi, deg.:	26	23	19

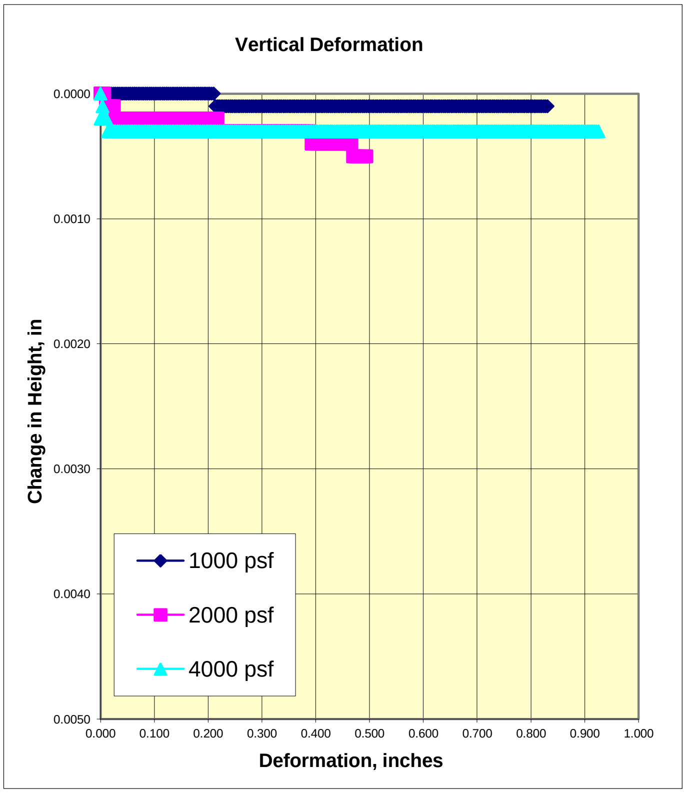
Remarks: This sample has an unusually highly curved strength envelope.


Secant Fully Softened Residual Stress Friction Angles

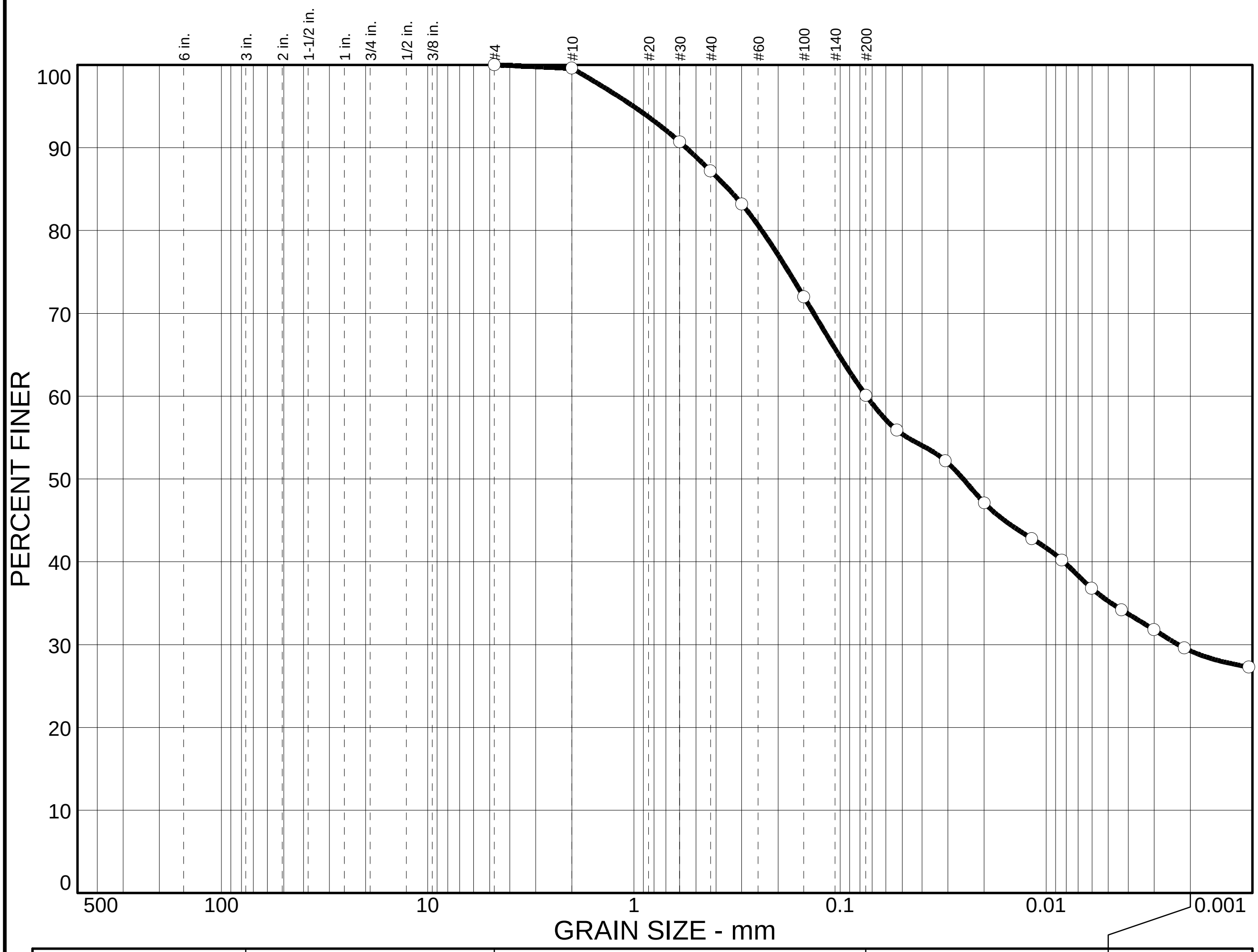

Strength Envelope


Deformation Curves

To convert degrees to inches of deformation multiply by 0.0291


Vertical Deformation

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	39.9	30.9	29.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.6		
#30	90.7		
#40	87.2		
#50	83.2		
#100	72.0		
#200	60.1		
#270	55.9		
0.0308 mm.	52.2		
0.0200 mm.	47.1		
0.0118 mm.	42.8		
0.0084 mm.	40.2		
0.0060 mm.	36.8		
0.0043 mm.	34.2		
0.0030 mm.	31.8		
0.0021 mm.	29.6		
0.0010 mm.	27.3		

* (no specification provided)

Soil Description

Strong Brown Sandy Elastic SILT

Atterberg Limits

PL= 34 LL= 55 PI= 21

Coefficients

D_{85}= 0.348 D_{60}= 0.0745 D_{50}= 0.0253
D_{30}= 0.0023 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= MH AASHTO=

Remarks

Sample No.: S-13 **Source of Sample:** B-2 **Date:** 12/3/14
Location: **Elev./Depth:** 35'

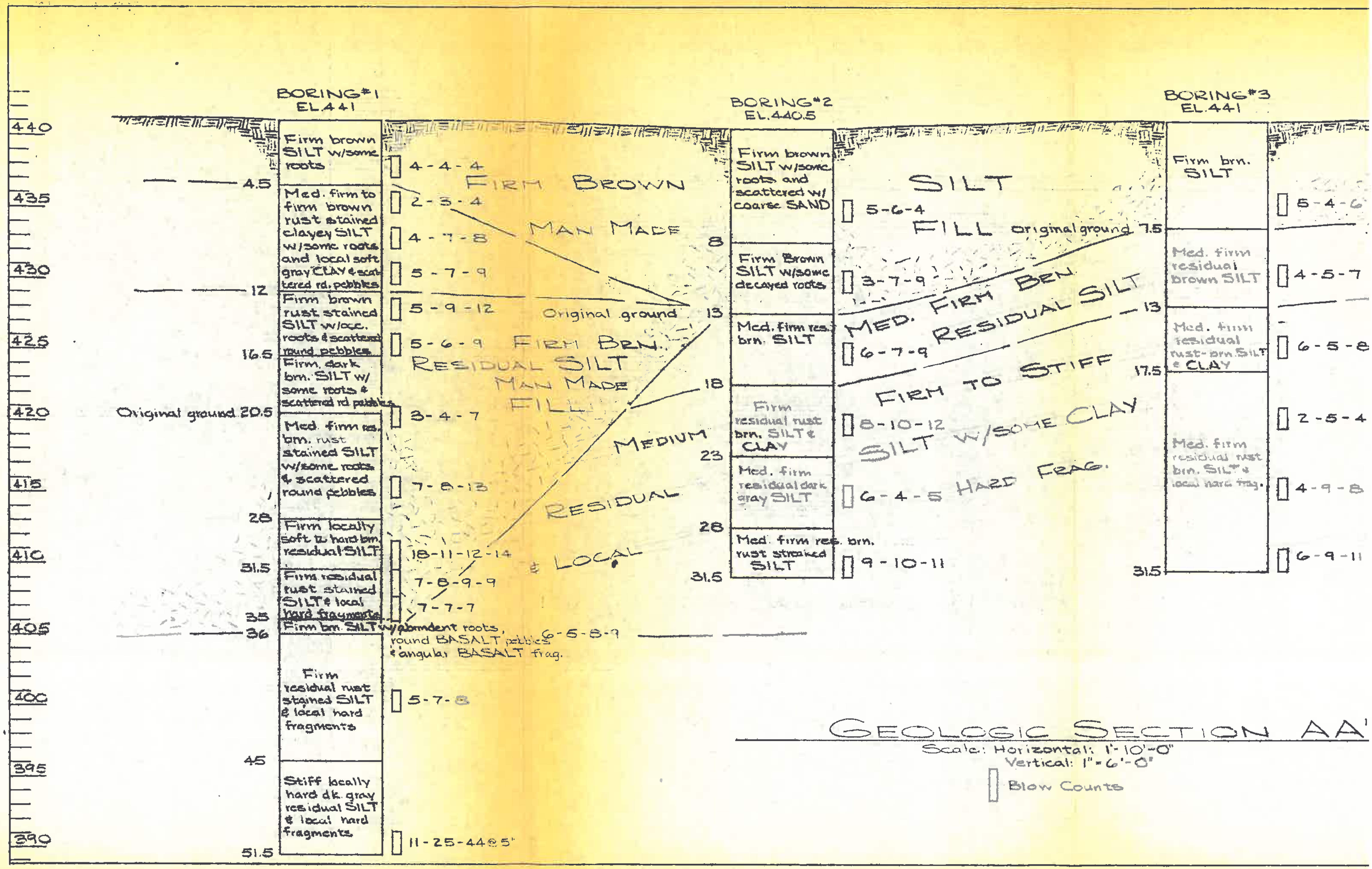
COOPER TESTING LABORATORY

Client: GRI
Project: Bolton Reservoir - 5338-A

Project No: 823-005 **Figure**

APPENDIX B

Logs of Subsurface Explorations by Others

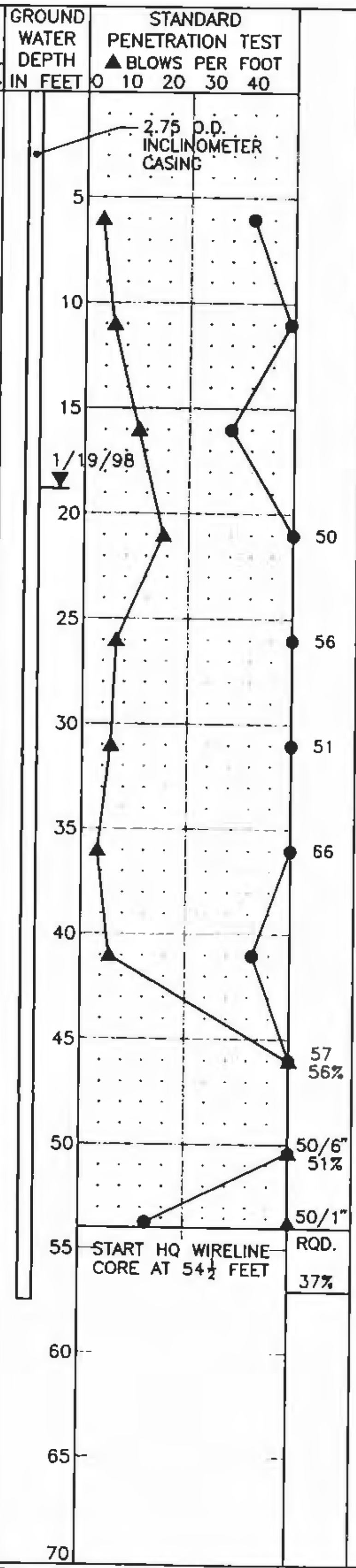


GEOLOGIC SECTION AA'

Scale: Horizontal: 1"- 10'-0"
Vertical: 1" = 6'-0"

▯ Blow Counts

ELEV.	DEPTH IN FEET	MATERIAL DESCRIPTION SURFACE ELEV. (FT.) 437 (approx.)	SAMPLES NO.	SAMPLES S.P.T.
		SOFT, to MEDIUM STIFF, brown, slightly clayey to clayey SILT (FILL).	1	4
			2	7
424	13	SOFT to STIFF, mottled orange-brown and gray, sandy, slightly clayey SILT (DECOMPOSED BASALT).	3	13
			4	19
			5	8
		...becomes gravelly	6	7
		...becomes gray	7	4
			8	7
395	42	VERY DENSE, gray, slightly clayey, sandy SILT; relic rock texture (DECOMPOSED BASALT).	9	57
			10	50/6"
			11	50/1"
382½	54½	SOFT to MEDIUM HARD, grey, moderately weatherd BASALT; highly jointed.	RUN NO. 1	CORE RECV. 90%
379½	57½	Bottom of Boring: 57½ feet		



LEGEND

- ▨ 2" S.P.T. SAMPLE
- * SAMPLE NOT RECOVERED
- U 3" THIN WALL SAMPLE
- P PITCHER SAMPLE
- IMPERVIOUS SEAL
- ▼ WATER LEVEL
- ■ PIEZOMETER TIP
- LIQUID LIMIT
- NATURAL WATER CONTENT
- PLASTIC LIMIT
- ● WATER CONTENT IN PERCENT

NOTES

1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
2. WATER LEVEL IS FOR DATE SHOWN AND MAY VARY WITH TIME OF YEAR.
3. THE ANNULUS AROUND THE INCLINOMETER CASING WAS BACKFILLED USING A TREMIED CEMENT-BENTONITE GROUT.
4. WATER LEVEL MEASURED IN ADJACENT PIEZOMETER DRILL HOLE LT-1P.

C1057\BORLOG01

DRILLER Geo-Tech Explorations
DATE START 12/5/97 FINISH 12/5/97
DRILLING TECHNIQUE 4⅞-inch O.D. Tricone Mud Rotary, HSA 8-inch O.D., HQ Coring

Landslide Technology
10250 S.W. Greenburg Rd.
Portland, OR 97223

TITLE
SUMMARY BORING LOG
LT-1

JOB
BOLTON RESERVOIR LANDSLIDE
WEST LINN, OREGON

DATE
JAN 1998
JOB NO.
1057
FIG. 2

APPENDIX C

Site-Specific Seismic Hazard Study

APPENDIX C

SITE-SPECIFIC SEISMIC HAZARD STUDY

General

GRI has completed a site-specific seismic hazard study for the proposed Bolton Reservoir in West Linn, Oregon. The purpose of the study was to evaluate potential seismic hazards associated with regional and local seismicity. The site-specific hazard study is intended to meet the requirements of the 2012 International Building Code (IBC), which was recently adopted by the 2014 Oregon Structural Specialty Code (OSSC). The 2012 IBC is based on the American Society of Civil Engineers (ASCE) 7-10 document *Minimum Design Loads for Buildings and Other Structures*. Our work was based on the potential for regional and local seismic activity, as described in the existing scientific literature, and on the subsurface conditions at the site, as disclosed by the subsurface explorations completed for this project. Specifically, our work included the following tasks:

1) A detailed review of available literature, including published papers, maps, open-file reports, seismic histories and catalogs, , and other sources of available information regarding the tectonic setting, regional and local geology, and historical seismic activity that might have a significant effect on the site.

2) Compilation and evaluation of subsurface data collected at and in the vicinity of the site, including classification and laboratory analysis of soil samples. This information was used to prepare a generalized subsurface profile for the site.

3) Identification of the potential seismic events (earthquakes) appropriate for the site and characterization of those events in terms of a generalized design event.

4) Office studies, based on the generalized subsurface profile and the generalized design earthquake, resulting in conclusions and recommendations concerning:

    a) specific seismic events that might have a significant effect on the site,

    b) the potential for seismic energy amplification and liquefaction or soil strength loss at the site, and

    c) site-specific acceleration response spectra for design of the proposed reservoir.

This appendix describes the work accomplished and summarizes our conclusions and recommendations.

Geologic Setting

On a regional scale, the site is located at the northern end of the Willamette Valley, a broad, gently deformed, north-south-trending topographic feature separating the Coast Range to the west from the Cascade Mountains to the east. The site is located approximately 100 km inland from the Cascadia Subduction Zone (CSZ), an active plate boundary along which remnants of the Farallon plate (the Gorda, Juan de Fuca, and Explorer plates) are being subducted beneath the western edge of the North American plate. The subduction zone is a broad, eastward-dipping zone of contact between the upper portion of the subducting slabs of the Gorda, Juan de Fuca, and Explorer plates and the over-riding North American plate as shown on the Tectonic Setting Summary, Figure 1C.

On a local scale, the site is located in the Portland Basin, a large, well-defined, northwest-trending structural basin bounded by high-angle, northwest-trending, right-lateral strike-slip faults considered to be seismogenic. The distribution of these faults relative to the site is shown on the Regional Geologic Map, Figure 2C. Additional faults in the project area that are considered potentially active by the U. S. Geological Survey (USGS) are shown on the Local Fault Map, Figure 3C. Information regarding the continuity and potential activity of these faults is lacking, due largely to the scale at which geologic mapping in the area has been conducted and the presence of thick, relatively young, basin-filling sediments that obscure underlying structural features. Other faults may be present within the basin, but clear stratigraphic and/or geophysical evidence regarding their location and extent is not presently available. Additional discussion regarding crustal faults is provided in the Local Crustal Event section below.

Because of the proximity of the site to the CSZ and its location within the Portland Basin, three distinctly different sources of seismic activity contribute to the potential for the occurrence of damaging earthquakes. Each of these sources is generally considered to be capable of producing damaging earthquakes. Two of these sources are associated with the deep-seated tectonic activity related to the subduction zone; the third is associated with movement on the local, relatively shallow structures within and adjacent to the Portland Basin.

The site is located on the eastern flank of the Tualatin Mountains, a topographic upland that separates the Portland Basin to the northeast from the Tualatin Basin to the west and the Willamette Valley to the south. Geologic mapping completed for the area indicates the site is located in the vicinity of the contact between the Miocene-age Wanapum Basalt and the Grande Ronde Basalt units of the Columbia River Basalt Group (Madin, 2009). The site and other areas of the Tualatin Mountain upland are capped by deposits of fine-grained, wind-blown silt, referred to as Portland Hills Silt. Quaternary alluvial deposits associated with the Willamette River and the Ice Age Missoula Floods (about 15,000 to 20,000 years ago) are present northeast of the site, north of Hwy 43.

Seismicity

General. The geologic and seismologic information available for identifying the potential seismicity at the site is incomplete, and large uncertainties are associated with estimates of the probable magnitude, location, and frequency of occurrence of earthquakes that might affect the site. The available information indicates the potential seismic sources that may affect the site can be grouped into three independent categories: *subduction zone events* related to sudden slip between the upper surface of the Juan de Fuca plate and the lower surface of the North American plate, *subcrustal events* related to deformation and volume changes within the subducted mass of the Juan de Fuca plate, and *local crustal events* associated with movement on shallow, local faults within and adjacent to the Portland Basin. Based on our review of currently available information, we have developed generalized design earthquakes for each of these categories in accordance with Section 1803 of the OSSC. The design earthquakes are characterized by three important properties: size, location relative to the subject site, and the peak horizontal bedrock accelerations produced by the event. In this study, earthquake size is expressed by the moment magnitude

(M); location is expressed as the closest distance to the fault rupture, measured in kilometers; and peak horizontal bedrock accelerations are expressed in units of gravity (1 g = 32.2 ft/sec^2 = 981 cm/sec^2).

Subduction Zone Event. The last interplate earthquake on the CSZ occurred in January 1700. Geological studies show that great megathrust earthquakes have occurred repeatedly in the past 7,000 years (Atwater et al., 1995; Clague, 1997; Goldfinger, 2003; and Kelsey et al., 2005), and geodetic studies (Hyndman and Wang, 1995; Savage et al., 2000) indicate rate of strain accumulation consistent with the assumption that the CSZ is locked beneath offshore northern California, Oregon, Washington, and southern British Columbia (Fluck et al., 1997; Wang et al., 2001). Numerous geological and geophysical studies suggest the CSZ may be segmented (Hughes and Carr, 1980; Weaver and Michaelson, 1985; Guffanti and Weaver, 1988; Goldfinger, 1994; Kelsey et al., 1994; Mitchell et al., 1994; Personius, 1995; Nelson and Personius, 1996; Witter, 1999), but the most recent studies suggest that for the last great earthquake in 1700, most of the subduction zone ruptured in a single M9.0 earthquake (Satake et al., 1996; Atwater and Hemphill-Haley, 1997; Clague et al., 2000). Published estimates of the probable maximum size of subduction zone events range from M8.3 to greater than M9.0. Numerous detailed studies of coastal subsidence, tsunamis, and turbidites yield a wide range of recurrence intervals, but the most complete records (>4,000 years) indicate average intervals of 350 to 600 years between great earthquakes on the CSZ (Adams, 1990; Atwater and Hemphill-Haley, 1997; Witter, 1999; Clague et al., 2000; Kelsey et al., 2002; Kelsey et al., 2005; Witter et al., 2003; Goldfinger et al, 2012). Tsunami inundation in buried marshes along the Washington and Oregon coast and stratigraphic evidence from the Cascadia margin support these recurrence intervals (Kelsey et al., 2005; Goldfinger, 2003).

The USGS probabilistic analysis assumes four potential locations for the location of the eastern edge of the earthquake rupture zone as shown on Figure 4C. The 2008 USGS mapping effort indicates two rupture scenarios are assumed to represent these megathrust events: 1) M9±0.2 events that rupture the entire CSZ every 500 years and 2) M8.3 to 8.7 events with rupture zones that occur on segments of the CSZ and occur over the entire length of the CSZ during a period of about 500 years (Petersen et al., 2008). The assumed distribution of earthquakes is shown on the Assumed Magnitude-Frequency Distribution, Figure 5C. This distribution assumes the larger M9.0 earthquake is the most likely single CSZ earthquake scenario, as also indicated by the USGS deaggregation for the site. Therefore, for our deterministic analysis, we have chosen to represent the subduction zone event by a design earthquake of M9.0 at a focal depth of 20 km and rupture distance of 100 km. This corresponds to a sudden rupture of the whole length of the Juan de Fuca-North American plate interface with an assumed rupture zone due west of the site. Based on an average of the attenuation relationships published by Youngs et al. (1997), Atkinson and Boore (2003), and Zhao et al. (2006), a subduction zone earthquake of this size and location would result in a peak horizontal bedrock acceleration of approximately 0.12 g at the site.

Subcrustal Event. There is no historic earthquake record of subcrustal, intraslab earthquakes in Oregon. Although both the Puget Sound and northern California region have experienced many of these earthquakes in historic times, Wong (2005) hypothesizes that due to subduction zone geometry, geophysical conditions, and local geology, Oregon may not be subject to intraslab earthquakes. In the Puget Sound area, these moderate to large earthquakes are deep (40 to 60 km) and over 200 km from the deformation front of the subduction zone. Offshore, along the northern California coast, the earthquakes are shallower (up to 40 km) and located along the deformation front. Estimates of the probable size, location, and frequency of subcrustal events in Oregon are generally based on comparisons of the CSZ with active convergent plate margins in other parts of the world and on the historical seismic record for the region surrounding Puget Sound, where significant events known to have occurred within the subducting Juan de Fuca plate have been recorded. Published estimates of the probable maximum size of these events range from M7.0 to 7.5. The 1949, 1965, and 2001 documented subcrustal earthquakes in the Puget Sound area correspond to M7.1, 6.5, and 6.8, respectively. Published information regarding the location and geometry of the subducting zone indicates that a focal depth of 50 km is probable (Weaver and Shedlock, 1989). We have chosen to represent the subcrustal event by a design earthquake of M7.0 at a focal depth of 50 km and a rupture distance of 60 km. Based on the attenuation relationships published by Youngs et al. (1997) and Atkinson and Boore (2003), a subcrustal earthquake of this size and location would result in a peak horizontal bedrock acceleration of approximately 0.14 g at the site.

Local Crustal Event. Sudden crustal movements along relatively shallow, local faults in the project area, although rare, have been responsible for local crustal earthquakes. The precise relationship between specific earthquakes and individual faults is not well understood, since few of the faults in the area are expressed at the ground surface, and the foci of the observed earthquakes have not been located with precision. The history of local seismic activity is commonly used as a basis for determining the size and frequency to be expected of local crustal events. Although the historical record of local earthquakes is relatively short (the earliest reported seismic event in the area occurred in 1920), it can serve as a guide for estimating the potential for seismic activity in the area.

Based on fault mapping conducted by the USGS, the Bolton Fault is the closest mapped crustal fault identified as a hazard to the site (USGS, 2008). The surface trace of the Bolton Fault is located about 900 ft northeast of the site (Madin, 2009). The Bolton Fault has a characteristic earthquake magnitude of 6.2. A crustal earthquake of this size and location would result in a peak horizontal bedrock acceleration of approximately 0.45 g at the site based on an average of the NGA ground motion relations published by Boore and Atkinson (2008), Campbell and Bozorgnia (2008), and Chiou and Youngs (2008).

Summary of Deterministic Earthquake Parameters

In summary, three distinctly different types of earthquakes affect seismicity in the project area. Deterministic evaluation of the earthquake sources using recently published attenuation ground motion relations provides estimates of ground response for each individual earthquake type. Unlike probabilistic estimates, these deterministic estimates are not associated with a relative hazard level or probability of occurrence and simply provide an estimate of the ground motion parameters for each type of fault at a given distance from the site. For each earthquake source, we have attempted to use attenuation relationships and weighting that are consistent with the development of the 2008 USGS seismic hazard maps. The basic parameters of each type of earthquake are as follows:

Earthquake Source	Attenuation Relationships for Target Spectra	Magnitude, M	Rupture Distance, km	Focal Depth, km	Peak Bedrock Acceleration, g	Average Peak Bedrock Acceleration, g
Subduction Zone	Youngs et al., 1997	9.0	100	20	0.14	0.12
	Atkinson and Boore, 2003	9.0	100	20	0.07	
	Zhao et al., 2006 (1)	9.0	100	20	0.14	
Subcrustal	Youngs et al., 1997	7.0	60	50	0.15	0.14
	Atkinson and Boore, 2003	7.0	60	50	0.13	

Earthquake Source	Attenuation Relationships for Target Spectra	Magnitude, M	Rupture Distance, km	Focal Depth, km	Peak Bedrock Acceleration, g	Average Peak Bedrock Acceleration, g
Local Crustal	Campbell and Bozorgnia, 2008	6.2	1	NA	0.43	0.45
	Chiou and Youngs, 2008	6.2	1	NA	0.52	
	Boore and Atkinson, 2008	6.2	1	NA	0.40	

(1) Relationship by Zhao et al. (2006) limited to magnitude 8.5.

Probabilistic Considerations

The probability of an earthquake of a specific magnitude occurring at a given location is commonly expressed by its return period, i.e., the average length of time between successive occurrences of an earthquake of that size or larger at that location. The return period of a design earthquake is calculated once a project design life and some measure of the acceptable risk that the design earthquake might occur or be exceeded are specified. These expected earthquake recurrences are expressed as a probability of exceedance during a given time period or design life. Historically, building codes have adopted an acceptable risk level by identifying ground acceleration values that meet or exceed a 10% probability of exceedance in 50 years, which corresponds to an earthquake with an expected recurrence interval of 475 years. Previous versions of the IBC developed response spectra based on ground motions associated with the Maximum Considered Earthquake (MCE), which is generally defined as a probabilistic earthquake with a 2% probability of exceedance in 50 years (return period of about 2,500 years) except where subject to deterministic limitations (Leyendecker et al., 2000).

The recent 2012 IBC develops response spectra using a Risk-Targeted Maximum Considered Earthquake (MCE$_R$), which is defined as the response spectrum that is expected to achieve a 1% probability of building collapse within a 50-year period. The design-level response spectrum is calculated as two-thirds of the MCE$_R$ ground motions. Since the MCE$_R$ earthquake ground motions were developed by the USGS to incorporate the targeted 1% in 50 years risk of structural collapse based upon a generic structural fragility, they are different than the ground motions associated with the traditional MCE. Although site response is evaluated based on the MCE$_R$, it should be noted that seismic hazards, such as liquefaction and soil strength loss, are evaluated using the Maximum Considered Earthquake Geometric Mean (MCE$_G$) peak ground acceleration (PGA), which is more consistent with the traditional MCE.

The 2012 IBC design methodology uses two mapped spectral acceleration parameters, S_S and S_1, corresponding to periods of 0.2 and 1.0 second, to develop the MCE$_R$ earthquake. The S_S and S_1 coefficients for the site located at the approximate latitude and longitude coordinates of 45.37°N and 122.63°W are 0.95 and 0.41 g, respectively.

Estimated Site Response

The effect of a specific seismic event on the site is related to 1) the type and quantity of seismic energy delivered to the bedrock beneath the site by the earthquake and 2) the type and thickness of soil overlying the bedrock at the site. Ground motion hazard analysis was completed to estimate this site-specific behavior in accordance with Section 21.2 of ASCE 7-10. The ground motion hazard analysis consisted of three significant components: 1) estimation of ground surface response using recently developed attenuation relationships that are capable of modeling soil site conditions (deterministic evaluation), 2) estimation of ground surface response using code-based adjustment factors based on soil site class (probabilistic evaluation), and 3) comparison of the deterministic and probabilistic ground surface response spectra to recommend a site-specific response spectrum for design. The following paragraphs describe the details of the ground motion hazard analysis.

To estimate the deterministic ground surface response spectrum, recently developed attenuation relationships were used to evaluate amplification and/or attenuation of bedrock ground motions through the soil column at the site. Based on our review of the USGS deaggregation for the site (USGS, 2014), an event on the CSZ and crustal seismicity represent the largest contributing sources to the seismic hazard at the site. Considering this, we have chosen to estimate the deterministic ground surface response using 84th percentile ground motions from the following two earthquake scenarios: 1) a M9.0 subduction zone earthquake at a distance of 100 km from the site, and 2) a M6.2 crustal earthquake at a distance of 1 km from the site. The attenuation relationship of Youngs et al. (1997) and the recently developed BC Hydro relationship of Abrahamson et al. (2012) were used to evaluate the subduction zone earthquake response. The NGA ground motion relations published by Boore and Atkinson (2008), Campbell and Bozorgnia (2008), and Chiou and Youngs (2008) were used to evaluate the crustal earthquake response. One input parameter for the attenuation relationships is the average shear wave velocity in the upper 100 ft of the soil profile. Based on published correlations with standardized field data and our experience with similar subsurface conditions, we estimate the average shear wave velocity at the site is on the order of 1,100 ft/s. The resulting deterministic MCE$_R$ ground surface response spectra are shown on Figure 6C. As required by Section 21.2.2 of ASCE 7-10, Figure 6C also shows the deterministic lower limit MCE$_R$ spectrum. The deterministic MCE$_R$ ground surface spectrum is taken as the larger of the 84th percentile ground motions and the deterministic lower limit. To estimate the probabilistic ground surface response spectrum, adjustment factors based on observed soil conditions are used to evaluate amplification and/or attenuation of bedrock ground motions through the soil column at the site. The site is classified as Site Class D, or a stiff soil site, based on the estimated average shear wave velocity in the upper 100 ft of the soil profile in accordance with Section 20.3 of ASCE 7-10. Corresponding short- and long-period adjustment factors F_a and F_v, of 1.12 and 1.59, respectively, were used to develop the probabilistic Site Class D MCE$_R$ response spectrum shown on Figure 7C.

In accordance with Section 21.2.3 of ASCE 7-10, the site-specific ground surface MCE$_R$ response spectrum is taken as the lesser of the probabilistic and deterministic MCE$_R$ ground motions. Figure 7C shows a comparison of the deterministic and probabilistic MCE$_R$ ground motions and indicates the code-based probabilistic Site Class D MCE$_R$ response spectrum is appropriate for the site. The design-level response spectrum is calculated as two-thirds of the MCE$_R$ response spectrum. We recommend using the Site Class D design response spectrum shown on Figure 8C for design of the reservoir.

Seismic Hazards

Liquefaction. Liquefaction is a process by which loose, saturated, granular materials, such as sand, and to a somewhat lesser degree soft, non-plastic silts, temporarily lose strength during and immediately after a seismic event. Liquefaction occurs as seismic shear stresses propagate through a saturated soil and distort the soil structure causing loosely packed groups of particles to contract or collapse. If drainage is impeded and cannot occur quickly, the collapsing soil structure increases the porewater pressure between the soil grains. If the porewater pressure increases to a level approaching the weight of the overlying soil, the granular layer temporarily behaves as a viscous liquid rather than a solid. As strength is lost, there is an increased risk of settlement, lateral spread, and/or slope instability. Liquefaction-induced settlement occurs as the elevated porewater pressures dissipate and the soil consolidates after the earthquake.

Based on preliminary evaluations, there is some risk of seismically induced soil strength loss in isolated soft layer(s) within the decomposed basalt that were encountered in some of the explorations at depths of about 20 to 40 ft below the ground surface. In our opinion, the risk of significant settlement due to seismically induced soil strength loss in these isolated zones is low. However, there is some risk of seismic slope instability at the site, and the presence of these loose and soft soil zones may increase the risk of slope movement during and immediately following an earthquake. We anticipate a ground improvement program will be completed at the site to limit the risk of seismically induced soil strength loss and slope instability.

Other Hazards. The risk of damage by tsunami and/or seiche at the site is absent due to the elevation of the site. In our opinion, the risk of liquefaction-induced lateral spreading and ground deformation at the site is low. As previously discussed, the surface trace of the Bolton Fault is located about 900 ft northeast of the site. Unless occurring on a previously unmapped or unknown fault, it is our opinion the risk of ground rupture at the site is low.

Based on our slope stability analyses completed for the project, there is a risk of seismically induced slope instability at the site associated with a relatively horizontal to shallow dip of soft layer(s) within the decomposed basalt. Soft layers were encountered locally in the borings between depths of about 20 and 40 ft below the ground surface. Our analyses indicate the potential seismic instability at the site would most likely consist of near-horizontal, translational block failures beneath the tank and on the sloping ground north of the tank. As currently planned, a ground improvement program will be completed beneath the tank footprint to reduce the risk of seismic movements beneath the tank. In addition, the top of the slope along the north side of the site will be flattened to decrease the risk of slope movement on the reservoir.

Conclusions

The 2012 IBC design methodology uses two spectral response coefficients, S_S and S_1, corresponding to periods of 0.2 and 1.0 second, to develop the MCE_R response spectrum. The S_S and S_1 coefficients for the site are 0.95 and 0.41 g, respectively. The results of the ground motion hazard analysis indicate the 2012 IBC Site Class D spectrum provides an appropriate estimate of the spectral accelerations at the site. We recommend using the Site Class D design spectrum shown on Figure 8C for the project.

References

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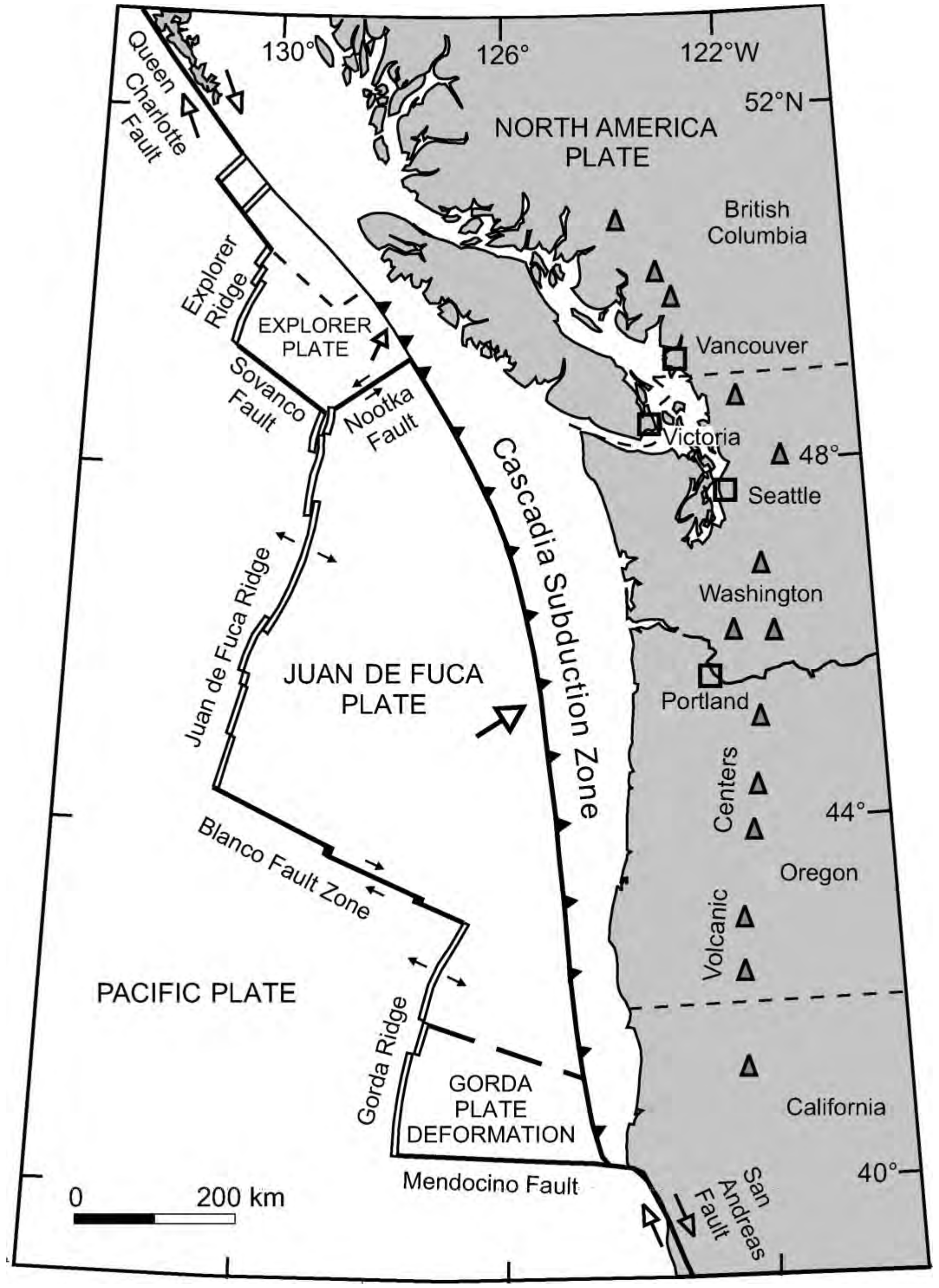
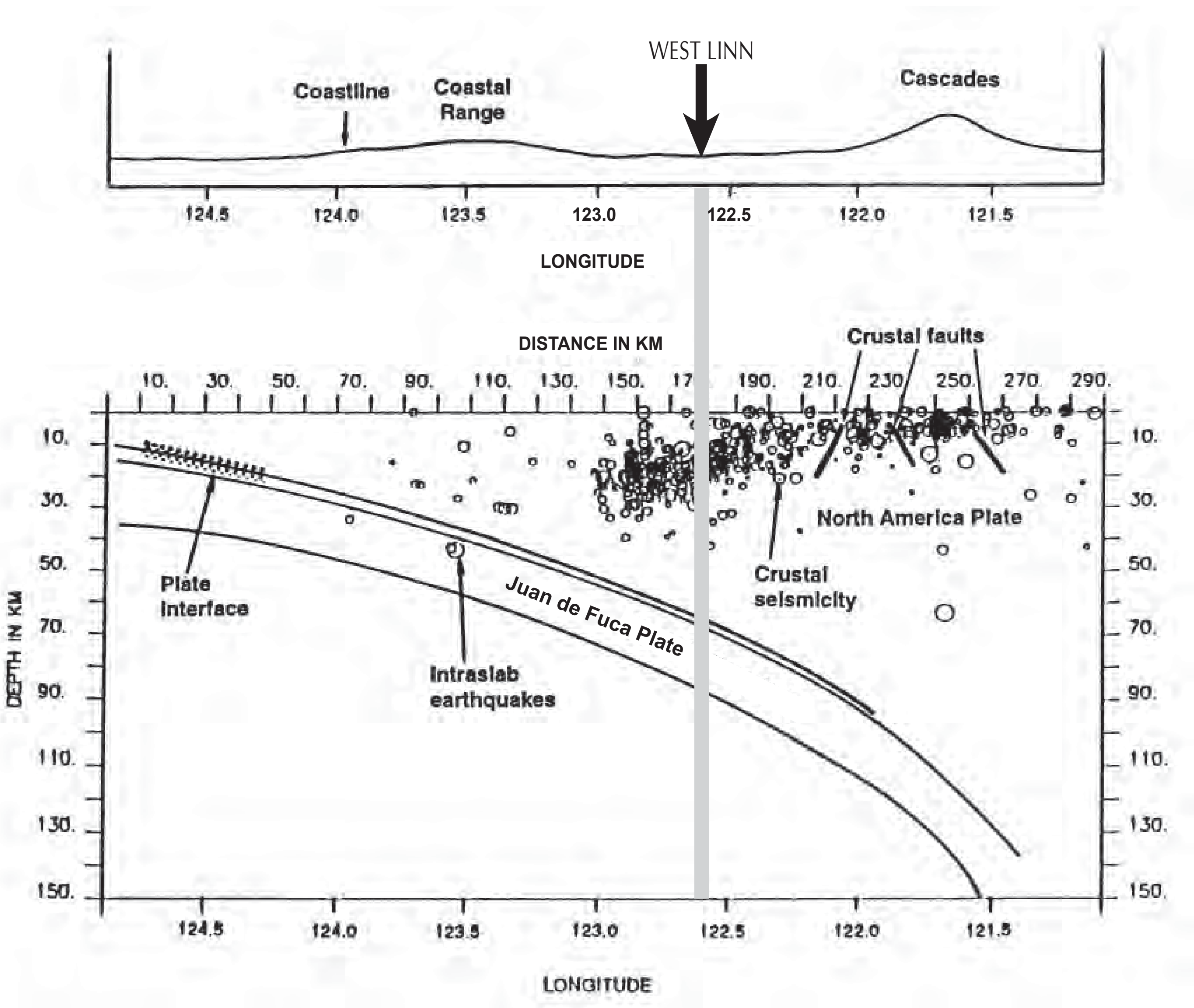


A) TECTONIC MAP OF PACIFIC NORTHWEST, SHOWING ORIENTATION AND EXTENT OF CASCADIA SUBDUCTION ZONE (MODIFIED FROM DRAGERT AND OTHERS, 1994)



B) EAST-WEST CROSS-SECTION THROUGH WESTERN OREGON AT THE LATITUDE OF PORTLAND, SHOWING THE SEISMIC SOURCES CONSIDERED IN THE SITE-SPECIFIC SEISMIC HAZARD STUDY (MODIFIED FROM GEOMATRIX, 1995)

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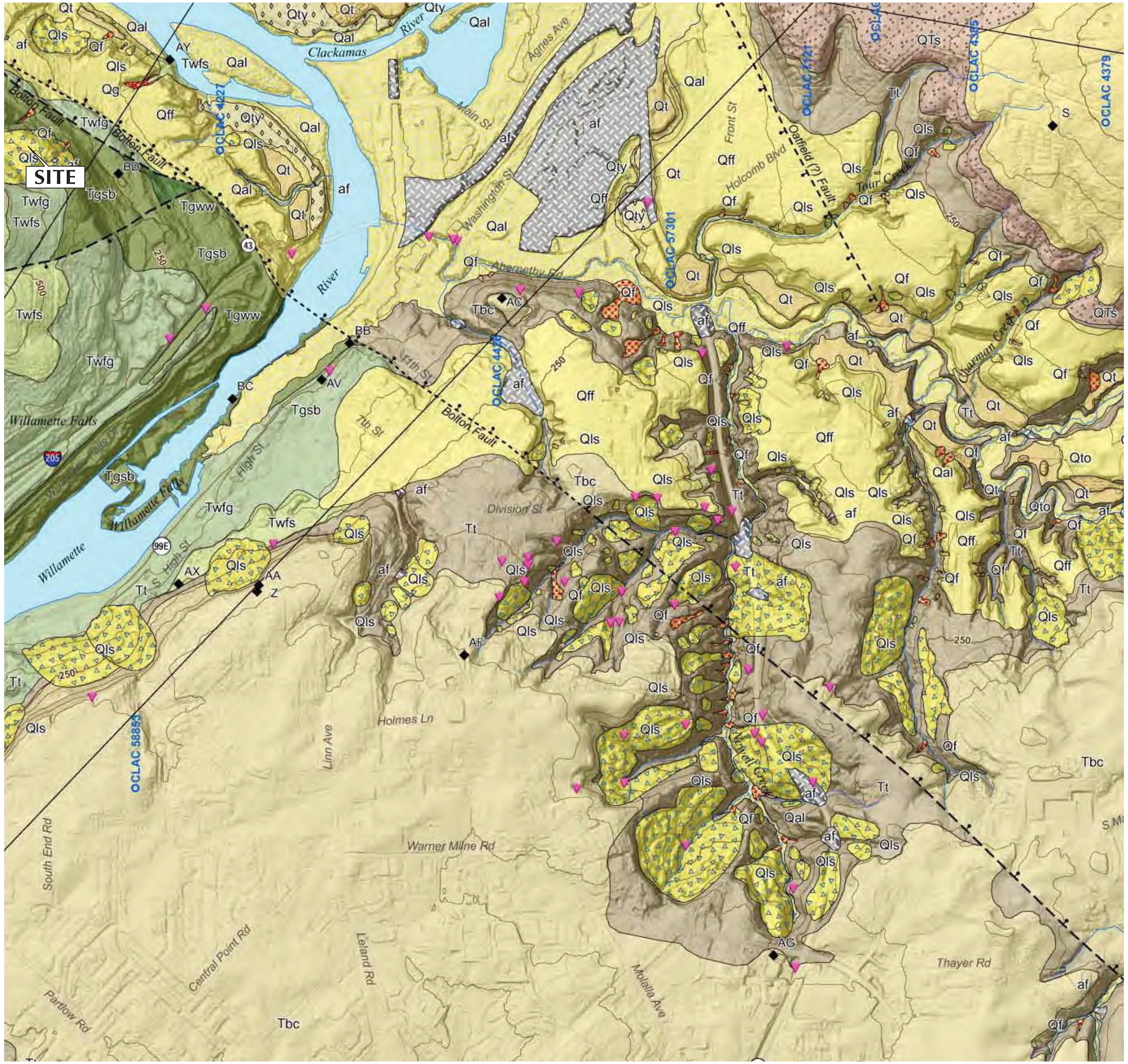
TECTONIC SETTING SUMMARY

JAN. 2015 JOB NO. 5338-A FIG. 1C



FROM: MADIN, I.P., 2009, GEOLOGIC MAP OF THE OREGON CITY 7.5' QUADRANGLE, CLACKAMAS COUNTY, OREGON: OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES GEOLOGIC MAP SERIES 119.

MAP SYMBOLS

◯	Contact, approximately located
-⊥--	Normal fault, approximate location
-⊥---	Normal fault, concealed location
-⊥--	Normal fault, inferred location
A—A'	Cross section line
🟦	Water body
◆	Geochemical sample site, labeled with map code
○	Location of water well used to construct cross section, labeled with Oregon Water Resources Department log identification number
▼	Location of minor debris flow from 1996-1997 storms (Hofmeister, 2000)
✪	Volcanic vent

EXPLANATION OF MAP UNITS

af	**Artificial fill** — Man-made deposits of mixed clay, silt, sand, gravel, and debris and rubble.

Quaternary Surficial Deposits

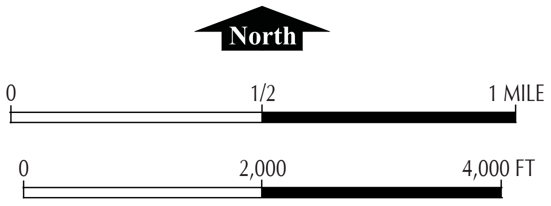
Qal	**Alluvial deposits (Quaternary)** — Gravel, sand, silt, and clay deposited in the active channels and floodplains of rivers and streams.
Qty	**Terrace deposits, younger (Quaternary)** — Lowest silt and sand (?) deposits capping strath terraces inset into Missoula Flood deposits along Abernethy Creek and the Willamette River near its confluence with the Clackamas River.
Qt	**Terrace deposits (Quaternary)** — Intermediate-elevation silt and sand (?) deposits capping strath terraces inset into Missoula Flood deposits along Abernethy Creek and the Willamette River near its confluence with the Clackamas River.
Qff	**Missoula (Bretz) flood deposits (Quaternary)** — Silt, sand, and minor gravel deposited by floods caused by the repeated failure of the glacial ice dam that impounded glacial Lake Missoula.
Qls	**Landslides (Quaternary)** — Chaotically mixed and deformed masses of rock, colluvium, and soil that have moved downslope in one or more events.

Miocene-Pleistocene fluvial sedimentary rocks

Qg	**Conglomerate (Pleistocene?)** — Pebble to cobble conglomerate exposed in the walls of a small stream canyon in the extreme northwest corner of the map area.
Tt	**Troutdale Formation sandstone, siltstone and mudstone (Miocene-Pliocene)** — Mudstone, claystone, sandstone, and minor conglomerate and tuff.

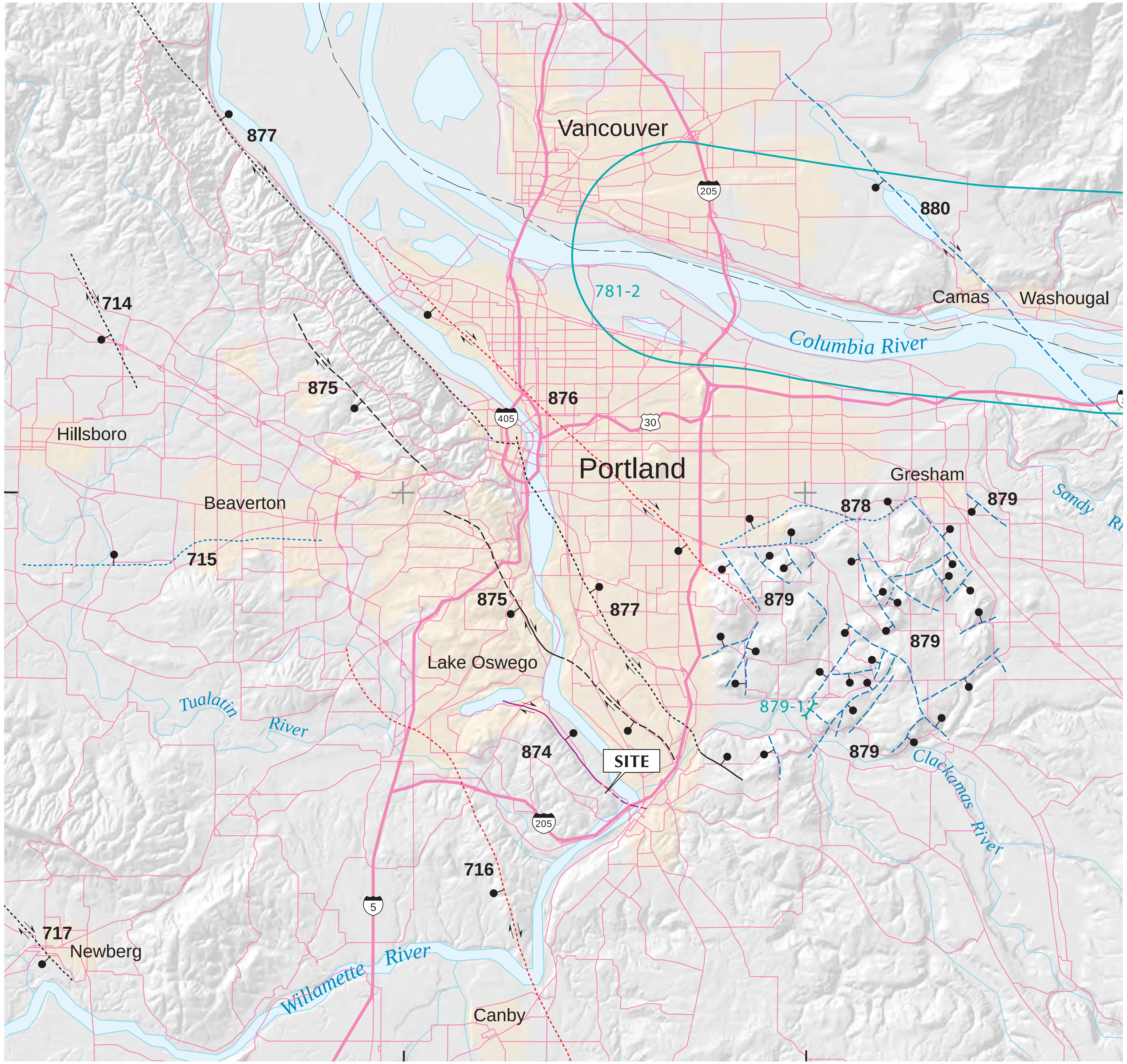
Miocene Columbia River Basalt Group lavas

Twfs	**Wanapum Basalt, Frenchman Springs Member, basalt of Sand Hollow (Miocene)** — Black medium-grained basalt flows with sparse plagioclase phenocrysts, well developed columnar jointing.
Twfg	**Wanapum Basalt, Frenchman Springs Member, basalt of Gingko (Miocene)** — Black medium-grained basalt flows with abundant plagioclase phenocrysts, well developed columnar jointing.
Tgww	**Grande Ronde Formation, basalt of Winter Water (Miocene)** — Flow or flows of fine-grained basalt.



GEOLOGIC MAP

JAN. 2015 JOB NO. 5338-A FIG. 2C



MAP EXPLANATION

TIME OF MOST RECENT SURFACE RUPTURE

- Holocene (<10,000 years) or post last glaciation (<15,000 years; 15 ka); no historic ruptures in Oregon to date
- Late Quaternary (<130,000; post penultimate glaciation)
- Late and middle Quaternary (<750,000 years; 750 ka)
- Quaternary, undifferentiated (<1,600,000 years; <1.6 Ma)
- Class B structure (age or origin uncertain)

SLIP RATE

- >5 mm/year
- 1.0-5.0 mm/year
- 0.2-1.0 mm/year
- <0.2 mm/year

TRACE

- Mostly continuous at map scale
- Mostly discontinuous at map scale
- Inferred or concealed

STRUCTURE TYPE AND RELATED FEATURES

- Normal or high-angle reverse fault
- Strike-slip fault
- Thrust fault
- Anticlinal fold
- Synclinal fold
- Monoclinal fold
- Plunge direction of fold
- Fault section marker

DETAILED STUDY SITES

- 731-2 Trench site
- 781-2 Subduction zone study site

CULTURAL AND GEOGRAPHIC FEATURES

- Divided highway
- Primary or secondary road
- Permanent river or stream
- Intermittent river or stream
- Permanent or intermittent lake

FAULT NUMBER	NAME OF STRUCTURE
716	CANBY-MOLALLA FAULT
874	BOLTON FAULT
875	OATFIELD FAULT
877	PORTLAND HILLS FAULT
879	DAMASCUS-TICKLE CREEK FAULT ZONE

FROM: PERSONIUS, S.F., AND OTHERS, 2003, MAP OF QUATERNARY FAULTS AND FOLDS IN OREGON, USGS OPEN FILE REPORT OFR-03-095.

North

0 5 10 MILES

0 5 10 KILOME-

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LOCAL FAULT MAP

JAN. 2015 JOB NO. 5338-A FIG. 3C

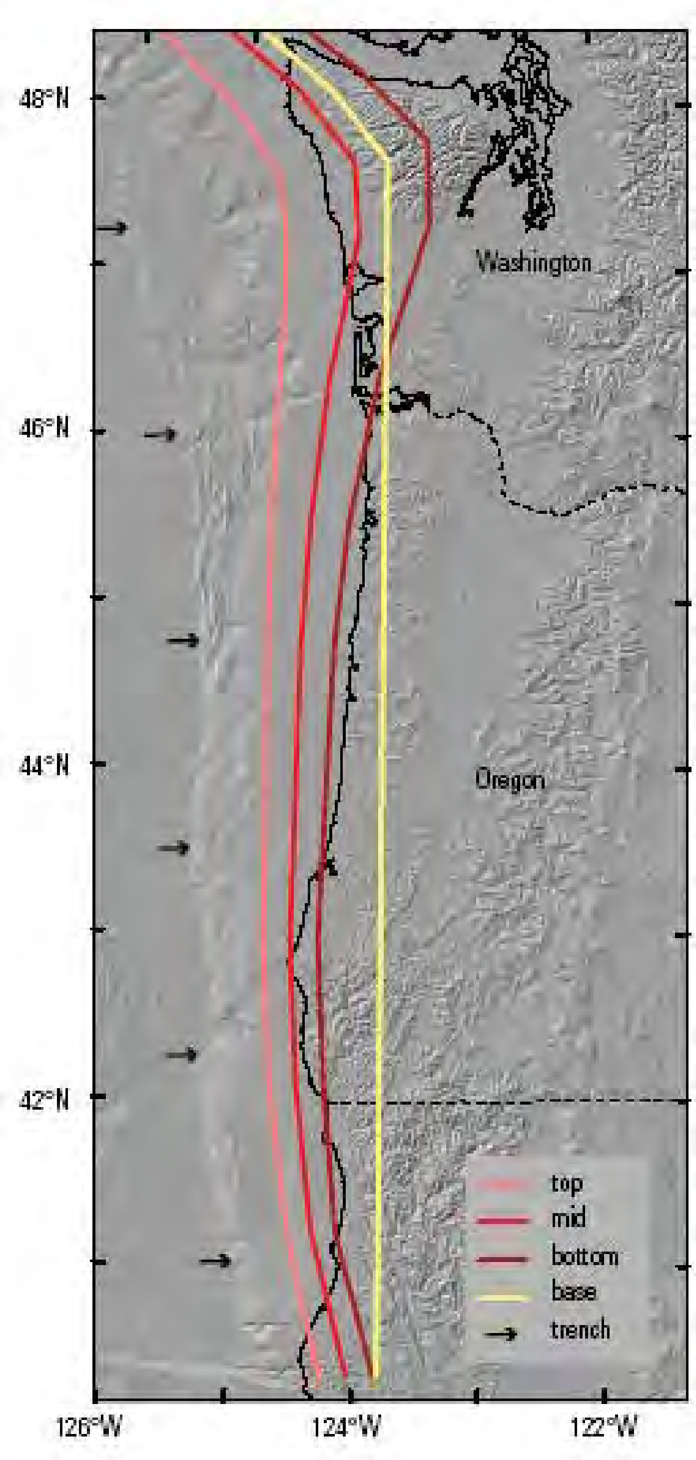

Figure 21. Location of the eastern edge of earthquake-rupture zones on the Cascadia subduction zone for the various models used in this study relative to the surficial expression of the trench: top, base of the elastic zone; mid, midpoint of the transition zone; bottom, base of the transition zones; base, base of the model that assumes ruptures extend to about 30-kilometers depth. Figure provided by Ray Weldon.

FROM: PETERSEN, MD, FRANKEL, AD, HARMSEN, SC, AND OTHERS, 2008, DOCUMENTATION FOR THE 2008 UPDATE OF THE UNITED STATES NATIONAL SEISMIC HAZARD MAPS: US GEOLOGICAL SURVEY, OPEN FILE REPORT 2008-1128

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ASSUMED RUPTURE LOCATIONS

(CASCADIA SUBDUCTION ZONE)

JAN. 2015 JOB NO. 5338-A FIG. 4C

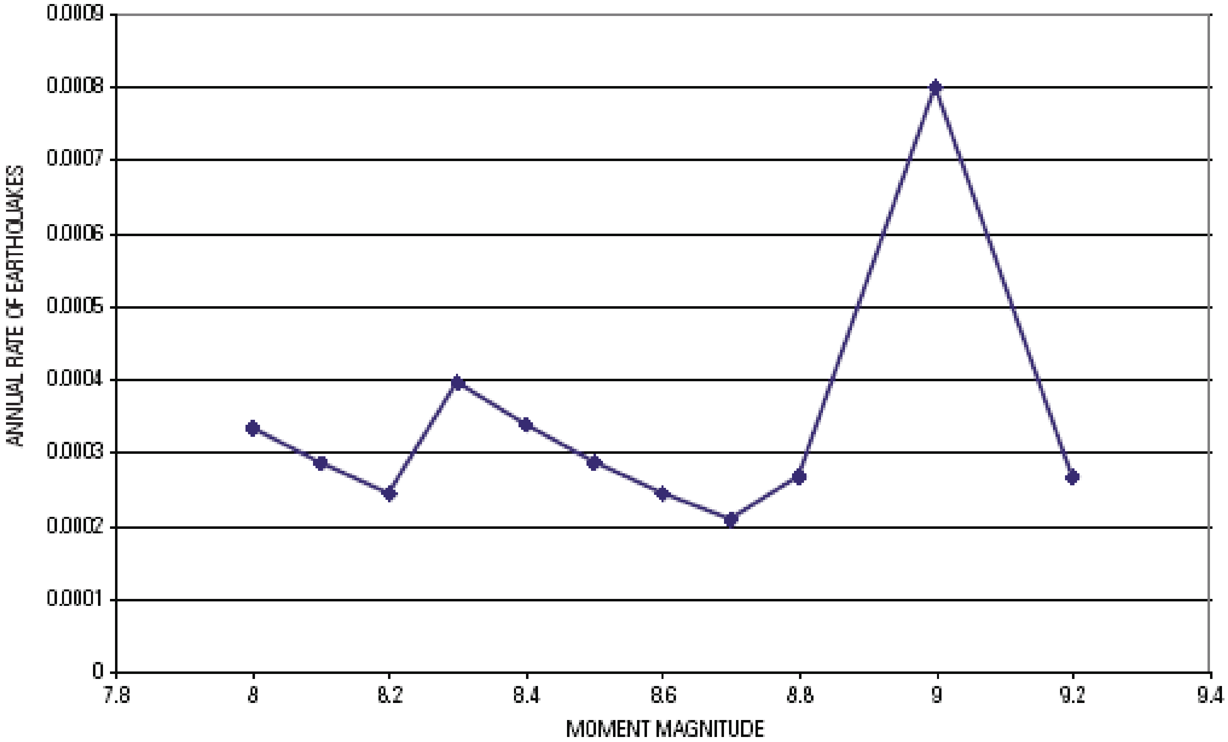

Figure 22. Magnitude-frequency distribution of the Cascadia subduction zone.

FROM: PETERSEN, M, FRANKEL, A, HARMSEN, S, AND OTHERS, 2008, DOCUMENTATION FOR THE 2008 UPDATE OF THE UNITED STATES NATIONAL SEISMIC HAZARD MAPS: US GEOLOGICAL SURVEY, OPEN FILE REPORT 2008-1128

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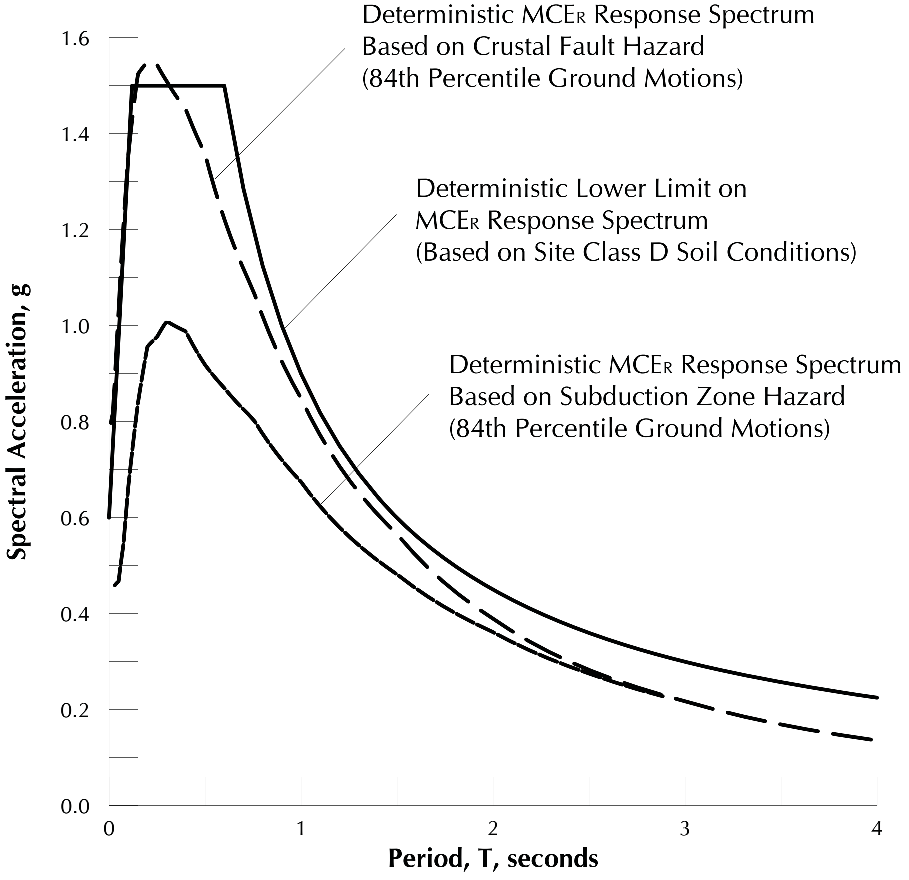
ASSUMED
MAGNITUDE-FREQUENCY DISTRIBUTION
(CASCADIA SUBDUCTION ZONE)

JAN. 2015 JOB NO. 5338-A FIG. 5C



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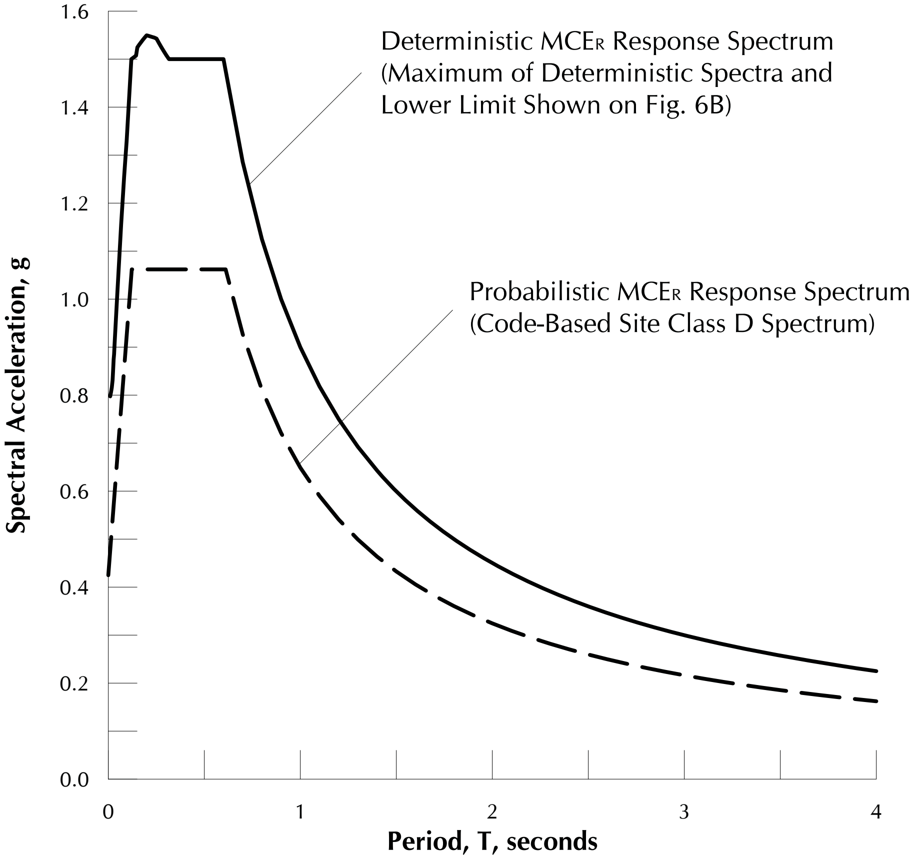
DETERMINISTIC MCE$_R$ RESPONSE SPECTRA

(5% DAMPING)

JAN. 2015 JOB NO. 5338-A FIG. 6C



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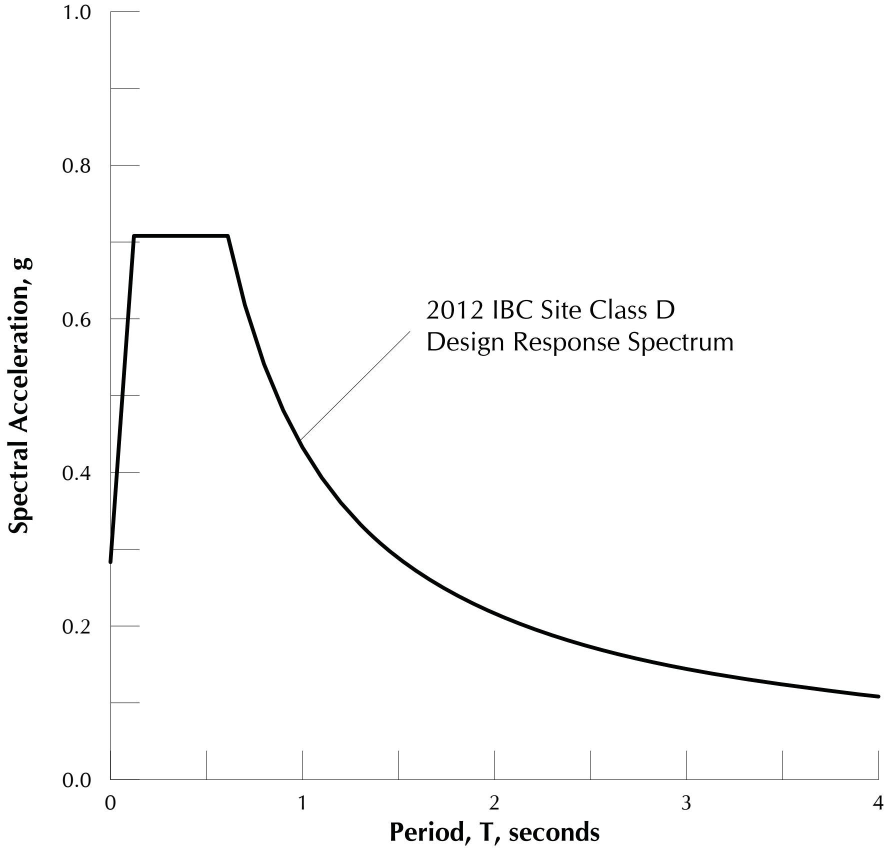
PROBABILISTIC AND DETERMINISTIC MCER
RESPONSE SPECTRA COMPARISON
(5% DAMPING)

JAN. 2015 JOB NO. 5338-A FIG. 7C



DESIGN RESPONSE SPECTRUM
(5% DAMPING)

JAN. 2015 JOB NO. 5338-A FIG. 8C

APPENDIX D

Limitations

APPENDIX D

LIMITATIONS

This report has been prepared to aid the project team in the planning and design of this project. The scope is limited to the specific project and location described herein, and our description of the project represents our understanding of the significant aspects of the project relevant to the design and construction of the proposed reservoir.

The conclusions and recommendations submitted in this report are based on the data obtained from the explorations made at the locations indicated on Figure 2 and from other sources of information discussed in this report. In the performance of subsurface investigations, specific information is obtained at specific locations at specific times. However, it is acknowledged that variations in soil and rock conditions may exist between exploration locations. This report does not reflect any variations that may occur between these explorations. The nature and extent of variation may not become evident until construction. If, during construction, subsurface conditions different from those encountered in the explorations are observed or encountered, we should be advised at once so that we can observe and review these conditions and reconsider our recommendations where necessary.