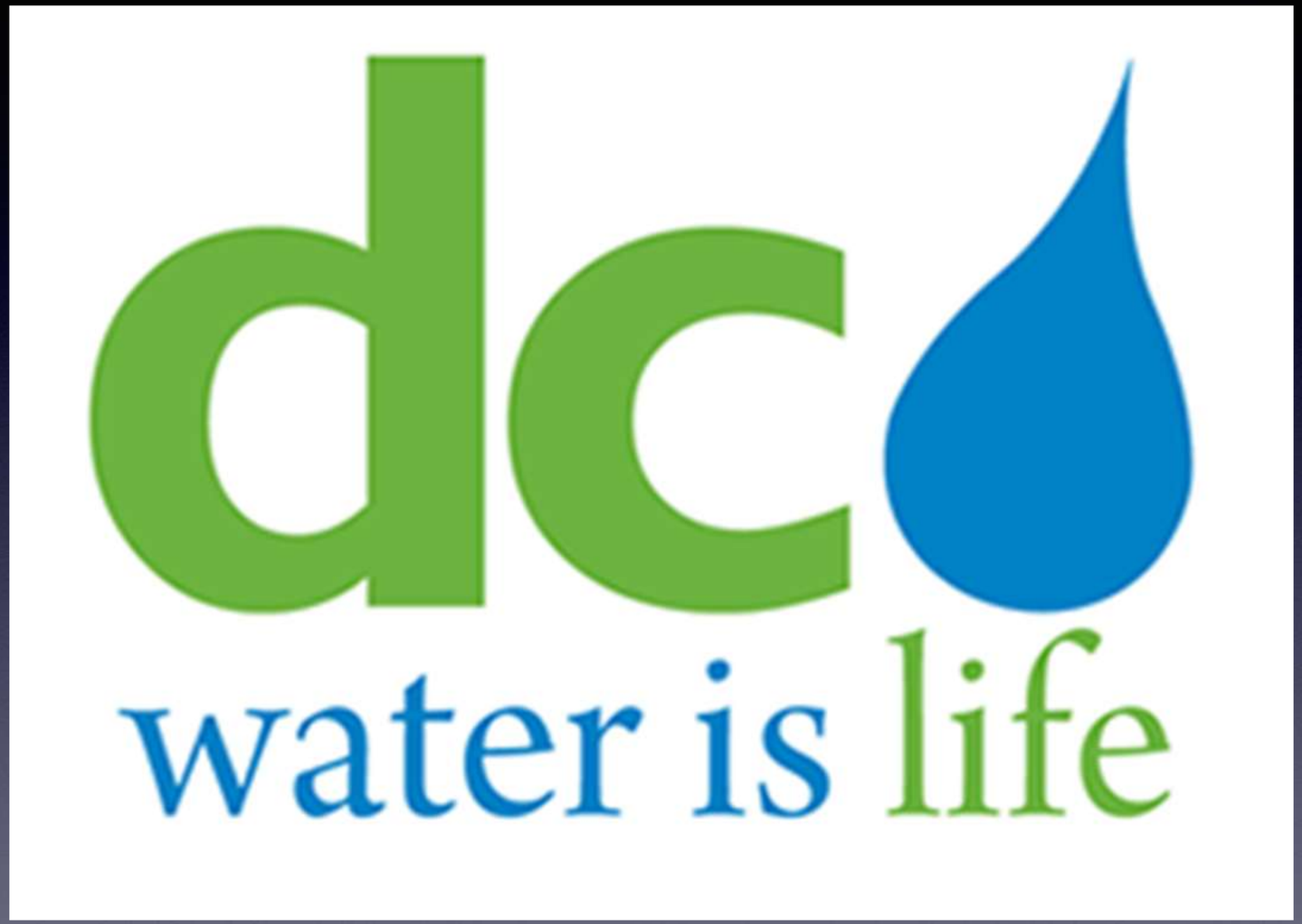
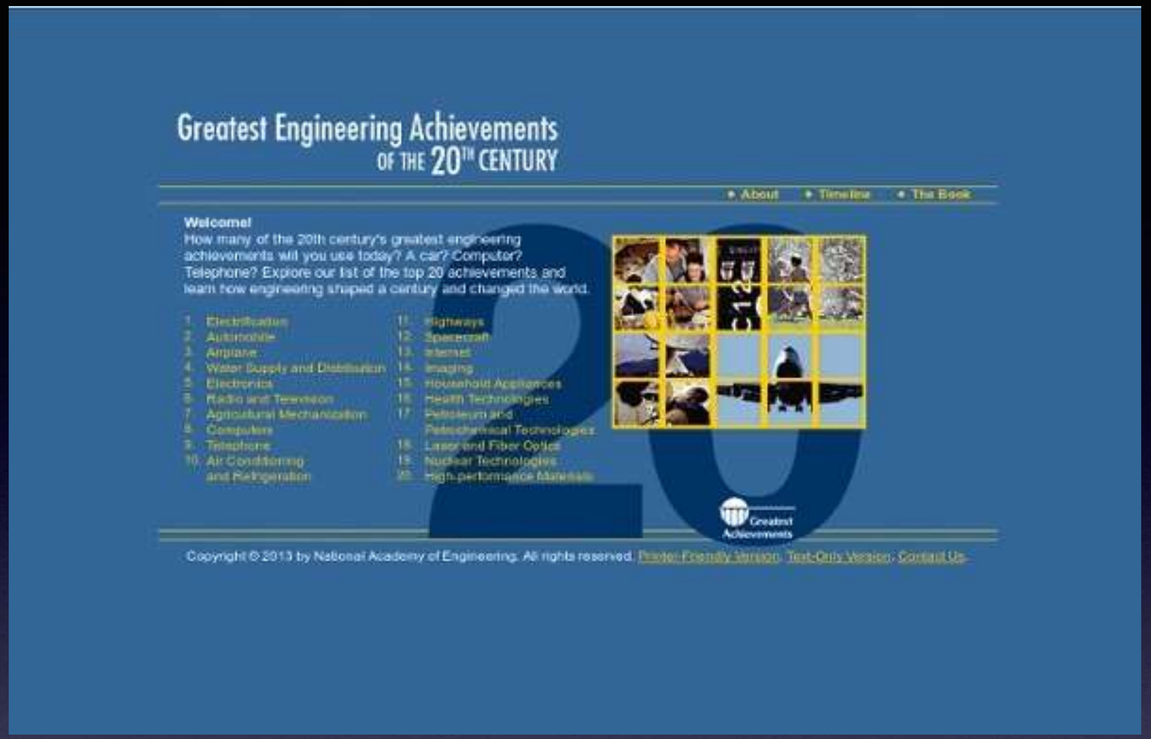
Water is Life

Catherine Howells, Ph.D.
PNWS Conference
April 30, 2015

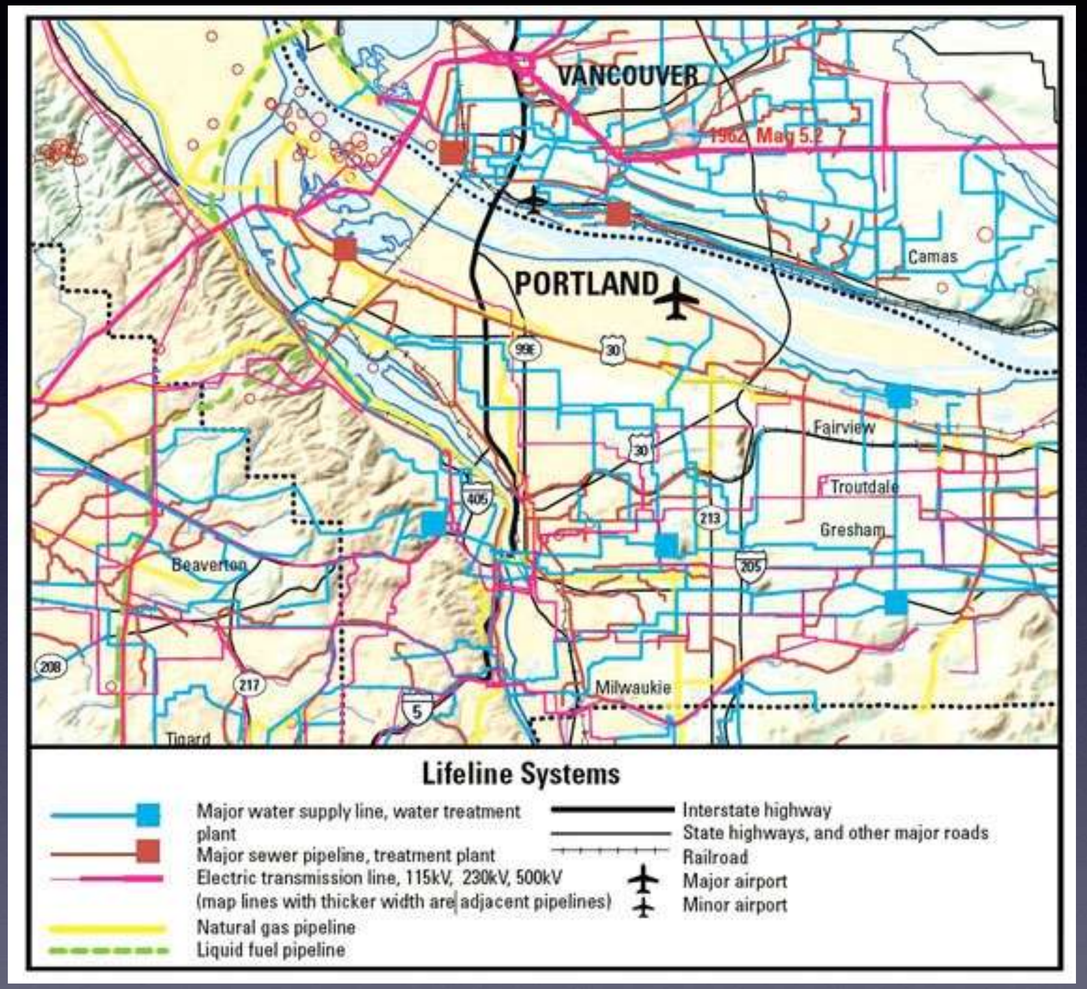

dc
water is life



1. Electrification
2. Automobile
3. Airplane
4. Water supply and distribution
5. Electronics

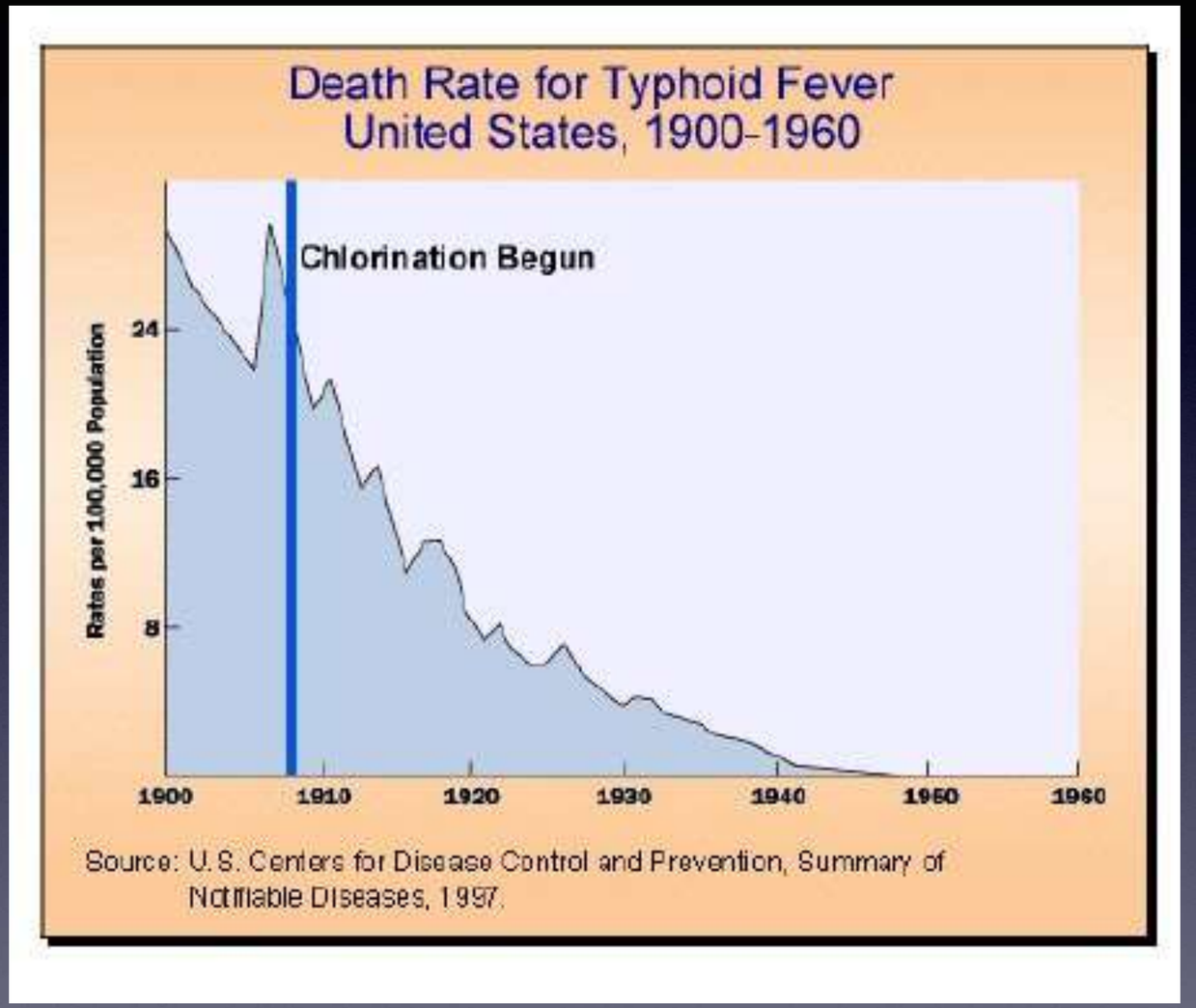
7 Days without Water

- one day no water comes out of the tap in an entire city and no one knows when it will come back
- day by day — what happens?


VANCOUVER
1962 Mag 5.2
PORTLAND
Camas
Fairview
Troutdale
Gresham
Beaverton
Milwaukie
Tigard
99E
30
405
213
205
208
217
5
Lifeline Systems
Major water supply line, water treatment plant
Major sewer pipeline, treatment plant
Electric transmission line, 115kV, 230kV, 500kV
(map lines with thicker width are adjacent pipelines)
Natural gas pipeline
Liquid fuel pipeline
Interstate highway
State highways, and other major roads
Railroad
Major airport
Minor airport

THE GREAT FIRE OF THE CITY OF NEW-YORK, 16 DECEMBER 1835.

Published January 1836 by the Proprietor H B Robinson, №48 Courtland Street New-York


Death Rate for Typhoid Fever
United States, 1900-1960
Chlorination Begun
Rates per 100,000 Population
24
16
8
1900
1910
1920
1930
1940
1950
1960
Source: U.S. Centers for Disease Control and Prevention, Summary of Notifiable Diseases, 1997.

Safe Drinking Water Act - Protecting America's Public Health

MULTIPLE RISKS REQUIRE MULTIPLE BARRIERS

Safe drinking water is essential to the health of American citizens and the economic health of our communities. However, drinking water is vulnerable to contamination from many potential threats. There are programs and activities that when operated effectively form a protective web of multiple barriers to ensure the safety of our drinking water. The success of these barriers relies on the involvement and vigilance of local, state and federal officials, the private sector, public interest groups and individual citizens.

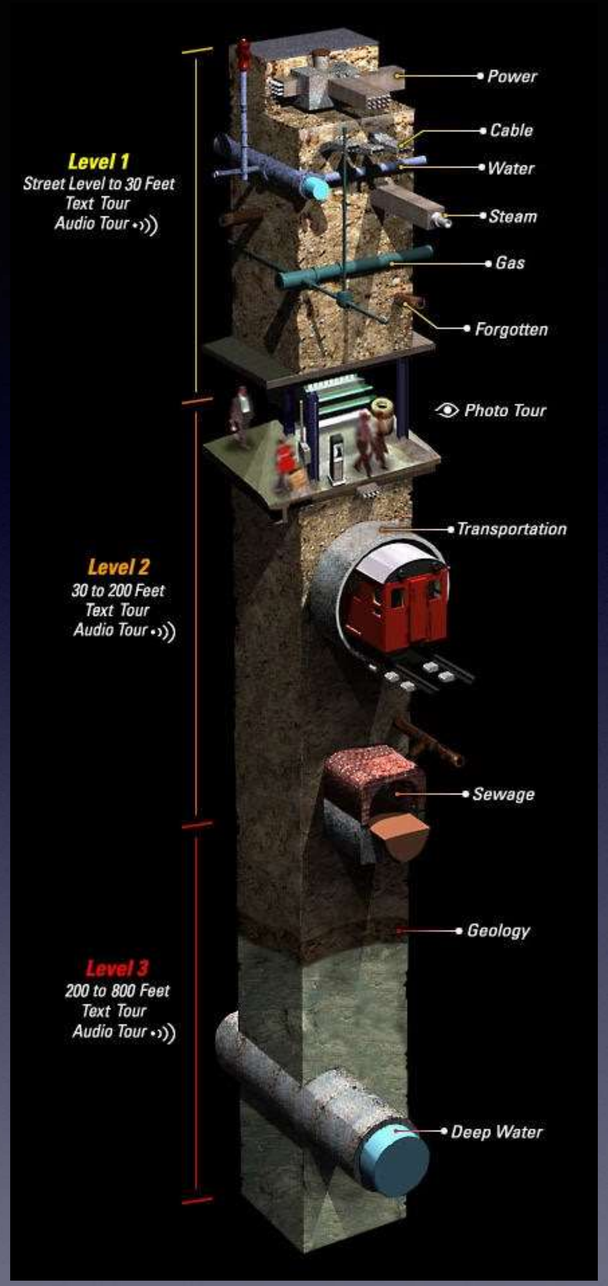
This poster identifies examples of

1. Surface and groundwater sources of drinking water (in blue),
2. Potential threats to those drinking water sources (in red), and
3. The multiple barriers that together protect our nation's public health (in green).
   - Risk Prevention Barrier
   - Risk Management Barrier
   - Risk Monitoring and Compliance Barrier
   - Individual Action Barrier

Safe Drinking Water Hotline – (800) 426-4791 Safewater Web Site – www.epa.gov/safewater

EPA
United States Environmental Protection Agency
EPA 816-H-02-003
January 2002


3324

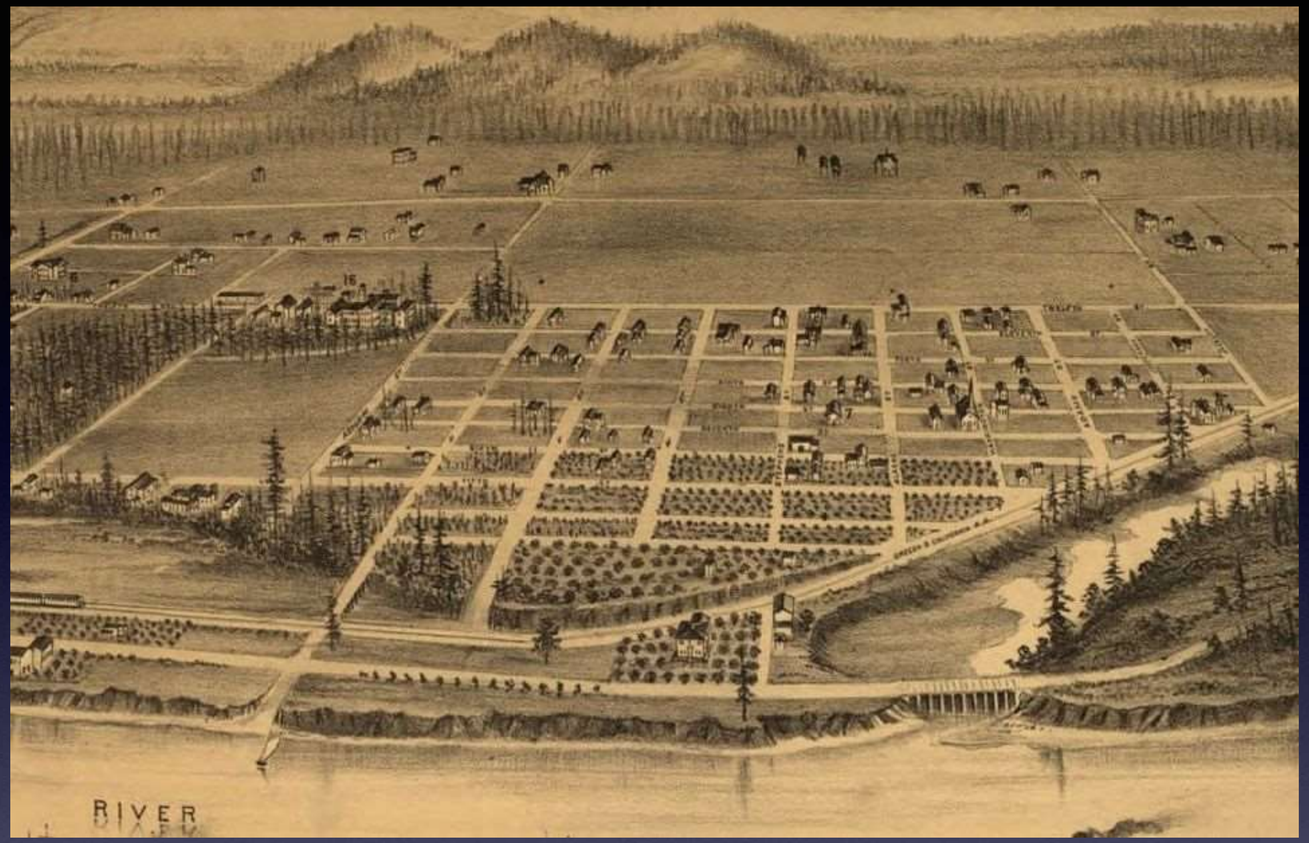

Level 1
Street Level to 30 Feet
Text Tour
Audio Tour
Level 2
30 to 200 Feet
Text Tour
Audio Tour
Level 3
200 to 800 Feet
Text Tour
Audio Tour
Power
Cable
Water
Steam
Gas
Forgotten
Photo Tour
Transportation
Sewage
Geology
Deep Water


WATER
SEWER
GAS
ELECTRIC
PHONE & CABLE

It’s Local

- pipes
- pumps
- valves
- fire hydrants
- growth
- drought
- earthquakes
- regulations
- public health
- pressure
- water rights
- storage
- design
- backflow
- source(s)
- security
- financing and rates
- water treatment
- aging infrastructure
- streets
- mapping
- dams
- people/politics


PORTLAND, OREGON.
Population 23,000.
LOOKING EAST TO THE CASCADE MOUNTAINS.


RIVER

VIEW OF

PORTLAND. OREGON.

1891

WITH COMPLIMENTS OF

STAVER & WALKER,

Water System Assets – $7.1 Billion

935,000 Customers Served

About 566,000 in the City of Portland and 368,000 through wholesale agreements

2 Sources

Bull Run Watershed and Columbia South Shore Well Field

75 Miles
Conduits

50 Miles
Transmission Mains

2,100 Miles
Distribution Mains

42
Pump Stations

9
Drinking Water Reservoirs

79
Tanks

6,500
Large Meters

167,000
Small Meters

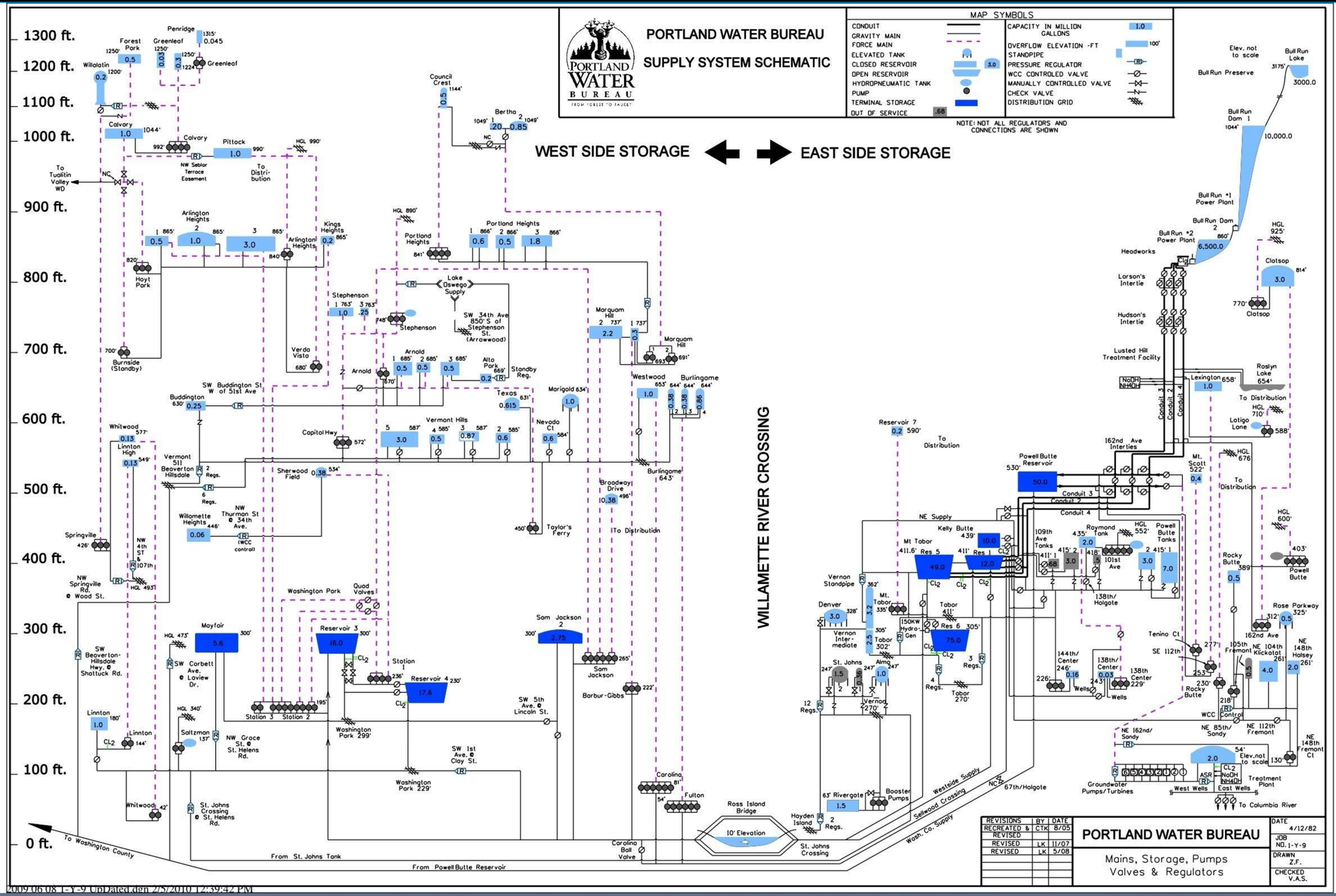
16,000
Hydrants

175
Properties

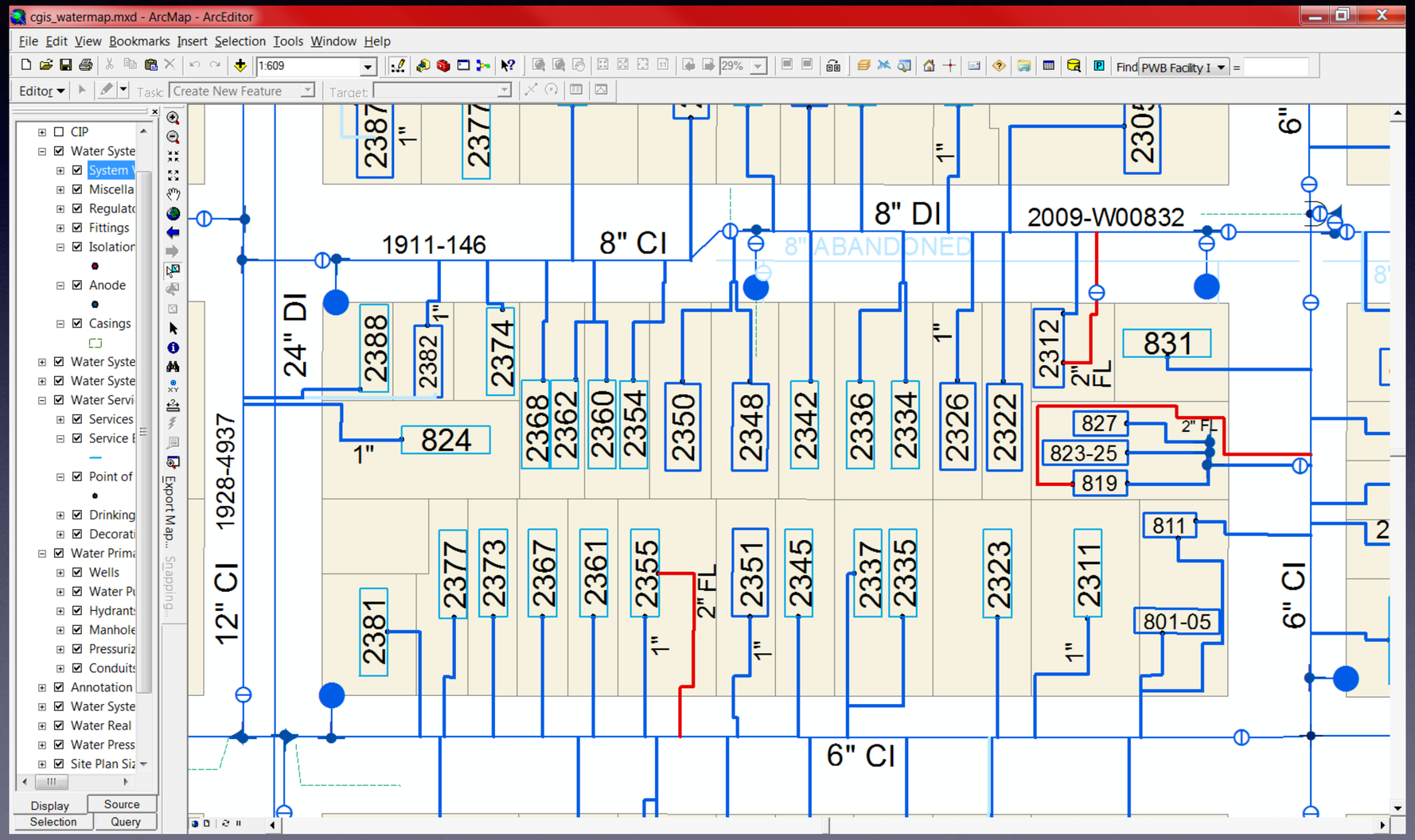
130
Drinking Fountains

PORTLAND

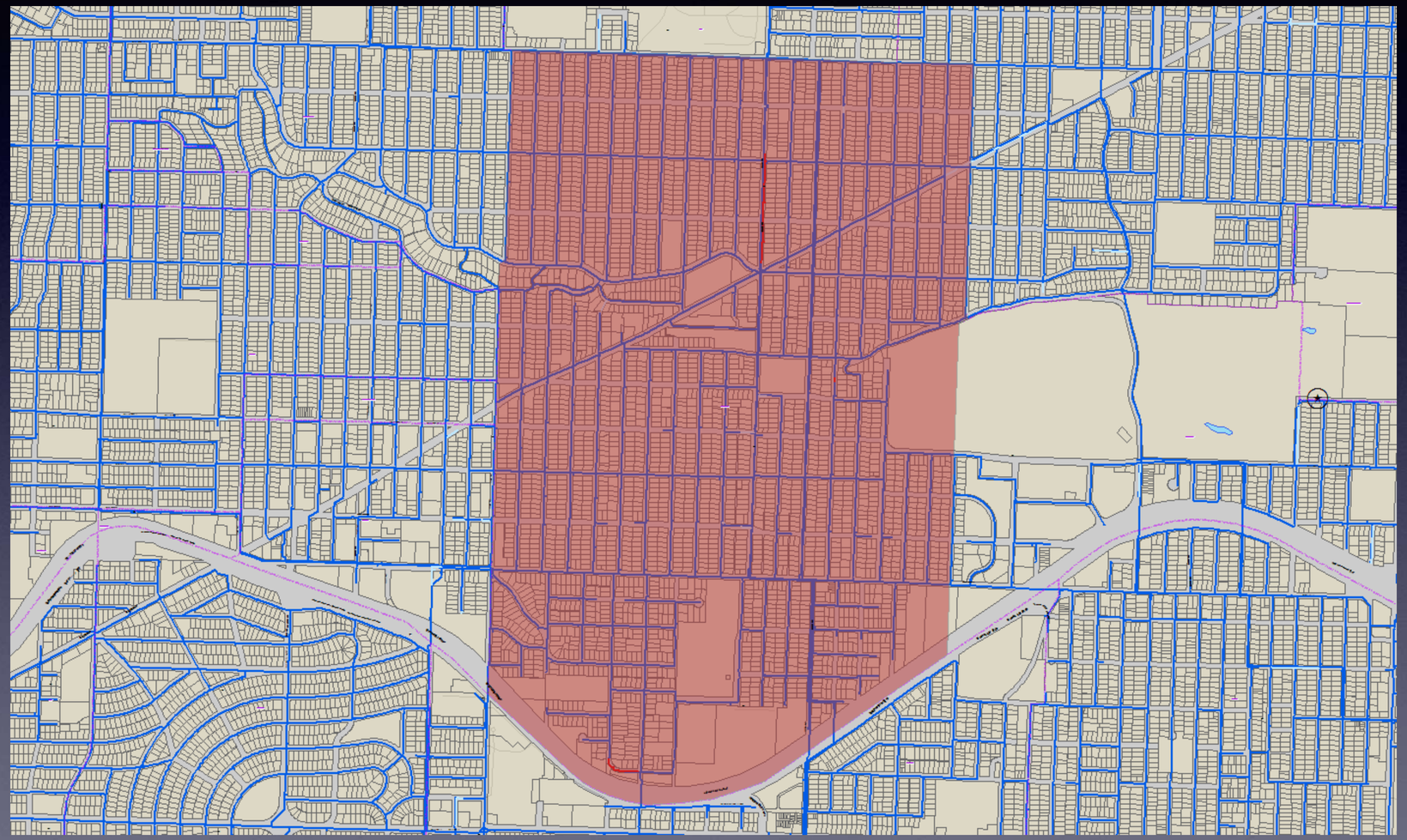

D.I.
250MP
ET 250
184


PORTLAND WATER BUREAU
SUPPLY SYSTEM SCHEMATIC
MAP SYMBOLS
CONDUIT
GRAVITY MAIN
FORCE MAIN
ELEVATED TANK
CLOSED RESERVOIR
OPEN RESERVOIR
HYDROPNEUMATIC TANK
PUMP
TERMINAL STORAGE
OUT OF SERVICE
CAPACITY IN MILLION GALLONS
OVERFLOW ELEVATION -FT
STANDPIPE
PRESSURE REGULATOR
WCC CONTROLED VALVE
MANUALLY CONTROLLED VALVE
CHECK VALVE
DISTRIBUTION GRID
NOTE: NOT ALL REGULATORS AND CONNECTIONS ARE SHOWN
WEST SIDE STORAGE
EAST SIDE STORAGE
WILLAMETTE RIVER CROSSING
1300 ft.
1200 ft.
1100 ft.
1000 ft.
900 ft.
800 ft.
700 ft.
600 ft.
500 ft.
400 ft.
300 ft.
200 ft.
100 ft.
0 ft.
Penridge
Forest Park
Greenleaf
Willalatin
Calvory
Pittock
To Tualitin Valley WD
NW Sebler Terrace Easement
To Distribution
Council Crest
Bertha
Arlington Heights
Kings Heights
Portland Heights
Hoyt Park
Burnside (Standby)
Lake Oswego Supply
Stephenson
SW 34th Ave 850'S of Stephenson St. (Arrowwood)
Marquam Hill
Verda Vista
Arnold
Standby Reg.
SW Buddington St W of 51st Ave
Buddington
Texos
Marigold
Westwood
Burlingame
Capitol Hwy
Vermont Hills
Nevada Ct
Whitwood
Linnton High
Vermont
Beaverton Hillsdale
Sherwood Field
Broadway Drive
To Distribution
Willamette Heights
NW Thurman St @ 34th Ave.
(WCC control)
Taylor's Ferry
Springville
NW 4th ST & 107th
NW Springville Rd. @ Wood St.
Washington Park
Quad Valves
Mayfair
Reservoir 3
Reservoir 4
Station 1
Station 2
Station 3
Sam Jackson
Barbur-Gibbs
SW Beaverton-Hillsdale Hwy. @ Shattuck Rd.
SW Corbett Ave. @ Loview Dr.
Washington Park 299'
SW 5th Ave. @ Lincoln St.
Linnton
Saltzman
NW Groce St. @ St. Helens Rd.
Washington Park 229'
SW 1st Ave. @ Clay St.
Whitwood
St. Johns Crossing @ St. Helens Rd.
Caroline
Fulton
Caroline Ball Valve
Ross Island Bridge
10' Elevation
Hayden Island
2 Regs.
St. Johns Crossing
To Washington County
From St. Johns Tank
From Powell Butte Reservoir
Reservoir 7
To Distribution
Powell Butte Reservoir
50.0
Conduit 3
Conduit 2
Conduit 4
162nd Ave Interties
NE Supply
Kelly Butte
Mt Tabor
Mt Tabor Res 5
Mt Tabor Res 1
Mt Tabor Res 6
Tabor
Vernon Standpipe
Vernon Intermediate
Denver
St. Johns
Almq
Vernon
150KW Hydro Gen
109th Ave Tanks
Raymond Tank
Powell Butte Tanks
101st Ave
138th/ Holgate
144th/ Center
138th Center
Wells
Tenino Ct
SE 112th
105th Fremont
NE 104th Klickatat
NE 148th Holsey
Rose Parkway
162nd Ave
Rocky Butte
Powell Butte
Mt. Scott
Lexington
Roslyn Lake
Latigo Lane
Clatsop
Headworks
Larson's Intertie
Hudson's Intertie
Lusted Hill Treatment Facility
Bull Run Preserve
Bull Run Lake
Bull Run Dam 1
Bull Run Dam 2
Bull Run #1 Power Plant
Bull Run #2 Power Plant
Elev. not to scale
3175'
3000.0
10,000.0
6,500.0
NaOH
Cl2
To Distribution
NE 162nd/ Sandy
NE 85th/ Sandy
NE 112th Fremont
NE 148th Fremont Ct
54' Elev. not to scale
Groundwater Pumps/Turbines
West Wells
East Wells
ASR
Treatment Plant
To Columbia River
63' Rivergate
Booster Pumps
Westside Supply
Sellwood Crossing
Wash. Co. Supply
NC
67th/Holgate
REVISIONS
RECREATED & REVISED CTK 8/05
REVISED LK 11/07
REVISED LK 5/08
PORTLAND WATER BUREAU
Mains, Storage, Pumps Valves & Regulators
DATE 4/12/82
JOB NO. 1-Y-9
DRAWN Z.F.
CHECKED V.A.S.
2009 06 08 1-Y-9 UpDated.dgn 2/5/2010 12:39:42 PM

The Water System



The Rose City Park Neighborhood



Approx 234 blocks, 3,600 Parcels

The Rose City Park Neighborhood Water System

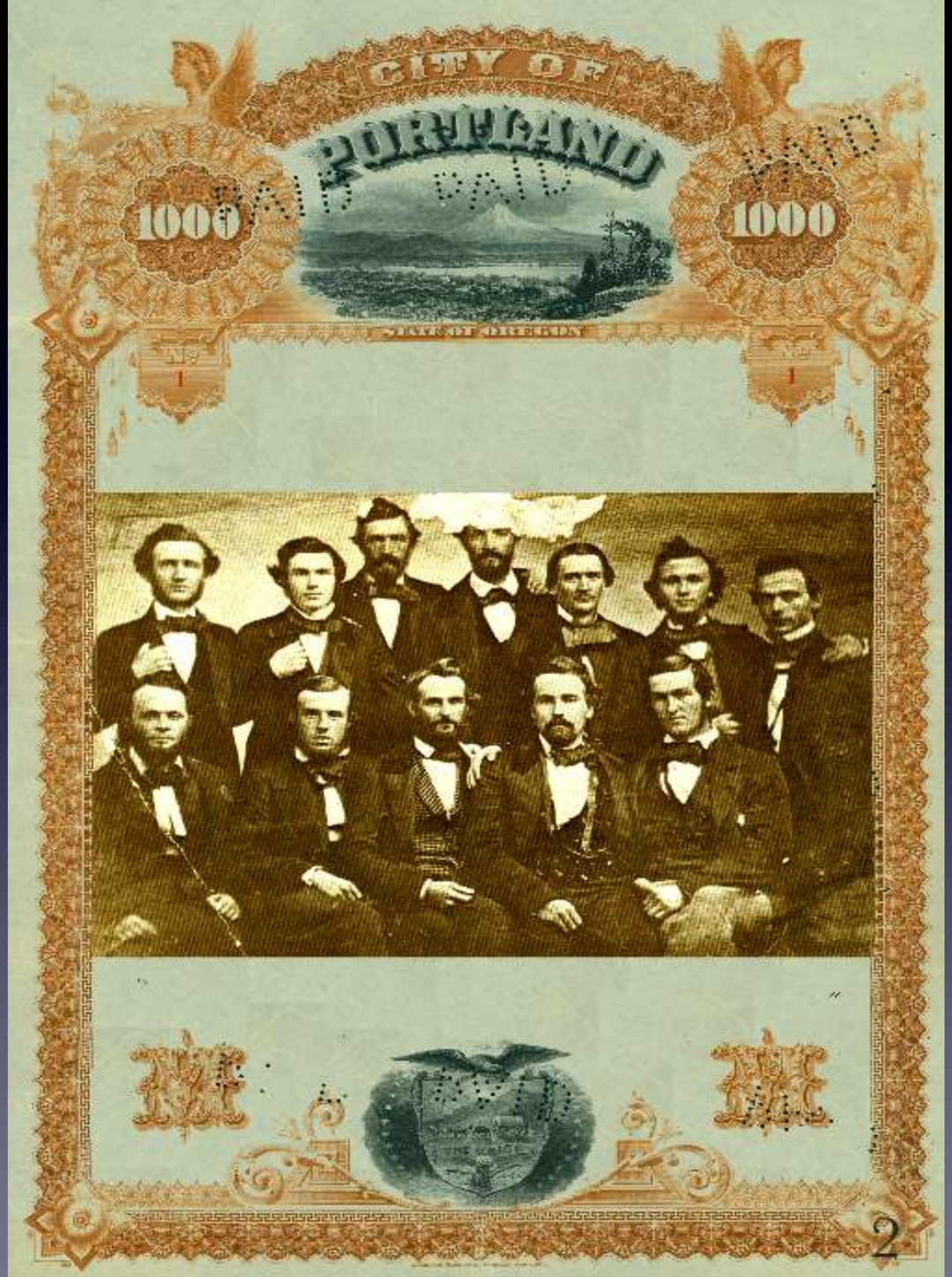
178,473 ft of 6” & 8” DI Water Main
Costs $20,246,000 to Install

221 Fire Hydrants @ $4,539 = $1,003,119

3,756 1” Services @ $2,428/ea. = $9,119,568

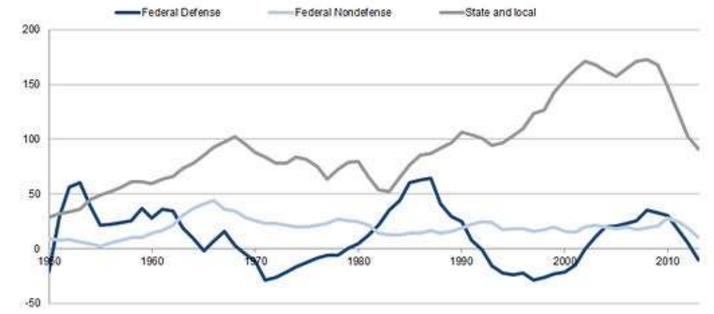
Water Infrastructure for Neighborhood
= $30,369,000.*

*Does Not Include Water Supply & Transport, Tanks, Pump Stations, et al


CITY OF
PORTLAND
1000
1000

Public Infrastucture Spending: Going Down

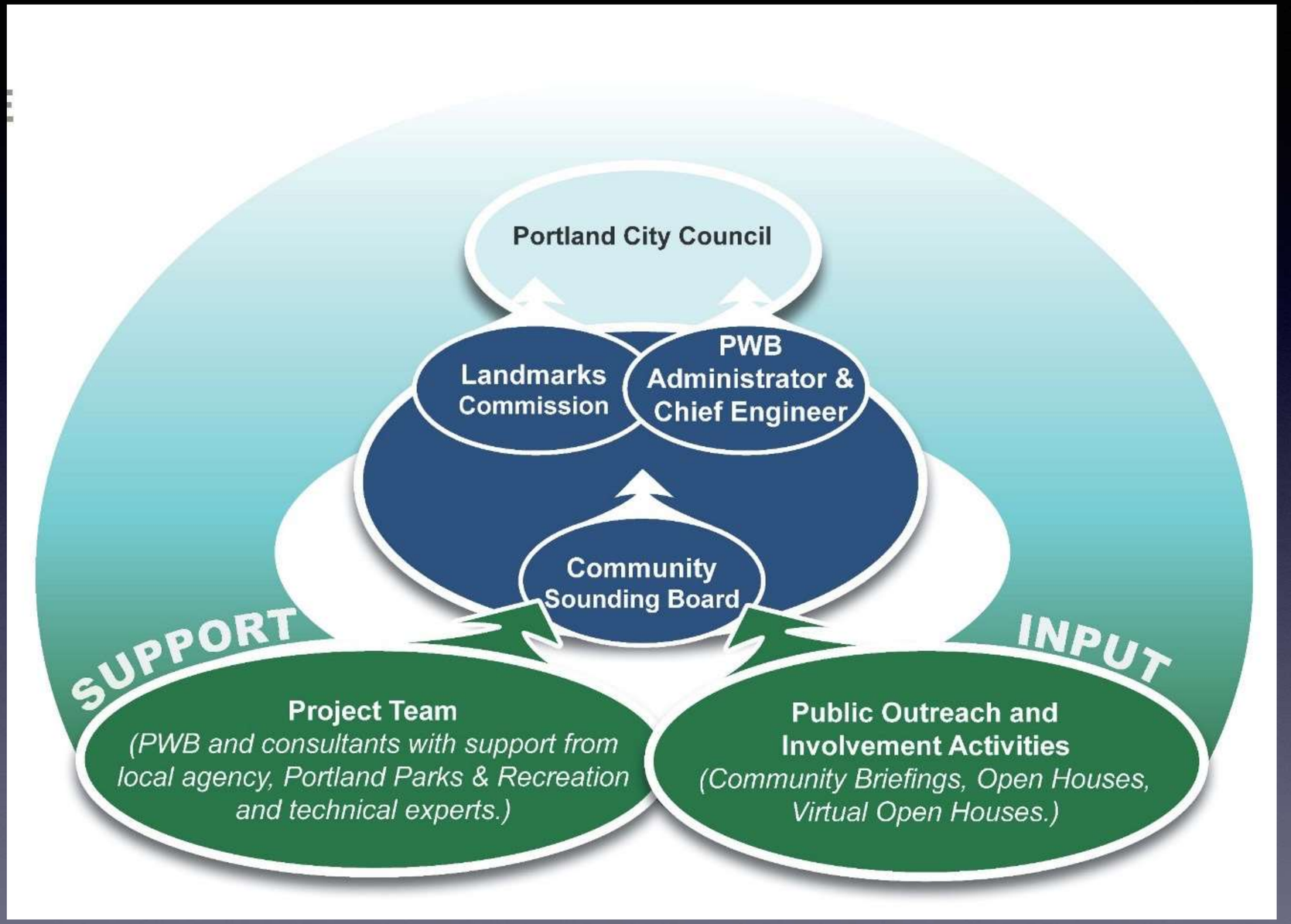
Net government investment spending, state & local, federal defense, federal non-defense, billions of 2014 dollars



Source: Bureau of Economic Analysis; Hutchins Center on Fiscal & Monetary Policy, Brookings

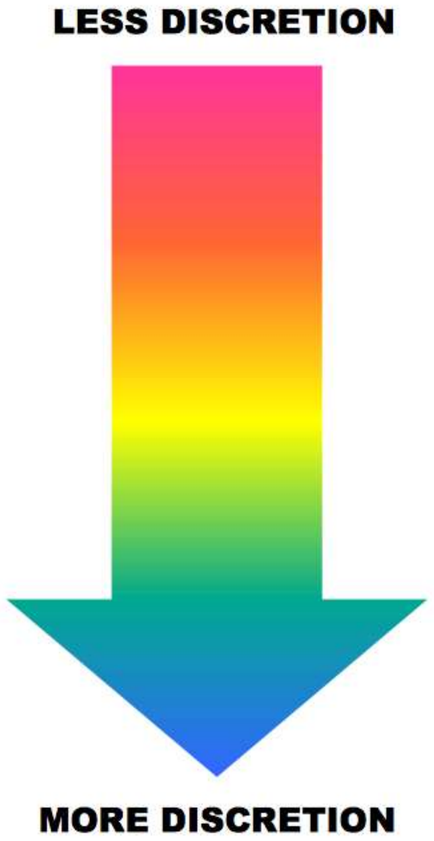
BROOKINGS

Capital Investment in Water and Wastewater Infrastructure


Portland City Council
Landmarks Commission
PWB Administrator & Chief Engineer
Community Sounding Board
SUPPORT
INPUT
Project Team
(PWB and consultants with support from local agency, Portland Parks & Recreation and technical experts.)
Public Outreach and Involvement Activities
(Community Briefings, Open Houses, Virtual Open Houses.)

What drives the CIP?

- **Regulatory Compliance**
- Public Health Protection
- Risk Mitigation
- Public Expectations
- Cost-to-Benefit Analyses
- Stewardship
- Council Direction



Resilience

- Entropy
- Black Swan events


Development
Partnership
Oregon
Plan
Resources
Flood
Natural
Hazards
Exploring
Tsunamis
Coordinator
Dust
tco
challenges
expertise
questions
role
Windstorms
Planning
resilience
Initiatives
Mitigation
key
Recovery
County
for
livelihoods
Community
disaster
aims
answers
Hazard
domains
Flow
innovation
Plans
Service
approaches
Landslides
Winter
Earthquake
Tsunami
technical
explore
importance
mechanisms
Debris
context
Storms
connect
Research
achieving
lessons
Center
work
State
Fire
Coast
OPDR

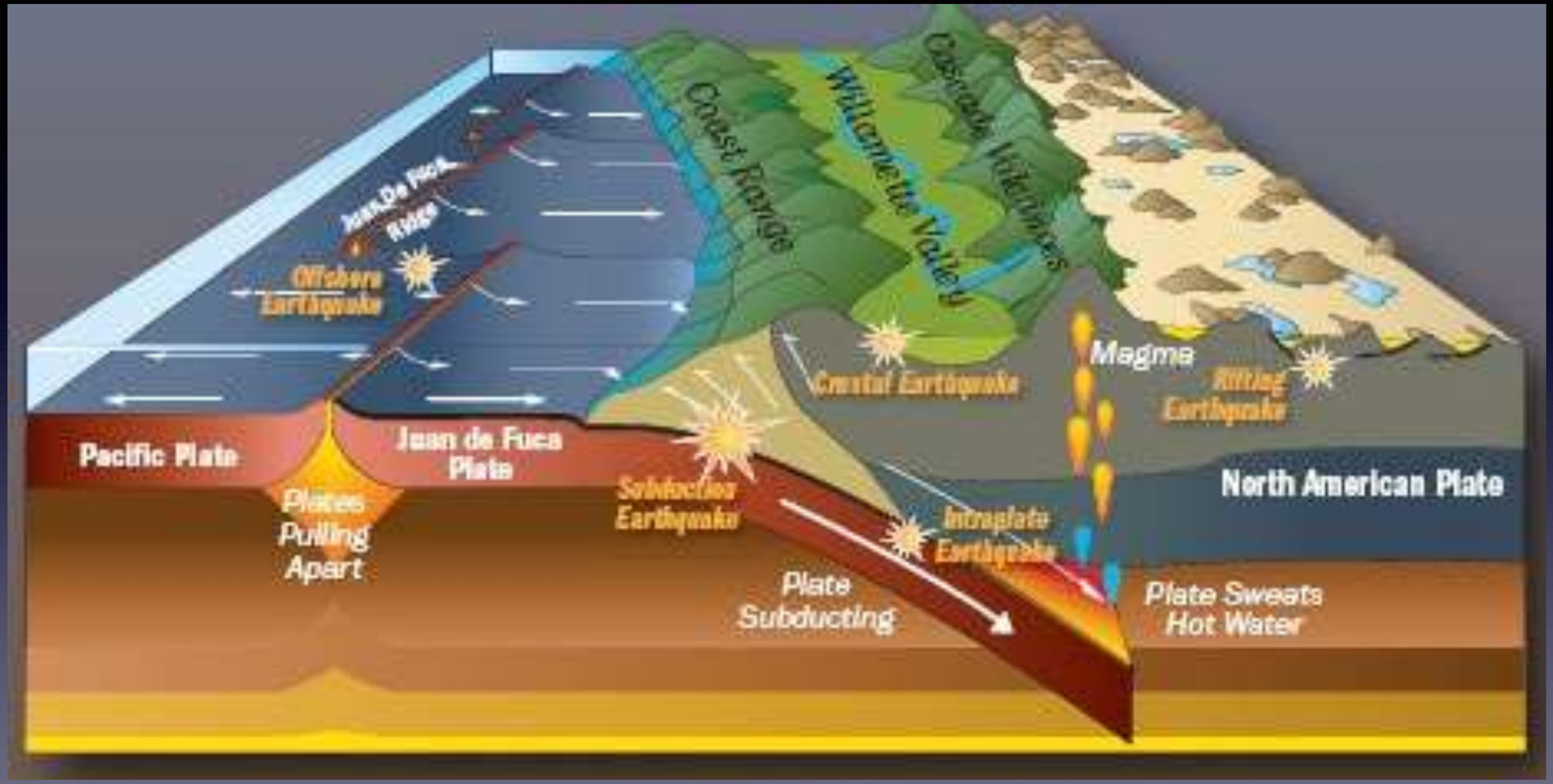
The Oregon Resilience Plan

Reducing Risk and Improving Recovery for the Next Cascadia Earthquake and Tsunami

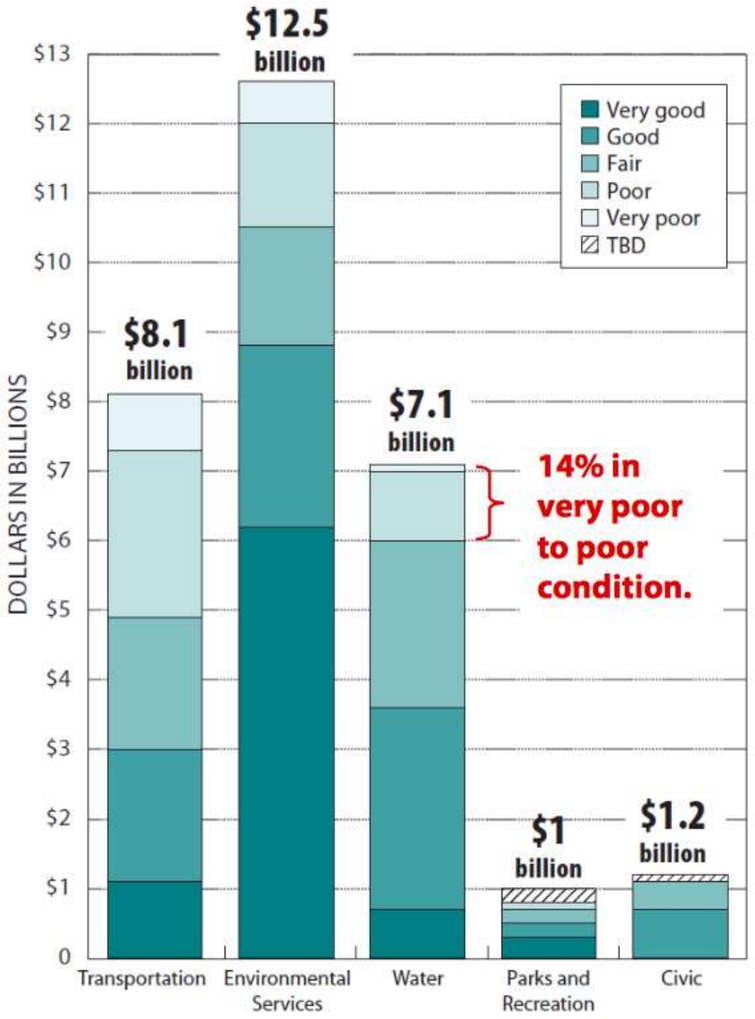
Report to the
77th Legislative Assembly

from
Oregon Seismic Safety Policy
Advisory Commission (OSSPAC)

Salem, Oregon
February 2013


Juan De Fuca Ridge
Offshore Earthquake
Coast Range
Willamette Valley
Cascade Volcanoes
Crustal Earthquake
Magma
Rifting Earthquake
Pacific Plate
Juan de Fuca Plate
North American Plate
Plates Pulling Apart
Subduction Earthquake
Intraplate Earthquake
Plate Subducting
Plate Sweats Hot Water

Condition of Assets



- Total asset value is **$7.1 billion**.
- About **14 %** of the bureau's assets are in very poor to poor condition, representing **$1 billion** of needed investment.
- About **half** of the 2,100 miles of pipes in the Distribution system are **more than 60 years old**.

PORTLAND WATER BUREAU


SIDEWALK
CLOSED
NYC DEP

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 (COAST)

	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			R	Y	G					X	
Water supply to critical facilities available				R		Y		G		X	
Water for fire suppression—at key supply points			R		Y			G		X	
Water for fire suppression—at fire hydrants						R	Y	G		X	
Water available at community distribution centers/points				R	Y	G	X				
Distribution system operational					R		Y	G			X

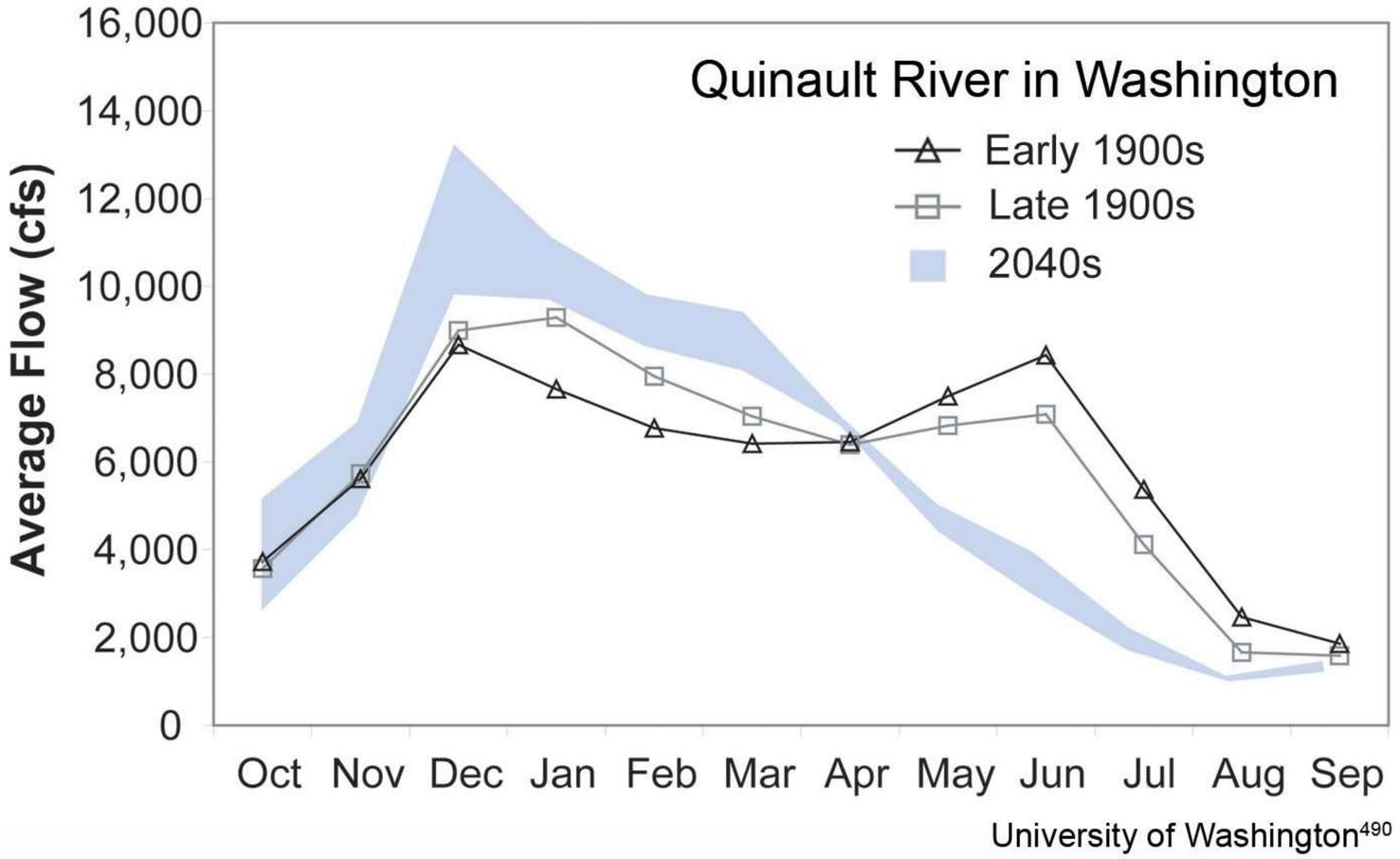
KEY TO THE TABLE

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

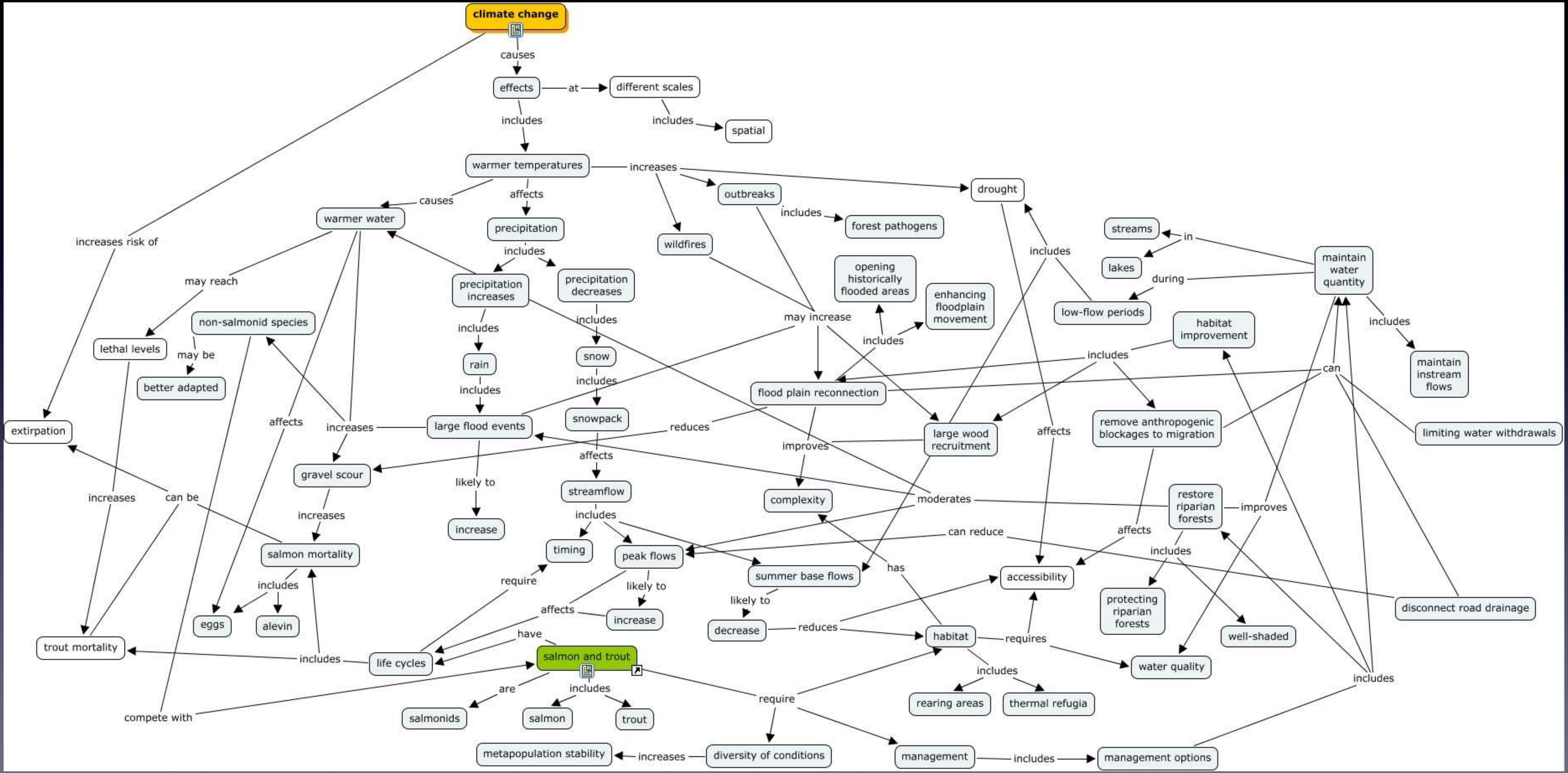
TARGET STATES OF RECOVERY: WATER & WASTEWATER SECTOR (VALLEY)

	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		



University of Washington[490]

As precipitation continues to shift from snow to rain, by the 2040s, peak flow on the Quinault River is projected to occur in December, and flows in June are projected to be reduced to about half of what they were over the past century. On the graph, the blue swath represents the range of projected streamflows based on an increase in temperature of 3.6 to 5.4°F. The other lines represent streamflows in the early and late 1900s.[487,494]


climate change
causes
effects
at
different scales
includes
spatial
includes
warmer temperatures
increases
drought
outbreaks
includes
forest pathogens
wildfires
causes
warmer water
affects
precipitation
includes
precipitation increases
precipitation decreases
increases risk of
may reach
lethal levels
non-salmonid species
may be
better adapted
extirpation
includes
rain
includes
large flood events
includes
snow
includes
snowpack
affects
streamflow
includes
timing
peak flows
summer base flows
likely to
increase
likely to
decrease
affects
increases
gravel scour
increases
salmon mortality
includes
eggs
alevin
can be
increases
trout mortality
includes
life cycles
require
have
salmon and trout
are
salmonids
includes
salmon
trout
compete with
require
diversity of conditions
increases
metapopulation stability
management
includes
management options
may increase
opening historically flooded areas
enhancing floodplain movement
includes
flood plain reconnection
improves
complexity
large wood recruitment
reduces
moderates
can reduce
has
habitat
reduces
requires
accessibility
water quality
includes
rearing areas
thermal refugia
streams
in
lakes
during
low-flow periods
maintain water quantity
includes
maintain instream flows
habitat improvement
includes
can
limiting water withdrawals
remove anthropogenic blockages to migration
affects
restore riparian forests
improves
includes
protecting riparian forests
well-shaded
disconnect road drainage
includes
affects
likely to
increase


Quench Buggy
www.quenchbuggy.com
FREE COLD
TAP WATER
i♥dc


DRINK WATER RESPONSIBLY
drink tap
DAKOTA
SXT

“You don’t cut ribbons for new water mains, but that’s what really matters”

Stephanie Minor, Mayor of Syracuse, NY

Questions?

chowells@pdx.edu