

Past to Present Decisions That Affect Us Now

- Catherine Howells, Ph.D.
- PNWS Conference
- May 9, 2014

Water: It's Complicated



- Electrification
- Automobile
- Airplane
- Water supply and distribution
- Electronics

Greatest Engineering Achievements OF THE 20TH CENTURY

♦ About ♦ Timeline ♦ The Book

Welcome!
How many of the 20th century's greatest engineering achievements will you use today? A car? Computer? Telephone? Explore our list of the top 20 achievements and learn how engineering shaped a century and changed the world.

| | |
|--|--|
| 1. Electrification | 11. Highways |
| 2. Automobile | 12. Spacecraft |
| 3. Airplane | 13. Internet |
| 4. Water Supply and Distribution | 14. Imaging |
| 5. Electronics | 15. Household Appliances |
| 6. Radio and Television | 16. Health Technologies |
| 7. Agricultural Mechanization | 17. Petroleum and Petrochemical Technologies |
| 8. Computers | 18. Laser and Fiber Optics |
| 9. Telephone | 19. Nuclear Technologies |
| 10. Air Conditioning and Refrigeration | 20. High-performance Materials |



 Greatest Achievements

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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



Drawn from life and colored and engraved by B. D.

Engraved according to an act of Congress on the 16th day of December 1835 in the City of New York by the Engraver of the United States and published by H. R. Robinson.

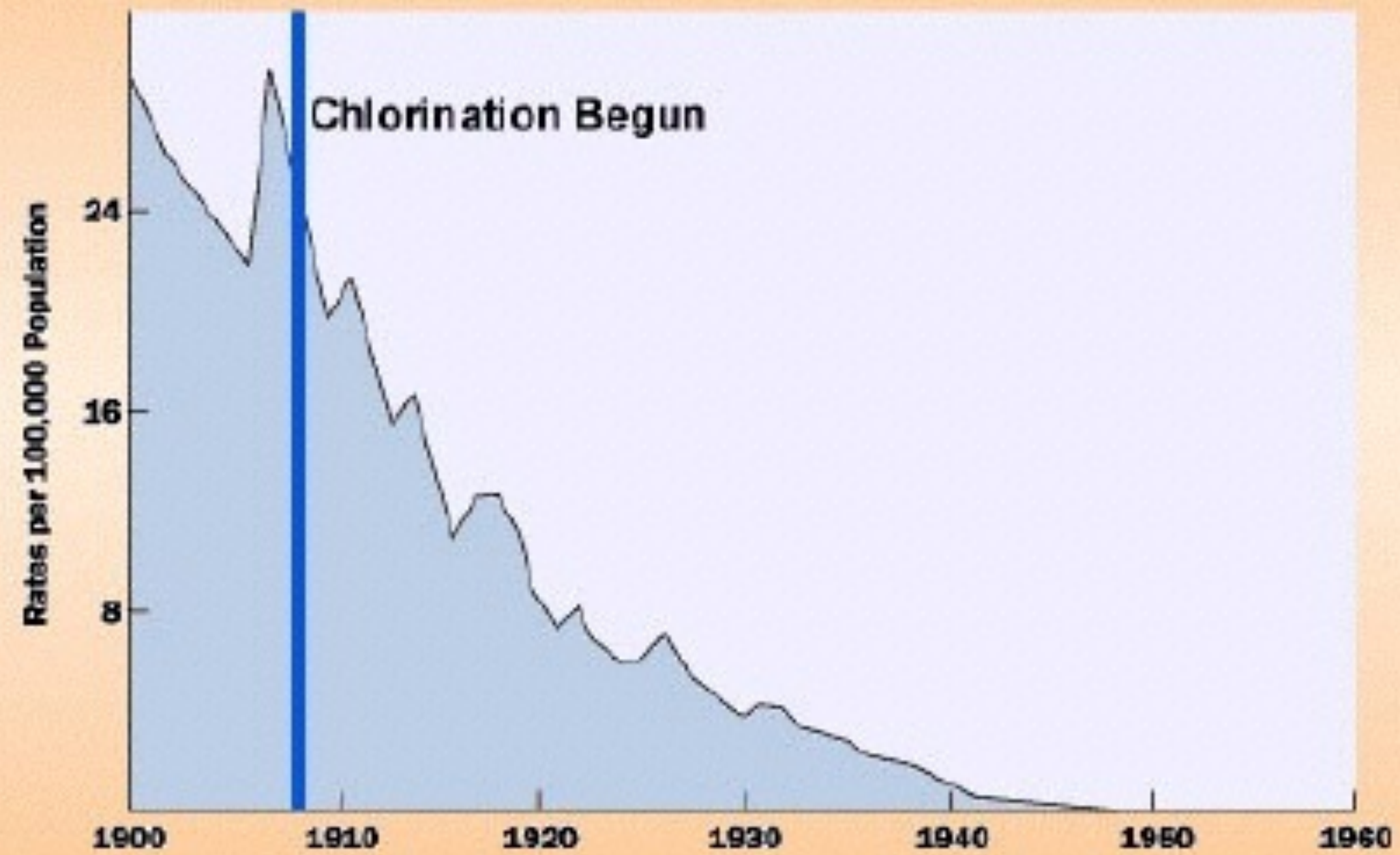
Printed and Colored by J. T. Bowen

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

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



Death Rate for Typhoid Fever United States, 1900-1960



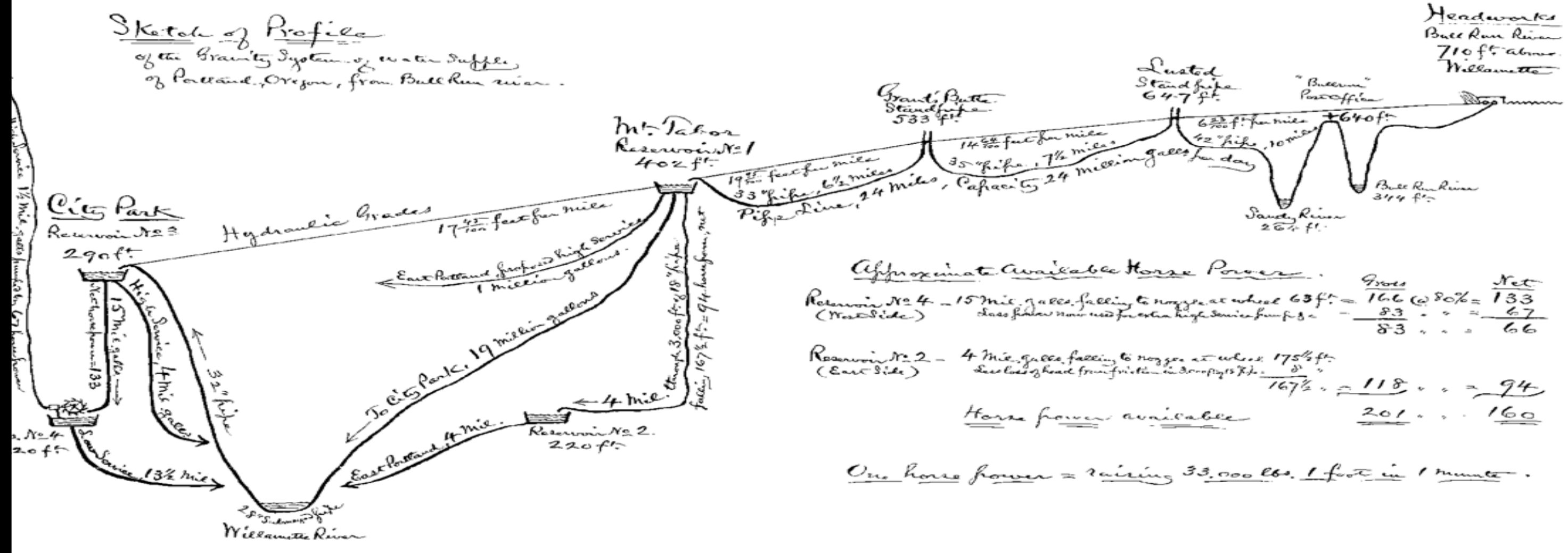
Source: U.S. Centers for Disease Control and Prevention, Summary of Notifiable Diseases, 1997.





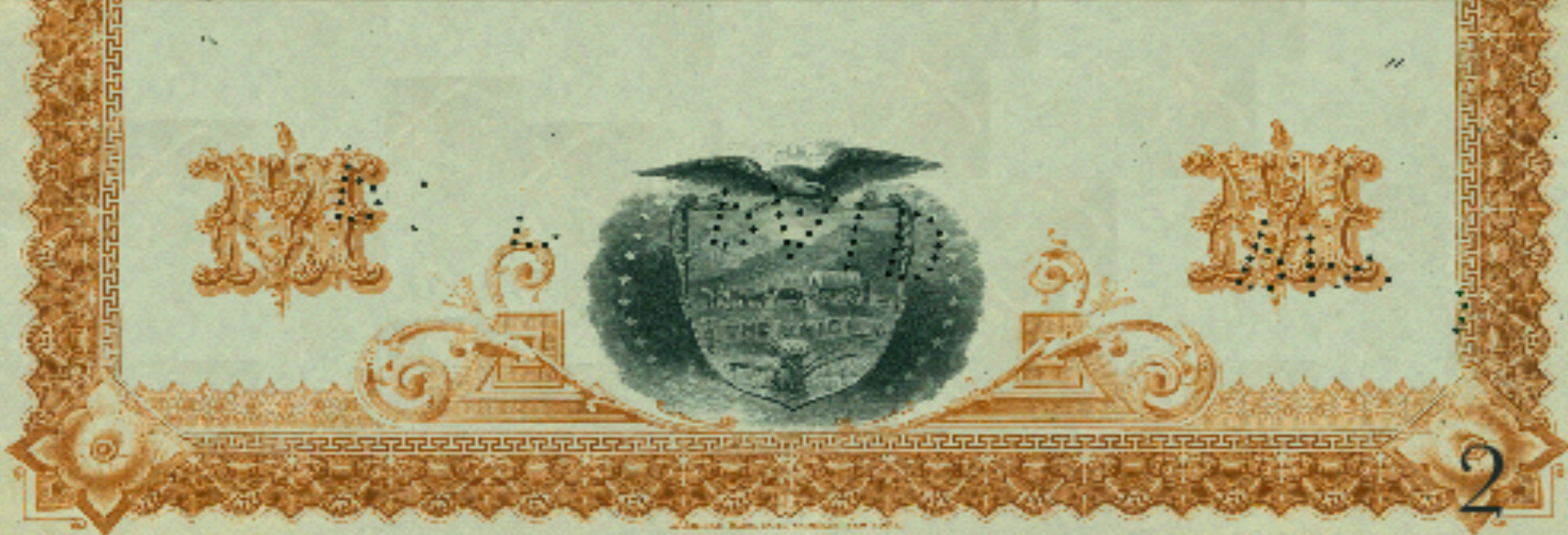




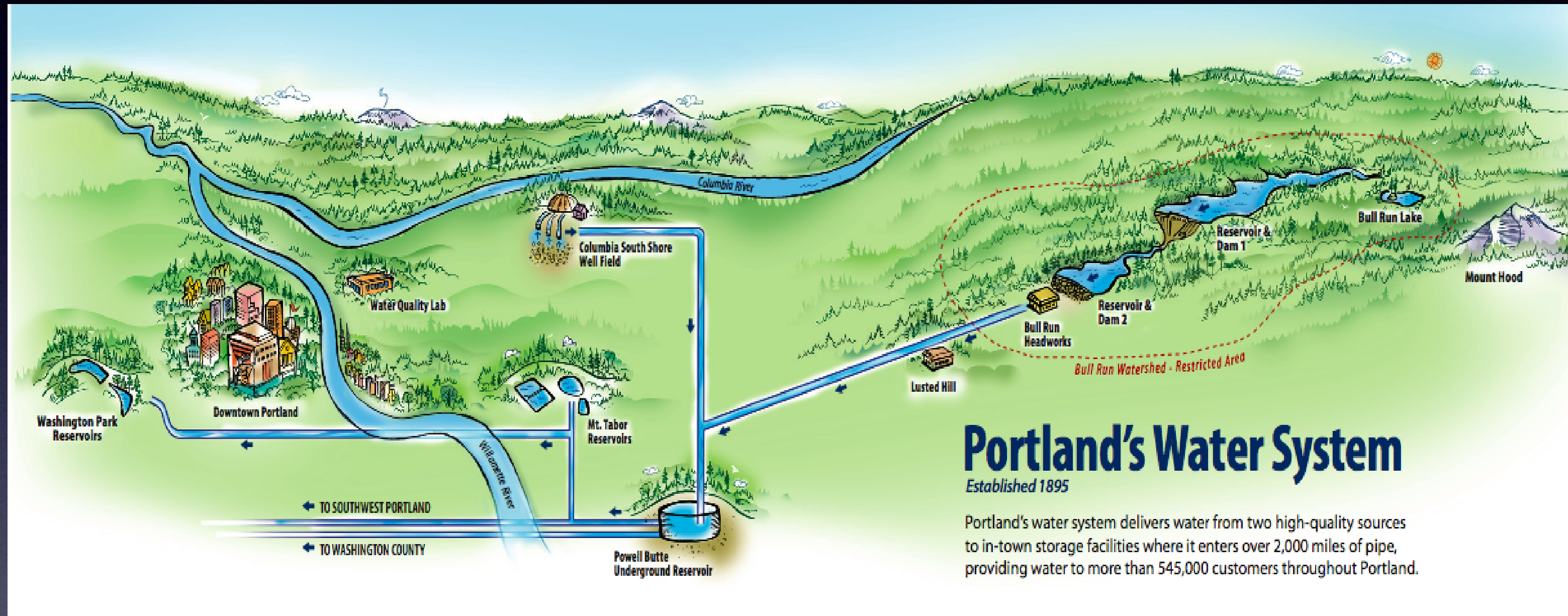


WATER: PORTLAND'S PRECIOUS HERITAGE

D. Clarke's schematic sketch of Portland's water system, with calculations of possible power generation



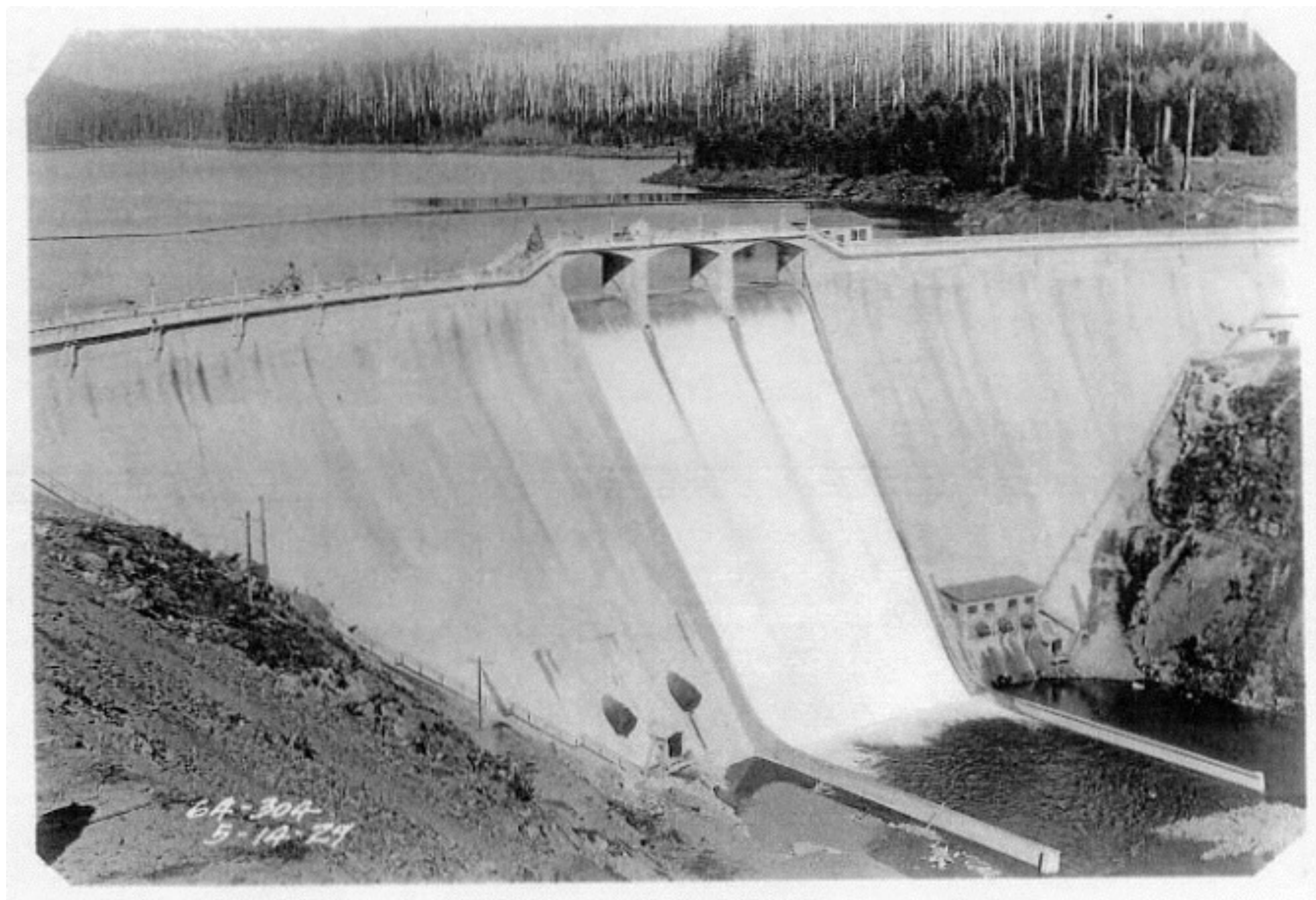


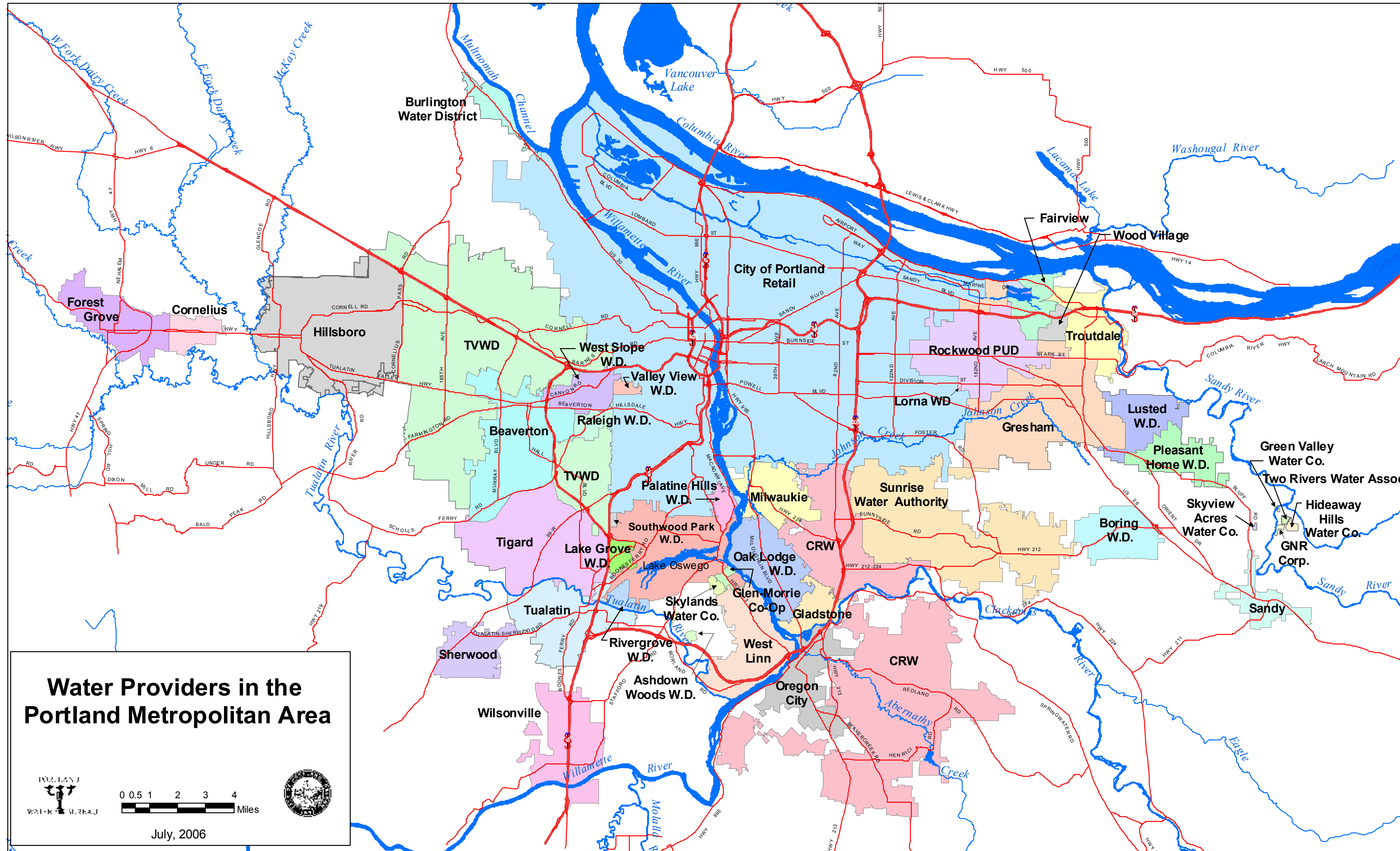


Portland's Water System

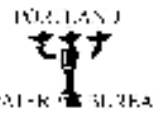
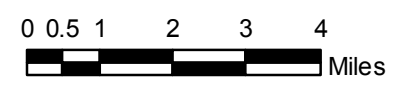

Established 1895

Portland's water system delivers water from two high-quality sources to in-town storage facilities where it enters over 2,000 miles of pipe, providing water to more than 545,000 customers throughout Portland.





Water Providers in the Portland Metropolitan Area

July, 2006

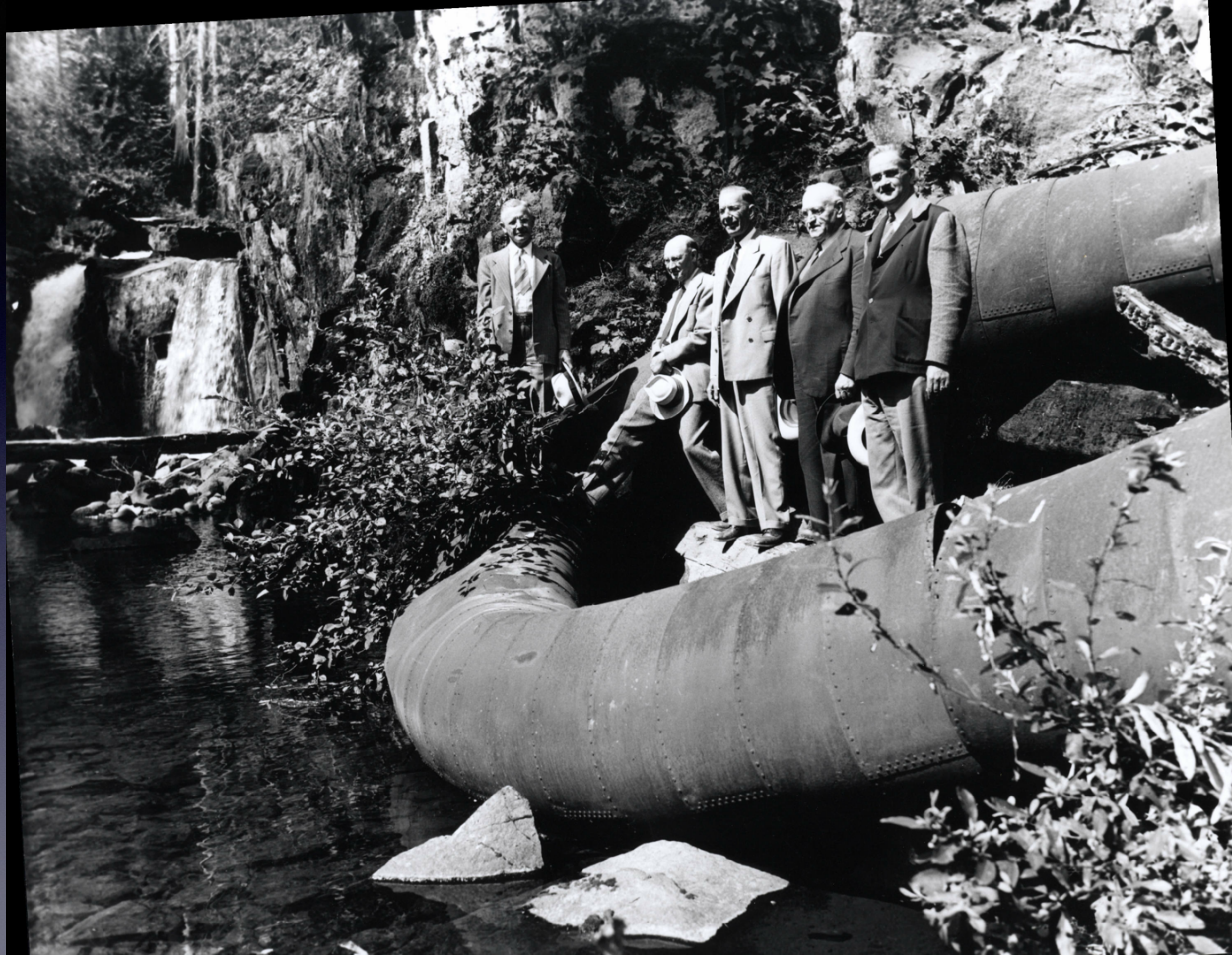












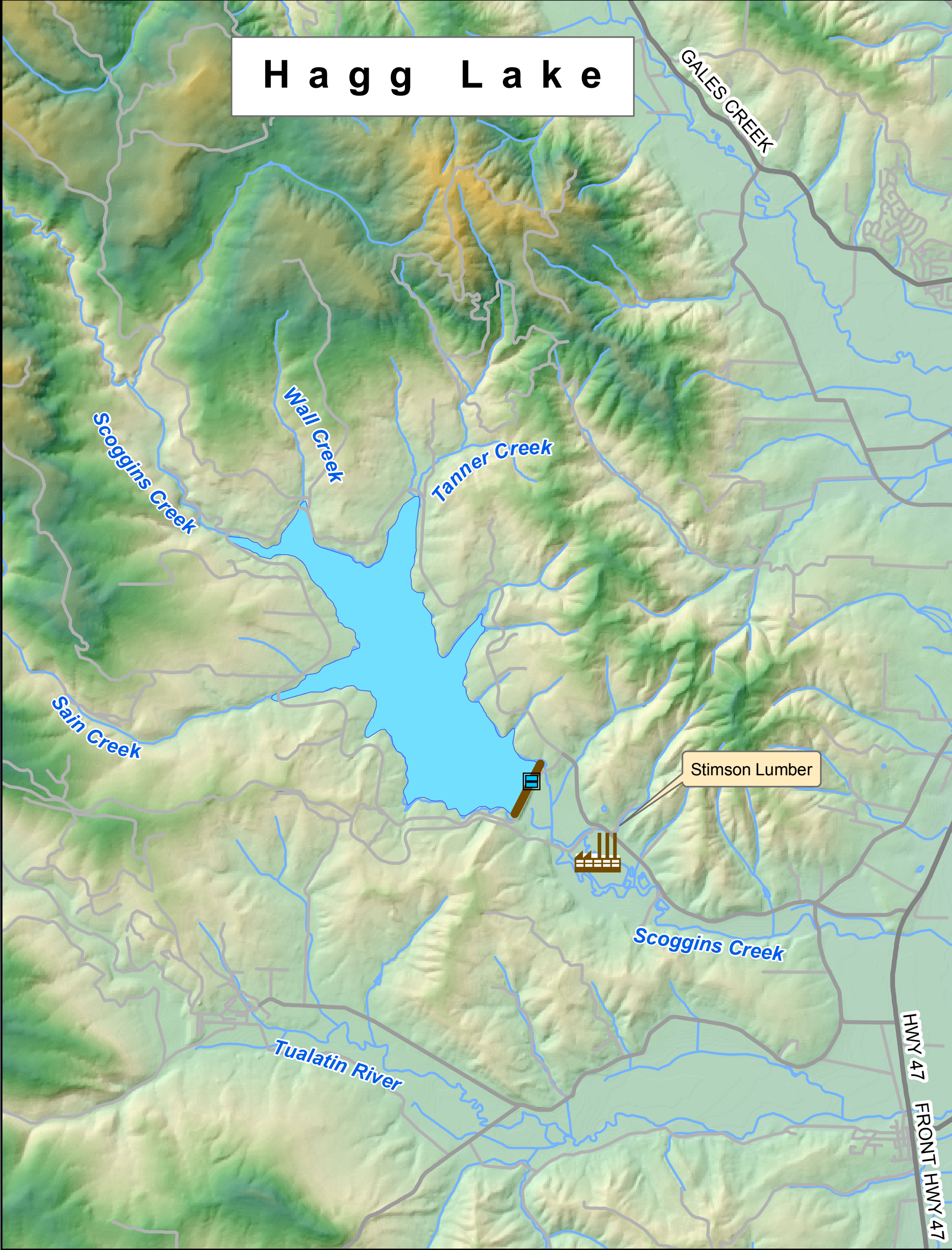








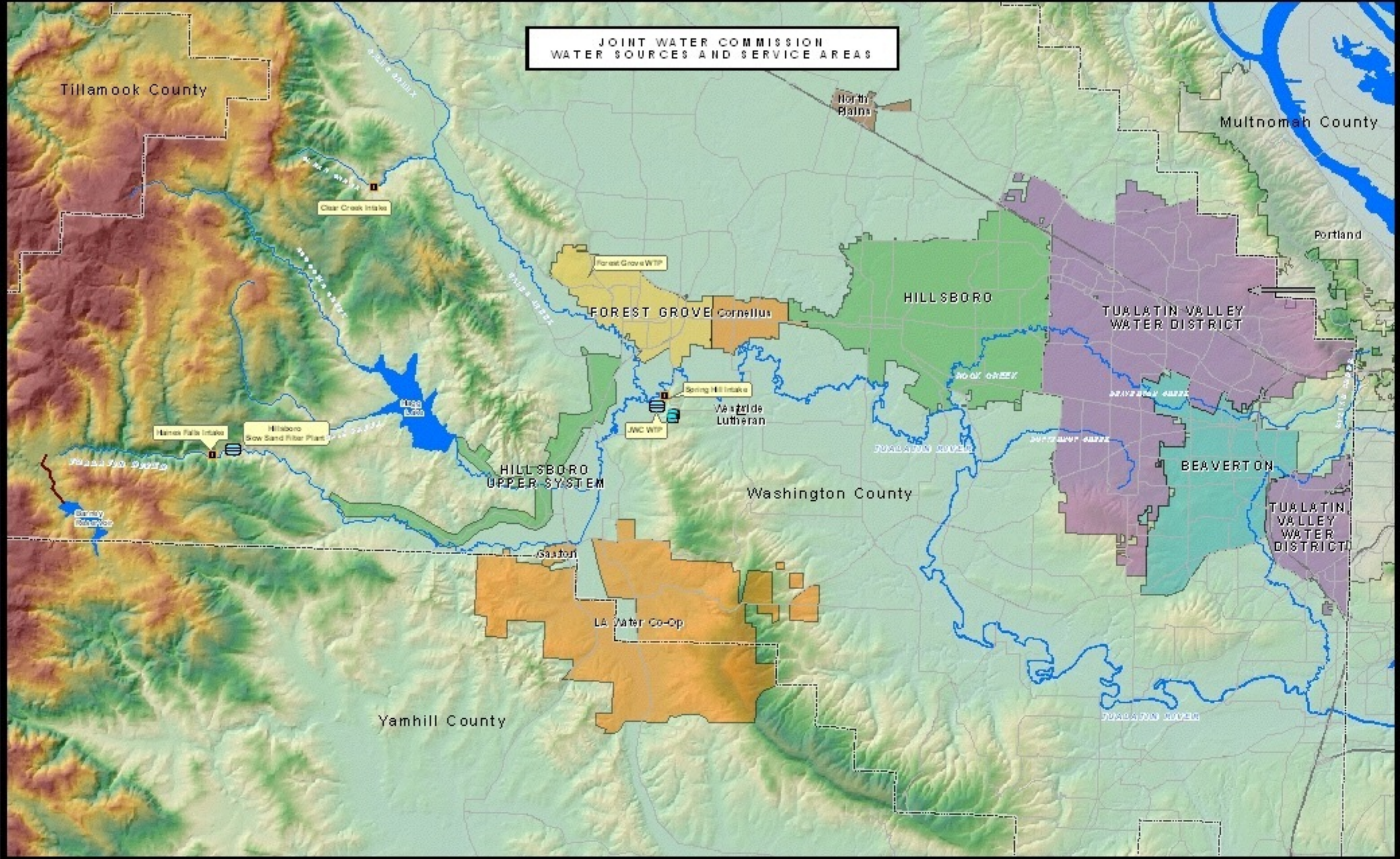
H a g g L a k e

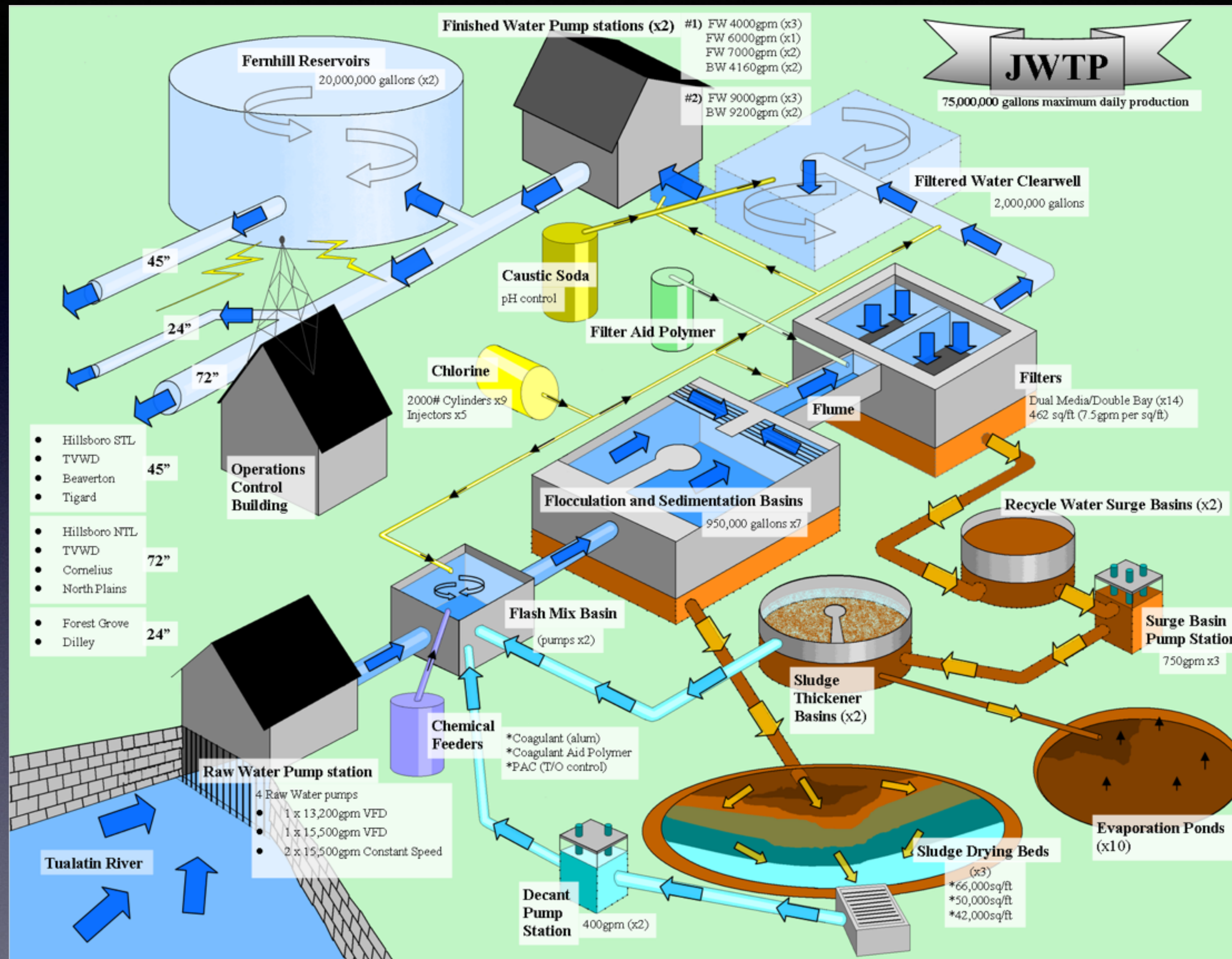




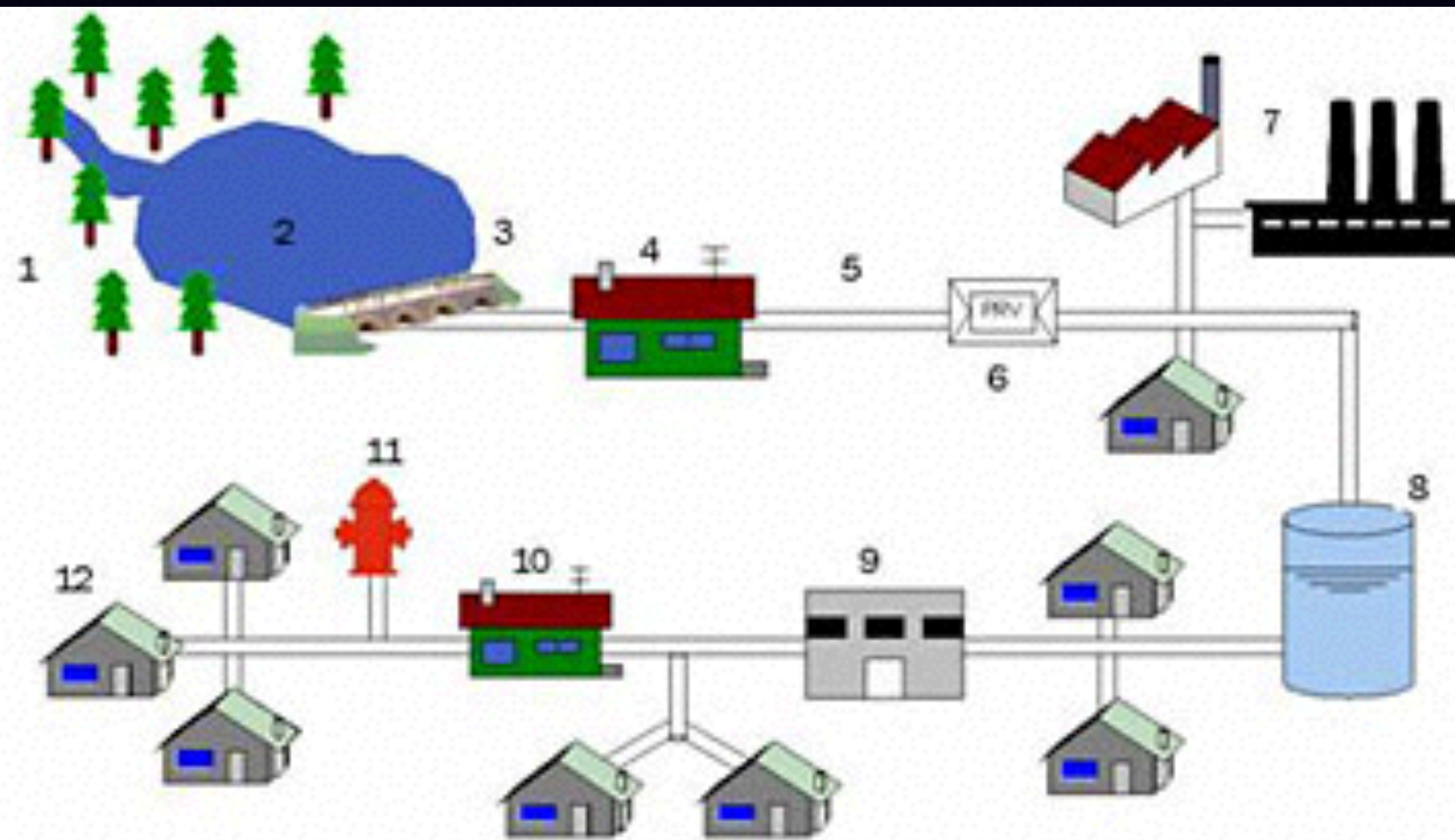


JOINT WATER COMMISSION
WATER SOURCES AND SERVICE AREAS









- | | | |
|---------------------------------|-------------------------------------|-----------------------------|
| 1. Watershed Management | 5. Treated Water Quality Monitoring | 9. Pump Stations |
| 2. Raw Water Quality Monitoring | 6. Pressure Reducing Valves | 10. Re-chlorination Station |
| 3. BC Hydro Penstocks | 7. Industrial Park | 11. Fire Hydrants |
| 4. Disinfection Station | 8. Reservoirs | 12. Your Home |

























Remove cover and slide clamp to cover exposed leak...



Secure repair clamp...



Completed vertical
main break repair...









11/12/2010



11/12/2010



6" Line Valve

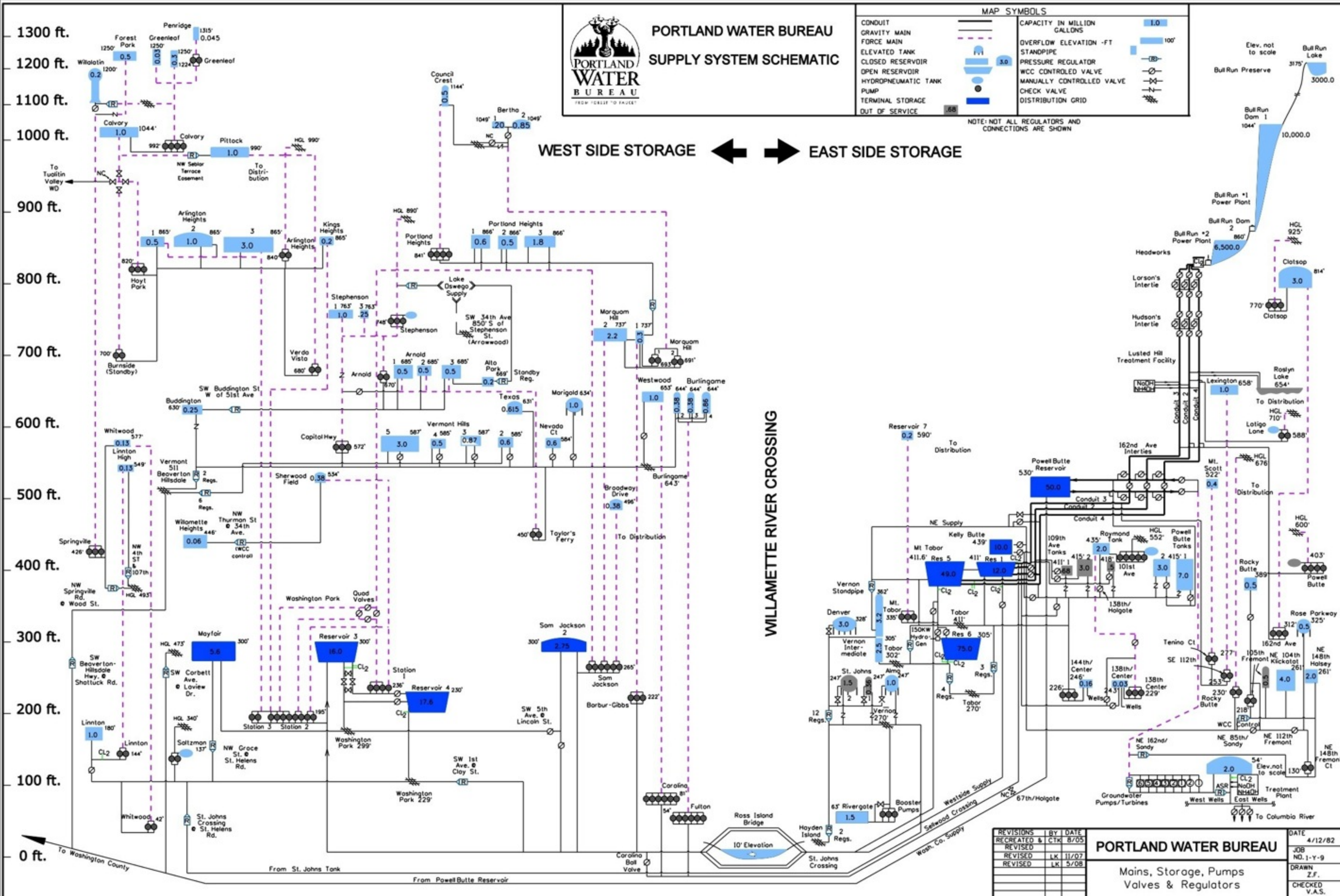




PORTLAND WATER BUREAU SUPPLY SYSTEM SCHEMATIC

| MAP SYMBOLS | |
|-----------------------------|------|
| CONDUIT | — |
| GRAVITY MAIN | — |
| FORCE MAIN | — |
| ELEVATED TANK | |
| CLOSED RESERVOIR | |
| OPEN RESERVOIR | |
| HYDRO-PNEUMATIC TANK | |
| PUMP | |
| TERMINAL STORAGE | |
| OUT OF SERVICE | |
| CAPACITY IN MILLION GALLONS | 1.0 |
| OVERFLOW ELEVATION -FT | 100' |
| STANDPIPE | |
| PRESSURE REGULATOR | |
| WCC CONTROLLED VALVE | |
| MANUALLY CONTROLLED VALVE | |
| CHECK VALVE | |
| DISTRIBUTION GRID | |

NOTE: NOT ALL REGULATORS AND CONNECTIONS ARE SHOWN



WEST SIDE STORAGE ← → EAST SIDE STORAGE

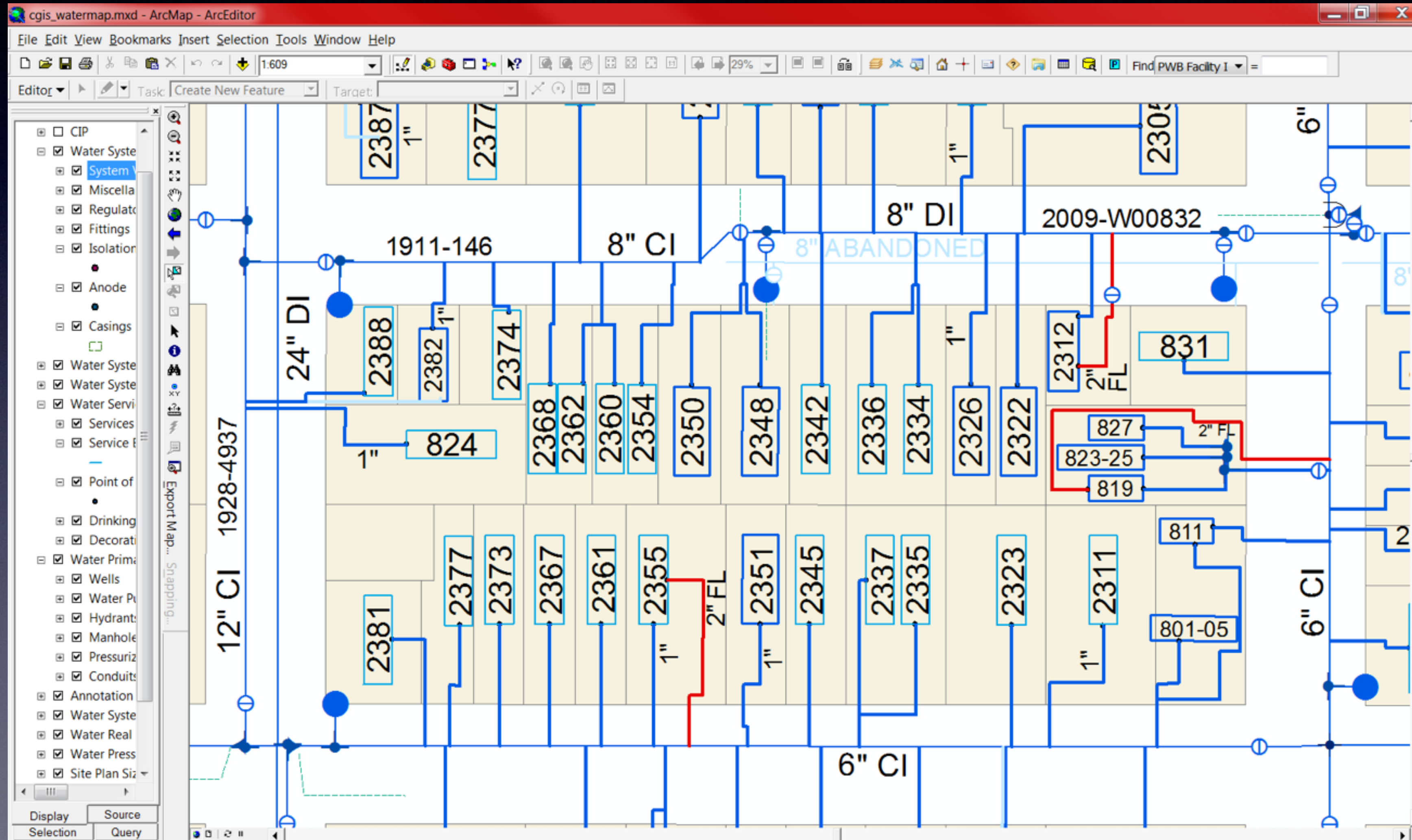
WILLAMETTE RIVER CROSSING

| REVISIONS | BY | DATE |
|-----------------|----|-------|
| RECREATED & CTK | | 8/05 |
| REVISED | LK | 11/07 |
| REVISED | LK | 5/08 |

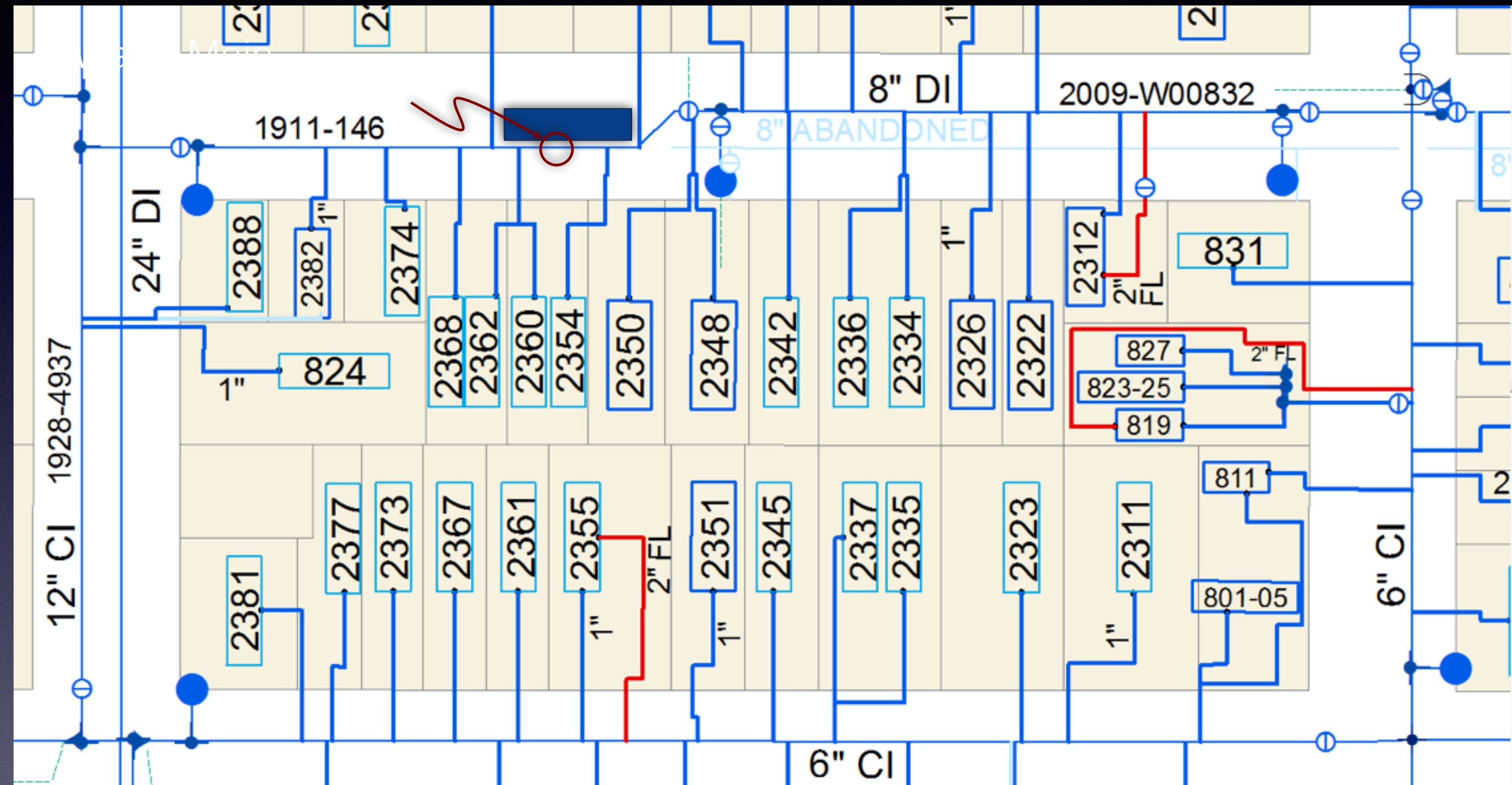
PORTLAND WATER BUREAU
Mains, Storage, Pumps
Valves & Regulators

| | |
|---------|---------|
| DATE | 4/12/82 |
| JOB NO. | 1-Y-9 |
| DRAWN | Z.F. |
| CHECKED | V.A.S. |

The Water System



The Water System



1,722 ft of 6" & 8" DI Water Main
Costs \$190,000 to Install*

The Business District Block Water System

1,722 ft of 6" & 8" DI Water Main
Costs \$195,000 to Install

4 Fire Hydrants @ \$4,539 = \$18,156

34 1" Services @ \$2,428/ea. = \$82,552

Water Infrastructure for 1 City Block = \$291,000.*

*Does Not Include Permits, SDC, Engineering, Dump and Fill Costs,
Paving, Overhead, et al

The Residential Block Water System

1,722 ft of 6" & 8" DI Water Main
Costs \$195,000 to Install

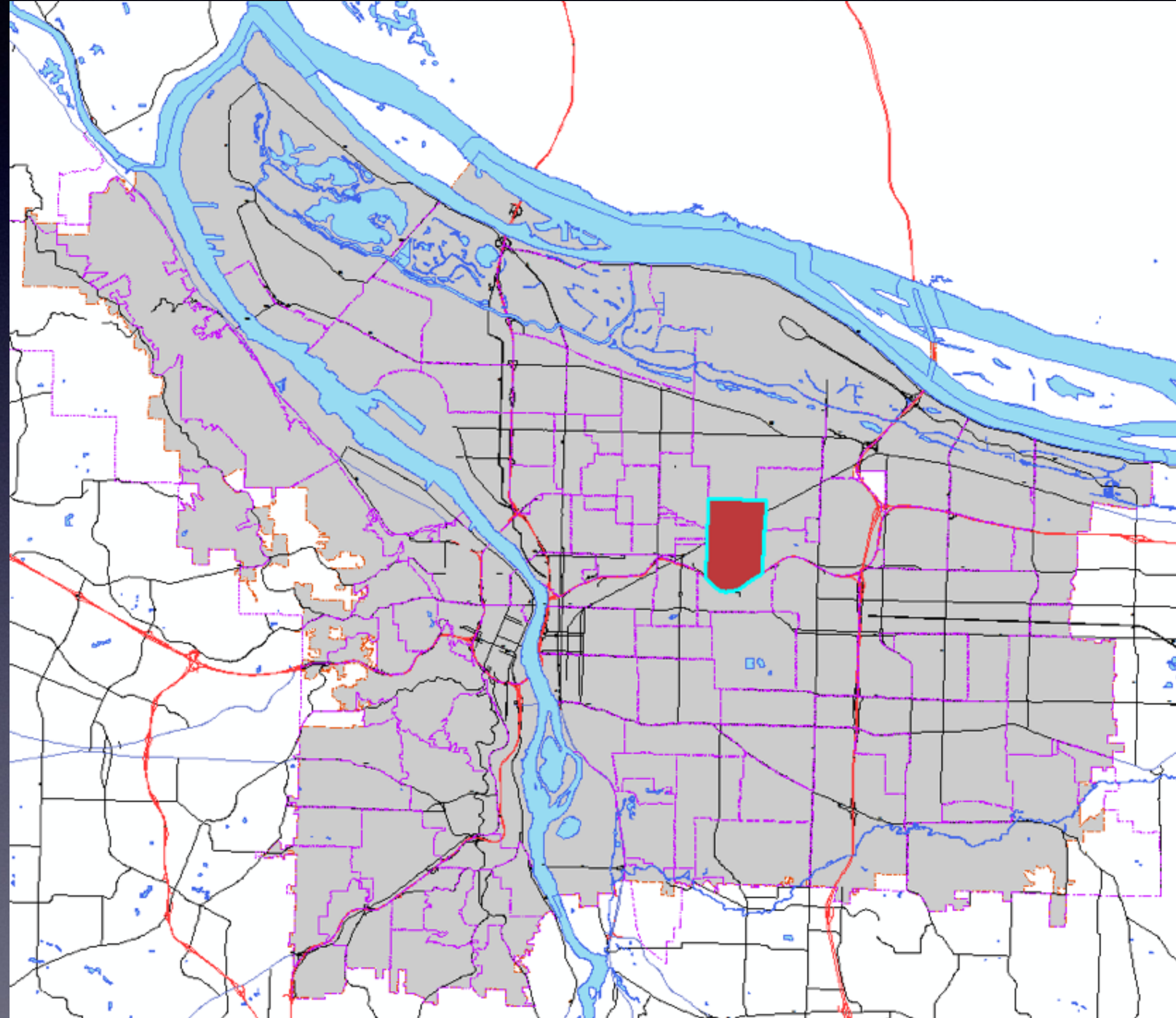
1 Fire Hydrant @ \$4,539 Cost = \$4,539

20 1" Services @ \$2,428/ea. = \$48,560

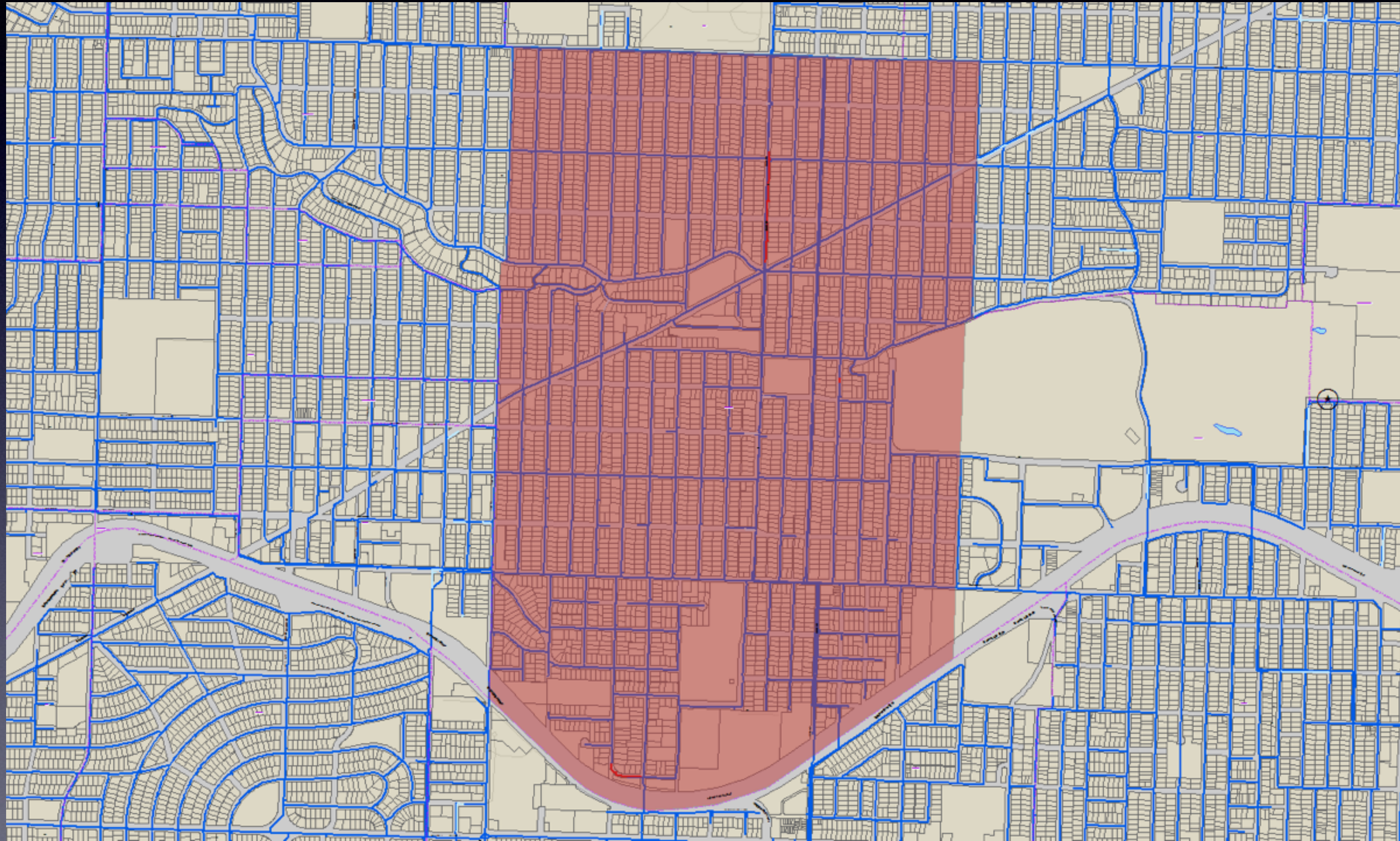
Water Infrastructure for 1 City Block = \$243,099.*

*Does Not Include Permits, SDC, Engineering, Dump and Fill Costs,
Paving, Overhead, et al

The Rose City Park Neighborhood



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



“People prone to skepticism can cover themselves with pseudo-science and conspiracy theories that thicken and harden like papier mache”

Michael Gerson, Washington Post (5/2/14)

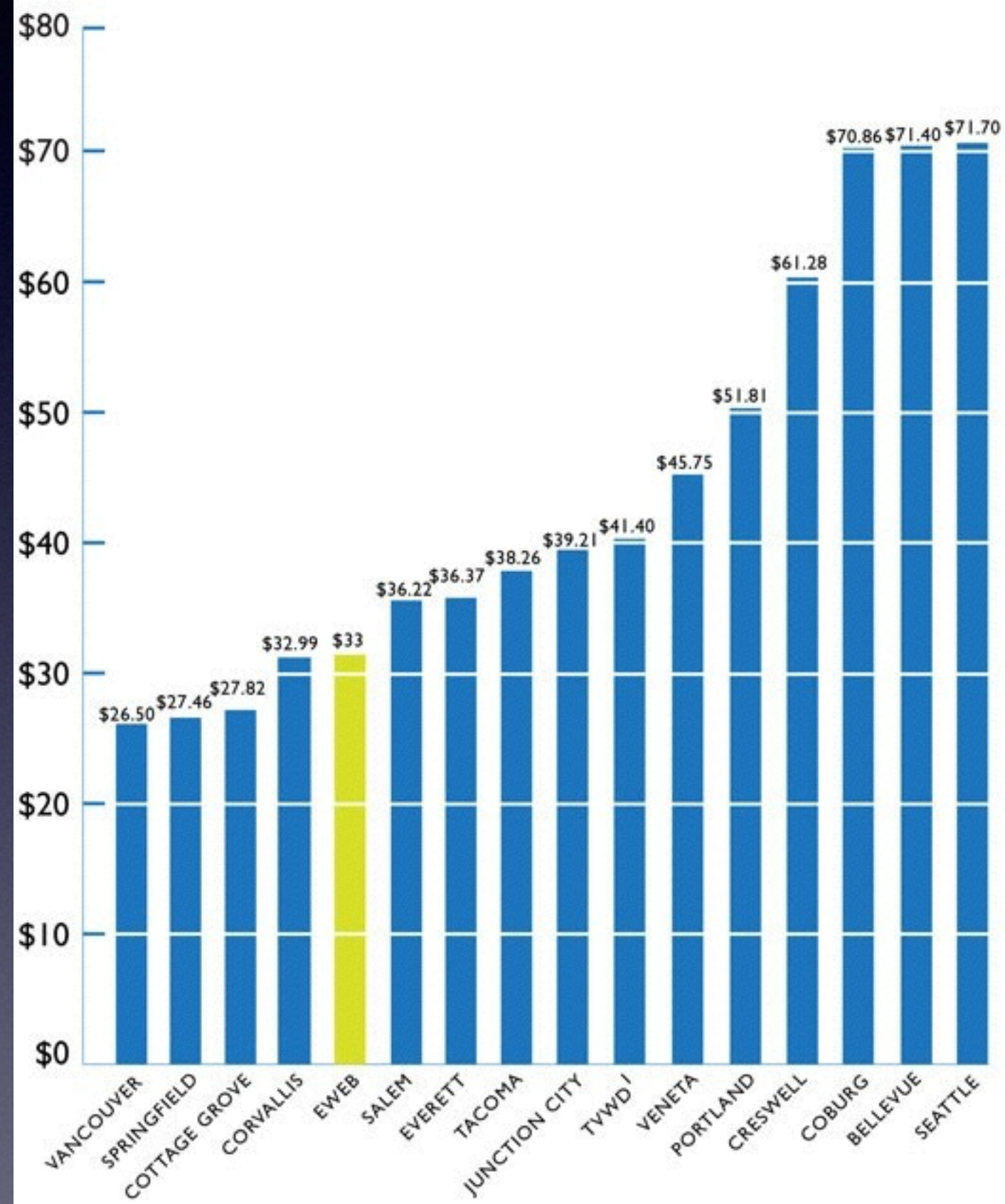
Circle of Blue's Urban Water Pricing Survey

| City | Service Area Population (00s) | Average Monthly Bill for Family of Four Using 50 gallons/person/day | Average Monthly Bill for Family of Four Using 100 gallons/person/day | Average Monthly Bill for Family of Four Using 150 gallons/person/day | Average Daily Per Capita Residential Use (gallons) | Average Annual Per Capita data from U.S. Urban Population (cm) | Population Density (persons/square mile), data from 2000 census |
|----------------------------------|-------------------------------|---|--|--|--|--|---|
| Uniform Seasonal | | | | | | | |
| Phoenix ⁶ | 1600 | 11.02 | 34.29 | 59.84 | 115 | 19 | 2782 |
| Uniform | | | | | | | |
| Fresno ¹ | 122 | 15.99 | 21.95 | 27.91 | 211 | 27 | 4097 |
| Memphis ^{4,8} | 583 | 16.02 | 26.50 | 36.98 | 96 | 132 | 2327 |
| Chicago ⁴ | N/A | 16.08 | 24.12 | 36.18 | N/A | 91 | 12750 |
| Baltimore ⁴ | 1800 | 19.25 | 39.50 | 79.00 | N/A | 104 | 8058 |
| New York ² | 8360 | 20.88 | 41.76 | 62.64 | 78 | 120 | 26402 |
| Seasonal Increasing Block | | | | | | | |
| San Antonio ⁷ | 1000 | 12.21 | 19.64 | 32.94 | N/A | 79 | 2808 |
| Salt Lake City ² | 380 | 14.48 | 22.89 | 32.67 | 180 | 41 | 1666 |
| Los Angeles ⁷ | 4000 | 27.18 | 58.49 | 99.07 | N/A | 30 | 7877 |
| Seattle ² | 630 | 42.15 | 72.78 | 117.33 | 52 | 97 | 6717 |
| Santa Fe ² | 78 | 43.28 | 121.42 | 224.26 | 68 | 36 | 1666 |
| Increasing Block | | | | | | | |
| Charlotte ¹⁰ | 774 | 14.16 | 35.68 | 78.24 | N/A | 109 | 2232 |
| Dallas ¹ | 1306 | 16.16 | 37.81 | 65.30 | 57 | 86 | 3470 |
| Las Vegas ² | 2000 | 17.18 | 32.93 | 52.72 | 110 | 10 | 2849 |
| Tucson ² | 775 | 17.46 | 33.04 | 72.64 | 98 | 30 | 2500 |
| Denver ⁵ | 1300 | 18.24 | 33.01 | 58.33 | 87 | 39 | 3616 |
| Austin ¹ | 796 | 19.18 | 47.17 | 94.30 | 94 | 81 | 2610 |
| Jacksonville ¹ | 614 | 19.54 | 30.04 | 40.55 | 84 | 130 | 970 |
| Houston ³ | 2060 | 21.97 | 39.49 | 71.17 | 72 | 117 | 3371 |
| Fort Worth ¹ | 625 | 22.20 | 43.48 | 67.24 | 81 | 86 | 1827 |
| Columbus ¹ | 1115 | 23.95 | 43.06 | 62.18 | 53 | 97 | 3383 |
| San Jose ² | 107 | 24.51 | 40.93 | 59.09 | 107 | 48 | 5118 |
| Philadelphia ^{1,8} | 1672 | 27.34 | 49.03 | 68.82 | 84 | 105 | 11234 |
| San Francisco ¹ | 2400 | 30.63 | 58.47 | 86.31 | 57 | 50 | 16636 |
| Boston ¹ | 609 | 31.84 | 65.47 | 99.72 | 41 | 105 | 12165 |
| Atlanta ⁷ | 1200 | 33.83 | 72.95 | 112.07 | N/A | 129 | 3161 |
| San Diego ⁹ | 1300 | 44.05 | 70.95 | 99.52 | N/A | 25 | 3772 |
| Decreasing Block | | | | | | | |
| Milwaukee ¹ | 661 | 16.11 | 26.83 | 37.55 | 47 | 84 | 6214 |
| Detroit ^{1,8} | 900 | 16.22 | 28.36 | 40.55 | 63 | 83 | 6855 |
| Indianapolis ¹ | 800 | 25.24 | 41.26 | 56.79 | 77 | 102 | 2163 |

Notes about Average Daily Per Capita Residential Use

- | | | | |
|-------------------------|---|--|---|
| 1) 2009 figures | 6) 2005-09 average | 8) calculated from household data divided by average household size from 2000 Census | 10) Charlotte provided a monthly average of 5,086 gallons per household |
| 2) 2008 figures | 7) does not calculate residential figures | 9) San Diego provided a 2001-09 average of 105 gallons | |
| 3) 2006 figures | | | |
| 4) did not provide data | | | |
| 5) 2004-08 average | | | |

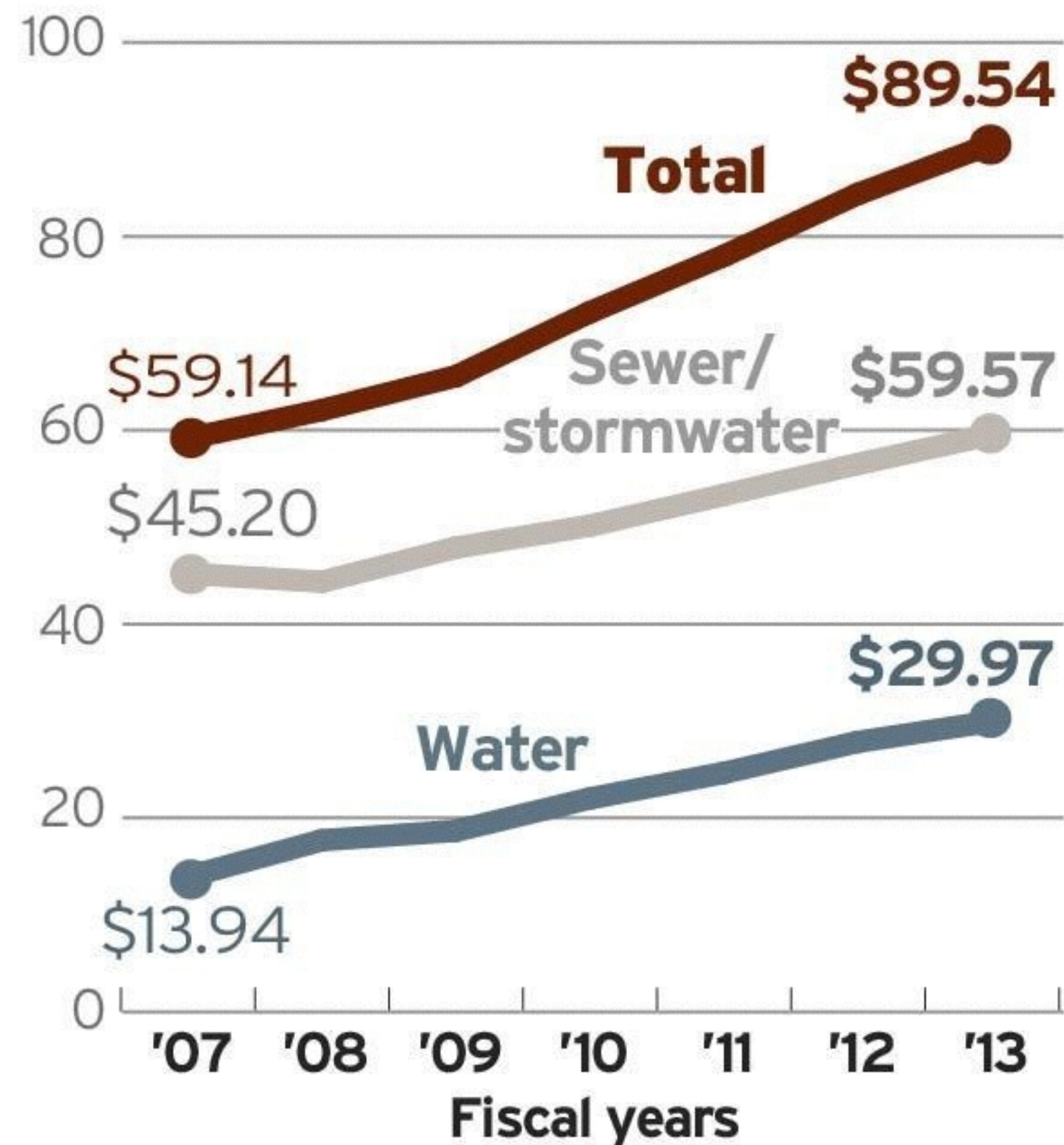
Typical Northwest Monthly Residential Calculated Average (9.0 kgal)



¹Tualatin Valley Water District (TVWD) serves Beaverton, portions of Hillsboro and Tigard.

Rising utility bills

Typical monthly water and sewer charges in Portland have jumped more than 50 percent in the past seven years.



Note: Portland bills homeowners every three months. The water bill above is based on 600 cubic feet per month.

Source: City of Portland



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

Stephanie Minor, Mayor of Syracuse, NY

Questions?

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