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USGS Washington Water Science Center

Groundwater Water Quality in Pierce and Thurston Counties

Presented by

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Today's Themes

- **National Water Quality Assessment (NAWQA) Program**
- **Nutrients in urban groundwater**
- **Volatile organic carbon compounds in urban groundwater**

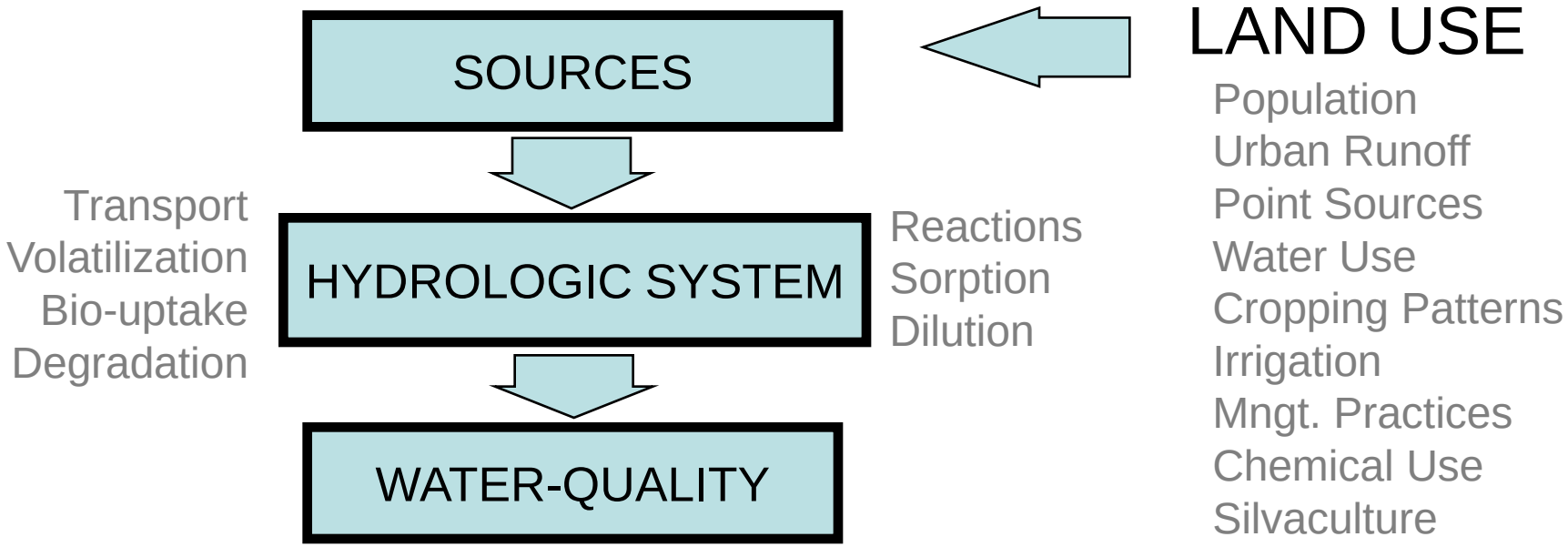
Gilliom et al., 2001, *The National Water-Quality Assessment Program-Entering a new decade of investigations.*
USGS Fact Sheet 071-01, 6 p.
http://water.usgs.gov/pubs/FS/fs-071-01/pdf/fs07101.pdf

Environmental framework

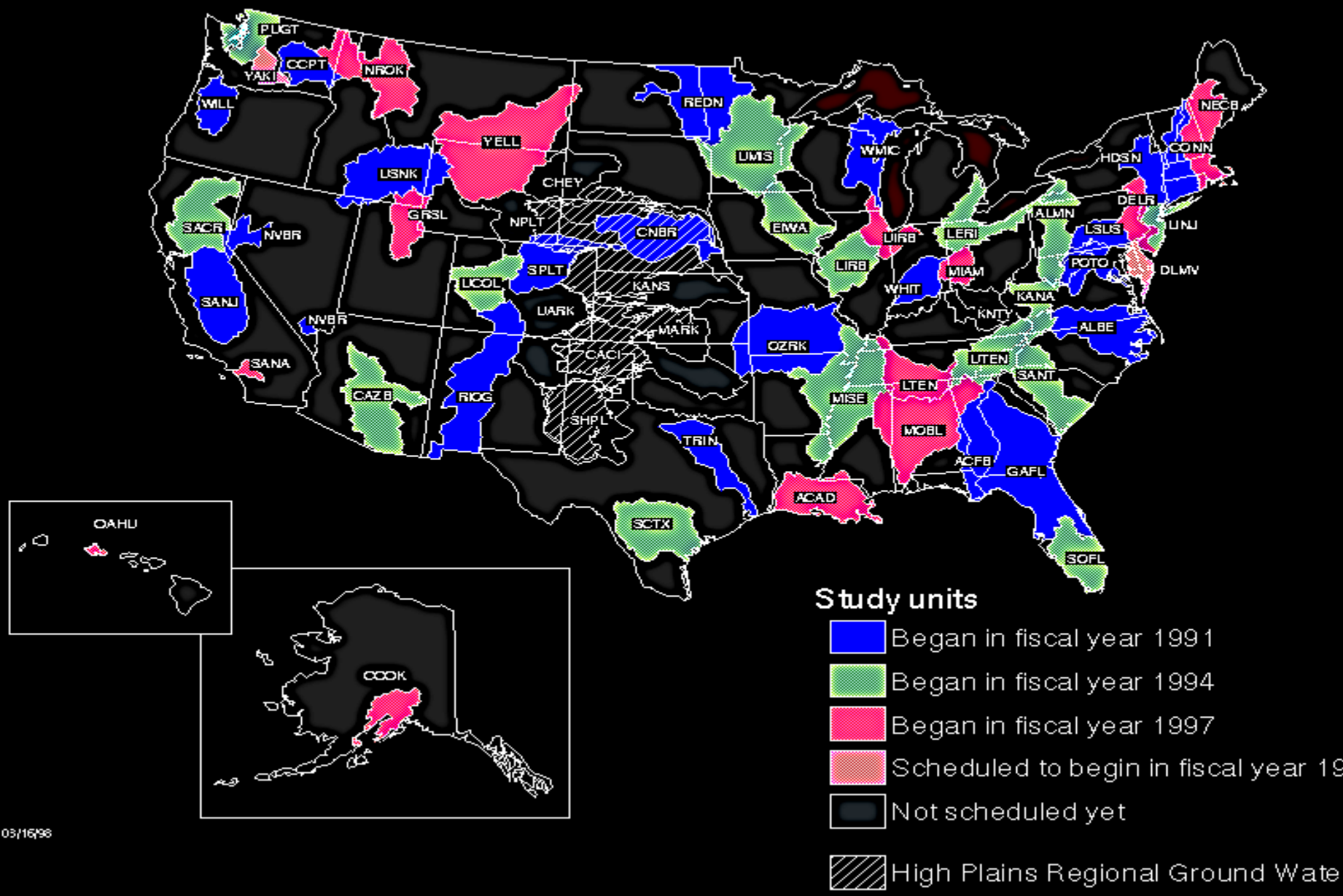
ANTHROPOGENIC FACTORS

- Population
- Water Use
- Land use and management practices
- Environmental releases
  - Point
  - Non point

Land Use Drives the National Design Process



NATIONAL WATER–QUALITY ASSESSMENT PROGRAM

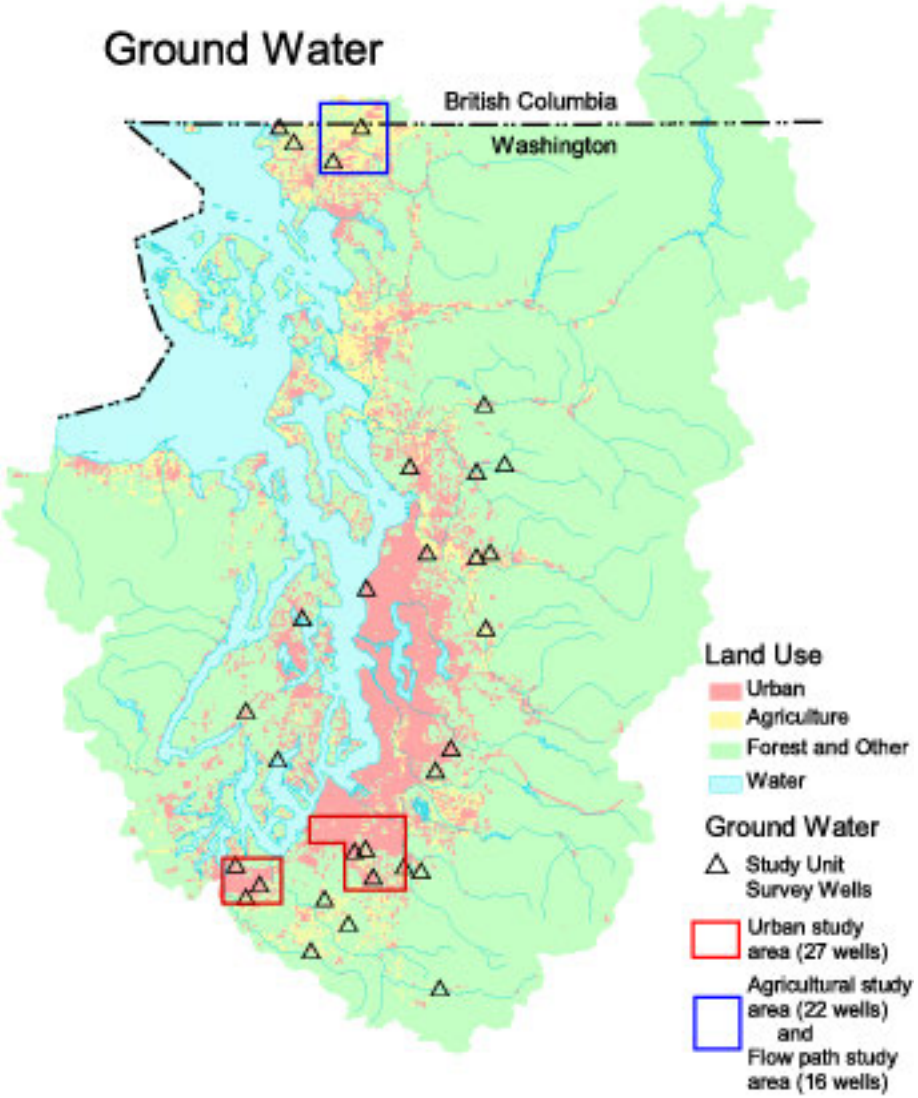


Groundwater Activities

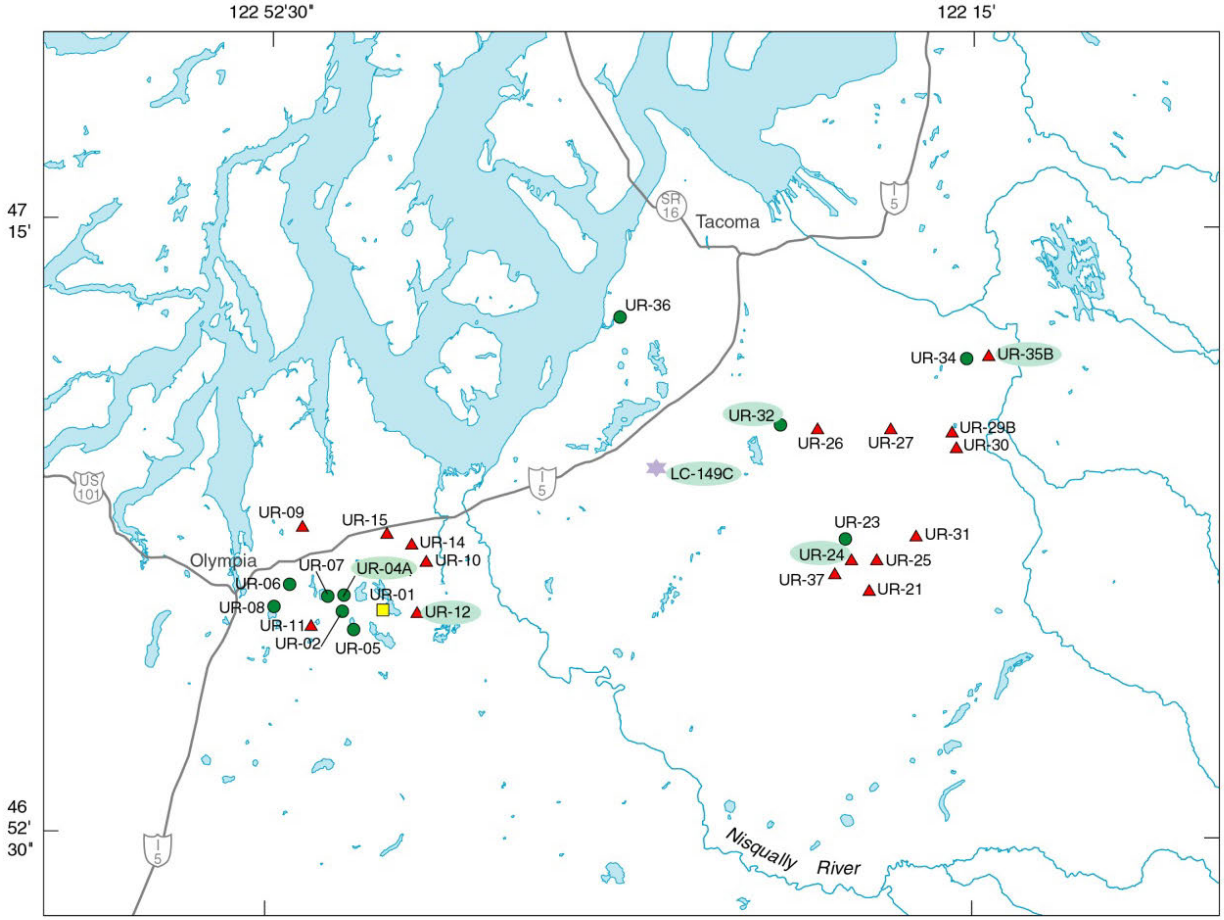
- Analysis of existing data
- Regional sampling (SUS)
- Targeted sampling (LUS)
- Geohydrologic and geochemical investigations (FP)
- Long-term monitoring

3 GW Study Areas of the PUGT Study Unit

Inkpen et al., 2000. *Ground-water quality in regional, agricultural, and urban settings in the Puget Sound Basin, Washington and British Columbia, 1996-1998.* USGS WRIR 00-4100, 66 p.



Urban GW Study wells - PUGT Study Unit



EXPLANATION

UR-01 Well identification number

Homes within a 500 meter radius of well

- Mostly sewered (more than 70 percent of residential areas)
- Mostly unsewered (more than 70 percent of residential areas)
- Mixed sewered and unsewered

Reference

UR-12 LIP TREND Well

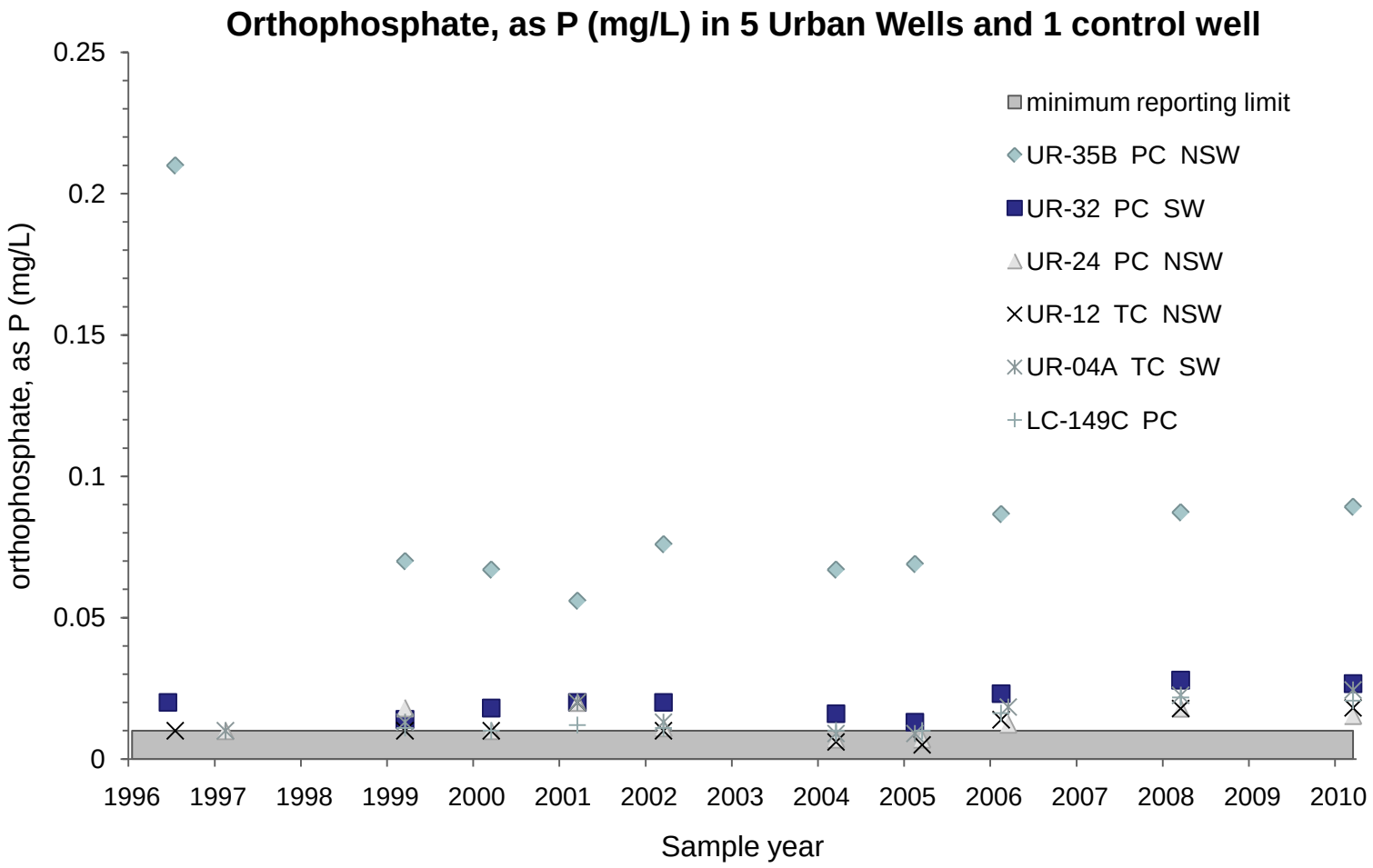
0 5 10 15 MILES

0 5 10 15 KILOMETERS

Nutrients in Groundwater

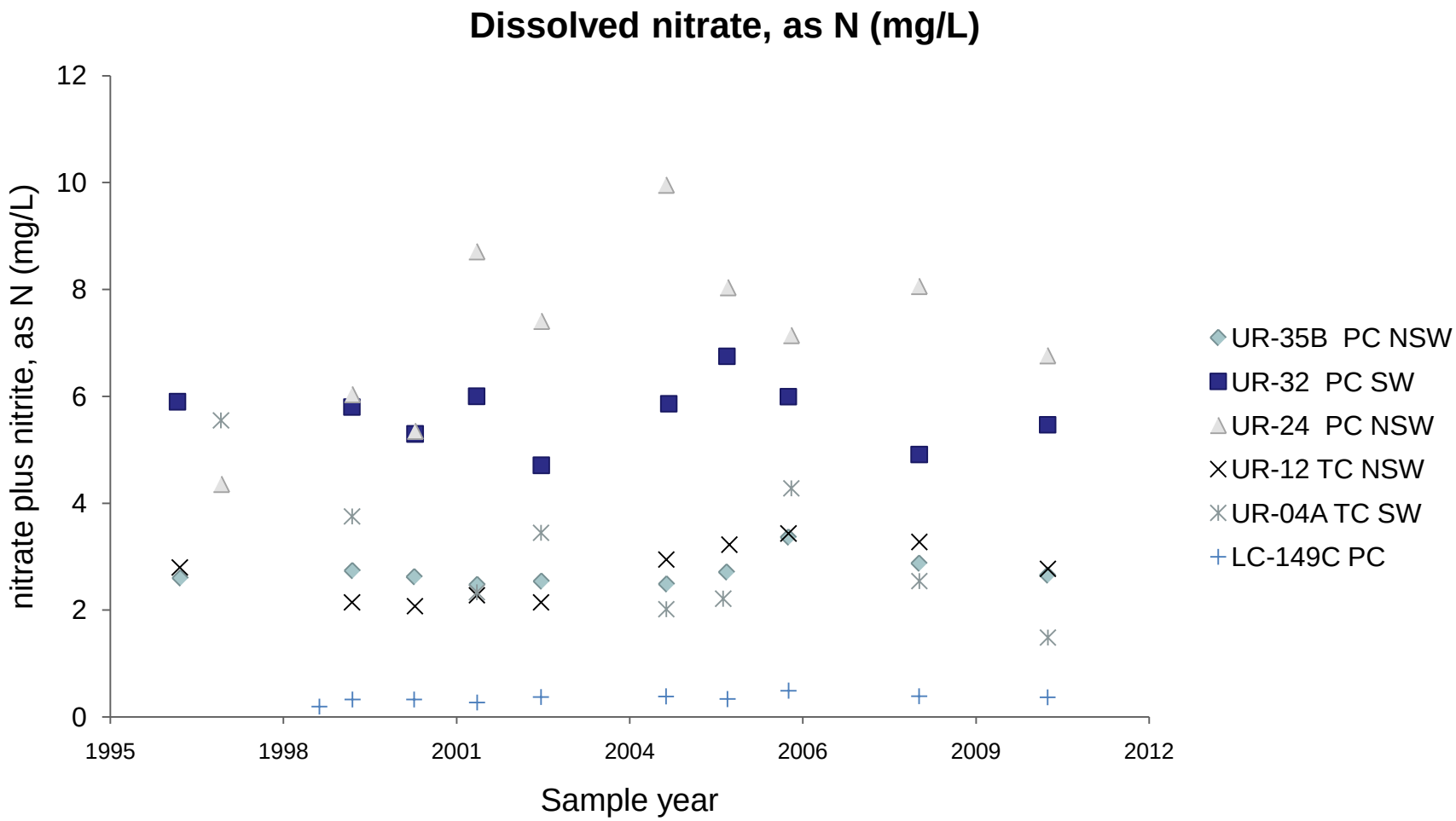
Provisional data available at NWISweb: http://nwis.waterdata.usgs.gov/wa/nwis/qwdata; Contact John Clemens at jclemens@usgs.gov for assistance in retrieving water quality data.

Phosphate in Urban Groundwater



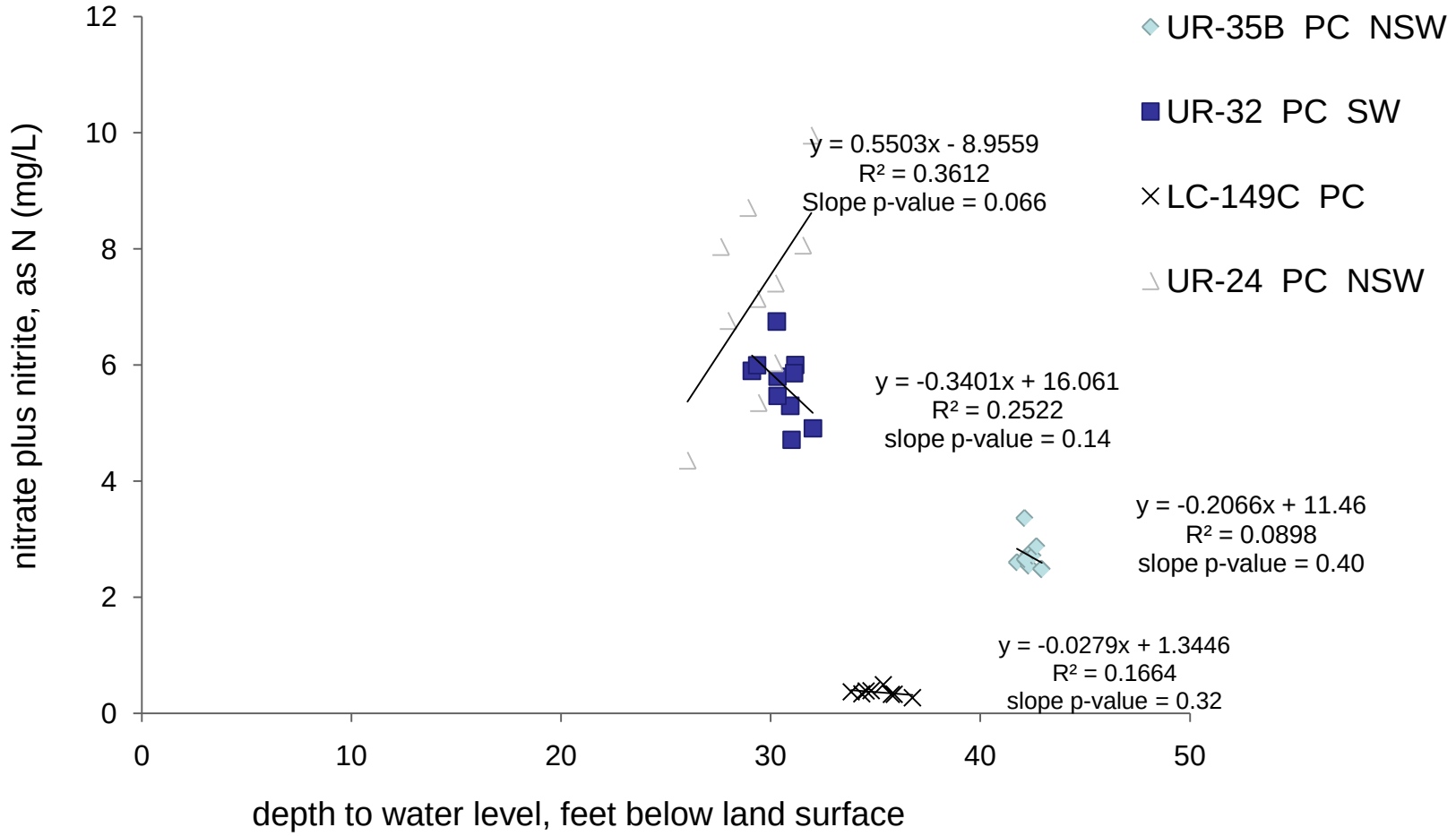
Provisional Data

Nitrate in Urban Groundwater



Provisional Data

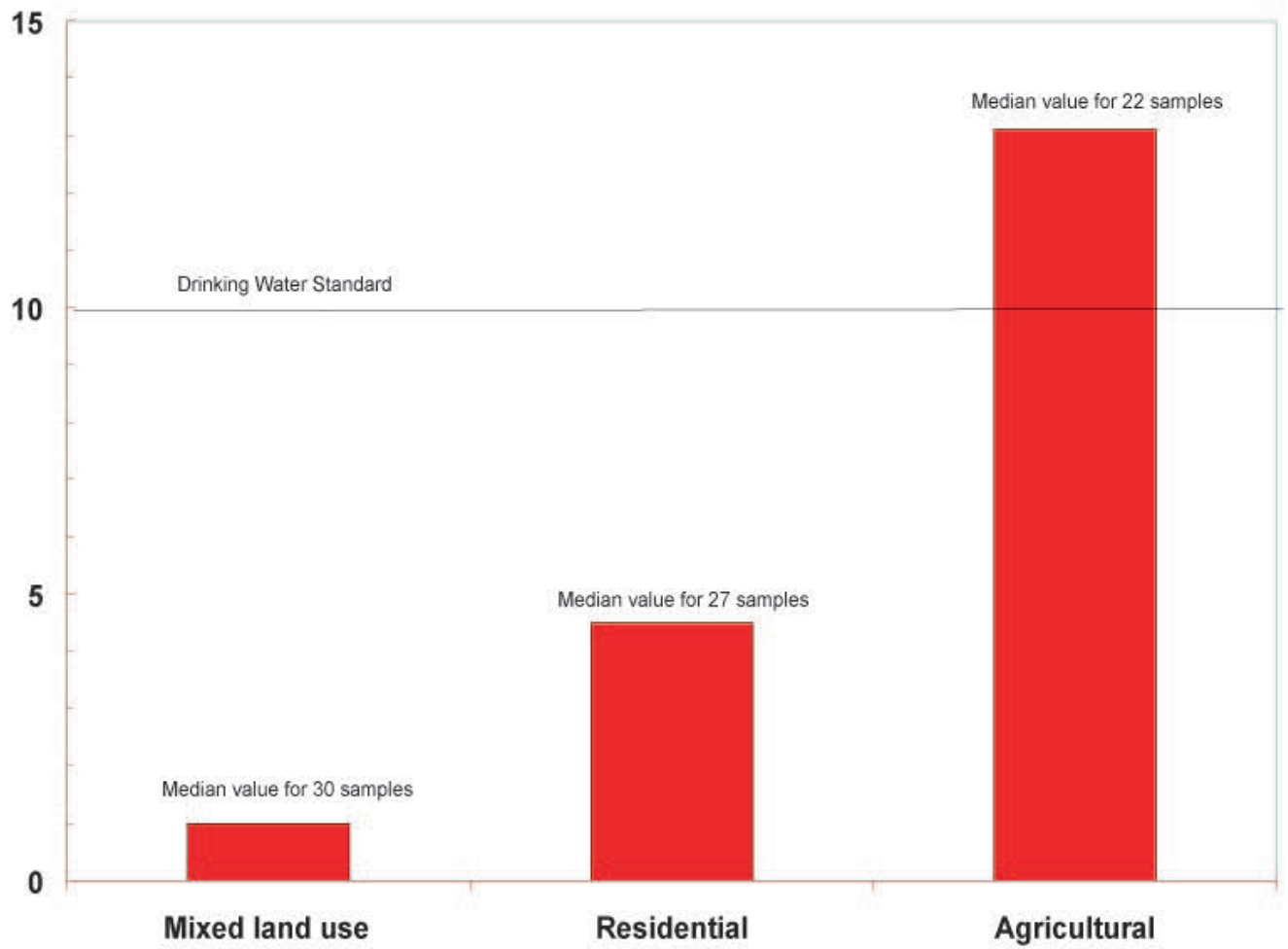
Nitrate concentrations versus depth to water



Provisional Data

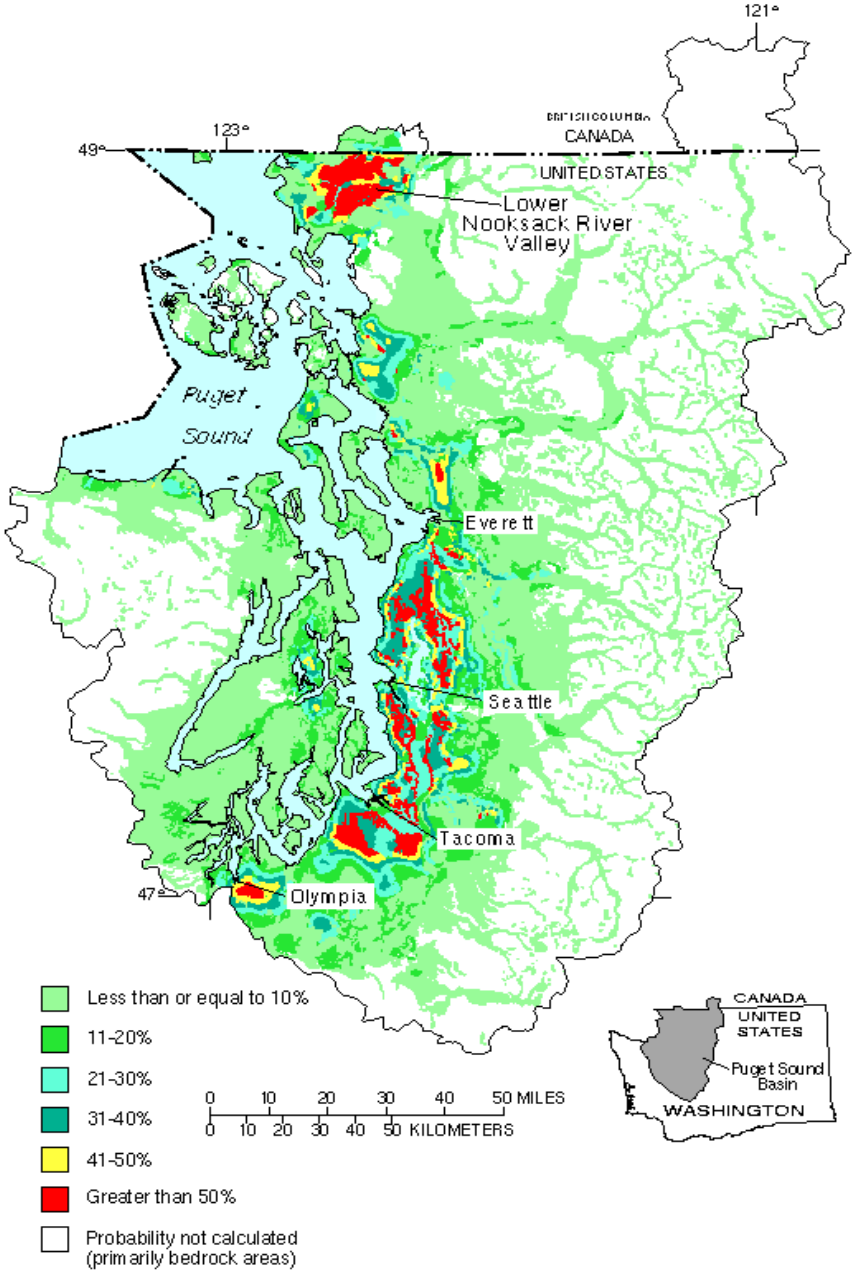
Nitrate in all PUGT Groundwater

Ebbert et al., 2000, *Water quality in the Puget Sound Basin, Washington and British Columbia, 1996-98. USGS Circular 1216, 31 p.*



http://pubs.usgs.gov/circ/circ1216/#pdf

Predicting Groundwater Vulnerability to Elevated Nitrate Concentrations



Vulnerability map. Probability (in percent) of detecting nitrate at concentrations of 3 milligrams per liter or greater in wells that are 50 feet deep in the Puget Sound Basin. USGS FS-061-97

Erwin, E.R. and Tesoriero, A.J., 1997 *Predicting ground-water vulnerability to nitrate in the Puget Sound Basin.* USGS Fact Sheet, 061-97.

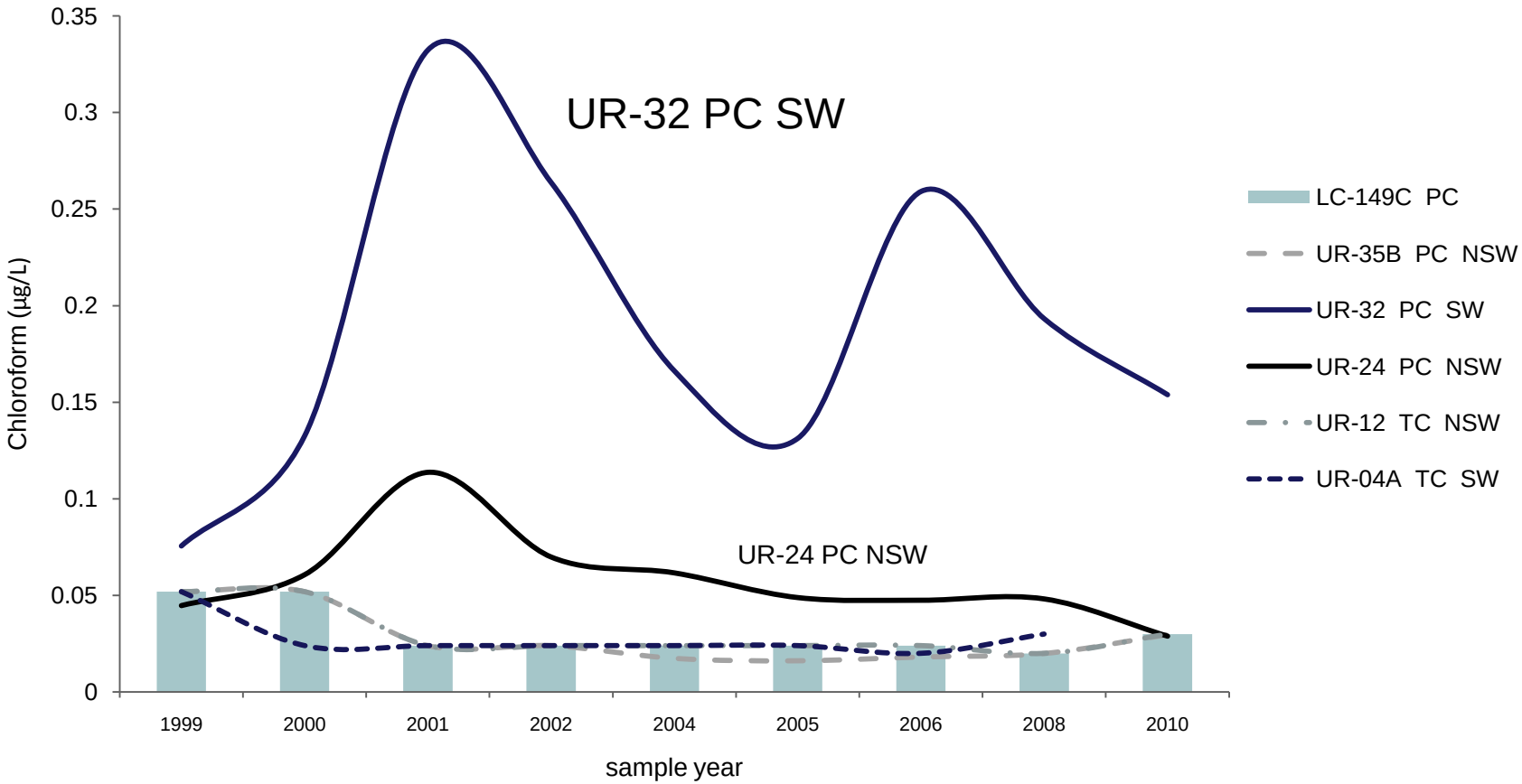
Chlorinated Volatile Organic Compounds (CVOCs) in Groundwater

Zogorski et al., 2006. Volatile Organic Compounds inthe Nation's Ground Water andDrinking-Water Supply Wells.
http://pubs.usgs.gov/circ/circ1292/pdf/circular1292.pdf

Provisional data available at NWISweb: http://nwis.waterdata.usgs.gov/wa/nwis/qwdata; Contact John Clemens at jclemens@usgs.gov for assistance in retrieving water quality data in the State of Washington.

Trichloromethane (chloroform)

Trihalomethanes: Bromodichloromethane, Tribromomethane, Dibromochloromethane all below reporting limit.



Provisional Data

Chlorinated Solvents and Gasoline Compounds

	Concentrations (µg/L)	Frequency of Detection of Estimated Values (Percentage)	Maximum Estimated Concentration (µg/L)	Well(s) Found
Chlorinated Solvents				
Tetrachloroethene		19	0.027	UR-32, UR-24
Vinyl chloride		0		
Trichloroethene		3	0.012	UR-32
cis-1,2-Dichloroethene		0		
trans-1,2-Dichloroethene		0		
1,1,1-Trichloroethane	0.15 at UR-04A	7	0.02	UR-32
1,1-Dichloroethane		0		
Chloroethane		0		
1,1-Dichloroethene		0		
Bromodichloromethane		8	0.088	UR-32
BTE(X)				
Toluene		3	0.07	UR-35B, UR-12
Benzene		0		
Ethylbenzene		3	0.01	UR-35B, UR-12
Carbon Disulfide		2	0.05	UR-35B

Provisional Data

Connecting Groundwater Flow Models

to

Water Quality

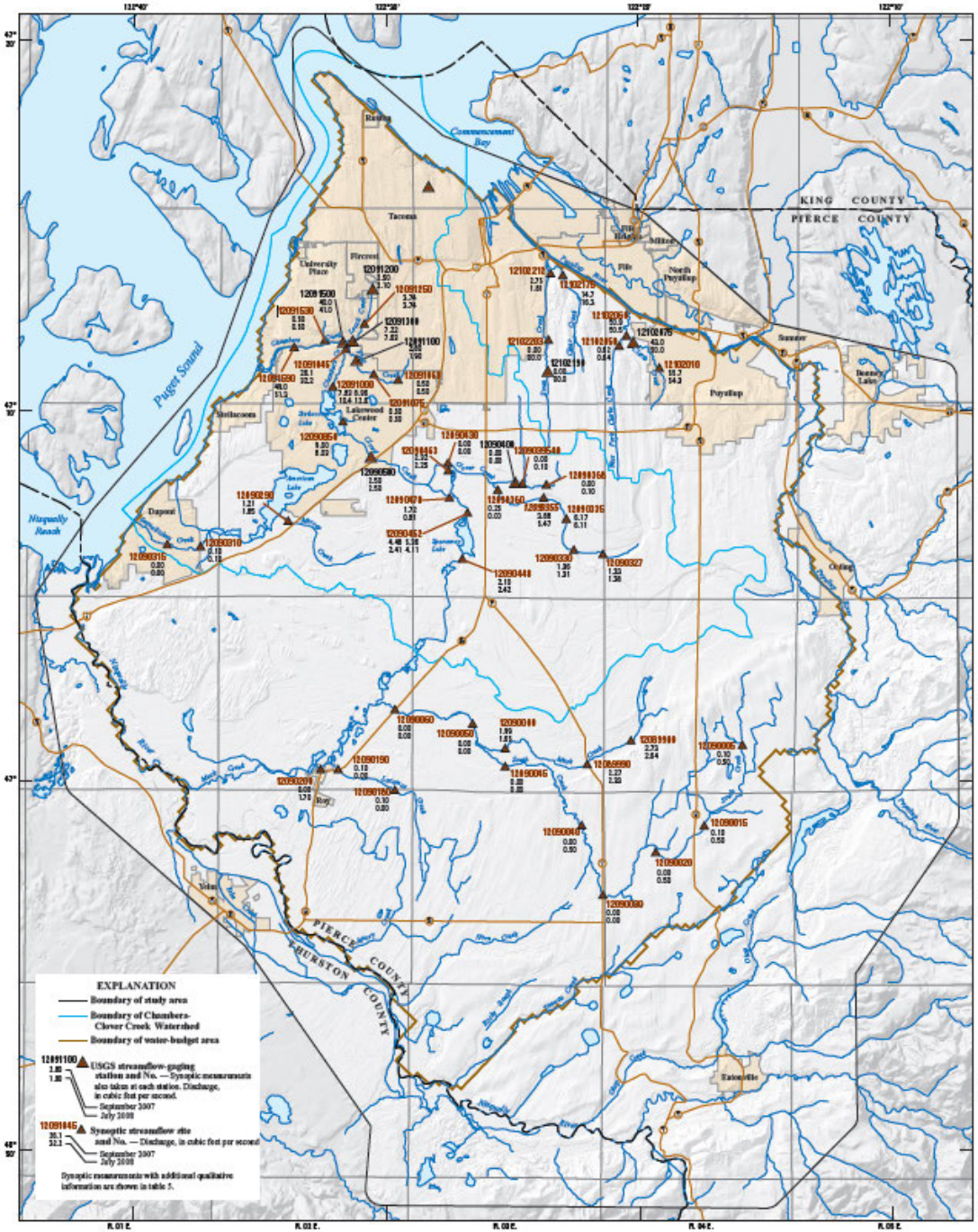
Chambers-Clover Creek

Gaining/losing reaches

- 7 streamflow gaging stations
- 44 synoptic streamflow msmt. sites (Sept 2007 and July 08)

12091100 ▲ **USGS streamflow-gaging station and No.** — Synoptic measurements also taken at each station. Discharge, in cubic feet per second.
2.80 — September 2007
1.90 — July 2008

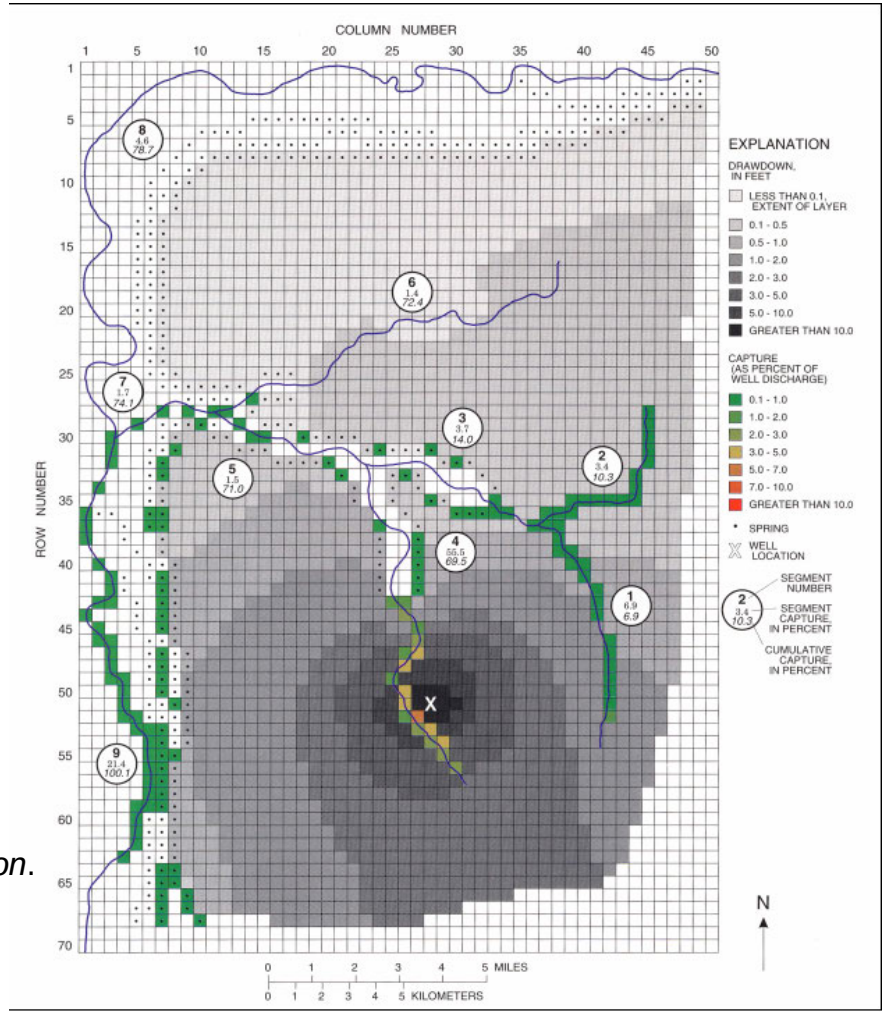
12091045 ▲ **Synoptic streamflow site and No.** — Discharge, in cubic feet per second
26.1 — September 2007
32.2 — July 2008



Source: Savoca and others, 2010, USGS Scientific Investigations Report 2010–5055

Groundwater Flow Model Applications

Model simulated streamflow capture due to groundwater pumping



Morgan and Jones, 1999. *Numerical model analysis of the effects of ground - water withdrawals on discharge to streams and springs in small basins typical of the Puget Sound Lowland, Washington*. USGS Water-Supply Paper 2492, 73 p

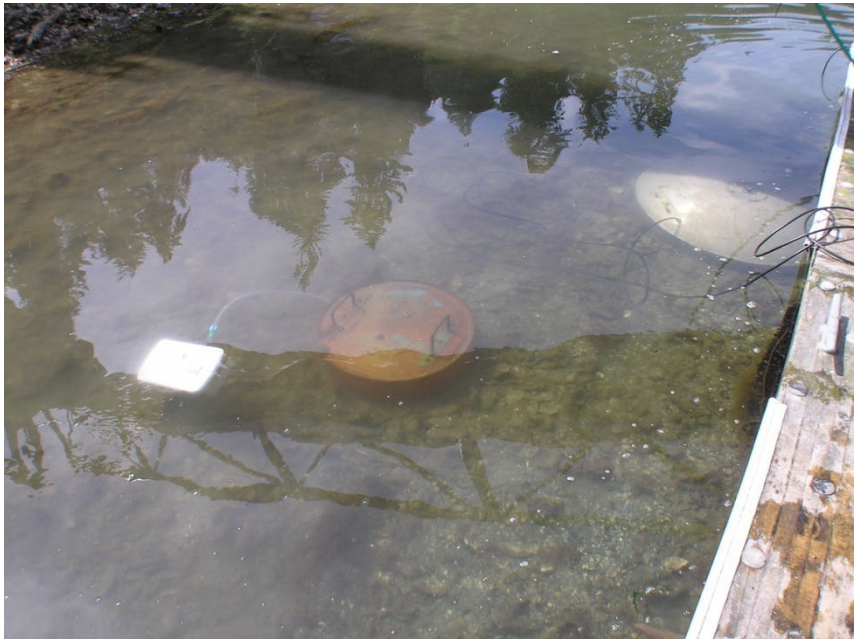
Water Quality Issues and GW Modeling

- Numerical flow models provide the physical basis for water quality models
  - GW Flow (rates and direction)
  - GW/SW interaction
  - Drainage networks (sewers, storm water, etc.)
  - Particle tracking
- Water Quality Models
  - Fate and Transport (Reactivity and Gradient)

Submarine groundwater discharge of nutrients

Measuring hydraulic gradients (manometer)

Measuring discharge rate (seepage meters)



Thank You

NAWQA Program:
http://water.usgs.gov/nawqa/

USGS Washington Water Science Center:
http://wa.water.usgs.gov/

USGS:
http://www.usgs.gov