URBAN WATERS, CONTAMINANTS, AND ECOLOGY – SORTING THE PUZZLE PIECES

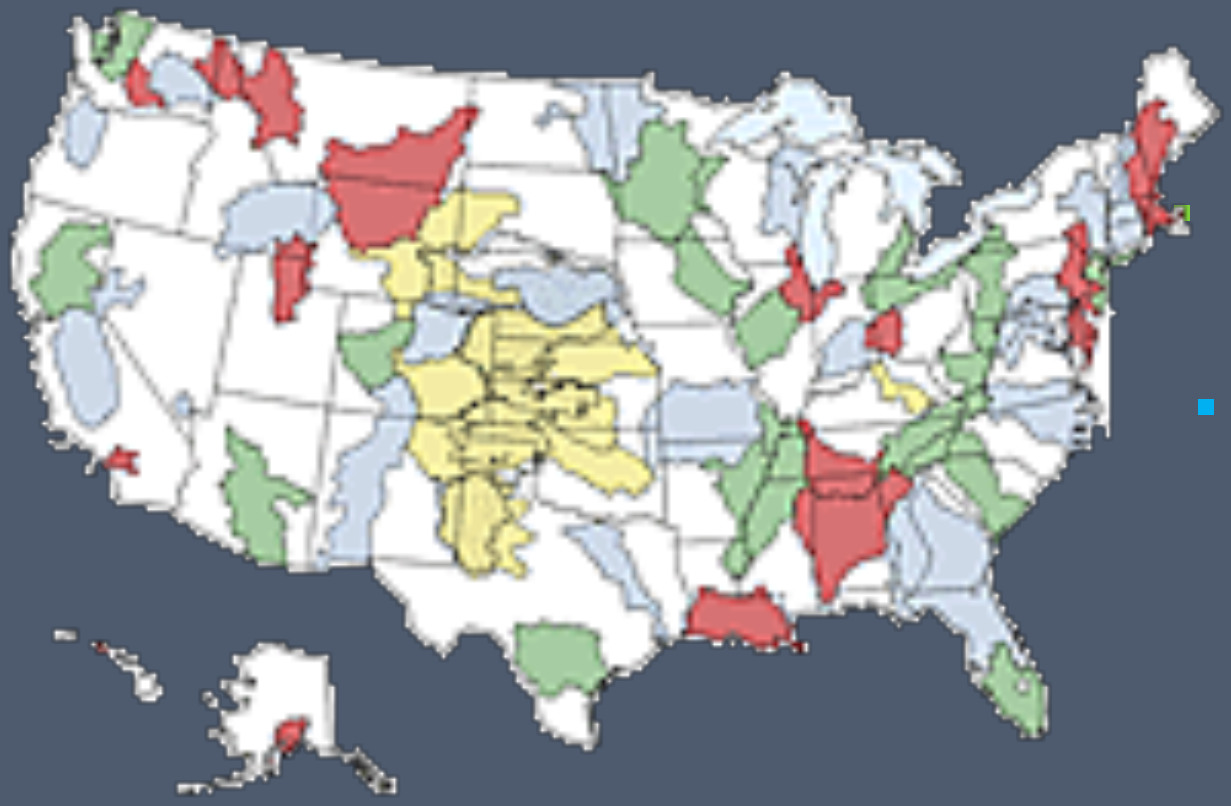
Jennifer Morace, US Geological Survey

USGS

3rd Annual Johnson Creek Science Symposium 10/17/2017

NAWQA Program

National Water Quality Assessment



1991-2001

- 51 study units
- Establish a baseline

2001-2012

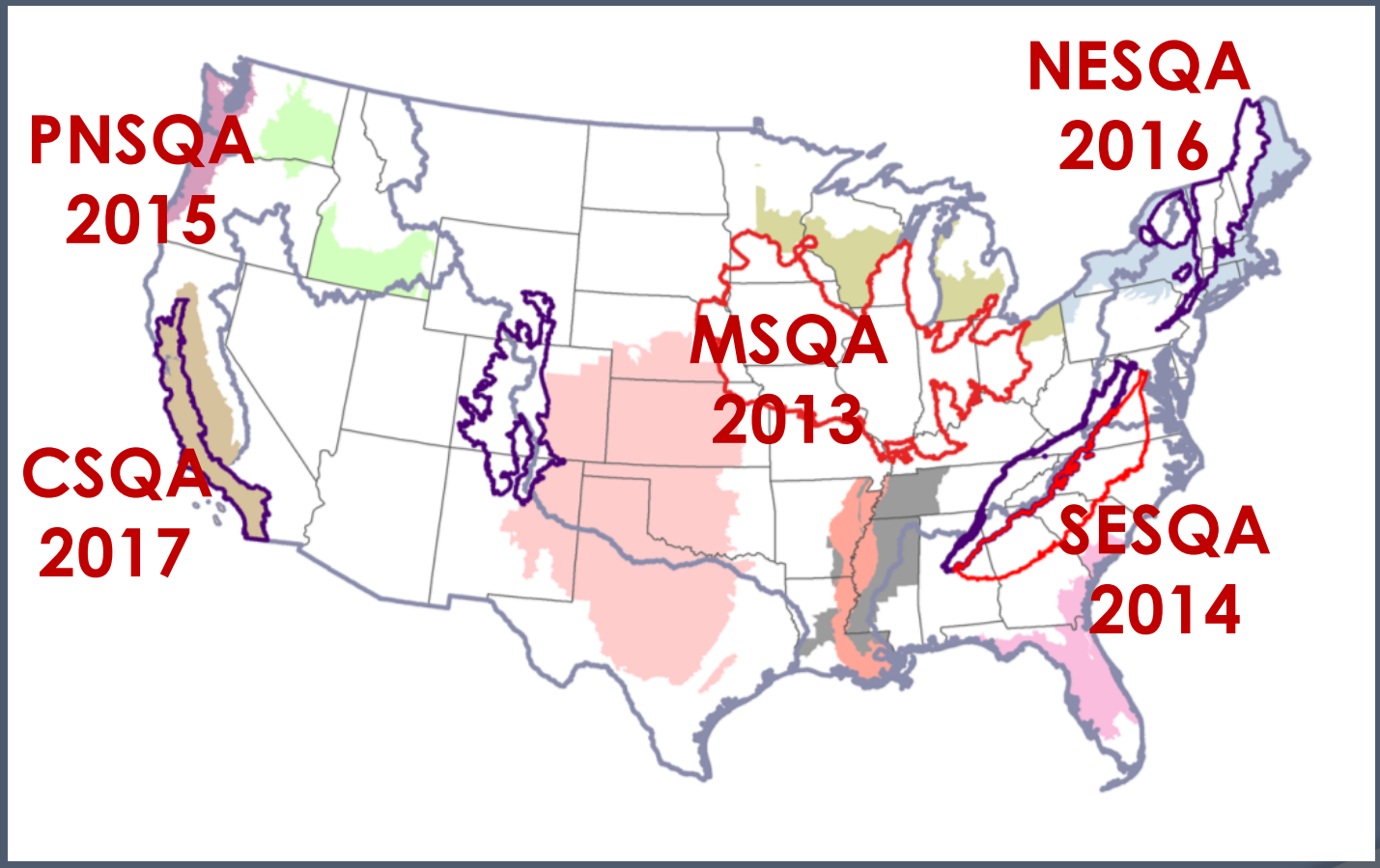
- 42 of 51 study units
- Establish trends
- Topical studies

2012-2021

- Continue trends and studies

USGS

Regional Stream Quality Assessment (RSQA)



Regional approach to evaluating ecosystem stressors and their effects

USGS

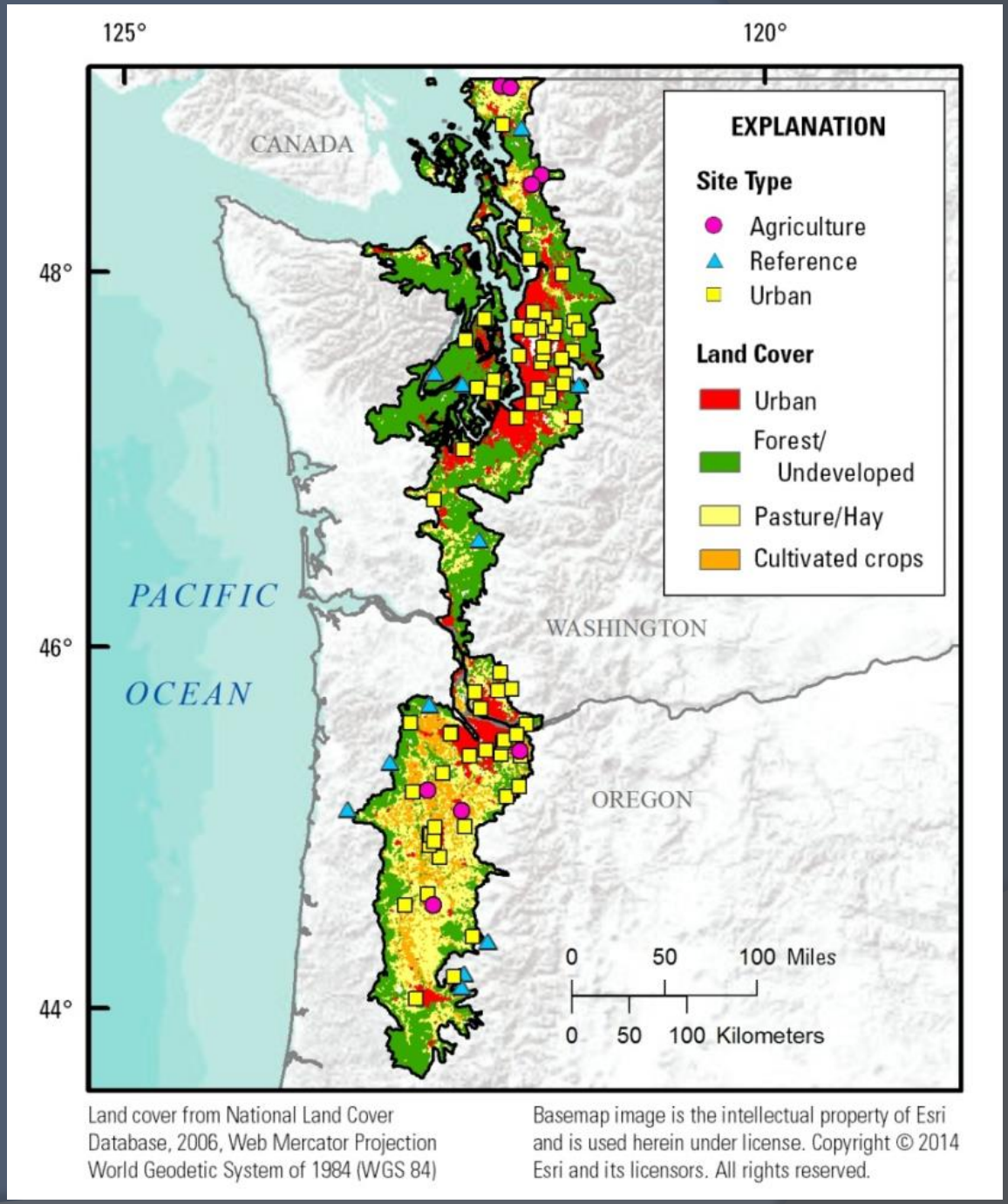
RSQA Objectives

- Status of the stream quality in each region
- Relations between stressors and ecological condition
- Relations between environmental setting and stream quality
- Develop regional models of stressors and ecological responses

USGS

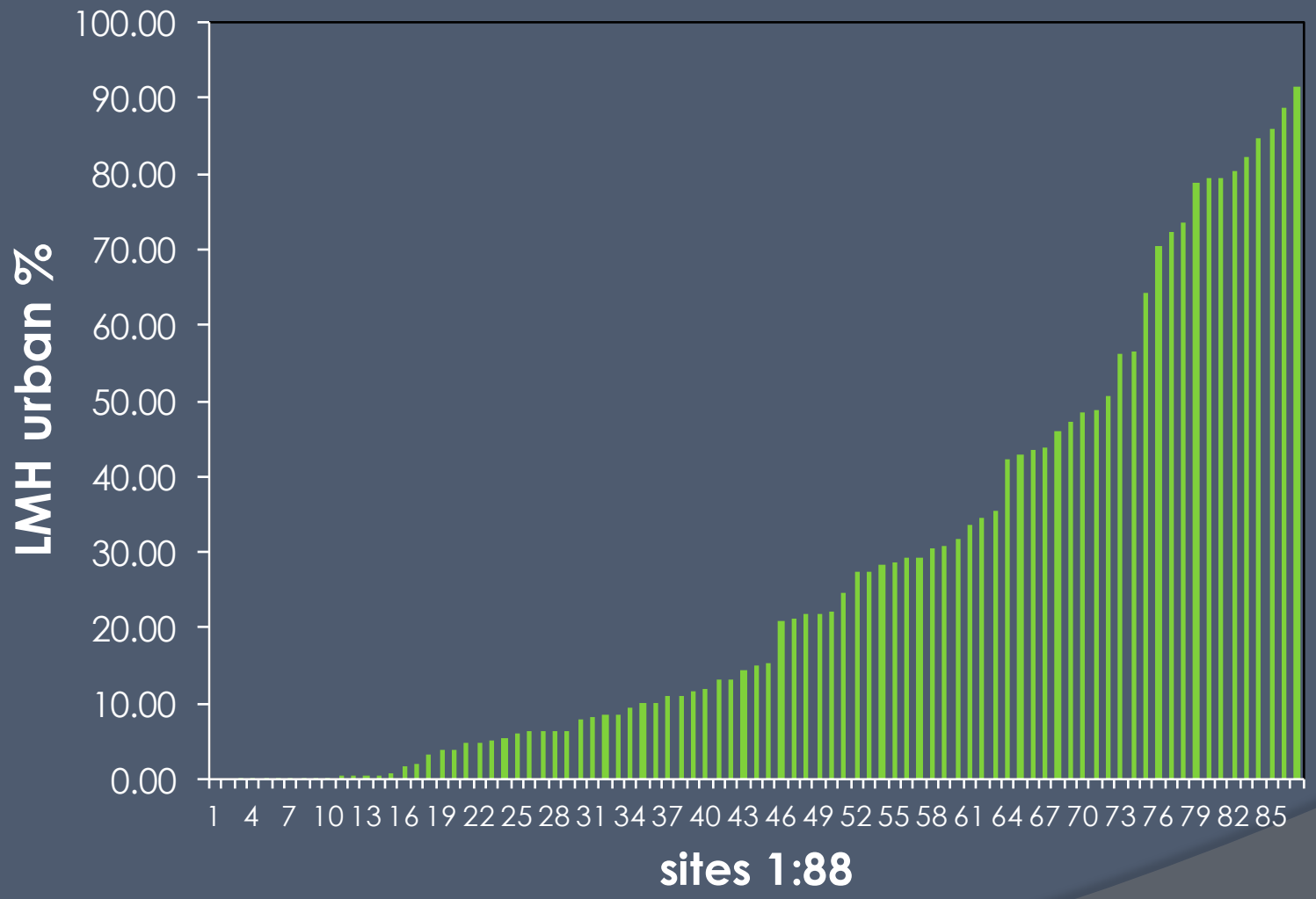
PNSQA
Pacific Northwest

- Willamette Valley and Puget Sound lowlands
- Urban stressors
- 88 sites



USGS

Urban gradient



USGS

70 Urban and Ag Sites

- Weekly samples: (10 weeks) pesticides, glyphosate (TX), nutrients, major ions, sediment, and DOC
- Four visits: Hg (WI)
- Three visits: OWI and PHARMs
- Two visits: glyphosate (KS) and N&O isotopes
- Sediment chem: HALO, SVOCs, metals, hormones, and OWI

18 Reference and rural sites

- Weekly samples: (4 weeks) pesticides (2437), nutrients, major ions, sediment, Hg, and DOC
- Sediment at half of the sites: for HALO (8093), SVOCs (5506), metals, PHARMs, hormones (6434), and OWI (5433)

USGS

Sampling timeline

Site type	Sampling	13-Apr	20-Apr	27-Apr	4-May	11-May	18-May	25-May	1-Jun	8-Jun	15-Jun	22-Jun	29-Jun
Regular Sites	WATER CHEM	1	2	3	4	5	6	7	8	9	10		
n=70	POCIS						POCIS						
	SED CHEM/TOX												
	ECO SURVEY												
Reference Sites	WATER CHEM							1	2	3	4		
n=18	POCIS						POCIS						
	SEDIMENT CHEM												
	ECO SURVEY												

USGS

452912122291200 Johnson Creek at Circle Ave

- Tier 4 (25-30% urban)
- Sandy, cobbly
- Upstream of Sycamore site to avoid channelization and too steep access
- Drainage area: 56.4 km^2
- Land use breakdown:
  - 34% Development
  - 21% Forest
  - 16.5% Pasture/grassland
  - 13.6% Crops
  - 12.5% Open area

USGS

14211499 Kelley Creek at SE 159th Drive

- Tier 3 (20-35% urban)
- Gravelly, cobbly
- Small and channelized
- Drainage area: 12.7 km^2
- Land use breakdown:
  - 27% Forest
  - 27% Pasture/grassland
  - 24% Development
  - 15% Open area
  - 3% Crops

USGS

Number of weeks in the 10-week sampling period that the compound was detected

Pesticide or degradate	J	Ky	Kg	B
2,4-D	6	6	5	9
Acephate	3			8
Aldicarb sulfoxide	1			
Asulam				2
Atrazine	5	7	6	8
CAAT	2		3	
CEAT	4		1	1
CIAT	1		4	
OIAT	1	1		
OIET	10	9	4	9
Azoxystrobin	8	2	4	10
Carbendazim	10	1	10	10
Bentazon			2	5
2-Amino-N-isopropylbenzamide				2
Bifenthrin			1	
Bromacil	6		5	
Carbaryl	2	1		4
4-Hydroxychlorothalonil	4			1
Chlorpyrifos				8
Chlorpyrifos oxon				2
Chlorsulfuron			2	
Diazinon				2
Dimethenamid	6			9
Diuron	9	2	8	10
DCPMU	10	1	7	10
DCPU	1			
Ethoprop	1		1	7
Et Me Pr phosphorothioate			1	
Fipronil	4		2	3
Desulfinylfipronil	1			2
Fipronil sulfide				1
Fipronil sulfone	2		2	2

Pesticide or degradate	J	Ky	Kg	B
Hexazinone	10	10	4	8
Demethyl hexazinone B	4	10		1
Imidacloprid	1			9
Metalaxyl	8	1		3
Metconazole				10
Methamidophos	1			3
Methoxyfenozide				1
Metolachlor	3		1	10
Dechlorometolachlor	1			9
Hydroxymetolachlor				8
Metolachlor OA				4
Metolachlor SA	9		8	9
Myclobutanil	2			9
Norflurazon	1	9		
Demethyl norflurazon	1	10		
Oryzalin	10	2		10
Paraoxon			1	
Prometon	9	8	6	7
Propyzamide				5
Propiconazole	9	1	2	8
1H-1,2,4-Triazole				4
Pyraclostrobin				8
Simazine	10	8	6	9
Hydroxysimazine	6	10	3	9
Sulfentrazone	8	1	5	
Sulfometuron-methyl	2	1	9	
Tebuconazole	1			
Tebupirimfos oxon		1		3
Tebuthiuron	5	3	10	
Tebuthiuron TP 108	1		6	
Triclopyr	8	6	3	7

USGS

The importance of mixtures

Number of pesticides & degradates over 10-week period

Johnson	Kelly	Kellogg	Beaver
44	24	31	46

Many of the compounds studied in this project do NOT have water-quality criteria

To fully understand the effects of the organisms and ecology of the stream, we need to learn more about mixture and sub-lethal effects

"Surprisingly low concentrations of toxic chemicals -- from fungicides to antidepressants -- can change the way some aquatic creatures swim and feed, according to new research."
– Science Daily, 10/16/17

USGS

Contact info:

Jennifer Morace
jlmorace@usgs.gov
503.251.3229

USGS
science for a changing world

National Water-Quality Assessment Program

The Pacific Northwest Stream Quality Assessment

In 2015, the U.S. Geological Survey (USGS) National Water-Quality Assessment (NAWQA) program is assessing stream quality in the Pacific Northwest. The goals of the Pacific Northwest Stream Quality Assessment (Pacific Northwest study) are to assess the quality of streams in the region by characterizing multiple water-quality factors that are stressors to aquatic life and to evaluate the relation between these stressors and biological communities. The effects of urbanization and agriculture on stream quality for the Puget Lowlands and Willamette Valley are the focus of this regional study (fig. 1). Findings will provide the public and policymakers with information regarding which human and environmental factors are the most critical in affecting stream quality and, thus, provide insights about possible approaches to protect or improve the health of streams in the region.

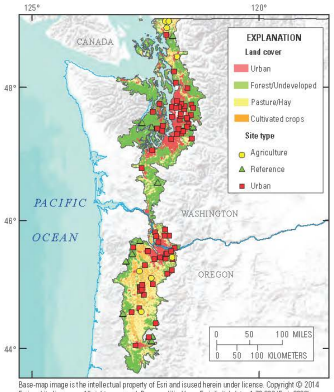


Figure 1. The Pacific Northwest Stream Quality Assessment study area. Study area boundary is based on the Willamette Valley and Puget Lowlands level 3 ecological regions (ecoregions) of the United States.

The Pacific Northwest study will be the third regional study by the NAWQA program, and it will be of similar design and scope as the first two—the Midwest in 2013 and the Southeast in 2014 (Van Metre and others, 2012, 2014).

Objectives

1. Determine the status of stream quality—contaminants, nutrients, sediments, toxicity of the bed sediments, streamflow, habitat, and biological communities—across the region.
2. Evaluate the relative influence of contaminants, nutrients, sediment, toxicity, streamflow, and habitat on biological communities in the streams sampled.
3. Evaluate relations between measured stressors and biological communities and the natural and anthropogenic characteristics of the watersheds.
4. Develop statistical models and management tools to predict concentrations of stressors, and, if possible, ecological conditions in wadeable streams across the region.

Approach

Eighty-eight sites are scheduled for sampling during April, May, and June 2015 in the region, with weekly sampling for 4 or 10 weeks at each site, depending on the land use in the watershed. Samples will be analyzed for contaminants, nutrients, and sediment (fig. 1). This water-quality "index" period will culminate with an ecological survey of habitat, algae, benthic invertebrates, and fish at all sites. Sediment will be collected during the ecological survey for analysis of sediment chemistry and toxicity. Rapid urban growth, particularly in the greater Seattle and Portland metropolitan areas, is causing water-quality concerns in the region. The study design therefore includes sampling 80 sites that reflect a wide range of urbanization, from dense urban watersheds to undeveloped reference watersheds. Eight sites representing the major types of agriculture in the region also will be sampled. The resulting data should span ranges of many specific stressors (for example, contaminants), allowing us to better understand the effects of those stressors on stream ecology.

Study Components

Assessing Ecological Condition—Algae, benthic macroinvertebrate, and fish communities will be sampled and physical habitat assessed once at all 88 sites in late June 2015. Samples will be collected along multiple transects within the stream reach following USGS NAWQA protocols (Moulton and others, 2002).

U.S. Department of the Interior
U.S. Geological Survey

Fact Sheet 2015–3020
March 2015

USGS

Fact sheet and methods report available online

USGS
science for a changing world

National Water-Quality Assessment Project

Design and Methods of the Pacific Northwest Stream Quality Assessment (PNSQA), 2015

Open-File Report 2017–1103

U.S. Department of the Interior
U.S. Geological Survey