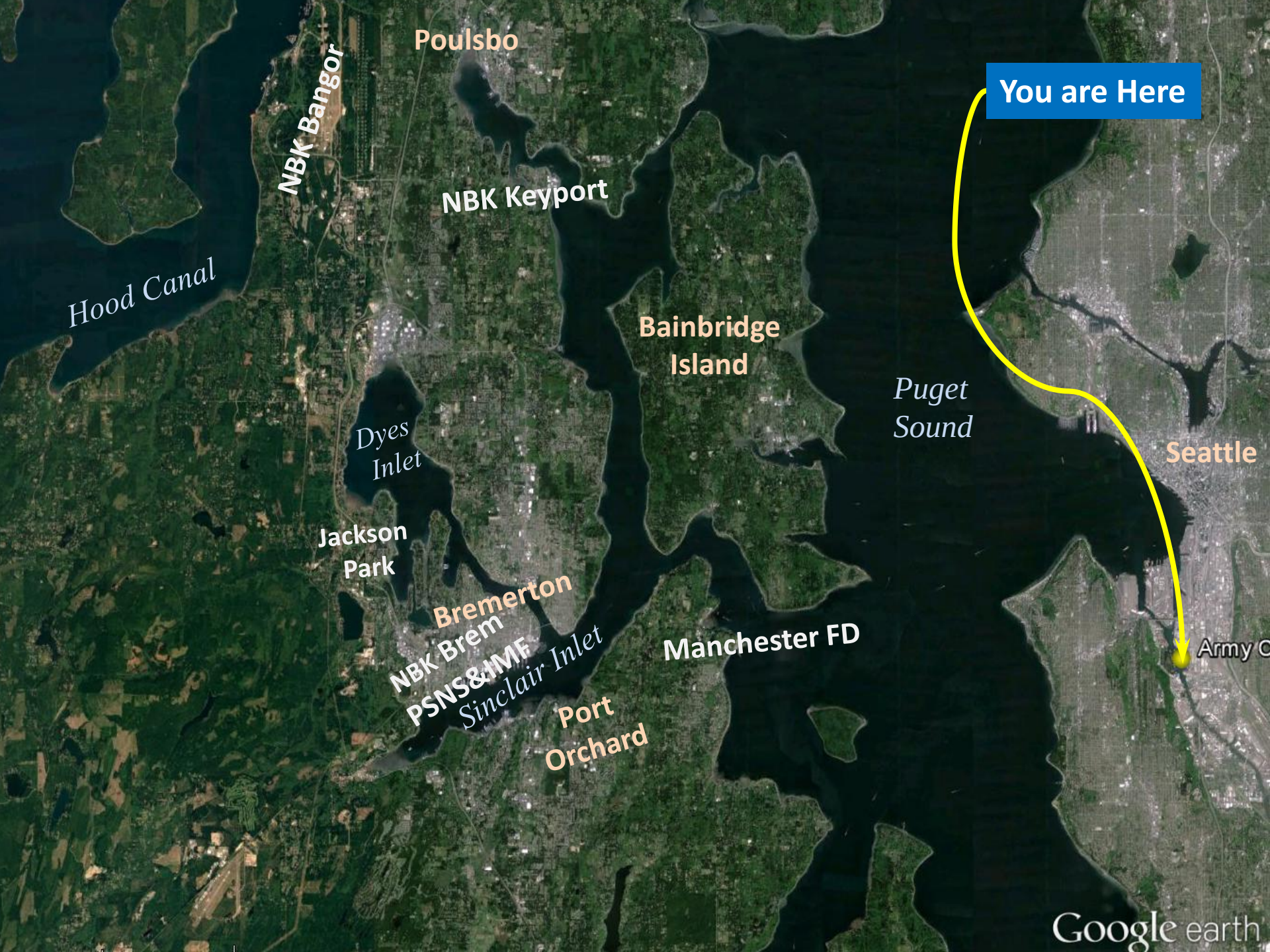
Recontamination Potential for Remediated Sediment Sites

Dr. Bob Johnston, Space and Naval Systems Center Pacific

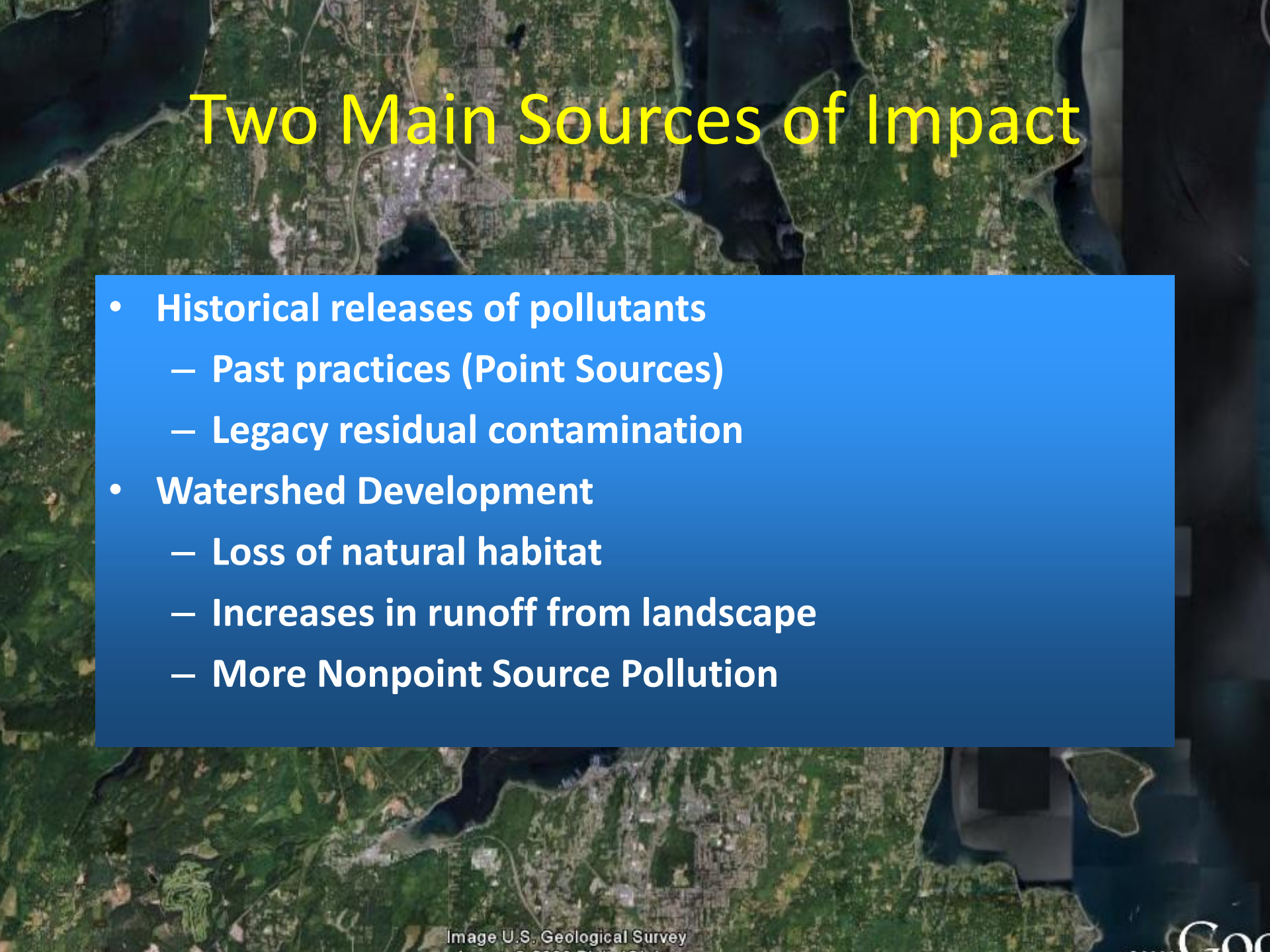
- Introduction/Background
- Watershed Based Management
  - Pressures and Drivers on the Landscape
  - Why is Storm Water Runoff a Problem?
- Runoff from Above and Below
- Redistribution of Contaminated Sediment
- 21st Century Contaminants of Concern
- Integrating Environmental Quality Goals
- Challenges and Opportunities


Poulsbo
NBK Bangor
You are Here
NBK Keyport
Hood Canal
Bainbridge Island
Puget Sound
Dyes Inlet
Seattle
Jackson Park
Bremerton
NBK Brem
PSNS&IMF
Sinclair Inlet
Manchester FD
Port Orchard
Army C
Google earth

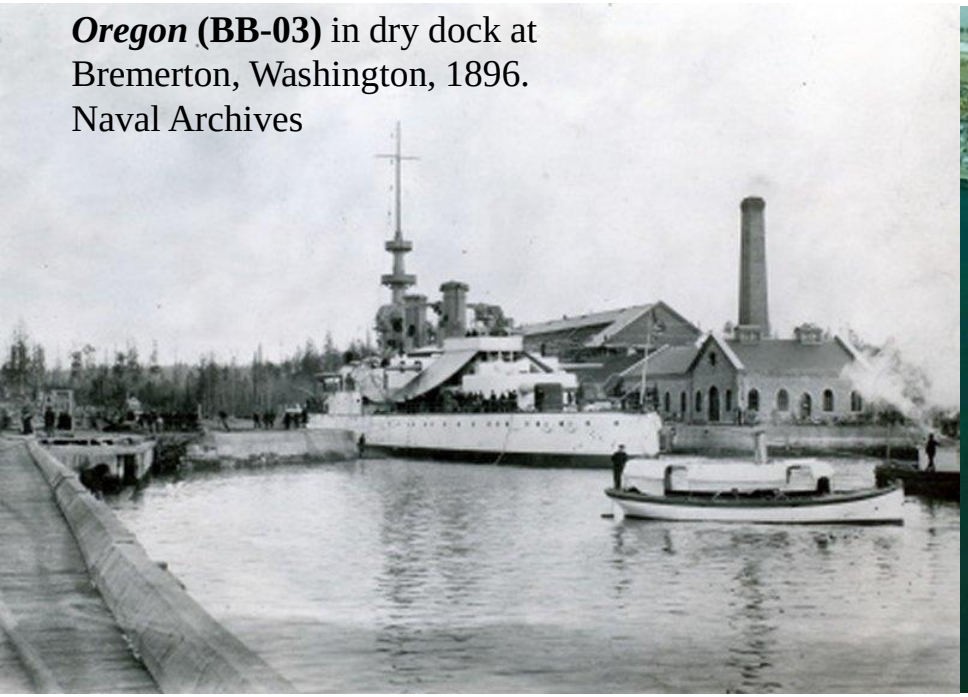

NBK
Clear Creek
Strawberry Creek
Barker Creek
SILVERDALE
Springbrook Creek
Pharmann Creek
Dyes Inlet
BAINBRIDGE ISLAND
Mosher Creek
Illahee Creek
Port Orchard Passage
Rich Passage
Chico Creek
Port Washington Narrows
Dee Creek
Wautaga Beach Creek
BREMERTON
Ostrich Bay Creek
PSNS
NBK
Beaver Creek
Sacco Creek
Sinclair Inlet
Wright Creek
Annapolis Creek
PORT ORCHARD
Gorst Creek
Olney Creek
KITSAP COUNTY
Blackjack Creek
Ross Creek
Anderson Creek
0 0.5 1 2
Miles

Two Main Sources of Impact

- Historical releases of pollutants
  - Past practices (Point Sources)
  - Legacy residual contamination
- Watershed Development
  - Loss of natural habitat
  - Increases in runoff from landscape
  - More Nonpoint Source Pollution



PSNS & IMF (Bremerton)



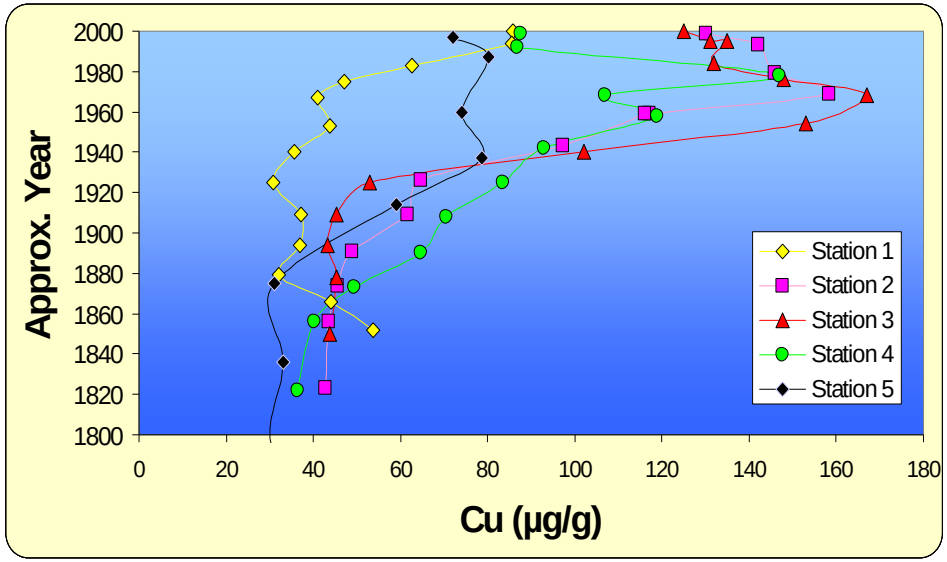
***Oregon* (BB-03)** in dry dock at Bremerton, Washington, 1896. Naval Archives

Shipyard Operation May 1992

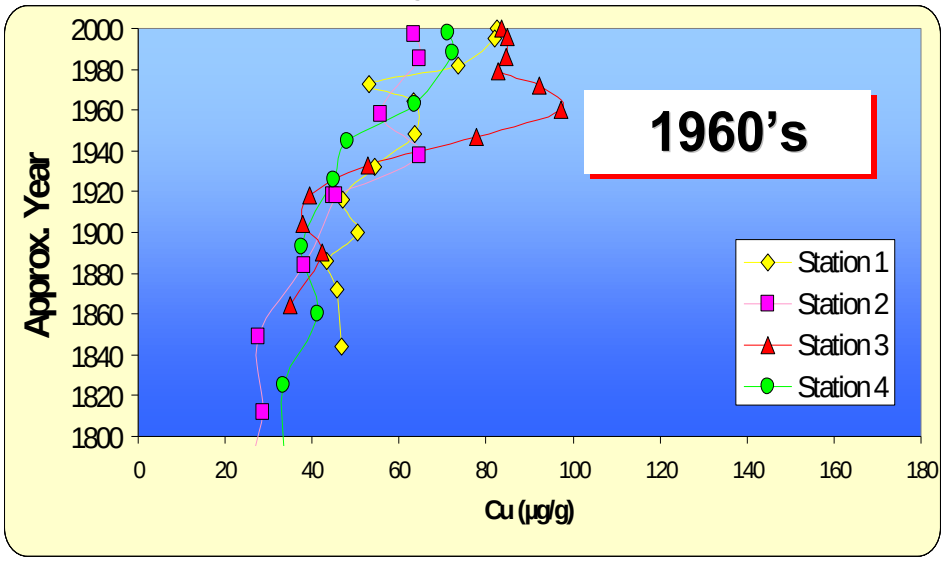
- Established in 1891.
- 179 acres of heavy industrial area (100% impervious surface)
- Old Infrastructure
- No buffer between work and water,
- Located on an “Impaired Water Body”

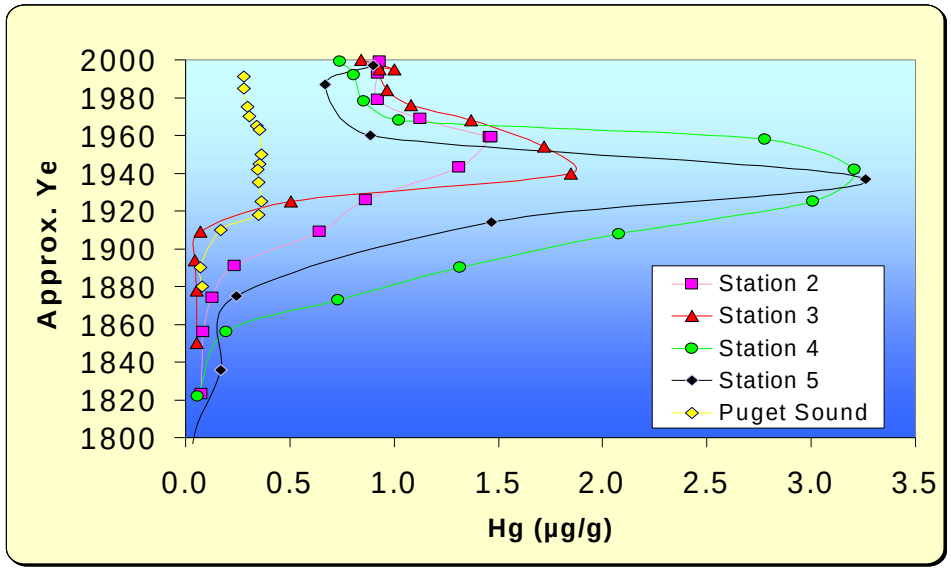
Sediment Core Profiles

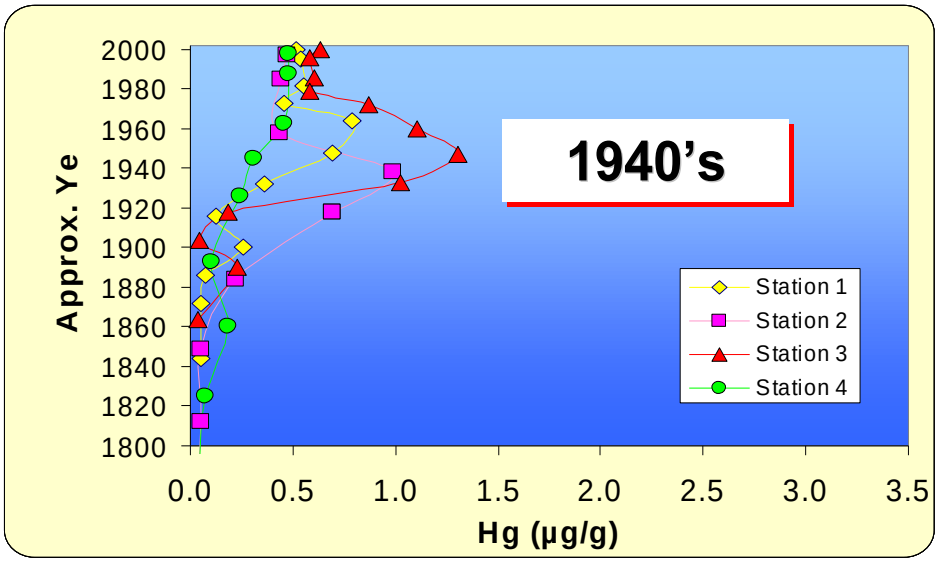
Sinclair Inlet



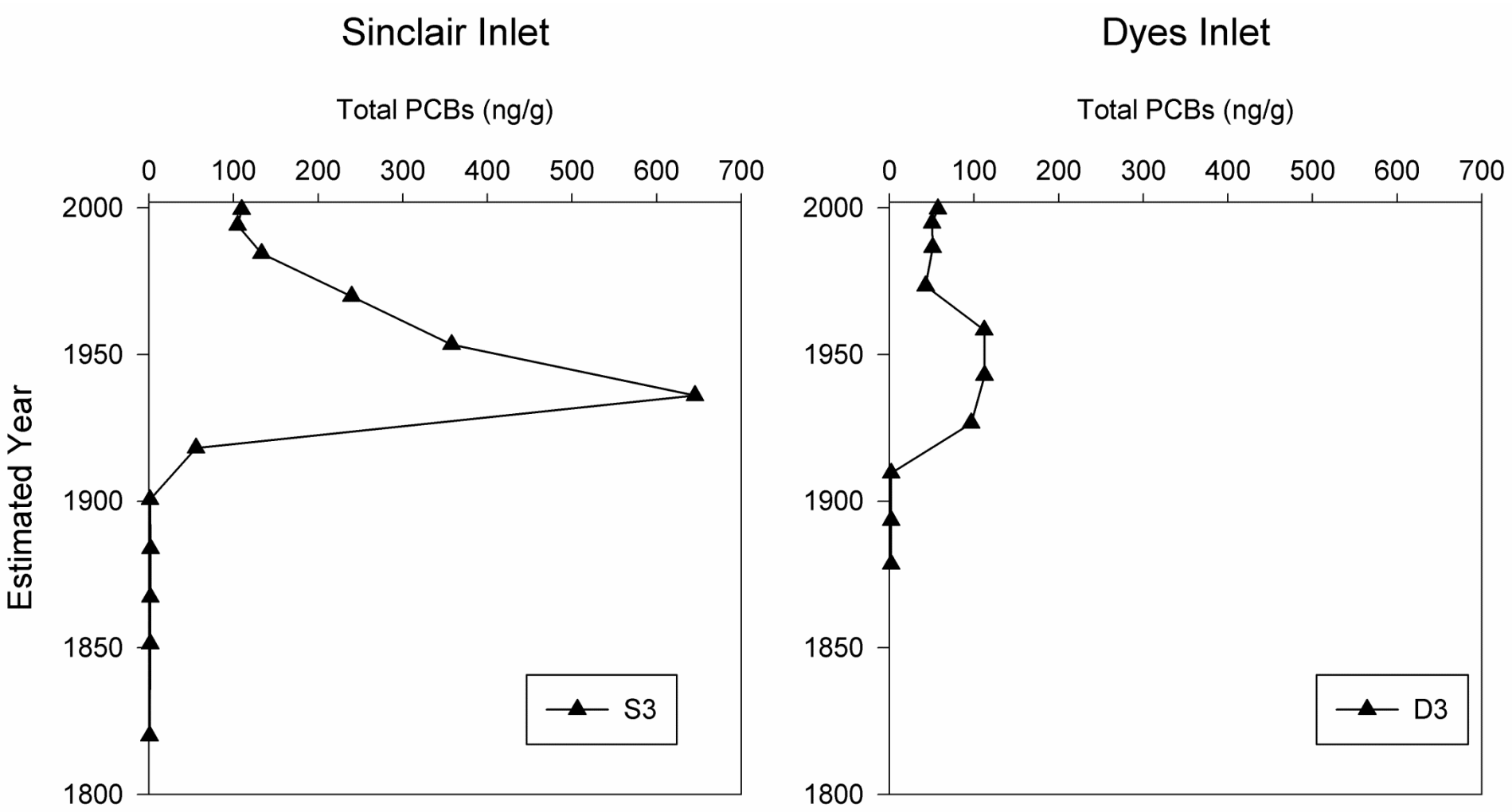
Dyes Inlet





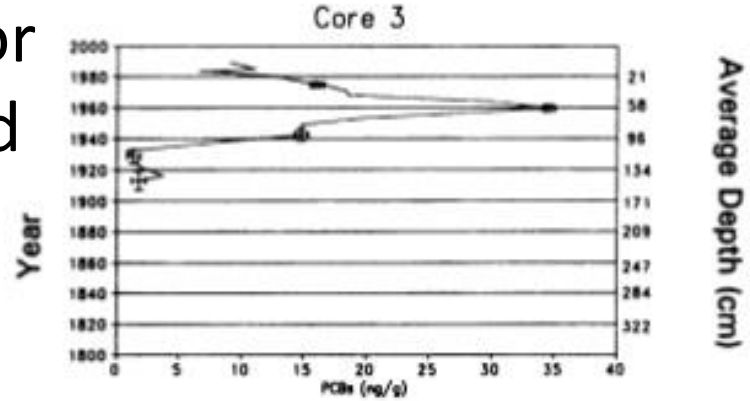


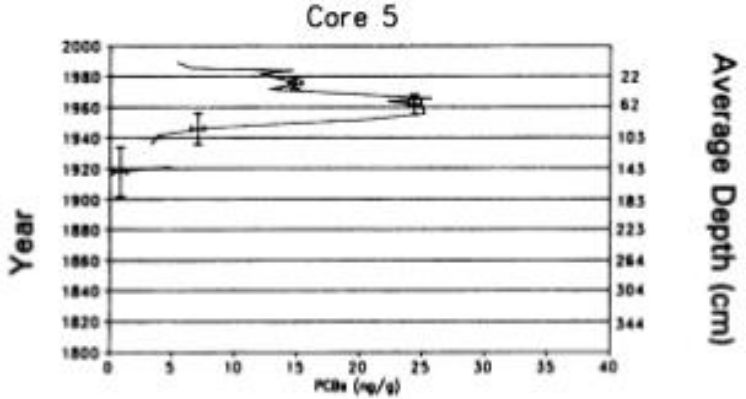
(Crecelius et al. 2003)

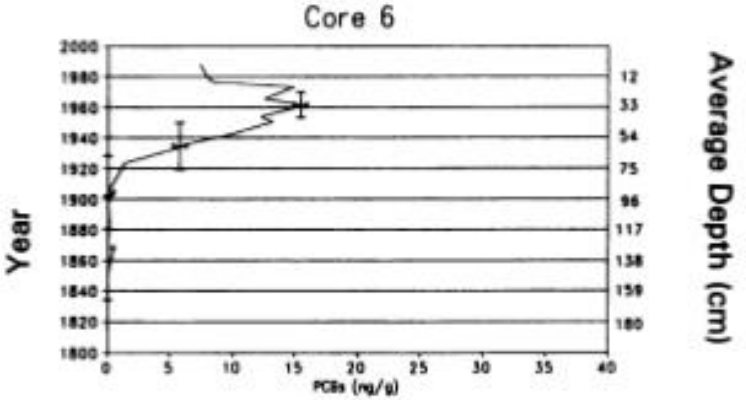


(Brandenberger, Crecelius, Johnston 2008)

PCB Core Profiles for central Puget Sound





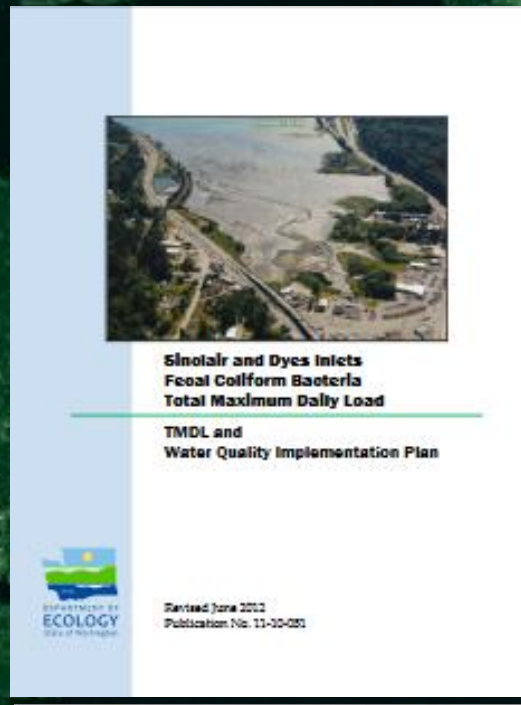


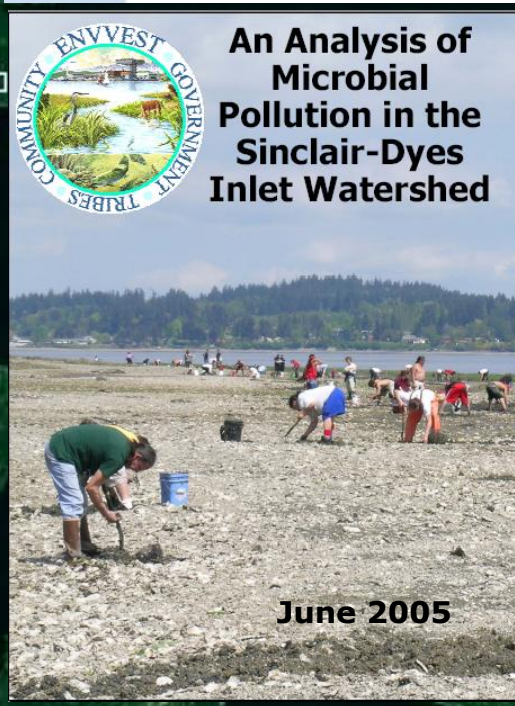
(Lefkovitz, Cullinan, Crecelius 1997)

Predicting FC Loads from Watershed

The watershed scale is the appropriate scale to address problems and engage stakeholders

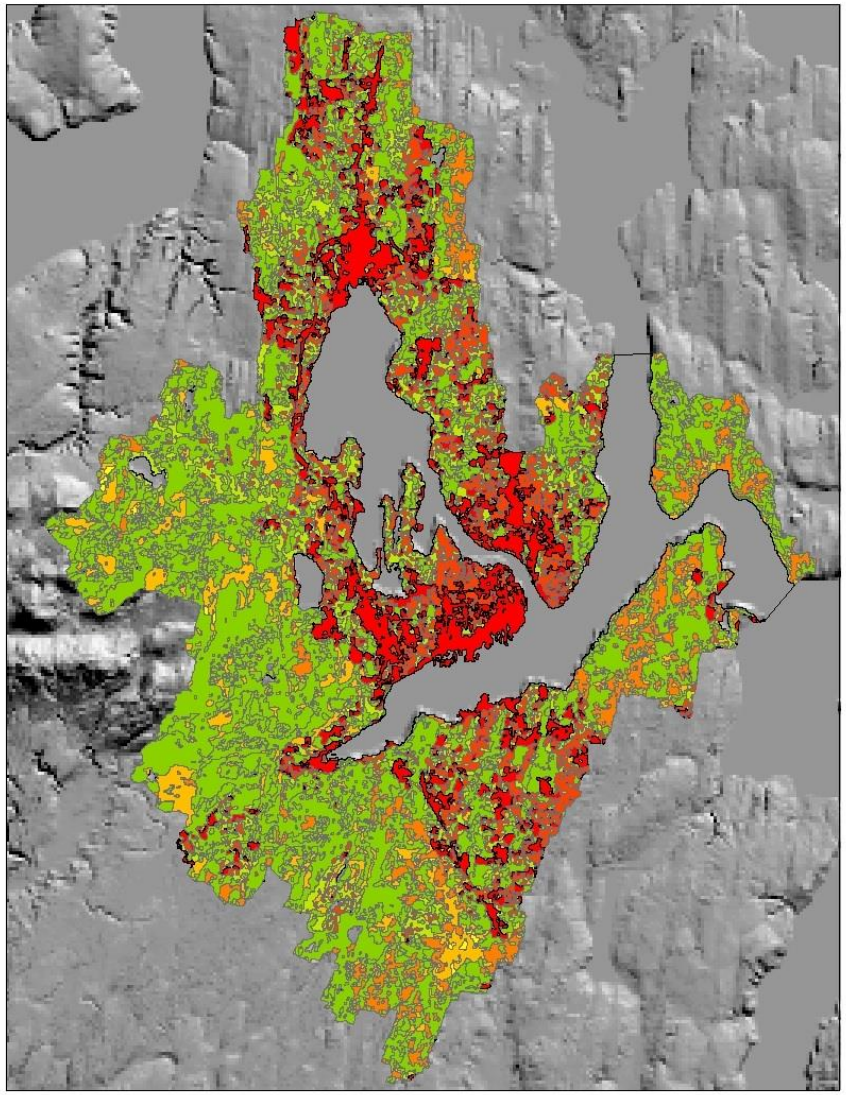
- Stream
- Stormwater
- Nearshore
- Marine





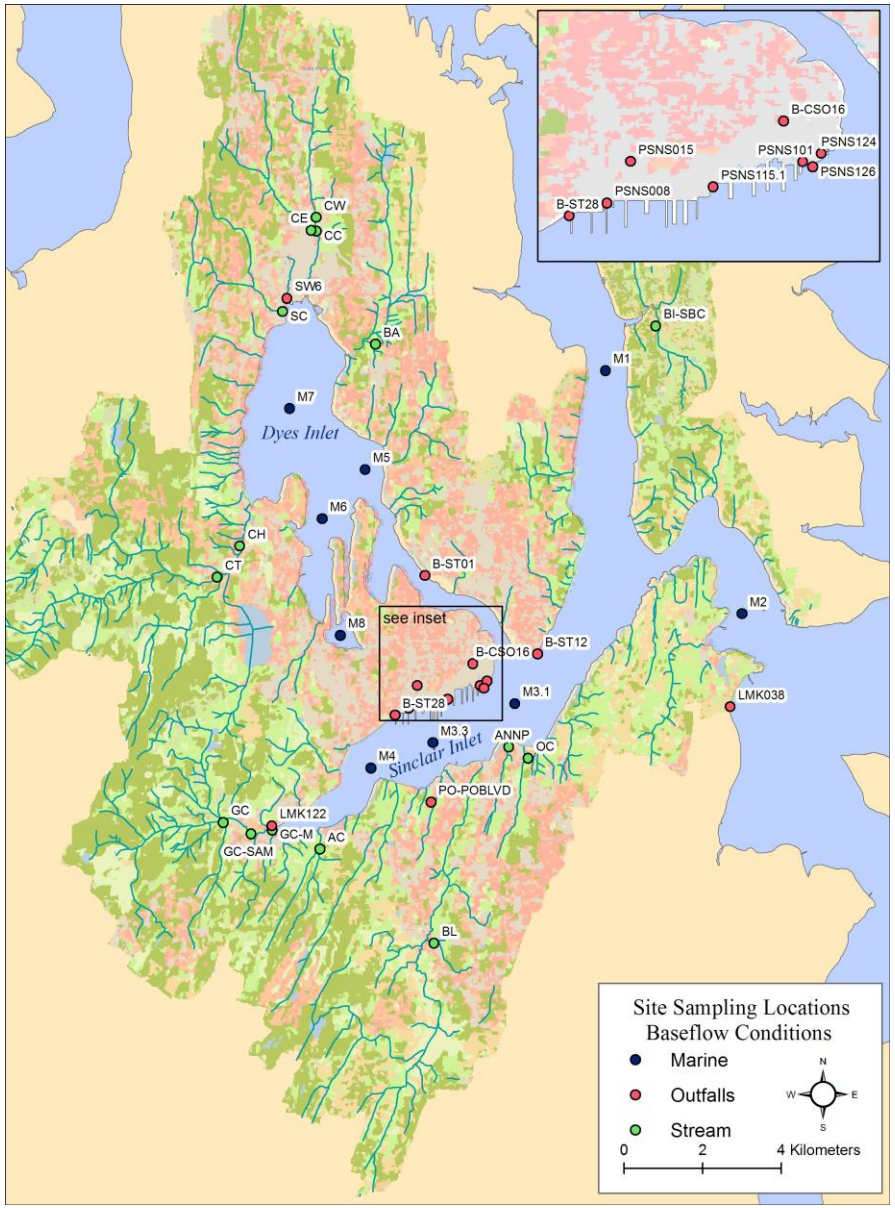
Landscape Chromatography

Sampled: n = 16:68 Streams and 18:87 Stormwater Outfalls
ranging from 2 to 9,634 acres



Increasing Development

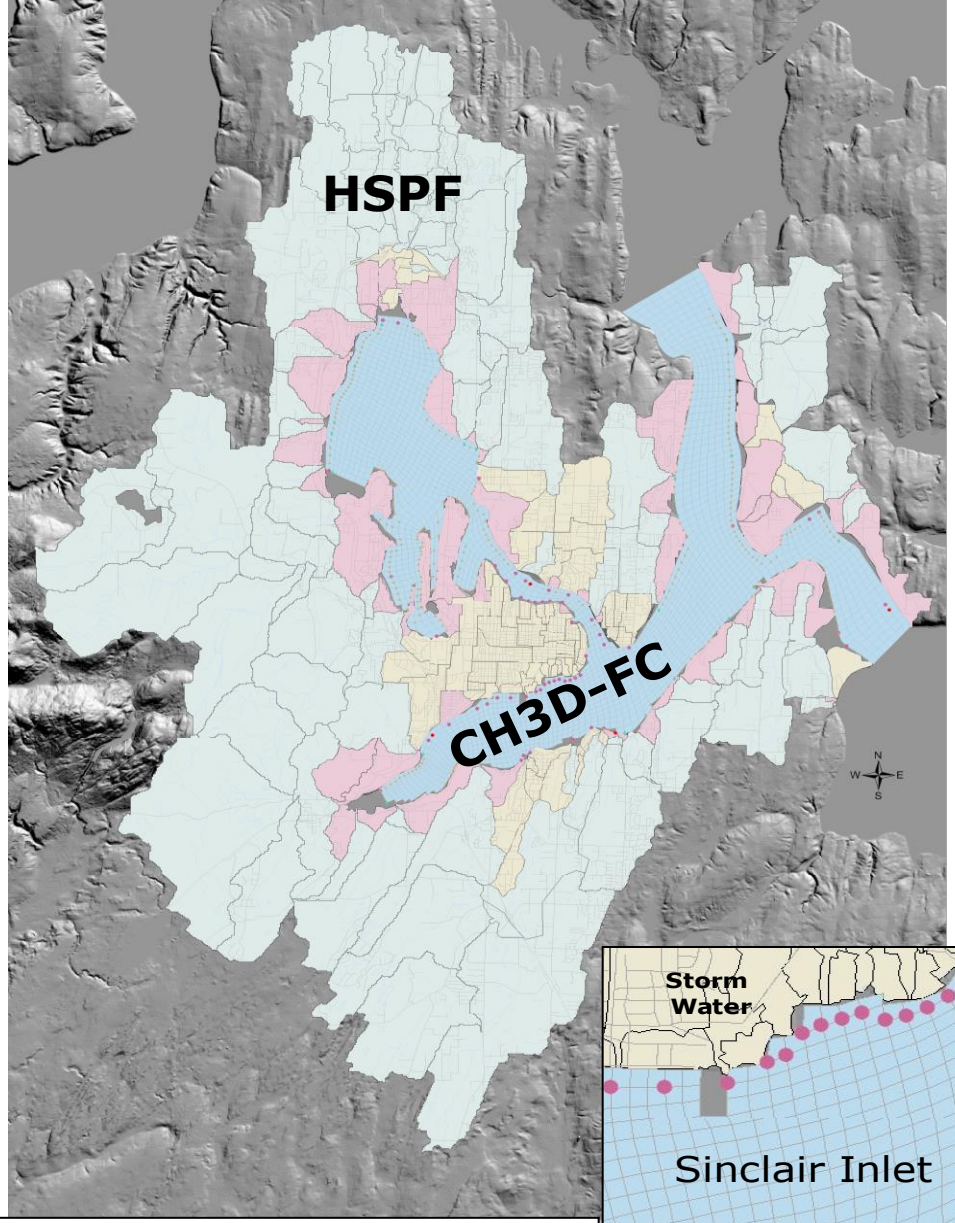
Total Impervious Area (TIA)

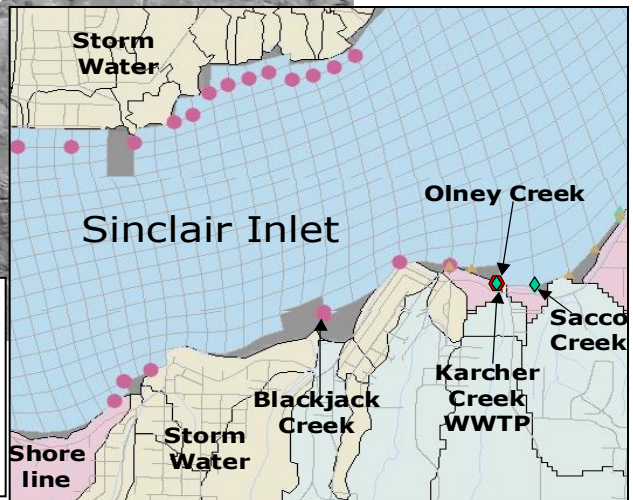


Integrated Modeling

The integrated watershed (HSPF) and receiving water (CH3D-FC) models all inputs.

Current Configuration:
39 Streams
50 Stormwater Outfalls
44 Shoreline Drainages
4 Treatment Plants
---
137 Separate Inputs





Inputs
- Stream
- Storm water
- Shoreline runoff
- Wastewater Treatment Plant (WWTP)

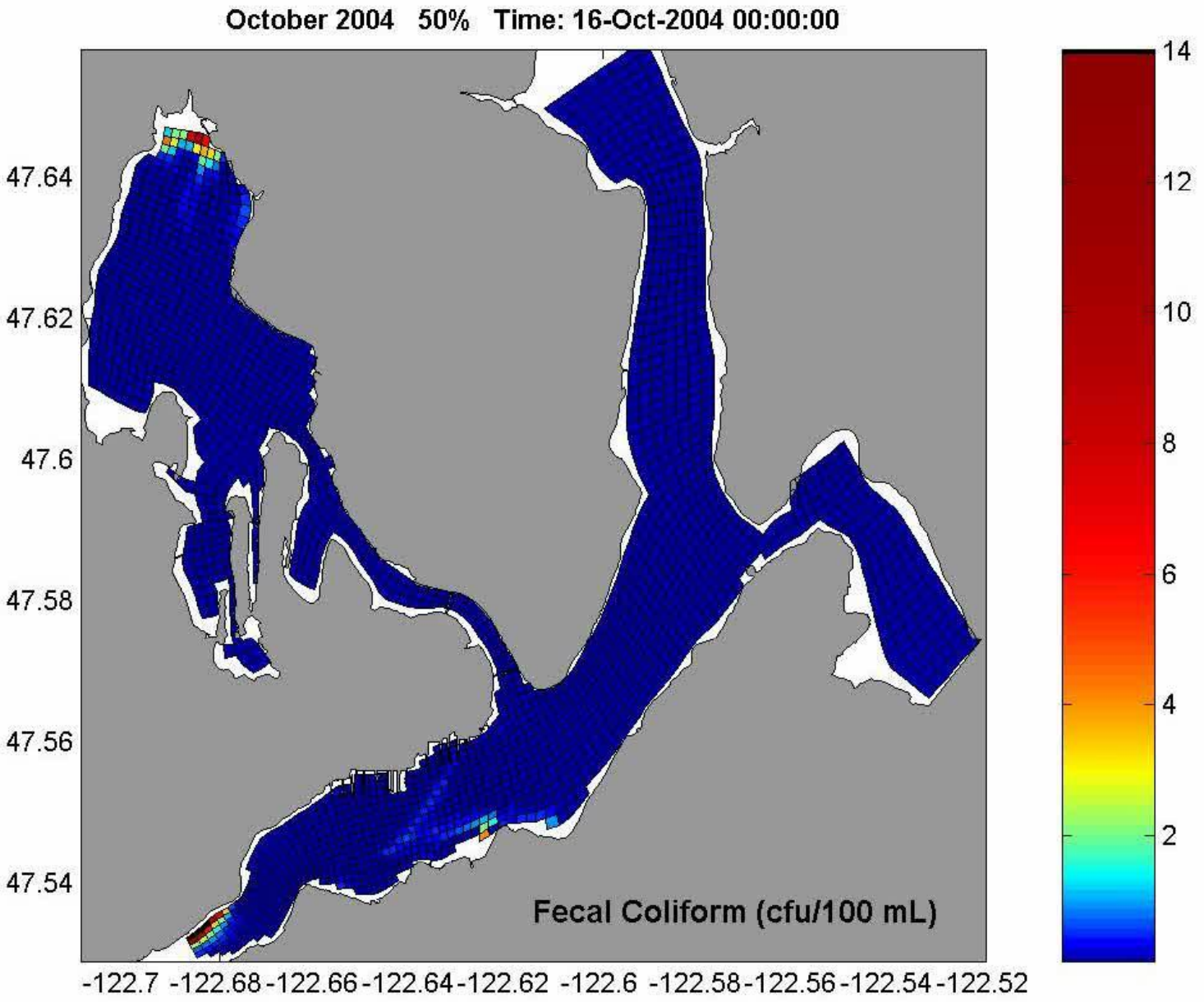
Simulation of Oct 2004 Storm Event

Color scale shows build up of contamination near creek mouths and nearshore areas with limited flushing

Upset condition occurred at Port Orchard treatment plant (19 Oct 24 1000)

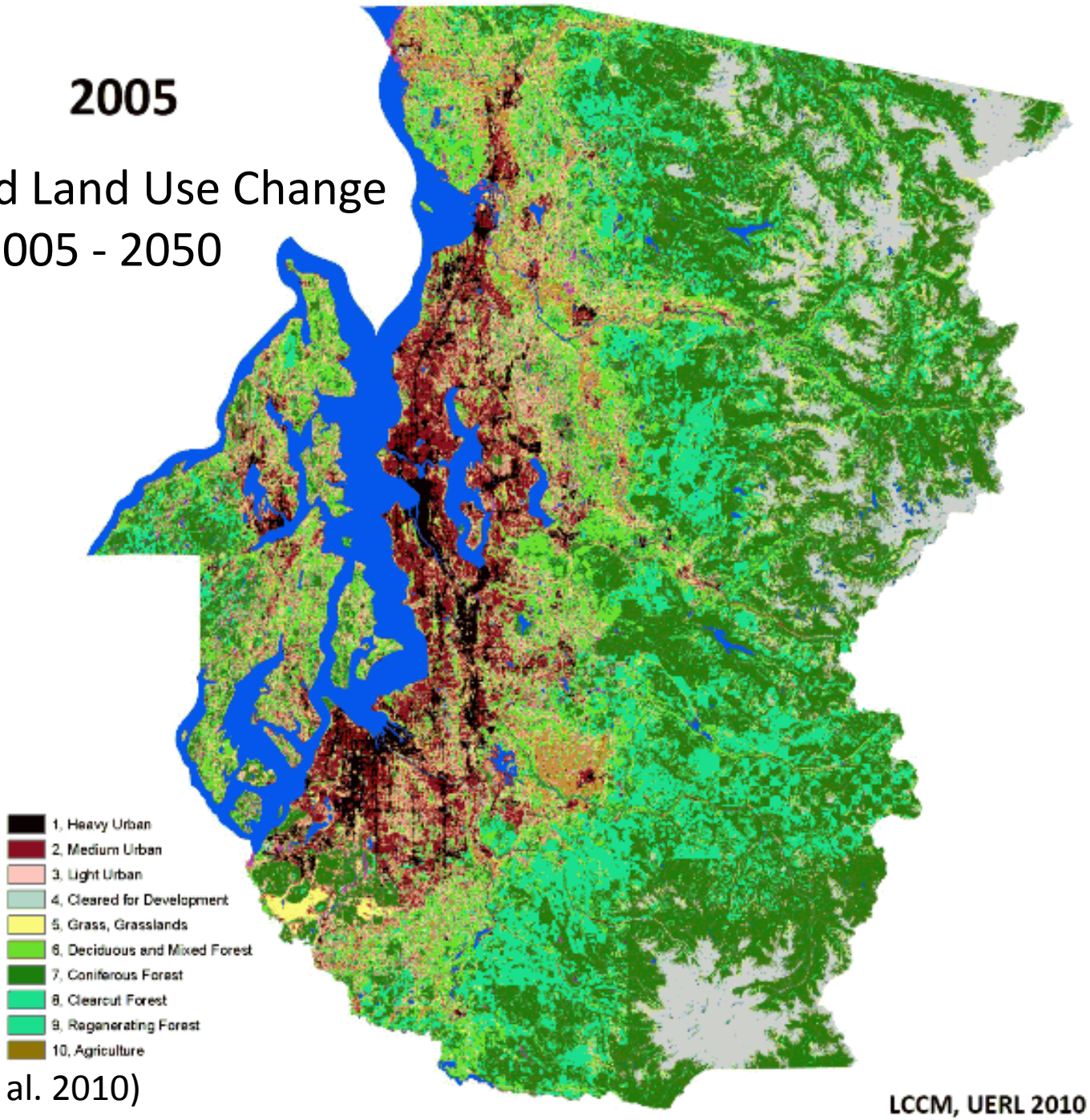
Effect of upset evident throughout Inlets

Short term effect as contamination is reduced by dispersion, mixing, and die off of harmful bacteria

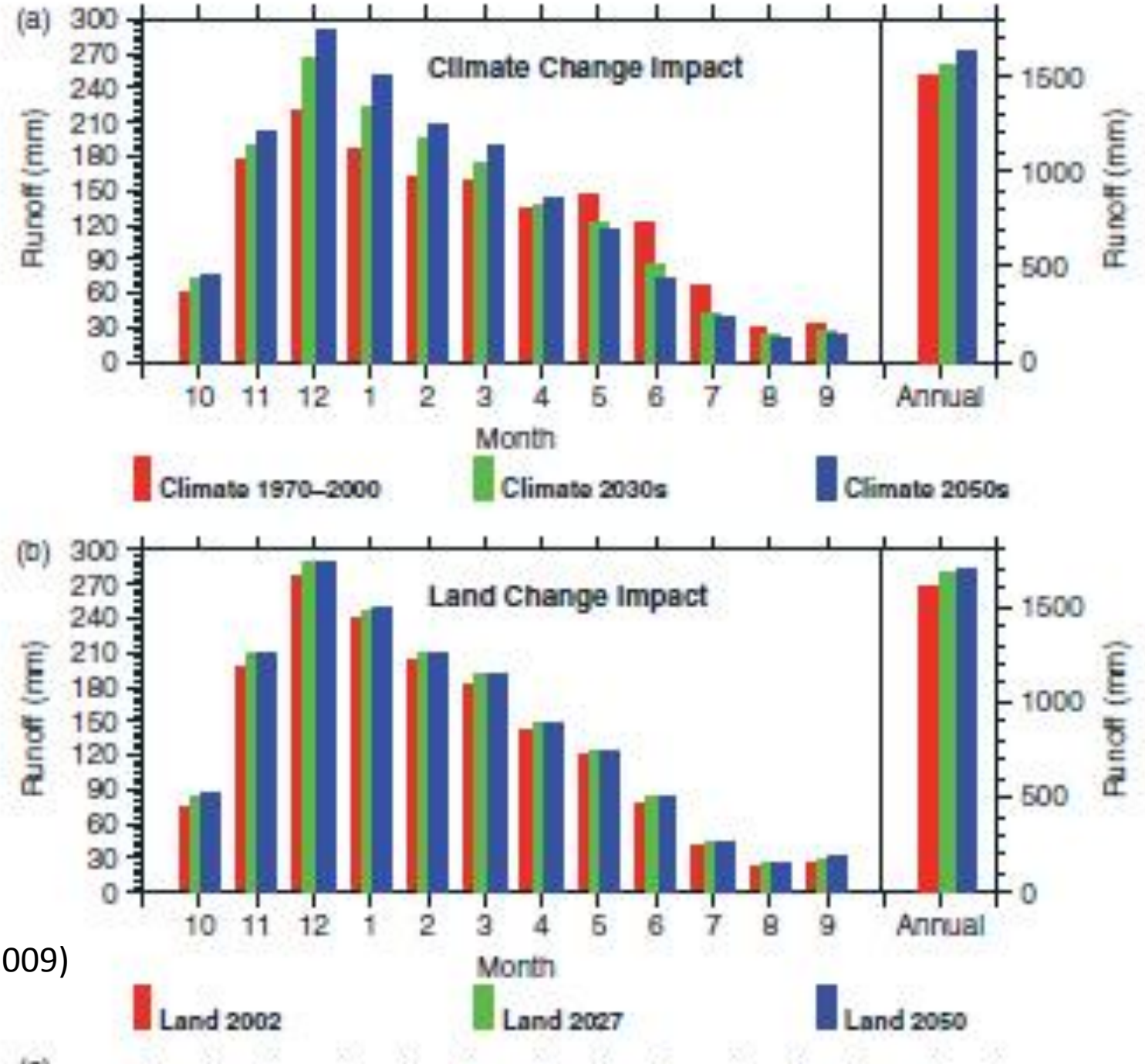


2005

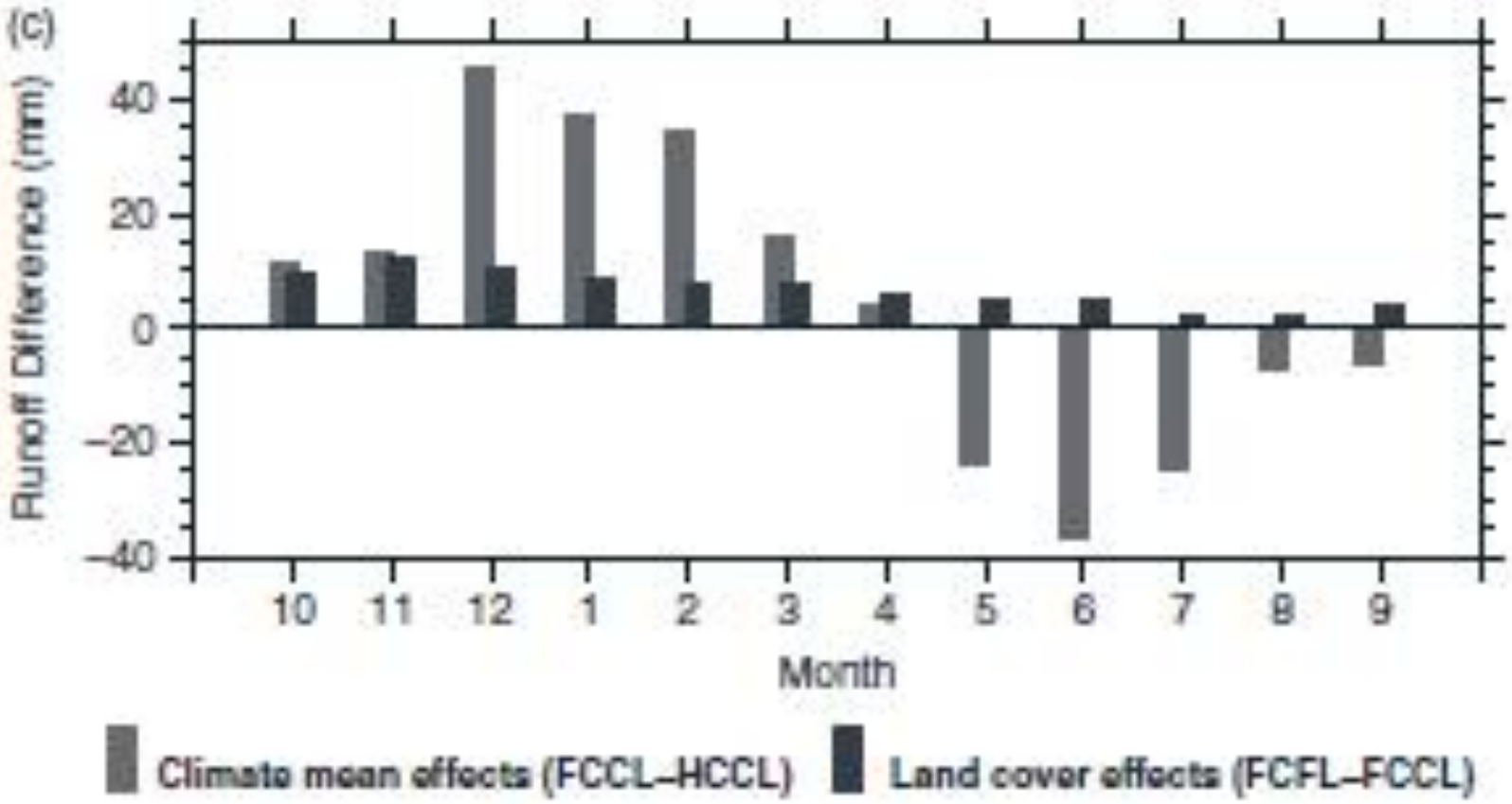
Simulated Land Use Change 2005 - 2050



(Alberti et al. 2010)



(Cuo et al. 2009)



(Cuo et al. 2009)

Solving Stormwater

https://www.youtube.com/watch?v=1JDsFJJJHSY

The Nature Conservancy in Washington

Subscribe 89

19 views

Park in Manchester cleans the environment

BY: Chris Henry

Kitsap Sun POSTED: 9:31 PM, Aug 15, 2015 UPDATED: 9:44 PM, Aug 15, 2015

MANCHESTER — It's a park; it's a water treatment facility. It's both. Manchester Stormwater Park, recently completed, is operated by Kitsap County, and enjoyed by Manchester residents and visitors.

Chris May, director for the county's stormwater division, (top left) and Kitsap County engineer Jon Brand look over the new spiral rain garden. It is the centerpiece of the new Manchester Stormwater Park. (LARRY STEAGALL / KITSAP SUN)

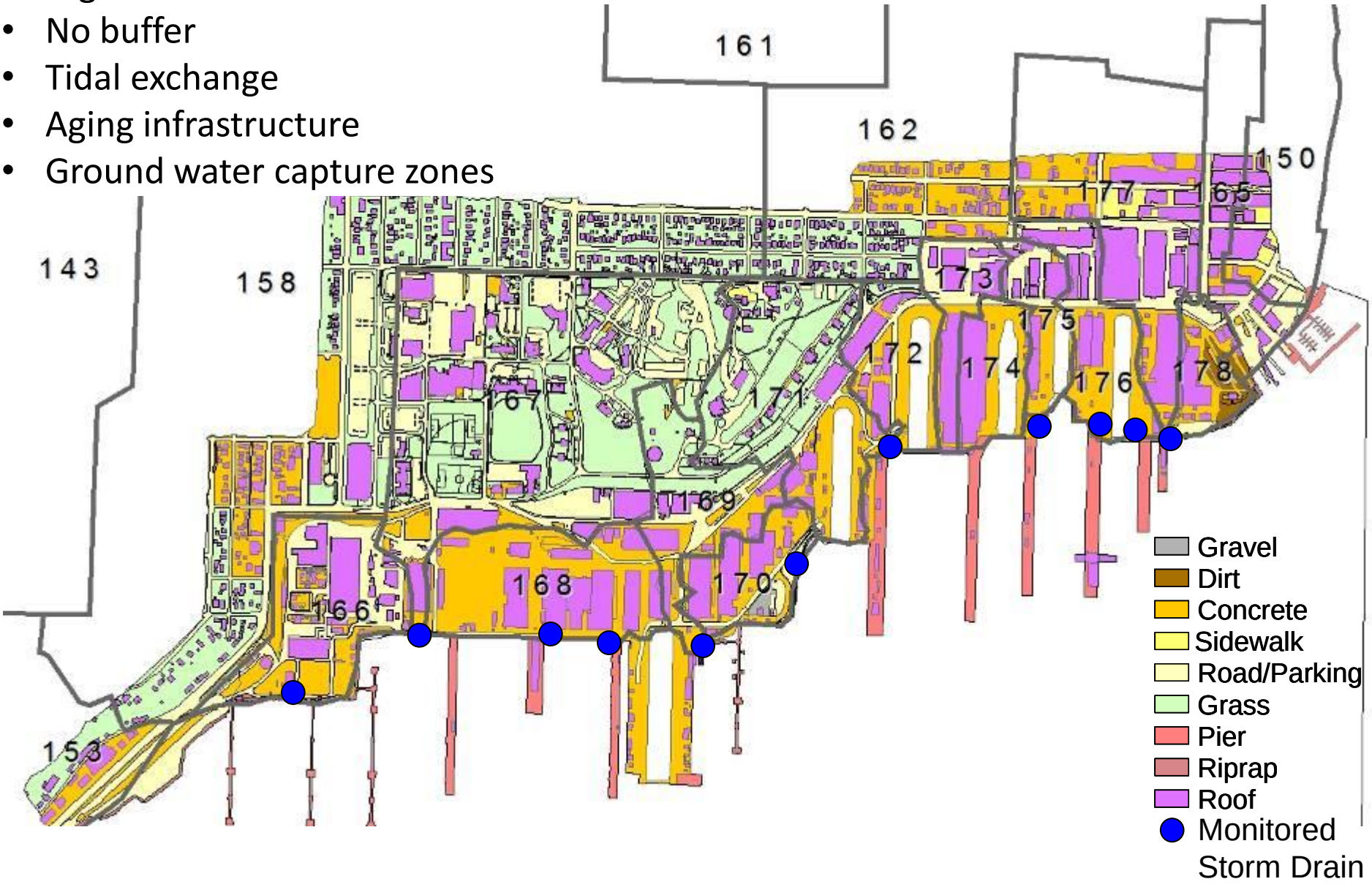
Park in Manchester cleans the environment

Manchester Stormwater Park

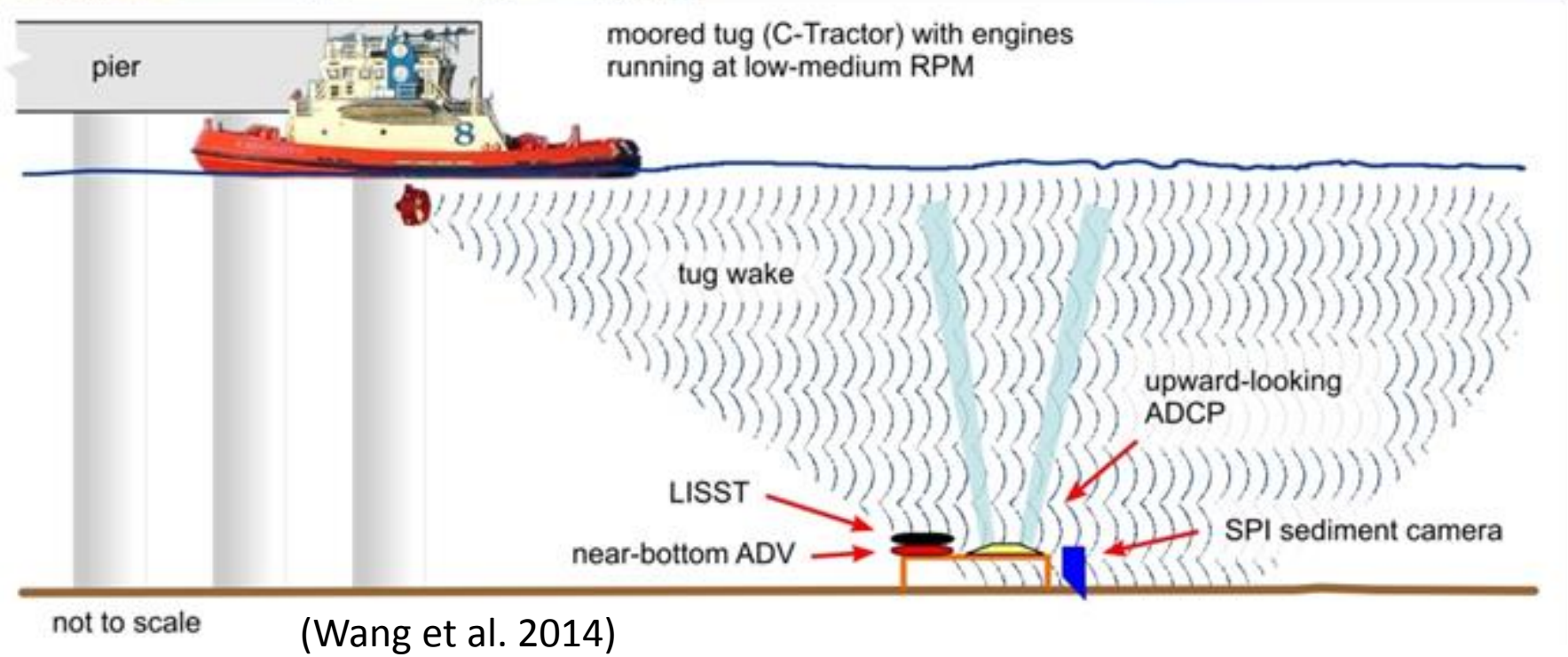
http://kitsap.paladinpanoramic.com/project/2231/44030

NBK Bremerton Stormwater Drainage Basins

- High industrial use
- No buffer
- Tidal exchange
- Aging infrastructure
- Ground water capture zones



Redistribution of Contaminated Sediment by Prop Wash



(Wang et al. 2014)

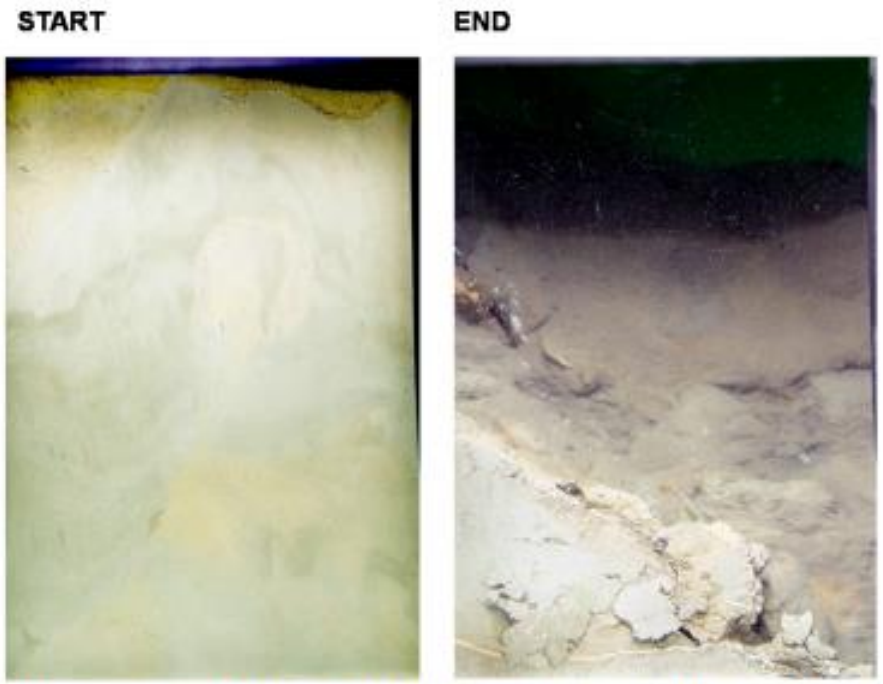
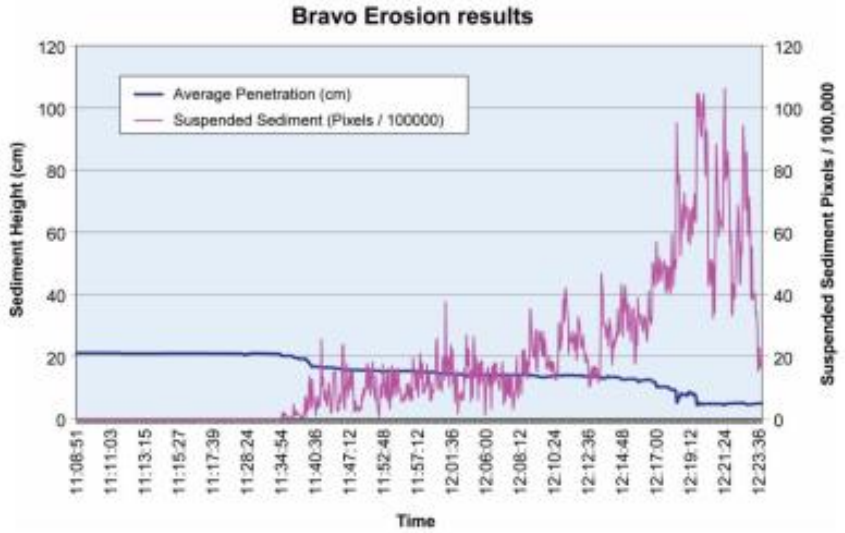


Figure 38. Sediment profile image at the Bravo site at the start (left) and end (right) of the experiment. Scale: width of each image = 14.5 cm.

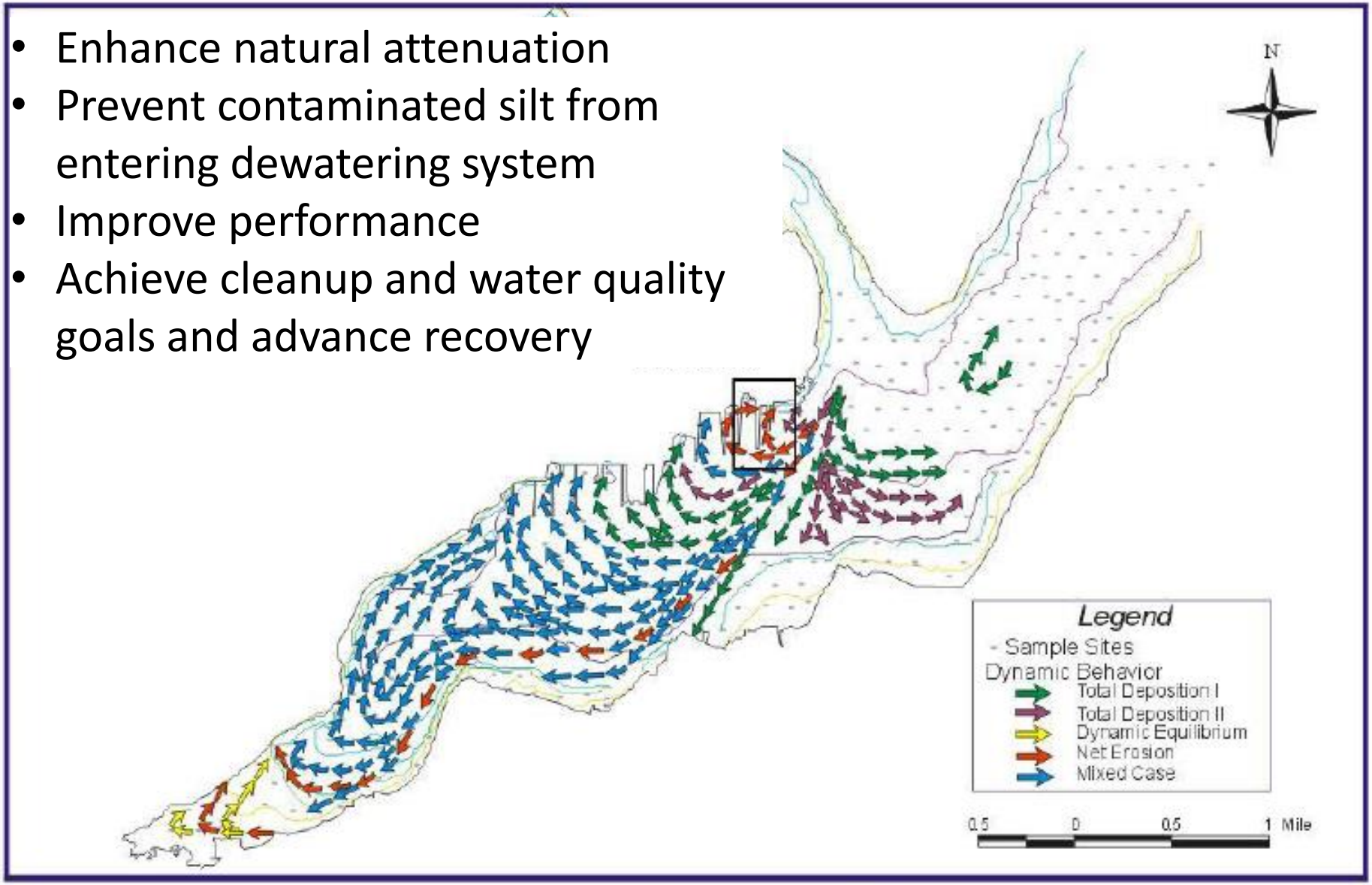


(Wang et al. 2014)

Figure 41. Height of sediment and amount of suspended sediment in water column as a function of time during Bravo experiment.

How to Manage Contaminated Silts

- Enhance natural attenuation
- Prevent contaminated silt from entering dewatering system
- Improve performance
- Achieve cleanup and water quality goals and advance recovery



Sediment Trend Analysis (McLaren 1998)

Feb., 25, 2016

LOCAL NEWS

Fish near Bremerton exposed to heavy drug doses

Drugs in Wastewater

Nanograms per liter found in wastewater from Bremerton and Tacoma.

	Bremerton	Tacoma
Amphetamine	164	67
Caffeine	1,170	152
Cocaine	59	8.5
Codeine	178	290
Cotinine (nicotine byproduct)	340	115
DEET (insect repellant)	684	23
Fluoxetine (Prozac)	57	60
Ibuprofen	1,060	116
Oxycodone	158	231
Metfromin (diabetes drug)	29,300	82,700
Valsartan (high blood pressure)	2,010	3,000

Source: NOAA, UW

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journal homepage: www.elsevier.com/locate/envpol

Contaminants of emerging concern in a large temperate estuary☆

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[b] Department of Environmental and Occupational Health Sciences, University of Washington, Seattle, WA, USA
[c] School of Aquatic and Fisheries Sciences, University of Washington, Seattle, WA, USA
[d] Center for Reproductive Biology, Washington State University, Pullman, WA, USA

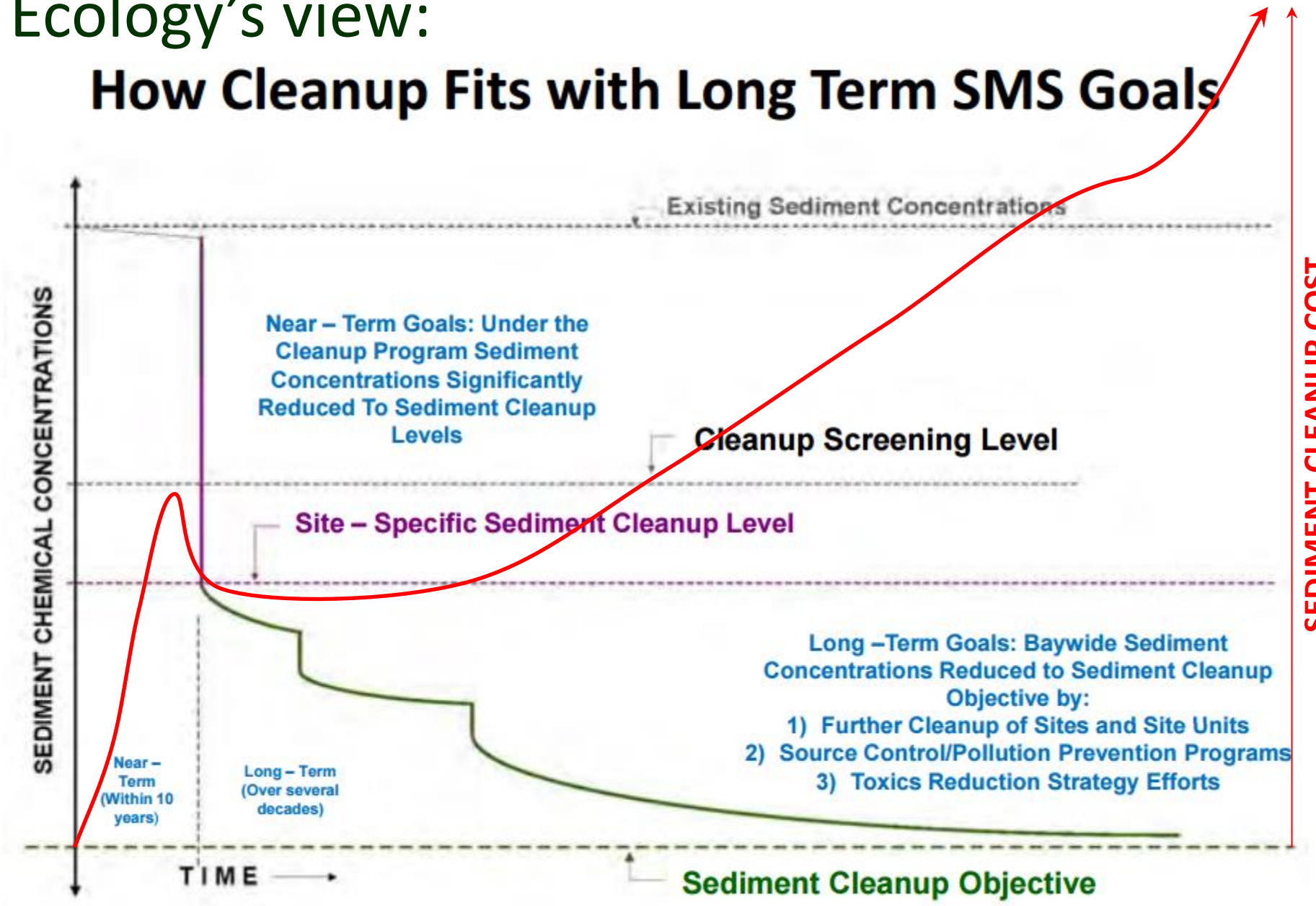
21st Century Contaminants of Concern

- Pharmaceuticals
- Personal Care Products
- Flame Retardants
- Alkylphenols
- Bisphenol A
- Phthalates
- Current use pesticides/herbicides

Integrating Environmental Quality Goals

- Overlap between Cleanup and Compliance at PSNS&IMF
  - If contaminated silt is entrained in Dry Dock drainage systems the silt could contribute to NPDES discharge permit violations
  - Dry Docks function as groundwater capture zones so contaminated groundwater from upland Cleanup sites may enter drainage system and impact NPDES discharges
  - Legacy contamination may effect Sediment Impact Zones at outfalls
- Source Control / Continuous Process Improvement
  - Effectiveness of BMPs and Process Improvement
- Partnering at watershed scale to meet recovery goals
  - Control contaminant loading to assure capacity to receive discharges and meet sediment cleanup objectives
  - Manage shifting baseline

Ecology's view:



(Anderson 2013 Sediment Management Annual Review Meeting)

Opportunities and Challenges

- Monitoring and Modeling Tools
  - Descriptive (*What?*), Explanatory (*Why?*), Predictive (*What if?)*
- Landscape Ecology / Landscape Chromatography
- Return on Investment for Restoration and Retrofit
- Watershed / Regional Management
- Integration of Cleanup, Compliance, and Recovery
- “Designing with the Environment in Mind” (ASME 2011)

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