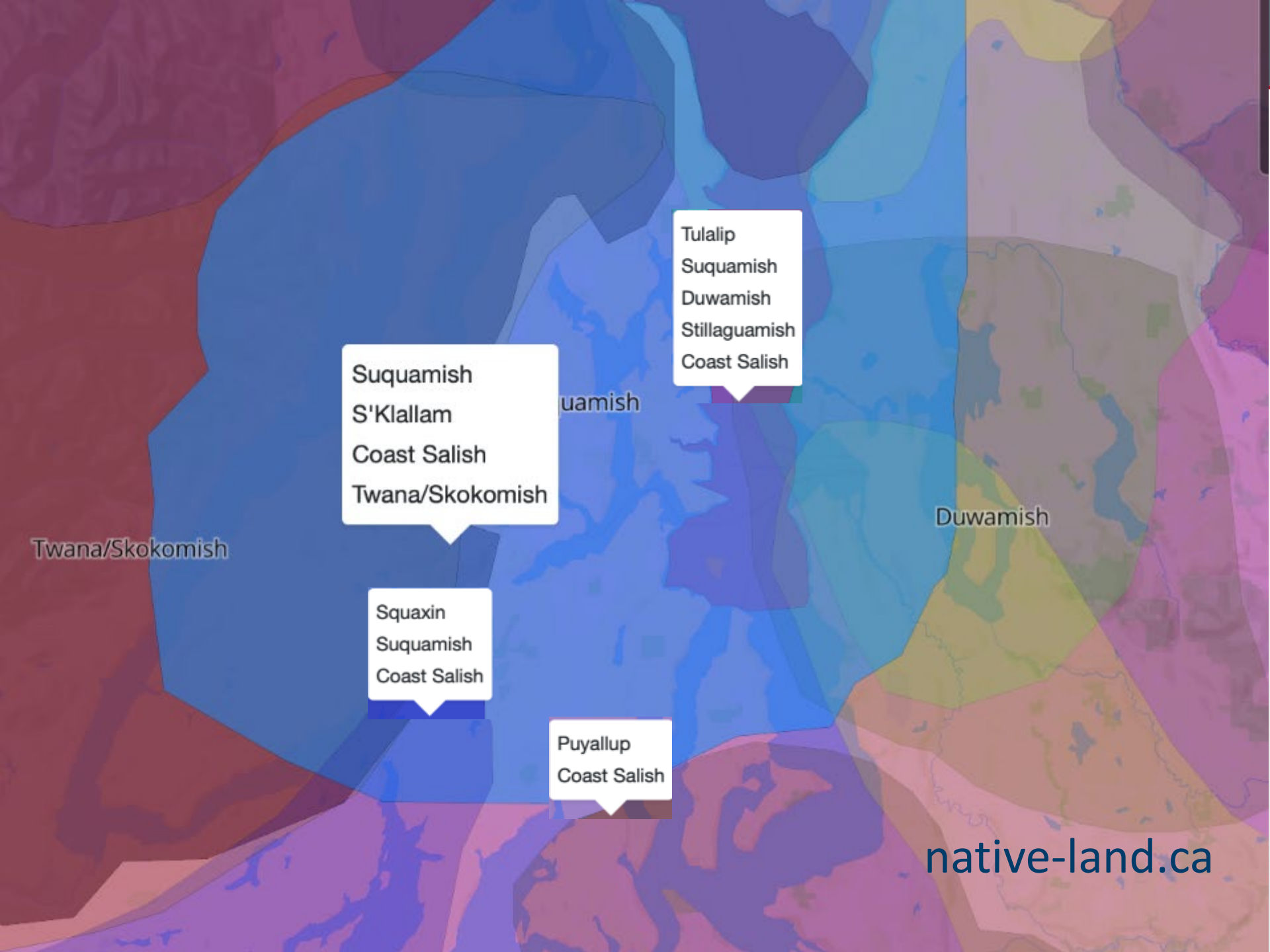
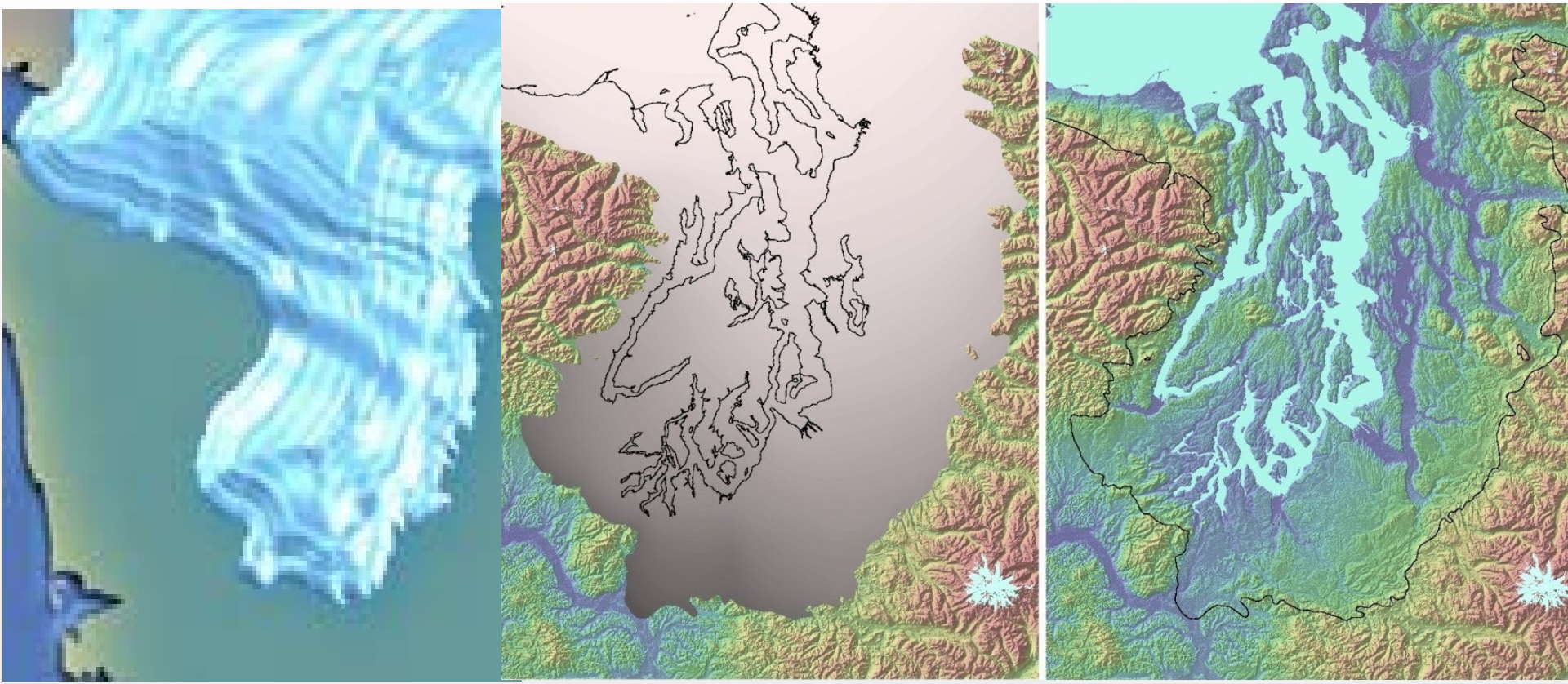
Protecting Water Starts at Home:
Local waterways and the Salish Sea

Bob Simmons, Associate Professor, Water Resources

Washington State University


Tulalip
Suquamish
Duwamish
Stillaguamish
Coast Salish
Suquamish
S'Klallam
Coast Salish
Twana/Skokomish
uamish
Duwamish
Twana/Skokomish
Squaxin
Suquamish
Coast Salish
Puyallup
Coast Salish
native-land.ca

Ice Ages



The Cordilleran Ice Sheet pushed southward into the Puget Lowland as many as six times over 100,000 years. The retreat of the Vashon Stade started approximately 17,000 years ago.


Glacial till
Sand
More Glacial Ti
Clay

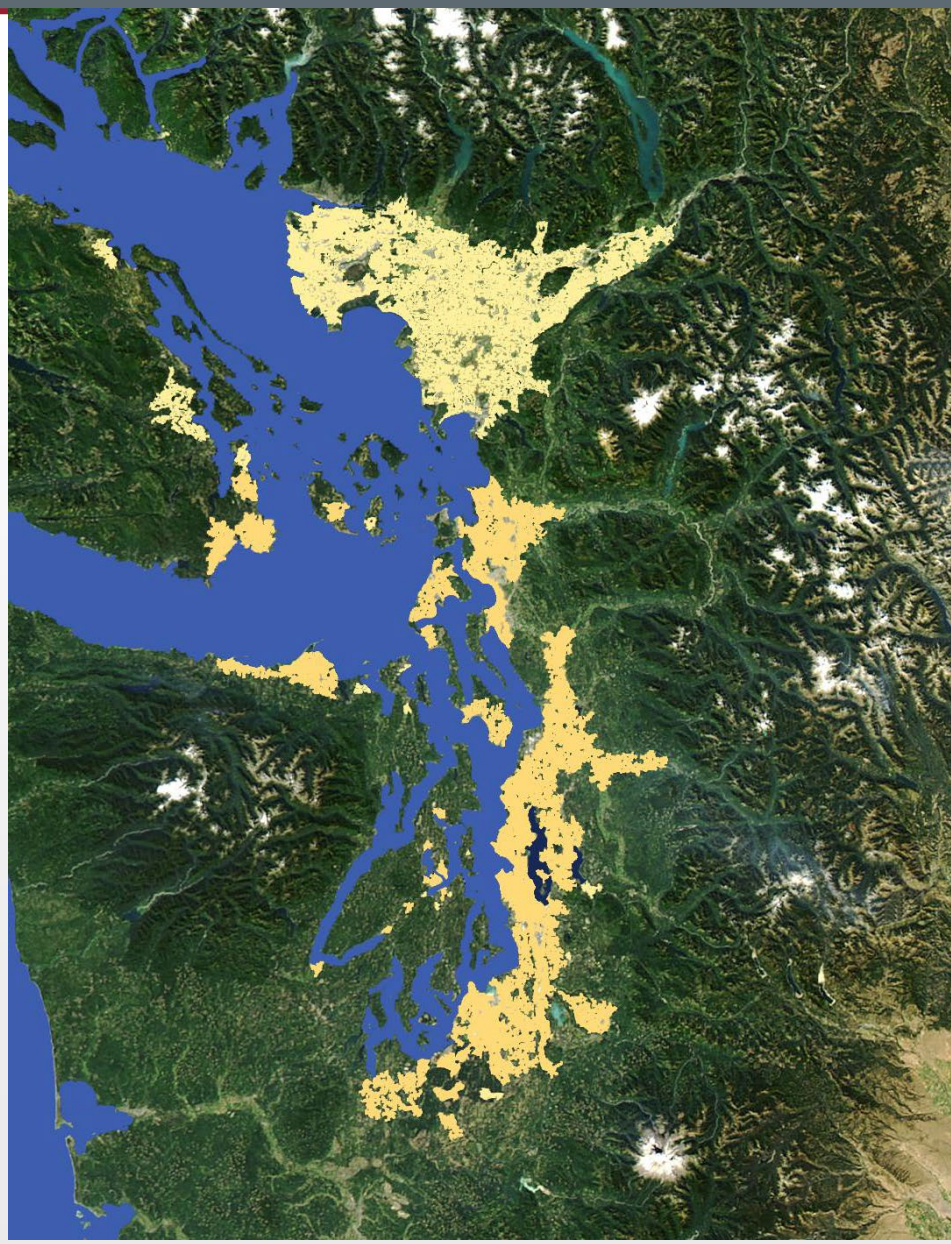
- Total watershed area, not counting the upper Fraser River area: 42,000 square miles

- Coastline, including islands: 4,642 miles

- Total number of islands: 419

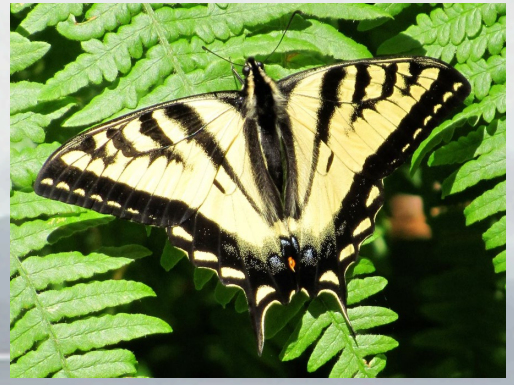
- Number of species listed as threatened, endangered or are candidates for listing: 54

Map of the Salish Sea and Surrounding Basin Stefan Freelan WWU 2009

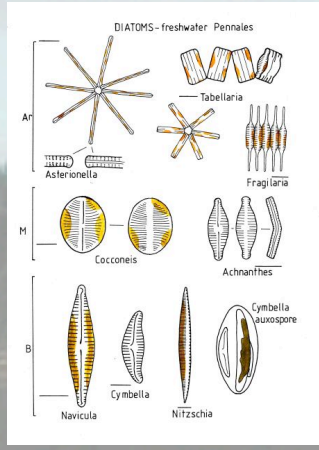


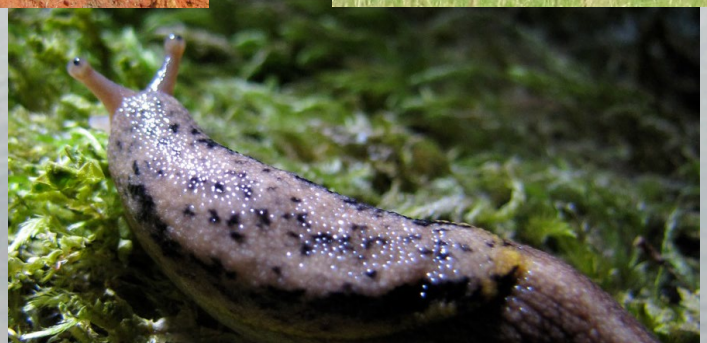
Who lives in a watershed

- Fish
- Birds
- Reptiles
- Amphibians
- Mammals
- … the little things that run the world

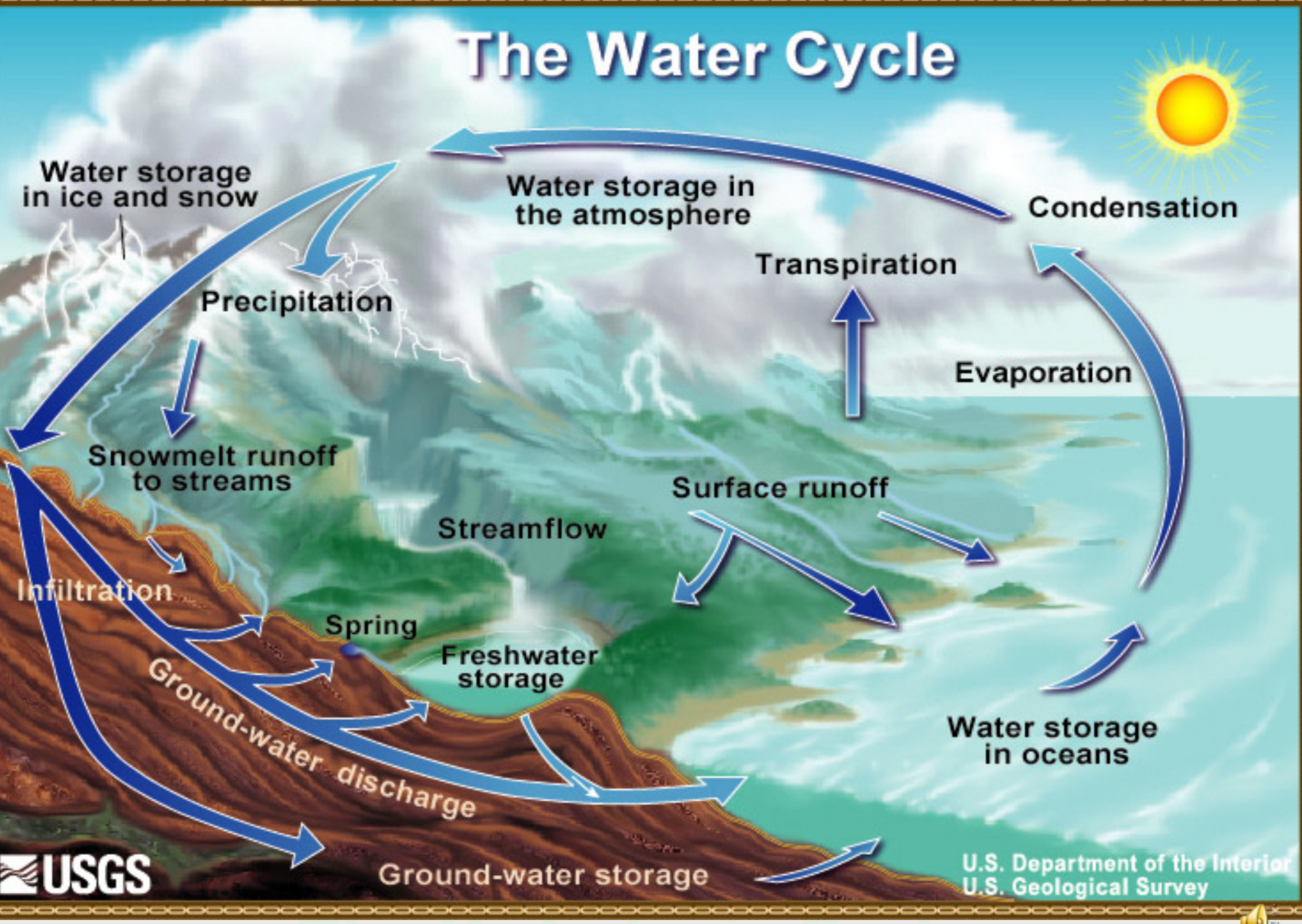


- Plants
- Moss
- Lichens
- Fungus
- Algae
- … the little things that really run the world





Slide courtesy of Jeff Adams Washington Sea Grant



The Hydrologic Cycle

Start of the Water Cycle

Photo: Bob Simmons

Forest Canopy

Photo: Bob Simmons

Photo: Bob Simmons

Photo: Bob Simmons


Herb Layer
Photo: Bob Simmons

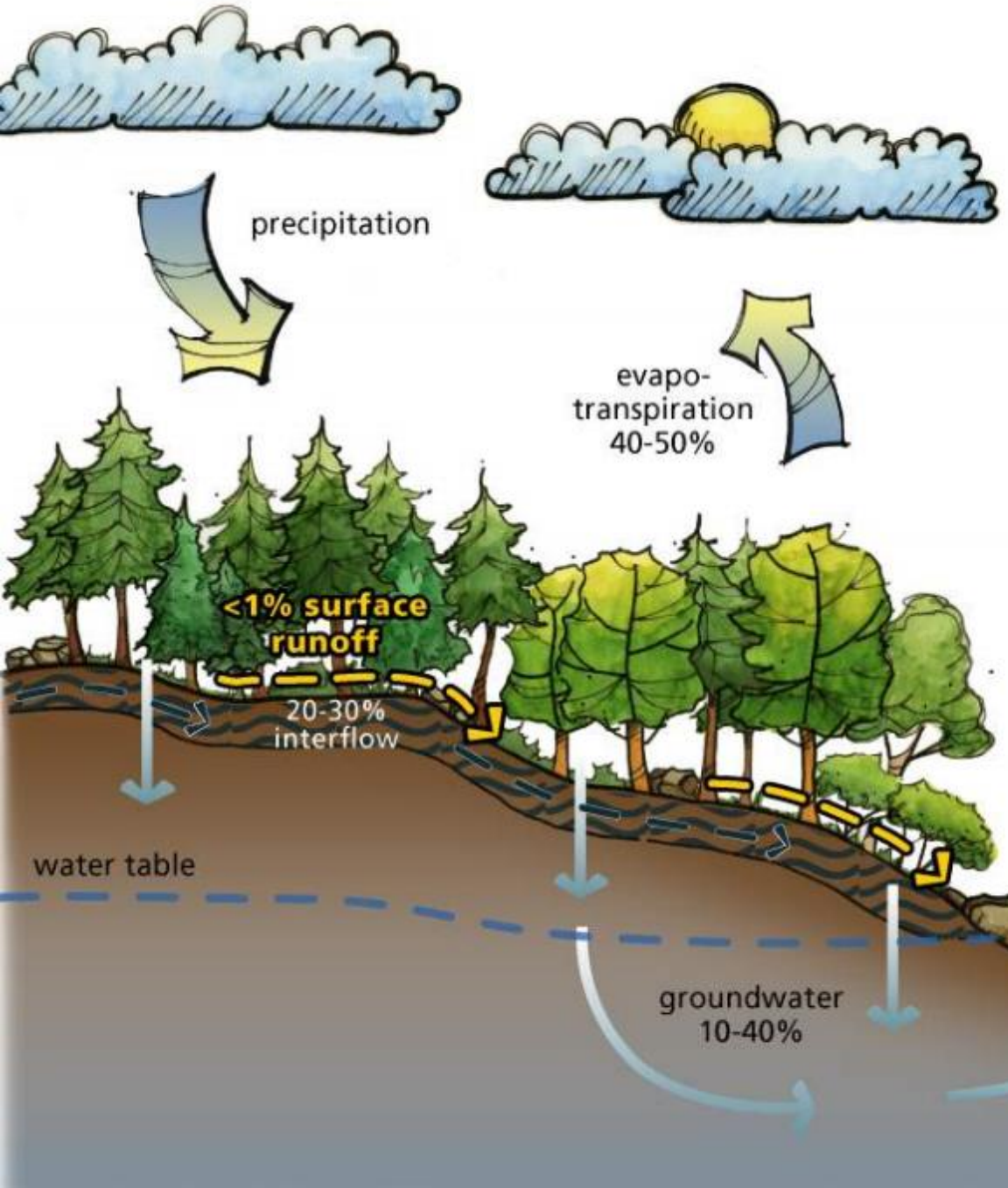
Duff Layer

Root Zone and Below

Photo: Bob Simmons

Forest Layers

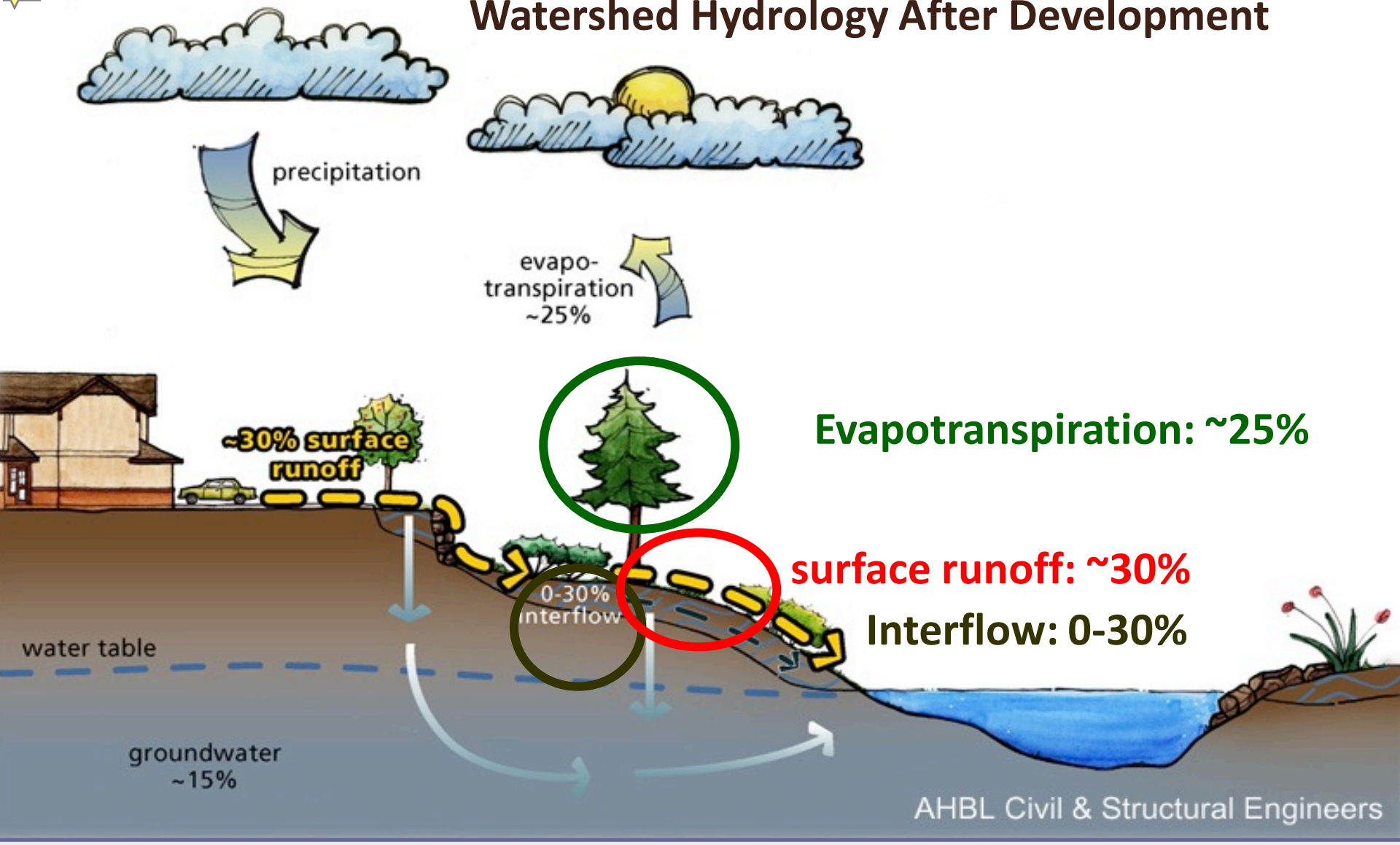
Graphic: Stacey Gianas



Undeveloped - Forest

- During winter months evaporation continues to be active while the transpiration component is minimal
- Storm events moderated by infiltration, evaporation, and evapotranspiration
- Water is available in substrata to sustain stream base flows during summer months
- As winter progresses, the interflow component of stream flow increases
- During the Summer and Fall streams are maintained primarily by glacial melt water and/or groundwater flow

Watershed Hydrology After Development



Evapotranspiration: ~25%

surface runoff: ~30%

Interflow: 0-30%


DUMP NO WASTE
DRAINS TO STREAM

Smothered salmon redd


Sea-Mart

Silverdale, WA

Photo: WA Dept of Ecology, 2016

Nonpoint Pollution

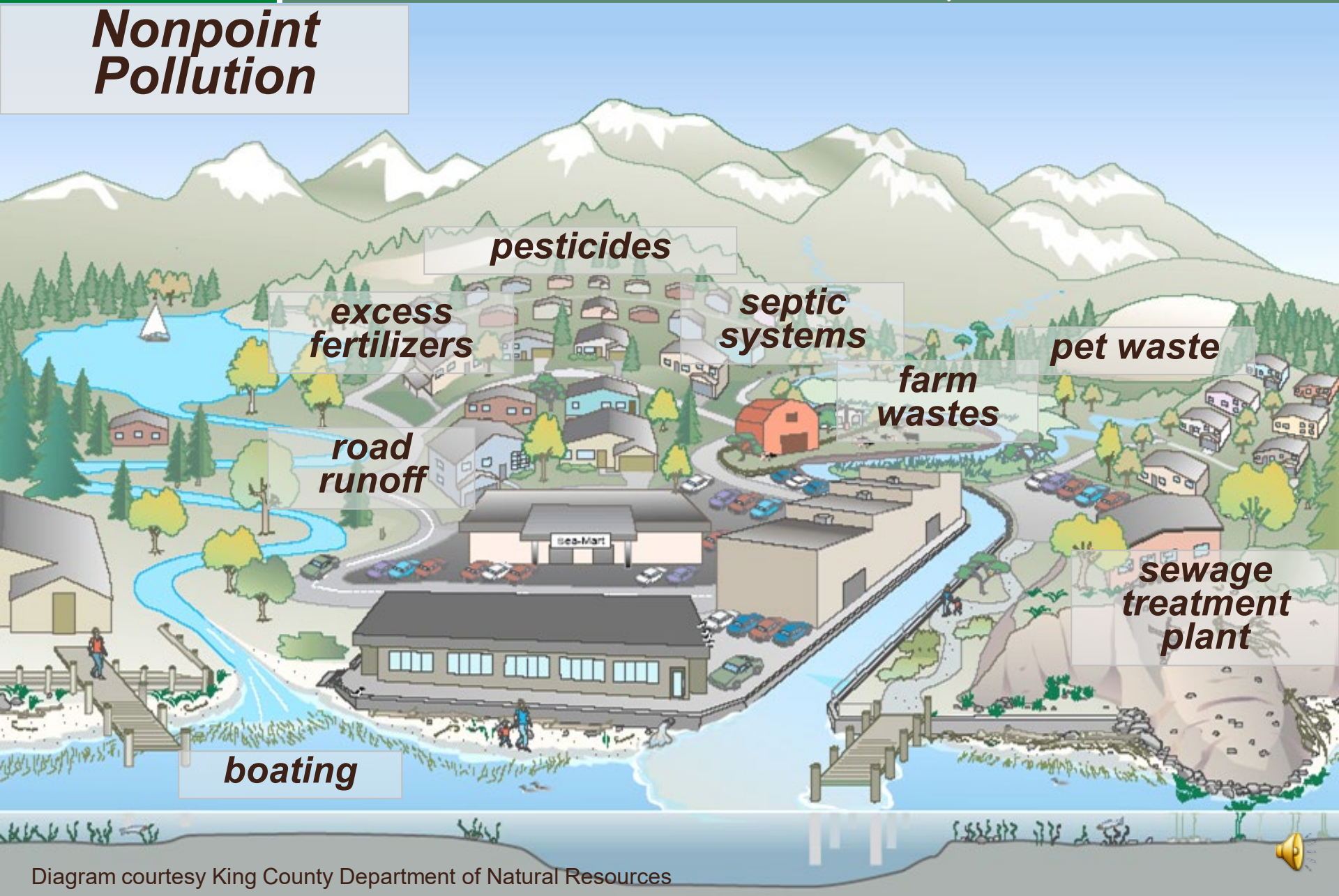
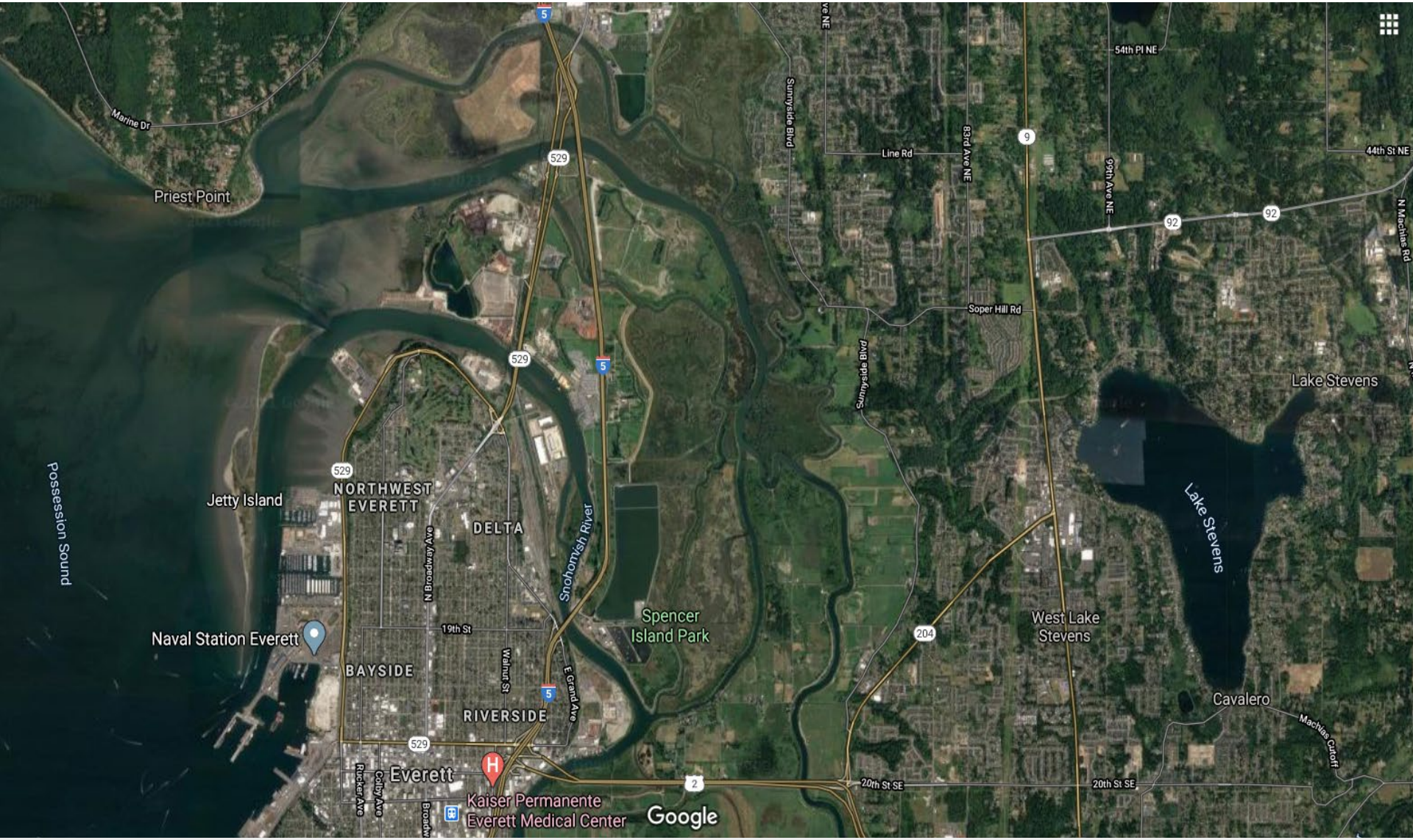
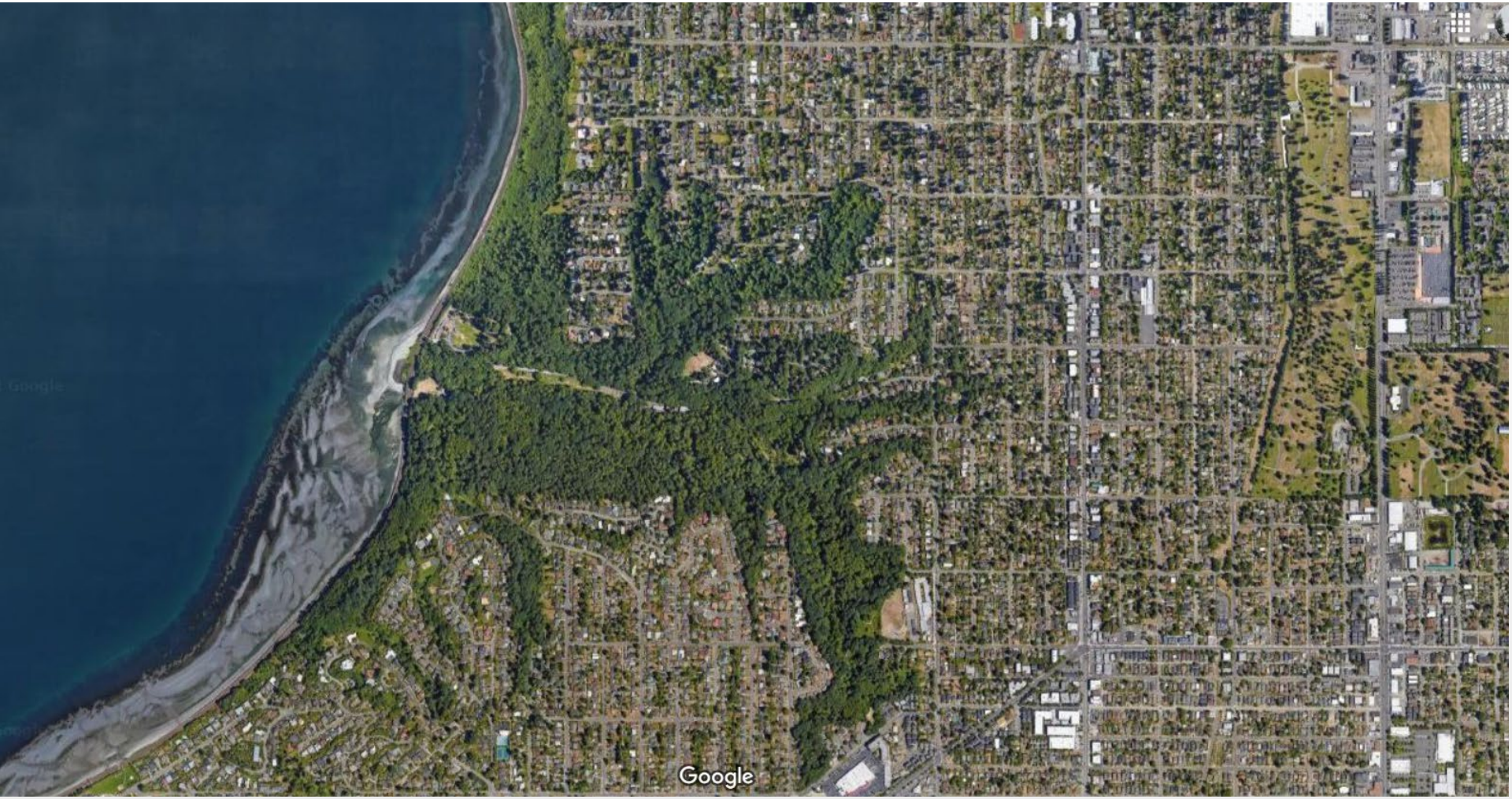


Diagram courtesy King County Department of Natural Resources

Everett, WA


Marine Dr
Priest Point
529
5
Sunnyside Blvd
Line Rd
83rd Ave NE
99th Ave NE
54th Pl NE
44th St NE
9
92
N Machias Rd
Soper Hill Rd
Lake Stevens
Possession Sound
Jetty Island
NORTHWEST EVERETT
DELTA
N Broadway Ave
Snohomish River
Spencer Island Park
Naval Station Everett
19th St
BAYSIDE
Walnut St
E Grand Ave
RIVERSIDE
West Lake Stevens
204
Cavalero
Machias Cutoff
Everett
Rucker Ave
Colby Ave
Broadway
Kaiser Permanente Everett Medical Center
2
20th St SE
Google

Carkeek Park, Piper's Creek



What is the leading cause of pollution in the Salish Sea?

Stormwater is the leading cause of pollution in the Salish Sea!

Photo: WA Dept of Ecology, 2016

75% of toxics are carried to the Puget Sound by runoff!

Source: Washington Dept. of Ecology, May 2011, Pub. #11-03-025

Commencement Bay, Tacoma

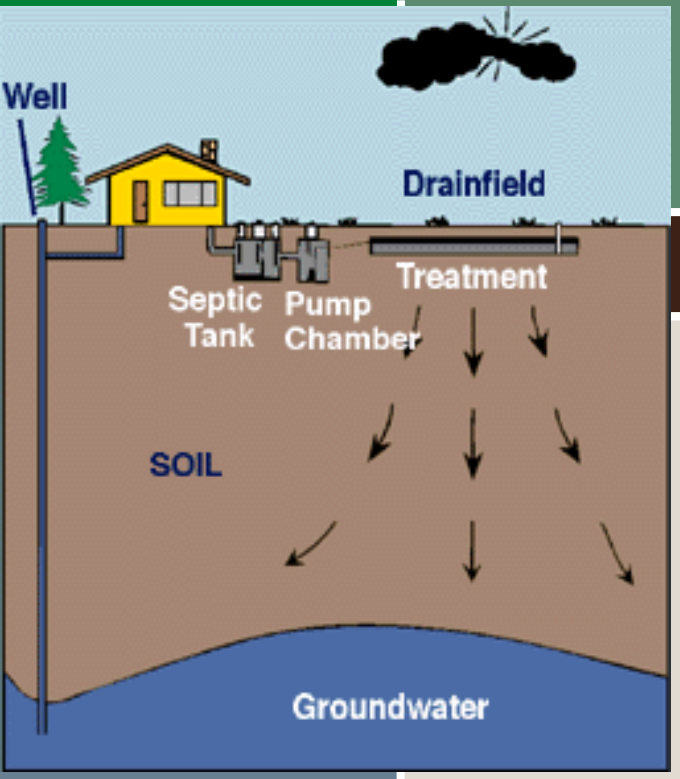
Photo: WA Dept of Ecology

Montlake Cut, Seattle

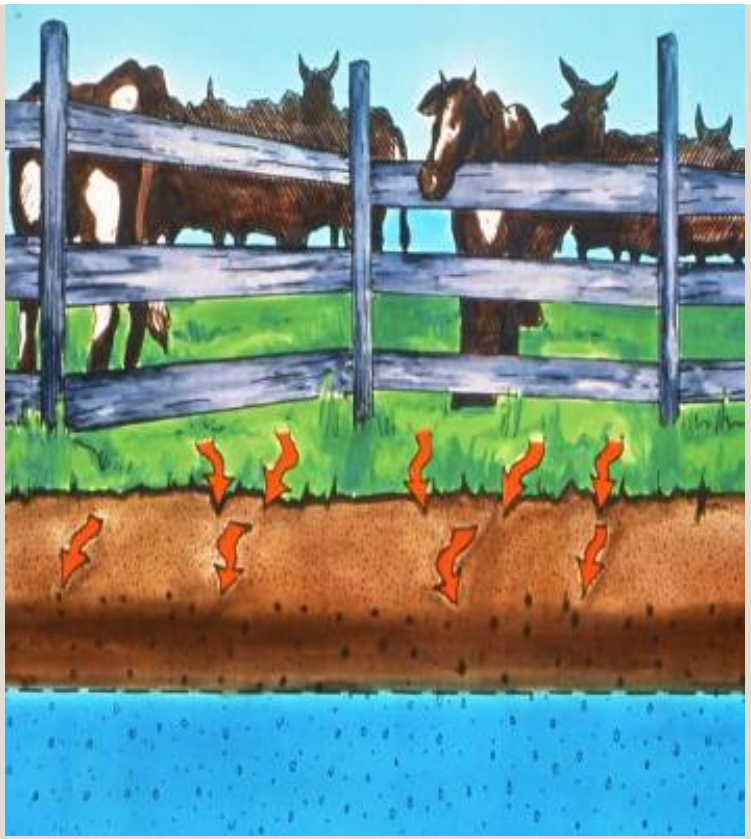
The stormwater pollution you see…

Photo by Blake Feist, NOAA Fisheries

Montlake Cut, Seattle



Septic Systems



Animals, Manure and Pet Waste

Pesticides

Our actions affect each other

Ground water does not respect boundaries

What you do may affect your well or your neighbor's well

&

What your neighbor does may affect your well

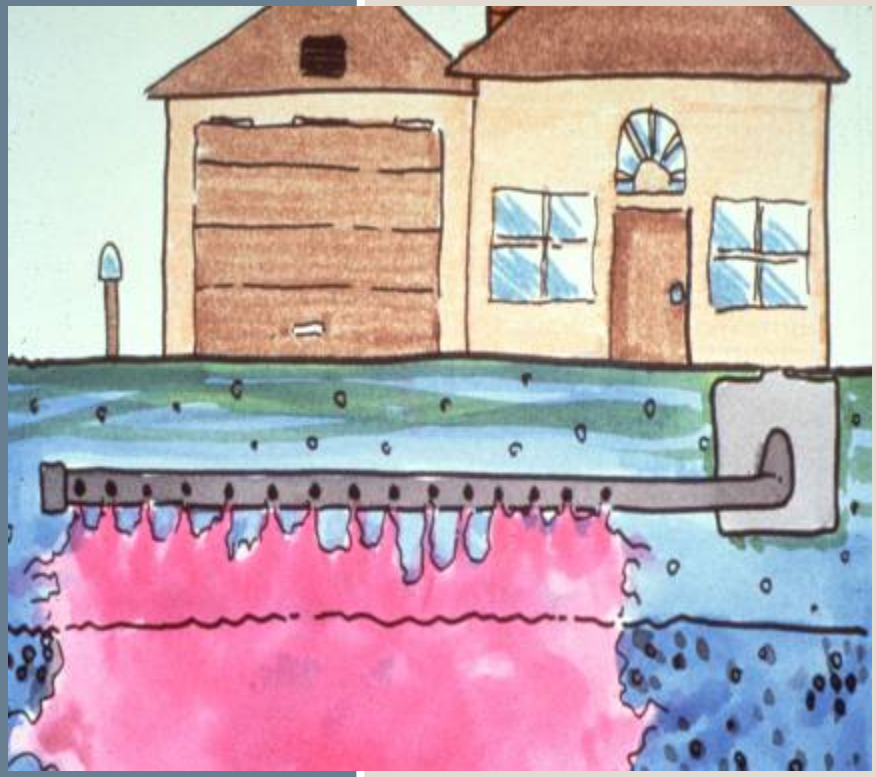
&

Groundwater eventually flows to waterways

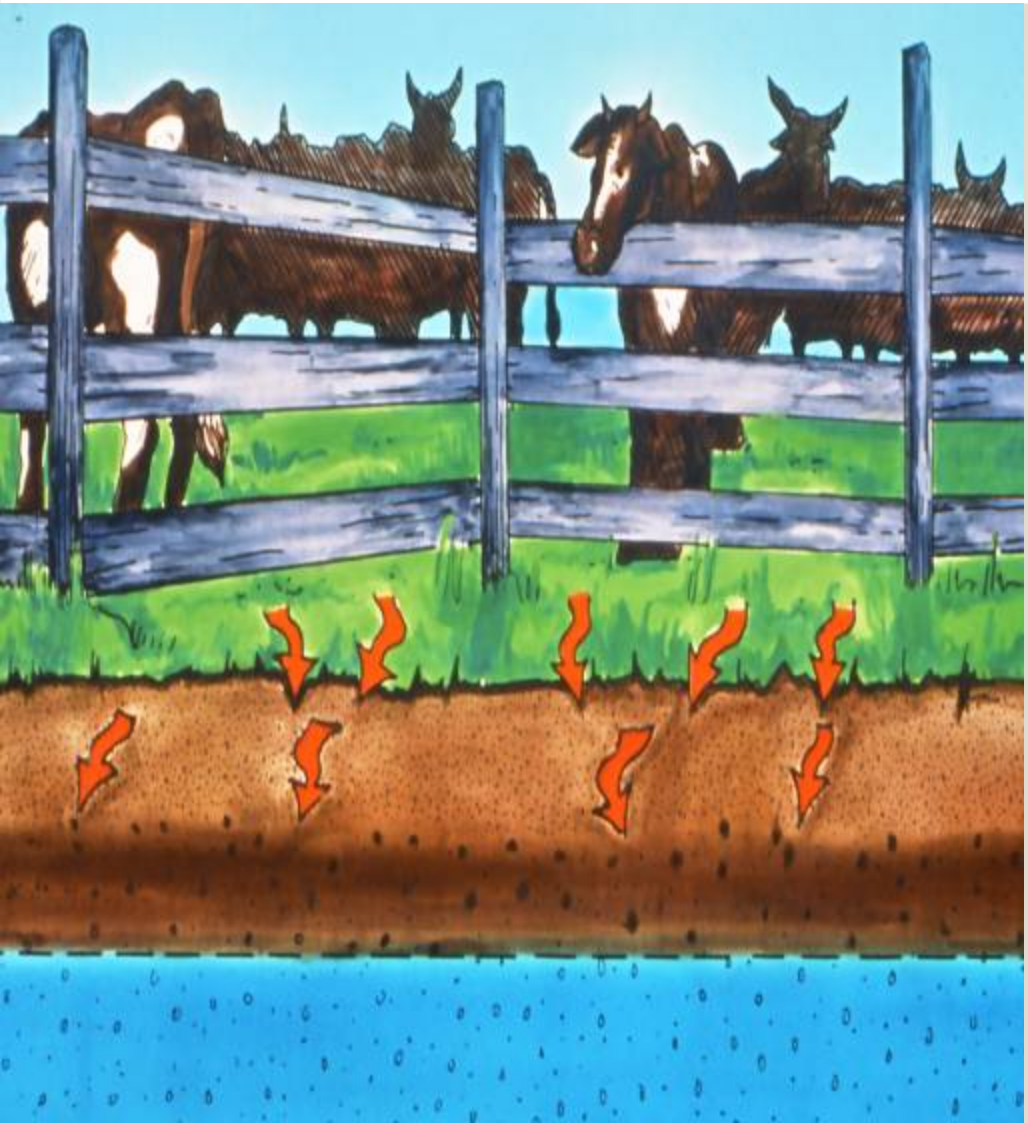
Possible Surface and Ground Water Contaminants

- Septic Systems
- Fertilizer, Manure, Animals
- Insecticides, Herbicides & Fungicides
- Household Hazardous Products
- Leaking Oil Tanks
- Road Runoff

Septic Systems: For only that which comes out of you!



Animals, Manure and Pet Waste



- Keep manure piles & animal enclosures away from well.
- Cover manure piles, spread at agronomic rates (Snohomish Conservation District)
- Pick up pet waste

Minimize Fertilizer Leaching and Runoff

- Do a soil test and use WSU Recommendations
- Use slow-release or organic fertilizer
- Apply at the correct rates, when the plants are growing and need the nutrients
- Avoid fertilizer and pesticide use close to a well or water bodies

What Chemicals Should I Use

To Kill Bugs

To Kill Weeds, Moss

To Prevent Fungus

To …..

To Make My Garden Healthy??

Pesticides are Designed to Kill Things

Insecticide

Rodenticide

Fungicide

Herbicide

Miticide

Homicide

They can also kill things that are not a problem

USGS Puget Sound Basin

USGS Fact Sheet 067-97:
Pesticides in Selected Small Streams
in the Puget Sound Basin, 1987-1995

BACK | Return to Front Page | NEXT

Significant Findings

Number and Type of Pesticides Detected

	In water	In bed sediments
Herbicide	17	2
Insecticide	5	4
Fungicide	1	1
Degradation products of DDT	0	2
Total	23	9

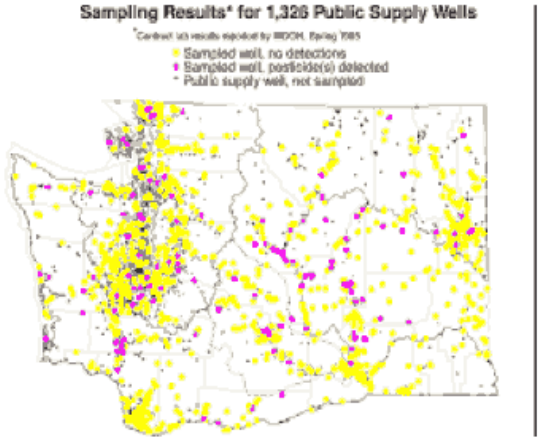
The most commonly detected pesticides in streams were among the most heavily used in the basin. The most frequently detected pesticide in streams was 2,4-D, the most heavily used herbicide in the Puget Sound Basin. Other commonly detected and heavily used pesticides were the herbicide dicamba and the insecticide diazinon.

Pesticide concentrations generally were small. None of the detected pesticides in streams exceeded existing State or Federal freshwater aquatic life criteria; however, criteria have been established for only two of the pesticides detected. Diazinon, mevinphos, malathion, and diuron were found in streams exceeding maximum concentrations recommended by the National Academy of Sciences for the protection of aquatic life (National Academy of

USGS | Groundwater Study

WASHINGTON STATE UNIVERSITY EXTENSION

Address http://wa.water.usgs.gov/pubs/fs/fs122-96/ Go



Sampling results for 1,326 public supply wells

- Pesticides were detected in 6% of 1,103 randomly selected public supply wells sampled across Washington.
- 21 of 27 analyzed pesticides were detected.
  Pesticides detected in three or more wells were:
  atrazine; simazine; dicamba; 2,4,5-TP; 2,4-DB; picloram; metribuzin
- The concentration of pentachlorophenol exceeded the EPA maximum contaminant level (MCL) in one well. Dieldrin and endrin concentrations exceeded EPA health advisory levels in one well each. However, EPA drinking water standards have not been established for 11% of the pesticides detected by contract labs in this study.
- More than 10% of wells with detections had more than one pesticide detected.

Risk assessment

Factors that correlated with pesticide detection were:

- **Land use** predominantly agricultural or urban
- **Well depth** less than 125 feet
- **Nitrate concentration** greater than 2.7 mg/L
  (Steve Swope, Pacific Groundwater Group, written commun., 1994)

http://npic.orst.edu/

1-800-858-7378

2,4-D
General Fact Sheet

Related

PDF Version

Technical Fac

What is 2,4-D?

2,4-D is an herbicide that kills plants by changing the way certain cells grow. 2,4-D comes in several chemical forms, including salts, esters, and an acid form. The toxicity of 2,4-D depends on its form. The form also affects what will happen to 2,4-D in the environment and what impacts it may have, especially on fish. 2,4-D is used in many products to control weeds, and it is often mixed with other herbicides in these products.

2,4-D was first used in the United States in the 1940s. Agent Orange, an herbicide used during the Vietnam War, contained both 2,4-D and 2,4,5-T. Dioxin, a by-product of 2,4,5-T, led to the ban of Agent Orange.

What are some products that contain 2,4-D?

Has anyone studied non-cancer effects from long-term exposure to 2,4-D?

Animals fed high doses of 2,4-D for several weeks sometimes had fewer young or the young did not have normal skeletons. This only happened if the amount of 2,4-D fed to the mothers was enough to affect the mothers. 2,4-D has not been linked to health problems in human mothers or infants.

Are children more sensitive to 2,4-D than adults?

While **children may be especially sensitive to pesticides** compared to adults, there are currently no data to conclude that children have increased sensitivity specifically to 2,4-D.

What happens to 2,4-D in the environment?

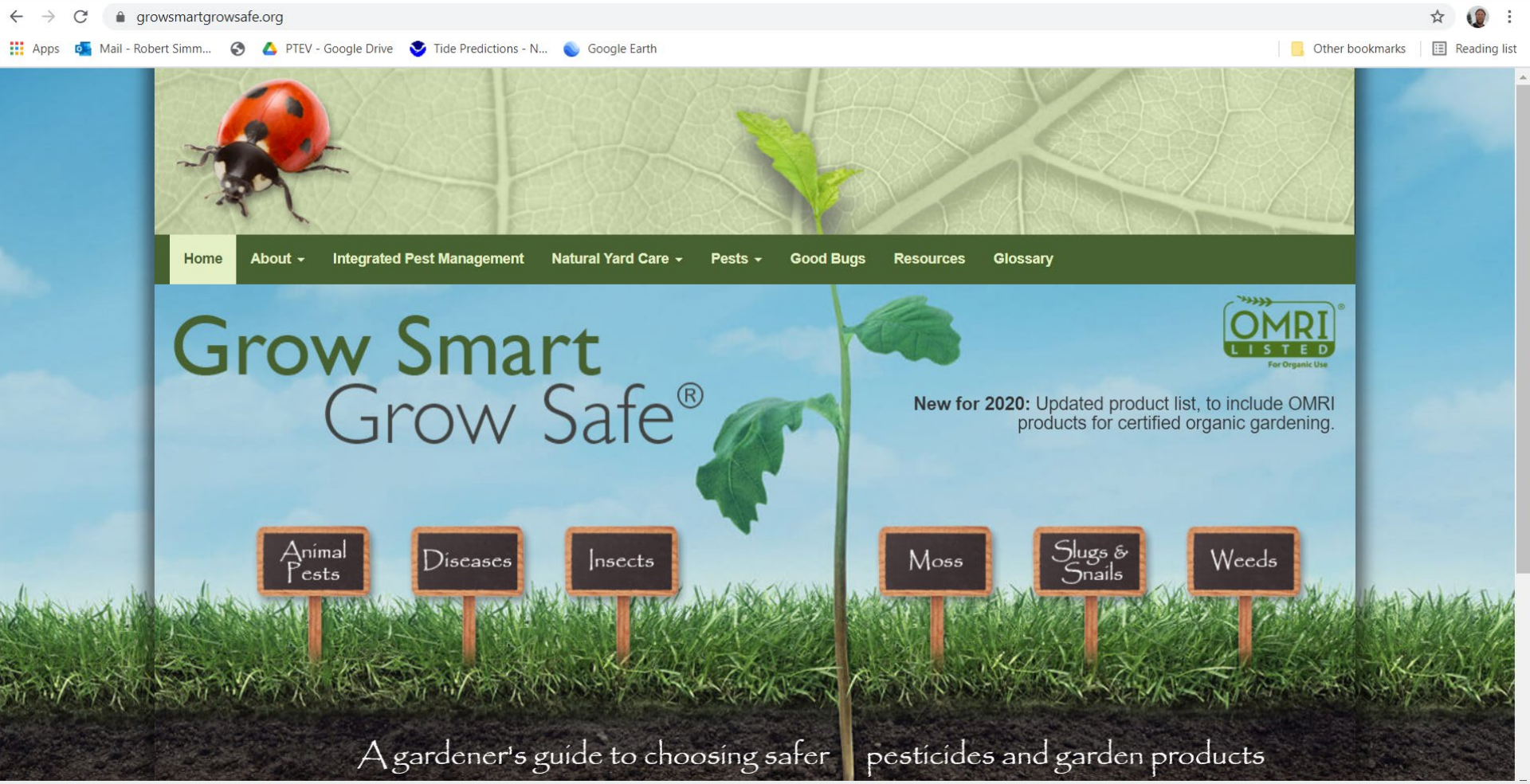
2,4-D goes through different changes in the environment depending on its form. Most of the time, 2,4-D breaks down in soil so that half of the original amount is gone in 1-14 days. This breakdown time is called the "half-life" of the pesticide. One form of 2,4-D, the butoxyethyl ester, had a much longer half-life in aquatic sediment of 186 days.

2,4-D is broken down by bacteria in water and in soil. Water alone can also break down 2,4-D. 2,4-D has been found at low levels in shallow groundwater and streams in both rural and urban areas.

Can 2,4-D affect birds, fish, or other wildlife?

How 2,4-D affects animals and plants depends on the form of 2,4-D. Some of the ester forms of 2,4-D can be very toxic to fish and other aquatic life. The salt forms may be only slightly toxic to aquatic animals. Aquatic animals are more sensitive to 2,4-D as water temperature rises. 2,4-D may be moderately toxic to practically non-toxic to birds if they eat it. Eggs sprayed with 2,4-D still hatched and the chicks were normal. 2,4-D is practically non-toxic to honeybees. It is not expected to be a hazard to other beneficial insects.

Grow Smart, Grow Safe Website

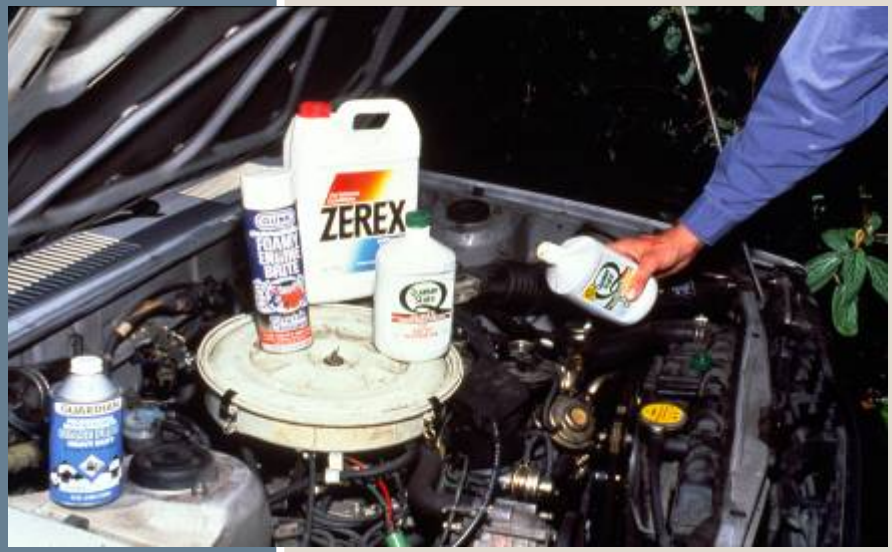


https://www.growsmartgrowsafe.org/

Leaking Oil Tanks

- In our rainy climate with our acid soils, underground tanks typically begin leaking after about 20 years.
- Best solution is to remove old tanks.
- Monitor fuel level when furnace is off.

Household Hazardous Products



- Read label to choose least hazardous
- Store in secondary containment
- Protect soil from vehicle and home maintenance projects

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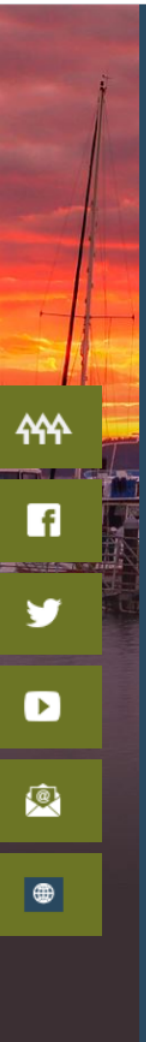
Snohomish County: Household Hazardous Waste

snohomishcountywa.gov/477/Hazardous-Waste

Apps | Mail - Robert Simm... | PTEV - Google Drive | Tide Predictions - N... | JLT Nature Programs | Google Earth | San Juan Ave, Port... | SHIFT SUMMIT &... | Other bookmar



Waste Restrictions

Accepted Household Hazardous Waste Products

The following items are accepted at the County's Household Hazardous Waste Drop-Off Station:

- Acids
- Aerosol Spray Cans
- *Antifreeze**
- *Batteries**
- Bleach
- Brake Fluid
- Chemistry Sets
- *Compact Fluorescent Light Bulbs** (*Discover additional information*)
- Cooking Oil
- Drain Cleaners
- Dyes
- Fertilizers
- *Fire Extinguishers**
- Flammable Liquids
- Floor Wax
- *Fluorescent Tubes/Bulbs**
- Fungicides
- Furniture Polish
- Fusee / Road Flares
- Gasoline / Diesel
- Glues
- Herbicides
- Hydraulic Fluid
- Insecticides
- Kerosene & Kerosene-filled Heaters
- Lamp Ballasts (unstamped/pre-1975)
- Lead
- Mercury
- Mildew Removers
- Moth Balls
- *Motor Oil**
- Neon Lights
- *Oil Filters**
- Oven Cleaners
- Paint, Varnish or Stains (Oil-based)
- Paint, Latex (for a fee)
- Paint Thinner
- Pesticides
- Photographic Chemicals
- Pool Chemicals
- *Propane Tanks** *(BBQ size or smaller)*
- Rug and Upholstery Cleaners
- Shoe or Silver Polish
- Smoke Detectors
- Solvents
- Switches containing Mercury
- Tar / Roofing Tar
- Thermometers or Thermostats containing Mercury
- Transmission Fluid
- Ultraviolet Light Tubes
- Wood Preservatives
- X-Ray Film

Enable

Stormwater Contaminants

- Nitrates, ammonia, phosphorus
- Fecal coliform, enterococcus, viruses, parasites, pathogens
- Turbidity and sediment
- Heavy Metals
  - Cu, Zn
  - Cd, Ni, Pb, Cr
- Polycyclic aromatic hydrocarbons PAHs
- Tire compounds

WASHIN
EX

Wastewater Contaminants

West Point Wastewater Treatment Plant

Photo: University of Washington

- Heavy Metals
- Pharmaceuticals
- Nitrates, ammonia
- Phosphorus
- Fecal coliform, enterococcus, viruses, parasites, pathogens
- Microfibers and associated bacteria
- Synthetic organic compounds used in food production, personal care products, plastics manufacturing, and other industrial processes such as flame retardants, dioxins, and steroid hormones

Pharmaceuticals discharged from wastewater treatment plants

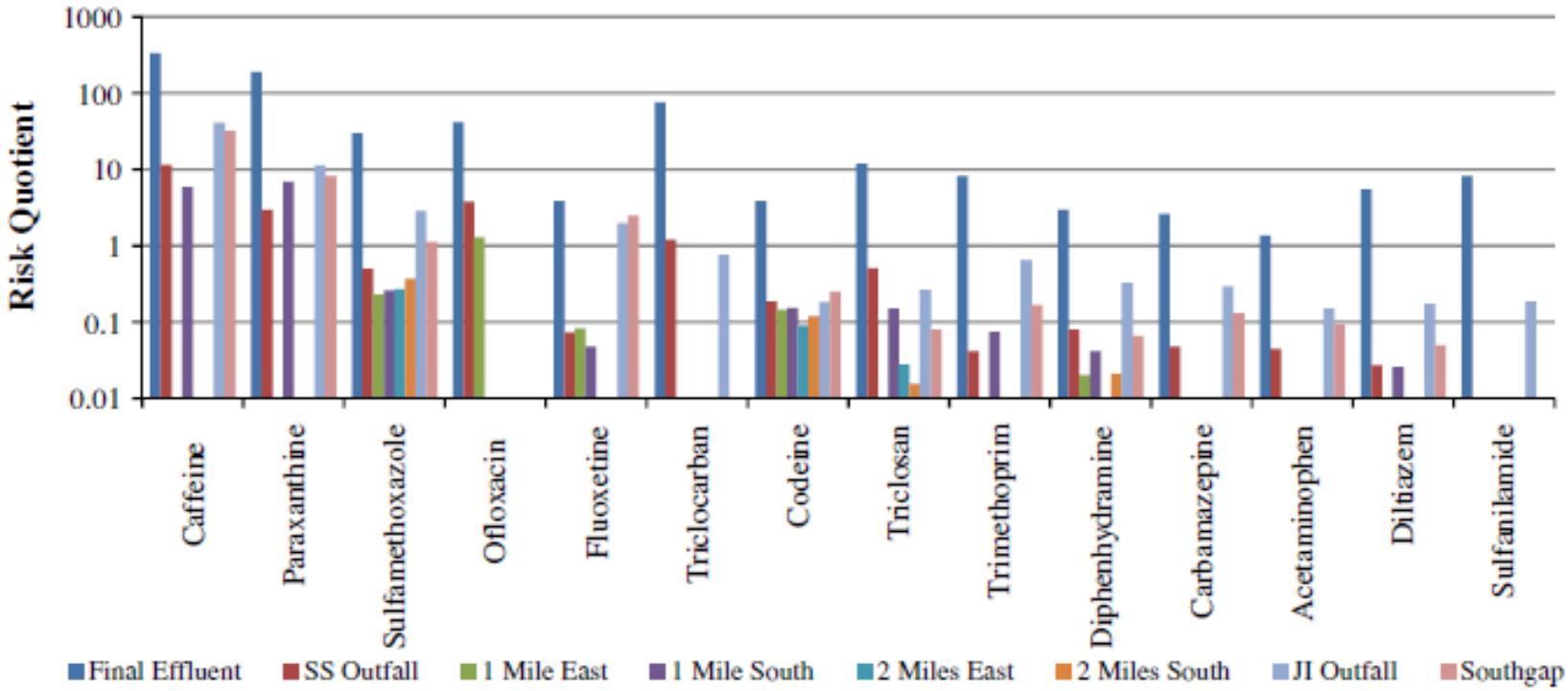


Fig. 3. Risk quotient for 14 PPCPs in wastewater effluent and in Lake Michigan (RQ > 1 is high risk, RQ from 0.1 to 1 is medium risk, and RQ < 0.1 is low risk).

Blair, et. al., 2013

Nathalie Hamel (and colleagues)
Vital Signs Reporting Lead, Puget Sound Partnership
November 20, 2019

“On the surface, Puget Sound looks beautiful, but it’s in grave trouble”

—Laura Blackmore, Executive Director, Puget Sound Partnership

Eyes Over Puget Sound - Website

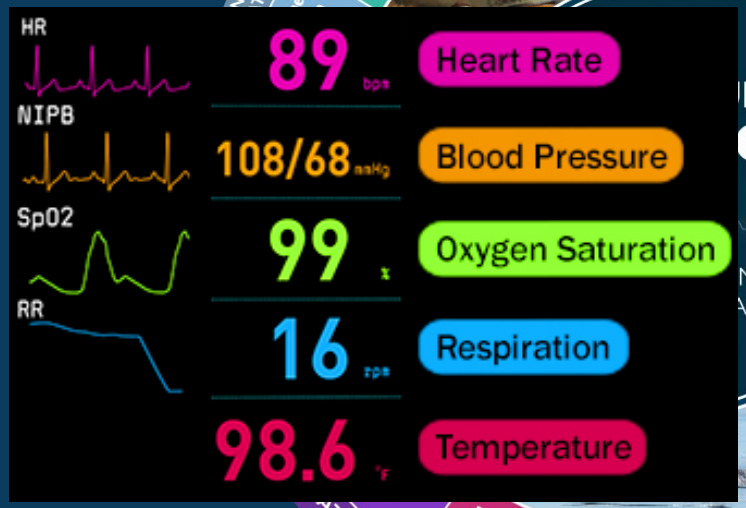
Red-brown bloom and organic surface debris flowing north with outgoing tide.
Location: Eld Inlet (South Sound), 12:47 PM

Example of the structure of the Vital Sign measures

RECOVERY GOAL	VITAL SIGN	INDICATOR	2020 TARGET
SPECIES & FOOD WEBS	ORCAS	NUMBER OF SOUTHERN RESIDENT KILLER WHALES	95 WHALES BY 2020

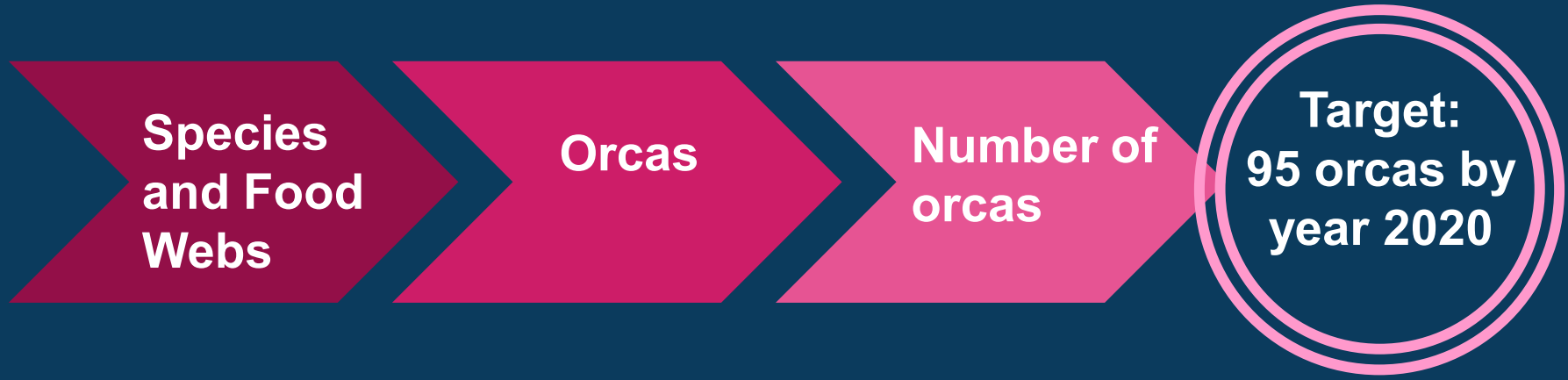
Visit the Puget Sound Vital Signs web site.

Puget Sound Partnership, 2019


HR
89 bpm
Heart Rate
NIPB
108/68 mmHg
Blood Pressure
SpO2
99 %
Oxygen Saturation
RR
16 rpm
Respiration
98.6 °F
Temperature

HEALTHY WATER QUALITY
Toxics in Fish
Marine Water Quality
Marine Sediment Quality
Freshwater Quality
HEALTHY HUMAN POPULATIO
Air Quality
Drinking Water
Local Foods
Onsite Sewage Systems
Pacific Herring
Orcas
Chinook Salmon
Birds
THRIVING SPECIES AND FOOD WEB
Sound Steward-ship
VIBRANT H

How we keep track of recovery



Vital Sign Assessment

Progress of indicators:

GETTING BETTER	MIXED RESULTS	NOT IMPROVING	GETTING WORSE	INSUFFICIENT DATA
10	9	7	3	23

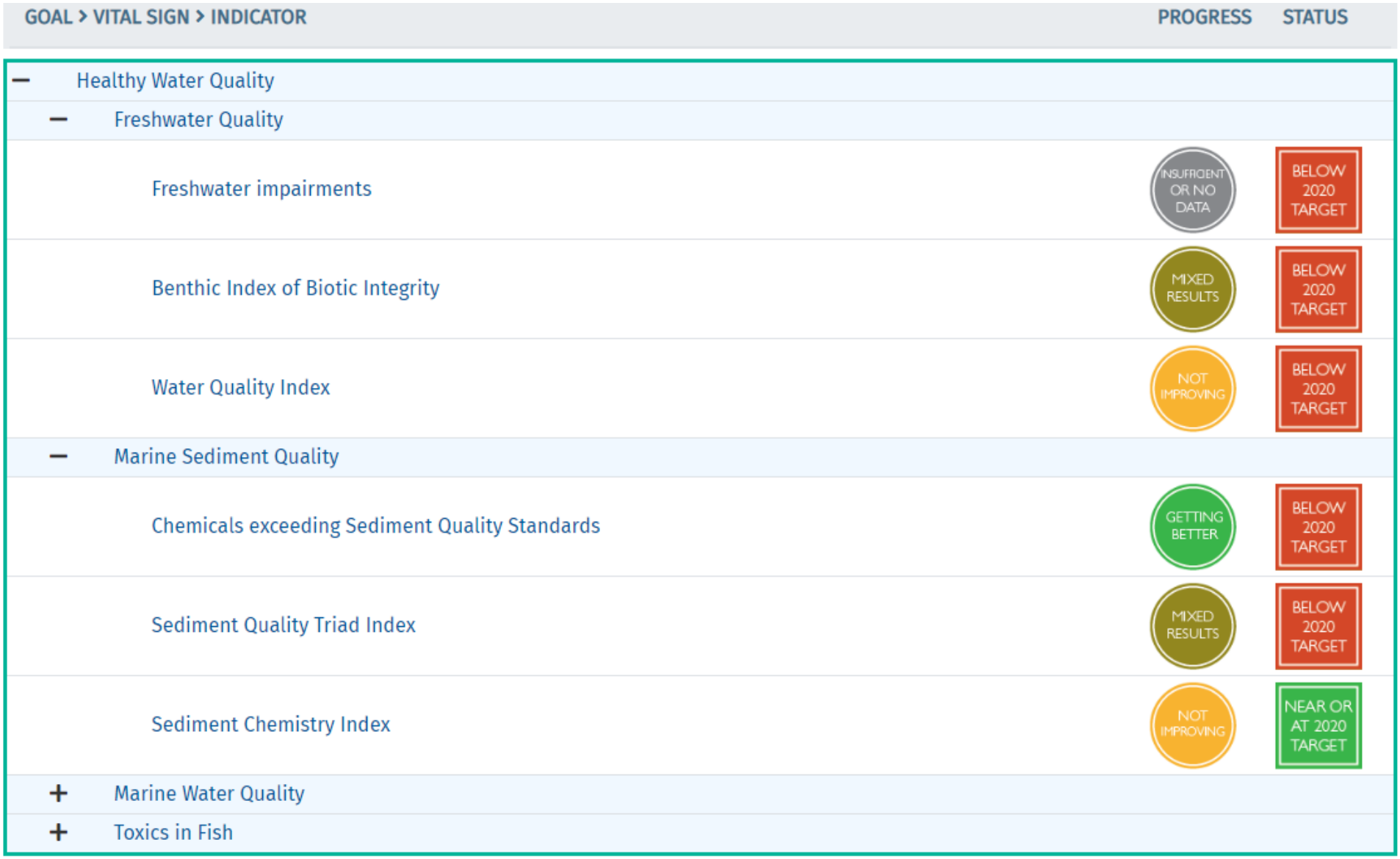
Status of indicators relative to 2020 targets:

✔ **4** Meeting 2020 targets

✖ **27** Not meeting 2020 targets

⊖ **21** indicators do not have targets but are reported in this table for progress relative to a baseline reference

Healthy Water Quality Vital Signs



Puget Sound Partnership, 2019

Healthy Water Quality Vital Signs

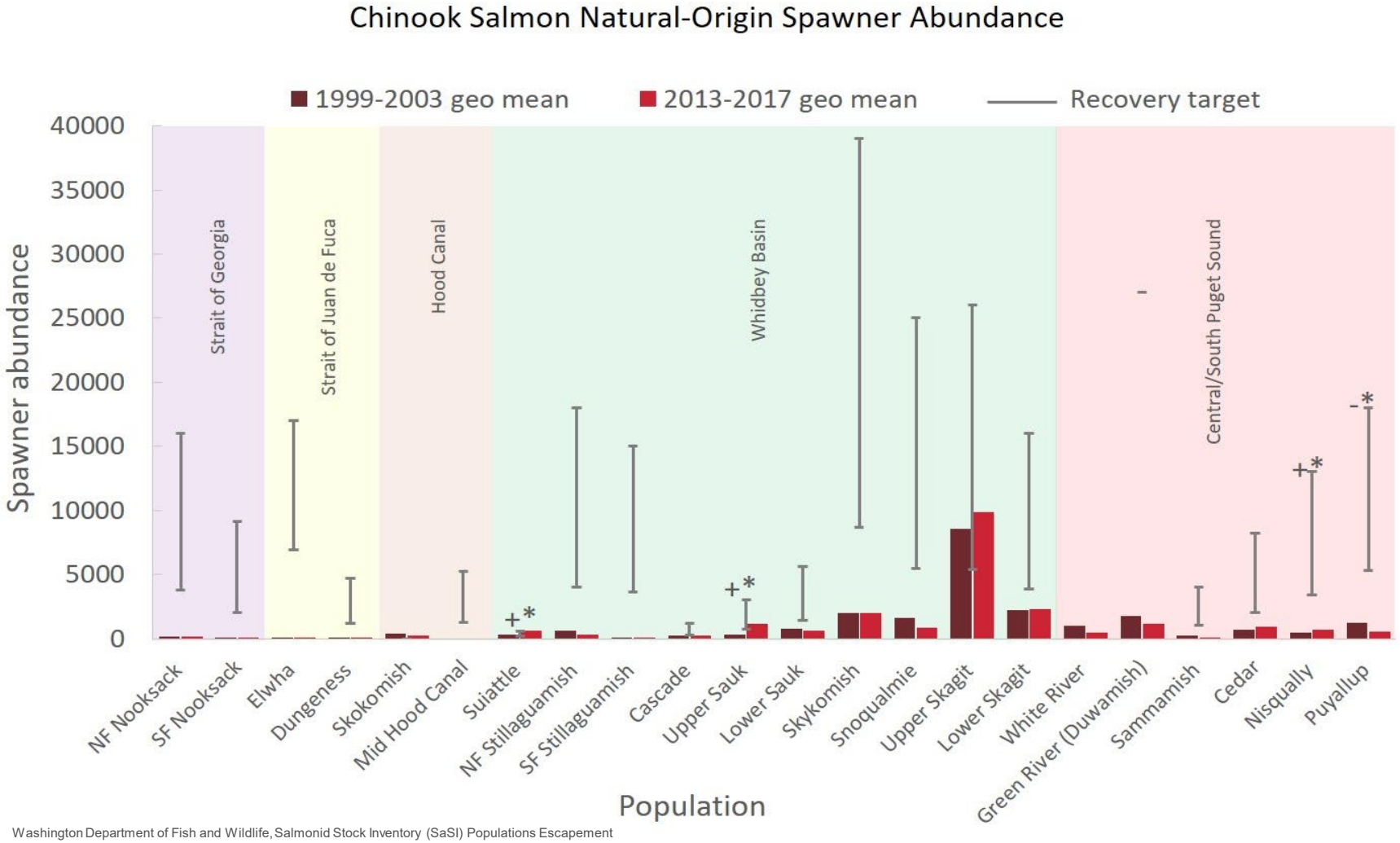
GOAL > VITAL SIGN > INDICATOR	PROGRESS	STATUS
− Healthy Water Quality		
+ Freshwater Quality		
+ Marine Sediment Quality		
− Marine Water Quality		
Marine Water Condition Index	GETTING WORSE	NO 2020 TARGET
Dissolved oxygen in marine waters	INSUFFICIENT OR NO DATA	BELOW 2020 TARGET
− Toxics in Fish		
Contaminants in adult Chinook salmon	INSUFFICIENT OR NO DATA	BELOW 2020 TARGET
Contaminants in English sole	MIXED RESULTS	BELOW 2020 TARGET
Contaminants in juvenile Chinook salmon	INSUFFICIENT OR NO DATA	BELOW 2020 TARGET
Contaminants in Pacific herring	MIXED RESULTS	BELOW 2020 TARGET

Puget Sound Partnership, 2019

Chinook Salmon Vital Sign

Puget Sound Partnership, 2019

CHINOOK SALMON POPULATION ABUNDANCE



Washington Department of Fish and Wildlife, Salmonid Stock Inventory (SaSI) Populations Escapement

The +* and -* symbols indicate that the population statistically significantly increased or declined, respectively, over the time period.

Puget Sound Partnership, 2019

Pacific Herring Vital Sign

BIOMASS OF SPAWNING PACIFIC HERRING

Two of the three stocks have declined since 2010

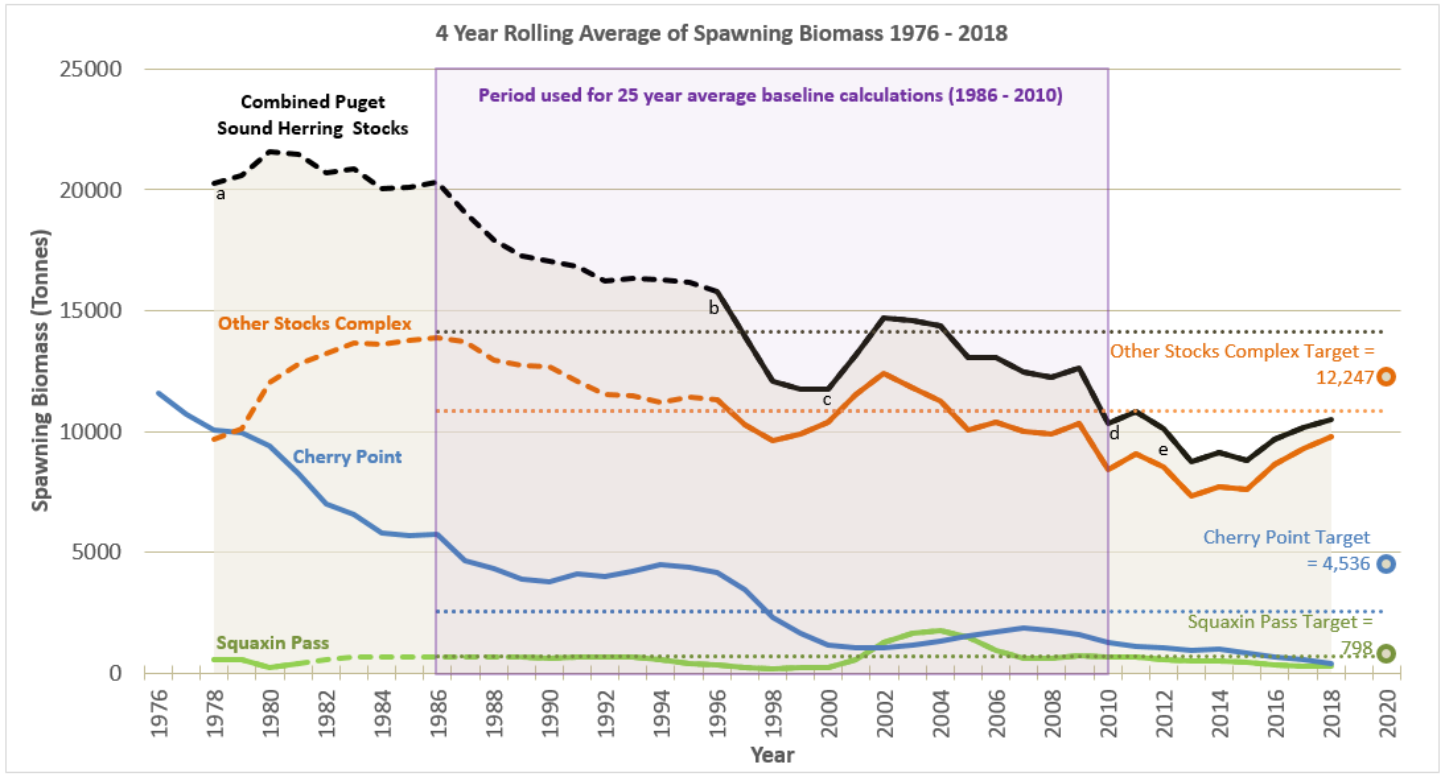
PROGRESS: GETTING WORSE

STATUS: BELOW 2020 TARGET

Puget Sound Partnership, 2019

Pacific Herring Vital Sign

BIOMASS OF SPAWNING PACIFIC HERRING



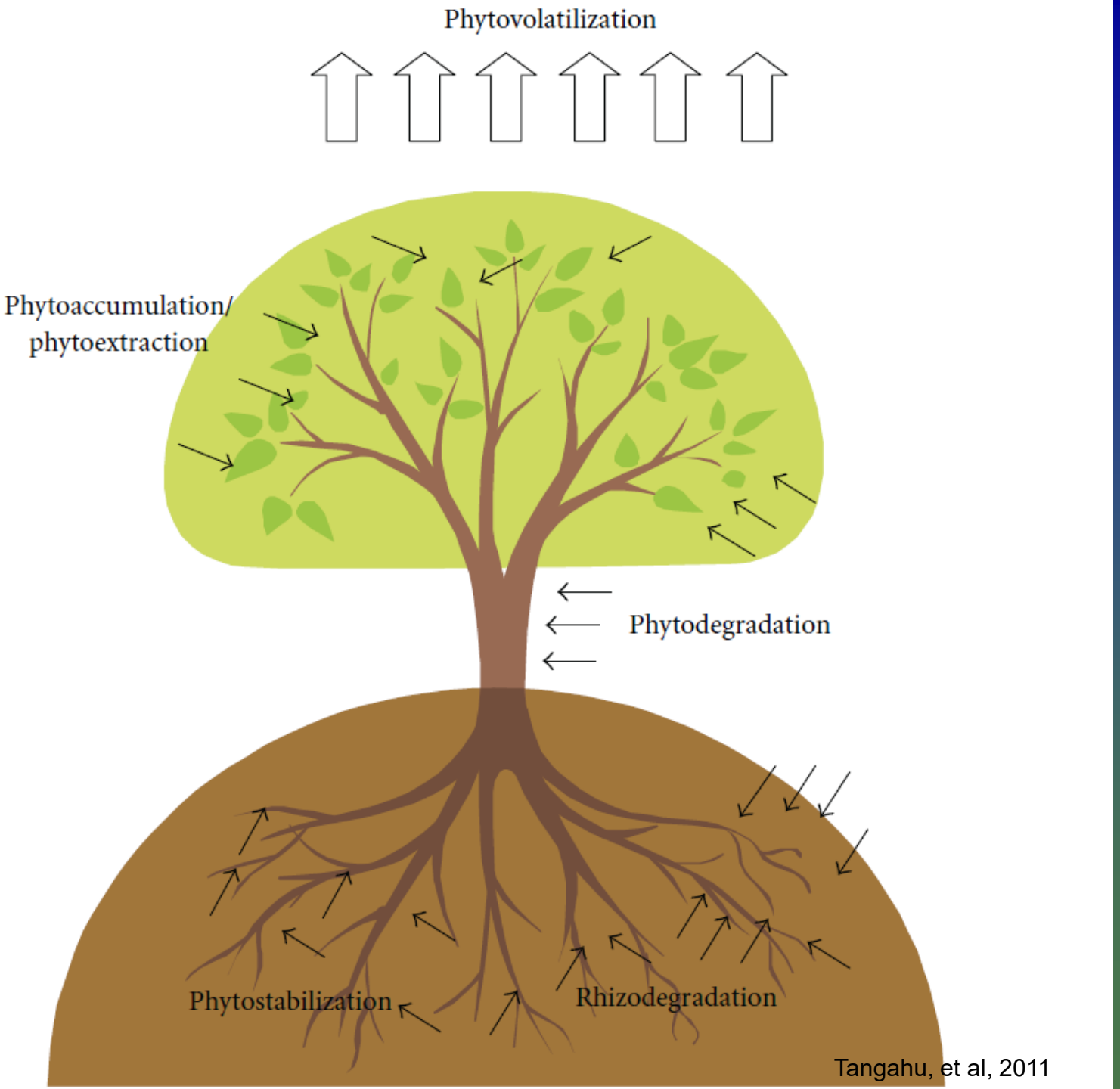
Washington State Department of Fish and Wildlife, Marine Fish Unit (Forage Fish)

PUGETSOUND PARTNERSHIP

www.stateofthesound.wa.gov

Forest Layers

Graphic: Stacey Gianas



Tangahu, et al, 2011

Mycorrhizal short roots of pine seedlings [Jim Deacon]


Questions?
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Thank You

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