Nitrogen in Puget Sound Story Map

Sheelagh McCarthy
Teizeen Mohamedali

DEPARTMENT OF ECOLOGY
State of Washington

Acknowledgements

Story Map Co-Authors

Teizeen Mohamedali, Paula Cracknell

Data + Information

Washington State Dept. of Ecology

- Marine Monitoring Unit, Freshwater Monitoring Unit, Groundwater Assessment Unit, Air Quality Program, Water Quality Program

King County
Herrera Environmental Consultants
National Oceanic and Atmospheric Administration
Oregon State University
Puget Sound Ecosystem Monitoring Program
Puget Sound Partnership
Washington State Department of Health
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Washington State University
United States Geological Survey
University of Maryland Center for Environmental Science
University of Washington

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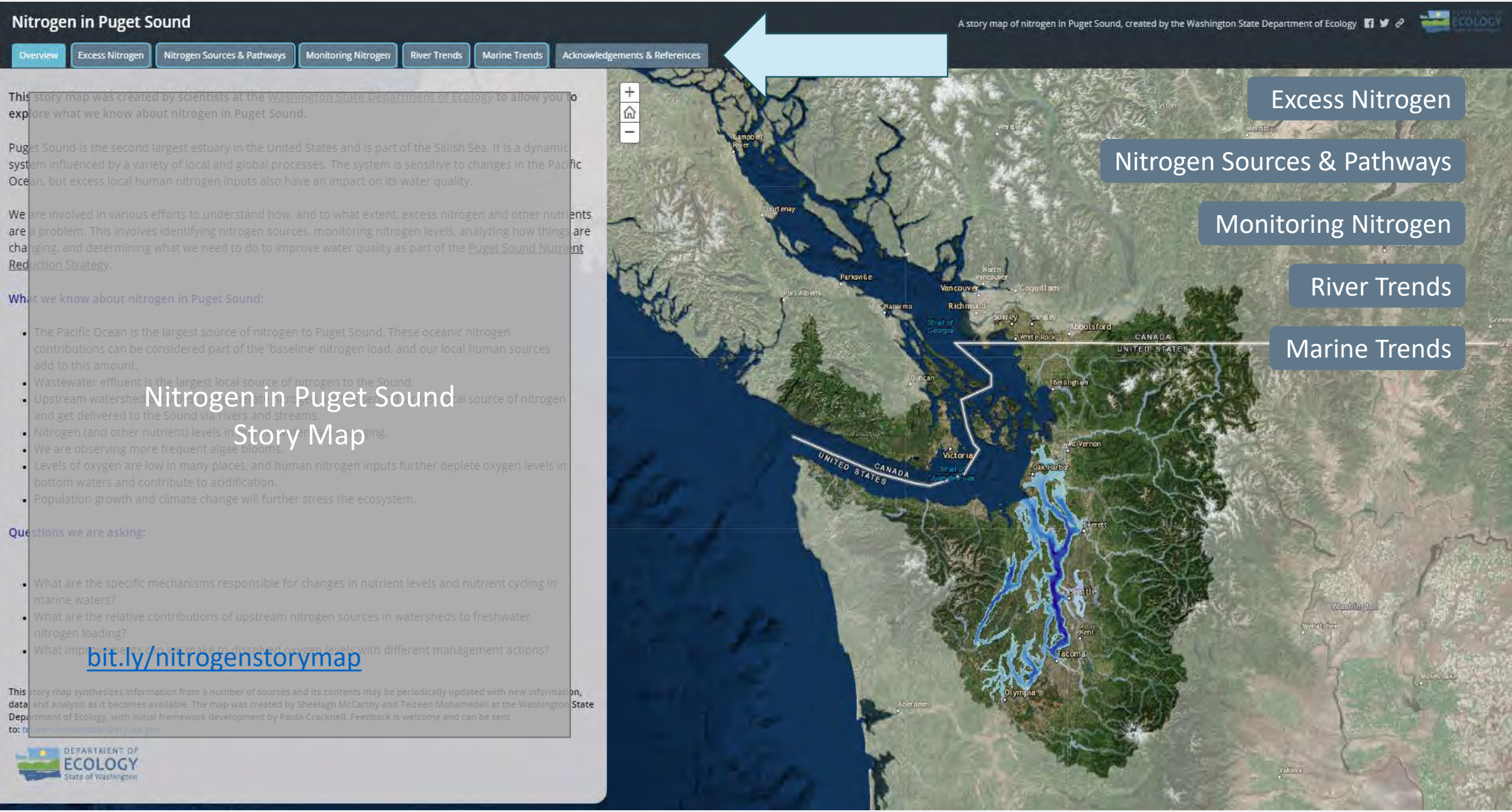
Nitrogen in Puget Sound
A story map of nitrogen in Puget Sound, created by the Washington State Department of Ecology
Overview
Excess Nitrogen
Nitrogen Sources & Pathways
Monitoring Nitrogen
River Trends
Marine Trends
Acknowledgements & References
This story map was created by scientists at the Washington State Department of Ecology to allow you to explore what we know about nitrogen in Puget Sound.
Puget Sound is the second largest estuary in the United States and is part of the Salish Sea. It is a dynamic system influenced by a variety of local and global processes. The system is sensitive to changes in the Pacific Ocean, but excess local human nitrogen inputs also have an impact on its water quality.
We are involved in various efforts to understand how, and to what extent, excess nitrogen and other nutrients are a problem. This involves identifying nitrogen sources, monitoring nitrogen levels, analyzing how things are changing, and determining what we need to do to improve water quality as part of the Puget Sound Nutrient Reduction Strategy.
What we know about nitrogen in Puget Sound:
The Pacific Ocean is the largest source of nitrogen to Puget Sound. These oceanic nitrogen contributions can be considered part of the 'baseline' nitrogen load, and our local human sources add to this amount.
Wastewater effluent is the largest local source of nitrogen to the Sound.
Upstream watersheds
and get delivered to the Sound via rivers and streams.
Nitrogen (and other nutrient) levels in
We are observing more frequent algae blooms.
Levels of oxygen are low in many places, and human nitrogen inputs further deplete oxygen levels in bottom waters and contribute to acidification.
Population growth and climate change will further stress the ecosystem.
Questions we are asking:
What are the specific mechanisms responsible for changes in nutrient levels and nutrient cycling in marine waters?
What are the relative contributions of upstream nitrogen sources in watersheds to freshwater nitrogen loading?
What impacts can
Nitrogen in Puget Sound
Story Map
bit.ly/nitrogenstorymap
This story map synthesizes information from a number of sources and its contents may be periodically updated with new information, data and analysis as it becomes available. The map was created by Sheelagh McCarthy and Teizeen Mohamedali at the Washington State Department of Ecology, with initial framework development by Paula Cracknell. Feedback is welcome and can be sent to:
DEPARTMENT OF ECOLOGY
State of Washington
Excess Nitrogen
Nitrogen Sources & Pathways
Monitoring Nitrogen
River Trends
Marine Trends
Campbell River
Courtenay
Parksville
Port Alberni
Nanaimo
North Vancouver
Vancouver
Coquitlam
Richmond
Surrey
Langley
White Rock
Abbotsford
CANADA
UNITED STATES
Duncan
Victoria
Bellingham
Mt Vernon
Oak Harbor
Everett
Seattle
Kent
Tacoma
Olympia
Aberdeen
Yakima

bit.ly/nitrogenstorymap

Challenges +
Lessons Learned

bit.ly/nitrogenstorymap

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Nitrogen in Puget Sound

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What we know about nitrogen in Puget Sound:

- The Pacific Ocean is the largest source of nitrogen to Puget Sound. These oceanic nitrogen contributions can be considered part of the 'baseline' nitrogen load, and our local human sources add to this amount.
- Wastewater effluent is the largest local source of nitrogen to the Sound.
- Upstream watersheds [illegible] al source of nitrogen and get delivered to the Sound via rivers and streams.
- Nitrogen (and other nutrient) levels in [illegible]ng.
- We are observing more frequent algae blooms.
- Levels of oxygen are low in many places, and human nitrogen inputs further deplete oxygen levels in bottom waters and contribute to acidification.
- Population growth and climate change will further stress the ecosystem.

Questions we are asking:

- What are the specific mechanisms responsible for changes in nutrient levels and nutrient cycling in marine waters?
- What are the relative contributions of upstream nitrogen sources in watersheds to freshwater nitrogen loading?
- What impacts can [illegible] make to dissolved oxygen levels with different management actions?

Nitrogen in Puget Sound
Story Map

bit.ly/nitrogenstorymap

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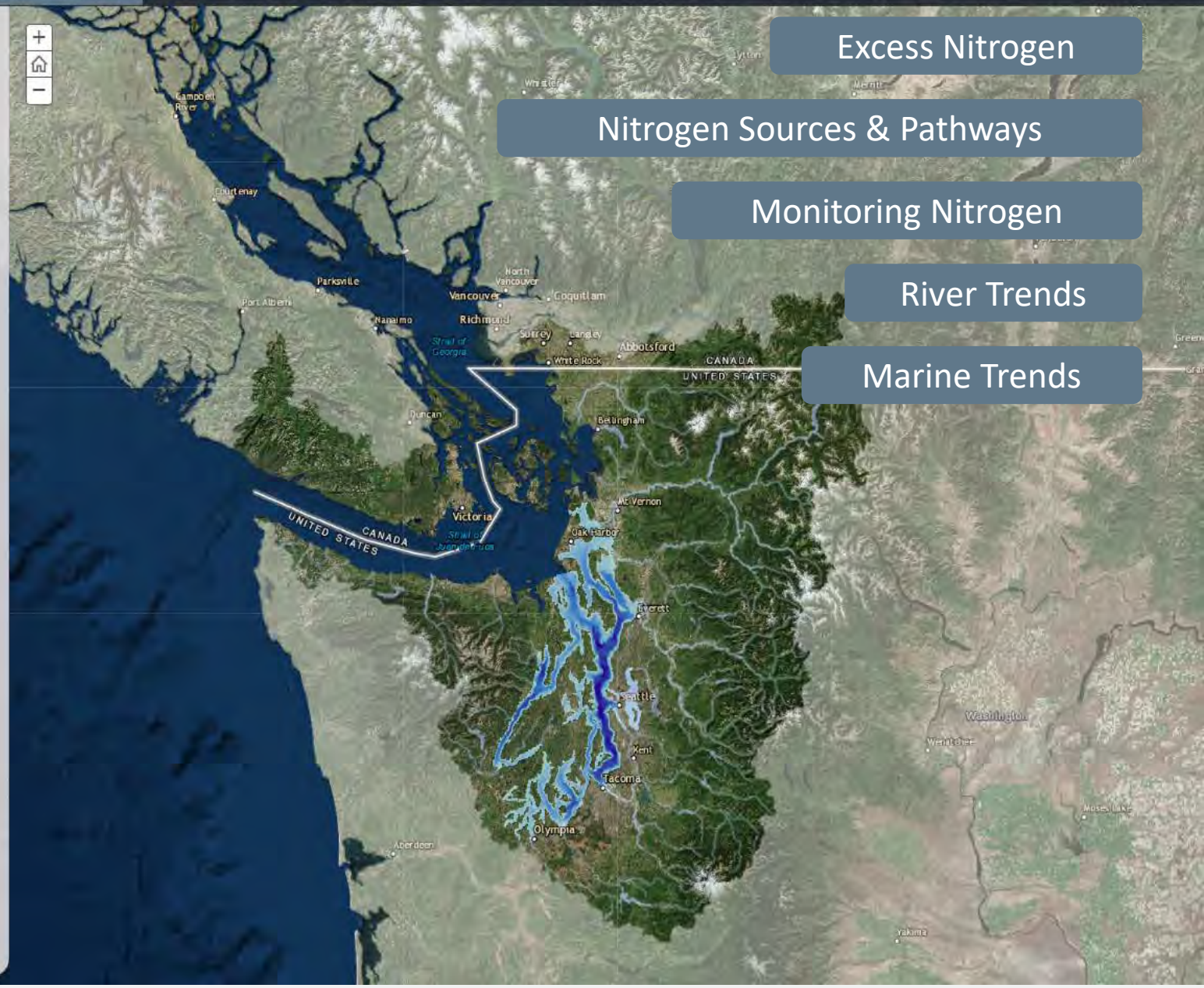
DEPARTMENT OF ECOLOGY
State of Washington



Algae blooms

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Excess nitrogen

Modeling dissolved oxygen

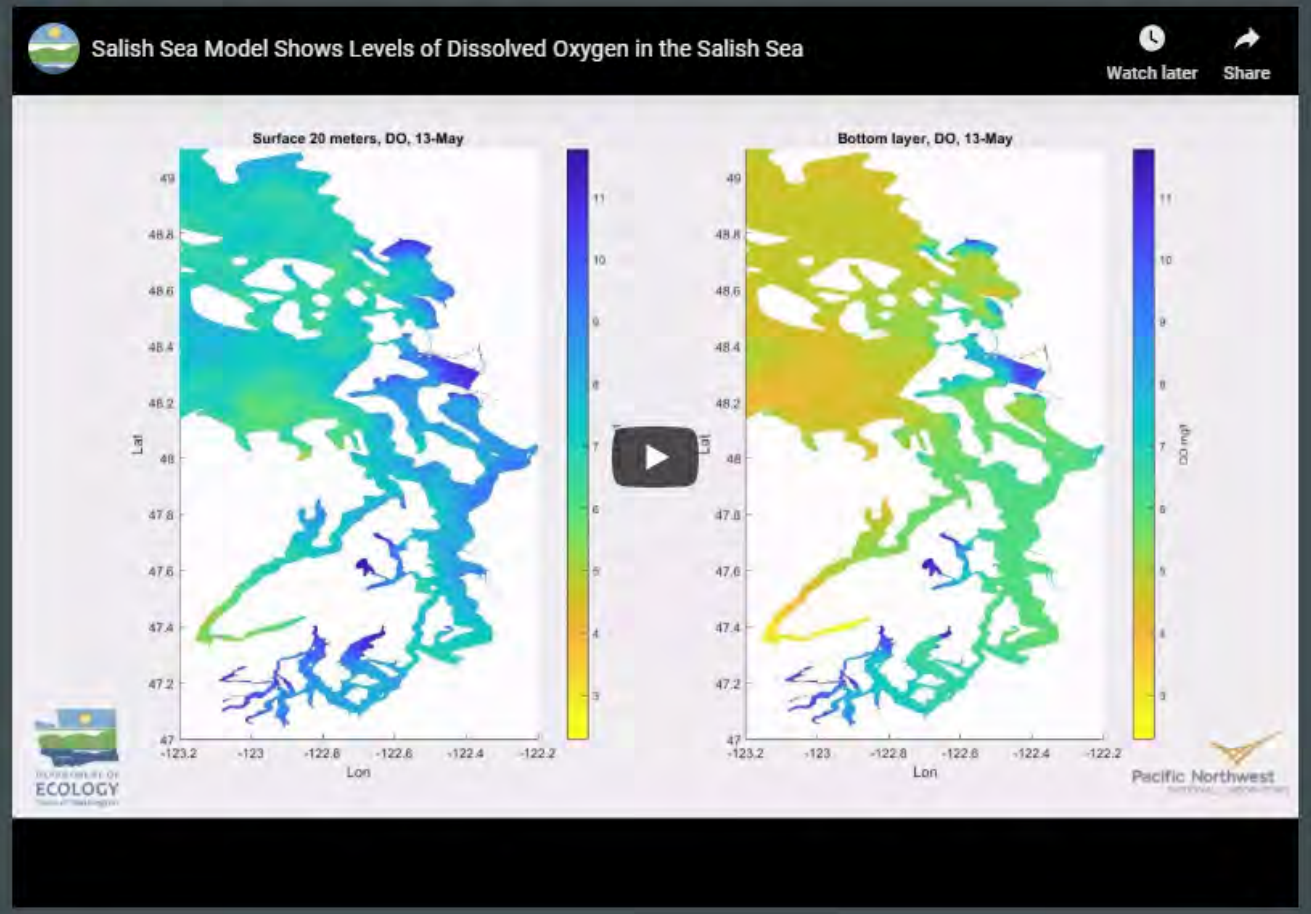
The Salish Sea Model takes into account the physical, chemical, and biological processes that affect oxygen levels, to simulate nutrient and oxygen levels in Puget Sound. This video shows an animation of results from the model, illustrating levels of dissolved oxygen in the surface (left) and bottom (right) of Puget Sound in 2008. The model results show that:

- Oxygen levels are significantly lower at the bottom than at the surface of the Sound
- Oxyg[illegible] all period (August - September)
- Oxygen levels vary spatially within Puget Sound

One of the questions that we are trying to answer using the Salish Sea Model, is: **How much of the observed dissolved oxygen problems in Puget Sound are a result of human sources of nitrogen from this region?**

The model will be used to guide management actions as part of the Puget Sound Nutrient Reduction Project.

Salish Sea Model



Where does nitrogen come from?

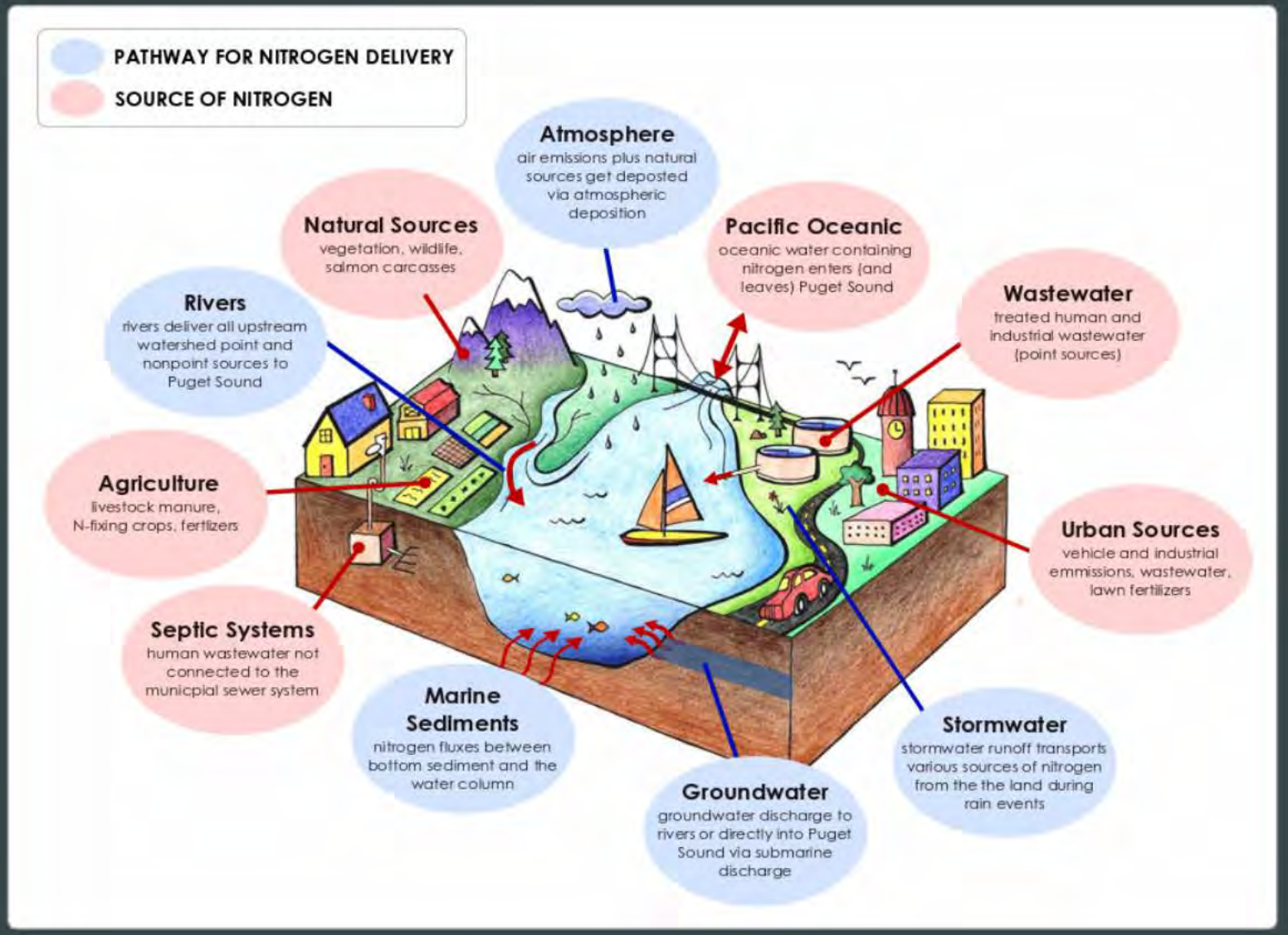
Nitrogen from many sources and pathways enter Puget Sound, as illustrated in the image to the right. Find details about each source and pathway by clicking on the tabs above.

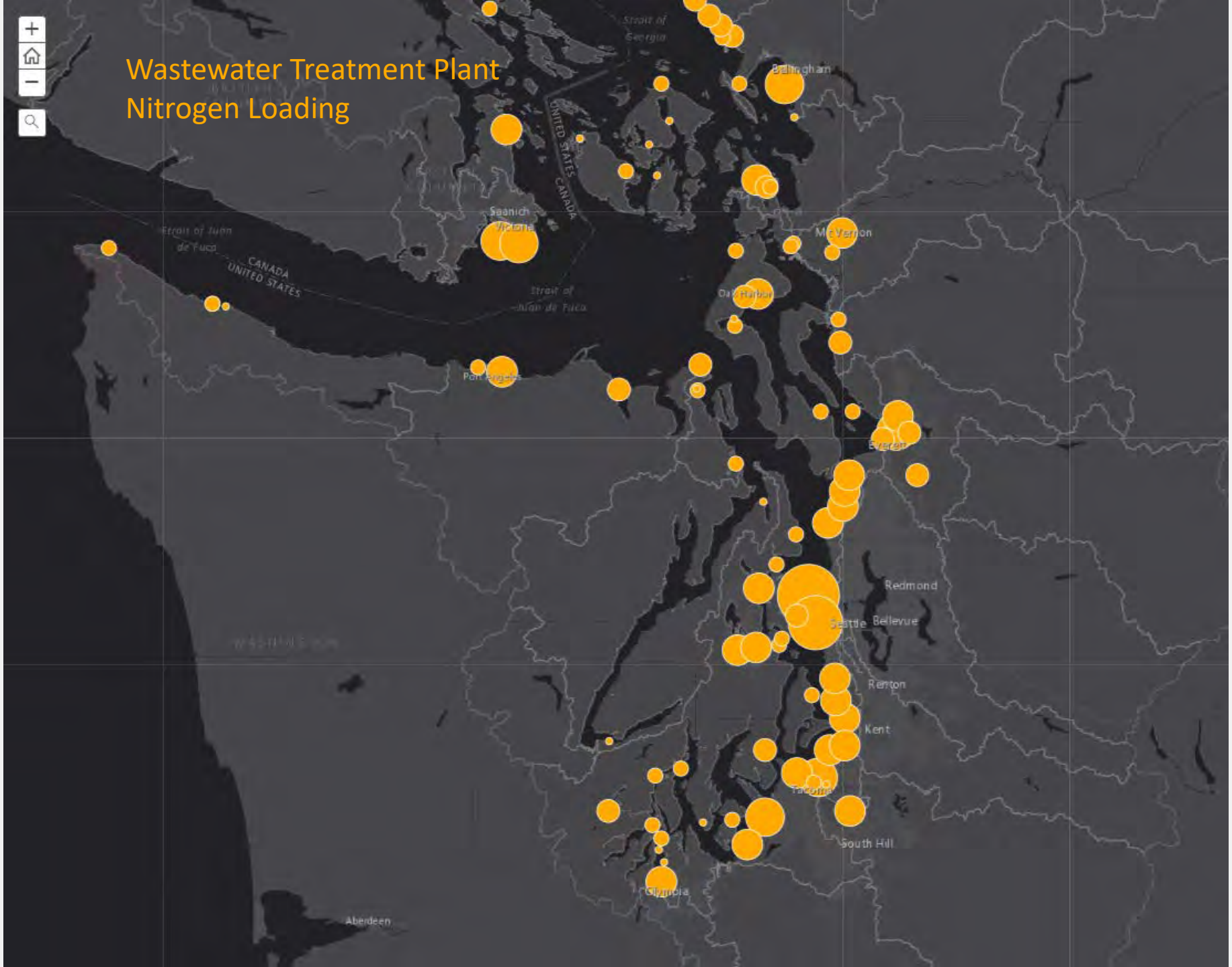
We are using the Salish Sea Model to evaluate the relative effects of human (anthropogenic) and natural nutrient sources on dissolved oxygen levels in Puget Sound. This model is being used to guide the Puget Sound Nutrient Reduction Project.

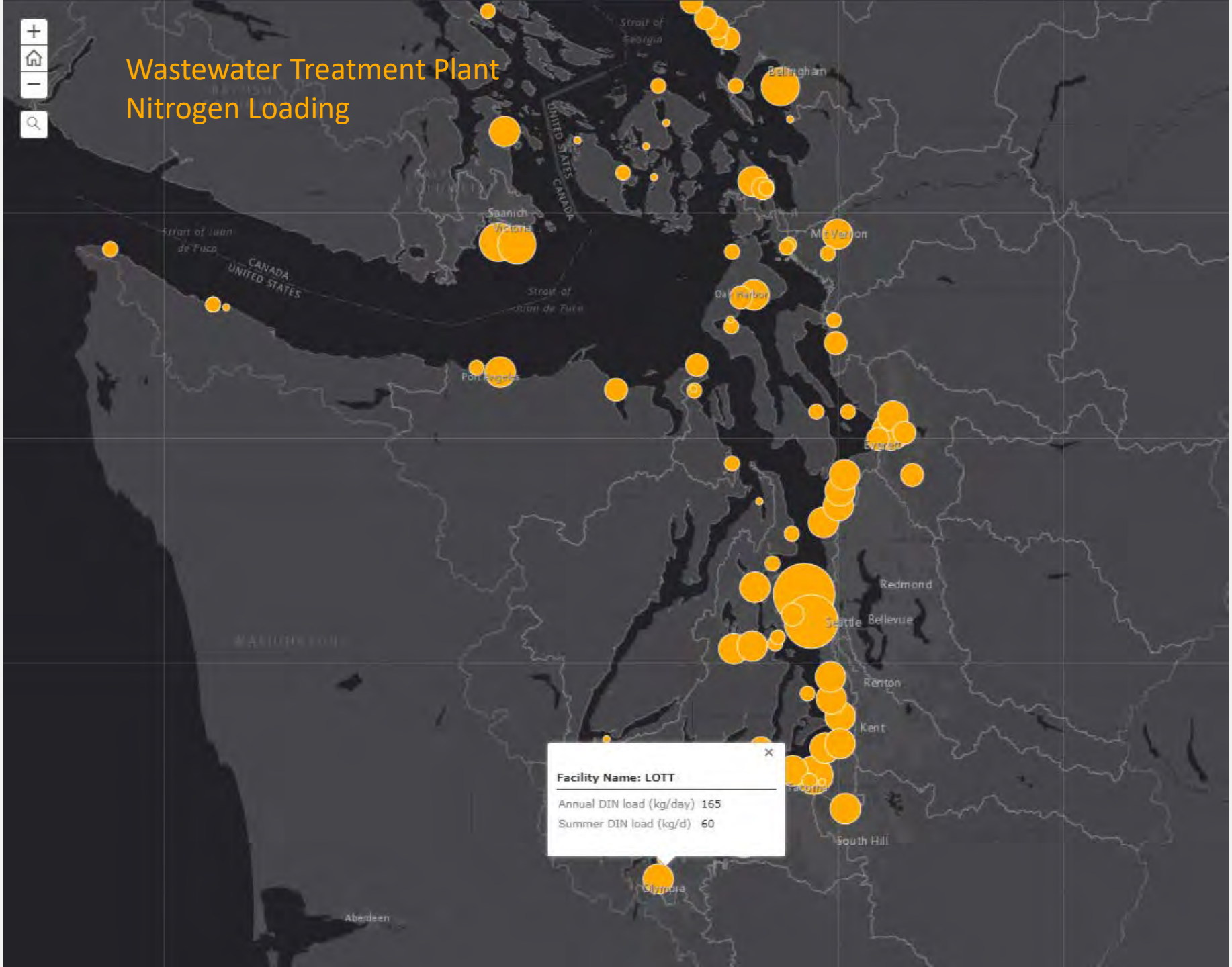
Where does nitrogen come from?

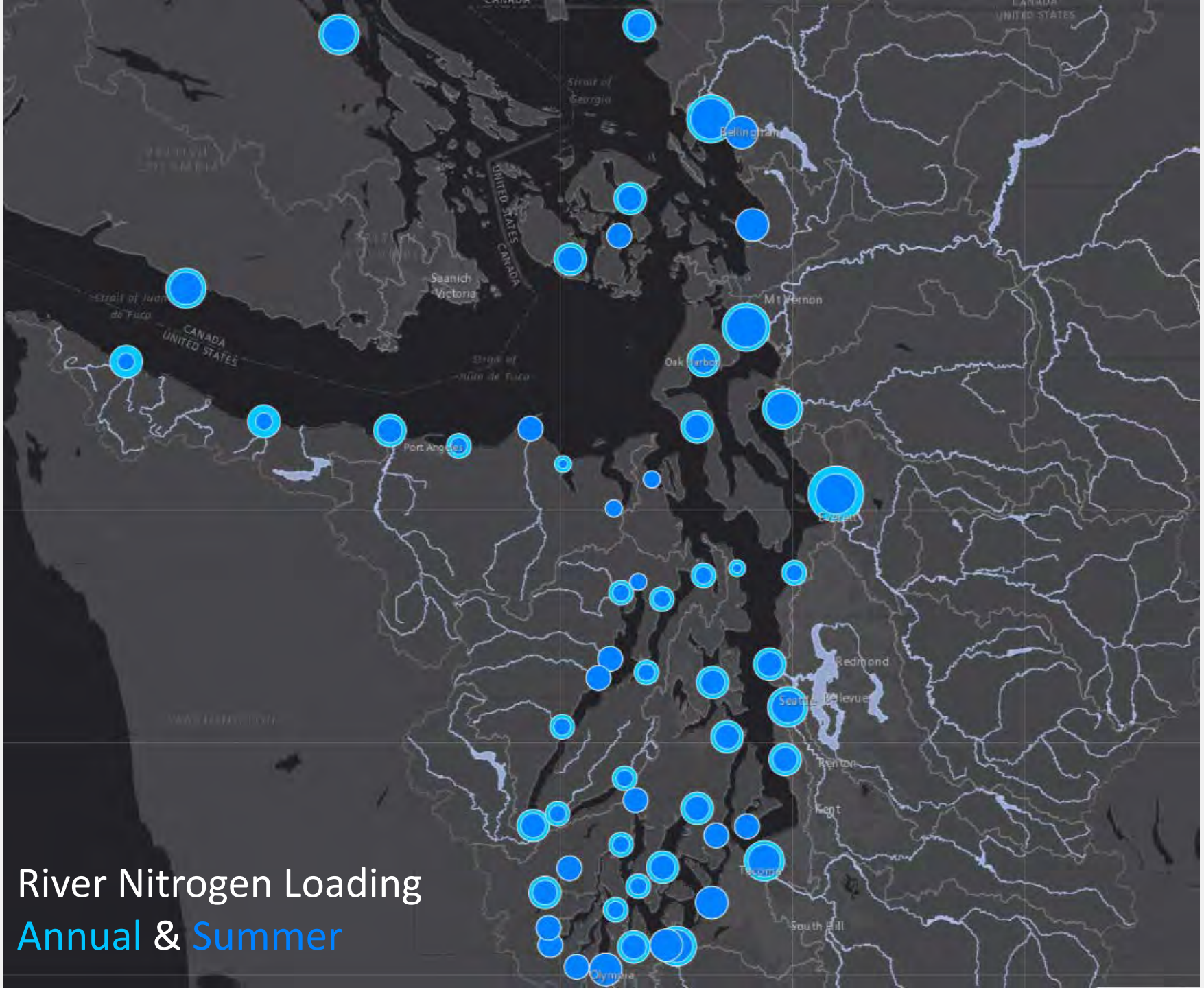
Various

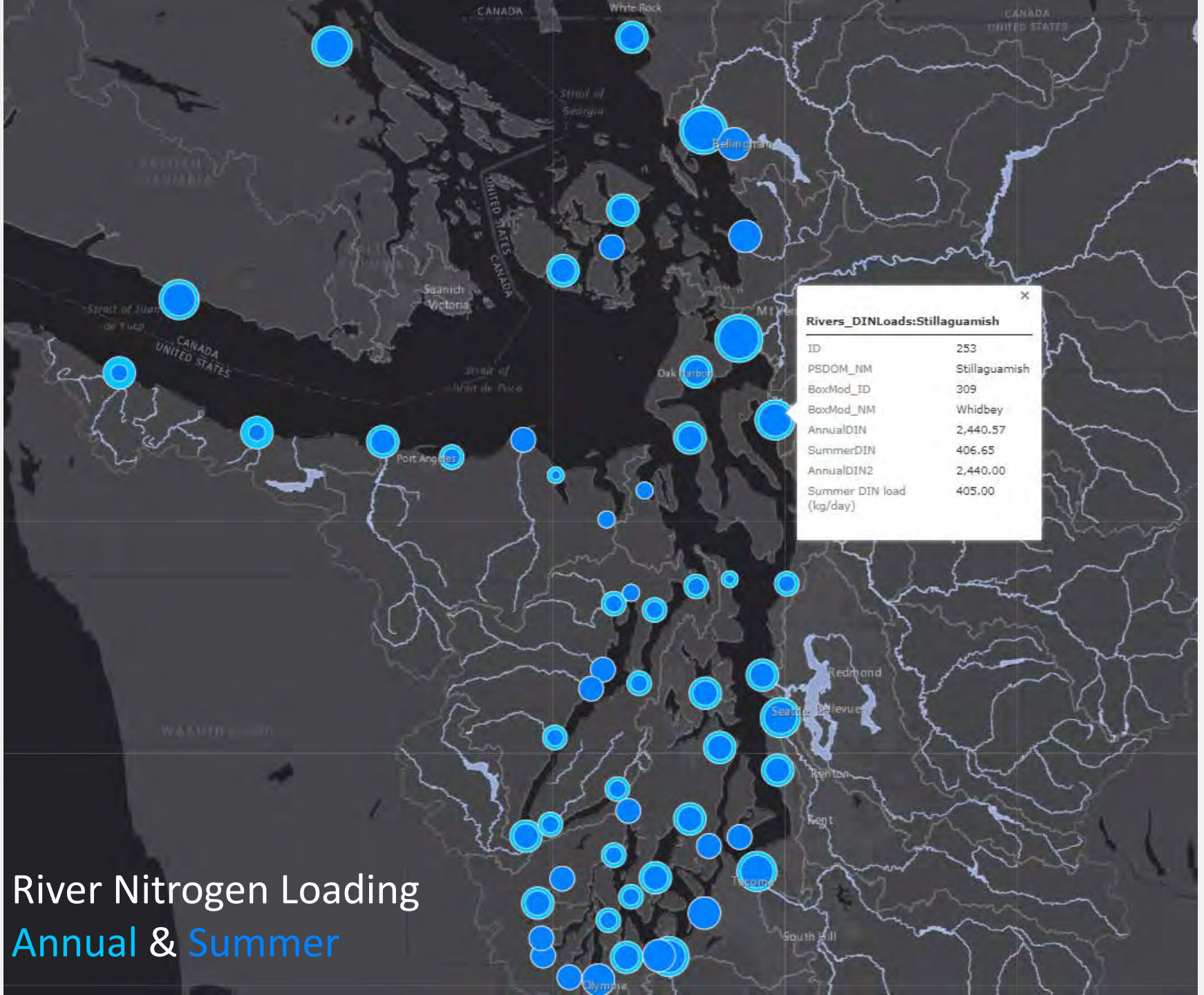
Pathways + Sources

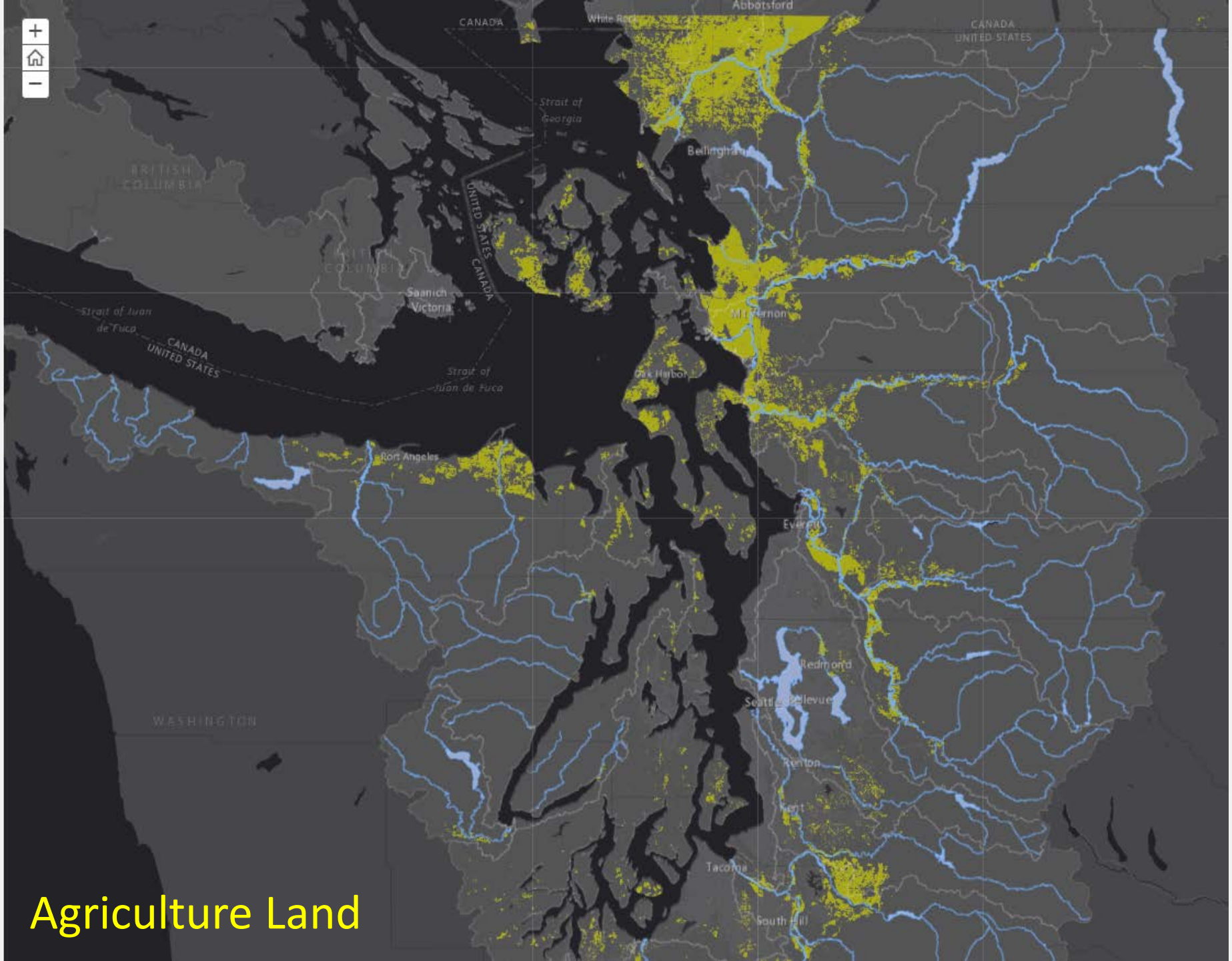



Wastewater Treatment Plant
Nitrogen Loading
Strait of Georgia
Bellingham
UNITED STATES
CANADA
Saanich
Victoria
Strait of Juan de Fuca
CANADA
UNITED STATES
Mt Vernon
Oak Harbor
Port Angeles
Everett
Redmond
Seattle
Bellevue
Renton
Kent
Tacoma
South Hill
Olympia
Aberdeen

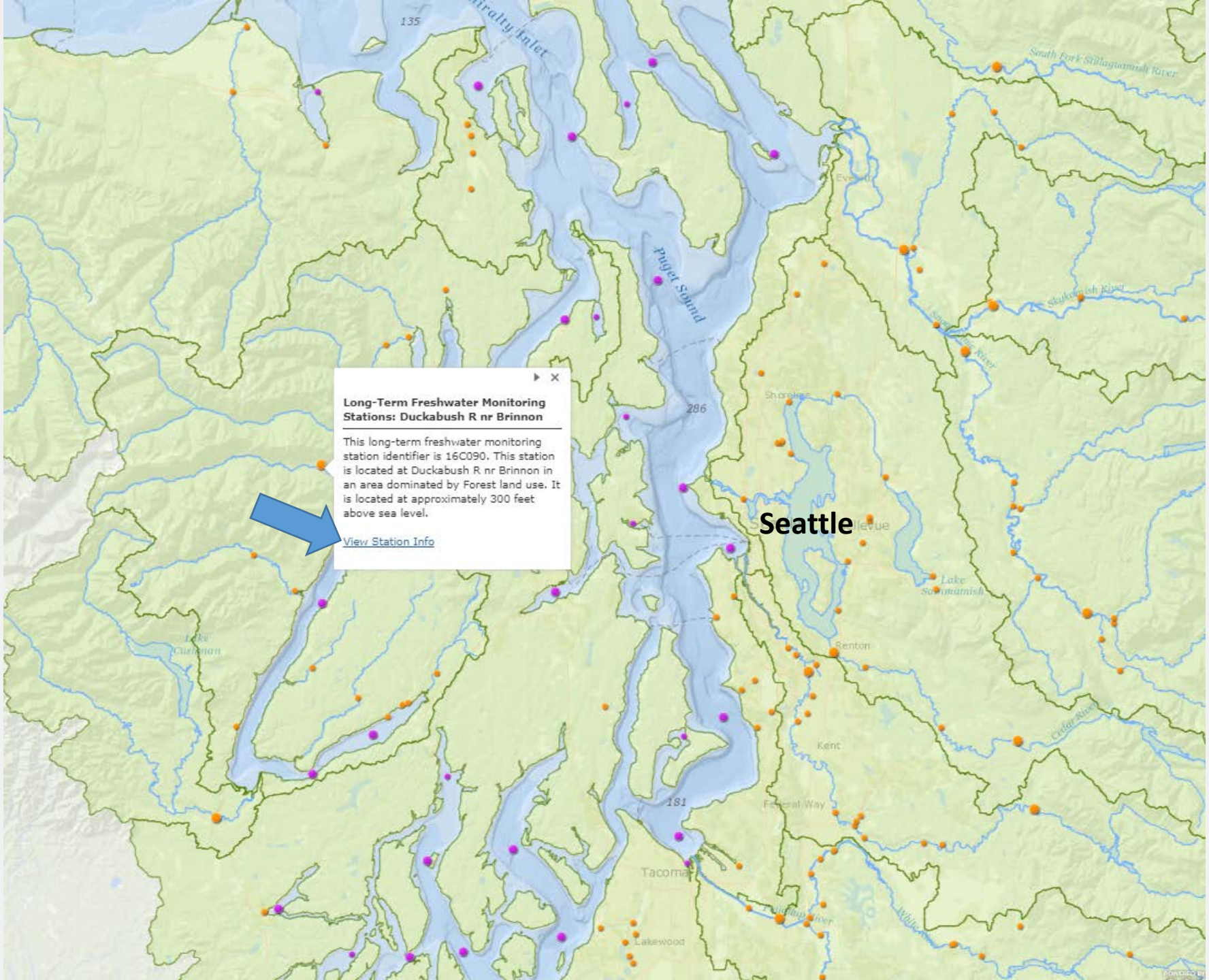

Wastewater Treatment Plant
Nitrogen Loading
Strait of Georgia
Bellingham
UNITED STATES
CANADA
Saanich
Victoria
Strait of Juan de Fuca
CANADA
UNITED STATES
Strait of Juan de Fuca
Mt Vernon
Oak Harbor
Port Angeles
Everett
Redmond
Seattle
Bellevue
Renton
Kent
Tacoma
South Hill
Olympia
Aberdeen
Facility Name: LOTT
Annual DIN load (kg/day) 165
Summer DIN load (kg/d) 60


River Nitrogen Loading
Annual & Summer


Rivers_DINLoads:Stillaguamish
ID 253
PSDOM_NM Stillaguamish
BoxMod_ID 309
BoxMod_NM Whidbey
AnnualDIN 2,440.57
SummerDIN 406.65
AnnualDIN2 2,440.00
Summer DIN load (kg/day) 405.00
River Nitrogen Loading
Annual & Summer


Agriculture Land
CANADA
Abbotsford
White Rock
CANADA
UNITED STATES
Strait of Georgia
Bellingham
BRITISH COLUMBIA
UNITED STATES
CANADA
Saanich
Victoria
Strait of Juan de Fuca
CANADA
UNITED STATES
Strait of Juan de Fuca
Mt Vernon
Oak Harbor
Port Angeles
Everett
Redmond
Seattle
Bellevue
WASHINGTON
Renton
Tacoma
South Hill

Admiralty Inlet
135
Puget Sound
286
Seattle
Seattle
Bellevue
Renton
Kent
Federal Way
181
Tacoma
Lakewood
South Fork Stillaguamish River
Lake Sammamish
Lake Cushman
Cedar River


Long-Term Freshwater Monitoring Stations: Duckabush R nr Brinnon
This long-term freshwater monitoring station identifier is 16C090. This station is located at Duckabush R nr Brinnon in an area dominated by Forest land use. It is located at approximately 300 feet above sea level.
View Station Info
Seattle
Puget Sound
Shoreline
Renton
Kent
Federal Way
Tacoma
Lakewood
Lake Sammamish
South Fork Stillaguamish River
Skykomish River
Cedar River
135
286
181

Acknowledgements & References

This Story Map contains content provided by Washington State Department of Ecology and other sources featured below.

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State of Washington

This Story Map was created by scientists at the Washington State Department of Ecology. The story map synthesizes information from a number of sources, and its contents may be periodically updated with new information, data, and analysis as it becomes available. We would like to acknowledge the following people for their contributions in providing information, guidance, and review for this project.

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WA Dept. of Ecology