



Sinclair Inlet, 9/13/2023. Photo courtesy: Eyes over Puget Sound, MMU, ECY



Phase 2 Salish Sea Modeling

Highlights of recently released report and related data products

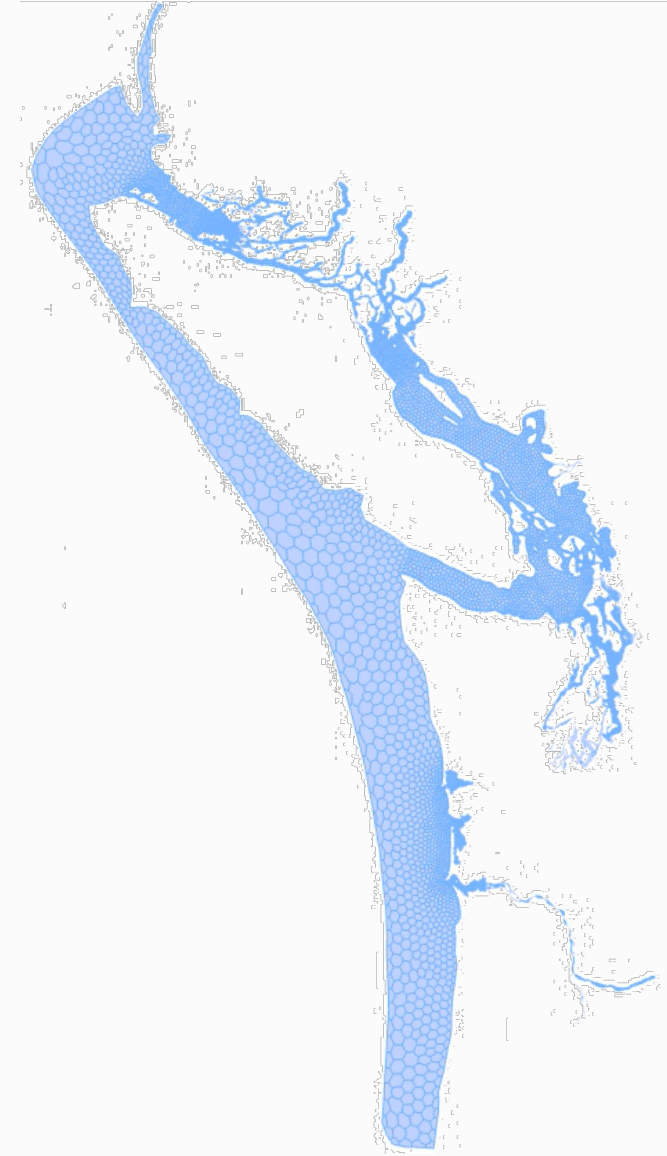
Hanis Zulmuthi

Environmental Assessment Program

June 24th, 2025

In the March forum, we:

- Provided context and summarized the key findings of our modeling work
- Presented Phase 2 Optimization Scenarios model results
- Presented model updates and performance metrics



SSM Phase 2 Report Published

Report published on June 12th, 2025:

- Link: <https://apps.ecology.wa.gov/publications/SummaryPages/2503003.html>
- Includes an **Executive Summary** that includes key model scenario results
- Includes **14 Appendices** that delve into further details and can be downloaded separately

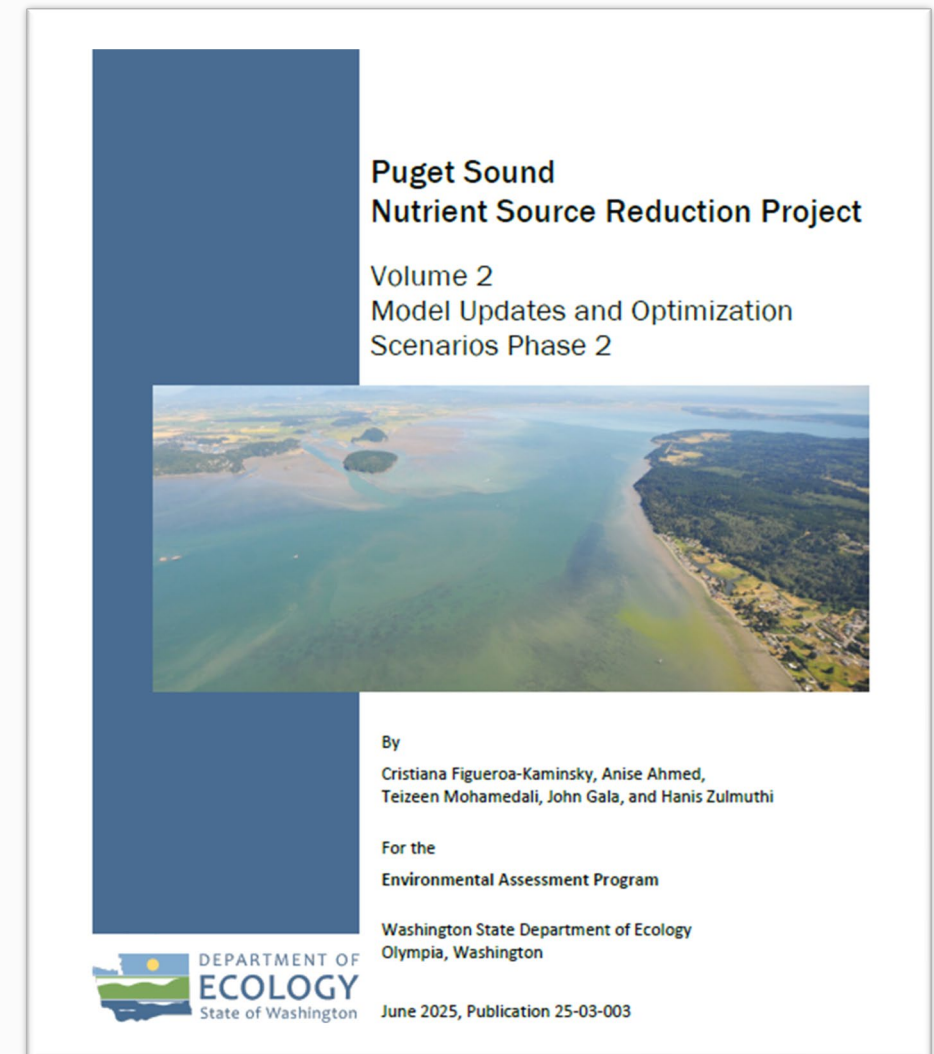


Table of Contents Outline

Introduction & Project Description

- Context based on prior work: multiple inlets and embayments in Puget Sound are vulnerable to lower DO due to human nutrient inputs

Methods

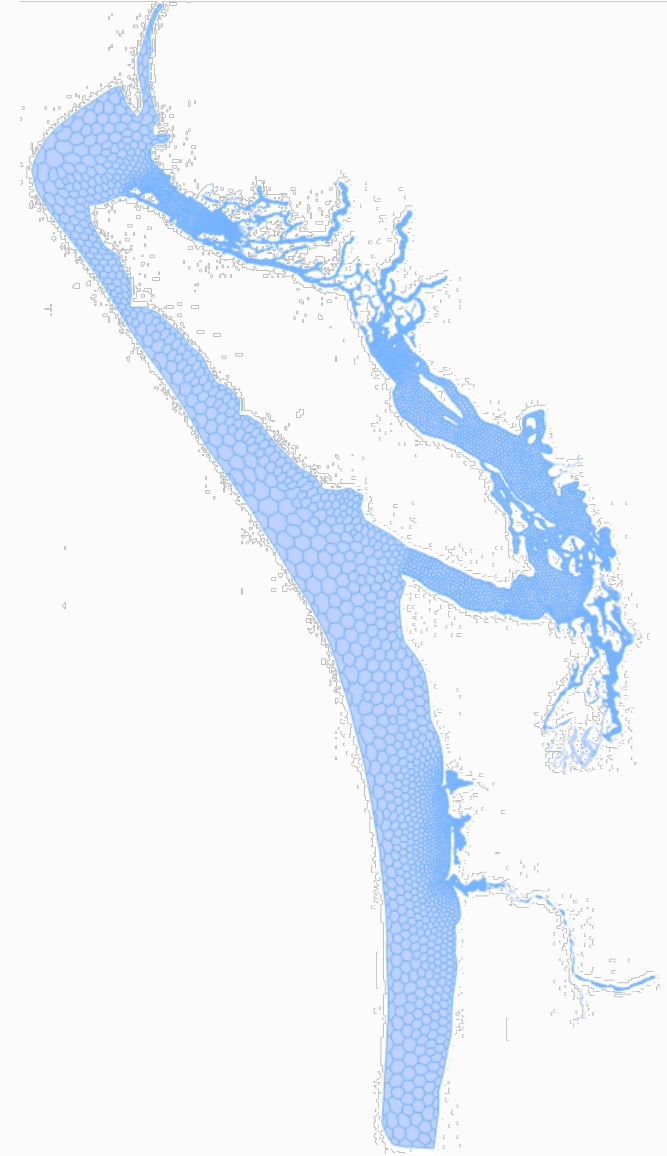
- Model updates
- Description of existing and reference conditions and refined nutrient reduction scenarios

Results & Discussion, Conclusions & Recommendations

- Model performance and limitations
- Processes consuming DO, uncertainty and sensitivity analysis
- DO noncompliance under existing conditions and Opt2 refined nutrient reduction scenarios

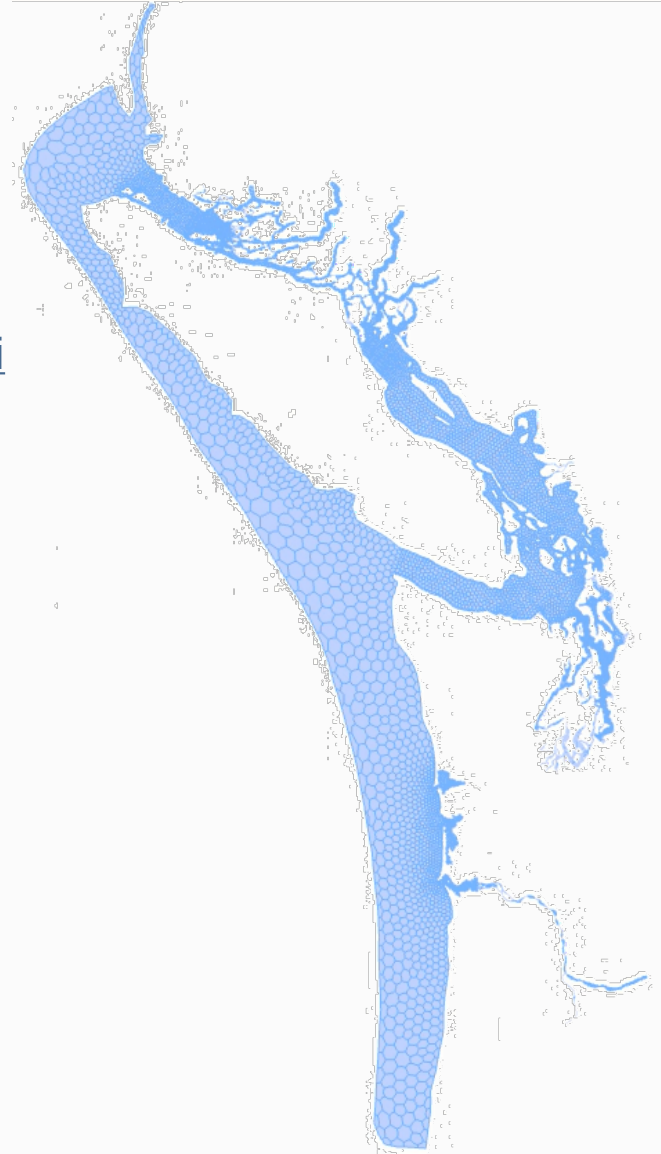
Key Takeaways

- Model performance improved due to updates.
- Fundamental key physical and biogeochemical processes are well represented in the model.
- Report contains initial and refined hypothetical nutrient reduction scenarios in support of the PSNSRP



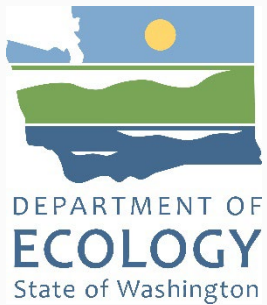
Additional Data Products

- **Downloadable SSM files** are available by July 4th here: <https://fortress.wa.gov/ecy/ezshare/EAP/SalishSea/SalishSeaModelBoundingScenarios.html>
- **Phase 2 SSM Scenarios Web Map:**
<https://gis.ecology.wa.gov/portal/apps/experiencebuilder/experience/?id=a4f911186f7d4ee89252f8089463886a>
- **USGS SPARROW model:**
 - Tool for estimating contributions of watershed sources and pathways
 - Preprint: <https://doi.org/10.22541/essoar.173878059.92247480/v1>
 - Mapper: <https://sparrow.wim.usgs.gov/sparrow-puget-sound/>
- Please direct report/modeling questions to Cristiana Figueroa-Kaminsky at: c.figueroa@ecy.wa.gov





Sinclair Inlet, 9/13/2023. Photo courtesy: Eyes over Puget Sound, MMU, ECY



Phase 2 Salish Sea Model Scenarios Web Map Demonstration

Jamie Wasielewski

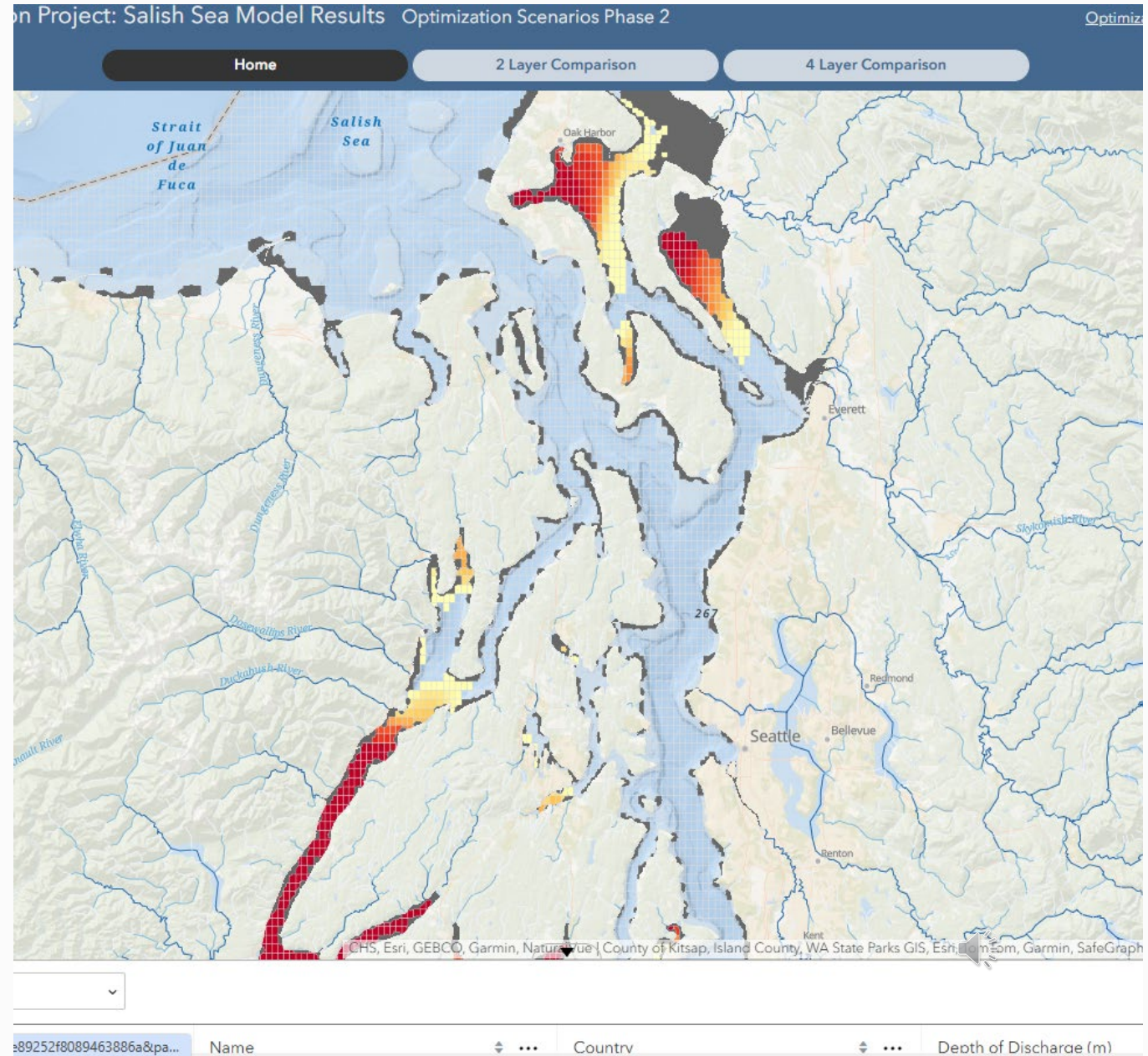
Environmental Assessment Program

June 24th, 2025



Web Map Overview

- Data
- Tools and Features
- Views



Web Map: Overview and Information

Puget Sound Nutrient Source Reduction Project: Salish Sea Model Results Optimization Scenarios Phase 2

[Optimization Phase 2 Report](#)

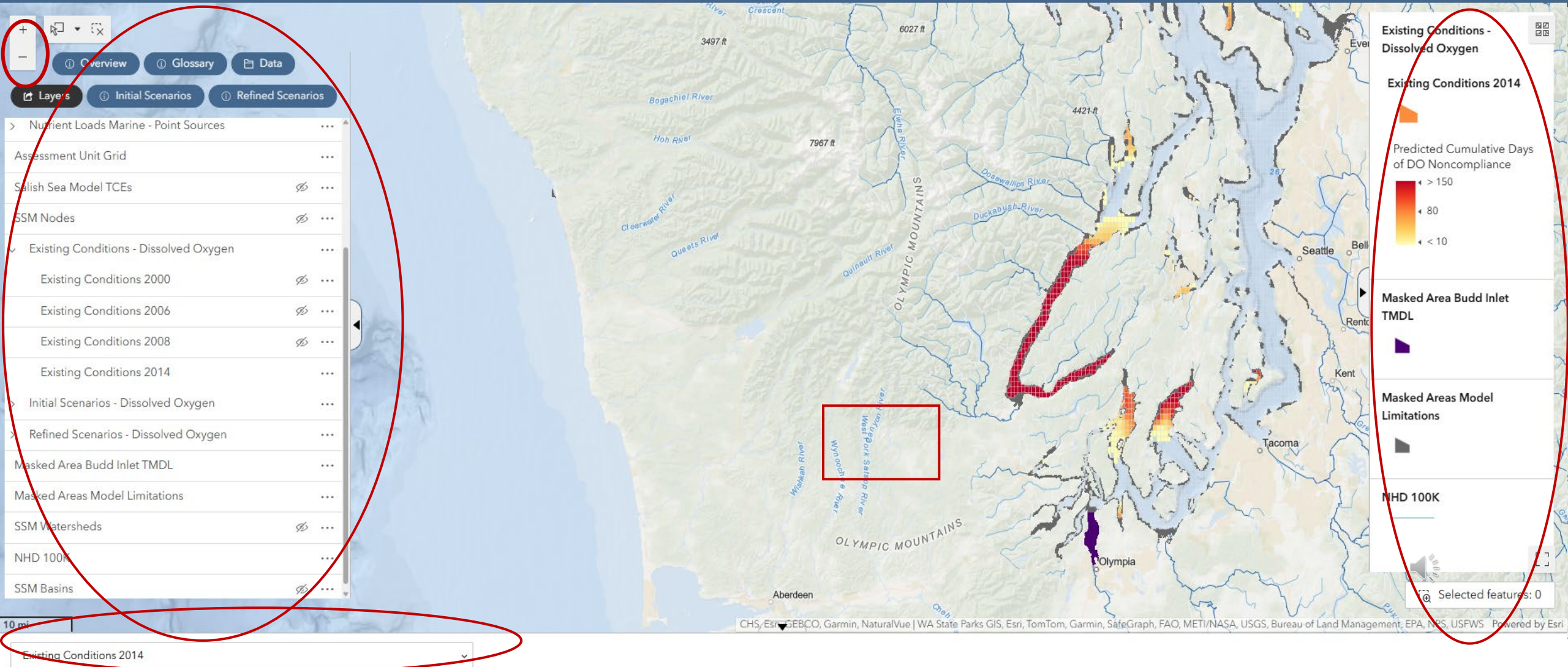
[Puget Sound Studies](#)

[Salish Sea Model](#)

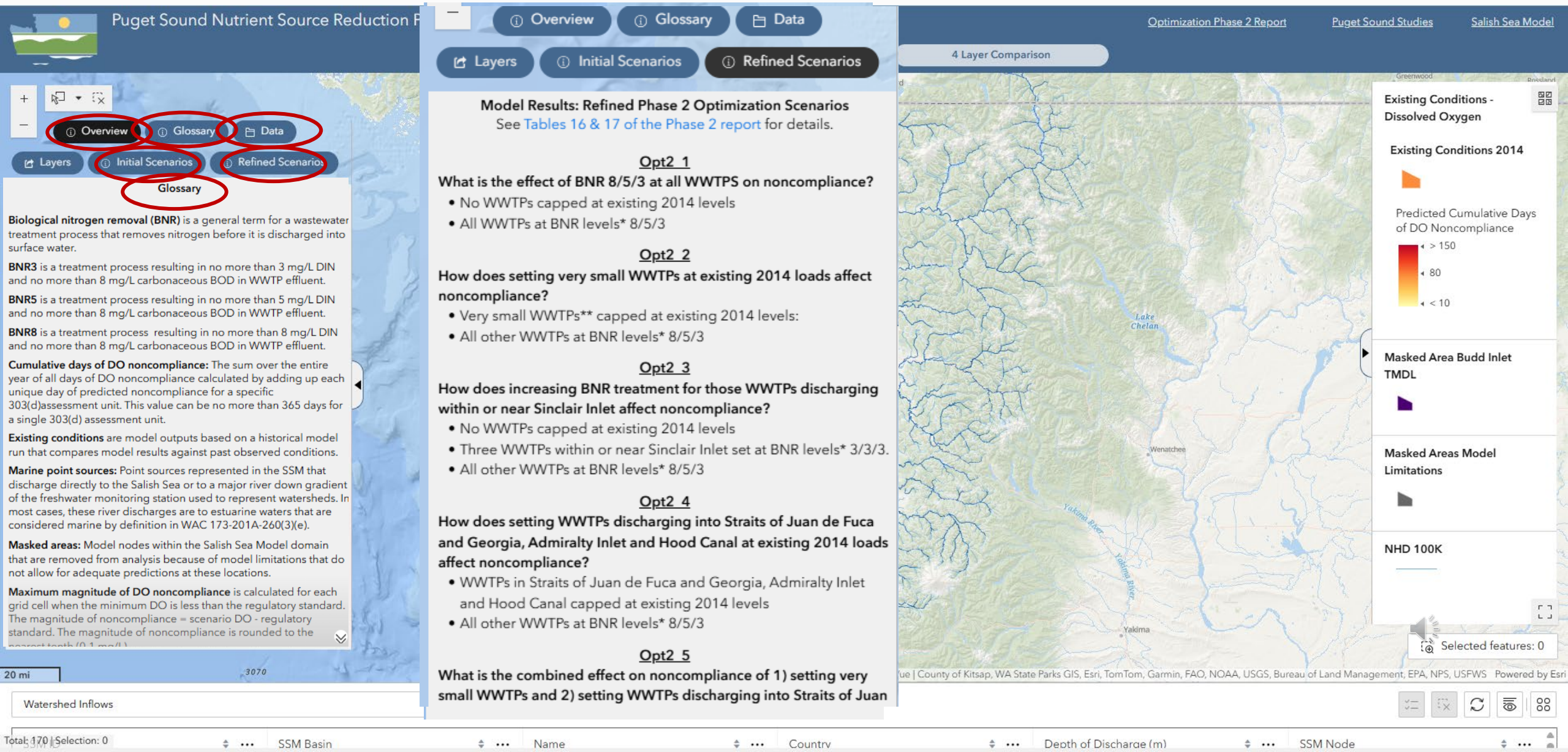
Home

2 Layer Comparison

4 Layer Comparison



Web Map: Overview and Information



Web Map: Available Data

The screenshot displays the 'Puget Sound Nutrient Source Reduction' web map interface. The 'Layers' panel on the left is open, showing a list of data layers. The 'Nutrient Loads - Watersheds' layer is selected and expanded, showing a list of watersheds and their associated data. The 'Refined Scenarios - Dissolved Oxygen' layer is also expanded, showing a list of scenarios. The legend on the right shows the 'Existing Conditions - Dissolved Oxygen' layer, which is currently selected. The legend includes a color scale for 'Predicted Cumulative Days of DO Noncompliance' ranging from red (> 150) to yellow (< 10). Other legend items include 'Masked Area Budd Inlet TMDL', 'Masked Areas Model Limitations', and 'NHD 100K'. The map shows the Puget Sound area with various data layers overlaid. The bottom of the screen shows a table with columns for 'SSM Basin', 'Name', 'Country', 'Depth of Discharge (m)', and 'SSM Node'. The table has a total of 170 rows and 0 selected rows.

Layers Panel:

- Watershed Inflows
- Marine Point Sources
- Nutrient Loads - Watersheds**
 - Nutrient Loads Marine - Point Sources
 - Assessment Unit Grid
 - Salish Sea Model TCEs
 - SSM Nodes
 - Existing Conditions - Dissolved Oxygen
 - Initial Scenarios - Dissolved Oxygen
 - Refined Scenarios - Dissolved Oxygen**
 - Opt2_1
 - Opt2_2
 - Opt2_3
 - Opt2_4
 - Opt2_5
 - Opt2_6
 - Opt2_7
 - Opt2_8
 - Opt2_9
 - Opt2_10
 - Masked Area Budd Inlet TMDL
 - Masked Areas Model Limitations
 - SSM Watersheds
 - NHD 100K

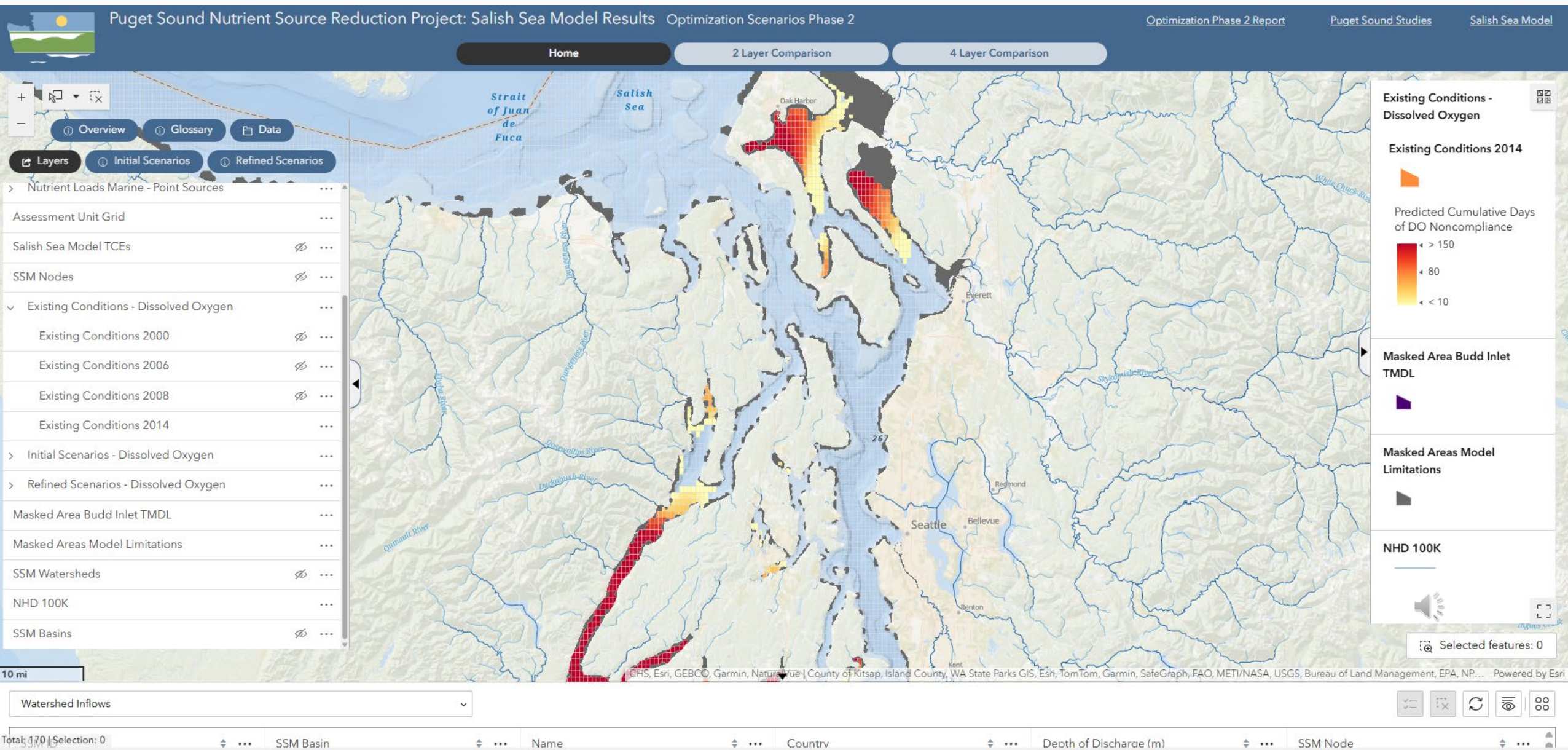
Legend:

- Existing Conditions - Dissolved Oxygen**
 - Predicted Cumulative Days of DO Noncompliance
 - > 150
 - 80
 - < 10
- Masked Area Budd Inlet TMDL
- Masked Areas Model Limitations
- NHD 100K

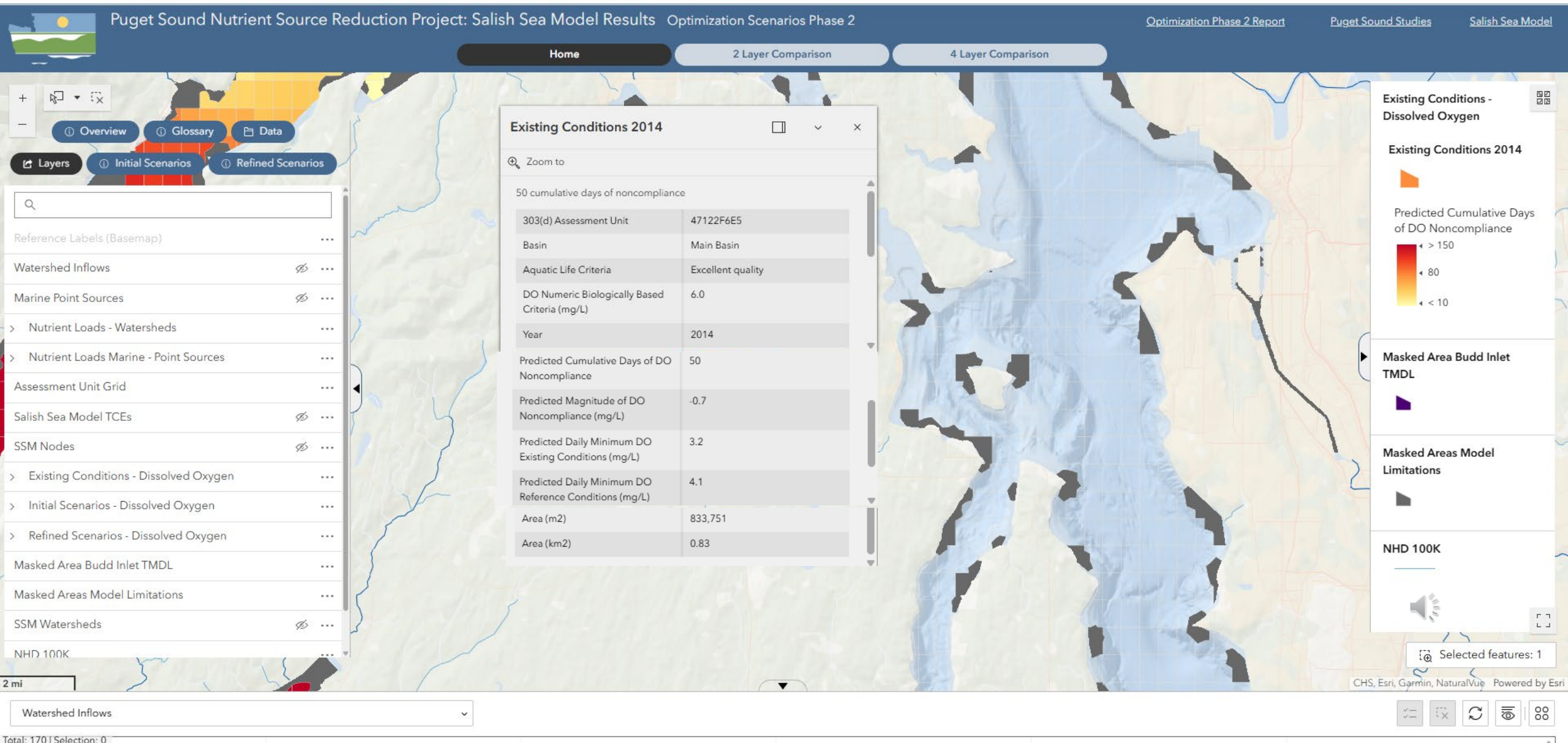
Table:

SSM Basin	Name	Country	Depth of Discharge (m)	SSM Node
Total: 170 Selection: 0				

Web Map: Layer Visibility



Web Map: Pop-ups



Web Map: Attribute Tables

Puget Sound Nutrient Source Reduction Project: Salish Sea Model Results Optimization Scenarios Phase 2

Optimization Phase 2 Report Puget Sound Studies Salish Sea Model

Home 2 Layer Comparison 4 Layer Comparison

Layers Initial Scenarios Refined Scenarios

- Nutrient Loads - Watersheds
- Nutrient Loads Marine - Point Sources
- Assessment Unit Grid
- Salish Sea Model TCEs
- SSM Nodes
- Existing Conditions - Dissolved Oxygen
 - Existing Conditions 2000

Existing Conditions - Dissolved Oxygen

Existing Conditions 2014

Predicted Cumulative Days of DO Noncompliance

Selected features: 0

2 mi

CHS, Esri, Garmin, NaturalVue Powered by Esri

Existing Conditions 2014

303(d) Assessment Unit	Basin	Aquatic Life Criteria	DO Numeric Biological Criteria	Year	Predicted Cumulative Days of DO Noncompliance	Predicted Magnitude of DO Noncompliance (mg/L)
Watershed Inflows			6.0	2014	0	
Marine Point Sources			6.0	2014	0	
Salish Sea Model TCEs			6.0	2014	0	
SSM Nodes			6.0	2014	0	
Existing Conditions 2000			6.0	2014	0	
Existing Conditions 2006			7.0	2014	0	
Existing Conditions 2008			7.0	2014	0	
Existing Conditions 2014			7.0	2014	0	
F1_C			7.0	2014	0	
F2_C			7.0	2014	0	
F3_C			7.0	2014	0	
Watershed Inflows			7.0	2014	0	5.2
			7.0	2014	0	5.3
			7.0	2014	0	5.1

Sort ascending
Sort descending

Search

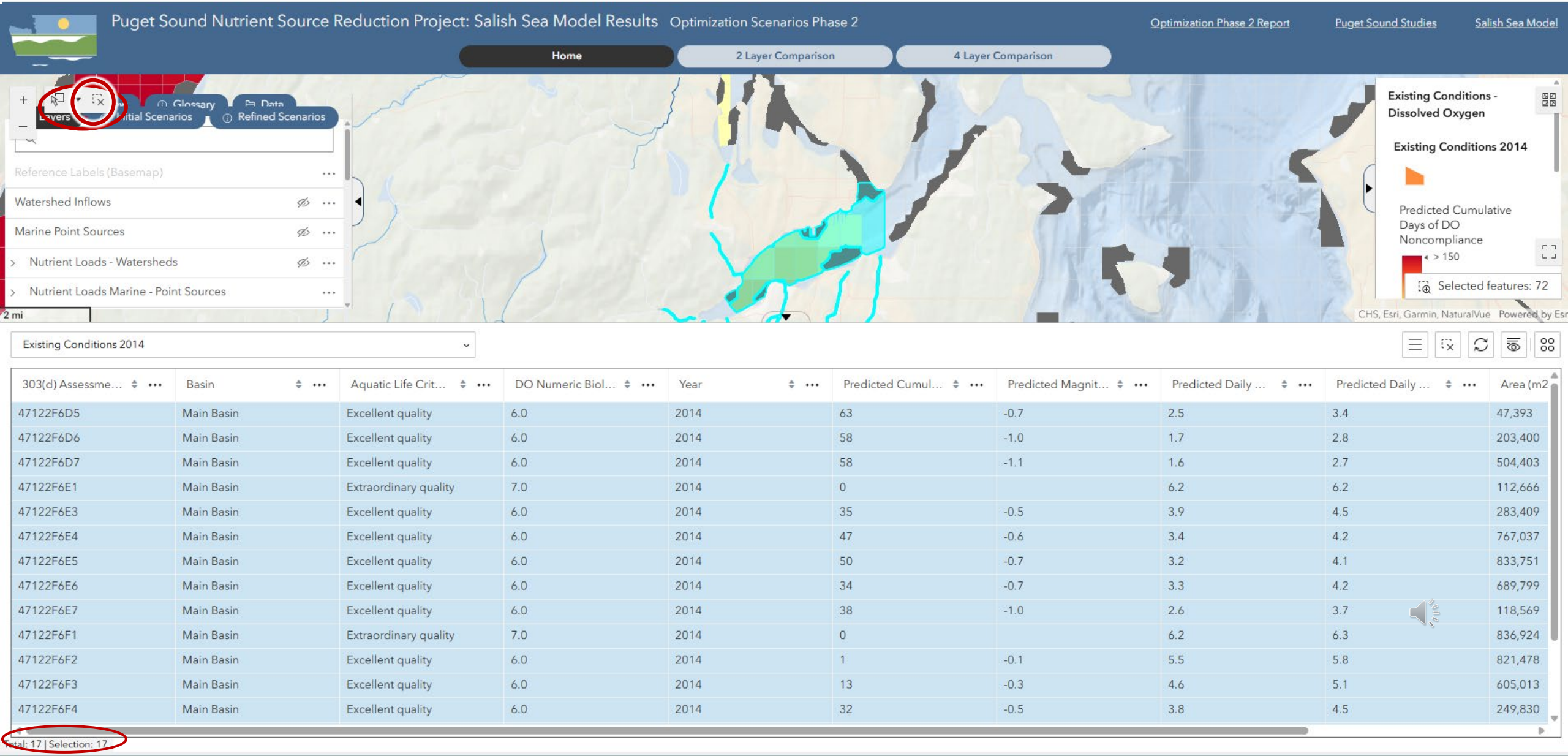
All data (8224)

- 303(d) Assessment Unit
- Basin
- Aquatic Life Criteria
- DO Numeric Biologically Based Criteria (r
- Year
- Predicted Cumulative Days of DO Noncompliance
- Predicted Magnitude of DO Noncompliance (mg/L)


Set filter
Statistics
Zoom to
Pan to
Export

Total: 8224 | Selection: 0

Web Map: Feature Selection & Filtering



Web Map: Feature Selection & Filtering



Puget Sound Nutrient Source Reduction Project: Salish Sea Model Results Optimization Scenarios Phase 2

[Optimization Phase 2 Report](#)[Puget Sound Studies](#)[Salish Sea Model](#)

Home2 Layer Comparison4 Layer Comparison

OverviewGlossaryDataLayersRefined Scenarios

Optimization Scenarios Phase 2 Results

The Salish Sea Model is a state-of-the-science computer tool used to understand human influence on nutrients and dissolved oxygen (DO) levels in Puget Sound. This interactive map shows Salish Sea Model results from the [Puget Sound Nutrient Source Reduction Project: Optimization Scenarios \(Phase 2\)](#) report. This work is in support of the Puget Sound Nutrient Source Reduction Project to [reduce human sources of nutrients](#) to protect Puget Sound.

The colored areas represent the predicted cumulative days of noncompliance with dissolved-oxygen standards for each optimization scenario (see Legend in right sidebar) by 303(d) assessment unit. These assessment units are used to evaluate attainment of Washington's water quality standards under Section 303(d) of the Clean Water Act and consist of a grid of approximately 790 m x 1130 m rectangles. Assessment unit size varies slightly due to shorelines, designated uses, and masked areas. (See [Appendix D](#) of the Phase 2 report for more information on masking due to model limitations.)

5 mi

YMPIC MOUNTAINS

Canyon River

Cop River

Olympia

Tacoma

Kent

Green River

White River

South Prairie Creek

Existing Conditions - Dissolved Oxygen

Existing Conditions 2014

Predicted Cumulative Days of DO Noncompliance

< > 150

< 80

< 10

Masked Area Budd Inlet

TMR

Selected features: 0

Existing Conditions 2014

South Sound

303(d) Assessment Unit	Basin	Aquatic Life Crit...	DO Numeric Biol...	Year	Predicted Cumul...	Predicted Magnit...	Predicted Daily ...	Predicted
47122D6H6	South Sound	Extraordinary quality	7.0	2014	161	-0.5	2.3	2.9
47122D6H4	South Sound	Extraordinary quality	7.0	2014	146	-0.5	2.4	3.1
47122D6H3	South Sound	Extraordinary quality	7.0	2014	122	-0.5	2.6	3.2
47122D6G4	South Sound	Extraordinary quality	7.0	2014	149	-0.4	2.6	3.3
47122D6G6	South Sound	Extraordinary quality	7.0	2014	163	-0.4	2.7	3.3
47122D6F4	South Sound	Extraordinary quality	7.0	2014	156	-0.4	2.7	3.3
47122D6G5	South Sound	Extraordinary quality	7.0	2014	159	-0.4	2.8	3.4
47122D6F5	South Sound	Extraordinary quality	7.0	2014	157	-0.4	2.9	3.4


Total: 479 | Selection: 0

Zoom toPan toShow on mapExport

All data (1)Set filter

39

Web Map: Feature Selection & Filtering



Puget Sound Nutrient Source Reduction Project: Salish Sea Model Results Optimization Scenarios Phase 2

Optimization Phase 2 ReportPuget Sound StudiesSalish Sea Model

Home2 Layer Comparison4 Layer Comparison

OverviewGlossaryDataLayersInitial ScenariosRefined Scenarios

Search

Reference Labels (Basemap) ...

Watershed Inflows ...

Marine Point Sources ...

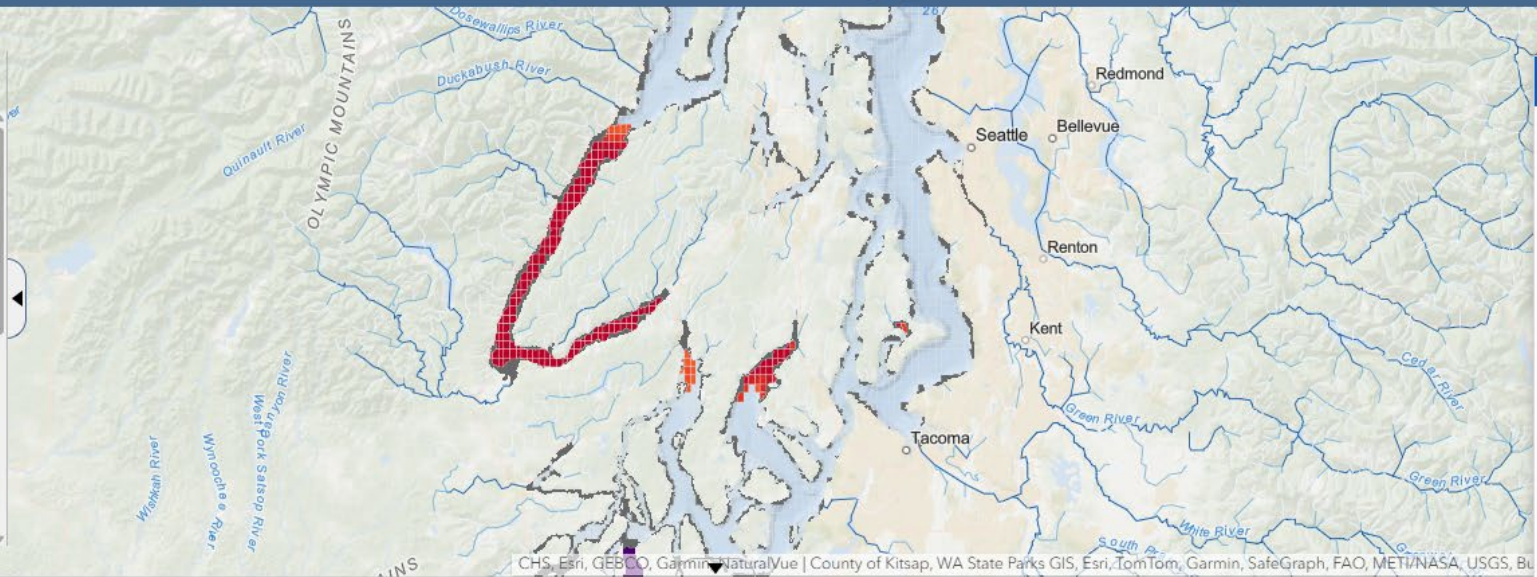
> Nutrient Loads - Watersheds ...

> Nutrient Loads Marine - Point Sources ...

Assessment Unit Grid ...

Salish Sea Model TCEs ...

SSM Nodes ...



CHS, Esri, GEBCO, Garmin, NaturalVue | County of Kitsap, WA State Parks GIS, Esri, TomTom, Garmin, SafeGraph, FAO, MET/NASA, USGS, Bu

Existing Conditions 2014

Set filter

Existing Conditions 2014

+ Add

123 Predicted... is greater than

100

Existing Conditions 2014

Search

303(d) Assessment Unit	Basin	Aquatic Life Crit...	DO Numeric Biol...	Year	Predicted Cumul...	Predicted Magnit...	Predicted Daily ...	Predicted Daily ...	AI
47122E8C6	Hood Canal	Extraordinary quality	7.0	2014	317	-0.6	0.1	0.3	62
47122E8B6	Hood Canal	Extraordinary quality	7.0	2014	316	-0.6	0.2	0.3	29
47122E8C7	Hood Canal	Extraordinary quality	7.0	2014	331	-0.6	0.2	0.3	46
47122E8B7	Hood Canal	Extraordinary quality	7.0	2014	328	-0.6	0.2	0.3	54
47122E8B8	Hood Canal	Extraordinary quality	7.0	2014	339	-0.6	0.2	0.3	68
47122E9B0	Hood Canal	Extraordinary quality	7.0	2014	346	-0.5	0.2	0.3	46
47122E8B9	Hood Canal	Extraordinary quality	7.0	2014	342	-0.5	0.2	0.3	73
47122E9A0	Hood Canal	Extraordinary quality	7.0	2014	349	-0.5	0.2	0.4	82

Total: 299 | Selection: 0

Web Map: Feature Selection & Filtering

Puget Sound Nutrient Source Reduction Project: Salish Sea Model Results Optimization Scenarios Phase 2

Optimization Phase 2 Report Puget Sound Studies Salish Sea Model

Home 2 Layer Comparison 4 Layer Comparison

Set filter

Existing Conditions 2014

123 Predicted... is greater than 100

Existing Conditions -

Set filter

Existing Conditions 2014

123 Predicted... is greater than 100

303(d) Assessme... Basin Aquatic Life Crit... DO Numeric Biol... Year Predicted Cumul... Predicted Magnit... Predicted Daily ...

47122D4J4 Main Basin Extraordinary quality 7.0 2014 117 -0.2 3.6

47122D4J5 Main Basin Extraordinary quality 7.0 2014 154 -0.3 3.2

47122D6B8 South Sound Extraordinary quality 7.0 2014 124 -0.2 3.5

47122D6C8 South Sound Extraordinary quality 7.0 2014 127 -0.3 3.5

47122D6C9 South Sound Extraordinary quality 7.0 2014 102 -0.2 3.5

47122D6D4 South Sound Extraordinary quality 7.0 2014 120 -0.2 3.4

Total: 299 | Selection: 0

All data (299)

Set filter

Statistics

Zoom to

Pan to

Export

Web Map: Attribute Tables - Export

Puget Sound Nutrient Source Reduction Project: Salish Sea Model Results Optimization Scenarios Phase 2

Optimization Phase 2 Report Puget Sound Studies Salish Sea Model

Home 2 Layer Comparison 4 Layer Comparison

Layers Initial Scenarios Refined Scenarios

Nutrient Loads - Watersheds

Nutrient Loads Marine - Point Sources

Assessment Unit Grid

Salish Sea Model TCEs

SSM Nodes

Existing Conditions - Dissolved Oxygen

Existing Conditions 2000

Existing Conditions 2014

South Sound

303(d) Assessme... Basin

47122A9I7	South Sound	Excellent quality	6.0	2014	0		6.7	6.9
47122A9I8	South Sound	Excellent quality	6.0	2014	0		6.9	7.0
47122A9J6	South Sound	Excellent quality	6.0	2014	0		6.5	6.7
47122A9J7	South Sound	Excellent quality	6.0	2014	0		6.6	6.7
47122B5H9	South Sound	Extraordinary quality	7.0	2014	0		5.3	5.4
47122B5I9	South Sound	Extraordinary quality	7.0	2014	0		5.3	5.5
47122B5J8	South Sound	Extraordinary quality	7.0	2014	0		5.3	5.4
47122B5J9	South Sound	Extraordinary quality	7.0	2014	0		5.3	5.4
47122B6B7	South Sound	Extraordinary quality	7.0	2014	0		5.2	5.4
47122B6B8	South Sound	Extraordinary quality	7.0	2014	0		5.2	5.4
47122B6B9	South Sound	Extraordinary quality	7.0	2014	0		5.3	5.4
47122B6C5	South Sound	Extraordinary quality	7.0	2014	0		5.1	5.3

Total: 479 | Selection: 127

Set filter

Existing Conditions 2014

+ Add

123 Predicted... is not

0

Export

Export to JSON

Export to CSV

Export to GeoJSON

Selected (127)

Statistics

Zoom to

Pan to

Show on map

Export

All data (479)

Set filter

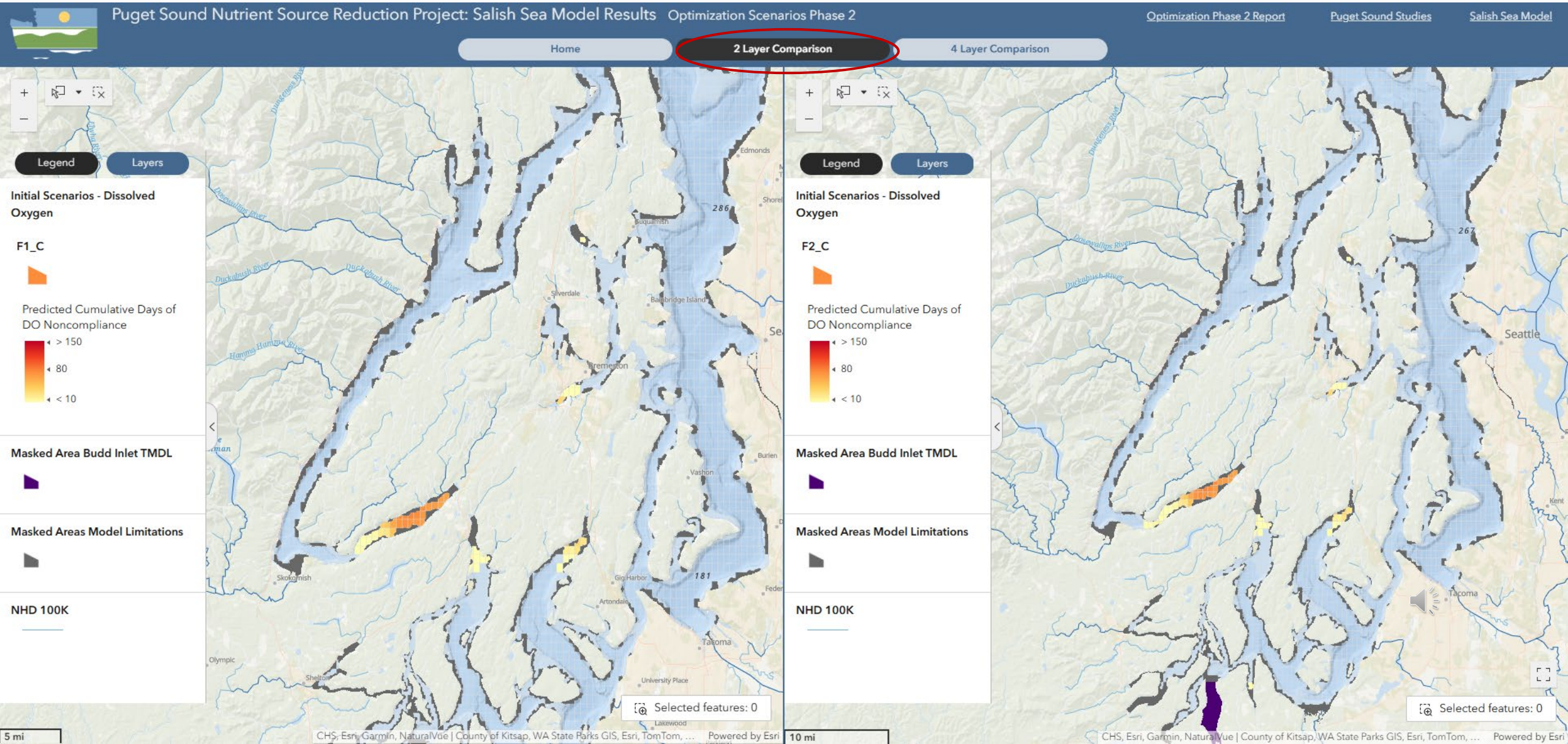
Statistics

Zoom to

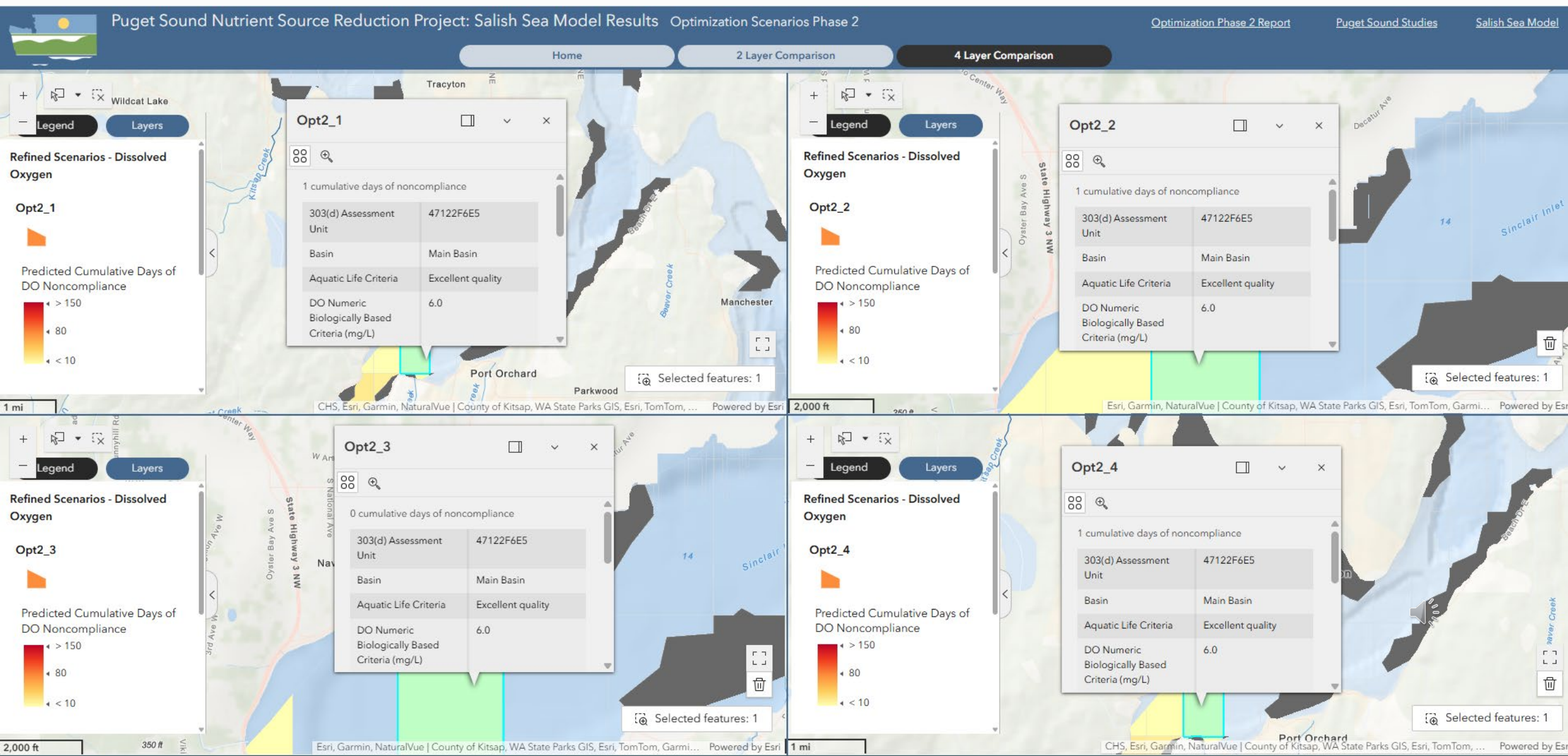
Pan to

Export

Web Map: Views



Web Map: Views



Questions?

Please direct questions about how to use the web map to Jamie Wasielewski at jamie.wasielewski@ecy.wa.gov

