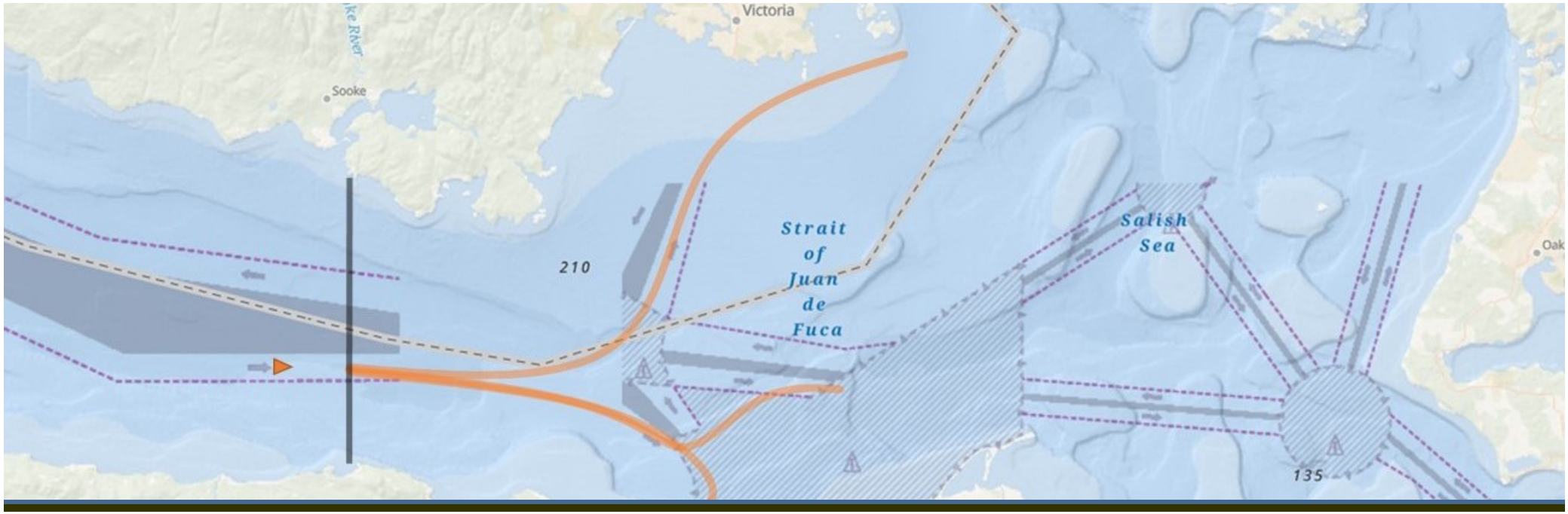


Ecology's Oil Spill Risk Model

March 3rd, 2022

Model Development Team

Adam Byrd, Alex Hess, Michael Koohafkan, JD Ross Leahy, James Murphy, and Alex Suchar

DEPARTMENT OF ECOLOGY
State of Washington

Today's outline

1. **Legislative Background**
2. **What is an Oil Spill Risk Model?**
3. **Our Modeling Approach**
4. **Our Movement Simulation Approach**
5. **Questions**

Legislative background

- ESHB 1578 was passed in 2019 to reduce the risk of oil spills, and protect Southern Resident Killer Whales

- Ecology's Spills Program tasked with development of an oil spill risk model

Analysis Questions

- …whether an emergency response towing vessel serving Haro Strait, Boundary Pass, Rosario Strait, and connected navigable waterways will reduce oil spill risk…

- …conduct an analysis of tug escorts using the model…

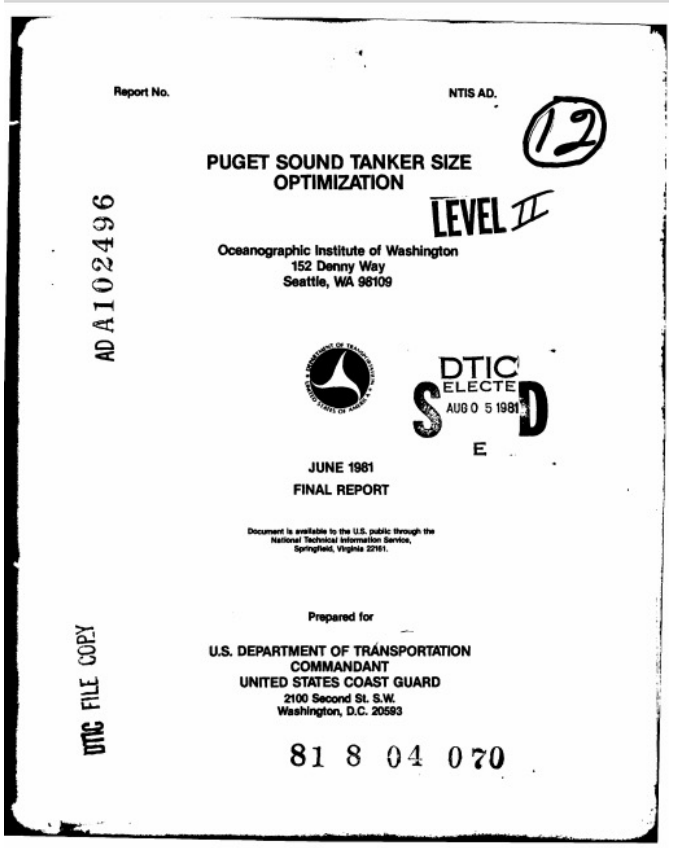
What is an Oil Spill Risk Model?

Decision Support Tool

Quantitative Approach to Policy Evaluation

Long History in Puget Sound Oil Spill Policy

- Puget Sound Tanker Size Optimization (1981)
- Volpe Scoping Risk Assessment (1997)
- 2005 Vessel Traffic Risk Assessment (2008)
- 2010 Vessel Traffic Risk Assessment (2015)
- 2015 Vessel Traffic Risk Assessment (2017)



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PUGET SOUND TANKER SIZE OPTIMIZATION

LEVEL II

AD A102496

Oceanographic Institute of Washington
152 Denny Way
Seattle, WA 98109

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JUNE 1981
FINAL REPORT

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COMMANDANT
UNITED STATES COAST GUARD
2100 Second St. S.W.
Washington, D.C. 20593

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What Good is an Oil Spill Risk Model?

The maritime system is complex

- A model helps identify unintended consequences

The maritime system is opaque

- A model helps piece together the available data

Maritime knowledge is dispersed

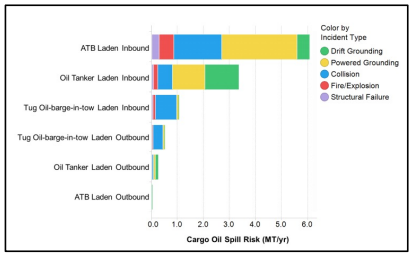
- Developing a model collaboratively helps all participants gain knowledge

Maritime oil spills are potentially catastrophic

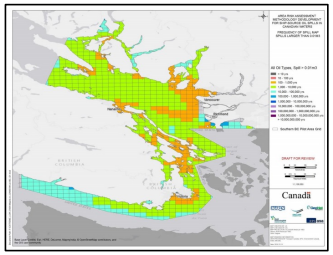
- A model can help us communicate the potential for a catastrophic spill

Castillo De Bellver Oil Spill: Source: CEDRE, ITOPF, CTX – Image: Castillo de Bellver in flames off the coast of South Africa

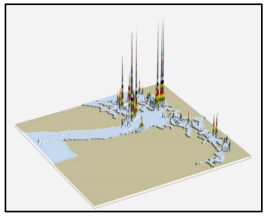
Why Build Our Own Model?



MARCS



SAMSON



GWU VTRA

Durable interest in this type of work

Reduced dependence on contracted work

Growing internal capacity and resources

A public sector model ensures transparency

Current Status

Modeling team in place

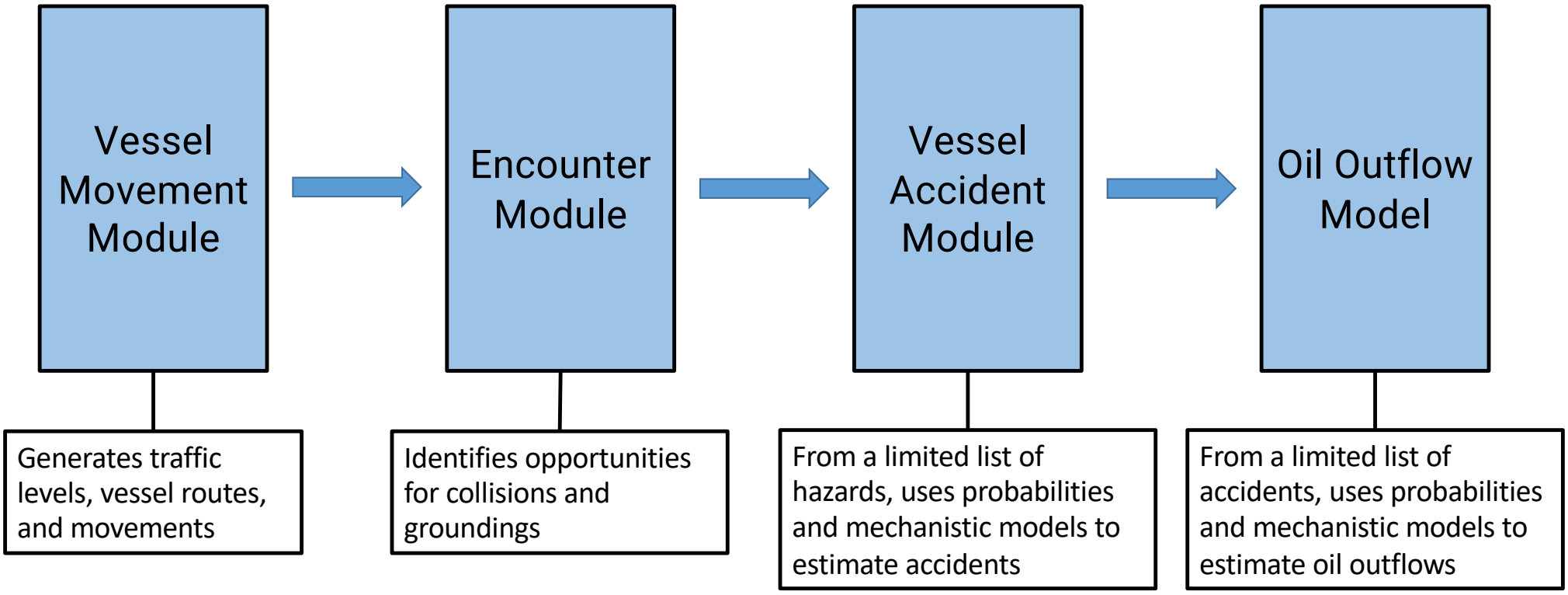
- Adam Byrd
- Alex Hess
- Michael Koohafkan
- JD Ross Leahy
- James Murphy
- Alex Suchar

Extensive outreach and collaboration

- Webinars
- Technical discussions
- Individual meetings

Transitioning from Model Development to Analysis Projects

Modeling Approach



Key Assumptions For Our Simulation Approach

Key Assumption 1

- Historical observations represent one possible version of what could have happened

Key Assumption 2

- Just because a accident is not observed in the historical record, doesn't mean it could never happen.

Key Assumption 3

- Oil spills result from accidents that are outcomes of different vessel traffic configurations and interventions

Simulation Objective

- Generate a sufficiently large number of "alternate realities" to assess the distribution of spill risk

Vessel Movement Simulation

Simulation Requirements

- Traffic similar but not identical to observed traffic
- Traffic variable enough to represent most possible traffic configurations

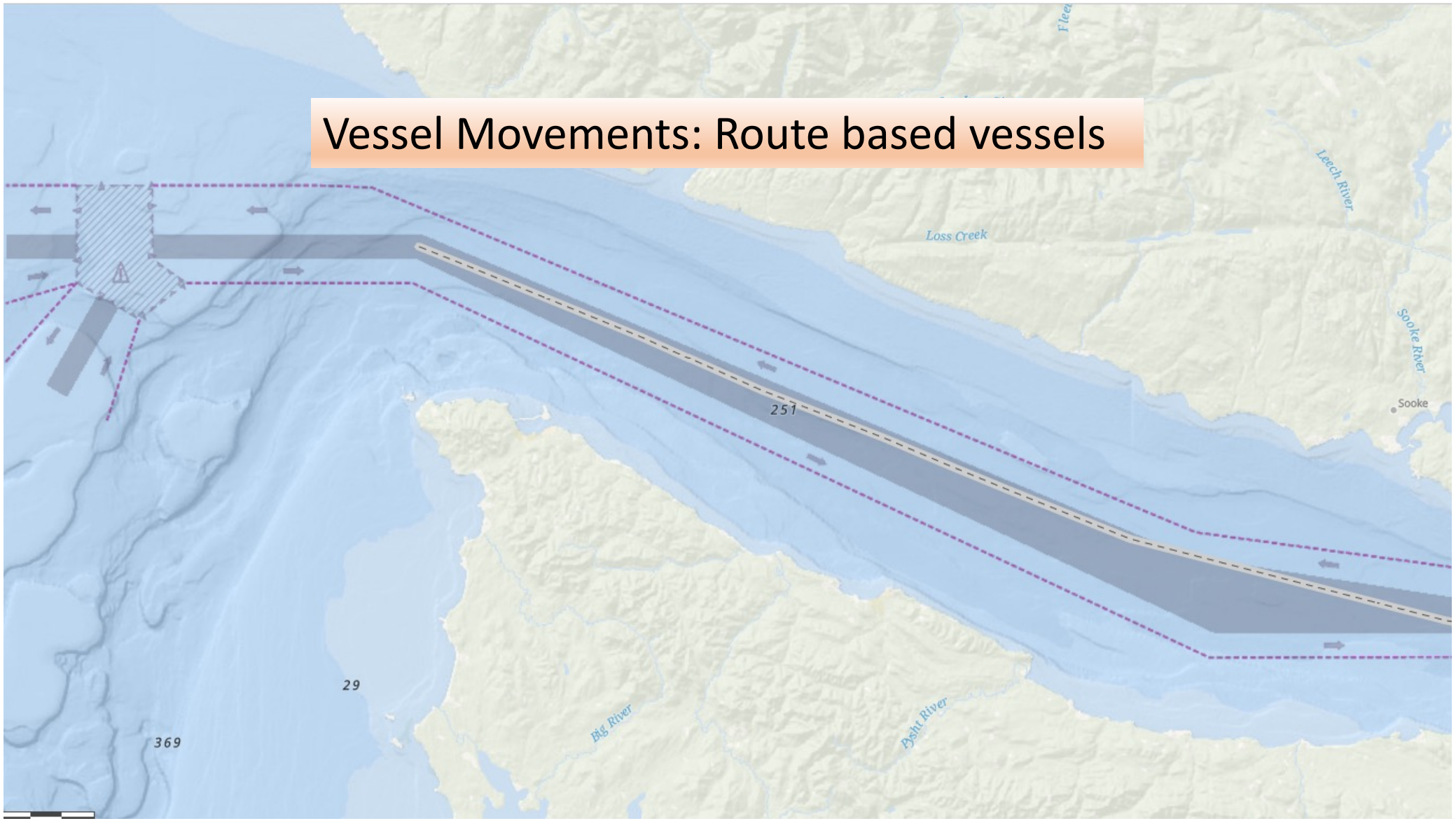
Assuring Credibility

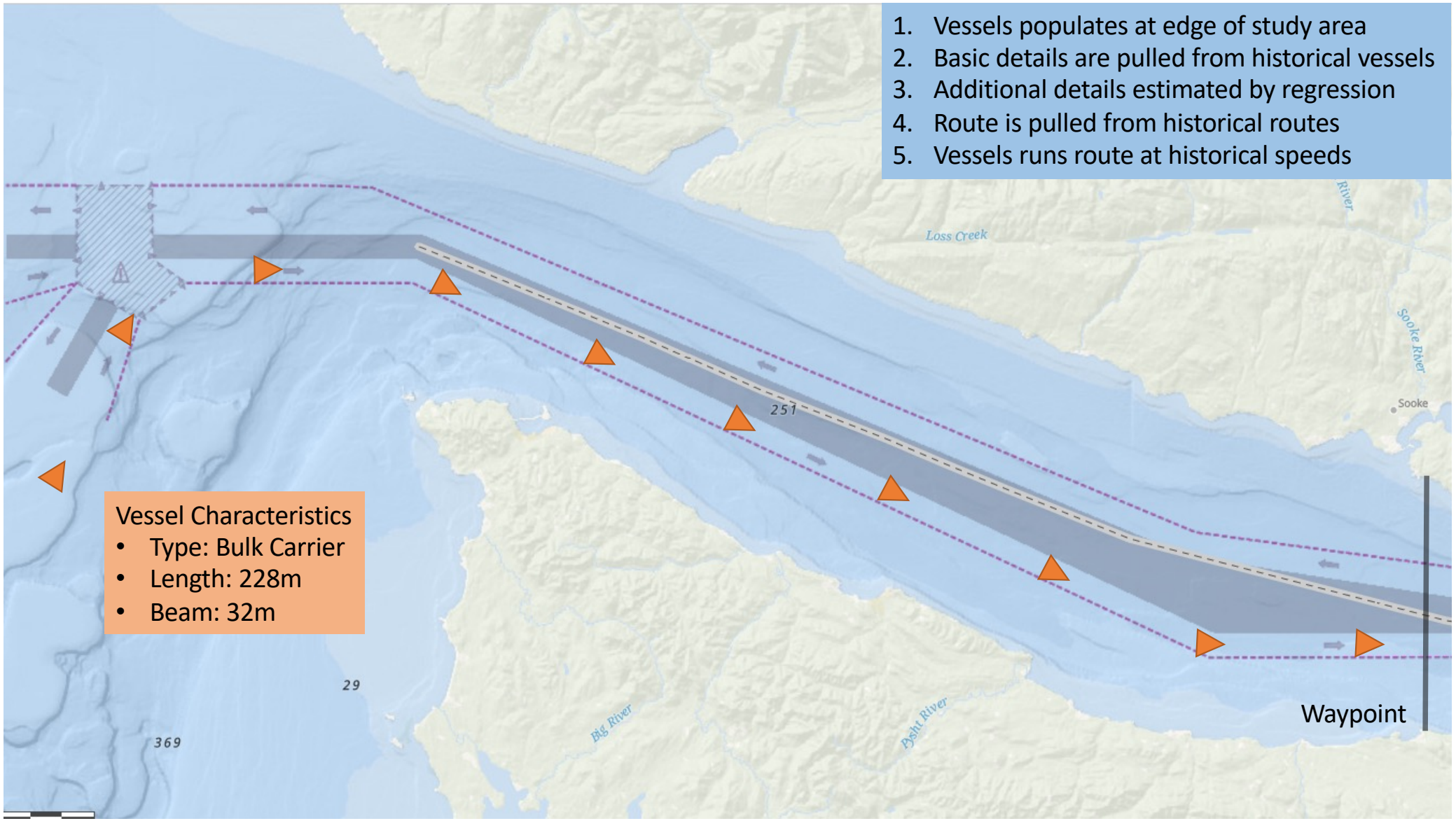
- Simulated vessels follow observed tracks.
- Vessel starting times are drawn from observed starting times
- Stay lengths are drawn from observed stay lengths
- Probabilities for route selection are drawn from observed routes

Generating Uniqueness

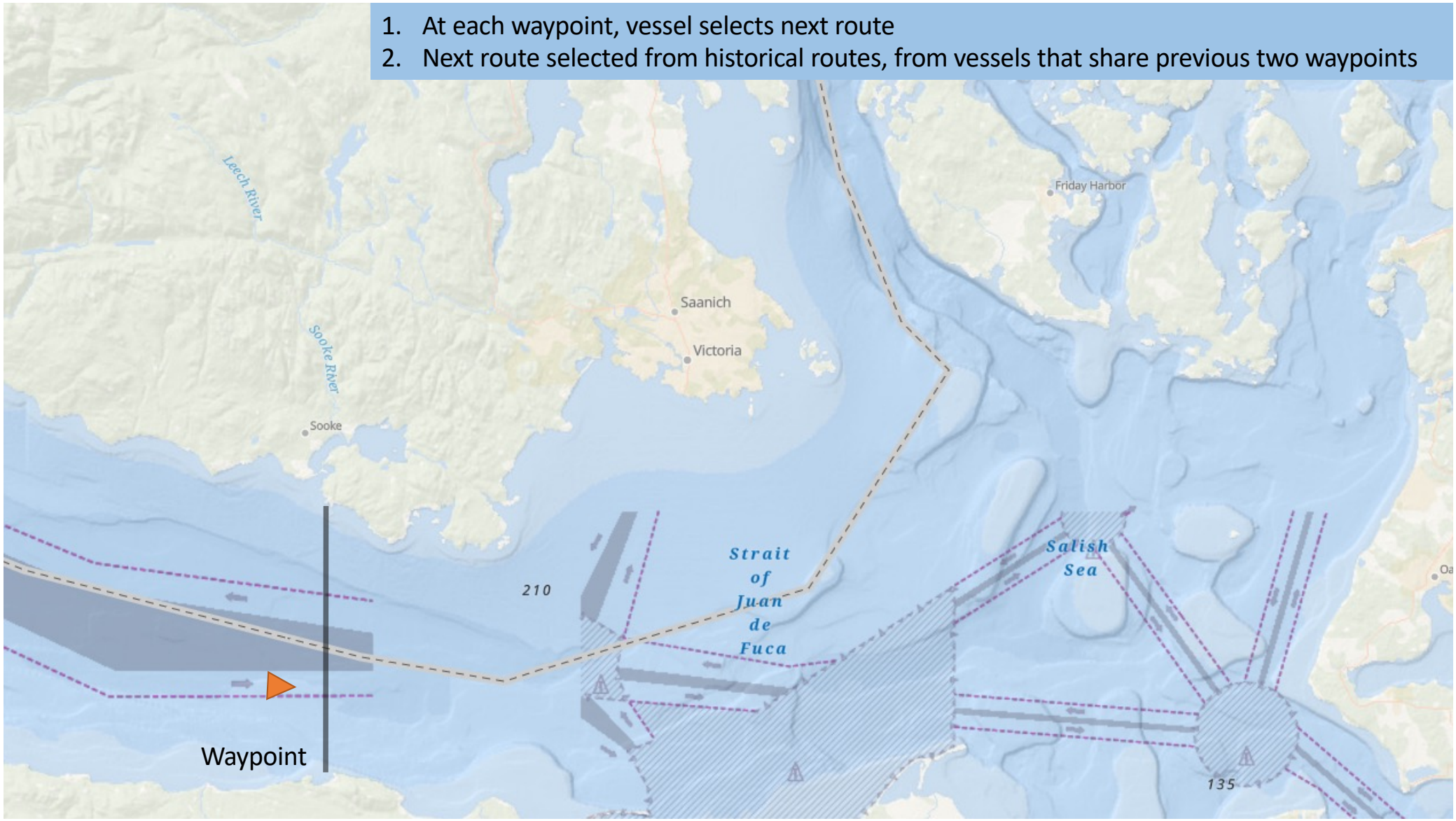
- Vessels can move at times not observed in the data
- Vessels can generate unique journeys

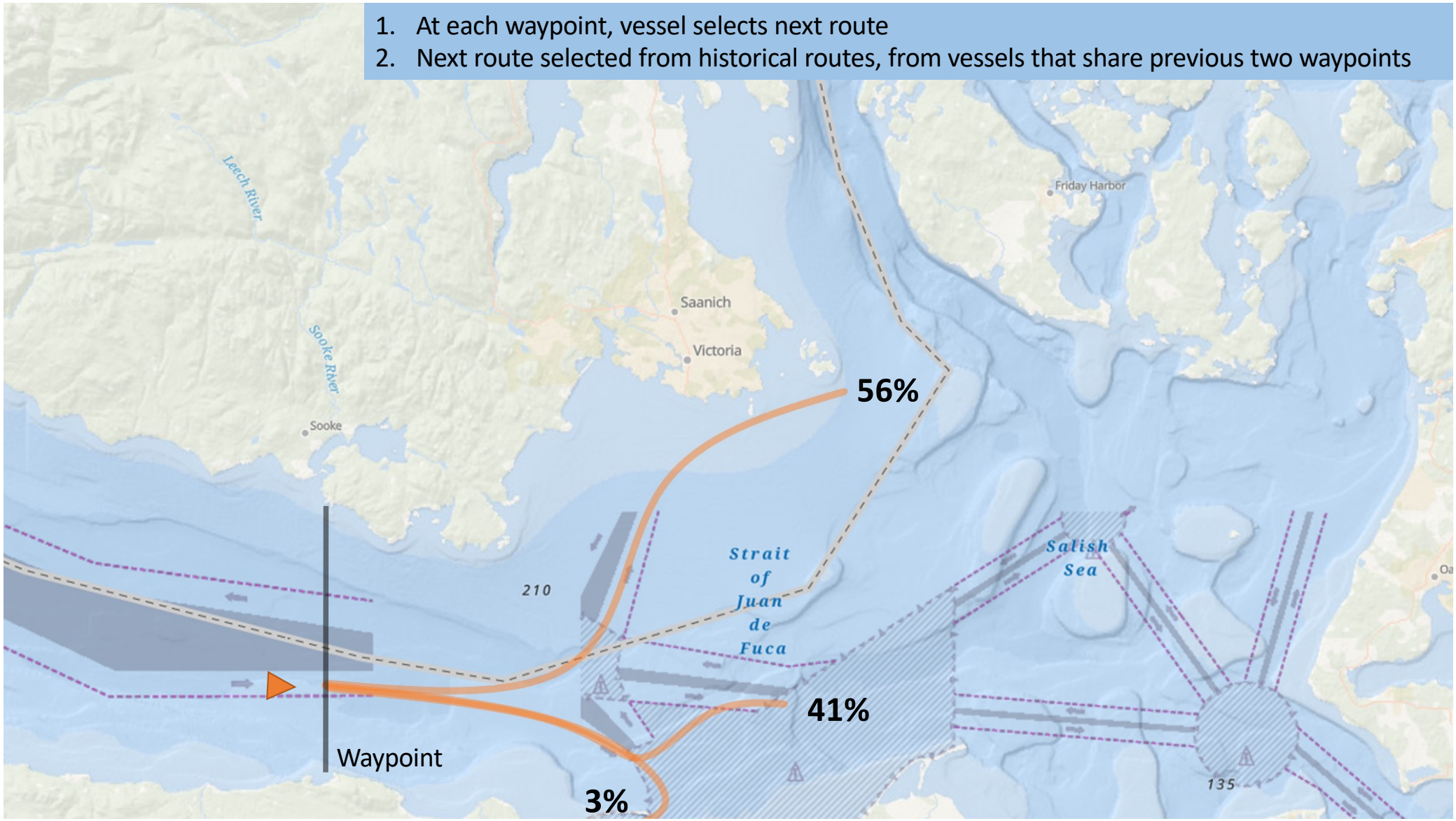
Vessel Movements: Route based vessels

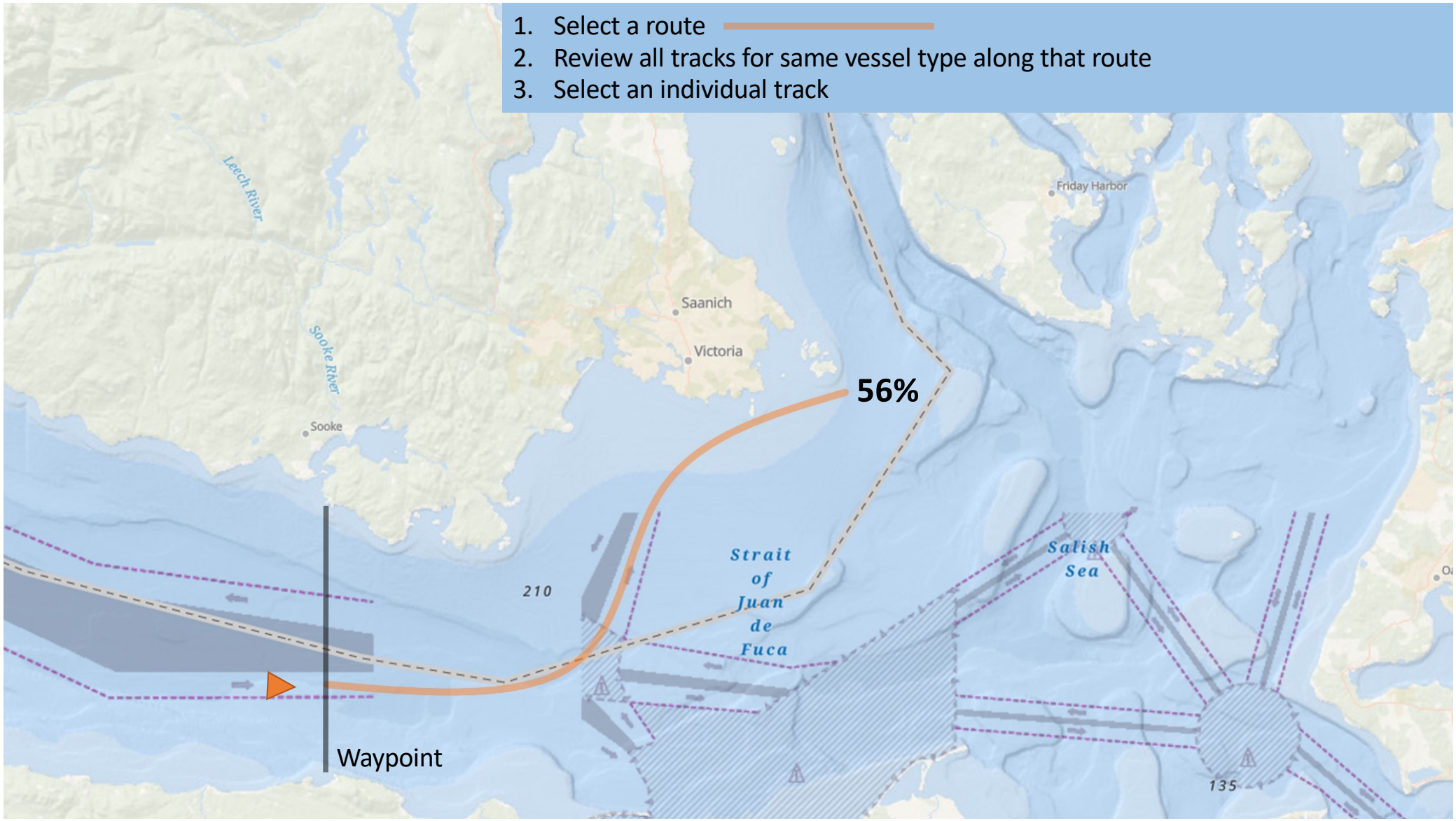


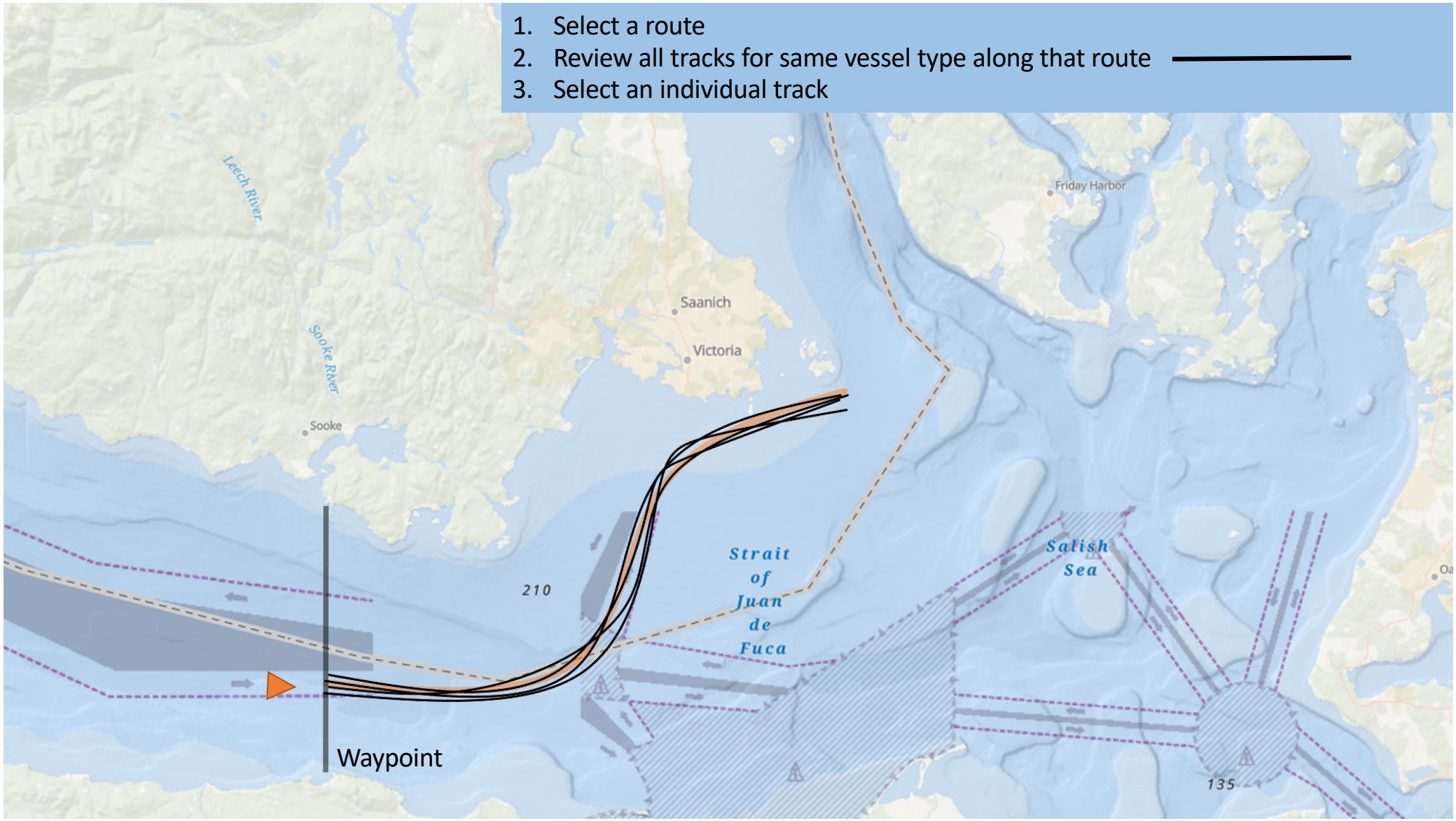

1. Vessels populates at edge of study area
2. Basic details are pulled from historical vessels
3. Additional details estimated by regression
4. Route is pulled from historical routes
5. Vessels runs route at historical speeds
Vessel Characteristics
• Type: Bulk Carrier
• Length: 228m
• Beam: 32m
Waypoint
Loss Creek
Spoke River
Sooke
251
29
369
Big River
Pysht River

1. At each waypoint, vessel selects next route
2. Next route selected from historical routes, from vessels that share previous two waypoints




1. At each waypoint, vessel selects next route
2. Next route selected from historical routes, from vessels that share previous two waypoints
Leech River
Sooke River
Sooke
Saanich
Victoria
Friday Harbor
56%
41%
3%
Waypoint
210
Strait of Juan de Fuca
Salish Sea
135


1. Select a route
2. Review all tracks for same vessel type along that route
3. Select an individual track
Leech River
Sooke River
Sooke
Saanich
Victoria
Friday Harbor
56%
210
Strait of Juan de Fuca
Salish Sea
135
Waypoint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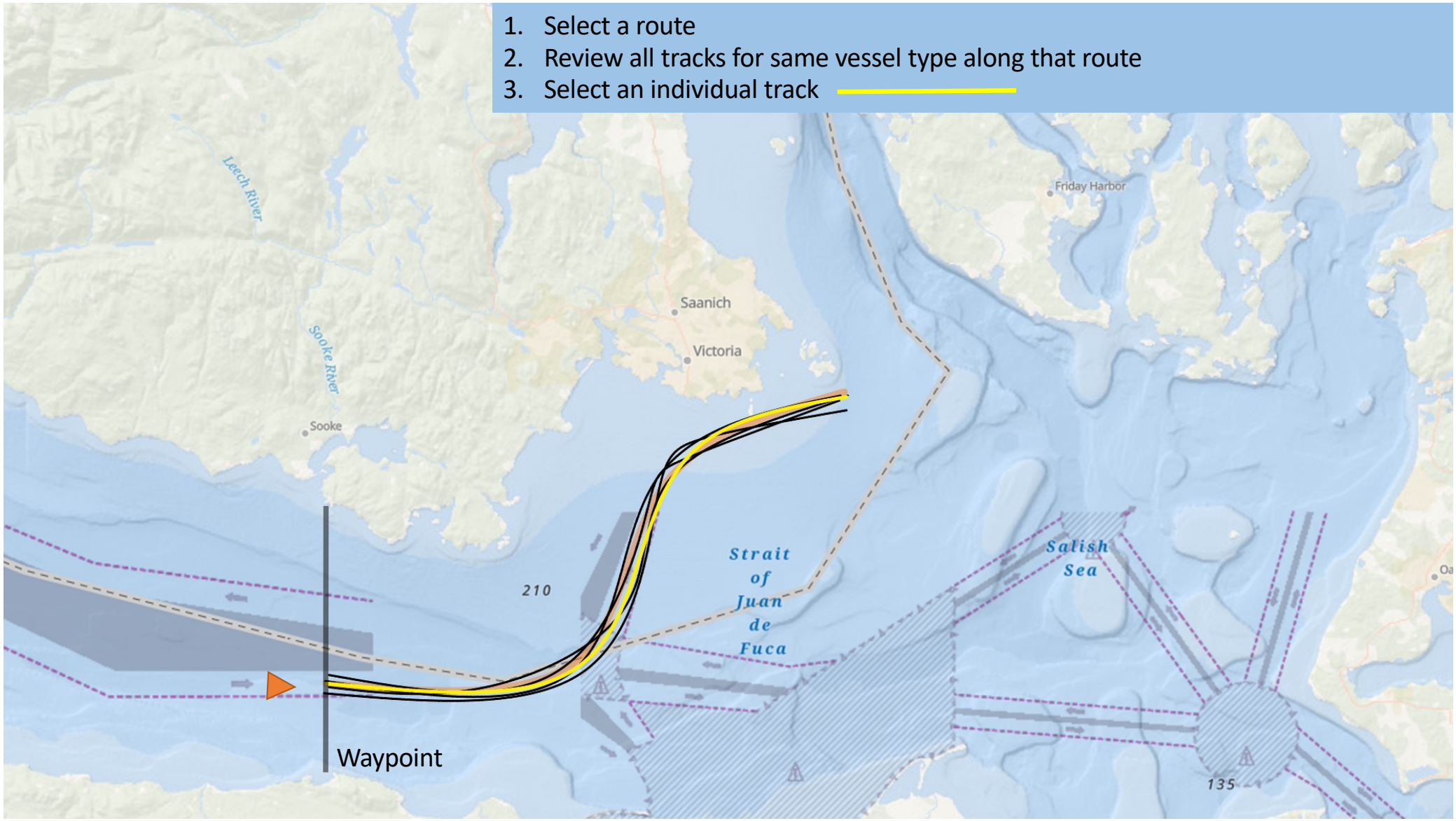
Sooke River
Sooke
Saanich
Victoria
Friday Harbor
Strait of Juan de Fuca
Salish Sea
210
135
Waypoint


1. Select a route
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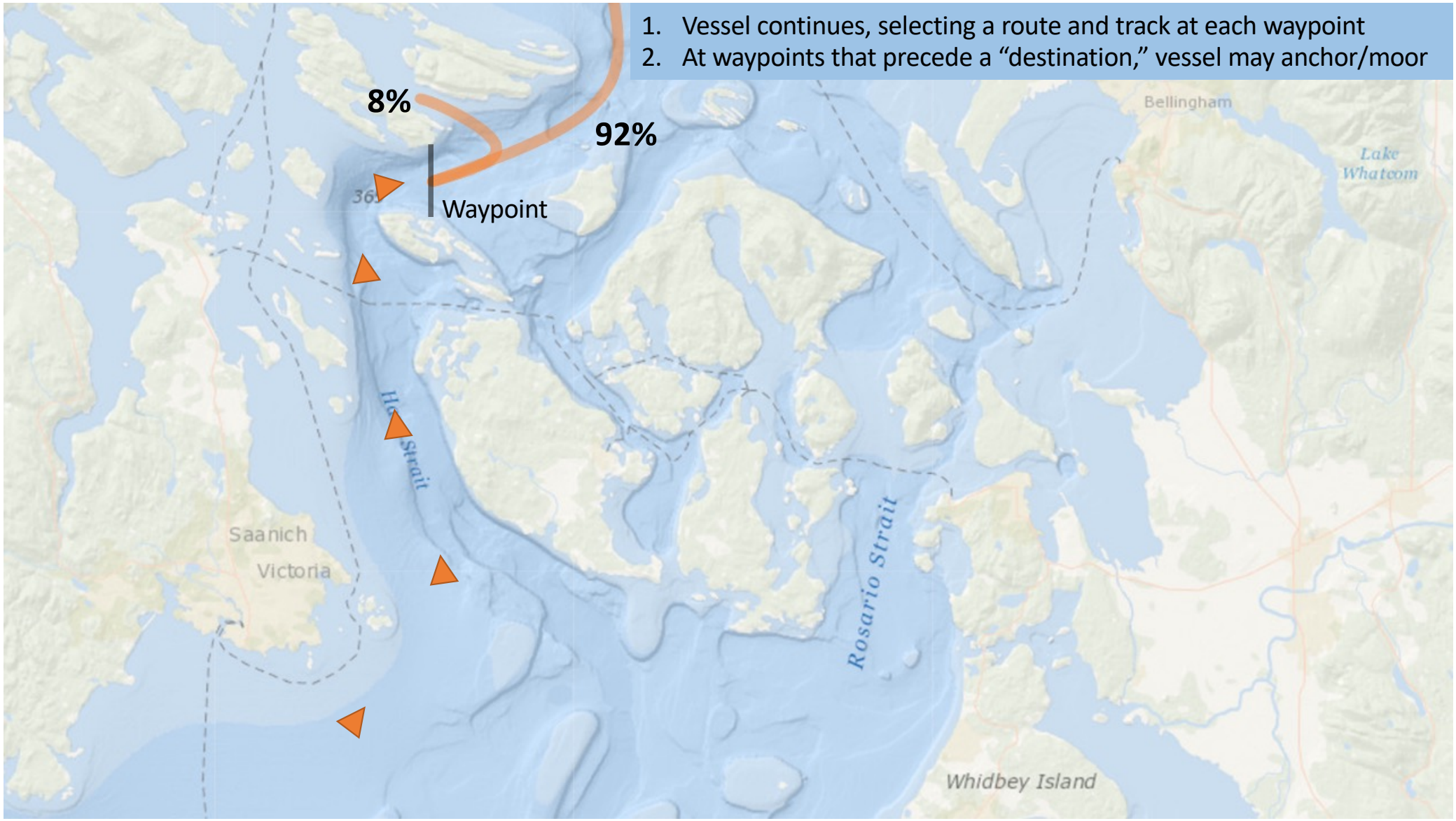
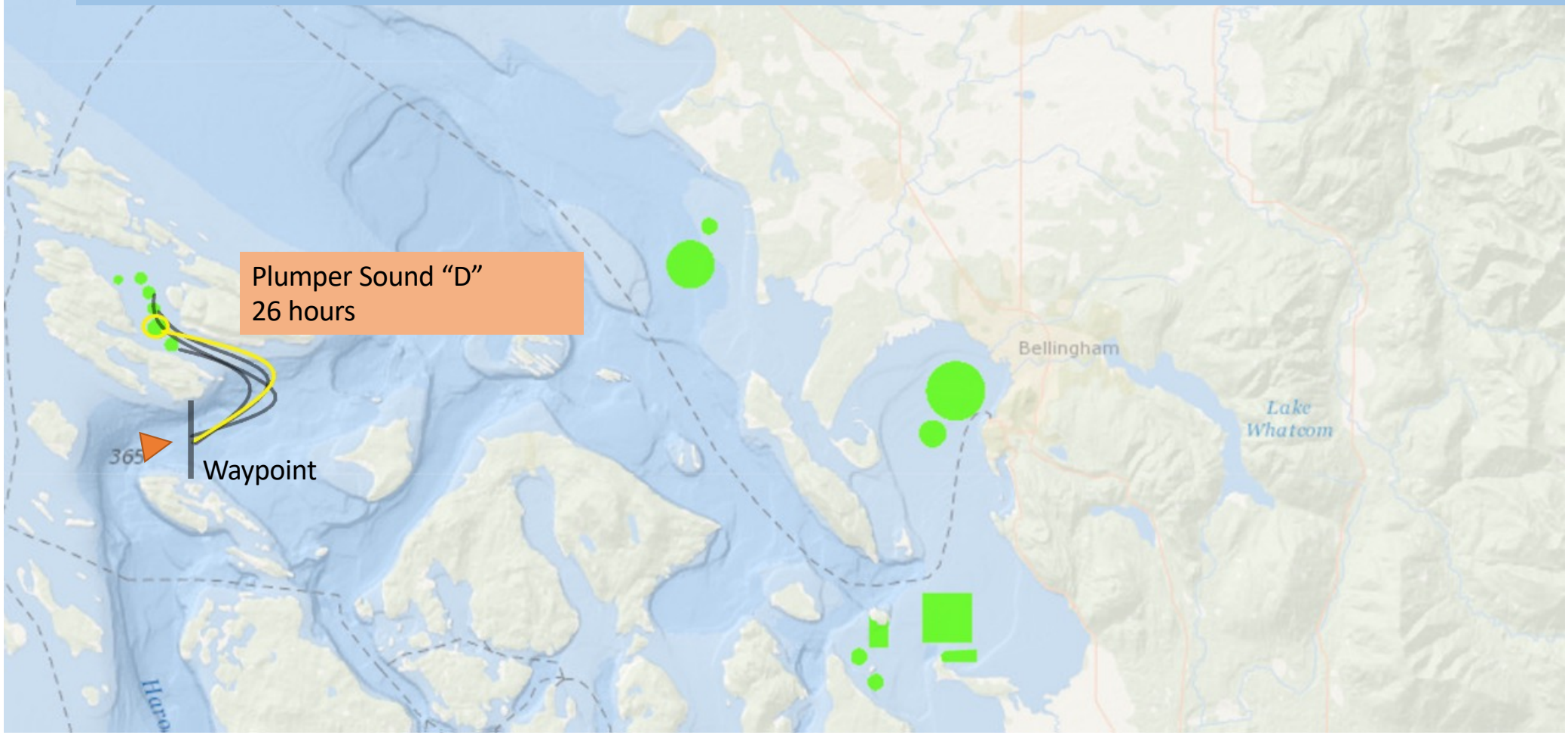
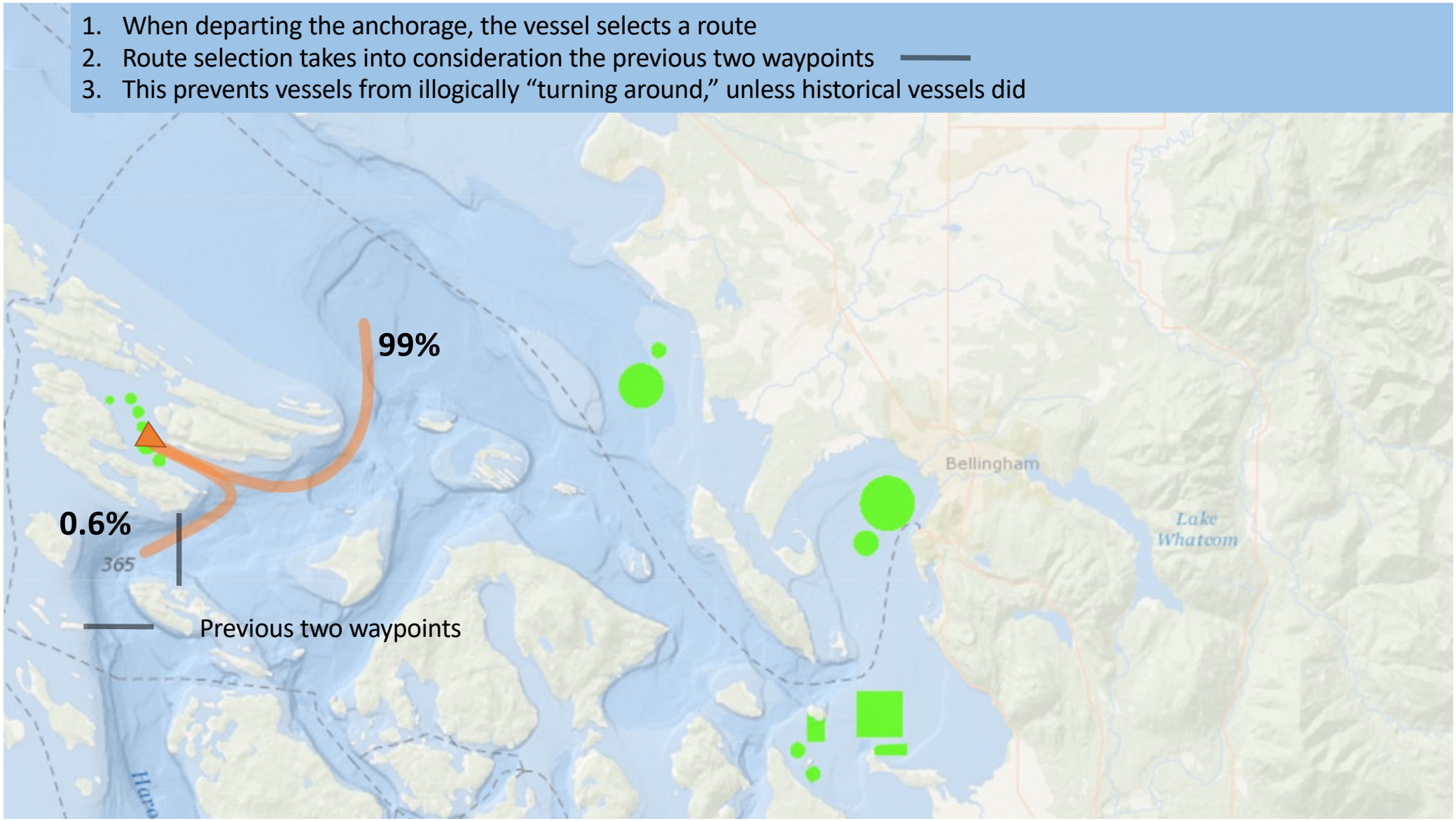
3. Select an individual track
Leech River
Sooke River
Sooke
Saanich
Victoria
Friday Harbor
Strait of Juan de Fuca
Salish Sea
210
135
Waypoint

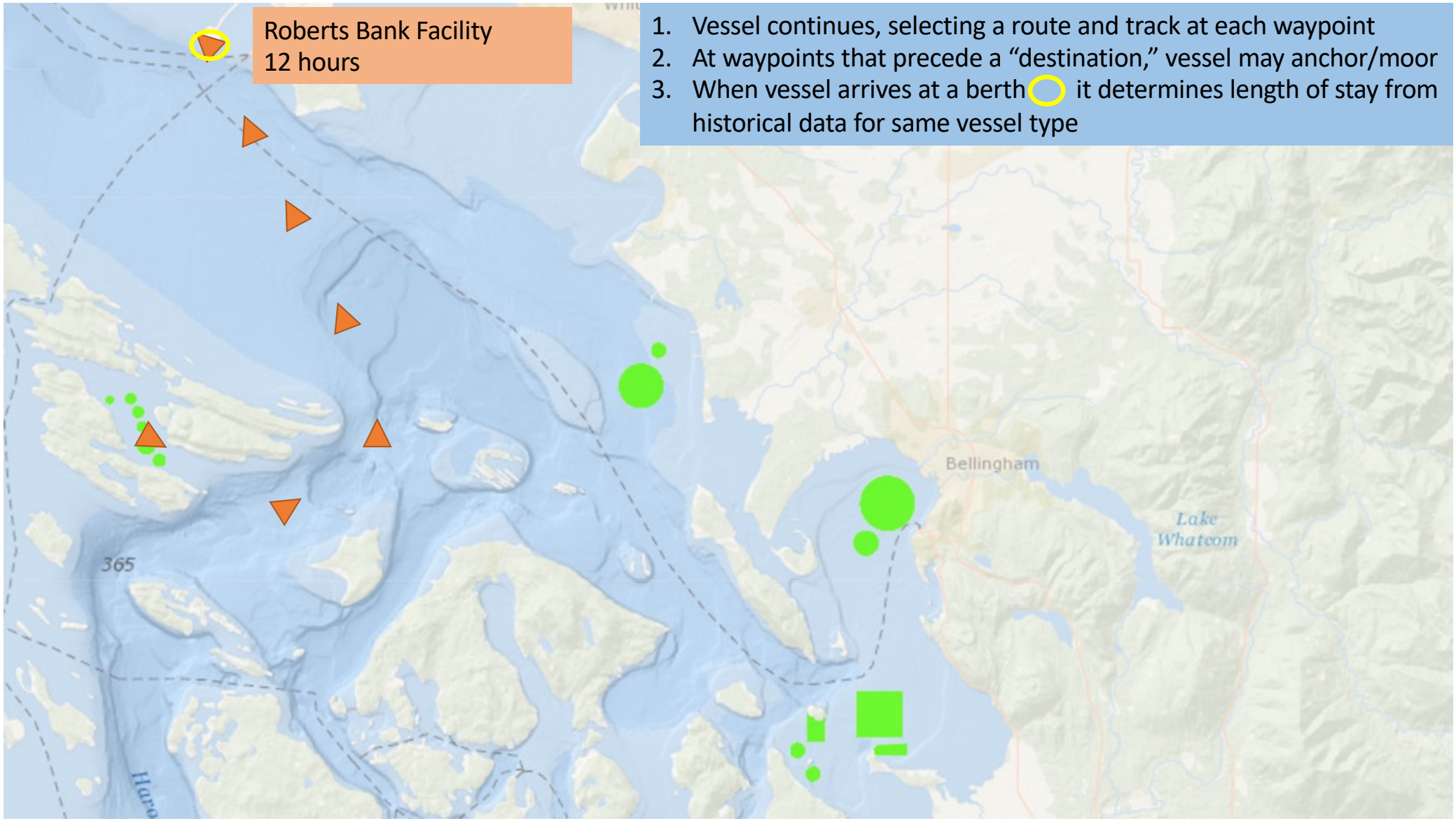

1. Vessel continues, selecting a route and track at each waypoint
2. At waypoints that precede a “destination,” vessel may anchor/moor
8%
92%
Waypoint
Bellingham
Lake Whatcom
Saanich
Victoria
Rosario Strait
Whidbey Island

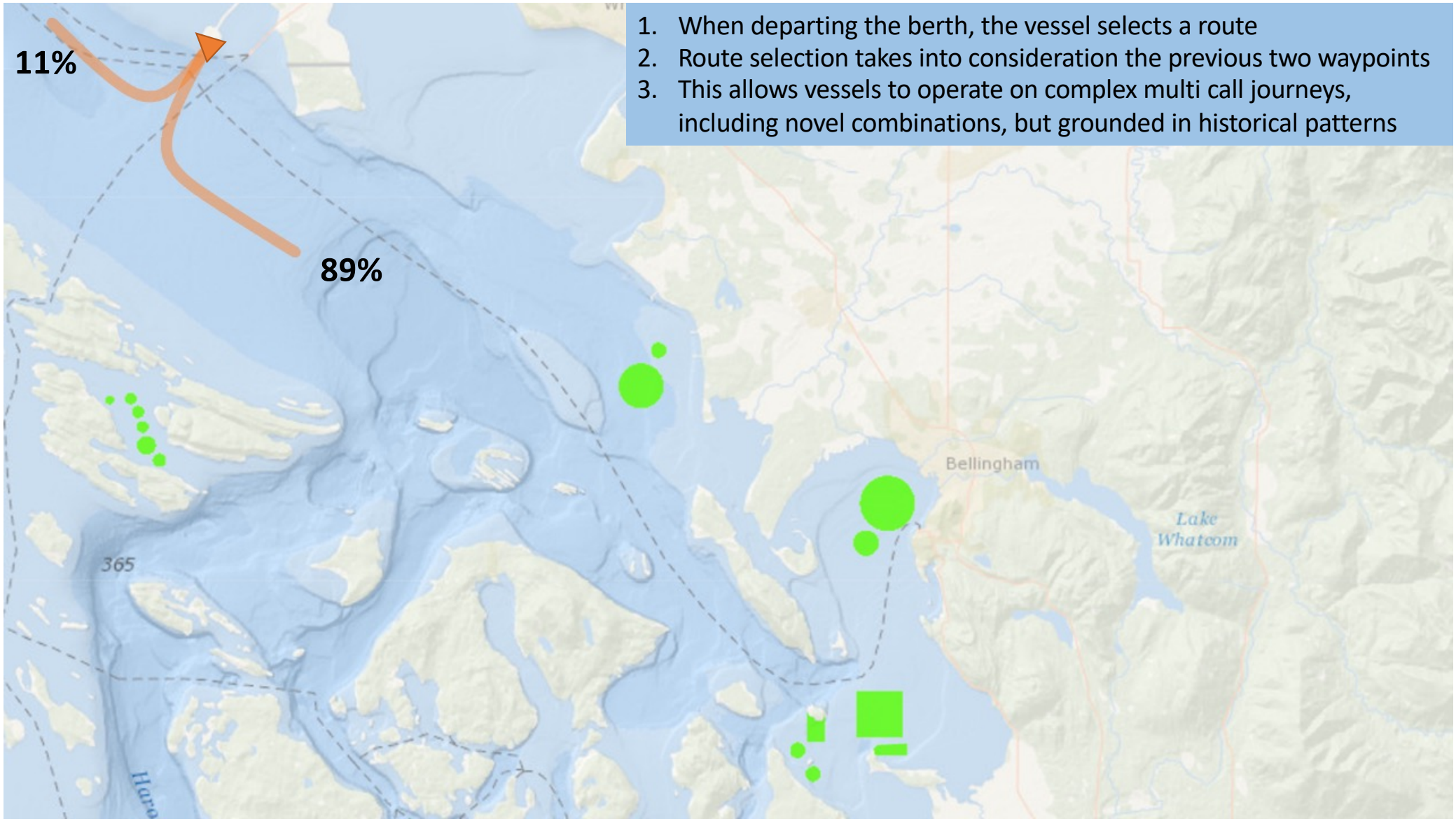
1. The individual tracks ——— may lead to different anchorage locations
2. When vessel arrives at an anchorage ◯ it determines length of stay from historical data for same vessel type
3. The vessel only anchors at available anchorages
4. If an anchorage is occupied, the vessel selects a different track leading to a different anchorage



1. When departing the anchorage, the vessel selects a route
2. Route selection takes into consideration the previous two waypoints
3. This prevents vessels from illogically "turning around," unless historical vessels did

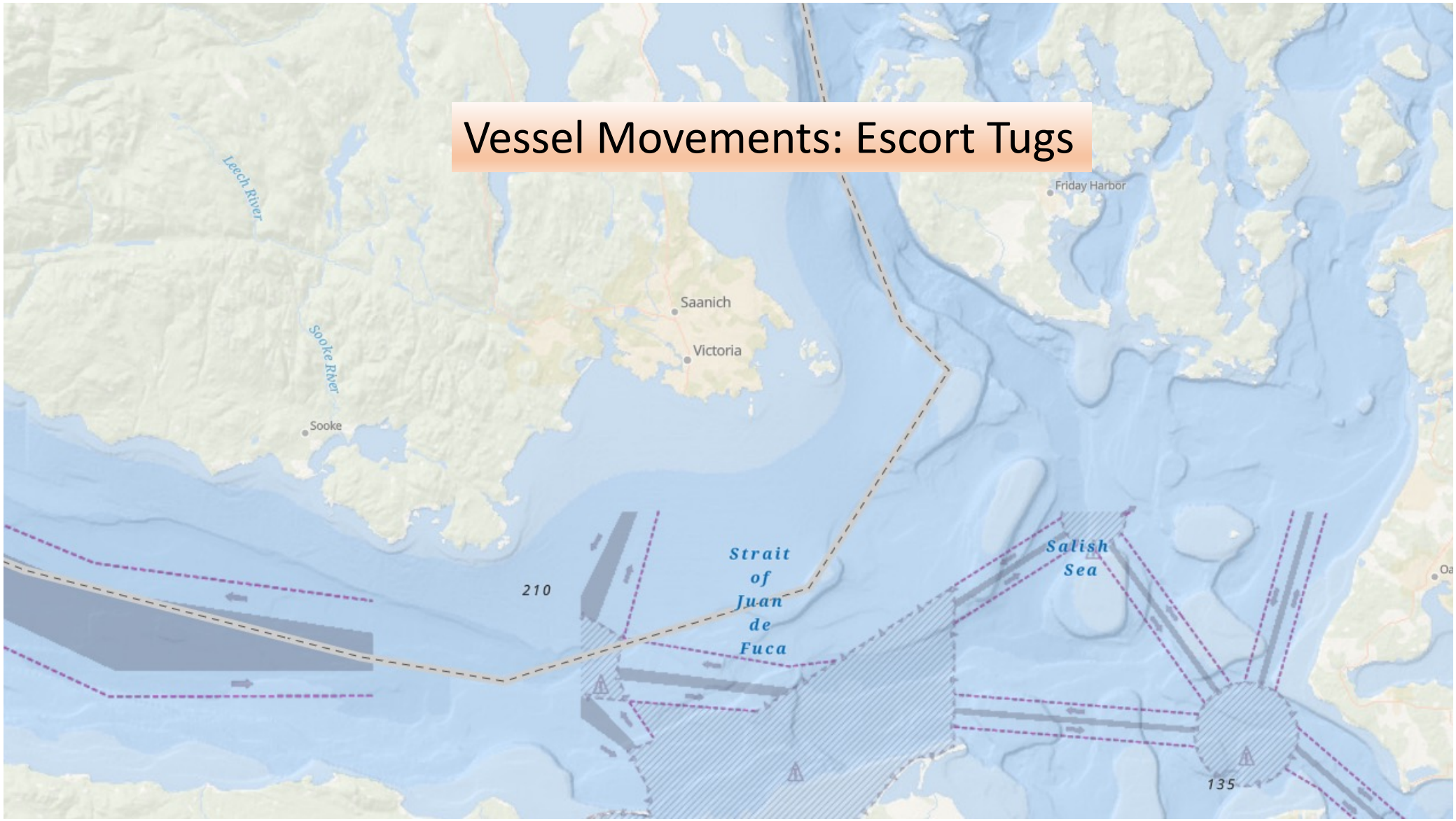



Roberts Bank Facility
12 hours
1. Vessel continues, selecting a route and track at each waypoint
2. At waypoints that precede a “destination,” vessel may anchor/moor
3. When vessel arrives at a berth it determines length of stay from historical data for same vessel type
Bellingham
Lake Whatcom
365

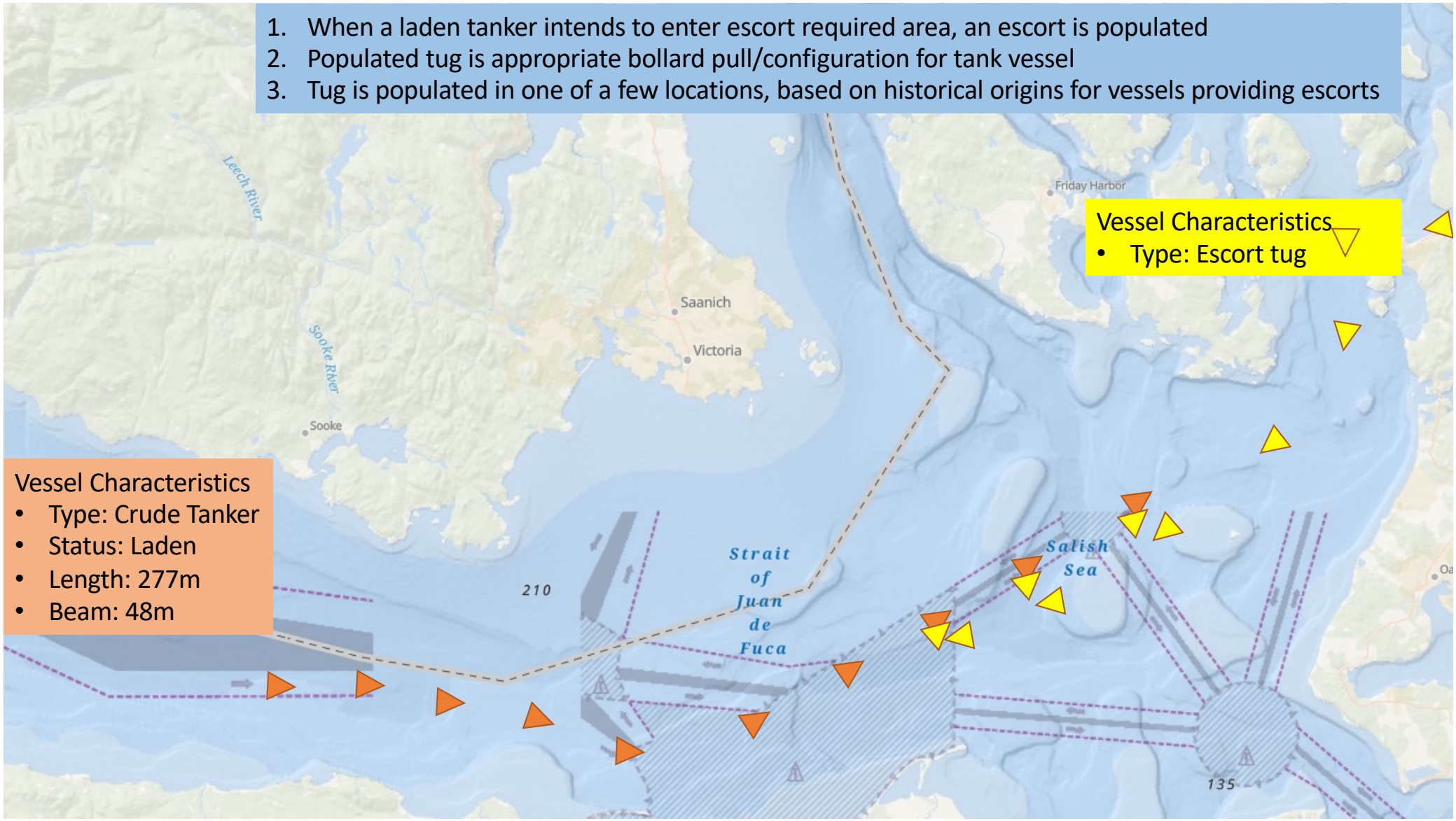


1. When departing the berth, the vessel selects a route
2. Route selection takes into consideration the previous two waypoints
3. This allows vessels to operate on complex multi call journeys, including novel combinations, but grounded in historical patterns

Vessel Movements: Escort Tugs



1. When a laden tanker intends to enter escort required area, an escort is populated
2. Populated tug is appropriate bollard pull/configuration for tank vessel
3. Tug is populated in one of a few locations, based on historical origins for vessels providing escorts



Vessel Characteristics
- Type: Escort tug

Vessel Characteristics
- Type: Crude Tanker
- Status: Laden
- Length: 277m
- Beam: 48m

Next Steps

- Continued work on model development
- Planning for upcoming analyses
- Outreach and consultation for analysis projects
- Reports due to Legislature, September 2023

Questions?