Assessing and Enhancing Estuary Resilience to Sea-Level Rise – Estuary Restoration in Action

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Project Background

Estuaries and coastal wetlands comprise less than 3% of BC's coastline, yet they support over 80% of BC's coastal fish and wildlife

"Hani' ts'em 'i' ni' hwu say tu lutemtst"

"When the tide is out the table is set"

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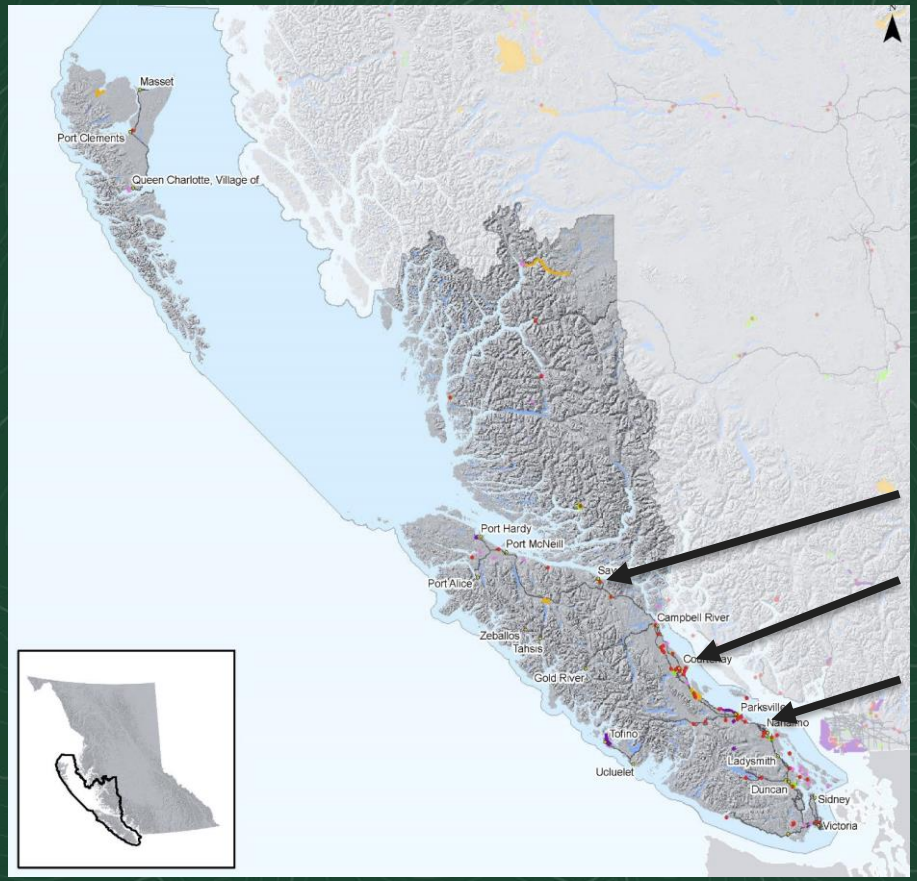
Project Background



Salmon River, 1978-2020

K'ómoks Slough, 1975

Nanoose Estuary, 1977

>110 sites = ~12,000 ha

80% of sites are within estuaries or foreshore areas

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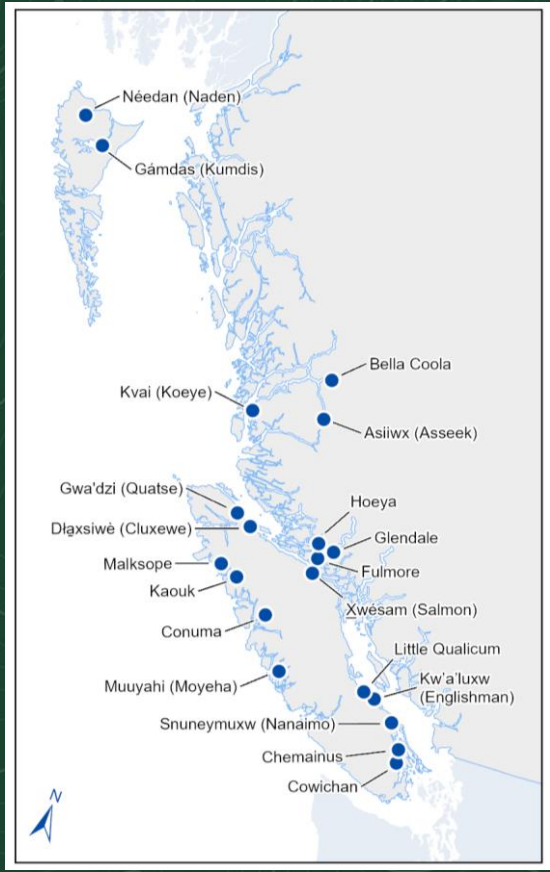
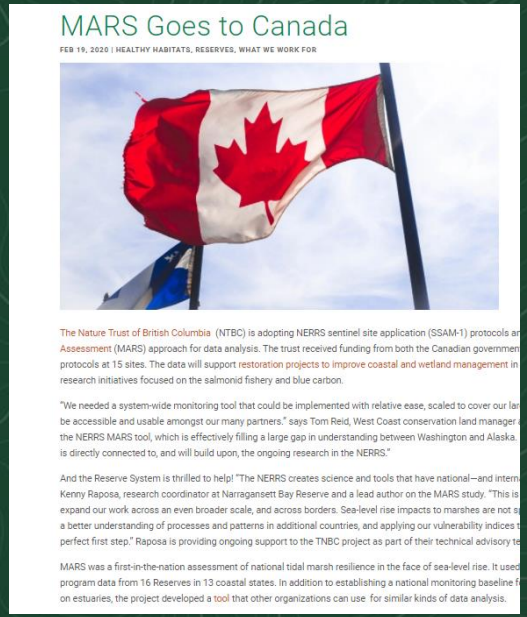
Marsh Resilience to Sea-Level Rise (MARS)





MARS Goes to Canada

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The Nature Trust of British Columbia (NTBC) is adopting NERRS sentinel site application (SSAM-1) protocols ar Assessment (MARS) approach for data analysis. The trust received funding from both the Canadian governmen protocols at 15 sites. The data will support restoration projects to improve coastal and wetland management in research initiatives focused on the salmonid fishery and blue carbon.

"We needed a system-wide monitoring tool that could be implemented with relative ease, scaled to cover our lar be accessible and usable amongst our many partners." says Tom Reid, West Coast conservation land manager the NERRS MARS tool, which is effectively filling a large gap in understanding between Washington and Alaska. is directly connected to, and will build upon, the ongoing research in the NERRS."

And the Reserve System is thrilled to help! "The NERRS creates science and tools that have national—and intern Kenny Raposa, research coordinator at Narragansett Bay Reserve and a lead author on the MARS study. "This is expand our work across an even broader scale, and across borders. Sea-level rise impacts to marshes are not s a better understanding of processes and patterns in additional countries, and applying our vulnerability indices perfect first step." Raposa is providing ongoing support to the TNBC project as part of their technical advisory te

MARS was a first-in-the-nation assessment of national tidal marsh resilience in the face of sea-level rise. It used program data from 16 Reserves in 13 coastal states. In addition to establishing a national monitoring baseline f on estuaries, the project developed a tool that other organizations can use for similar kinds of data analysis.

Given the importance of estuarine ecosystems and the threats to them, on-going monitoring and adaptive management is critical

NERRA
National Estuarine Research Reserve ASSOCIATION

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Implementation of MARS in Coastal BC

Project goals:

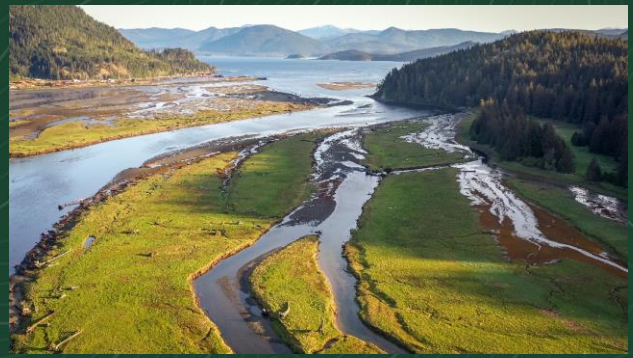
1. Development of meaningful and lasting partnerships between Coastal First Nations, NTBC, and other project partners;

2. Monitoring and research to assess estuary resilience to sea-level rise at 15 (now 20) sites on Vancouver Island, the central coast, and Haida Gwaii;

3. Implementation of several major ecological restoration projects utilizing data collected;

4. Increased knowledge and capacity of all partners to make informed management, conservation, restoration, and enhancement decisions; and,

5. Showcase the integration of science and cultural knowledge and heritage.



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Strong Partnerships for Estuary Resilience

Tlowitsis Nation

K'ómoks First Nation

MAMALILIKULLA FIRST NATION

Nanwakolas Council

Ahousaht First Nation

Snaw-naw-as First Nation

Council of the Haida Nation

Da'naxda'xw-Awaetlala First Nation

Nuxalk First Nation

Cowichan Tribes

Snuneymuxw First Nation

Heiltsuk First Nation

Halalt First Nation

Qualicum First Nation

KWAKIUTL FIRST NATION

Ka:'yu:'k't'h'/Che:k'tles7et'h' First Nations

HABITAT CONSERVATION TRUST FOUNDATION

Hakai
Science on the Coastal Margin

SFU Salmon Watersheds Lab

Environment and Climate Change Canada
Environnement et Changement climatique Canada

Ducks Unlimited Canada

UBC Faculty of Forestry Indigenous Ecology Lab

Uu-a-thluk
TAKING CARE OF

Funding for this project was provided under the BC Salmon Restoration and Innovation Fund (BC SRIF), a contribution program funded jointly between Fisheries and Oceans Canada, and the Province of BC.

Fisheries and Oceans Canada | Pêches et Océans Canada

BRITISH COLUMBIA

Marsh Resilience to Sea-Level Rise (MARS)

MARS Resilience Category	Metric
Marsh Elevation Distribution	Percent of marsh below local Mean High Water
	Percent of marsh in the lowest third of overall plant distribution
	Skewness (distribution of vegetation in elevation profile)
Unvegetated to Vegetated Ratio	Unvegetated to Vegetated Ratio[1]
Marsh Elevation Change	Rate of marsh elevation change over time
Sediment Supply	Short-term sediment accretion
	Long-term sediment accretion
	Turbidity
Tidal Range	Tidal range
Sea-Level Rise (SLR)	Long-term rate of relative SLR

[1] Metric added from Ganju et al. (2013) based on recommendations presented in Wasson et al. (2019).

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MARS Outputs – Mgmt Implications

Level of Resilience to SLR	Focus of Efforts	Example Action
High	Preservation	Secure additional lands not designated as conservation lands
		Maintain ecological integrity (e.g. reduce pollutants, remove invasive species)
Moderate	Enhancement of resilience	Sediment additions to increase marsh platform
		Removal of historic dikes, berms, etc. restricting tidal influence
		Enhancing connectivity to freshwater channels to increase organic soil formation
Low	Facilitate desired transformation	Secure adjacent lands for conservation to allow for landward migration
		Removal of barriers to landward migration of marshes
		Reduce/reprioritize investment in conservation/restoration if no viable strategy is identified

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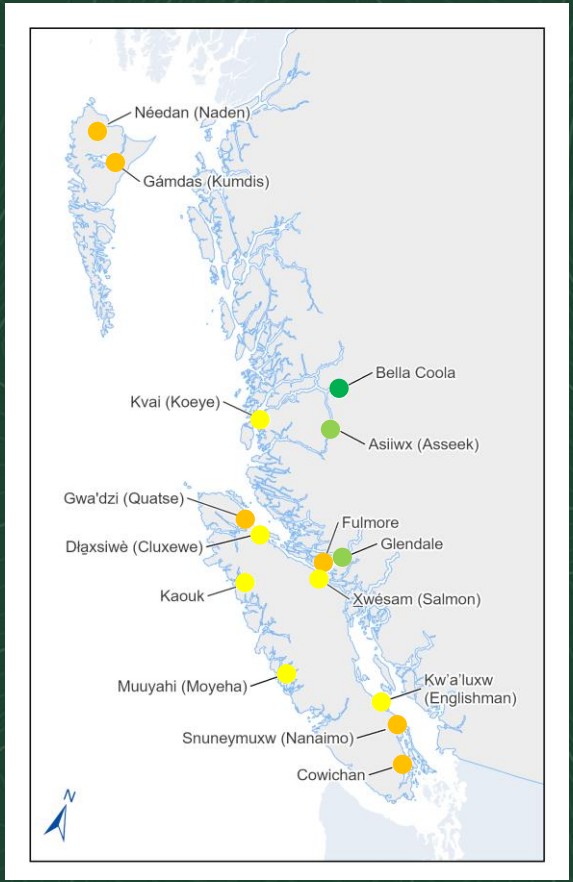
MARS Scoring



Resilience Rank	Number of Sites
HIGH	1
MODERATE-HIGH	2
MODERATE	6
MODERATE-LOW	6

Twelve of the 15 sites (80%) exhibited characteristics that indicate Moderate to Moderate-Low resilience to sea-level rise.

All sites exhibited a low level of resilience in at least one MARS category.

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Using the MARS Outputs

MARS Index Scores	
MARS Risk	2
MARS Average	2.5
MARS Ratio	0.3
MODERATE-LOW	

RISK: Low scores in multiple categories represent increased risk.

AVERAGE: Overall average across the six resilience metric categories.

RATIO: Scores <1 indicate that marshes are not gaining elevation at rates commensurate with projected sea-level rise.

This estuary has a MODERATE-LOW resilience score and indicates the estuary is vulnerable to marsh drowning from sea-level rise.

Moderate	Enhancement of resilience	Sediment additions to increase marsh platform
		Removal of historic dikes, berms, etc. restricting tidal influence
		Enhancing connectivity to freshwater channels to increase organic soil formation
Low	Facilitate desired transformation	Secure adjacent lands for conservation to allow for landward migration
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Identification of restoration/enhancement projects or other conservation actions to address resilience score

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Using the MARS Outputs

Restoration Project Planning

Table 1: Table of Evaluation Criteria Used to Evaluate Projects

Option	Process Restored	Project Size	Habitat Ecological Value	Resilience	Certainty of Success	Land Status	Community Support	Project Risk	Liability Concerns	Constraints	Timing	Capital Cost	Operation & Maintenance Cost	Regulatory Effort

In addition to the MARS outputs, a multi-factor, matrix-based approach was used to evaluate and rank potential restoration projects. This approach included quantitative and qualitative measures, partner input, and expert opinion.

Table 2: Excerpt of Completed Options Evaluation Matrix Used to Evaluate Projects

Option	Resilience	Certainty of Success	Land Status	Project Risk	Liability Concerns	Constraints	Timing	Capital Cost	Capital Cost per Area ($/ha)	Operations & Maintenance Cost	Regulatory Effort	Raw Score	Raw Rank	Expert-Adjusted Rank
	3	3	3	3	3	2	3	3	3	3	2	31	1	1
	2	1	2	2	3	2	3	3	3	2	3	26	2	2

Capital cost ranking: $0–500 k = 3; $0.5–1 M = 2; >$1 M = 1

$/ha ranking: $0–500 k = 3; $0.5–1 M = 2; >$1 M = 1

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Restoration Projects

Gwa’dzi Estuary: Roadway Breach, Tidal Channel Reconnection

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Restoration Projects

Gwa’dzi Estuary: Roadway Breach, Tidal Channel Reconnection

Before

After

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Restoration Projects

Snuneymuxw Estuary: Freshwater & Sediment Redistribution

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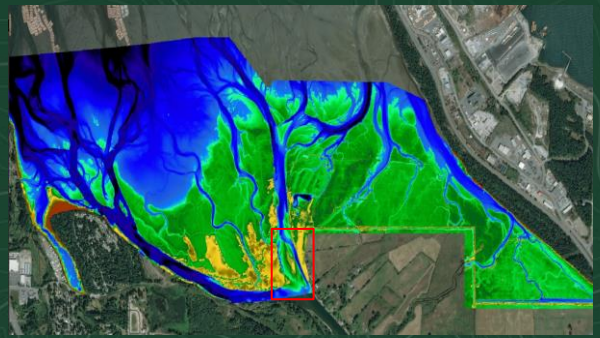
Restoration Projects

Snuneymuxw Estuary: Freshwater & Sediment Redistribution

Before

Nearing Completion

After



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Restoration Projects

Xwésam Estuary: Reconnecting Tidal Channels

Estuary
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Restoration Projects

Xwésam Estuary: Reconnecting Tidal Channels

Before

After

Estuary
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Restoration Projects

Kw'a'luxw Estuary: Shoreline and Coastal Process Restoration

Estuary
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Restoration Projects

Kw'a'luxw Estuary: Shoreline and Coastal Process Restoration

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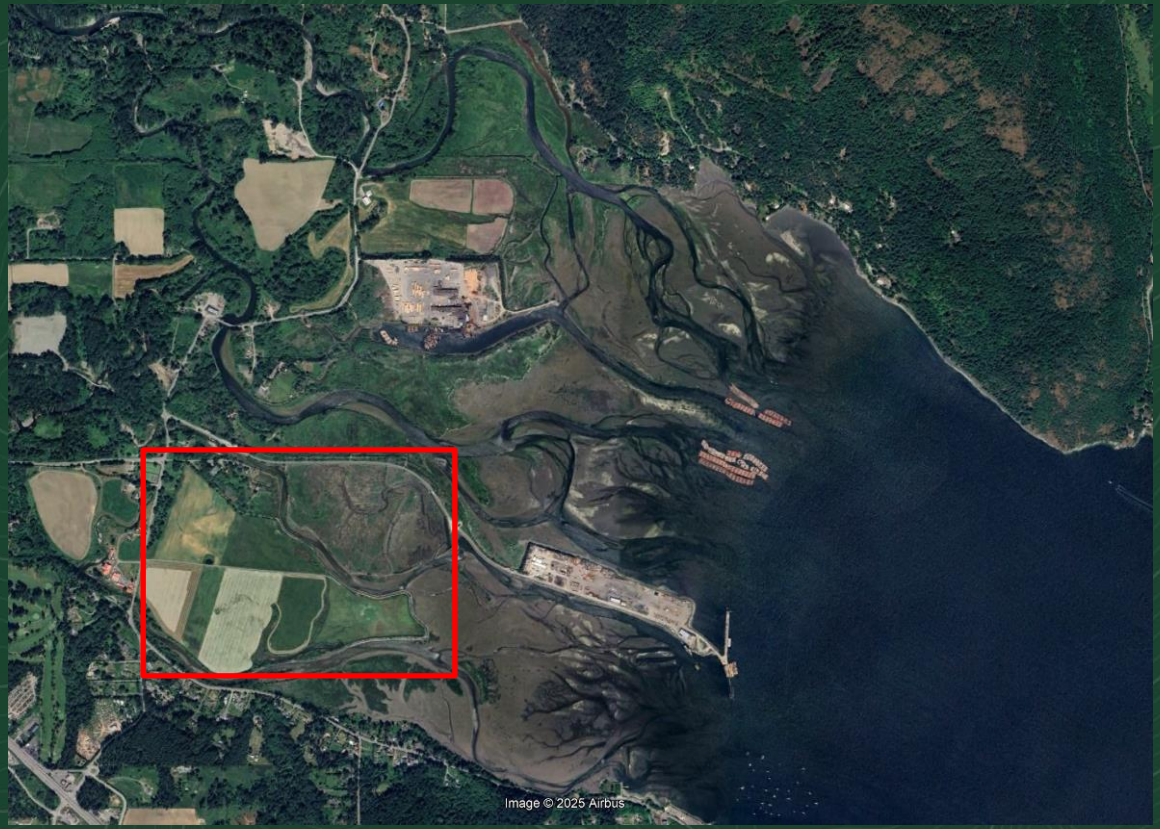
Restoration Projects

Cowichan Estuary: Dike Removal & Food Systems Revitalization



Multi-phased project to increase estuary resilience through the restoration of lost estuarine marsh

Large component of Indigenous Food System Revitalization

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Restoration Projects

Cowichan Estuary: Phase 1 - Koksilah Marsh Berm Removals

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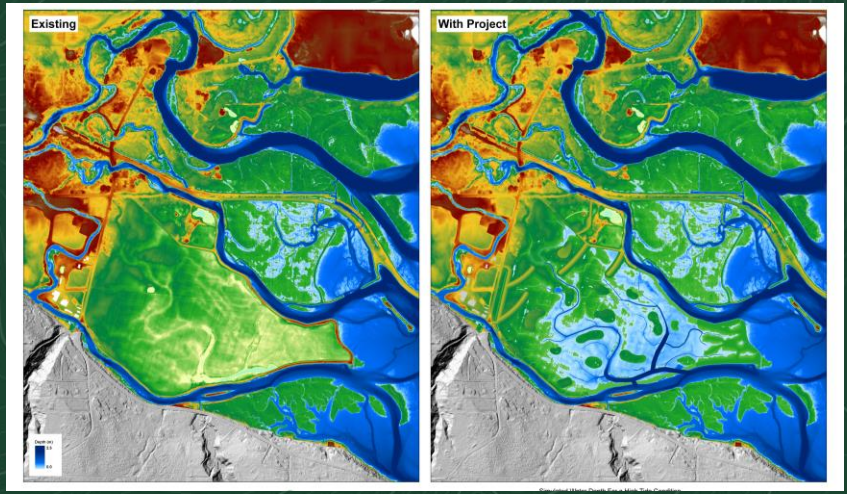
Restoration Projects

Cowichan Estuary: Phase 2 – Cowichan Farm



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Restoration Projects

Cowichan Estuary: Phase 2 – Indigenous Food System Revitalization

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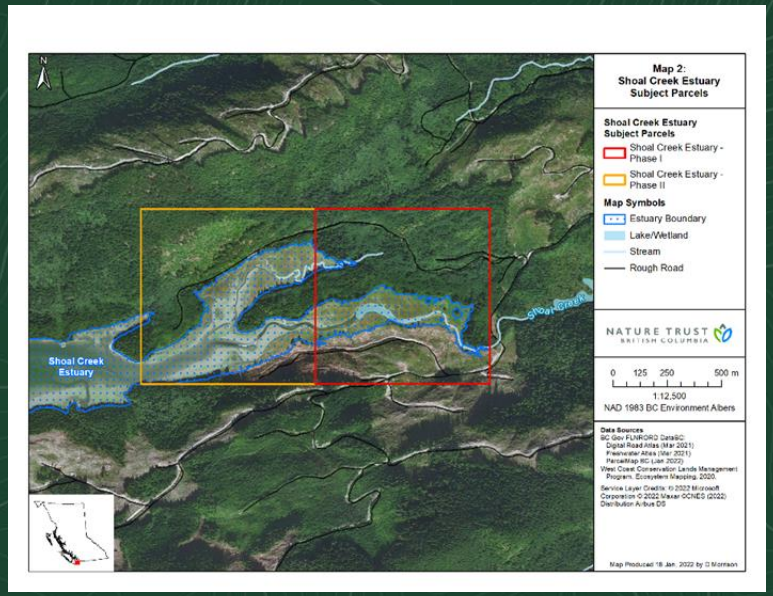
Land Securement

Shoal Estuary: Acquisition to Facilitate Landward Migration



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Keys to Success

1. Indigenous Community Partnerships
   - All knowledge sources respected and acknowledged in project planning and implementation with shared decision making
   - Place based environmental stewardship
   - Recognition of the interconnectedness of all species
   - Incorporation of Indigenous Food Systems revitalization and reclamation to restoration outcomes and goals
   - Equitable funding and opportunity
2. Partnership with eNGOs, academic institutions, Federal/Provincial agencies/scientists
3. Stable and consistent funding including ongoing resources for monitoring and adaptive management
4. Assessment tools that are easily scalable across a broad landscape
5. Linkages and opportunities to support concurrent research activities (e.g. water quality, blue carbon, juvenile salmonids)

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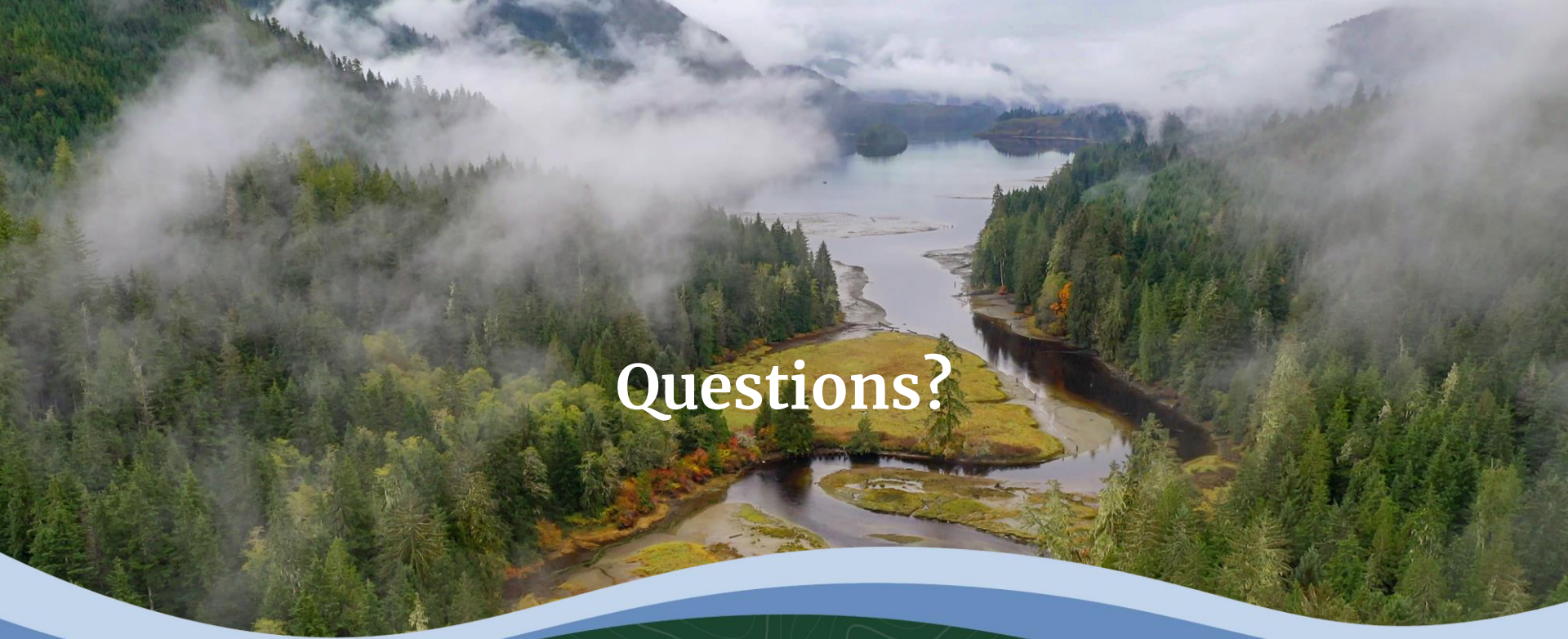

Questions?

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