GROUNDWATER:
OUR SHARED RESPONSIBILITY

Webinar
13 February 2024

Islands Trust

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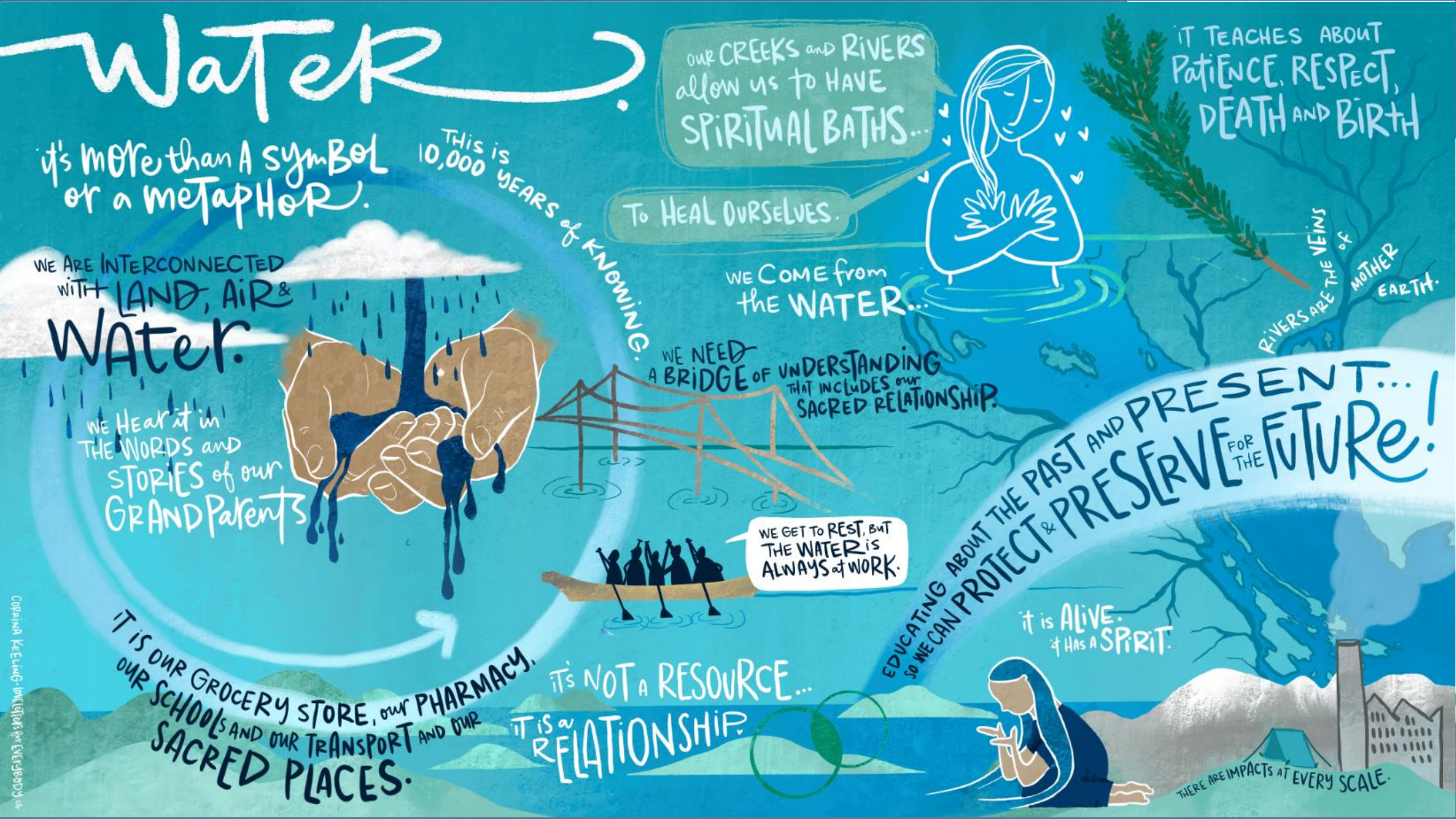
Object of the Trust

To preserve and protect the Trust Area and its unique amenities and environment for the benefit of the residents of the Trust Area and of British Columbia in cooperation with municipalities, regional districts, improvement districts, First Nations, other persons and organizations and the government of British Columbia.

Islands Trust


Water.
it's more than A symBol or a metaphor.
This is 10,000 years of knowing.
our creeks and rivers allow us to have spiritual baths...
To heal ourselves.
it teaches about patience, respect, death and birth
rivers are the veins of mother earth.
we come from the water...
we are interconnected with land, air & water.
we hear it in the words and stories of our grandparents
we need a bridge of understanding that includes our sacred relationship.
we get to rest, but the water is always at work.
educating about the past and present... so we can protect & preserve for the future!
it is alive. it has a spirit.
it is our grocery store, our pharmacy, our schools and our transport and our sacred places.
it's not a resource... it is a relationship.
there are impacts at every scale.
corrina keeling illustrations for everybody

Islands Trust Freshwater Sustainability Strategy

Released December 2021

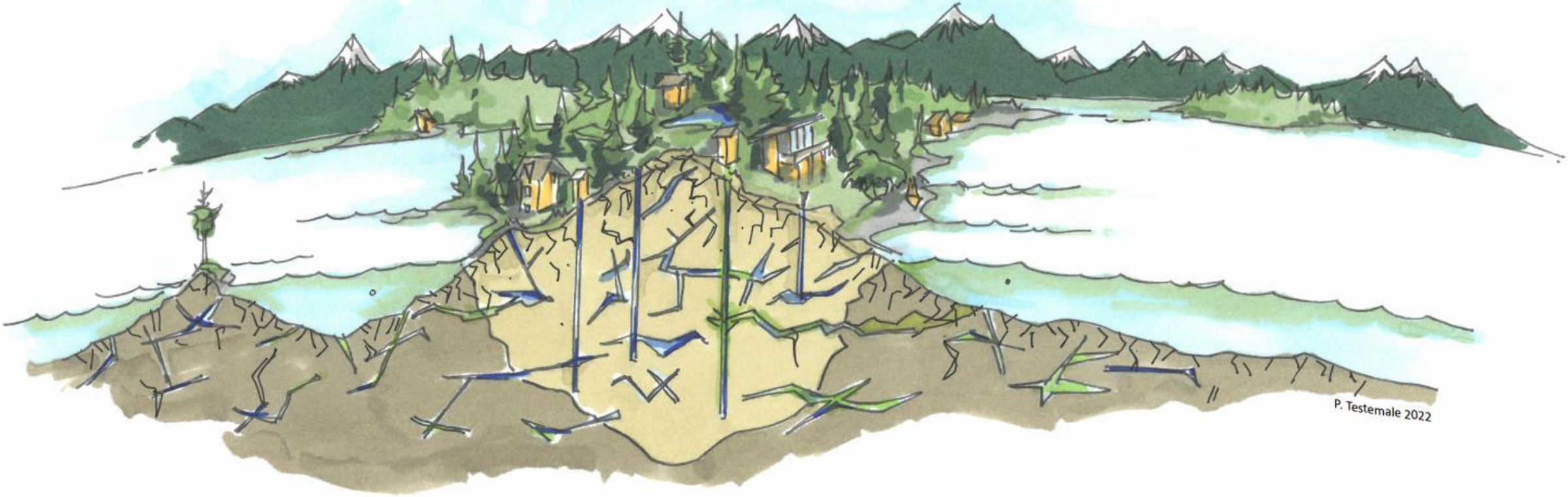
Freshwater Sustainability Strategy Purpose

Freshwater sustainability is a key lens through which Islands Trust land use decisions are made

Freshwater Sustainability Strategy Purpose

Islands Trust continues to support research, advocate for water literacy, and provide open public access to knowledge about freshwater

Groundwater is a unique amenity in the Islands Trust Area



All groundwater comes from **meteoric water.**
Rain, snow, and fog provide all essential freshwater for island life.

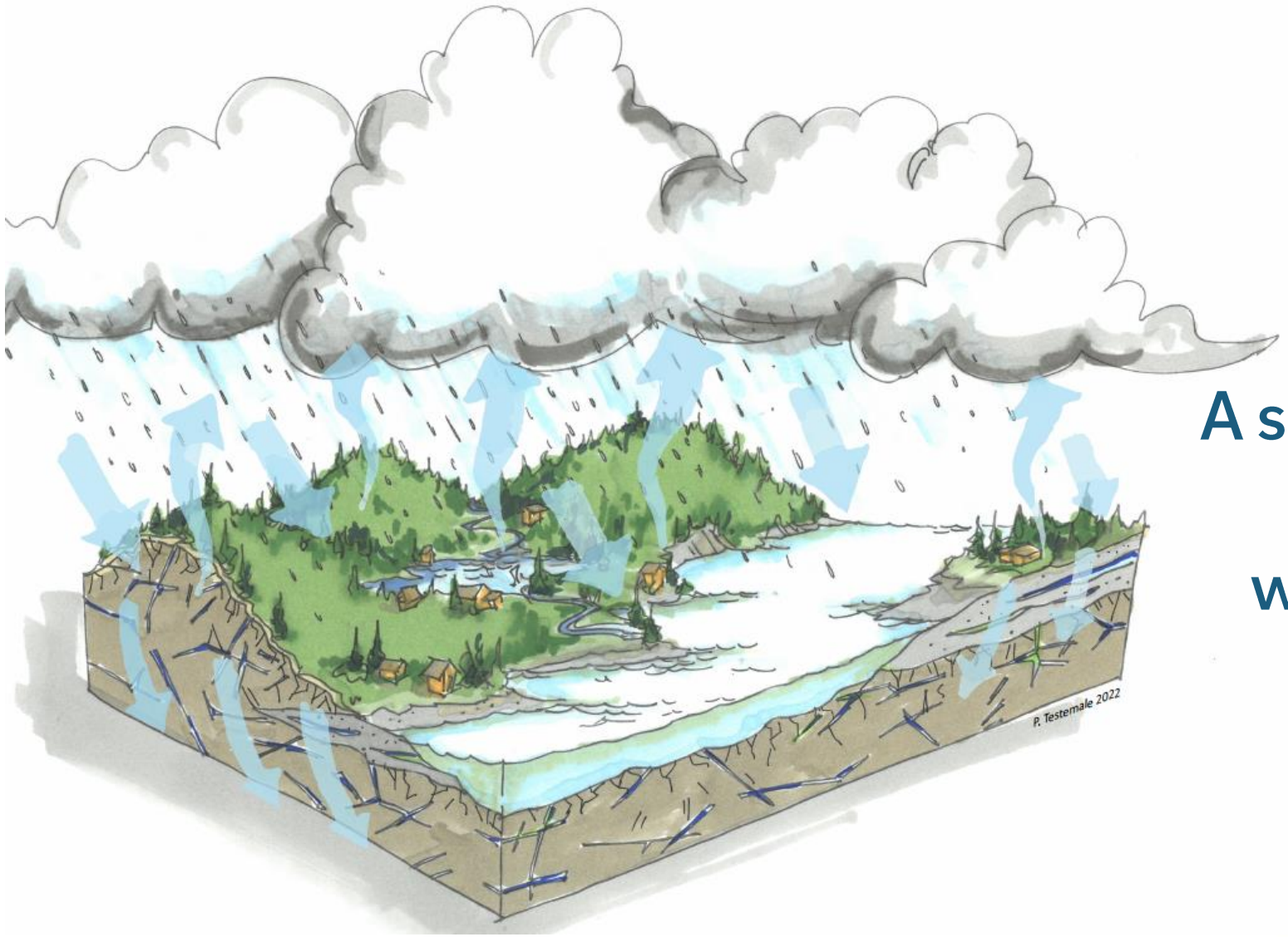
Groundwater Sustainability Science Program

Groundwater Sustainability Planning Program (GWSS)	
GWSS 1	Improve data management to inform decision making
GWSS 2	Develop a coordinated long-term water monitoring program
GWSS 3	Continue groundwater data and information inventory
GWSS 4	Continue groundwater recharge potential mapping
GWSS 5	Continue groundwater availability assessments
GWSS 6	Establish groundwater regions as a focus for land use planning for all Islands
GWSS 7	Integrate water availability and vulnerability information into land use policies and regulations
GWSS 8	Implement appropriate planning and regulatory tools to protect vulnerable aquifers and sensitive aquatic ecosystems
GWSS 9	Improve the availability of water-related information to support development application reviews
GWSS 10	Customize water supply requirements for new development to local circumstances

GROUNDWATER SUSTAINABILITY SCIENCE PROGRAM

Islands Trust Area Aquifer Conceptualization Project

Islands Trust



What is an Aquifer?

A subterranean geological unit that can store and transmit water in useful quantities for domestic, industrial, and ecological use.

Aquifer Conceptualization

https://all-geo.org/highlyallochthonous/2008/02/layer-cake-stratigraphy/

Unique Geology?

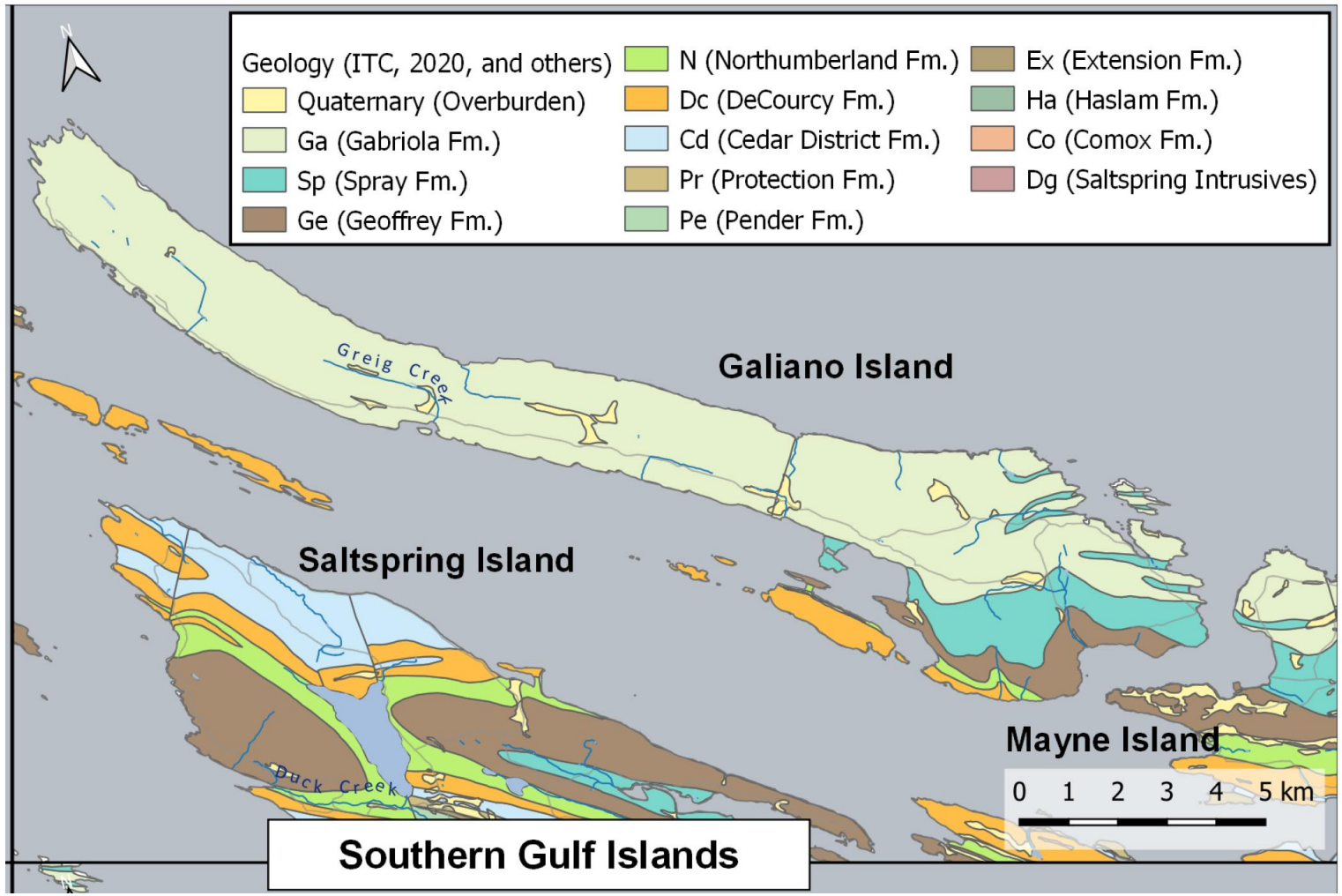
Island aquifers are unique since they are considered as a catchment basin rather than an extensive layered geological stack

Aquifer Conceptualization

An Island Water Basin

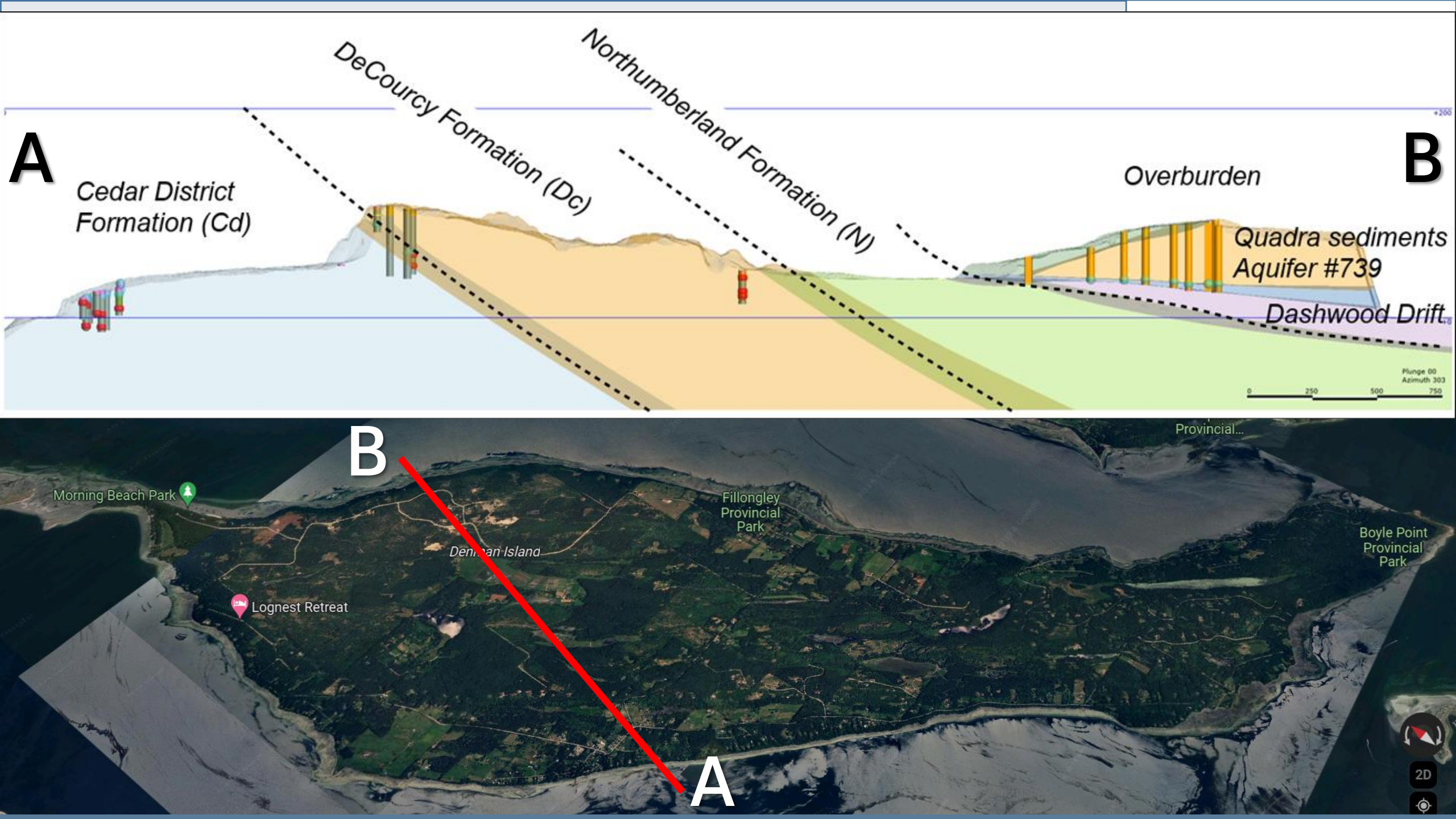
https://all-geo.org/highlyallochthonous/2008/02/layer-cake-stratigraphy/

Aquifer Conceptualization

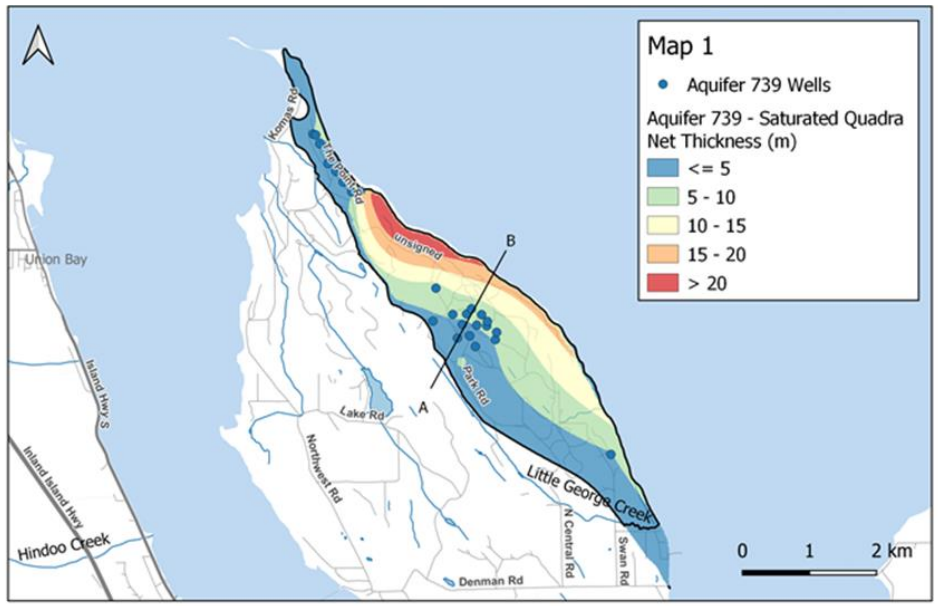


One Aquifer, One Island.

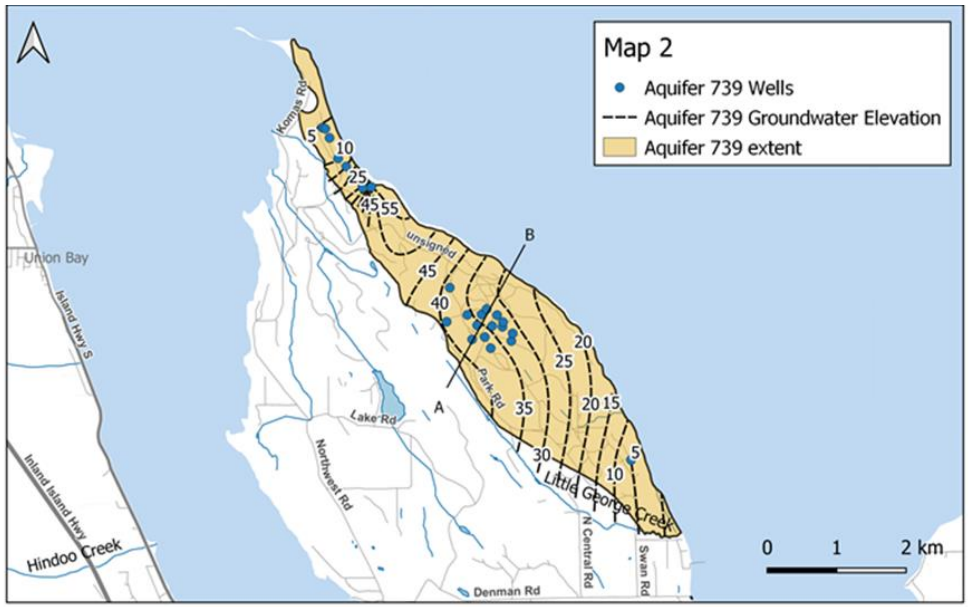
Example:
Galiano Island is mapped as one aquifer (AQ 320) although it contains several geological formations


A
B
Cedar District Formation (Cd)
DeCourcy Formation (Dc)
Northumberland Formation (N)
Overburden
Quadra sediments Aquifer #739
Dashwood Drift
Plunge 00
Azimuth 303
0
250
500
750
B
A
Morning Beach Park
Lognest Retreat
Denman Island
Fillongley Provincial Park
Boyle Point Provincial Park
2D

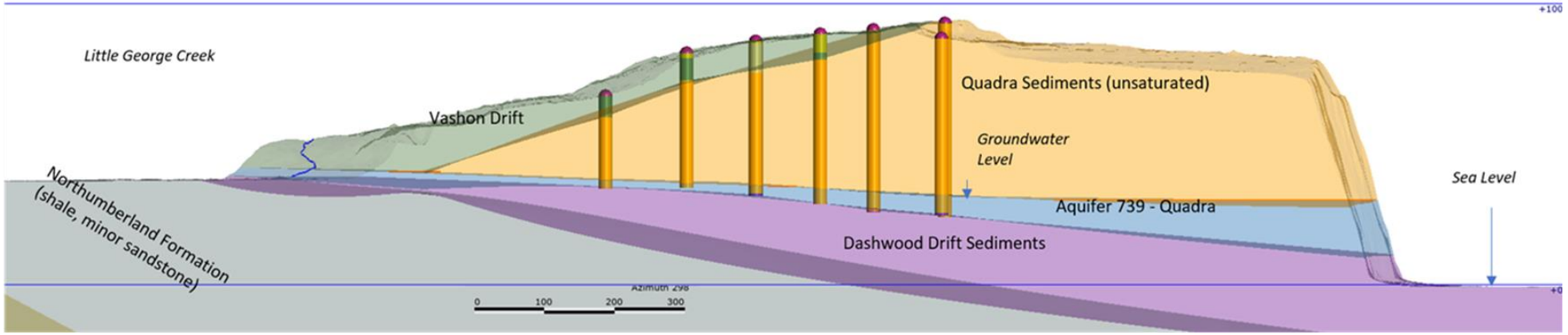
Aquifer Conceptualization



A (southwest)



B (northeast)

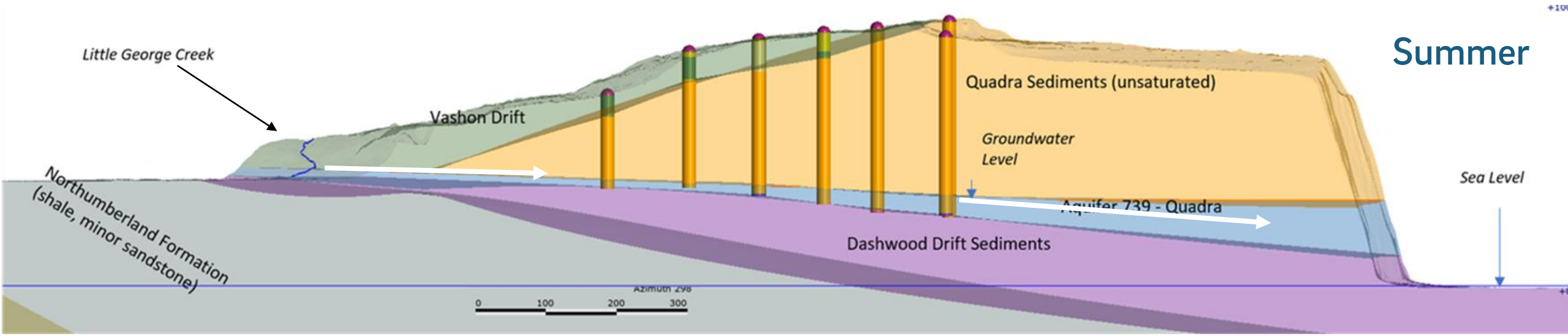


Example:
Denman Is.

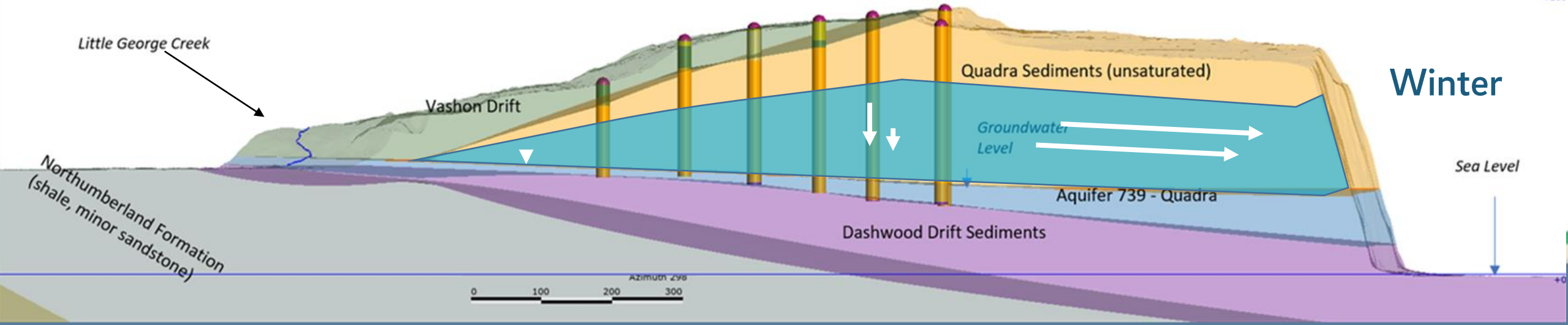
Unconsolidated Aquifer AQ 739

Bedrock Aquifer AQ 740

Aquifer Conceptualization

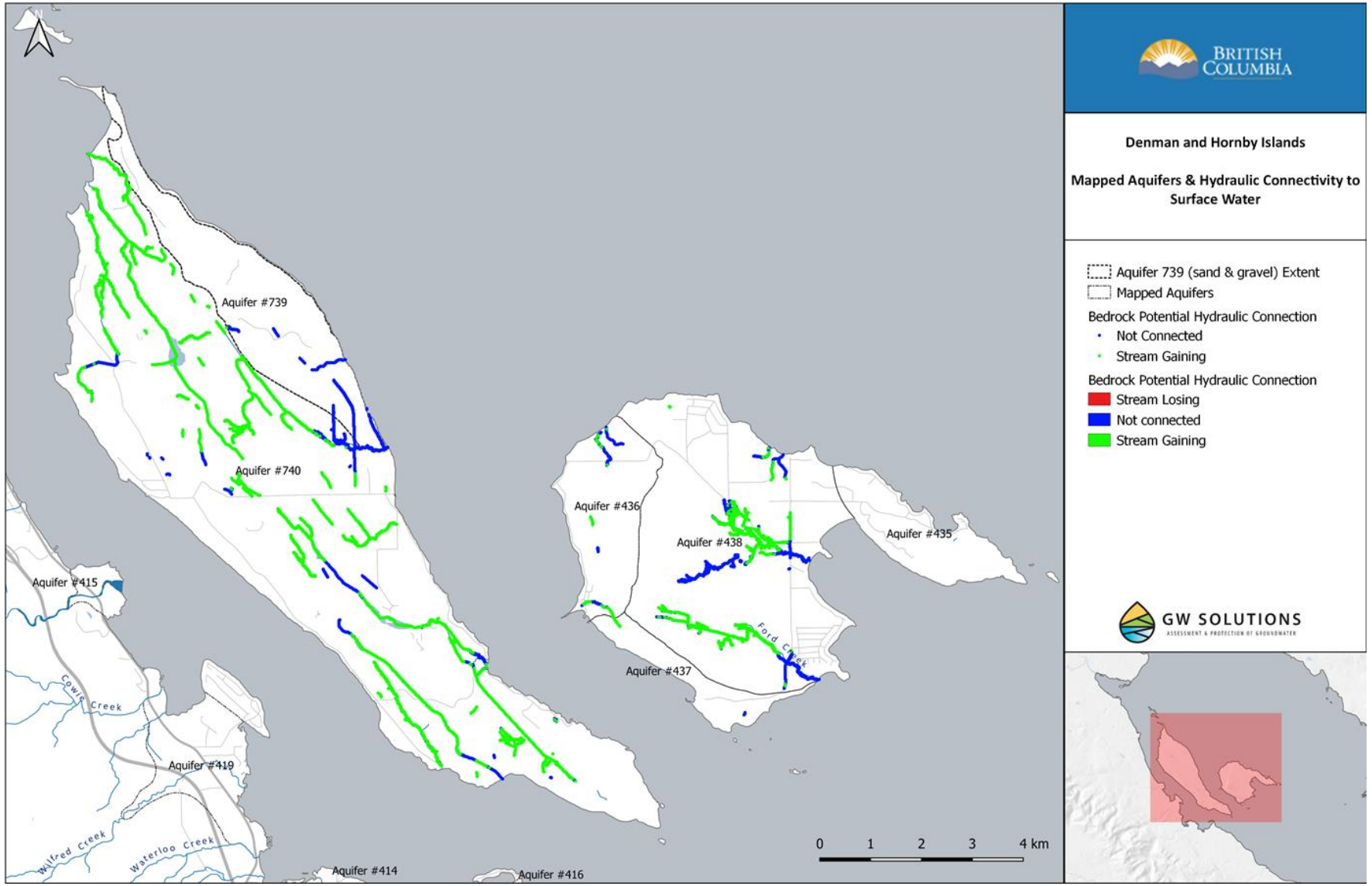


Summer



Winter

Aquifer Conceptualization



Surface water and groundwater

Potential hydraulic connectivity of aquifers to streams

Used for Water Authorizations

Groundwater Regions

water management units that are used for land-use planning, water authorizations, and research

Aquifer Conceptualization

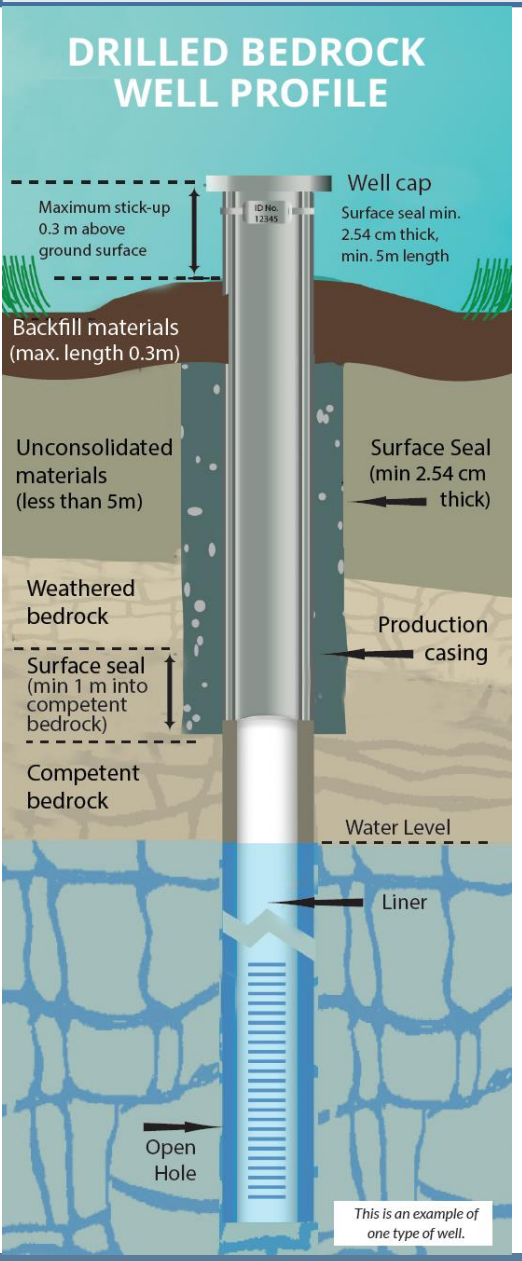
Delineation of Groundwater Regions

- Defined groundwater regions from previous studies
- Watershed mapping
- Topography relief & surface drainage
- Water wells concentration zones
- Subsurface geology & structural geology
- Mapped aquifers

What is a Well?

Provides homeowners, municipalities, industry, and agricultural access to water stored underground

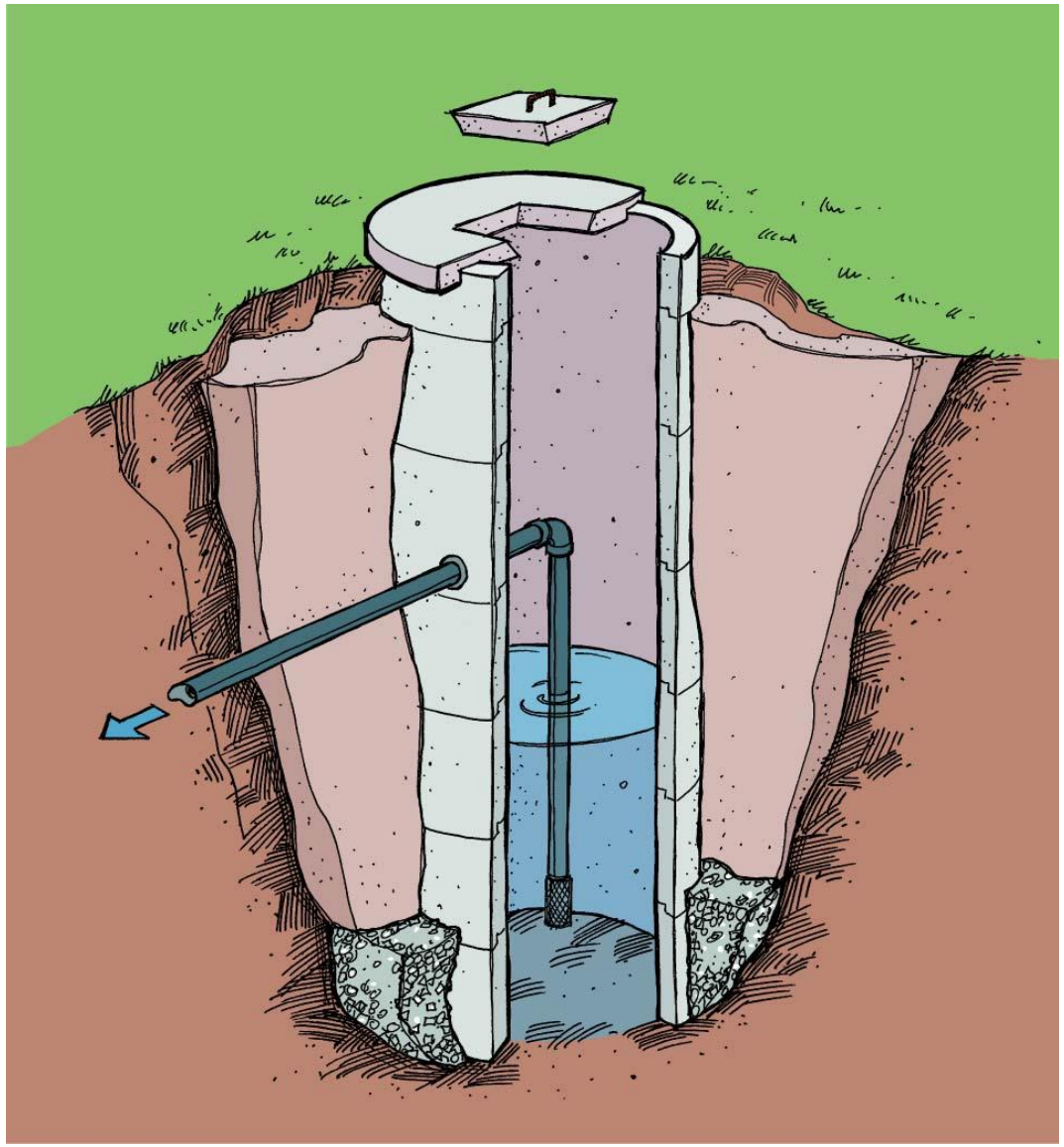
Aquifer Conceptualization



Drilled Wells

https://hydrogeo-logic.com/blog/domestic-groundwater-use-in-bc/

Aquifer Conceptualization



https://www.groundwatergovernance.org/the-age-of-a-water-well

BRITISH COLUMBIA

Best Practices for Dug Wells

A DUG WELL IS NOT TYPICALLY RECOMMENDED; however, in some instances a dug well can provide water where it is limited and a shallow aquifer is the only source. The purpose of this brochure is to provide home owners and contractors with best practices for dug water supply wells.

WHAT IS A DUG WELL?

Dug (or excavated) wells are shallow, typically less than 15 m (50 ft) deep and 1 m (3 ft) wide (*see Figure 1*). They are relatively inexpensive to construct as they are commonly dug using excavators, backhoes or power shovels. Unfortunately, the shallow depth of a dug well makes them vulnerable to contamination and susceptible to lowered water levels from drought, neighbouring well interference, and local changes in drainage.

FIGURE 1 *A typical Dug Well*

HOW DO I CHOOSE A LOCATION FOR MY DUG WELL?

To minimize water quality and quantity impacts, dug wells should be at least 3 m (10 ft) deep and sited away from surface water sources. Surface water can carry contaminants from the land surface into your well and the aquifer. Check with your local government about setbacks for construction of wells near streams, lakes and wetlands.

A new water supply well needs to be at least 15 m (50 ft) from an existing water supply well, unless the same person owns both wells and only one new well will be constructed, or if the existing well is not in use/intended for use in the future. The Health Hazards Regulation requires wells to be sited away from possible sources of contamination; at least 6 m (20 ft) from the nearest building, 30 m (100 ft) from any probable source of contamination (e.g., septic tank or drain field, storage of chemicals including paints and pesticides, animal manure, parked cars, etc.), and 120 m (400 ft) from a cemetery or dumping ground (e.g., landfill) (*see Figure 2*).

FIGURE 2 *Regulated setbacks from potential contamination sources*

HOW DO I PROPERLY CONSTRUCT A DUG WELL?

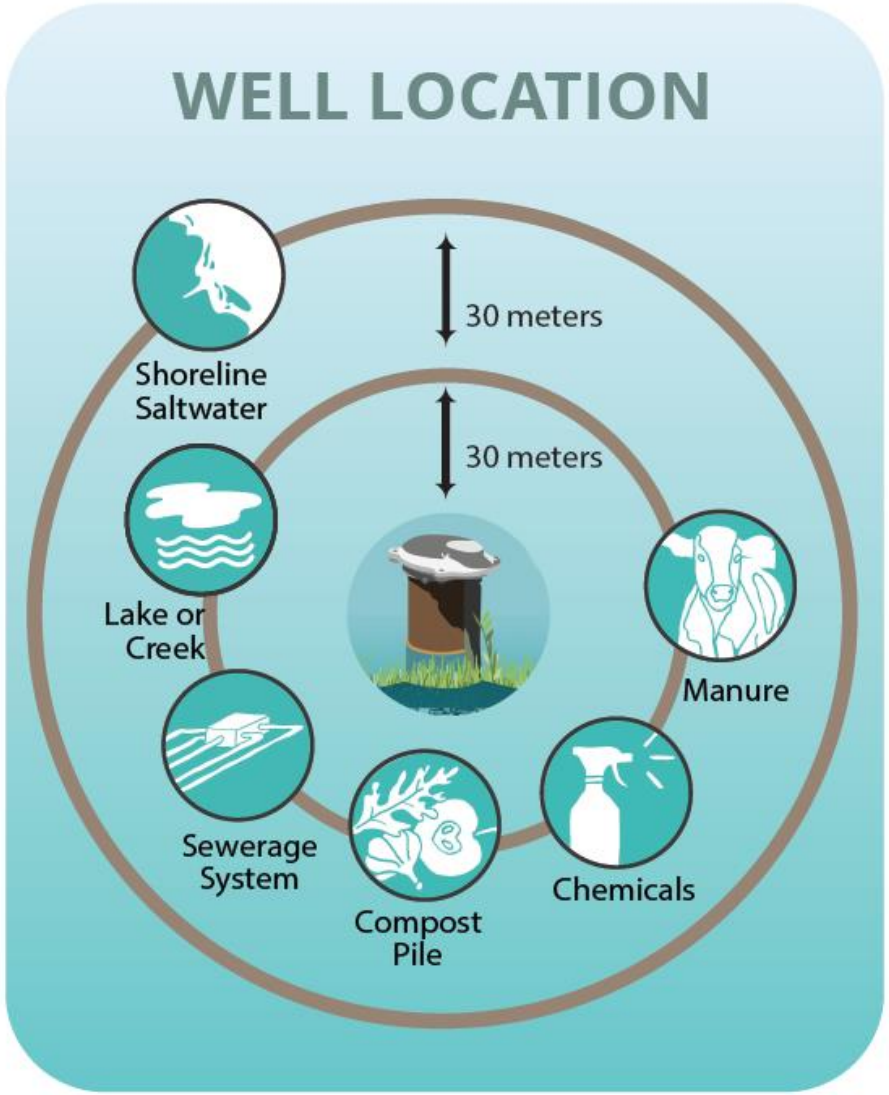
Anyone can construct a dug well less than 15 m (50 ft) deep; any deeper requires a registered well driller. However, the person constructing the well must be familiar with and follow the construction standards in the Groundwater Protection Regulation (*see Figure 3*):

FIGURE 3 *Properly constructed dug well*

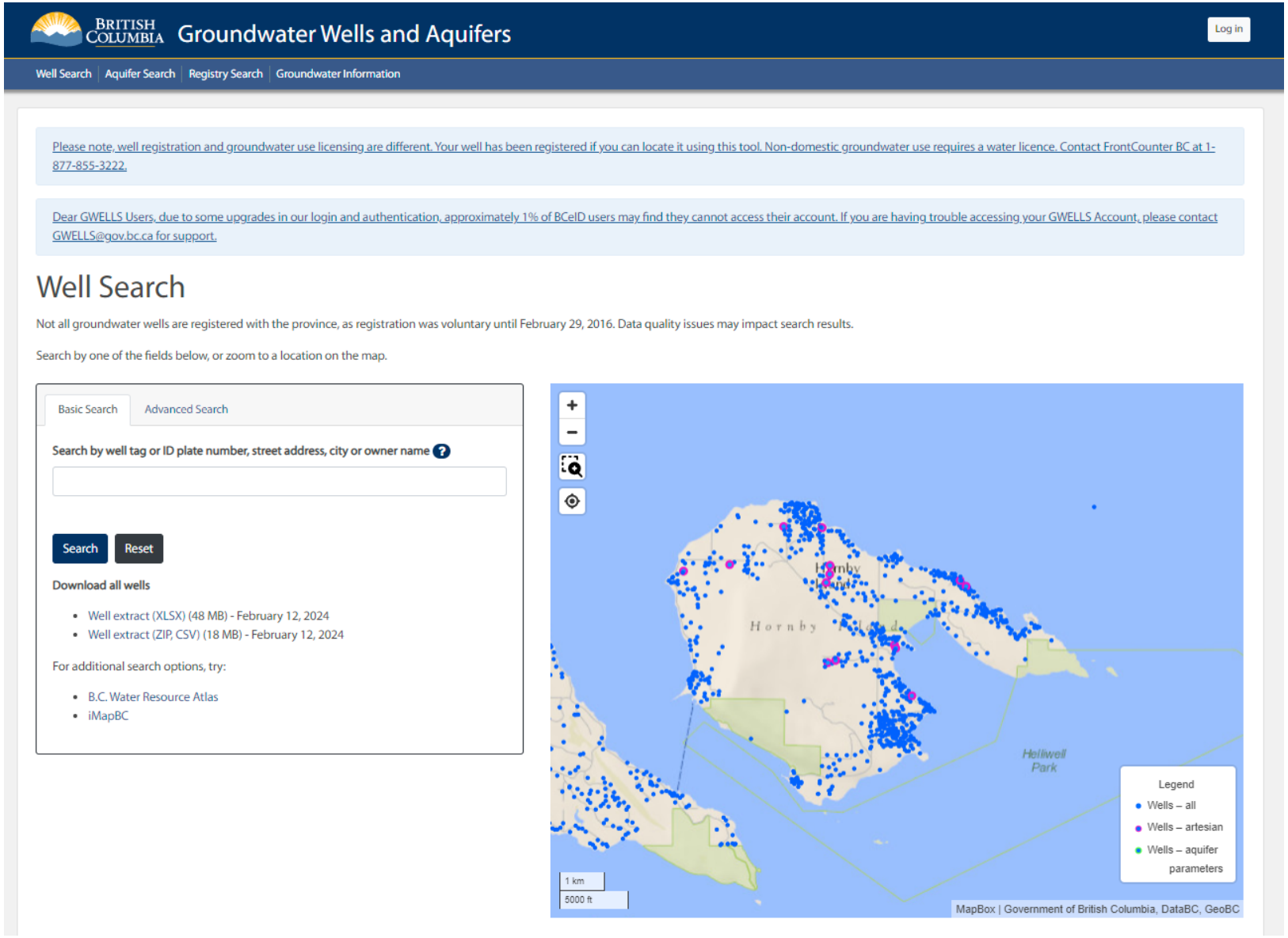
[1]

Dug Wells

Aquifer Conceptualization



Aquifer Conceptualization



Well Search

Aquifer Conceptualization

Well Summary

For best print results, use the Chrome browser

Well Tag Number: 94041
Well Identification Plate Number: 14324
Owner Name: HORNBY ISLAND RESIDENTS' AND RATEPAYERS' ASSOCIATION
Intended Water Use: Water Supply System
Artesian Condition: No

Well Status: New
Well Class: Water Supply
Well Subclass: Not Applicable

Aquifer Number: 438
Technical Report: N/A

Observation Well Number:
Observation Well Status:
Environmental Monitoring System (EMS) ID:

Alternative specs submitted: No
Drinking Water Area Indicator: No

Sections

Location Information
Well Activity
Well Work Dates
Well Completion Data and Artesian Flow
Lithology
Casing Details
Aquifer Parameters
Surface Seal and Backfill Details
Liner Details
Screen Details
Well Development
Well Yield
Well Decommissioning
Comments
Disclaimer

Licensing Information

Licensed Status: Licensed
Licence Number: 501661

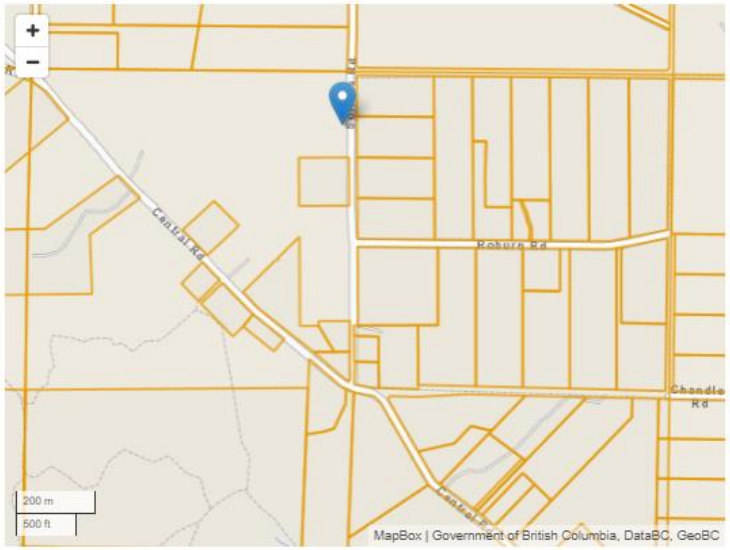
Location Information

Street Address: SOLLANS ROAD
Town/City: HORNBY ISLAND

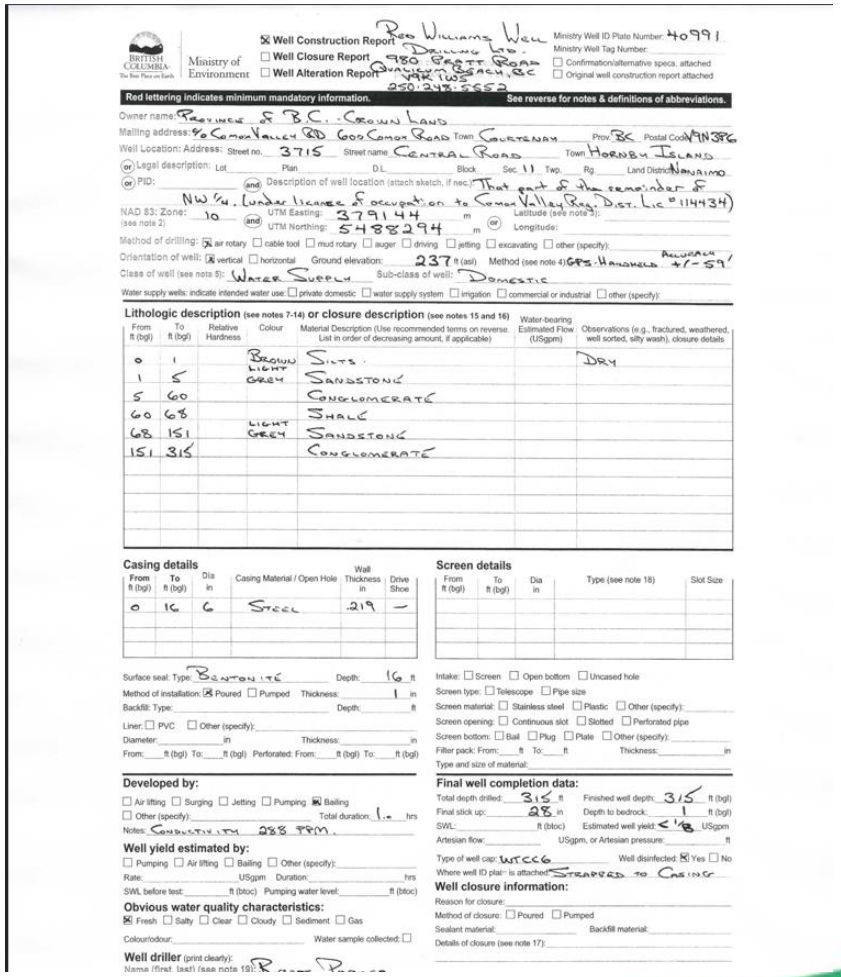
Legal Description:

Lot	
Plan	
District Lot	
Block	
Section	11
Township	
Range	
Land District	32
Property Identification Description (PID)	

Description of Well Location: THAT PART OF SECTION 11, HORNBY ISLAND, FORMERLY SURVEYED AS BLOCK F, NORTHWEST 1/4 OF SECTION 11, NANAIMO DISTRICT, CROWN LAND, LEASED UNDER THE LAND ACT



Geographic Coordinates - North American Datum of 1983 (NAD 83)
Latitude: 49.53804
Longitude: -124.66516
UTM Easting: 379526
UTM Northing: 5488602
Zone: 10
Coordinate Acquisition Code: (10 m accuracy)



Ministry of Environment
☒ Well Construction Report — Reg Williams Well Drilling Ltd. — Ministry Well ID Plate Number: 40991
☐ Well Closure Report — 980 Pratt Road, Qualicum Beach, BC — Ministry Well Tag Number:
☐ Well Alteration Report — V9K 1W5 — 250-248-5552
☐ Confirmation/alternative specs. attached
☐ Original well construction report attached

Red lettering indicates minimum mandatory information. See reverse for notes & definitions of abbreviations.

Owner name: Province of B.C. - Crown Land
Mailing address: % Comox Valley RD 600 Comox Road Town Courtenay Prov. BC Postal Code V9N 3P6
Well Location: Address: Street no. 3715 Street name Central Road Town Hornby Island
Legal description: Lot Plan D.L. Block Sec. 11 Twp. Rg. Land District Nanaimo
PID: and Description of well location (attach sketch, if nec.): That part of the remainder of NW ¼, (under licence of occupation to Comox Valley Reg. Dist. Lic # 114434)
NAD 83: Zone: 10 (see note 2) and UTM Easting: 379144 m and UTM Northing: 5488294 m or Latitude (see note 3): Longitude:
Method of drilling: ☒ air rotary ☐ cable tool ☐ mud rotary ☐ auger ☐ driving ☐ jetting ☐ excavating ☐ other (specify):
Orientation of well: ☒ vertical ☐ horizontal Ground elevation: 237 ft (asl) Method (see note 4) GPS-Handheld +/- 5m Accuracy
Class of well (see note 5): Water Supply Sub-class of well: Domestic
Water supply wells: indicate intended water use: ☐ private domestic ☐ water supply system ☐ irrigation ☐ commercial or industrial ☐ other (specify):

Lithologic description (see notes 7-14) or closure description (see notes 15 and 16)

From ft (bgl)	To ft (bgl)	Relative Hardness	Colour	Material Description (Use recommended terms on reverse. List in order of decreasing amount, if applicable)	Water-bearing Estimated Flow (USgpm)	Observations (e.g., fractured, weathered, well sorted, silty wash), closure details
0	1		Brown	Silts		Dry
1	5		Light Grey	Sandstone		
5	60			Conglomerate		
60	68			Shale		
68	151		Light Grey	Sandstone		
151	315			Conglomerate		

Casing details

From ft (bgl)	To ft (bgl)	Dia in	Casing Material / Open Hole	Wall Thickness in	Drive Shoe
0	16	6	Steel	.219	—

Screen details

From ft (bgl)	To ft (bgl)	Dia in	Type (see note 18)	Slot Size

Surface seal: Type: Bentonite Depth: 16 ft
Method of installation: ☒ Poured ☐ Pumped Thickness: 1 in
Backfill: Type: Depth: ft
Liner: ☐ PVC ☐ Other (specify): Diameter: in Thickness: in From: ft (bgl) To: ft (bgl) Perforated: From: ft (bgl) To: ft (bgl)
Intake: ☐ Screen ☐ Open bottom ☐ Uncased hole
Screen type: ☐ Telescope ☐ Pipe size
Screen material: ☐ Stainless steel ☐ Plastic ☐ Other (specify):
Screen opening: ☐ Continuous slot ☐ Slotted ☐ Perforated pipe
Screen bottom: ☐ Ball ☐ Plug ☐ Plate ☐ Other (specify):
Filter pack: From: ft To: ft Thickness: in
Type and size of material:

Developed by:
☐ Air lifting ☐ Surging ☐ Jetting ☐ Pumping ☒ Bailing
☐ Other (specify): Total duration: 1.0 hrs
Notes: Conductivity 288 ppm.

Well yield estimated by:
☐ Pumping ☐ Air lifting ☐ Bailing ☐ Other (specify):
Rate: USgpm Duration: hrs
SWL before test: ft (btoc) Pumping water level: ft (btoc)

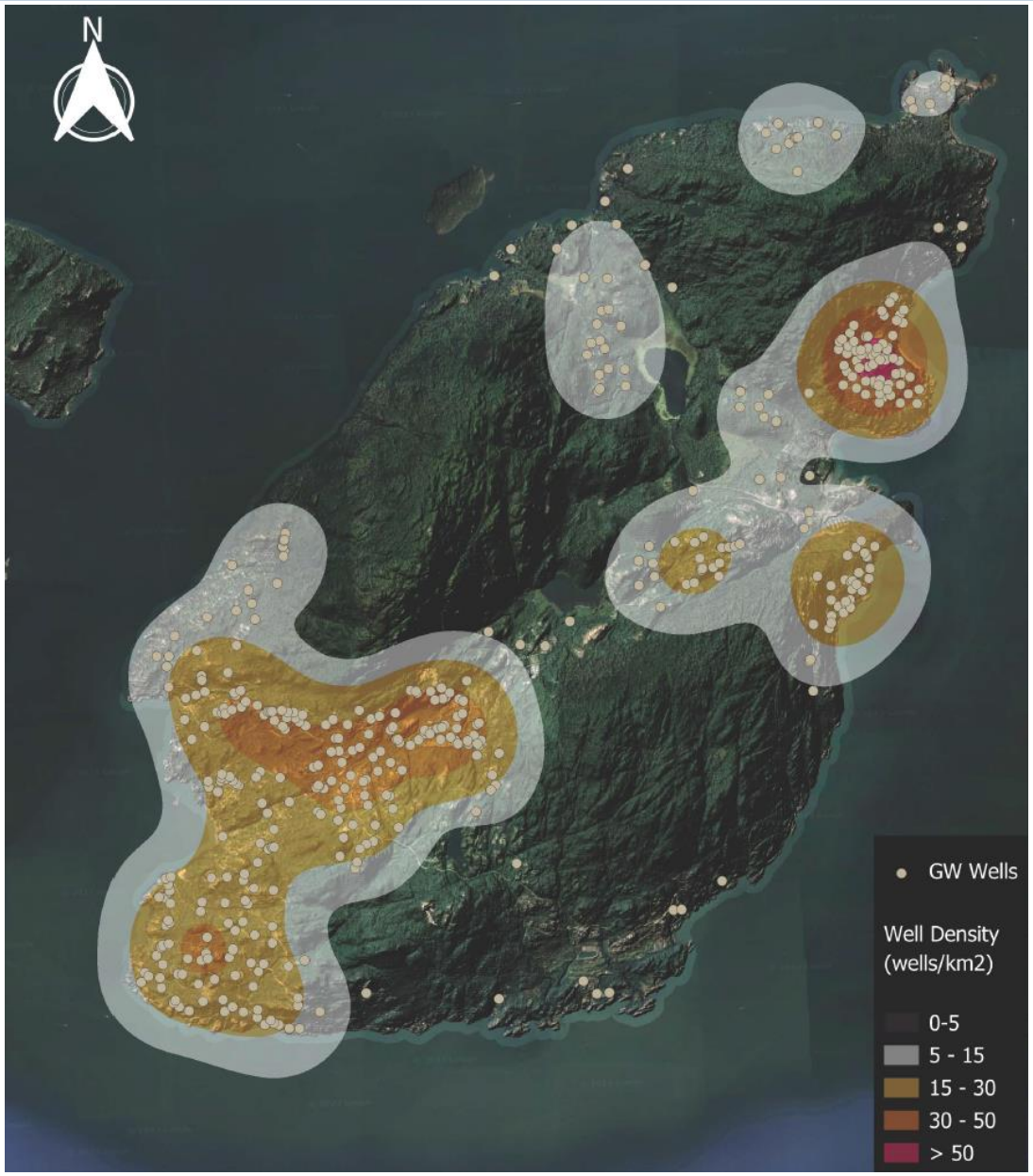
Obvious water quality characteristics:
☒ Fresh ☐ Salty ☐ Clear ☐ Cloudy ☐ Sediment ☐ Gas
Colour/odour: Water sample collected: ☐

Well driller (print clearly):
Name (first, last) (see note 19): R. [illegible] Perkins

Final well completion data:
Total depth drilled: 315 ft Finished well depth: 315 ft (bgl)
Final stick up: 28 in Depth to bedrock: 1 ft (bgl)
SWL: ft (btoc) Estimated well yield: < 1/8 USgpm
Artesian flow: USgpm, or Artesian pressure: ft
Type of well cap: WTCC6 Well disinfected: ☒ Yes ☐ No
Where well ID plate is attached: Strapped to Casing

Well closure information:
Reason for closure:
Method of closure: ☐ Poured ☐ Pumped
Sealant material: Backfill material:
Details of closure (see note 17):

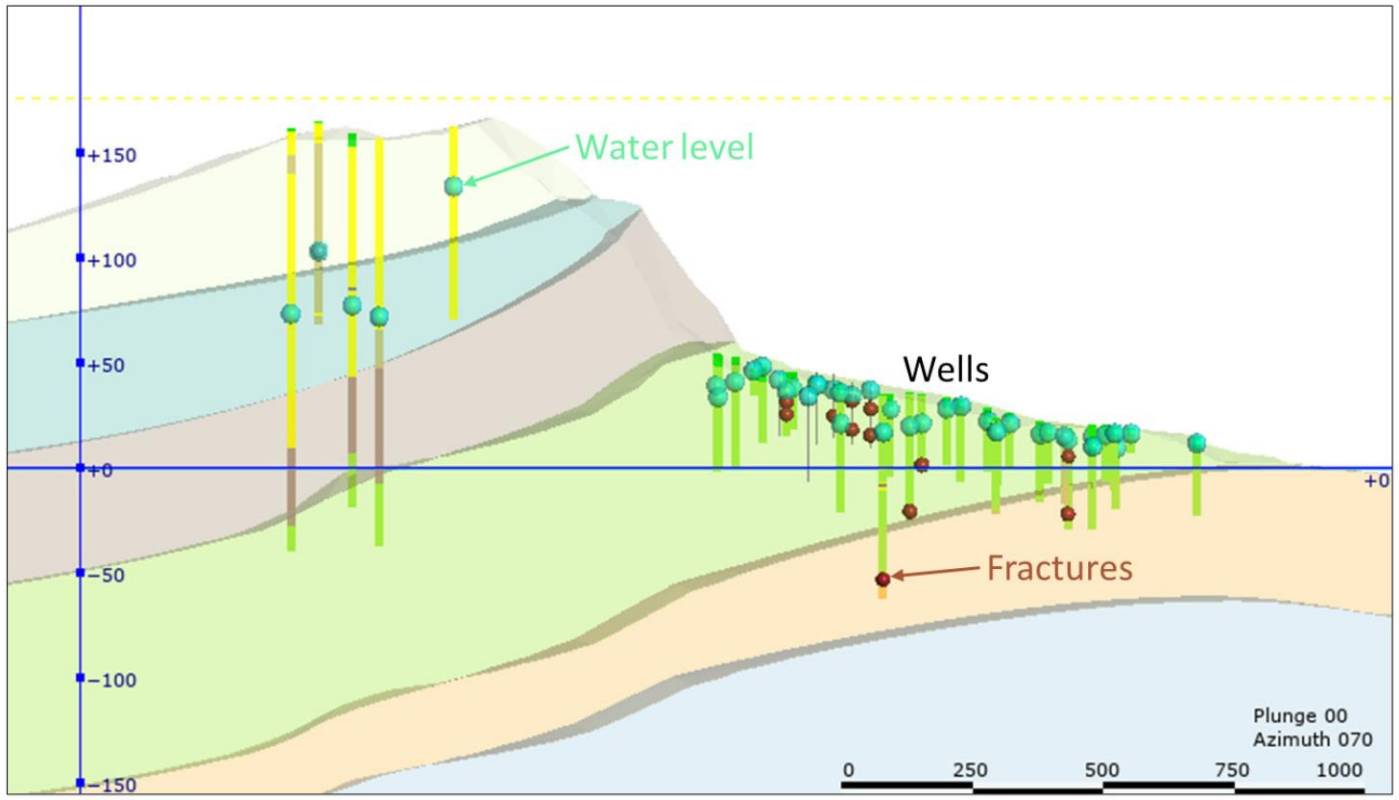
Aquifer Conceptualization



Well Records

The Islands Trust Area has high domestic well density compared to other regions in the province.

Using machine learning from over 20,000 groundwater well records valuable data was collated into this project.



Well Records

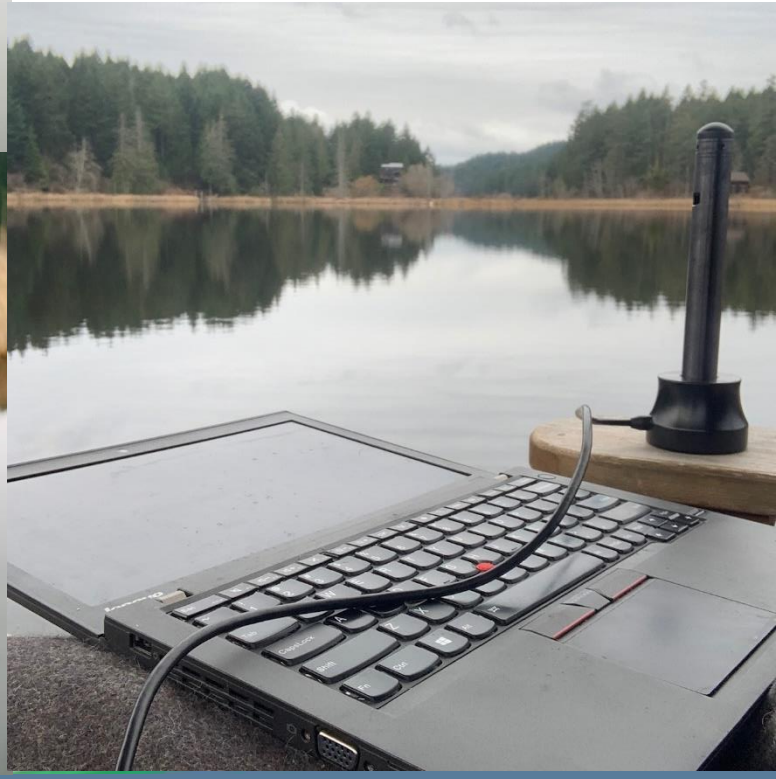
Well record data includes Important information.

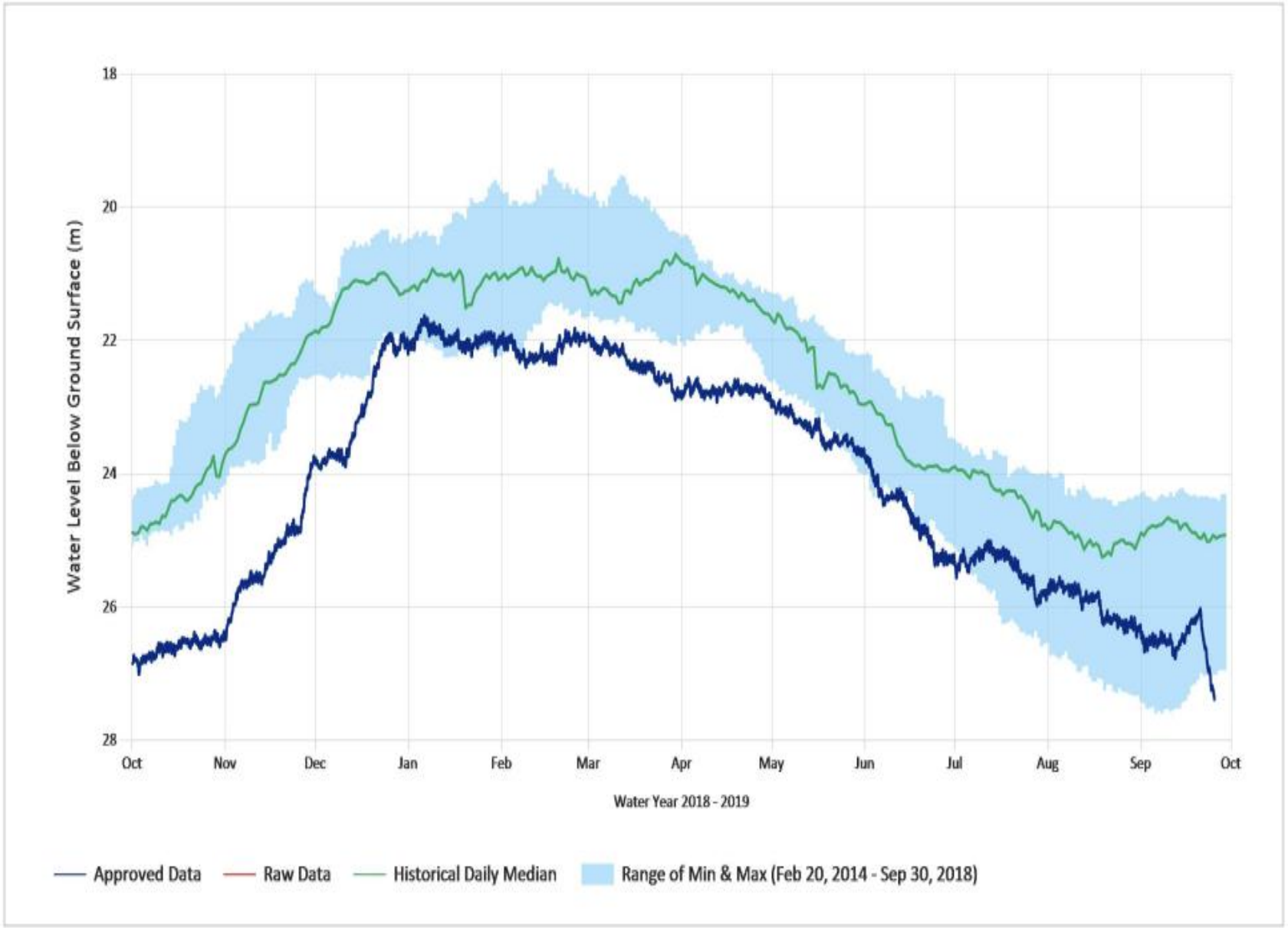
Can be used to predict groundwater resources or identify water quality issues

Aquifer Conceptualization

Photo: W.Shulba

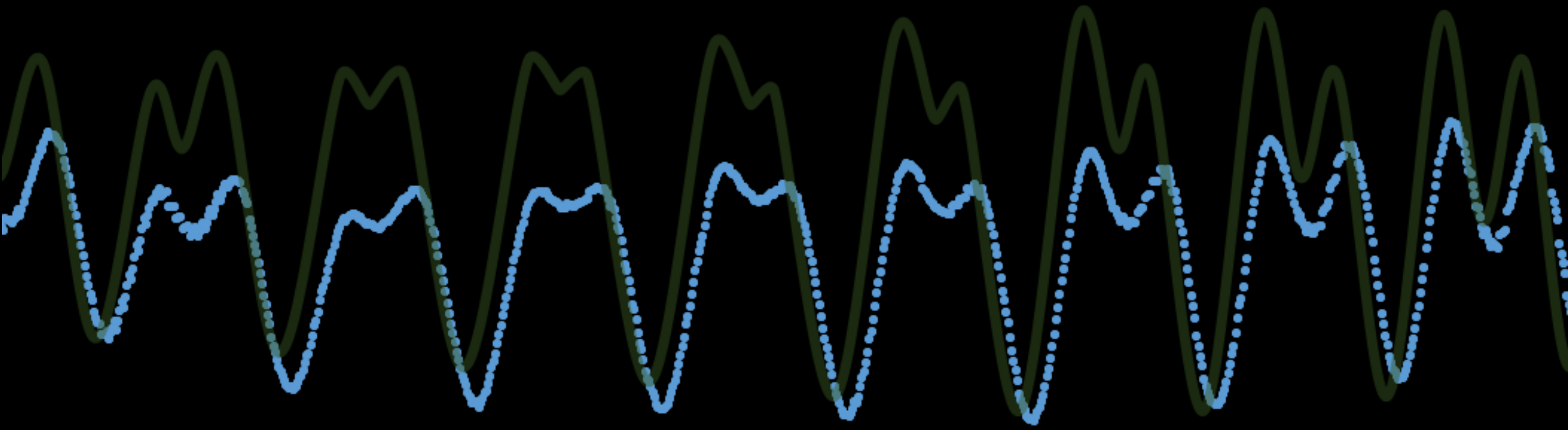
Well Monitoring





Provincial Groundwater Observation Wells Network

Fulford Harbour Tidal Predictions

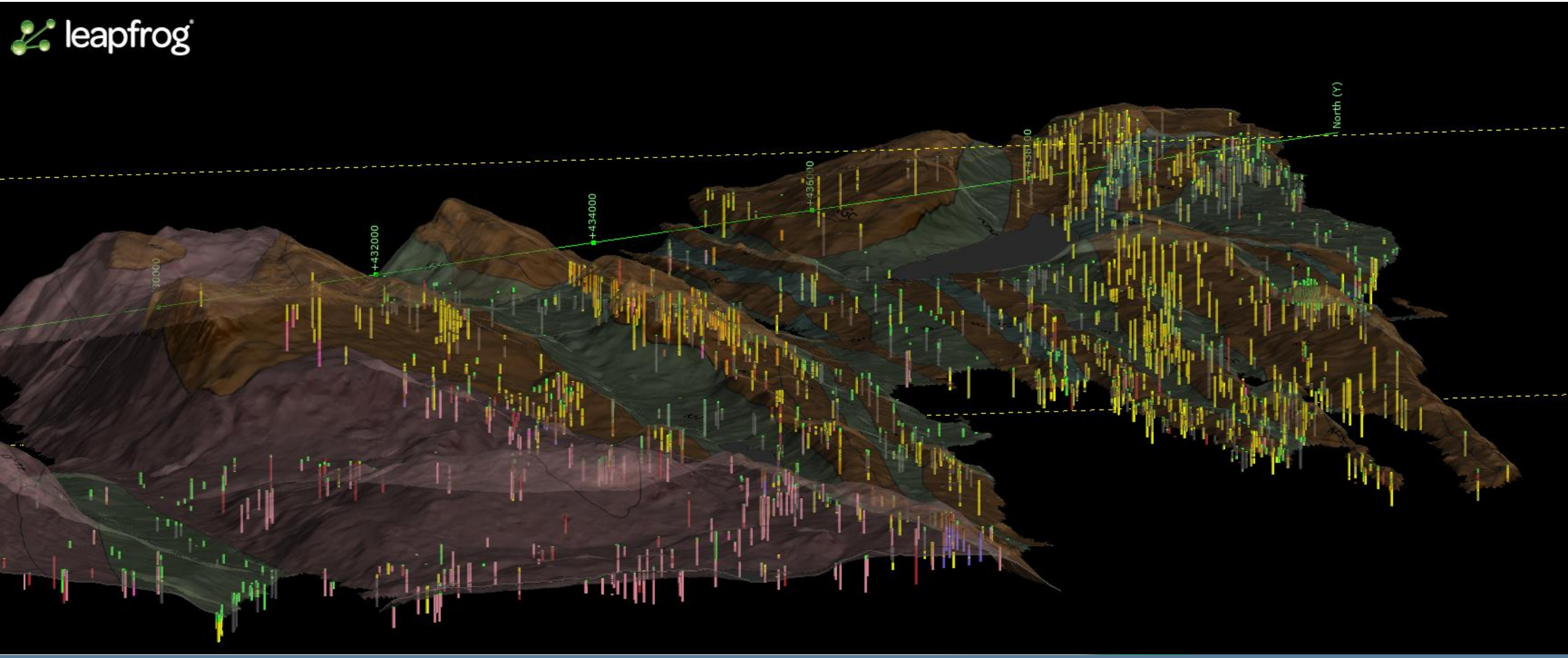


Groundwater Well Level
(Piezometric Surface)

Salt Spring Island
Volunteer Observation Wells Network

Aquifer Conceptualization

Three-dimensional Hydrogeological Model Viewer Demonstration

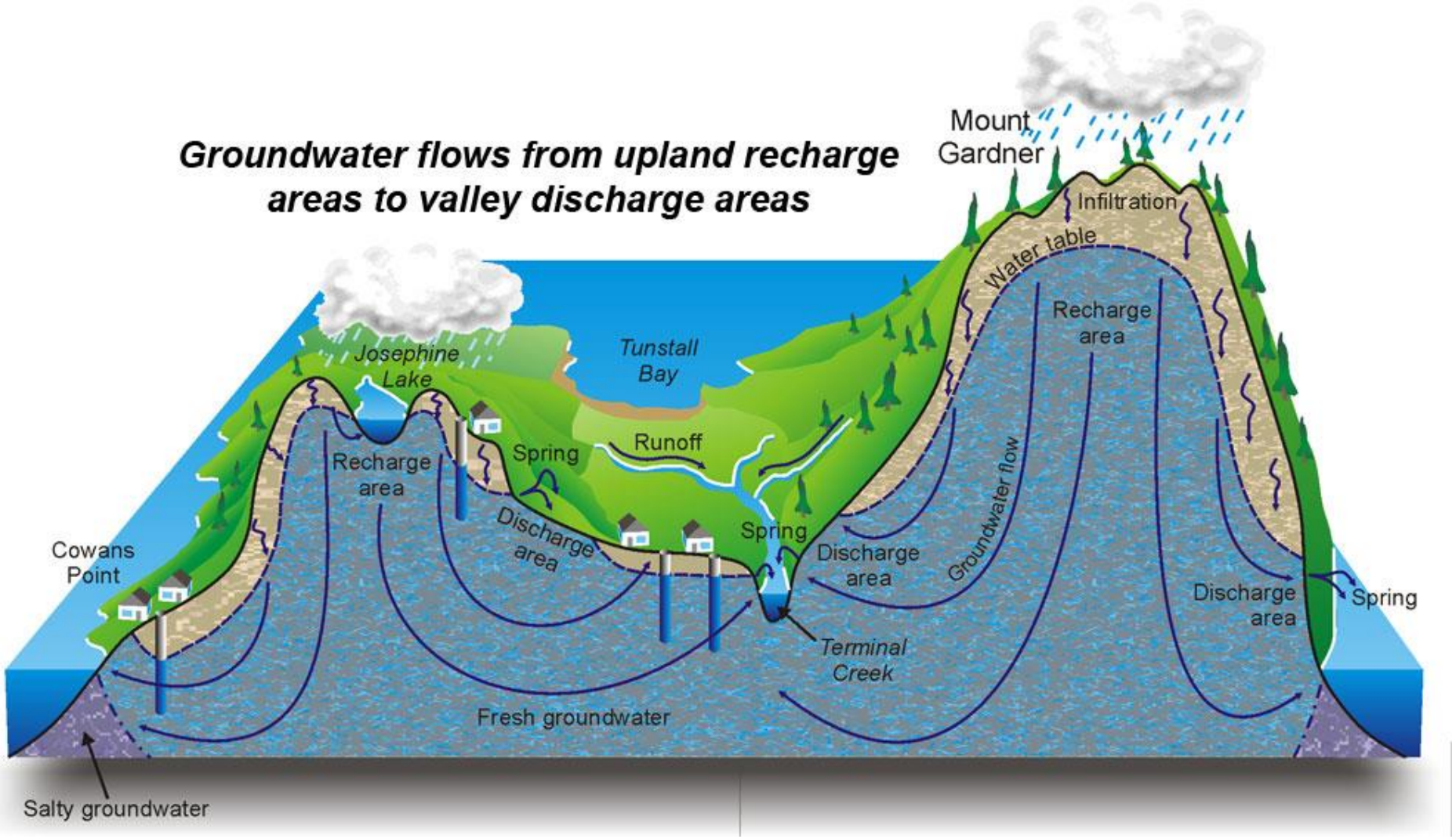


GROUNDWATER SUSTAINABILITY SCIENCE PROGRAM

Islands Trust Area Groundwater Recharge Mapping Project

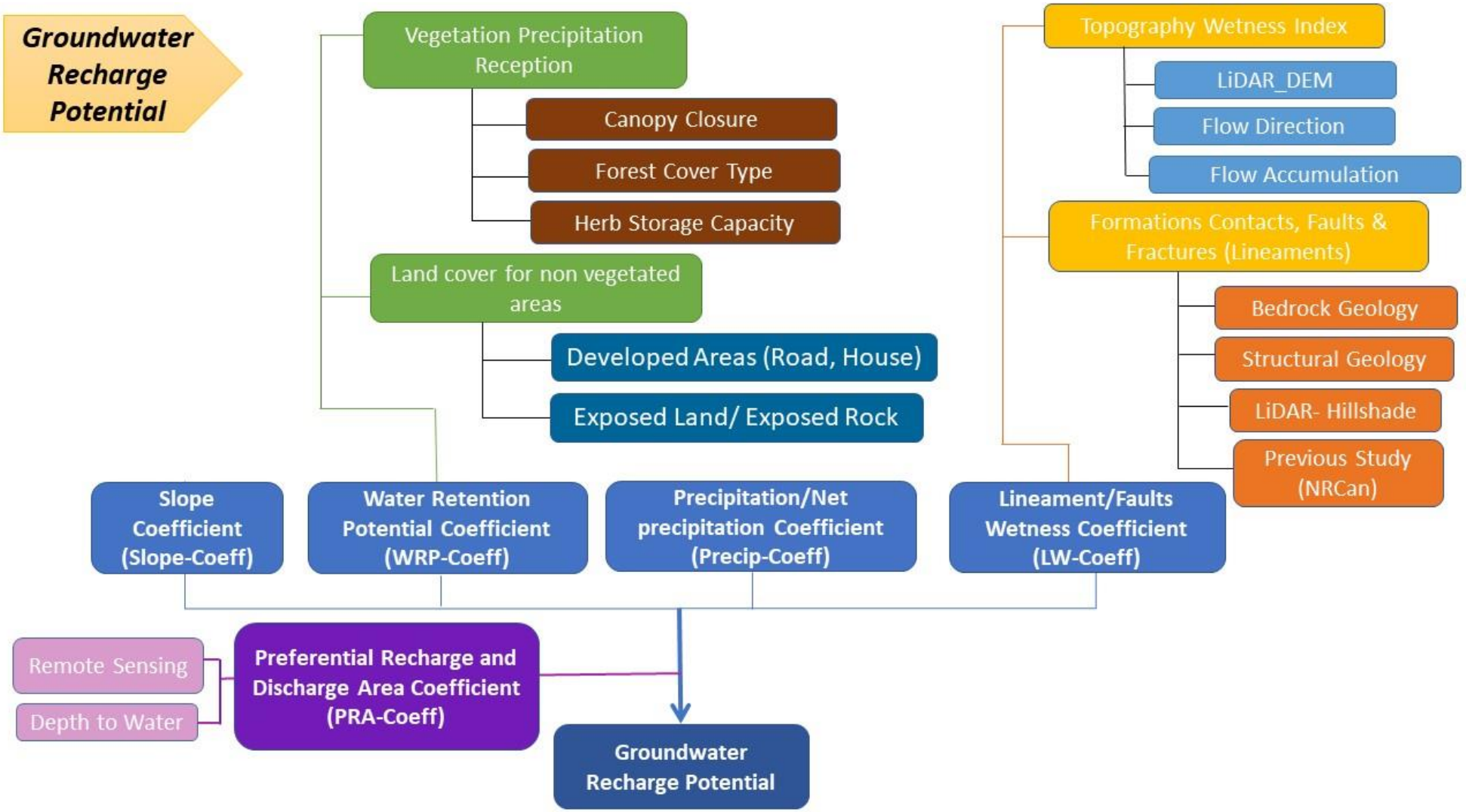
Islands Trust

Groundwater Recharge Mapping

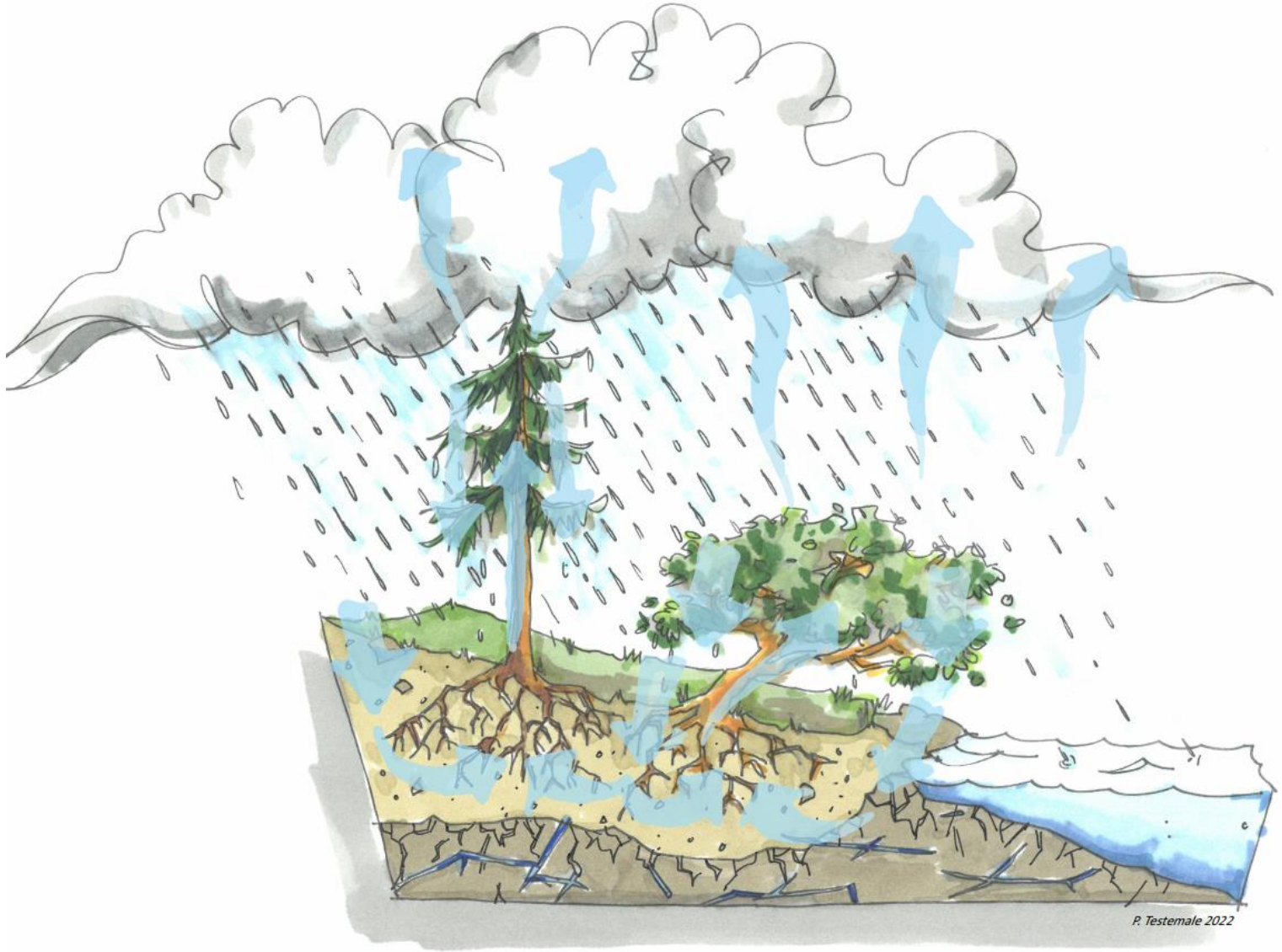


What is *Recharge?*

Groundwater Recharge Mapping



Mapping Methodology



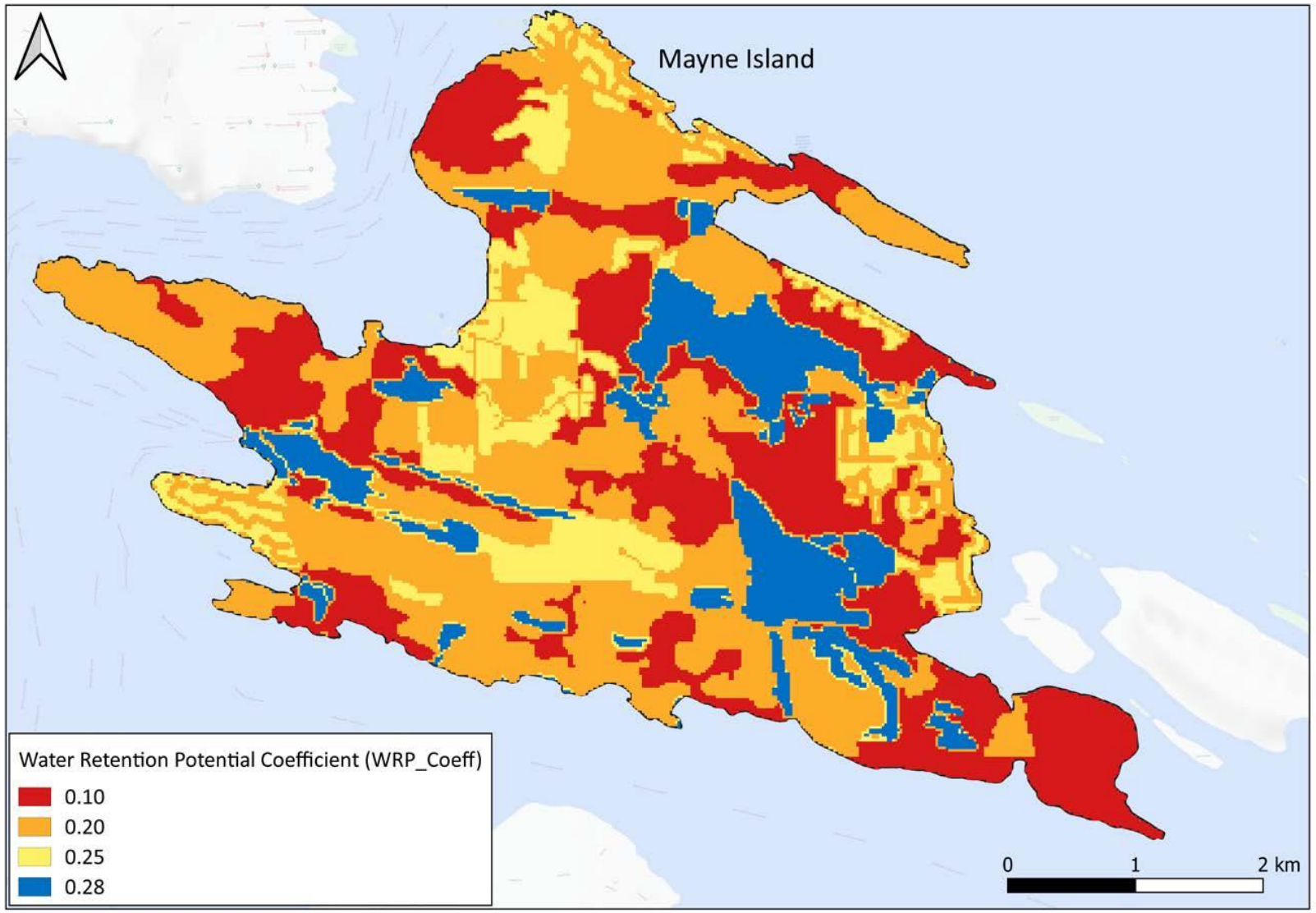
Groundwater Ecology?

Ecosystem role in groundwater recharge is paramount

Groundwater Ecology?

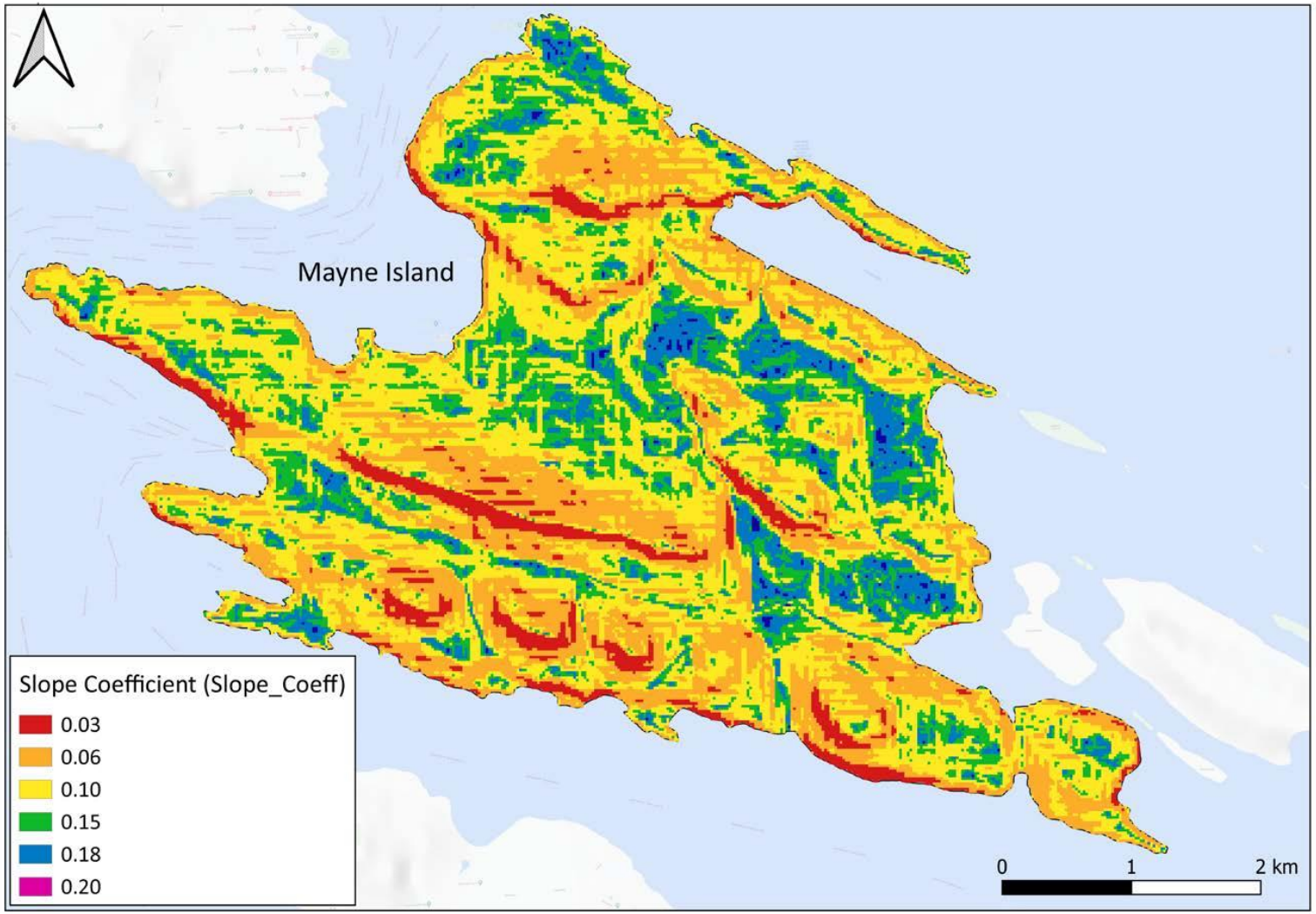
Healthy forests absorb water

Groundwater Recharge Mapping



Water retention areas

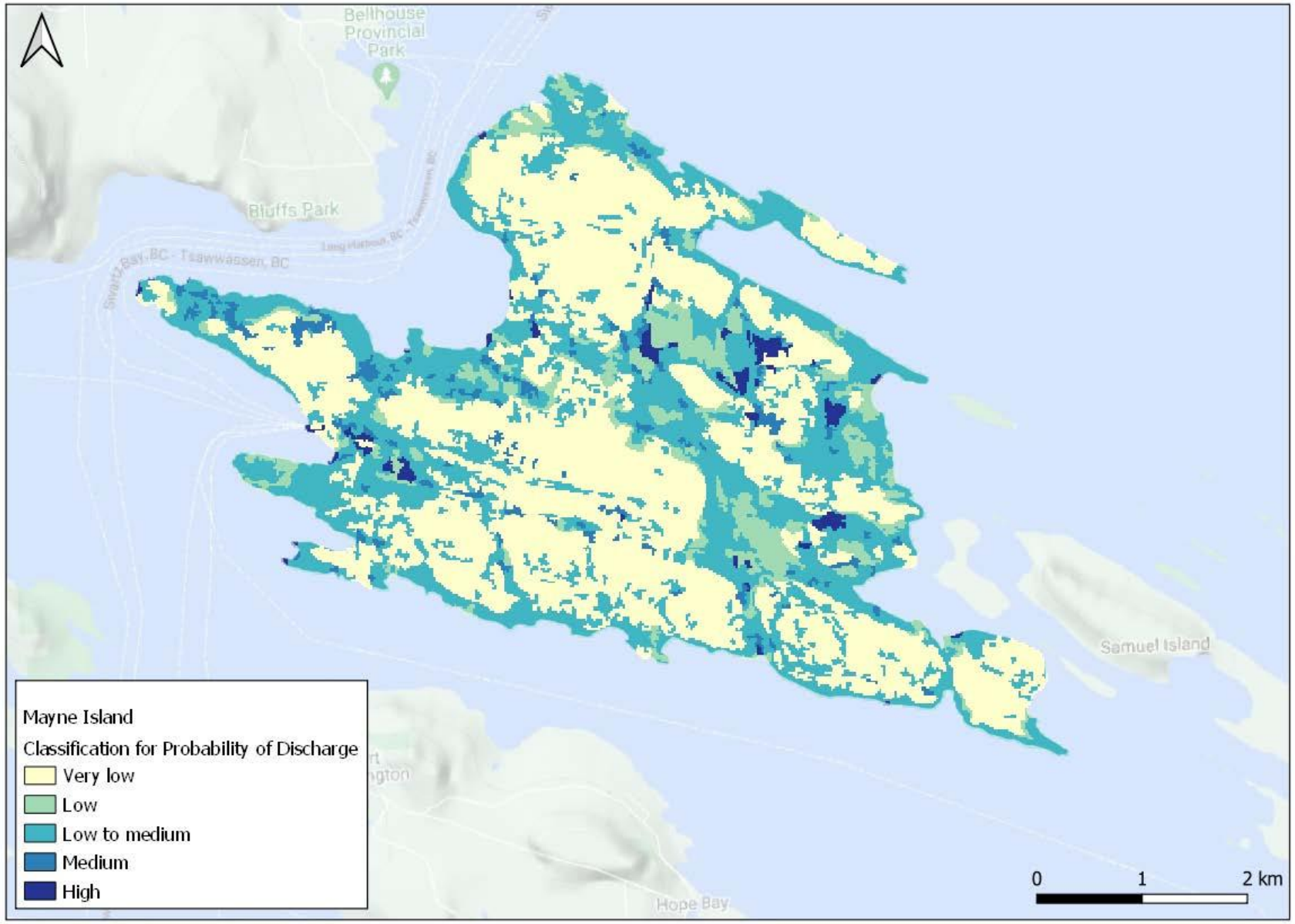
To runoff
or to not runoff



Slope and Recharge

Steep areas do not promote recharge

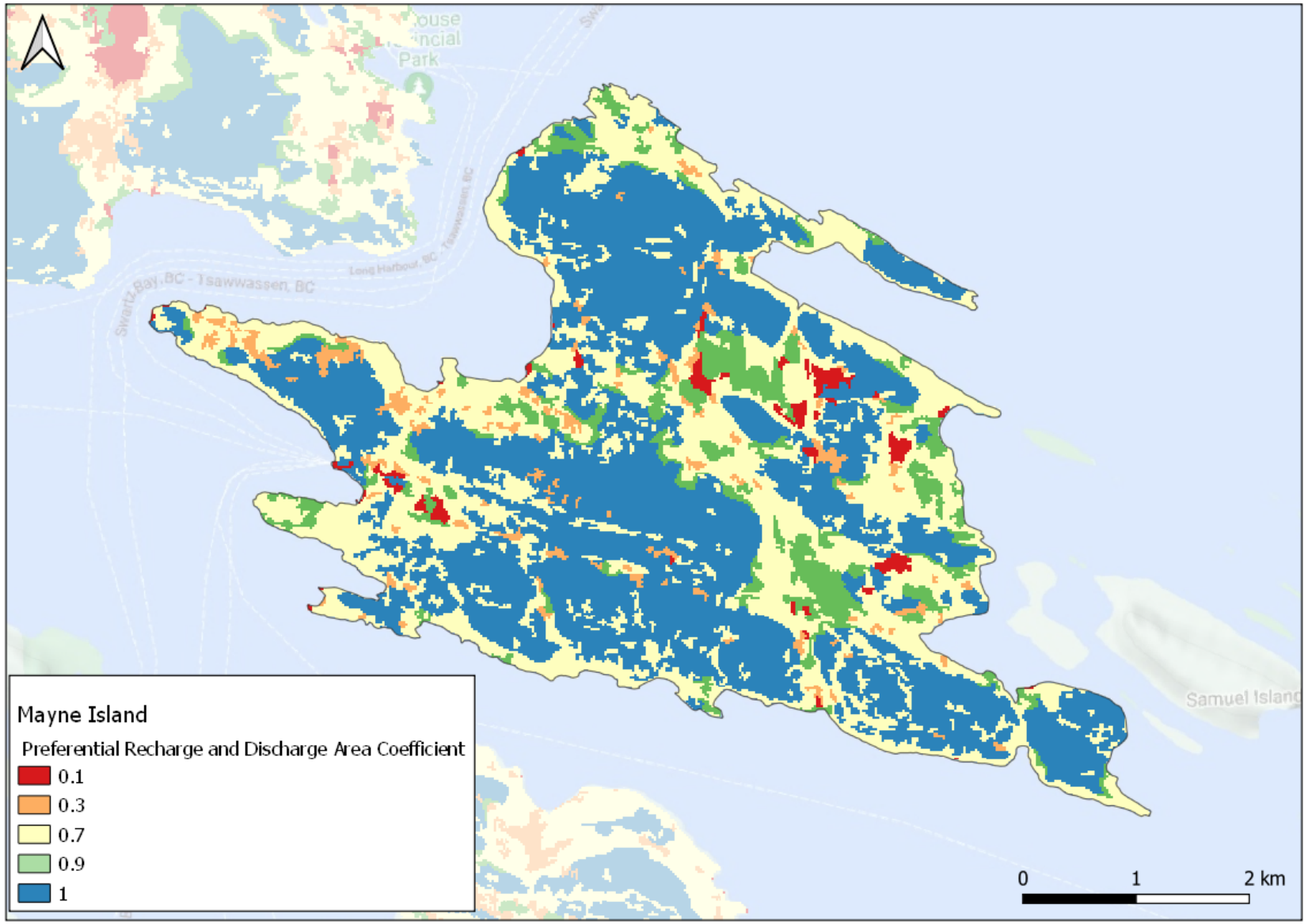
Groundwater Recharge Mapping



Discharge areas

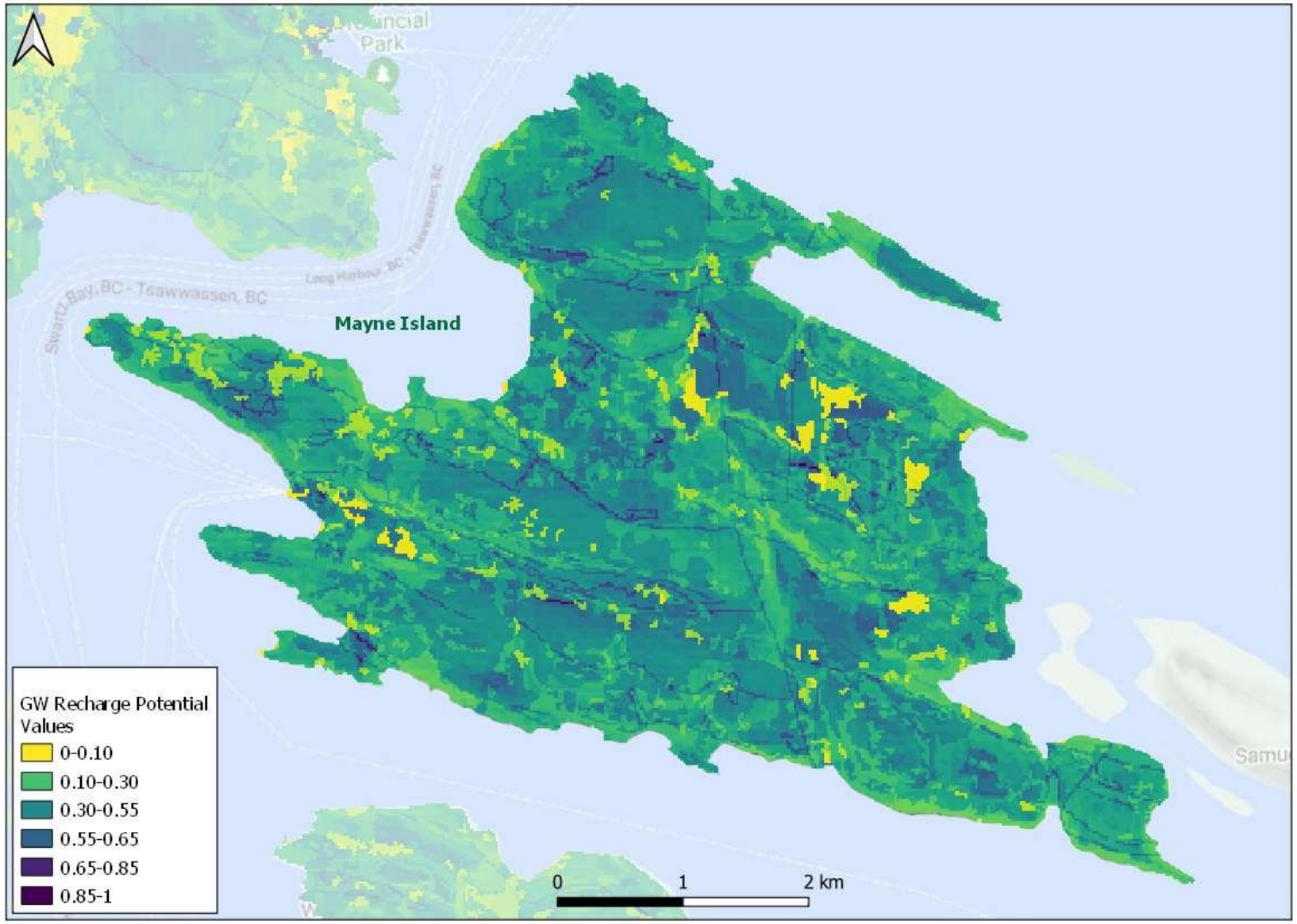
Not all areas recharge groundwater

Groundwater Recharge Mapping



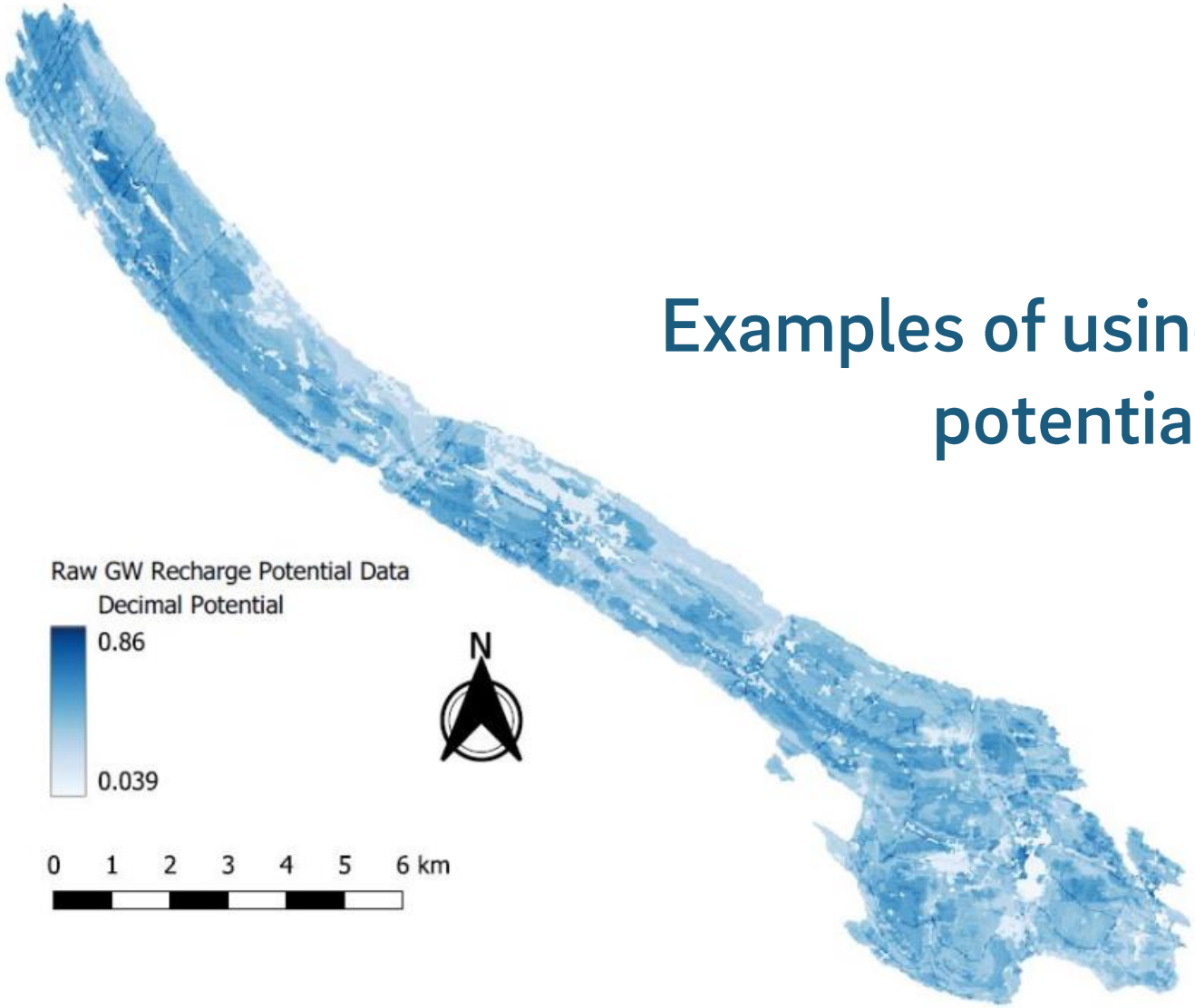
Discharge & Recharge Relationship

Groundwater Recharge Mapping



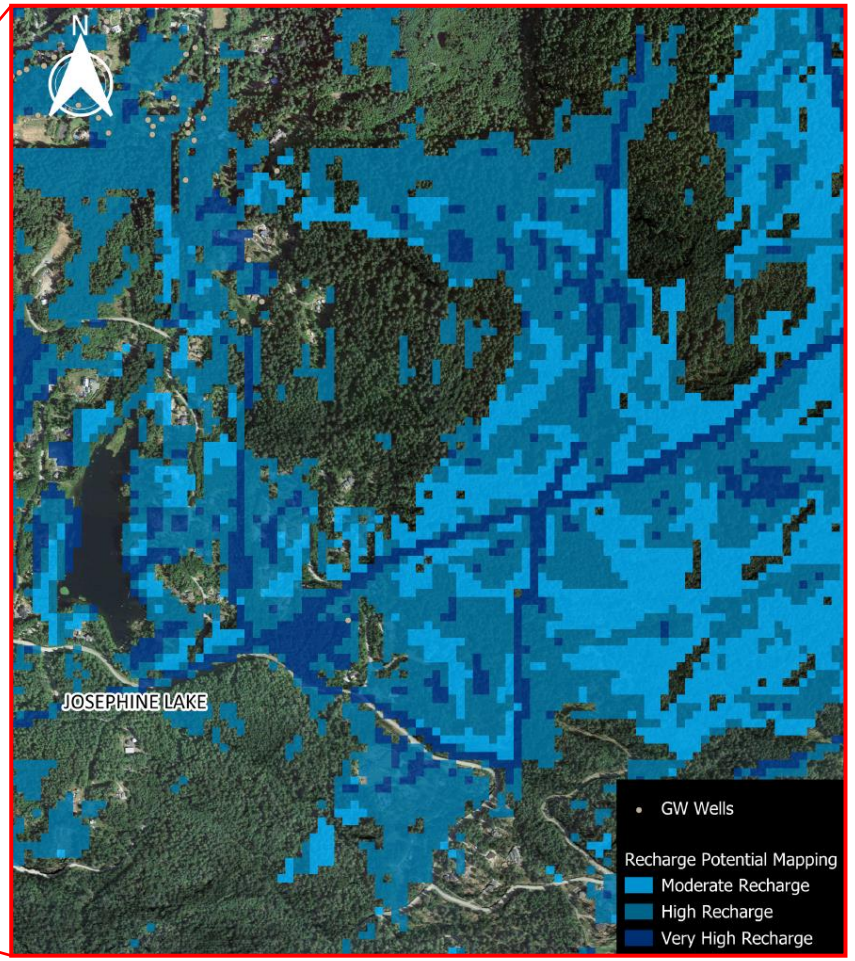
Raw recharge potential data

Groundwater Recharge Mapping



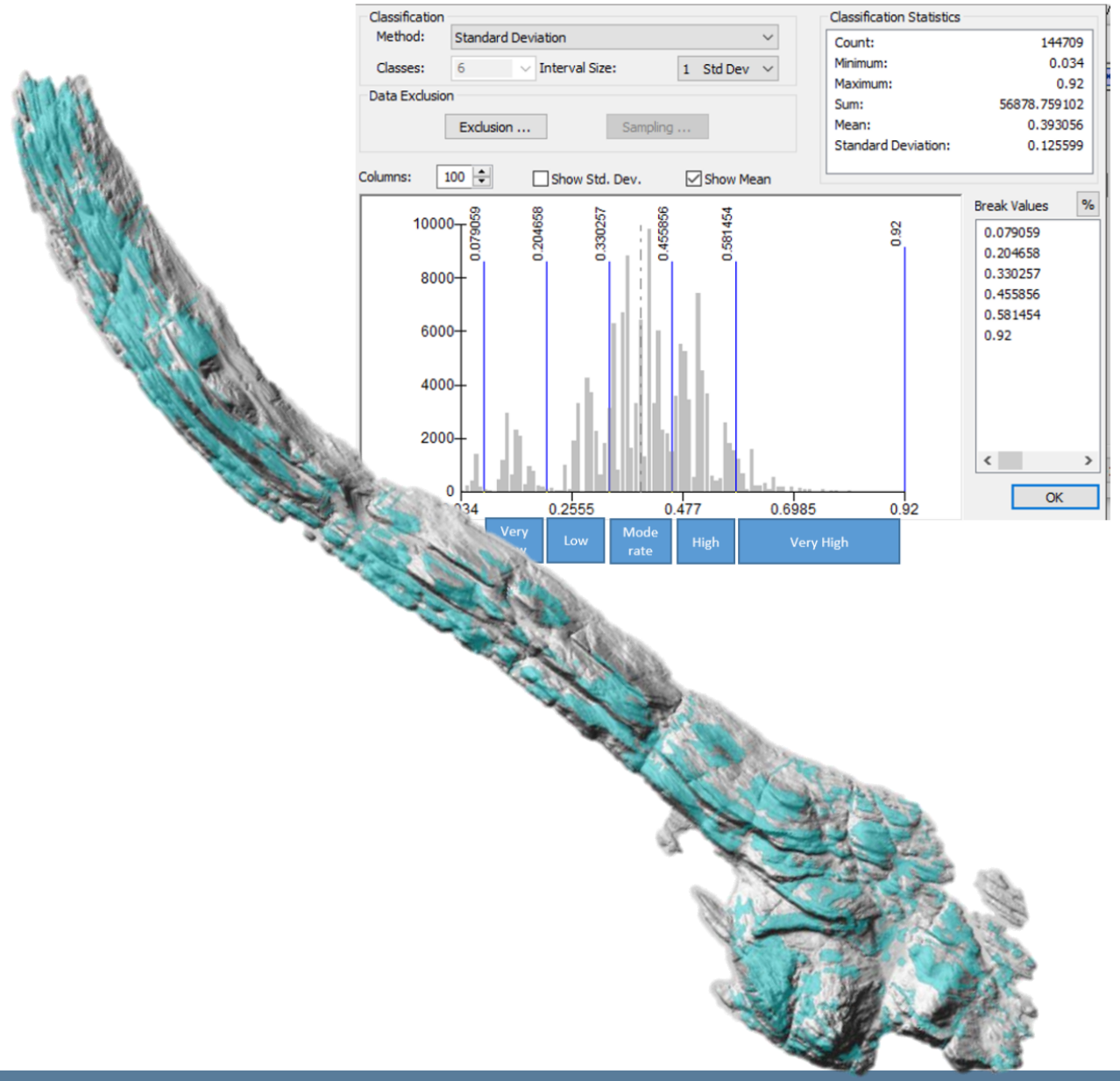
Examples of using raw recharge potential mapping data

Groundwater Recharge Mapping

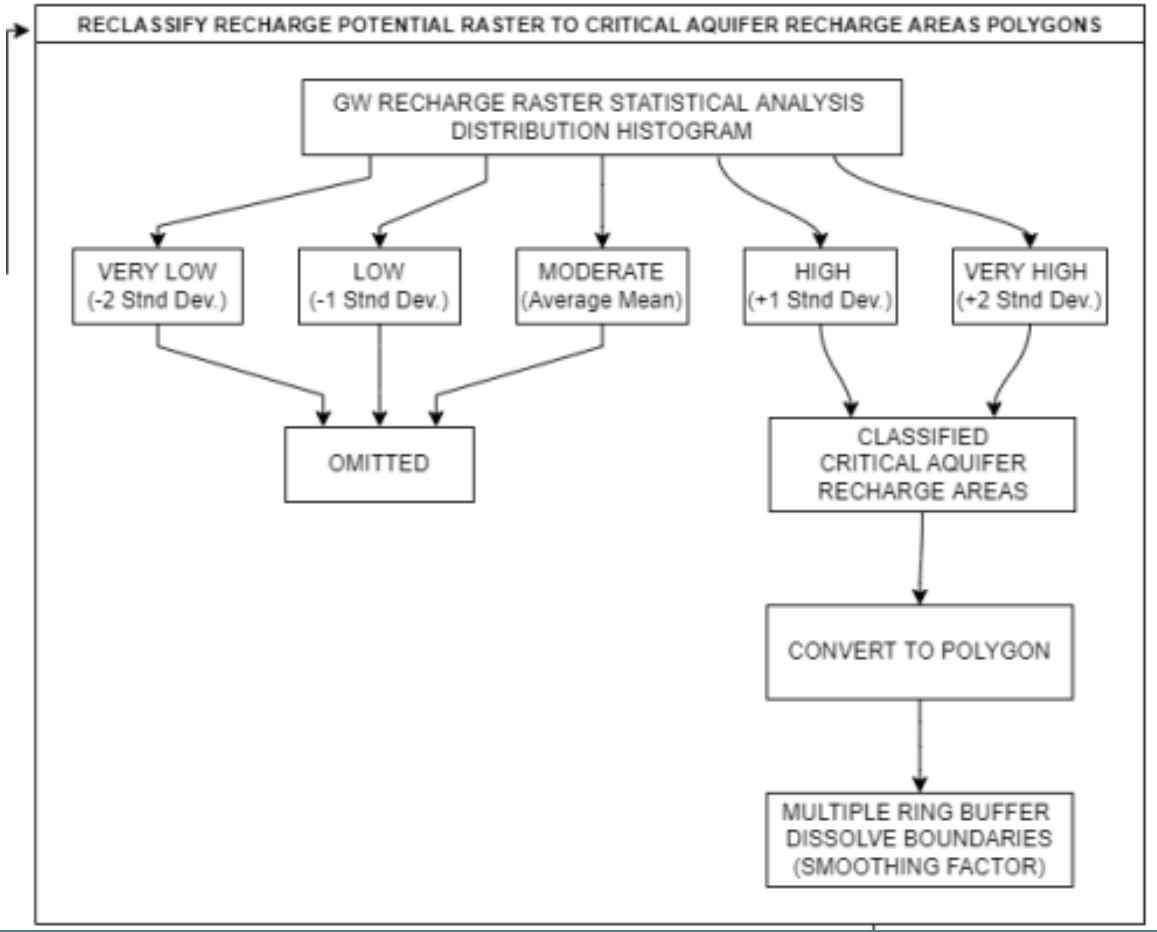


Classified Recharge Potential Data

Groundwater Recharge Mapping



Critical Aquifer Recharge Areas



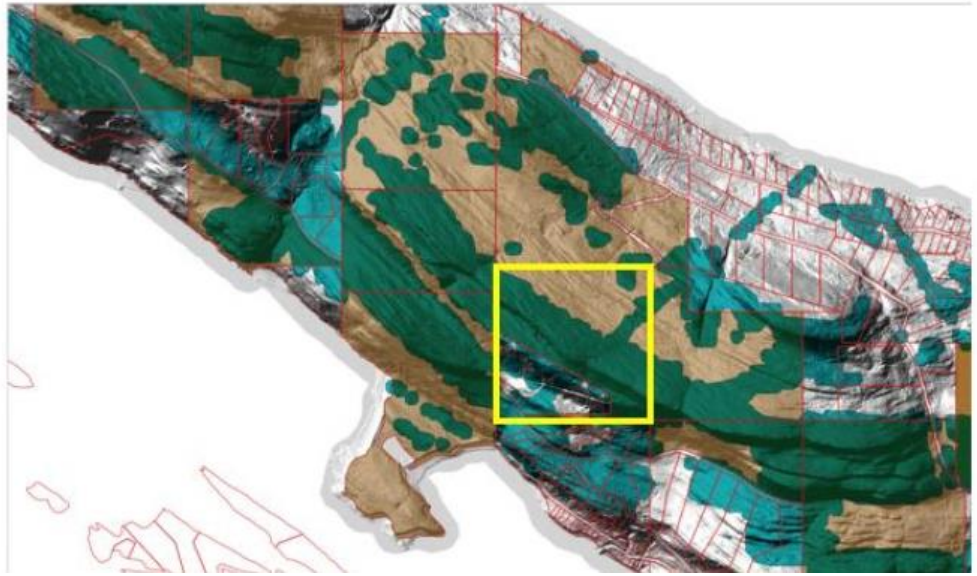
Groundwater Recharge Mapping

How much Critical Aquifer Recharge Area Per Lot Parcel?

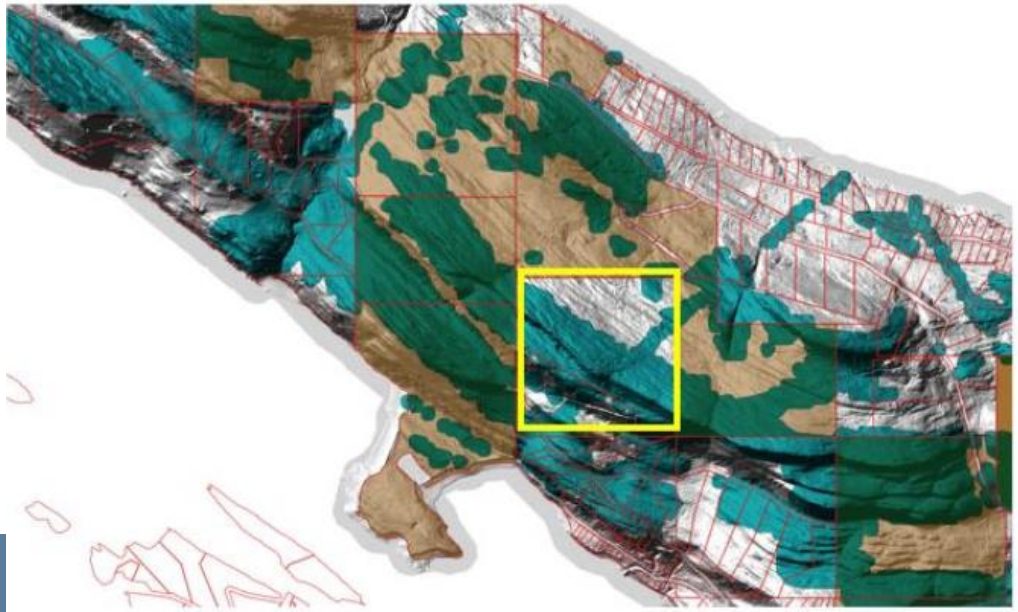
Critical Aquifer Recharge Area per Parcel Option	Parcels affected	Total Critical Aquifer Recharge Area Protected (Hectares)	Percentage of Total Critical Aquifer Recharge Area Protected (%)
2-hectare	182	2095	87%
5-hectare	95	1832	76%
10-hectare	62	1591	66%
20-hectare	36	1240	51%

Groundwater Recharge Mapping

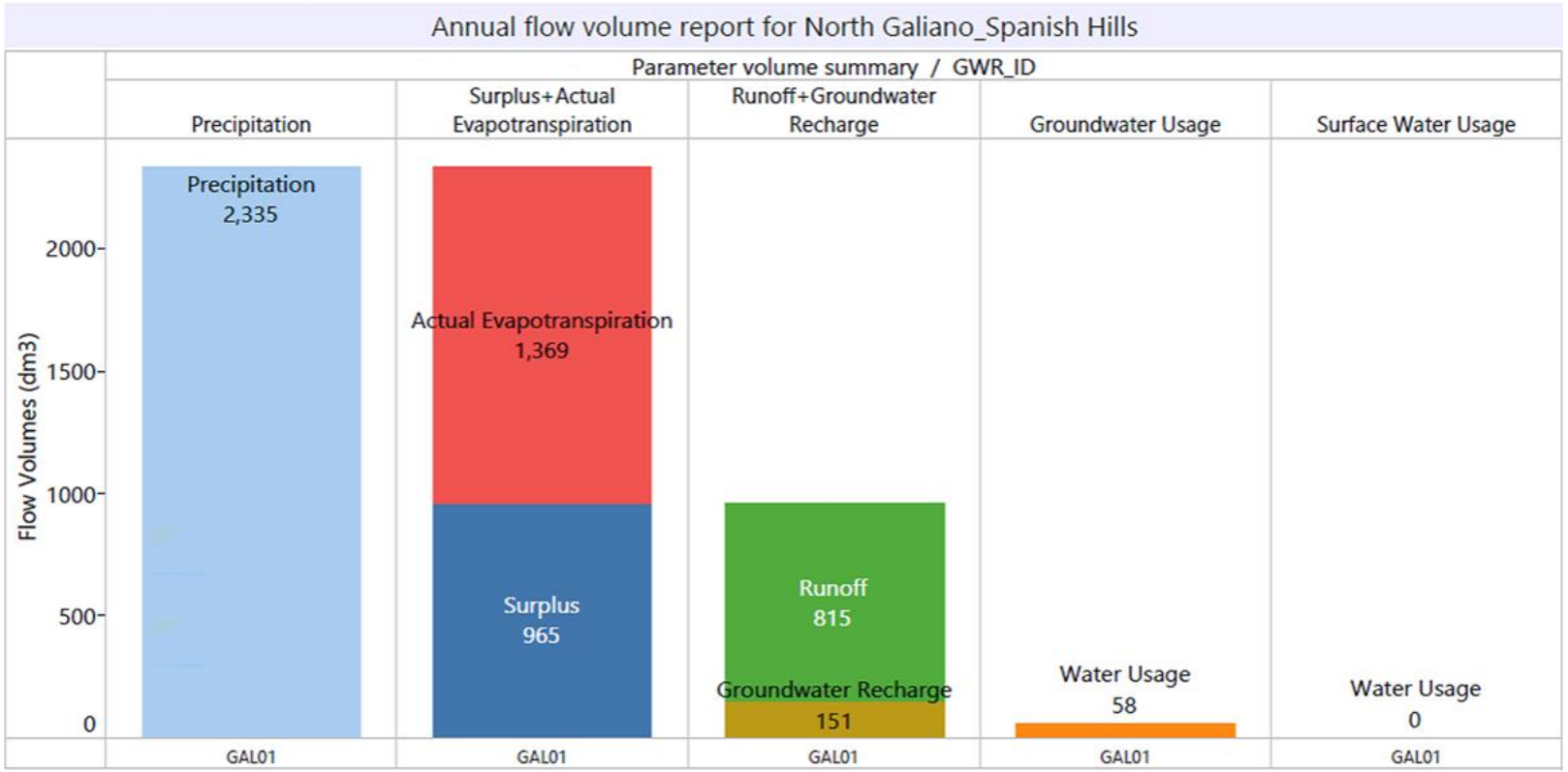
10-Hectare Option



20-Hectare Option



Groundwater Recharge Mapping



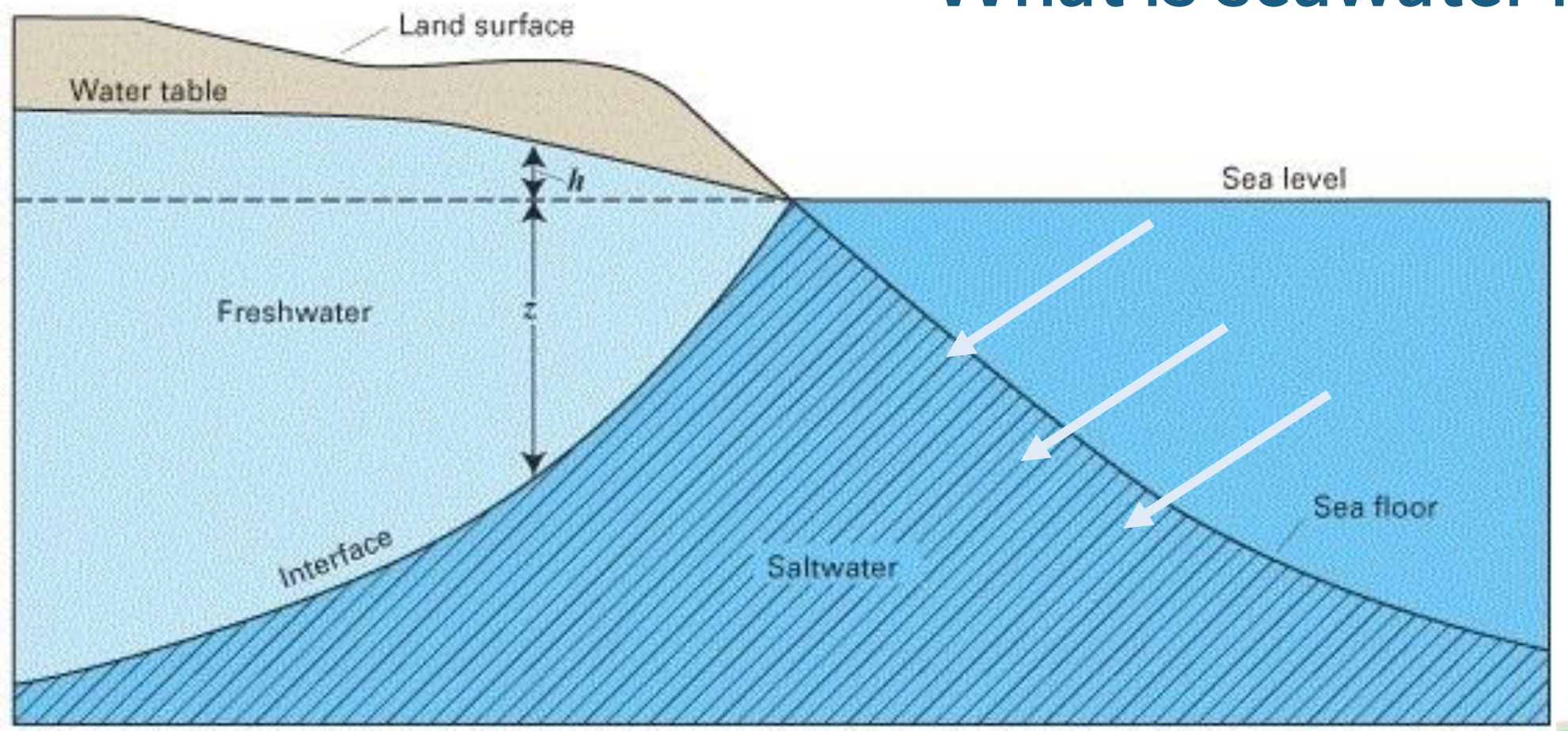
Regional Groundwater Availability Studies for determining Island Water Balance

GROUNDWATER SUSTAINABILITY SCIENCE PROGRAM

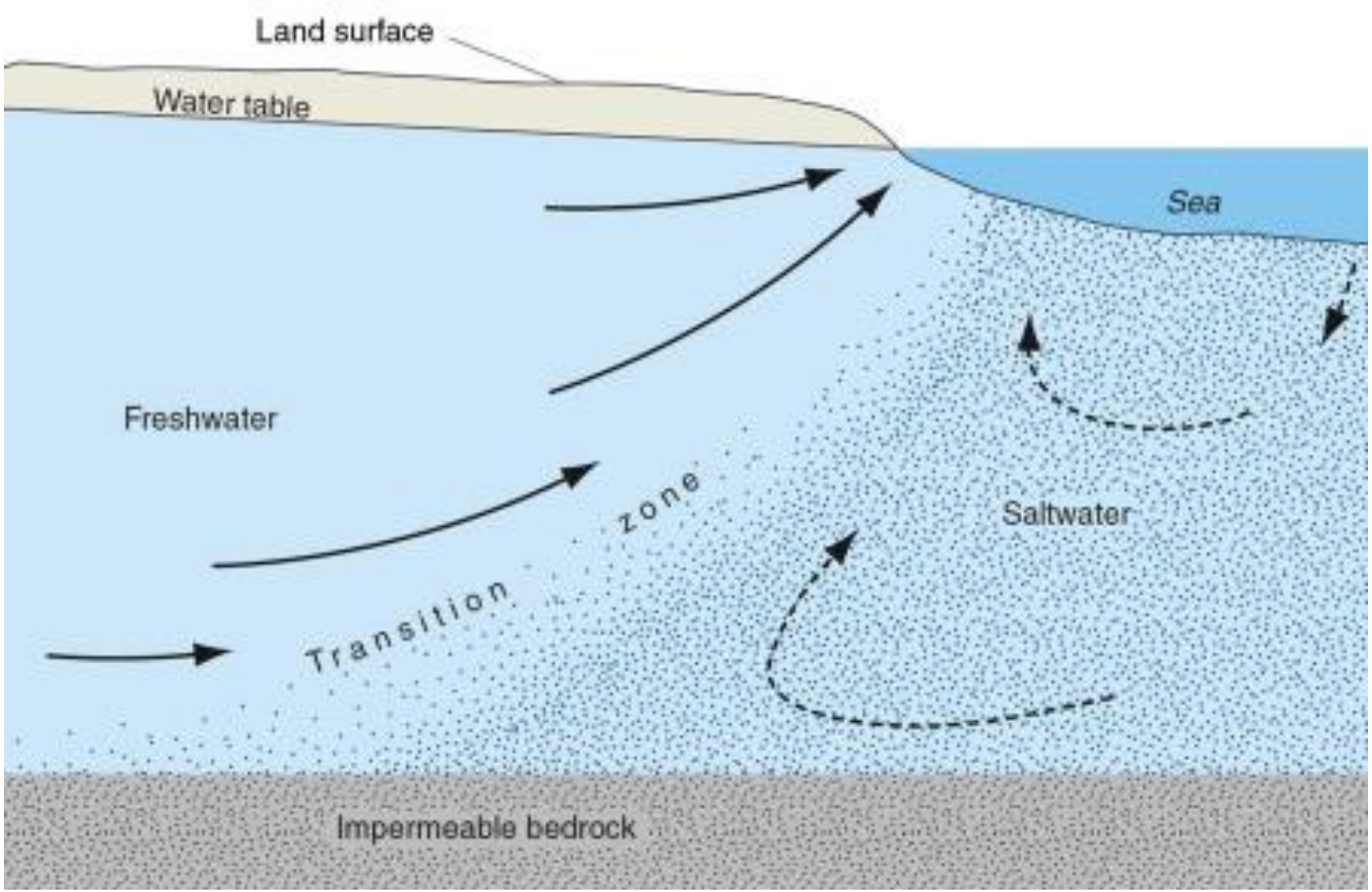
Islands Trust Area Risk of Seawater Intrusion

Islands Trust

What is seawater intrusion?



Risk of Seawater Intrusion in Wells

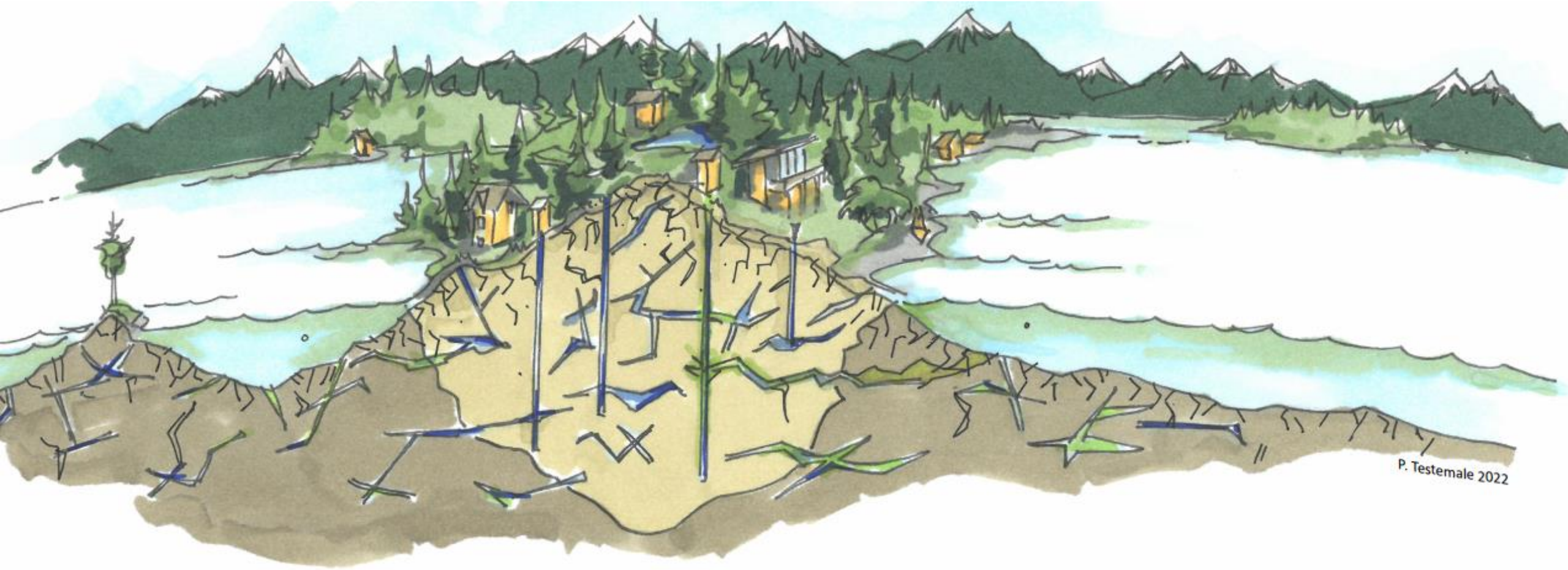


Subsurface Freshwater- Seawater Interface

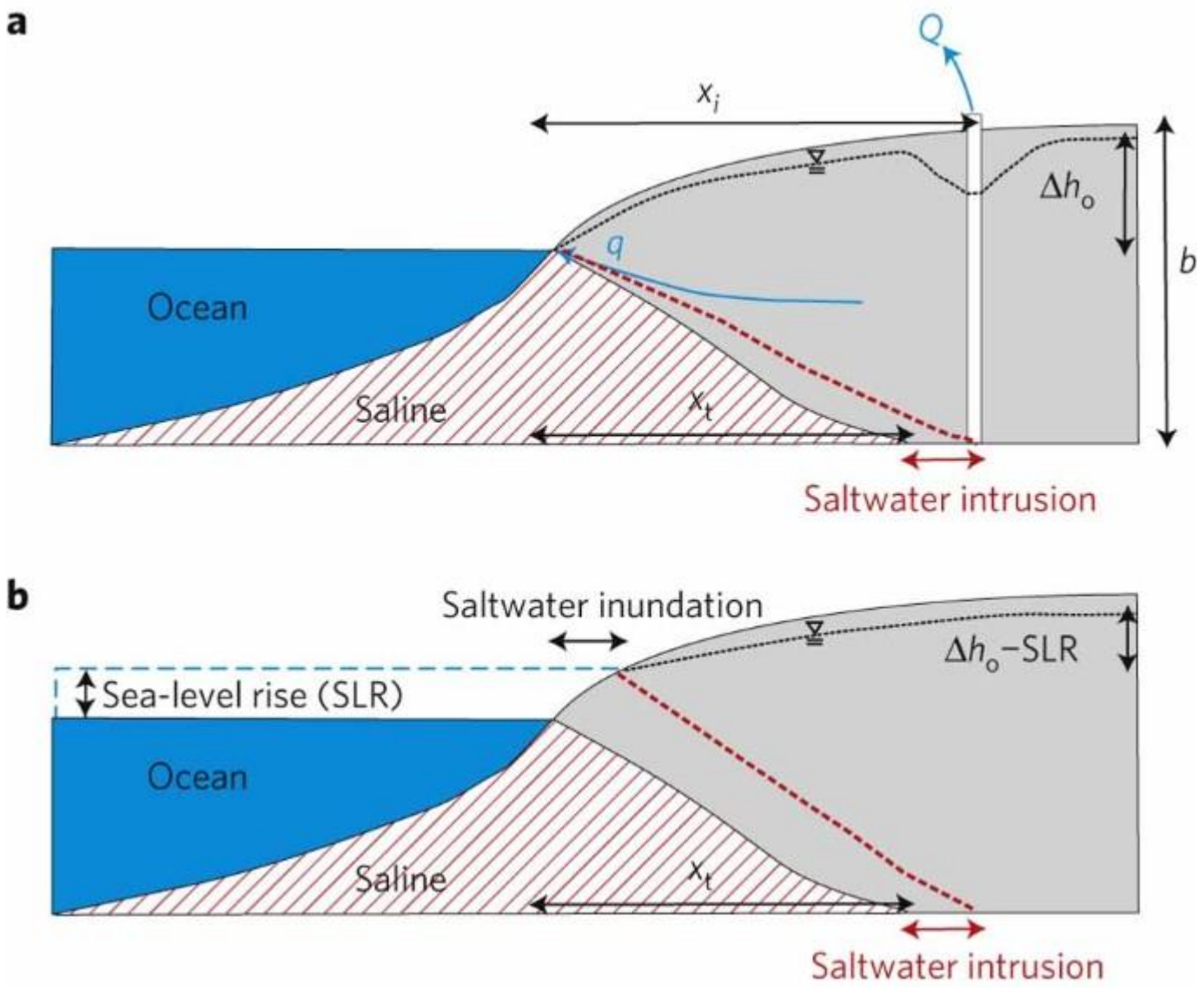
Barlow, P.M. (2003) Occurrence and Flow of Freshwater and Saltwater in Coastal Aquifers. In: Barlow, P.M., Ed., Ground Water in Freshwater-Saltwater Environments of the Atlantic Coast, U.S. Geological Survey, Reston, Chapter 1. https://doi.org/10.3133/cir1262

Risk of Seawater Intrusion in Wells

Fractured Seawater intrusion?



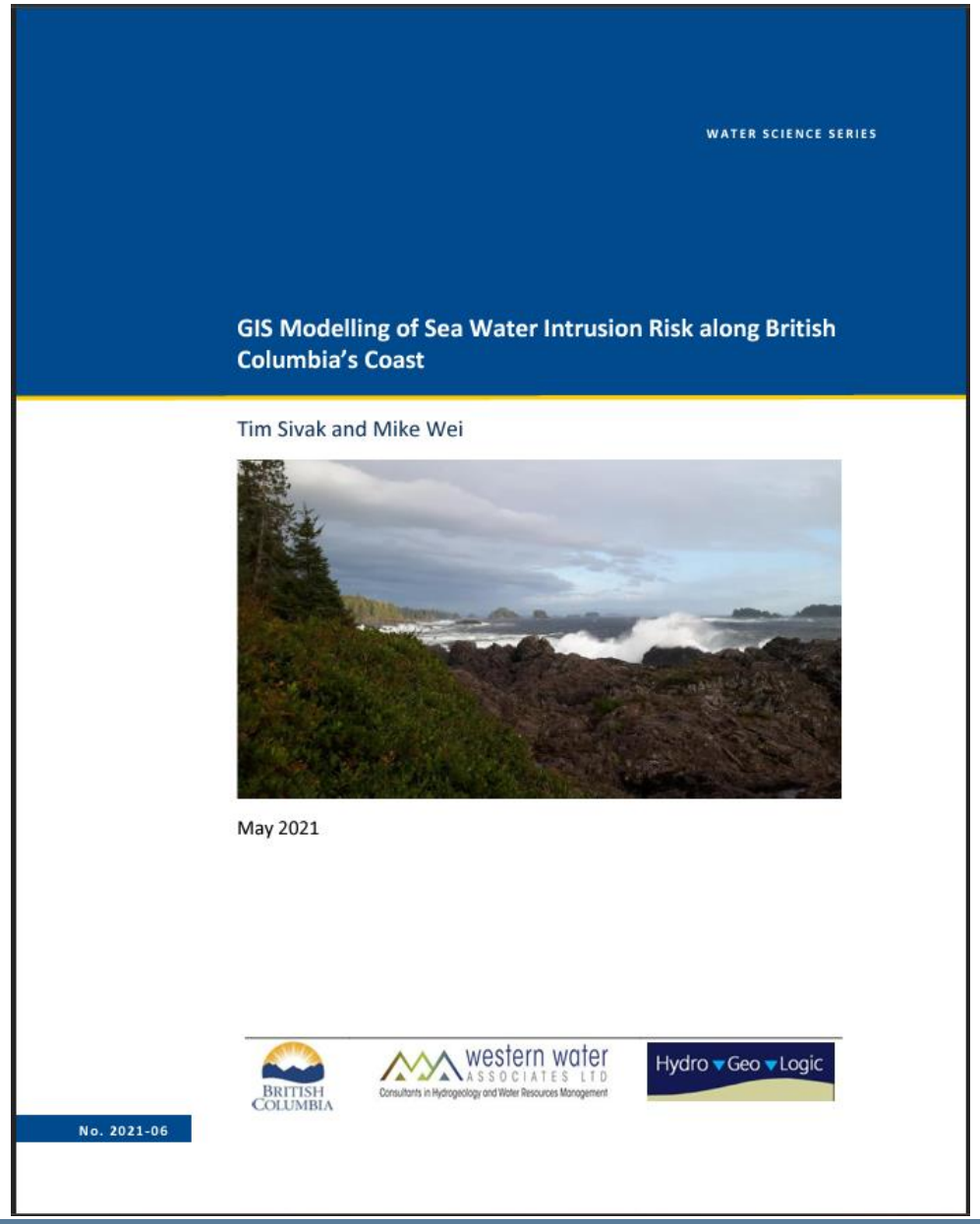
Risk of Seawater Intrusion in Wells



Can seawater intrusion risk be influenced by sea level rise?

Ferguson, G., Gleeson, T. *Vulnerability of coastal aquifers to groundwater use and climate change.* Nature Climate Change 2, 342–345 (2012).

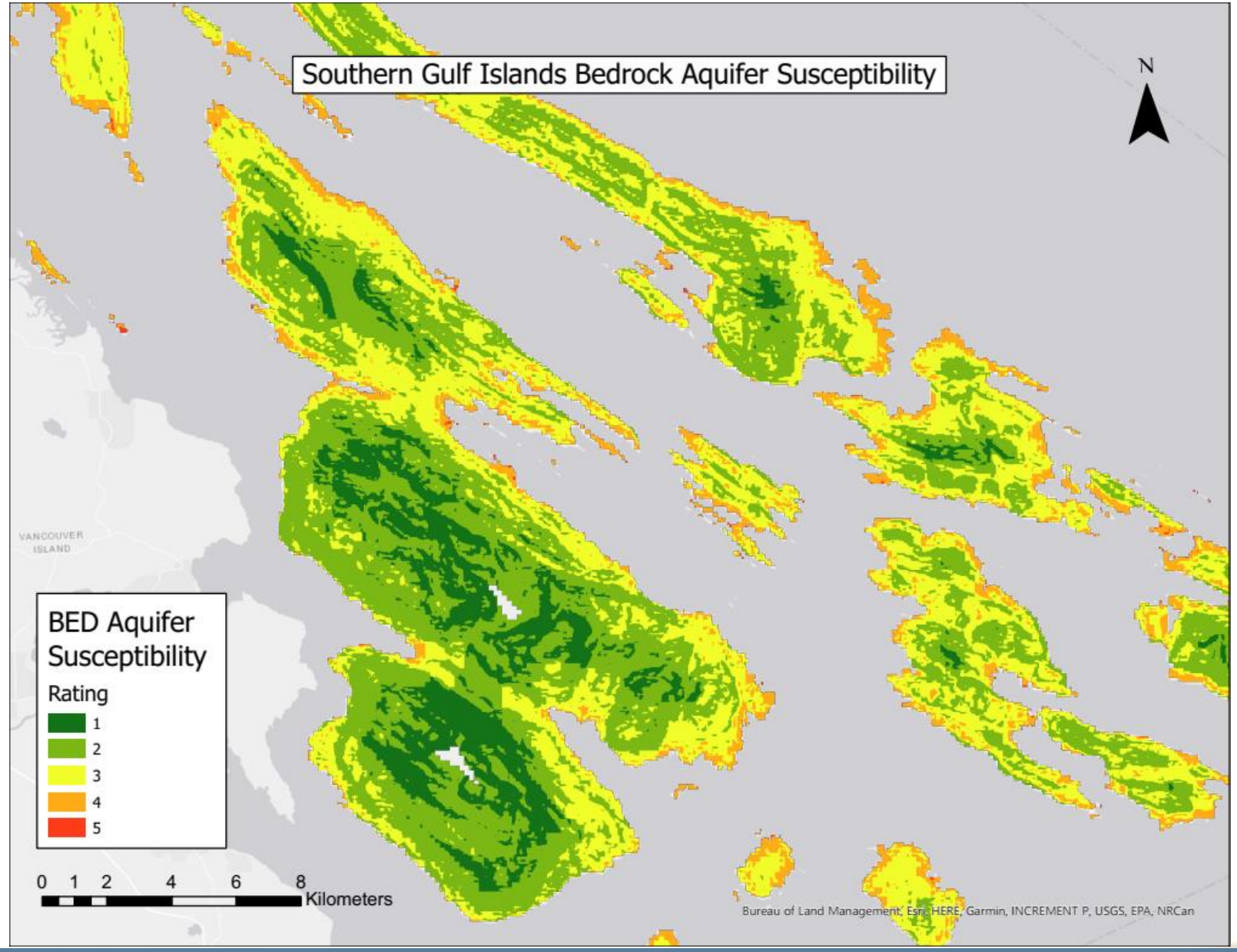
Risk of Seawater Intrusion in Wells



Mapping Risk of *Seawater Intrusion*

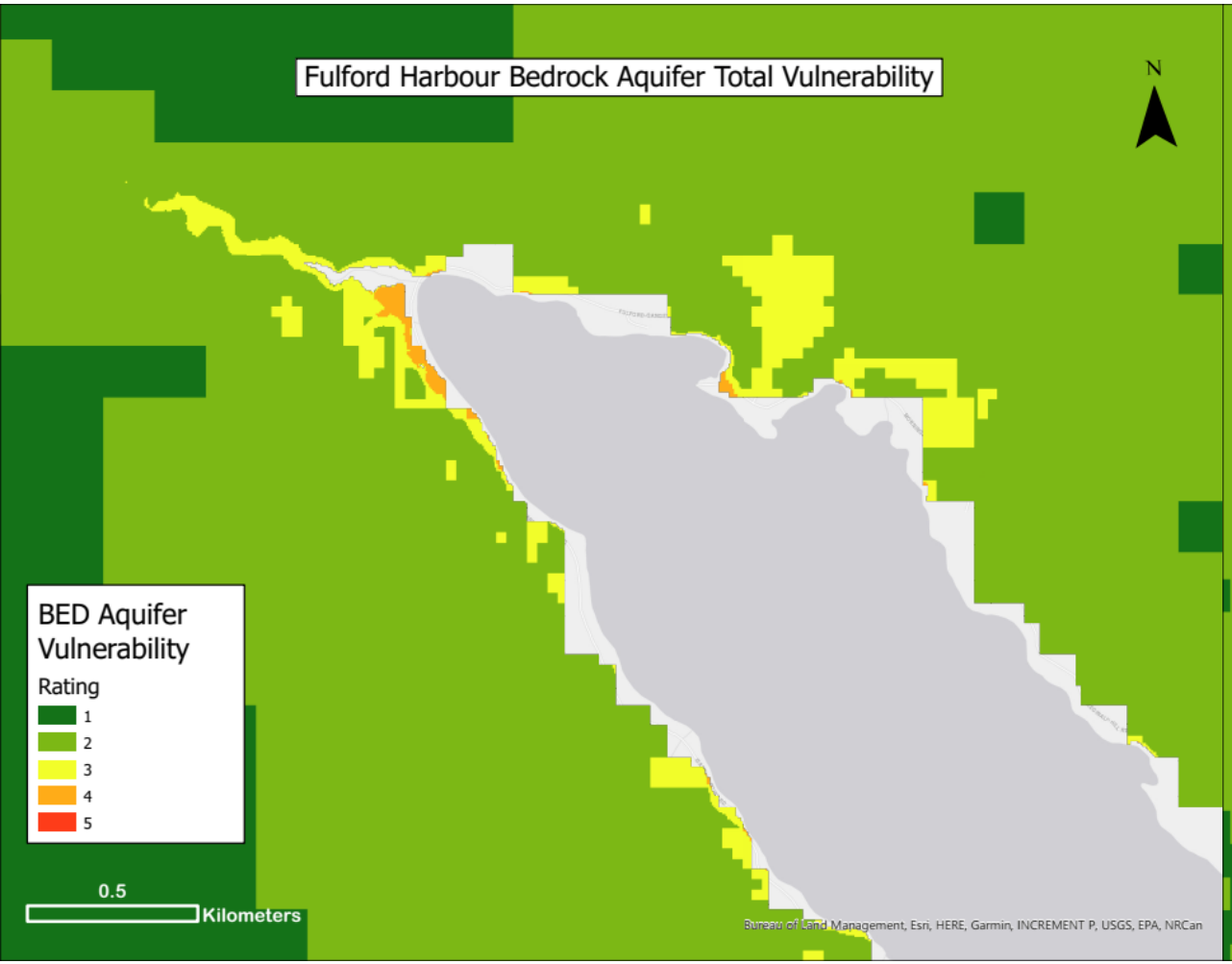
Western Water Associates Ltd (Sivak, T. and M. Wei), 2021. *GIS Modelling of Sea Water Intrusion Risk along British Columbia's Coast*. Water Science Series 2021-06.

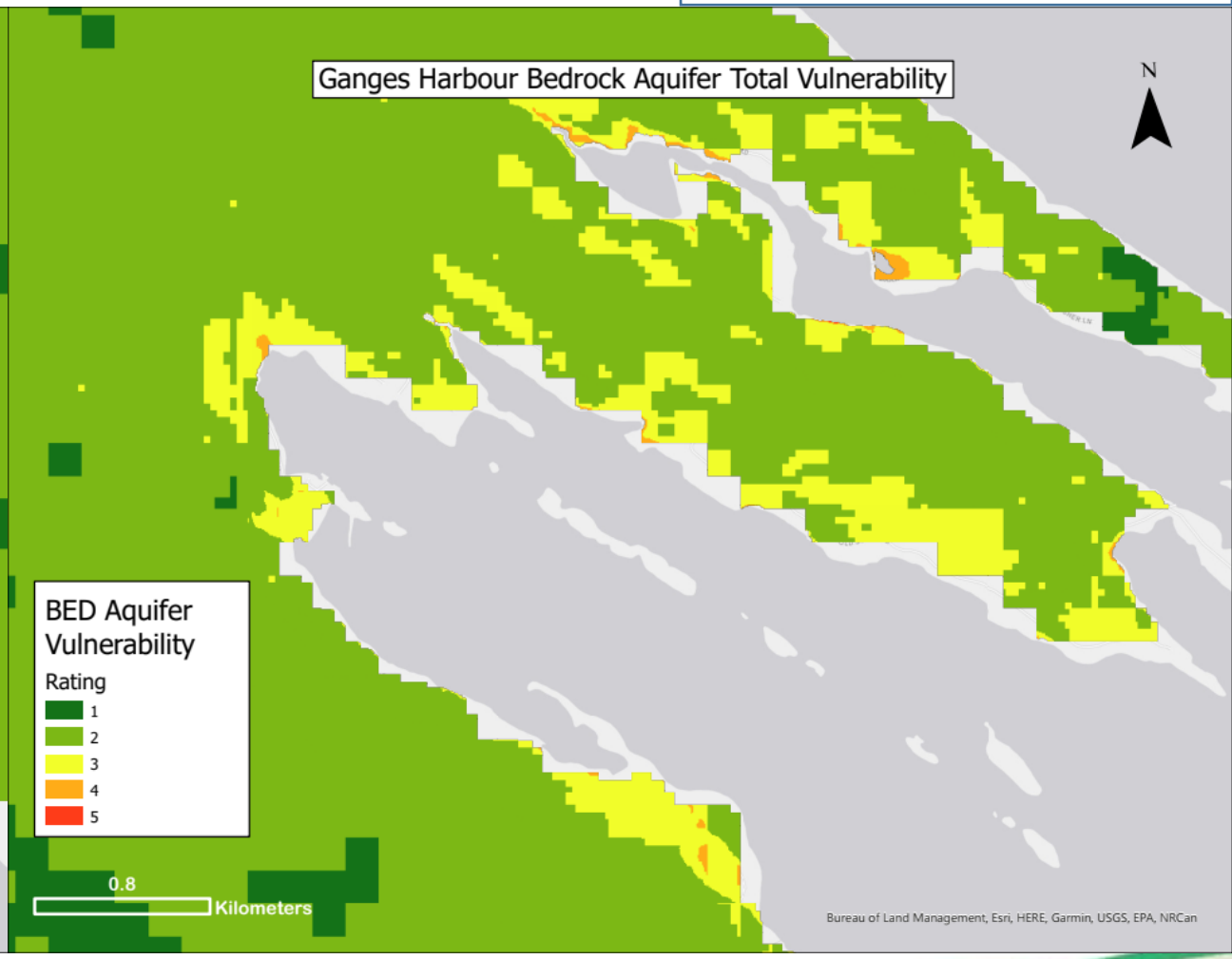
Risk of Seawater Intrusion in Wells



Mapping Risk of *Seawater Intrusion*

Risk of Seawater Intrusion in Wells





Risk of Seawater Intrusion in Wells

What is saltwater intrusion and why is it a concern?

Saltwater intrusion occurs when saline (salty) water is drawn into a freshwater aquifer. Saltwater intrusion can affect one well, or multiple wells in an aquifer, making the water unpotable (unpleasant to drink). People with hypertension should not drink groundwater with a high salt content. The health of plants and fertility of soil can be negatively impacted if irrigated with saline groundwater. Once saltwater intrusion occurs, the changes in the aquifer may be permanent or may take many years to recover.

What causes saltwater intrusion?

Saltwater intrusion can occur due to either natural processes or human activities. In aquifers adjacent to the coast and on islands like the Gulf Islands, freshwater floats as a lens above the saltwater, forming a wedge that extends inland from the shoreline *(see Fig. 1)*. Salinity typically increases gradually at the base of the freshwater lens, but in fractured rock aquifers a single fracture can deliver saltwater to a well *(Fig. 3)*. The thickness and depth of the freshwater lens can vary seasonally, or over a longer term due to changes in the amount of precipitation and recharge occurring. Well pumping can also alter the location (depth or distance inland) of the saltwater-freshwater transition zone *(Fig. 2)*.

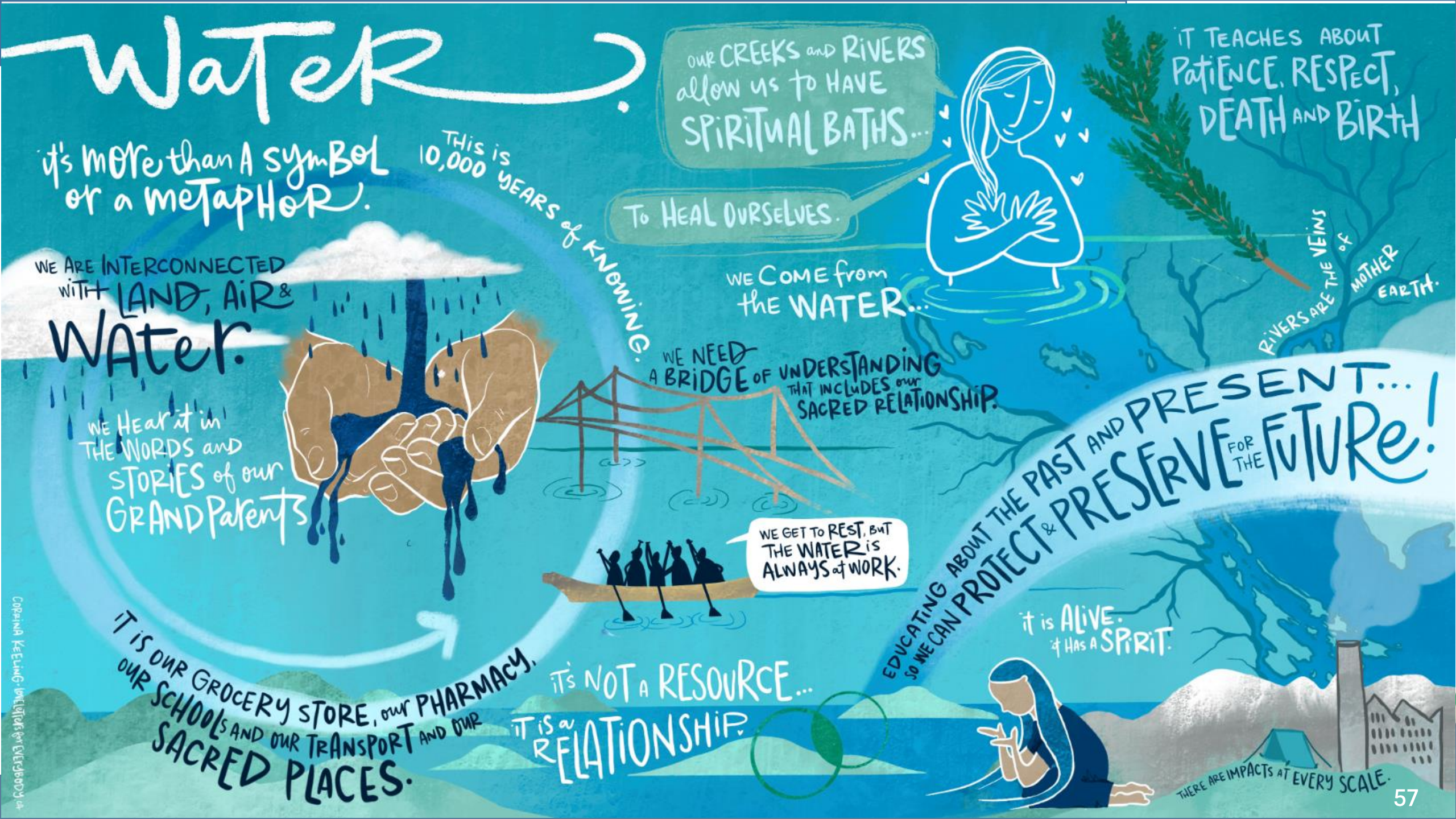
While intermixing of freshwater and seawater is one of the main causes of saltwater intrusion in coastal B.C., groundwater within deeper aquifers may also be salty due to geologic processes and interactions between rocks and water over a long time period (e.g. millennia). If a well draws water from one of these deeper aquifers, it can cause saline water to migrate or mix with fresher groundwater in shallow aquifers. Isolated areas of saltwater have also been found at relatively shallow depths e.g.< 50 m in some areas such as Saanich, Mayne Island, Saltspring Island and near Parksville.

What areas are at highest risk?

Areas at highest risk of saltwater intrusion include locations:

- Close to the coast;
- Where there is a low to moderate slope;
- On peninsulas or in areas with a limited source area for groundwater recharge;
- Where there is a high density of wells;
- Where there are high rates of pumping from a single well or from multiple wells in a coastal area;
- Where the static (non-pumping) groundwater level is at or below sea level.

Well Sitting
Well Depth
Well Alteration
Well Monitoring
Decommissioning wells
Reduce Use
Reduce Pump Depth
Low Rate Pumping
Increase Storage
Prevent Leaks
Discontinue Use


Water.
it's more than A symBOL or a meTapHOR.
This is 10,000 YEARS of KNOWING.
OUR CREEKS and RIVERS allow us to HAVE SPIRITUAL BATHS...
To HEAL OURSELVES.
IT TEACHES ABOUT PatiENCE, RESPECT, DEATH and BIRTH
RIVERS ARE THE VEINS of MOTHER EARTH.
WE ARE INTERCONNECTED WITH LAND, AIR & WATER.
WE COME from the WATER...
WE NEED A BRIDGE OF UNDERSTANDING THAT INCLUDES our SACRED RELATIONSHIP.
WE HEAR it in THE WORDS and STORIES of our GRANDPARENTS
WE GET TO REST, BUT THE WATER is ALWAYS at WORK.
EDUCATING ABOUT THE PAST AND PRESENT... SO WE CAN PROTECT & PRESERVE FOR THE FUTURE!
it is ALIVE. it HAS A SPIRIT.
IT IS OUR GROCERY STORE, our PHARMACY, our SCHOOLS AND our TRANSPORT AND our SACRED PLACES.
it's NOT A RESOURCE... it is a RELATIONSHIP.
THERE ARE IMPACTS AT EVERY SCALE.
CORRINA KEELING: LOVE LETTERS for EVERYBODY

THANK YOU

Question and Answer Session

Islands Trust

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William Shulba, P.Geo.

Senior Freshwater Specialist

freshwater@islandstrust.bc.ca

Does groundwater come from Mount Baker?

Questions and Answers