Savary Island Groundwater Assessment

Results & Recommendations

Presentation to qRD Community Information Meeting

October 28, 2025

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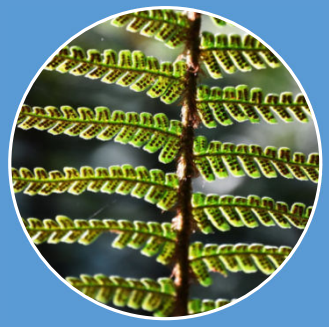
qathet REGIONAL DISTRICT

GW SOLUTIONS
ASSESSMENT & PROTECTION OF GROUNDWATER

ʔayhos (Ay hos) – *a double headed serpent who was changed into an island by χaχyɛ ti qaymɪxʷ the Transformer*

Tla'amin Nation
Traditional Names

Project scope & timeline



Phase 1: Compile and update water-related information

- Updated map of water sources
- Gathered existing monitoring & land use data
- Resident survey (online & field assessment)
- Collected & analyzed current data (groundwater levels, field water quality e.g. electrical conductivity)
- Prepared hydrogeologic model of island aquifers

2024 August – September

Phase 2: Groundwater quantity and quality hazard assessment

- Developed water balance for island (water availability vs demand)
- Assessed impacts of climate change on the water balance
- Evaluated aquifer vulnerability to contamination from the land surface
- Assessed sea water intrusion hazard and impact

October-November

Phase 3: Develop an aquifer protection plan and monitoring strategy

- Identified strategies to address hazards related to land use and aquifer setting
- Recommended planning & other measures to help preserve and protect water resources on the island

December-January 2025

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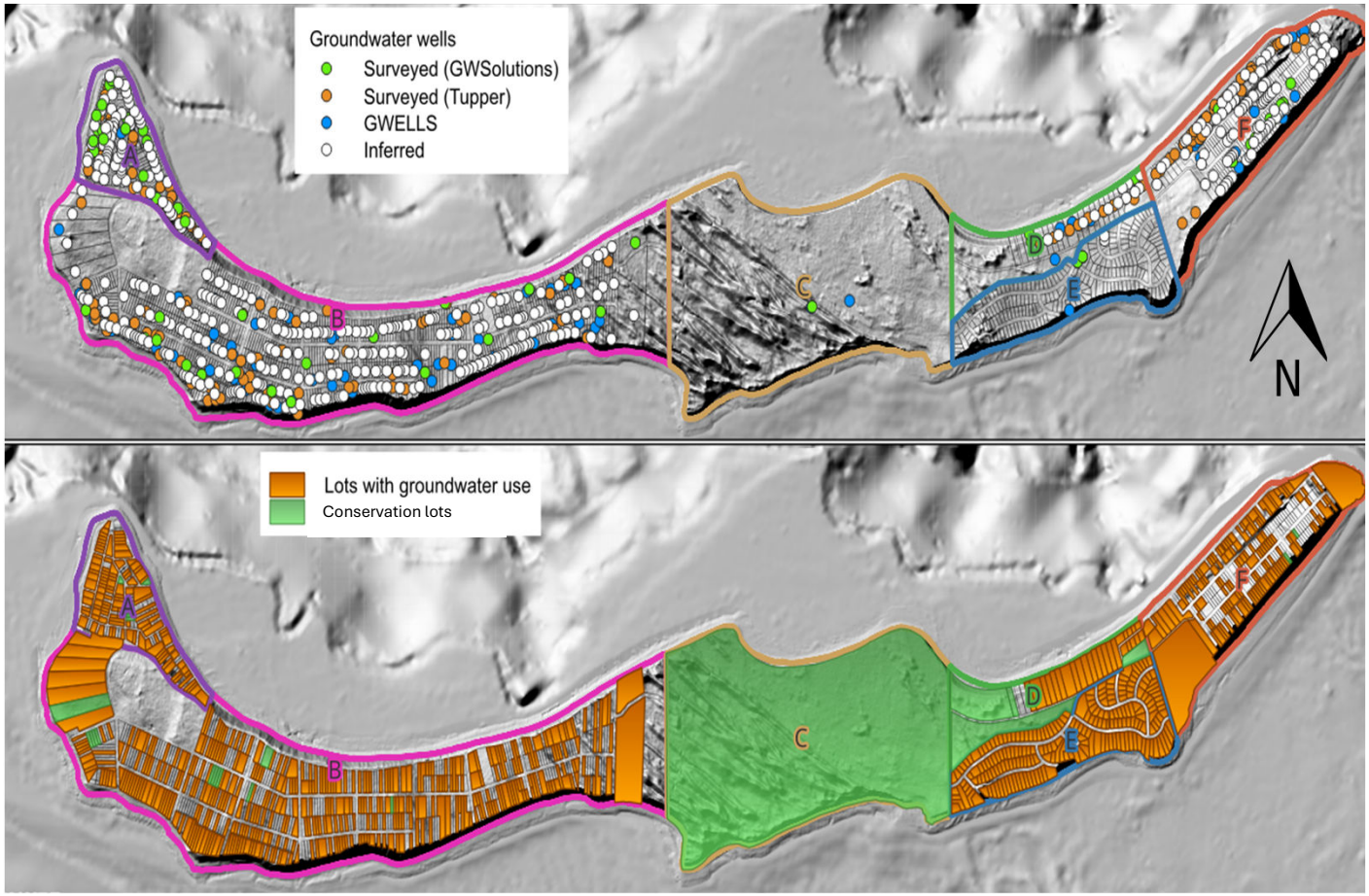
Savary Island lots and well inventory



Population	
Year-round	70 to 100
Seasonal	1000 to 3000
Lots	
Total	1363
Developed	841
Mostly small lots	0.3 acre
Island Area	5 km^2
Wells	
Field verified	233
Inferred (based on land use)	426

3D Hydrostratigraphic Model

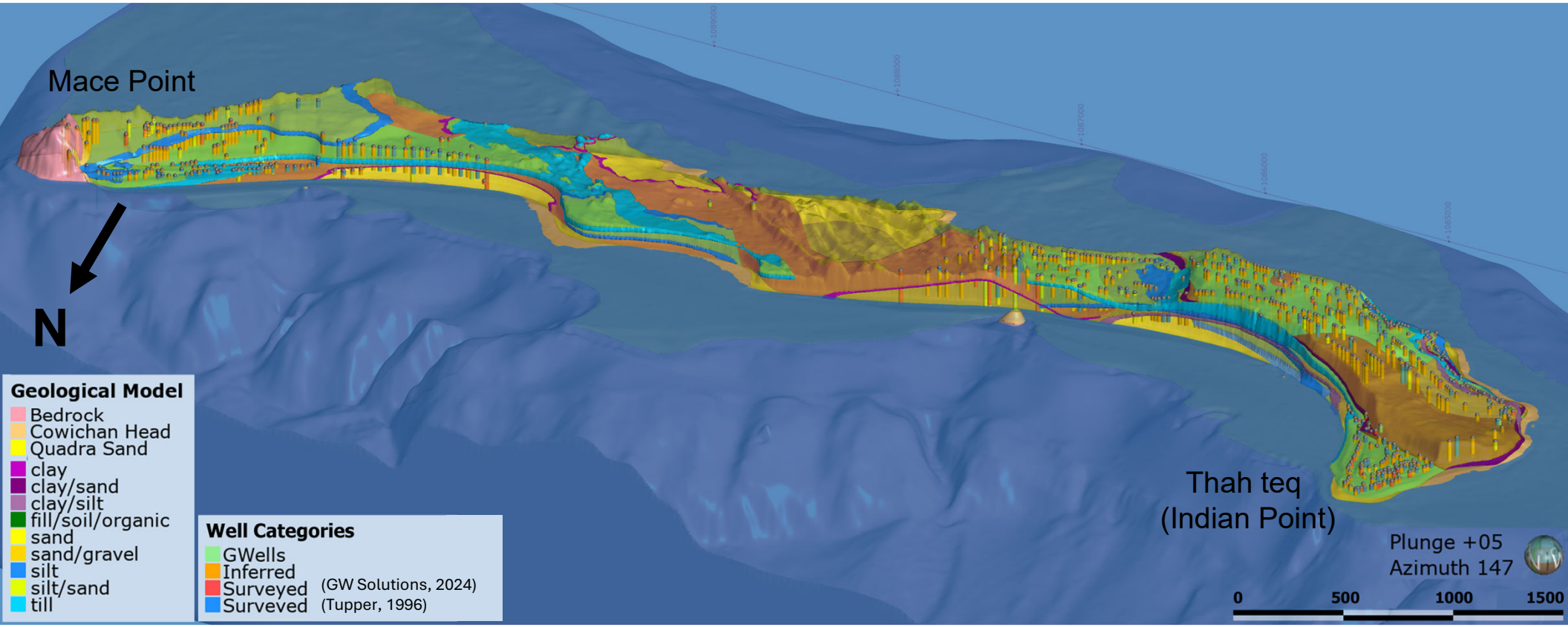
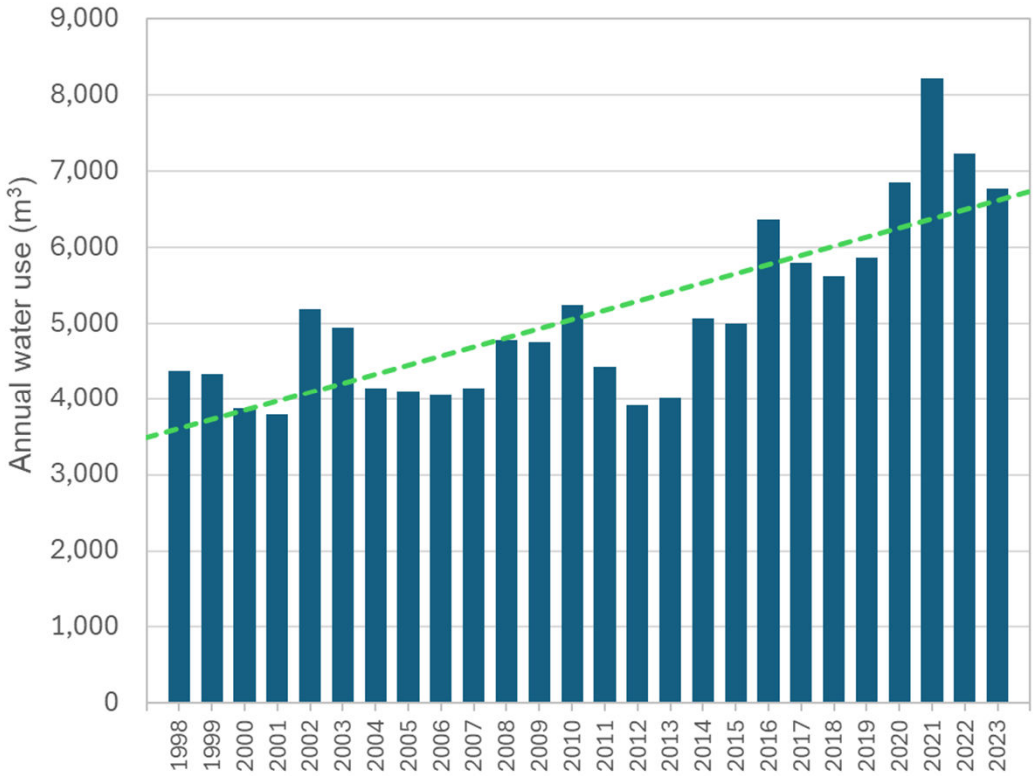



Photo: A. Barroso

Field assessment

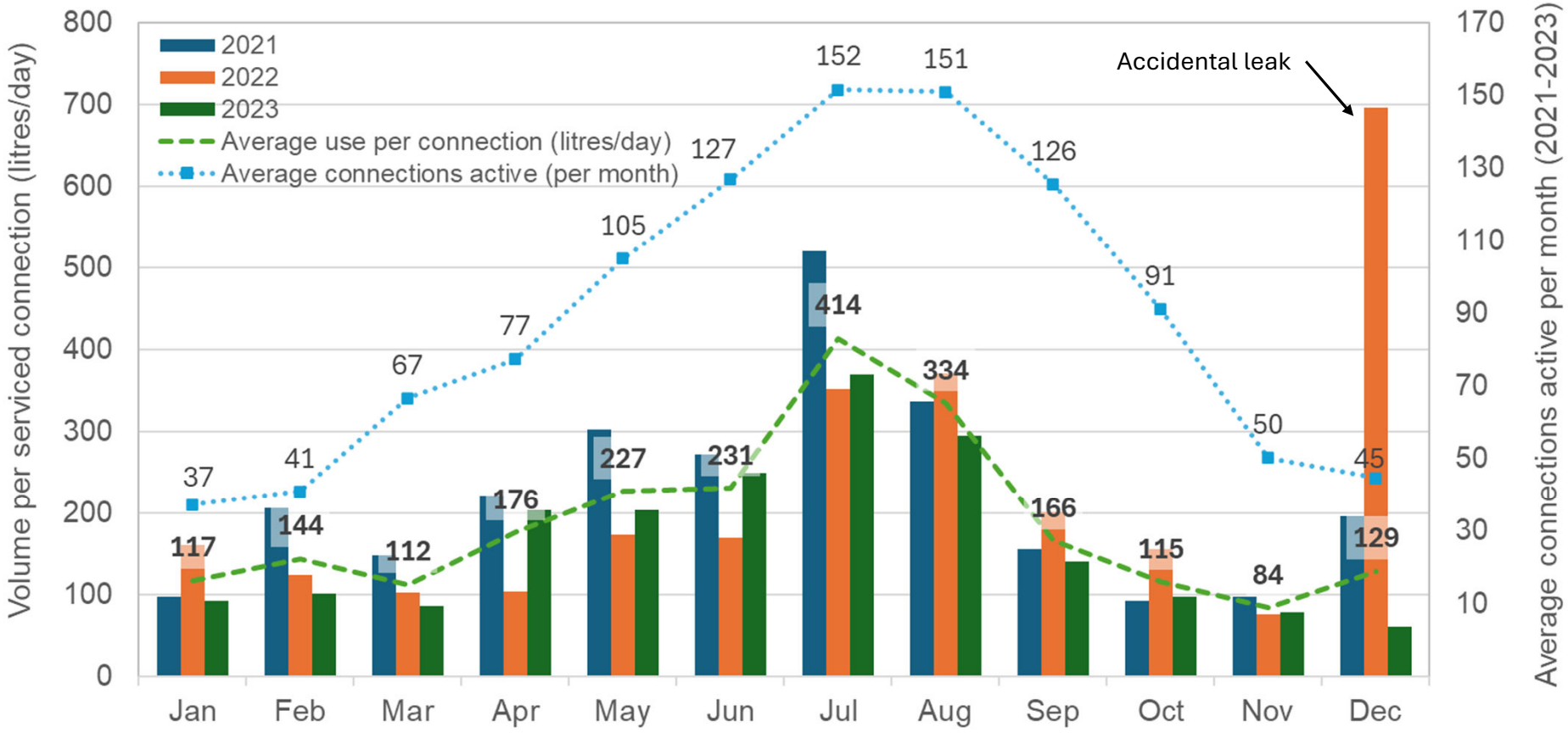
- Collected spatial coordinates and document the details of different water sources (e.g. sand points, drilled wells) (77 sites)
- Measured groundwater levels (38 sites), estimated well discharge/pumping rates, measured spring discharge rate
- Collected samples for field analysis of water quality (temperature, pH, electrical conductivity, total dissolved solids)(47 sites)
- Conducted downhole salinity measurements and profiles (wells at risk or showing evidence of saltwater intrusion)(12 sites)
- Collected samples for laboratory analysis of geochemical quality (28 wells, 1 spring, 2 ocean)

Water Use & Residency Patterns



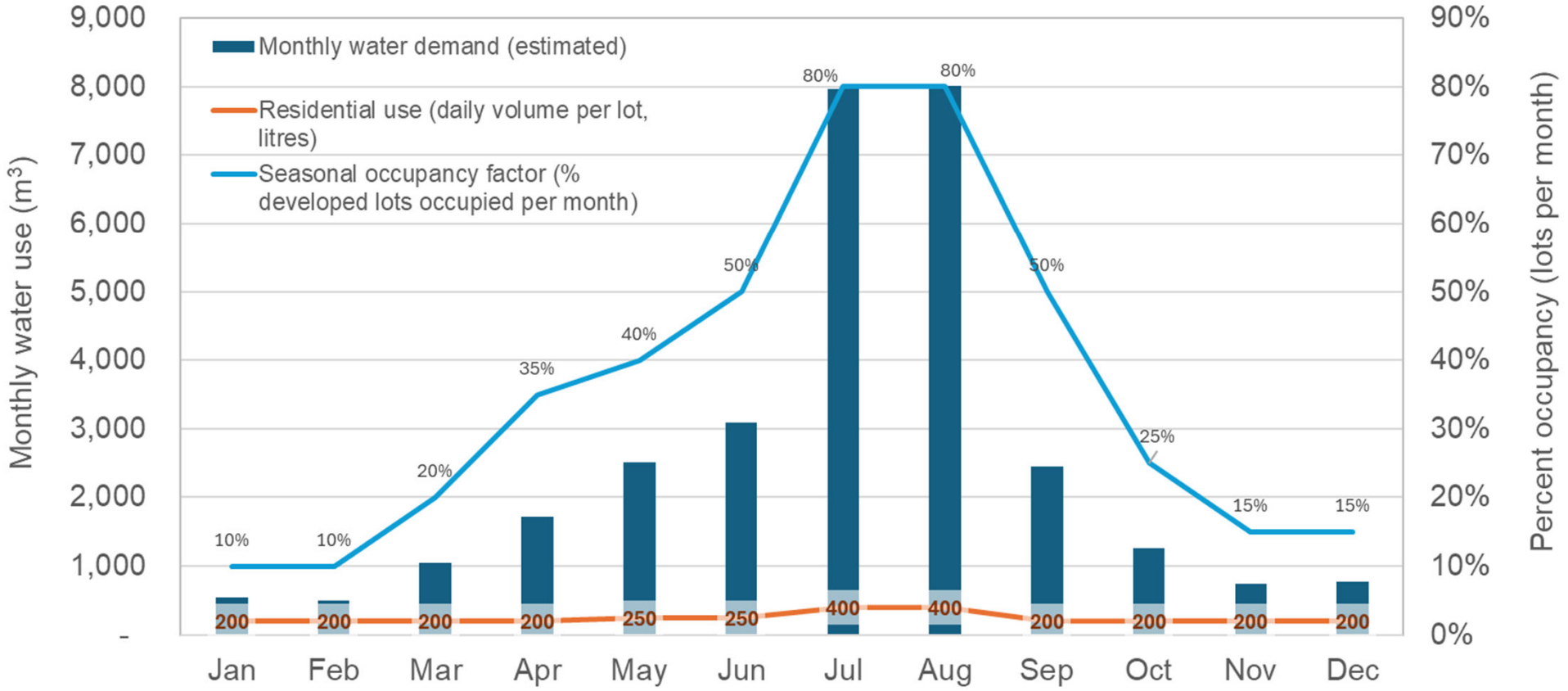
Savary Shores Improvement District (SSID) Annual Water Use (1998-2023). Green line indicates long-term trend.

Water Use & Residency Patterns



Savary Shores Improvement District average daily water use per connection and number active connections per month (2021-2023).

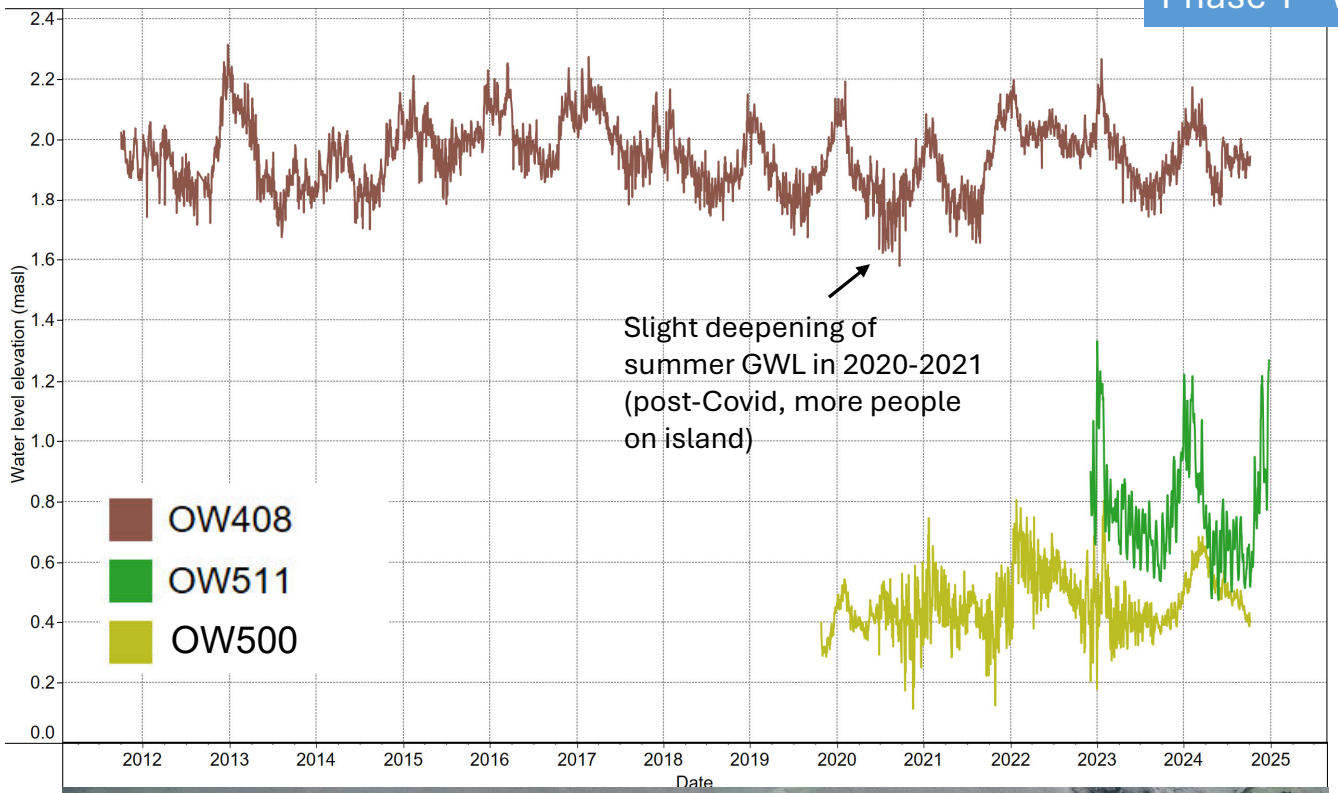
Water Use & Residency Patterns

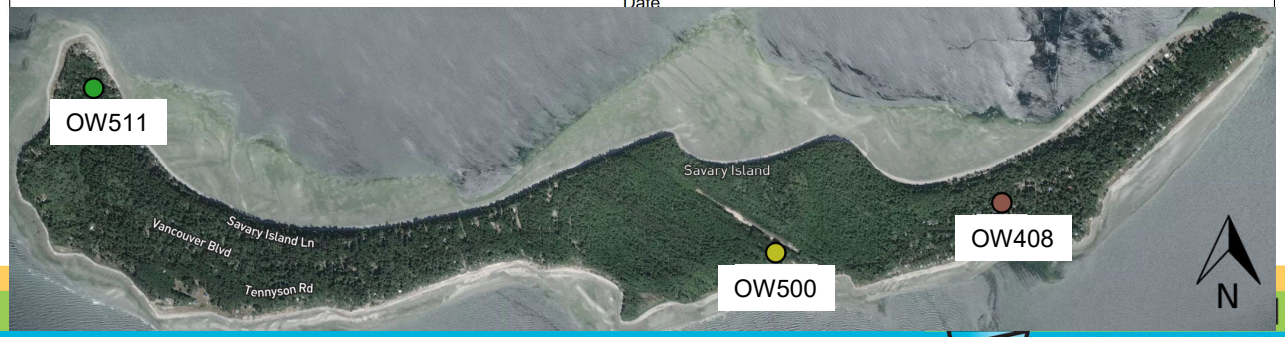


Savary Island 2025 estimated monthly water demand, average residential use per lot and seasonal occupancy (%).

Monitoring

Phase 1 – Water data collection





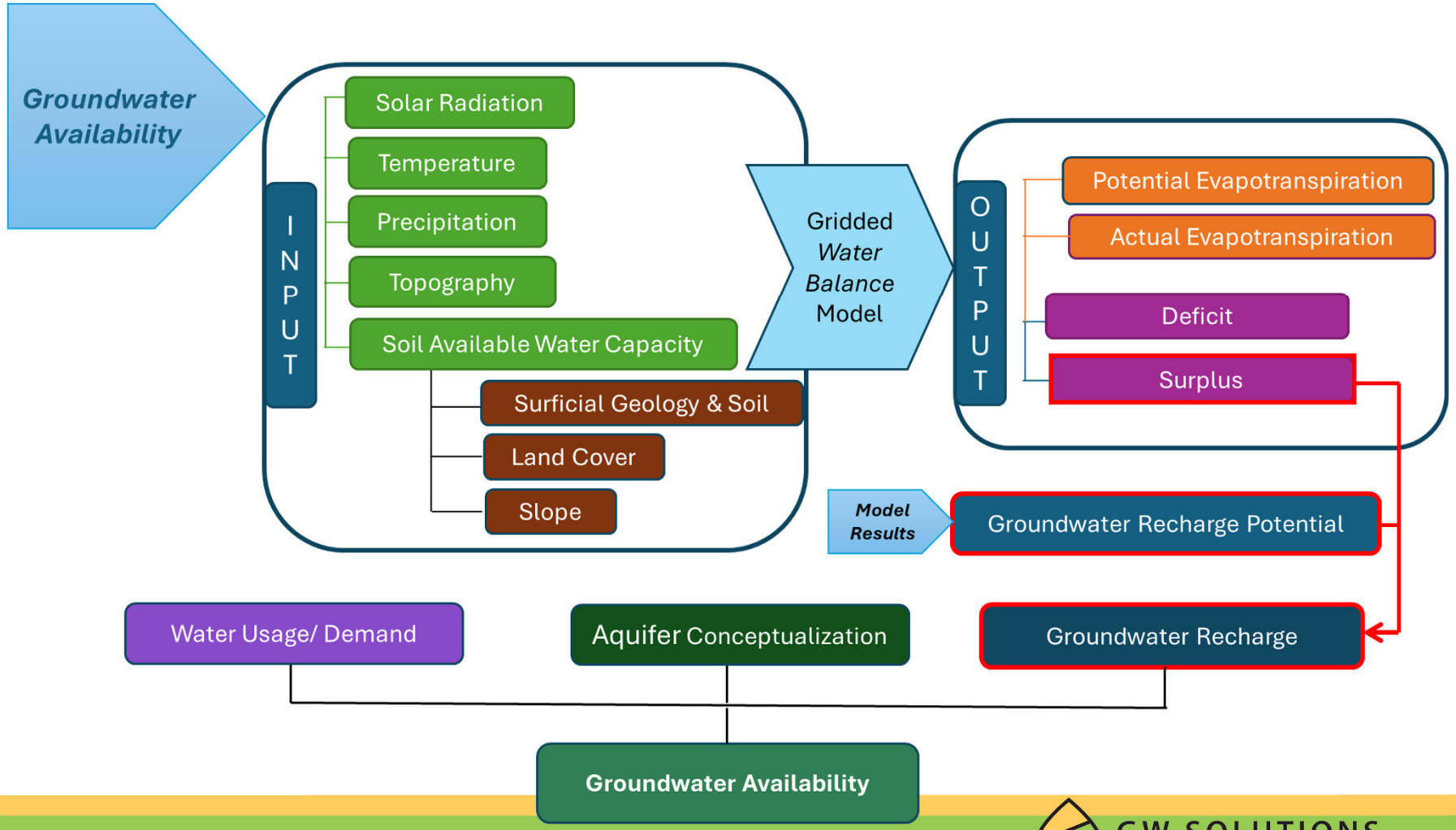
OW 408

- Inland/higher elevation in SSID well field
- Influenced by SSID well pumping and tides
- Annual range in groundwater level ~0.5 m

OW 500 & OW 501

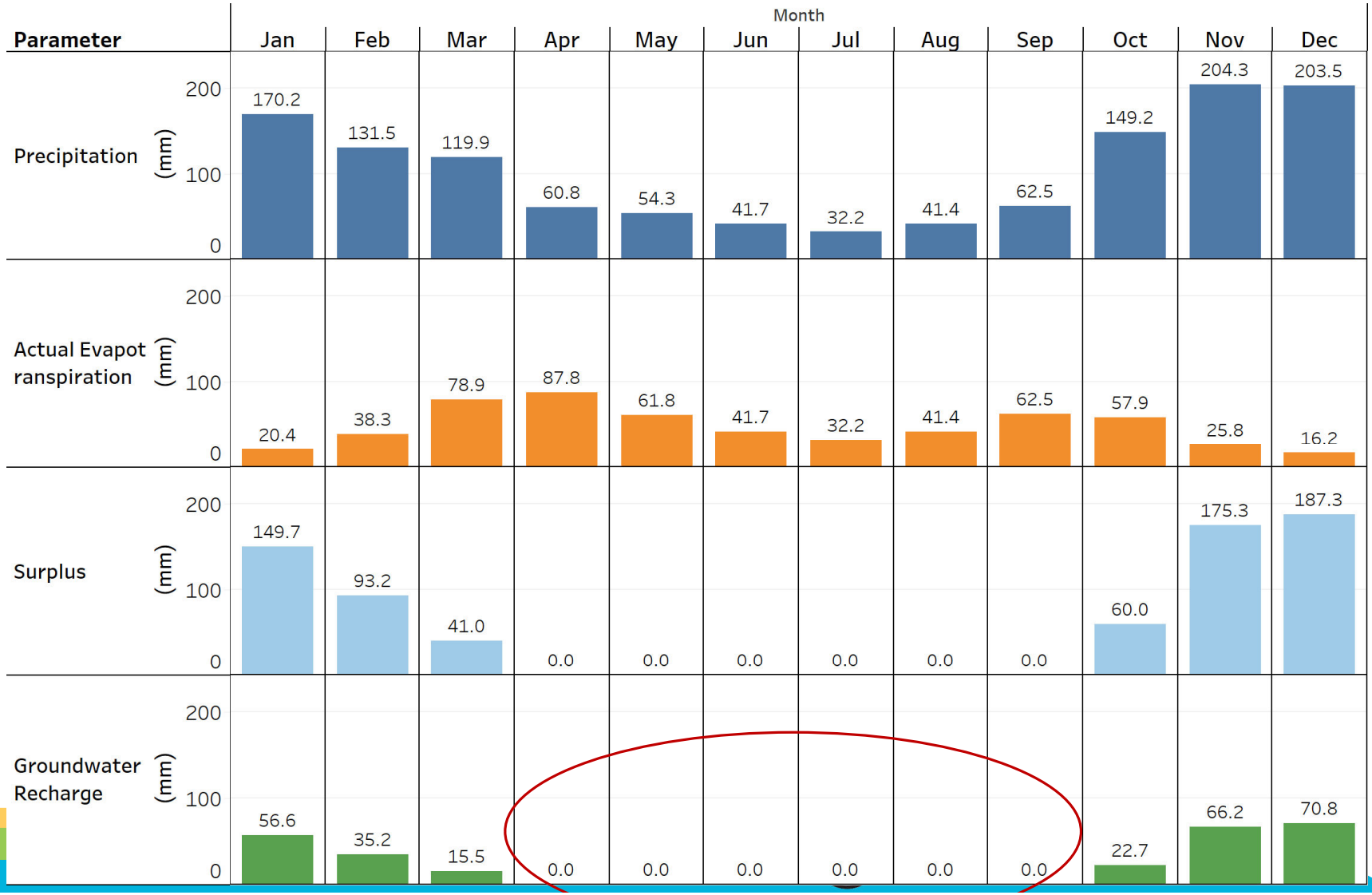
- Located closer to coast
- Tidal influence
- Groundwater levels close to sea level
- Annual range in GWL 0.5 to 0.8 m

Water Balance Model

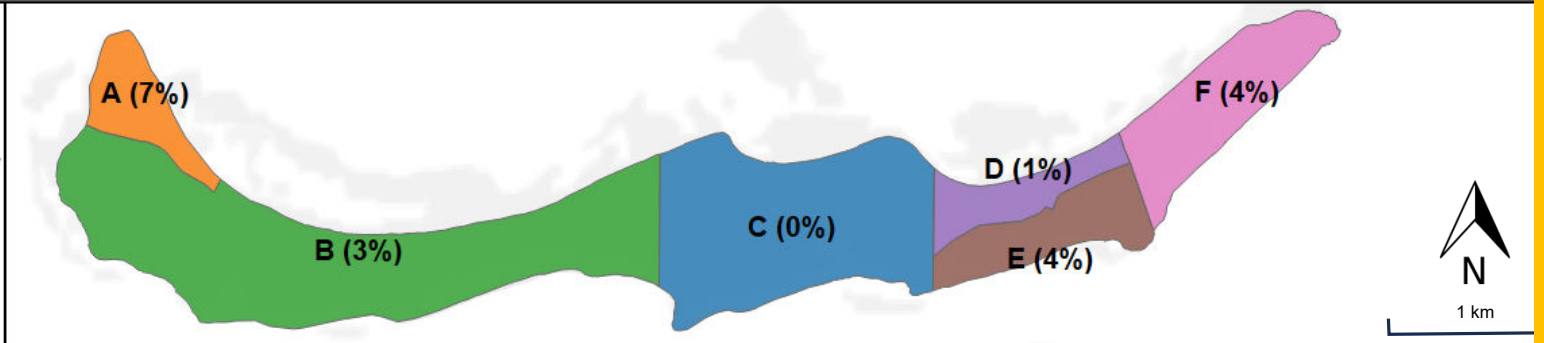
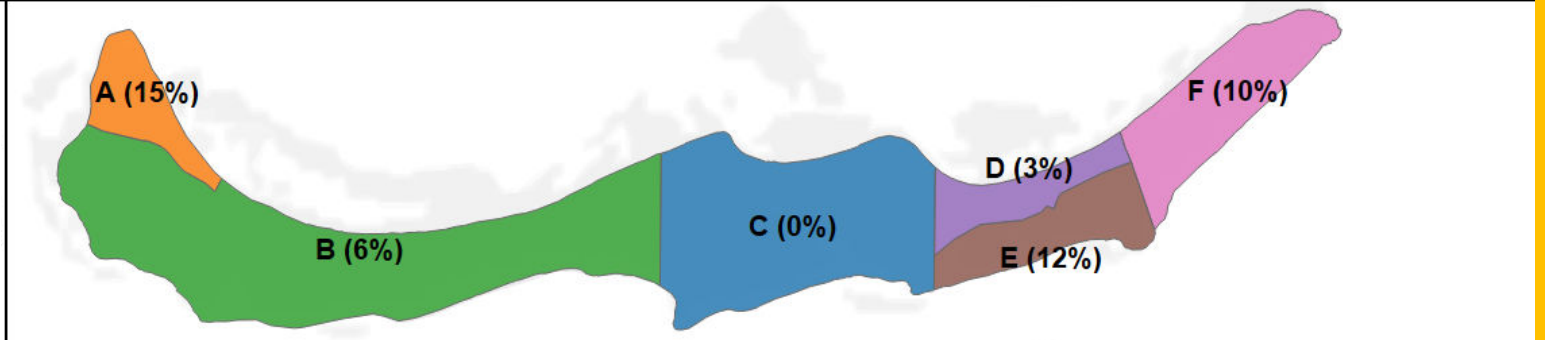
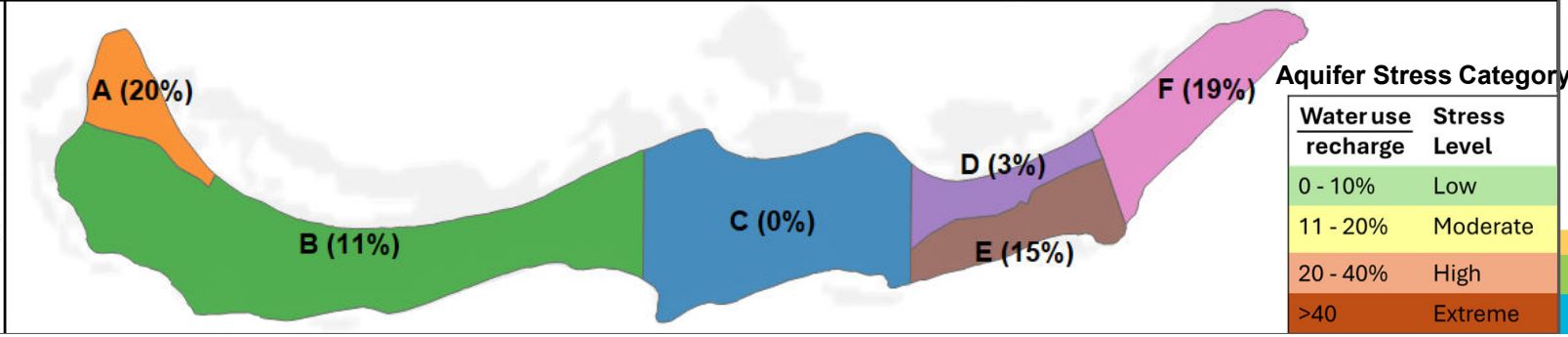


Savary Island Water Balance SSP 2.6 (2025)

No surplus or groundwater recharge from April-September (water supplied from aquifer storage)



Water Availability vs Demand (Scenarios)

Current low water use and seasonal population	
Full-time residence, currently developed lots, low water use	
Full-time residence, all lots occupied, low water use	

Currently low aquifer stress Increased stress expected with growth scenarios

All assume *low* water use (below average for similar communities)


Photo: L. Johnson

Water Balance

- Diffuse recharge received over island footprint (infiltration influenced by slope and soil characteristics)
- Current water demand up to 7% of annual recharge
- Per household water demand in low range (100 – 400 L/d)
- Seasonal deficit - highest population & water use in summer
- Higher water demand and increased seasonal aquifer stress anticipated with growth scenarios

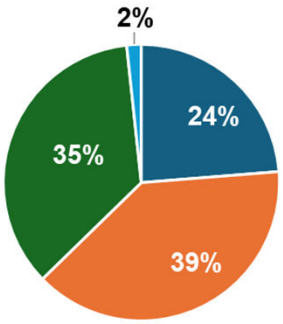
Climate Change

- Annual precipitation may increase but will be received over shorter period
- Monthly groundwater recharge likely to decrease in all months except December
- Much longer dry season (no recharge from April – Sept)
- Increased risk of hazards such as seasonal drought, seawater intrusion and wildfire

Aquifer vulnerability

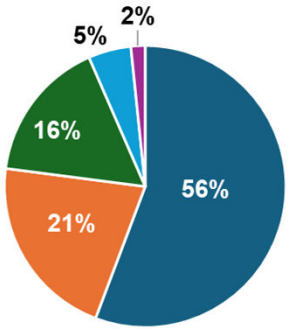
- Aquifer vulnerability index high to extremely high
  - Very permeable sand aquifer
  - Low elevation areas with shallow water table <5 m below ground
- Clay, till, silt layers may slow contaminant infiltration

Online survey results (N=59)



Residency

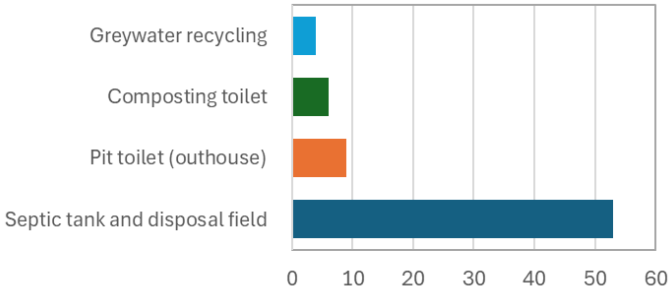
- Full time resident (live 6 or more months on island)
- Seasonal (<6 months, incl "Other" category)
- Summer resident
- Other (1-3 weeks per year)

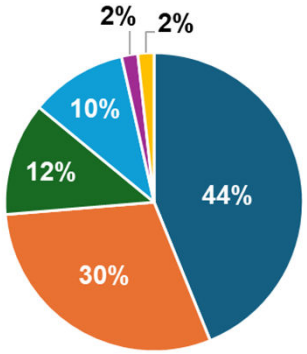


Water source

- Drilled well
- Sand point well
- Local water service (e.g. SSID)
- Bottled water
- Excavated (dug) well

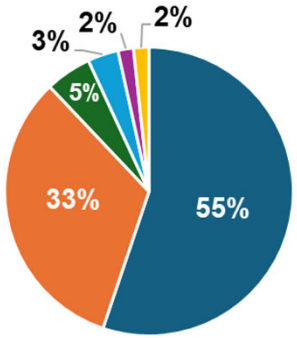
Sewage treatment methods





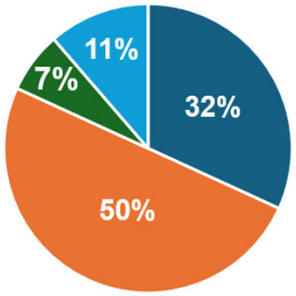
Water testing

- Have never tested water quality
- Every three to five years
- Tested by water system (SSID)
- Infrequently (less than every five years)
- Twice per year (summer and winter)
- Once per year



Water treatment method

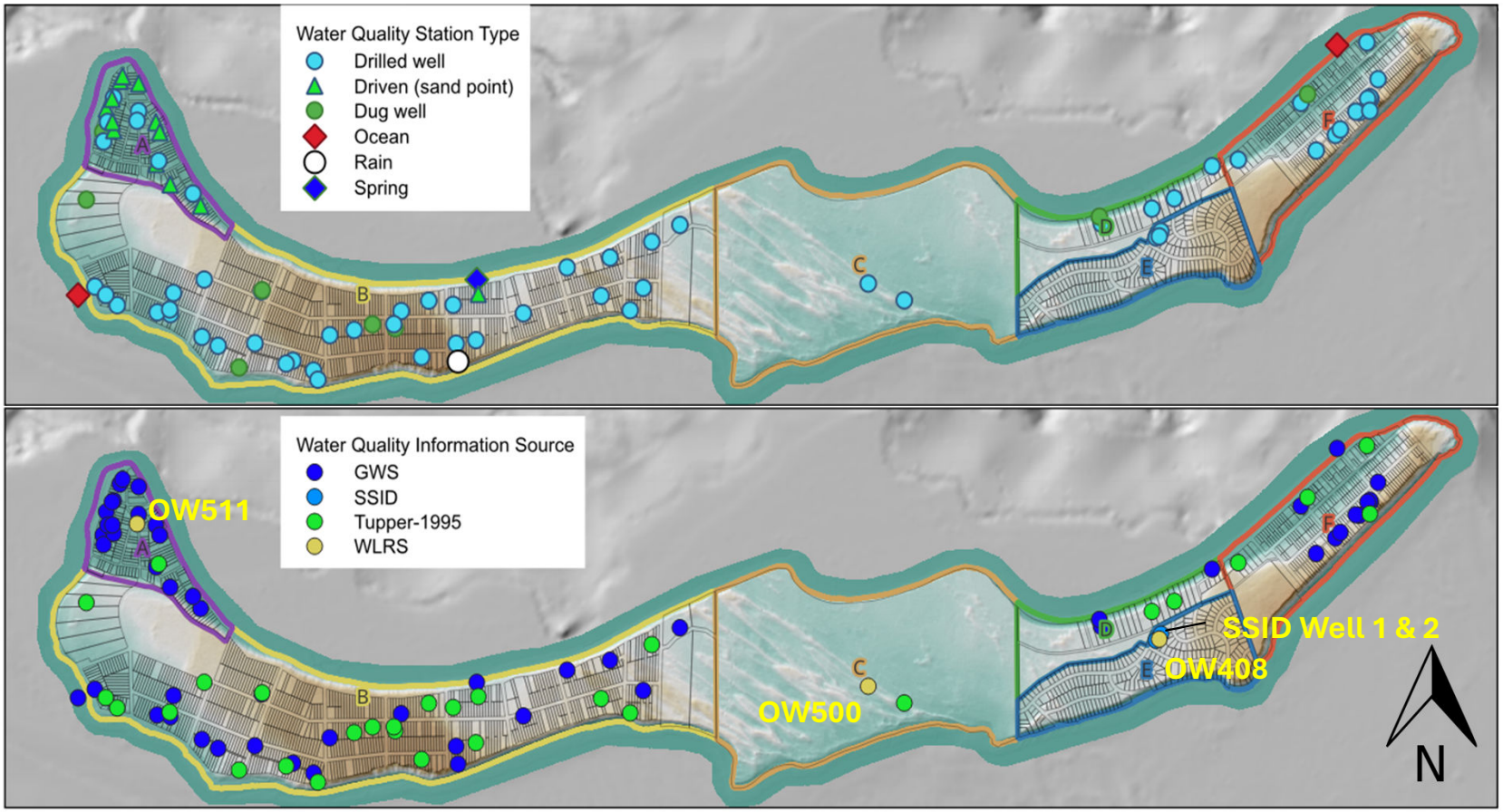
- No form of disinfection or treatment is used
- Filter (e.g. ceramic, carbon, including countertop jugs)
- Chlorine injection
- Ultraviolet disinfection
- Water softener
- Boil drinking water before use



Wastewater system maintenance

- Have never maintained
- Pumpout every 3 to 5 years
- Pumpout every 8 to 10 years
- Pumpout when needed

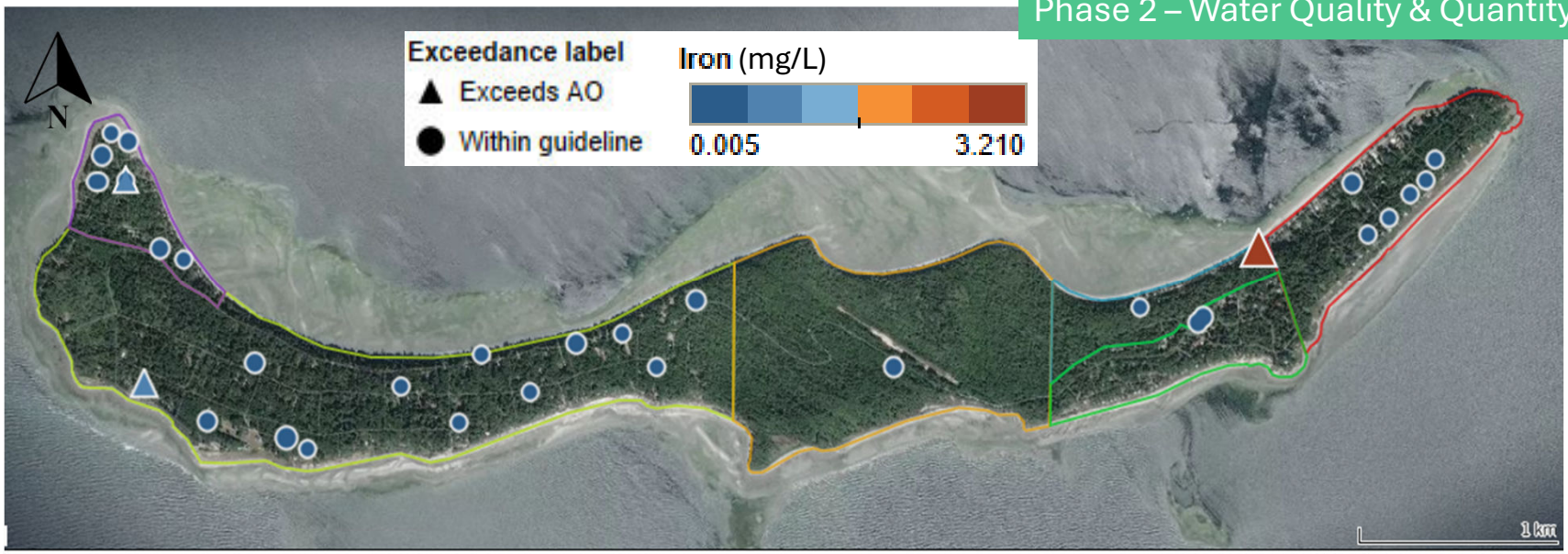
Water Quality Data Sources/Locations

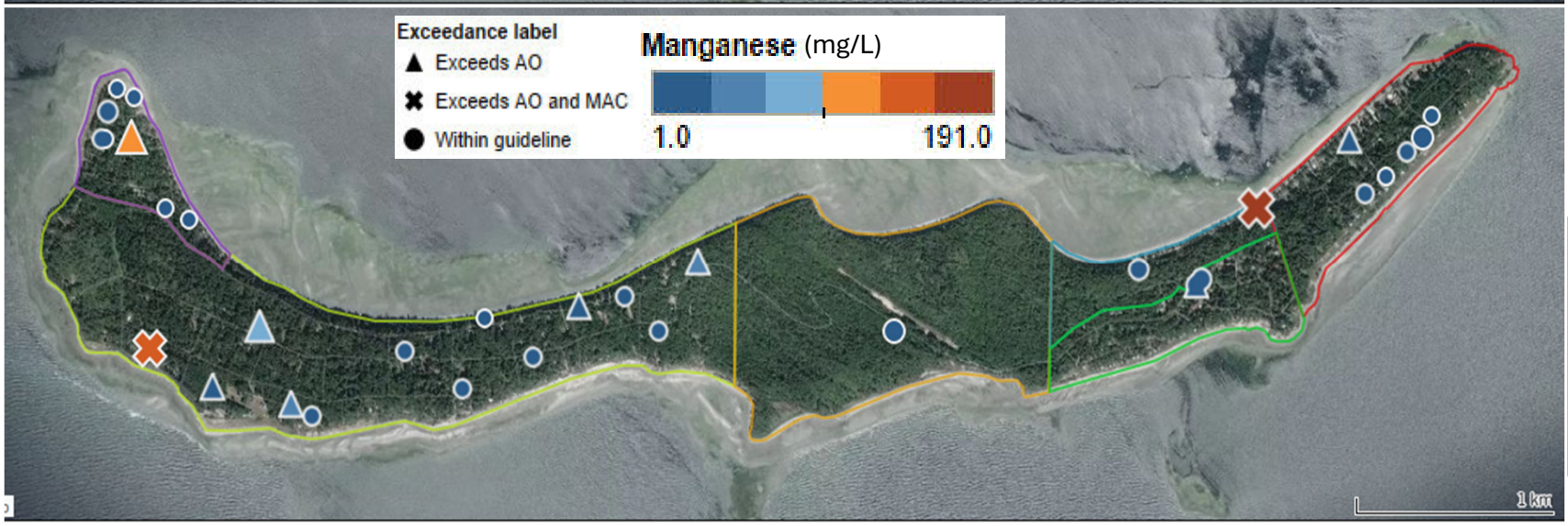


Sept 2024 Field work
Water inventory – 77 sites
Field parameter – 47 sites
Downhole EC – 12 sites
Lab samples 32 sites (28 wells)

Results combined with historical data

Wells sampled in September 2024 (dark blue)





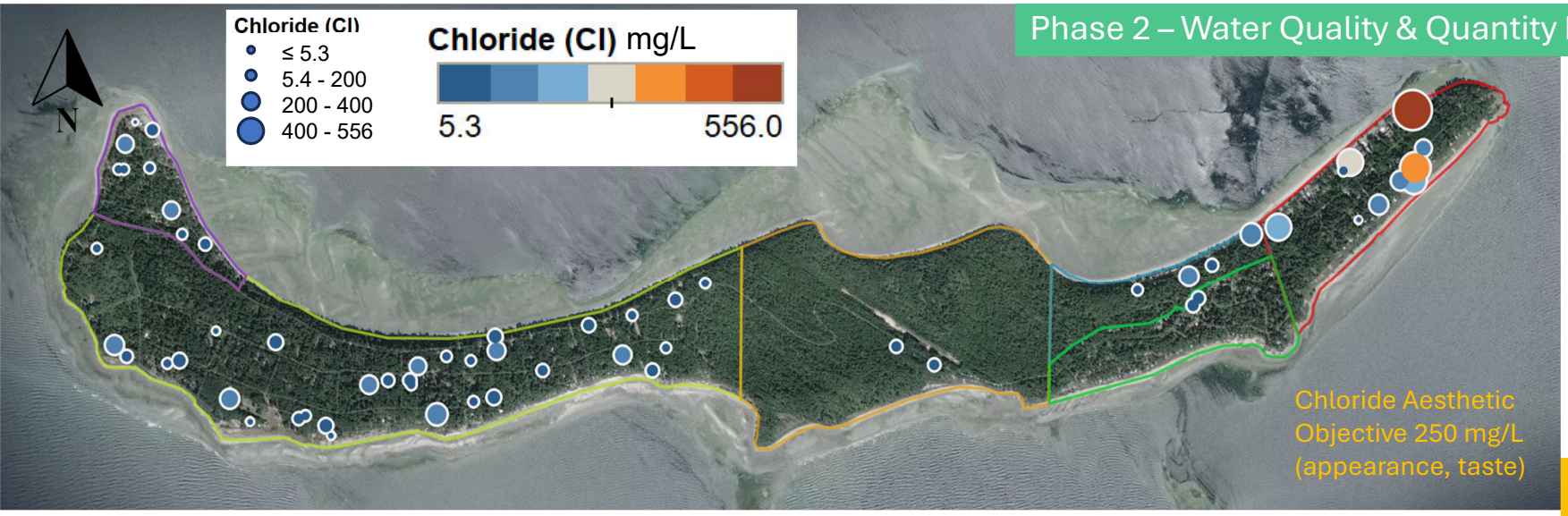
Iron and Manganese
Commonly occurring natural contaminants

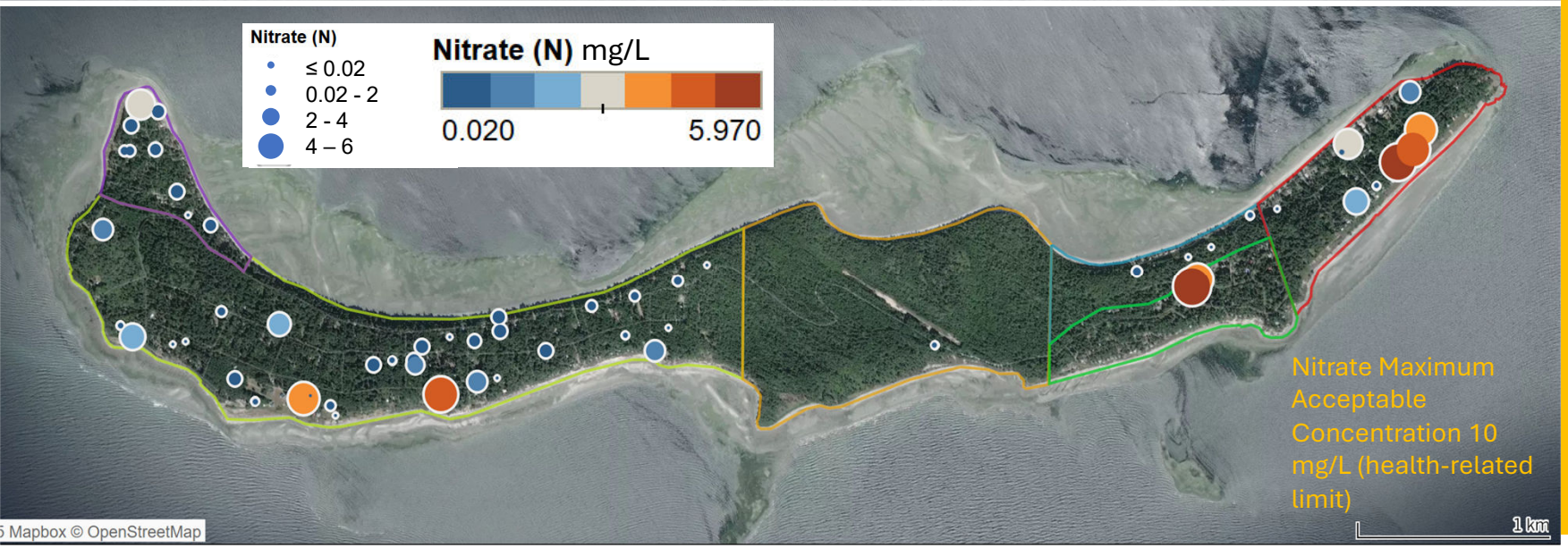
Drinking Water Quality Guidelines

AO=Aesthetic Objective (appearance, taste)

MAC=Maximum Acceptable Concentration (health-related limit)

Savary Island groundwater generally fresh, good quality

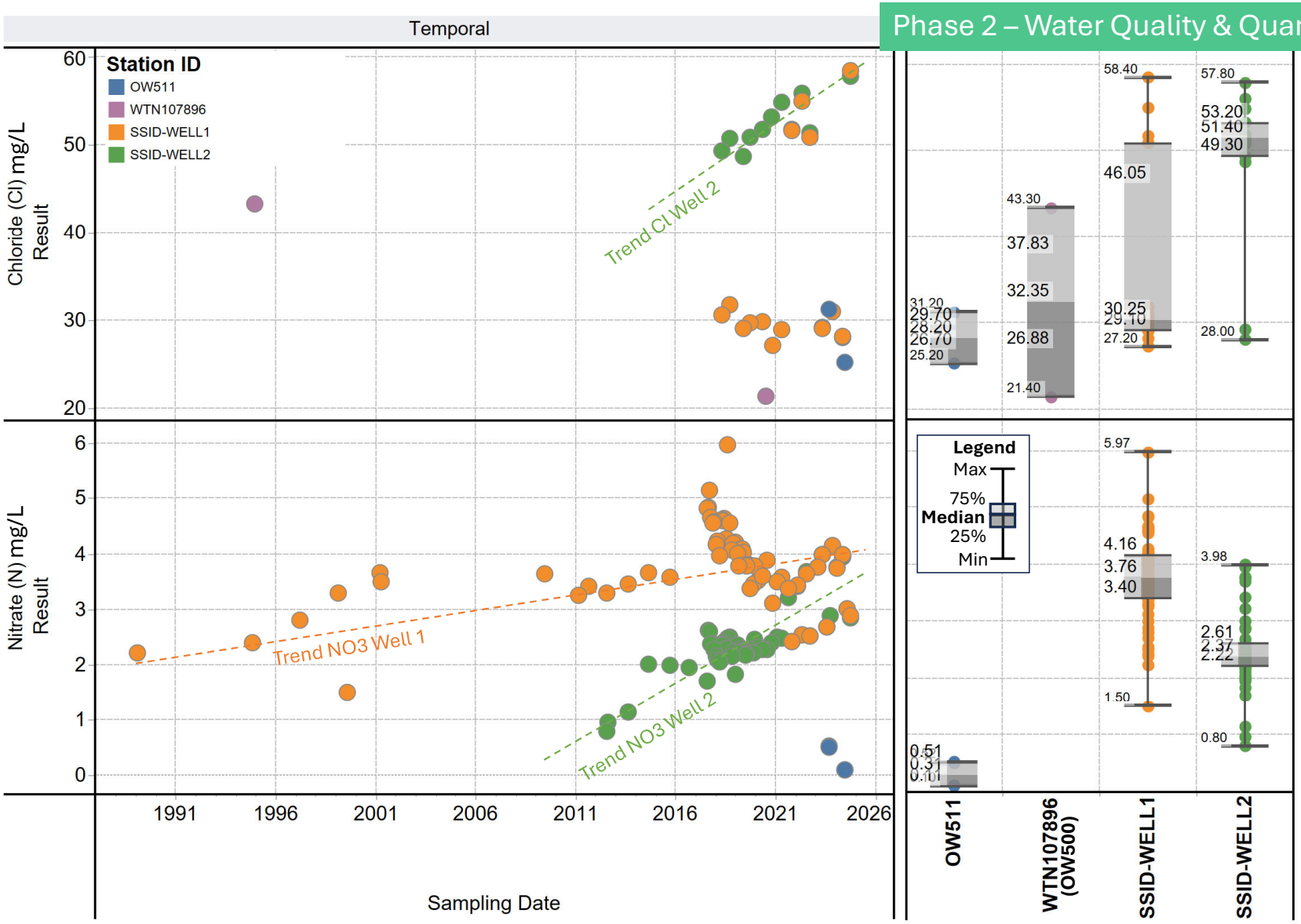




Chloride and Nitrate
Contaminants that indicate land use impact (septic systems, sea water intrusion)

Chloride above guidelines in some areas

Nitrate below guidelines (above 2 mg/L impacted by nutrients from septic systems)



Temporal Trends
Savary Shores Improvement District Wells & Provincial Observation Wells

Increasing chloride trend SSID Well 2

Increasing nitrate trend SSID Well 1 & 2 (all below guideline)

Nitrate generally higher in wet season samples

Saltwater & seawater intrusion – what is it?

- Mixing between fresh and saline water
- Coastal aquifers
  - Active intrusion processes (seawater mixing)
  - Relict sea water in areas of previously higher sea level
  - Connate water trapped in rock formation
- Inland aquifers with saline zones
  - Deep, mature groundwater
- Average fresh groundwater in BC coastal aquifers chloride generally less than 150 mg/L
- Sea water chloride concentration TDS ~35,000 mg/L, chloride ~19,000 mg/L
  - 2% mix seawater - reduces potability
  - 4% mix seawater – water unusable for most purposes
- Mature groundwater can have high concentration of mineral and salts (including sodium, chloride)

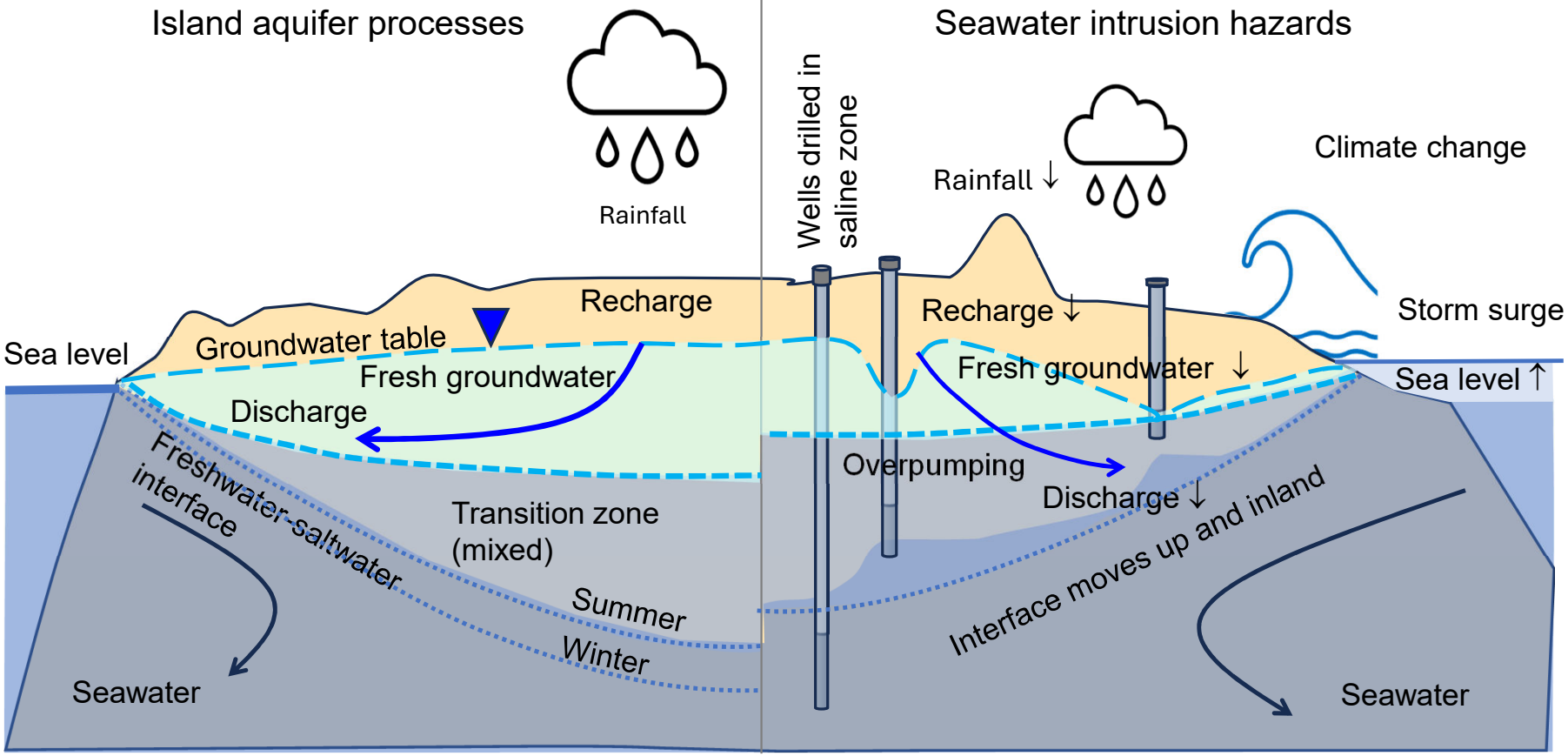
Seawater intrusion identified as significant hazard on Savary Island


Photo: S. Barroso

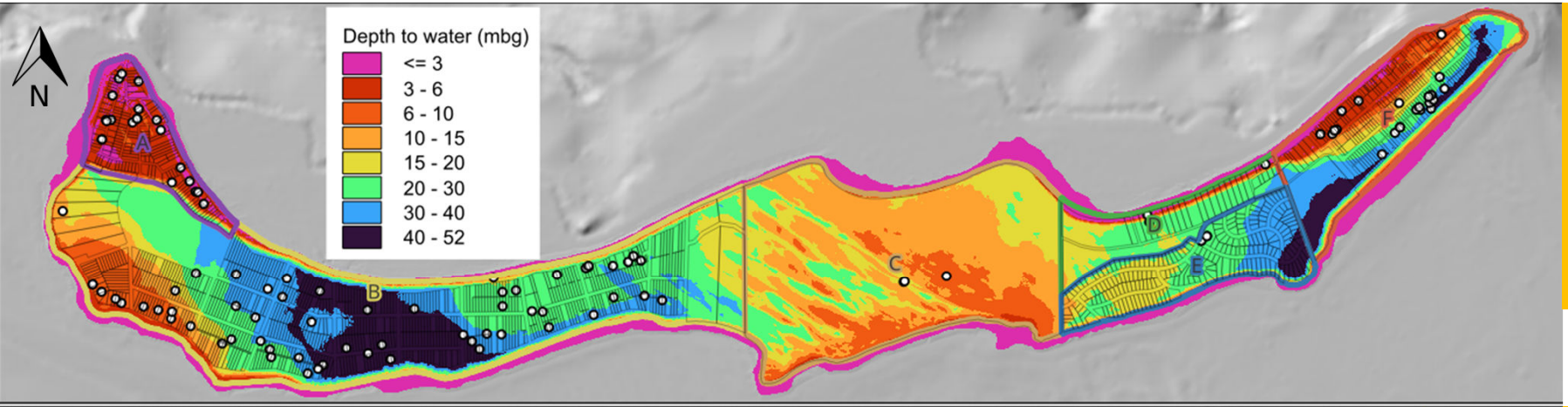
Saltwater intrusion hazard areas & contributing factors

- Close to coast
- Low groundwater and topographic gradient
- Limited recharge
- High well density
- High volumes of groundwater extraction at single location (uncontrolled leaks)
- Where deeper wells intersect transition between fresh groundwater and brackish or saline zone
- Static groundwater level close to sea level (pumping water level below sea level)
- Climate change will worsen impact (longer dry season, increased drought, sea level rise, storm surge)

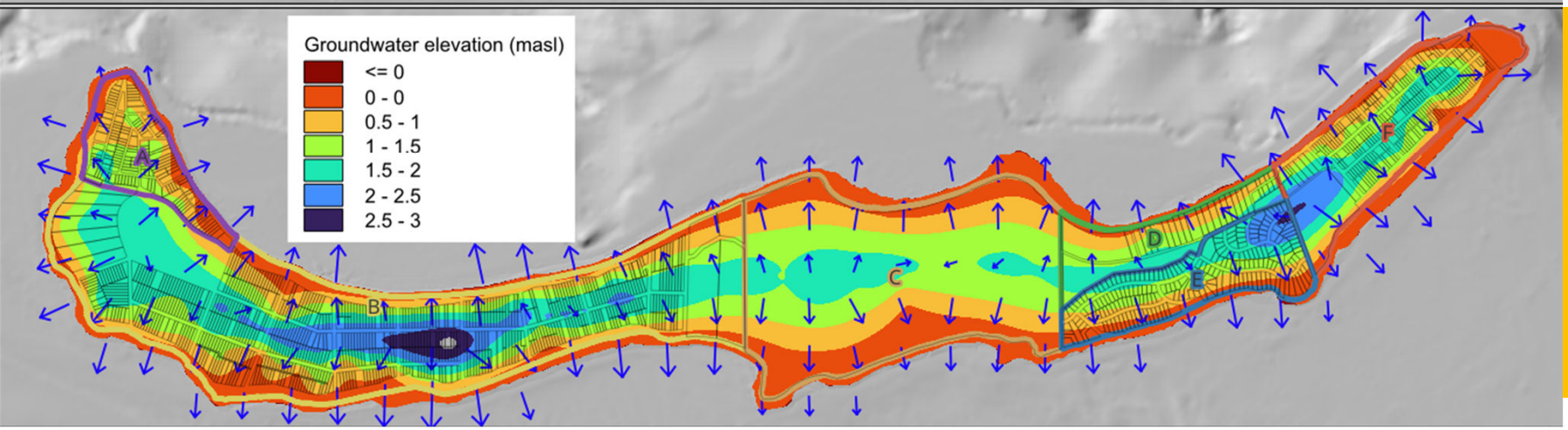
Climate Change and Seawater Intrusion Hazard



Groundwater elevation and depth



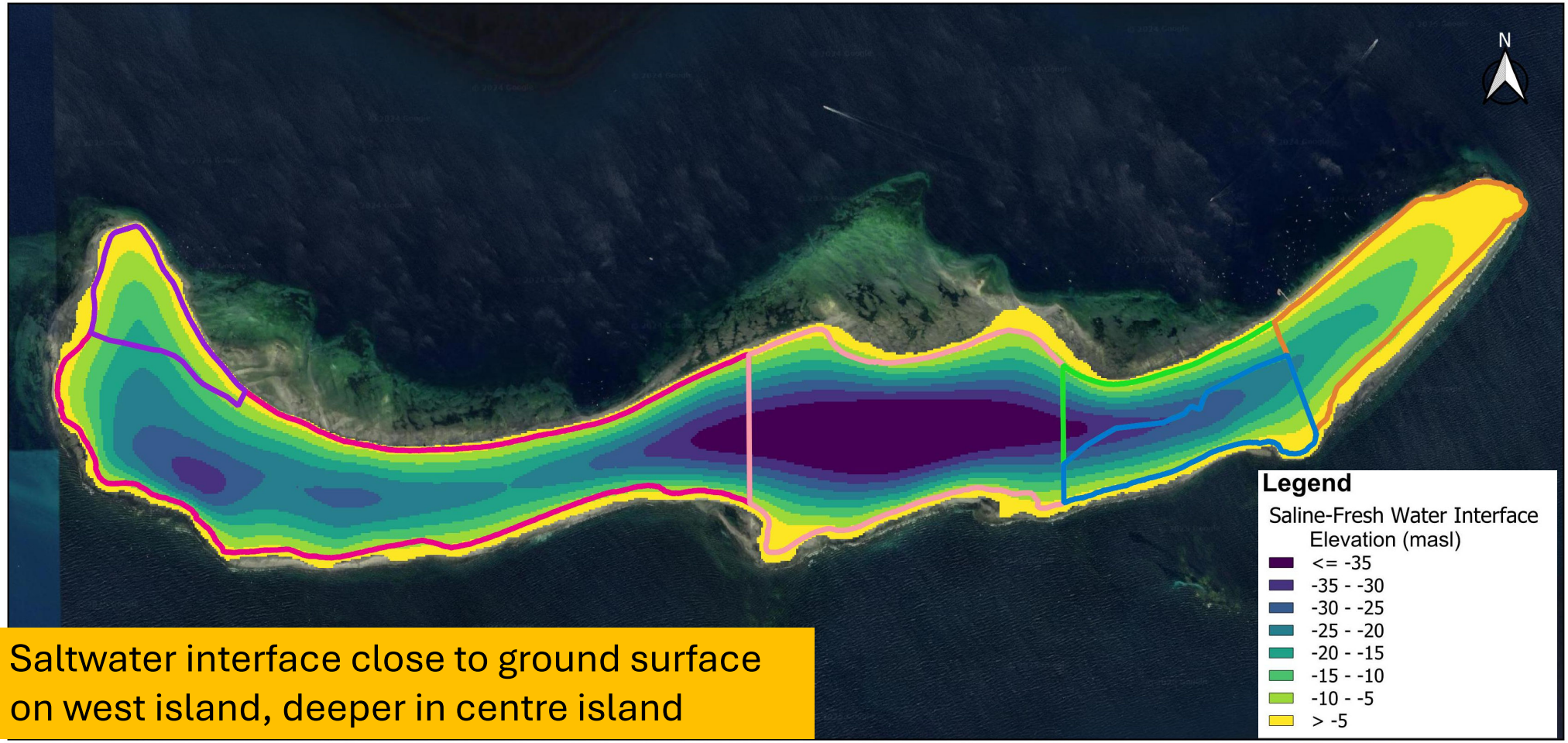
Very shallow groundwater table - high vulnerability to contamination on west and northeast Savary



Very shallow freshwater lens above sea level (groundwater pumping below sea level increases seawater intrusion hazard)

Depth to Saltwater Interface

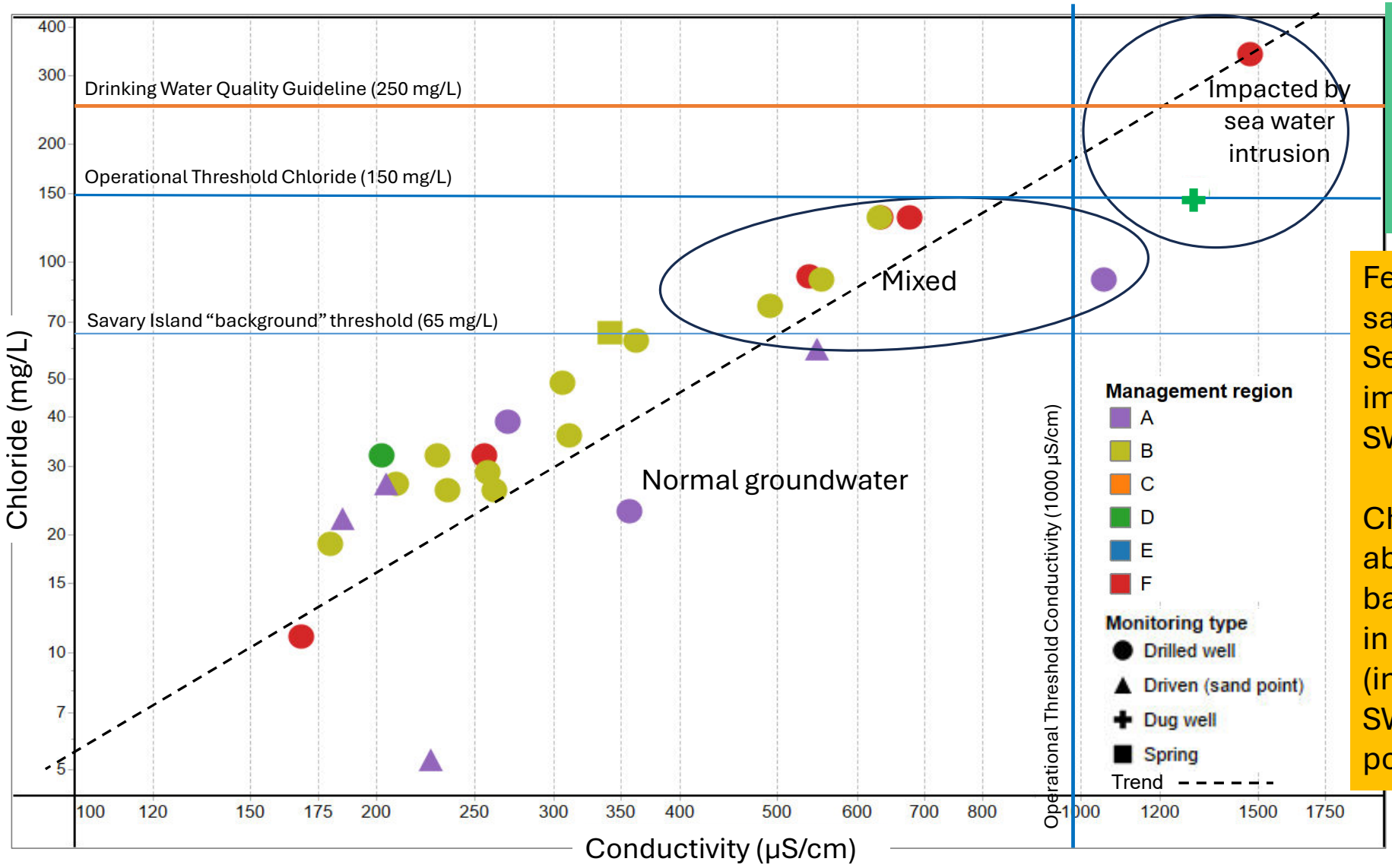
1089054.2015381004 E
549995.4242003064 N



Saltwater interface close to ground surface on west island, deeper in centre island

1081087.1247758567 E
546229.6103663056 N
EPSG:3005

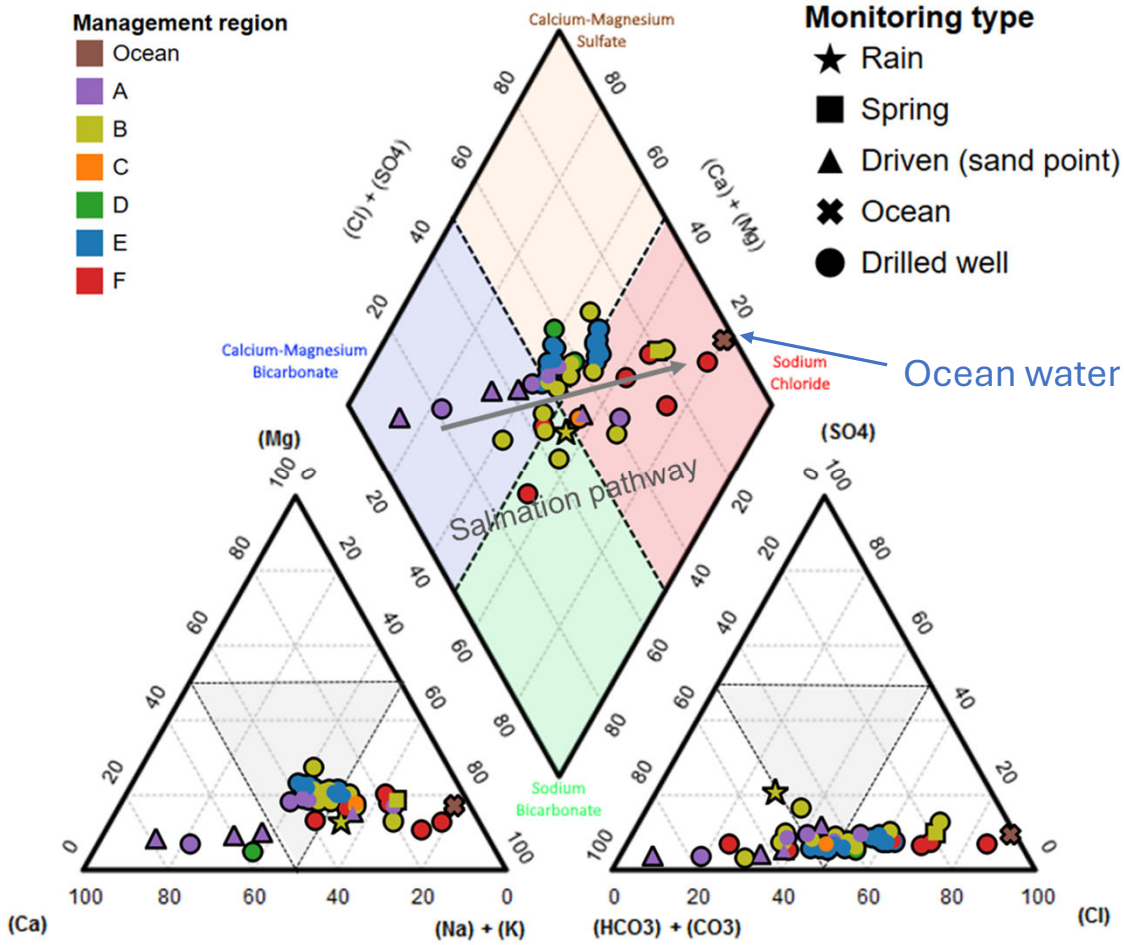
0 0.5 1 km



Phase 2 – Water Quality & Quantity Hazard Assessment

Few wells sampled in Sept 2023 impacted by SWI

Chloride above background in some wells (impacted by SWI or septic pollution



Piper plot showing proportion of major elements in water samples from Savary Island water sources.

Major element ratio indicates groundwater mixed between fresh and more saline sources

Saltwater intrusion – why is it a problem?

- Once salination of aquifer occurs, the change may be permanent or take many years to recover
- High TDS and chloride corrodes pipes and fixtures
- Increases costs for well maintenance or replacement
- Elevated chloride and fluoride in sea water increase formation of harmful trihalomethanes in chlorinated water
- *Water Sustainability Act* (S. 58) prohibits well operation that causes saline or seawater intrusion and affects quality and use of the groundwater
- Alternative water sources such as desalination are costly, energy intensive or are linked to other environmental harms (e.g. disposal of concentrated brine solution)

Best Practices for Well Construction & Maintenance

GW SOLU
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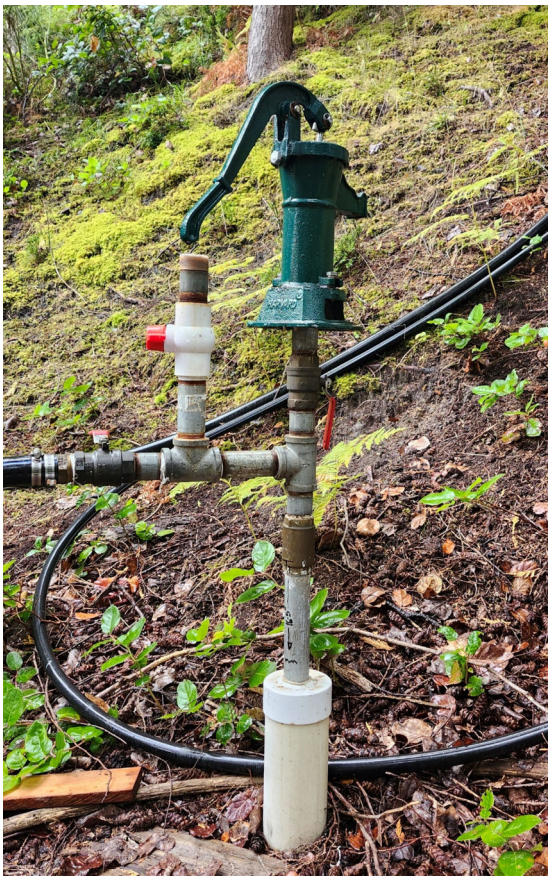
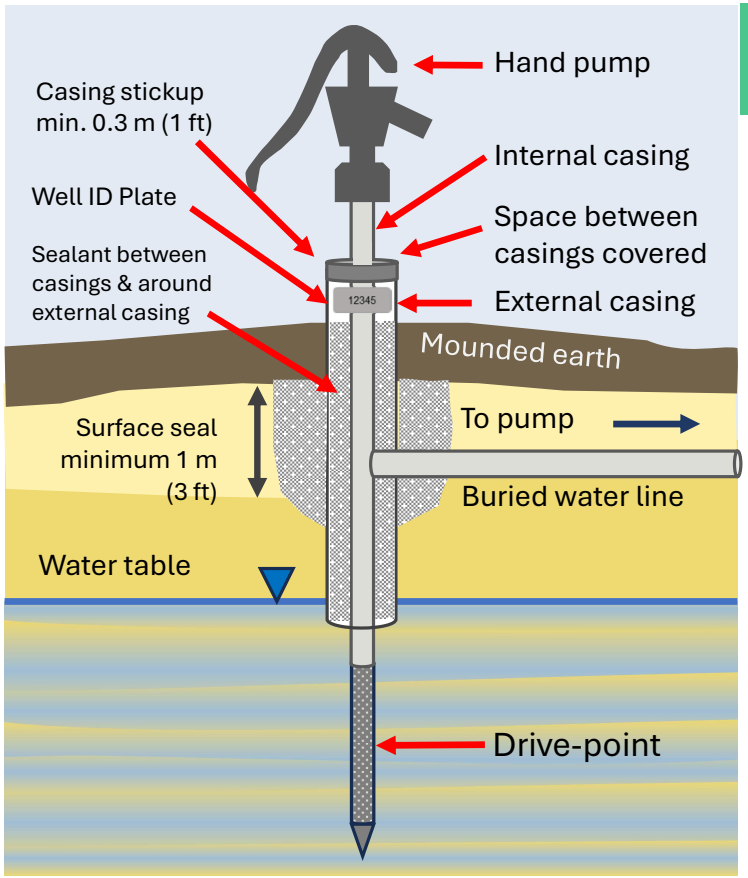
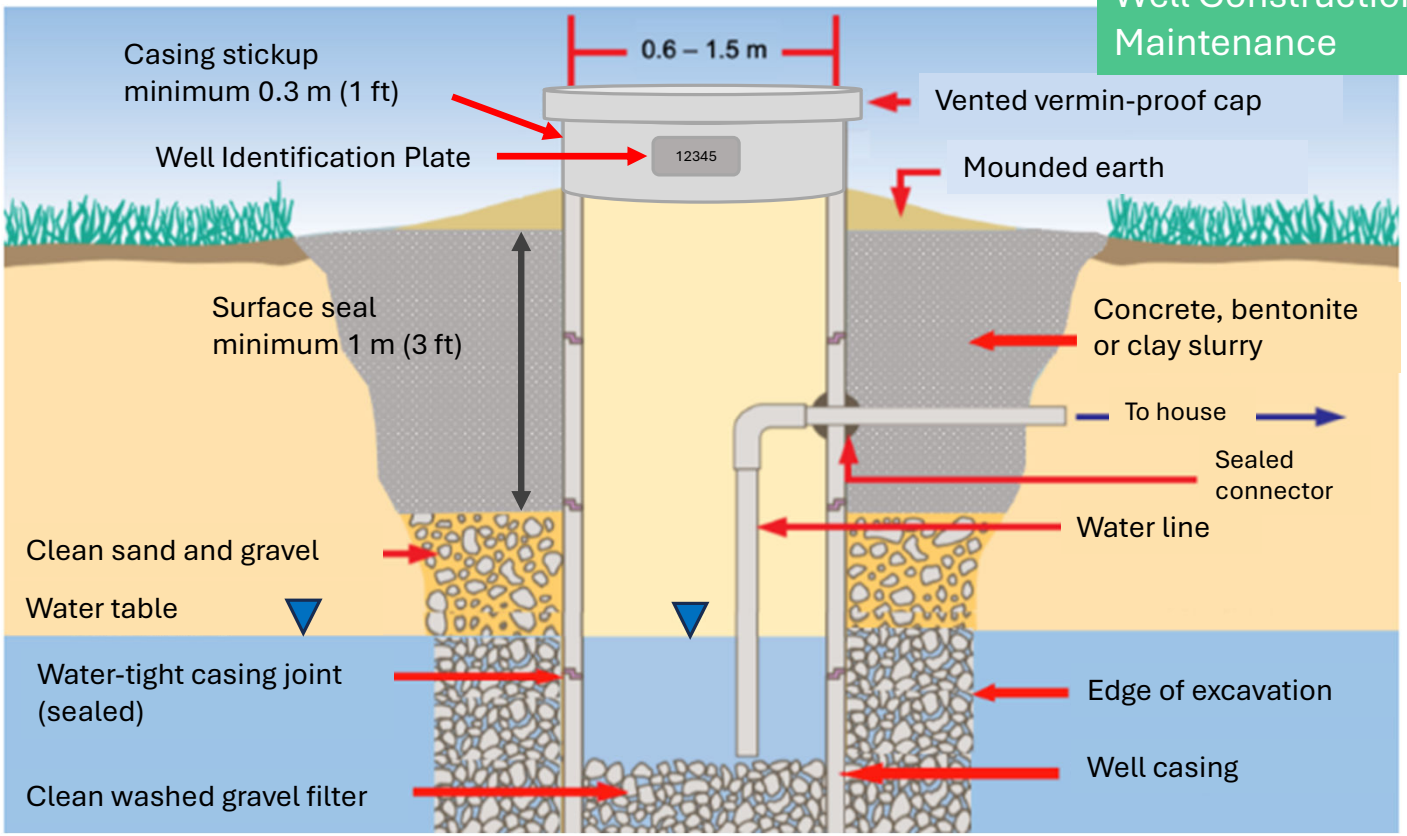




Sand point (driven) wells are constructed using a cylindrical pipe with a screen and pointed end which is hammered into the ground. They are usually shallower than drilled wells, with a smaller diameter (e.g. 2") stainless steel or galvanized aluminum screen. Sand points are considered vulnerable to contamination and water supply may be limited in the dry season.

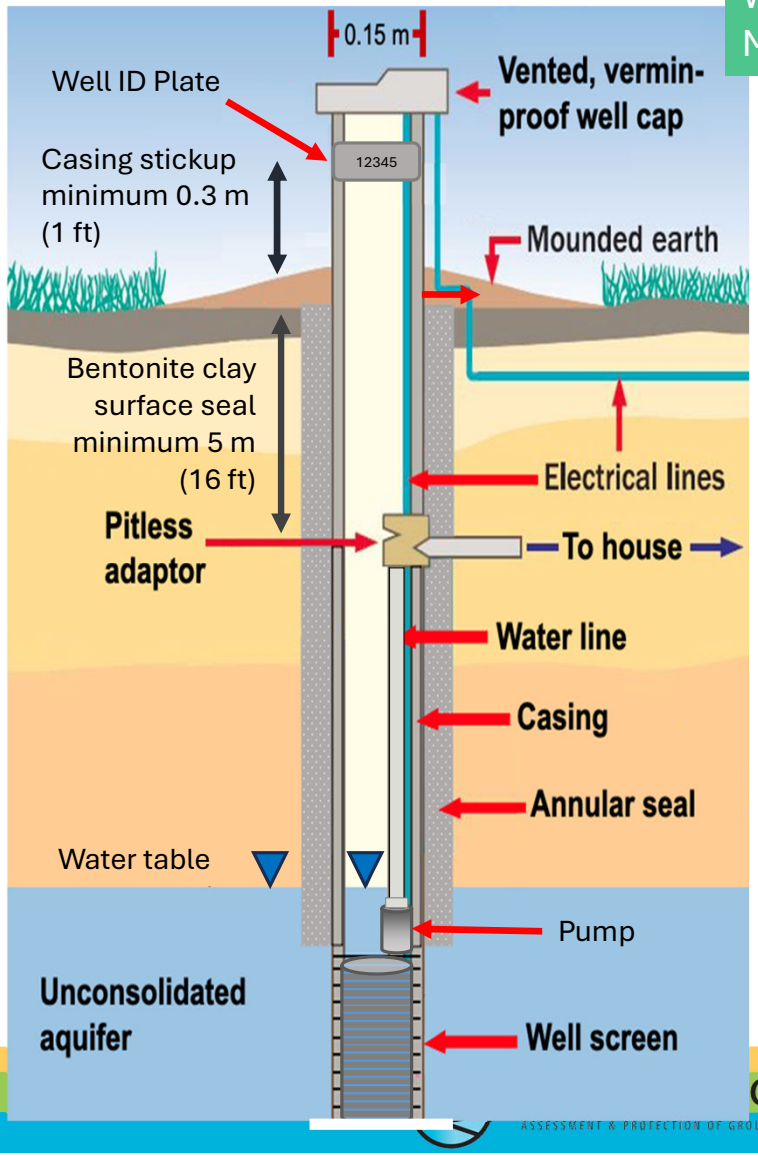


Excavated (dug) wells are typically large diameter, shallow, with sides made of cement or wood cribbing. These types of wells are considered highly vulnerable to contamination and seasonal water supply may be limited.

Photos: S. Barroso & A. Barroso. Image modified from 3.2 Dug Wells – Domestic Wells – Introduction and Overview (gw-project.org)

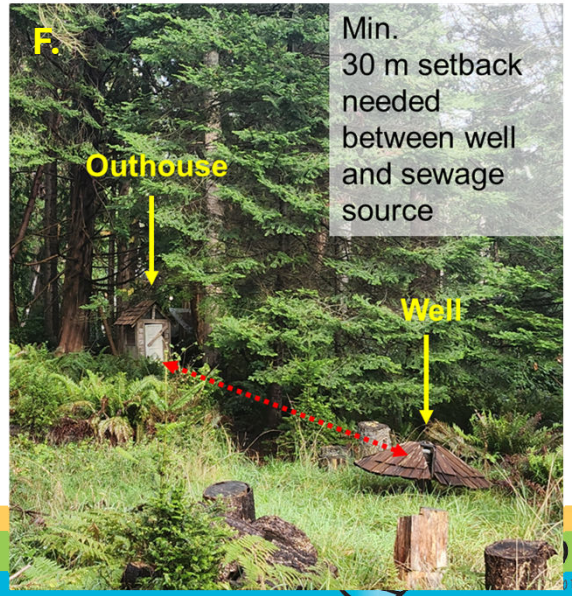
Domestic drilled wells in unconsolidated (sand and gravel) aquifers are often 0.15 m (6”) in diameter with steel casing and stainless steel well screen (bottom left). The wells vary in depth, water production and vulnerability depending on the aquifer characteristics.

Image modified from: [3.1 Drilled Wells – Domestic Wells – Introduction and Overview (gw-project.org)]



Pitless adapter

Well Construction & Maintenance



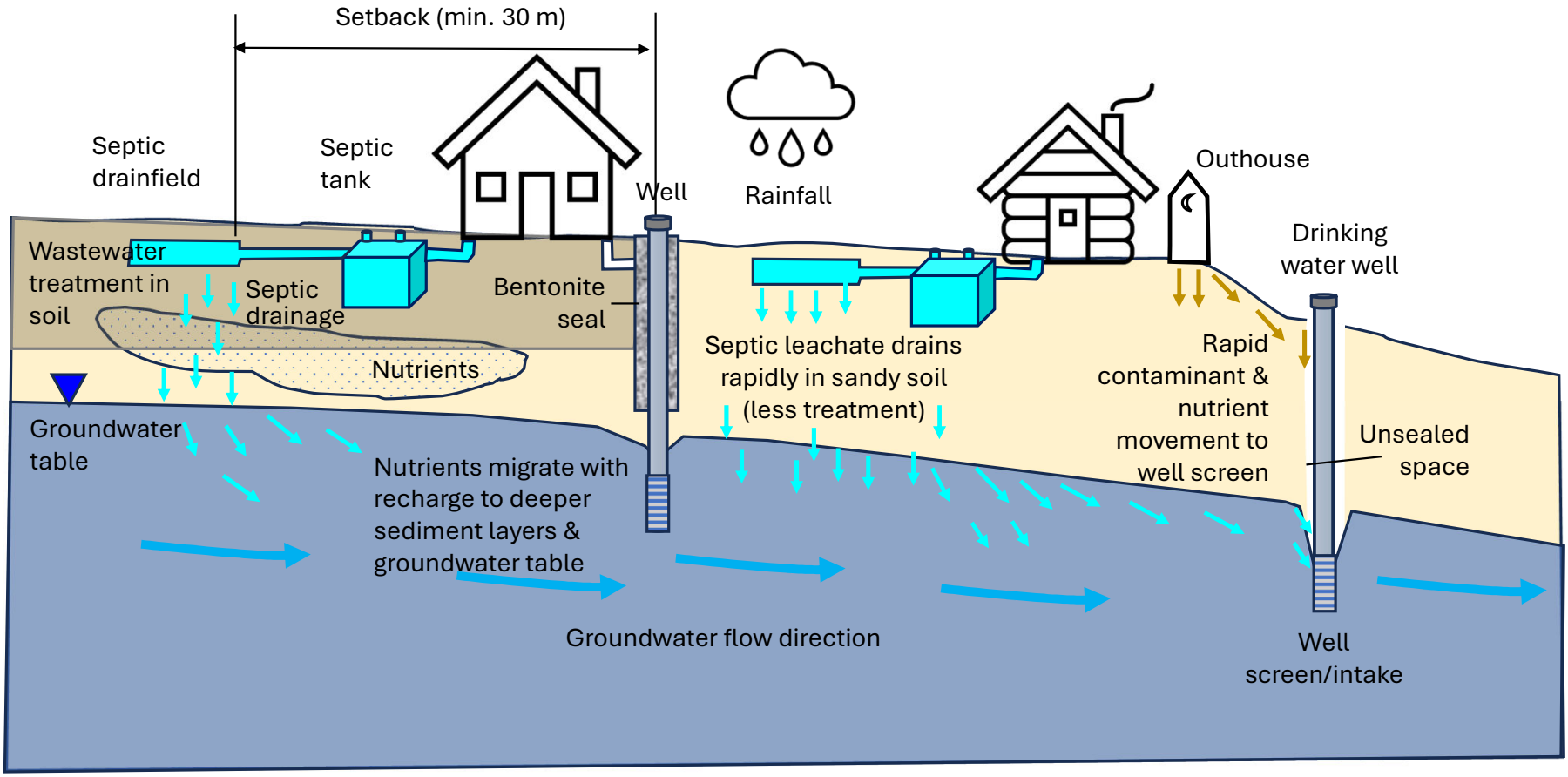
A Unfilled annular space (recently drilled well)

B-C Unfilled annular space and water line trench (historical wells)

D Generator less than 3 m from well (and no spill pan)

E Older well with casing stickup close to ground level

F Well located < 30 m from source of sewage contamination


Setback (min. 30 m)
Septic drainfield
Septic tank
Well
Rainfall
Outhouse
Drinking water well
Wastewater treatment in soil
Septic drainage
Bentonite seal
Nutrients
Septic leachate drains rapidly in sandy soil (less treatment)
Rapid contaminant & nutrient movement to well screen
Unsealed space
Groundwater table
Nutrients migrate with recharge to deeper sediment layers & groundwater table
Groundwater flow direction
Well screen/intake

Rainwater Capture

- Currently not widely used water source (secondary source for gardens, etc.)
- Good option on lots that do not have a drilled well
- Many properties already have water storage tanks
- Design and cost depends on use (outdoor, indoor non-potable, potable)
- Resources
  - Regional District of Nanaimo Rainwater Harvesting Best Practices Guidebook
  - Salt Spring Island Non-Potable Rainwater Harvesting Best Practices Guide
  - MyCarpentry.com Rainwater Harvesting Calculator
  - Ministry of Health Guidance for Treatment of Rainwater Harvested for Potable Use

Rainwater catchment system on east Savary Island

Rainwater catchment system at Cortes Island Recycle Depot

Phase 2 – Water Quality & Quantity Hazard Assessment

Water quality

- Groundwater from most wells is fresh and meets Guidelines for Canadian Drinking Water Quality
- Natural contaminants present (iron, manganese)
- Nitrate (& chloride) indicate septic system impacts
- Increasing nitrate trend observed in some areas, results below guidelines (long-term health impacts can occur at concentrations below limit)

Well construction and maintenance

- Most well construction compliant with provincial Groundwater Protection Regulations
- Wells have greater protection from contamination when properly installed and maintained
  - Bentonite surface seals
  - Setback from contaminant sources (sewage sources, fuel)
- Well owners would benefit from education and support for well testing and septic system maintenance

Sea Water Intrusion Hazard

- Island has a very thin lens of fresh water overlying saline transition zone
- Sea water intrusion is a significant hazard to water quality, quantity likely to impact long-term sustainability
- SWI indicated by elevated chloride (total dissolved solids and conductivity)
- Observed trend of replacing shallow sand point wells with deeper drilled wells (likely to increase water use and aquifer drawdown)
- Monitoring and well owner education is critical to reduce risk
- Well drillers and pump installers play a critical role in education and prevention


Photo: A. Barroso

Savary Island Well & Property Owners What You Can Do

- Conserve water! Install low water use fixtures, limit non-essential water use, including outdoor irrigation
- Check for and quickly fix uncontrolled leaks, hoses left open, etc.
- Used stored water in cisterns pumped from a well or other backup supplies (e.g., rainwater collection)
- In multi-well systems, alternate the pumping of each well to limit drawdown and allow water levels to recover
- Record changes in water quality over time (salty taste, corrosion of pipes and fixtures)
- Collect samples for lab analysis of geochemical water quality annually or semi-annually, including analysis of salinity indicators (chloride, EC, TDS)
- Properly decommission (backfill) unused wells
- If the well produces salty water seasonally or periodically
  - Use an alternate supply, investigate the cause, and seek advice from a driller, pump installer, or other qualified person
  - Purchase a low-cost water quality meter (e.g. TDS), monitor and note trends, seasonal differences, or changes

Aquifer Protection Plan Recommendations

Monitoring (Groundwater Quantity & Quality)

- Continue existing monitoring (OW408, OW511) and formalize OW500 (central island) as monitoring location (ENV/FLNR)
- On-island support for network maintenance (e.g. SSID or local contactors)
- Expand volunteer water level monitoring in other areas (use LTC loggers)
- Develop water quality monitoring network (neighbourhood surveys, electrical conductivity (EC))
- Data repository (shared info)

Education and support for well and property owners

- Aquifer signage
- Community presentation of groundwater study results
- Well Smart workshops
- Septic Smart workshops
- Well inventory and GWELLS registration
- Financial, logistical, educational support for well upgrades, decommissioning or testing e.g. sample bottle pick up or drop off location, surface seal retrofits

Photo: S. Barroso

Aquifer Protection Plan Recommendations

Sewerage and pollution prevention

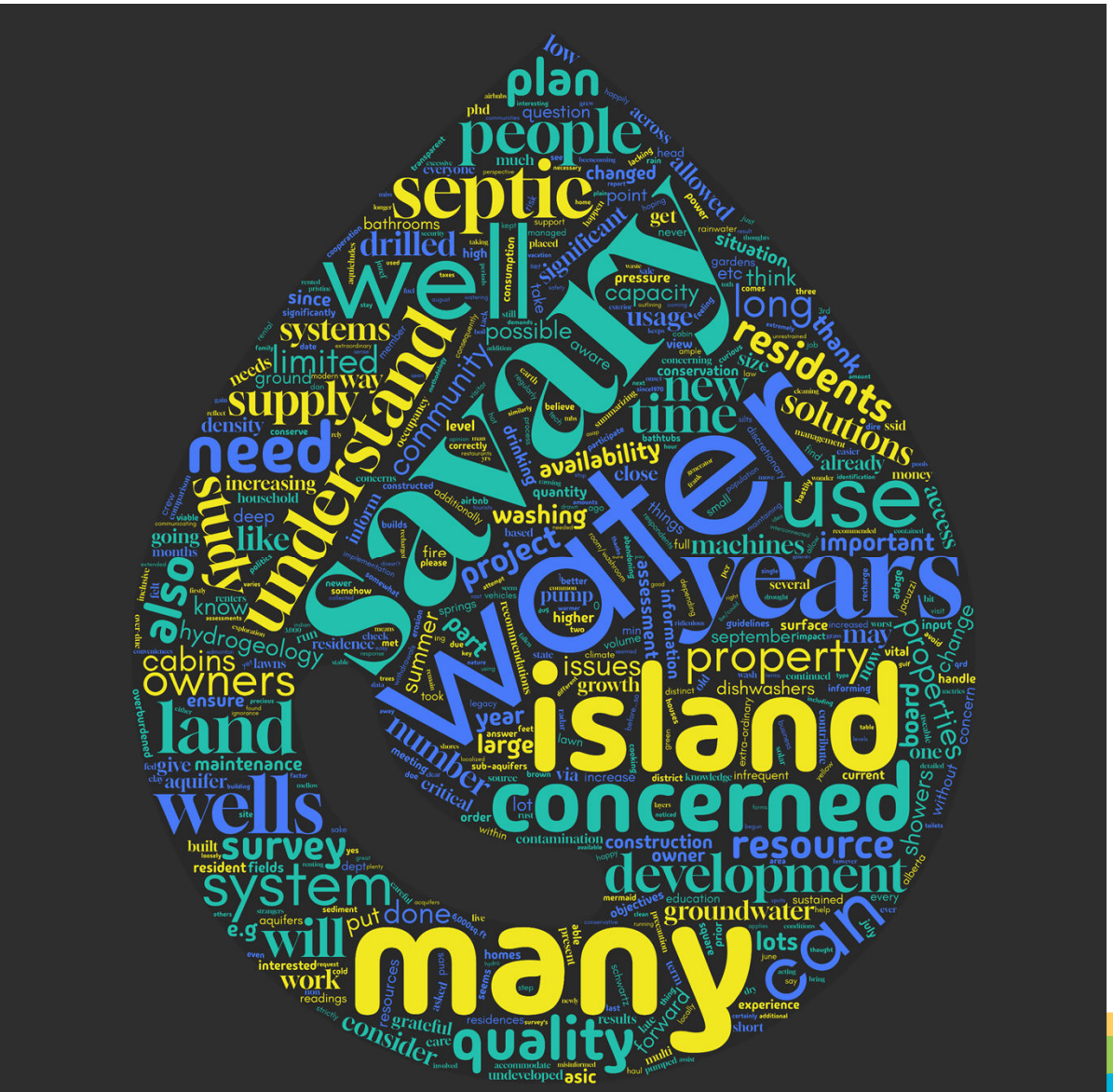
- Work with regulatory agencies to enforce compliance with septic design and installation requirements (Vancouver Coastal Health)
- Enforce compliance with storage of hazardous materials, dumping and waste handling and accumulation

Well driller and pump installers education and compliance

- Work with regulatory agencies to increase compliance enforcement of well drillers and pump installers and use of sea water intrusion prevention practices (Ministry of Water, Land & Resource Stewardship)

Land Use and Water Protection Planning & Rural Water Supply Options

- Evaluate and develop different sources (Regional water services, shared or community water sources, water lots, rainwater capture)
- *Development and land use practices must be compatible with low water use*
- Bylaws, covenants (water sample for building or occupancy, water storage, business license for vacation rental earning above an annual threshold)
- Invest in qRD Drinking Water Protection Program - examples from other communities Regional District of Nanaimo, southern Gulf Islands (Islands Trust)



Thank you! Questions & discussion

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Full report available at: [Land Use | Plans & Zoning | Electoral Area A | qathet Regional District]

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