



DRINKING WATER
WATERSHED
PROTECTION

RDN Drinking Water & Watershed Protection Program

Technical Advisory Committee November 10, 2016



Partner Updates



Agenda

USHP Stream Assessments	Reports – J. Pisani
Area H OCP Update Hydrogeology Review	Report – B. Lyons (Waterline)
Area E Water Monitoring Plan	Report – M. Bolton (Golder)
Phase 2 Water Budget Scoping – French Creek & Cedar-Yellow Point	Report – A. Burgert (Piteau)
Wetland Mapping & Monitoring	Presentation – K. Harris & A. Van Acken (VIU)
Gabriola Groundwater Modelling	Presentation – R. Burgess (SFU)
Question for the committee.... “What would you like to see from the DWWP program in 2017?”	Verbal

Hydrogeological Review of Aquifers in Electoral Area H in Support of the Official Community Plan

Waterline Resources Inc.

November 10th, 2016

Bernadette Lyons, M.Sc.E., P.Eng, Hydrogeological Engineer

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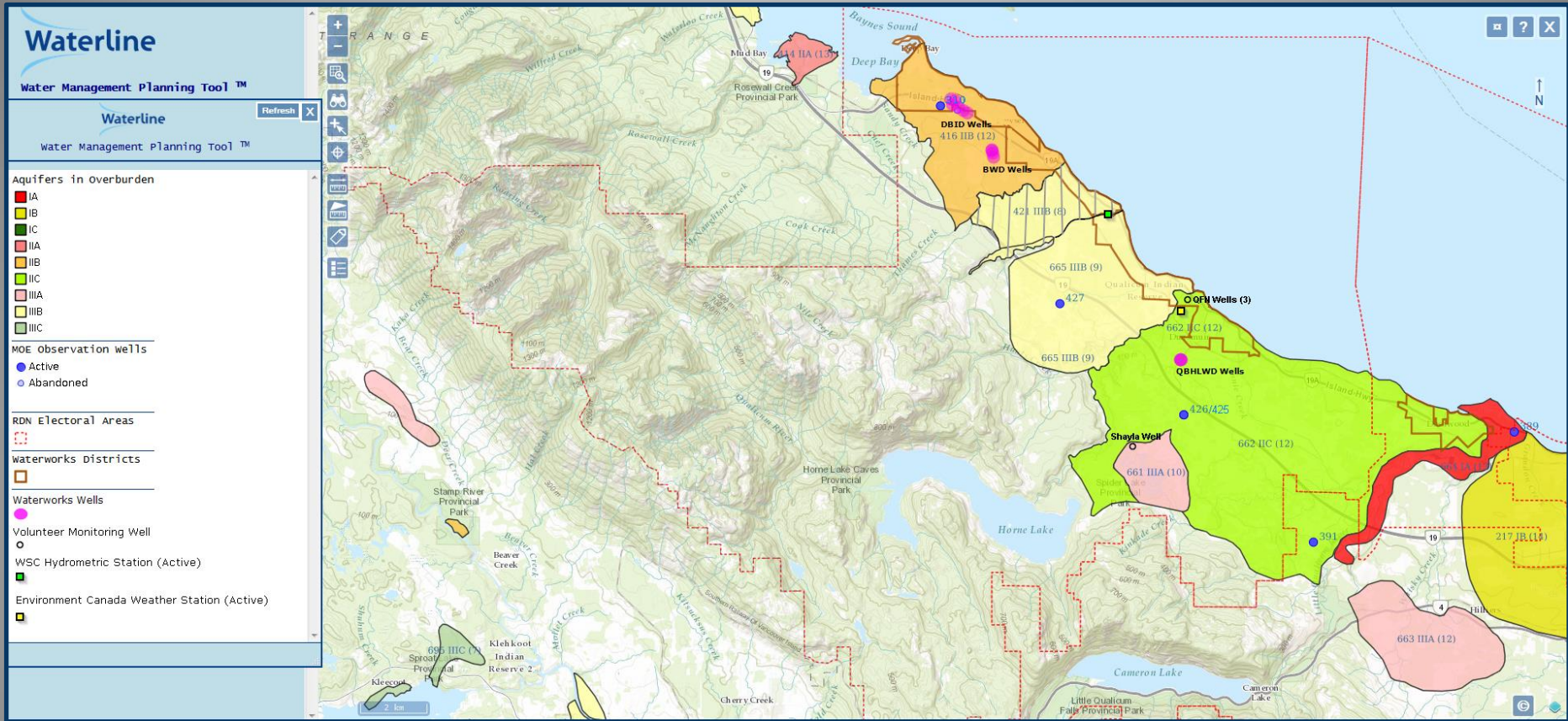
Waterline Scope

- Review major hydrogeological studies and the hydrogeological monitoring data collected in Area H since the Phase 1 Water Budget was completed, including data from 2011 to present,
- Provide an updated qualitative assessment of aquifer recharge to inform the OCP, and
- Provide an updated qualitative assessment of groundwater-surface water interaction to inform the OCP.

Presentation Outline

- Aquifers in Electoral Area H
- Updated hydrostratigraphy from the GSC study
- Case Study: Aquifer 416 Deep Bay
 - ✓ Aquifer response to daily precipitation
 - ✓ Aquifer response to annual precipitation
- Data gaps and Inconsistencies
- Conclusions and Recommendations

Electoral Area H – Study Area and Aquifers



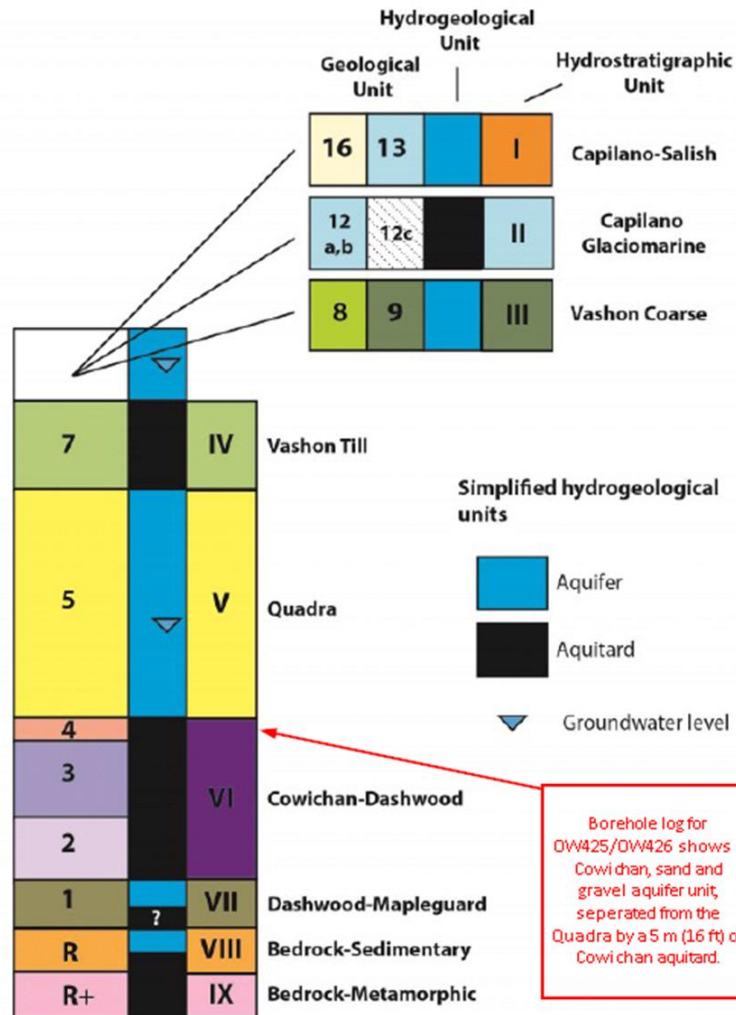
Updated Hydrostratigraphy

Geological legend

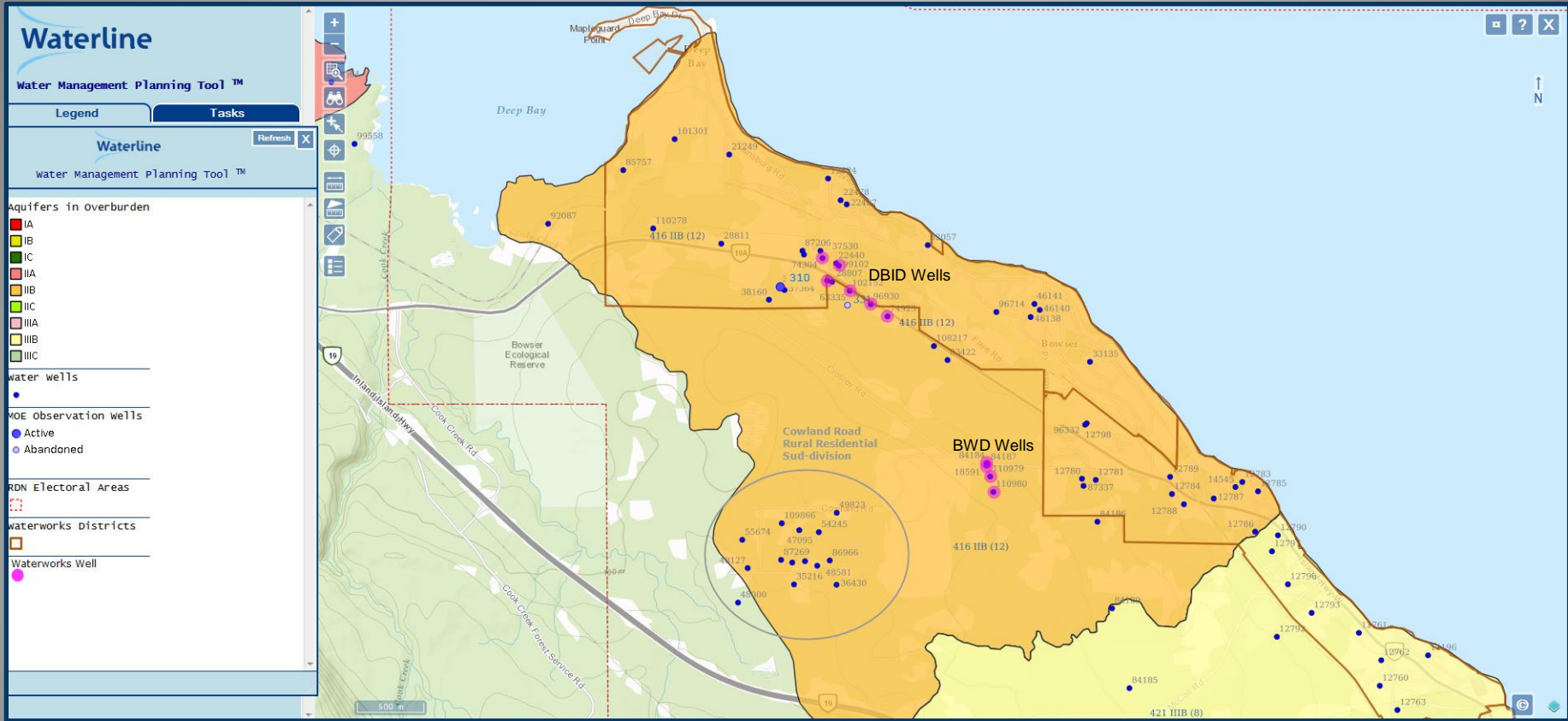
Salish sediments	
16	Shore, deltaic and fluvial deposits: deltaic deposits gravel, sand, silt, clay, peat
Capilano sediments	
13	Terraced fluvial deposits: deltaic deposits gravel and sand underlain by silt and clay
12 a,b	Marine deposits: 12a silt, clay, stony clay 12b sand, sandy gravel underlain by clay 12c marine veneer (< 1.5 m) } Thickness: 0.1 to 9 m
12 c	
Vashon drift	
8 9	Glacio-fluvial deposits: gravel, sand and lenses of till
7	Ground moraine deposits: till, lenses of gravel, sand and silt
Quadra Sand	
5	Sand, minor gravel (fluvial environment)
Cowichan Head Formation	
4	Silt, gravel, sand, peat, peaty soil, driftwood (swamp environment)
3	Clay and stony clay with marine shells (sub-littoral environment)
Dashwood drift	
2	Till, lenses of gravel and silts
Mapleguard sediments	
1	Sand, silt; minor clay and gravel
Bedrock	
R	Conglomerat, sandstone and siltstone

Source: Benoit et al. 2015

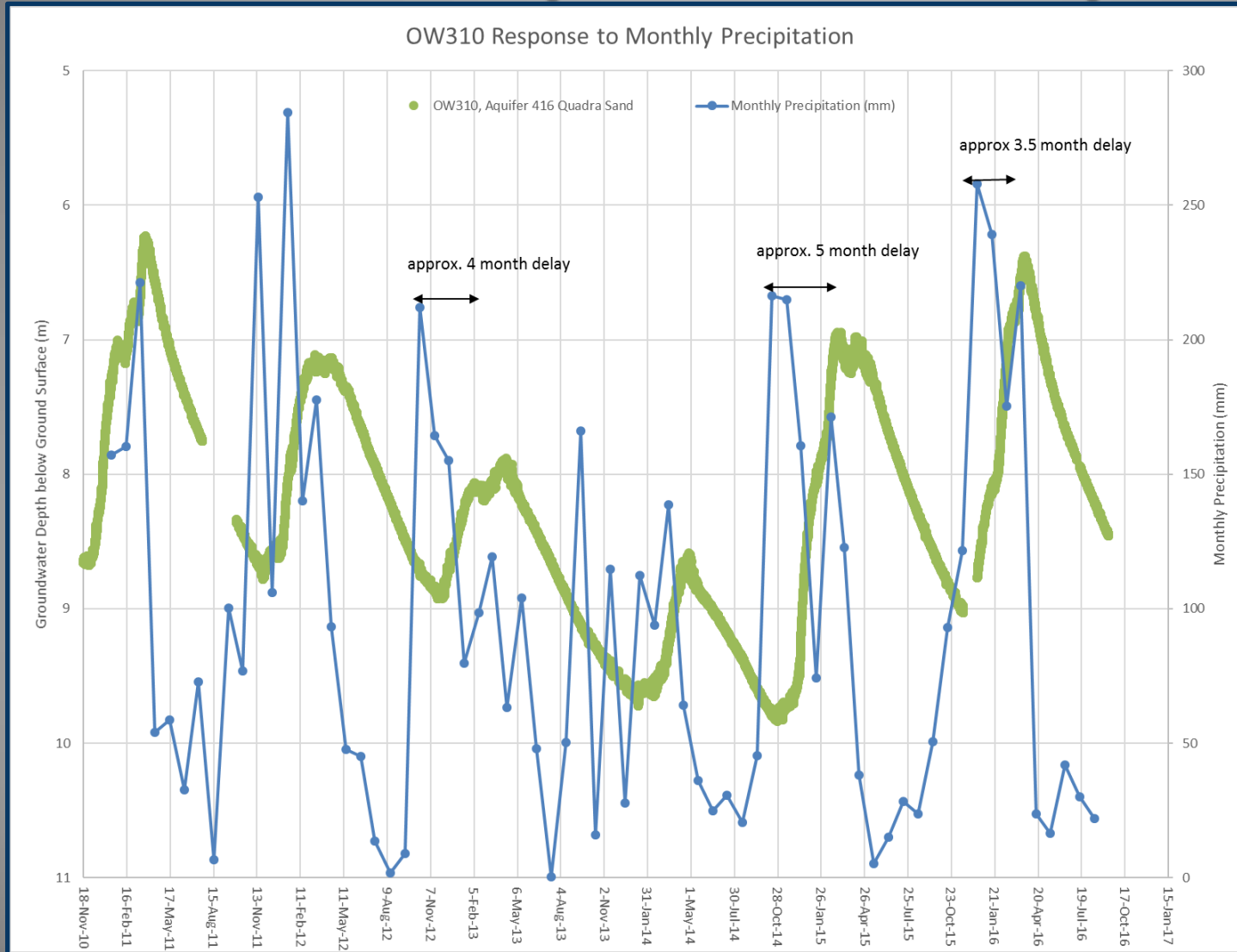
Waterline annotations in red



Aquifer 416 – Quadra Sand

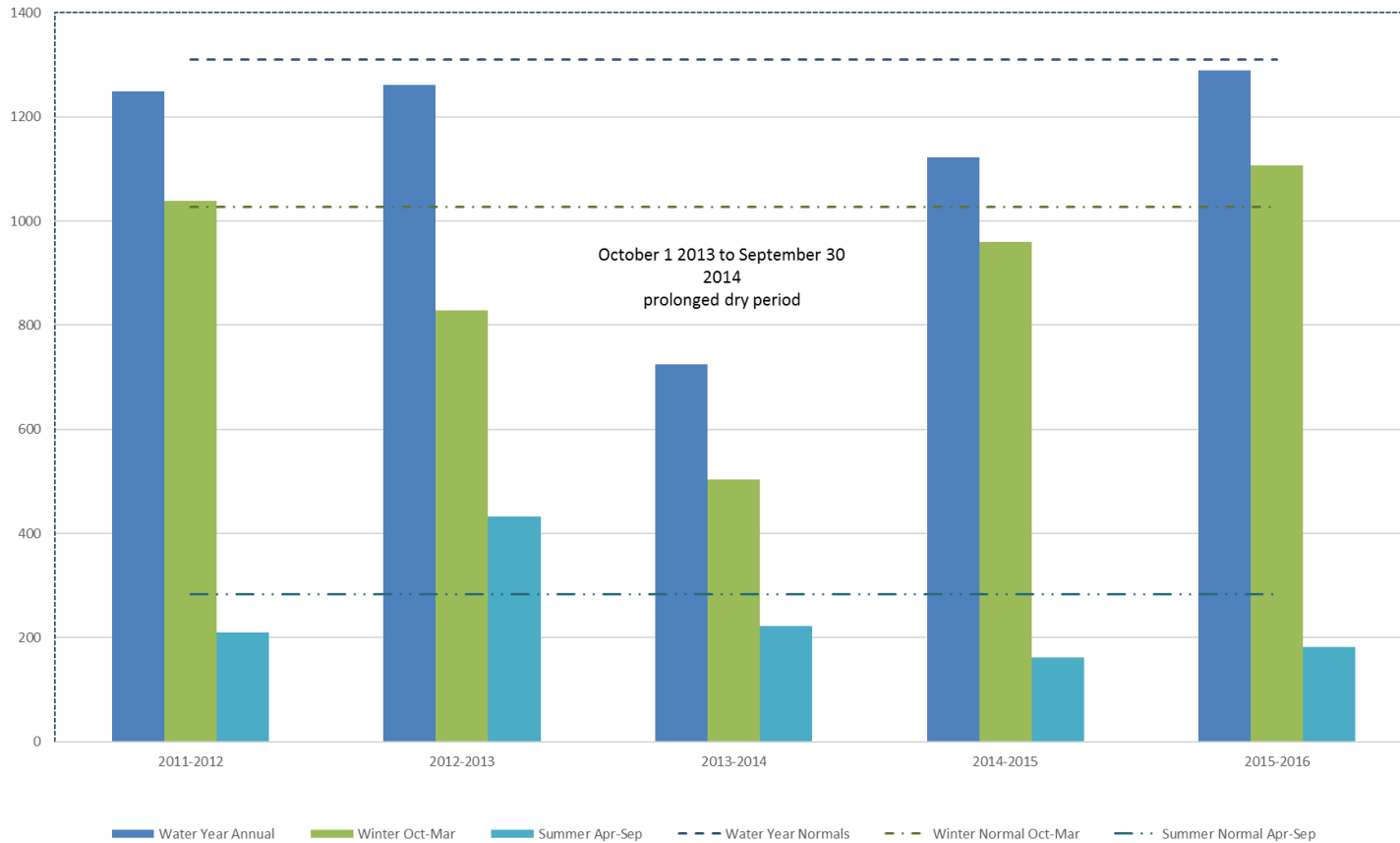


Seasonal Response to Precipitation



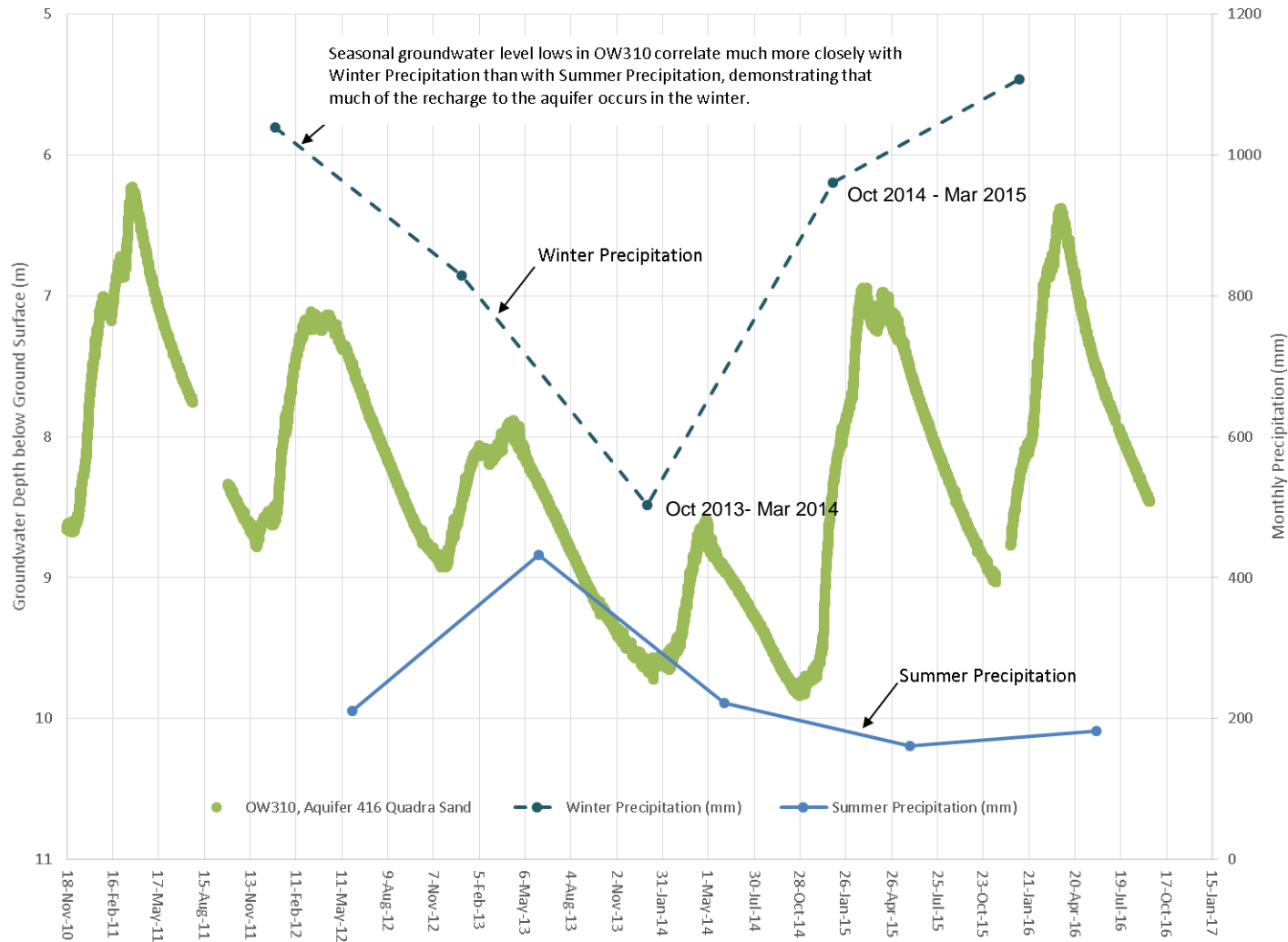
Water-Year Precipitation

Qualicum R Fish Research, Station 1026565
Annual Precipitation by Water Year (Oct 1 to Sept 30)



Annual Response to Precipitation

OW310 Response to Annual Precipitation



Data Gaps and Inconsistencies

- Provincial aquifer mapping needs updating to:
 - Include new information from the GSC Nanaimo Lowland study that has potentially identified two additional aquifers in Area H:
 - a Cowichan Formation aquifer near OW426 and
 - a Quadra Sand aquifer near OW427.
 - More accurately reflect vulnerability of the aquifers.
 - Review new borehole data in Aquifer 421 and reconsider the extents of that aquifer.

Data Gaps and Inconsistencies

- Seven of the eight groundwater monitoring wells in Area H do not provide meaningful data for the aquifers as they are currently mapped:
 - Three of the four BC GOWN wells in Area H are completed in unmapped aquifers.
 - Volunteer Groundwater Observation Network wells:
 - The Shayla Road well is completed in the Quadra sand Aquifer 662 not Vashon (Kame) Aquifer 661, as was previously thought and water use in the well overwhelms the natural fluctuations in groundwater levels.
 - No borehole information is available for the 3 QFN monitoring wells.

Data Gaps and Inconsistencies

These data gaps limit the assessment of aquifer recharge for the Area H aquifers and if not rectified can significantly affect groundwater management decisions made by the RDN and water users.

Recommendations

- Inform the Province of the need to update aquifer mapping in Area H.
- Identify appropriate groundwater monitoring well locations in each aquifer, to support future recharge assessments.
- Establish water management objectives to protect aquifer recharge. For example, consider:
 - ✓ Developing guidelines to assess and maintain the recharge capacity of land (similar to septic suitability requirements).
 - ✓ Compile the data and use it to develop recharge maps.

Recommendations

- Encourage large water users in Area H to conduct long-term performance monitoring (water levels, flow, quality).
- Consider using environmental isotopes to determine the age, source, and origin of aquifer recharge.

Questions?

Thank You





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DRAFT WATER MONITORING PLAN

ELECTORAL AREA E (NANOOSE)

Background

- Build on the Phase 1 Water Budget Project
- Objective: to identify sources of uncertainty and work collaboratively with partners to develop a monitoring program that will
 - support detailed analysis & water budget models to assess supply and use
 - provide the technical basis to guide land use decisions in the area
 - support the development of a Water Sustainability Plan

Scope

- Review available information
- Update Geodatabase and Conceptual Model
- Host Public Feedback Session in Nanoose, BC
- Identify data gaps in existing monitoring network and develop Water Monitoring Plan

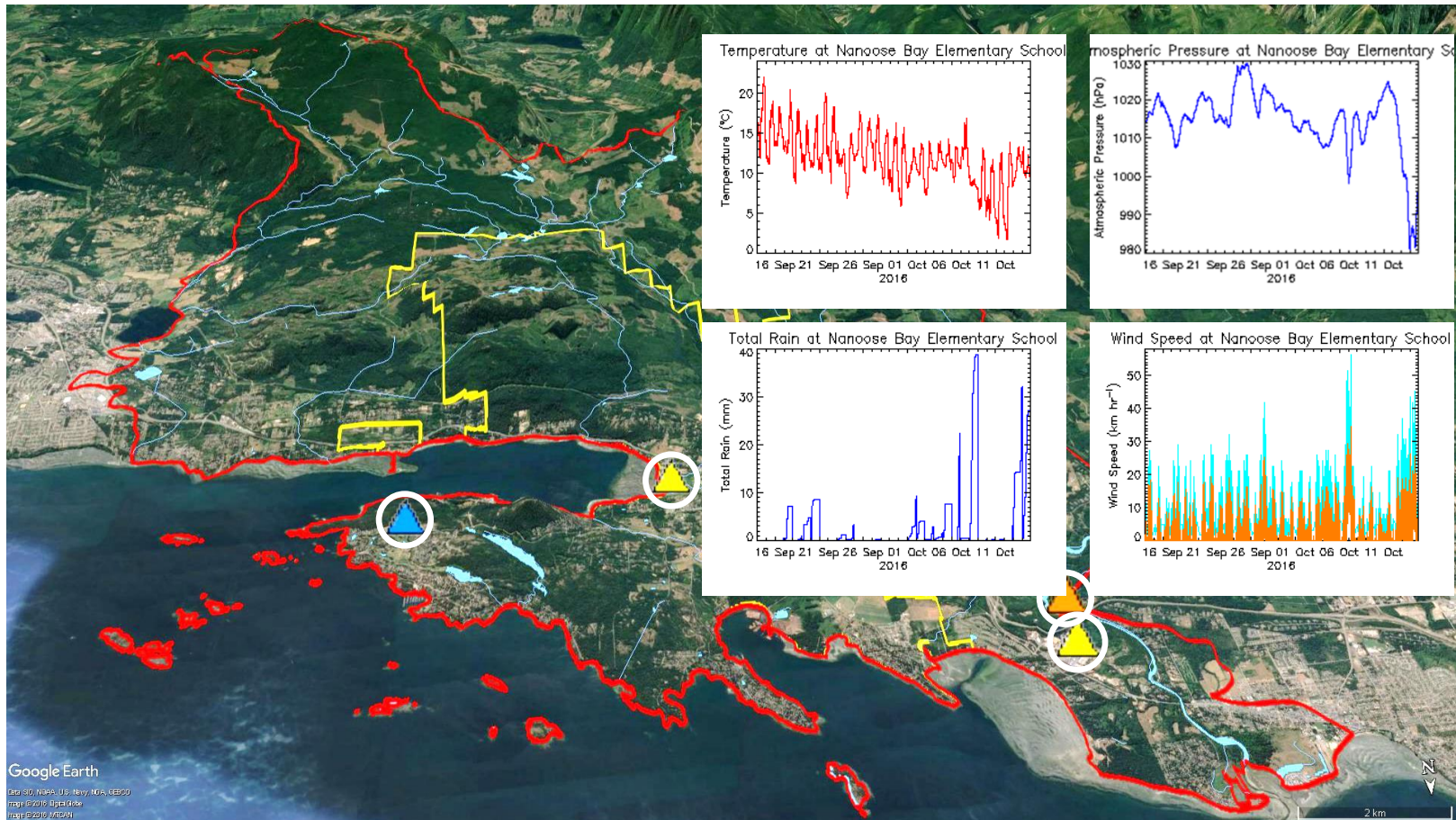
Project Area



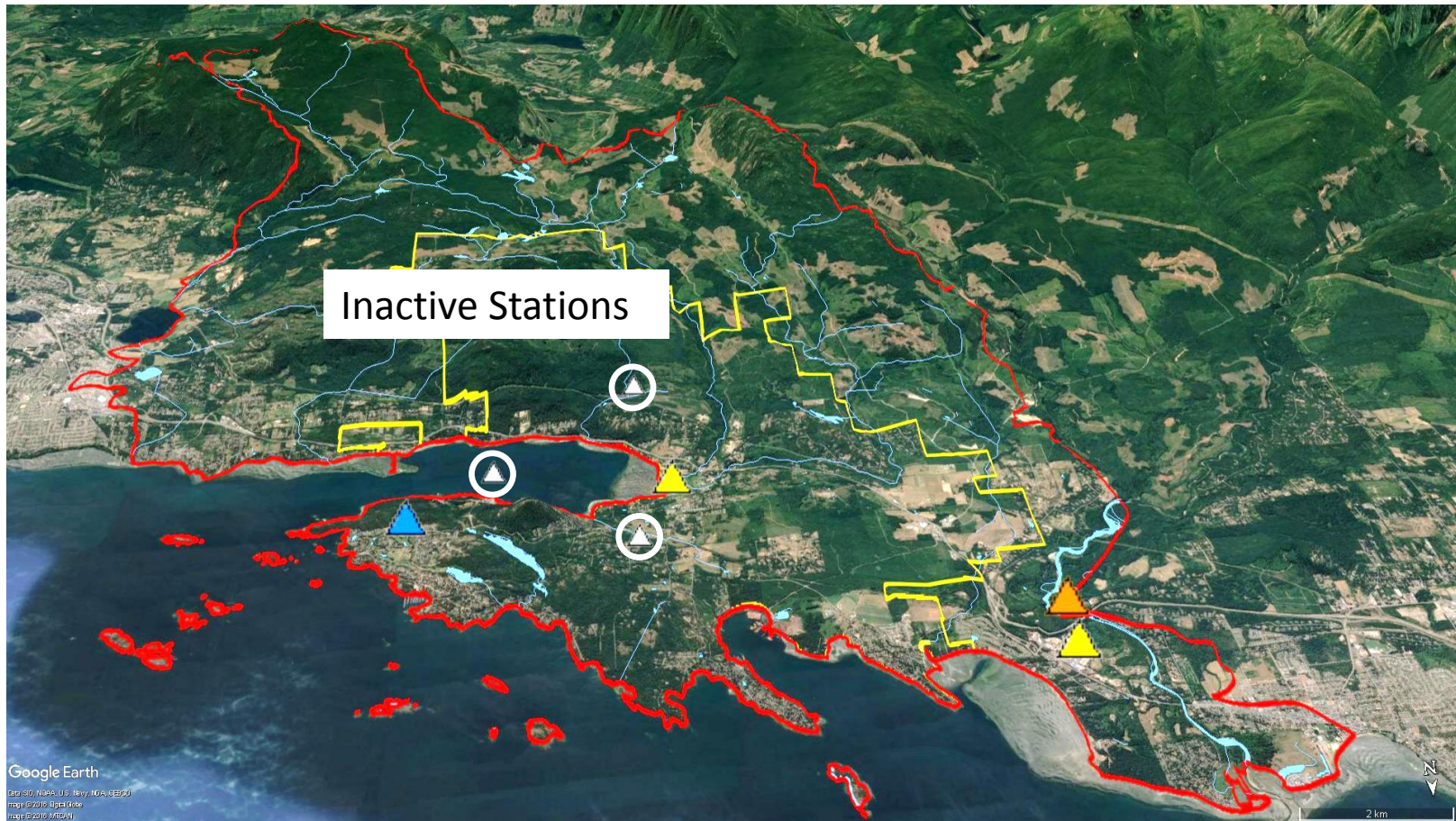
Project Area



Climate Monitoring Stations



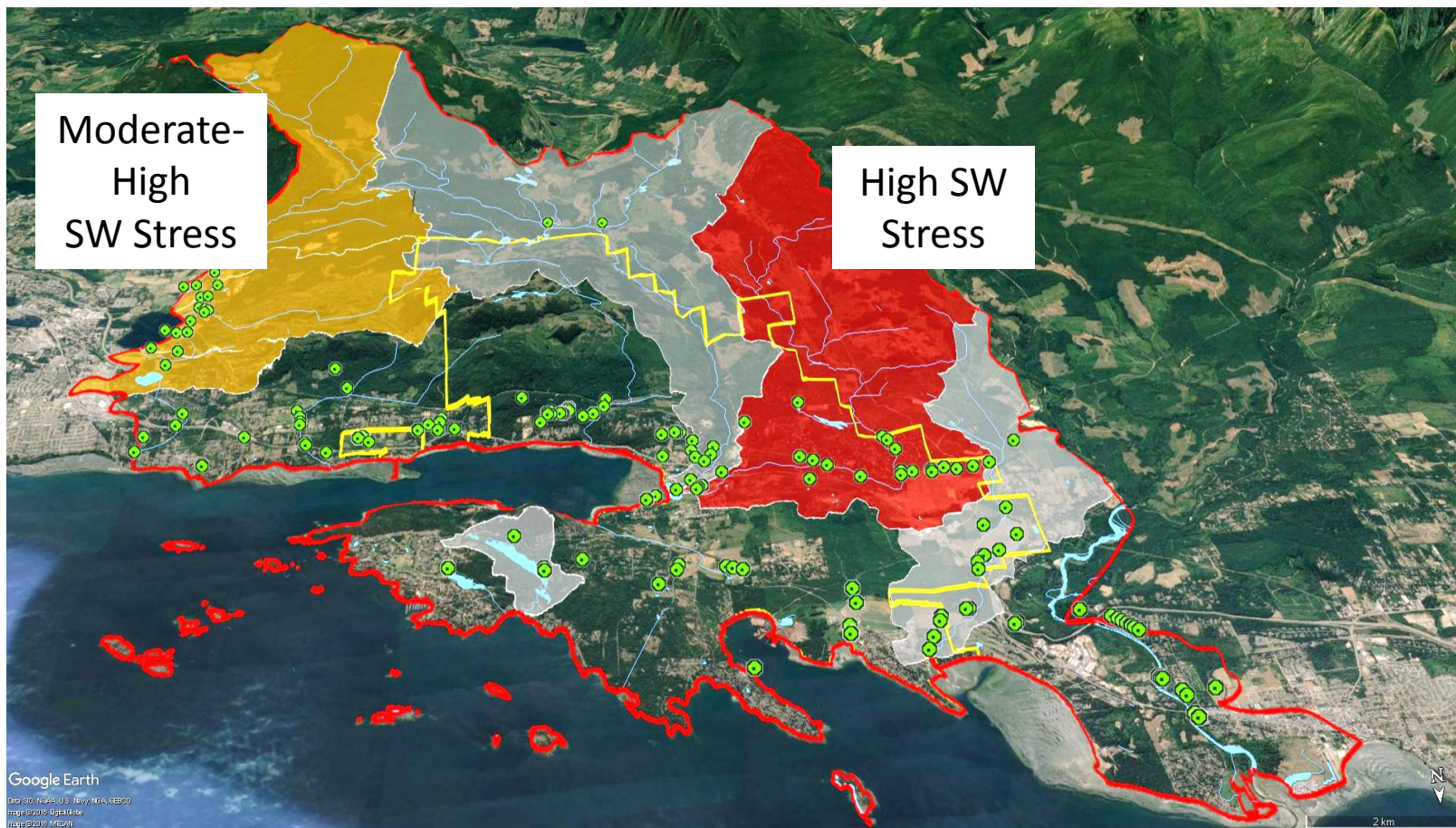
Climate Monitoring Stations



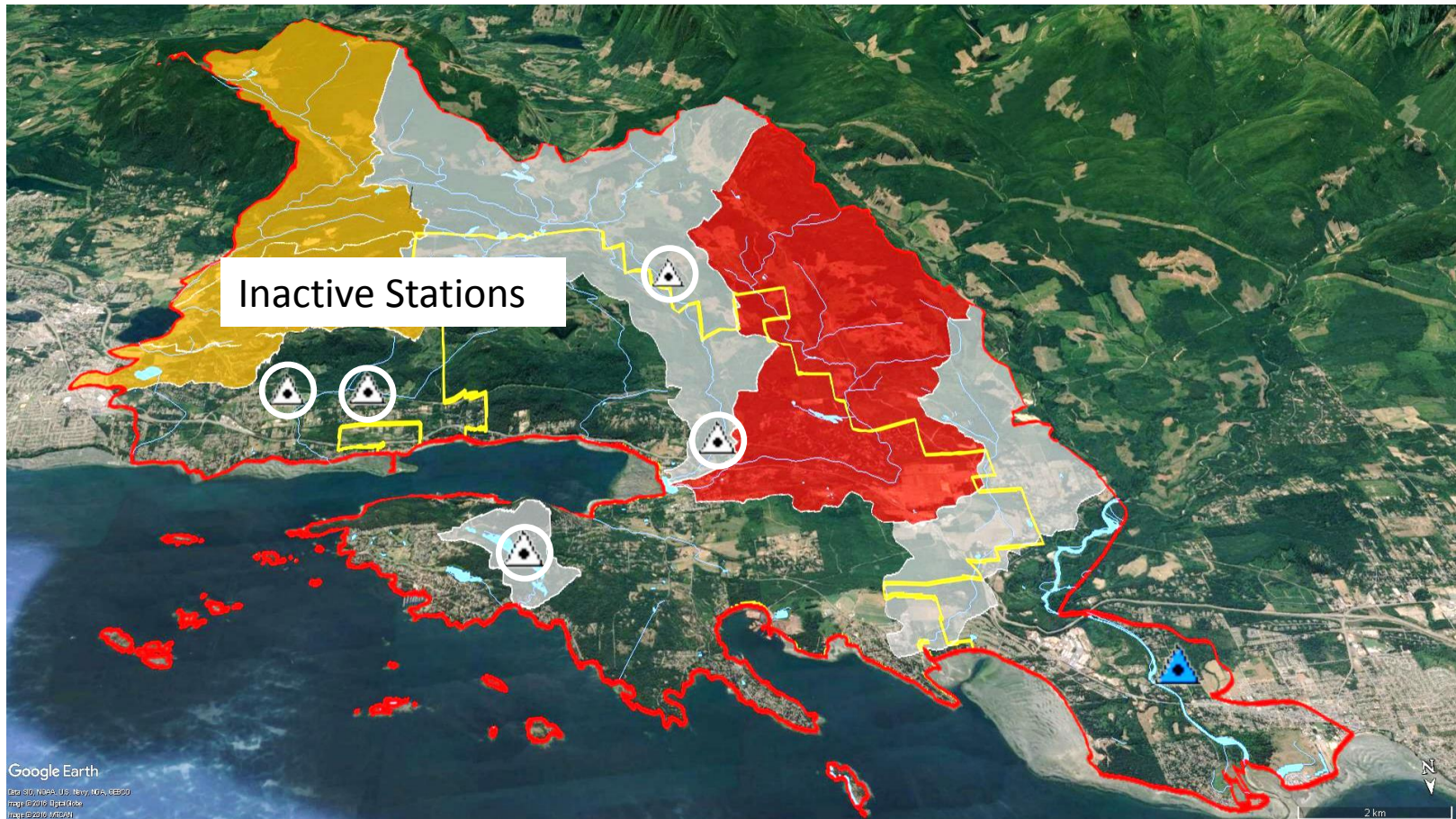
Surface Water Licenses



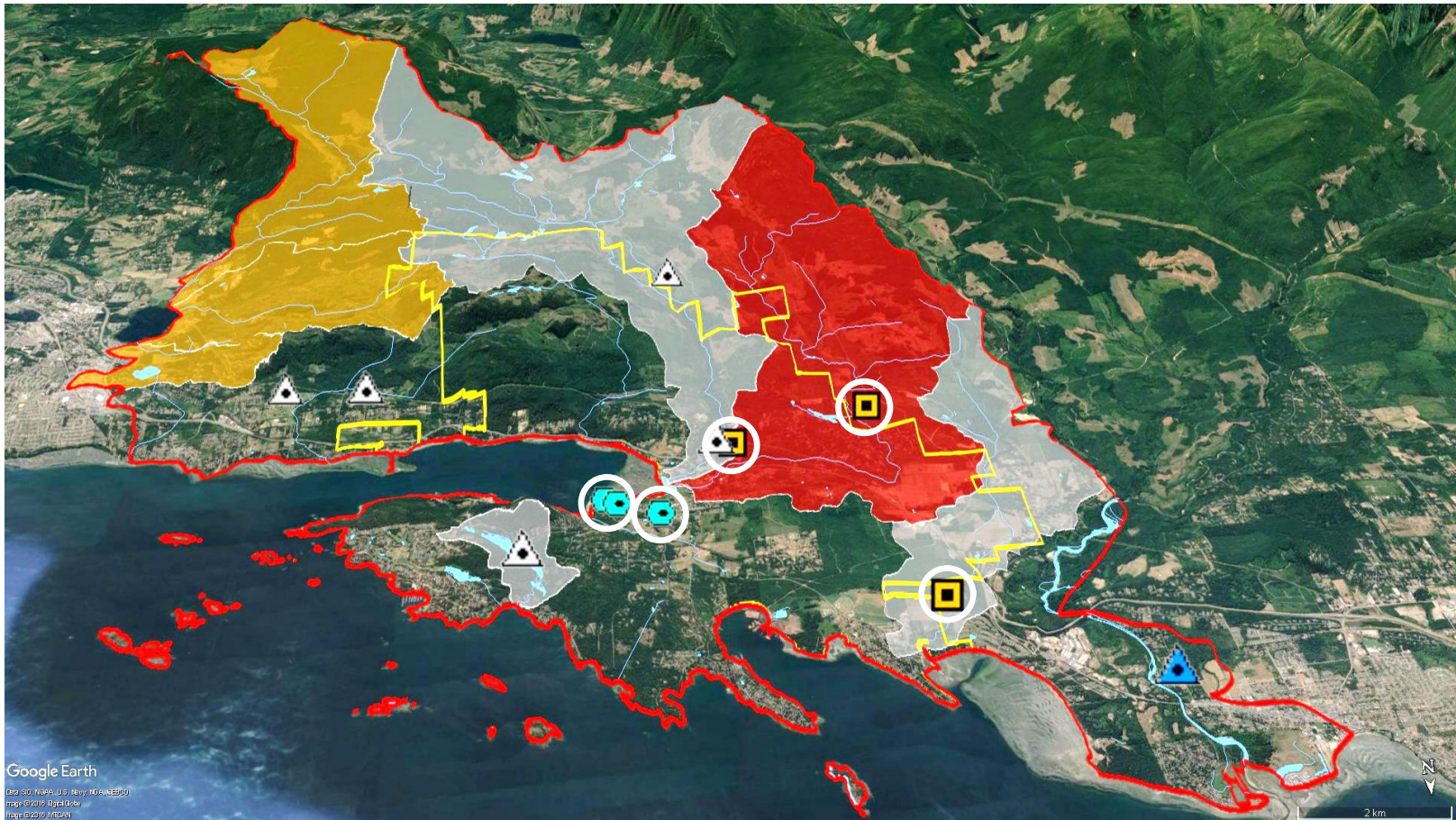
Surface Water Stress Assessments



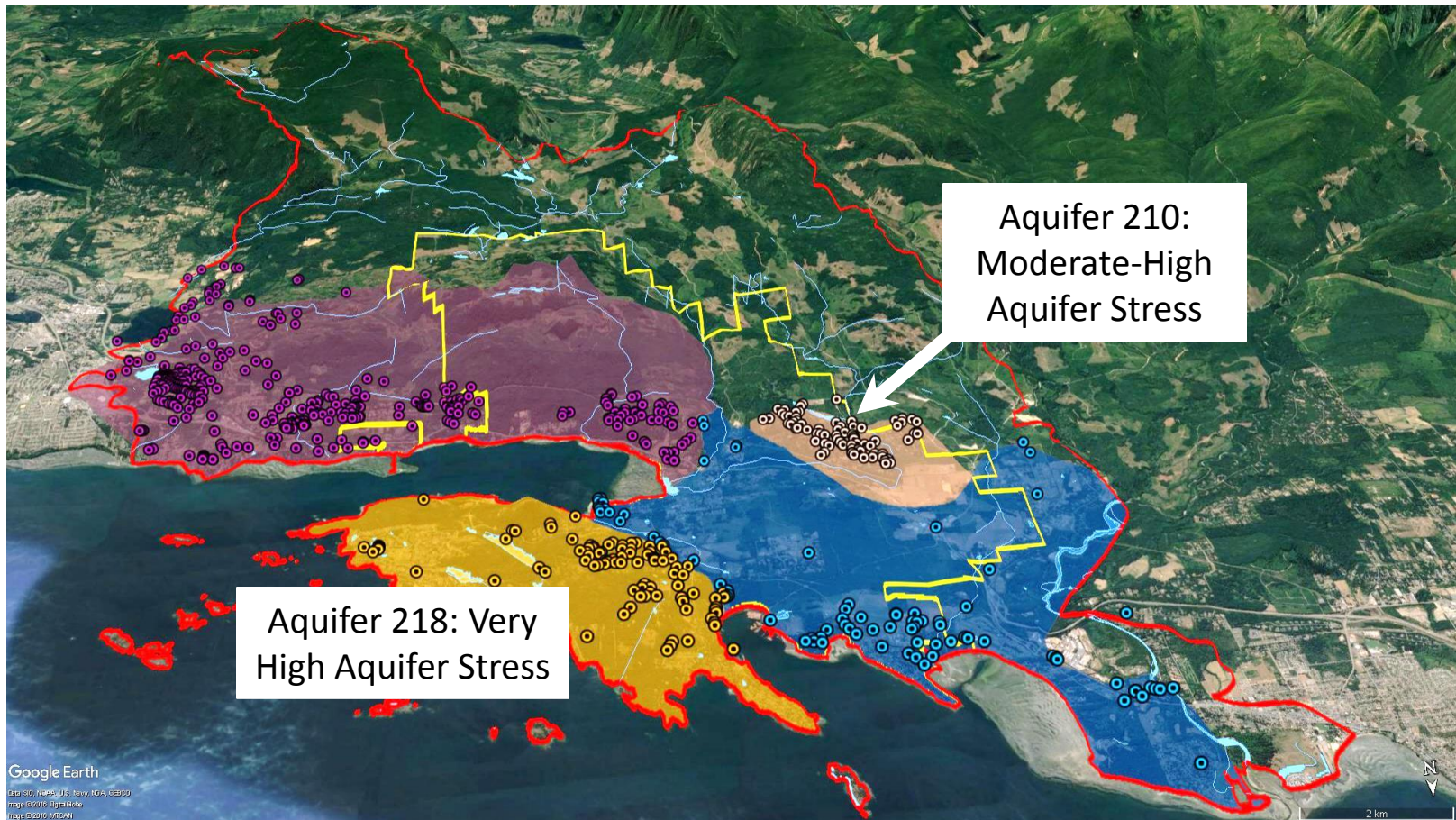
Hydrometric Stations



Other Surface Water Monitoring



Bedrock Aquifers



Overburden Aquifers



Water Service Areas



Groundwater Monitoring Wells



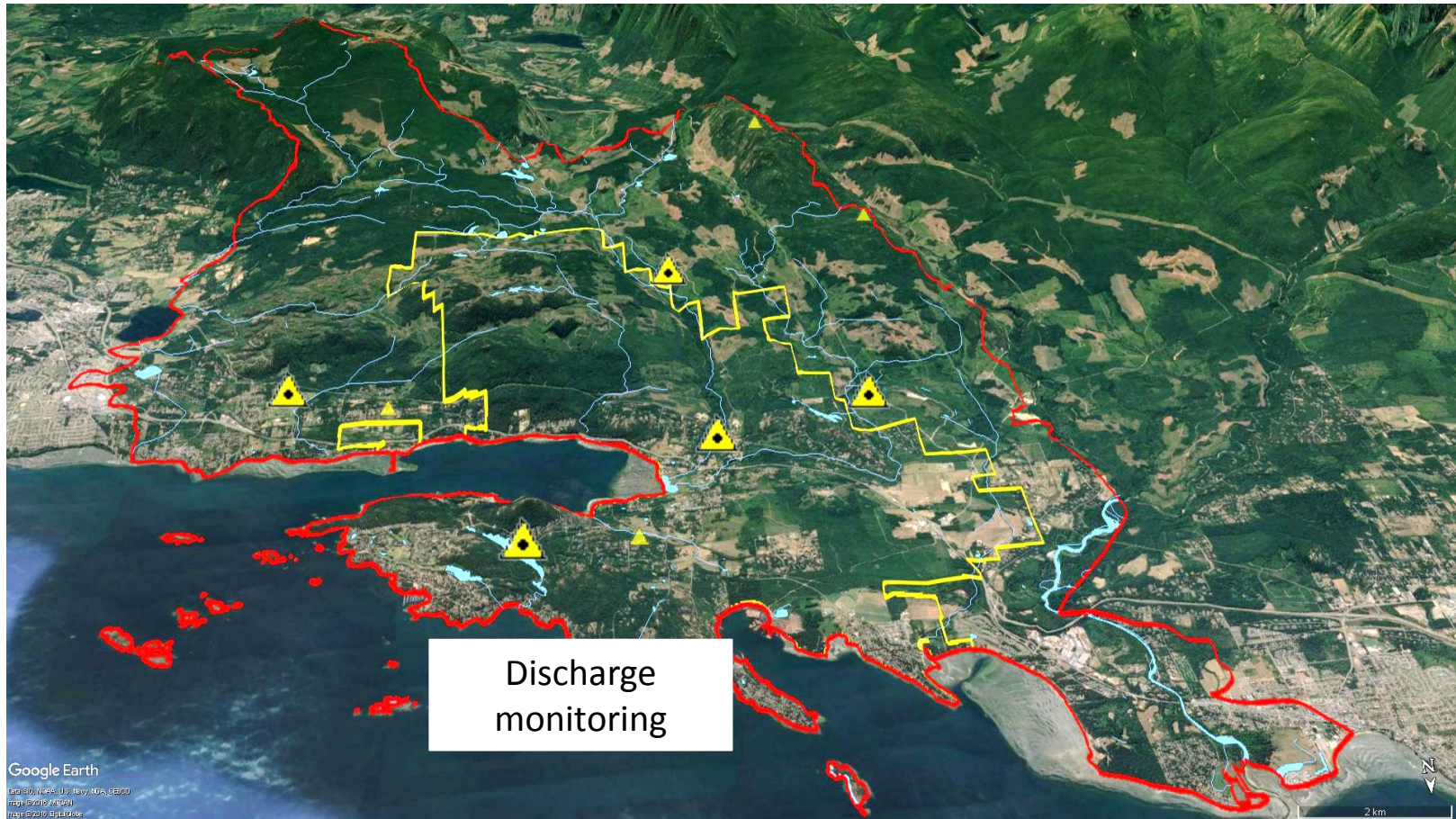
Water Monitoring Plan: Key Elements

- Strategic locations identified to address data gaps – prioritized to guide implementation
- Potential partnerships
- Preliminary Costs

Proposed Climate Monitoring Locations



Proposed Hydrometric Station Locations

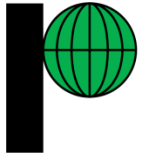


Proposed Groundwater Monitoring Locations



Next Steps for Implementation

- Consult the public on Draft Monitoring Plan and incorporate feedback into the plan
- Engage potential partners to identify opportunities for collaboration
- Conduct detailed review of potential monitoring locations
- Develop a data management plan



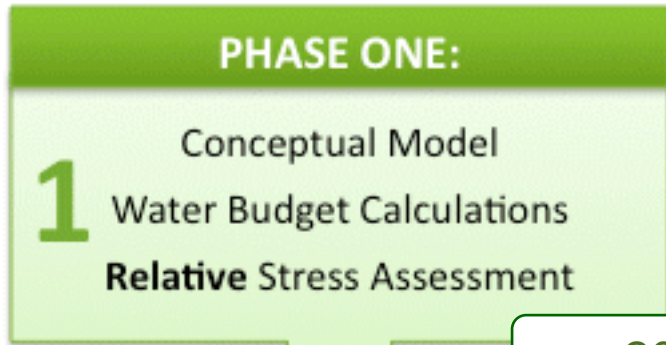
PITEAU ASSOCIATES

GEOTECHNICAL AND HYDROGEOLOGICAL CONSULTANTS



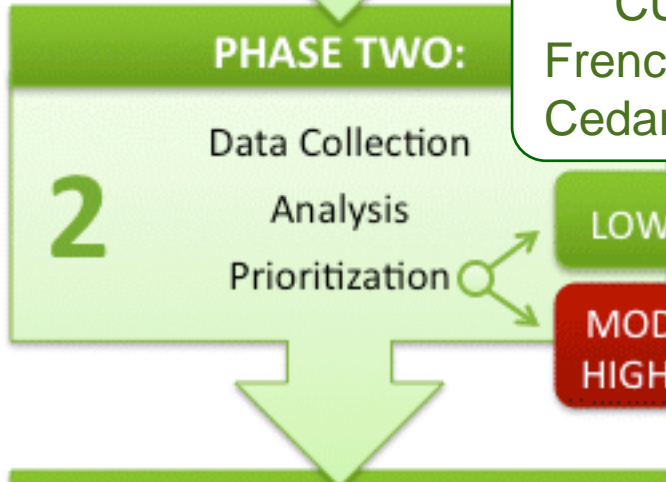
SCOPING FOR PHASE 2 WATER BUDGETS

FRENCH CREEK AND CEDAR-YELLOWPOINT



2013

CURRENT:
French Creek and
Cedar/Yellowpoint

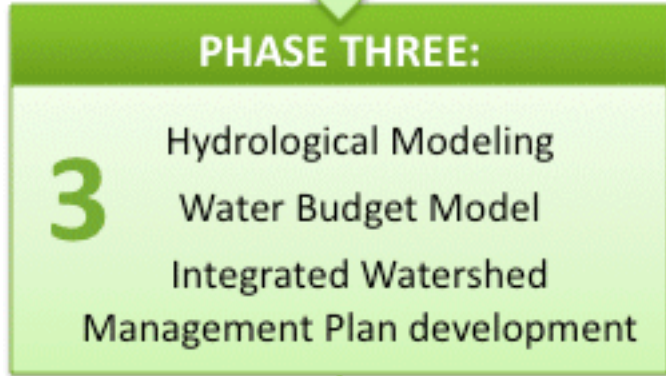


LOW STRESS

MODERATE / HIGH STRESS

Continued Data Collection

Additional Data Collection



Ecological Components

Climate Studies

Water Quality



French Creek

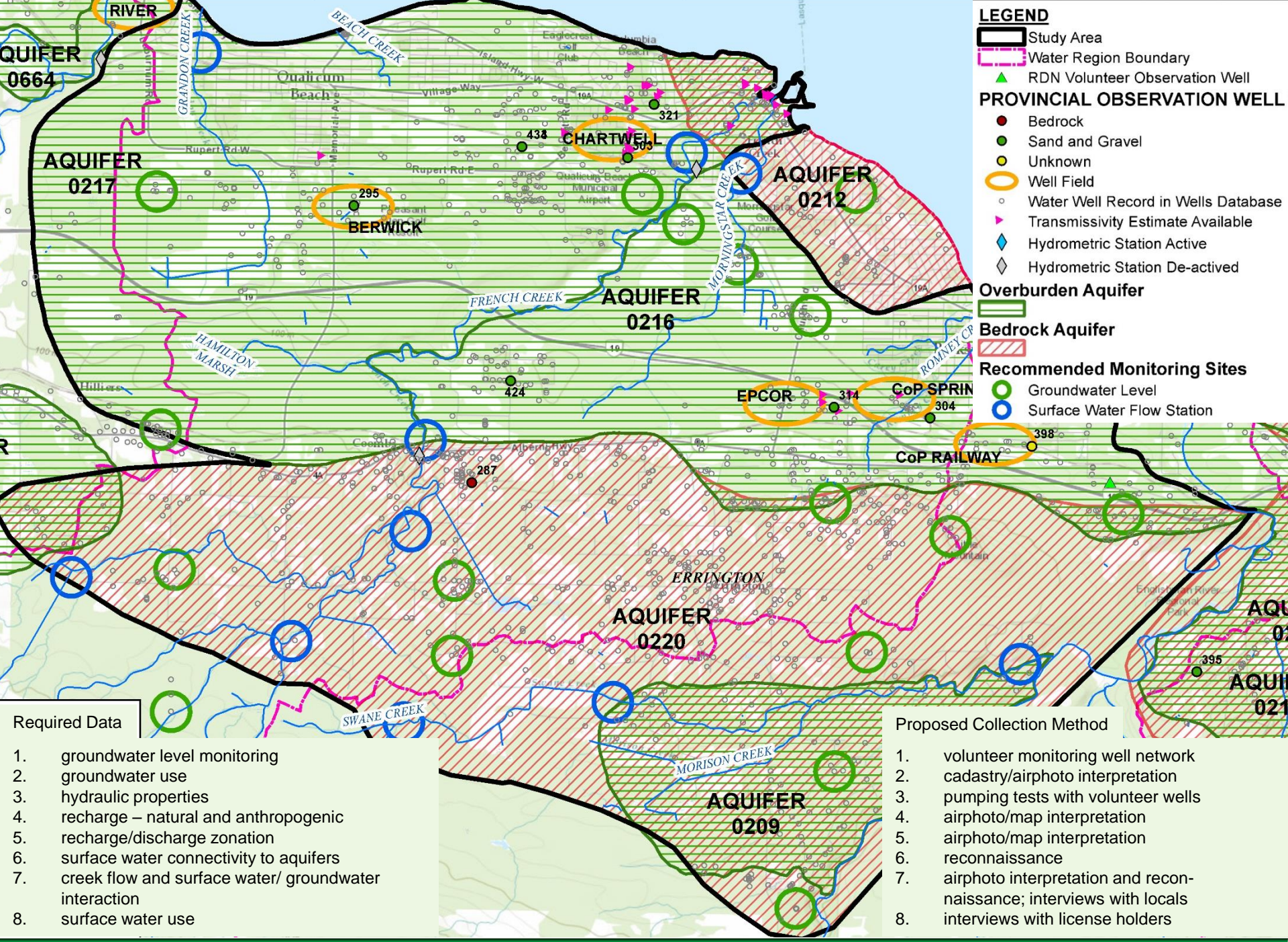
Required Data

1. groundwater levels
2. groundwater use
3. hydraulic properties
4. recharge – natural and anthropogenic
5. recharge/discharge zonation
6. surface water connectivity to aquifers
7. creek flow and surface water/
groundwater interaction
8. surface water use

Proposed Collection Method

1. volunteer monitoring well network
2. cadastry/airphoto interpretation
3. pumping tests with volunteer wells
4. airphoto/map interpretation
5. airphoto/map interpretation
6. reconnaissance
7. airphoto interpretation and
reconnaissance; interviews with locals
8. interviews with license holders





LEGEND

- Study Area
- Water Region Boundary
- ▲ RDN Volunteer Observation Well
- PROVINCIAL OBSERVATION WELL**
- Bedrock
- Sand and Gravel
- Unknown
- Well Field
- Water Well Record in Wells Database
- ▶ Transmissivity Estimate Available
- ◆ Hydrometric Station Active
- ◇ Hydrometric Station De-activated
- Overburden Aquifer**
-
- Bedrock Aquifer**
-
- Recommended Monitoring Sites**
- Groundwater Level
- Surface Water Flow Station

Required Data

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2. groundwater use
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Cedar-Yellowpoint

Required Data

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2. groundwater use
3. hydraulic properties
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5. recharge/discharge zonation
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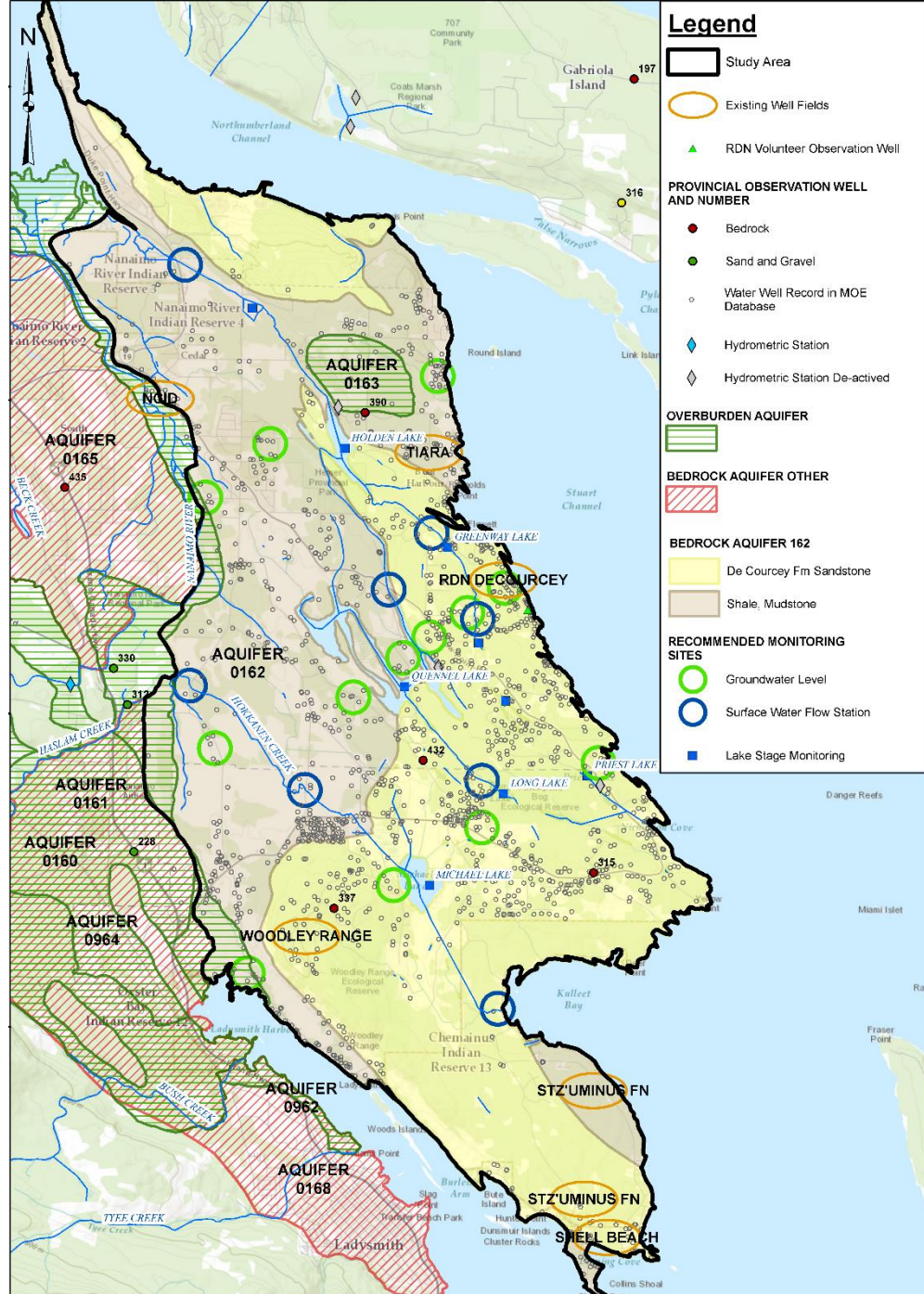
Cedar-Yellowpoint

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COMMENTS

DISCUSSION



Wetland Mapping in the RDN



Presented By
Kayla Harris and Ashley Van Acken
For the
Drinking Water & Watershed Protection Program



Outline

- Introduction
- What we have done
- What we are currently doing
- Next steps
- Conclusion



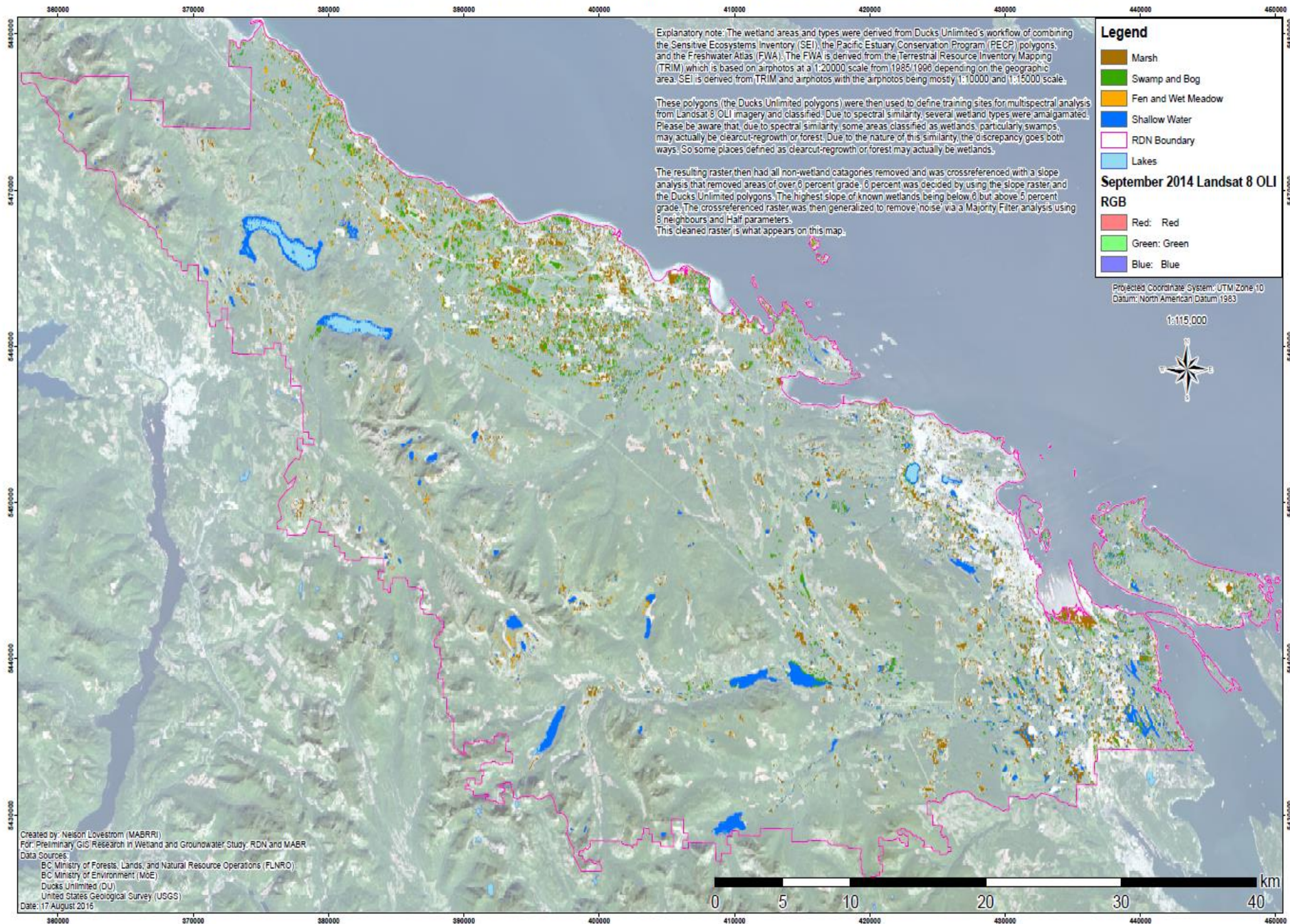
Introduction

- The development of the wetland mapping project
- Preliminary research & mastering the methods
- Private property accessibility
- Site evaluation and interpretation

What we have done

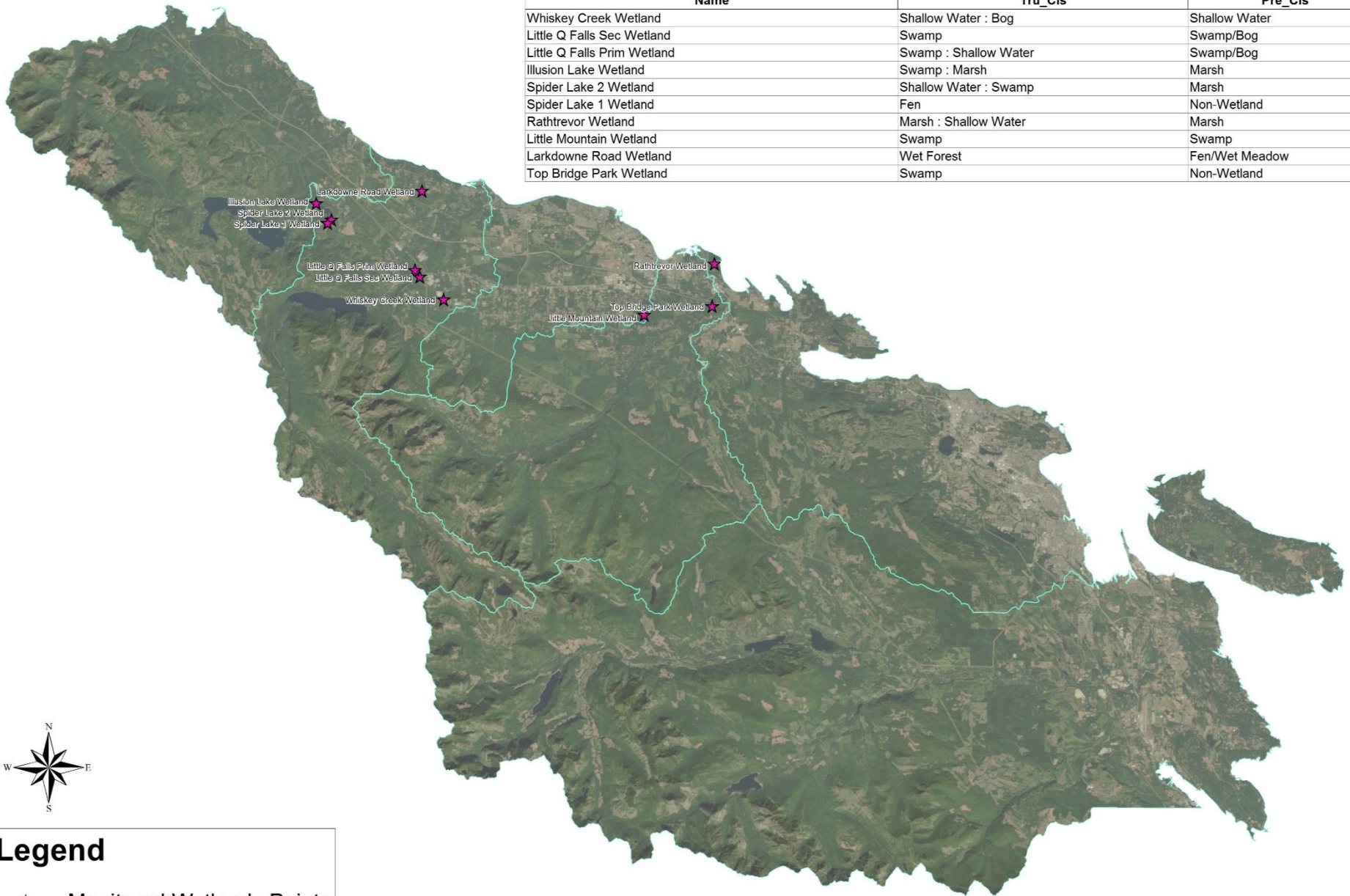
- Ground-truthed study sites from predictive maps created by Nelson Lovestrom
- Total of **10 wetlands Mapped** including:
 - Little Qualicum water region **(7)**
 - South Wellington and Nanoose water region **(1)**
 - Englishman River water Region **(1)**
 - French Creek water Region **(1)**
- Recently received **6/12** letters of support granting accessibility to private lands for the French Creek water region
- Wetland Mapping training with twelve MVIHES volunteers

Regional District of Nanaimo Wetlands from Multispectral Analysis: Landsat 8 OLI (September 6, 2014)



Ground Truthed Wetlands in the RDN

Name	Tru_Cls	Pre_Cls
Whiskey Creek Wetland	Shallow Water : Bog	Shallow Water
Little Q Falls Sec Wetland	Swamp	Swamp/Bog
Little Q Falls Prim Wetland	Swamp : Shallow Water	Swamp/Bog
Illusion Lake Wetland	Swamp : Marsh	Marsh
Spider Lake 2 Wetland	Shallow Water : Swamp	Marsh
Spider Lake 1 Wetland	Fen	Non-Wetland
Rathrevor Wetland	Marsh : Shallow Water	Marsh
Little Mountain Wetland	Swamp	Swamp
Larkdowne Road Wetland	Wet Forest	Fen/Wet Meadow
Top Bridge Park Wetland	Swamp	Non-Wetland



Legend

- ★ Monitored Wetlands Points
- RDN_WaterRegions



What we are currently doing

- Mapping takes place every Monday with three MABRRI students
- Recent focus is on the Little Qualicum water region due to abundance of publicly accessible land
- In addition to field days, information collected from each study site is added to a VIU database. This data is then used in the appropriate water region report, where field observations are analyzed
- Consultation with Vancouver Island University faculty to discuss unique wetland sites
- The search for grant funding

Next steps

- Completion of the Little Qualicum water region
- Continue mapping within the French Creek and Englishman River water regions
- Finalize mapping within all seven water regions
- Identify priority sites with a variety of surrounding land uses for monitoring groundwater recharge



Conclusion

- Refined mapping methods and standards to ensure data collection was sufficient during field analysis
- Training with MVIHES volunteers to help with mapping wetlands
- A total of 10 wetland sites have been ground-truthed and mapped across four water regions with the majority of sites residing in the Little Qualicum Water Region
- Professional discussions and meetings with Vancouver Island University faculty
- Moving forward MABRRI students will finalize the Little Qualicum water region and continue mapping in French Creek and Englishman River water regions

Gabriola Groundwater Modelling

Ryan Burgess, MSc Candidate, Simon Fraser
University

Discussion

What would you like to see from the
DWWP Program in 2017?



State of our
Aquifer Reports

Policy
development

More outreach
events



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NEW BUSINESS, COMMENTS, QUESTIONS ?

THANK YOU!