Ministry of **Forests, Lands and Natural Resource Operations**

SOUTH COWICHAN GROUNDWATER QUALITY

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Presentation to

Public Meeting *June 18, 2014*

Shawnigan Lake Community Centre

CVRD

BRITISH COLUMBIA

Outline

- Groundwater basics
- South Cowichan groundwater quality study
  - Objectives
  - Results
- Well protection
- Summary

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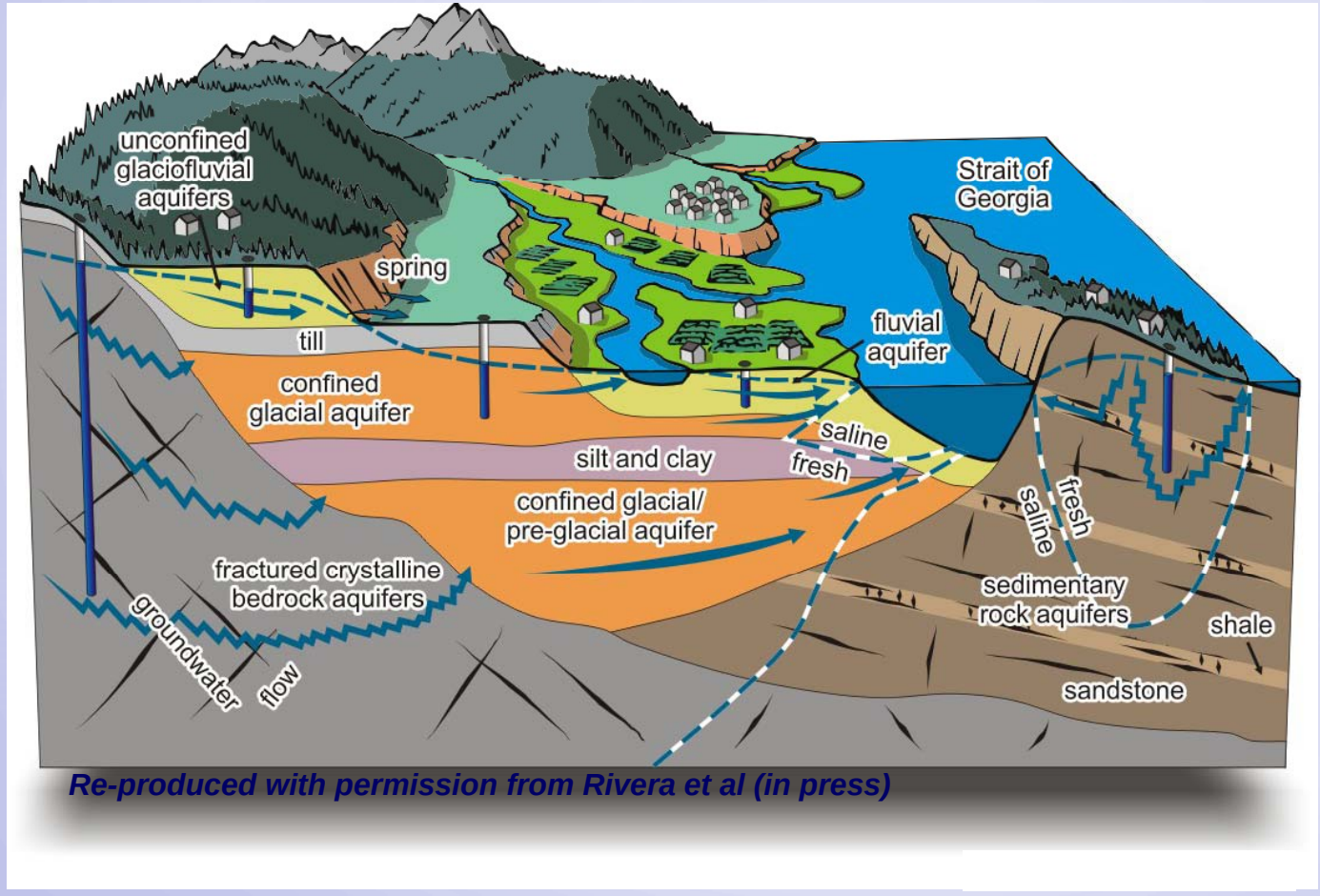
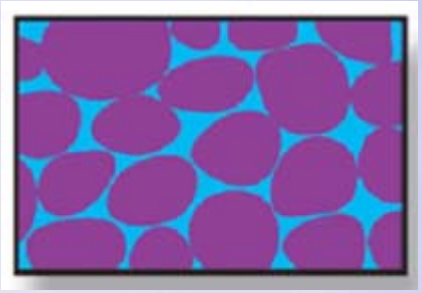
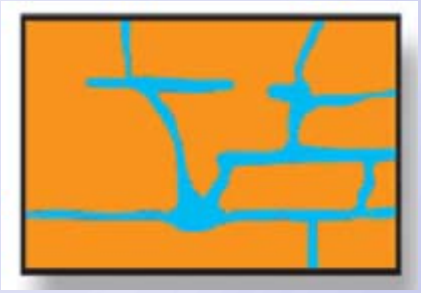
Aquifers in a Coastal Environment



Re-produced with permission from Rivera et al (in press)



Water between grains of sand



Water in rock fractures

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Importance of Groundwater on Vancouver Island & Gulf Islands

> 35,000 existing wells (30% of B.C. total)

Groundwater use

- Municipalities (~9% use solely groundwater)
- >900 small water systems (~70% groundwater)
- Domestic wells, especially in rural areas & Gulf Islands
- Industrial and commercial uses (aquaculture, agriculture, mining and forestry, tourism)
- Essential for ecosystem health (e.g. stream base flow)

Common Groundwater Quantity Concerns

- Groundwater use not licensed in BC—future changes with *Water Sustainability Act* (April 2015)
- Common water quantity issues:
  - Interference between adjacent well users
  - Low well yields, insufficient recharge e.g. bedrock aquifers
  - Seasonal water shortages e.g. Gulf Islands
  - Aquifer overuse or depletion e.g. deepening of groundwater levels

Common Groundwater Quality Concerns

Water quality parameter	Example
Naturally present minerals and elements	Elevated iron and/or manganese, hardness (calcium & magnesium), boron, fluoride, arsenic or other metals
Bacterial contaminants & indicators (natural or human source)	Total coliforms, fecal coliforms, *E. coli*
Natural contaminants related to well use or location of aquifer	High TDS, sodium and chloride associated with salt water intrusion in coastal aquifers
Contaminants from human activities	Nitrates (farm practices, sewage disposal) hydrocarbons, pesticides

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South Cowichan Groundwater Quality Study

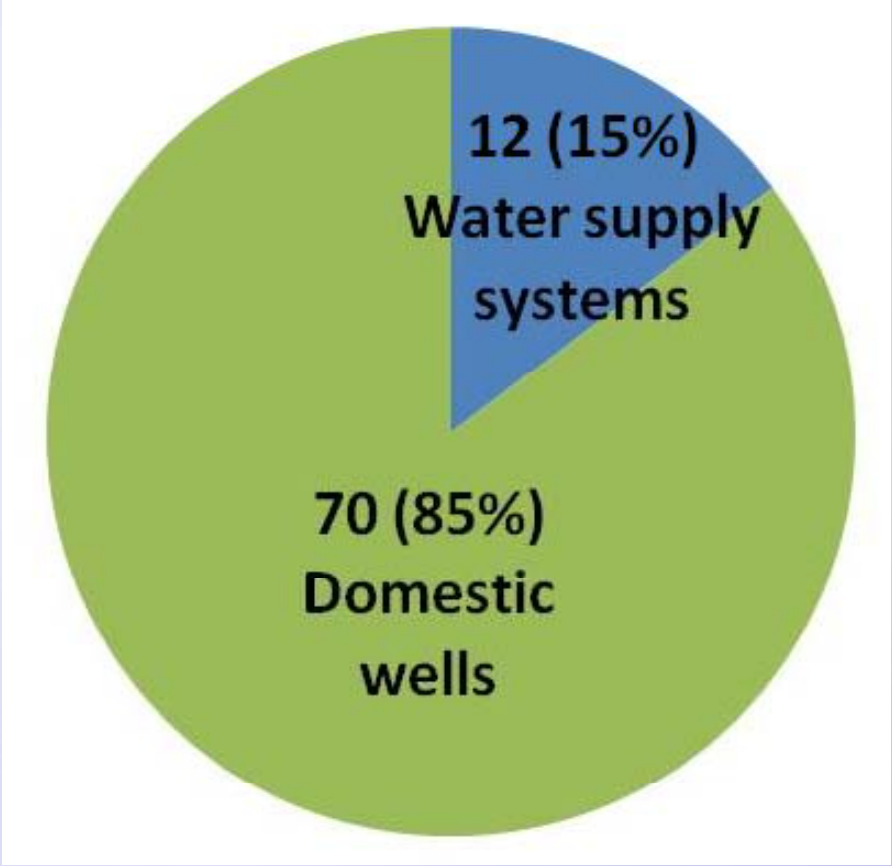
- Partnership (including *funding*) between FLNRO and CVRD
- Sampling completed in winter 2013-2014

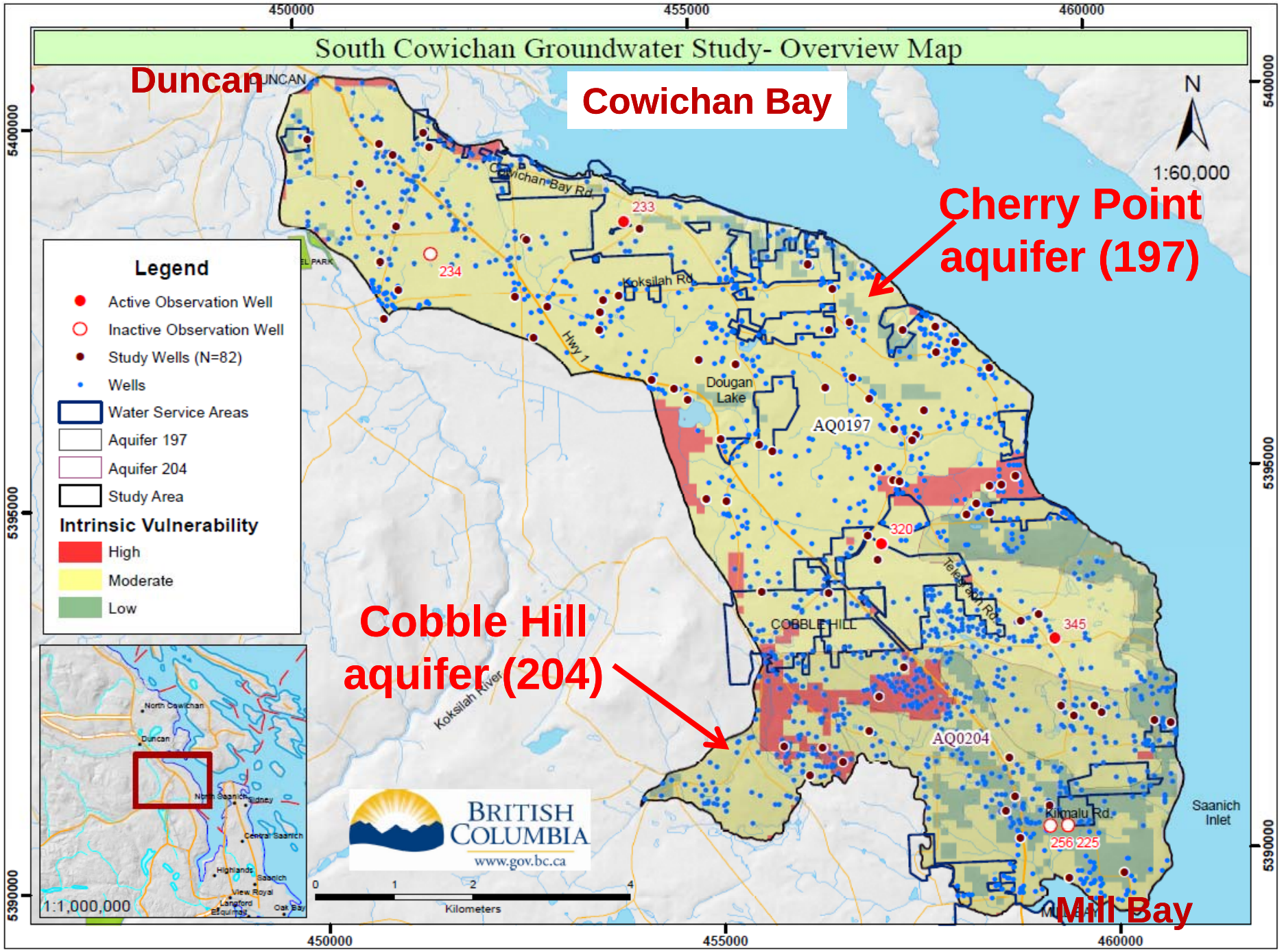
Objectives:

- Describe groundwater geochemistry in heavily used aquifers (unconsolidated, bedrock)
- Identify water quality concerns (natural, anthropogenic)
- Provide residents with information on well maintenance & protection

South Cowichan Groundwater Quality Study

- Cobble Hill and Cherry Point aquifers
- 82 wells sampled
  - 70 private domestic
  - 12 water supply systems
- Parameters analyzed:
  - General chemistry
  - Metals
  - Bacteria (Total coliforms & *E. coli*)
  - Nitrate isotopes (sites > 2 mg/L nitrate-N)




South Cowichan Groundwater Study- Overview Map
Duncan
Cowichan Bay
Cherry Point aquifer (197)
Cobble Hill aquifer (204)
Mill Bay
N
1:60,000
Legend
Active Observation Well
Inactive Observation Well
Study Wells (N=82)
Wells
Water Service Areas
Aquifer 197
Aquifer 204
Study Area
Intrinsic Vulnerability
High
Moderate
Low
AQ0197
AQ0204
COBBLE HILL
Dougan Lake
Koksilah Rd
Hwy 1
Koksilah River
Kilmalu Rd
Saanich Inlet
233
234
320
345
256
225
1:1,000,000
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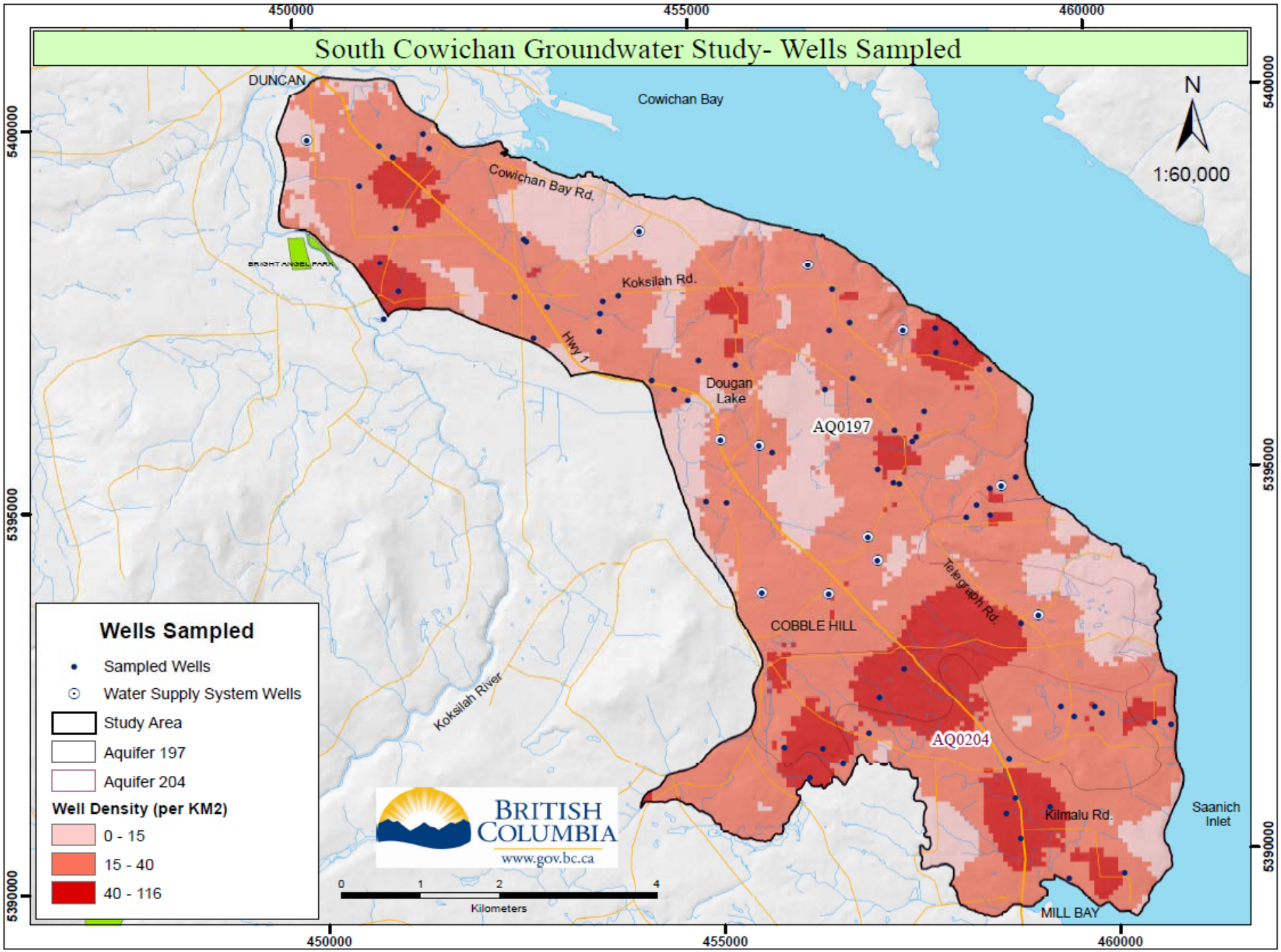
Kilometers
450000
455000
460000
5400000
5395000
5390000


South Cowichan Groundwater Study- Wells Sampled
450000
455000
460000
5400000
5395000
5390000
DUNCAN
Cowichan Bay
N
1:60,000
Cowichan Bay Rd.
Koksilah Rd.
Hwy 1
Dougan Lake
AQ0197
Telegraph Rd.
COBBLE HILL
Koksilah River
AQ0204
Kilmalu Rd.
Saanich Inlet
MILL BAY
BRIGHT ANGEL PARK
Wells Sampled
Sampled Wells
Water Supply System Wells
Study Area
Aquifer 197
Aquifer 204
Well Density (per KM2)
0 - 15
15 - 40
40 - 116
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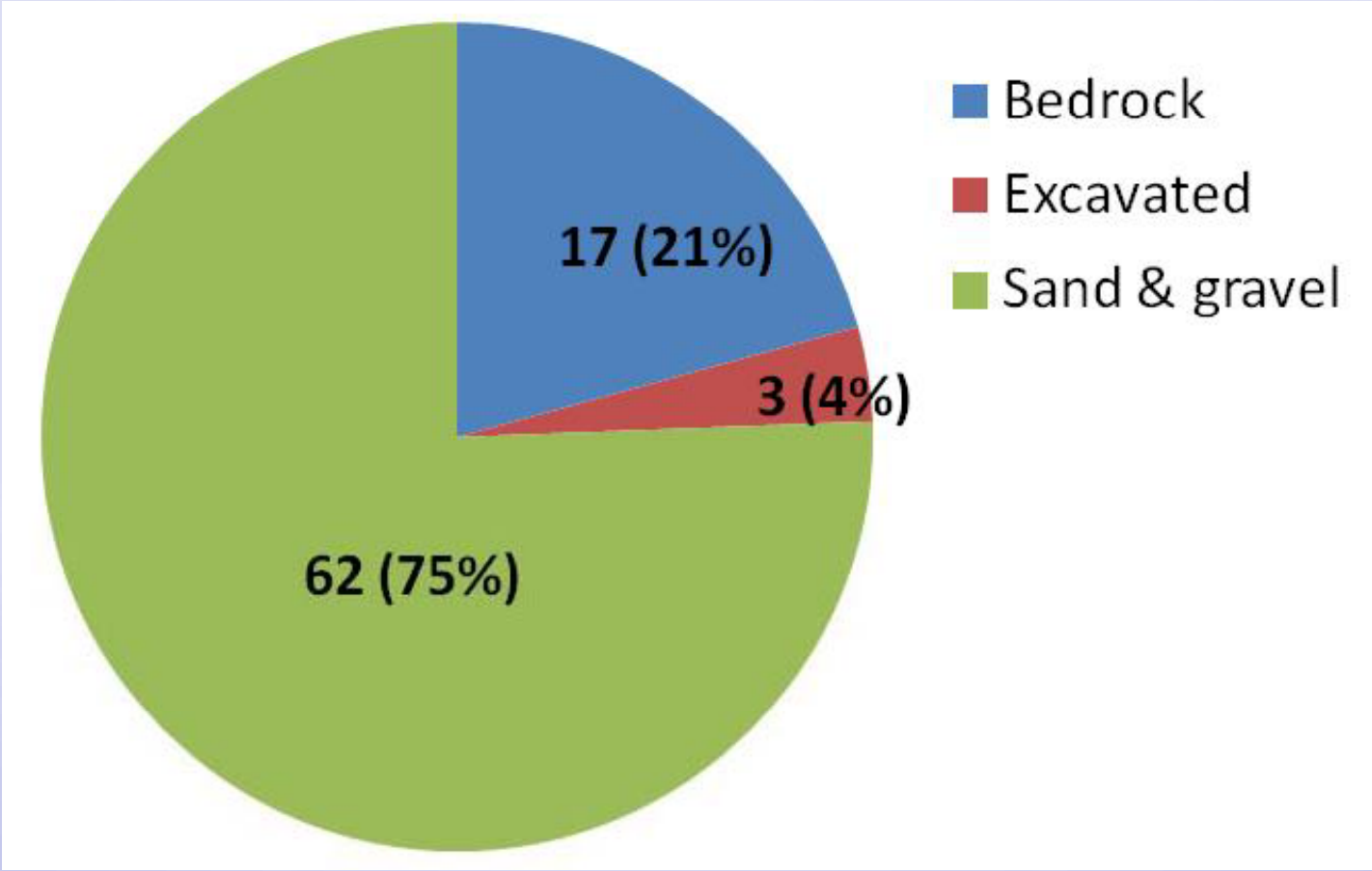
www.gov.bc.ca
0 1 2 4
Kilometers

South Cowichan Groundwater Study –Well types sampled

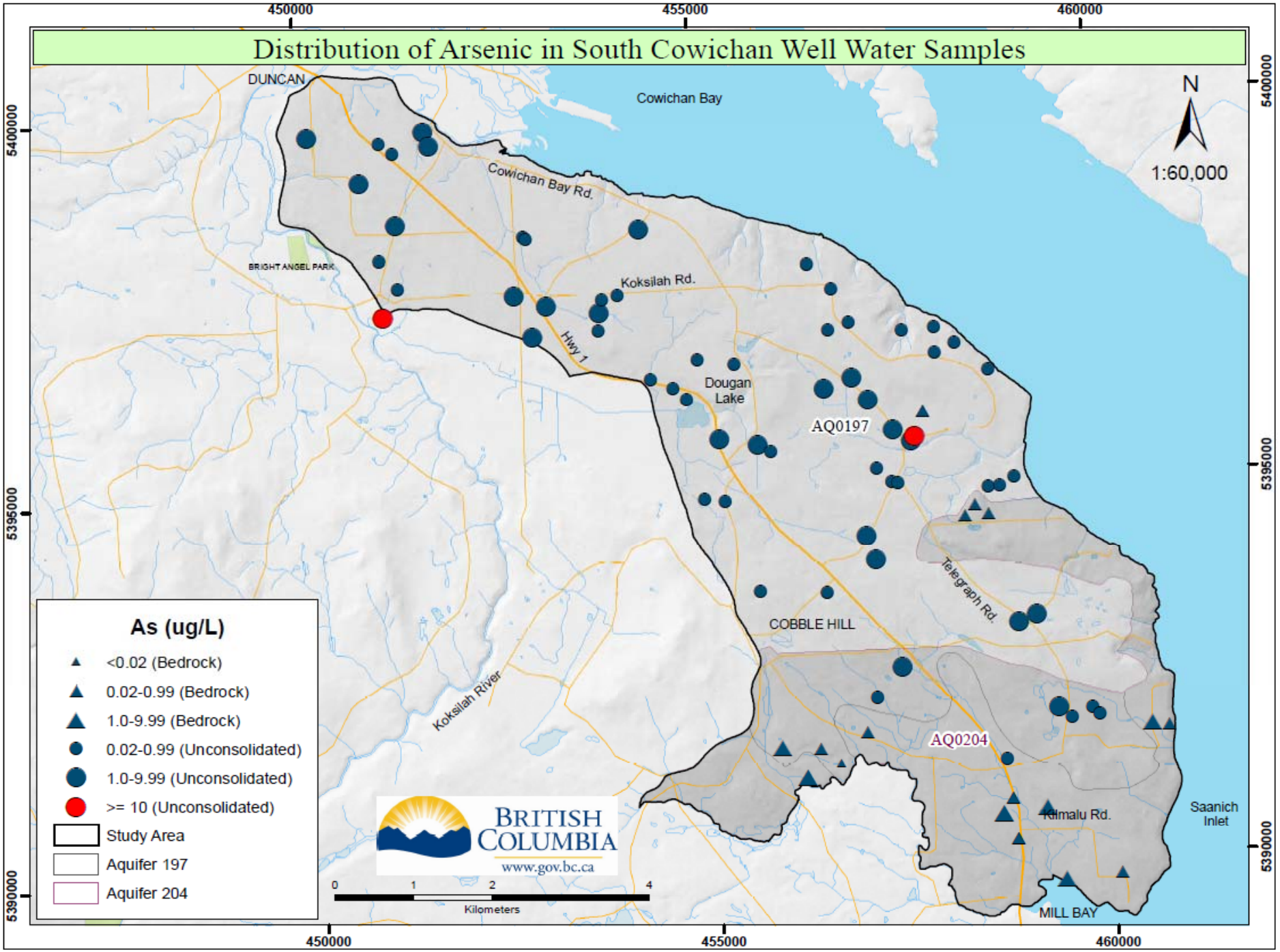


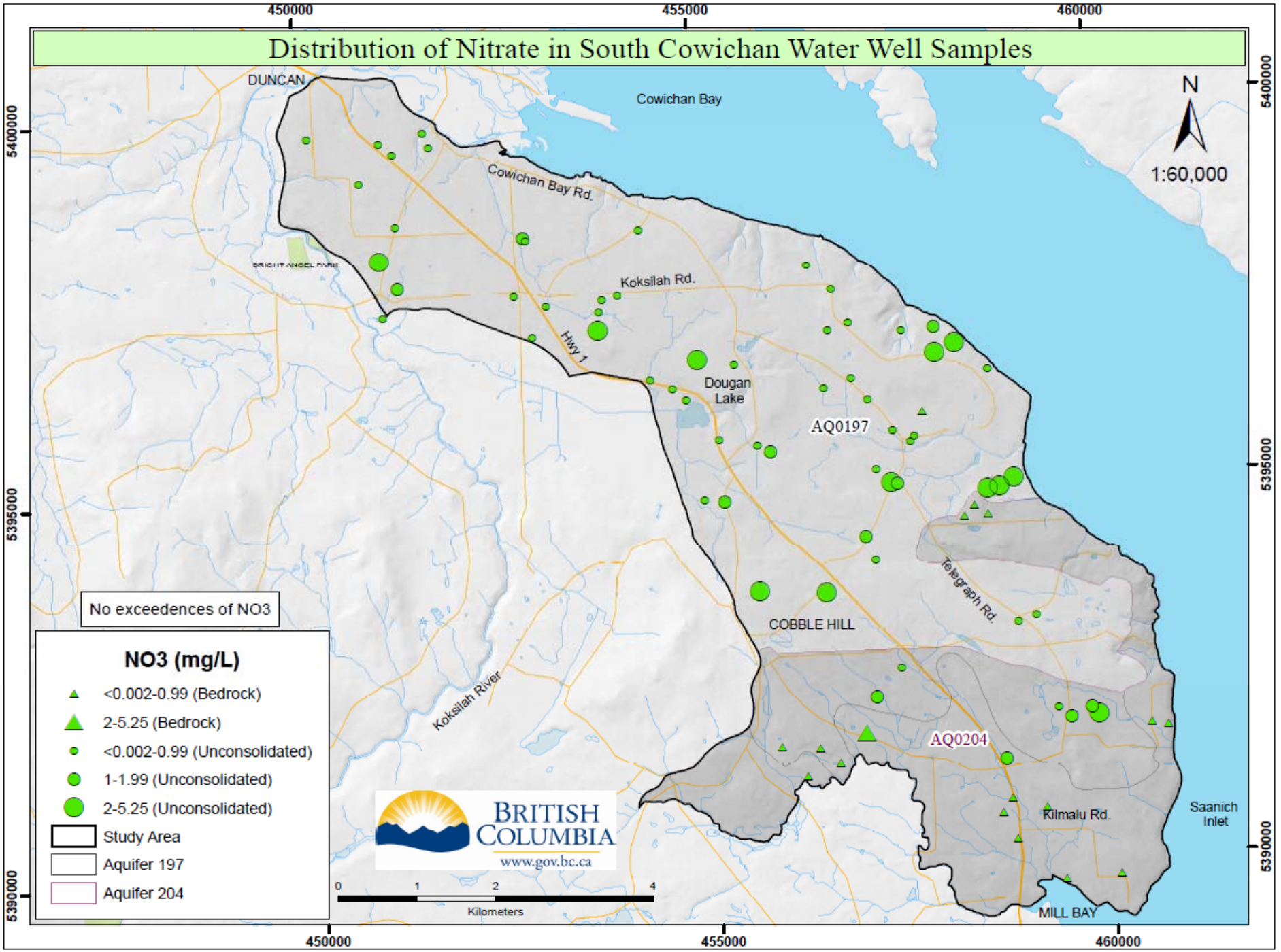
South Cowichan Groundwater Quality – Results

- Overall water quality very good

Health Related Parameters*	Results
Arsenic	2 wells (2%)≥10 μg/L 31 wells (38%) arsenic from >1 to 9 μg/L Median concentration=0.54 μg/L
Nitrate-N	No exceedences of 10 mg/L guideline Median concentration = 0.02 mg/L

***Health Canada, guidelines for Canadian drinking water quality (2011)**

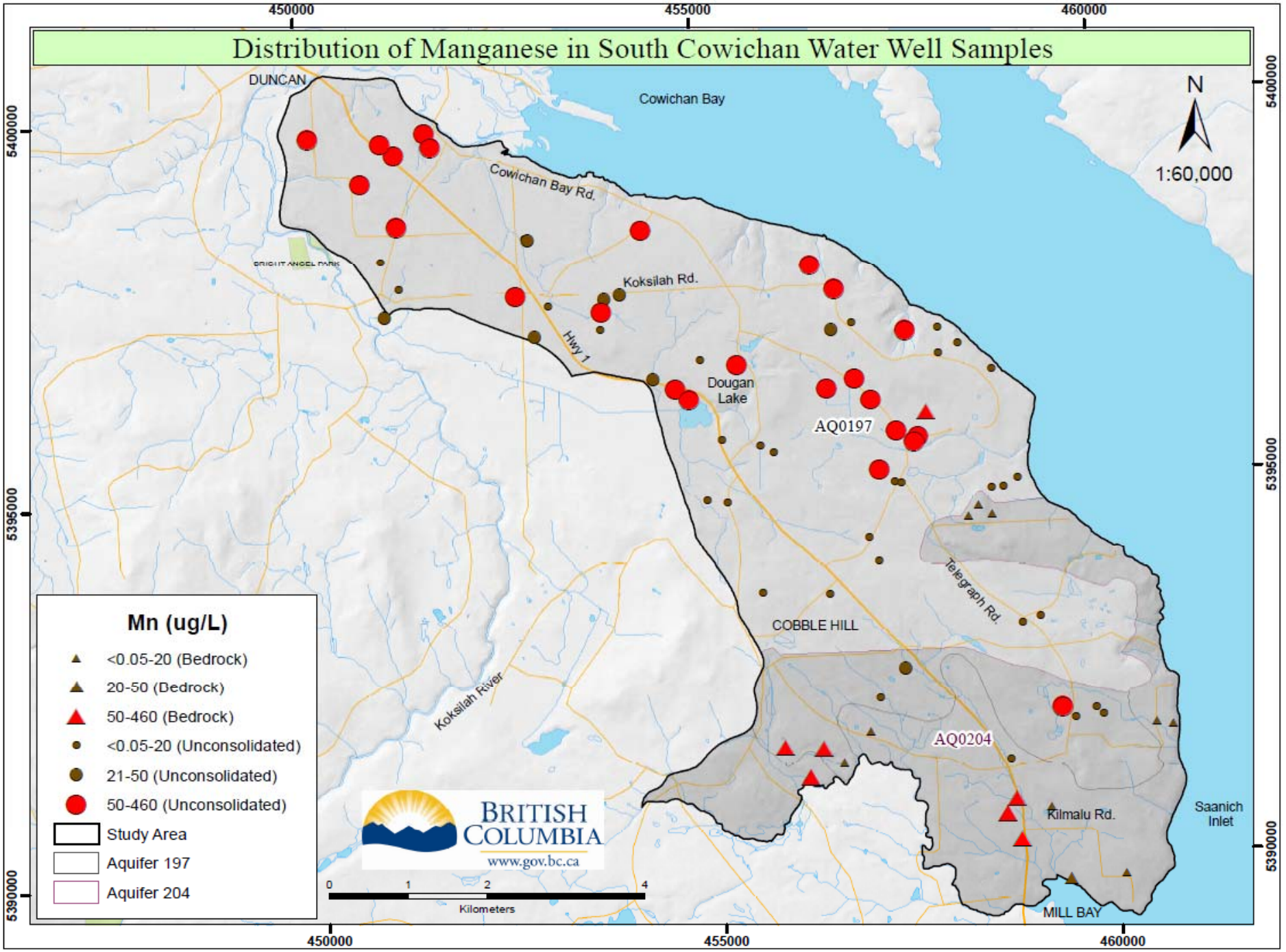

Distribution of Arsenic in South Cowichan Well Water Samples
450000
455000
460000
5400000
5395000
5390000
DUNCAN
Cowichan Bay
N
1:60,000
Cowichan Bay Rd.
BRIGHT ANGEL PARK
Koksilah Rd.
Hwy 1
Dougan Lake
AQ0197
Telegraph Rd.
COBBLE HILL
Koksilah River
AQ0204
Kilmalu Rd.
Saanich Inlet
MILL BAY
As (ug/L)
<0.02 (Bedrock)
0.02-0.99 (Bedrock)
1.0-9.99 (Bedrock)
0.02-0.99 (Unconsolidated)
1.0-9.99 (Unconsolidated)
>= 10 (Unconsolidated)
Study Area
Aquifer 197
Aquifer 204
BRITISH COLUMBIA
www.gov.bc.ca
0 1 2 4
Kilometers

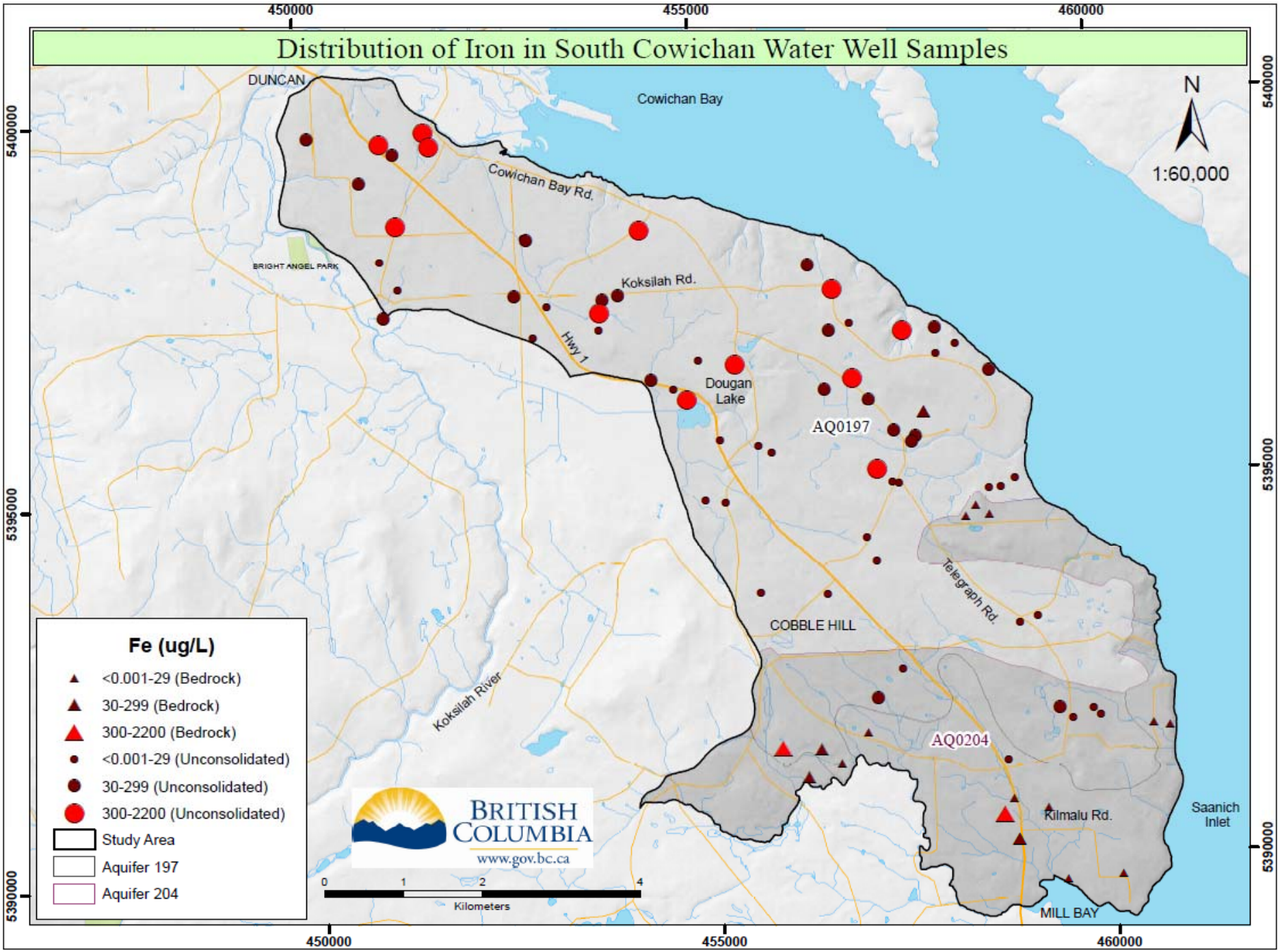

Distribution of Nitrate in South Cowichan Water Well Samples
450000
455000
460000
5400000
5395000
5390000
DUNCAN
Cowichan Bay
Cowichan Bay Rd.
Koksilah Rd.
Hwy 1
Dougan Lake
AQ0197
COBBLE HILL
Telegraph Rd.
Koksilah River
AQ0204
Kilmalu Rd.
Saanich Inlet
MILL BAY
N
1:60,000
No exceedences of NO3
NO3 (mg/L)
<0.002-0.99 (Bedrock)
2-5.25 (Bedrock)
<0.002-0.99 (Unconsolidated)
1-1.99 (Unconsolidated)
2-5.25 (Unconsolidated)
Study Area
Aquifer 197
Aquifer 204
BRITISH COLUMBIA
www.gov.bc.ca
0
1
2
4
Kilometers

South Cowichan Groundwater Quality – Results

Aesthetic Parameters* (affect taste and odour)	Results
Manganese	31 wells (38%) >50 μg/L guideline
Iron	14 wells (17%) >300 μg/L guideline

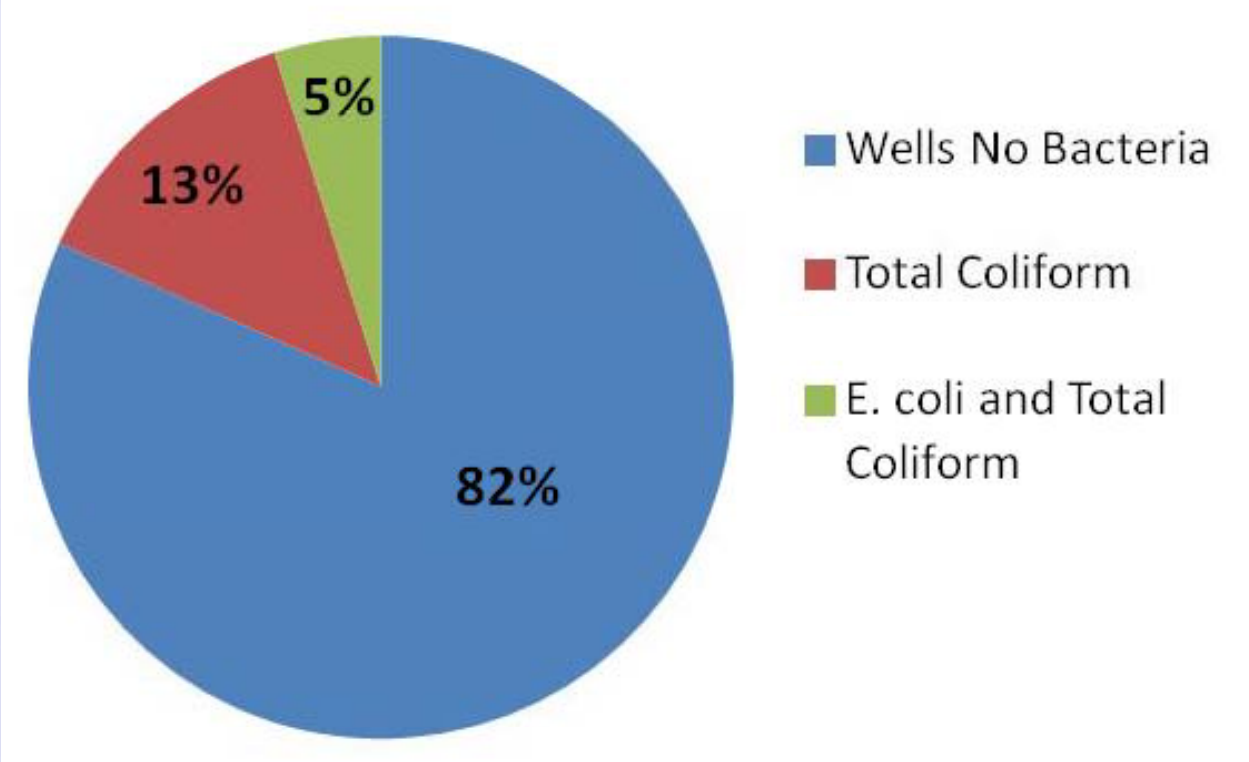
***Health Canada, guidelines for Canadian drinking water quality (2011)**


Distribution of Manganese in South Cowichan Water Well Samples
450000
455000
460000
5400000
5395000
5390000
DUNCAN
Cowichan Bay
Cowichan Bay Rd.
Koksilah Rd.
Hwy 1
Dougan Lake
AQ0197
COBBLE HILL
Telegraph Rd.
Koksilah River
AQ0204
Kilmalu Rd.
Saanich Inlet
MILL BAY
N
1:60,000
Mn (ug/L)
<0.05-20 (Bedrock)
20-50 (Bedrock)
50-460 (Bedrock)
<0.05-20 (Unconsolidated)
21-50 (Unconsolidated)
50-460 (Unconsolidated)
Study Area
Aquifer 197
Aquifer 204
BRITISH COLUMBIA
www.gov.bc.ca
0
1
2
4
Kilometers


Distribution of Iron in South Cowichan Water Well Samples
450000
455000
460000
5400000
5395000
5390000
DUNCAN
Cowichan Bay
N
1:60,000
Cowichan Bay Rd.
BRIGHT ANGEL PARK
Koksilah Rd.
Hwy 1
Dougan Lake
AQ0197
Telegraph Rd.
COBBLE HILL
Koksilah River
AQ0204
Kilmalu Rd.
Saanich Inlet
MILL BAY
Fe (ug/L)
<0.001-29 (Bedrock)
30-299 (Bedrock)
300-2200 (Bedrock)
<0.001-29 (Unconsolidated)
30-299 (Unconsolidated)
300-2200 (Unconsolidated)
Study Area
Aquifer 197
Aquifer 204
BRITISH COLUMBIA
www.gov.bc.ca
0
1
2
4
Kilometers

South Cowichan Groundwater Quality - Results

- Bacteria indicate that other pathogens could be present in the water
- Many wells with bacteria had obvious maintenance problems



Factors Influencing Groundwater Quality:

1. Well location
2. Construction and Setup
3. Maintenance
4. Proper closure of unused wells
5. Aquifer characteristics
6. Land use/human activities

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Well Maintenance – Needs Work

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Well Maintenance – Needs Work

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Well Maintenance – Vulnerable Shallow Wells

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Well Maintenance – Needs Work

TOTAL COLIFORM 34 CFU/100mL, E.coli 19 CFU/100 mL

Where's the well???

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Well Maintenance – Good

Dug Well

Drilled Wells

Drilled Wells in Pits (not recommended)

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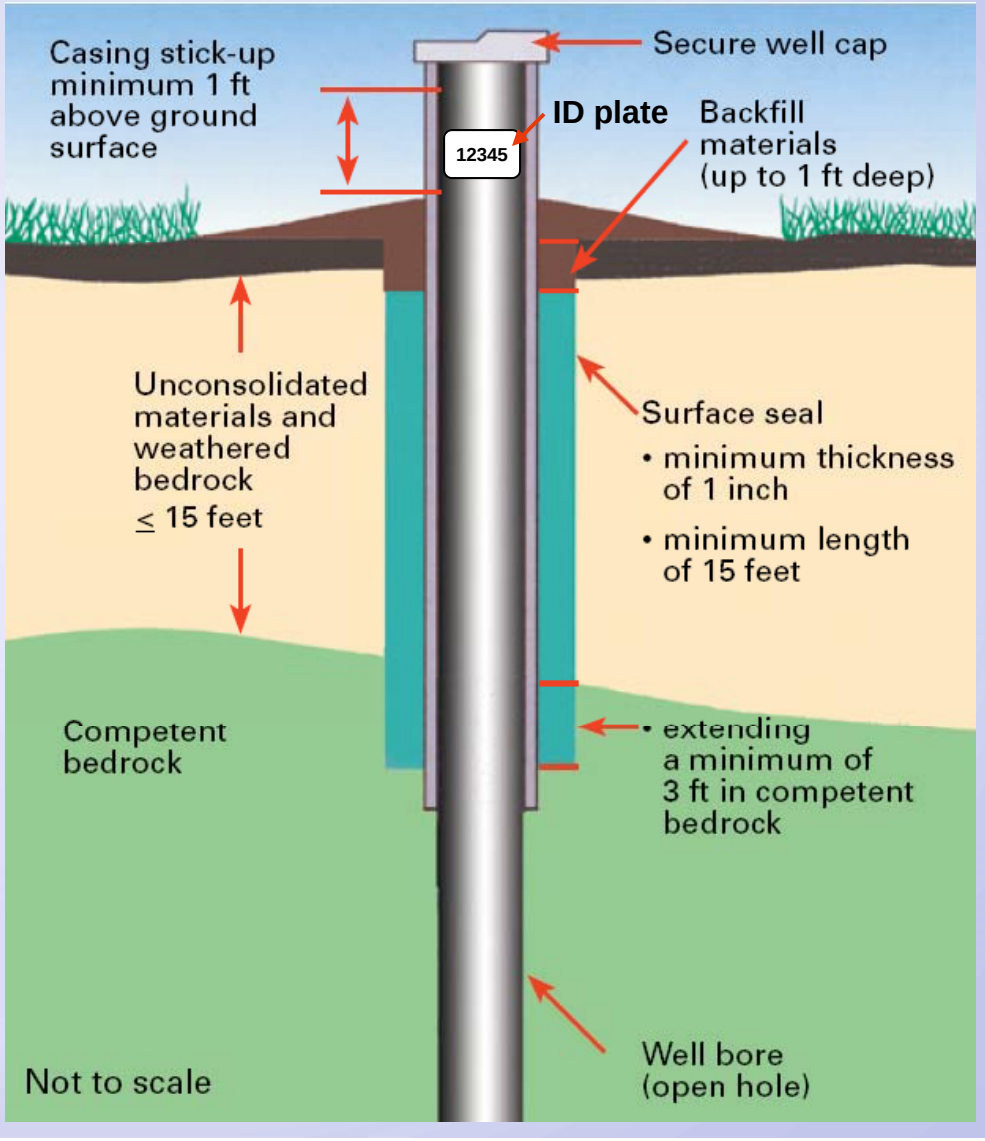
Well Head Protection – Drilled Wells

- **Secure cap**
- **Identification plate***
- **Minimum stickup ≥ 0.3 m***
- **Ground around well graded to prevent ponding of water around the well head***
- **Surface seal is intact***

***Good practice and <u>legal requirement</u> for "new" wells constructed on or after Nov. 1, 2005**



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Well Head Protection – Excavated Wells

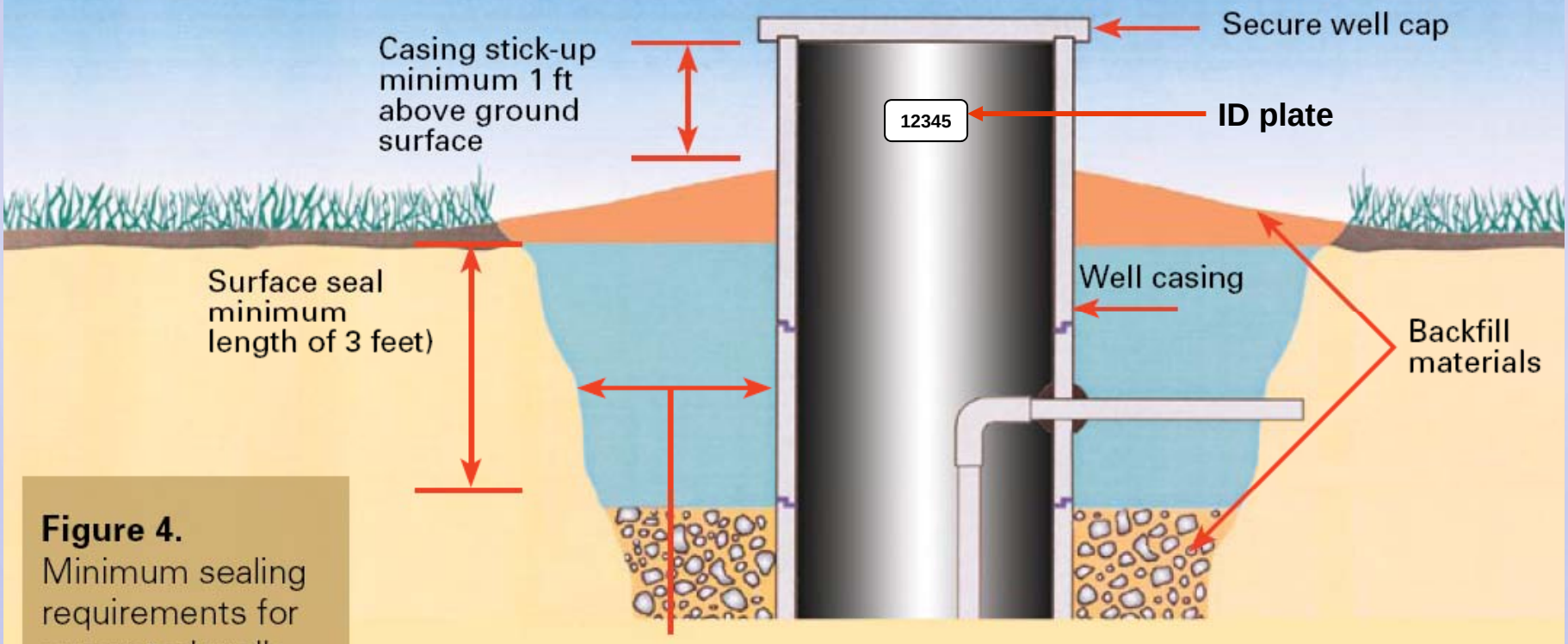
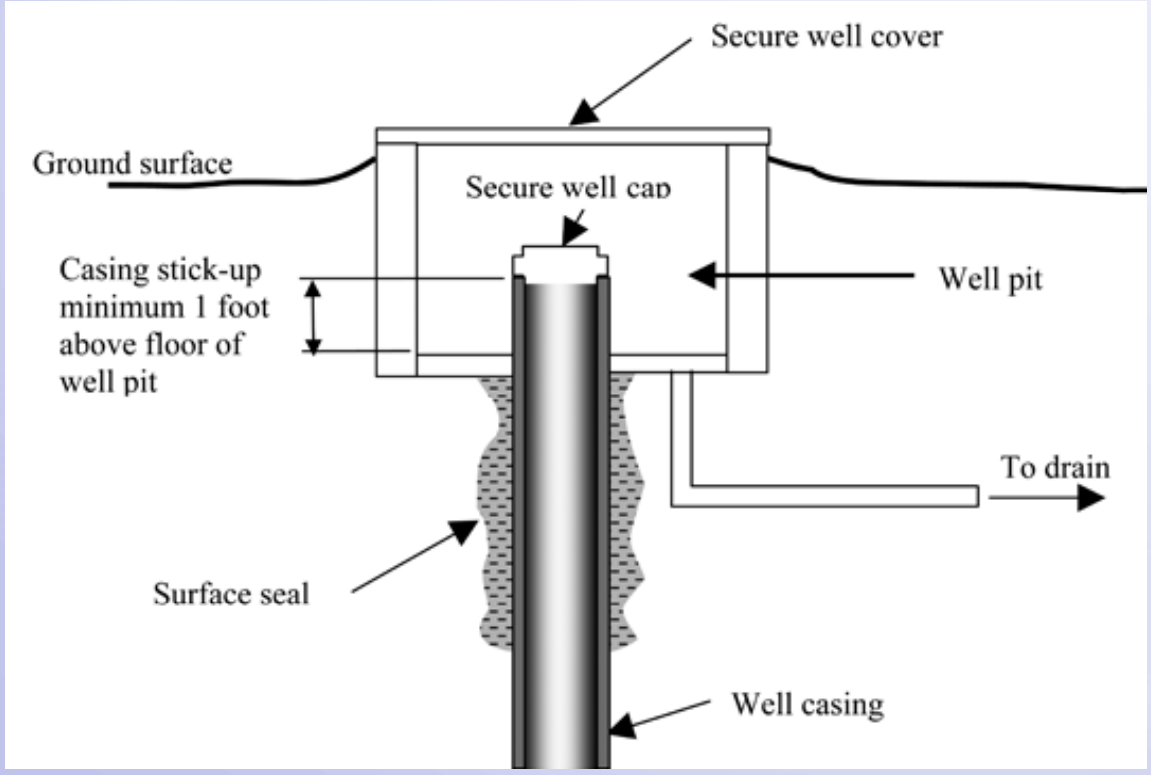


Figure 4. Minimum sealing requirements for excavated wells

Not to scale

Wells in Pits – Recommended Upgrades

- Current standard for new wells



- Existing wells recommend replacing or retrofitting pit

Summary

- Groundwater quality in the study area is good
- Some elements are present that can affect health, or taste/odour of groundwater for drinking, most from natural sources
- Ambient nitrate concentrations are low
- Area residents (private well owners) benefit from testing and education on well maintenance
- Important for well owners to test water from their own well on a regular basis

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Thank you!

Questions?

Resources

- Google: **BC Groundwater Quality**
- Refer to handout on recommended groundwater resources