Stakeholder Meeting

January 10, 2023

2021 - 2022 Stakeholder Meeting

Agenda Items:

- Mine Site and Receivership Status - QCC
- Overview and Status of Activities - QCC
  a. Water Management Systems - QCC
  b. Compliance with PE:7008 - QCC
  c. Potential Seepage Locations - QCC
  d. Receiving Environment Water Quality - QCC
  e. Biota Monitoring in Lakes - QCC
  f. Sediment and Benthic Invertebrate Monitoring Program - QCC
- Update on Projects - QCC
  a. Site Wide Water Balance and Source Terms Update - QCC
- Question Session

Mine Site and Receivership Status

On September 26, 2019, The Bowra Group Inc. was appointed Receiver of Quinsam Coal Corporation.

The mine has been operating in care and maintenance to maintain the health and safety of employees and the environment

Mandate to fulfill Environmental terms and conditions outlined in amended permit's PE:7008 issued under the Environmental Management Act and amendments of the Mine Permit C-172 issued under the Mines Act Permit

Overview and Status of Activities

Mine Site

- Continuous Care and Maintenance

Underground Rehabilitation

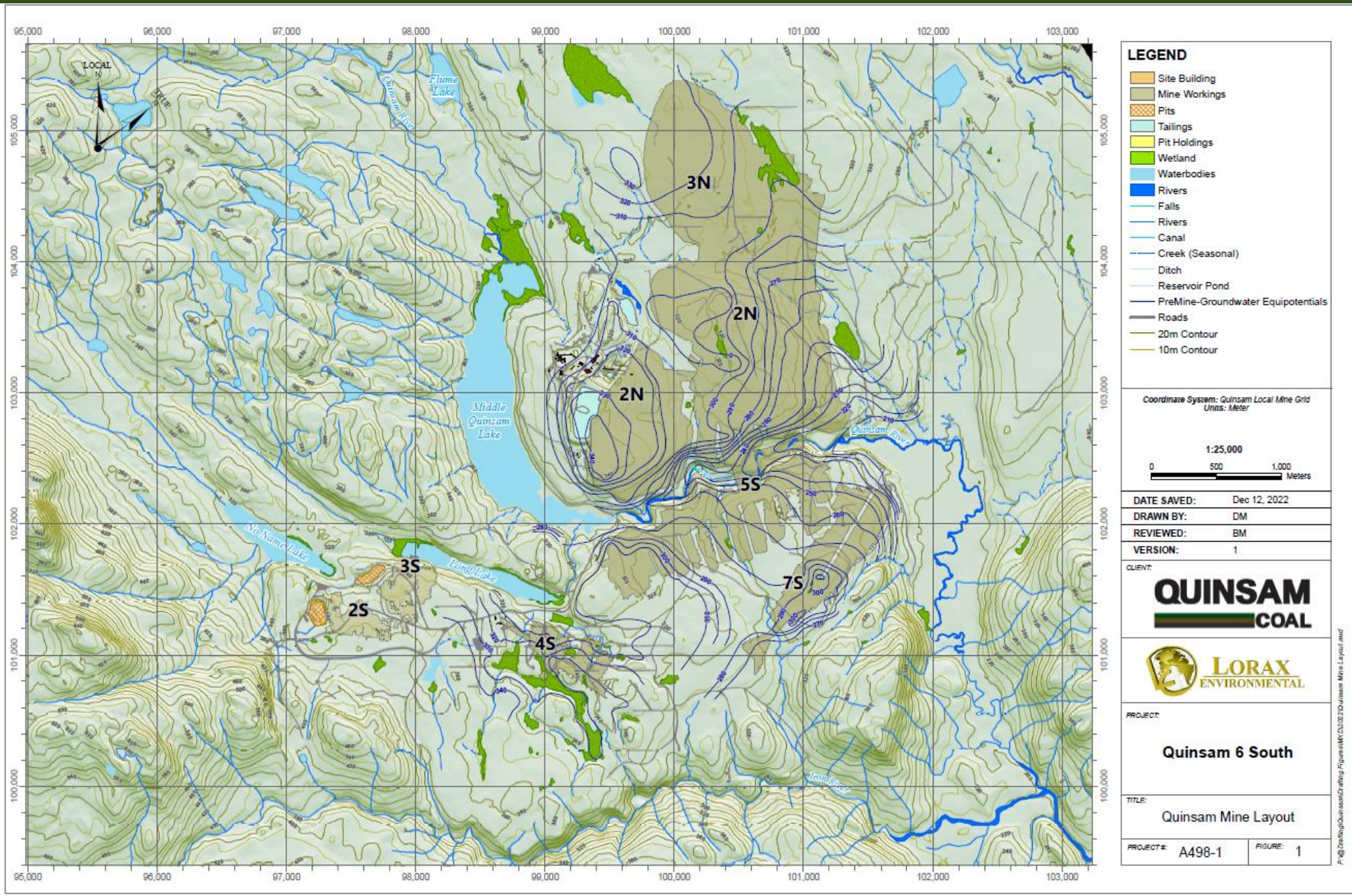
- Roof bolting in 2-North mine
- Road work in 7-South

Vegetation Control:

- Under power lines,
- Tailings storage facility and water dams

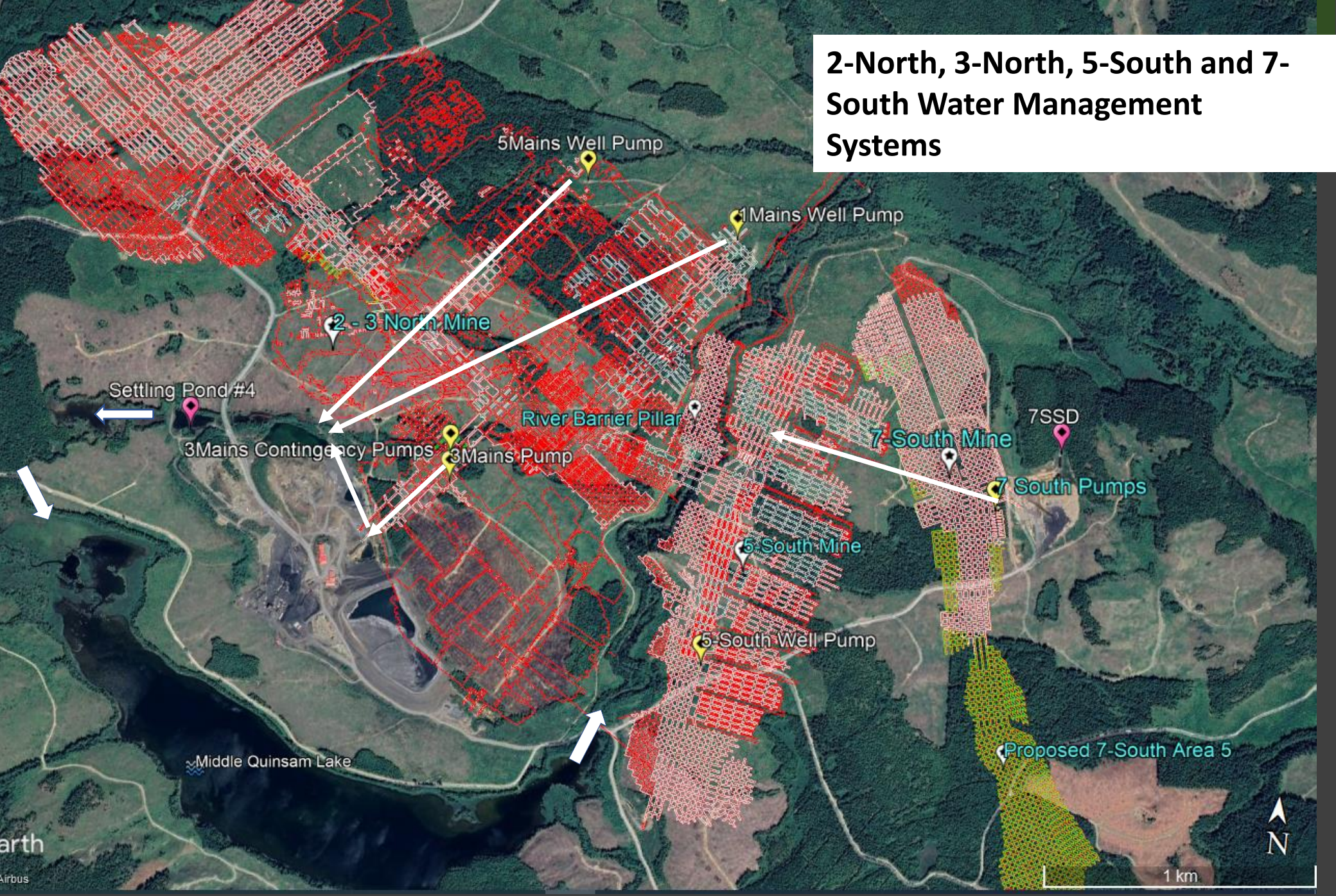
Monitoring Program

- Modified sediment and benthic invertebrate monitoring program
- Identifying and characterizing potential seepage areas
- Compliance with Permit

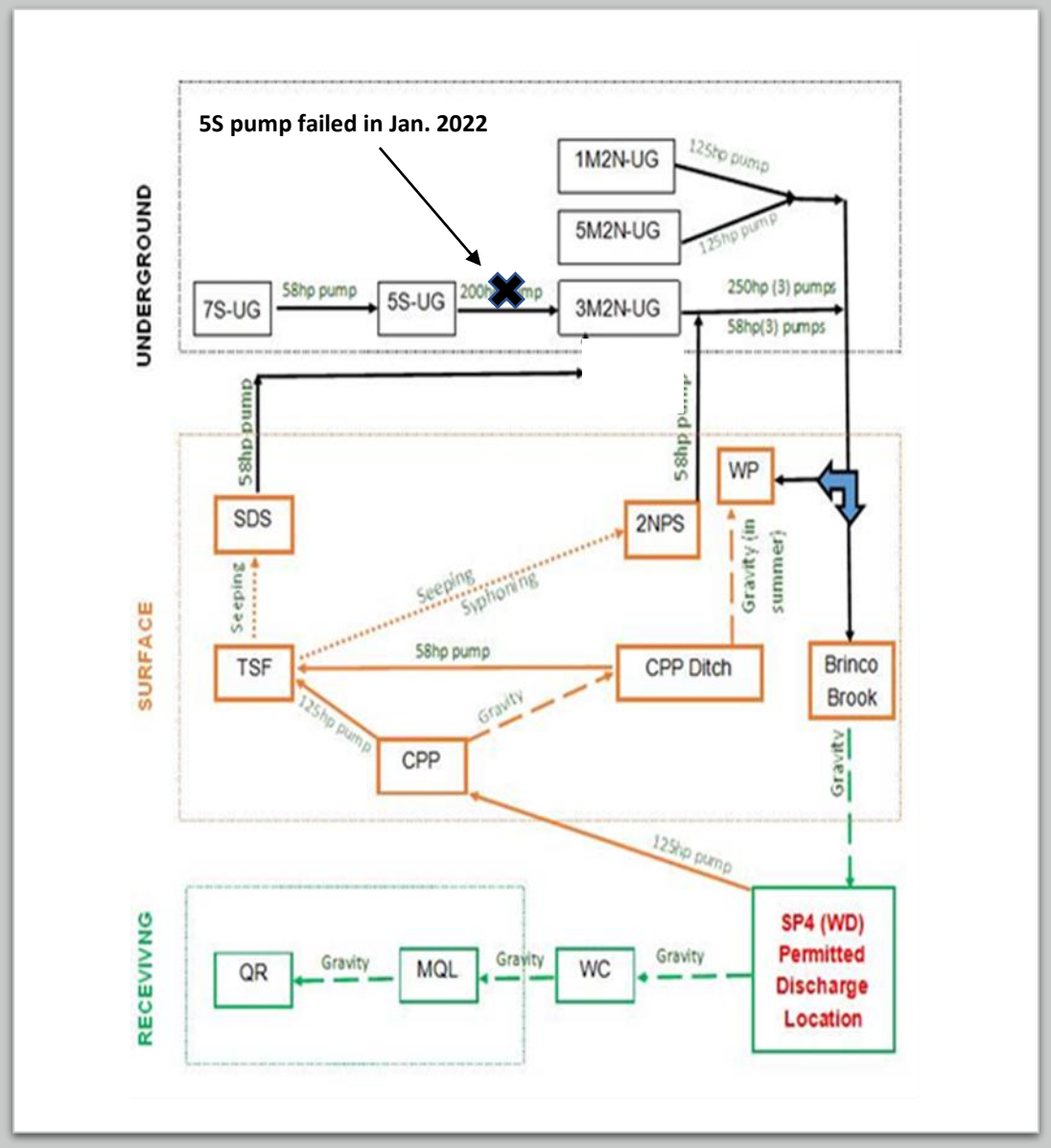


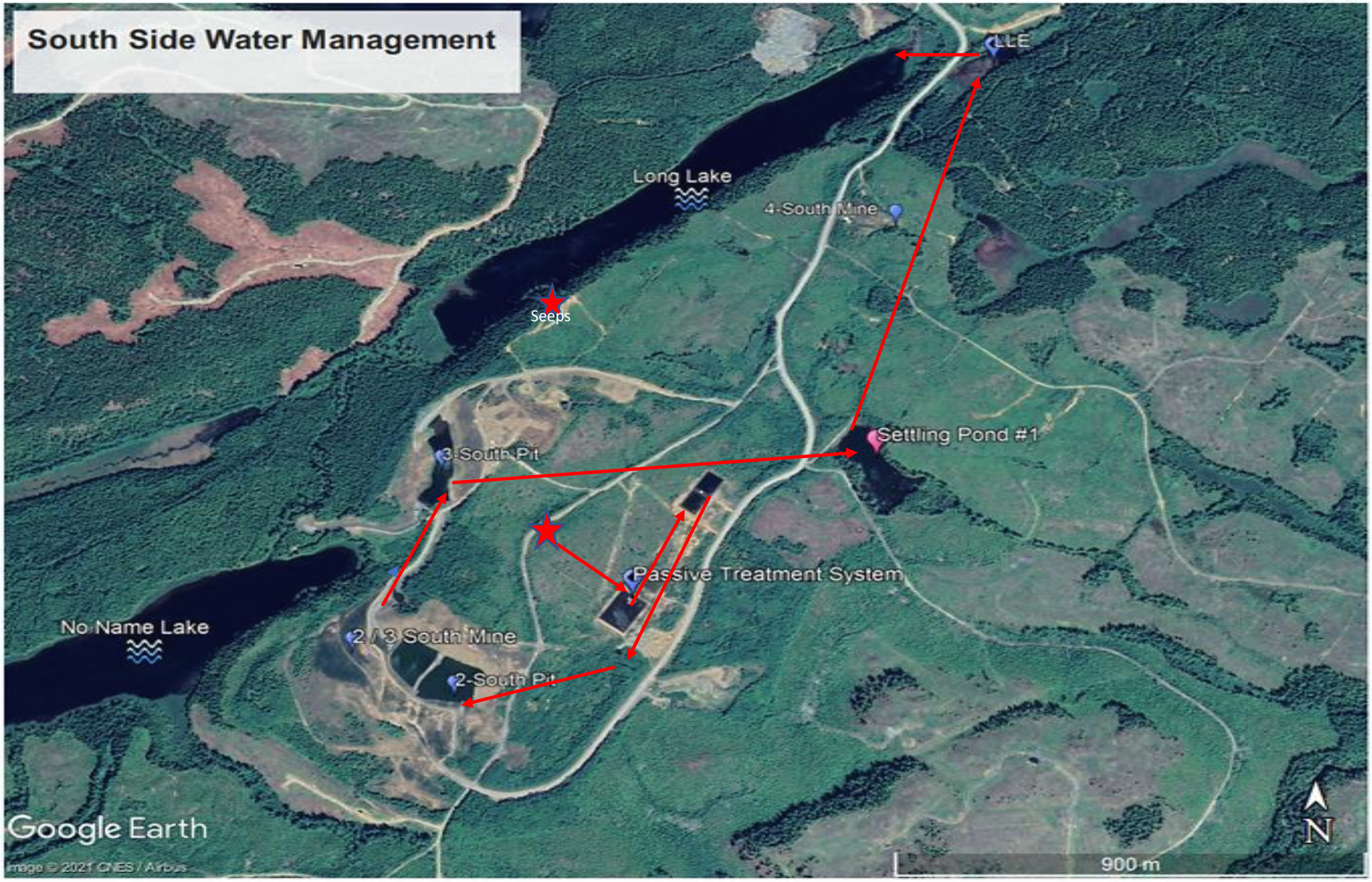
Mass Loading to Quinsam River 88 Panel Groundwater Assessment. Lorax 2012

2-North, 3-North, 5-South and 7-South Water Management Systems



7-South, 5-South and 2-North – Water Management System




South Side Water Management
LLE
Long Lake
4-South Mine
Seeps
Settling Pond #1
3-South Pit
Passive Treatment System
No Name Lake
2 / 3 South Mine
2-South Pit
Google Earth
image © 2021 CNES / Airbus
900 m
N

Non-Compliance with PE:7008 - Summary

Referred for Administrative Penalties

Unauthorized Discharges Long Lake Seeps, Potential Mine Related Seepage Areas (S and S2) and Failure of Authorized Works (5-South Pump) were referred for administrative penalties.

Level 2

Non-compliance resulting in a minor, temporary impact on the environment or minor, a temporary threat to human health or safety; or Significant administrative non-compliance.

Category C

Warning, Admin Penalty, Admin Sanction

Using the Non-Compliance Decision Matrix, the compliance determination for this inspection has been assessed as Level 2, Category C, AMP.

Water Quality Predictions

Hydrogeology Summary

Mine	Seepage Flux (m^3/d)	Shortest Travel Time (years)	Reflooding Time (years)	Receiving Water
7-South	50	6	15	Quinsam River
2-North – 3-North	220	1.4	4	Quinsam River[1]
5-South - RBP	48	1.5	2.5	Quinsam River
4-South	1.4	18[2]	1[3]	Middle Quinsam Lake[4]

Notes:

1. Small component of flow to Middle Quinsam Lake
2. Travel time to Long Lake 3 years
3. Estimate only
4. 10% of flow (0.14 m^3/d) reports to Long Lake

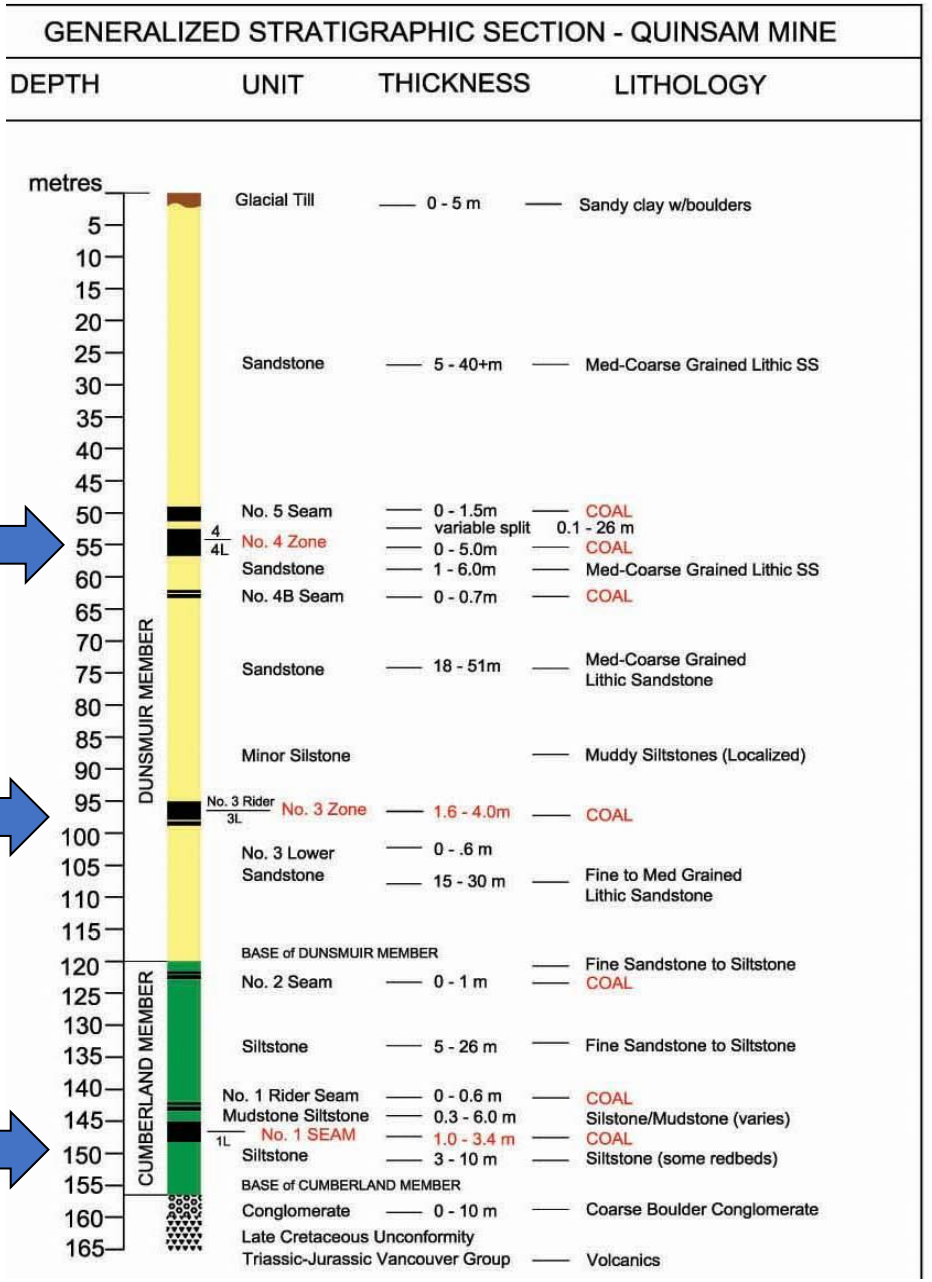
Mass Loading to Quinsam River 88 Panel Groundwater Assessment. Lorax 2012

Stratigraphic Position of Mines

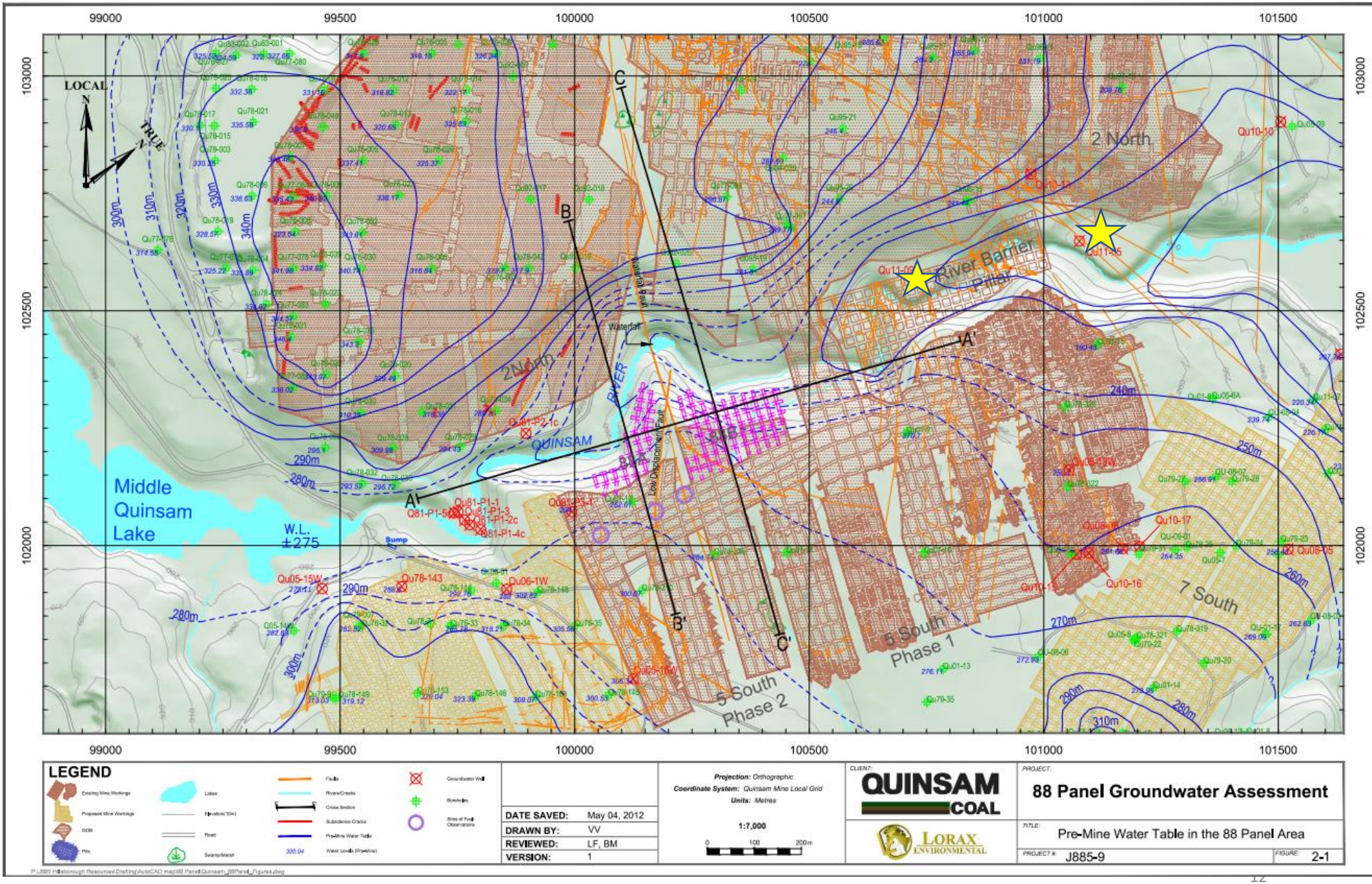
7 South Mine – No. 4 Seam

4 South Mine – No. 3 Seam

2 North Mine
3 North Mine - No. 1 Seam
5 South Mine



2 North / 3 North and 5 South Groundwater Evaluation. Lorax 2011



LEGEND

Existing Mine Workings
Proposed Mine Workings
OCM
Pits
Lakes
Elevation(10m)
Road
Swamp/Marsh
Faults
Rivers/Creeks
Cross Section
Subsidence Cracks
Pre-Mine Water Table
Water Levels (Pre-Mine)
Groundwater Well
Boreholes
Sites of Fish Observations

DATE SAVED:	May 04, 2012
DRAWN BY:	VV
REVIEWED:	LF, BM
VERSION:	1

Projection: Orthographic
Coordinate System: Quinsam Mine Local Grid
Units: Metres

1:7,000

0 100 200 m

CLIENT: QUINSAM COAL

LORAX ENVIRONMENTAL

PROJECT: **88 Panel Groundwater Assessment**

TITLE: Pre-Mine Water Table in the 88 Panel Area

PROJECT #: J885-9

FIGURE: 2-1

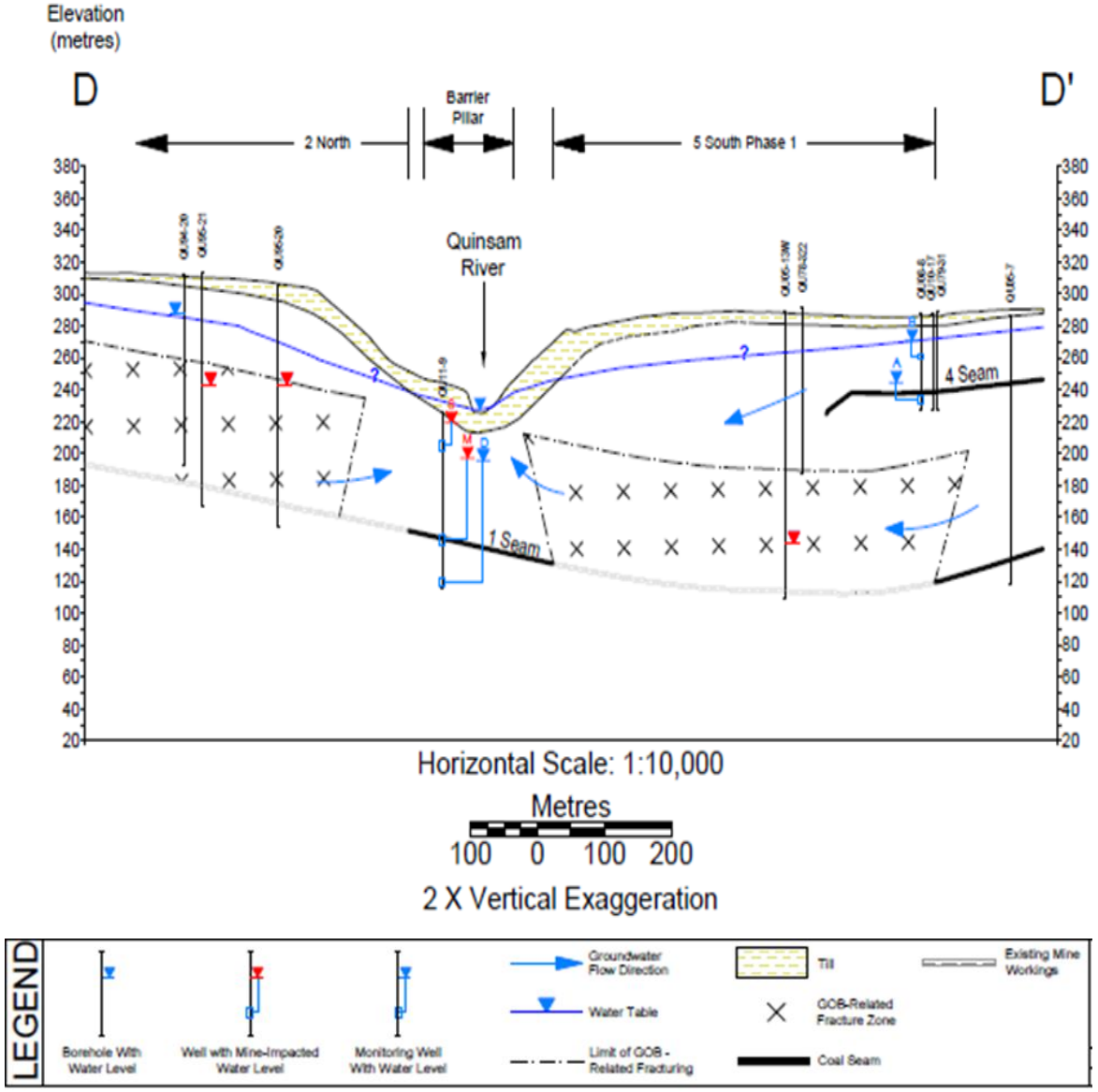
P:\J885 Hillsborough Resources\Drafting\AutoCAD maps\88 Panel\Quinsam_88Panel_Figures.dwg

Potential Mine Related Seepage

Cross section displays QU11-09 borehole located in the River Barrier Pillar (RBP). Groundwater has an upward vertical seepage toward the river. 5-South is primarily lateral through the mine perimeter.

Groundwater wells QU11-09 and QU11-05 are at similar elevations:

QU11-09 (226.3 mASL)
QU11-05 (228.4 mASL)
(downstream)



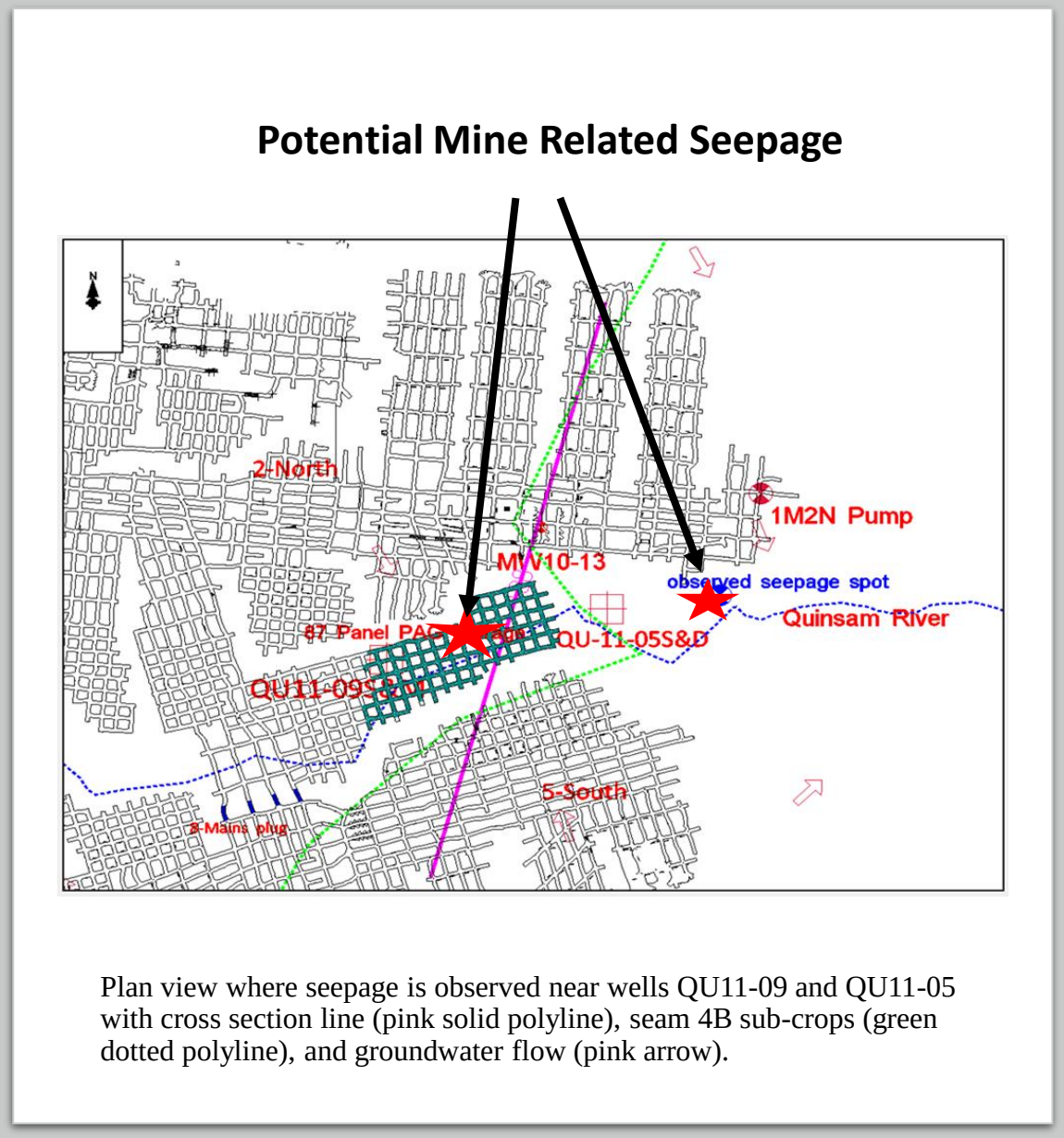
2 North / 3 North and 5 South Groundwater Evaluation. Lorax 2011

Potential Mine Related Seepage Locations

Mechanisms for groundwater flow is predominant though bedrock fractures and geological faults.

River Barrier Pillar and 2-North dominant lithology is siltstone/mudstone.

Seepage waters display similar trends as mine waters and shallow groundwater.

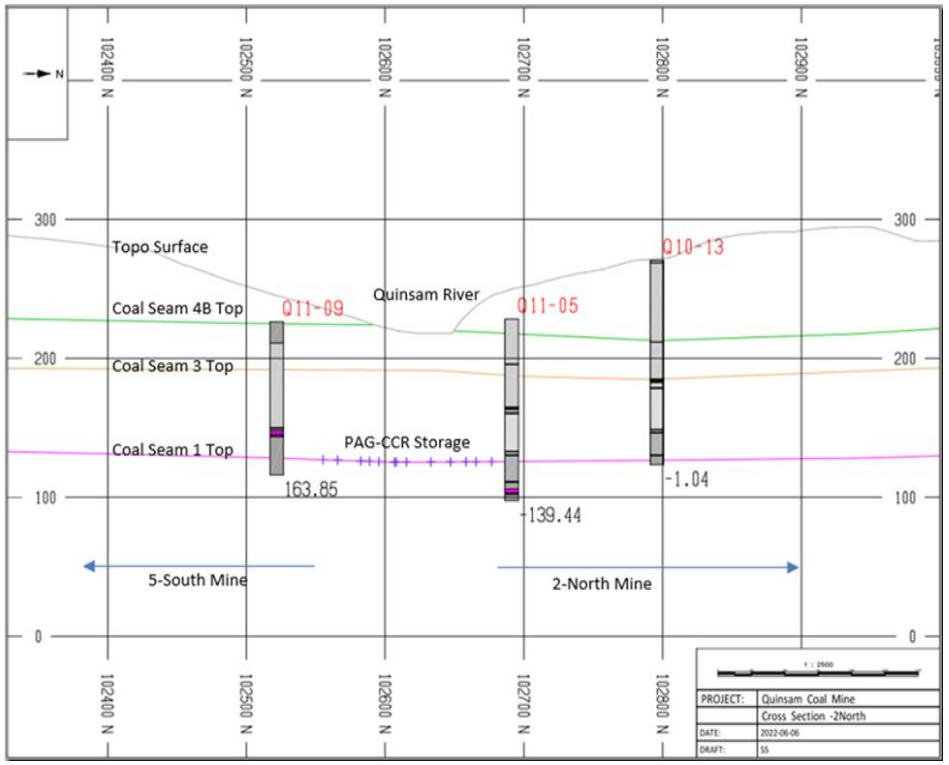


Plan view where seepage is observed near wells QU11-09 and QU11-05 with cross section line (pink solid polyline), seam 4B sub-crops (green dotted polyline), and groundwater flow (pink arrow).

Potential Mine Related Seepage Locations

Cross section in North-South direction near the seepage areas QU11-09 and QU11-05 at locations S and S2.

Groundwater in these areas interacts with the No. 3 coal seam and No. 4 coal seam that sub-crops at the river.



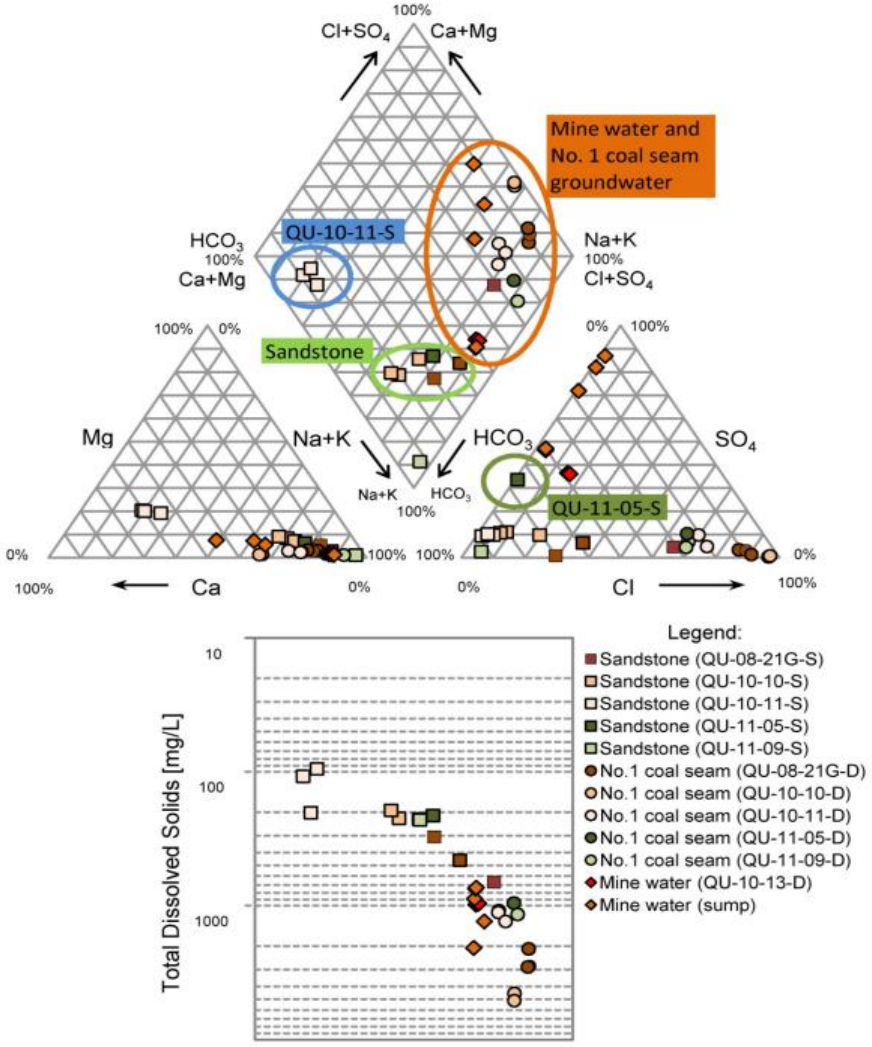


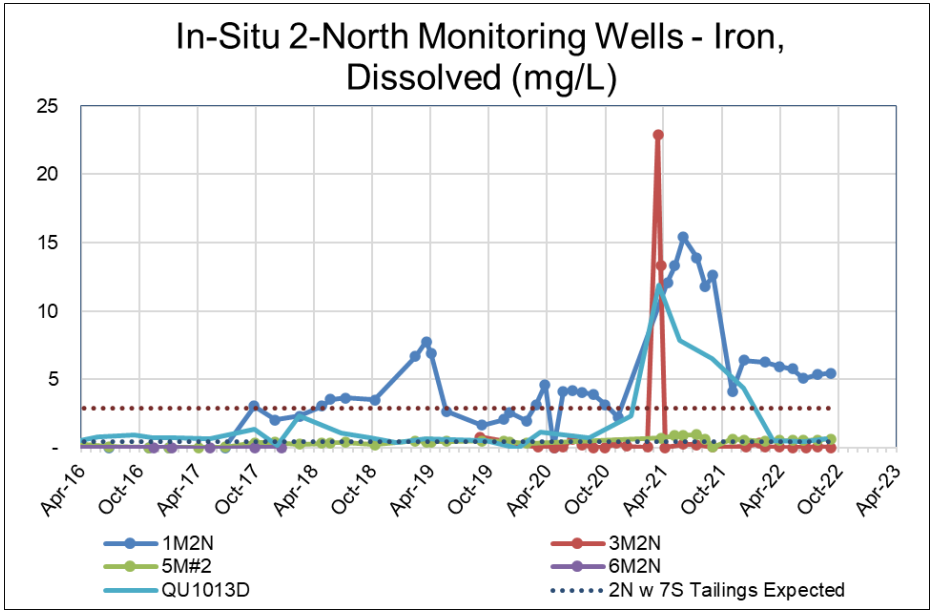
Figure 5-5: **Piper plot of 2 North groundwaters showing three distinct water types; mine water, Dunsmuir sandstone and No. 1 coal seam. The ion contents are plotted as percentages of total equivalents per litre.**

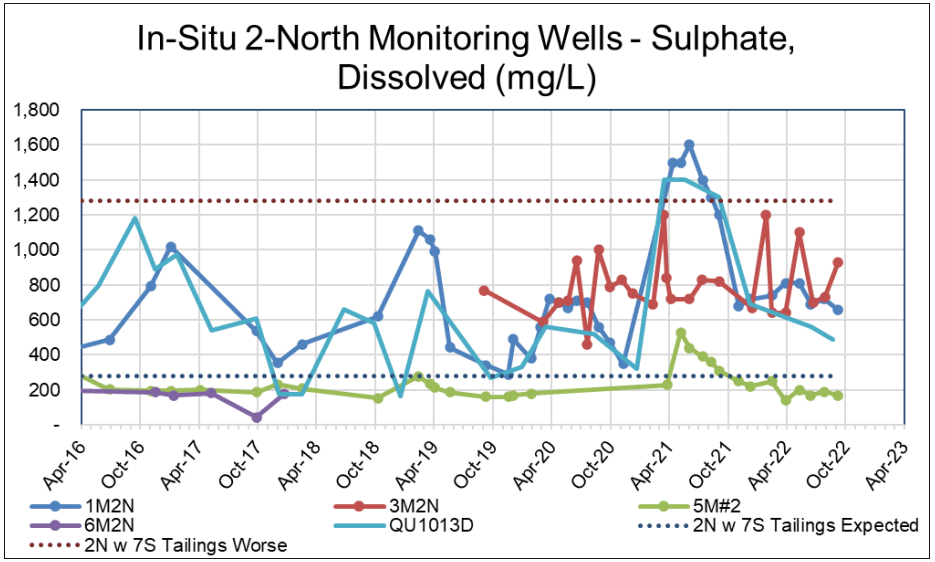
2 North / 3 North and 5 South Groundwater Evaluation. Lorax 2011

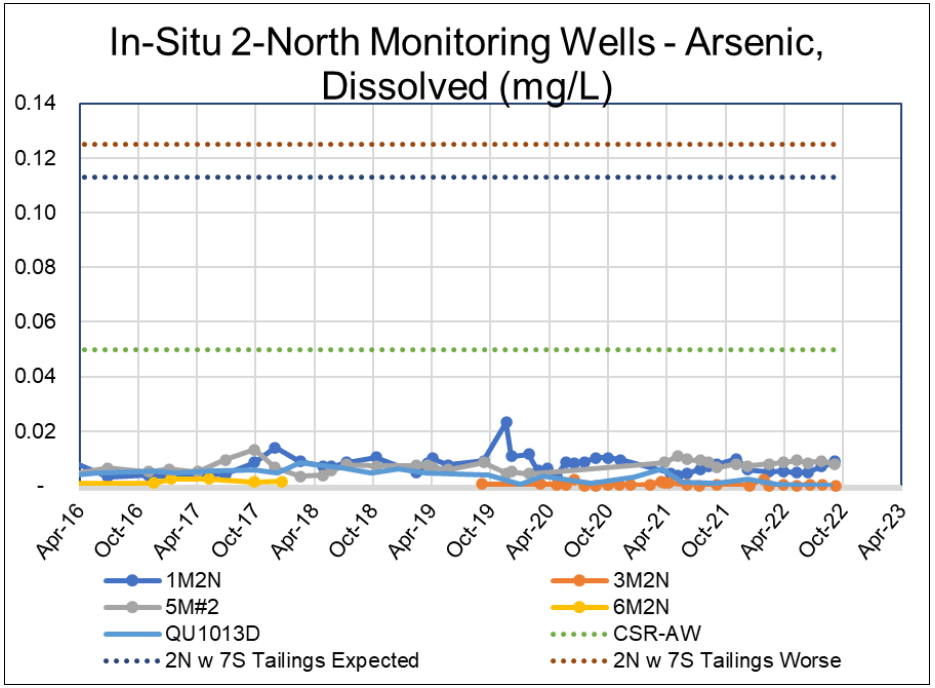
2-North Mine waters - distinct sulphate signature, classified as a sodium-sulphate calcium bicarbonate type water

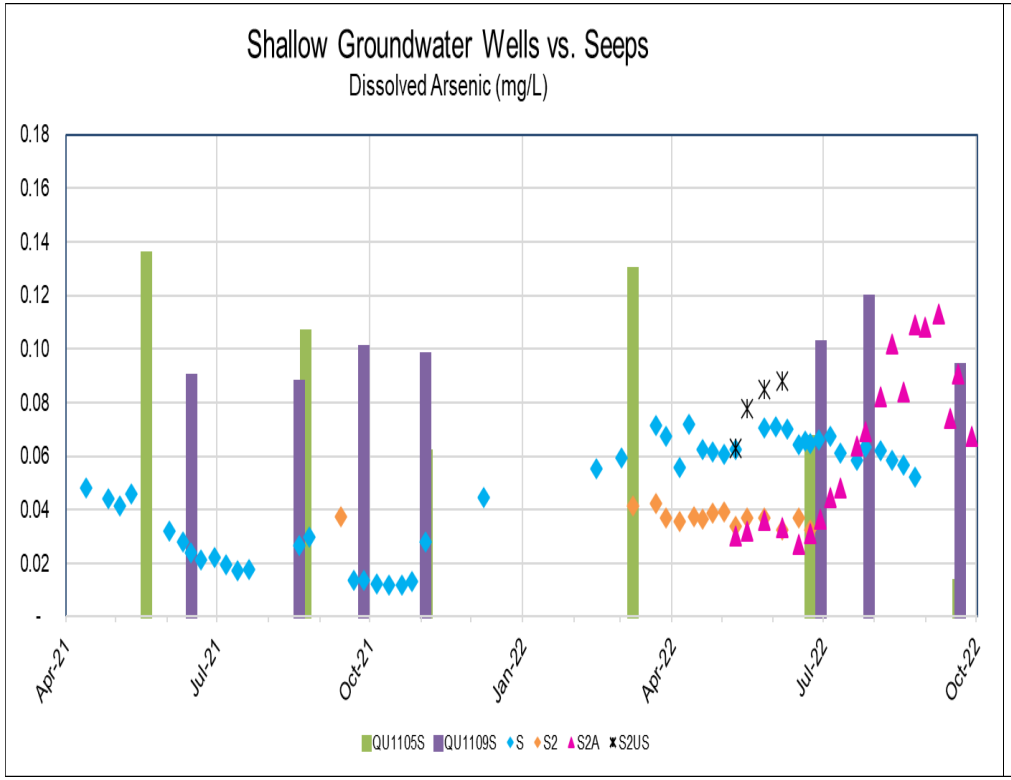
No. 1 seam from 2-North Area – deeper waters are sodium-chloride Shallower waters are sodium bicarbonate type waters.
Plot distinctly from mine waters indicating not strongly mine influenced. Chloride signature indicates these waters are older than sodium and calcium bicarbonate formation waters.

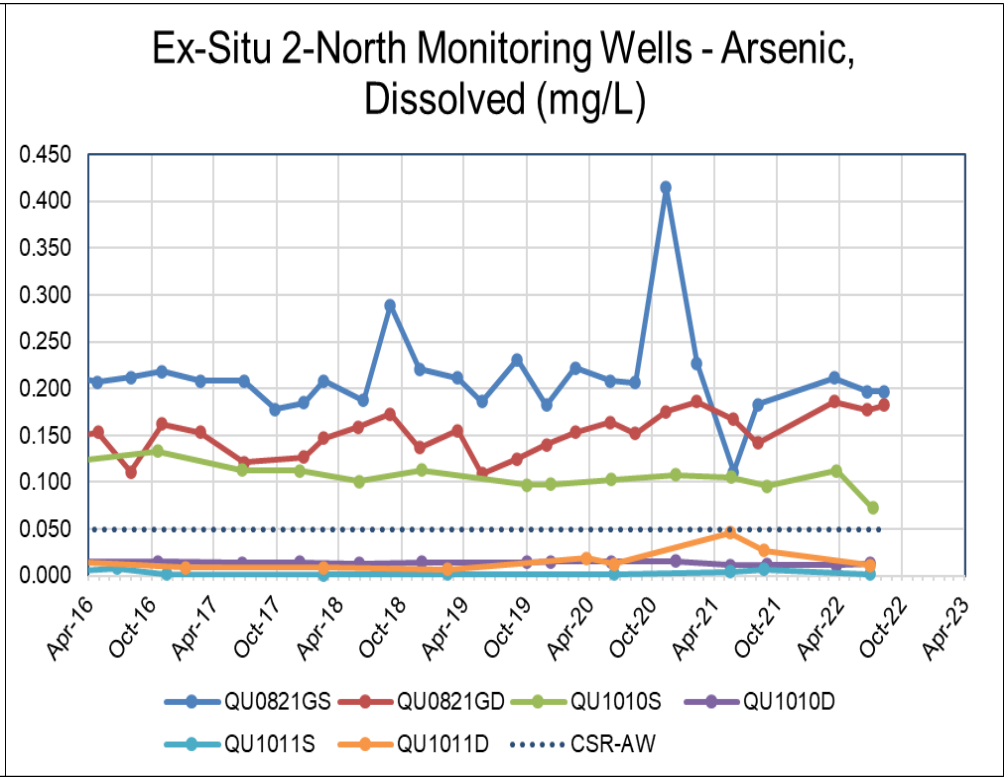
Dunsmuir sandstone waters are predominantly sodium bicarbonate and those influenced by fractured flow from mine water have a sulphate signature.


In-Situ 2-North Monitoring Wells - Iron, Dissolved (mg/L)
25
20
15
10
5
-
Apr-16
Oct-16
Apr-17
Oct-17
Apr-18
Oct-18
Apr-19
Oct-19
Apr-20
Oct-20
Apr-21
Oct-21
Apr-22
Oct-22
Apr-23
1M2N
3M2N
5M#2
6M2N
QU1013D
2N w 7S Tailings Expected

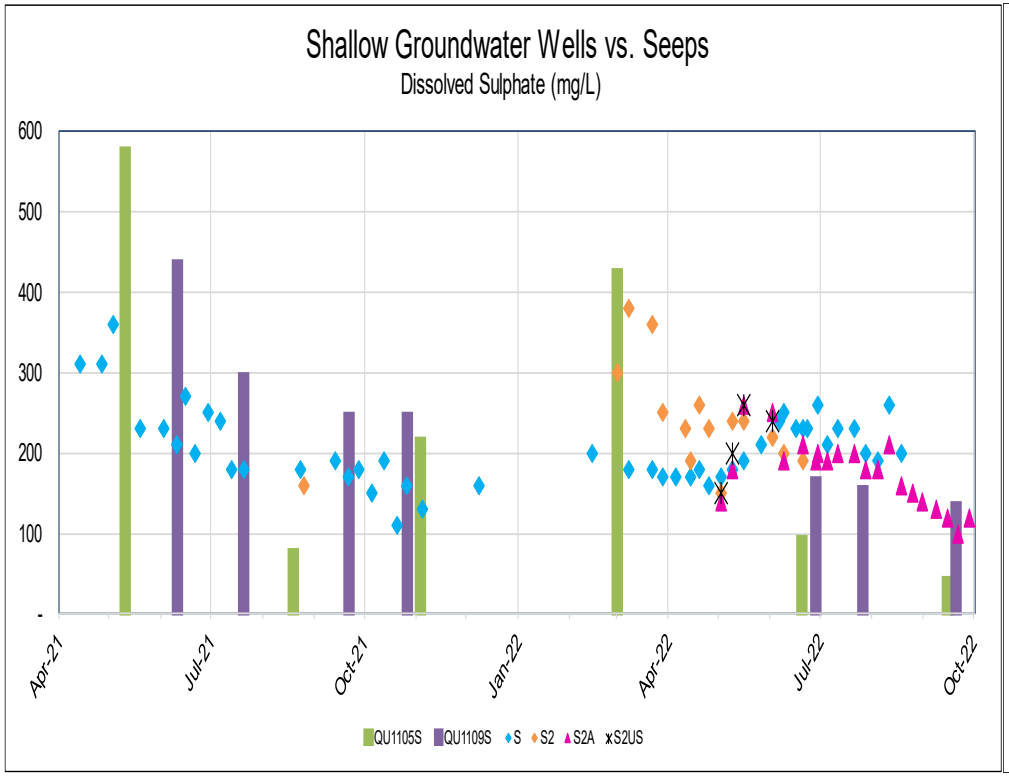

In-Situ 2-North Monitoring Wells - Sulphate, Dissolved (mg/L)
1,800
1,600
1,400
1,200
1,000
800
600
400
200
-
Apr-16
Oct-16
Apr-17
Oct-17
Apr-18
Oct-18
Apr-19
Oct-19
Apr-20
Oct-20
Apr-21
Oct-21
Apr-22
Oct-22
Apr-23
1M2N
3M2N
5M#2
6M2N
QU1013D
2N w 7S Tailings Expected
2N w 7S Tailings Worse

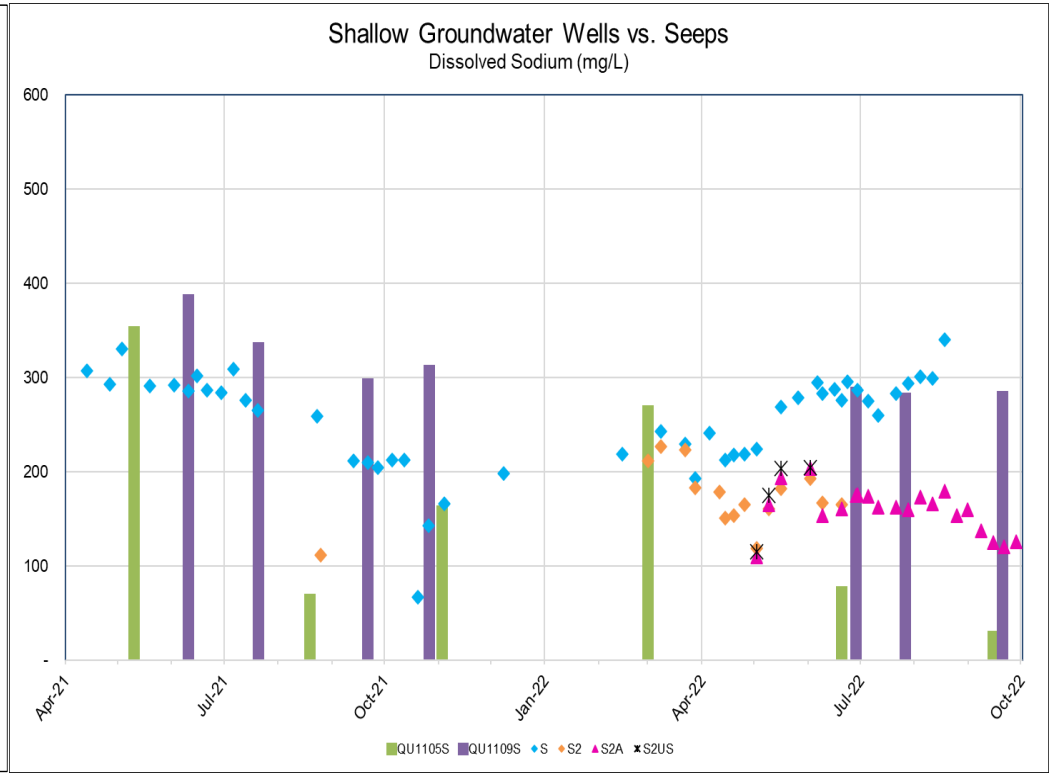

In-Situ 2-North Monitoring Wells - Arsenic, Dissolved (mg/L)
0.14
0.12
0.10
0.08
0.06
0.04
0.02
-
Apr-16
Oct-16
Apr-17
Oct-17
Apr-18
Oct-18
Apr-19
Oct-19
Apr-20
Oct-20
Apr-21
Oct-21
Apr-22
Oct-22
Apr-23
1M2N
3M2N
5M#2
6M2N
QU1013D
CSR-AW
2N w 7S Tailings Expected
2N w 7S Tailings Worse



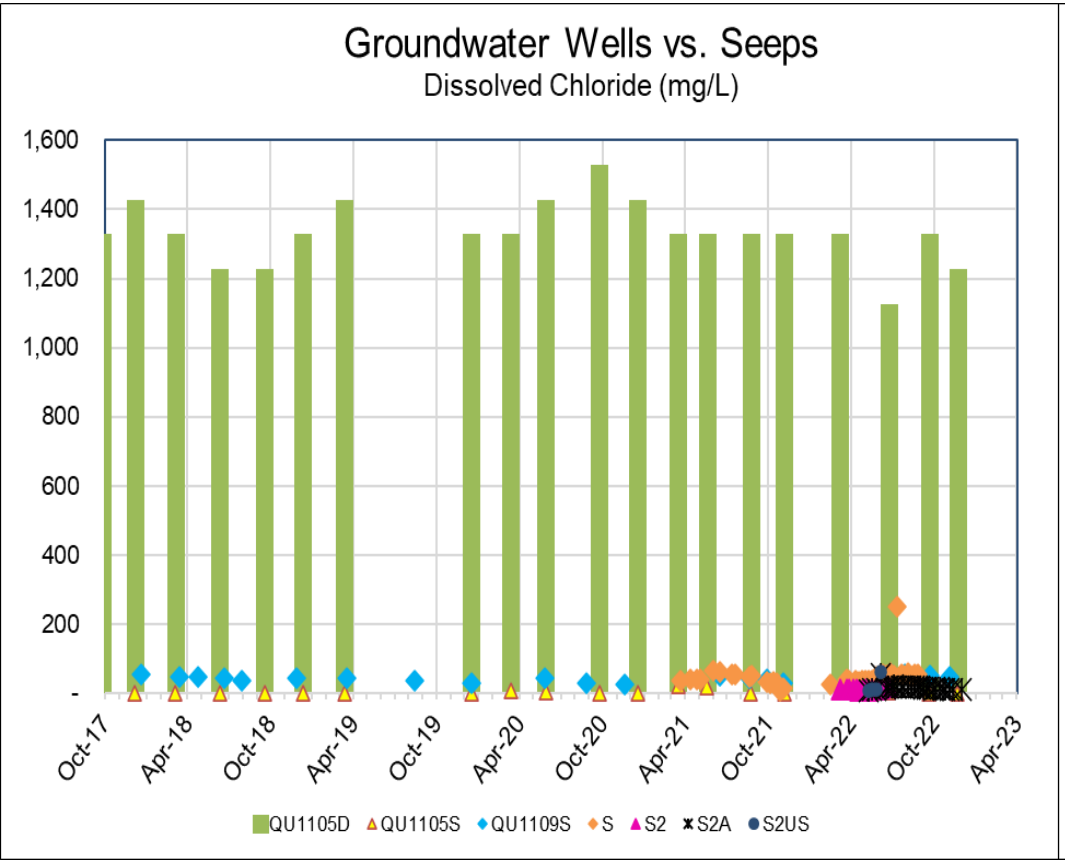


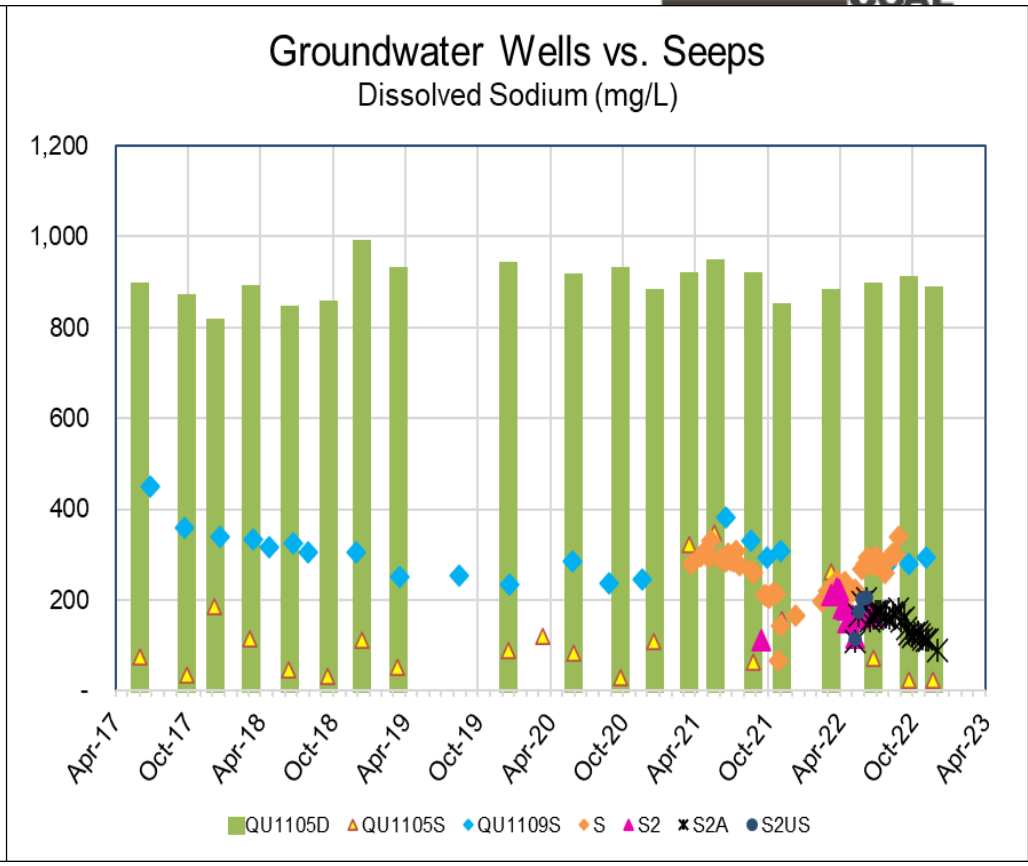
Arsenic was elevated in the Dunsmuir sandstone relative to levels observed in the No. 1 Seam, this is consistent with the realgar mineralization previously observed in the sandstone formation (Lorax, 2011b).





The possible influence of sulphate rich mine water is observed in the shallow groundwaters and seepage waters having a sodium bicarbonate sulphate signature. Fractured flow is suspected at these locations as indicated by the high hydraulic conductivity and very rapid recharge rates observed in the shallow groundwater wells.





Groundwater tends to evolve to sodium chloride type water as it ages in the formation flow path (Freeze, 1979) indicating the down-dip 2 North, No.1 coal seam groundwater is older groundwater with chloride concentrations increasing with formation contact time. *Low levels indicate these waters are younger groundwaters with limited formation contact time.*

Receiving Environment Water Quality Guidelines and Objectives

- Receiving environment (lakes and rivers) at Quinsam Mine are compared to British Columbia (B.C.) **Approved Water Quality Guidelines (WQGs)** for Freshwater Aquatic Life. Both chronic (30-day expose) and acute (immediate expose).

Water Quality Objectives (WQOs) Middle Quinsam and Long Lake and Quinsam River are also compared to relevant for Middle Quinsam Sub-basin developed in 1986.

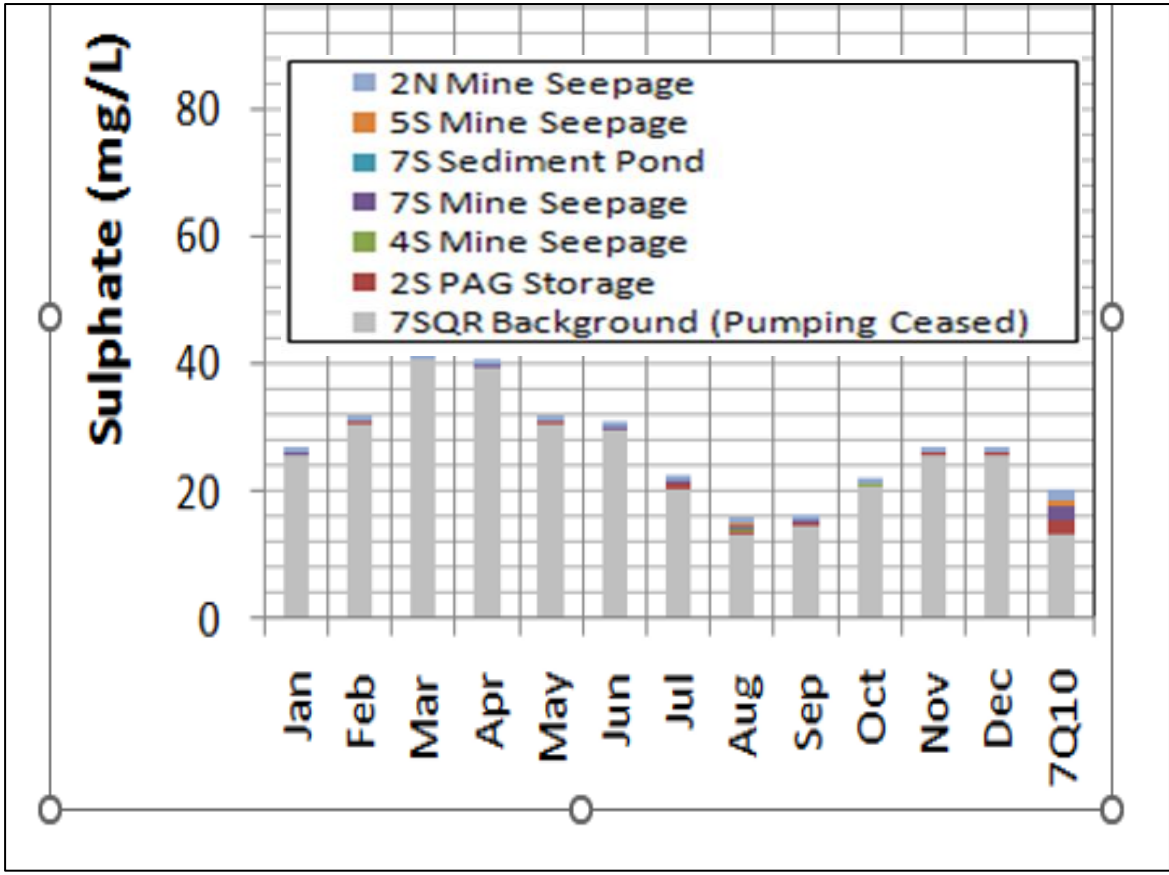
- In most cases WQG's are more currant and stringent than WQO's.

WQGs:

- Exceeding a WQG's does not imply that unacceptable risks exists, but rather that the potential for adverse effects may be increased and additional investigation may be required.

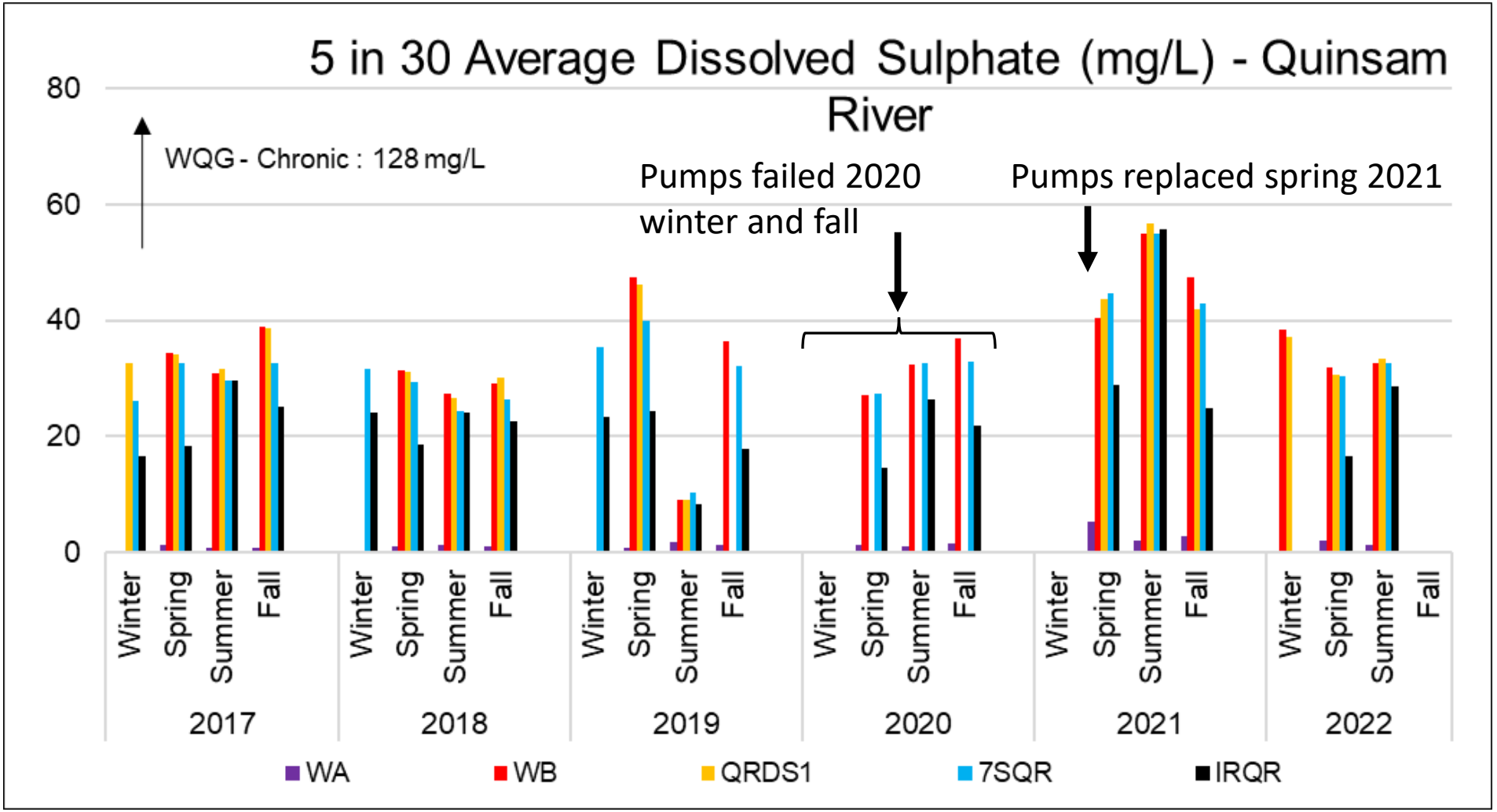
Predicted Post-Closure Cumulative Effects on the Quinsam River

- Expected concentrations for Quinsam River - Water quality remains below both chronic and acute WQG's
- Worst case - Highest predicted concentrations for mine influenced parameters (*e.g.*, SO_4, As, Co and Fe) 7Q10 (7-day lowest flow event)

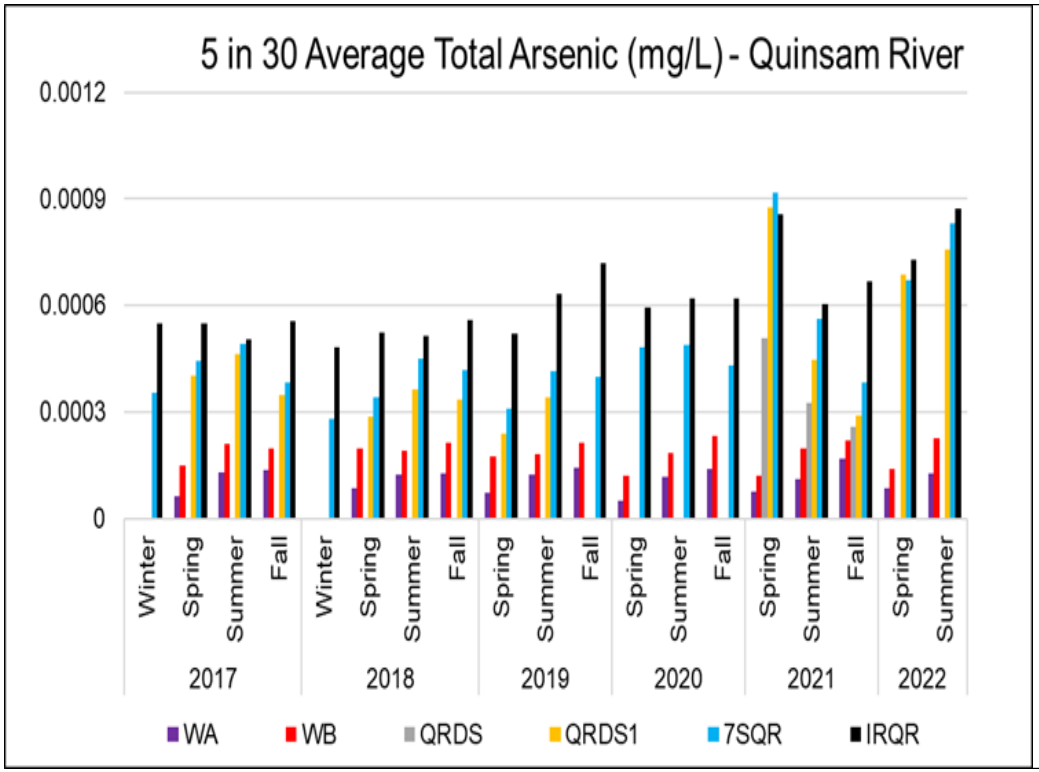


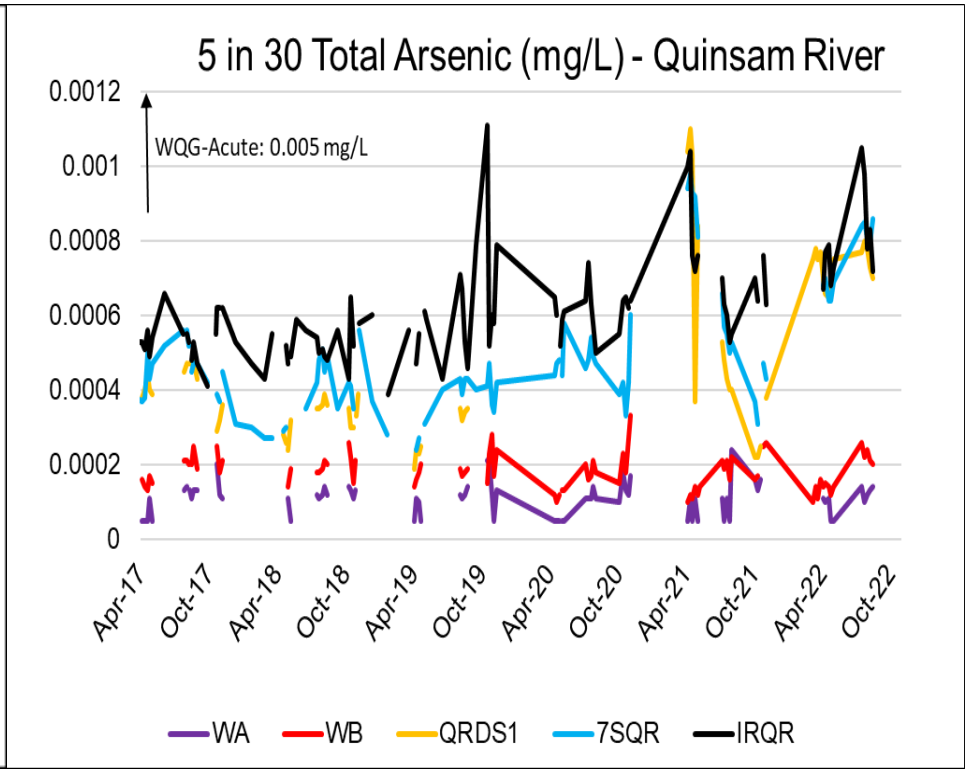
Mass Loading to Quinsam River 88 Panel Groundwater Assessment. Lorax 2012

UPSTREAM OF MINE INFLUENCE to DOWNSTREAM MINE INFLUENCED MONITORING LOCATIONS

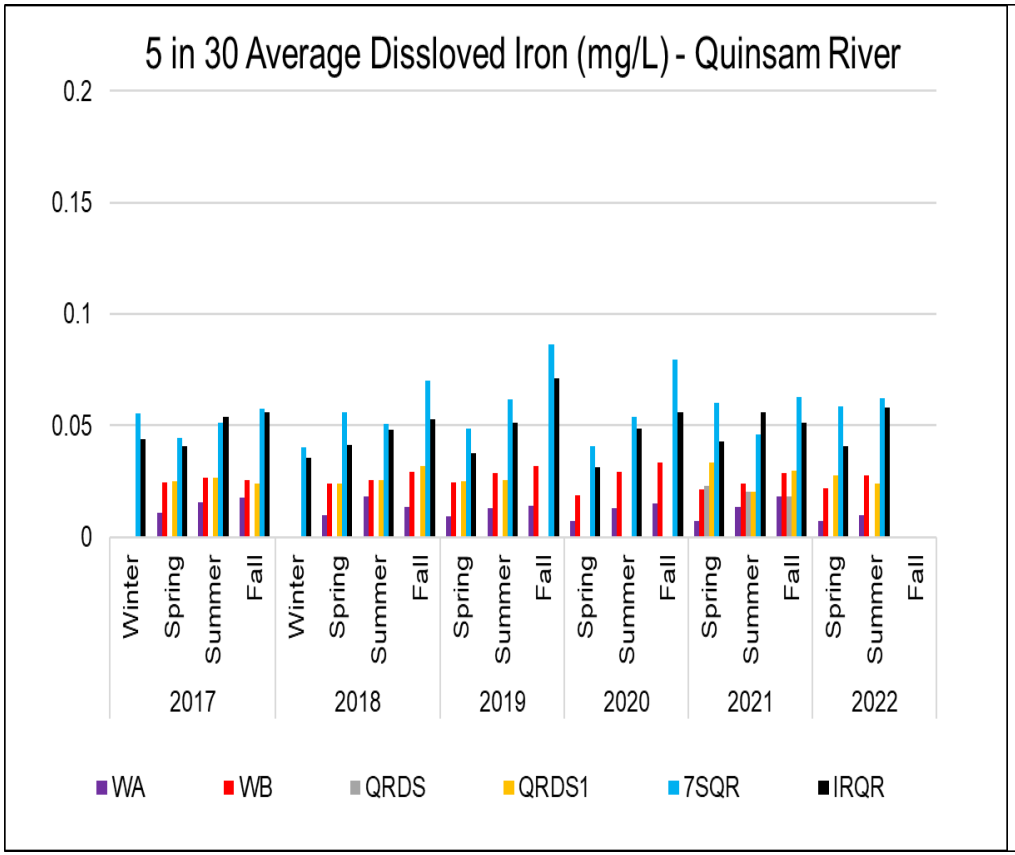


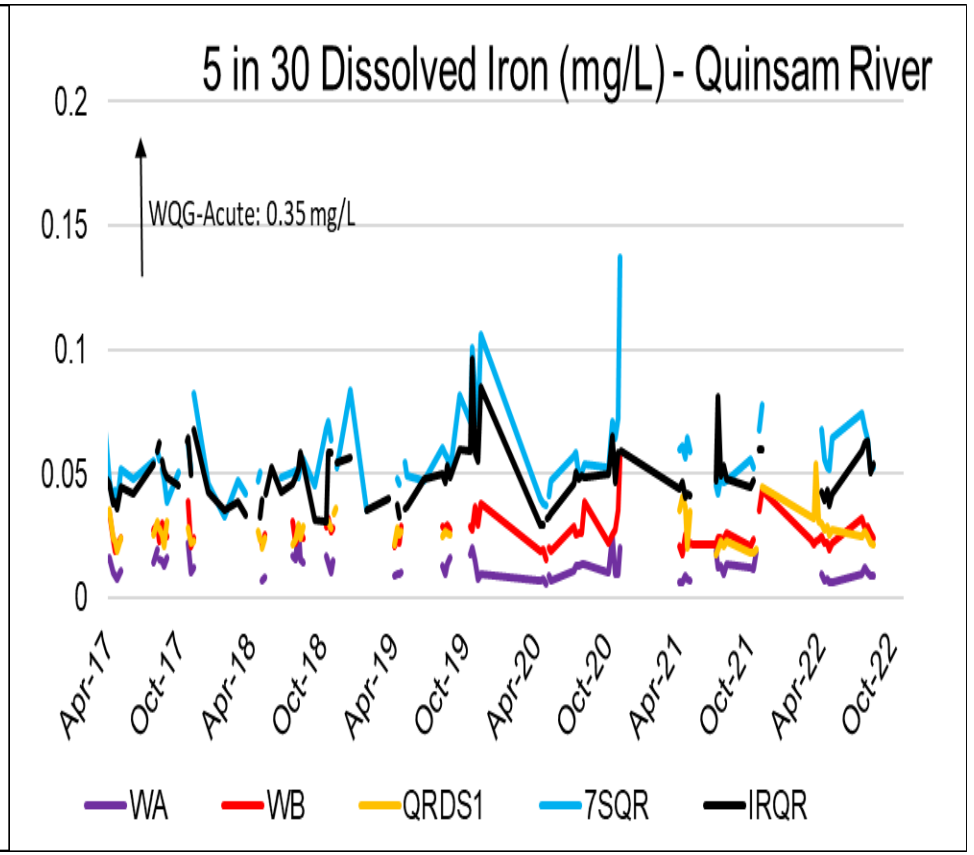
UPSTREAM OF MINE INFLUENCE TO DOWNSTREAM MINE INFLUENCED MONITORING LOCATIONS



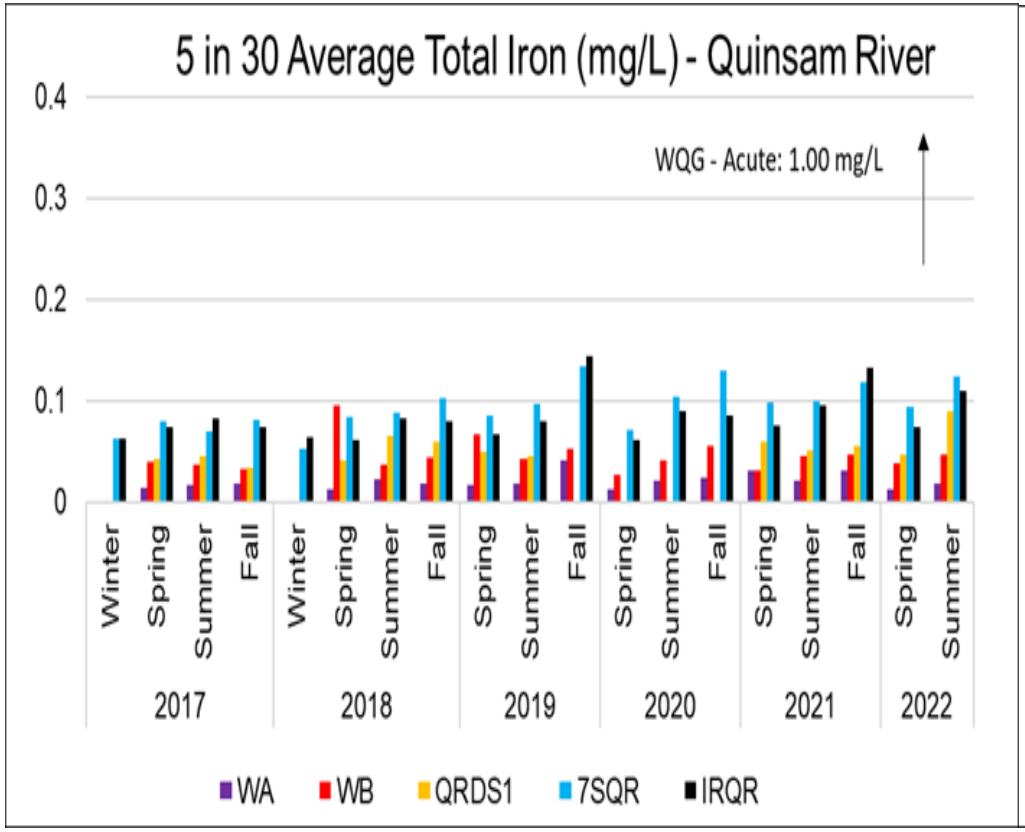


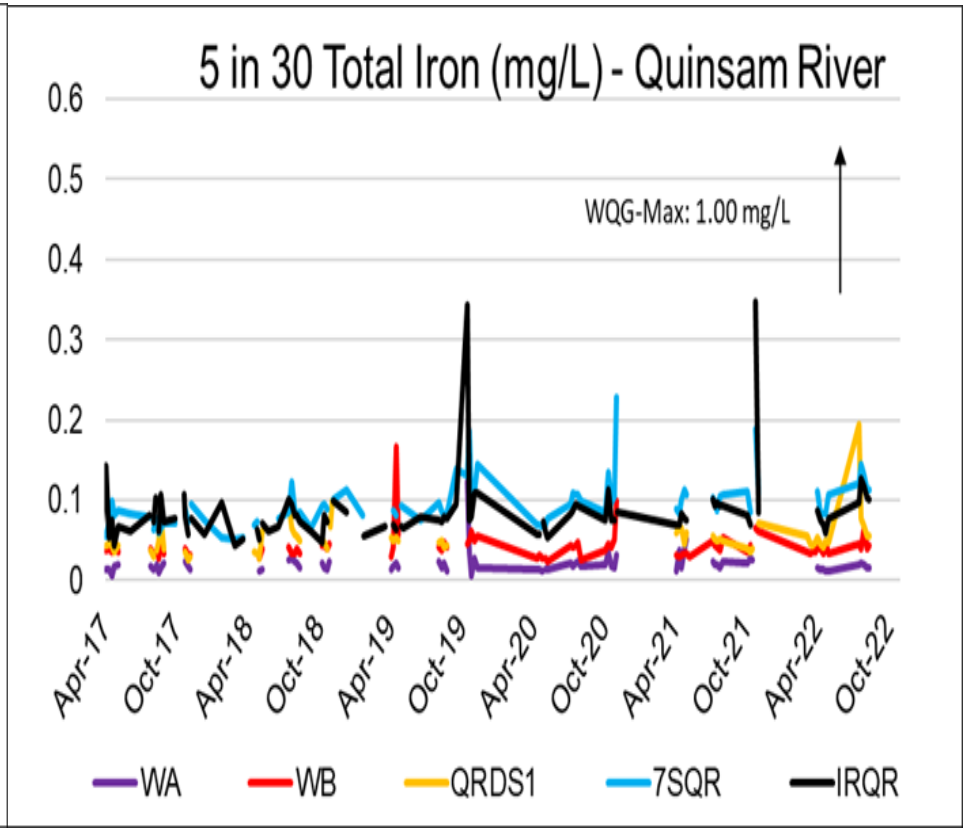
UPSTREAM OF MINE INFLUENCE to DOWNSTREAM MINE INFLUENCED MONITORING LOCATIONS

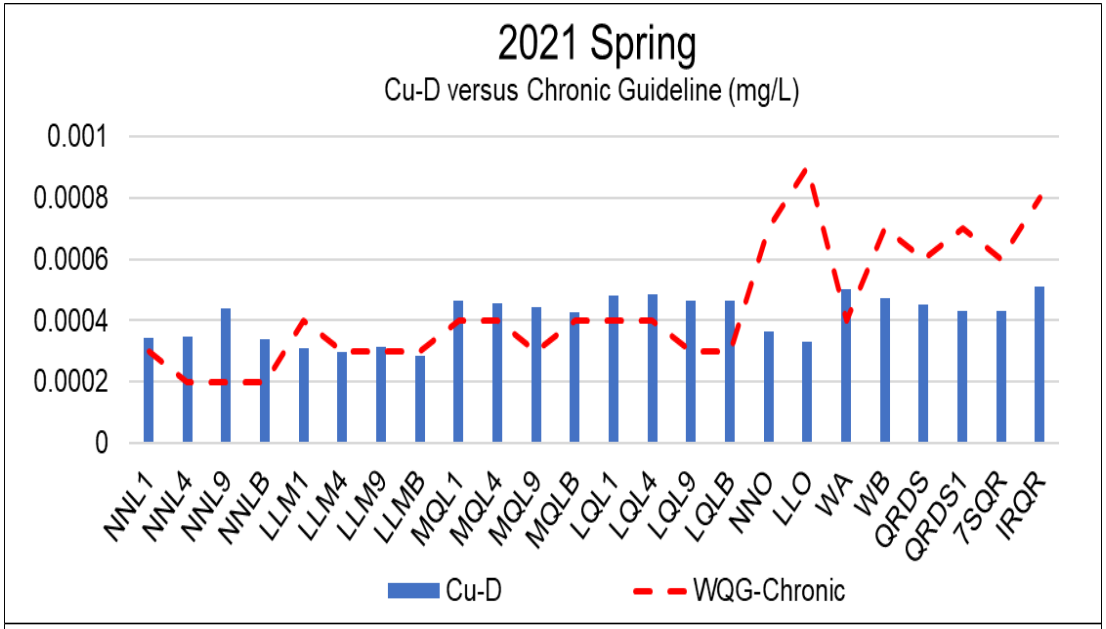


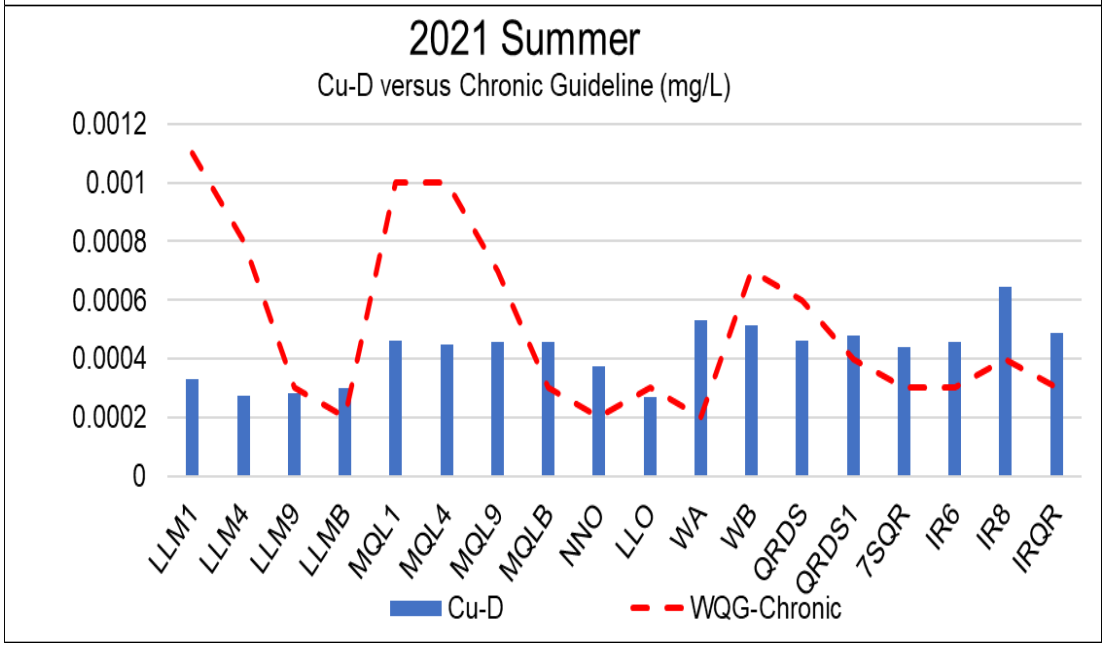


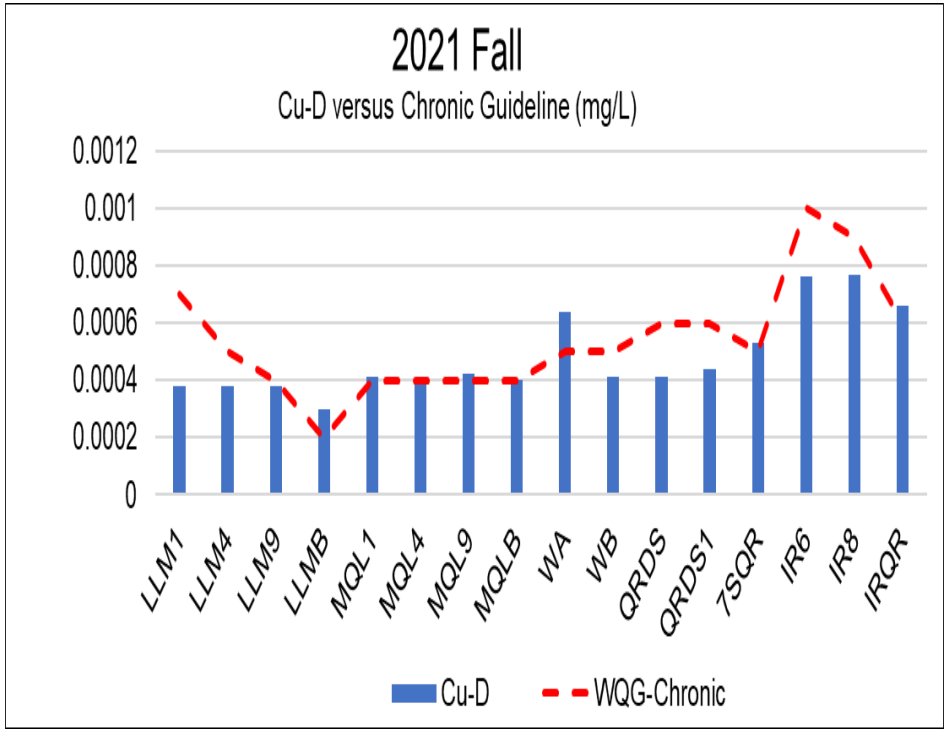
UPSTREAM OF MINE INFLUENCE to DOWNSTREAM MINE INFLUENCED MONITORING LOCATIONS

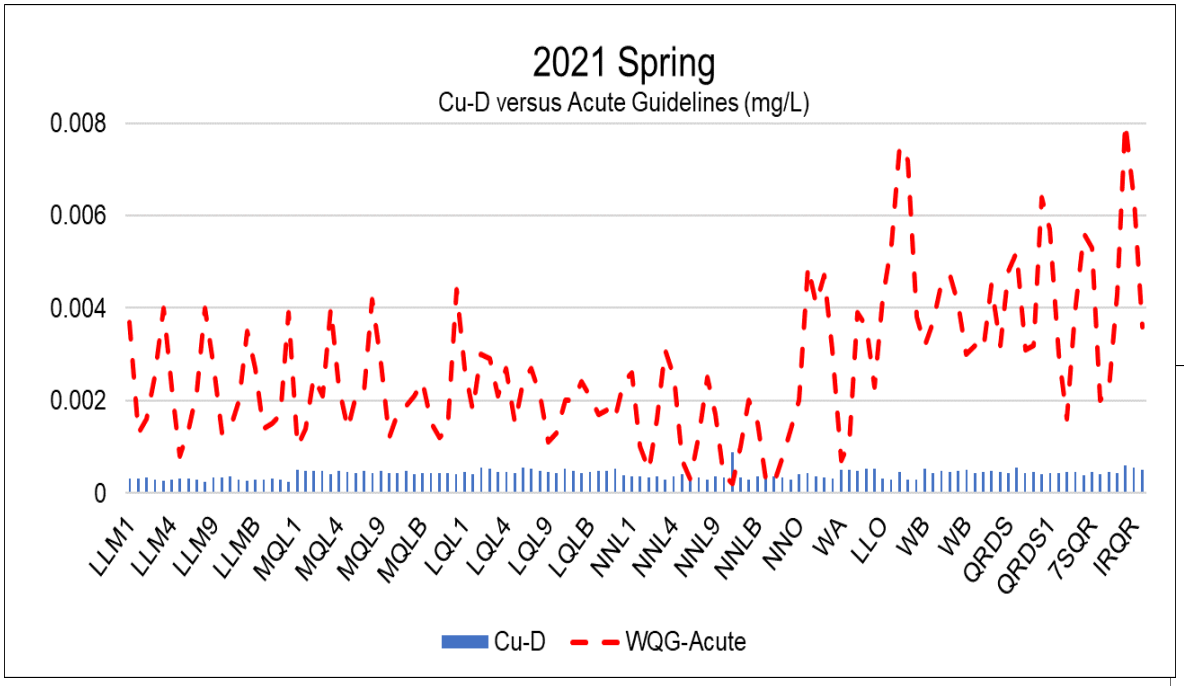


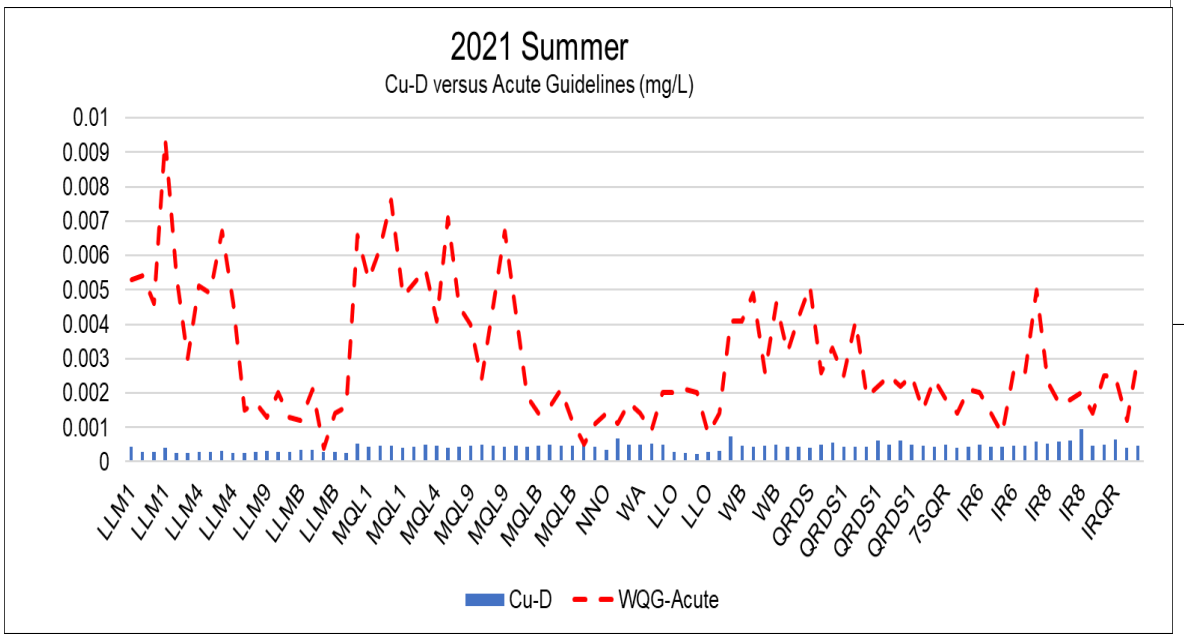


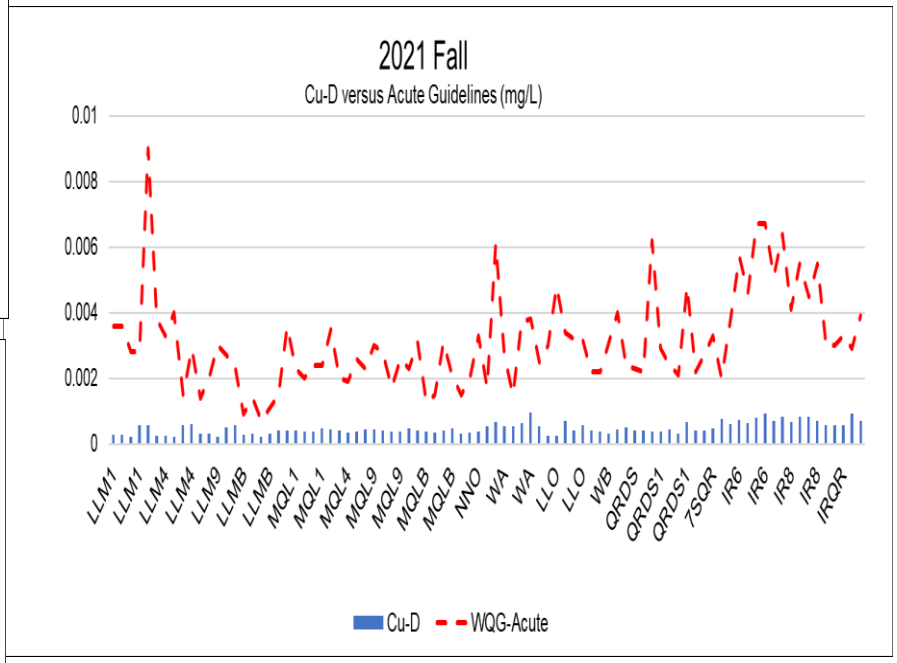

2021 Spring
Cu-D versus Chronic Guideline (mg/L)
0.001
0.0008
0.0006
0.0004
0.0002
0
NNL1
NNL4
NNL9
NNLB
LLM1
LLM4
LLM9
LLMB
MQL1
MQL4
MQL9
MQLB
LQL1
LQL4
LQL9
LQLB
NNO
LLO
WA
WB
QRDS
QRDS1
7SQR
IRQR
Cu-D
WQG-Chronic

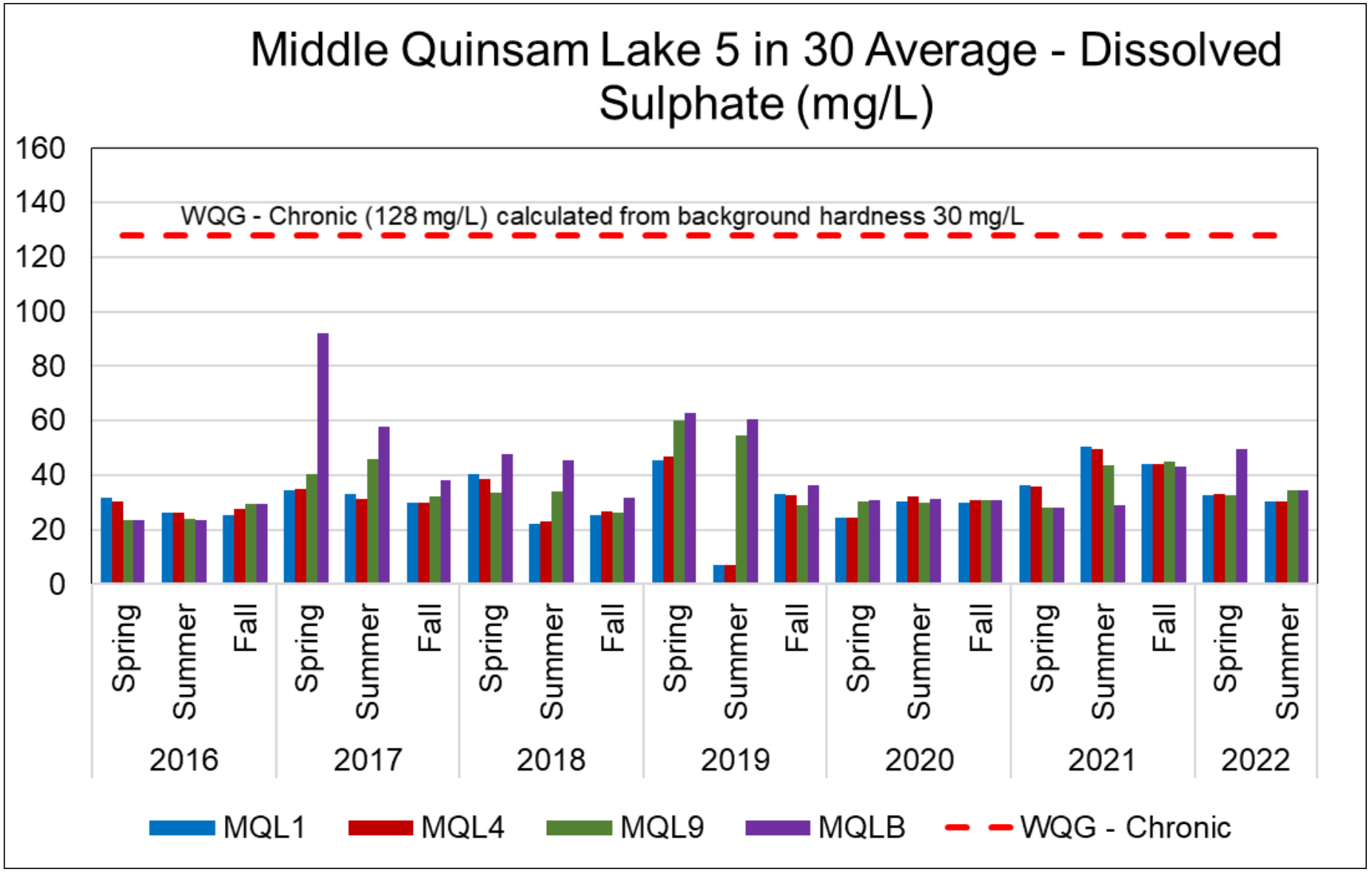

2021 Summer
Cu-D versus Chronic Guideline (mg/L)
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
LLM1
LLM4
LLM9
LLMB
MQL1
MQL4
MQL9
MQLB
NNO
LLO
WA
WB
QRDS
QRDS1
7SQR
IR6
IR8
IRQR
Cu-D
WQG-Chronic

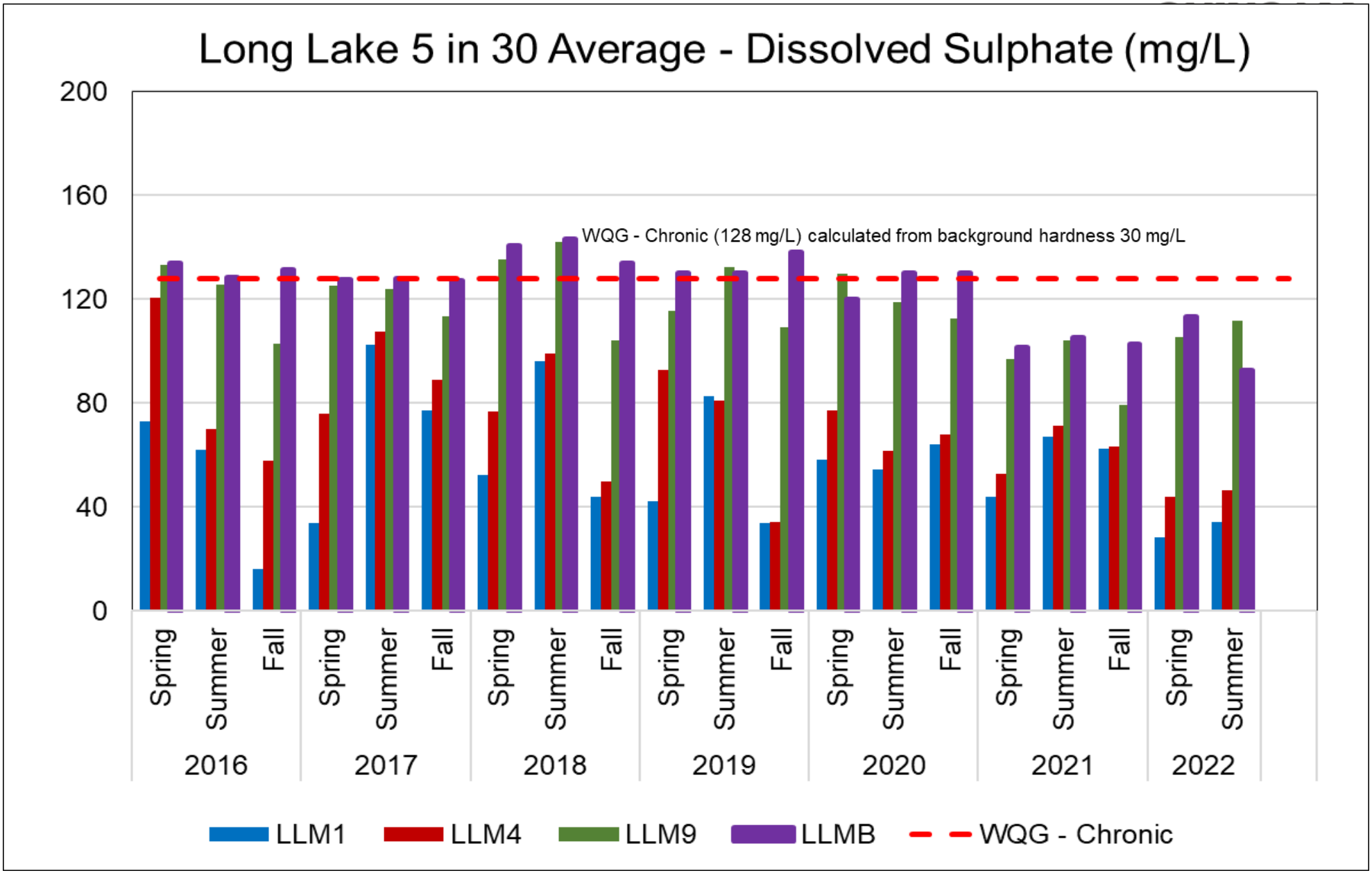

2021 Fall
Cu-D versus Chronic Guideline (mg/L)
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
LLM1
LLM4
LLM9
LLMB
MQL1
MQL4
MQL9
MQLB
WA
WB
QRDS
QRDS1
7SQR
IR6
IR8
IRQR
Cu-D
WQG-Chronic

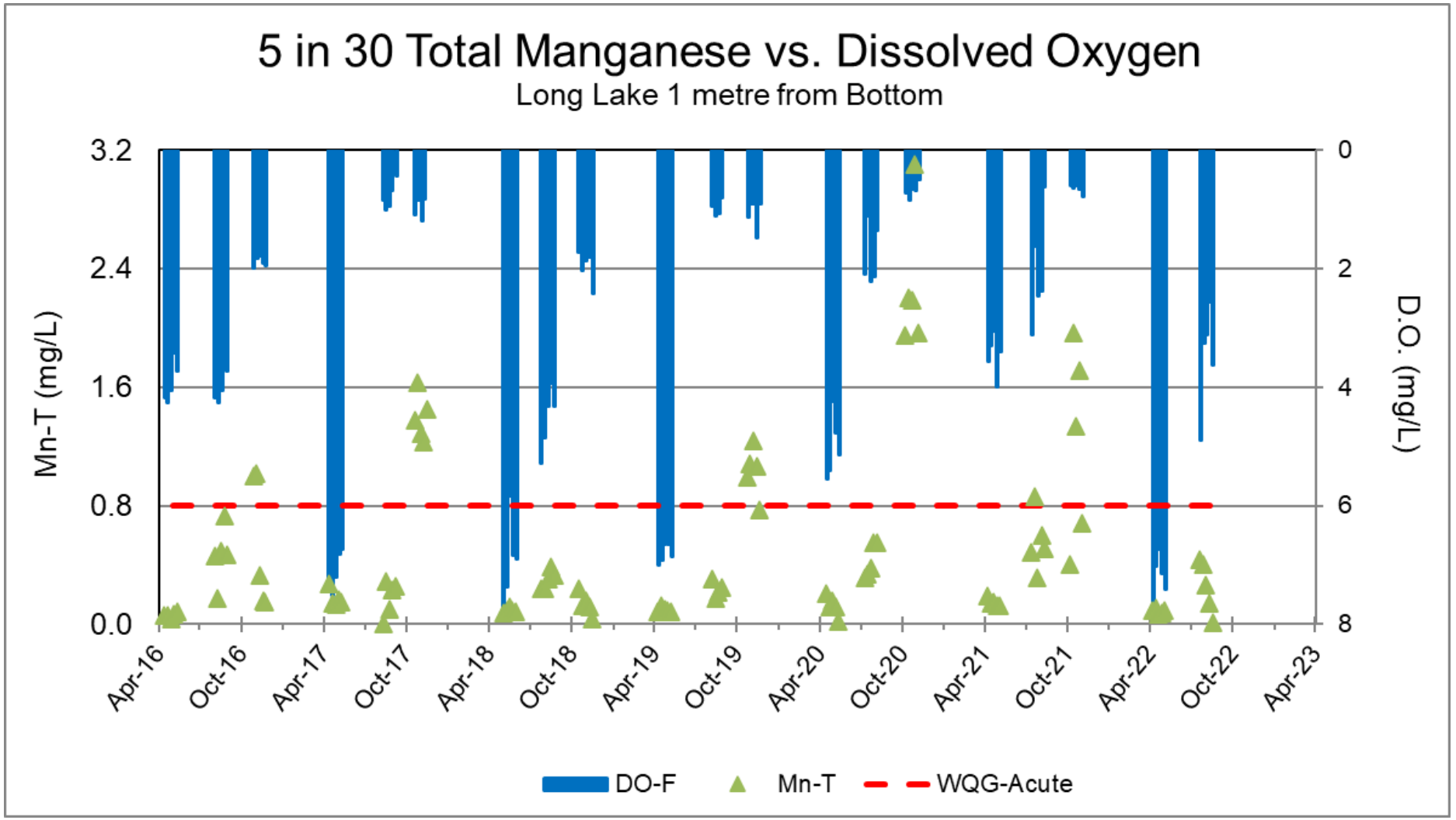

2021 Spring
Cu-D versus Acute Guidelines (mg/L)
0.008
0.006
0.004
0.002
0
LLM1 LLM4 LLM9 LLMB MQL1 MQL4 MQL9 MQLB LQL1 LQL4 LQL9 LQLB NNL1 NNL4 NNL9 NNLB NNO WA LLO WB WB QRDS QRDS1 7SQR IRQR
Cu-D
WQG-Acute


2021 Summer
Cu-D versus Acute Guidelines (mg/L)
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
LLM1 LLM1 LLM4 LLM4 LLM9 LLMB LLMB MQL1 MQL1 MQL4 MQL9 MQL9 MQLB MQLB NNO WA LLO LLO WB WB QRDS QRDS1 QRDS1 QRDS1 7SQR IR6 IR6 IR8 IR8 IRQR
Cu-D
WQG-Acute


2021 Fall
Cu-D versus Acute Guidelines (mg/L)
0.01
0.008
0.006
0.004
0.002
0
LLM1 LLM1 LLM4 LLM4 LLM9 LLMB LLMB MQL1 MQL1 MQL4 MQL9 MQL9 MQLB MQLB NNO WA WA LLO LLO WB QRDS QRDS1 QRDS1 7SQR IR6 IR6 IR8 IR8 IRQR
Cu-D
WQG-Acute

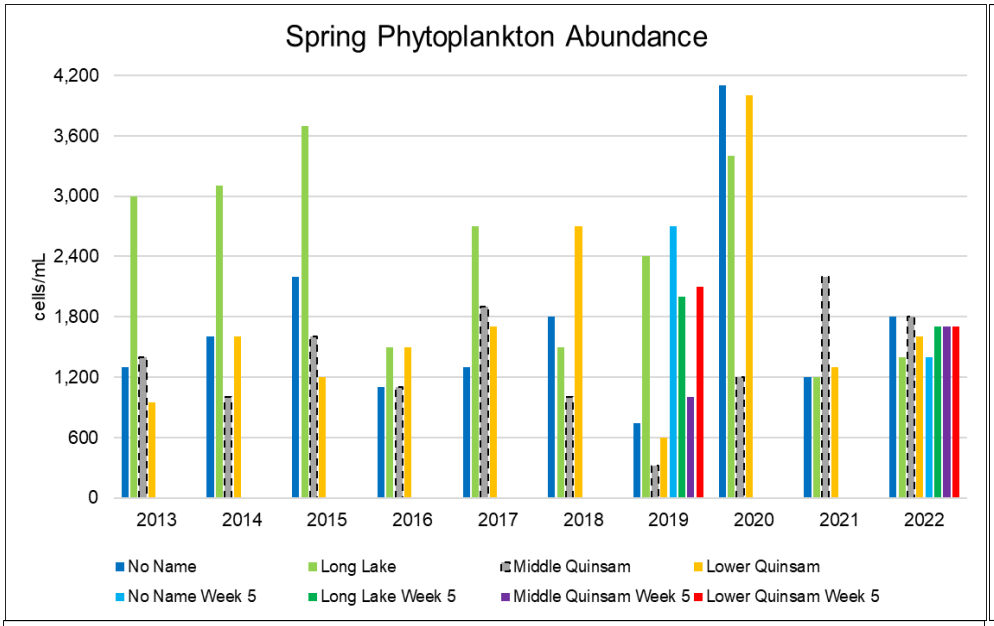

Middle Quinsam Lake 5 in 30 Average - Dissolved Sulphate (mg/L)
160
140
120
100
80
60
40
20
0
WQG - Chronic (128 mg/L) calculated from background hardness 30 mg/L
Spring
Summer
Fall
2016
2017
2018
2019
2020
2021
2022
MQL1
MQL4
MQL9
MQLB
WQG - Chronic

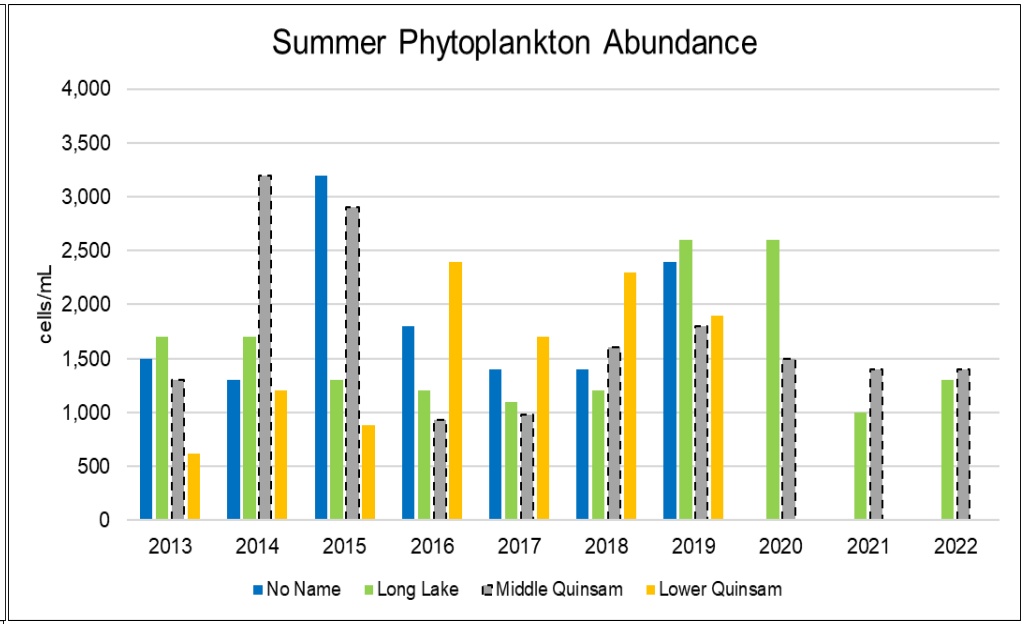

Long Lake 5 in 30 Average - Dissolved Sulphate (mg/L)
200
160
120
80
40
0
WQG - Chronic (128 mg/L) calculated from background hardness 30 mg/L
Spring
Summer
Fall
2016
2017
2018
2019
2020
2021
2022
LLM1
LLM4
LLM9
LLMB
WQG - Chronic

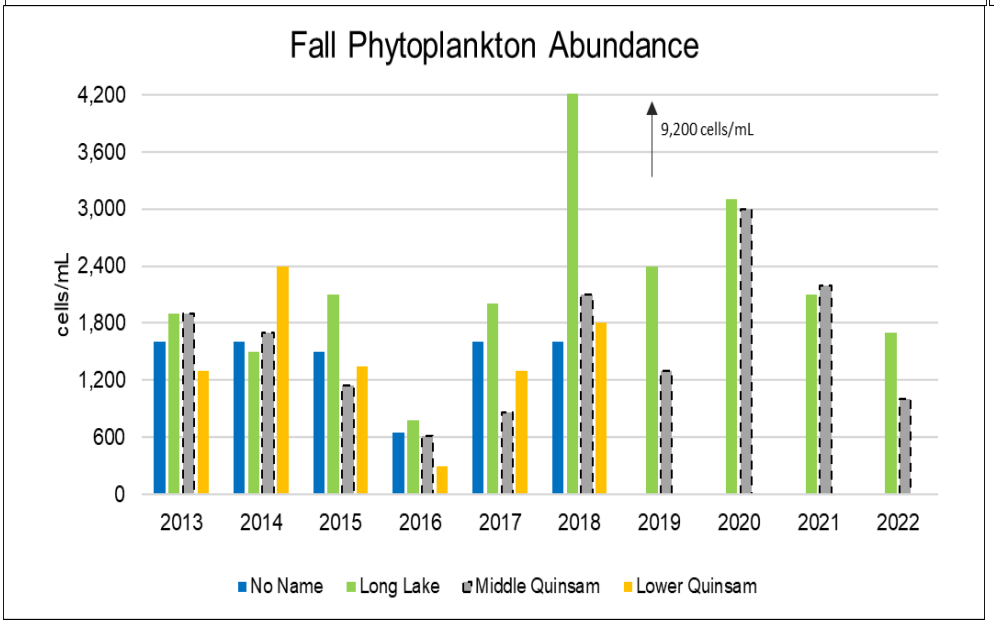

5 in 30 Total Manganese vs. Dissolved Oxygen
Long Lake 1 metre from Bottom
Mn-T (mg/L)
3.2
2.4
1.6
0.8
0.0
D.O. (mg/L)
0
2
4
6
8
Apr-16
Oct-16
Apr-17
Oct-17
Apr-18
Oct-18
Apr-19
Oct-19
Apr-20
Oct-20
Apr-21
Oct-21
Apr-22
Oct-22
Apr-23
DO-F
Mn-T
WQG-Acute

Biota Monitoring in Lakes - An understanding of the phytoplankton population and its distribution enables conclusions to be drawn about a water body's health, composition, and ecological status.

QUINSAM COAL

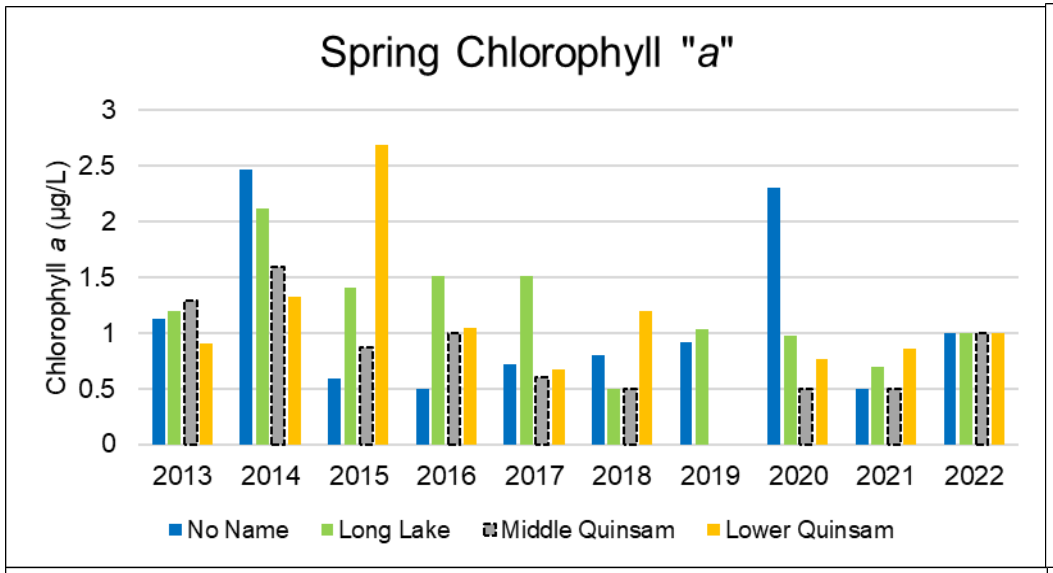


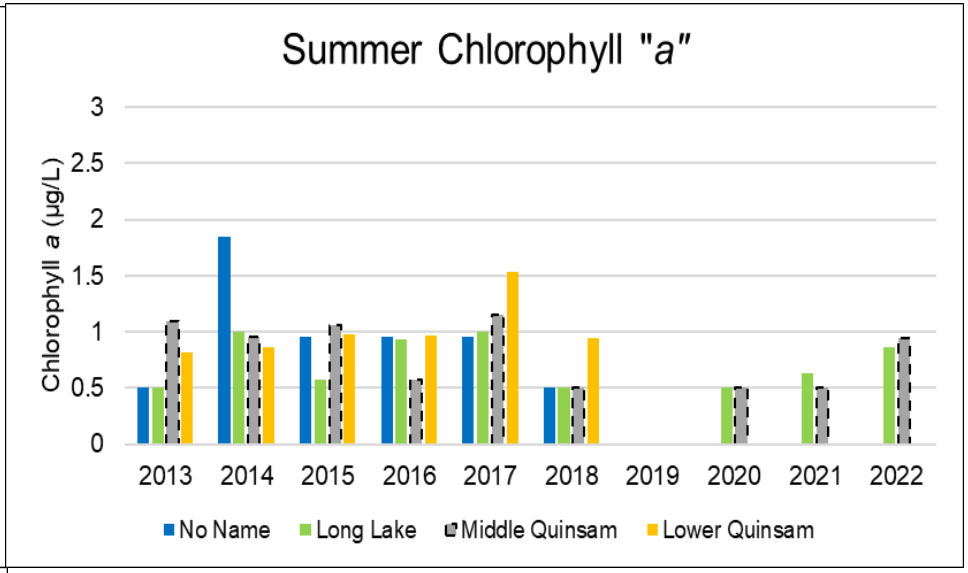


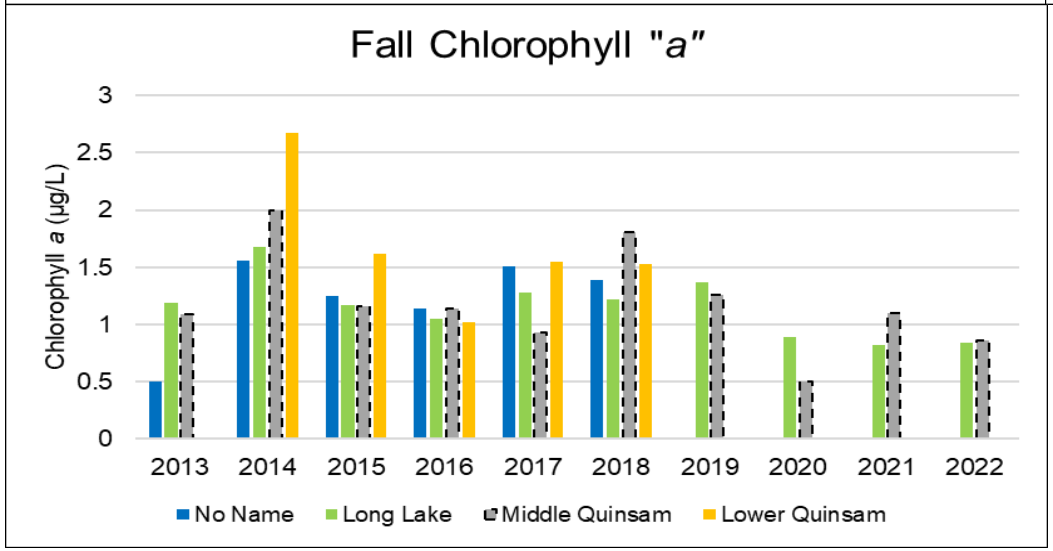


Phytoplankton includes algae and cyanobacteria, both of which contain at least one form of chlorophyll (chlorophyll a), the major photosynthetic pigment. Sensitive to changes in water quality (Wetzel 2001). Many lakes have a spring and fall phytoplankton bloom (peak growth period) following the seasonal "overturns" or mixing of the water column, redistributing nutrients.

Historical Chlorophyll “a” concentrations reported for these lakes reflected oligotrophic conditions (mean of 1.7 µg/L, maximum of 4.5 µg/L).







Chlorophyll ”*a*” - absorbs sunlight and converts it to sugar during photosynthesis. In lakes and rivers, it is produced by microscopic plants called algae.

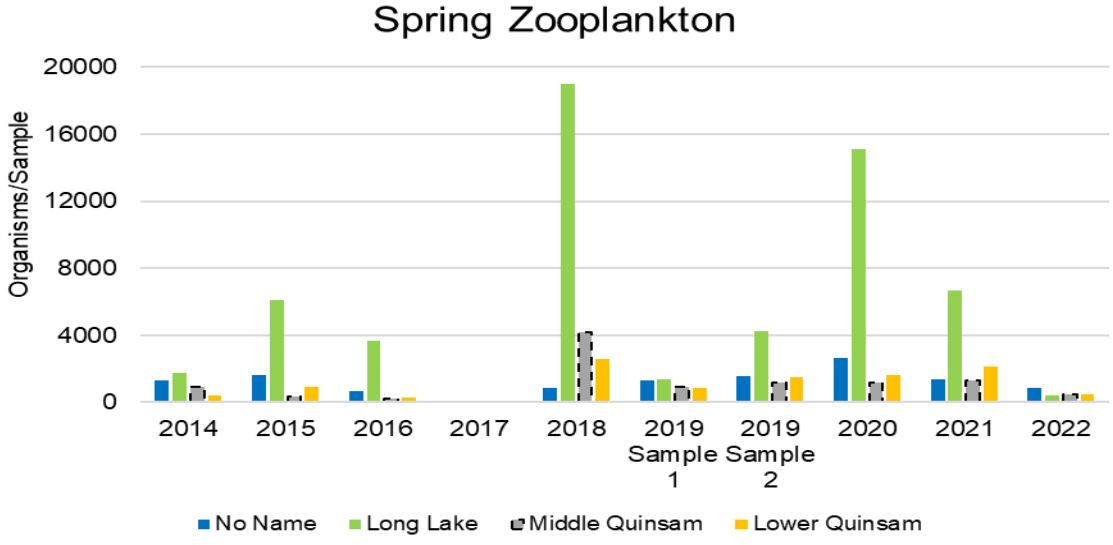
Concentrations are an indicator of phytoplankton abundance and biomass in coastal and estuarine waters.

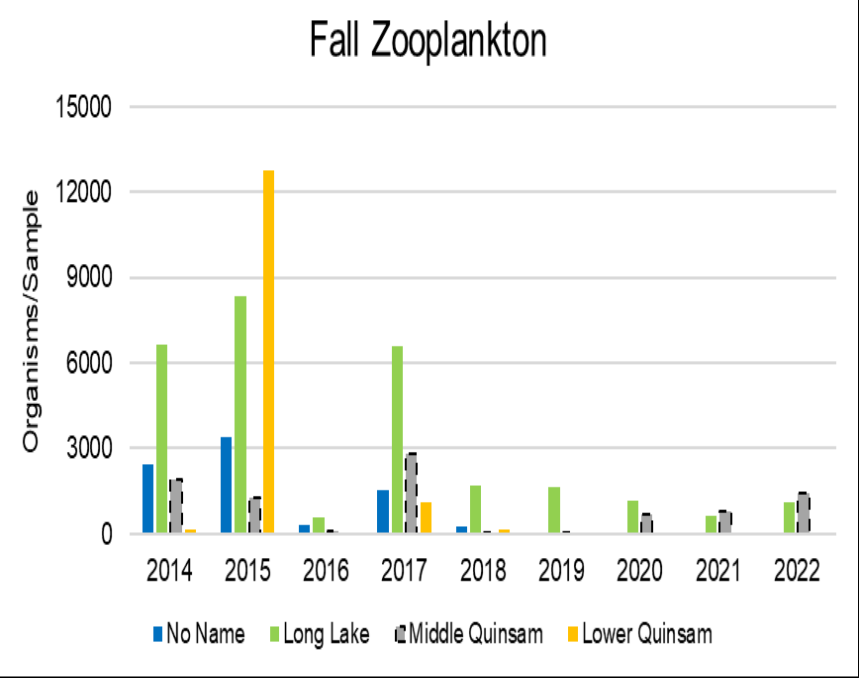
High levels often indicate poor water quality and low levels often suggest good conditions.

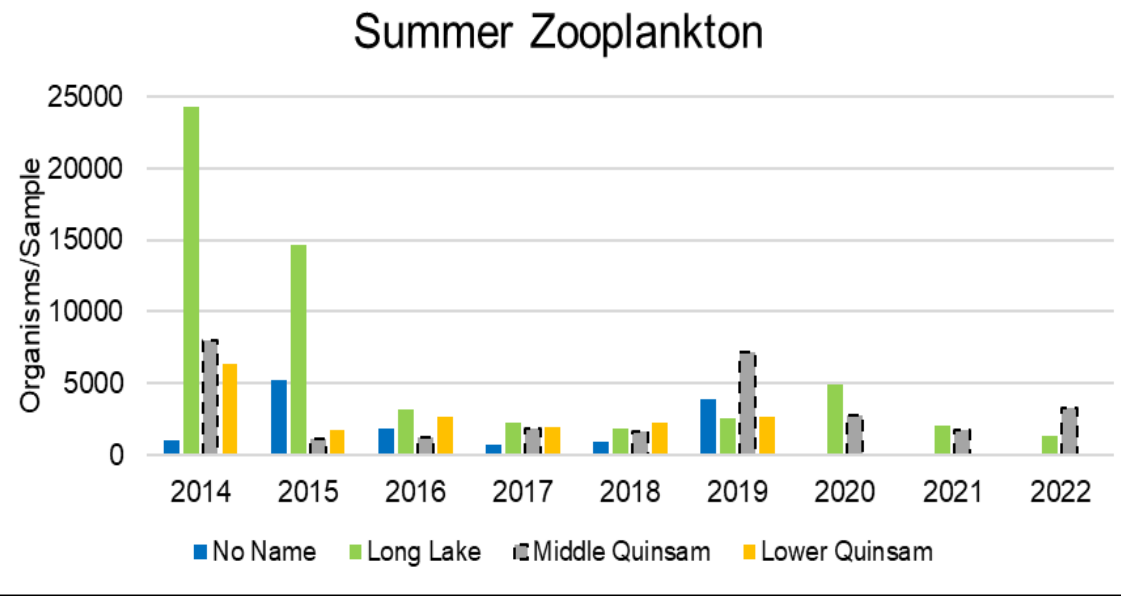
These lakes have low level of Chlorophyll ‘a” indicating good water quality.

Zooplankton Abundance

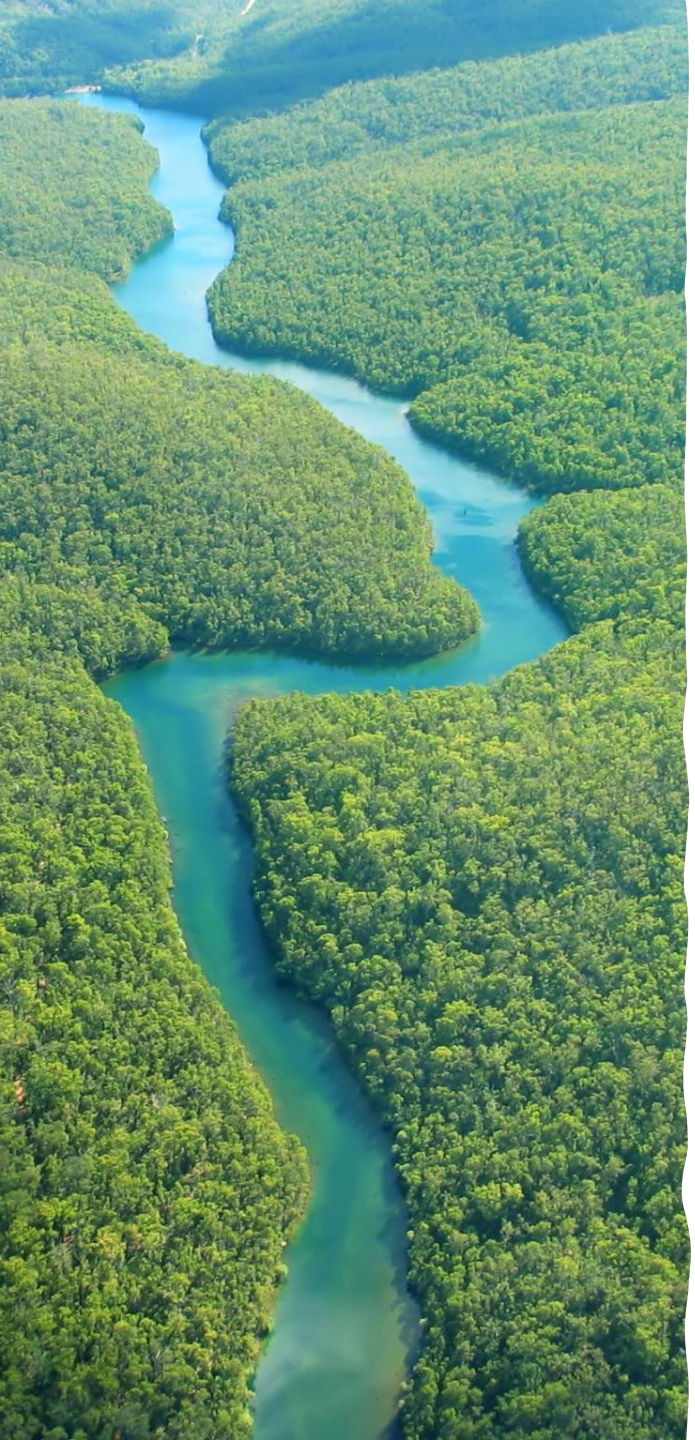
Abundance is the relative representation of a species in a particular ecosystem. It is usually measured as the number of individuals found per sample.







Zooplankton form the second trophic level in the water column of lakes (secondary producers), grazing on phytoplankton, consuming organic matter, and providing a food source for juvenile fish (Wetzel 2001). Abundance and composition of the zooplankton community vary among lakes due to variation in water chemistry, lake characteristics, and grazing pressures from fish (Wetzel 2001).



Conclusion

No Name, Long, Middle Quinsam, and Lower Quinsam lakes support phytoplankton communities typical of oligotrophic conditions and distinct zooplankton communities in each lake that provide typical prey for fish.

There were no indications of adverse effects of mine discharges on the plankton communities (density, taxonomic richness and composition) in the spring, summer and fall samples for lakes.

Sediment and Benthic Invertebrate Monitoring Program -

Canadian Aquatic Biomonitoring Network (CABIN)

- Sediment and benthic invertebrate monitoring were conducted in 2020 (Iron River) and 2021 (Quinsam River) to meet conditions (4.2.4 and 4.2.7) of amended Permit PE-7008 (dated June 23, 2015).

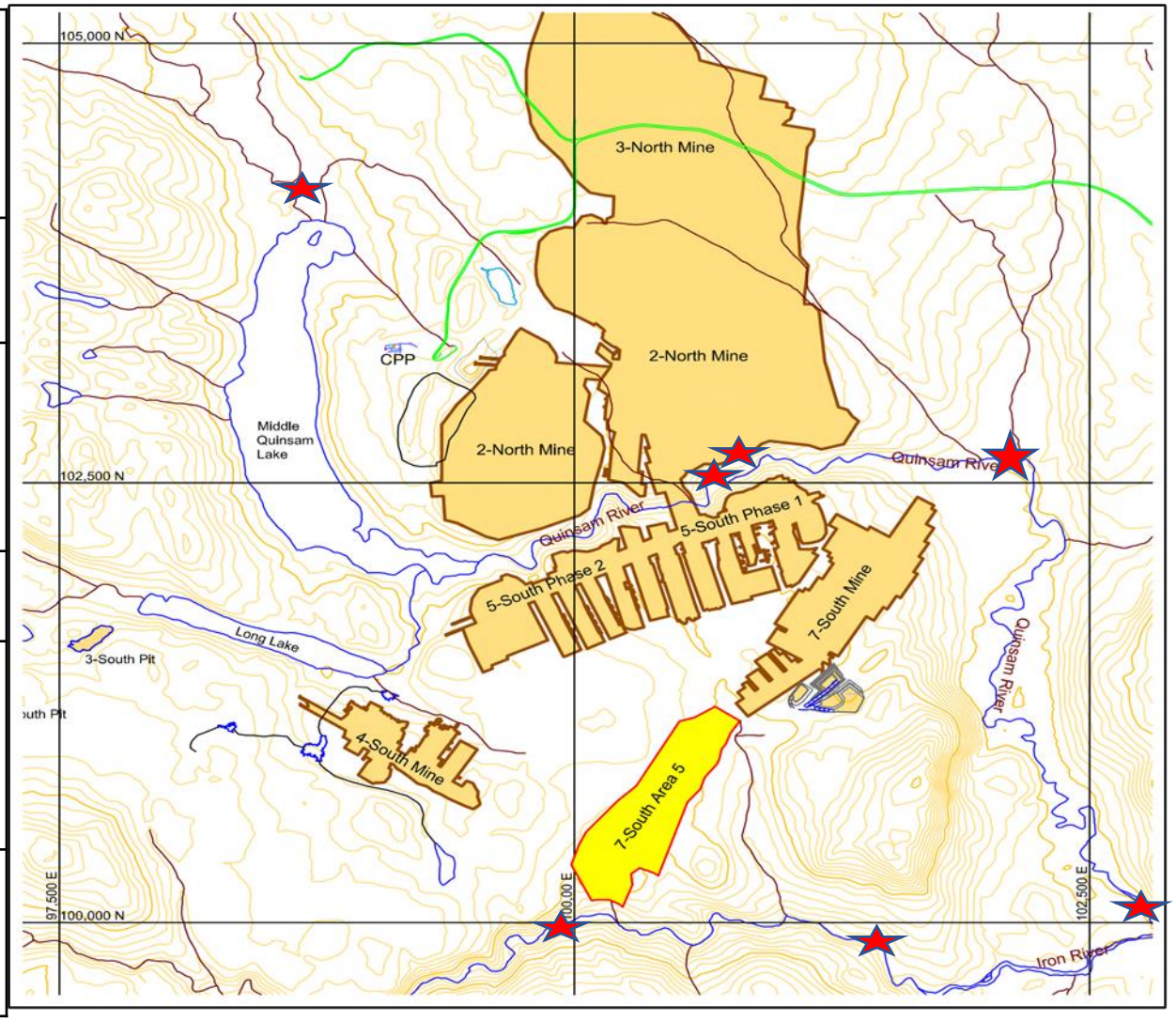
- In 2021 only a partial biological monitoring program was performed including a habitat assessment, collection of benthic invertebrate organisms, water, and sediment chemistry on the Quinsam River.

- The 2021 Quinsam River monitoring program was designed to supplement existing sediment and benthic invertebrate monitoring performed in 2016 including continuous water quality monitoring.

- Results evaluate historical sediment and chemistry with benthic biota in the Quinsam River that receive mine impacted discharges and reference sites with similar characteristics.

2020 and 2021 Sediment and Benthic Monitoring Sites

Water-body Type	Station Name	Site
Iron River	Iron River Upstream of 7SA5 (IRN-06)	IR6 (EMS # E297231)
	Iron River downstream of 7SA5 and 242 inputs (IRN-08)	IR8 (EMS # E297232)
Quinsam River	Argonaut Road (WA) Upstream of Mine Influence	WA (EMS # 0126402)
	Upstream of 7 South Mining Operation (QRD-02) and (QRD-03)	QRDS2 and QRDS3
	Downstream of 7 South Mining Operation (7SQR)	7SQR (EMS # E292113)



Sediment Analyses and Guidelines

Samples were analyzed for: total moisture, particle size, total organic carbon, paste pH, total sulphur, total metals (<63 µm), and polycyclic aromatic hydrocarbons (PAH).

Results compared to Canadian Council of Ministers of Environment (CCME) sediment quality guidelines: the interim sediment quality guidelines (ISQG) and probable effects levels (PEL) (CCME 2017).

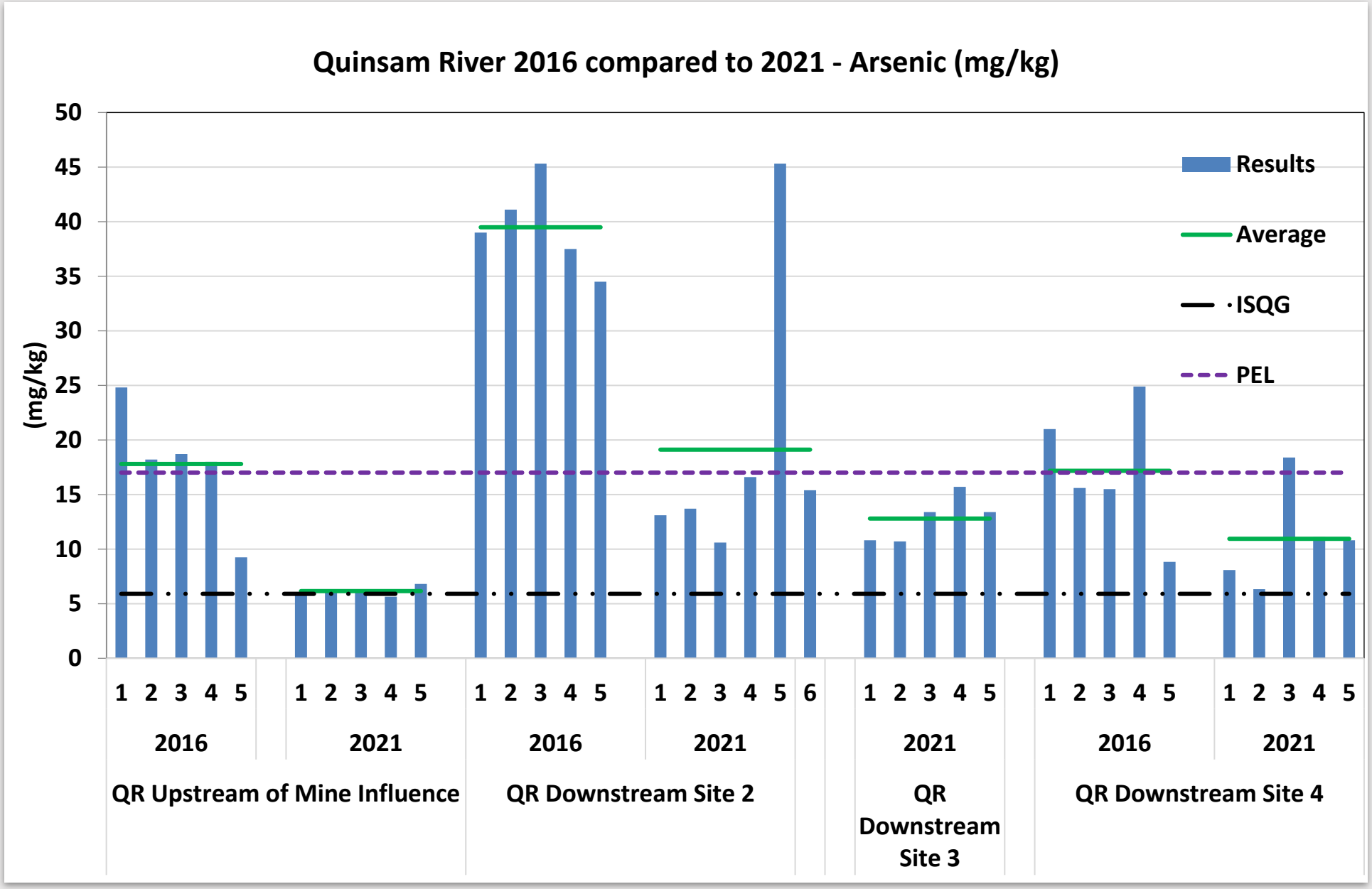
"The ISQG reflects the concentration below which adverse biological effects are expected to occur rarely. The PEL defines the level above which adverse effects are expected to occur frequently" (CCME 2001).

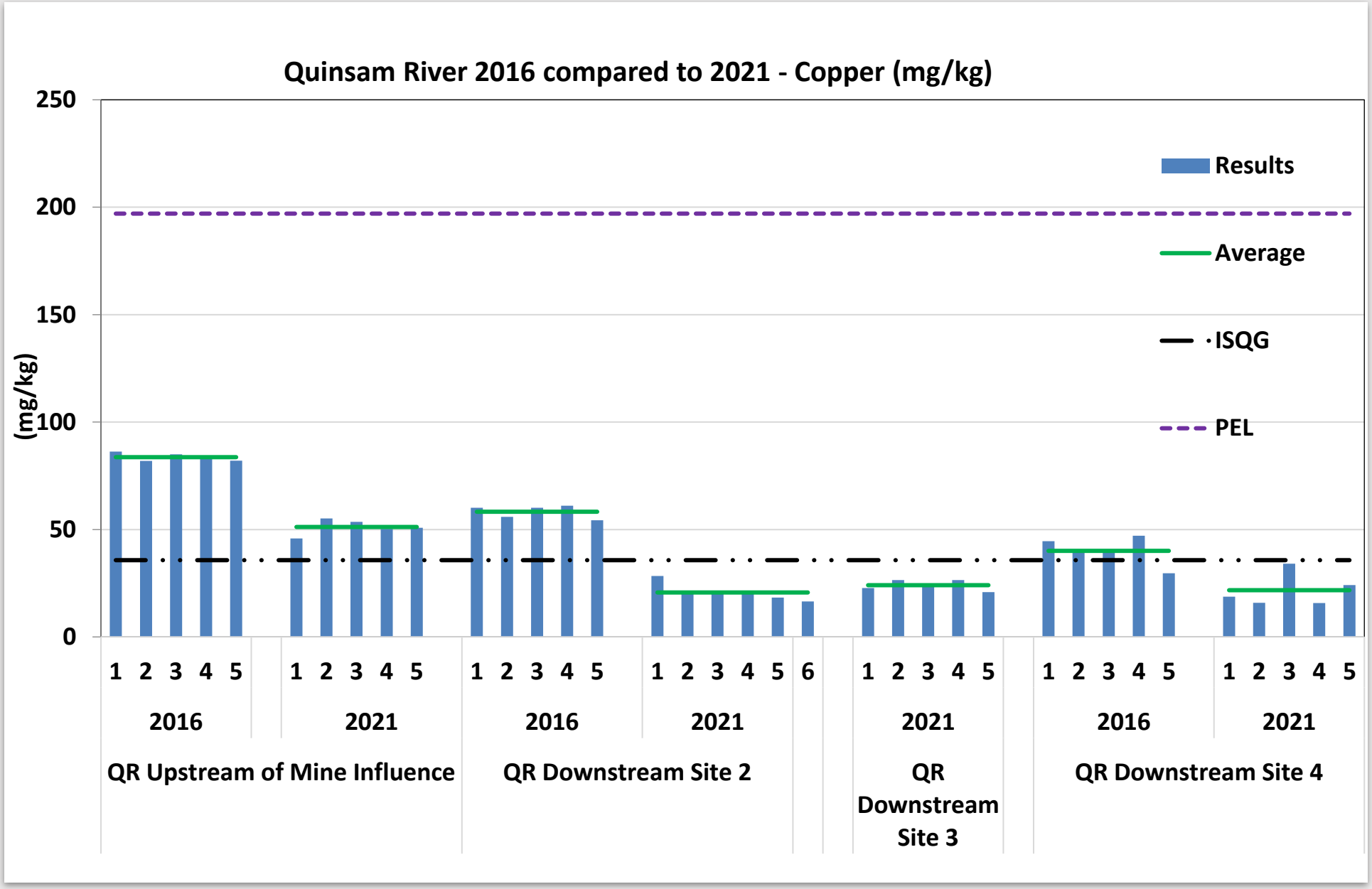
Sediment Results

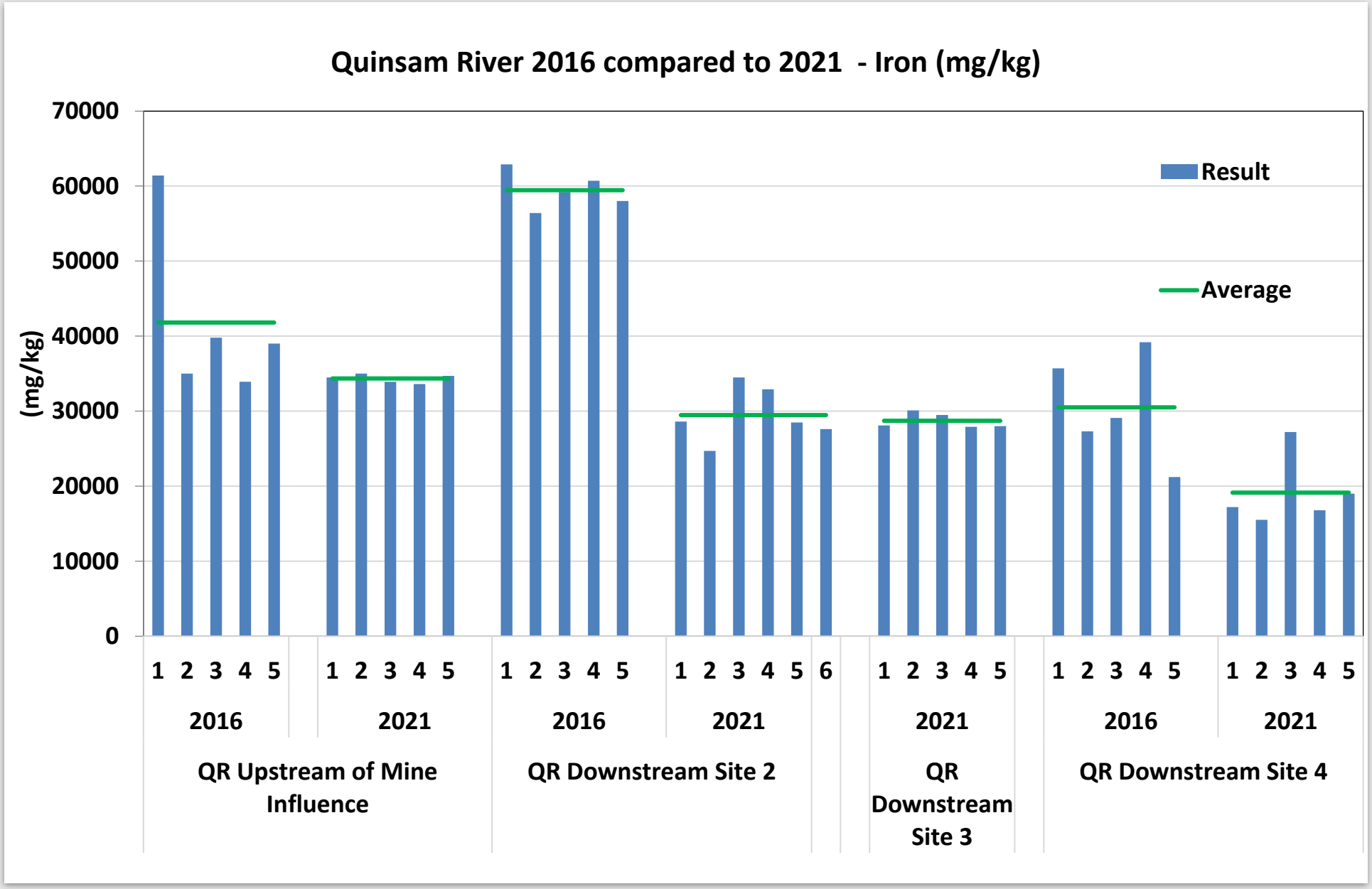
- **Iron River Stations :** Low PAH levels (with some parameters exceeding the ISQG), arsenic concentrations higher than the PEL (reflecting the sedimentary stratum with elevated arsenic), and cadmium, chromium, copper, and zinc concentrations higher than the ISQG in some samples.

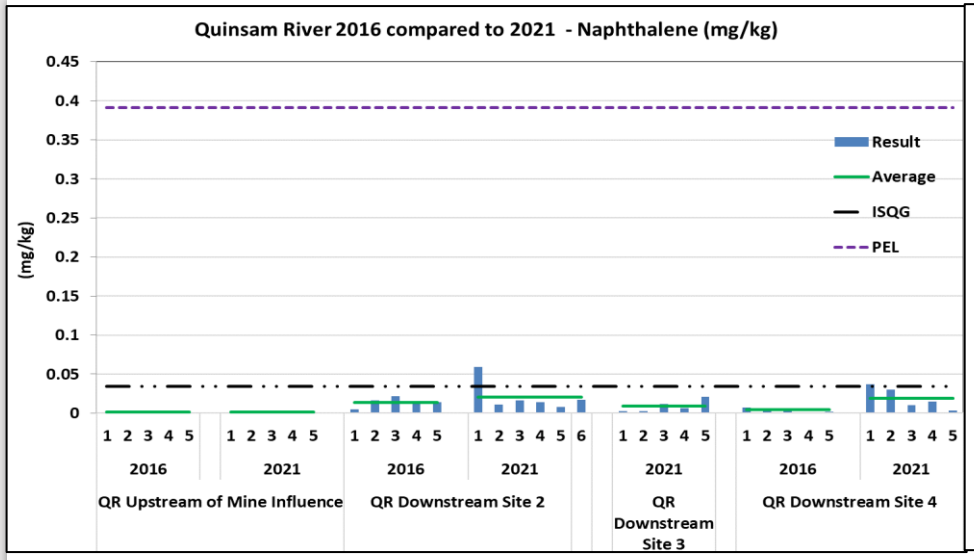
- **Quinsam River Stations :** Low PAH levels (with some parameters higher than the ISQG at QRD-02 and QRD-03), arsenic concentrations higher than the ISQG, and isolated occurrences of copper and cadmium higher than ISQG.

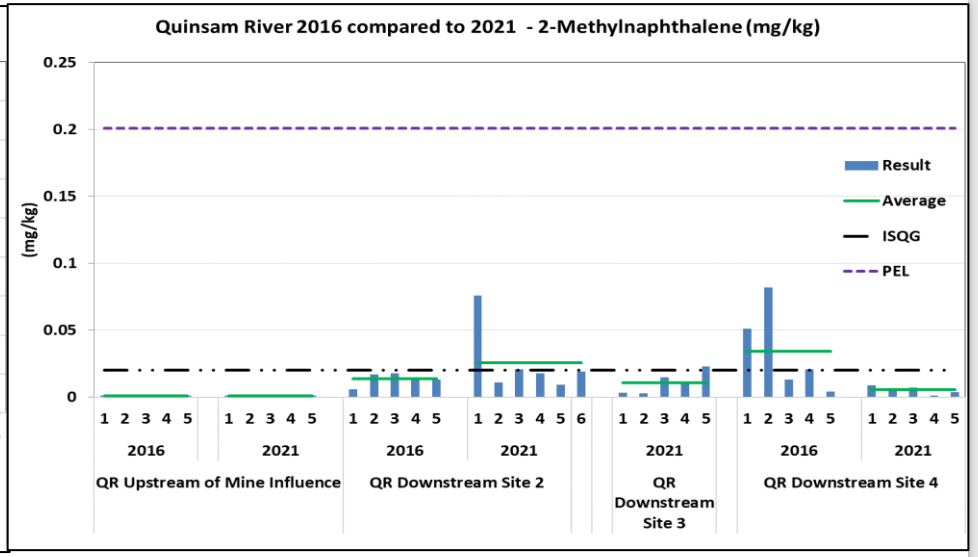
- **Arsenic concentrations** were highest at QRD-02, with some values higher than the PEL.
- **Seep** sample S2 had notably elevated arsenic concentrations (more than 400 times the PEL), along with elevated iron and manganese concentrations compared to the river stations.

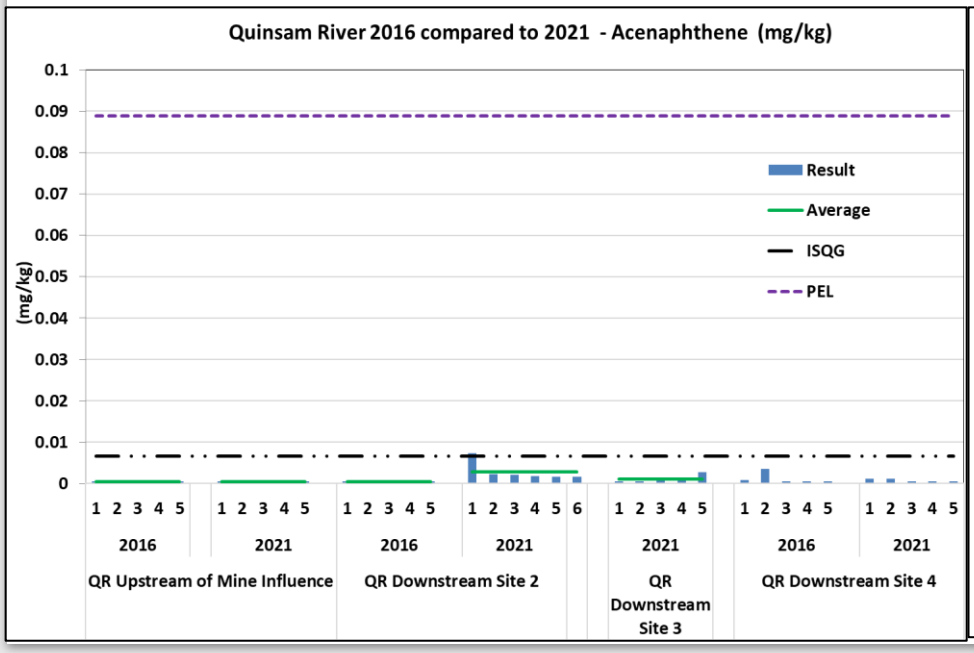

Quinsam River 2016 compared to 2021 - Arsenic (mg/kg)
(mg/kg)
50
45
40
35
30
25
20
15
10
5
0
Results
Average
ISQG
PEL
1 2 3 4 5
2016
1 2 3 4 5
2021
QR Upstream of Mine Influence
1 2 3 4 5
2016
1 2 3 4 5 6
2021
QR Downstream Site 2
1 2 3 4 5
2021
QR Downstream Site 3
1 2 3 4 5
2016
1 2 3 4 5
2021
QR Downstream Site 4

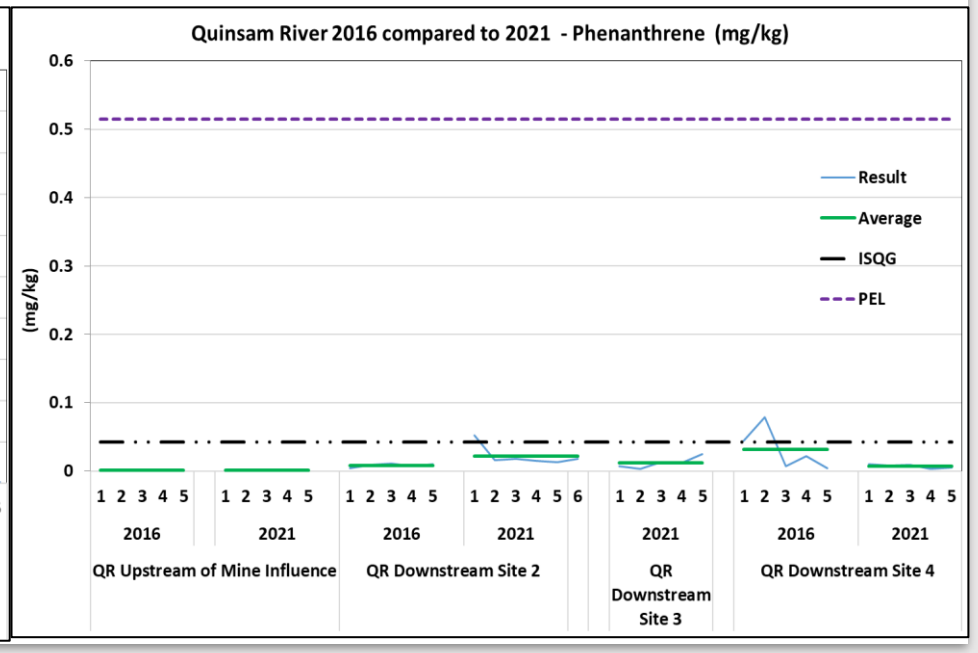

Quinsam River 2016 compared to 2021 - Copper (mg/kg)
250
200
150
100
50
0
(mg/kg)
Results
Average
ISQG
PEL
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5 6
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
2016
2021
2016
2021
2021
2016
2021
QR Upstream of Mine Influence
QR Downstream Site 2
QR Downstream Site 3
QR Downstream Site 4


Quinsam River 2016 compared to 2021 - Iron (mg/kg)
70000
60000
50000
40000
30000
20000
10000
0
(mg/kg)
Result
Average
1 2 3 4 5
2016
1 2 3 4 5
2021
QR Upstream of Mine Influence
1 2 3 4 5
2016
1 2 3 4 5 6
2021
QR Downstream Site 2
1 2 3 4 5
2021
QR Downstream Site 3
1 2 3 4 5
2016
1 2 3 4 5
2021
QR Downstream Site 4


Quinsam River 2016 compared to 2021 - Naphthalene (mg/kg)
(mg/kg)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Result
Average
ISQG
PEL
1 2 3 4 5
2016
2021
QR Upstream of Mine Influence
QR Downstream Site 2
QR Downstream Site 3
QR Downstream Site 4


Quinsam River 2016 compared to 2021 - 2-Methylnaphthalene (mg/kg)
(mg/kg)
0.25
0.2
0.15
0.1
0.05
0
Result
Average
ISQG
PEL
1 2 3 4 5 6
2016
2021
QR Upstream of Mine Influence
QR Downstream Site 2
QR Downstream Site 3
QR Downstream Site 4


Quinsam River 2016 compared to 2021 - Acenaphthene (mg/kg)
(mg/kg)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Result
Average
ISQG
PEL
1 2 3 4 5 6
2016
2021
QR Upstream of Mine Influence
QR Downstream Site 2
QR Downstream Site 3
QR Downstream Site 4


Quinsam River 2016 compared to 2021 - Phenanthrene (mg/kg)
(mg/kg)
0.6
0.5
0.4
0.3
0.2
0.1
0
Result
Average
ISQG
PEL
1 2 3 4 5 6
2016
2021
QR Upstream of Mine Influence
QR Downstream Site 2
QR Downstream Site 3
QR Downstream Site 4

Sediment and Water Quality for Potential Seepage Area

Parameter	Matrix	Criteria [1]	Criteria [2]	Result	Units
Fluoranthene	Sediment	0.111	2.355	0.011	mg/kg
Total Antimony (Sb)	Sediment			1.19	mg/kg
Total Arsenic (As)	Sediment	5.9	17	8290	mg/kg
Total Barium (Ba)	Sediment			1160	mg/kg
Total Calcium (Ca)	Sediment			13600	mg/kg
Total Cobalt (Co)	Sediment			25.2	mg/kg
Total Iron (Fe)	Sediment			275000	mg/kg
Total Manganese (Mn)	Sediment			15000	mg/kg
Total Phosphorus (P)	Sediment			625	mg/kg
Total Sodium (Na)	Sediment			908	mg/kg
Total Strontium (Sr)	Sediment			315	mg/kg
Total Thallium (Tl)	Sediment			0.096	mg/kg
Total Uranium (U)	Sediment			0.54	mg/kg
% silt by hydrometer	Sediment			25	%
Clay Content	Sediment			6.4	%
Moisture	Sediment			92	%
Benzo(b)fluoranthene	Sediment			<0.010	mg/kg
Total Boron (B)	Sediment			59.3	mg/kg
Total Organic Carbon (C)	Sediment			6.1	%

Sediment result showed elevated concentrations of arsenic compared to ISQG and PEL (400 times).
Elevated iron, neutral pH conditions resulting in elevated arsenic observed in the sediment through the mechanisms of adsorption and co-precipitation.

Description	Potential Seepage on QR near QU11-05		
Location Name	S2	WQG -Acute	September 13, 2021
pH	pH Units	6.00 to 9.00	6.90
Cond	uS/cm		387
SO4-D	mg/L		160
As-T	mg/L	0.005	**0.0908**
Fe-T	mg/L	1.00	**1.85**
Mn-T	mg/L	0.8706	0.498
As-D	mg/L		0.0375
Fe-D	mg/L	0.35	0.342
Mn-D	mg/L		0.387

Bold indicates result is above Acute-WQG

Benthic Invertebrate Community

Benthic invertebrates and stream habitat data collected following the procedures of the Canadian Aquatic Biomonitoring Network (CABIN), a biomonitoring program for assessing the health of freshwater ecosystems in Canada.

Benthic invertebrate communities provide an indicator of the health of that water body. Taxonomic data were analyzed using the Reference Condition Approach (RCA) and for community metrics using the CABIN data analysis tools. The data were analyzed using the Preliminary BC Coastal RCA Model (2010) (the Model).

Abundance of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies), known as the EPT group, referred to as pollution-sensitive organisms, associated with clean water (coarse substrates, well oxygenated, low organic enrichment).

The benthic invertebrate community data were evaluated using the Preliminary Coastal BC Reference Condition Approach (RCA) model (2010). RCA Site Assessments, 2016, 2020, and 2021

Site	Year	Reference Group	Vector 1 vs 2	Vector 1 vs 3	Vector 2 vs 3	Overall
IRN-06	2020	2	Similar to Reference	Similar to Reference	Similar to Reference	Similar to Reference
IRN-08	2020	2	Similar to Reference	Similar to Reference	Similar to Reference	Similar to Reference
WA	2016	3	Mildly Divergent	Similar to Reference	Mildly Divergent	Mildly Divergent
WA	2021	3	Divergent	Similar to Reference	Mildly Divergent	Divergent
QRD-02	2016	3	Similar to Reference	Mildly Divergent	Similar to Reference	Mildly Divergent
QRD-02	2021	3	Similar to Reference	Mildly Divergent	Divergent	Divergent
QRD-03	2021	3	Divergent	Similar to Reference	Mildly Divergent	Divergent
7SQR	2016	3	Similar to Reference	Mildly Divergent	Mildly Divergent	Mildly Divergent
7SQR	2021	3	Mildly Divergent	Similar to Reference	Mildly Divergent	Mildly Divergent

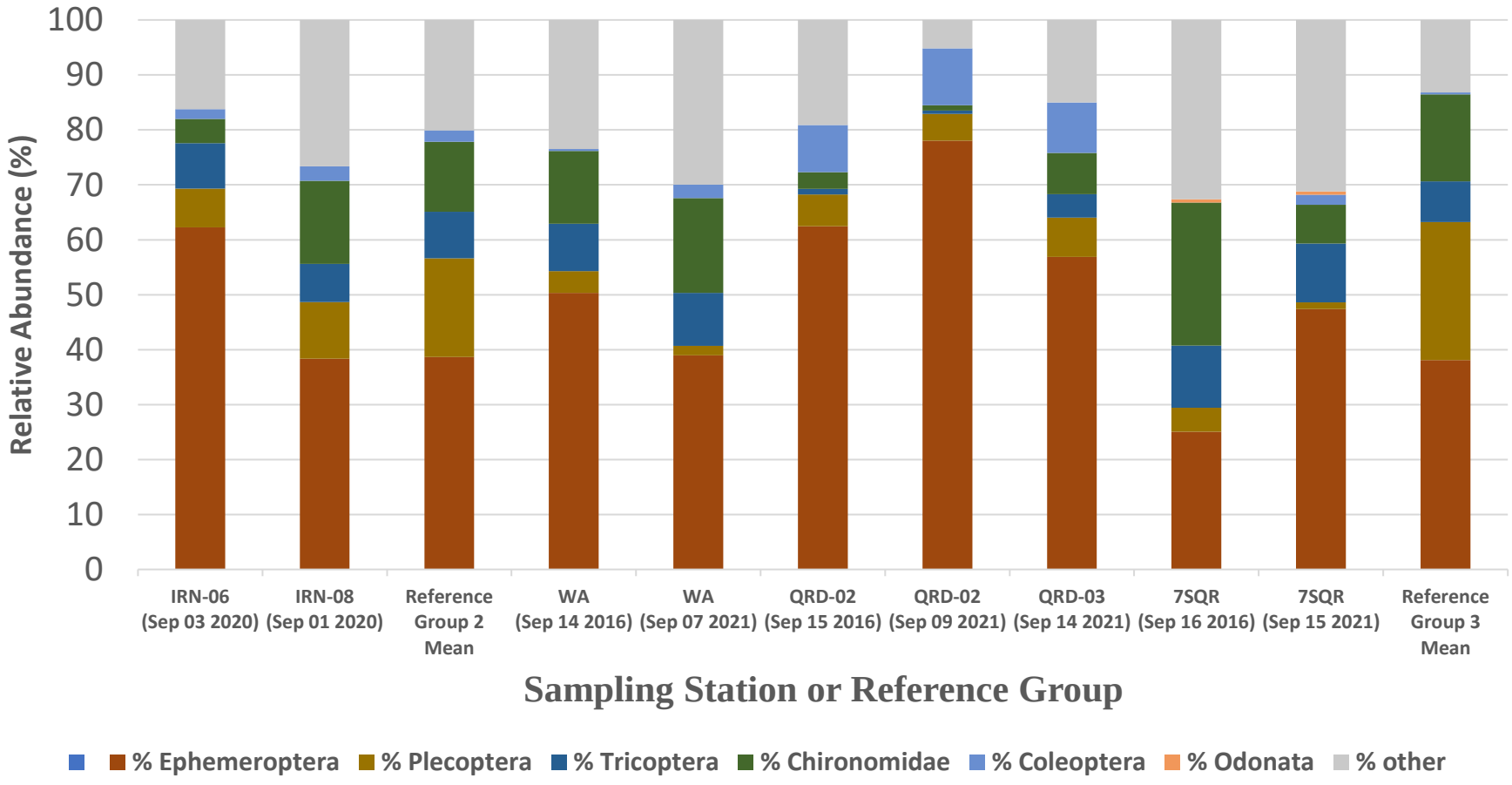
Benthic Invertebrate Community Family-Level Indices, Iron and Quinsam Rivers, 2020 and 2021

Index	IRN6 (2020)	IRN8 (2020)	Reference Group 2 Average (±Standard Deviation)	WA (2021)	QRD-02 (2021)	QRD-03 (2021)	7SQR (2021)	Reference Group 3 Average (±Standard Deviation)
Total Abundance	1,372	3,864	1369±852	2,100	1,844	3,913	2,260	1110±880
Family Richness	21	26	20±3	21	17	19	24	18±3
EPT Richness	12	14	11±2	7	10	8	9	11±2
Simpson's Diversity	0.9	0.9	0.8±0.1	0.8	0.5	0.8	0.8	0.8±0.1
Pielou's Evenness	0.8	0.8	0.7±0.1	0.8	0.4	0.7	0.7	0.7±0.1

Notes:

EPT: Ephemeroptera, plecoptera, trichoptera

Community Composition at the Iron River and Quinsam River Stations



Iron River, the RCA model results and individual metrics (family richness, EPT richness, EPT predominance) indicate the river supports a variety of insect taxa that indicate good habitat conditions. The benthic invertebrate communities were similar to the RCA model Group 2. Reference condition (invertebrate communities at undisturbed sites).

Quinsam River, the RCA model results at the four stations indicate the invertebrate communities differ from the Reference Condition for the assigned Reference Group 3. However, the communities are abundant, diverse, and dominated by EPT taxa. The difference from the assigned Reference Group may be associated with factors other than the mine. Potential influence of Quinsam Mine is detected in the invertebrate community metrics at QRD-02, but by station 7SQR, the community improves to conditions better than at station WA.

Comparison to Historical Data

In 2016, Quinsam River stations WA, QRD-02, and 7SQR were sampled following CABIN protocols. The sites were assessed using the Preliminary Coastal BC RCA model (2010) and were predicted to Reference Group 3. In 2016, the three sites were assessed as being mildly divergent from the Reference Condition (Slide 48). Using this assessment, WA and QRD-02 were further from the Reference Condition in 2021 than in 2016 and 7SQR was similar.

In general, the Quinsam River invertebrate communities were dominated in both 2016 and 2021 by EPT organisms; the percent Ephemeroptera remained the same or increased between 2016 and 2021, and percent Plecoptera, Trichoptera, and Chironomidae remained similar. The exception was a decrease in Chironomidae at 7SQR from 26% in 2016 to 7% in 2021.