

Table 5.6-F1: Predicted Pit Lake Water Quality under the Base Case Scenario compared to BCWQ Guidelines for the Protection of Aquatic Life, McNab Aggregate Project, BC

Table with 23 columns: Parameter, Units, BC Water Quality Guidelines (Maximum, notes, 30-Day Average, notes), Groundwater - All sampling locations (95th Percentile), and Years 1-16, plus Closure. Rows are categorized into Conventional, Major Ions, Nutrients, and Dissolved Metals.

- Notes:
A = approved guideline, W = working guideline
a) BC Water Quality (BCWQ) guidelines for the protection of freshwater aquatic life
b) calculated value: calculated TDS based on standard methods (APHA, 2005)
c) assumed alkalinity based on mean of shake flask extraction test, used for calculation of TDS
d) calculated hardness based on concentrations of calcium and magnesium
e) hardness dependent F guideline: BC Max WQG (mg/L) = (-51.73 + 92.57 * log(hardness))^0.01; equation was only applied when the hardness was >= 10, otherwise 0.4 was used.
f) hardness dependent sulphate guideline: BC 30-d WQG (mg/L) = 128 at hardness <30 mg/L, at hardness 31-75 mg/L = 218, at hardness 76-180 mg/L = 309, at hardness 181-250 mg/L = 429, at hardness >250 mg/L determine base on site water
g) pH and temperature dependent ammonia guideline: values selected from Tables 3 and 4 in BC WQG based on maximum baseline temperature of 18°C and pH 8.0
h) chloride dependent nitrite guideline: BC Max WQG (mg/L) = 0.06 at Cl <2 mg/L, at Cl 2-4 mg/L = 0.12, at Cl 4-6 mg/L = 0.18, at Cl 6-8 mg/L = 0.24, at Cl 8-10 = 0.30, at Cl >10 = 0.6
BC 30-d WQG (mg/L) = 0.02 mg/L at Cl <2 mg/L, at Cl 2-4 mg/L = 0.04, at Cl 4-6 mg/L = 0.06, at Cl 6-8 mg/L = 0.08, at Cl 8-10 mg/L = 0.1, at Cl >10 = 0.2
i) pH dependent dissolved Al guideline: BC Max WQG (mg/L) = 0.1 at pH >=6.5, at pH <6.5 = EXP(1.209-2.426*(pH)+0.286*(pH^2)); BC 30-d WQG (mg/L) = 0.05 at pH >=6.5, at pH <6.5 = EXP(1.6-3.327*(median pH)+0.402*(median pH^2)); minimum baseline surface water pH = 5.57
j) hardness dependent dissolved Cd guideline: BC WQG Long-term average (ug/L) = 2.718^(1.03*ln(hardness)-5.274); BC WQG short-term max (ug/L) = 2.718
k) guideline is for Cr(VI)
l) hardness dependent Cu guideline: BC Max WQG (mg/L) = (0.094(hardness+2))/1000; BC 30-d WQG (mg/L) = 0.002 at hardness <=50 mg/L, at hardness >=50 mg/L = 0.04*hardness/1000
m) hardness dependent Pb guideline: BC Max WQG (mg/L) = 0.003 at hardness <=8 mg/L, at hardness >8 mg/L = (EXP(1.273*ln(hardness))-1.46)/1000; BC 30-d WQG (mg/L) = (3.31+EXP(1.273(ln(hardness))-4.704))/1000 at hardness >8 mg/L, no guideline at hardness <=8 mg/L
n) hardness dependent Mn guideline: BC Max WQG (mg/L) = 0.01102*(hardness)+0.54; BC 30-d WQG (mg/L) = 0.0044*hardness+0.605
o) BC 30-d WQG (mg/L) = 0.00002 when methylmercury (MeHg) is 0.5% of total Hg, = 0.00001 at 1% MeHg, = 0.00000125 at 8% MeHg; applied most conservative guideline
p) hardness dependent Ni guideline: BC Max WQG = 0.025 at hardness <60 mg/L, at hardness 60-120 mg/L = 0.065, at hardness 120-180 mg/L = 0.11, at hardness >180 mg/L = 0.15
q) hardness dependent Ag guideline: BC Max WQG (mg/L) = 0.0001 at hardness <=100 mg/L, at hardness >100 mg/L = 0.003; BC 30-d WQG (mg/L) = 0.00005 at hardness <=100 mg/L, at hardness > 100 mg/L = 0.0015
r) hardness dependent Zn guideline: BC Max WQG (mg/L) = (33+0.75(hardness-90))/1000; BC 30-d WQG (mg/L) = (7.5+0.75(hardness-90))/1000
s) up to 10 - highly sensitive to acid inputs; 10 to 20 - moderately sensitive; over 20 - low sensitivity. Refer to calcium regarding sensitivity to acid inputs, the more restrictive of calcium or alkalinity is applicable.
t) up to 4 - highly sensitive to acid inputs; 4 to 8 - moderately sensitive; over 8 - low sensitivity. Refer to alkalinity, the more restrictive of calcium or alkalinity applies.

Summary table with 3 rows: 123 Indicates concentration exceeding the BC Max WQ Guideline and baseline plus 10%; 123 Indicates concentration exceeding the BC 30-d WQ Guideline and baseline plus 10%; 123 Indicates concentration exceeding baseline plus 10% where there is no guideline value.

APPENDIX 5.6-F
Groundwater Quality Predictions

Table 5.6-F2: Predicted Pit Lake Water Quality under the Base Case Scenario compared to CCME Guidelines, McNab Aggregate Project, BC

Table with 22 columns: Parameter, Units, CCME Guidelines (Short-term, Long-term), notes, Groundwater - All sampling locations (95th Percentile), and Years 1-16 plus Closure. Rows include Conventional parameters (Total Dissolved Solids, Alkalinity, Hardness), Major Ions (Calcium, Chloride, Fluoride, Magnesium, Potassium, Sodium, Sulphate), Nutrients (Ammonia, Nitrate, Nitrite, Total Kjeldhal Nitrogen, Total Phosphorus), and Dissolved Metals (Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Lithium, Manganese, Mercury, Molybdenum, Nickel, Selenium, Silicon, Silver, Thallium, Tin, Titanium, Uranium, Vanadium, Zinc).

Notes:

- i = interim guideline
a) Canadian Council of Ministers of the Environment (CCME). Guidelines for the protection of freshwater aquatic life.
b) calculated value: calculated TDS based on standard methods (APHA, 2005)
c) assumed alkalinity based on mean of shake flask extraction test, used for calculation of TDS
d) calculated hardness based on concentrations of calcium and magnesium
e) pH and temperature dependent ammonia guideline: based on maximum baseline temperature of 18°C and pH of 8.0
f) pH dependent Al guideline: CCME Al (mg/L) = 0.005 at pH<6.5, CCME Al (mg/L)= 0.1 at pH >6.5 (minimum observed baseline surface water pH = 5.57)
g) hardness dependent Cd guideline: CCME Short-term Guideline (mg/L) = 0.00011 at hardness <5.3 mg/L, at hardness ≥5.3 to ≤360 mg/L = (10^(1.016*log(hardness)-1.71))/1000, at hardness >360 mg/L = 0.0077
CCME Long-term Guideline (mg/L) = 0.00004 at hardness <17 mg/L, at hardness ≥17 to ≤280 mg/L = 10^(0.83(log(hardness))-2.46)/1000, at hardness >280 mg/L = 0.00037
h) guideline is for Cr(VI)
i) hardness dependent Cu guideline: CCME (mg/L) = 0.002 at hardness <82 mg/L, at hardness ≥82 to ≤180 mg/L = (0.2*EXP(0.8545(ln(hardness))-1.465))/1000
j) hardness dependent Pb guideline: CCME (mg/L) = 0.001 at hardness ≤60 mg/L, at hardness >60 to ≤180 mg/L = (EXP(1.273(ln(hardness))-4.705))/1000, at hardness >180 mg/L = 0.007
k) hardness dependent Ni guideline: CCME (mg/L) = 0.025 at hardness ≤60 mg/L, at hardness >60 to ≤180 mg/L = EXP(0.76*(ln(hardness))+1.06)/1000, at hardness >180 mg/L = 0.15
l) CCME guidance framework trigger values (mg/L): ultra-oligotrophic <0.004, oligotrophic 0.004-0.01, mesotrophic 0.01-0.02, meso-eutrophic 0.02-0.035, eutrophic 0.035-0.1, hyper-eutrophic >0.1

Table with 2 columns: Value (123, 123, 123) and Description (Indicates concentration exceeding the CCME short-term guideline and baseline plus 10%, Indicates concentration exceeding the CCME long-term guideline and baseline plus 10%, Indicates concentration exceeding baseline plus 10% where there is no guideline value).

Table 5.6-F3: Predicted Pit Lake Water Quality under the Conservative Scenario compared to BCWQ Guidelines for the Protection of Aquatic Life, McNab Aggregate Project, BC

Table with 22 columns: Parameter, Units, BC Water Quality Guidelines for the Protection of Freshwater Aquatic Life (Maximum, notes, 30-Day Average, notes), Groundwater - All sampling locations (95th Percentile), and years 1-16, plus Closure. Rows include Conventional (Total Dissolved Solids, Alkalinity, Hardness), Major Ions (Calcium, Chloride, Fluoride, Magnesium, Potassium, Sodium, Sulphate), Nutrients (Ammonia, Nitrate, Nitrite, Total Kjeldahl Nitrogen, Total Phosphorus), and Dissolved Metals (Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Lithium, Manganese, Mercury, Molybdenum, Nickel, Selenium, Silicon, Silver, Thallium, Tin, Titanium, Uranium, Vanadium, Zinc).

Notes:

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j) hardness dependent dissolved Cd guideline: BC WQG Long-term average (ug/L) = 2.718^(0.736*ln(hardness)-4.943); BC WQG short-term max (ug/L) = 2.718^(1.03*ln(hardness)-5.274)
k) guideline is for Cr(VI)
l) hardness dependent Cu guideline: BC Max WQG (mg/L) = (0.094(hardness+2))/1000; BC 30-d WQG (mg/L) = 0.002 at hardness <=50 mg/L, at hardness >=50 mg/L = 0.04*hardness/1000
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n) hardness dependent Mn guideline: BC Max WQG (mg/L) = 0.01102*(hardness)+0.54; BC 30-d WQG (mg/L) = 0.0044*hardness+0.605
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u) based on probabilistic model results.

Table with 2 columns: Value (123) and Description (Indicates concentration exceeding the BC Max WQ Guideline and baseline plus 10%, Indicates concentration exceeding the BC 30-d WQ Guideline and baseline plus 10%, Indicates concentration exceeding baseline plus 10% where there is no guideline value).

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j) hardness dependent Pb guideline: CCME (mg/L) = 0.001 at hardness <=60 mg/L, at hardness >60 to <=180 mg/L = (EXP(1.273*(ln(hardness))-4.705))/1000, at hardness >180 mg/L = 0.007
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n) based on probabilistic model results

Table with 2 columns: Value, Description. Rows: 123 Indicates concentration exceeding the CCME short-term guideline and baseline plus 10%. 123 Indicates concentration exceeding the CCME long-term guideline and baseline plus 10%. 123 Indicates concentration exceeding baseline plus 10% where there is no guideline value.