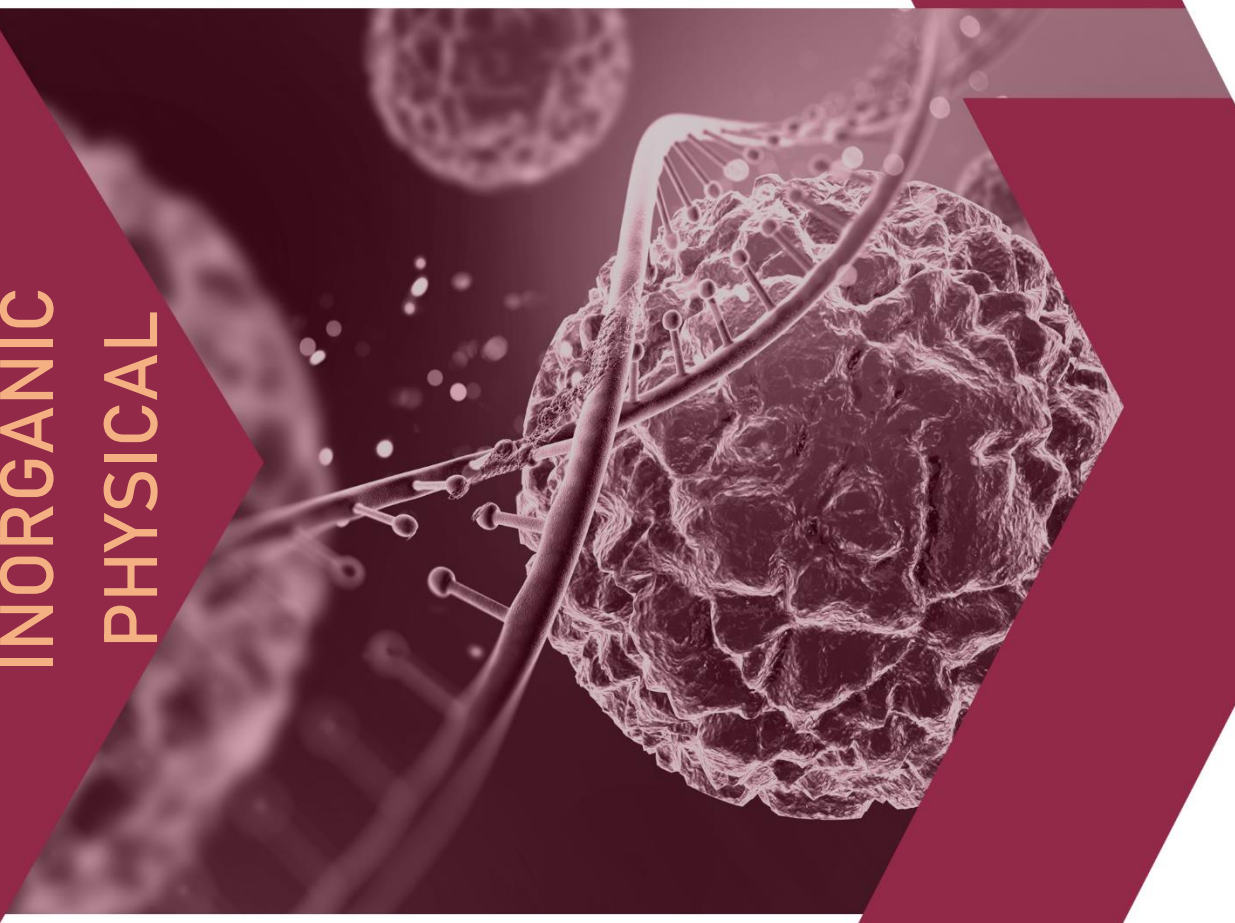
MICROBIOLOGY
ORGANIC
INORGANIC
PHYSICAL



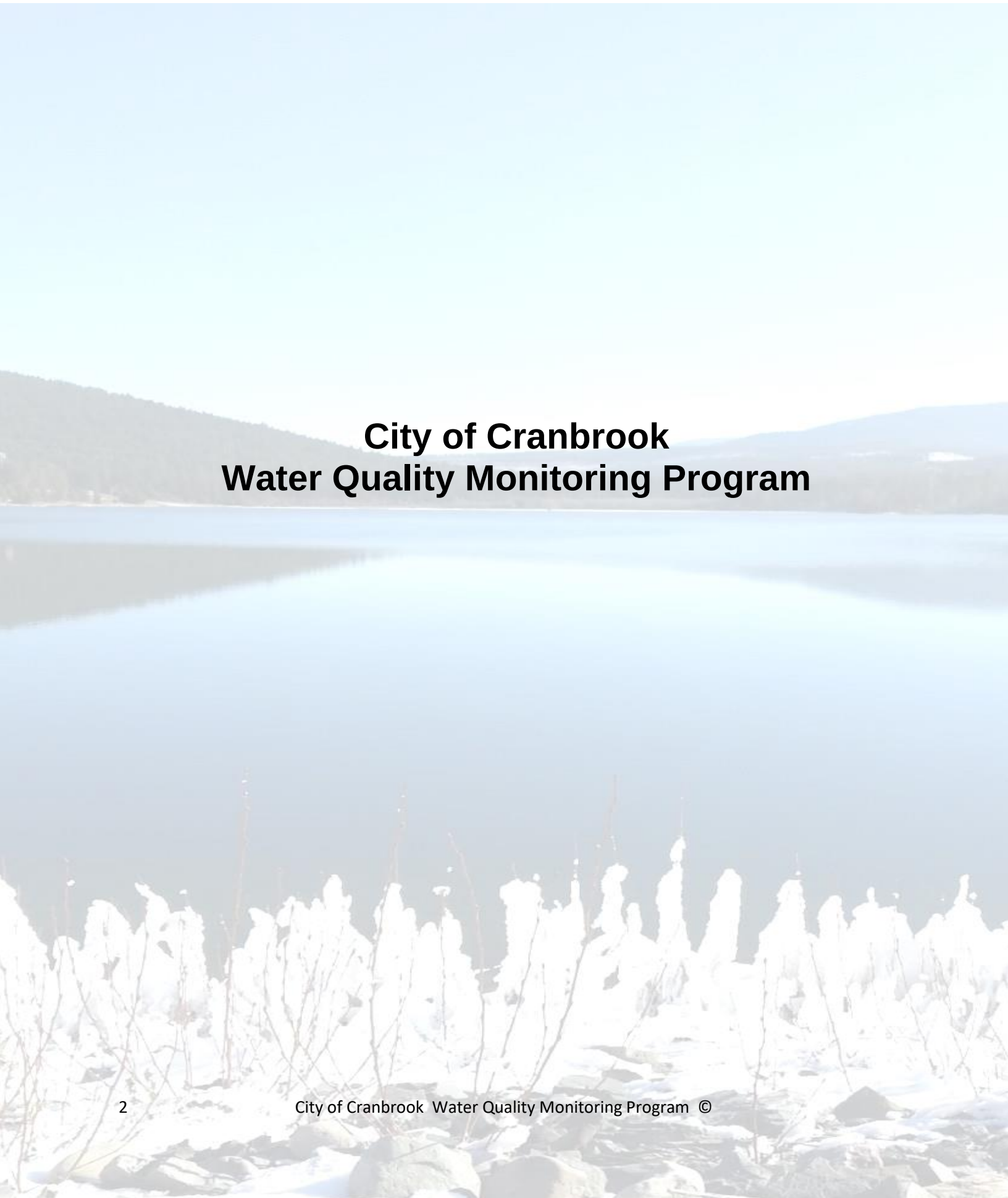
Water Quality

MONITORING

PROGRAM

MOUNTAINS OF OPPORTUNITY

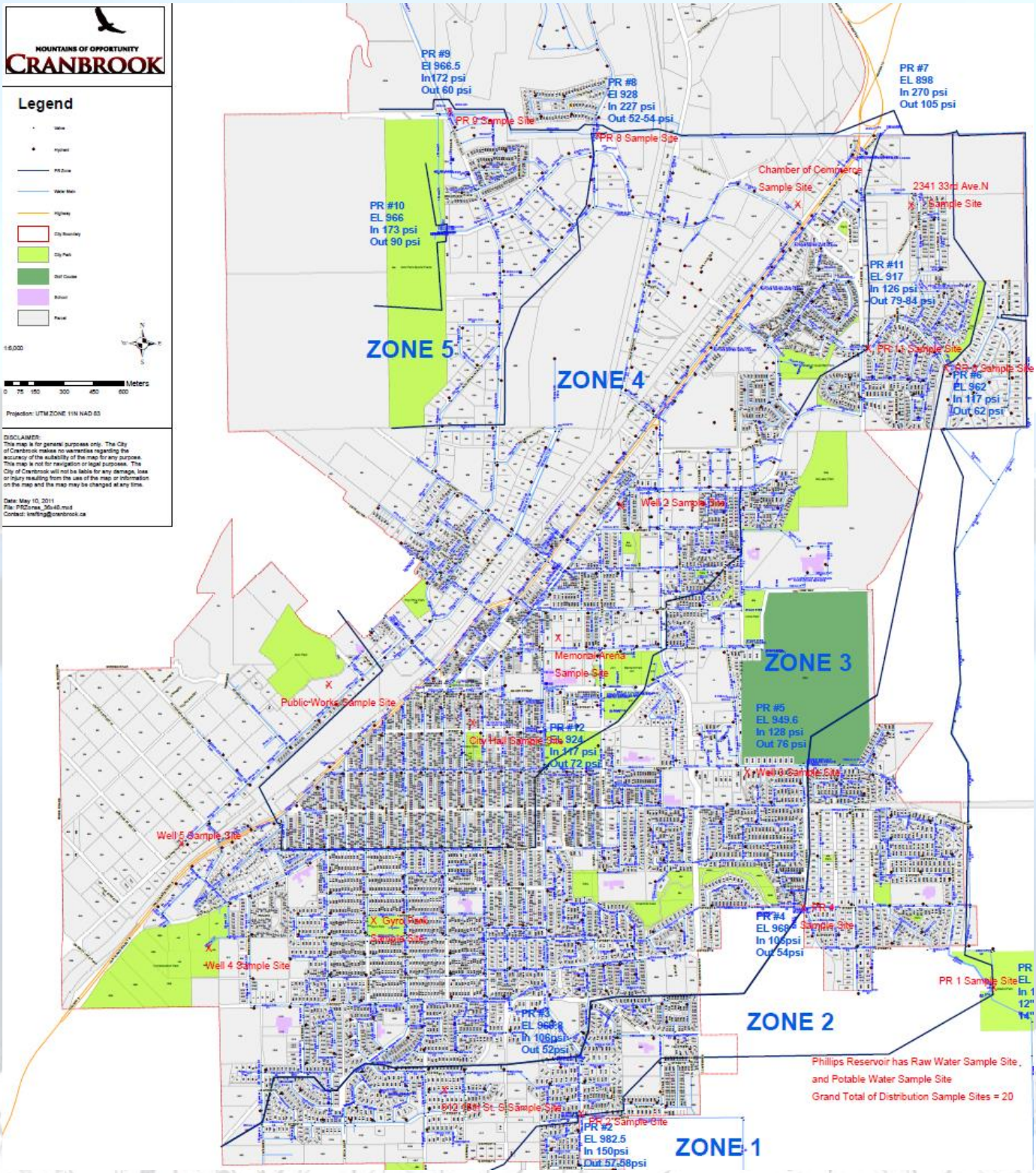
CRANBROOK



City of Cranbrook
Water Quality Monitoring Program

TABLE OF CONTENTS

SAMPLE SITE MAP



WATER SYSTEM OVERVIEW

The City of Cranbrook is committed to the delivery of safe and desirable drinking water to the citizens of Cranbrook. The Utility section of City Public Works, works diligently to ensure that the water is of the highest quality it can provide. From 'Source to Tap', water is collected and sampled on-site and also submitted to an independent lab to sample for a variety of parameters, including Bacteriological, Inorganic and Organic chemistry, and Nutrients to ensure that the water is of good quality. Samples are taken on daily, weekly, monthly, and annually schedules.

Certified Operators collect daily samples to measure for Turbidity, pH, Temperature, Conductivity, and of course Free and Total Chlorine residuals at multiple sites within its distribution system and at the Phillips Reservoir Disinfection Facility. Weekly bacteriological samples are collected and submitted to and independent lab to verify that the water is bacteria free.

Disinfection By-Products (DBP) samples are collected and submitted quarterly during the colder winter months and monthly during hot summer months. First users, middle of system and end of system, where the water is the oldest are targeted and sampled. Sample analysis targets the group of compounds for Trihalomethanes (THM) and Halo acetic Acids (HAA). Total Organic Carbon (TOC) and Dissolved Organic Carbon (DOC) are also collected with the DBP samples and sent to an independent lab.

Inorganic and Organic chemistry is collected and submitted annually to ensure that the water entering the distribution system is in compliance with the Guidelines for Canadian Drinking Water Quality issued by the Government of Canada, and also to ensure that the water quality is consistent year after year. These samples are collected from Gold Creek Reservoir, Phillips Reservoir, Gold/Joseph Creek Diversion building, City Deep Wells, and 2 sites within the distribution system.

RAW WATER SOURCE

The City of Cranbrook surface water supply comes from two Watersheds. The City obtains its raw water from the Joseph and Gold Creeks, which are diverted into the Philips raw water reservoir. Existing conditional water licenses include:

- Joseph Creek (#39845) for 3,770,000 imperial gallons per day (198 L/s)
- Gold Creek (#39842) for 8,077,000 imperial gallons per day (425 L/s)

The maximum quantity of water that may be diverted based on these licenses for the City's domestic use is 11,847,000 imperial gallons per day (623 L/s). Gold Creek and Joseph Creek Watersheds are located southeast of the city.

Located approximately 4.5 km southeast of Cranbrook, the Phillips Reservoir is the sole storage facility for the City. It was created in 1974, with the construction of an earth-filled

dam on Joseph Creek. The reservoir holds approximately 2.3 billion litres (500 million imperial gallons) of water that will settle out particulates before raw water is transferred to the treatment facility.

WATER TREATMENT

The treatment facility is located at the Phillips Reservoir. Settled water is carried from the reservoir through a 750-mm diameter transmission main. The facility consists of the following unit processes:

a) Flow measurement
b) Chlorination
c) Fluoridation
d) Back-up disinfection – sodium hypochlorite
e) Booster pumps (for disinfection only)

As settled water enters the treatment facility from Phillips Reservoir, the turbidity is measured. Fluoride is then fed into the flow. There are two booster pumps which inject chlorine at one point, which achieves a chlorine contact time of 30 minutes. The flow rate through the system is also measured. Treated water leaving the facility into the distribution system is monitored for chlorine residual, pH, conductivity, dissolved oxygen and temperature. City's SCADA system records and trends all parameters and certified operators verify instruments daily with handheld field instrumentation.

The treated water is carried from Phillips Reservoir to the distribution system by a 750-mm diameter high pressure concrete pipeline. The transmission main is approximately 3,535 m long and was constructed in 1974. The 750-mm diameter pipe converges into two 600-mm diameter pressure concrete pipelines in the distribution system which supply the first PRV stations

The City of Cranbrook's primary water supply is from surface water obtained from Joseph and Gold Creeks, which divert raw water into the Phillips Reservoir. Raw water is settled in the reservoir assisting in the reduction of turbidity before the water is conveyed into the Treatment Facility. The current method of treatment consists of inline chorine and fluoride injection before the water is conveyed to the City's distribution system.

Existing instrumentation at the Treatment Facility provides ongoing data to the SCADA system for the following parameters:

- Flow measurement (Total Consumption),
- Reservoir Level
- Source turbidity
- Water pH and temperature
- Chlorine Residual
- Dissolved Oxygen

- Conductivity

The City of Cranbrook aims to produce water for drinking and other domestic purposes which are free of pathogenic organisms and their indicators.

DISTRIBUTION SYSTEM

As directed in the *Drinking Water Protection Act and Regulations* a water supplier is required to have their bacteriological water monitoring analyzes completed by an accredited laboratory that is approved by the Provincial Health Officer. City of Cranbrook has employed MB Labs Ltd. to analyze bacteriological samples plus a multitude of other parameters.

Due to the nature of the water system, there are a number of operators taking water quality samples and performing field measurements. Annual operator water quality training is provided to verify that results are obtained correctly; duplicate samples are taken at locations which coincide with the sampling schedule.

The water distribution system consists of approximately 160km of water mains, ranging in diameter from 50mm (2”) to 762mm (30.5”) and consisting primarily of ductile iron material. 13 Pressure Reducing Stations with pressure ranges from 230 psig to 64 psig. The City has developed three groundwater wells, which are used to augment its water supply during periods of high demand and to satisfy fire flow requirements. The groundwater wells are also the emergency backup supply for the system.

Additional measurement of distribution system water quality is also provided at the following locations:

- PRV #1 (Chlorine Residual, pH, and Temperature)
- PRV #2 (Chlorine Residual, pH, and Temperature)
- PRV #9 (Chlorine Residual, pH, Temperature, and Turbidity)
- PRV #11 (Chlorine Residual, pH, and Temperature)
- PRV #12 (Chlorine Residual, pH, and Temperature)
- Well #3 (Chlorine Residual, pH, and Temperature)
- Well #4 (Chlorine Residual, pH, and Temperature)
- Well #5 (Chlorine Residual, pH, and Temperature)

Water Sampling – Source to Tap

RAW WATER SOURCE

Watersheds and Catchments

Every two weeks City Utility Operators collect samples for field analysis and submission to an independent lab.

Sample sites include:

WTX - Facility Name	WTX - Sampling Point Name
Baker Creek U/S Joseph Creek	Site 9a - Baker Cr. U/S Joe. Cr
Gold Creek Branch 8	Site 5 -Branch 8 Bridge
Gold Creek Reservoir	Site 7 - Gold Crk Res Off Platform
Gold Creek U/S Joseph Creek	Site 9 - Gold Crk U/S Joe Crk
U/S Gold Creek Reservoir	Site 6 - U/S Gold Crk Reservoir
Joseph Creek Mid Watershed	Site 3 - Joe Crk Mid-Shed
Joseph Creek U/S Gold Creek	Site 4 - Joe Crk U/S Gold Crk
Upstream Phillips Reservoir	Site 10 - Upstream Phillips Reservoir

Field parameters include:

- Temperature
- Turbidity
- Dissolved Oxygen
- Conductivity

Samples submitted for analysis include:

- Total and Fecal Coliform
- E. coli Bacteria
- Background Bacteria
- Nitrates/Nitrites
- Enterococci
- Yeast/Fungi
- Sulfur Reducing Bacteria
- Total Plate Counts
- Colour
- Alkalinity
- Total Kjeldahl Nitrogen
- Ammonia
- Orthophosphates
- Total Dissolved Solids
- Total Suspended Solids
- Turbidity

Note: Spring Runoff (Freshet) – During Freshet, samples from the Joseph Creek Confluence at the Diversion Structure will be collected weekly. (Tentatively, March to July). Diversion bypass will be opened when turbidity is 2.5 NTU or higher for a 24 hour running average.

Enteric Parasites

The City of Cranbrook collects samples for the analysis of Enteric Parasite, namely Cryptosporidium and Giardia. Samples are collected by filtering 500 litres of water through a 1-micron woven filter. Samples are then sent to an Independent Laboratory for analysis. Samples are collected Monthly during the year.

Facility Name	Sampling Point Name
Gold Creek Reservoir	Site 7 – Gold Creek Res. off Platform
Joseph Creek & Gold Creek Confluence	Site 9 - Joe Creek U/S Gold Creek
Upstream Phillips Reservoir	Site 10 - Upstream Phillips Reservoir
Phillips Reservoir - Plant	Phillips Reservoir RAW

Phillips Reservoir

The City of Cranbrook initiated an intensive Pathogen Monitoring Program in 2014. The program consists of sampling the Phillips Reservoir's stratospheric layers within the water column. Samples are taken from the Epilimnion, Metalimnion, and Hypolimnion layers. These layers are predetermined by the temperature thermoclines, and change seasonally. Samples are collected monthly during the months of April to October.

Sites include:

Facility Name	Sampling Point Name
Phillips Reservoir	Site 12 - Epilimnion
Phillips Reservoir	Site 12 - Hypolimnion
Phillips Reservoir	Site 12 - Metalimnion
Phillips Reservoir	Site 13 - Epilimnion
Phillips Reservoir	Site 13 - Hypolimnion
Phillips Reservoir	Site 13 - Metalimnion
Phillips Reservoir	Site 14 - Epilimnion
Phillips Reservoir	Site 14 - Hypolimnion
Phillips Reservoir	Site 14 - Metalimnion
Phillips Reservoir - Plant	Phillips Reservoir POTABLE
Phillips Reservoir - Plant	Phillips Reservoir RAW

Field parameters include:

- Depth
- Temperature
- Turbidity
- Dissolved Oxygen
- Conductivity

Samples submitted for analysis include:

- Total and Fecal Coliform
- Algal Profiling
- E. Coli Bacteria
- Background Bacteria
- Nitrates/Nitrites
- Enterococci
- Yeast/Fungi
- Sulfur Reducing Bacteria
- Turbidity
- Total Plate Counts
- Colour
- Alkalinity
- Total Kjeldahl Nitrogen
- Ammonia
- Orthophosphates
- Total Dissolved Solids
- Total Suspended Solids

DISTRIBUTION SYSTEM

City Utility Operators collect samples for field analysis and submission to an independent lab weekly. A total of 44 samples are submitted each month to comply with the Drinking Water Protection Act, schedule B. Samples shall be taken on the first Monday of every month, Tuesdays when a statutory holiday falls on the Monday and submitted to an independent lab. Total of 20 samples sites are broken into two routes of 11 sites. Each route is sampled opposite of each other, with the Phillips Reservoir Raw and Potable being sampled on each route.

Note: Operators will take duplicate samples when chlorine residuals are below 0.30 mg/L

Field parameters include:

- Total Chlorine Residual
- Free Chlorine Residual
- Temperature
- Turbidity
- Fluoride Residuals (Phillips Reservoir Only)

Samples submitted for analysis include:

- Total and Fecal Coliform
- E. coli Bacteria
- Background Bacteria
- Metals and Nutrients
- Disinfection By-products

Phillips Reservoir Raw and Potable, PR #1, and one floating distribution system site also are sampled for:

- Lactose Fermenters
- Algal Profiling
- Total Aero-monas
- Sulfur Reducing Bacteria
- Yeast/Fungi
- Total Plate Count
- Microbial Identification

The frequency and number of samples for microbiological control monitoring is based on recommendations from the *Drinking Water Protection Act and Regulations.*

Schedule A - Water Quality Standards for Potable Water

Fecal Coliform bacteria – No detectable fecal Coliform bacteria per 100mLs
Escherichia coli (*E. coli)* – No detectable *E. coli* per 100mLs
Total Coliform Bacteria:

(a) 1 sample in a 30-day period - No detectable Total Coliform per 100 mLs
(b) More than 1 sample in a 30-day period - At least 90% of samples have no detectable total bacteria per 100 millilitres

Schedule B – Frequency of Monitoring Samples

Population served by the prescribed Water Supply System: 5,000 to 90,000.
Number of samples per month: 1 per 1,000 populations

Distribution Sample Routes

ROUTE # 1

SITE	WTX#
Phillips Reservoir-Potable	30653
Phillips Reservoir- Raw	30666
PR #1	305F9
PR #4	30672
PR #9	305FB
PR #11	305FC
Well #3	305FE
Well #4	305FF
Well #5	30600
Gyro Park	30673

ROUTE # 2

SITE	WTX#
Phillips Reservoir-Potable	30653
Phillips Reservoir- Raw	30666
PR #2	305FA
PR #6	3066E
PR #8	30677
Well #2	30675
Well #3	305FE
Well #4	305FF
Well #5	30600
Public Works Yard	3066D
Chamber of Commerce	3066F

Note: All Production Wells are sampled weekly when Well pump is on.

Distribution Water Quality

There are 9 sample sites throughout the distribution system where water quality field analysis is performed. These sites include but are not limited to others randomly:

- PR #1
- PR #2
- PR #9
- PR #11
- PR #12
- Phillips Reservoir – Raw
- Well #3
- Well #4
- Well # 5
- Phillips Reservoir – Potable

Chlorine Monitoring

Free chlorine residuals are monitored at sites that are visited daily. In addition of this, a chlorine residual monitoring schedule will be reviewed, in areas of the system that could have low residuals.

Fluoride Monitoring

City of Cranbrook currently adds Hydrofluorosilicic Acid to its drinking water. Fluoride Dosage rates are calculated using the amount of Fluoride used divided by water consumption. Currently the average dosage rate is 0.74 mg/L.

GROUNDWATER WELLS

The City has three deep wells that are to be operated daily in 2020. Daily regular water quality parameters are sampled on-line and with handheld equipment for verification. The wells fall under all other schedules for collection and submission of samples to an independent lab. Samples are also collected for the B-TEX group of hydrocarbons quarterly.

Field parameters include:

- Total Chlorine Residual
- Free Chlorine Residual
- Temperature
- Turbidity

Samples submitted for analysis include:

- Total and Fecal Coliform
- E. coli Bacteria
- Background Bacteria
- B-TEX Group
- Metals and Nutrients
- Disinfection By-products

DISINFECTION BY-PRODUCTS

At minimum, quarterly monitoring of treated water from surface water and groundwater sources is recommended for both THMs and HAAs. Increased frequency may be required for facilities using surface water sources2 during peak by-product formation periods.

GCDW MAC

THM'S	HAA'S
0.1 mg/L	0.08 mg/L

BASED ON AN ANNUAL RUNNING AVERAGE

DBP-Sampling Schedules

City of Cranbrook Utility Operators sample for DBP, (THM&HAA) quarterly during low potential months, i.e., winter and fall. As the water temperatures increase through the hotter summer months samples will be taken monthly at the end of the system where water age is the greatest.

These schedules are broken down as follows.

Schedule A – Regular quarterly sampling. (January/March/June/November)

First Customer

- PR #1
- PR #8

Middle of Distribution System

- Gyro Park
- Well #2

End of System User

- Public Works Yard
- 300 Blk of 1st Ave. S
- Wildstone Trunk Line. (Separation Hydrant)

Schedule B – Monthly Summer Months (July-September)

- Public Works Yard
- 300 Blk of 1st Ave. S
- Wildstone Trunk Line. (Separation Hydrant)

Samples shall be taken on the first Monday of every month, Tuesdays when a statutory holiday falls on the Monday, and submitted with the regular Distribution Samples to an independent lab.

APPENDICES

Appendix A - Watershed and Catchment Sample Sites

Appendix B - Distribution Samples Sites

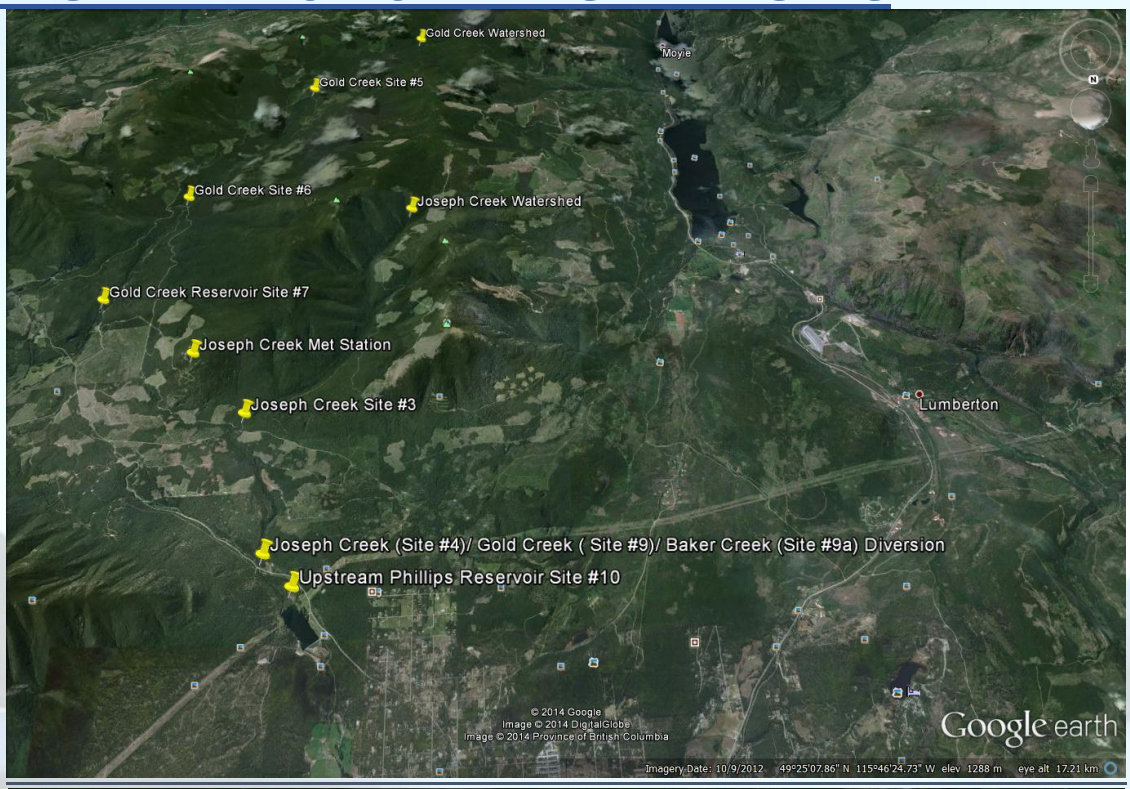
Appendix C - Standard Operating Procedures
Field Equipment Quality Control
How to take a Water Sample

Appendix D - Water Quality Action Plan

Appendix E - Weekly Sampling Schedule

Appendix F - Manganese Monitoring /Testing

APPENDIX A – WATERSHED AND CATCHMENT SAMPLE SITES




Joseph Creek Watershed
Moyie Lake
Image © 2014 Province of British Columbia
Image © 2014 DigitalGlobe
© 2014 Google
Google earth
2005
Imagery Date: 6/23/2010 49°22'22.42" N 115°46'00.42" W elev 1532 m eye alt 13.66 km


Upstream Phillips Reservoir Site #10
Image © 2014 Province of British Columbia
Google earth
2005
Imagery Date: 12/31/2004 49°27'33.66" N 115°41'49.03" W elev 1092 m eye alt 1.96 km

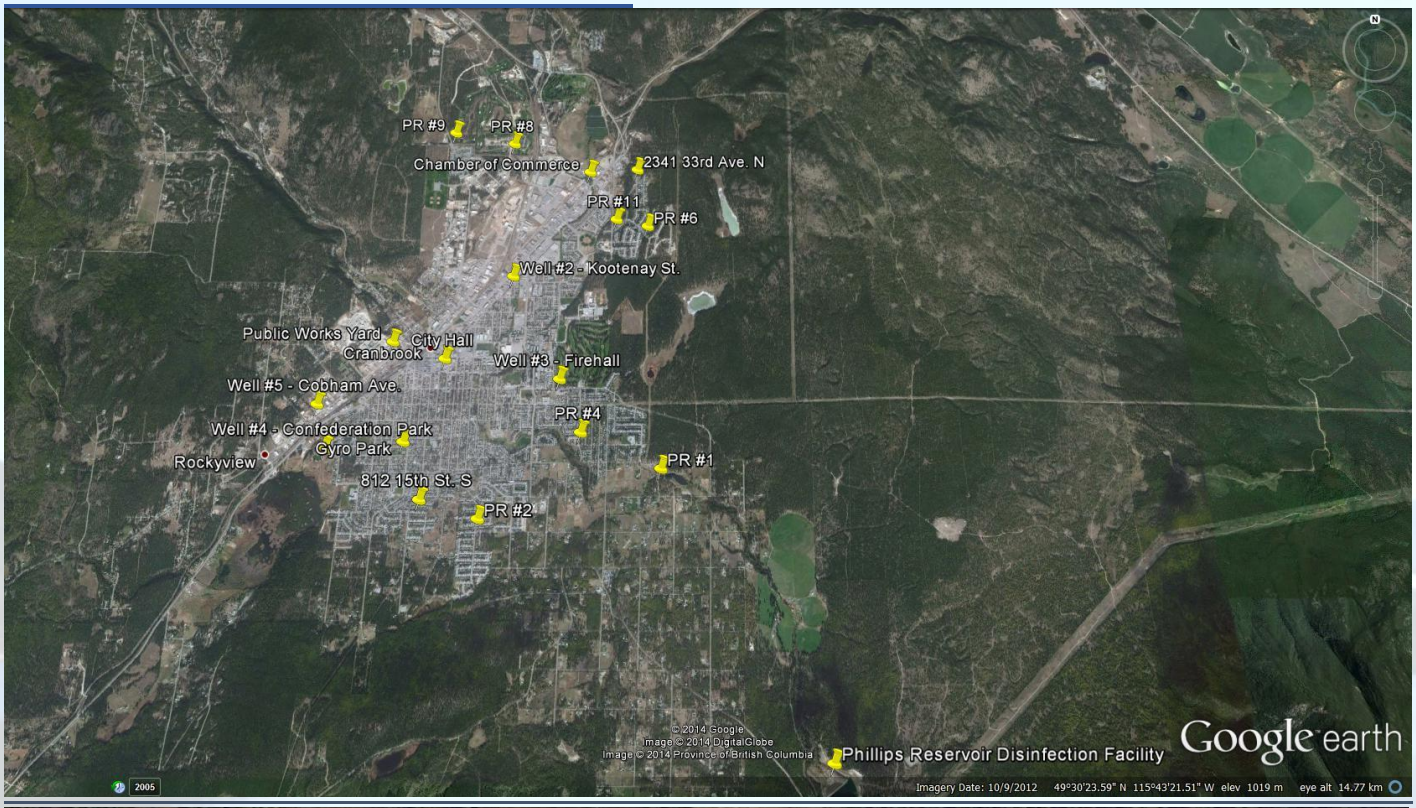

Joseph Creek (Site #4)/ Gold Creek (Site #9)/ Baker Creek (Site #9a) Diversion
© 2014 Google
Image © 2014 Province of British Columbia
Google earth
2005
Imagery Date: 12/31/2004 49°27'07.65" N 115°41'17.78" W elev 1116 m eye alt 1.59 km


Joseph Creek Site #3
© 2014 Google
Image © 2014 Province of British Columbia
Google earth
2005
Imagery Date: 12/31/2004 49°25'21.46" N 115°40'44.63" W elev 1334 m eye alt 3.13 km

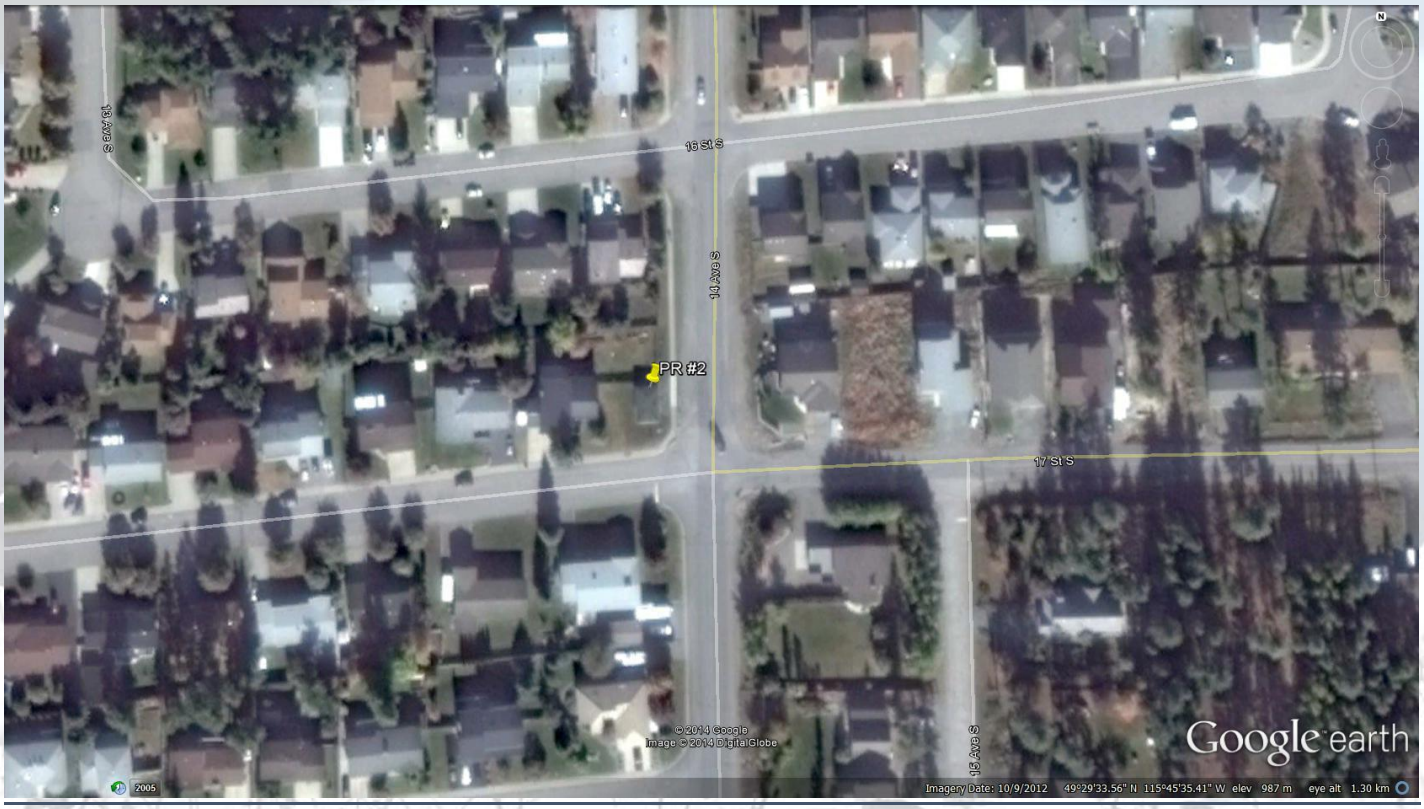

Gold Creek Site #5
image © 2014 DigitalGlobe
Google earth
2005
Imagery Date: 6/23/2010 49°18'44.90" N 115°41'06.74" W elev 1463 m eye alt 1.69 km

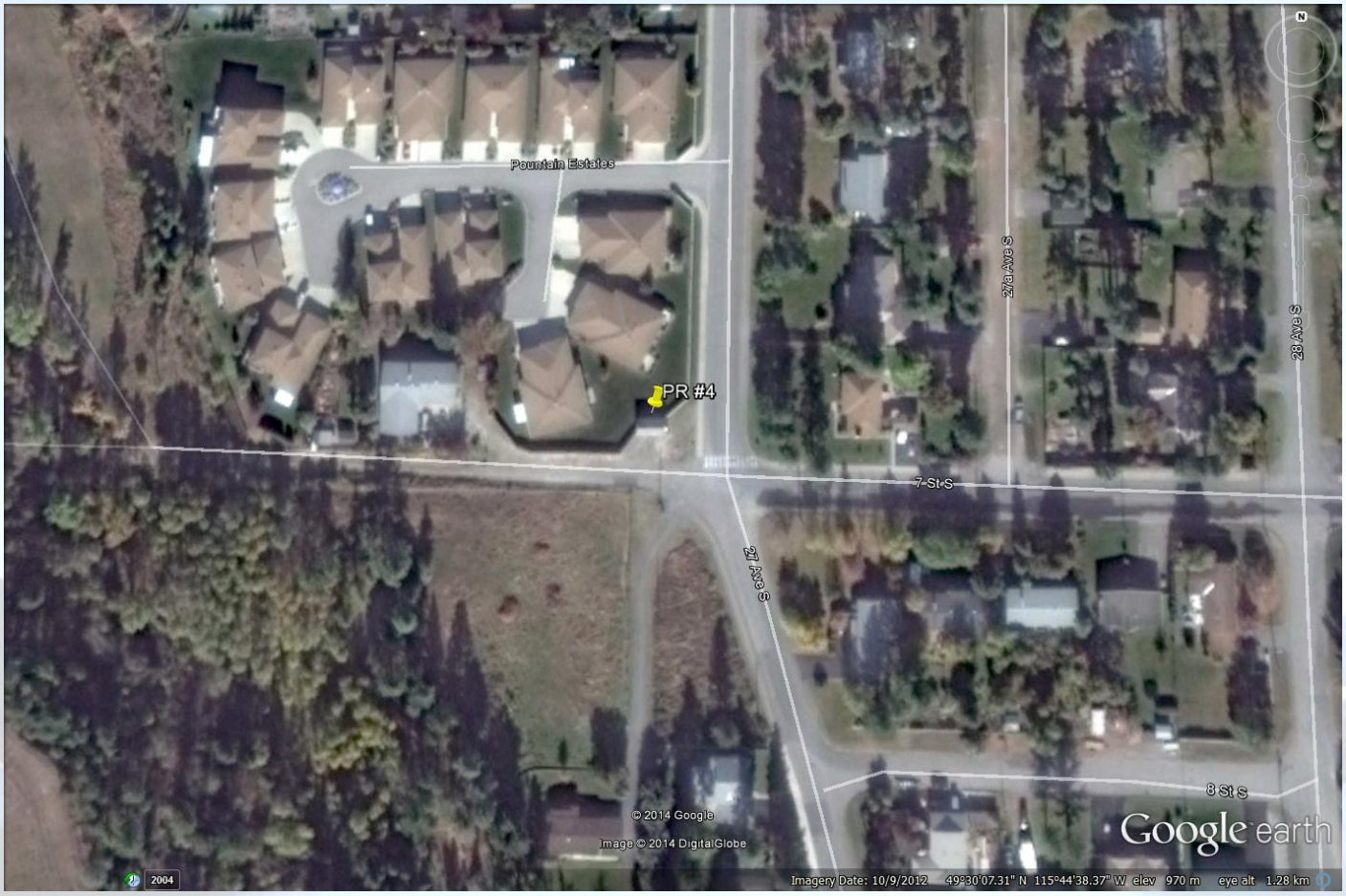

Gold Creek Site #6
image © 2014 DigitalGlobe
Google earth
2005
Imagery Date: 6/23/2010 49°21'18.67" N 115°38'45.08" W elev 1373 m eye alt 1.62 km

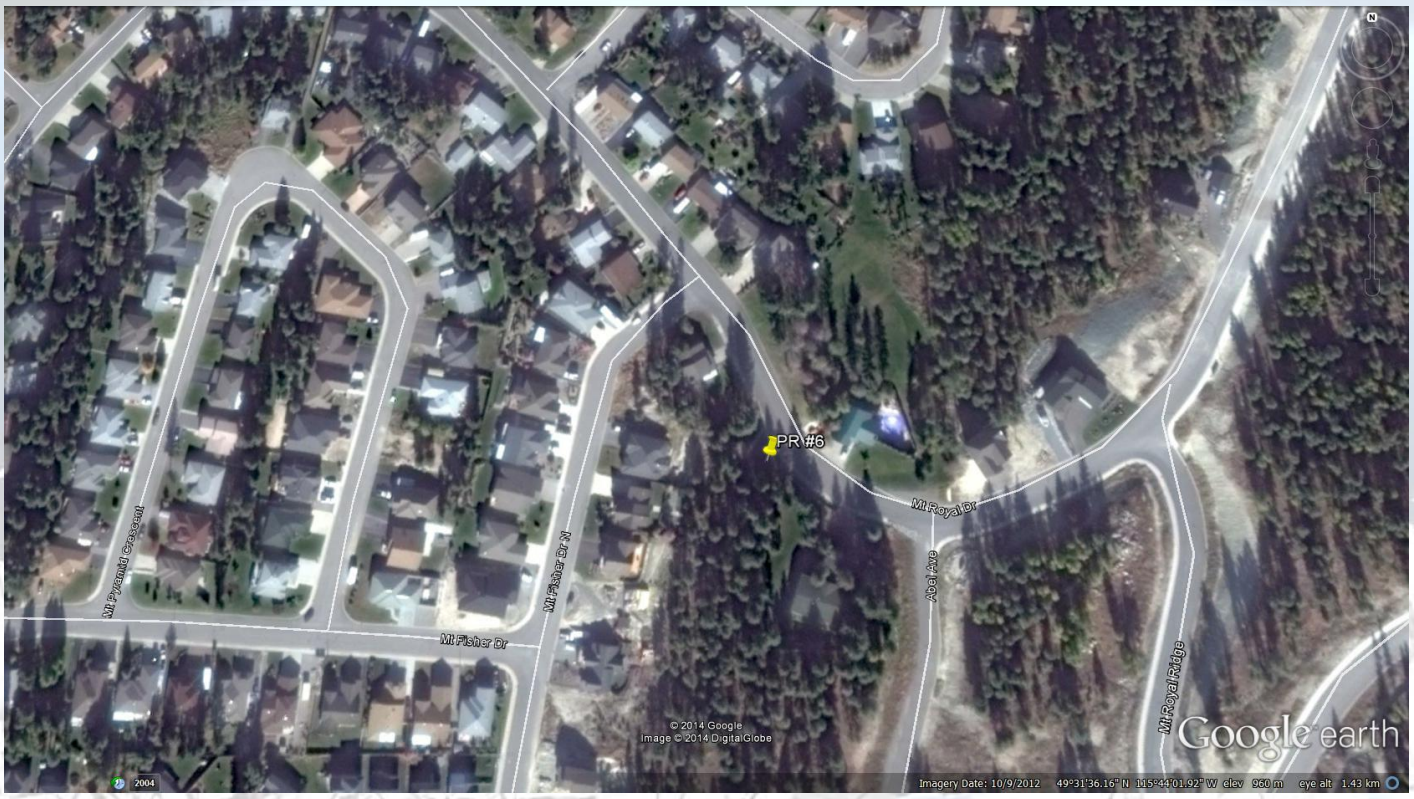
APPENDIX B – DISTRIBUTION SAMPLE SITES




34 Ave S
Summit Dr
9 St S
Idlewild Lake
PR #1
Summit Dr S
13 St S
© 2014 Google
Image © 2014 DigitalGlobe
Google earth
2004
Imagery Date: 10/9/2012 49°29'54.29" N 115°43'46.56" W elev 1004 m eye alt 1.85 km

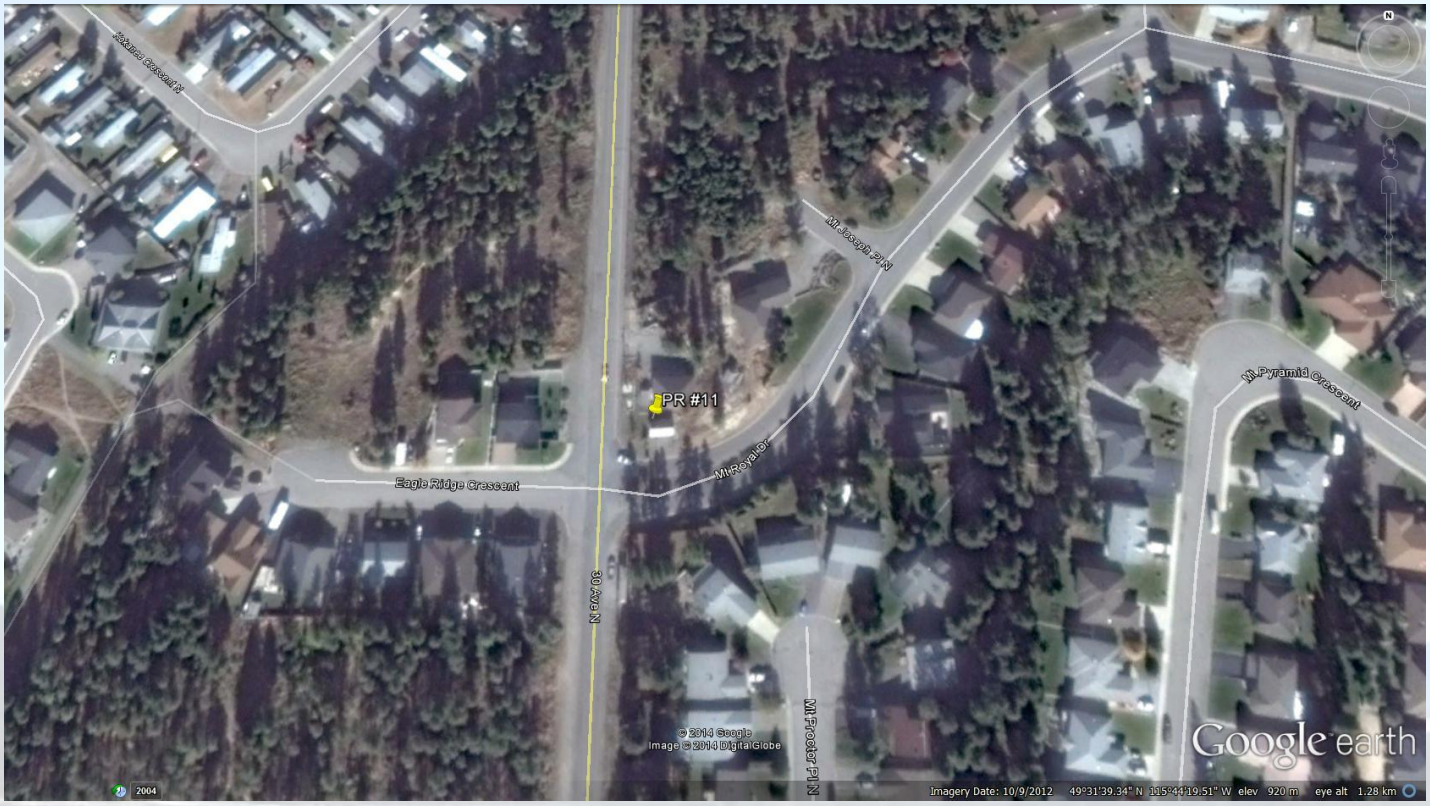

13 Ave S
15 St S
14 Ave S
PR #2
17 St S
15 Ave S
© 2014 Google
Image © 2014 DigitalGlobe
Google earth
2005
Imagery Date: 10/9/2012 49°29'33.56" N 115°45'35.41" W elev 987 m eye alt 1.30 km

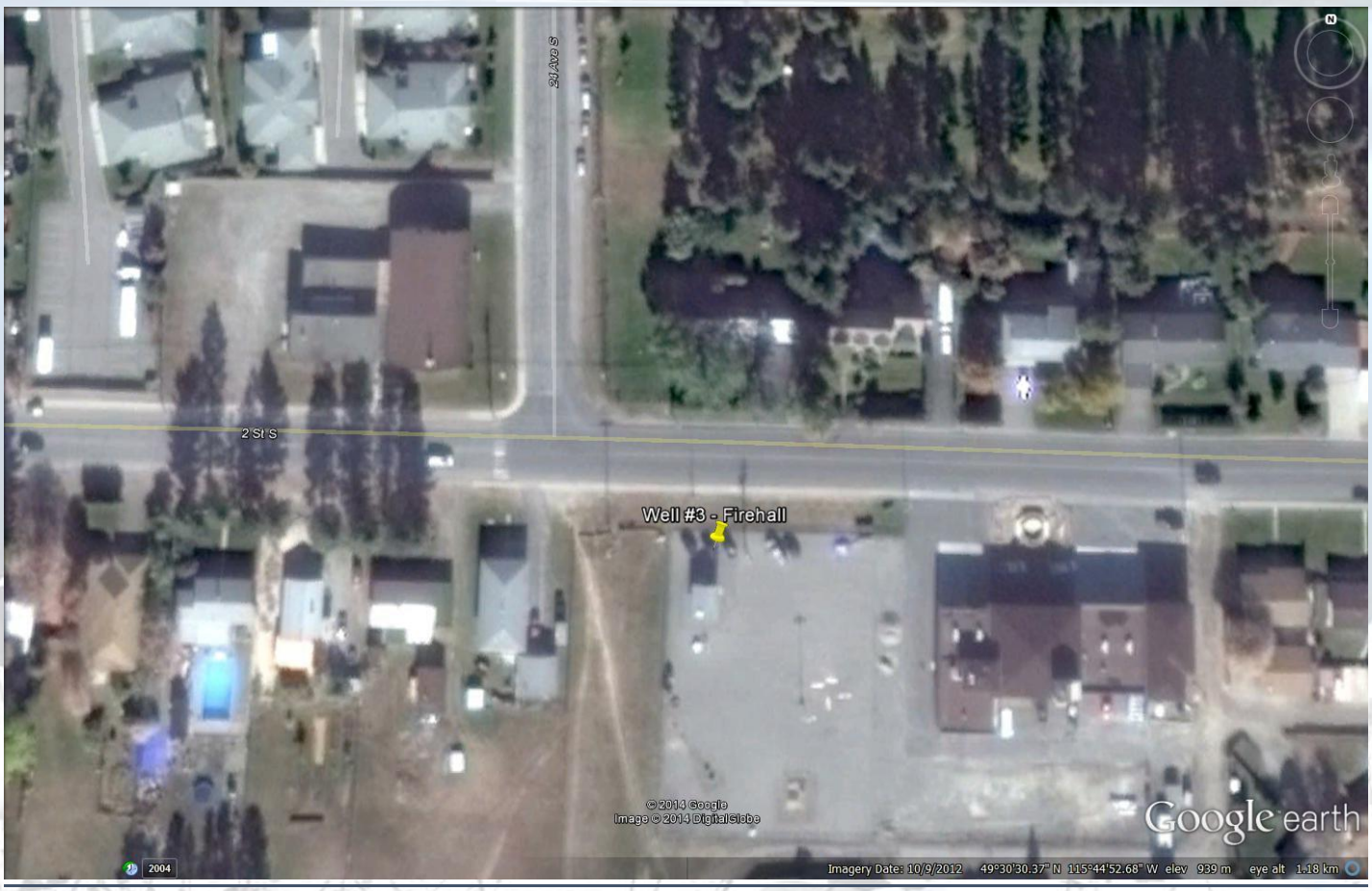

Fountain Estates
PR #4
7 St S
27a Ave S
28 Ave S
27 Ave S
8 St S
© 2014 Google
Image © 2014 DigitalGlobe
Google earth
2004
Imagery Date: 10/9/2012 49°30'07.31" N 115°44'38.37" W elev 970 m eye alt 1.28 km


PR #6
Mt Royal Dr
Mt Pyramid Crescent
Mt Fisher Dr N
Mt Fisher Dr
Adel Ave
Mt Royal Ridge
© 2014 Google
Image © 2014 DigitalGlobe
Google earth
2004
Imagery Date: 10/9/2012 49°31'36.16" N 115°44'01.92" W elev 960 m eye alt 1.43 km


PR #8
Wildstone Cr
Industrial Road F
Industrial Road G
Industrial Road I
© 2014 Google
Image © 2014 Digital Globe
Google earth
Imagery Date: 10/9/2012 49°32'13.37" N 115°45'28.41" W elev 929 m eye alt 1.42 km

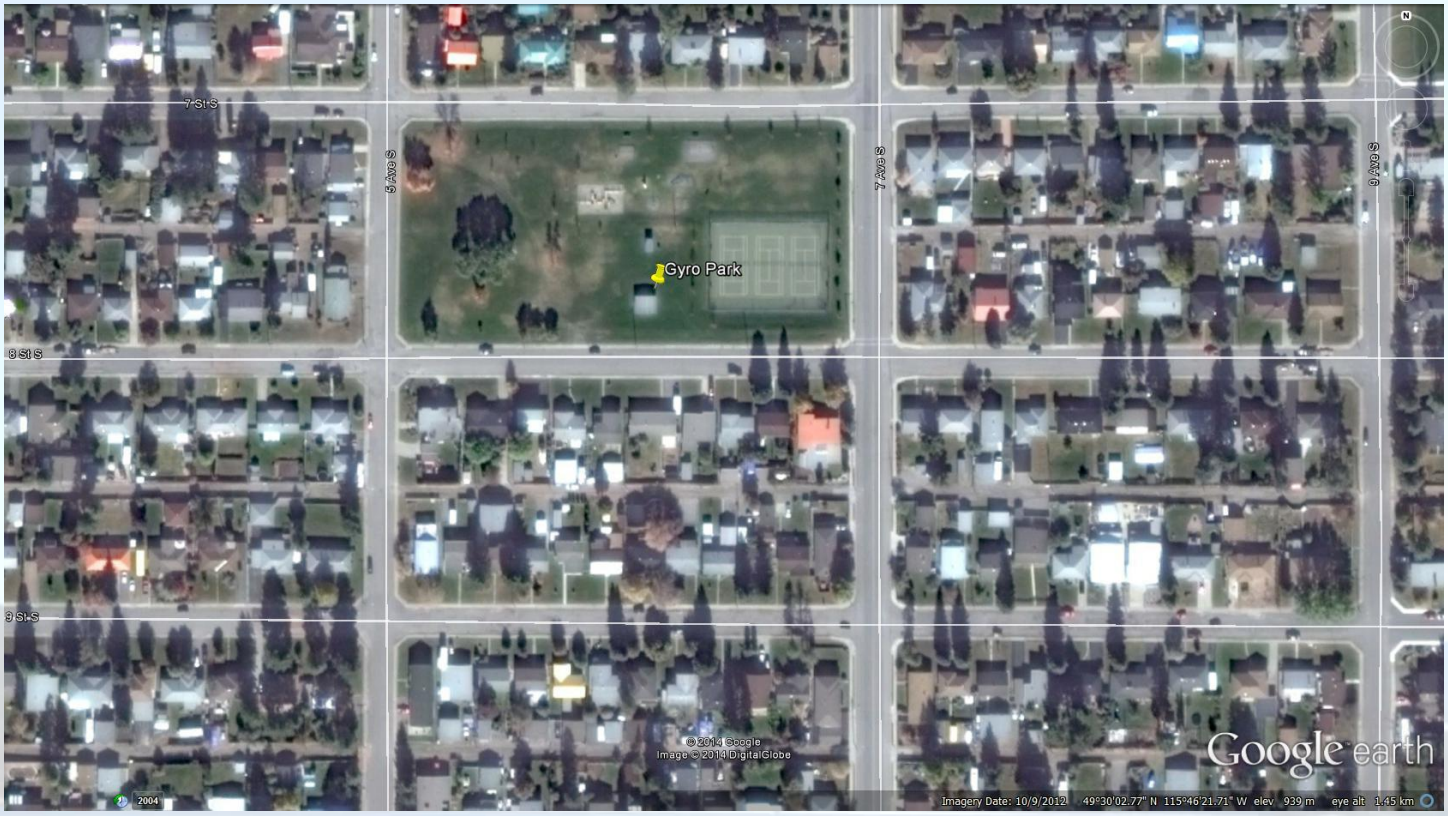

PR #9
Estella Field Rd
27 St NW
Industrial Road 2
Cranbrook Heights
© 2014 Google
Image © 2014 Digital Globe
Google earth
Imagery Date: 10/9/2012 49°32'17.47" N 115°46'03.87" W elev 968 m eye alt 1.42 km


PR #11
Eagle Ridge Crescent
Mt Joseph Pl N
Mt Pyramid Crescent
Mt Royal Dr
30 Ave N
Mt Procter Pl N
© 2014 Google
Image © 2014 DigitalGlobe
Google earth
2004
Imagery Date: 10/9/2012 49°31'39.34" N 115°44'19.51" W elev 920 m eye alt 1.28 km


2 St S
Well #3 - Firehall
© 2014 Google
Image © 2014 DigitalGlobe
Google earth
2004
Imagery Date: 10/9/2012 49°30'30.37" N 115°44'52.68" W elev 939 m eye alt 1.18 km


Van Horne St S
Wallisville St S
3
Joseph Creek Dr
Industrial Rd S
Well #4 - Confederation Park
© 2014 Google
Image © 2014 DigitalGlobe
Google earth
2005
Imagery Date: 10/9/2012 49°30'02.92" N 115°47'13.28" W elev 927 m eye alt 1.60 km


McBride St W
Lamb St W
Well #5 - Cobham Ave.
Cobham Ave W
Van Horne St S
3
Little Van Horne St S
Fink St W
© 2014 Google
Image © 2014 DigitalGlobe
Google earth
2004
Imagery Date: 10/9/2012 49°30'18.72" N 115°47'17.15" W elev 926 m eye alt 1.60 km


7 St S
8 St S
9 St S
6 Ave S
7 Ave S
9 Ave S
Gyro Park
© 2014 Google
Image © 2014 DigitalGlobe
Google earth
2004
Imagery Date: 10/9/2012 49°30'02.77" N 115°46'21.71" W elev 939 m eye alt 1.45 km


King St
Fairground St W
Cobham Ave W
Public Works Yard
Quarry
Van Horne St S
9 Ave S
© 2014 Google
Image © 2014 DigitalGlobe
Google earth
2004
Imagery Date: 10/9/2012 49°30'44.72" N 115°46'33.77" W elev 927 m eye alt 1.60 km

APPENDIX C –
STANDARD OPERATING PROCEDURES

Field Equipment Quality Control – Weekly Checks

Purpose:

The purpose of SOP is to assist Water Quality Operators to verify and ensure reliable results of water quality field equipment.

Equipment:

Field Equipment:
- Hach Colorimeter DR 9000
- Hach 2100Q Turbidimeter
- Hach HQ40d Multi parameter (conductivity, pH, Dissolved Oxygen)

Calibration Standards:
- Hach Turbidity Standards
- Hach DR Check Absorbance Standards
- pH Buffers (4,7,10)
- Conductivity Standard (1000 us/cm NaCl)
- Silicon Oil (conditioning sample cells)
- Lab Water (Deionized/Distilled)

Procedures:

Before leaving office to perform field testing of the water quality within the City of Cranbrook Water Distribution System verification of field equipment is required.

a) Make sure all field equipment is clean and free from any contaminants.
b) Condition all Sample Cells with Silicon Oil from kit. This will assist in filling minor scratches on bottle. If large or a lot of scratches, consider replacing sample cell.
c) Verify Instruments, following Instrument Operators Manuals
d) Check expiry date on all Standards. If expired do not use.

Hach 2100Q Turbidity Meter

a) Shake 10 NTU verification standard vigorously for 1 minute.
b) Let verification standard sit for 1 minute or until bubbles in cell have disappeared
c) Wipe off any smudge marks on side of cell
d) Press VERIFY CAL button, and follow prompts on screen.
e) If calibration verification passed, press done, you are now finished

If calibration verification has FAILED, continue with calibration of meter

a) Shake all turbidity standards vigorously for 1 minute
b) Allow bubbles in cells to dissipate
c) Press calibration button on the bottom left of meter
d) Wipe off ant smudge marks on sides of cells
e) Follow prompts on screen for all standards
f) Press STORE to save results
g) Reinsert verification and follow prompts
h) Press done, calibration is now complete

Hach HQ40d Multiparameter

a) Choose which probe you wish to verify (only one probe at a time)
b) Clean probe and wipe off excess water
c) Insert desired probe in calibration standard
- pH requires buffers 4,7,10
- Conductivity requires NaCl at 1000 us/cm

d) Press calibration button
e) Follow prompts from meter for each probe

EXO 1 Multiparameter Sonde Maintenance

a) Weekly
   I. visual checks
   II. clean sensors
b) Monthly
   I. clean and lubricate O-rings
   II. calibrate sensors
c) Annual
   I. Send sonde to YSI for maintenance and verification

How to Take a Water Sample

Sample Containers:

Containers must be appropriate for the type and volume for analysis requested. Samples collected for microbiological tests must be clean & sterile (i.e. zip lock bags). Chemistry samples must be in specially cleaned containers with specific preservatives. If you require containers, the laboratory will provide these upon request.

Sampling:

Always choose a sampling site that will be representative of the water to be tested. For example, if it is household drinking water, the kitchen tap is the best sampling site.
Never use gloves of any sort for weekly Distribution Bacteriological samples.

Household Tap

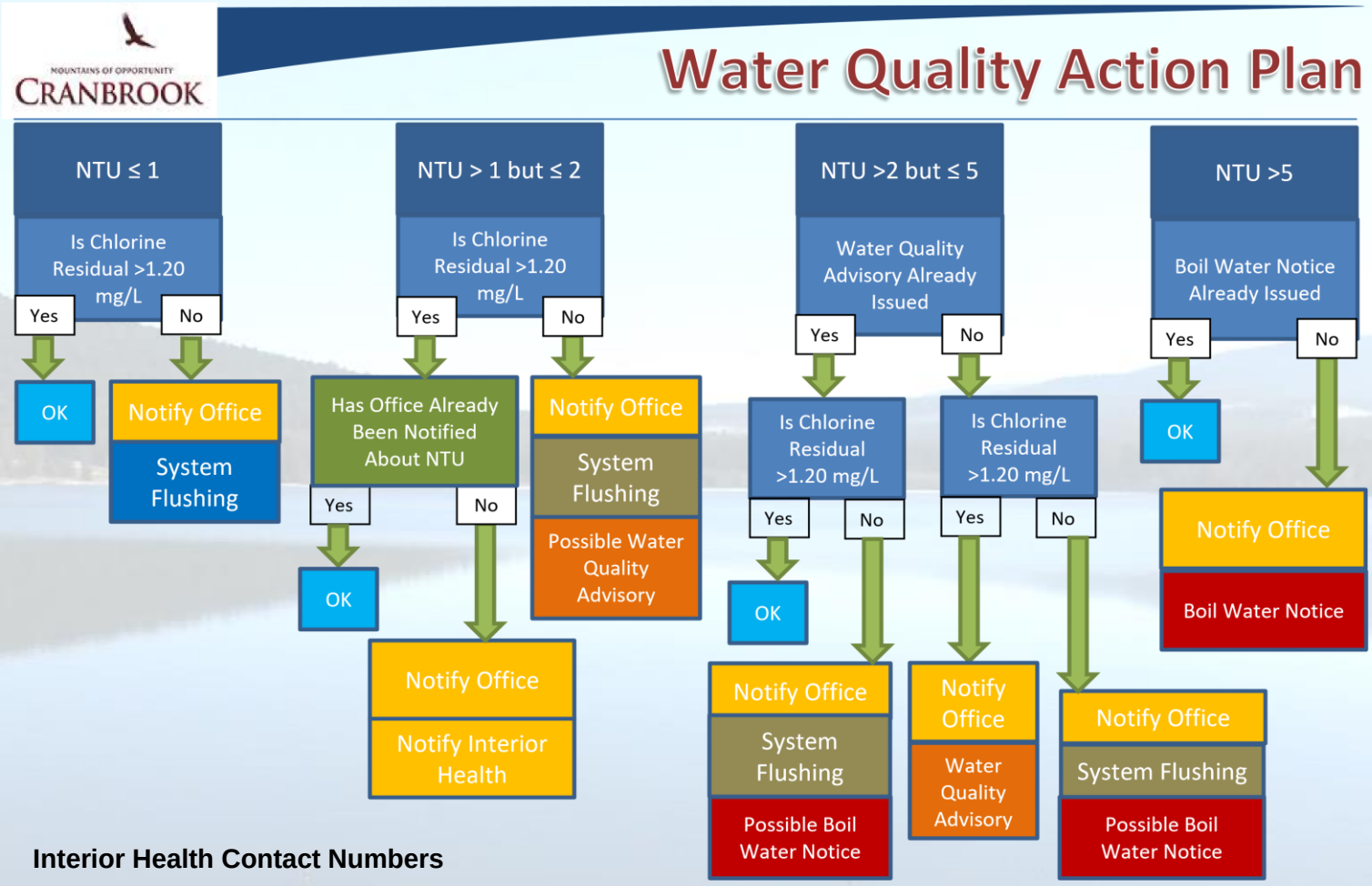
1. Keep the sample bottle closed until it is time to take the sample.
2. Remove any aerators or screens from the tap. Disinfect sample tap with Isopropanol
3. Let the water run for 2-3 minutes.
4. Restrict water flow to permit filling bottle without splashing.
5. Remove bottle cap, taking care to avoid soiling.
6. DO NOT touch the inside of the cap or neck of the bottle, and protect them from contamination.
7. NEVER RINSE the bottle
8. Hold the bottle near the base and fill; replace cap & tighten.
9. Keep the bottle out of sunlight and keep cool (DO NOT freeze)
10. Label the bottle with sample location, date, and time collected.
11. The sample must be delivered to the laboratory as soon as possible.

Rivers, Streams, Lakes or Reservoirs:

1. Select the sampling site(s) to be representative of the water supply. Choose a location that is deep enough to avoid bottom sediments and close to water intakes.
2. Remove bottle cap, taking care to avoid soiling.
3. DO NOT touch the inside of the cap or neck of the bottle, and protect them from contamination.
4. NEVER RINSE the bottle
5. Hold the bottle near the base, plunge the bottleneck downward below water surface.
6. Tip bottle upward INTO the water flow and AWAY from your hand. The water must flow into the bottle before it flows over your hand. If the water is still (as in a reservoir) move the bottle forward as it is tipped upward.
7. Replace the cap and tighten the lid
8. Keep the bottle out of sunlight and keep cool (but NOT frozen)
9. Label the bottle with sample location, date, and time collected.
10. The sample must be delivered to the laboratory as soon as possible.

Note: All samples for coliform analysis MUST be @ the laboratory within 30 hours to be considered valid by BC Ministry of Health

Appendix D -
Water Quality Action Plan



Interior Health Contact Numbers

Jennifer Beverley: 250-342-5658

Interior Health Authority
Medical Health Officer on Call 1-866-457-5648
This number is to be used only for emergency contact of a Medical Health Officer, outside of normal business hours (evenings and weekends).

Appendix E -
Weekly Sampling Schedule

WEEKLY SAMPLING SCHEDULE - DISTRIBUTION SYSTEM		
Distribution Route #1 Opposite Monday from Route #2 ***All Wells are sampled weekly when "PUMP ON"***		
Site and WaterTrax	**Bottle**	**Parameter**
Phillips Reservoir – Raw - 30666	200mL Plastic	Total/Fecal Coliforms, E. coli, Total Plate Count, Nutrients, field parameters
Phillips Reservoir – Potable - 30653	200mL Plastic	Total/Fecal Coliforms, E. coli, Total Plate Count, Nutrients, field parameters
PR #1 - 305F9	200mL Plastic	Total/Fecal Coliforms, E. coli, field parameters
PR #4 - 30672	200mL Plastic	Total/Fecal Coliforms, E. coli, field parameters
PR #9 - 305FB	200mL Plastic	Total/Fecal Coliforms, E. coli, field parameters
PR #11 - 305FC	200mL Plastic	Total/Fecal Coliforms, E. coli, field parameters
Well #3 (**When Pump OFF**) - 305FE Pump ON – Raw- 31E8C Pump ON – Pot. - 31E8B	200mL Plastic	Total/Fecal Coliforms, E. coli, field parameters
Well #5 – 30600 **(Pump OFF)** Pump ON –Raw – 3425F Pump ON – Potable – 3425E	200mL Plastic	Total/Fecal Coliforms, E. coli, field parameters
Gyro Park - 30673	200mL Plastic	Total/Fecal Coliforms, E. coli, field parameters
Lagoons WD Pre-treatment 4194E	200mL Plastic	Total/Fecal Coliforms, E. coli, field parameters
Lagoons WD Post Treatment 4194D	200mL Plastic	Total/Fecal Coliforms, E. coli, field parameters

Distribution Route #2 Opposite Monday from Route #1 ***All Wells are sampled weekly when "PUMP ON"***		
Site and WaterTrax	**Bottle**	**Parameter**
Phillips Reservoir – Raw - 30666	200mL Plastic	Total/Fecal Coliforms, E. coli, Total Plate Count, Nutrients, field parameters
Phillips Reservoir – Potable - 30653	200mL Plastic	Total/Fecal Coliforms, E. coli, Total Plate Count, Nutrients, field parameters
PR #2 – 305FA	200mL Plastic	Total/Fecal Coliforms, E. coli, Total Plate Count, Nutrients, field parameters
PR #6 – 3066E	200mL Plastic	Total/Fecal Coliforms, E. coli, field parameters
PR #8 – 30677	200mL Plastic	Total/Fecal Coliforms, E. coli, field parameters
PR #12 – 305FD	200mL Plastic	Total/Fecal Coliforms, E. coli, field parameters
Well #2 – 30675	200mL Plastic	Total/Fecal Coliforms, E. coli, field parameters
Well #4 – 305FF **(Pump OFF)** Pump ON – Raw – 3425C Pump ON – Potable – 3425E	200mL Plastic	Total/Fecal Coliforms, E. coli, field parameters
Public Works Yard – 3066D	200mL Plastic	Total/Fecal Coliforms, E. coli, field parameters
Chamber of Commerce – 3066F	200mL Plastic	Total/Fecal Coliforms, E. coli, field parameters
Lagoons WD Pre-treatment 4194E	200mL Plastic	Total/Fecal Coliforms, E. coli, field parameters
Lagoons WD Post Treatment 4194D	200mL Plastic	Total/Fecal Coliforms, E. coli, field parameters

Watershed & Catchment

Phillips Reservoir Raw & Potable (Nutrients) 4/9 collected during Winter Months

Site and WaterTrax	Bottle	Parameter
Site #3 – 3064E	200mL/500mL	Coliforms, E. coli, Nutrients, field parameters
Site #4 – 3064F	200mL/500mL	Coliforms, E. coli, Nutrients, field parameters
Site #5 - 30645	200mL/500mL	Coliforms, E. coli, Nutrients, field parameters
Site #6 - 30646	200mL/500mL	Coliforms, E. coli, Nutrients, field parameters
Site #7 – 30647	200mL/500mL	Coliforms, E. coli, Nutrients, field parameters
Site #9 - 30648	200mL/500mL	Coliforms, E. coli, Nutrients, field parameters
Site #9a-30651	200mL/500mL	Coliforms, E. coli, Nutrients, field parameters
Site #10-30650	200mL/500mL	Coliforms, E. coli, Nutrients, field parameters

Enteric Parasites

Site and WaterTrax	Bottle	Parameter
Site #7 – 30647	500L/ FILTERED	Cryptosporidium/Giardia
Site #9 - 30648	500L/ FILTERED	Cryptosporidium/Giardia
Site #10-30650	500L/ FILTERED	Cryptosporidium/Giardia
Phillips Reservoir – Raw – 30666	500L/ FILTERED	Cryptosporidium/Giardia

Phillips Reservoir – Pathogen Monitoring

Site and WaterTrax	Bottle	Parameter
Phillips Reservoir – Pot. – 30653	200mL/500mL	Nutrients/ field parameters
Phillips Reservoir – Raw – 30666	200mL/500mL/Filter	Nutrients/ field parameters/ Chlorophyll
Site #12 Epilimnion – 3065D	200mL/500mL/Filter	Coliforms, E. coli, Nutrients, field parameters/Chlorophyll
Site #12 Metalimnion – 3065E	200mL/500mL/Filter	Coliforms, E. coli, Nutrients, field parameters/Chlorophyll
Site #12 Hypolimnion – 3065F	200mL/500mL/Filter	Coliforms, E. coli, Nutrients, field parameters/Chlorophyll
Site #13 Epilimnion – 30660	200mL/500mL/Filter	Coliforms, E. coli, Nutrients, field parameters/Chlorophyll
Site #13 Metalimnion – 30661	200mL/500mL/Filter	Coliforms, E. coli, Nutrients, field parameters/Chlorophyll
Site #13 Hypolimnion - 30662	200mL/500mL/Filter	Coliforms, E. coli, Nutrients, field parameters/Chlorophyll
Site #14 Epilimnion - 30663	200mL/500mL/Filter	Coliforms, E. coli, Nutrients, field parameters/Chlorophyll
Site #14 Metalimnion – 30664	200mL/500mL/Filter	Coliforms, E. coli, Nutrients, field parameters/Chlorophyll
Site #14 Hypolimnion - 30665	200mL/500mL/Filter	Coliforms, E. coli, Nutrients, field parameters/Chlorophyll

Metals Scan+/Nutrients Sample (Quarterly)

Taken Monday During Distribution Samples January/April/July/October

Site and WaterTrax	Bottle	Parameter	Route
Phillips Reservoir – Potable – 30653	500mL x 2	Metals Scan+/Nutrients	Route 1
Phillips Reservoir – Raw – 30666	500mL x 2	Metals Scan+/Nutrients	Route 1
PR #1 – 305F9	500mL x 2	Metals Scan+/Nutrients	Route 1
PR #11 - 305FC	500mL x 2	Metals Scan+/Nutrients	Route 1
PR #9 - 305FB	500mL x 2	Metals Scan+/Nutrients	Route 1
Well #3 Pump ON – Raw- 31E8C	500mL x 2	Metals Scan+/Nutrients	Route 1
Well #4 Pump ON – Raw- 3425C	500mL x 2	Metals Scan+/Nutrients	Route 1

Disinfection By-Products/ B-TEX Group Schedule A = Quarterly Schedule B = Monthly (July-September) *Taken First Monday During Distribution Samples*			
Site and WaterTrax	**Bottle**	**Parameter**	**Schedule**
PR #1 – 305F9 – First User	40mL Glass x 2	THM / HAA	Schedule A (Jan./Apr./Jul./Oct.)
PR #8 – 30677 – First User	40mL Glass x 2	THM / HAA	Schedule A (Jan./Apr./Jul./Oct.)
Gyro Park – 30673 – Middle User	40mL Glass x 2	THM / HAA	Schedule A (Jan./Apr./Jul./Oct.)
Well #2 – 30675 – Middle User	40mL Glass x 2	THM / HAA	Schedule A / **Schedule B**
Public Works – 3066D – Middle User	40mL Glass x 2	THM / HAA	Schedule A / **Schedule B**
Wildstone Trunk – End User	40mL Glass x 2	THM / HAA	Schedule A / **Schedule B**
Well #3 - Pump ON – Raw - 31E8C	40mL Glass x 2	B-TEX	Schedule A (Jan./Apr./Jul./Oct.)
Well #4 – Pump ON – Raw – 3425C	40mL Glass x 2	B-TEX	Schedule A (Jan./Apr./Jul./Oct.)
Well #5 – Pump ON –Raw – 3425F	40mL Glass x 2	B-TEX	Schedule A (Jan./Apr./Jul./Oct.)
Lagoons WD Post Treatment 4194E	40mL Glass x 2	B-TEX	Schedule A (Jan./Apr./Jul./Oct.)

Projects are collected once per month on opposite weeks of each other except during Spring Runoff which is considered March to July, Watershed Samples Collected WEEKLY (Mondays) from Joseph Creek Confluence at Diversion Structure

Operators will take duplicate samples when the Free Chlorine Residual is less than 0.30 mg/L

MOUNTAINS OF OPPORTUNITY
CRANBROOK

Monitoring/Testing for Manganese

Summary:

Monitoring and testing for Manganese Levels in drinking water is vital for community well-being. Manganese occurs naturally in the environment and is widely distributed in air, water and soil. Manganese may be present in water in the environment from natural sources (rock and soil weathering) or as a result of human activity.

Guideline:

The maximum acceptable concentration (MAC) for total manganese in drinking water is 0.12 mg/L.

Health Effects:

Manganese is an essential element for humans. Deficiency is considered highly unlikely in Canada, as adequate amounts are obtained from food. Available studies are not adequate to support a link between manganese and cancer.

Aesthetic Considerations:

Concerns regarding the presence of manganese in drinking water are often related to consumer complaints regarding discolored water. The proposed aesthetic objective, (AO) of 0.02 mg/L would minimize the occurrence of discolored water complaints and improve consumer confidence in drinking water quality.

Distribution System:

Low levels of manganese in source or treated water, (current or historic) may accumulate in the distribution system and periodically lead to high levels of manganese at the tap. Most well-operated and optimized treatment facilities can achieve manganese concentrations of 0.015 mg/L or less in the treated water, which would minimize the accumulation of manganese and the associated potential release of manganese in the distribution system.

Application of the Guideline:

Considering that manganese levels can vary significantly in source water and within treatment facilities and distribution systems, it is necessary to design system-specific monitoring programs that enable utilities to have a good understanding of manganese levels from source to tap. The locations, frequency and type of samples that should be collected will differ, depending on the desired objective and site, specific considerations.

Monitoring:

Water sources should be characterized to determine if manganese is present. This should include sampling during periods when manganese is most likely to be elevated in surface waters, such as thermal stratification in the summer and lake turnover in the fall. Monitoring of surface water should be done quarterly, with weekly monitoring being done during summer and fall in lakes and reservoirs subject to large fluctuations in manganese concentrations. All sampling/testing will be performed by a certified, qualified Utilities Operator, to ensure that the MAC value does not exceed, 0.015 mg/L. The city will investigate the cause of manganese fluctuations and assess the risks to water users.

Manganese Testing Procedure:

-MAC Testing will be done by a certified/qualified Utilities Operator.

-Testing to be conducted:

- -On surface waters during thermal stratification in the summer, and lake turnover in the fall.
- -In the distribution system, after any hydraulic disturbances, (main breaks or hydrant flushing) or if there is any change in water chemistry, (pH, temp, source water type or uncontrolled source water blending, CL2 residual, or uncontrolled disinfectant blending.
- -Monitoring will be done during any discolored water event.
- -MAC is 0.12 mg/L (120 ug/L), aesthetic objectives (AO) for total Manganese in drinking water is 0.02 mg/L (20.0 ug/L) as indicated in the Guidelines for Canadian Drinking Water Quality: Technical Document.
- -Distribution sampling should be located where there are both increased risk factors for Manganese accumulation, (proximity to water treatment plant, pipe materials, biofilm).
- -For systems where Manganese is present in source water, including systems that are not treating their water for Manganese, the MAC applies to water, entering and within the distribution system.
- -Testing will be done HACH, MN-5 and Hanna HI97745c Field Kits
- -On regular Water Quality sampling routes, weekly.

-Definitions:

- -MAC: Maximum Acceptable Concentration
- -Manganese: Inorganic element found in rocks, soil and nodules in lakes
- -AO: Aesthetic Objective

Manganese Test Sites and Schedule:

Schedule:

Distribution Route (1) (Weekly with Test Kits)
-PR #1
-PR #4
-PR #9
-Well #3, Pump Off
-Well #3, Pump On, RAW and Potable
-Well #5, Pump Off
-Well #5 Pump On, RAW and Potable
-Gyro Park
-Phillips Reservoir, RAW and Potable = (With Test Kits) & (Monthly Samples to Lab)

Distribution Route (2) (Weekly with Test Kits)
-PR #2
-PR #6
-PR #8
-PR #12
-Well #4, Pump Off
-Well #4, Pump on RAW and Potable

High Flows Through the Treatment Plant: >6000 IG/min
-PR's 1, 2, 9 & 11 are a priority
-During Yearly Hydrant Flushing

Manganese Testing/Equipment:

-During testing, the Hanna digital handheld test kit will be used. Test kit samples will be compared with lab test for verification.

-If test samples are high, send sample to lab for analysis.

Test Kits:

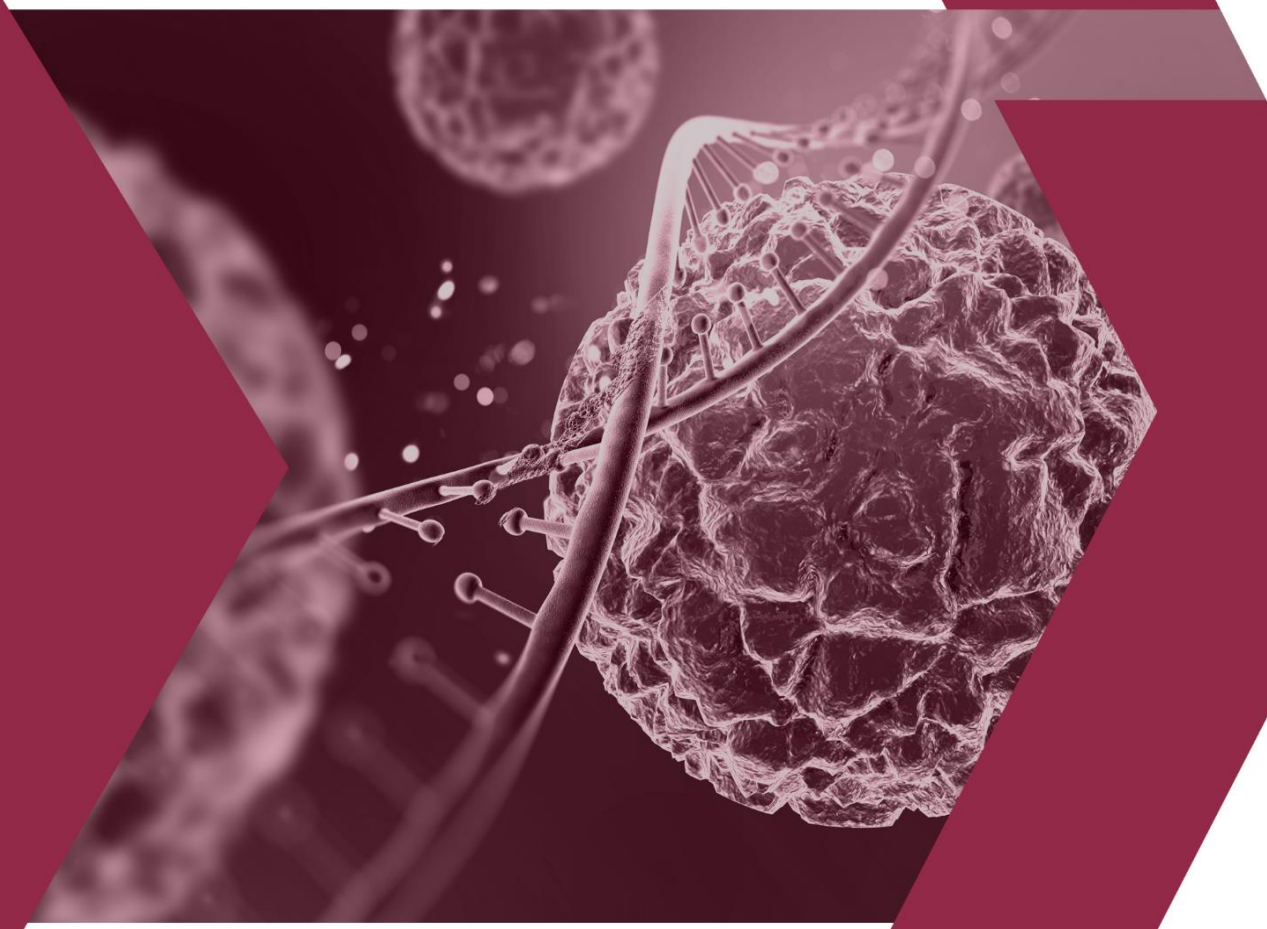
-Hanna HI97745c, field test kit.


HANNA
100%
09:11:34
0.51
mg/L
Iron LR (Fe)
Read
Methods
Zero
CAL Check
Iron Low Range
Manganese Low Range

-Guideline for Canadian Drinking Water Quality for Manganese

-Guidelines for Canadian Drinking Water Quality, (Guideline Technical Document) Manganese

https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-guideline-technical-document-manganese.html



MOUNTAINS OF OPPORTUNITY

CRANBROOK