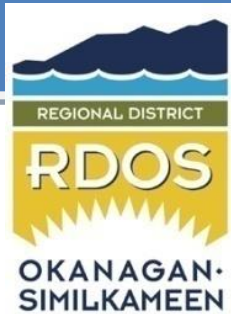
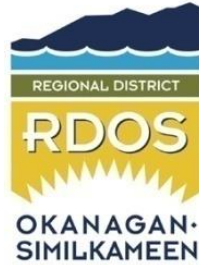


2023

ANNUAL WATER QUALITY MONITORING REPORT WILLOWBROOK WATER SYSTEM



Willowbrook Well Pump Station



**2023 ANNUAL WATER QUALITY MONITORING REPORT
WILLOWBROOK WATER SYSTEM
WILLOWBROOK, B.C.**

Copy prepared for:
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1. Introduction

As the owner and operator of the Willowbrook water system, the Regional District Okanagan-Similkameen is responsible for the following Annual Report summarizing the results from the 2023 *Water Quality Monitoring Program*. The report is a conditional requirement of the *Permit to Operate* issued by the Interior Health Authority (IHA) and the *BC Drinking Water Protection Act and Regulation*.

2. System Description

The Willowbrook water system is located within Electoral Area C, to the east between Oliver and Okanagan Falls. The water system consists of a shallow groundwater well, storage reservoir and a distribution system. The system supplies water to approximately 80 domestic services and provides fire protection to the community of Willowbrook. In 2020, the Interior Health Authority classified the Willowbrook well as Groundwater at Risk of Containing Pathogens, viruses only (GARP, viruses only). As a result, the groundwater is now treated with chlorine (sodium hypochlorite).

3. System Classification and Operator Certifications

3.1. System Classification

The *British Columbia Environmental Operators Certification Program (BC EOCP)* is responsible for the classification of potable water systems in BC. The Willowbrook distribution system remained classified as a *Small Water System (SWS)* in 2023.

3.2. Operator Certification

The *British Columbia Environmental Operators Certification Program (BC EOCP)* is also responsible for certification of all water system operators. Operators may hold certification(s) in the disciplines of Water Distribution and/or Water Treatment with four levels of certification achievable within each discipline. RDOS Operators annually attend courses, seminars and complete online training required to maintain their levels of certification. In addition, all operators annually continue to work on augmenting and furthering their levels of certification. All RDOS Operators are certified through the BC EOCP as indicated in the table below.

OPERATOR EOCP CERTIFICATION No.	WATER DISTRIBUTION CERTIFICATION LEVELS				WATER TREATMENT CERTIFICATION LEVELS			
	IV	III	II	I	IV	III	II	I
1162	X						X	
4194			X					
4840			X				X	
4839		X						X
6926		X						X
8266				X				X
8761		X						X
9322		X						X
1000977			X					X

Table 1: RDOS Operator Certifications 2023

4. Annual Water Usage

The source water for the Willowbrook water system is a shallow groundwater well. In 2023, a total of 151,660 m³ of water was pumped from the Willowbrook well, a slight increase from 146,092 m³ in 2022.

4.1. Consumption Records

	Cubic Meters (m ³)	US Gallons	Date
Annual Total Usage	151,660	38,221,180	
Minimum Daily Flow	97	25,625	December 8/23
Maximum Daily Flow	1,248	329,687	August 6/23

Table 2: Annual Water Consumption 2023

Both annual and monthly water consumption has been trended as shown in the following two graphs.

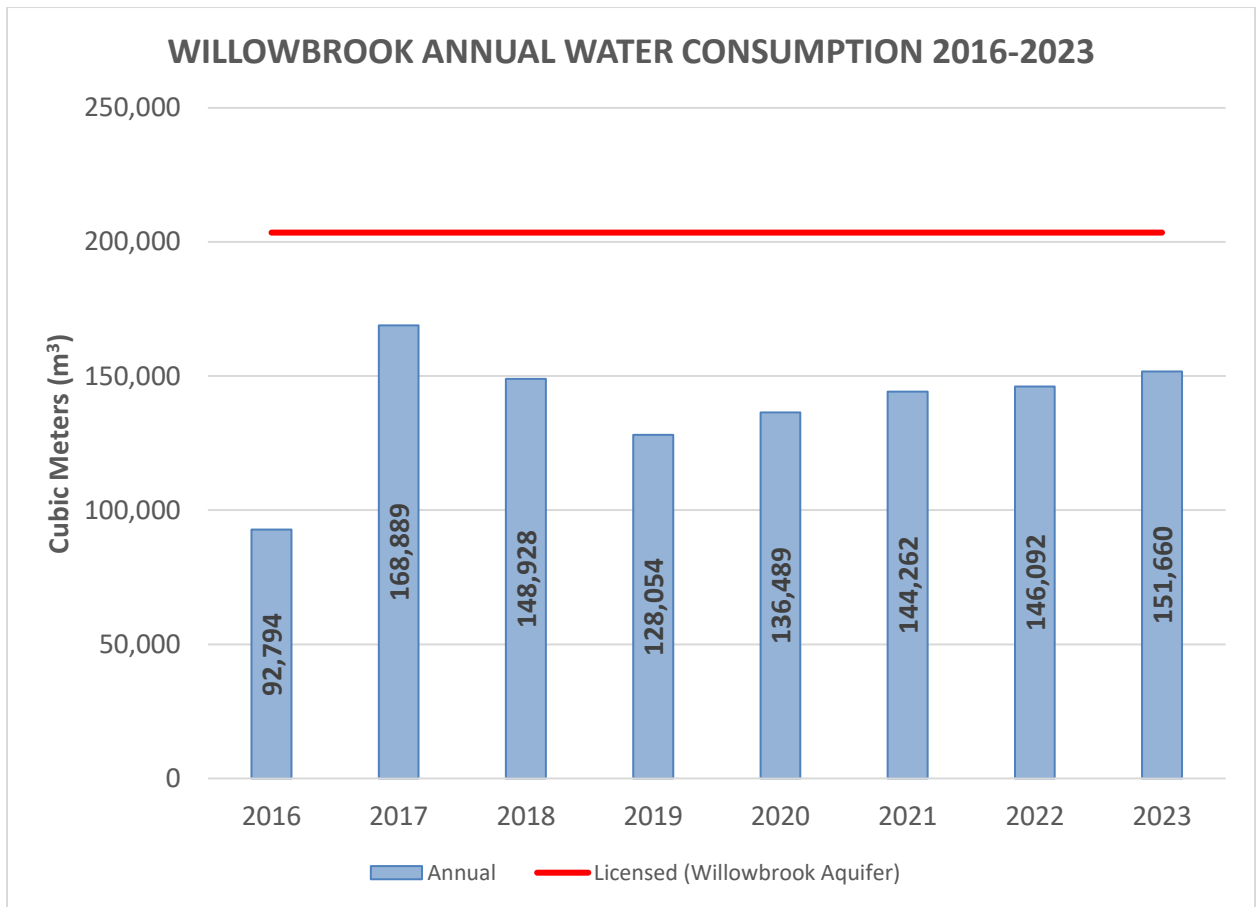


Figure 1: Annual Water Consumption 2016 to 2023

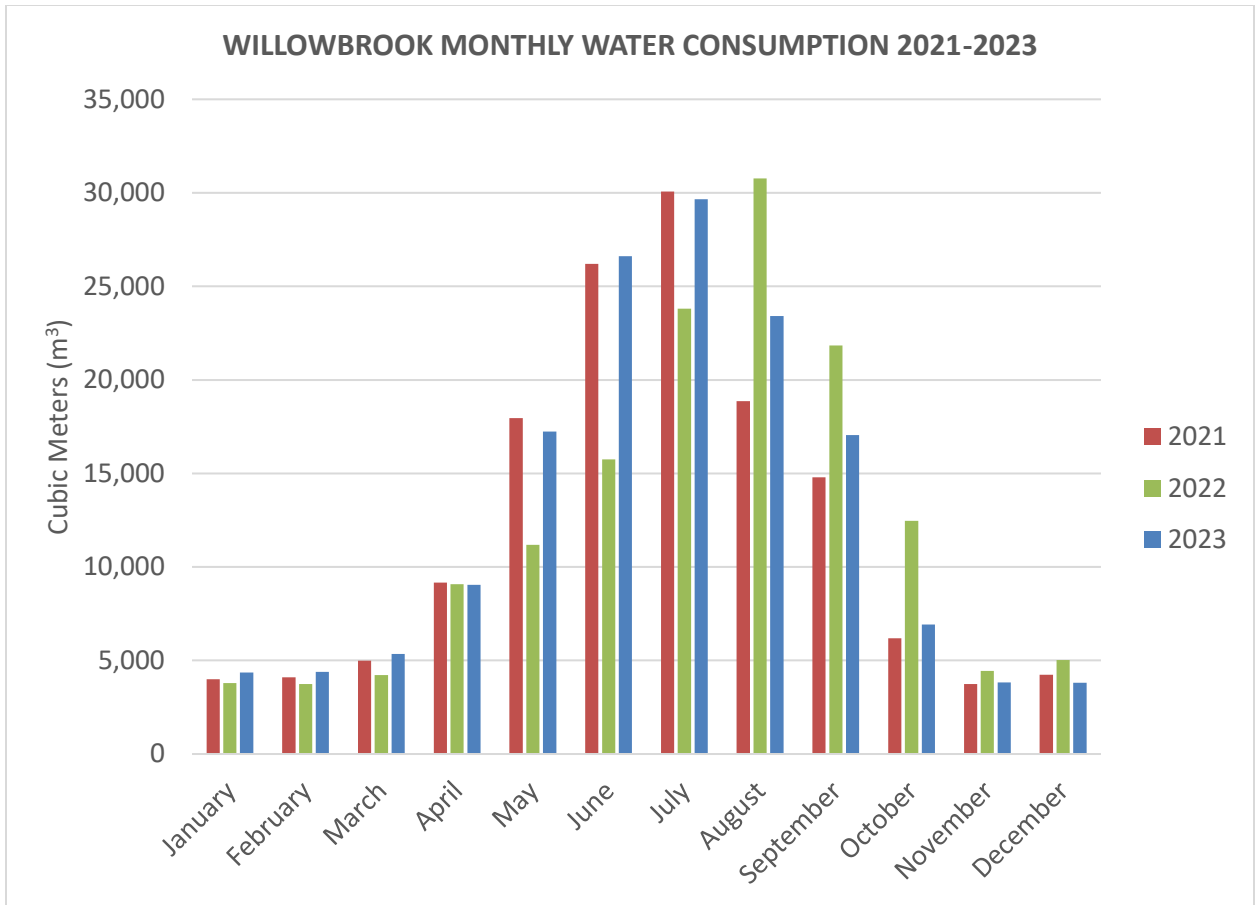


Figure 2: Monthly Water Consumption 2021 to 2023

4.2. Water Conservation

- On June 8, 2023, the Willowbrook water system moved from Stage “Normal” to Stage 1 water restrictions.
- On August 18, 2023, the Willowbrook water system moved from Stage 1 water restrictions to Stage 4 water restrictions in response to the Park Rill wildfire adjacent to Willowbrook.
- On September 1, 2023, the Willowbrook water system moved from Stage 4 water restrictions to Stage 3 water restrictions.
- On October 16, 2023, the Willowbrook water system moved from Stage 3 water restrictions to Stage “Normal”.

5. Aquifer Monitoring

The aquifer that the Willowbrook well draws from is monitored continuously by the Province as part of its Groundwater Observation Network. Observation Well No. 282 is located in Willowbrook on Myers Road. The RDOS currently uses this well for monitoring the Willowbrook aquifer.

In 2023, the measured recharge into the Willowbrook aquifer was more than the previous two years, however, the overall trend of the static level in the last five years still appears to be declining.

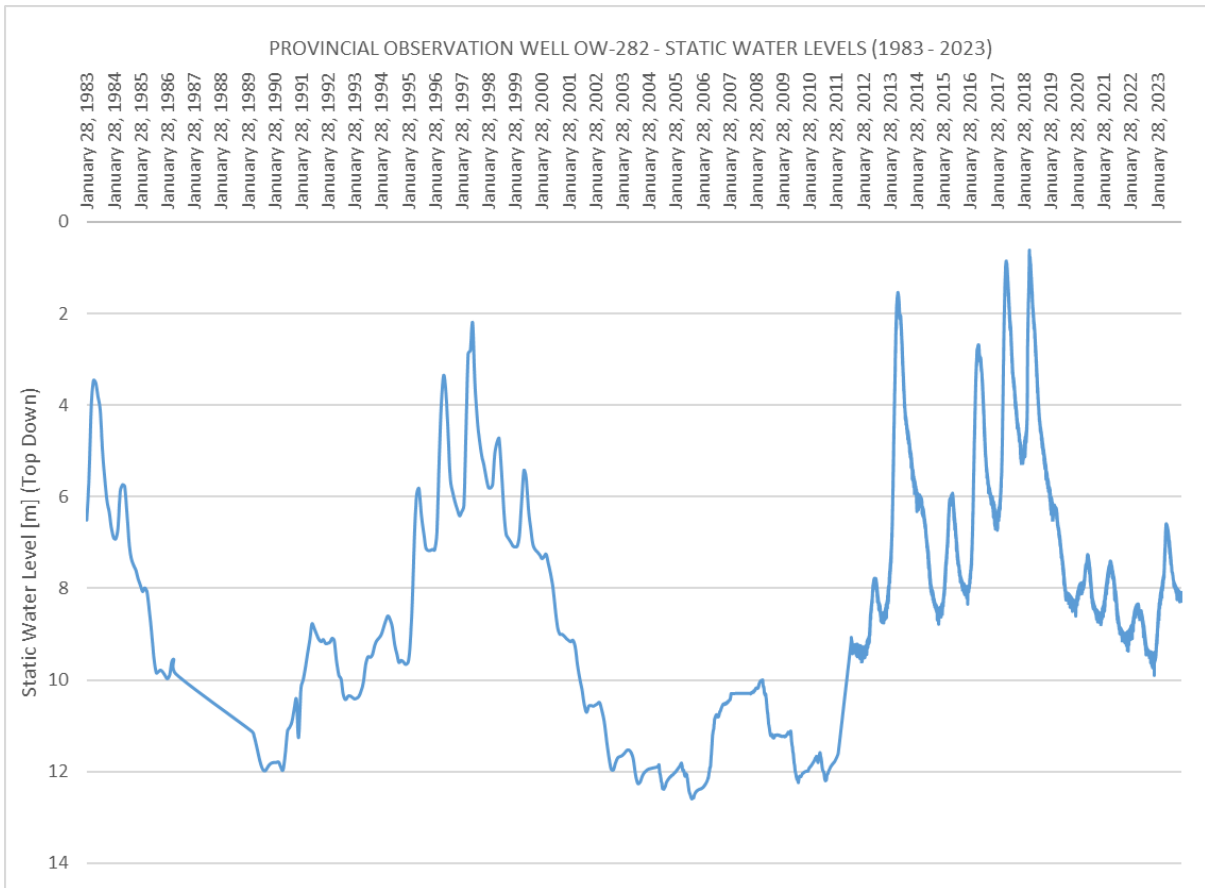


Figure 3: Willowbrook Aquifer Level, 1983 - 2023

6. Source Water Quality Monitoring

All untreated source water quality parameters are compared to the applicable criteria set out in the *British Columbia Drinking Water Protection Act and Regulation (DWPA)*, the *Guidelines for Canadian Drinking Water Quality (GCDWQ)*, Interior Health Authority programs and Operational Guidelines (OG). The *DWPA* and *GCDWQ* define these parameters and set Aesthetic Objectives (AO) and Maximum Acceptable Concentrations (MAC).

All 2023 accredited laboratory tests were performed by Caro Analytical Services (Kelowna, B.C.)

6.1. Source Water Bi-Weekly Monitoring

Bi-weekly monitoring of the Willowbrook well includes bacteriological grab samples and field measured parameters using field test kits. Samples from the well were analyzed for Total Coliforms and *Escherichia coli (E.coli)*. The groundwater source is considered “raw water” as the source is treated with chlorine. The table below summarizes the bacteriological laboratory results and the field measured parameters from the Willowbrook groundwater well.

Analyte	Unit	Average	Min	Max	Number of Results	Number of Results with Exceedances
Field Results						
Conductivity	µS/cm	936	869	1034	25	0
pH		7.49	7.23	7.79	25	0
Total dissolved solids	mg/L	665	617	734	25	0
Temperature	°C	9.1	7.5	10.7	25	0
Turbidity	NTU	0.18	0.07	0.44	24	0
Lab Results						
Microbiological						
Background bacteria	CFU/100 mL	<1	<1	<1	22	0
Total coliforms (counts)	CFU/100 mL	<1	<1	<1	26	0
E. coli (counts)	CFU/100 mL	<1	<1	<1	26	0

Table 3: Willowbrook Well Bi-Weekly Testing 2023 Summary

6.2. Source Water Potable Water Testing

Annually, the RDOS submits a sample of the untreated well water to an accredited lab for comprehensive potable water testing. The results of these test are compared against the *Guidelines for Canadian Drinking Water Quality*. The GCDWQ establishes Maximum Acceptable Concentration (MAC), Interim Maximum Allowable Concentrations (IMAC) and Aesthetic Objectives (AO) for parameters if applicable. In 2023, there were no exceedances of the guidelines in the Willowbrook groundwater well annual sample.

This comprehensive test includes physical parameters (e.g. color, turbidity, temperature, ultraviolet transmittance), chemical parameters (e.g. hardness, total metals and nutrients). Changes in these parameters may result in the need for water notifications for customers (i.e. Boil Water Notice or Water Quality Advisory) or the requirement for treatment processes to be implemented. The following tables display the results for the respective comprehensive potable water tests.

All 2023 accredited laboratory tests were performed by Caro Analytical Services (Kelowna, B.C.).

All tested source water parameters met the applicable guidelines in 2023 with no notable increasing or decreasing trends.

6.2.1. Source Water General Potability Parameters 2023

Analyte	Unit	Sampling Location		Well 13-Sep-21	Well 26-Sep-22	Well 06-Nov-23
		Date Sampled				
		Guideline				
		GCDWQ MAC	GCDWQ AO			
Lab Results						
General						
Alkalinity (total, as CaCO ₃)	mg/L	NG	NG	368	389	338
Total organic carbon	mg/L	NG	NG	2.53	2.16	4.36
Chloride	mg/L	NG	250	41.3	41.5	38.0
Colour	CU	NG	15	<5.0	<5.0	<5.0
Conductivity	µS/cm	NG	NG	959	942	914
Total cyanide	mg/L	0.2 ^{1.1}	NG	<0.0020	<0.0020	<0.0020
Fluoride	mg/L	1.5	NG	1.02	1.14	1.18
Hardness (as CaCO ₃), from total Ca/Mg	mg/L	NG	NG	405	396	414
Langelier Index		NG	NG	1.3	1.2	1.0
pH		NG	7.0 - 10.5 _{2.1}	8.18	8.24	8.10
Total dissolved solids (computed)	mg/L	NG	500	570	575	551
Sulphate	mg/L	NG	500 ^{2.2}	103	102	101
Sulphide (total, as S)	mg/L	NG	0.047 ^{2.3}	<0.020	<0.020	<0.020
Turbidity	NTU	N ^{1.2}	NG	0.12	<0.10	0.10
UV transmittance at 254 nm - filtered	%	NG	NG	91.7	91.6	90.3
UV transmittance at 254 nm - unfiltered	%	NG	NG			90.3
Nutrients						
Ammonia (total, as N)	mg/L	NG	NG	<0.050	<0.050	<0.050
Nitrate (as N)	mg/L	10	NG	2.24	2.28	2.13
Nitrite (as N)	mg/L	1	NG	<0.010	<0.010	<0.010
Potassium (total)	mg/L	NG	NG	3.44	3.32	3.56

See Guideline Notes in Section 6.2.2

Table 4: Willowbrook Well General Potability Parameters 2021 to 2023

6.2.2. Guidelines Notes for General Potability Parameters

1. Notes for Guidelines for Canadian Drinking Water Quality - Maximum Acceptable Concentrations (GCDWQ MAC)

Note 1.1 for Total cyanide:

The MAC for free cyanide is 0.2 mg/L. A maximum of 0.2 mg/L was used, in this report, to identify exceedances for total cyanide as a means for determining the potential for exceeding the free cyanide guideline.

Note 1.2 for Turbidity:

Waterworks systems that use a surface water source or a groundwater source under the direct influence of surface water should filter the source water to meet health-based turbidity limits, as defined for specific treatment technologies. Where possible, filtration systems should be designed and operated to reduce turbidity levels as low as possible, with a treated water turbidity target of less than 0.1 NTU at all times. Where this is not achievable, the treated water turbidity levels from individual filters should meet the requirements described in GCDWQ. For systems that use groundwater that is not under the direct influence of surface water, which are considered less vulnerable to faecal contamination, turbidity should generally be below 1.0 NTU. For effective operation of the distribution system, it is good practice to ensure that water entering the distribution system has turbidity levels below 1.0 NTU.

2. Notes for Guidelines for Canadian Drinking Water Quality - Aesthetic Objectives (GCDWQ AO)

Note 2.1 for pH:

The operational guideline for pH is a range of 7.0 to 10.5 in finished drinking water.

Note 2.2 for Sulphate:

There may be a laxative effect in some individuals when sulphate levels exceed 500 mg/L. Health authorities should be notified of drinking water sources containing above 500 mg/L.

Note 2.3 for Sulphide (total, as S):

The aesthetic objective for sulphide (as H₂S) is 0.05 mg/L. This is equivalent to 0.047 mg/L sulphide (as S).

6.2.3. Source Water Total Metals 2021 - 2023

Analyte	Unit	Guideline		Sampling Location Date Sampled		
		GCDWQ MAC	GCDWQ AO	Well 13-Sep-21	Well 26-Sep-22	Well 06-Nov-23
Lab Results						
Total Metals						
Aluminum (total)	mg/L	2.9 ^{1.1}	0.100 ^{2.1}	0.0068	<0.0050	<0.0050
Antimony (total)	mg/L	0.006	NG	<0.00020	<0.00020	<0.00020
Arsenic (total)	mg/L	0.010 ^{1.2}	NG	0.00060	<0.00050	0.00056
Barium (total)	mg/L	2.0 ^{1.3}	NG	0.0799	0.0802	0.0851
Boron (total)	mg/L	5	NG	<0.0500	<0.0500	0.0530
Cadmium (total)	mg/L	0.007 ^{1.4}	NG	<0.000010	<0.000010	<0.000020
Calcium (total)	mg/L	NG	NG	87.0	86.8	92.1
Chromium (total)	mg/L	0.05	NG	0.00064	0.00174	<0.00050
Cobalt (total)	mg/L	NG	NG	<0.00010	<0.00010	<0.00010
Copper (total)	mg/L	2 ^{1.5}	1	0.00492	0.00378	0.00344
Iron (total)	mg/L	NG	0.3	0.013	<0.010	<0.010
Lead (total)	mg/L	0.005 ^{1.6}	NG	<0.00020	<0.00020	<0.00020
Magnesium (total)	mg/L	NG	NG	45.6	43.6	44.6
Manganese (total)	mg/L	0.12 ^{1.7}	0.02 ^{2.2}	0.00028	0.00029	0.00022
Mercury (total)	mg/L	0.001	NG	<0.000010	<0.000010	<0.000010
Molybdenum (total)	mg/L	NG	NG	0.00998	0.0101	0.0136
Nickel (total)	mg/L	NG	NG	0.00076	0.00085	0.00043
Selenium (total)	mg/L	0.05	NG	<0.00050	<0.00050	<0.00050
Sodium (total)	mg/L	NG	200	55.2	50.1	56.1
Strontium (total)	mg/L	7.0 ^{1.8}	NG	3.11	3.34	
Uranium (total)	mg/L	0.02	NG	0.00839	0.00749	0.00967
Zinc (total)	mg/L	NG	5.0	0.0242	0.0103	0.0114

See Guideline Notes in Section 6.2.4

Table 5: Willowbrook Well Total Metals Potability 2021 to 2023

6.2.4. Guideline Notes for Total Metals Potability

1. Notes for Guidelines for Canadian Drinking Water Quality - Maximum Acceptable Concentrations (GCDWQ MAC)

Note 1.1 for Aluminum (total): The maximum acceptable concentration (MAC) for total aluminum in drinking water is 2.9 mg/L (2,900 µg/L) based on a locational running annual average of a minimum of quarterly samples taken in the distribution system. (Update March 5, 2021)

Note 1.2 for Arsenic (total): Every effort should be made to maintain arsenic levels in drinking water as low as reasonably achievable.

Note 1.3 for Barium (total): Update January 24, 2020. The MAC was revised from 1.0 mg/L to 2.0 mg/L.

Note 1.4 for Cadmium (total): A maximum acceptable concentration (MAC) of 0.007 mg/L (7 µg/L) is established for total cadmium in drinking water, based on a sample of water taken at the tap. (Update July 14, 2020).

Note 1.5 for Copper (total): A maximum acceptable concentration (MAC) of 2 mg/L is established for total copper in drinking water, based on a sample of water taken at the tap. Guidelines for Canadian Drinking Water Quality - Guideline Technical Document on Copper, June 2019.

Note 1.6 for Lead (total): The maximum acceptable concentration (MAC) for total lead in drinking water is 0.005 mg/L (5 µg/L), based on a sample of water taken at the tap and using the appropriate protocol for the type of building being sampled. Every effort should be made to maintain lead levels in drinking water as low as reasonably achievable (or ALARA). (GCDWQ: Guideline Technical Document; March, 2019)

Note 1.7 for Manganese (total): Guidelines for Canadian Drinking Water Quality - Guideline Technical Document on manganese, May 2019.

Note 1.8 for Strontium (total): Guidelines for Canadian Drinking Water Quality - Guideline Technical Document on strontium, May 2019.

2. Notes for Guidelines for Canadian Drinking Water Quality - Aesthetic Objectives (GCDWQ AO)

Note 2.1 for Aluminum (total): The operational guidance (OG) value for total aluminum in drinking water is 0.100 mg/L (100 µg/L) to optimize water treatment and distribution system operations. This value is based on a locational running annual average. The sampling frequency required to calculate the locational running annual average will vary based on the type of treatment facility and the sampling location. (Update March 5, 2021)

Note 2.2 for Manganese (total): Guidelines for Canadian Drinking Water Quality - Guideline Technical Document on manganese, May 2019.

7. Distribution System Water Quality

All treated distribution water quality parameters are compared to the applicable criteria set out in the *British Columbia Drinking Water Protection Act and Regulation (DWPA)*, the *Guidelines for Canadian Drinking Water Quality (GCDWQ)*, Interior Health Authority programs and Operational Guidelines (OG). The *DWPA* and *GCDWQ* define these parameters and set Aesthetic Objectives (AO) and Maximum Acceptable Concentrations (MAC).

All accredited laboratory tests in 2023 were performed by Caro Analytical Services (Kelowna, B.C.)

7.1. Distribution System Bacteriological Results

The Willowbrook distribution system has two dedicated sample stations that are alternated between bi-weekly. Samples from the distribution system were analyzed for Total Coliforms and *Escherichia coli (E.coli)*. Schedule A of the *BC Drinking Water Protection Regulation* provides bacteriological testing criteria as given below.

Schedule A

Water Quality Standards for Potable Water
(sections 2 and 9)

Parameter:	Standard:
Fecal coliform bacteria	No detectable fecal coliform bacteria per 100 ml
<i>Escherichia coli</i>	No detectable <i>Escherichia coli</i> per 100 ml
Total coliform bacteria	
(a) 1 sample in a 30 day period	No detectable total coliform bacteria per 100 ml
(b) more than 1 sample in a 30 day period	At least 90% of samples have no detectable total coliform bacteria per 100 ml and no sample has more than 10 total coliform bacteria per 100 ml

In 2023, all distribution samples had no detections for total coliforms or *E.coli*. The following is a summary of the bacteriological laboratory results from the treated water distribution system.

Analyte	Sampling Location	Unit	Average	Min	Max	Number of Results	Number of Results with Exceedances
Lab Results: Microbiological							
Background bacteria	Green Lake and Meyers Rd	CFU/100 mL	<1	<1	<1	11	0
	Green Lake Rd North	CFU/100 mL	<1	<1	<1	2	0
	Green Lake Rd South	CFU/100 mL	<1	<1	<1	12	0
Total coliforms (counts)	Green Lake and Meyers Rd	CFU/100 mL	<1	<1	<1	13	0
	Green Lake Rd North	CFU/100 mL	<1	<1	<1	2	0
	Green Lake Rd South	CFU/100 mL	<1	<1	<1	13	0
E. coli (counts)	Green Lake and Meyers Rd	CFU/100 mL	<1	<1	<1	13	0
	Green Lake Rd North	CFU/100 mL	<1	<1	<1	2	0
	Green Lake Rd South	CFU/100 mL	<1	<1	<1	13	0

Table 6: Distribution Water Bacteriological Testing 2023 Summary

7.2. Distribution System Free Chlorine Residuals

The following is a summary of the free chlorine residual measurements from the distribution system. Free chlorine is measured with bacteriological samples. Free chlorine residuals are required to be maintained between 0.2 mg/L and 2.0 mg/L of free chlorine.

Analyte	Sampling Location	Unit	Average	Min	Max	Number of Results	Number of Results with Exceedances
Field Results							
Chlorine (free)	Green Lake and Meyers Rd	mg/L	0.51	0.42	0.59	12	0
	Green Lake Rd South	mg/L	0.60	0.33	0.86	14	0

Table 7: Distribution Free Chlorine Residuals 2023 Summary

7.3. Distribution System Water Quality Field Parameters

The following is a summary of the field parameters that are measured routinely in the distribution system.

Analyte	Sampling Location	Unit	Average	Min	Max	Number of Results	Number of Results with Exceedances
Field Results							
Conductivity	Green Lake and Meyers Rd	µS/cm	921	870	1037	10	0
	Green Lake Rd North	µS/cm	998	998	998	1	0
	Green Lake Rd South	µS/cm	940	866	1028	14	0
pH	Green Lake and Meyers Rd		7.44	7.23	7.64	10	0
	Green Lake Rd North		7.08	7.08	7.08	1	0
	Green Lake Rd South		7.53	7.34	7.74	14	0
Total dissolved solids	Green Lake and Meyers Rd	mg/L	659	617	735	10	0
	Green Lake Rd North	mg/L	708	708	708	1	0
	Green Lake Rd South	mg/L	663	614	726	14	0
Temperature	Green Lake and Meyers Rd	°C	9.5	3.9	14.9	10	0
	Green Lake Rd North	°C	14	14	14	1	0
	Green Lake Rd South	°C	9	6.5	13.2	14	0
Turbidity	Green Lake and Meyers Rd	NTU	0.09	0.05	0.14	11	0
	Green Lake Rd North	NTU	0.32	0.32	0.32	1	0
	Green Lake Rd South	NTU	0.14	0.09	0.24	13	0

Table 8: Distribution Field Measured Parameters 2023 Summary

7.4. Water Quality Complaints

None to report for 2023.

8. Water System Notifications

The Interior Health Authority's team of drinking water officers are responsible for providing the oversight to ensure compliance and drinking water safety. The IHA is responsible for issuing *Permits to Operate* to drinking water systems. The Interior Health Authority has four types of water notifications to inform users of negative impacts to water quality.

8.1. Water Quality Advisory (WQA)

There is some level of risk associated with consuming the drinking water but a Boil Water Notice is not needed. The risk is elevated for people with weakened immune systems, the elderly and infants and young children.

No WQAs issued for 2023.

8.2. Boil Water Notice (BWN)

There are organisms in the water that can make you sick. To safely consume (swallow) the water, you must bring it to a rolling boil for at least 60 seconds, or use a safe alternate source of water.

No BWNs issued in 2023.

8.3. Do Not Consume (DNC)

There are harmful chemicals or other bad things in the water that can make you sick. You cannot make the water safe by boiling. The water can make you sick if you consume (swallow) it. You cannot use the water for drinking, brushing teeth, washing/preparing/cooking food or pet's drinking water. You can bath, shower and water plants and gardens with the water.

No DNCs issued in 2023.

8.4. Do Not Use (DNU)

There are known microbial, chemical or radiological contaminants in the water and that any contact with the water with the skin, lungs or eyes can be dangerous. Do not turn on your tap for any reason and do not use your water. You CANNOT make the water safe by boiling it.

No DNUs issued in 2023.

9. Program Updates and Status

9.1. Cross Connection Control Program

A cross connection is any actual or potential connection between the drinking water (potable) system and a non-potable substance (contaminant). Backflow is when the flow of water in a pipe reverses from the normal direction. When a cross connection and backflow occur simultaneously often the result is a contaminant entering the drinking water system.

Cross connection in plumbing systems require backflow preventers corresponding to the degree of hazard as indicated by the CSA B64.10, “Manual for the Selection and Installation of Backflow Preventers”, as referenced in the BC Plumbing Code, or as determined by a CCC hazard assessment survey.

The RDOS adopted a Regional CCC Bylaw, No.2851, in 2020 to address cross connection and backflow prevention applicable to all agricultural, industrial, commercial and institutional properties. These property uses are required to have a suitable backflow protection device installed.

In February, 2023 the RDOS started implementation of its Regional Cross Connection Control program with MTS Inc. (Vernon, B.C.) contracted as the program administrator.

9.2. Capital Works / System Additions

No items of note in 2023.

9.3. Emergency Response Plan

The *Emergency Response Plan* is scheduled to be updated in 2024.

9.4. Future System Upgrades

The RDOS’s Engineering Services issued a Request for Proposals (RFP) in early 2022 for the design of a new storage reservoir for the Willowbrook water system. ECORA Engineering (Penticton, B.C.) was awarded the design of the new reservoir and have produced a Preliminary Design Report for the RDOS. The RDOS applied for grant funding which would cover 100% of the estimated 2 million dollars to construct the new reservoir, however, this grant application was unsuccessful. The RDOS will continue to explore funding opportunities in order to keep moving forward toward the construction of a new storage reservoir.

9.5. Supervisory Control and Data Acquisition (SCADA System)

No items of note in 2023.

9.6. System Maintenance/Upgrades

No items of note in 2023.

9.7. Water Quality Monitoring Program

The Water Quality Monitoring Program is scheduled to be updated in 2024.

10. Summary

All tested source water parameters from the Willowbrook groundwater well met the applicable criteria in 2023. All tested distribution water parameters met the applicable criteria in 2023. The operation of the Willowbrook system by a team of RDOS *EOCP* certified Operators resulted in the continuous supply of high quality water to the community of Willowbrook. The RDOS continues to work on reviewing and upgrading the various programs that support facilitating the highest quality of water possible.