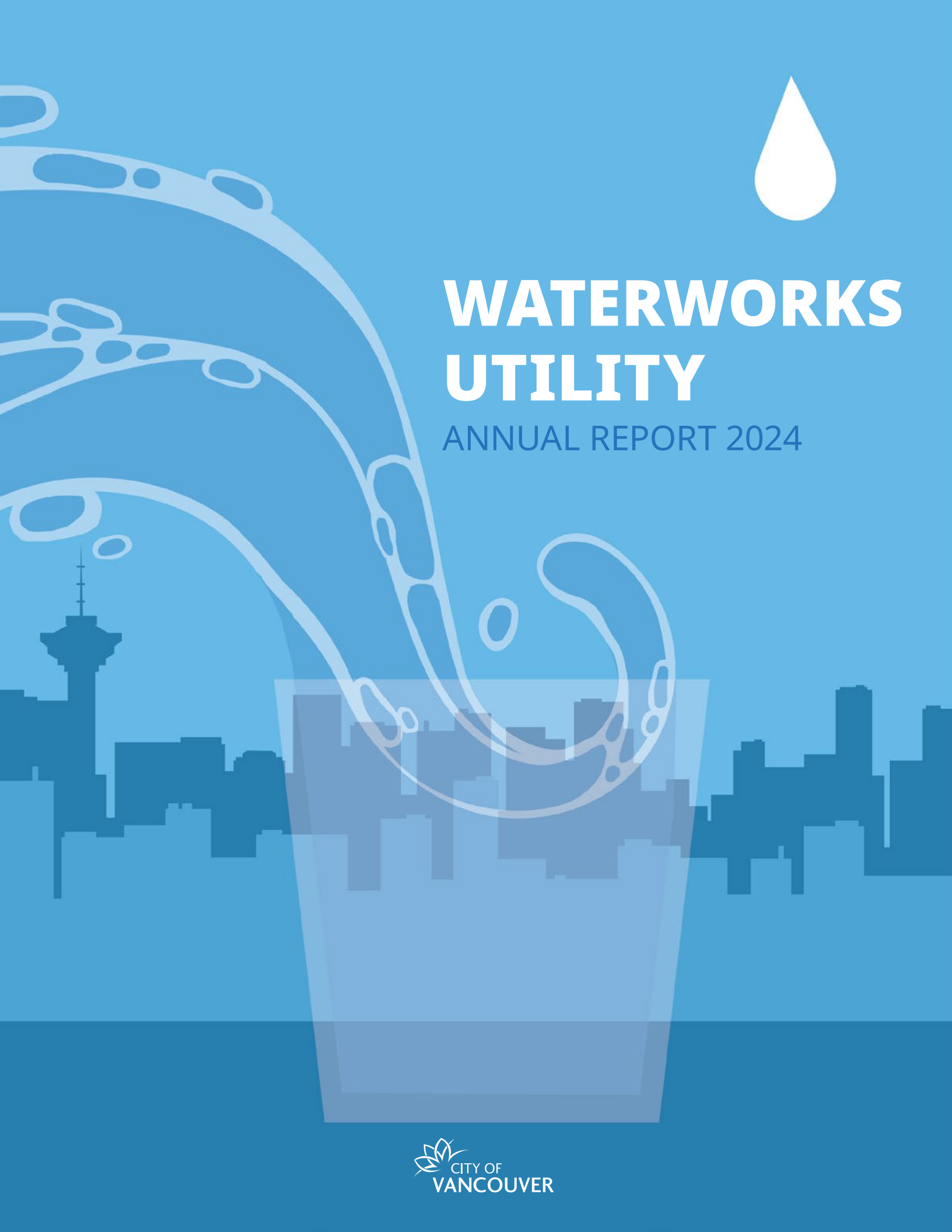

WATERWORKS UTILITY

ANNUAL REPORT 2024

CITY OF VANCOUVER

The 2024 Waterworks Utility Annual Report cover pages were designed by Izzy Law, a Media Arts student at Sir Charles Tupper Secondary School.

Waterworks Utility Annual Report 2024

The City of Vancouver acknowledges that it is situated on
the traditional, ancestral and unceded territories of
the xʷməθkʷəy̓əm (Musqueum) Indian Band,
the Sḵwx̱wú7mesh (Squamish) Nation, and
the səl̓ilwətaʔɬ / sel̓íl̓witulh (Tsleil-Waututh) Nation,
who continue to steward and protect the lands and waterways
since time immemorial.

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Acronyms and Abbreviations

AMI	Advanced Metering Infrastructure
AO	Aesthetic Objective
BCDWPA	British Columbia Drinking Water Protection Act
BCDWPR	British Columbia Drinking Water Protection Regulation
BSP	Broadway Subway Plan
°C	Degrees Celsius
CFU	Colony Forming Units
Cl_2	Chlorine
DBP	Disinfection By-product
E. coli	*Escherichia coli*
ERP	Emergency Response Plan
GCDWQ	Guidelines for Canadian Drinking Water Quality
HAA	Haloacetic Acid
HPC	Heterotrophic Plate Count
K	Thousands
km	Kilometre
m	Metre
M	Million
MAC	Maximum Acceptable Concentration
mg/L	Milligram per Litre
mL	Millilitre
mm	Millimetre
N/A	Not Available
NTU	Nephelometric Turbidity Unit
pH	Measure of acidity or basicity; pH 7 is neutral
ppb	Parts per Billion
ppm	Parts per Million
SaaS	Software as a Service
THM	Trihalomethane
UDCL	Utility Development Cost Levy
µg/L	Micrograms per Litre
VOCs	Volatile Organic Carbons
WDMS	Water Demand Management Strategy
WQMRP	Water Quality Monitoring and Reporting Plan for Metro Vancouver and Local Government Members

Useful Contacts and Websites

City of Vancouver	vancouver.ca	☎ 3-1-1 Make a request online: Van311
Metro Vancouver Water Services	metrovancouver.org/services/water	☎ 604-432-6200
Vancouver Coastal Health	vch.ca	☎ 604-675-3800
Health Canada	canada.ca/en/health-canada.html	☎ 1-833-784-4397
Waterworks Bylaw 4848	bylaws.vancouver.ca/4848c.PDF	
Drinking Water Sampling Results	vancouver.ca/home-property-development/drinking-water-monitoring-and-results.aspx	
City of Vancouver: Water Quality and Water Pressure	vancouver.ca/home-property-development/problems-with-water-quality-or-pressure.aspx	
How to Check your Toilet for Leaks	youtube.com/watch?v=3TtNRUf7-lg	
The Irrigation Assessment Program	youtube.com/watch?v=SJ4A54jkpMk	
City of Vancouver: Traffic Impacts and Construction Projects	vancouver.ca/streets-transportation/roadwork.aspx	

Executive Summary

This report summarizes the City of Vancouver Waterworks Utility activities and program outcomes for the year 2024. It includes a financial summary for the year, and provides in-depth information on Waterworks performance in programs for:

- Drinking Water Quality
- Water Conservation and Demand Management
- Capital Asset Management
- Asset Operations and Maintenance

This report is posted on the City's website to assure the public of the excellent quality of Vancouver's drinking water, and to highlight the programs and activities supporting continuous delivery of clean, safe drinking water to Vancouver customers.

In accordance with provincial regulations governing water suppliers in British Columbia, the City of Vancouver is required to conduct routine testing of the drinking water quality and to make these results publicly available within 6 months of year-end. This report fulfills those requirements.

If you have any questions about this report, please contact us at 3-1-1 or make a request online with the Van311 App.

1.0 City of Vancouver Waterworks Utility

Mission Statement

Dedicated to the enhancement and protection of public health and safety
by providing a reliable, accessible and sustainable supply of high-quality drinking water,
through a system well-managed and maintained
by a team of dedicated and committed staff.

The City of Vancouver Waterworks Utility (Waterworks) purchases treated drinking water from Metro Vancouver and operates a City-wide network of transmission and distribution water mains to deliver this water to customers. In 2024, Waterworks delivered 104.1 billion litres of drinking water throughout Vancouver.

Waterworks consists of the Design Branch, which plans, designs and administers the utility, and the Operations Branch, which builds, operates, and maintains the distribution system.

Waterworks operates on a self-funded basis, with revenues from water customers and the water stabilization reserve covering the costs of water procurement, capital and operating expenses, and debt charges.

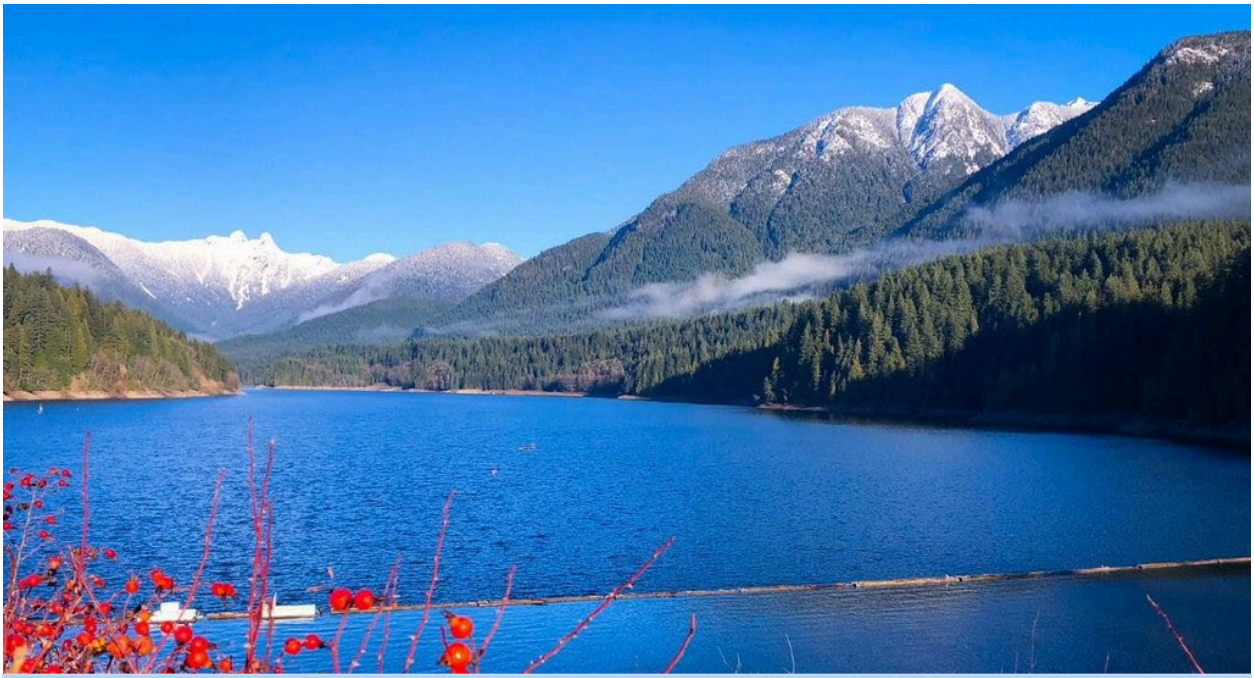
Total actual expenditures amounted to $164M in 2024, with $96M allocated to purchasing bulk water from Metro Vancouver and $68M dedicated to system maintenance, including debt servicing costs for capital borrowing.

2.0 Source Water

All drinking water in Vancouver is purchased from Metro Vancouver. Our water supply originates from three local watersheds: Capilano, Seymour and Coquitlam. The watersheds contain large collection lakes called reservoirs, which collect and store rainfall and snowmelt from the mountains. To protect drinking water quality, Metro Vancouver keeps the watersheds closed to public access. No recreational, agricultural or industrial activities that may contaminate the water are permitted inside watershed boundaries.

Metro Vancouver also owns and operates the Seymour-Capilano Filtration Plant and the Coquitlam Water Treatment Plant, where the source waters undergo treatment and disinfection before distribution to the municipality.

To ensure the water remains safe and of the highest quality, Metro Vancouver conducts regular monitoring and testing of both untreated and treated water. The results are publicly available on their website at metrovancouver.org.



The Capilano Reservoir, managed by Metro Vancouver, offers educational opportunities through guided tours. For information on watershed field trips and upcoming events, please contact Metro Vancouver at ☎ 604-432-6200 or visit their website. *Image courtesy of Metro Vancouver.*

3.0 Drinking Water Quality Monitoring Program

The British Columbia Drinking Water Protection Act (BCDWPA) and British Columbia Drinking Water Protection Regulation (BCDWPR) govern water suppliers in the province. Each municipal water purveyor, including the City of Vancouver, is mandated to hold an annual operating permit issued by the region's Drinking Water Officer.

To ensure compliance with provincial legislation, the Water Quality Monitoring and Reporting Plan for Metro Vancouver and Member Municipalities (WQMRP) was jointly developed by regional Medical Health Officers, Metro Vancouver, and local government members, including the City of Vancouver.

The City's water quality monitoring program operates under the protocols outlined in the WQMRP. Drinking water is routinely collected from 53 sampling stations located throughout the City's distribution system (Appendix A), and analyzed for compliance with the BCDWPR, the WQMRP, and Health Canada's Guidelines for Canadian Drinking Water Quality (GCDWQ). To enhance monitoring frequency, in 2023 the City moved from biweekly to weekly sampling of all drinking water sampling stations. Sampling parameters and reference frequencies are shown in Table 1.

In 2024, Waterworks collected 2,475 water samples for analysis of:

- Bacteria – *Escherichia coli* (*E. coli),* total coliforms, heterotrophic plate count (HPC)
- Chemical and physical parameters – free and total chlorine, pH, temperature, turbidity

Sampling results are publicly accessible on the City's website, underscoring commitment to communication and transparency.

In event of deviation from drinking water quality standards and guidelines, an investigation is conducted immediately to identify and correct any possible causes. The City will inform the public immediately of any potential health risks through various communications channels, including radio, newspapers, television, and social media platforms. A summary of the City's Emergency Response and Contingency Plan can be found in section 6 of this report.

Table 1. Water Quality Parameters and Testing Frequency

Category	Parameter	Sample Station Sites	Frequency
Bacteriological	*E. coli*	All[1]	Weekly
	Total coliform		
	HPC		
Chemical	Chlorine – free	All[1]	Weekly
	Chlorine – total		
	pH		
Physical	Temperature	All[1]	Weekly
	Turbidity		
Disinfection By-products	Haloacetic Acids (HAA)	Representative sites	Quarterly
	Trihalomethanes (THM)		
Metals	Copper	Representative sites	Semi-annually
	Iron		
	Lead		
	Zinc		
	Other[2]		
Aesthetic	Odour & Taste	Any Site	Complaint Basis

1. "All" refers to all Vancouver's water sampling stations (53).
2. The methodology for metals analysis produces additional results (Appendix C).

3.1 Drinking Water Quality Data

3.1.1 Sampling Frequency

BCDWPR Schedule B
Frequency of Monitoring Samples for Prescribed Water Supply Systems

Population Served by the Prescribed Water Supply System	Number of Samples Per Month
less than 5 000	4
5 000 to 90 000	1 per 1 000 of population
more than 90 000	90 plus 1 per 10 000 of population in excess of 90 000

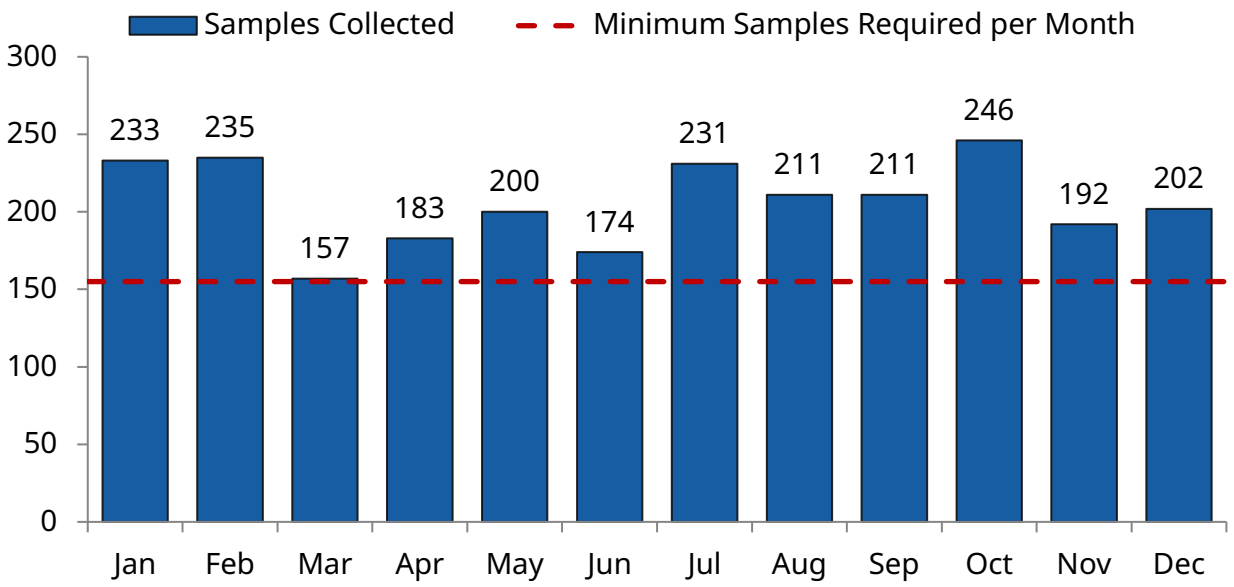
In 2024, Vancouver's drinking water was compliant with frequency of monitoring standards set in Schedule B of the BCDWPR. The City's water sampling program exceeded the minimum number of samples per month required by Schedule B (Table 2).

Table 2. Population Size and Water Sampling Frequency in Vancouver

Year	City of Vancouver Population (incl. undercount)	Number of samples per month Required[1]	Number of samples per month Collected[2]	Number of samples per year Collected
2024	756,008	157	206	2,475

1. Minimum number of samples per month required by Schedule B of the BCDWPR.
2. The 2024 data on population was collected from the provincial government's statistical office, BC Stats Population Estimates & Projections for British Columbia.

Figure 1. Monthly Total Samples Collected in 2024



3.1.2 Bacteriology

BCDWPR Schedule A
Water Quality Standards for Potable Water

Parameter	Standard
Fecal coliform bacteria	No detectable fecal coliform bacteria per 100 mL
Escherichia coli	No detectable *Escherichia coli* per 100 mL
Total coliform bacteria (a) 1 sample in a 30-day period (b) more than 1 sample in a 30-day period	No detectable total coliform bacteria per 100 mL 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

E. coli

In 2024, one (1) of the 2,475 water samples collected tested positive for *Escherichia coli* (*E. coli*).

1. September 25: Sampling station #27 (Wall Street and North Slocan Street) - 1 colony forming unit (CFU)/100 mL

As per the Waterworks Emergency Response Plan, City staff immediately notified the Drinking Water Officer and conducted a risk assessment, which found no risk to public health. Repeat samples were collected for two consecutive days from:

- The affected station
- All stations in the same pressure zone, and
- One station in each neighboring pressure zone.

In addition, routine sampling continued as scheduled.

No *E. coli* or total coliforms were detected in any follow-up samples. A comprehensive review of system parameters concluded the initial positive result was due to accidental contamination during sample collection or analysis. This finding confirmed that the drinking water met all regulatory requirements and was safe for consumption.

E. coli detection in drinking water has a strict maximum acceptable concentration (MAC) of zero. Under the BCDWPA, laboratories must immediately notify the City and the Medical Health Officer when *E. coli* is detected. A joint risk assessment is then conducted to evaluate public health risks and determine appropriate protection measures. This includes reviewing bacteriological test results, chlorine residuals, pressure levels, and other relevant data. The affected area is resampled immediately.

If the water system is operating within expected parameters, officials may wait for confirmation from follow-up results before taking further action. However, if any risk is identified, immediate actions, such as issuing a boil water notice, may be implemented as outlined in the City's Waterworks Emergency Response Plan.

Total Coliforms

In 2024, four (4) of the 2,475 samples collected tested positive for total coliform bacteria. At no time did the percentage of samples that tested positive for total coliforms exceed the 10% stipulated in the BCDWPR. One sample exceeded the standard of 10 detectable total coliforms per 100 mL (CFU/100 mL).

1. August 7: Sampling station #9 (Harrison Drive and Rosedale Drive) - 1 CFU/100mL
2. August 23: Sampling station #60 (York Avenue and Vine Street) - 1 CFU/100mL
3. September 25: Sampling station #27 (Wall Street and North Slocan Street) - 1 CFU/100mL
4. October 17: Sampling station #39 (W 37th Avenue and Hudson Street) - 54 CFU/100mL

After each result indicating the presence of total coliforms, the affected sampling stations

were disinfected, repeat samples were collected, and all follow-up results showed no coliforms detected. Per the BCDWPR, following the October 17th result, City staff informed the Drinking Water Officer and conducted a risk assessment which did not identify risk to public health. All other parameters remained consistent and within standards and guidelines.

Total coliform is a test of all bacteria within the coliform group. While not directly correlated with human health risk, the detection of total coliform may indicate possible conditions for pathogen and/or parasite contamination within the water supply. Alternatively, it can indicate contamination during sample collection or laboratory test analysis.

3.1.3 Physical and Chemical Parameters

The majority of physical and chemical parameter results were within acceptable ranges as per the GCDWQ. When a sample fell outside the guideline range, it was a temporary occurrence and did not affect water potability.

Table 3. Physical and Chemical Parameters

Parameter	Guidelines	Results		
		Av.	Min	Max
Chlorine – free (mg/L Cl_2)	≥0.04 mg/L Cl_2	0.60	0.04	1.37
Chlorine – total (mg/L Cl_2)	≤2.0 mg/L Cl_2	0.65	0.08	1.39
pH	7.0 – 10.5	8.39	7.86	8.98
Temperature (°C)	AO: ≤15°C	11.3	3.0	22.1
Turbidity (NTU)	≤1 NTU	0.22	0.08	24.1

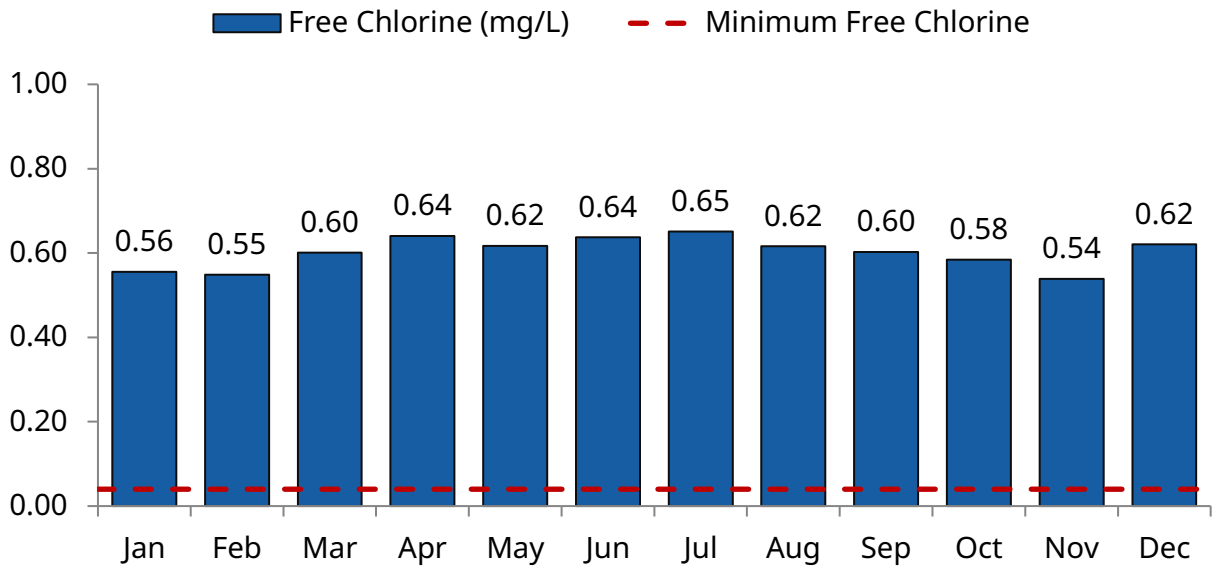
Chlorine (Cl_2)

Chlorine is used to disinfect the water and safeguard against microbial re-growth or contamination. Though the GCDWQ does not have a MAC for chlorine, most Canadian drinking water supplies maintain free chlorine residuals in the 0.04 - 2.0 mg/L range in the distribution system.

In 2024, 100% of water samples showed chlorine levels within recommended operational guidelines. The average value for total chlorine was 0.65 mg/L and for free chlorine was 0.60 mg/L.

Free chlorine refers to the amount of chlorine available in the water to continue disinfecting. Total chlorine includes both free chlorine and combined chlorine. Combined chlorine forms when free chlorine reacts with organic material in the water. While combined chlorine still has some disinfecting ability, it's much weaker than free chlorine. Having a slightly higher total chlorine reading than free chlorine shows that some chlorine has already been used to keep the water clean, and is normal in a well-maintained system.

Figure 2. Average Monthly Chlorine (free) in 2024



pH

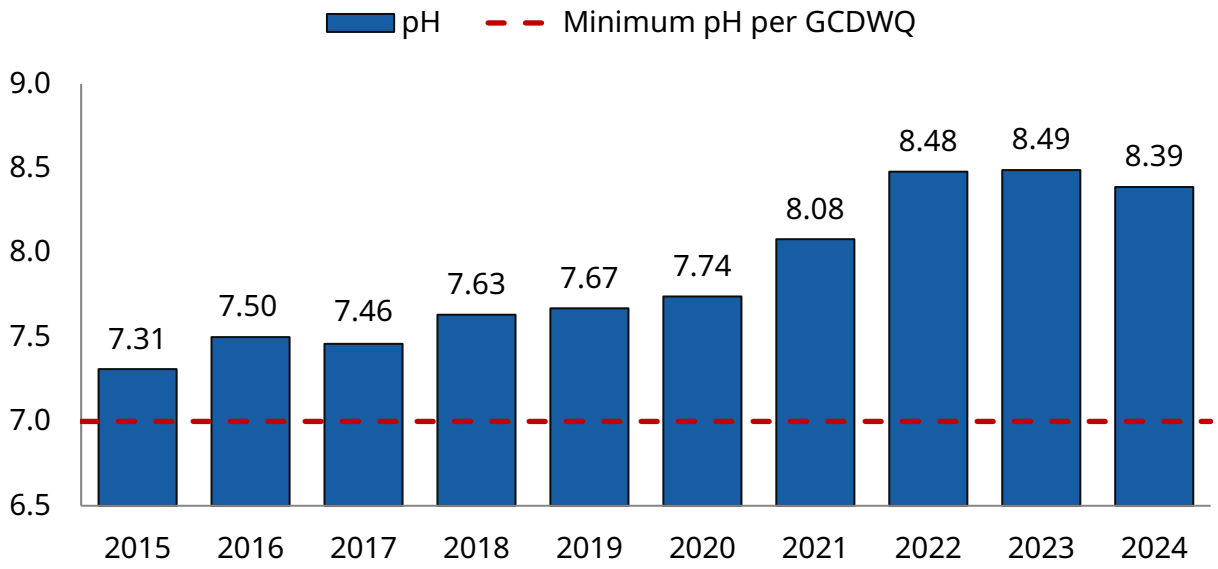
pH is a measure of the acidity/basicity of water. Per the GCDWQ, drinking water should have a pH range of 7 to 10.5.

In 2024, the average pH in Vancouver was 8.39.

The pH of water can determine which chemical reactions will occur in piping infrastructure and possible leaching of metals. Metro Vancouver's corrosion control program treats the region's naturally soft and acidic water by raising the pH and alkalinity so that it is less likely to corrode building pipes made of copper or lead.

The City of Vancouver primarily consumes water treated by the Seymour-Capilano filtration plant, which uses calcium hydroxide (lime) to increase pH and carbon dioxide to increase alkalinity. The water treatment plant on the Coquitlam source uses sodium carbonate to increase pH.

Figure 3. Average pH (2015-2024)

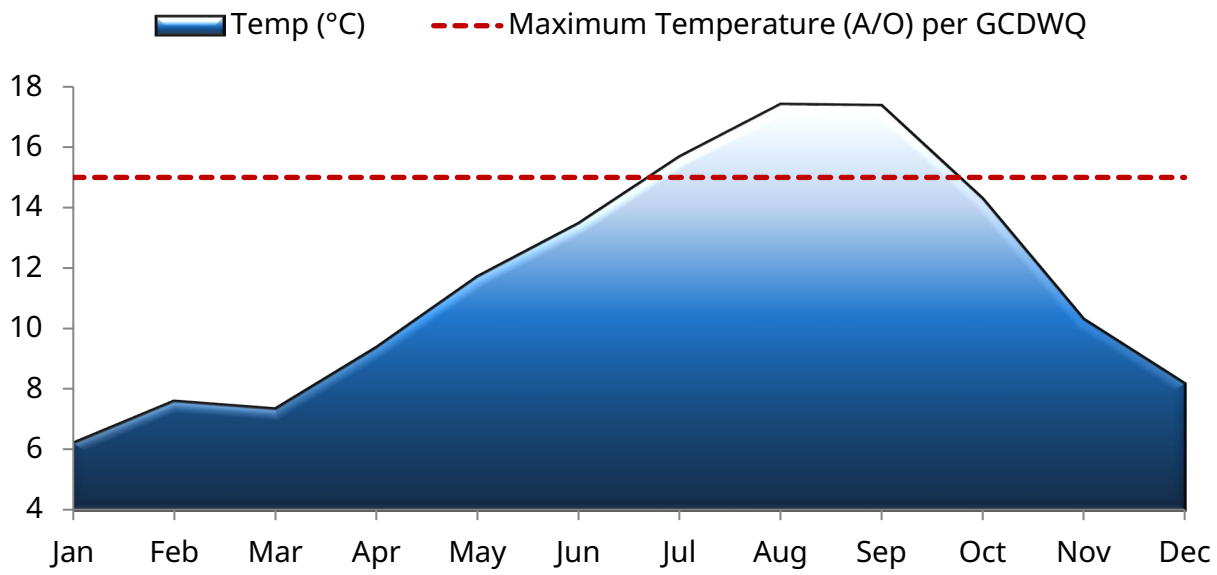


Temperature

The GCDWQ sets an aesthetic objective (A/O) for drinking water at less than 15°C. Temperatures above 15°C can impact aesthetic qualities and bacterial re-growth.

Vancouver's drinking water temperature is directly related to the source water and seasonal changes. The average drinking water in the distribution system remained below 15°C most of the year, with the exception of summer months.

Figure 4. Average Monthly Temperature (°C) in 2024

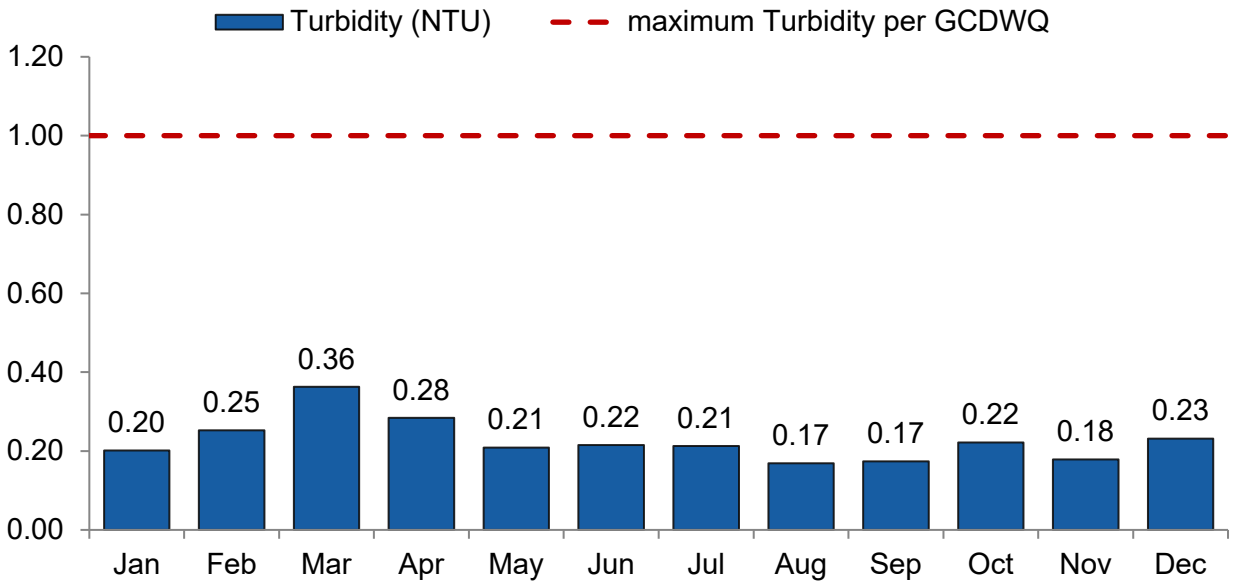


Turbidity

Turbidity is a measure of the clarity or cloudiness of water. The GCDWQ sets an objective of less than or equal to 1.0 NTU for turbidity in drinking water. Elevated turbidity levels can pose an aesthetic concern for customers and limit the effectiveness of disinfection.

The majority (99.0%) of water samples had turbidity results lower than 1.0 NTU. When turbidity above 1.0 NTU was briefly observed, there was no associated bacteriological growth.

Figure 5. Average Monthly Turbidity (NTU)



3.1.4 Disinfection By-products, Metals, Volatile Organic Compounds, and Aesthetics

All Disinfection By-Products (DBP) were well below the Maximum Acceptable Concentrations (MAC) as per the GCDWQ. Metals results were below GCDWQ MAC and met aesthetic objectives (AO). DBP results and Metals results are provided in Appendices B and C. Aesthetic concerns from the public were managed on a case-by-case basis.

Disinfection By-products (DBPs)

DBPs are compounds formed by the interaction between chlorine and naturally occurring organic substances in the water, such as breakdown products of decaying leaves and vegetation. Two groups of DBPs, Haloacetic acids (HAA) and Trihalomethanes (THM), are monitored four times yearly at 10 locations.

The MAC listed in the GCDWQ is based on locational running annual averages from quarterly samples. The running locational averages for THM and HAA in Vancouver's drinking water were consistently below the MAC (see Appendix B).

Metals

Metal levels are monitored twice yearly at 5 locations. Sampling results showed metals in Vancouver's drinking water were below the GCDWQ MAC (see Appendix C).

Table 4. DBPs, Metals, VOCs, and Aesthetic Concerns

Category	Parameter	Guidelines	Results
Disinfection By-products (DBPs)	Haloacetic Acids, total (HAAs)	MAC 80 ppb	All sample results were below guideline MAC (Appendix B)
	Trihalomethanes, total (THMs)	MAC 100 ppb	
Metals	Copper	≤ 1.0 mg/L (AO)	All sample results were below guideline MAC or AO. (Appendix C)
	Iron	≤0.3 mg/L (AO)	
	Lead	0.010 mg/L (MAC)	
	Zinc	≤5.0 mg/L (AO)	
	Other	Parameter specific	
Volatile Organic Compounds (VOCs)	Vinyl Chloride	MAC 0.002 mg/L	Not applicable
Aesthetics	Odour & Taste	Not Specified	Case-by-case assessment

Aesthetics

In 2024, Waterworks received 534 questions and complaints from the public about the drinking water and performed 35 investigations to resolve customers' concerns. The remainder of the investigations were resolved by phone and email. Most complaints were related to localized discolouration due to water main construction and repair work, hydrant operation or private-side plumbing activity. The Utility's jurisdiction over water quality terminates at the property service line; however, we support customers with our expertise and experience.

Table 5. Water Quality Complaints in 2024

Category	Total Number of Complaints in 2024
Appearance: Dirty/Turbid	435
Appearance: Milky/Cloudy	21
Odour: Chemical/Chlorine	29
Other: Miscellaneous	49

Vancouver customers are encouraged to report water quality complaints by calling 3-1-1 or using the VAN311 app. Customer feedback supports our ability to promptly address possible issues with our distribution system, or to improve customer experience when the root cause is on the private side. More information on how to resolve water quality complaints is available on the City's website.

3.2 Cross Connection Control Program

The Cross Connection Control Program is a cooperative effort between Vancouver's Drinking Water Utility and City Plumbing Inspectors, as well as business owners, property owners and contractors. The program is responsible for administration and enforcement of Water Works By-law No. 4848 – Part IV.

Many industrial, institutional, commercial and residential properties have cross connections, such as:

- In-ground irrigation systems
- Water-fed boilers
- Fire sprinklers
- Commercial kitchen equipment

Backflow prevention is required for these connections to prevent non-potable liquids from backflow into the drinking water supply. Backflow is the undesirable reversal of flow of water or other substances into the drinking water supply.

Backflow incidents may be caused by:

- Back siphonage: Negative or reduced pressure in the water supply system
- Backpressure: Downstream pressure exceeds the pressure in the water supply system

Backflow prevention assemblies are mechanical devices with internal, springs, seals, and other moving parts that may fail due to wear and tear over time. These assemblies must be maintained in good working condition and tested annually to ensure they continue to function properly and prevent backflow.

The program also conducts proactive audits of city-owned and private properties to identify where potential contamination of the drinking water system may occur. From these audits, we enforce the installation of backflow prevention methods and annual testing of existing backflow assemblies to help ensure the continued high-quality of our drinking water system.

In 2024, we received over 40,000 backflow assembly test reports, a 212% increase over the last decade and 58% increase over the last 5 years.

Backflow assemblies are vital components in preserving the integrity and safety of the water supply system by preventing the reverse flow of water and potential contamination.

3.3 Access to Water

Based on the United Nations and World Health Organization's 2010 declaration recognizing the fundamental human right to access clean water, the City of Vancouver launched a program in 2012 to expand equitable access to water. This initiative has grown into the Access to Water Program, which emphasizes equitable access, climate change adaptation and extreme heat preparedness.

The Access to Water program has 3 primary functions:

1. **Installation, Operation and Maintenance of Permanent Drinking Water Fountains**: Enhancing equitable access to drinking water throughout the city.
2. **Heat Relief and Emergency Response:** Addressing the immediate water needs during heatwaves and other emergencies.
3. **Green Events:** Leveraging city events as platforms for outreach and to encourage reduction in waste and bottled water use.

Waterworks staff conduct routine cleaning, sanitizing and maintenance of all the

Engineering owned assets. With this infrastructure being connected directly into the City's water system, users can expect the same high-quality drinking water they receive from their taps at home.

3.31 Temporary Assets

A fan favourite within our various communities across the City of Vancouver are the Access to Water's temporary infrastructure. The Water Utility owns and operates a total of 34 temporary units:

- 11 Temporary Hand Washing Stations
- 10 Temporary Drinking Fountains
- 13 Temporary Misting Stations

In 2024, these assets were installed between early May and mid-November. We work to identify areas with gaps in water access, ensuring that installations bring equitable access to the community and supplement additional water access for the warmest months. The temporary drinking fountains and hand washing stations often serve as a pilot for a future permanent installation. Additionally, the beloved misting stations are placed in high traffic areas where they not only attract attention from all demographics but also have been known to generate interest from other municipalities.

3.32 Permanent Infrastructure

In 2024, the Access to Water program collaborated with Street Activities to facilitate the installation of 2 permanent, freeze proof drinking fountains at upgraded parklets. This partnership promotes climate action initiatives, as well as equitable access to drinking water. The new locations are:

- Maple Street & West 4^{4th} Avenue
- Main Street & West 21st Avenue

The program also facilitated the installation of 3 more permanent fountains, including 2 hand washing stations, within our most vulnerable communities.

- 71 East Hastings Street
- Princess Avenue & East Hastings Street
    - Hand Washing Function
- Helmcken Street & Seymour Street
    - Hand Washing Function

The Access to Water program also mentored a Greenest City Scholar from the University of British Columbia who developed an Objective Index for Equitable & Accessible Access to Drinking Water in Vancouver. This innovative index is the first of its kind and can be

adjusted as needed to identify the optimal number of permanent drinking fountains that should be installed across the city to achieve equitable and accessible access to drinking water.

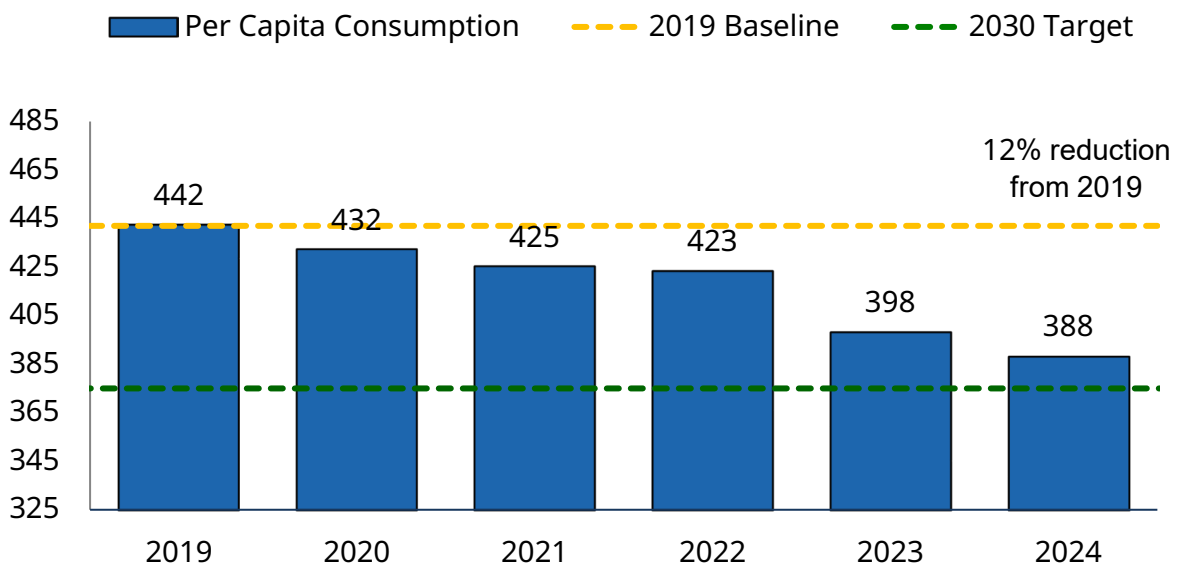
Helmcken Street and Seymour Street boasts a new freeze-proof Murdock drinking fountain and hand wash station, providing year-long access to drinking water and personal hygiene. For more information about Vancouver's public drinking fountains, please visit the City's website.

4.0 Water Conservation and Demand Management

Water conservation is a key component of drinking water demand management, protecting our drinking water supply now and into the future. A growing population with densified development, and the effects of climate change on source waters, put increasing pressure on Vancouver's drinking water supply. The Water Demand Management Strategy (WDMS, 2021) implements operational and policy requirements to offset the growing demand on our drinking water system, modeling sustainable use for future generations. Expanding regional drinking water supply has high financial, social, and environmental costs; reducing drinking water demand delays future needs for costly source expansion.

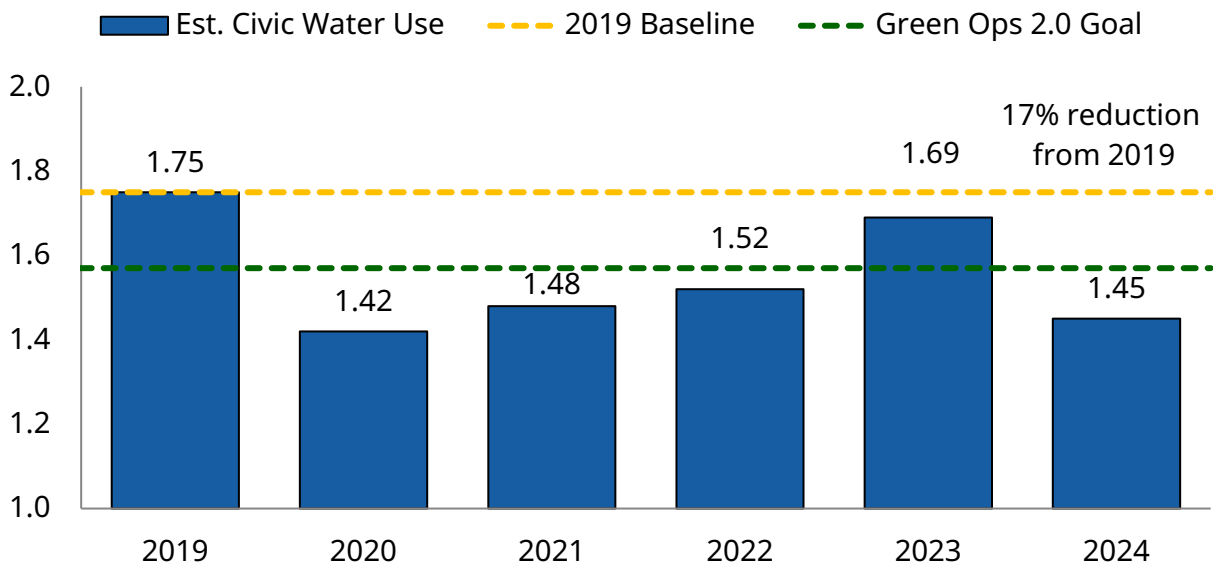
The WDMS builds on previous conservation success to support further reductions via accelerated residential water metering, advanced meter reading technology, and equitable water rates. The strategy targets a 15% reduction in drinking water consumption per capita by 2030, in addition to recognizing the need to offset drinking water use where feasible in future development. At the end of 2024, consumption was at 388 L/cap/day; a 12% drop from 2019 (Figure 6: Per Capita Water Consumption).

Figure 6. Per Capita Water Consumption (litres/capita/day)



The Green Operations 2.0 Plan (2020) further aims to reduce civic facility water consumption by 10% from 2019 levels, by 2030. In 2020, the 10% reduction goal was surpassed, associated primarily with pandemic-related facility closures (Figure 7: Civic Facilities and Operations Water Consumption). Civic water use in 2024 was 1.45 billion litres, or 17% below the 2019 baseline.

Figure 7. Civic Facilities and Operations Water Consumption (billions of litres)



Operational highlights in 2024 include:

- Installation of 12 new water meters in existing civic facilities.
- 1,600 notification letters to customers regarding high water consumption.
- Resolution of 288 new high water consumption cases from customers, involving 92 site visits by Water Conservation Plumbers.
- Residential Leak Detection and Irrigation Assessment program from May – August.
- Drinking Water Regulations Enforcement Program issued 521 tickets and 189 warnings.
- Developed policy research proposal to investigate effectiveness of current watering regulations.
- Policy analysis of accelerated Single Family metering, including installing a meter when property ownership is transferred.

5.0 Asset Management

The Drinking Water Utility is responsible for the installation, operation, and maintenance of the City's water distribution system. This includes 1,475 km of water mains, 98,694 service connections, 27,039 meters, 6,581 hydrants, 26,495 valves, and 32 pressure reducing valve (PRV) stations. The Utility also operates and maintains the Dedicated Fire Protection System comprised of 12 km of 600 mm diameter steel pipe, designed to withstand the maximum credible earthquake for Vancouver. Detailed information about the system inventory is available in Appendix D.

Funding for Waterworks is allocated through the Capital and Operating Budgets. The capital program funds the installation, replacement, and upgrading of infrastructure. The operating program covers the purchase of bulk water from Metro Vancouver and all costs associated with the maintenance and operation of the municipal water system.

5.1 Capital Program

In 2024, capital investments in the water system totaled approximately $31.4M. This funding was allocated across twenty-five sub-programs, which supported the installation of new infrastructure that primarily replaced aged water mains, service connections, hydrants, and meters. Major capital programs are highlighted in the following sections.

5.1.1 Distribution Main Construction

Distribution main construction, funded through the Distribution Main Replacement and Utility Development Cost Levy (UDCL) programs, represents the largest component of the Waterworks capital budget. In 2024, 11 km of distribution main were constructed at a cost of $21M.

The Waterworks asset management team ensures the water system remains reliable by identifying replacement candidates and setting a target replacement rate for each capital planning cycle. The target rate is determined by reviewing the distribution system's overall condition, specifically considering main age, material, and the leak or break history. The goal is to find a replacement rate that minimizes the risk of water main failure while maximizing the service life of system assets. The target rate has evolved over time: In 2011, the target rate was set at 0.8% system per year; from 2012-2018 it was adjusted to 1.0% however due to funding constraints a reduced target of 0.5% system per year was adopted, and from 2019-2024 the target rate was increased to a range of 0.5%-to-1.10% system per year to better align with deterioration rates of the system assets, however, due

to funding, risk assessment, and coordination opportunities, the end result replacement rate trend is reflected in Figure 8.

The water main renewal rate will continue to increase to 1.2% per year over the next decade. This adjustment is in anticipation of a large portion of the water system nearing the end of its service life.

Waterworks completes many distributions main replacement projects throughout the year to ensure our water supply is reliable and resilient. Customers that might be affected by upcoming work will receive advance notification by mail. Additionally, any projects causing road closures are announced on the City's website.

Figure 8. Annual Distribution Main Replacement Rate (2015-2024)

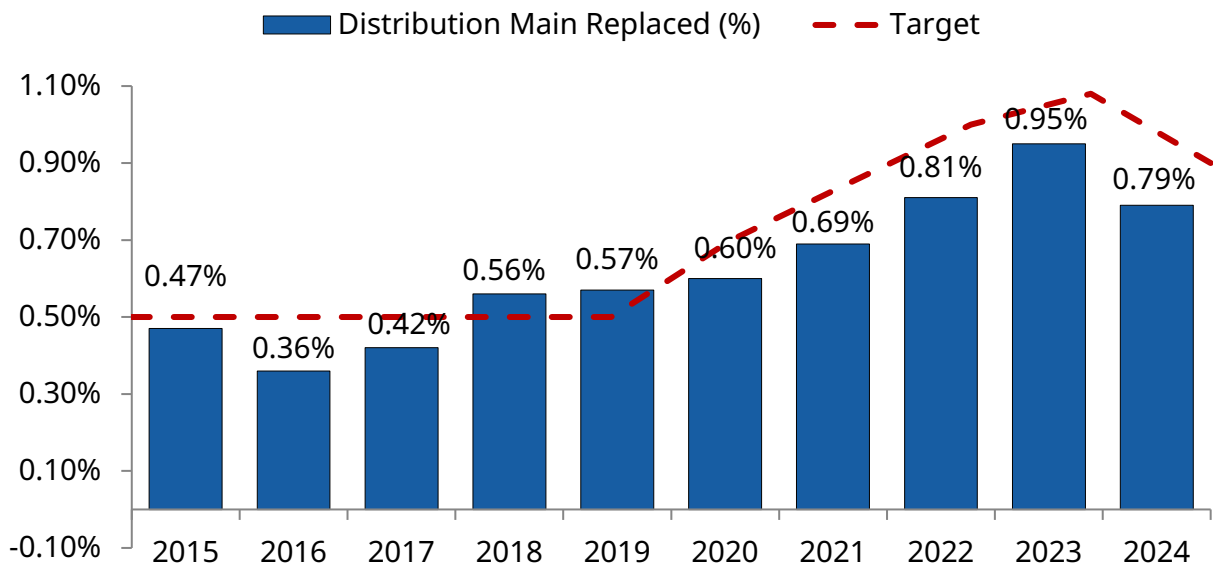


Table 6. Completed Distribution Main Program Funded Projects

Package Name (if applicable)	Street Segment	Pipe Diameter (mm)	Length of Project (m)
Kerrisdale South (2024)	West 62nd Avenue, East Boulevard to Granville Street (2024)	200	242
	Cypress Street, West 52nd Avenue to West 57th Avenue	200	309
Burnaby Street, Bidwell Street	Burnaby Street, Beach Avenue to Cardero Street (2024)	200	260

and Nelson Street	Bidwell Street, Burnaby Street to Harwood Street	200	110
	Bidwell Street, West Georgia Street to Haro Street	200	288
Renfrew Heights (2024)	Malta Avenue, Haida Drive to Dieppe Drive (2024)	200	198
	Malta Place, Malta Avenue to 92 Malta Place	150	82
	Haida Drive, Malta Avenue to Dieppe Drive	150	271
	Worthington Drive, Falaise Avenue to Mons Drive	150	148
	Malta Avenue, Worthington Drive to Haida Drive	200	159
	Worthington Drive, Mons Drive to Normandy Drive	200	363
	Falaise Avenue, Seaforth Drive to Dieppe Drive	300	398
	Falaise Place, 89 Falaise Place to Falaise Avenue	150	54
	Matapan Crescent, Falaise Avenue to Vimy Crescent	150	447
	Vimy Crescent, Matapan Crescent to Dieppe Drive	200	488
	Dieppe Drive, Falaise Avenue to Malta Avenue	300	172
	Dieppe Place, Dieppe Drive to Vimy Crescent	150	227
	East 57th Avenue, Ontario Street to Prince Edward Street	200	615
Hastings Sunrise South	East 8th Avenue, Lillooet Street to Cassiar Street	200	579
	Windermere Street, East 8th Avenue to East Broadway	200	105
	East 8th Avenue, Nootka Street to Lillooet Street	200	189
	Lillooet Street, East 7th Avenue to East 8th Avenue	200	96
	East 8th Avenue, Renfrew Street to Nootka Street	200	235
	East 7th Avenue, 2311 Cassiar Street to Rupert Street	200	
	Windermere Street, East 6th Avenue to East 7th Avenue	100	91
	East 7th Avenue, Lillooet Street to Rupert Street (2024)	200	379
Glen Drive, North and South Terminal Avenue	Terminal Avenue, Glen Drive to 865 Terminal Avenue	300	278
	Glen Drive, Evans Avenue to Terminal Avenue	300	108
	Terminal Avenue, Glen Drive to 900 Terminal Avenue	200	61
Kerrisdale South	Laburnum Street, West 63rd Avenue to Angus Drive	200	332

	West 63rd Avenue, SW Marine Drive to Laburnum Street	200	143
	West 62nd Avenue, SW Marine Drive to Angus Drive	200	433
	Angus Drive, SW Marine Drive to West 61st Avenue	300	780
St. George Street	East 24th Avenue, Carolina Street to Fraser Street	200	150
	East 24th Avenue, Prince Edward Street to St. George Street	200	199
	St. George Street, East 18th Avenue to East 22nd Avenue (2024)	200	186
	West 12th Avenue, Cypress Street to Pine Street	300	360
Kensington Cedar South (2024)	Argyle Street, East 32nd Avenue to East 33rd Avenue	200	202
	Dumfries Street, 5356 Dumfries Street to East 39th Avenue	200	160
	East 39th Avenue, Dumfries Street to Fleming Street	200	93
	Fleming Street, East 37th Avenue to East 39th Avenue (2024)	200	220
		Total	**10.2 km**

Table 7. Completed UDCL Program Funded Distribution Main Projects

Project Name	Street Segments	Pipe Diameter (mm)	Length of Project (m)
	Willow Street, West 42nd Avenue to West 46th Avenue	200	427
		Total	**0.427km**

Table 8. Completed Developer Funded Distribution Main Projects

Project Name	Street Segments	Pipe Diameter (mm)	Length of Project (m)
Creelman Avenue,	Creelman Avenue, Cypress Street to Chestnut Street	300	100

Chestnut Street and Greer Avenue	Chestnut Street, Creelman Avenue to Greer Avenue	300	101
	Greer Avenue, Cypress Street to Chestnut Street	300	111
		Total	**0.312 km**

5.1.2 Transmission Main Replacement Program

Like the distribution main replacement program, the transmission main replacement program supports water system reliability by replacing aging infrastructure. Transmission mains, defined as larger than 300 mm in diameter, are essential to convey large volumes of water throughout the City. They represent approximately 5% of the City's 1,475 km of water main network. The City earmarks funding for one or two transmission replacement projects in each capital plan (every 4 years).

The design of the West Pender Street transmission main, which began in 2023, was completed in 2024. Construction for Phase 1, covering the section of West Pender Street between Burrard Street and Bute Street, began in April 2024. This phase involved the replacement of 490 m of 600 mm transmission main and was completed in November 2024. Phase 2, scheduled to begin in the second quarter of 2025, will replace 685 m of 450 mm transmission main between Bute Street and Cardero Street.

5.1.3 Major Waterworks Construction Projects

In 2024, the City of Vancouver continued to coordinate work closely with other utilities and public right-of-way projects to minimize impact to the public during essential water main replacements.

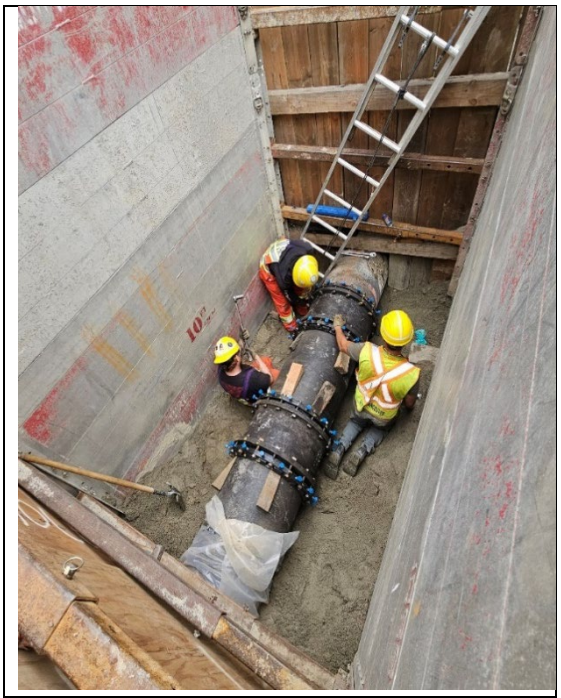
- **West Pender Transmission Main**
  Phase 1 of the West Pender Transmission Main Project was completed in 2024, replacing 0.5 km of aging transmission main along West Pender Street, between Burrard Street and Bute Street. The project was successfully completed on schedule and within the estimated budget. The remaining section of the West Pender Transmission Main will be scheduled for future work, in coordination with other transmission main projects.

- **Renfrew Heights**
  The Renfrew Heights project consisted of replacing 3.6 km of aging water main in the Renfrew Heights neighborhood. Construction began in October 2023 and was completed in October 2024. This project was unique in that it was designed

externally by Binnie and constructed internally by City of Vancouver Waterworks Operations crews.

- **Creelman Avenue, Chestnut Street and Greer Avenue**
  To provide municipal services to the Seńáḵw Development, the City and the Squamish Nation entered into the Seńáḵw Services Agreement in May 2022. As part of this agreement, distribution water main upgrades were required in the Kits Point neighborhood to meet water servicing requirements. The design was complex, involving several approved crossings of Metro Vancouver infrastructure and accommodating future infrastructure work in the area by other parties. The project team coordinated closely with stakeholders, and successfully completed the upgrade of 310 m of distribution water main in August 2024.

- **West 12th Avenue, Cypress Street to Pine Street**
  The water main on West 12th Avenue, between Cypress Street and Pine Street, was identified as a high-risk candidate for replacement. Originally, the replacement was scheduled to follow the completion of the Broadway Subway Project (BSP) due to its location within the BSP's street use limitations and restrictions zone. However, following four main breaks at the Burrard Street and West 12th Avenue intersection in 2024, it became clear that the replacement needed to be prioritized before winter, when the risk of further breaks increases. The project team collaborated closely with the City Leadership Team, the Province, and the BSP to approve this emergency work, and navigate street use restrictions. Despite working within a limited timeline and design resources, the team successfully expedited the design process to ensure that the 360 m of high-risk, aging water main was replaced prior to winter.



West Pender Transmission Main: Bute Street tie-in

Renfrew Heights: New water main laid on Vimy Crescent

Creelman Avenue, Chestnut Street and Greer Avenue: Water main installation on Geer Avenue

West 12th Avenue, Cypress Street to Pine Street: Water main construction along W 12th Avenue

5.1.4 Service Installations

The City of Vancouver owns close to 100,000 water service lines which connect commercial and residential properties to the water system.

Based on the expected life and current age of service assets, there is a goal to replace 1,250 to 1,400 services each year, achieved through:

- 150-200 reactive renewals (leaking services replaced instead of repaired)
- Approximately 900 services upgraded through redevelopment (though not all will be “old” services due for renewal), and
- 200-300 service renewals through the distribution main replacement program.

The asset management team monitors the number of service leaks and failures and the replacement levels achieved year-to-year to ensure that funding levels continue to support the required renewal rates for the service network. Table 9 illustrates the number of services that were installed and/or replaced in 2024.

Table 9. Service Installations

Program	Installations
Reactive replacement of leaking services	100
Proactive replacement of aging services	160
New commercial services	167
New residential services	961
Total	**1,388**

The number of leaking services were lower than forecast, which resulted in fewer reactive replacements.

5.1.5 Advanced Metering Infrastructure (AMI) Project

The current meter reading system, originally procured in 2006, is now reaching the end of its useful service life. This project will replace the current reading system with an Advanced Metering Infrastructure (AMI) system. The AMI system consists of data receivers installed on existing structures around the City, which collect data hourly from surrounding water meters. Operating the AMI system will involve implementing a cloud-base Software as a Service (SaaS) platform, providing City staff with access to customers water consumption data, alerts for high water usage or broken meters, and improve customer billing procedure.

The City evaluated available technologies and services through a competitive Request for Proposal process. Installation and implementation of the new and more robust meter reading technology will begin in 2025.

5.2 Operations and Maintenance Program

Operating and maintenance expenditures in 2024 were approximately $7.6M, under the program budget of $7.8M. The annual maintenance budget supports reactive maintenance to complete emergency repairs and ongoing corrective and preventative maintenance programs designed to:

- Ensure that water system components are reliable and in good working order.
- Maximize service life of components to realize the initial capital investment benefit.
- Promote efficient operation of the water system, resulting in a higher level of customer service.

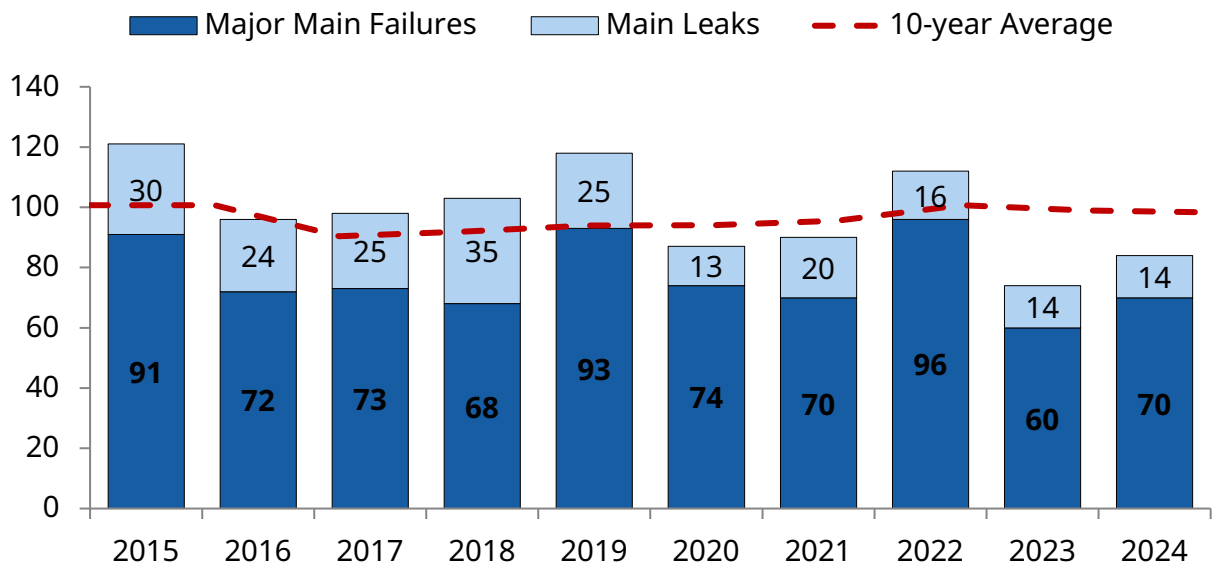
5.2.1 Main Breaks

Promptly responding to water main breaks is critical to prevent possible property damage, safeguard drinking water quality, and minimize service disruptions for customers. In 2024, crews responded to 84 water main failures. The majority of the water main breaks and leaks occur during the winter months from October to January.

Waterworks collects data to track and report on program and system performance. The number of main breaks per 100 km of pipe is typically used as an indicator of the overall condition of a water distribution system.

In 2024, the City of Vancouver ranked well relative to Canadian municipal water systems despite having one of the oldest systems, with 5.7 breaks per 100 km of pipe, compared to the national median of 6.5 breaks per 100 km. When compared to other systems with a similar system age (40-50 years), Vancouver has a below average main break rate.

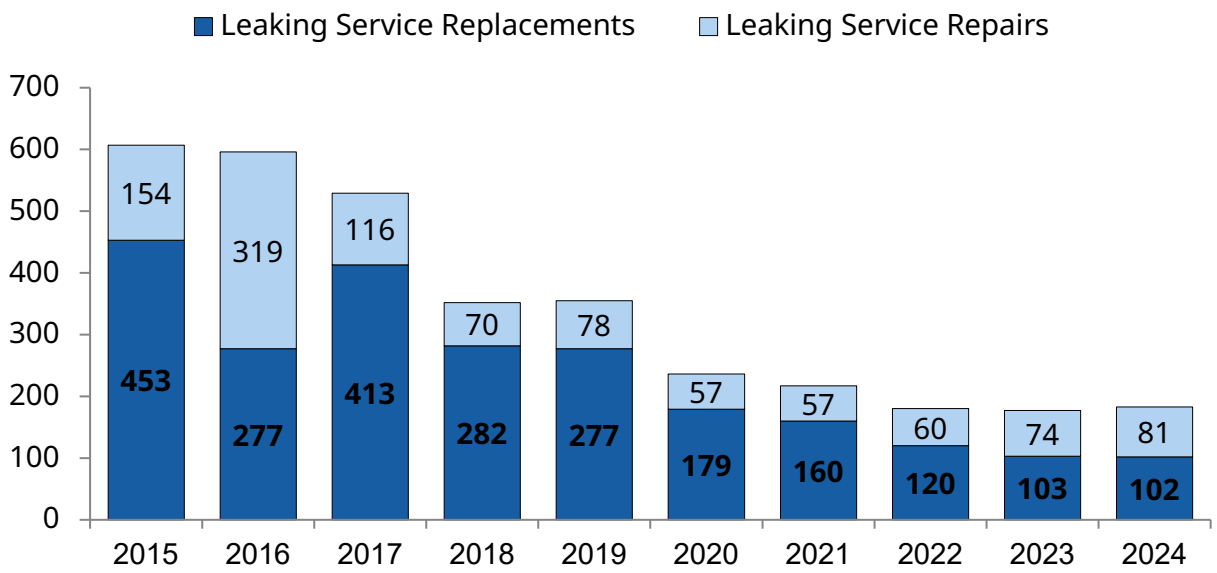
Figure 9. Main Break/Leak History (2015-2024)



5.2.2 Service Leak Repairs

In 2024, 183 leaking services were repaired (81) or replaced (102). The number of leaking services in 2024 was a significant drop compared to six years previous. The decrease in leaks is hypothesized to be a result of targeted proactive replacements during construction projects, improved renewal funding starting in 2017, and Metro Vancouver's pH adjustments implemented to decrease corrosivity of the drinking water to copper.

Figure 10. Service Leak History (2015-2024)



5.2.3 Proactive Leak Detection

In 2024, 100% of the City's water mains were proactively inspected for leaks. The Proactive Leak Detection program uses acoustic equipment to detect leaks that would otherwise go undetected.

Identifying and repairing leaking services helps reduce system water losses and reduce operating costs. Throughout the year, the leak detectors identified 251 leaks. The leak detection summary is provided in Table 10.

Table 10. Proactive Leak Detection Results

Main leaks	City side service leaks	Hydrant leaks	Valve leaks	Private side leaks	Total
3	24	127	53	44	251
		82.5%		17.5%	

5.2.4 Water Meters

In 2024, the aging meter replacement capital funding was used to replace 716 water meters. Waterworks replaced 45 large meters (>50 mm), with a focus on some of the older, more costly meters. Waterworks tests large meters, which comprise 10% of the total meter inventory, every 1-3 years for safety, operability, and accuracy of readings. Large meters are repaired or replaced as required based on the results.

The remaining meters replaced were aging small meters (≤50 mm). In 2024, 671 small meters were replaced. Small meters make up 90% of the meter inventory and are expected to last 20-25 years depending on their level of consumption. As small meters age, they gradually lose accuracy, and it becomes economical to replace them once they exceed their estimated service life. These replacement life cycles were verified through consumption analysis and testing to ensure accurate readings and equitable billing to our customers. A large portion of our small meter inventory is approaching the end of its expected life and will require replacement over the next 10 years.

5.2.5 Hydrants

As part of the annual fire hydrant inspection program, 100% of the hydrants in the system were inspected in 2024 to ensure proper operation. Through the preventative maintenance program and construction projects, 55 hydrants were replaced in 2024.

6.0 Emergency Response Plan Summary

The City’s Waterworks Emergency Response Plan (ERP) plays a vital role in ensuring the safety and reliability of the water distribution system. In the event of an emergency, this plan provides a structured approach to safeguarding the drinking water supply and protecting public health.

The ERP is designed to meet the requirements set forth in the BCDWPA and BCDWPR, serving as a comprehensive Emergency Response Plan. Additionally, in accordance with Section 15(a) of the BCDWPR, this summary of the ERP aims to inform water users about the plan's key elements and objectives.

The ERP operates in conjunction with current corporate-level emergency plans and business continuity plans within the City of Vancouver. Together, these plans ensure a coordinated and effective response to emergencies that may impact the City's water supply.

The Waterworks Emergency Response objectives are as follows (in priority order):

1. Provide water for firefighting, including the Dedicated Fire Protection System.
2. Repair and restore the water system on a priority basis.
3. Ensure an adequate supply of potable water, with a focus on high priority facilities.
4. Maintain high standards of water quality to protect public safety.

The ERP defines clear roles and responsibilities for staff during emergencies, ensuring a coordinated and efficient response.

During the implementation of the ERP, staff will adhere to safety protocols, communicate with relevant agencies, and minimize further damage to the water system.

Following an emergency event, staff will document actions taken, evaluate the effectiveness of the emergency response, and revise the ERP as necessary to enhance preparedness and resilience.

7.0 Financial Review

The City of Vancouver Drinking Water Utility is self-funded utility. Water purchases, capital and operating expenses, and debt charges are covered by revenues collected from water users each year. Total actual expenditures for 2024 were $164M. Of this amount, $96M was used to purchase bulk potable water from Metro Vancouver and the remaining $68M was spent rebuilding and maintaining the water system, including servicing debt costs from past capital borrowing. A breakdown of budgeted versus actual expenditures and revenues is provided in Table 11.

Waterworks carries a "Water Rate Stabilization Reserve" to provide a funding buffer for year-over-year variations in demand and forecasted increases of bulk water rates from Metro Vancouver. In 2024, total expenditures exceeded total revenues, so $5.9M was transferred from the reserve.

Table 11. Financial Summary

2024 Revenue	Budget	Actual
Flat Rate	$61,301,530	$61,065,176
Metered Rate	$93,516,695	$90,938,362
Meter Service Charge	$5,817,769	$6,531,039
Fire Line Flat Rate	$4,038,594	$4,171,658
Other Revenues	$858,171	$1,146,620
Total Revenues	$165,532,759	$163,852,856

2024 Expenditures	Budget	Actual
City Debt	$52,878,505	$54,661,841
Water Purchases (Metro Vancouver)	$100,264,868	$95,911,283
Operating & Maintenance	$20,280,443	$19,220,499
Total Expenditures	$173,423,816	$169,793,623
Transfer (from)/to Stabilization Reserve	($7,891,057)	($5,940,768)
Total Expenditures (incl. Transfer)	$165,532,759	$163,852,856

Appendix A

Map of Drinking Water Sample Stations

CITY OF VANCOUVER

WATER SAMPLING SITES
53 DEDICATED STATIONS

Appendix B

Disinfection By-products Sampling Results

Disinfection By-products Sampling Results[1]

Sample Site	Date Sampled	THM (ppb)						HAA (µg/L)						
		Bromodichloromethane	Bromoform	Chlorodibromomethane	Chloroform	Total Trihalomethanes	**Total THM Quarterly Average (GCDWQ Limit 100 ppb)**	Dibromoacetic Acid	Dichloroacetic Acid	Monobromoacetic Acid	Monochloroacetic Acid	Trichloroacetic Acid	Total Haloacetic Acid	**Total HAA Quarterly Average (GCDWQ Limit 80 ppb)**
Station 3 Porter & Victoria	29-May-23	<1	<1	<1	22	24	**30**	<0.5	9.3	<0.5	0.8	6	16	**17**
	23-Sep-23	1	<1	<1	25	27	**32**	<0.5	8.2	<0.5	0.5	7.2	16	**17**
	4-Dec-23	<1	<1	<1	25	26	**36**	<0.5	12	<0.5	0.8	8.7	22	**17**
	30-Jan-24	<1	<1	<1	21	22	**25**	<0.5	12	<0.5	<0.5	8.3	20	**19**
	24-Apr-24	<1	<1	<1	27	28	**26**	<0.5	13	<0.5	<0.5	9.1	22	**20**
	13-Sep-24	1	<1	<1	25	27	**26**	<0.5	9.2	<0.5	<0.5	6.9	16	**20**
	26-Nov-24	<1	<1	<1	29	30	**26**	<0.5	15	<0.5	1	12	28	**19**
Station 7 8100 Champlain	29-May-23	<1	<1	<1	21	23	**32**	<0.5	8.4	<0.5	<0.5	5	13	**20**
	23-Sep-23	1	<1	<1	24	26	**30**	<0.5	11	<0.5	3.6	13	28	**17**
	4-Dec-23	<1	<1	<1	27	29	**32**	<0.5	9.3	<0.5	<0.5	8.9	18	**16**
	30-Jan-24	<1	<1	<1	21	22	**25**	<0.5	11	<0.5	<5.0	6.7	18	**19**
	24-Apr-24	<1	<1	<1	29	30	**27**	<0.5	14	<0.5	1.1	12	27	**23**
	13-Sep-24	1	<1	<1	25	27	**27**	<0.5	8.3	<0.5	<0.5	5.6	14	**19**
	26-Nov-24	<1	<1	<1	35	35	**26**	<0.5	12	<0.5	0.7	14	26	**20**
Station 24 Champlain & Arlington	29-May-23	<1	<1	<1	22	24	**30**	<0.5	8.5	<0.5	<0.5	5	13	**15**
	23-Sep-23	1	<1	<1	27	29	**32**	<0.5	5.8	<0.5	4.7	11	21	**15**
	4-Dec-23	<1	<1	<1	27	28	**37**	<0.5	8.8	<0.5	<0.5	7.2	16	**15**
	30-Jan-24	<1	<1	<1	22	22	**26**	<0.5	11	<0.5	<0.5	6.7	18	**17**
	24-Apr-24	<1	<1	<1	28	28	**27**	<0.5	9.5	<0.5	0.6	5.7	16	**18**
	13-Sep-24	1	<1	<1	25	27	**26**	<0.5	7.8	<0.5	<0.5	4.8	13	**16**
	26-Nov-24	<1	<1	<1	29	30	**26**	<0.5	13	<0.5	0.8	9.4	23	**16**
Station 28 E 10th & Woodland	29-May-23	<1	<1	<1	25	27	**32**	<0.5	9.5	<0.5	0.9	7	17	**18**
	23-Sep-23	1	<1	<1	27	29	**34**	<0.5	8.3	<0.5	<0.5	5.3	14	**19**
	4-Dec-23	<1	<1	<1	28	30	**40**	<0.5	13	<0.5	1.3	9.6	24	**20**
	30-Jan-24	<1	<1	<1	22	23	**27**	<0.5	12	<0.5	<0.5	7.7	20	**19**
	24-Apr-24	<1	<1	<1	29	30	**28**	<0.5	13	<0.5	0.7	9.3	23	**20**
	13-Sep-24	1	<1	<1	27	29	**28**	<0.5	9.6	<0.5	0.7	5.9	16	**21**
	26-Nov-24	<1	<1	<1	36	37	**27**	<0.5	15	<0.5	1.2	15	31	**20**
Station 30 1100 Foundry Quay	29-May-23	<1	<1	<1	21	23	**24**	<0.5	8.5	<0.5	<0.5	4	13	**13**
	23-Sep-23	1	<1	<1	21	23	**26**	<0.5	8.8	<0.5	<0.5	5	14	**14**
	4-Dec-23	<1	<1	<1	24	25	**29**	<0.5	11	<0.5	<0.5	6	17	**14**
	30-Jan-24	<1	<1	<1	20	20	**23**	<0.5	11	<0.5	<0.5	5.9	17	**15**
	24-Apr-24	<1	<1	<1	25	26	**24**	<0.5	11	<0.5	0.9	6.5	19	**17**
	13-Sep-24	1	<1	<1	22	24	**24**	<0.5	8.4	<0.5	<0.5	4.9	13	**17**
	26-Nov-24	<1	<1	<1	25	26	**23**	<0.5	13	<0.5	1	8.2	22	**16**

1. Disinfection By-product analysis performed by Metro Laboratory.
2. COV Sampling Station 70 replaced COV Sampling Station 46 on Nov 14, 2022.

Disinfection By-products Sampling Results[1]

Sample Site	Date Sampled	THM (ppb)						HAA (µg/L)						
		Bromodichloromethane	Bromoform	Chlorodibromomethane	Chloroform	Total Trihalomethanes	**Total THM Quarterly Average (Guideline Limit 100 ppb)**	Dibromoacetic Acid	Dichloroacetic Acid	Monobromoacetic Acid	Monochloroacetic Acid	Trichloroacetic Acid	Total Haloacetic Acid	**Total HAA Quarterly Average (Guideline Limit 80 ppb)**
Station 54 Salish & Sennok	29-May-23	<1	<1	<1	21	23	**30**	<0.5	7.7	<0.5	<0.5	5	12	**15**
	23-Sep-23	1	<1	<1	23	25	**33**	<0.5	8.1	<0.5	<0.5	5	13	**16**
	4-Dec-23	<1	<1	<1	26	28	**36**	<0.5	8.5	<0.5	<0.5	8	16	**15**
	30-Jan-24	<1	<1	<1	22	22	**25**	<0.5	10	<0.5	<5.0	7.3	17	**15**
	24-Apr-24	<1	<1	<1	28	29	**26**	<0.5	11	<0.5	0.8	7.8	20	**17**
	13-Sep-24	1	<1	<1	25	27	**27**	<0.5	7.9	<0.5	<0.5	5.6	14	**17**
	26-Nov-24	<1	<1	<1	29	30	**26**	<0.5	11	<0.5	<0.5	11	22	**17**
Station 55 W 23rd & Balaclava	29-May-23	<1	<1	<1	20	22	**27**	<0.5	8.3	<0.5	<0.5	4	12	**14**
	23-Sep-23	1	<1	<1	23	24	**29**	<0.5	8.1	<0.5	<0.5	4	12	**15**
	4-Dec-23	<1	<1	<1	23	25	**31**	<0.5	11	<0.5	0.8	7	18	**14**
	30-Jan-24	<1	<1	<1	20	20	**23**	<0.5	11	<0.5	<5.0	6.1	17	**15**
	24-Apr-24	<1	<1	<1	25	26	**24**	<0.5	11	<0.5	1	6.1	18	**16**
	13-Sep-24	<1	<1	<1	21	22	**23**	<0.5	7.2	<0.5	0.6	4.6	12	**16**
	26-Nov-24	<1	<1	<1	28	29	**23**	<0.5	13	<0.5	1.3	9.8	24	**16**
Station 58 Euclid & Chatham	29-May-23	<1	<1	<1	18	20	**26**	<0.5	7.5	<0.5	1	3	11	**13**
	23-Sep-23	1	<1	<1	24	26	**27**	<0.5	8.5	<0.5	<0.5	7	15	**13**
	4-Dec-23	<1	<1	<1	22	23	**29**	<0.5	10	<0.5	<0.5	6	16	**13**
	30-Jan-24	<1	<1	<1	18	19	**22**	<0.5	12	<0.5	<0.5	5.8	18	**15**
	24-Apr-24	<1	<1	<1	25	26	**24**	<0.5	10	<0.5	<0.5	5.1	15	**16**
	13-Sep-24	1	<1	<1	22	23	**23**	<0.5	7.7	<0.5	<0.5	4.2	12	**15**
	26-Nov-24	<1	<1	<1	24	25	**23**	<0.5	13	<0.5	<0.5	8	21	**15**
Station 62 Belmont & Tolmie	29-May-23	<1	<1	<1	21	23	**32**	<0.5	7.5	<0.5	0.9	5	14	**14**
	23-Sep-23	1	<1	<1	27	29	**34**	<0.5	5.1	<0.5	<0.5	5	10	**15**
	4-Dec-23	<1	<1	<1	28	30	**40**	<0.5	5.2	<0.5	0.9	9	15	**15**
	30-Jan-24	<1	<1	<1	23	24	**27**	<0.5	6.4	<0.5	<0.5	7.5	14	**13**
	24-Apr-24	<1	<1	<1	32	33	**29**	<0.5	4.8	<0.5	<0.5	8.2	13	**13**
	13-Sep-24	1	<1	<1	24	26	**28**	<0.5	5.7	<0.5	<0.5	4.9	11	**13**
	26-Nov-24	<1	<1	<1	32	34	**28**	<0.5	6.1	<0.5	<0.5	12	18	**13**
Station 70[2] 723 SE Marine	29-May-23	<1	<1	<1	22	24	**N/A**	<0.5	7.7	<0.5	<0.5	5	12	**N/A**
	23-Sep-23	1	<1	<1	22	24	**N/A**	<0.5	11	<0.5	<0.5	10	21	**N/A**
	4-Dec-23	<1	<1	<1	23	25	**32**	<0.5	11	<0.5	<0.5	7	18	**15**
	30-Jan-24	<1	<1	<1	20	20	**23**	<0.5	11	<0.5	<0.5	6.4	18	**17**
	24-Apr-24	<1	<1	<1	25	26	**24**	<0.5	11	<0.5	<0.5	7.1	18	**19**
	13-Sep-24	1	<1	<1	25	27	**25**	<0.5	9.5	<0.5	<0.5	5	14	**17**
	26-Nov-24	<1	<1	<1	32	32	**24**	<0.5	16	<0.5	1	11	28	**17**

1. Disinfection By-product analysis performed by Metro Laboratory.
2. COV Sampling Station 70 replaced COV Sampling Station 46 on Nov 14, 2022.

Appendix C

Metals Sampling Results

Metals Sampling Results[1]

Sample Site	Date Sampled	GCDWQ MAC (µg/L)										
		<100 (OG)[2]	6	10	1000	5000	5	n/a	50	n/a	**≤1000 (AO)**	**≤300 (AO)**
		Aluminum Total	Antimony Total	Arsenic Total	Barium Total	Boron Total	Cadmium Total	Calcium Total	Chromium Total	Cobalt Total	**Copper Total**	**Iron Total**
Station 9 Harrison & Rosedale	24-Apr-16	27	<0.5	<0.5	2.8	<10	<0.2	8900	<0.05	<0.5	**<0.5**	**27**
	24-Oct-18	29	<0.5	<0.5	3	<10	<0.2	7790	<0.05	<0.5	**<0.5**	**18**
Station 19 38th & Camosun	24-Apr-16	40	<0.5	<0.5	2.5	<10	<0.2	8400	0.07	<0.5	**<0.5**	**16**
	24-Oct-18	25	<0.5	<0.5	2.9	<10	<0.2	8090	<0.05	<0.5	**<0.5**	**10**
Station 26 Franklin & Kootenay	24-Apr-16	40	<0.5	<0.5	2.8	<10	<0.2	9230	0.11	<0.5	**<0.5**	**29**
	24-Oct-18	22	<0.5	<0.5	3.3	<10	<0.2	7490	<0.05	<0.5	**<0.5**	**13**
Station 34 10th & Willow	24-Apr-16	41	<0.5	<0.5	2.5	<10	<0.2	8580	0.07	<0.5	**2.8**	**16**
	24-Oct-18	24	<0.5	<0.5	3	<10	<0.2	7700	<0.05	<0.5	**3.9**	**6**
Station 39 37th & Hudson	24-Apr-16	38	<0.5	<0.5	2.7	<10	<0.2	8090	0.08	<0.5	**<0.5**	**5**
	24-Oct-18	23	<0.5	<0.5	3.1	<10	<0.2	7970	<0.05	<0.5	**<0.5**	**6**

1. Metals analysis performed by Metro Laboratory. Copper, Iron, Lead, and Zinc tested as per the WQMRP.
2. OG = Operational guidelines; AO = Aesthetic Objectives
3. MAC of 120 far exceeds the Mn in our water; so we compare to lower A/O.

Metals Sampling Results[1]

Sample Site	Date Sampled	GCDWQ MAC (µg/L)										
		5	n/a	≤20 (AO)	1	n/a	n/a	n/a	50	n/a	≤200000 (AO)	**≤5000 (AO)**
		Lead Total	Magnesium Total	Manganese [3] Total	Mercury Total	Molybdenum Total	Nickel Total	Potassium Total	Selenium Total	Silver Total	Sodium Total	**Zinc Total**
Station 9 Harrison & Rosedale	24-Apr-16	**<0.5**	223	4.4	<0.05	<0.5	<0.5	158	<0.5	<0.5	1760	**<3.0**
	24-Oct-18	**<0.5**	288	8.9	<0.05	<0.5	<0.5	242	<0.5	<0.5	2420	**<3.0**
Station 19 38th & Camosun	24-Apr-16	**<0.5**	219	3.5	<0.05	<0.5	<0.5	157	<0.5	<0.5	1600	**<3.0**
	24-Oct-18	**<0.5**	306	8.2	<0.05	<0.5	<0.5	244	<0.5	<0.5	2360	**<3.0**
Station 26 Franklin & Kootenay	24-Apr-16	**<0.5**	230	5.7	<0.05	<0.5	<0.5	161	<0.5	<0.5	1650	**<3.0**
	24-Oct-18	**<0.5**	295	8.4	<0.05	<0.5	<0.5	241	<0.5	<0.5	2200	**<3.0**
Station 34 10th & Willow	24-Apr-16	**<0.5**	221	7	<0.05	<0.5	<0.5	155	<0.5	<0.5	1610	**<3.0**
	24-Oct-18	**<0.5**	299	8.3	<0.05	<0.5	<0.5	238	<0.5	<0.5	2230	**<3.0**
Station 39 37th & Hudson	24-Apr-16	**<0.5**	223	2.5	<0.05	<0.5	<0.5	157	<0.5	<0.5	1650	**<3.0**
	24-Oct-18	**<0.5**	302	7.2	<0.05	<0.5	<0.5	243	<0.5	<0.5	2320	**<3.0**

1. Metals analysis performed by Metro Laboratory. Copper, Iron, Lead, and Zinc tested as per the WQMRP.
2. OG = Operational guidelines; AO = Aesthetic Objectives
3. MAC of 120 far exceeds the Mn in our water; so we compare to lower A/O.

Appendix D

System Inventory

Appendix E - System Inventory

Diameter	Asbestos Cement	Concrete	HDPE[1]	Steel	DICL[2]	Cast Iron	Other[3]	PVC	Unknown[4]
System total (m)	60	8,132	3,030	36,140	680,029	739,225	6,386	799	856
Pre-1920									
20 mm						0	38		
25 mm						0	4		
50 mm						0	82		1
75 mm						279			
100 mm						582			
150 mm				47	4	8,072			2
200 mm				63	9	5,343			
300 mm						2,317			13
400 mm				24					61
450 mm				235					
600 mm									
625 mm				6					
650 mm									
800 mm				3,258					
Total (m)	**0**	**0**	**0**	**3,633**	**12**	**16,592**	**124**	**0**	**77**
Years: 1920-1929									
25 mm							5		
100 mm						578			
150 mm						14,677			
200 mm						3,313			
300 mm						330			
450 mm				29					
500 mm				11					
600 mm				1,430					
Total (m)	**0**	**0**	**0**	**1,470**	**0**	**18,899**	**5**	**0**	**0**
Years: 1930-1939									
20 mm						1	21		
25 mm							2		
50 mm							36		
100 mm				150		331			
150 mm				35		32,557			
200 mm						10,016			1
300 mm				60		7,097			
350 mm				10					
450 mm				3,385					
500 mm				1,236					
600 mm				968					
625 mm				690					
750 mm				1,737					
800 mm				3					
Total (m)	**0**	**0**	**0**	**8,274**	**0**	**50,001**	**59**	**0**	**1**
Years: 1940-1949									
25 mm							10		
40 mm						15			
100 mm						532			
150 mm				5	1	80,191			
200 mm					13	33,988			23
300 mm				29		10,914			
450 mm						266			
800 mm				426					
Total (m)	**0**	**0**	**0**	**459**	**14**	**125,906**	**10**	**0**	**23**
Years: 1950-1959									
25 mm							79		
50 mm						12	584		
100 mm						470			
150 mm				6	45	102,882			
200 mm				12	1	54,641			
250 mm				24					
300 mm				93	99	34,775			30
450 mm				40	1	29			
600 mm				491					
750 mm				952					
Total (m)	**0**	**0**	**0**	**1,617**	**146**	**192,809**	**663**	**3**	**30**

1. HDPE - High-Density Polyethylene
2. DICL - Cement Lined Ductile Iron
3. Other - Combined Data for Copper Galvanized Pipe
4. Unknown - Data missing regarding material

Appendix E - System Inventory

Diameter	Asbestos Cement	Concrete	HDPE[1]	Steel	DICL[2]	Cast Iron	Other[3]	PVC	Unknown[4]
System total (m)	60	8,132	3,030	36,140	680,029	739,225	6,386	799	856
Years: 1960-1969									
20 mm						8	136		
25 mm							553		
40 mm							334		
50 mm							1,259		
100 mm				6	537	2,198			
150 mm				39	469	115,276			29
200 mm	60			81	769	111,829			
300 mm				1,016	6,601	27,053			1
350 mm				1					
450 mm				420	1,828	8,559			
500 mm				114	2				
600 mm				325					
650 mm				509					
675 mm				1,507					
750 mm				877					
900 mm				7					
Total (m)	**60**	**0**	**0**	**4,902**	**10,207**	**304,923**	**2,283**	**0**	**30**
Years: 1970-1979									
20 mm							38		
25 mm							105	32	
40 mm							110		
50 mm						1	127	60	
100 mm					2,088				
150 mm					44,701	5,388			
200 mm				14	52,249	4,846		2	5
250 mm					10				
300 mm				57	51,144	312			
400 mm					4,462				
450 mm				1,145	707				
500 mm					1,642				
600 mm				24	1,275				2
625 mm				5					
750 mm		154		16					
800 mm				264					
Total (m)	**0**	**154**	**0**	**1,526**	**158,208**	**10,547**	**381**	**94**	**8**
Years: 1980-1989									
20 mm							58		
25 mm							1	37	
40 mm							255		
50 mm							502	12	
100 mm					989				
150 mm				41	33,938	299			
200 mm				70	27,265	143		4	5
250 mm					6				
300 mm			37	40	37,586	82		1	10
400 mm				14	473				
450 mm		53		29	3,159				
550 mm					49				
650 mm		1							
750 mm		6,324		1,165					
900 mm		1,599							
1000 mm				172					
Total (m)	**0**	**7,978**	**37**	**1,530**	**103,465**	**524**	**816**	**54**	**15**

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Appendix E - System Inventory

Diameter	Asbestos Cement	Concrete	HDPE[1]	Steel	DICL[2]	Cast Iron	Other[3]	PVC	Unknown[4]
System total (m)	60	8,132	3,030	36,140	680,029	739,225	6,386	799	856
Years: 1990-1999									
20 mm							38		
25 mm							102		
40 mm							31		
50 mm					3		346		
100 mm					1,021			9	
150 mm					10,485			192	
200 mm					69,512	4		186	
250 mm					34				
300 mm					55,506			4	
400 mm				5	2,379				
450 mm				14	1,106				
500 mm				8					
600 mm				5,705	5,520				
750 mm				101					
900 mm					3,689				
1000 mm				10					
Total	**0**	**0**	**0**	**5,843**	**149,254**	**4**	**518**	**392**	**0**
Years: 2000-2009									
20 mm							17		
25 mm					29		69		
40 mm							1		
50 mm							155		
100 mm			298		2,791				
150 mm			148	3	6,418	14			
200 mm					85,813	103	1		6
250 mm					3				
300 mm				6	36,000			11	5
400 mm				40	55				
450 mm					557				
500 mm				2					
600 mm				5,861	4,528				
650 mm									
750 mm				4	210				
900 mm					1				
Total (m)	**0**	**0**	**446**	**5,917**	**136,413**	**117**	**242**	**11**	**11**
Years: 2010-2019									
25 mm							23		
40 mm							43		
50 mm			79				93		
100 mm			590		567	1			
150 mm			131		4,023	197		1	
200 mm			32		72,211	107		142	5
300 mm					17,149	11		38	
400 mm				9	25				
450 mm					30				
500 mm					20				
600 mm				2	5,736			1	
750 mm					51				
unknown					15				1
Total (m)	**0**	**0**	**832**	**11**	**99,826**	**315**	**160**	**183**	**6**

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4. Unknown - Data missing regarding material

Appendix E - System Inventory

Diameter	Asbestos Cement	Concrete	HDPE[1]	Steel	DICL[2]	Cast Iron	Other[3]	PVC	Unknown[4]
System total (m)	60	8,132	3,030	36,140	680,029	739,225	6,386	799	856
Years: 2020-2024									
25 mm							40		
40 mm							1		
50 mm							13		
100 mm					17				
150 mm			184		1,128	8			
200 mm			88		11,778	9		3	
300 mm			35		7,012	1			
400 mm			1,408						
450 mm				2	36				
600 mm				1	489				
750 mm					839			2	
900 mm					730				
Total (m)	**0**	**0**	**1,715**	**3**	**22,029**	**18**	**54**	**6**	
Years: Unknown									
20 mm						20	68		
25 mm							328		
40 mm							66		
50 mm						5	655	57	31
75 mm						28			
100 mm					21	1,173			
150 mm				209	2	10,897			170
200 mm				99	271	3,885			433
250 mm						1,076			
300 mm				13	103	1,333			8
350 mm				1					
400 mm									2
450 mm				9	58	154			10
500 mm				2					
600 mm				591					
800 mm				23					
1000 mm				8					
Total (m)				**955**	**455**	**18,571**	**1,072**	**57**	**656**
Total watermain in system (m)									**1,474,657**

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