2004 Annual Bacteriological Summary of Greater Victoria's Drinking Water

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Executive Summary

The *2004 Annual Bacteriological Summary of Greater Victoria's Drinking Water* is the second report in the Water Quality Division's 2004 annual report series. It extends the bacteriological information given in the *2004 Annual Overview of Greater Victoria's Drinking Water Quality* and details the bacteriological results for the source water, first customer, transmission system, distribution system reservoirs and the distribution systems of individual water purveyors who are part of the Greater Victoria Drinking Water System. When completed, these annual reports are posted on the CRD website at http://www.crd.bc.ca/water/water_quality/water_quality_reports.htm.

The primary observations and conclusions contained in this report are listed below:

1. **Overall Summary**. In general, the overall bacteriological quality of the drinking water in Greater Victoria continues to be very good and meets the requirements of the Provincial and Federal limits.

2. **Sample Collection**. In 2004, the Water Quality Division collected and analysed 4,306 bacteriological samples from 150 sampling locations in the Greater Victoria Drinking Water System. This includes samples collected from the raw source (untreated water), first customer, transmission mains, distribution system reservoirs and distribution systems. A similar number of samples were collected in 2003 and 2002.

3. **Source Water**. In 2004, as in the past few years, the level of total coliform bacteria in the raw source water entering the treatment plants continued to be elevated during the summer (**Figure 1**). A bacterial spike was observed in late July, 2004 closely following the transplant of several thousand fish from Deception Creek and Deception Reservoir into Sooke Reservoir (**Figure 1C**) under the direction of Fisheries officials. Nevertheless, as in previous years, the quality of the raw water entering the plant easily met the fecal coliform limit of 20 colony forming units per 100 mL in the USEPA Surface Water Treatment Rule and therefore continued to qualify to remain an unfiltered surface water supply under this portion of their regulations (**Figure 1B**). The level of 20 per 100 mL was only exceeded once the entire year. Both the median value of 0 per 100 mL and the maximum value of 21 per 100 mL indicate a good quality source that is not subject to contamination.

4. **First Customer**. Total coliform bacteria were observed at the first customer sampling location below the Japan Gulch Treatment Plant during July but did not exceed the Canadian Guideline limit of 10% monthly percentage total coliform positive samples (**Figure 3**). The annual total coliform positive sample rate of 0.4% was similar to 2003 and one of the lowest ever observed (**Figure 4a**) and was primarily due to the use of the combination of ultraviolet light and free chlorine as primary disinfectants. No fecal coliform (*E. coli*) bacteria were found in any of the samples collected at this point. This provides further assurance of the bacterial safety of Greater Victoria's drinking water.

5. **Transmission Mains**. None of the samples collected from the transmission mains feeding the municipalities contained total coliforms (**Figure 5**). This result is the best observed in the past decade (**Figure 5a**) and shows that no total coliform bacteria are being delivered to the municipal distribution systems.

6. **Distribution System Reservoirs**. Samples collected from the distribution system reservoirs showed some bacteriological regrowth associated with the low chlorine residuals as a result of the poor water circulation through the reservoirs (**Figure 6A**). When the distribution system reservoirs are considered as a group, the total coliform Guideline level of 10% positive samples was never exceeded in 2004. Similarly, on an individual basis, none of the distribution system

reservoirs had an annual percentage positive that exceeded the 10% limit with the exception of Kirby Road Reservoir in Sooke. Over the past decade, there has been a general improvement in the bacteriological quality of the water in the distribution system reservoirs (**Figure 6D**).

7. **Greater Victoria Distribution System**. When the results of all the individual distribution systems are considered as a whole, the Greater Victoria Distribution System complied with both the Provincial Regulation and the Federal Guidelines for bacteriological water quality during all months of the year. Total coliforms were found during six months in 2004 (**Figure 7**). The total coliform positive rate of 0.6% was virtually identical to 2003 and one of the lowest ever observed in the past decade and continued the trend of declining total coliform positive samples in the Greater Victoria Distribution System and hence, improved bacteriological water quality (**Figure 7a**).

8. **Individual Municipal Distribution Systems**. In 2004, none of the municipal distribution systems exceeded the monthly total coliform limit of 10% and, in general, the bacteriological water quality of all of the municipal distribution systems has improved over time (since 1992). This includes

    - Central Saanich (**Figure 8** and **Figure 8a)**
    - North Saanich (**Figure 9** and **Figure 9a**)
    - Oak Bay (**Figure 10** and **Figure 10a**)
    - Saanich (**Figure 11** and **Figure 11a**)
    - Sidney (**Figure 12** and **Figure 12a**)
    - Victoria/Esquimalt (**Figure 13** and **Figure 13a**)
    - Juan de Fuca Distribution System (**Figure 14** and **Figure 14a**).

9. **Chlorine Residual**. The median annual chlorine residual at the first customer sampling location below the Japan Gulch Plant was 1.25 mg/L (similar to 2003). Overall, within the distribution system, the median annual chlorine residual was 0.68 mg/L, higher than that found in 2003 (0.58 mg/L) and similar to that found in 2002 and 2001 (0.67 and 0.64 mg/L, respectively). Within the municipal distribution systems, the median annual chlorine residual varied from a low of 0.40 mg/L for Sidney to a high of 0.80 mg/L for Oak Bay.

10. **Water Temperature**. At the Japan Gulch Plant, the coldest daily water temperature recorded was 3.0°C in January while the warmest was 20.9°C in August 2004. The Guideline limit of 15°C was exceeded from July 9, 2004 to October 18, 2004 which was similar to previous years. Compared to other Canadian cities, the summer temperature of the drinking water in Greater Victoria is extremely warm. However, the Water Services Department cannot control the temperature of the water.

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For web version see **Map 1** on the CRD web site at
http://www.crd.bc.ca/water/maps/documents/3637.pdf

1. Introduction

The *2004 Annual Bacteriological Summary of Greater Victoria's Drinking Water* is the second report in the Water Quality Division's 2004 annual water quality report series. It extends the bacteriological information provided in the *2004 Annual Overview of Greater Victoria's Drinking Water Quality* and details the bacteriological results for the source water, first customer, transmission system, distribution system reservoirs and the distribution systems of individual water purveyors who are part of the Greater Victoria Drinking Water System. All reports are posted on the Capital Regional District (CRD) website at http://www.crd.bc.ca/water/water_quality/water_quality_reports.htm

2. Water System Description

In 2004, the Greater Victoria Drinking Water System (**Map 1**) provided drinking water to approximately 320,000 people. It is the second largest drinking water system in British Columbia and is comprised of two service areas:

1. The **Greater Victoria Drinking Water Service Area** supplied water to approximately 311,000 people in Victoria, Saanich, Oak Bay, Esquimalt, the Saanich Peninsula municipalities and the Western Communities via the Japan Gulch Treatment Plant.

2. The **Sooke District Drinking Water Service Area** supplied water to approximately 9,000 people in Sooke and East Sooke via the Charters Treatment Plant.

These two service areas are described below relative to their operation in 2004.

2.1. SOURCE WATER SYSTEM

Drinking water for the Greater Victoria Drinking Water System comes from a protected watershed called the Greater Victoria Water Supply Area (**Map 1**). This area, which is approximately 11,000 hectares in size and protected from public access and industrial activities, is located about 30 km northwest of the city.

Greater Victoria Drinking Water Service Area

The five reservoirs in the Supply Area have been used as a source of drinking water since the early 1900's. Sooke Reservoir, the largest of the reservoirs, is the primary water source for the city, supplying approximately 95% of Greater Victoria's drinking water. The four reservoirs in the Goldstream system, including Butchart Reservoir, Lubbe Reservoir, Goldstream Reservoir and Japan Gulch Reservoir, typically remain off-line and are used as a backup water supply. Controlled releases from the Goldstream Watershed supply water to the Salmonid Enhancement Fisheries project at Japan Gulch and to the Goldstream River.

Water at the southern extremity of Sooke Reservoir enters one of the variable depth gates (typically the bottom gate is used) in the Sooke Reservoir Intake Tower and passes through a 30-mesh stainless steel traveling screen (openings of 0.5 mm). It then continues through two 1220 mm (48") diameter pipelines to the Head Tank, through the 8.8 km (5.5 mile) long, 2300 mm (91") diameter Kapoor Tunnel, into the 1525 mm (60") and/or the 1220 mm (48") diameter pipe connecting the Kapoor Tunnel to the Japan Gulch Treatment Plant and finally

flows into the Japan Gulch UV Treatment Facility.

During the brief periods of its use, (typically only when the tunnel is out of service for inspection by CRD staff) water in the Goldstream River watershed is released from Goldstream Reservoir and flows down the upper reaches of Goldstream River into Japan Gulch Reservoir. Water from Japan Gulch Reservoir enters the Japan Gulch Intake Tower through a low level intake gate. In the Japan Gulch Intake Tower, the water passes through a 14 mesh, stainless steel screen and continues into a 1220 mm (48") diameter pipe to the Japan Gulch Plant.

In 2004, all water received at the Japan Gulch Treatment Plant originated from Sooke Reservoir with the exception of a brief period (Jan 15-Jan 29) when the Goldstream Reservoirs via Japan Gulch Reservoir supplied the system during the period when the Kapoor Tunnel was drained and inspected.

Sooke District Drinking Water Service Area

The Districts of Sooke and East Sooke were also supplied with drinking water primarily from Sooke Reservoir. This water flows by gravity to the Charters Treatment Plant via the 42" concrete pipe commonly called the flowline. When the flowline is out of service for maintenance, the source of water for this system comes from Charters Reservoir and the Charters Creek Watershed.

In 2004, all water received at the Charters Treatment Plant originated from Sooke Reservoir.

2.2. WATER TREATMENT

The drinking water in Greater Victoria is unfiltered and in 2004, the source water from Sooke Reservoir continued to meet the USEPA criteria to remain an unfiltered drinking water supply.

Greater Victoria Drinking Water Service Area

At the Japan Gulch Treatment Plant, the water passes through a three part disinfection process in sequential order – two primary disinfectant steps followed by a secondary disinfectant step:

1. *UV Disinfection*. In 2004, as the final part of the Enhanced Disinfection Project, ultraviolet (UV) disinfection was added to the treatment process at the two treatment plants. UV disinfection provides the first step of the primary disinfection process (disinfection of the raw source water entering the plants) and inactivates parasites such as *Giardia* and *Cryptosporidium* as well as reducing the level of bacteria in the water.

2. *Free Chlorine Disinfection*. The second step of the primary disinfection process is the addition of free chlorine. This step was changed in 2001, as the first part of the Enhanced Disinfection Project and provides approximately 10 minutes or so (depending upon flow) of contact time between the free chlorine and the water. Previously, the water was disinfected using chloramines. This change provided a much stronger oxidant (free chlorine) for the disinfection of the source water and inactivates bacteria and viruses.

3. *Ammonia Addition*. The third step in the disinfection process is the addition of ammonia to form chloramines at a point downstream where the water has been in contact with the free chlorine for approximately 10 minutes or more. The ammonia is added at a ratio of approximately 5 parts chlorine to 1 part ammonia. In the water, these chemicals combine to produce a chloramine residual. This residual remains in the water and

continues to protect the water from bacterial contamination (secondary disinfection) as it travels throughout the pipelines of the distribution system.

During most of 2004, the Water Services Department maintained a steady dosage rate of 1.5 mg/L of free chlorine at the Japan Gulch Treatment Plant. The chlorine dosage level was maintained at 1.5 mg/L from January to July 14th. On July 15th the dosage was increased to 1.6 mg/L and as the water temperature increased above 15ºC, the dosage was increased to 1.7 mg/L and remained at this level until December 16th when the dosage was decreased to 1.5 mg/L.

During this period, the CRD Environmental Services Department continued to periodically rechlorinate portions of the water system on the Saanich Peninsula to control bacterial regrowth.

Sooke District Drinking Water Service Area

The dosage of chlorine and ammonia at the Charters Treatment Plant was changed in concert with that used at the Japan Gulch Plant.

2.3. TRANSMISSION SYSTEM WATER MAINS

Using a series of large diameter transmission mains, the CRD Water Services Department supplies bulk, treated (disinfected) water to the municipalities of Victoria, Esquimalt, Oak Bay, Saanich and, in the Western Communities, to the Juan de Fuca Water Distribution System. On the Saanich Peninsula, bulk, treated water is supplied to the Saanich Peninsula Water Commission (SPWC) who in turn supply it to Central Saanich, North Saanich and Sidney via the Saanich Peninsula Trunk Water Distribution System. This latter system is operated by the CRD Environmental Services Department for the CRD Water Services Department.

2.3.1. WATER SERVICES DEPARTMENT TRANSMISSION SYSTEM

In 2004, the Water Services Department used seven large diameter transmission mains to supply water to the municipal distribution systems in the Greater Victoria Drinking Water Service Area (**Map 1**).

- Main #1 is a 1067 mm (42") cement mortar-lined steel pipe that starts at the Humpback pressure regulating valve (PRV) below the Humpback Reservoir Dam and ends at the David Street vault. Over the past decade or so, the majority of this transmission main has been upgraded from a smaller 914 mm (36") diameter, riveted steel pipe. At the end of 2004, only a small section of the total 17.3 km length is awaiting replacement with the larger diameter pipe. This water main provides water primarily to the City of Victoria but also services portions of Saanich and the Western Communities.

- Main #2 is a 780 mm (31") diameter steel pipe which starts at the Colwood overpass, parallels Main #1 on the south side of the Gorge water way and runs primarily through Esquimalt and Vic West. Main #2 rejoins Main #1 at the David Street vault after crossing the Point Ellice Bridge. This supply main is 7.6 km in length and provides water to View Royal, Victoria and Esquimalt.

- Main #3 is primarily a 990 mm (39") diameter steel pipe that supplies water from the Humpback PRV and terminates at the Department's Mt. Tolmie Reservoir. There are several sections in this line that include 1220 mm (48") and 810 mm (32") diameter pipe. The 810 mm diameter pipe terminates at the Oak Bay meter vault. This supply main is 21.3 km in length and provides water to the Western Communities, Saanich, Victoria and Oak Bay.

- Main #4, a high pressure transmission main, is primarily a 1220 mm (48") diameter steel pipe that supplies water from the Japan Gulch Plant primarily to Saanich and the Saanich Peninsula. There are two small sections of 1320 mm (52") and 1372 mm (54") reinforced concrete pipe. This transmission main is 26.2 km in length and terminates near the Saanich-Central Saanich boundary where it transfers water to the 762 mm (30") trunk main extending to McTavish Upper Reservoir supplying the municipalities on the Saanich Peninsula, and to Bear Hill Reservoir and Hamsterly Pump Station near Elk Lake.

- Main #5 is a 1524 mm (60") diameter pipe that connects the Kapoor Tunnel via the Japan Gulch Plant to the Humpback PRV just below the old Humpback Reservoir dam. It is approximately 1.6 km in length and provides water to Mains #1 and #3.

- Main #7 is a 610 mm (24") diameter steel pipe that runs from Goldstream and Whitehead to Metchosin and Duke. It is 4 km in length and provides water to portions of Colwood, Langford and Metchosin.

- Main #8 is a 457 mm (18") diameter steel pipe that runs from Glen Lake School, primarily along Happy Valley Road to Happy Valley and Glenforest. It is 3.6 km in length and provides water to Langford, Colwood and Metchosin.

There are three active interconnections between the high pressure Main #4 and the low pressure Main #1 and #3 where water can be transferred from Main #4 to the other two mains via pressure reducing valve (PRV) stations. These stations are located at Esler's, Adams Storage, and Camden. There are also a series of interconnections between Main #1 and Main #3 with the major interconnections at Esler's, Price Road, Station Road, Tillicum and Dupplin Road.

2.3.2. SAANICH PENINSULA TRUNK WATER DISTRIBUTION SYSTEM

The Saanich Peninsula Trunk Water Distribution System receives water at several points on the Saanich Peninsula from the regional transmission system and supplies it to four customers on the Saanich Peninsula: the municipalities of Central Saanich, North Saanich and Sidney and the Agricultural Research Station.

The Saanich Peninsula Trunk Water Distribution System is comprised of 46 km of transmission mains including the 750 mm Bear Hill Main, the 400 mm Keating Main, the 400 mm Dean Park Main and the 250-500 mm Saanich Peninsula mains.

At McTavish Reservoir (the terminus of the regional transmission system) the Saanich Peninsula Trunk System continues further along the peninsula via a 610 mm (24") diameter concrete cylinder pipe. In the vicinity of the airport, this main reduces to a 406 mm (16") diameter asbestos cement pipe that terminates at the Deep Cove Pumphouse. A dedicated 250 mm diameter perm/PVC pipe connects Deep Cove Pumphouse with Cloake Hill Reservoir. A 457 mm (18") diameter transite pipe along Mills Road connects the trunk main to the northwest end of the Sidney Distribution System.

The CRD Environmental Services Department also operates six major pumping stations located at Hamsterly, Martindale, Lowe Road, Dean Park Lower, Dean Park Middle and Deep Cove along with two minor pumping stations located at Mt. Newton and Dawson Upper Reservoir.

2.4. BALANCING RESERVOIRS

2.4.1. SUPPLY SYSTEM RESERVOIRS

In 2004, the CRD Water Services Department operated the following large supply system reservoirs in the Greater Victoria Drinking Water Service Area:

- Mount Tolmie Reservoir, a double-celled, 27,300 cubic metre (6 million imperial gallon (MIG)) reservoir, is located on Mount Tolmie at the terminus of Main #3.

- Haliburton Reservoir, a single-celled, 22,700 cubic metre (5 MIG) reservoir, is located off Haliburton Road east of Beaver Lake and is supplied from Main #4.

In 2004, the CRD Environmental Services Department operated 8 supply reservoirs as part of the Saanich Peninsula Trunk Water Distribution System.

- Bear Hill Reservoir, a single-celled, 4,546 cubic metre (1.0 MIG) reservoir located on Bear Hill in Saanich.
- Cloake Hill Reservoir, a single-celled, 4,550 cubic metre (1.0 MIG) reservoir located on Cloake Hill in North Saanich.
- Dawson Upper Reservoir, a single-celled, 455 cubic metre (0.1 MIG) reservoir located off Benvenuto Ave in Central Saanich.
- Dean Park Lower Reservoir, a double-celled, 4,545 cubic metre (1.0 MIG) reservoir located beside Dean Park Road in North Saanich.
- Dean Park Middle Reservoir, a double-celled, 2 730 cubic metre (0.6 MIG) reservoir located near the bottom of Dean Park in North Saanich.
- Dean Park Upper Reservoir, a double-celled, 4,550 cubic metre (1.0 MIG) reservoir located near the top end of Dean Park in North Saanich.
- McTavish Upper Reservoir, a single-celled, 4,550 cubic metre (1.0 MIG) reservoir located at the terminus of Main #4 on the south side of McTavish Road in North Saanich.
- McTavish Lower Reservoir, a single-celled, 2,280 cubic metre (0.5 MIG) reservoir located on the south side of McTavish Road in North Saanich.

2.4.2. DISTRIBUTION SYSTEM RESERVOIRS

In 2004, the Water Services Department operated 13 reservoirs in the municipalities of Colwood, Langford, Metchosin, View Royal, Sooke and East Sooke. In Colwood, Townview Reservoir serviced the eastern slope of Triangle Mountain while Batting Place Reservoir serviced a small high elevation area on the south slope. Whisperwind Reservoir and Peacock Reservoir serviced the high elevation area in Langford, north of the Trans Canada Highway. Stirrup Place Reservoir serviced a local high elevation area in Metchosin between Pears Road and Glenforest Way. Further south in Metchosin, Rocky Point Reservoir provided service along Rocky Point Road to the local area and Becher Bay Reserve. Deer Park Reservoir serviced a high elevation area downstream of Rocky Point Reservoir. In Sooke, Helgesen is the largest reservoir with Henlyn and Kirby being relatively small reservoirs supplying local areas. Coppermine and Silver Spray Reservoirs serviced the East Sooke distribution system.

Saanich operated five reservoirs including the large 27,300 cubic metre (6 MIG) Rithet Reservoir, which is located in Broadmead, and several smaller reservoirs including Wesley Reservoir, Hartland Road Reservoir and two reservoirs at the top of Mt. Tolmie – Cromwell Reservoir and Saanich's Mt. Tolmie Reservoir.

Victoria has one small reservoir, Regents Tower, which, in the past, supplied a local high-elevation area. This reservoir was not used in 2003 or in 2004 and has effectively been taken out of service.

2.5. DISTRIBUTION SYSTEM

Greater Victoria Drinking Water Service Area

The distribution system of the Greater Victoria Drinking Water Service Area is comprised of eight individual distribution systems. Seven of the eight distribution systems are separately owned and operated by the municipalities of Central Saanich, North Saanich, Oak Bay, Saanich, Sidney, and Victoria (Victoria owns and operates the distribution system in Esquimalt). The eighth distribution system, the Juan de Fuca Water Distribution System is operated by the CRD Water Services Department for the Western Communities of Langford, Colwood, Metchosin and View Royal. (**Note**: Sooke and portions of the Juan de Fuca Electoral Area are included under the jurisdiction of the Juan de Fuca Water Distribution System area but are located in a separate drinking water service area.)

2.5.1. CENTRAL SAANICH DISTRIBUTION SYSTEM

In 2004, ten pressure zones, seven off the Bear Hill Main and three off the Martindale Valley main supplied the Central Saanich Distribution System. The Bear Hill main supplied the Tanner Ridge area by direct feed, the central area in one pressure zone through three pressure regulating vaults (PRV's), the Saanichton area in two pressure zones through two PRV's, the Brentwood Bay area, and the Tsartlip First Nation through a PRV. Five smaller pressure zones served the rest of Central Saanich. Upper Dawson Reservoir supplied a small area of higher elevation residences in Brentwood Bay. Martindale Pump supplied an agricultural area in the southeast corner of the municipality. The Island View Road area was supplied by the Stelly's Pump Station. The Mount Newton Pump provided water to the northeast corner and to the Tsawout First Nation lands. A municipally owned pump station on Oldfield Road serviced a small area in the southwest corner.

Bear Hill Reservoir had the largest service population in Central Saanich providing approximately 80% of the Central Saanich's water. It was the primary supply to most of Central Saanich (south of Haldon Road) including Brentwood Bay.

2.5.2. NORTH SAANICH DISTRIBUTION SYSTEM

In 2004, water was supplied to the North Saanich Distribution System from a number of points along the SPWC peninsula trunk main. This included Dean Park via the Lowe Road Pump Station, Dean Park Pump Stations and Dean Park Reservoirs, Deep Cove/Lands End area via connections upstream of the Deep Cove Pump Station, Cloake Hill Reservoir via Deep Cove Pump Station and Swartz Bay. In the North Saanich Distribution System Cloake Hill Reservoir is the largest pressure zone. Water flowed generally in a easterly direction through the Dean Park pressure zone, northwest into the Deep Cove / Lands End area and northeast to the Swartz Bay area. Dean Park Upper Reservoir supplied a small portion of the Dean Park Estates.

The storage reservoirs servicing North Saanich were Dean Park Lower, Middle and Upper Reservoirs, McTavish Upper Reservoir and Cloake Hill Reservoir.

North Saanich provided water to the Greater Victoria Airport via the 8" line on the east side of the airport. Water quality in the airport system falls under Federal jurisdiction and was not tested by the Water Services Department.

2.5.3. OAK BAY DISTRIBUTION SYSTEM

In 2004, water was supplied to the Oak Bay Distribution System at Lansdowne and Foul Bay Road from Main #3. The water flowed in a west to east direction across Lansdowne with north and south branches. Oak Bay has a 406 mm (16") combination feeder/collector system, which crosses Oak Bay diagonally from northwest to southeast. Water is collected in the north end and distributed to the south end via the 406 mm main. Oak Bay has an outer loop flow on Beach Drive to the Victoria boundary.

Oak Bay has four local pressure areas supplied by booster pumps. Sylvan Lane Pump Station supplied the Barkley-Sylvan area, Plymouth supplied the North Henderson area, Foul Bay supplied the south Henderson area and Uplands Pump Station (seasonal) supplied the Uplands area. There are 2 interconnections with the Victoria system which are normally closed but which can be used in emergencies.

2.5.4. SAANICH DISTRIBUTION SYSTEM

In 2004, water was supplied to the Saanich Distribution System at a number of points from the Department's large transmission mains. Water was supplied from Main #1 at Dupplin, Wilkinson, and Marigold; from Main #3 at Douglas, Tillicum Foul Bay, Admirals, Shelbourne, Richmond and Maplewood Pumphouse and from Main #4 at Burnside, Blue Ridge, Roy Road, Markham, Layritz, Cherry Tree Bend and Sayward. In the Saanich Distribution System, water flowed generally in a northerly direction from Main #1 and #3 and both east and west from Main #4.

There are four major pumping systems in the Saanich Distribution System. Maplewood pumps water north from Main #3, ending in the Gordon Head area. Cherry Tree Bend pumps from Main #4 to Wesley Reservoir and the west central high elevation area. Royal Oak is a booster pump for Rithet Reservoir that is used during peak flows in the summer months. The Mt. Tolmie/Plymouth pump takes water from Main #3 and the Mt. Tolmie Reservoirs and pumps to Saanich's Mt. Tolmie Reservoir and the Gordon Head area via a 610 mm (24") diameter main.

Water from Sayward supplies the north end of the Saanich Distribution System via Main #4 with a southerly flow through Cordova Bay. Saanich also has a number of other small pressure zones controlled by pump stations.

2.5.5. SIDNEY DISTRIBUTION SYSTEM

In 2004, water was supplied to the northern portion of the Sidney Distribution System from the 305 mm (12") diameter main at Mills Road via the SPWC 460 mm (18") main on Mills Road. This was in turn connected to the SPWC peninsula main at Mills Road and West Saanich Road upstream of the Deep Cove Pump Station. The southern portion of the distribution system was supplied from a 305 mm (12") main that is connected to the SPWC peninsula main via McTavish Lower Reservoir. Within the Sidney Distribution System, water flowed generally from the west via Mills Road and from the south via McTavish Lower Reservoir and met in the middle of the distribution system with approximately 60% of the water coming from the Mills Road supply.

2.5.6. VICTORIA/ESQUIMALT DISTRIBUTION SYSTEM

In 2004, water was supplied to the Victoria/Esquimalt Distribution System at the David Street vault from Main #1 and Main #2. The system divides into several lesser mains at that vault. Water was also supplied to Victoria from Main #3 at Cook and Mallek, Sommerset and Shelbourne. There is an outer loop of the distribution system along Dallas

Road in the Victoria/Esquimalt Distribution System and water flows generally in a north to south direction.

Water was supplied to Vic West and Esquimalt at Tyee from Main #2. Esquimalt was also supplied from Main #2 at Admirals and by connections along Craigflower at Lampson and Burleith.

2.5.7. JUAN DE FUCA WATER DISTRIBUTION SYSTEM

In 2004, water was supplied to the Juan de Fuca Water Distribution System (in this report, not including Sooke) primarily from Main #1 and Main #3. Parts of Langford and View Royal were supplied from Main #4 with pressure reduction at Esler's. In the Juan de Fuca Water Distribution System, water flowed generally in a northerly and southerly direction away from the supply mains. William Head Prison and the Becher Bay meter vault are located at the southern extremities of this system.

Sooke District Drinking Water Service Area

2.5.8. SOOKE/EAST SOOKE DISTRIBUTION SYSTEM

The Sooke/East Sooke Distribution System begins at the Sooke River Road Pumphouse, which receives chloraminated water from the Charters Treatment Plant. The primary water supply main to the community follows Sooke River Road downstream of the Sooke River Road Pumphouse and splits at Milne's Landing going east toward Sassenos and west toward the central area of Sooke. An underwater pipeline across Sooke Harbour supplies portions of East Sooke.

3. Bacteriological Monitoring Program

The Water Quality Division of the CRD Water Services Department is responsible for monitoring the bacteriological quality of the drinking water in the Greater Victoria Drinking Water System. This monitoring is conducted according to the directions of the Water Quality Division's Water Quality Compliance Monitoring Program. This Program is described in the Water Quality Division's *Water Quality Management Plan* and follows the requirements of both the Provincial *2003 Drinking Water Protection Act* and the Federal *Guidelines for Canadian Drinking Water Quality (April 2003 update)*.

3.1. PARAMETERS AND REGULATIONS

A description of the bacteriological parameters used by the Water Quality Division and the regulatory limits associated with those parameters that were in place in 2004 are outlined below.

3.1.1. TOTAL COLIFORM BACTERIA

Total coliforms. Total coliforms are a group of bacteria found in high numbers in both human and animal intestinal wastes and therefore are found in water that has been contaminated with fecal material. Unfortunately, bacteria with the biochemical characteristics of total coliforms are also found in non-contaminated water. Thus, in the absence of fecal coliforms (a more direct indicator of fecal contamination), the presence of total coliforms may indicate older fecal contamination or the presence of decaying organic matter. Although the total coliform bacteria group is a less reliable indicator of sewage contamination, because of its superior survival characteristics, it is preferred as an indicator of treatment adequacy in drinking water supply systems (MOH, 1982).

Test Method. Total coliforms are analyzed by the Water Quality Division's Main Laboratory using the membrane filter test and are reported as colony forming units (CFU) per 100 millilitres (mL) of water. The total coliform test measures the quantity of bacteria capable of producing a red colony with a green sheen on an Endo-type growth medium containing lactose within 24 hours at 35°C. (**Note**: Starting in 2004, for the raw source water, total coliforms are analyzed using the defined substrate technology (DST) method to provide better specificity during periods of high background bacterial levels).

The total coliform bacteria test is used by the Water Quality Division to indicate the presence of sewage and/or storm water contamination and ensure compliance with the regulations.

Regulatory Limits. In disinfected drinking water, both the Federal and Provincial maximum acceptable concentration are zero total coliforms per 100 mL in all samples. However, since total coliform bacteria are not uniformly distributed in drinking water and are subject to considerable variation, the maximum acceptable concentration is interpreted as:

- *No sample should contain more than 10 total coliform organisms per 100 mL.*
- *No consecutive sample from the same site should show the presence of coliform organisms*
- *Not more than 10% of the samples based on a minimum of 10 samples should show the presence of coliform organisms.*

3.1.2. BACKGROUND BACTERIA

Background Bacteria. Background bacteria are used as a general measure of the bacterial population present in a drinking water system and in the raw (undisinfected) source water. Under increasing nutrient conditions and/or a reduction in the concentration of chlorine residual, the background bacteria may increase and provide an early warning of the potential growth of coliforms.

Test Method. Background bacteria are analyzed by the Water Quality Laboratory using membrane filtration and reported as colony forming units (CFU) per 100 mL. The background bacteria test measures the quantity of bacteria capable of growing on an Endo-type growth medium containing lactose within 24 hours at 35°C.

Regulatory Limits. In disinfected drinking water, the Federal maximum acceptable concentration of background bacteria is 200 colonies per 100 mL. In 2004, there was no Provincial regulatory limit for this parameter.

3.1.3. FECAL COLIFORMS

Fecal Coliforms. Fecal coliforms are a subset of the total coliform bacterial group and are also are found in human and animal intestinal wastes. However, they are a more precise indicator of the presence of sewage contamination than total coliforms. The fecal coliform bacteria group includes the genera *Escherichia* and, to a lesser extent, *Klebsiella* and *Enterobacter*.

Test Method. Fecal coliforms are analyzed by the Water Quality Laboratory using the membrane filter method and are reported as colony forming units (CFU) per 100 mL. The fecal coliform bacteria test measures the quantity of bacteria capable of producing gas from EC medium within 24 hours when incubated at 44.5°C.

Regulatory Limits. In disinfected drinking water, the Federal and Provincial maximum acceptable concentration of fecal coliforms are zero fecal coliforms per 100 mL.

3.1.4. ESCHERICHIA COLI

Escherichia coli. *Escherichia coli* (*E. coli*) is a bacterium that is present in the normal intestinal bacteria of human beings and warm-blooded animals. It is the predominant bacterial species that comprises the fecal coliform group of bacteria. While most members of this species are considered harmless some strains of *E. coli* cause diarrhoeal illness.

Test Method. *E. coli* are analyzed by the Water Quality Laboratory using the defined substrate technology (DST) method. (**Note**: For the purposes of this report, the term fecal coliform is used for all data using either the membrane filtration (fecal coliform test) or the DST method (*E. coli* test)).

Regulatory Limits. In disinfected drinking water, the Federal and Provincial maximum acceptable concentration of *E. coli* is zero *E. coli* per 100 mL.

3.1.5. HETEROTROPHIC PLATE COUNT BACTERIA

Heterotrophic Plate Count Bacteria. Heterotrophic plate count bacteria are used as a general measure of the bacterial population present in a drinking water system and in the raw source water. Under increasing nutrient conditions and/or a reduction in the concentration of chlorine residual, the heterotrophic bacteria are usually the first group to increase and provide an early warning of the potential growth of coliforms. Specifically, heterotrophic plate count bacteria are used to monitor the disinfection of the water at the disinfection plants, to track the decline in chlorine residuals in the distribution system and in the balancing reservoirs and to ensure compliance with the regulations.

Test Method. The Water Quality Division uses two different methods for analyzing heterotrophic plate count bacteria. Both methods quantify the bacteria by membrane filtration and the results are reported as colony forming units (CFU) per 1.0 mL.

- HPC2D. The HPC2D test measures the quantity of heterotrophic bacteria capable of growing on m-HPC Medium within 2 days (48 hours) at 35°C.

- HPC7D. The HPC7D test measures the quantity of heterotrophic bacteria capable of growing on m-HPC Medium within 7days at 28°C.

Regulatory Limits. In disinfected drinking water, the Federal maximum acceptable concentration of HPC2D is 500 colonies per mL. In 2004, there was no Provincial regulatory limit for this parameter. There is no Federal or Provincial regulatory limit on the quantity of HPC7D allowed in drinking water. In the absence of a regulatory limit, the Water Quality Division uses an operational limit of 10,000 HPC7D bacteria per 1.0 mL.

3.2. BACTERIOLOGICAL SAMPLING

The number of sampling locations and the sampling frequency used at those stations were based on the population of the community using a formula in accordance with the Federal Guidelines and the complexity of the distribution system.

When positive bacteriological results were found, the Water Quality Division resampled those locations and, depending upon the situation, may have requested the agency operating the distribution system to flush the mains at that location and/or drain and disinfect distribution reservoirs.

Greater Victoria Drinking Water Service Area

In 2004, bacteriological samples were collected from the raw source water entering the Japan Gulch Treatment Plant, the UV treated water and from the treated water at the first customer sampling location below the plant 5 days per week. The large transmission mains and the Department's supply reservoirs were monitored weekly. The smaller distribution system reservoirs were monitored bi-weekly. The majority of the locations within the municipal distribution systems were sampled bi-weekly with a smaller number being sampled monthly. Bacteriological samples were collected from the municipal distribution systems on a bi-weekly schedule with some locations being monitored weekly and some monthly.

The Water Quality Division used 86 permanent, pre-established bacteriological sampling locations within the distribution system of the Greater Victoria Drinking Water Service Area. In addition, 15 sampling locations were used to monitor the transmission mains and 27 sampling locations were used to monitor the supply and distribution system reservoirs.

Sooke District Drinking Water Service Area

In 2004, weekly bacteriological samples were collected from the raw water upstream of the Charters Treatment Plant and from the treated water at the Sooke River Road Pumphouse (prior to first customer). The distribution system reservoirs were sampled bi-weekly. The Water Quality Division used 7 sampling locations for bacteriological sample collection in the distribution system and 9 sampling locations in the distribution system reservoirs of the Sooke District Drinking Water Service Area.

3.3. ANALYSIS AND REPORTING

3.3.1. ANALYSIS

The bacteriological analysis program was comprised of two components: a field component and a laboratory component for existing water mains and a special testing program for new water mains prior to putting them into service.

Field Component. All samples collected were analysed in the field for chlorine residual level and water temperature.

Laboratory Component. In general, bacteriological samples were analysed for total coliform (TC) bacteria, fecal coliform (FC) bacteria, background bacteria (TCBK) and heterotrophic plate count bacteria incubated at 35°C for 2 days (HPC2D). Raw water samples were analysed for TC, TCBK, *E. coli* and heterotrophic plate count bacteria incubated at 35ºC for 2 days (HPC2D) or at 28ºC for 7 days (HPC7D).

New Water Mains. All new water mains were tested for TC, *E. coli*, chlorine residual, and turbidity. All repeat samples from positive locations (resamples) were analysed for TC, *E. coli*, chlorine residual and water temperature.

3.3.2. REPORTING

The bacteriological results of the samples collected from the drinking water service area distribution system were reported in several ways both to the office of the Chief Medical Health Officer and to the distribution system purveyors. Written reports containing the previous week's analytical results were faxed weekly and written summaries were

provided monthly via the CRD web site. Depending upon the nature of the result, adverse results from positive samples were either faxed or notified directly by telephone.

3.4. CERTIFICATION AND AUDITS

To ensure that the analytical testing is performed to the highest possible standard, the Water Quality Laboratory participates in several types of external quality assurance and quality control (QA/QC) programs in addition to rigorous internal quality QA/QC procedures that are included as part of the methodology and are a normal component of good laboratory practice.

3.4.1. CERTIFICATION

The Province of British Columbia requires that all laboratories analyzing drinking water samples be approved in writing by the Provincial Health Officer. Laboratory approval requires both an approval certificate and a proficiency testing certificate as noted below:

- **Water Bacteriology Testing Laboratory Approval Certificate**. This certificate is issued by the BC Provincial Health Officer for bacteriological testing of drinking water in the Province of British Columbia. This certificate is renewed every two years via an on-site inspection of the analytical laboratory.

- **Clinical Microbiology Proficiency Testing Program Certificate of Participation**. This certificate is issued by the Advisory Committee for Water Bacteriology Laboratories which is operated by the Department of Pathology and Laboratory Medicine at the University of British Columbia. Satisfactory performance is required to maintain laboratory certification.

3.4.2. AUDITS

The Vancouver Island Health Authority (VIHA) collects a limited number of drinking water samples from the Greater Victoria Drinking Water System as part of their audit on the Water Quality Division's Drinking Water Compliance Monitoring Program. In 2004, approximately 150 bacteriological samples were collected during two 2-week periods in the spring and fall by VIHA staff. These samples are analyzed by an independent local laboratory and reported to VIHA. The results for these samples were consistent with the data reported by the Water Quality Laboratory and therefore, satisfactory to the VIHA.

3.5. RESPONSIBILITIES OF WATER PURVEYORS

The *2003 BC Safe Drinking Water Regulation* places the responsibility on the water purveyor (owner and/or operator of a distribution supply system) to ensure that the drinking water in municipally-owned distribution systems is bacteriologically safe. In the Juan de Fuca Water Distribution System (comprised of Colwood, Langford, Metchosin, View Royal, Sooke and portions of the Juan de Fuca Electoral Area), the purveyor is the CRD Water Services Department. Therefore, the Department has the direct responsibility for monitoring the bacteriological quality in these municipalities. However, in the municipally-owned and operated distribution systems in the Greater Victoria Drinking Water Service Area, it should be emphasized that while the CRD Water Quality Division collects, analyses and reports the results of the bacteriological samples, the Division collects bacteriological samples in the municipally-owned distribution systems only as a service to the municipalities and they, as the water purveyor, are responsible for taking action on any lapses related to the bacteriological quality of the water originating within their system.

4. Bacteriological Results

The bacteriological results of the samples collected by Water Quality Division staff in 2004 from the Greater Victoria Drinking Water Service Area are summarised in this section. The bacteriological sample results from the Sooke District Drinking Water Service Area were generally consistent with the results in the Greater Victoria Drinking Water Service Area and, unless specifically noted, are not reported here.

In this report, the bacteriological results are divided into the following groupings according to the type of sampling location:

- Raw Water Entering the Plant **Section 4.1**
- UV Treated Water **Section 4.2**
- First Customer **Section 4.3**
- Transmission Mains **Section 4.4**
- Distribution System Reservoirs **Section 4.5**
- Greater Victoria Distribution System **Section 4.6**
- Municipal Distribution Systems **Section 4.7 – 4.13**

4.1. RAW WATER ENTERING PLANT

The bacteriological quality of the raw source water is an important indicator of the degree of treatment required to provide the optimum protection from microbiological contaminants and ensure a safe water supply. However, neither the *Guidelines for Canadian Drinking Water Quality* nor the *BC Drinking Water Protection Act* specify a Maximum Acceptable Concentration (MAC) for total coliforms or fecal coliforms in the raw source water. Therefore, in the absence of a Federal or Provincial limit, the quality of the raw source water was compared with the limits specified in the United States Environmental Protection Agency (USEPA) Surface Water Treatment Rule (SWTR):

To avoid the requirement to filter a surface water source, the SWTR states

- *If fecal coliforms are determined, the source water fecal coliform concentration must not exceed 20 per 100 mL or the total coliform concentration must not exceed 100 per 100 mL in more than 10 percent of the samples (running total) for the previous six months.*

- *When monitoring for both parameters has been done, the rule requires that only the fecal coliform limit be met.*

4.1.1. SAMPLES COLLECTED

In 2004, a total of 246 bacteriological samples were collected from the raw source water entering the Japan Gulch Treatment Plant. Typically, 20 samples or so per month were collected, one sample on each weekday. (**Note**: The numerical results are provided in **Table 1** near the end of this report. **Appendix A** provides an explanation of the column headings used in the tables.)

4.1.2. WATER TEMPERATURE

The median annual temperature of the water entering the Japan Gulch Plant was 11.1°C (**Table 1)**. The highest median monthly temperature was observed in August 2004 at 19.1°C and the lowest was observed in January at 4.0°C (**Figure 1**). The coldest daily water temperature recorded was 3.0°C in January while the highest maximum daily water

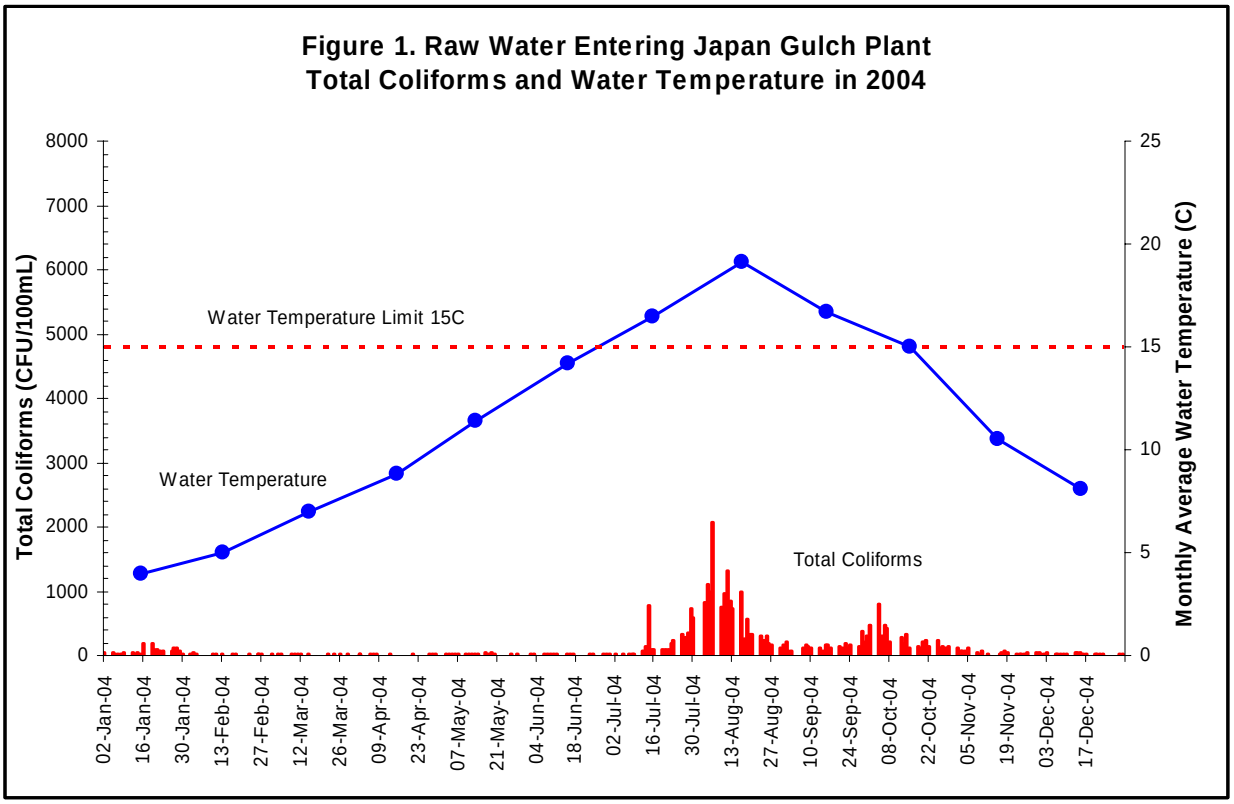
temperature was 20.9°C recorded in August 2004. All of these values are typical of those observed in previous years.

Compared to other Canadian cities, the summer temperature of the source water entering the Greater Victoria Drinking Water System is extremely warm.

4.1.3. BACTERIA

Total Coliforms. In 2004, the level of total coliform bacteria in the raw water entering the Japan Gulch Treatment Plant from Sooke Reservoir was relatively high from late July through mid-August, peaking at 2,063 colony-forming units (CFU) per 100 mL on August 6th (**Figure 1**). Total coliform concentrations exceeded 1,000 CFU/100 mL in samples collected from August 4th to August 11th. Although this level of total coliforms was substantially lower than in recent years (2000-2003), it is difficult to know if the improvement was real or an artifact of the more specific method of coliform detection that was used in 2004 (DST) versus that used in previous years (membrane filtration).

Figure 1. Raw Water Entering Japan Gulch Plant
Total Coliforms and Water Temperature in 2004



Fecal Coliforms. In contrast to the seasonal peak observed for total coliforms in the summer of 2004, the levels of fecal coliforms (*E. coli*) were similar to those in 2003 and did not display any significant seasonal trend although fecal coliform numbers were higher in January (during periods of heavy rainfall) (**Figure 1A**).

The median annual fecal coliform (actually *E. coli* in 2004) bacterial concentration in the raw source water entering the Japan Gulch Plant was 0 CFU/100 mL and ranged from 0 to 21 (**Figure 1A**) easily meeting the fecal coliform limit of 20 CFU/100 mL in the USEPA Surface Water Treatment Rule and therefore continues to qualify to remain an unfiltered surface water supply under this portion of their regulations.

Figure 1A. Raw Water Entering Japan Gulch Plant
Fecal Coliforms (*E. coli*) in 2004

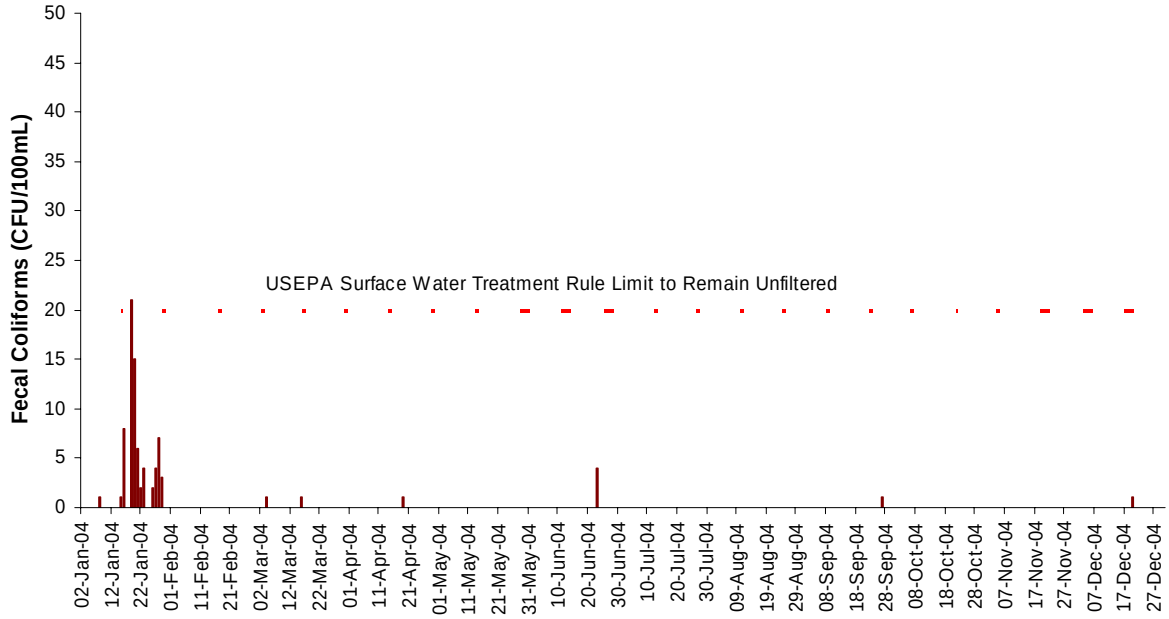
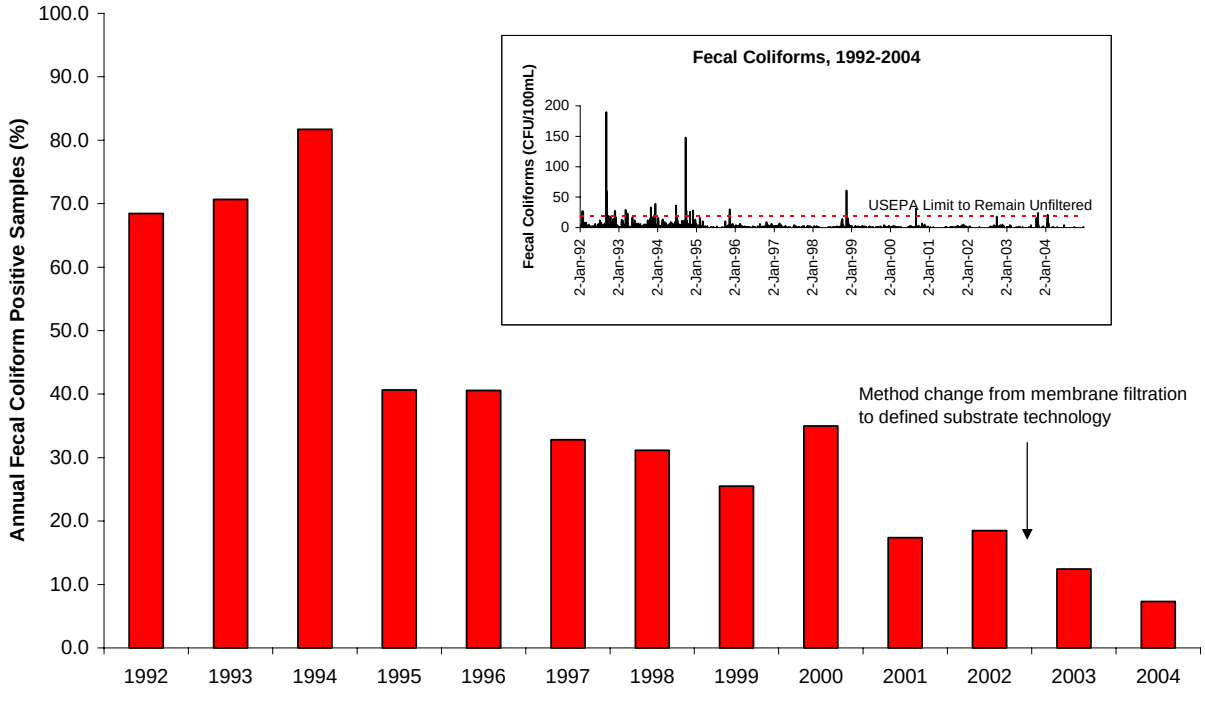


Figure 1B. Raw Water Entering Japan Gulch Plant
Annual % Samples with Fecal Coliforms Present, 1992-2004

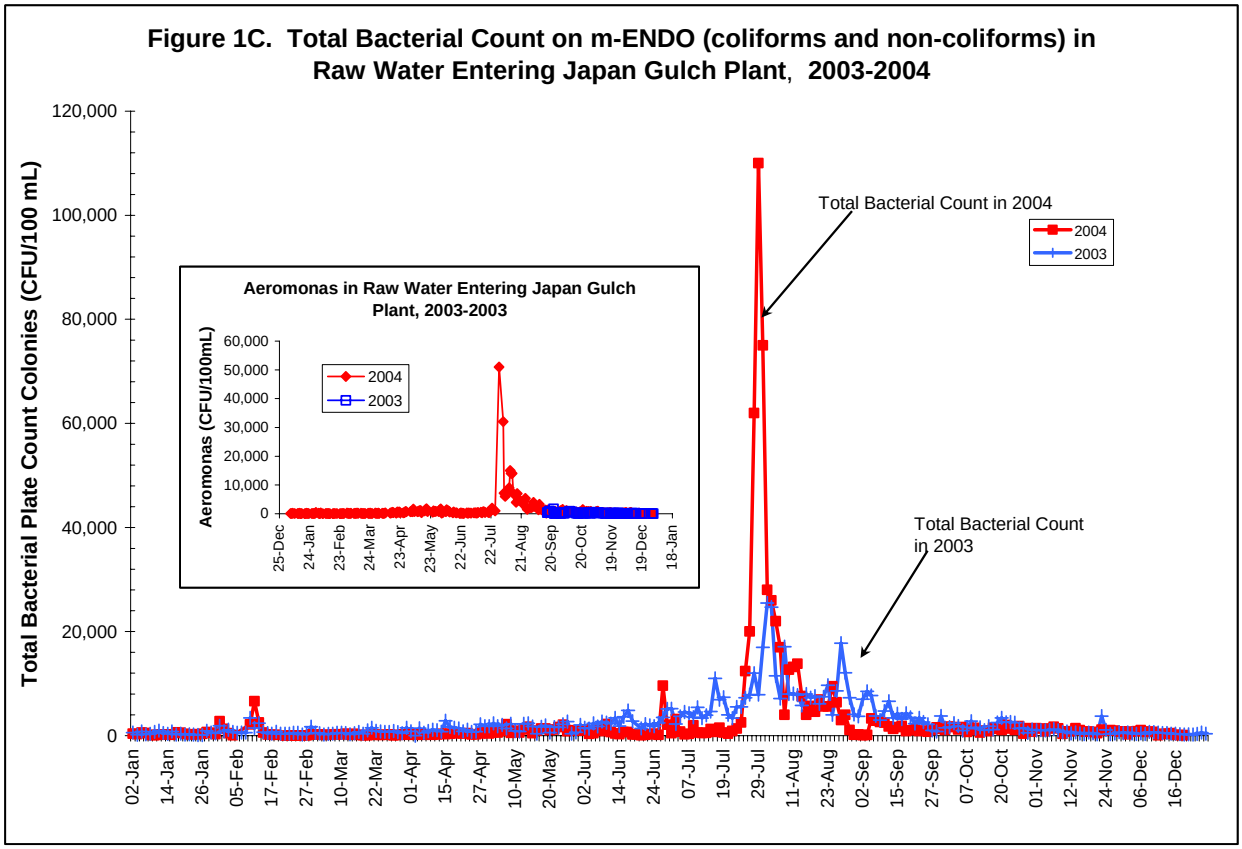


Over the past decade or so, the annual percentage of samples with fecal coliforms present has decreased from a maximum of 82% positive in 1994 to a minimum of 7.3% in 2004 (**Figure 1B**) indicating that the source water has improved. The method change in 2003 would not have affected these numbers.

Total Bacterial Count (Coliforms and Background Bacteria). Elevated levels of total bacteria on an m-ENDO plate (primarily background bacteria) were observed in the raw water entering the Japan Gulch Plant during the late summer of 2004 (**Figure 1C**). The total bacterial count peaked in late August and then gradually returned to baseline levels. This pattern was similar to previous years but differed substantially in quantity. In 2004, the total count rose to over 100,000 CFU/100 mL and was comprised primarily of bacteria called *Aeromonas hydrophila*. Previously, the level of background bacteria had never exceeded approximately 30,000 CFU/100 mL. Overwhelming circumstantial evidence tied this sudden increase in bacterial concentrations to the transplanting of several thousand fish from Deception Creek and Deception Reservoir into Sooke Reservoir that occurred under the direction of Provincial and Federal fisheries officers.

Approximately 80% of the background colonies were determined to be a bacterial genus called *Aeromonas* **(Figure 1C).** *Aeromonas* analysis is a new test that was added by the Water Quality Laboratory in the fall of 2003. *Aeromonas* is a common type of bacteria indigenous to surface waters and may be found in non-chlorinated or low flow sections of chlorinated or chloraminated water distribution systems. Monitoring the presence and numbers of this bacterium is desirable as some aeromonads may be pathogenic and pose a human health risk. The goal in 2003 and 2004 was to establish base line levels of this bacterium in our source water and determine if any survived the disinfection process.

Figure 1C. Total Bacterial Count on m-ENDO (coliforms and non-coliforms) in Raw Water Entering Japan Gulch Plant, 2003-2004



Heterotrophic Plate Count. The level of 2-day heterotrophic plate count bacteria (HPC2D) generally followed a similar pattern to that of the bacteria in 2003. The HPC2D levels showed a slight increase in late July and a larger albeit short-lived increase in October but not to the same degree as that observed for the total coliforms.

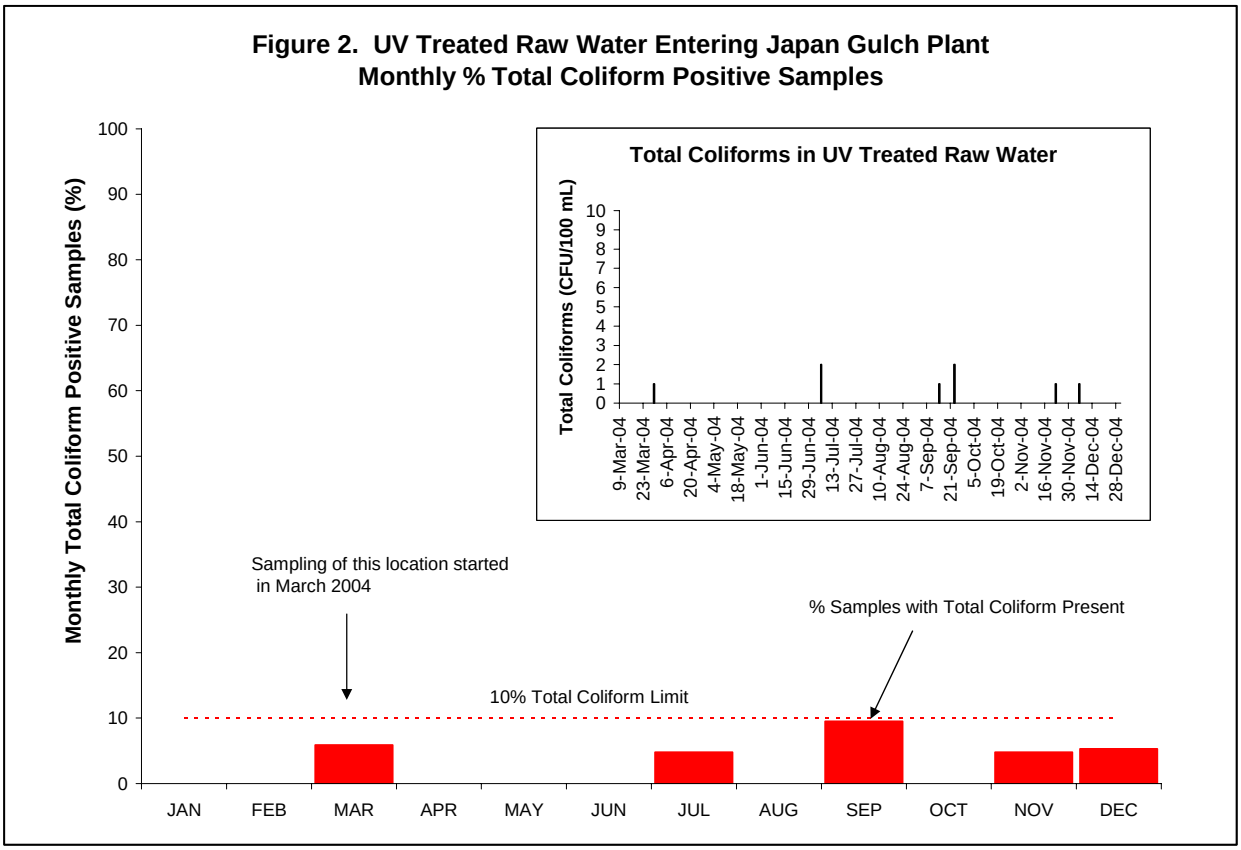
4.2. UV TREATED WATER

Ultraviolet (UV) disinfection of the raw water began in January 2004 and a sampling point to monitor this disinfection step was established in March 2004.

4.2.1. BACTERIA

The level of total coliform bacteria in the UV treated raw water was very low ranging from 0 to 2 CFU/100mL. From March to December 2004, coliforms survived the UV disinfection during five months, March, July, September, November and December (**Figure 2**). The annual *Aeromonas* positive rate was only 3% for the UV treated water, well below the 10% positive total coliform limit. The six total coliform positives were identified as *Enterobacter aerogenes*, (50%) *Citrobacter freundii* (16.7%), *E. coli* (16.7%), and *Aeromonas hydrophila* (16.7%). These results indicate that the UV disinfection step reduces the bacterial population of the raw source water about 1000 fold and provides good redundancy for primary disinfection (compare inset chart in **Figure 2** with **Figure 1** noting that different scales are used).

Figure 2. UV Treated Raw Water Entering Japan Gulch Plant
Monthly % Total Coliform Positive Samples



4.3. FIRST CUSTOMER

The bacteriological data collected by the Water Quality Division staff during 2004 from the treated water below the Japan Gulch Plant (below both the UV and chlorine disinfection steps) and prior to the bulk of the first customers in the distribution system are summarised in **Table 2** and charted in **Figure 3**. In this report, this sampling location is referred to as "First Customer".

4.3.1. SAMPLES COLLECTED

In 2004, 251 bacteriological samples were collected from the first customer sampling location below the Japan Gulch Plant (**Table 2**). Typically, one sample was collected each week day with the monthly total ranging from 19-24.

4.3.2. BACTERIA

Total Coliforms. In 2004, there was only one occurrence of positive total coliforms at the first customer sampling location (**Figure 3** and **Figure 4)**. On a monthly basis, this positive result produced a monthly percentage positive rate of 4.8% (**Table 2** and **Figure 3**) and an annual percentage positive rate of 0.4% (**Table 2**). None of the samples analyzed contained more than 10 total coliforms per 100 mL (**Table 2** and **Figure 4**).

Figure 3. Treated Water Below Japan Gulch Plant - Total Coliforms and Chlorine Residual in 2004

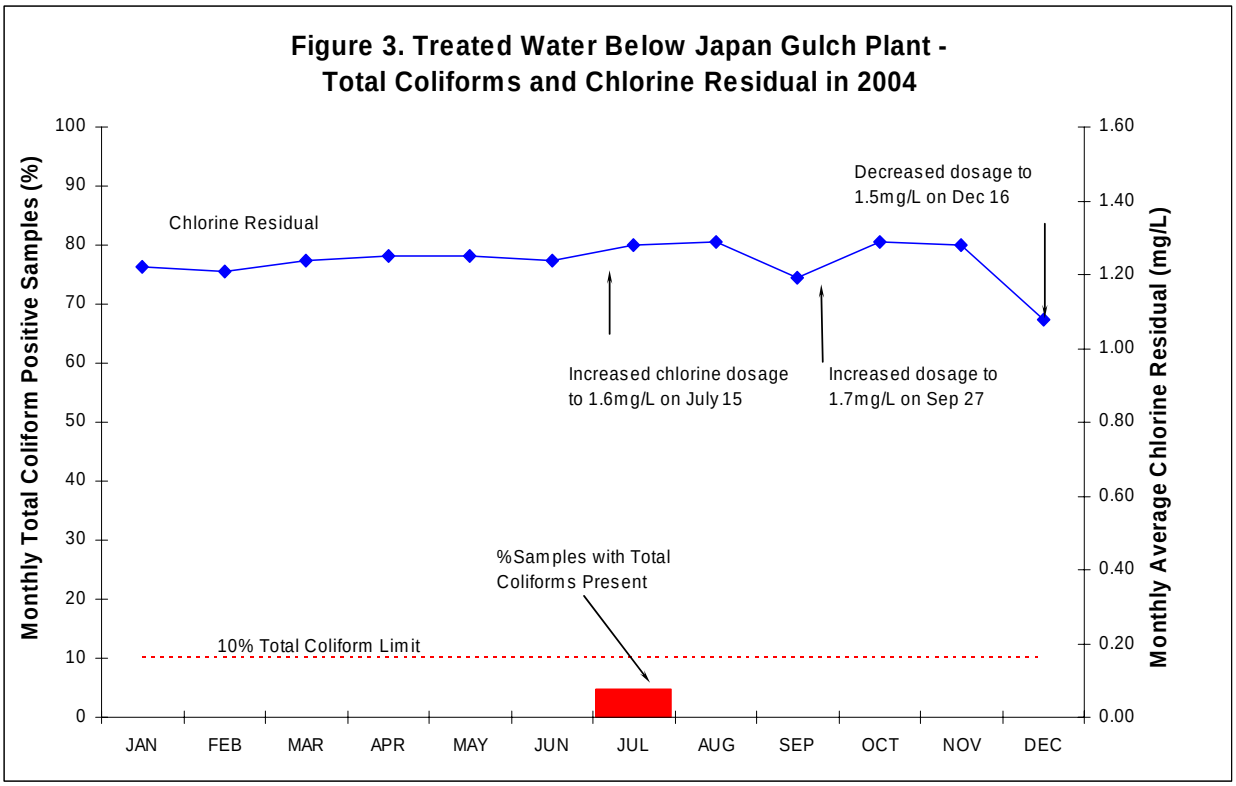


Figure 4. Treated Water at First Customer below Japan Gulch Plant
Total Coliforms in 2004

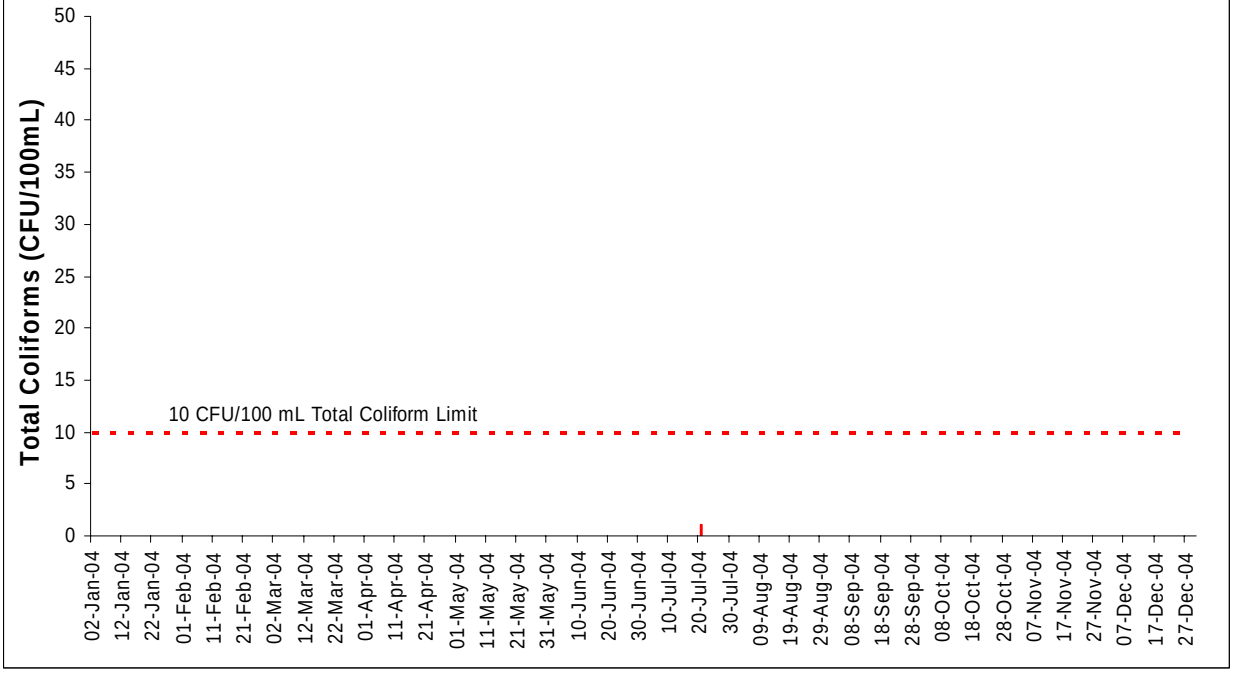
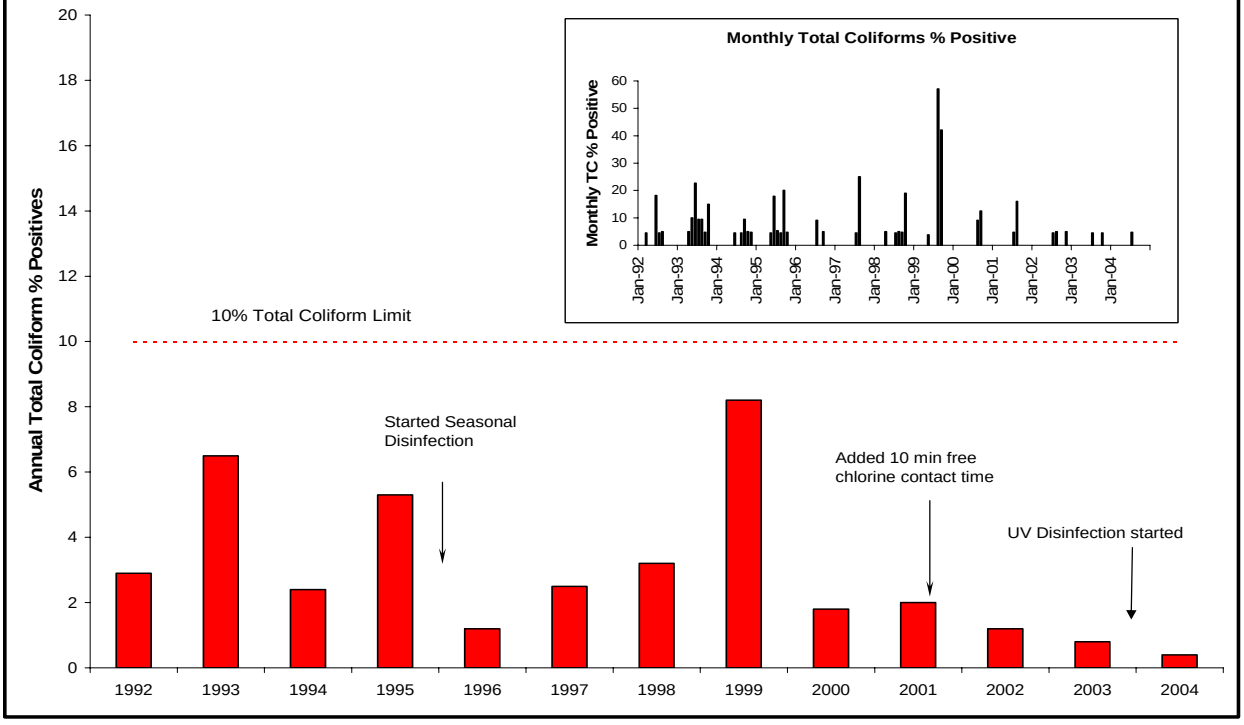
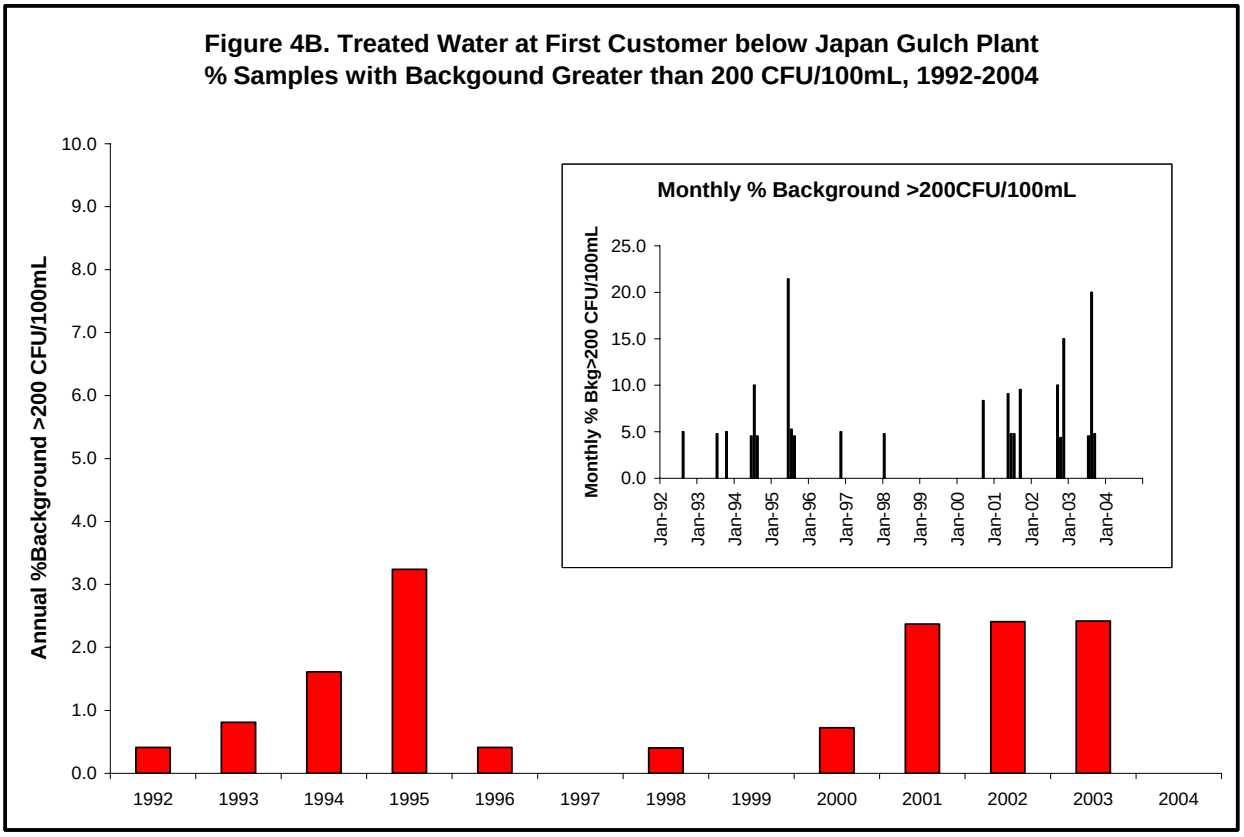


Figure 4A. Treated Water at First Customer below Japan Gulch Plant
% Samples with Total Coliforms Present





The annual total coliform positive rate of 0.4% was one of the lowest ever observed (**Figure 4A**), slightly lower than the 0.8% seen in 2003 and 2002 (2.0% in 2001, 1.8% in 2000, 8.2% in 1999, 3.2% in 1998, 2.5% in 1997, 1.2% in 1996, and 5.3% in 1995). In 1995, before the practice of altering the chlorine dosage, coliforms were detected in six months of the year. In 1996, 1997, 2000, 2001, 2002 and 2003 coliforms were detected in two months of the year and in 1998 coliforms were detected in five months of the year.

Fecal Coliforms. During 2004, no fecal coliforms were detected in any of the 251 samples collected from the first customer location below the Japan Gulch Treatment Plant (**Table 2**). This is significant as it indicates that no sewage-associated contamination was present in the water entering the distribution system and provides an assurance of the bacterial safety of Victoria's drinking water.

Background Bacteria. In 2004, there were no samples with background bacterial colonies exceeding 200 per 100 mL (**Table 2**). This is better than in recent years (**Figure 4B**). In 2001, 2002, and 2002, background bacterial colonies exceeded 200 per 100 mL in a total of six samples each year, at an annual rate of 2.4% over the 200 CFU/100mL level.

Heterotrophic Plate Count. None of the samples exceeded the HPC limit of 500 CFU/mL in the Guidelines (**Table 2**). This result is similar to previous years.

4.3.3. CHLORINE RESIDUAL AND WATER TEMPERATURE

Chlorine Residual. The median annual total chlorine residual measured at the first customer sampling point below the Japan Gulch Plant was 1.25 mg/L (**Table 2**). The minimum daily chlorine residual measured below Japan Gulch Plant was 0.0 mg/L in

August during a chlorination failure at the plant. The maximum daily chlorine residual recorded was 1.48 mg/L recorded in late July. The lowest monthly median chlorine residual occurred in December at 1.08 mg/L (after the dosage rate was reduced) with the highest in August and October at 1.29 mg/L (**Table 2**).

To reduce the potential for breakthrough of bacteria through the disinfection process, the chlorine dosage was maintained at 1.5 mg/L from January through mid-July (**Figure 3**) and increased in September during a period of higher chlorine demand. The combination of an appropriate chlorine dosage, the ten minute minimum free chlorine contact time and the UV disinfection of the raw source water reduced the number of total coliform positive samples to only one in late July (**Figure 4**).

Water Temperature. The median annual temperature of the water at the first customer location below the Japan Gulch Plant was 10.5°C (**Table 2**). The highest median monthly temperature was observed in August 2003 at 19.2°C and the lowest was observed in January at 4.2°C. The coldest daily water temperature recorded was 3.0°C in January while the highest maximum daily water temperature was 21.1°C recorded in August 2004. All of these values are typical of those observed in previous years.

4.4. TRANSMISSION MAINS

The sampling locations on the transmission mains (also called supply mains) included all the major points of supply to the individual municipal distribution systems and provided information on the bacterial levels and chlorine residuals supplied to those distribution systems or portions of a distribution system.

4.4.1. SAMPLES COLLECTED

In 2004, 472 bacteriological samples were collected from the transmission mains feeding the municipal distribution systems (**Table 3**). Many of these samples were collected at the entrances to the municipal distribution systems and provided the baseline bacteriological water quality and chlorine residual being delivered to those municipal distribution systems. Typically, the baseline levels for chlorine residual are somewhat different for those municipalities that are relatively close to the Japan Gulch Plant compared to those that are located some distance from the treatment plant.

4.4.2. BACTERIA

Total Coliforms. None of the samples collected from the transmission mains in 2004 contained total coliform bacteria (**Table 3 and Figure 5**). This result is the best that has been observed in the past decade or so (**Figure 5A**) and indicates that no total coliforms are being delivered to the municipal distribution systems.

Fecal Coliforms. None of the transmission main samples contained fecal coliform bacteria (**Table 3**).

Background Bacteria. Three samples collected from the transmission mains exceeded the 200 CFU/100 mL background bacteria limit (**Table 3**).

Heterotrophic Plate Count. None of the samples collected from the transmission mains exceeded the HPC limit of 500 CFU/mL (**Table 3**).

Figure 5. Transmission Mains
Total Coliforms and Chlorine Residual in 2004

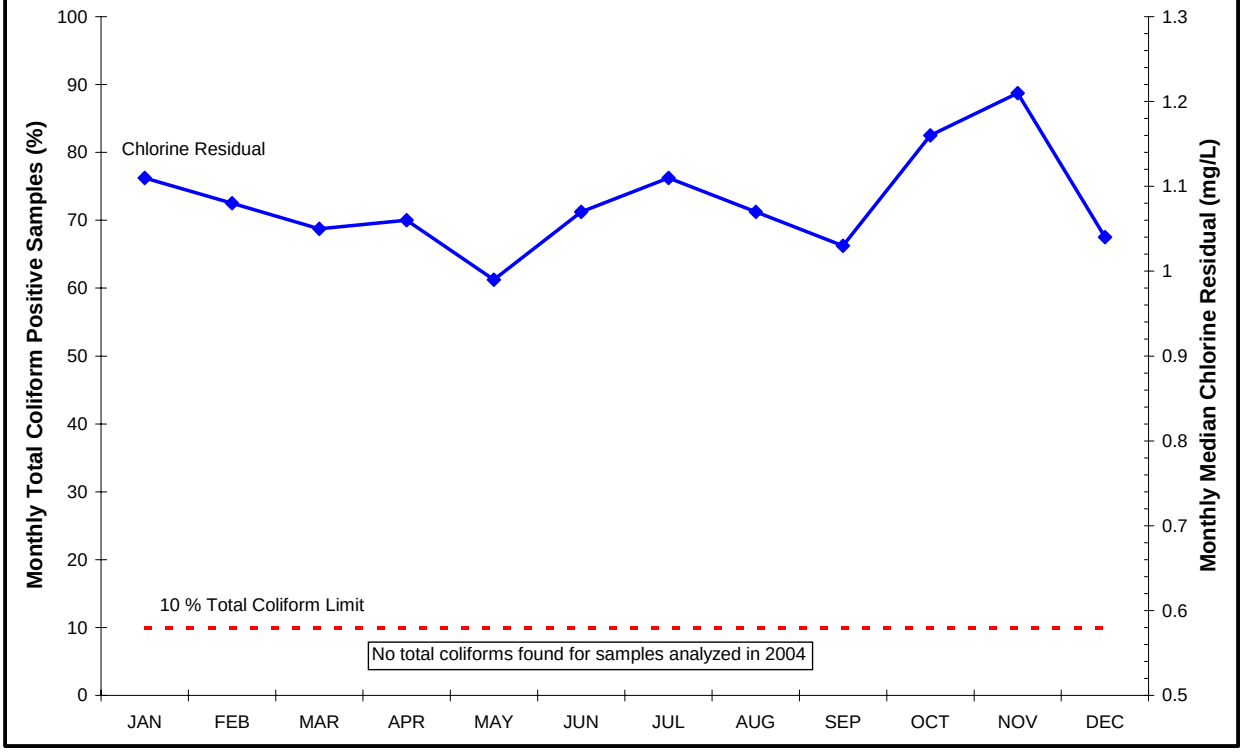
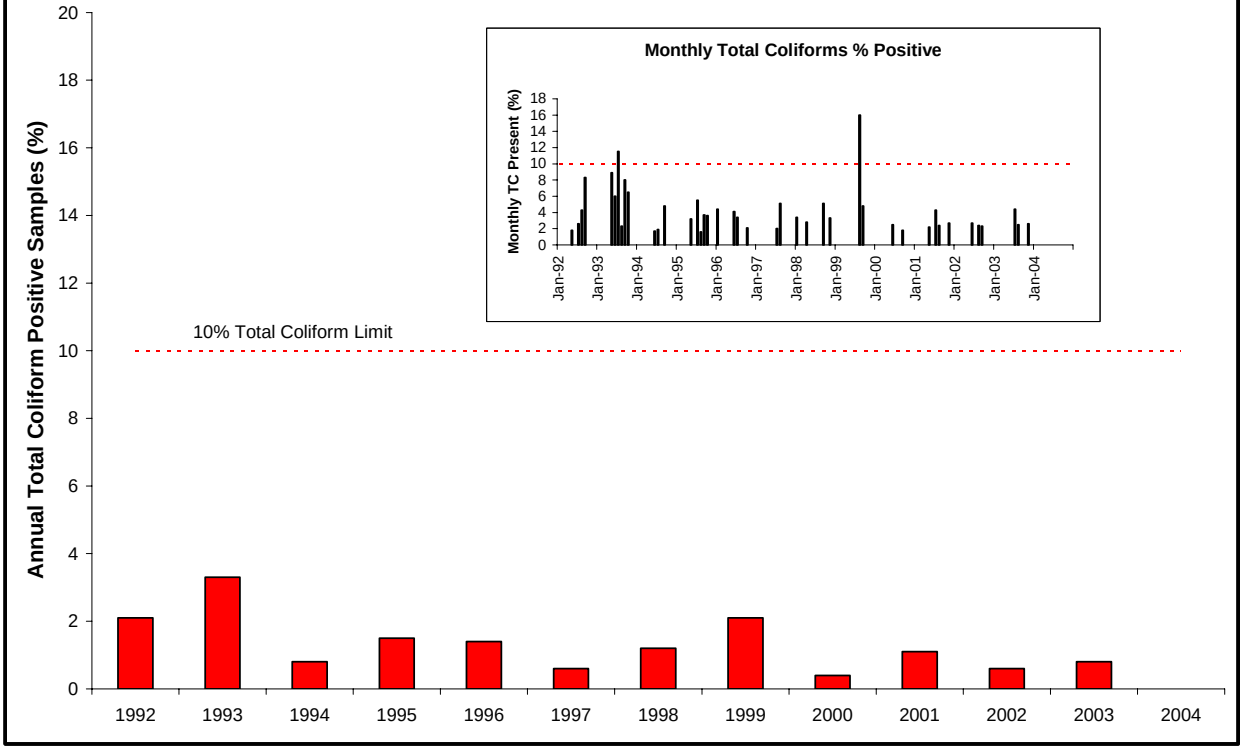


Figure 5A. Transmission Mains - Annual % Samples with
Total Coliforms Present, 1992-2004



4.4.3. CHLORINE RESIDUAL AND WATER TEMPERATURE

Chlorine Residual. The annual median chlorine residual for the transmission main samples was 1.08 mg/L (**Table 3**). The chlorine residual in the transmission mains displayed seasonal variation, decreasing in the winter months, increasing through the summer months and then increasing following the change in dosage before decreasing again (**Figure 5**). The lowest monthly median chlorine residual occurred during the month of May at 0.99 mg/L and the highest in November at 1.21 mg/L (**Table 3** and **Figure 5**).

Water Temperature. The annual median water temperature for the transmission mains was 11.1°C (**Table 3**). The maximum monthly median temperature of 19.5°C occurred in August while the minimum temperature of 5.0°C occurred in January. As expected, these levels were only marginally different from the temperature of the water at the first customer location below the Japan Gulch Plant.

4.5. DISTRIBUTION SYSTEM RESERVOIRS

The reservoirs located within the Greater Victoria Drinking Water System fall under two main categories: large, supply reservoirs operated by the CRD Water Services Department and the CRD Environmental Services Department and smaller distribution system reservoirs operated by the municipal water purveyor. These smaller reservoirs provide water pressure to a local high elevation area of the distribution system along with local fire protection. For the purposes of this report, all of these reservoirs were grouped together and called distribution system reservoirs.

Twenty-four reservoirs located in the Greater Victoria Drinking Water System were sampled during 2004. This number includes all of the supply and local storage reservoirs operated by the Water Services Department, the majority of reservoirs operated by the municipalities and all of the reservoirs operated by the CRD Environmental Services Department on the Saanich Peninsula. Generally, one sampling location was used for each cell of each reservoir.

4.5.1. SAMPLES COLLECTED

The total number of bacteriological samples collected by Water Quality Division staff from the Greater Victoria distribution system reservoirs in 2004 was 894 (**Table 4**). Typically, about 70-75 samples were collected each month. However, during some months the monthly totals were higher, due to the collection of repeat samples when positives were observed.

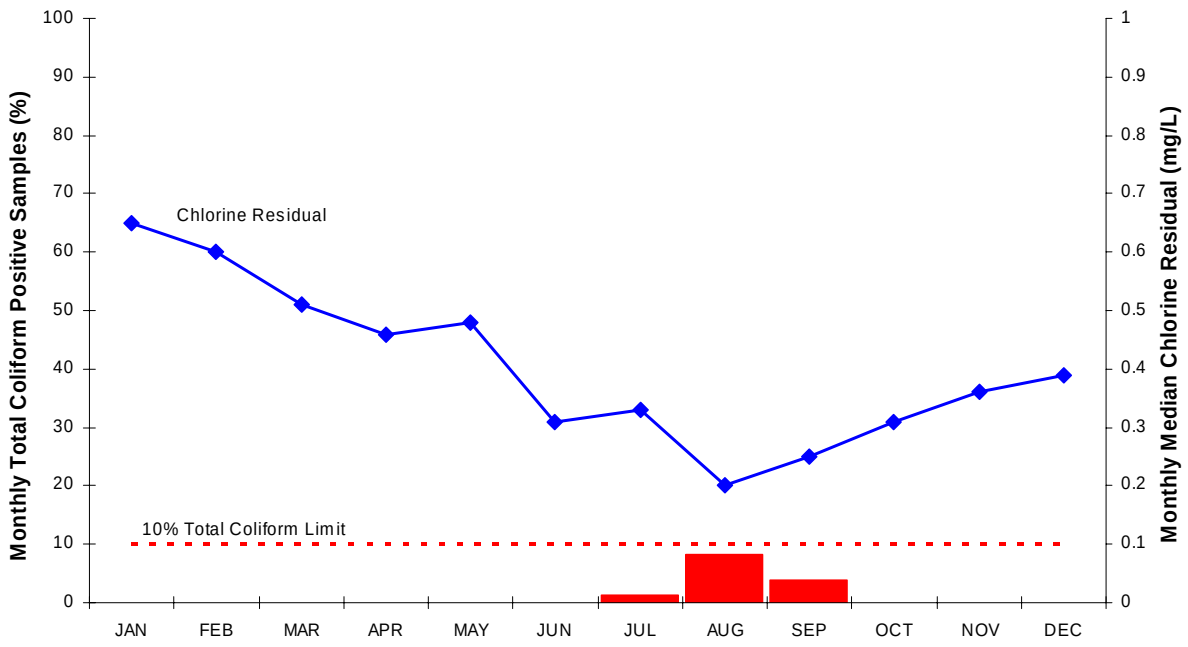
4.5.2. BACTERIA

Total Coliforms. In 2004, eleven samples (1.2%) collected from the Greater Victoria Drinking Water System reservoirs contained total coliform bacteria (**Table 4**)**.** These eleven positive samples occurred during the warmer weather months of July through September. When the results of all of the reservoirs are grouped together, the 10% positive total coliform limit was never exceeded during any month of 2004 (**Figure 6A**). This was an improvement from previous years for these reservoirs.

One of the positive coliform samples had a total coliform count greater than the 10 CFU/100 mL limit and none of the resamples contained total coliforms. On an annual basis Kirby Road Reservoir exceeded the 10% total coliform limit with an annual percentage positive total coliform rate of 11.5% (**Figure 6B**). This result is similar to 2003 and 2002 and an improvement from previous years. Of all the supply and distribution reservoirs sampled in the Greater Victoria Drinking Water System,

Coppermine Road, Kirby Road and Walfred Reservoirs demonstrated the poorest bacteriological water quality with higher percentage positive samples for total coliforms and/or higher percentage of samples with background colonies greater than 200/100 mL (**Figures 6B and 6C**).

Figure 6A. Distribution System Reservoirs
Total Coliforms and Chlorine Residual in 2004



In the long term there has been a significant improvement in the bacteriological quality of the Greater Victoria Distribution System Reservoirs as evidenced by the general reduction in the annual percentage of samples with total coliforms present from a high of 21% in 1992 to a low of 1.2% in 2004 (**Figure 6D**). There has also been a reduction in the number of months where total coliform occurrence was over the 10% positive limit from a high of eight months in 1992 to a low of no months having exceeded the 10% positive total coliform limit in 2002, 2003 and 2004.

Fecal Coliforms. Two of the distribution system reservoir samples contained fecal coliform bacteria (**Table 4**). One of the fecal positives was from Stirrup Reservoir in late September. The bacterium was identified as *Escherichia coli*. The reservoir was rechlorinated and the resample following the rechlorination was negative for both total coliforms and *E. coli*. The other fecal positive sample was from Coppermine Road Reservoir in early August. The bacterium was identified as *Kluyvera sp.* The resample was negative for both total and fecal coliforms.

Background Bacteria. Nineteen samples (2.1%) collected from the Greater Victoria distribution system reservoirs in 2004 had background bacterial counts that exceeded 200 CFU/100 mL (**Table 4**). The majority of these positives occurred during the warm months of the year (July through October).

Heterotrophic Plate Count. Two samples (0.2%) exceeded the HPC limit of 500 CFU/mL (**Table 4**). This is an improvement from previous years.

Figure 6B. Distribution System Reservoirs
Total Coliforms and Chlorine Residual in 2004

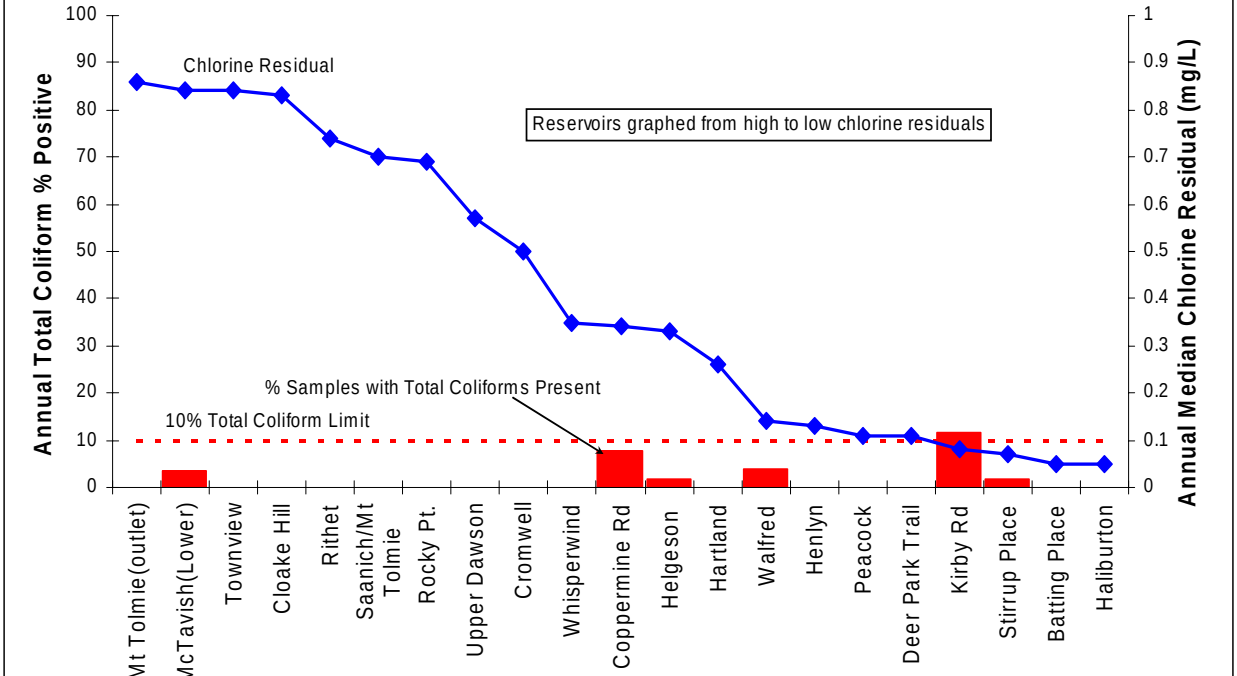


Figure 6C. Distribution System Reservoirs
Background Bacteria and Chlorine Residual in 2004

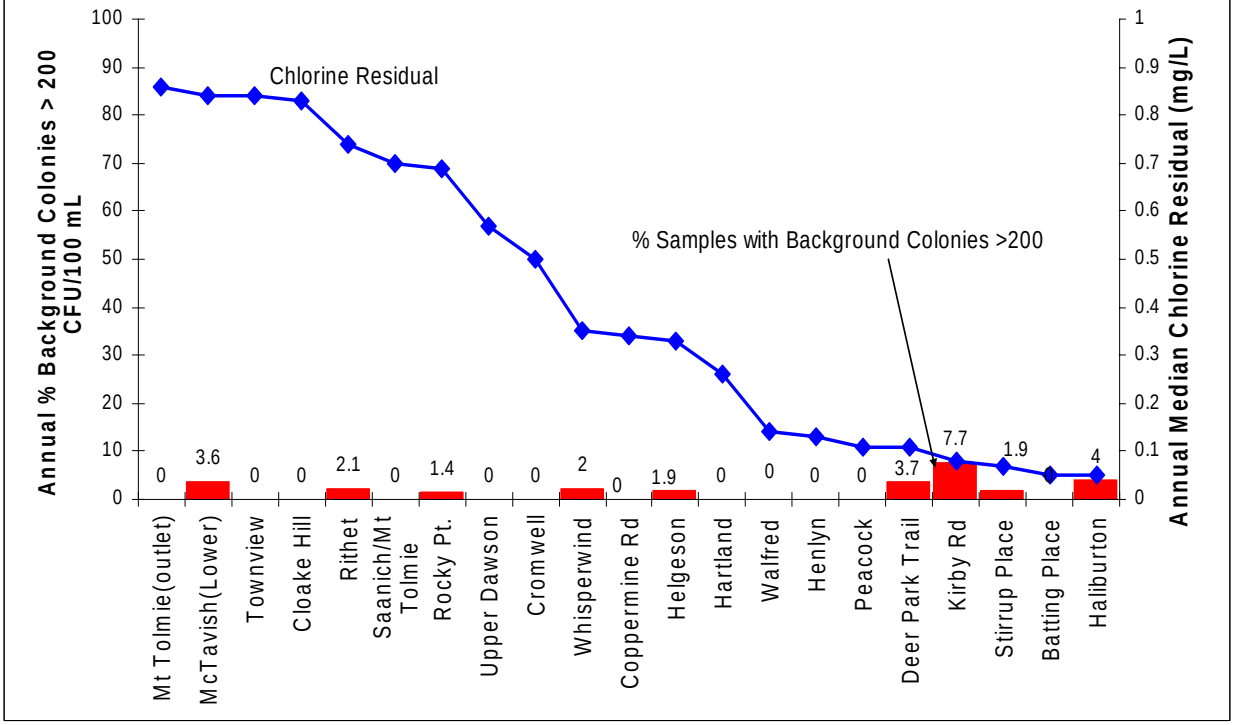
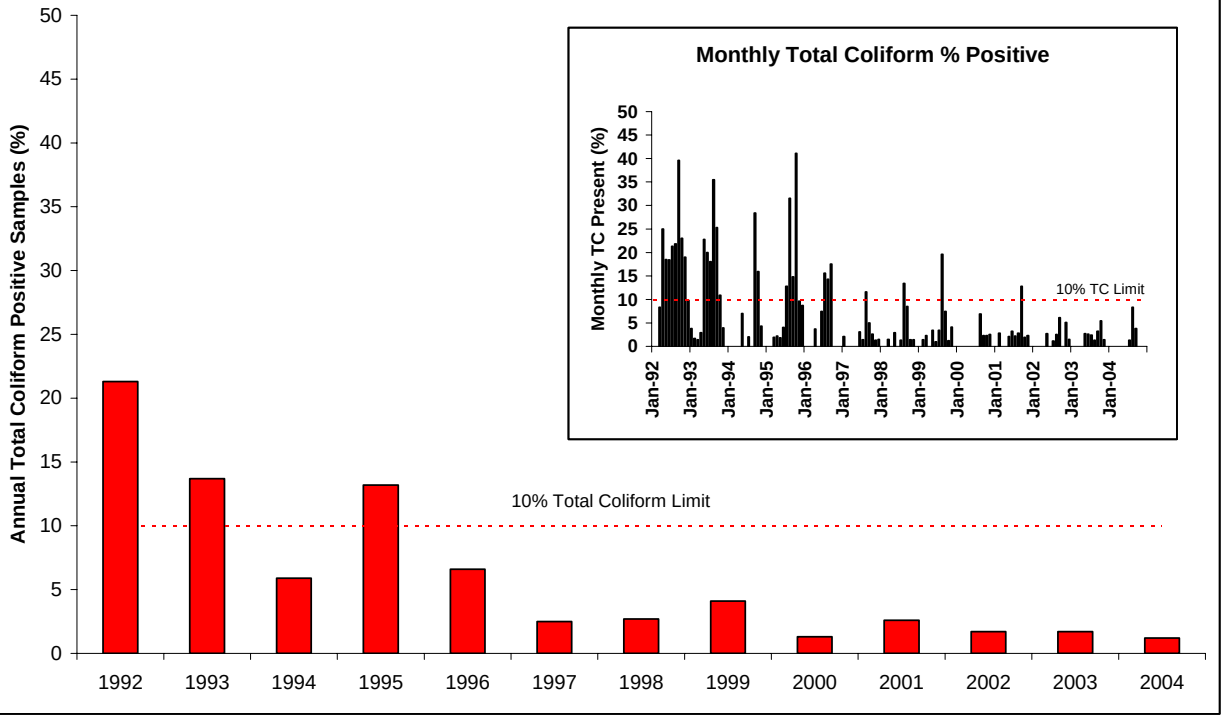


Figure 6D. Distribution System Reservoirs - Annual % Samples with Total Coliforms Present, 1992-2004



4.5.3. CHLORINE RESIDUAL AND WATER TEMPERATURE

Chlorine Residual. The combined median monthly chlorine residual for all the Greater Victoria distribution system reservoirs sampled by the Water Quality Division decreased during January to August and then slowly increased during the fall and winter months. (**Figure 6A**).

A number of the reservoirs in the Greater Victoria distribution system demonstrated relatively poor circulation of water or long detention times for the water in the reservoir as evidenced by low chlorine residuals in those reservoirs. This was particularly evident in the Western Communities where a number of reservoirs had annual median chlorine residuals below 0.2 mg/L: Walfred Reservoir (0.17 and 0.14), Henlyn Reservoir (0.18), Kirby Road Reservoir (0.13), Stirrup Place Reservoir (0.13 and 0.06), Batting Place Reservoir (0.08) (**Figure 6B**).

Water Temperature. The median monthly temperature of the water in all of the distribution system reservoirs combined was lowest in January at 6.3^{o}C and highest in August 2004 at 19.5^{o}C (**Table 4**).

4.6. GREATER VICTORIA DISTRIBUTION SYSTEM

The 2004 bacteriological results of the samples collected each month from the individual municipal distribution systems were combined together to make a single dataset. This makes the assumption that the distribution is one large distribution system irrespective of municipal boundaries. In this report, this overall distribution system is called the Greater Victoria Distribution System. The sampling locations in this dataset included all the distribution system locations within individual municipalities and excluded the large supply main sampling locations and the distribution system reservoirs located in those municipalities.

4.6.1. SAMPLES COLLECTED

In 2004, a total of 1,960 bacteriological samples were collected from the individual distribution system sampling locations and combined into a single dataset for the Greater Victoria Distribution System (**Table 5**).

4.6.2. BACTERIA

Total Coliforms. Twelve samples (0.6%) collected from the Greater Victoria Distribution System contained total coliform bacteria (**Table 5**). Total coliform bacteria were detected during six months of the year (January, March, June and August through October) (**Figure 7**) but these occurrences did not exceed the 10% total coliform limit during any month of the year. These results are similar to the past two years.

Thus, the Greater Victoria Distribution System was in compliance with the total coliform limit in the *BC Drinking Water Protection Act* during all months in 2004. This is similar to 2000, 2002, and 2003 and a marked improvement from previous years. In 1992,1993,1995 and 1999, the system was out of compliance in one or more months of the year while in 2001, total coliforms were detected during nine months of the year (**Figure 7a**).

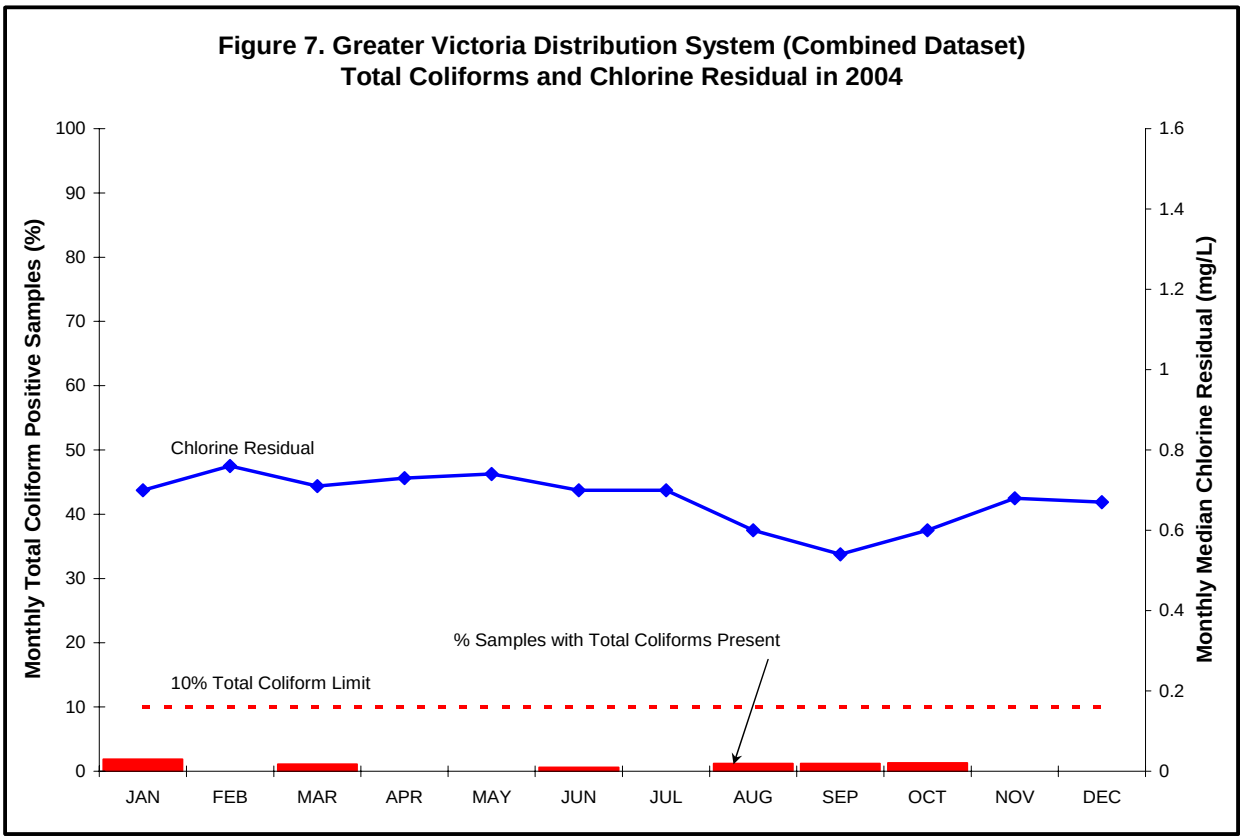
None of the resamples collected contained total coliforms and no samples contained 10 or more total coliforms per 100 mL (**Table 5**).

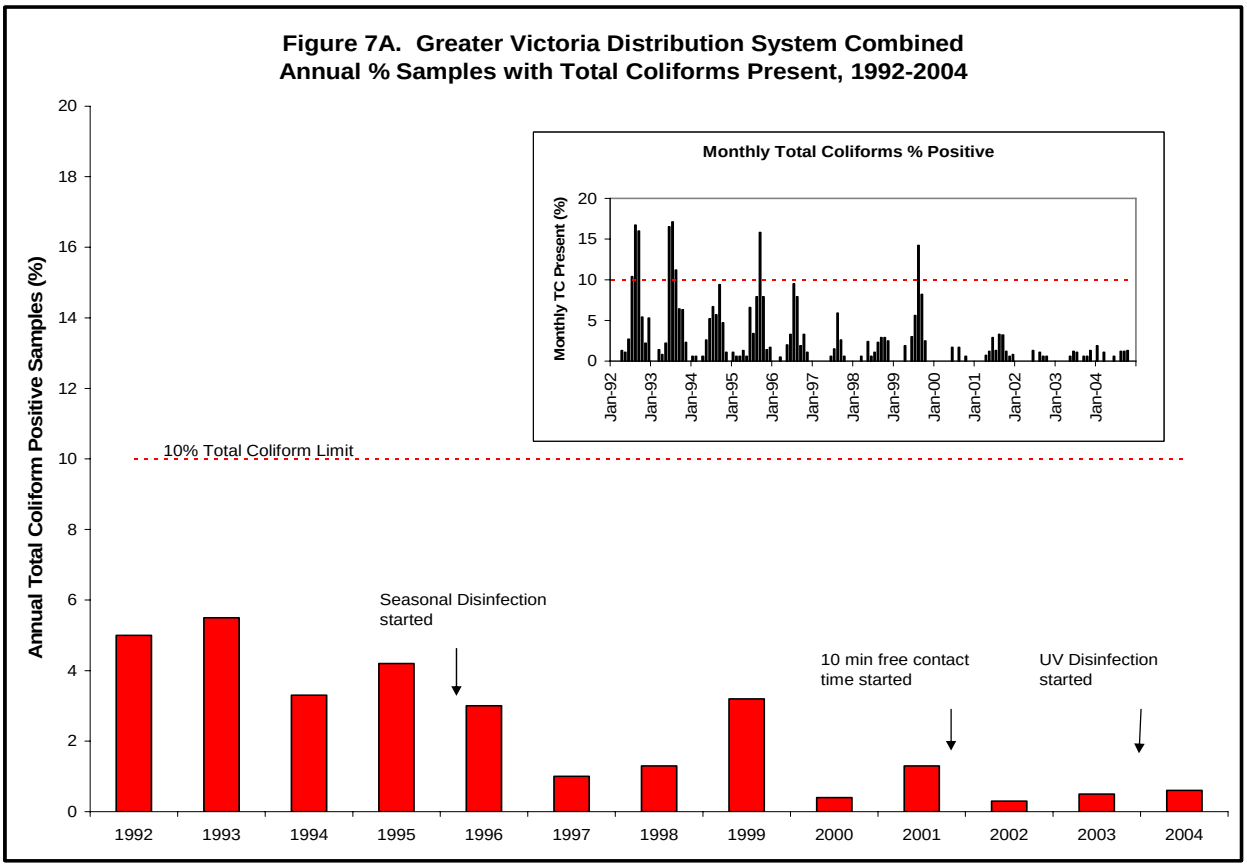
Fecal Coliforms. Fecal coliforms were found in four samples, one in January, one in June, one in August and one in September (**Table 5**). In three of the four cases, the bacterium was identified as *Klebsiella pneumoniae*, a common constituent of biofilm, and not a good indication of fecal contamination. The positive *E. coli* sample was from the Western Communities at Glenforest pumphouse in late September. No good explanation for this occurrence is available. In all cases, the resamples were negative for total and fecal coliforms.

4.6.3. CHLORINE RESIDUAL AND WATER TEMPERATURE

Chlorine Residual. The annual median chlorine residual observed in the Greater Victoria Distribution System (combined stations) was 0.68 mg/L (**Table 5**). This value is somewhat higher than the level observed in 2003 and similar to previous years. The level of chlorine residual in the distribution system ranged between 0.0 and 1.34 mg/L. The highest value observed was well below the 3.0 mg/L limit in the Canadian Guidelines for chloramines. The chlorine residual remained fairly constant from January through July and then dropped slightly in August and early September before rising gradually in the winter months reflecting the steady dosage rate for the majority of the year (**Figure 7**).

**Figure 7. Greater Victoria Distribution System (Combined Dataset)
Total Coliforms and Chlorine Residual in 2004**





Water Temperature. The annual median water temperature for the Greater Victoria Distribution System was 12.4°C and was slightly higher (10.5°C) than the temperature of the water entering the water system at the Japan Gulch Plant. The median monthly temperature ranged from 6.9°C in January to 20.2°C in August (**Table 5**). The maximum daily water temperature of 22.2°C was reached in Oak Bay during the month of August.

4.7. CENTRAL SAANICH DISTRIBUTION SYSTEM

Thirteen sampling locations were used by the Water Quality Division to monitor the bacteriological quality of the water in the Central Saanich Distribution System. Ten locations were sampled bi-weekly and three monthly.

4.7.1. SAMPLE COLLECTION

During 2004, a total of 287 bacteriological samples were collected from the Central Saanich Distribution System (**Table 6**).

4.7.2. BACTERIA

Total Coliforms. Total coliforms were found in samples collected in January, June and September from three locations (Larkvale and Jeffree in September, Mt. Newton Cross Rd in June and from Lochside Drive in January) in the Central Saanich Distribution System (Table 6). This Distribution System complied with the 10% total coliform positive limit for all months of the year during 2004 (Figure 8).

Over the long term, since 1999, there has been an improvement in the bacteriological

quality of the water in the Central Saanich Distribution System as evidenced by the reduction in the annual percentage of samples with total coliforms positive and the general trend of reduction of the number of months where total coliform positives were observed (Figure 8a). In addition, since 1999, the Central Saanich Distribution System has complied with the 10% total coliform positive limit for all months up to and including 2004 (Figure 8a).

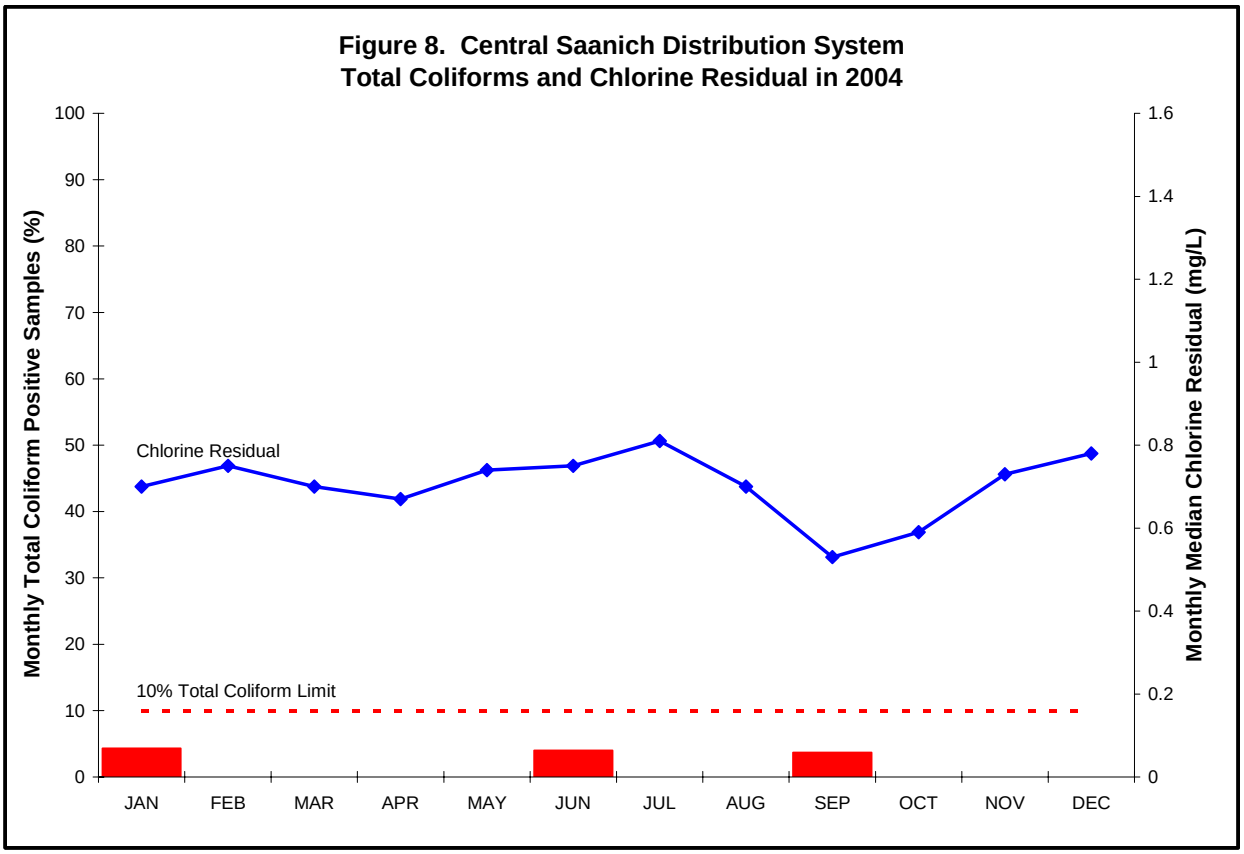
Fecal Coliforms. One fecal coliform positive sample was found for the Mt. Newton Cross Rd location in June 2004. The bacterium was identified as *Klebsiella pneumoniae*, a bacterium often associated with regrowth in bio-films. The resample collected the next day was negative for total and fecal coliforms (**Table 6**).

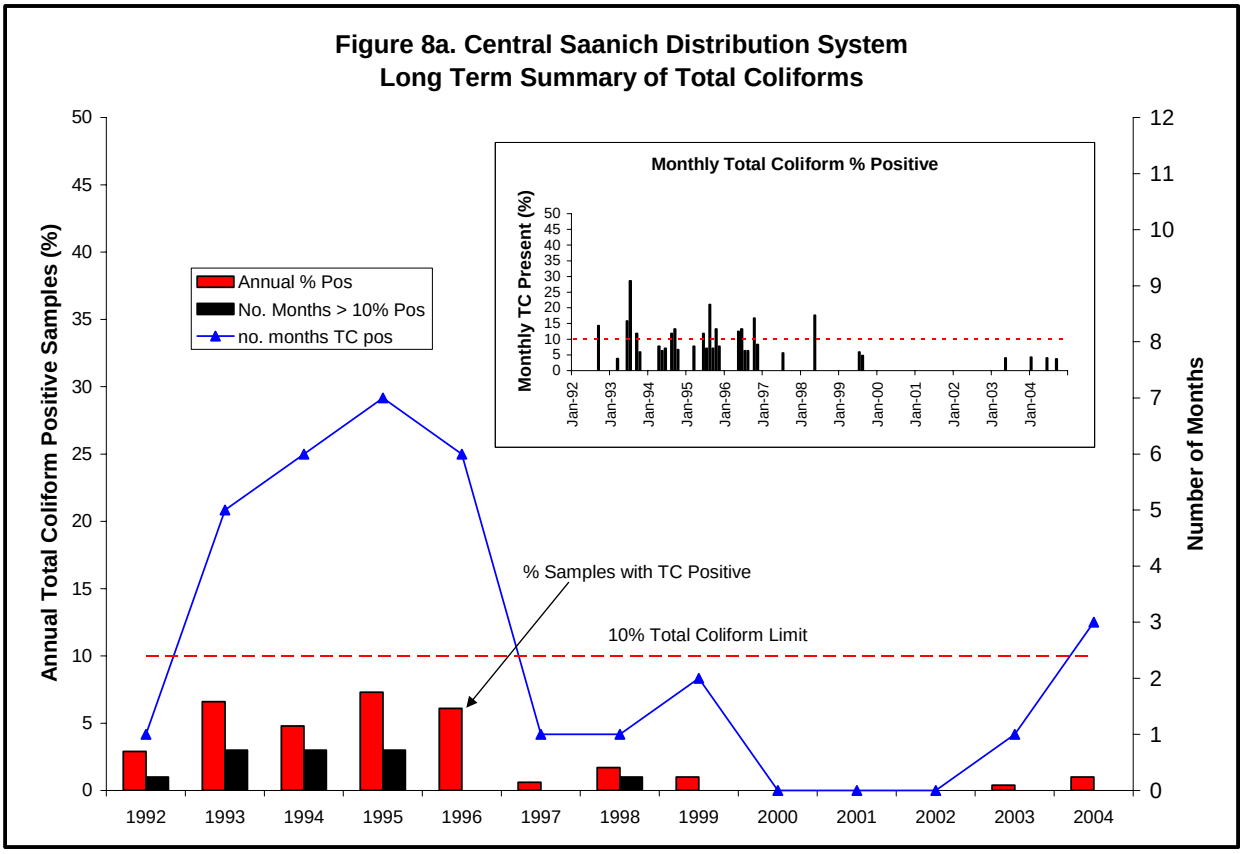
4.7.3. CHLORINE RESIDUAL AND WATER TEMPERATURE

Chlorine Residual. The annual median chlorine residual for the Central Saanich Distribution System was 0.69 mg/L (**Table 6**). The monthly median chlorine residual remained fairly constant throughout the year with the exception of July and August when the residual dipped slightly (**Figure 8**).

Water Temperature. The annual median water temperature in the Central Saanich Distribution System was 12.1°C with monthly medians ranging between 7.0°C and 20.1°C (**Table 6**).

Figure 8. Central Saanich Distribution System
Total Coliforms and Chlorine Residual in 2004





4.8. NORTH SAANICH DISTRIBUTION SYSTEM

Nine sampling locations were used to monitor the bacteriological quality of the drinking water in the North Saanich Distribution System. One of these locations was sampled weekly, five locations bi-weekly and three locations monthly. The majority of these sampling locations are extremities of the distribution system.

4.8.1. SAMPLE COLLECTION

During 2004, a total of 184 bacteriological samples were collected from the North Saanich Distribution System (**Table 7**).

4.8.2. BACTERIA

Total Coliforms. None of the samples collected from the North Saanich Distribution System contained total coliform bacteria (**Table 7** and **Figure 9**).

Over the long term, in a similar fashion to Central Saanich, the bacteriological quality of the water in the North Saanich Distribution System has improved from 1999 onwards as evidenced by the reduction in the annual percentage of samples with total coliforms positive and the reduction of the number of months where total coliform positives were observed (**Figure 9a**). In addition, since 1996, the North Saanich Distribution System has complied with the 10% total coliform positive limit for all months up to and including 2004 (**Figure 9a**).

Fecal Coliforms. No fecal coliforms were present in any of the samples collected from the North Saanich Distribution System.

4.8.3. CHLORINE RESIDUAL AND WATER TEMPERATURE

Chlorine Residual. The annual median chlorine residual for the North Saanich Distribution System was 0.49 mg/L. The monthly median chlorine residuals ranged from a low of 0.34 mg/L in August to a high of 0.62 in November (**Table 7**). This chlorine residual pattern was slightly different than that observed in other municipal distribution systems and is a reflection of the rechlorination used by the CRD Environmental Services Department primarily in the water supplied to the municipal system from the Deep Cove Pumping Station (**Figure 9**). It is interesting to note that the annual median chlorine residual in the North Saanich Distribution System was lower than the annual median residual for the combined distribution system and was the second lowest observed for any of the municipal distribution systems even with the rechlorination of the water.

Water Temperature. The annual median water temperature in the North Saanich Distribution System was 12.1°C (**Table 7**), similar to that found in 2000, 2001 and 2002 and lower than in 2003.

Figure 9. North Saanich Distribution System
Total Coliforms and Chlorine Residual in 2004

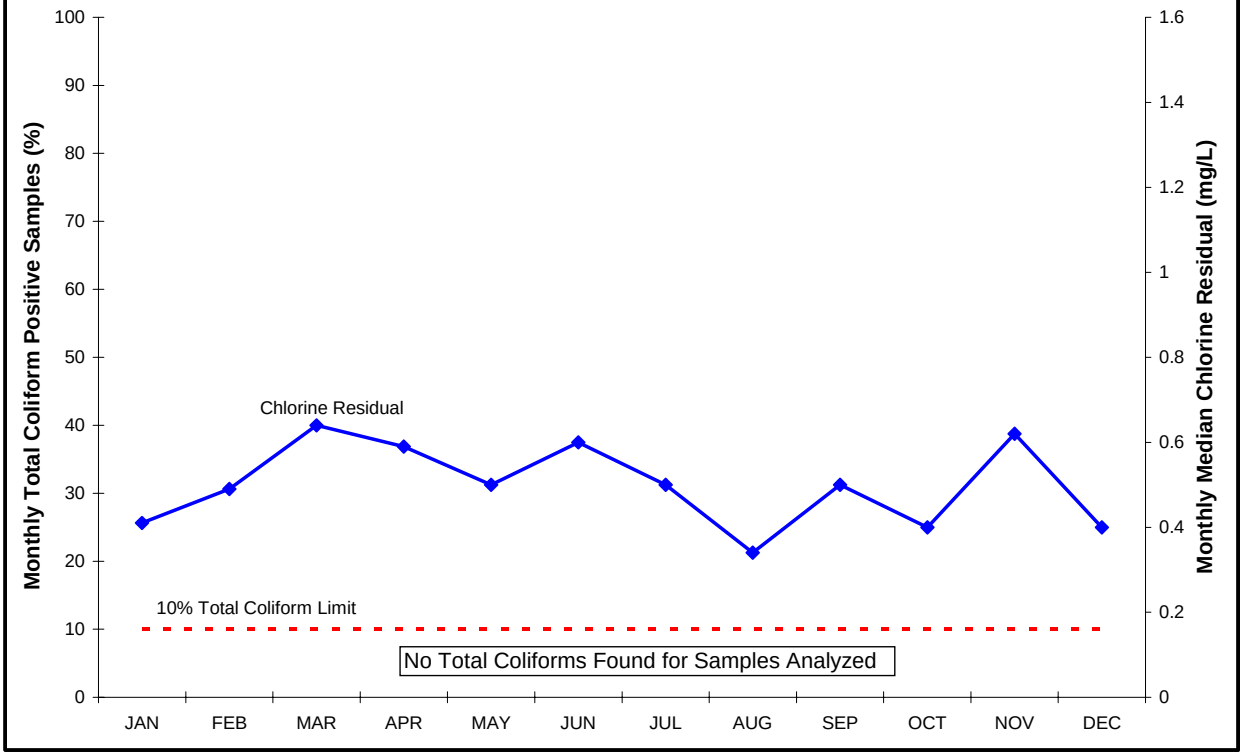
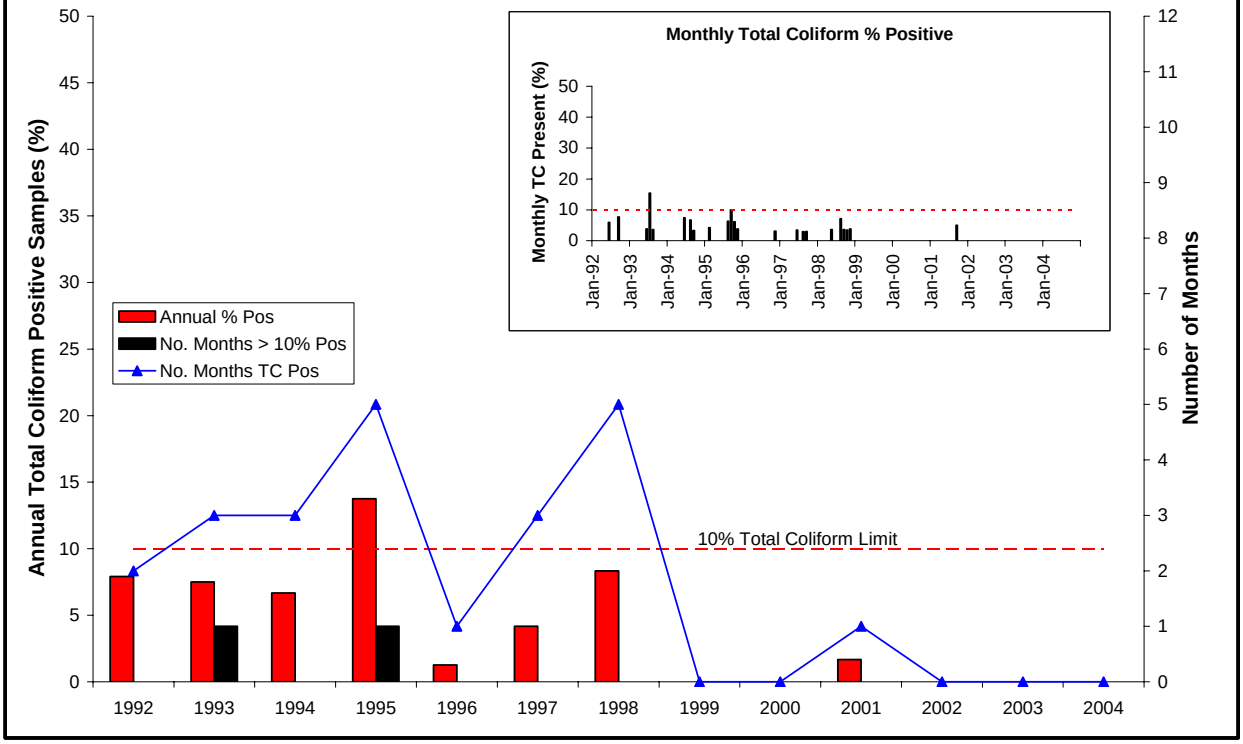


Figure 9a. North Saanich Distribution System
Long Term Summary of Total Coliforms



4.9. OAK BAY DISTRIBUTION SYSTEM

Eight sampling locations were used to monitor the bacteriological quality of the drinking water in the Oak Bay Distribution System. Seven locations were sampled bi-weekly and one was sampled monthly.

4.9.1. SAMPLE COLLECTION

During 2004, a total of 177 bacteriological samples were collected from the Oak Bay Distribution System (**Table 8**).

4.9.2. BACTERIA

Total Coliforms. One of the samples collected from the Oak Bay Distribution System contained total coliform bacteria (**Table 8** and **Figure 10**). This is similar to 2000 to 2003 and an improvement from 1999 when coliforms were found during two months of the year. None of the background counts exceeded the 200 CFU/100 mL Guideline.

Over the long term, the bacteriological quality of the water in the Oak Bay Distribution System has improved over time as evidenced by the reduction in the annual percentage of samples with total coliforms positive and the reduction of the number of months where total coliform positives were observed (**Figure 10a**).. From 2000 through 2004, the Oak Bay Distribution System complied with the 10% total coliform positive limit for all months as no coliforms were observed (**Figure 10a**).

Fecal Coliforms. No fecal coliform bacteria were observed in any of the samples collected from the Oak Bay Distribution System.

4.9.3. CHLORINE RESIDUAL AND WATER TEMPERATURE

Chlorine Residual. The annual median chlorine residual for the Oak Bay Distribution System was 0.80 mg/L (**Table 8**) and, as was the case in previous years, was the highest observed for the municipal distribution systems. The lowest monthly median chlorine residual occurred in December (0.49 mg/L) and the highest in July (0.92 mg/L) (**Figure 10**).

Water Temperature. The annual median water temperature in the Oak Bay Distribution System was 12.5°C (**Table 8**) with monthly median values ranging from 7.0°C to 20.6°C.

Figure 10. Oak Bay Distribution System
Total Coliforms and Chlorine Residual in 2004

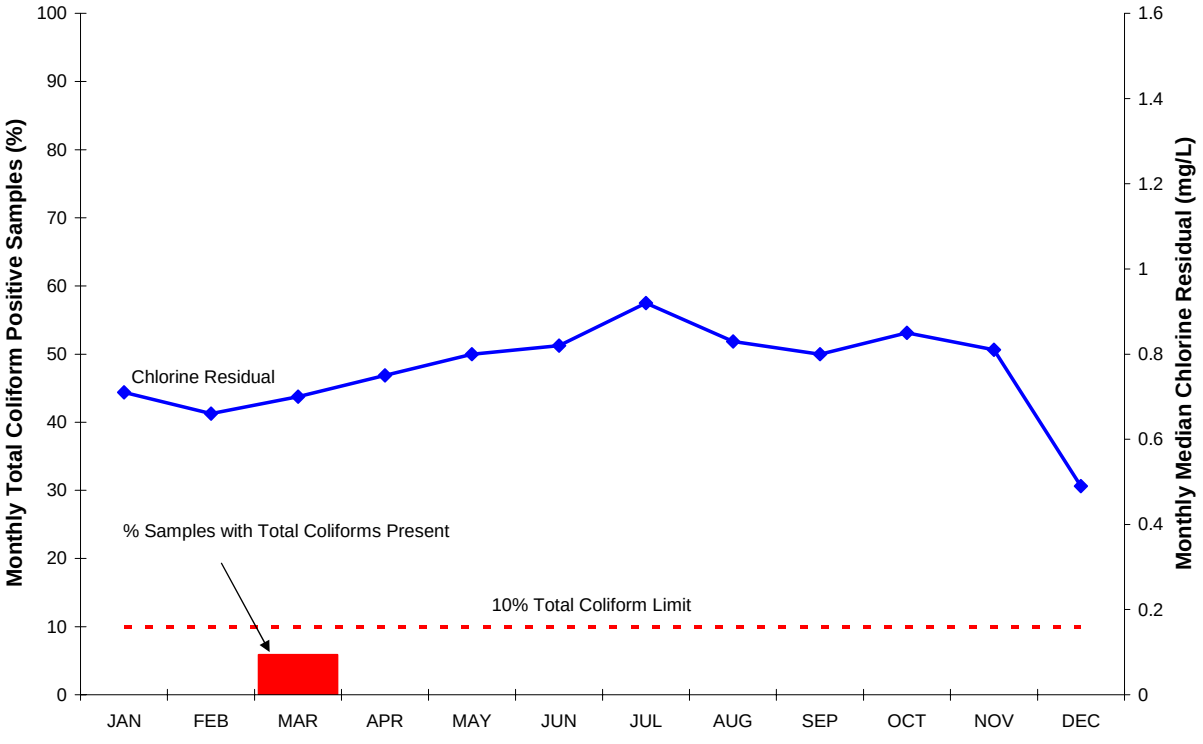
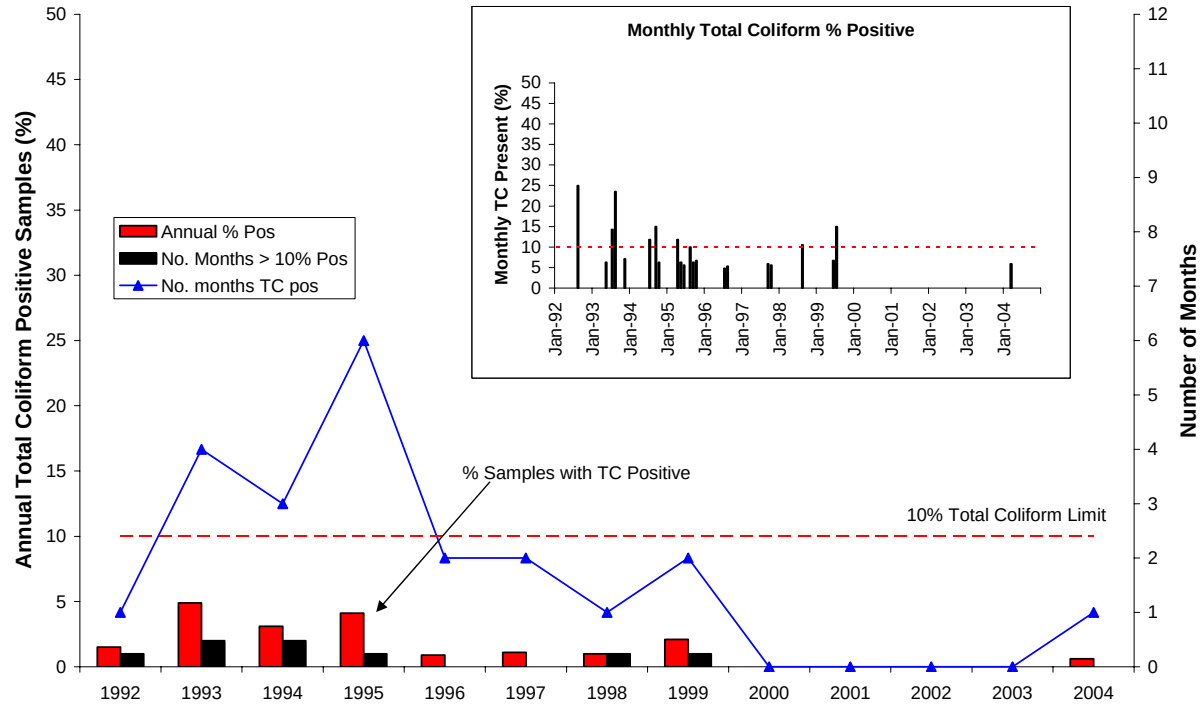


Figure 10a. Oak Bay Distribution System
Long Term Summary of Total Coliforms



4.10. SAANICH DISTRIBUTION SYSTEM

Twenty-one sampling locations were used to monitor the bacteriological quality of the drinking water in the Saanich Distribution System. Seventeen locations were sampled bi-weekly, three were sampled monthly and one was sampled weekly.

4.10.1. SAMPLE COLLECTION

During 2004 a total of 507 bacteriological samples were collected from the Saanich Distribution System (**Table 9**). This is the largest municipal distribution system in the area with the largest population and this is reflected in the number of samples collected from the system.

4.10.2. BACTERIA

Total Coliforms. Five samples collected from the Saanich Distribution System in January, March, August and October contained total coliform bacteria (**Table 9**). All of the resamples were negative for coliforms. Expressed on an annual percentage basis, the total coliform positive rate was 1.0%. All monthly percentages for total coliform positive samples were under the 10% total coliform positive limit (**Figure 11**). Eighteen samples (3.6%) had background counts higher than 200 CFU/100 mL. All of these results are similar to the previous four years and an improvement from 1999.

Over the long term, there has been an improvement in the bacteriological quality of the Saanich Distribution System water as evidenced by the general reduction in the percentage of samples with total coliforms present and a reduction in the number of months where total coliforms were observed (**Figure 11a**). The Saanich Distribution System has complied with the 10% total coliform positive limit for all months of the years 2000 through 2004 (**Figure 11a**).

Fecal Coliforms. One of the samples collected in August from the 760 Vernon sampling location contained one fecal coliform bacteria. The organism responsible for the fecal coliform positive was identified as *Klebsiella pneumoniae.* The resample was negative for total and fecal coliforms.

4.10.3. CHLORINE RESIDUAL AND WATER TEMPERATURE

Chlorine Residual. The annual median chlorine residual for the Saanich Distribution System was 0.59 mg/L (**Table 9**) which was slightly higher than that for the Greater Victoria Distribution System as a whole (0.58). The lowest monthly median chlorine residual occurred in October (0.45) and the highest in January and March (0.65) (**Figure 11**).

Water Temperature. The annual median water temperature in the Saanich Distribution System was 12.7°C, and ranged from 6.6°C to 20.3°C (**Table 9**).

Figure 11. Saanich Distribution System
Total Coliforms and Chlorine Residual in 2004

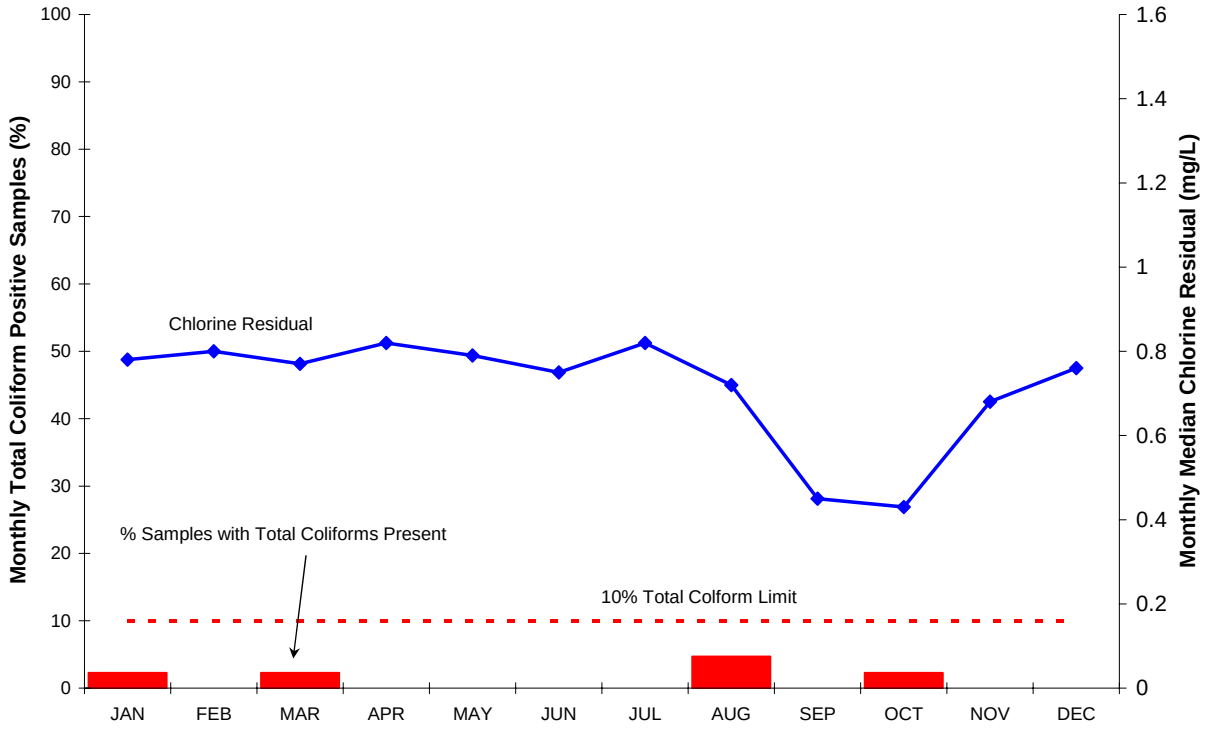
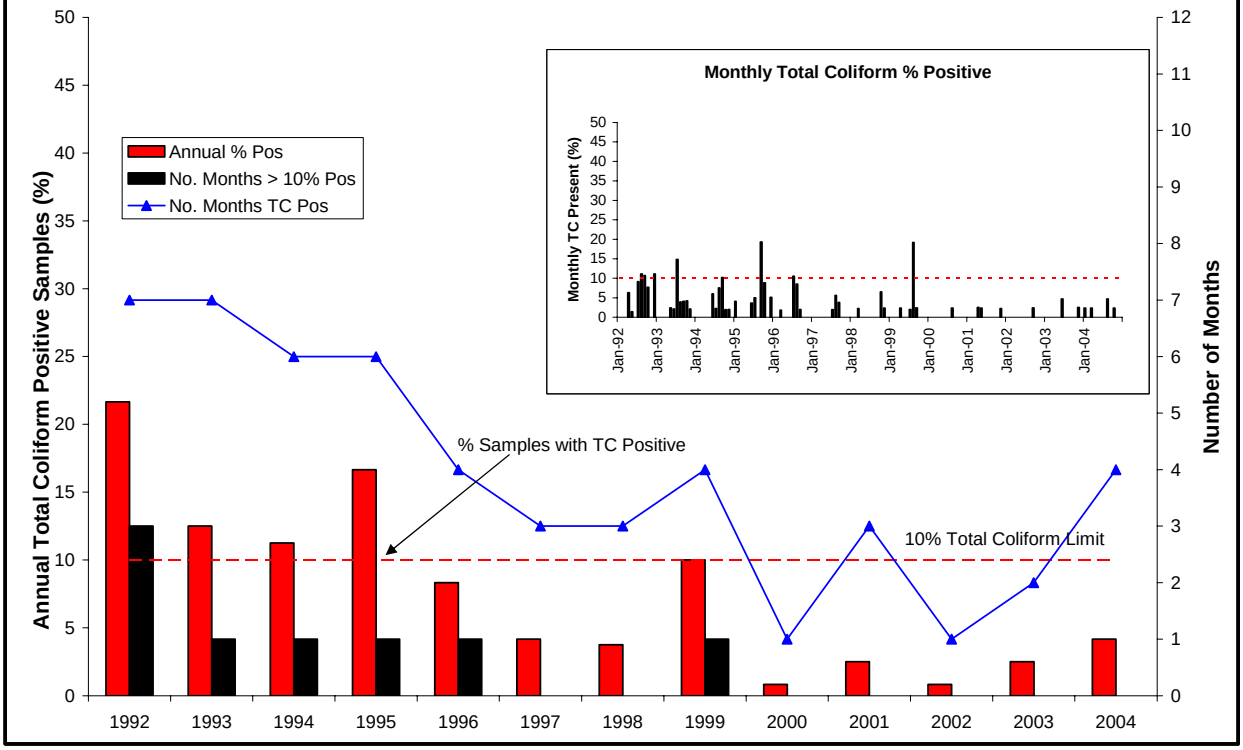


Figure 11a. Saanich Distribution System
Long Term Sumary of Total Coliforms



4.11. SIDNEY DISTRIBUTION SYSTEM

Six sampling locations were used to monitor the bacteriological quality of drinking water in the Sidney Distribution System. Five locations were sampled bi-weekly with one location sampled monthly (extremity).

4.11.1. SAMPLE COLLECTION

During 2004, a total of 137 bacteriological samples were collected from the Sidney Distribution System (**Table 10**).

4.11.2. BACTERIA

Total Coliforms. One of the samples collected in October (Orchard and Fourth St location) from the Sidney Distribution System contained total coliform bacteria (**Table 10** and **Figure 12**). Two samples had background counts greater than 200 CFU/100 mL. These results are similar to the previous four years and an improvement from 1999.

Over the long term the bacteriological quality of the water in the Sidney Distribution system has improved over time as evidenced by the general reduction in the annual percentage of samples with total coliforms positive and the reduction of the number of months where total coliform positives were observed (**Figure 12a**). The Sidney Distribution System has complied with the 10% total coliform positive limit for all months of 2000 through 2004 (**Figure 12a**).

Fecal Coliforms. None of the samples from the Sidney Distribution System contained fecal coliform bacteria.

4.11.3. CHLORINE RESIDUAL AND WATER TEMPERATURE

Chlorine Residual. The annual median chlorine residual for the Sidney Distribution System was 0.40 mg/L (**Table 10**) with the lowest monthly median chlorine residual occurring in October (0.22) and the highest in March and May (0.57) (**Figure 12**).

Water Temperature. The annual median water temperature in the Sidney Distribution System was 12.8°C (**Table 10**).

Figure 12. Sidney Distribution System
Total Coliforms and Chlorine Residual in 2004

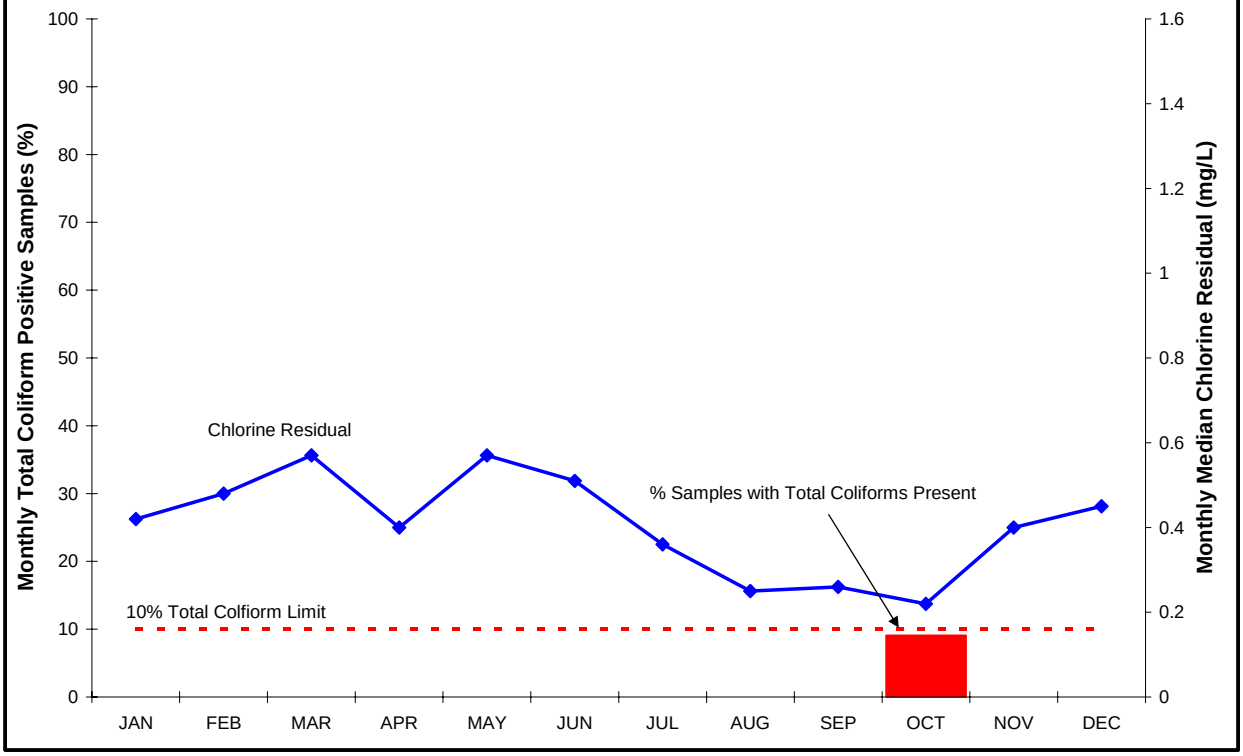
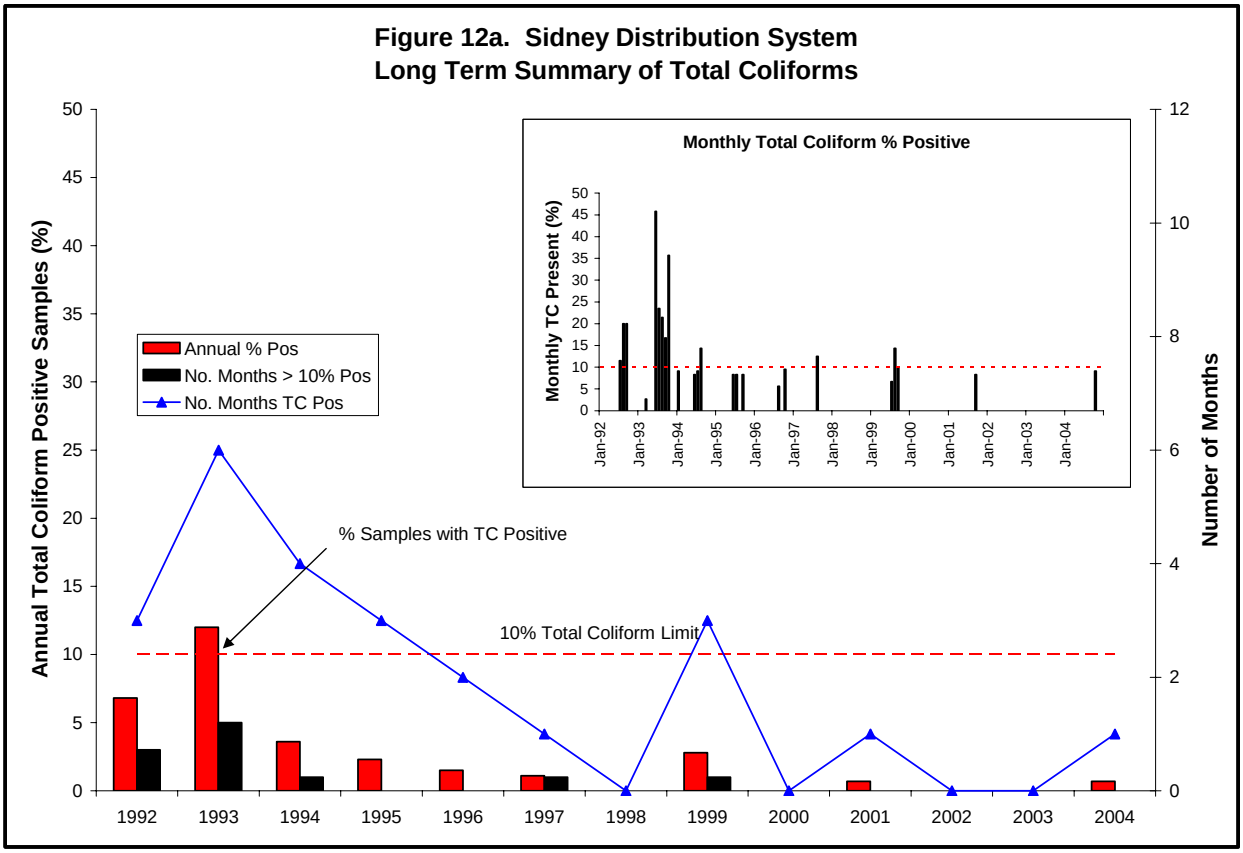


Figure 12a. Sidney Distribution System
Long Term Summary of Total Coliforms



4.12. VICTORIA / ESQUIMALT DISTRIBUTION SYSTEM

Twelve sampling locations were used to monitor the bacteriological quality of drinking water in the City of Victoria and Esquimalt Distribution System. (**Note**: The City of Victoria owns and operates the distribution system in Esquimalt.) These locations were all sampled bi-weekly with the exception of two locations sampled monthly.

4.12.1. SAMPLE COLLECTION

During 2004, a total of 278 bacteriological samples were collected from the sampling locations in the Victoria/Esquimalt Distribution System (**Table 11**).

4.12.2. BACTERIA

Total Coliforms. None of the samples collected from the Victoria/Esquimalt Distribution System contained total coliform bacteria (**Figure 13**). Only one sample had background counts higher than 200 CFU/100 mL (**Table 11**).

Overall, these results are similar to the good results in previous years (1.6% annual positive rate in 1994, 1.5% positive in 1995, 1.1% in 1996, 0% in 1997, 1.1% in 1998, 1.0% in 2000 and 2001 and 0.4% in 2002 and 2003). In general, the bacteriological quality of the Victoria/Esquimalt Distribution System water has improved over the long term (**Figure 13a**). There has been a reduction in the annual percentage samples having total coliforms as well as the number of months with coliforms present. The Victoria/Esquimalt Distribution System has been in compliance with the monthly 10% limit for coliforms for all months of the years 2000 through 2004 (**Figure 13a**).

Fecal Coliforms. There were no fecal coliform positives samples from the Victoria/Esquimalt Distribution System in 2004.

4.12.3. CHLORINE RESIDUAL AND WATER TEMPERATURE

Chlorine Residual. The annual median chlorine residual for the Victoria/Esquimalt Distribution System was 0.76 mg/L (**Table 11**) with the lowest monthly median chlorine residual occurring in September (0.60) and the highest in January (0.92). The annual median chlorine residual in the Victoria/Esquimalt Distribution System was higher than the annual median residual for the Greater Victoria Distribution System. The chlorine residual showed some seasonal variation during 2004 decreasing through the early summer and fall and then increasing from late-September through mid-November (**Figure 13**).

All sampling locations within the Victoria/Esquimalt Distribution System had satisfactory chlorine residuals (above 0.2 mg/L) with the exception of the supply to the HMC Malahat building which had a median residual of only 0.11 mg/L (ranging from 0.04 to 0.21). This is similar to previous years for this location.

Water Temperature. The annual median water temperature in the Victoria/ Esquimalt Distribution System was 13.0°C (**Table 11**), similar to past years.

Figure 13. Victoria/Esquimalt Distribution System
Total Coliforms and Chlorine Residual in 2004

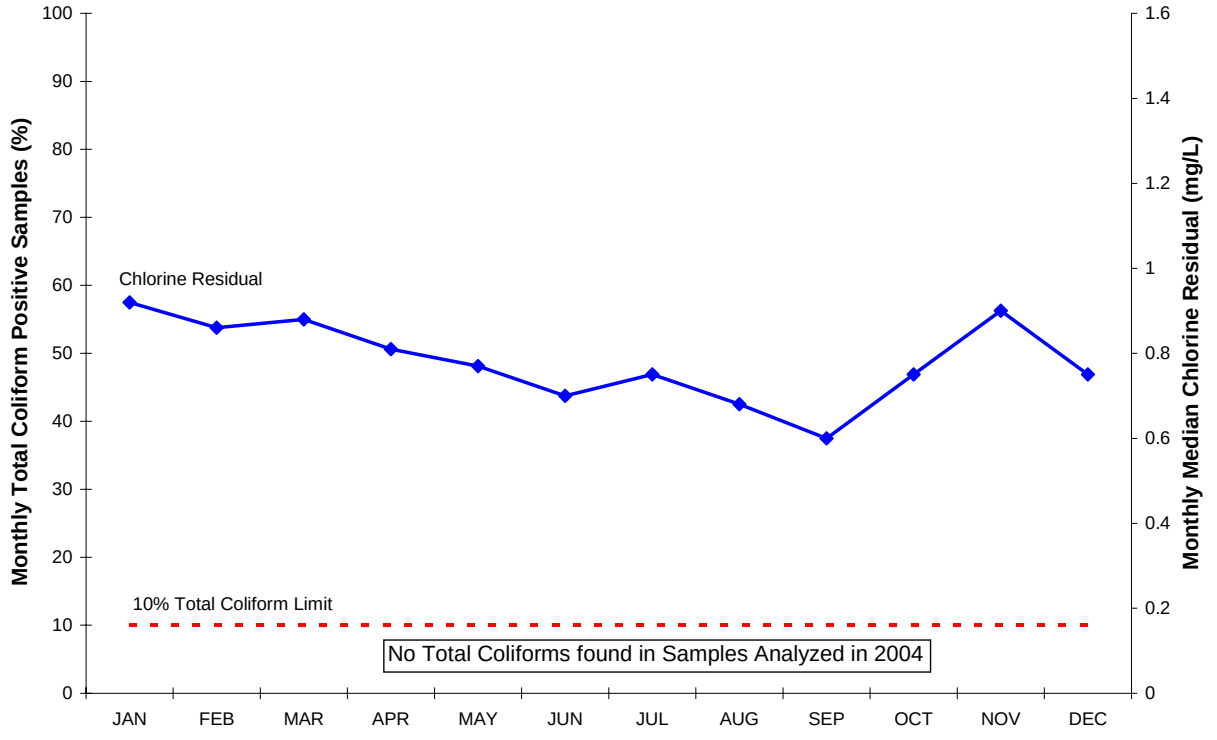
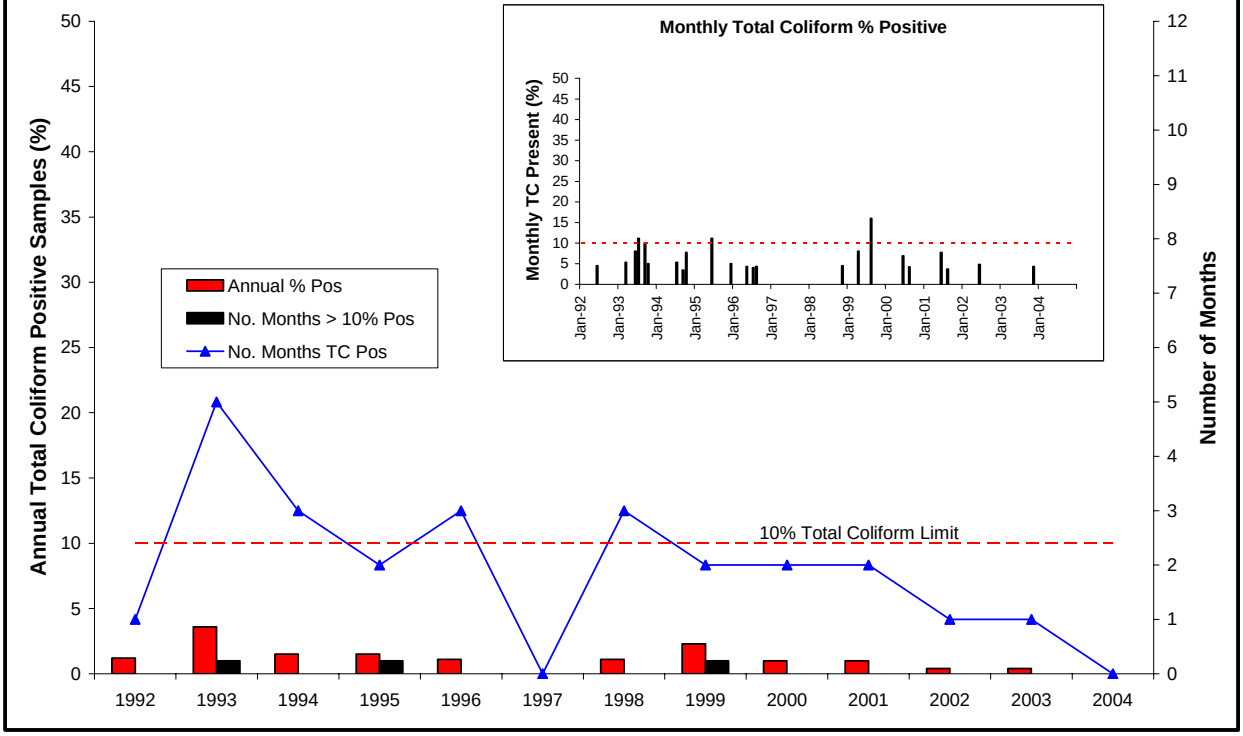


Figure 13a. Victoria/Equimalt Distribution System
Long Term Summary of Total Coliforms



4.13. JUAN DE FUCA WATER DISTRIBUTION SYSTEM

Seventeen sampling locations were used to monitor the bacteriological quality of drinking water in the Juan de Fuca Water Distribution System which includes the municipalities of Colwood, Langford, Metchosin and View Royal. **(Note**: The distribution systems in Sooke and East Sooke are not included in this data set as these systems are supplied by a different treatment plant – Charters Treatment Plant. No bacteriological problems were found in those systems in 2004.)

Eleven locations were sampled bi-weekly, two were sampled weekly (one mid-zone and one extremity), and four locations were sampled monthly.

4.13.1. SAMPLE COLLECTION

During 2004, a total of 390 bacteriological samples were collected from the Juan de Fuca Water Distribution System (**Table 12**). This is a higher sampling frequency than would normally be expected for the population size in the Juan de Fuca Water Distribution System. However, the distribution system is quite spread out with some long distances between users and is more complex than some of the other municipal distribution systems. Thus, this type of system requires additional monitoring to ensure bacteriologically safe drinking water.

4.13.2. BACTERIA

Total Coliforms. Two samples (0.5%) contained total coliform bacteria (**Table 12**). Total coliform positive samples were observed in January and September from two of the seventeen sampling locations (**Figure 14**).

The monthly percentage positives for total coliform samples did not exceed the 10% total coliform positive limit for any month of the year. This is similar to 2003 and 2002 and an improvement from 2001 when the Juan de Fuca Water Distribution System was the only distribution system to exceed this limit. None of the resamples contained total coliforms and none of the samples collected contained more than 10 total coliforms. None of the samples had background counts that were greater than 200 CFU/100 mL. Overall, these results are better than those in recent years (**Figure 14**).

Over the long term, there has been a general improvement in the bacteriological quality of the water in the Juan de Fuca Water Distribution System with the exception of 1999 and 2001 as evidenced by the reduction in the overall annual percentage positive samples having coliforms and the number of months when coliforms were present (**Figure 14a**). However, due to the size of the distribution system relative to the population, the improvement in water quality has not been as dramatic as in other Greater Victoria municipal distribution systems.

As noted above, there are substantial distances between users in some parts of the Western Communities distribution system. In general, this increases the detention time of the water in the distribution system and contributes to the loss of chlorine residual and the regrowth of bacteria. To compound this problem, at or near the extremity of the distribution system in Metchosin, water is supplied to three federal facilities: the Department of National Defence (DND) and William Head Correctional Institute via a single water main on William Head Road and the Becher Bay Reserve.

The results of samples collected from the three points of supply to these facilities are provided below:

- **DND**. In 2004, the supply to the Mary Hill Reservoir (operated by DND) was sampled monthly. Low to moderate total chlorine residuals (ranging from 0.08 to 0.42 mg/L and a median of 0.21 mg/L) were observed with no evidence of total coliforms or background bacteria exceeding the limits. However, as the water in this reservoir loses its chlorine residual, DND rechlorinates the water in the reservoir and provides it to their internal distribution system on the base.

- **William Head Correctional Institute**. In 2004, the supply to William Head Correctional Institute was sampled every 2 weeks. Low to moderate total chlorine residuals (ranging from 0.06 to 0.39 mg/L and a median of 0.18 mg/L) were observed with no samples containing total coliform bacteria or having background bacteria levels exceeding the limits. Within the internal distribution system of the Institute, the chlorine residuals fall to zero leaving it vulnerable to bacterial regrowth. In 2002, Public Works Canada installed a rechlorination facility within the Institute to enhance chlorine residuals within that internal distribution system.

- **Becher Bay Reserve**. In 2004, the supply to the Becher Bay Reserve was sampled weekly. Typically, the chlorine residuals at this location were low (ranging from 0.00 to 0.72 mg/L with a median of 0.21 mg/L). Total coliforms were not detected in samples collected in 2004 and no samples had background bacteria exceeding the 200 per 100 mL limit. This is similar to 2003 and 2002 and a vast improvement from 2001 when this one location accounted for 76% of the positive samples observed in the Juan de Fuca Water Distribution System. In September 2002, a rechloramination station was installed at Rocky Point Reservoir to address the problem of low chlorine residuals at this location and within this general area. In addition, discussions have been held with Health Canada officials about the installation of a chlorine booster station within the Becher Bay Reserve internal system.

Fecal Coliforms. One sample collected from Happy Valley at Dicker was found to contain fecal coliforms in January 2004. The fecal bacterium was identified as *Klebsiella sp*. and was not *E. coli*. The resample was negative for total and fecal coliforms.

4.13.3. CHLORINE RESIDUAL AND WATER TEMPERATURE

Chlorine Residual. The annual median chlorine residual for the Juan de Fuca Water Distribution System was 0.66 mg/L (**Table 12**). This was the second lowest chlorine residual observed among the municipal distribution systems and is a reflection of this extended distribution system. The lowest monthly median chlorine residual occurred in March (0.38) and the highest in May (0.78). (**Figure 14**). Four of the seventeen locations within the distribution system had very low annual median chlorine residuals (0.04, 0.17, 0.18, and 0.18 mg/L).

Water Temperature. The annual median water temperature in the Juan de Fuca Water Distribution System was 11.9°C, similar to previous years (**Table 12**).

Figure 14. Juan de Fuca Water Distribution System
Total Coliforms and Chlorine Residual in 2004

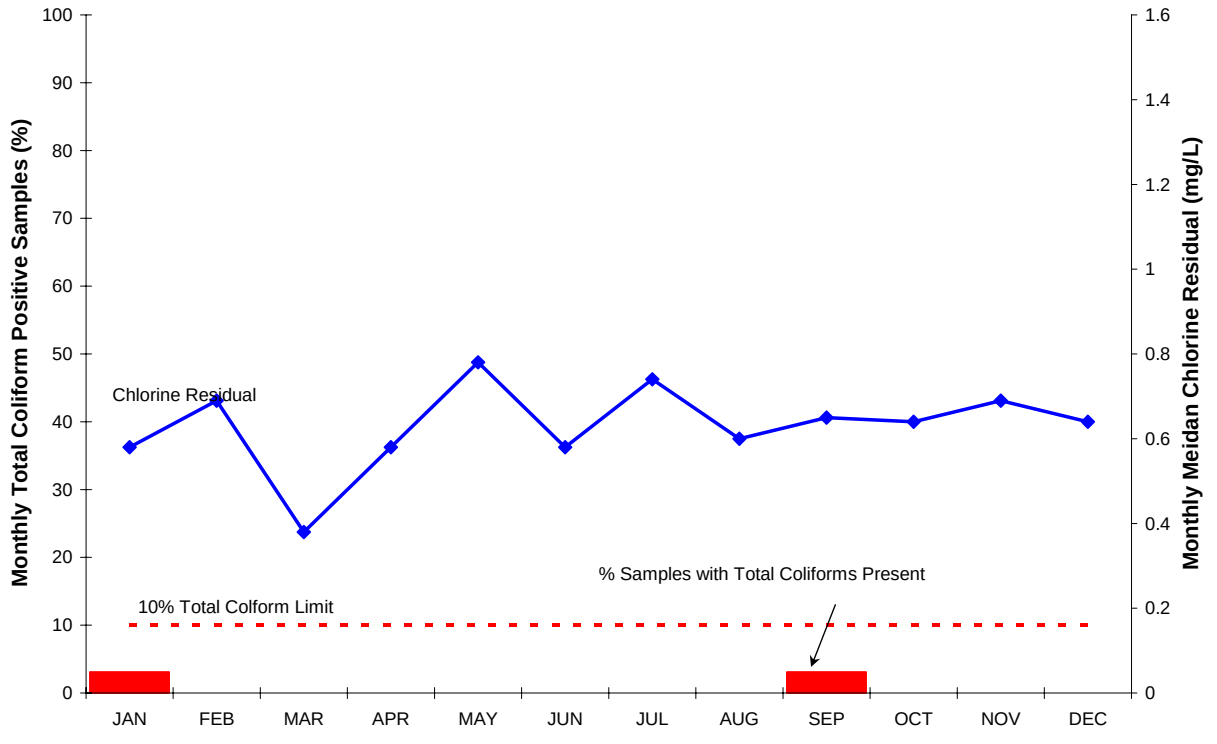
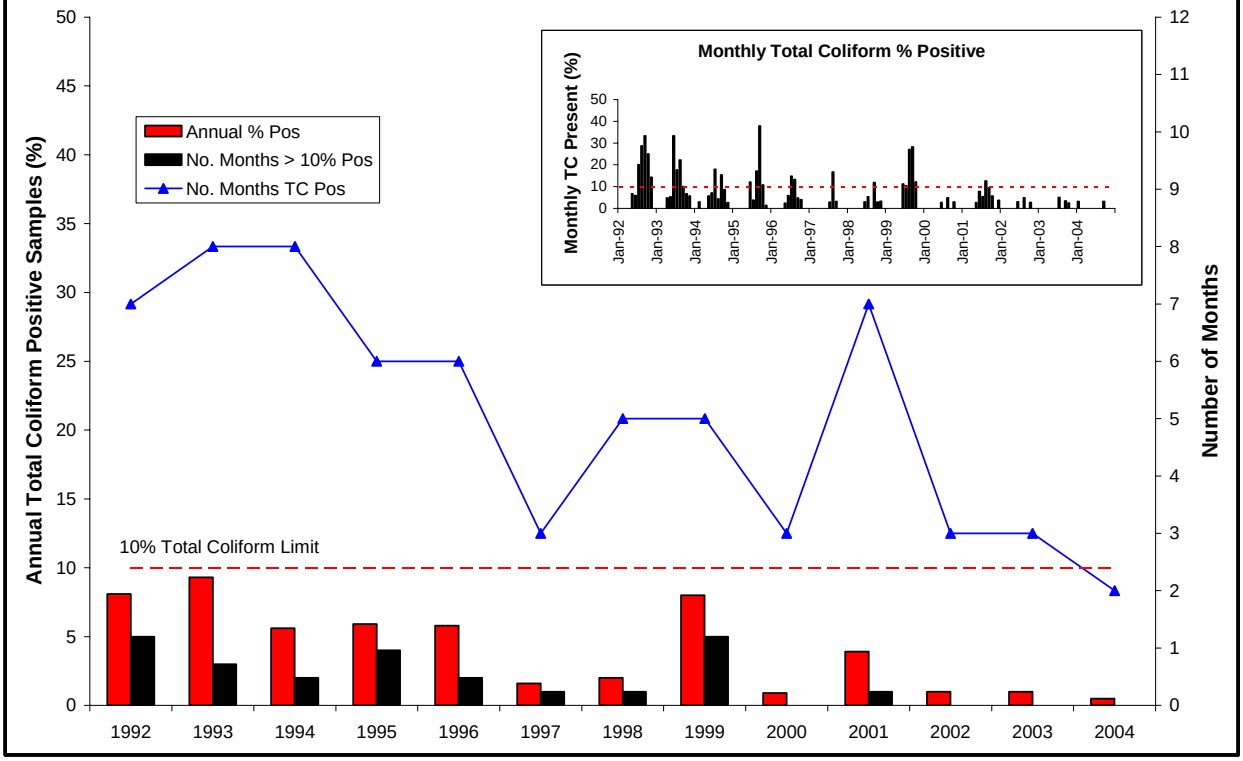


Figure 14a. Juan de Fuca Water Distribution System
Long Term Summary of Total Colforms



APPENDIX A. Headings Used In Tables

The tables listed in this report contain the following column headings:

Samples Collected. This column shows the number of bacteriological samples that were collected monthly from the sampling points in the drinking water system.

Total Coliforms - Samples TC>0. This column shows the number of samples collected in which total coliforms were present.

Total Coliforms - Percent TC>0. This column shows the number of samples that contained total coliforms as a percentage of the total number of monthly samples collected. To meet the microbiological standard, the BC Safe Drinking Water Regulation specifies that 90% or more of the samples collected within a 30-day period must have 0 total coliforms per 100 mL. Stated another way, the Guidelines for Canadian Drinking Water Quality specify that not more than 10% of the samples should show the presence of coliform organisms.

Total Coliforms - Resamples TC>0. This column shows the number of special samples (resamples) that were collected as a follow up to an earlier sample that contained total coliform bacteria. The Federal regulations specify that resamples should not contain total coliforms.

Total Coliforms - Samples TC>10. This column shows the number of samples collected in which total coliforms exceeded 10 colony forming units per100 mL.

TCBK Samples TCBK > 200. This column shows the instances when the background colonies (non-coliform) exceeded 200 colony forming units per 100 mL.

FC Samples FC>0. This column shows the number of samples collected in which fecal coliforms were present. Fecal coliforms (FC) are the bacterial group that is used to indicate the presence of fecal (sewage) contamination in drinking water.

HPC2D – Samples Collected. This column shows the number of samples that were analysed for heterotrophic plate count bacteria incubated for a two-days at 35°C.

HPC2D – Samples >500. This column shows the number of samples that contained more than 500 HPC2D colony forming units per millilitre.

Chlorine Residual Median. This column shows the monthly median (central value between the high and the low) chlorine residual, in milligrams per litre, for the samples collected from the specified area during any particular month.

Water Temperature Median. This column shows the monthly median water temperature, in degrees Celsius, for the samples collected from the specified area during any particular month.

Table 1. 2004 Bacterial quality of the raw water entering the Japan Gulch Plant.

		Total Coliforms					E. coli	HPC2D		Water Temp.
Month	Samples Collected	Samples TC>0	Percent TC>0	Resamples TC>0	Samples TC>10	Samples TCBK>200	Samples Present	Samples Collected	Samples >500	Median °C
JAN	21	21	100		21	12	12	21	0	4.0
FEB	17	17	100		13	8	0	17	0	5.0
MAR	23	23	100		17	7	2	23	0	7.0
APR	20	20	100		10	15	1	19	0	8.8
MAY	20	19	95.0		16	20	0	20	0	11.4
JUN	22	22	100		16	19	1	22	0	14.2
JUL	21	21	100		21	21	0	21	2	16.5
AUG	21	21	100		21	21	0	21	2	19.1
SEP	21	21	100		21	21	1	21	1	16.7
OCT	20	20	100		20	20	0	20	0	15.0
NOV	21	21	100		20	21	0	21	0	10.5
DEC	19	19	100		19	15	1	17	0	8.1
TOTAL	**246**	**245**	**99.6%**		**215**	**200**	**18**	**243**	0 **5**	**11.1**

Table 2. 2004 Bacterial quality of the treated water at the first customer.

		Total Coliform					Fecal Coliform	HPC2D		Chlorine Residual	Water Temp.
Month	Samples Collected	Samples TC>0	Percent TC>0	Resamples TC>0	Samples TC>10	Samples TCBK>200	Samples FC>0	Samples Collected	Samples >500	Median mg/L Cl_2	Median °C
JAN	21	0	0.0	0	0	0	0	21	0	1.22	4.2
FEB	20	0	0.0	0	0	0	0	20	0	1.21	5.4
MAR	23	0	0.0	0	0	0	0	23	0	1.24	6.9
APR	19	0	0.0	0	0	0	0	19	0	1.25	8.2
MAY	20	0	0.0	0	0	0	0	20	0	1.25	11.0
JUN	22	0	0.0	0	0	0	0	22	0	1.24	13.7
JUL	21	1	4.8	0	0	0	0	21	0	1.28	16.2
AUG	24	0	0.0	0	0	0	0	21	0	1.29	19.2
SEP	21	0	0.0	0	0	0	0	21	0	1.19	16.1
OCT	20	0	0.0	0	0	0	0	20	0	1.29	14.2
NOV	21	0	0.0	0	0	0	0	21	0	1.28	10.1
DEC	19	0	0.0	0	0	0	0	17	0	1.08	7.3
TOTAL	**251**	**1**	**0.4%**	**0**	**0**	**0**	**0**	**246**	**0**	**1.25**	**10.5**

TC = Total Coliforms, **TCBK** = Background colonies on Total Coliform test filter, **FC** = Fecal Coliforms
HPC2D = Heterotrophic Plate Count bacteria incubated for 2 days, **Cl_2** = chlorine
> = Greater than, **mg/L** = milligrams per litre, °**C** = degrees Celsius

Table 3. 2004 Bacterial quality of the transmission mains.

		Total Coliform					Fecal Coliform	HPC2D		Chlorine Residual	Water Temp.
Month	Samples Collected	Samples TC>0	Percent TC>0	Resamples TC>0	Samples TC>10	Samples TCBK>200	Samples FC>0	Samples Collected	Samples >500	Median mg/L Cl_2	Median ^{o}C
JAN	31	0	0.0	0	0	0	0	18	0	1.11	5.0
FEB	38	0	0.0	0	0	0	0	24	0	1.08	5.9
MAR	48	0	0.0	0	0	0	0	31	0	1.05	7.3
APR	38	0	0.0	0	0	0	0	22	0	1.06	9.1
MAY	42	0	0.0	0	0	2	0	26	0	0.99	11.4
JUN	43	0	0.0	0	0	1	0	25	0	1.07	14.6
JUL	37	0	0.0	0	0	0	0	25	0	1.11	16.9
AUG	41	0	0.0	0	0	0	0	26	0	1.07	19.5
SEP	36	0	0.0	0	0	0	0	20	0	1.03	16.7
OCT	37	0	0.0	0	0	0	0	1	0	1.16	14.9
NOV	43	0	0.0	0	0	0	0	1	0	1.21	10.7
DEC	38	0	0.0	0	0	0	0	1	0	1.04	8.1
Total	**472**	**0**	**0.0%**	**0**	**0**	**3**	**0**	**220**	**0**	**1.08**	**11.1**

Table 4. 2004 Bacterial quality of the distribution system reservoirs.

		Total Coliform					Fecal Coliform	HPC2D		Chlorine Residual	Water Temp.
Month	Samples Collected	Samples TC>0	Percent TC>0	Resamples TC>0	Samples TC>10	Samples TCBK>200	Samples FC>0	Samples Collected	Samples >500	Median mg/L Cl_2	Median ^{o}C
JAN	67	0	0.0	0	0	1	0	67	0	0.65	6.2
FEB	70	0	0.0	0	0	0	0	70	0	0.60	7.0
MAR	77	0	0.0	0	0	0	0	78	0	0.51	8.3
APR	67	0	0.0	0	0	0	0	67	0	0.46	10.0
MAY	75	0	0.0	0	0	0	0	75	1	0.48	12.7
JUN	82	0	0.0	0	0	0	0	82	1	0.31	14.8
JUL	78	1	1.3	0	0	2	0	75	0	0.33	18.0
AUG	84	7	8.3	0	0	9	1	75	0	0.20	19.5
SEP	78	3	3.8	0	1	5	1	68	0	0.25	17.1
OCT	71	0	0.0	0	0	1	0	27	0	0.31	14.3
NOV	81	0	0.0	0	0	1	0	25	0	0.36	10.7
DEC	64	0	0.0	0	0	0	0	21	0	0.39	8.8
TOTAL	**894**	**11**	**1.2%**	**0**	**1**	**19**	**2**	**730**	**2**	**0.39**	**12.1**

TC = Total Coliforms, **TCBK** = Background colonies on Total Coliform test filter, **FC** = Fecal Coliforms
HPC2D = Heterotrophic Plate Count bacteria incubated for 2 days, **Cl_2** = chlorine
> = Greater than, **mg/L** = milligrams per litre, °**C** = degrees Celsius

Table 5. 2004 Bacterial quality of the Greater Victoria Distribution System.

		Total Coliform					Fecal Coliform	HPC2D		Chlorine Residual	Water Temp
Month	Samples Collected	Samples TC>0	Percent TC>0	Resamples TC>0	Samples TC>10	Samples TCBK>200	Samples FC>0	Samples Collected	Samples >500	Median mg/L Cl_2	Median ^{o}C
JAN	161	3	1.9	0	0	0	1	95	0	0.70	6.9
FEB	160	0	0.0	0	0	0	0	97	0	0.76	7.5
MAR	182	2	1.1	0	0	0	0	106	0	0.71	8.9
APR	161	0	0.0	0	0	0	0	89	1	0.73	10.9
MAY	164	0	0.0	0	0	0	0	100	0	0.74	12.9
JUN	173	1	0.6	0	0	2	1	105	2	0.70	15.4
JUL	167	0	0.0	0	0	1	0	95	0	0.70	18.1
AUG	162	2	1.2	0	0	7	1	90	1	0.60	20.2
SEP	170	2	1.2	0	0	3	1	84	0	0.54	17.9
OCT	156	2	1.3	0	0	5	0	36	2	0.60	15.2
NOV	158	0	0.0	0	0	2	0	24	0	0.68	11.9
DEC	146	0	0.0	0	0	2	0	24	0	0.67	9.9
TOTAL	**1960**	**12**	**0.6%**	**0**	**0**	**22**	**4**	**945**	**6**	**0.68**	**12.4**

Table 6. 2004 Bacterial quality of the Central Saanich Distribution System.

		Total Coliform					Fecal Coliform	HPC2D		Chlorine Residual	Water Temp.
Month	Samples Collected	Samples TC>0	Percent TC>0	Resamples TC>0	Samples TC>10	Samples TCBK>200	Samples FC>0	Samples Collected	Samples >500	Median mg/L Cl_2	Median ^{o}C
JAN	23	1	4.3	0	0	0	0	13	0	0.70	7.0
FEB	23	0	0.0	0	0	0	0	15	0	0.75	7.5
MAR	26	0	0.0	0	0	0	0	18	0	0.70	8.5
APR	26	0	0.0	0	0	0	0	15	0	0.67	10.7
MAY	27	0	0.0	0	0	0	0	14	0	0.74	12.4
JUN	25	1	4.0	0	0	0	1	15	0	0.75	15.0
JUL	23	0	0.0	0	0	0	0	15	0	0.81	18.2
AUG	21	0	0.0	0	0	0	0	15	0	0.70	20.1
SEP	27	1	3.7	0	0	0	0	14	0	0.53	18.1
OCT	21	0	0.0	0	0	1	0	2	0	0.59	15.6
NOV	24	0	0.0	0	0	0	0	0	0	0.73	12.0
DEC	21	0	0.0	0	0	0	0	1	0	0.78	9.9
TOTAL	**287**	**3**	**1.0%**	**0**	**0**	**1**	**1**	**137**	**0**	**0.65**	**12.1**

TC = Total Coliforms, **TCBK** = Background colonies on Total Coliform test filter, **FC** = Fecal Coliforms
HPC2D = Heterotrophic Plate Count bacteria incubated for 2 days, **Cl_2** = chlorine
> = Greater than, **mg/L** = milligrams per litre, °**C** = Degrees Celsius

Table 7. 2004 Bacterial quality of the North Saanich Distribution System.

		Total Coliform					Fecal Coliform	HPC2D		Chlorine Residual	Water Temp.
Month	Samples Collected	Samples TC>0	Percent TC>0	Resamples TC>0	Samples TC>10	Samples TCBK>200	Samples FC>0	Samples Collected	Samples >500	Median mg/L Cl_2	Median ^oC
JAN	16	0	0	0	0	0	0	9	0	0.41	7.3
FEB	17	0	0	0	0	0	0	11	0	0.49	7.7
MAR	18	0	0	0	0	0	0	13	0	0.64	8.9
APR	14	0	0	0	0	0	0	10	0	0.59	10.9
MAY	15	0	0	0	0	0	0	9	0	0.50	12.9
JUN	17	0	0	0	0	0	0	11	0	0.60	15.3
JUL	16	0	0	0	0	0	0	11	0	0.50	17.5
AUG	13	0	0	0	0	0	0	10	0	0.34	20.2
SEP	15	0	0	0	0	0	0	7	0	0.50	17.9
OCT	15	0	0	0	0	0	0	6	0	0.40	14.8
NOV	14	0	0	0	0	0	0	2	0	0.62	12.0
DEC	14	0	0	0	0	0	0	3	0	0.40	10.0
TOTAL	**184**	**0**	**0**	**0**	**0**	**0**	**0**	**102**	**0**	**0.49**	**12.1**

Table 8. 2004 Bacterial quality of the Oak Bay Distribution System.

		Total Coliform					Fecal Coliform	HPC2D		Chlorine Residual	Water Temp.
Month	Samples Collected	Samples TC>0	Percent TC>0	Resamples TC>0	Samples TC>10	Samples TCBK>200	Samples FC>0	Samples Collected	Samples >500	Median mg/L Cl_2	Median ^oC
JAN	12	0	0.0	0	0	0	0	6	0	0.71	7.0
FEB	13	0	0.0	0	0	0	0	7	0	0.66	8.0
MAR	17	1	5.9	0	0	0	0	7	0	0.70	9.5
APR	17	0	0.0	0	0	0	0	8	0	0.75	11.5
MAY	15	0	0.0	0	0	0	0	7	0	0.80	13.0
JUN	15	0	0.0	0	0	0	0	8	0	0.82	15.3
JUL	16	0	0.0	0	0	0	0	7	0	0.92	17.6
AUG	15	0	0.0	0	0	0	0	8	0	0.83	20.6
SEP	17	0	0.0	0	0	0	0	9	0	0.80	18.3
OCT	14	0	0.0	0	0	0	0	0	0	0.85	15.6
NOV	13	0	0.0	0	0	0	0	0	0	0.81	11.9
DEC	13	0	0.0	0	0	0	0	0	0	0.49	9.8
TOTAL	**177**	**1**	**0.6%**	**0**	**0**	**0**	**0**	**67**	**0**	**0.80**	**12.5**

TC = Total Coliforms, **TCBK** = Background colonies on Total Coliform test filter, **FC** = Fecal Coliforms
HPC2D = Heterotrophic Plate Count bacteria incubated for 2 days, **Cl_2** = chlorine
> = Greater than, **mg/L** = milligrams per litre, °**C** = Degrees Celsius

Table 9. 2004 Bacterial quality of the Saanich Distribution System.

		Total Coliform					Fecal Coliform	HPC2D		Chlorine Residual	Water Temp.
Month	Samples Collected	Samples TC>0	Percent TC>0	Resamples TC>0	Samples TC>10	Samples TCBK>200	Samples FC>0	Samples Collected	Samples >500	Median mg/L Cl_2	Median ^{o}C
JAN	44	1	2.3	0	0	0	0	25	0	0.78	6.6
FEB	42	0	0.0	0	0	0	0	22	0	0.80	7.4
MAR	44	1	2.3	0	0	0	0	23	0	0.77	8.9
APR	40	0	0.0	0	0	0	0	15	0	0.82	10.9
MAY	42	0	0.0	0	0	0	0	26	0	0.79	12.8
JUN	44	0	0.0	0	0	2	0	24	1	0.75	15.9
JUL	44	0	0.0	0	0	1	0	20	0	0.82	18.3
AUG	43	2	4.7	0	0	4	1	17	1	0.72	20.3
SEP	44	0	0.0	0	0	3	0	19	0	0.45	18.1
OCT	44	1	2.3	0	0	4	0	13	2	0.43	15.6
NOV	40	0	0.0	0	0	2	0	9	0	0.68	11.9
DEC	36	0	0.0	0	0	2	0	5	0	0.76	9.7
TOTAL	**507**	**5**	**1.0%**	**0**	**0**	**18**	**1**	**218**	**4**	**0.72**	**12.7**

Table 10. 2004 Bacterial quality of the Sidney Distribution System.

		Total Coliform					Fecal Coliform	HPC2D		Chlorine Residual	Water Temp.
Month	Samples Collected	Samples TC>0	Percent TC>0	Resamples TC>0	Samples TC>10	Samples TCBK>200	Samples FC>0	Samples Collected	Samples >500	Median mg/L Cl_2	Median ^{o}C
JAN	11	0	0.0	0	0	0	0	7	0	0.42	7.1
FEB	11	0	0.0	0	0	0	0	7	0	0.48	7.5
MAR	13	0	0.0	0	0	0	0	8	0	0.57	9.2
APR	10	0	0.0	0	0	0	0	5	0	0.40	10.8
MAY	11	0	0.0	0	0	0	0	7	0	0.57	13.0
JUN	11	0	0.0	0	0	0	0	7	0	0.51	15.8
JUL	13	0	0.0	0	0	0	0	7	0	0.36	17.9
AUG	12	0	0.0	0	0	2	0	6	0	0.25	20.2
SEP	12	0	0.0	0	0	0	0	6	0	0.26	18.3
OCT	11	1	9.1	0	0	0	0	5	0	0.22	15.7
NOV	11	0	0.0	0	0	0	0	4	0	0.45	12.2
DEC	11	0	0.0	0	0	0	0	4	0	0.37	10.1
Total	**137**	**1**	**0.7%**	**0**	**0**	**2**	**0**	**73**	**0**	**0.40**	**12.8**

TC = Total Coliforms, **TCBK** = Background colonies on Total Coliform test filter, **FC** = Fecal Coliforms
HPC2D = Heterotrophic Plate Count bacteria incubated for 2 days, **Cl_2** = chlorine
> = Greater than, **mg/L** = milligrams per litre, °**C** = Degrees Celsius

Table 11. 2004 Bacterial quality of the Victoria/Esquimalt Distribution System.

		Total Coliform					Fecal Coliform	HPC2D		Chlorine Residual	Water Temp.
Month	Samples Collected	Samples TC>0	Percent TC>0	Resamples TC>0	Samples TC>10	Samples TCBK>200	Samples FC>0	Samples Collected	Samples >500	Median mg/L Cl_2	Median ^{o}C
JAN	23	0	0.0	0	0	0	0	13	0	0.92	6.9
FEB	22	0	0.0	0	0	0	0	14	0	0.86	7.9
MAR	27	0	0.0	0	0	0	0	14	0	0.88	9.6
APR	23	0	0.0	0	0	0	0	16	1	0.81	12.0
MAY	24	0	0.0	0	0	0	0	15	0	0.77	14.0
JUN	27	0	0.0	0	0	0	0	18	0	0.70	16.3
JUL	21	0	0.0	0	0	0	0	13	0	0.75	19.7
AUG	23	0	0.0	0	0	1	0	15	0	0.68	20.9
SEP	23	0	0.0	0	0	0	0	11	0	0.60	18.1
OCT	21	0	0.0	0	0	0	0	2	0	0.75	15.4
NOV	22	0	0.0	0	0	0	0	1	0	0.90	11.9
DEC	22	0	0.0	0	0	0	0	2	0	0.75	9.7
Total	**278**	**0**	**0.0%**	**0**	**0**	**1**	**0**	**134**	**1**	**0.76**	**13.0**

Table 12. 2004 Bacterial quality of the Juan de Fuca Water Distribution System.

		Total Coliform					Fecal Coliform	HPC2D		Chlorine Residual	Water Temp.
Month	Samples Collected	Samples TC>0	Percent TC>0	Resamples TC>0	Samples TC>10	Samples TCBK>200	Samples FC>0	Samples Collected	Samples >500	Median mg/L Cl_2	Median ^{o}C
JAN	32	1	3.1	0	0	0	1	22	0	0.58	6.9
FEB	32	0	0.0	0	0	0	0	21	0	0.69	7.2
MAR	37	0	0.0	0	0	0	0	23	0	0.38	8.6
APR	31	0	0.0	0	0	0	0	20	0	0.58	10.5
MAY	30	0	0.0	0	0	0	0	22	0	0.78	12.5
JUN	34	0	0.0	0	0	0	0	22	1	0.58	14.8
JUL	34	0	0.0	0	0	0	0	22	0	0.74	17.5
AUG	35	0	0.0	0	0	0	0	19	0	0.60	19.7
SEP	32	1	3.1	0	0	0	1	18	0	0.65	17.0
OCT	30	0	0.0	0	0	0	0	8	0	0.64	14.8
NOV	34	0	0.0	0	0	0	0	8	0	0.69	11.3
DEC	29	0	0.0	0	0	0	0	9	0	0.64	9.9
Total	**390**	**2**	**0.5%**	**0**	**0**	**0**	**2**	**214**	**1**	**0.66**	**11.9**

TC = Total Coliforms, **TCBK** = Background colonies on Total Coliform test filter, **FC** = Fecal Coliforms
HPC2D = Heterotrophic Plate Count bacteria incubated for 2 days, **Cl_2** = chlorine
> = Greater than, **mg/L** = milligrams per litre, °**C** = Degrees Celsius