CAPITAL REGIONAL DISTRICT
Water Services

# 2006 Annual Overview of Greater Victoria's Drinking Water Quality


Maria Roxborough
Laboratory Manager
Water Quality Division

Bernie Morris
Senior Water Sampling Technician
Water Quality Division

Laura Kline
Aquatic Ecology Technician
Water Quality Division

and

G. Stewart Irwin
Senior Manager
Water Quality Division


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WATER SERVICES
**CAPITAL REGIONAL DISTRICT**
479 Island Highway
Victoria, BC



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# *EXECUTIVE SUMMARY*

This report is the annual overview of water quality testing that was conducted in 2006 in the Greater Victoria Drinking Water System. The test results show that Greater Victoria's drinking water continues to be good quality and is safe to drink. With a few minor exceptions, all the results were within the limits of both the *Guidelines for Canadian Drinking Water Quality* and the BC *Drinking Water Protection Regulation.* The full report is posted at http://www.crd.bc.ca/water/waterquality/annualreports.htm on the Capital Regional District (CRD) website.

**Samples and Tests.** In 2006, the Water Quality Division collected 6,856 samples from the Greater Victoria Drinking Water System and analyzed those samples for 47,468 individual tests. Approximately 300 different types of testing were conducted on these samples.

**Bacteria in Source Water**. In 2006, 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 late summer and peaking in mid to late October (**Figure 3**). The quality of the raw water entering the plant continued to easily meet the fecal coliform (*E. coli*) 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 3B**). The level of 20 per 100 mL was only reached once the entire year. Both the median value of 0 per 100 mL and the maximum value of 20 per 100 mL indicate a good quality source that is not subject to contamination.

**Treatment**. The treatment process used to disinfect the raw source water entering the distribution system continued to be ultraviolet (UV) disinfection followed by free chlorine and then ammonia (to produce chloramines). The chlorine dosage level was maintained at 1.6 mg/L throughout the year. This dosage level resulted in a monthly median total chlorine residual ranging from 1.11 to 1.37 mg/L at the entry point to the distribution system (**Figure 4**).

**Bacteria at First Customer**. Two total coliform positive samples were found from the 247 samples taken at the first customer sampling location below the Japan Gulch Treatment Plant during 2006 (**Figure 4**). The annual total coliform positive sample rate of 0.8% was similar to the previous four years and much better than earlier years before the use of UV 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.

**Bacteria in Distribution System**. When all of the results from the various municipal distribution systems are grouped together, the percentage of total coliform positive samples in the distribution system did not exceed the 10% Guideline limit during any month in 2006 and was therefore in compliance with the BC *Drinking Water Protection Regulation*. Over a 15 year period of time, a reduction in total coliform detection and hence, an improvement in the bacteriological water quality (**Figure 5**) was observed.

**Parasites.** In 2006, no viable *Giardia* cysts were detected. The average annual percentage of samples containing non-viable *Giardia* cysts was 8.3% (median 0/100 mL) (**Figure 6**). (**Note**: The Guidelines do not allow for this distinction.) Three non-viable *Giardia* cysts were detected in one sample in February and one non-viable cyst in another sample collected in November. Non-viable cysts are incapable of causing disease. None of the samples contained *Cryptosporidium* oocysts (**Figure 7**). The long term average (1992-2006) *Cryptosporidium* oocyst concentration was 0.035 oocysts per 100 L. While this is an extremely low value for a surface water supply, the addition of UV disinfection provides assurance that no infective *Cryptosporidium* oocysts can enter Greater Victoria's drinking water.

**Physical-Chemical-Radiological**. All the physical, chemical and radiological parameters were well within the Canadian Guideline limits except for water temperature (aesthetic limit of 15ºC) and one high turbidity sample. In both 2005 and 2006, the water temperature entering the plant was cooler than in previous years because it was being drawn from a deeper strata in the reservoir. All inorganic chemicals including metals and non-metals were within Guideline values. No synthetic organic chemicals including pesticides and herbicides were detected in the raw water entering the treatment plants.

**Disinfection By-Products**. Disinfection by-products such as total trihalomethanes were well below (range of 2.6-20.7 μg/L) the Canadian Guideline value of 100 μg/L in the chloraminated portion of the distribution system but were higher in the portion of the distribution system in North Saanich where periodically additional free chlorine is being added to the water to prevent the regrowth of bacteria (**Figure 8A**). In that section of the distribution system, during the period when the additional chlorine is being added, the total trihalomethane concentration ranged from 28 to 83 μg/L. Similarly, in that same portion of the distribution system, a second group of disinfection by-products, haloacetic acids (referred to as HAA5 because the limit is based on the concentration of a group of five HAAs) were also elevated and ranged from 32-94 μg/L (**Figure 8B**). A Canadian Guideline limit is in preparation.

**Sooke Reservoir Biological Activity**. The overall level of algal activity in Sooke Reservoir can be measured using chlorophyll-a, a component of all algal cells. In 2006, the concentration of chlorophyll-a in the south basin was the highest ever observed (**Figure 9**). The median increase in chlorophyll-a for the 4 years following the initial raising of the water level in Sooke Reservoir was 69% **(Figure 10)**.

The primary contributor to the higher levels of chlorophyll-a observed in Sooke Reservoir in 2003 through 2006 was the higher levels of total phosphorus, a nutrient that is needed for the algae to grow. As can be seen in **Figure 11**, while the median concentration of total phosphorus was approximately 70% higher than in previous years in both the north and south basins of Sooke Reservoir, it was similar to 2005 and slightly lower than in 2003 and 2004. The higher levels coincided with flooding of the newly cleared lands around the margin of Sooke Reservoir when the reservoir was expanded.

In 2006, three distinct algal bloom events occurred in Sooke Reservoir. There were two primary algal contributors to these three blooms, which also resulted in the high levels of chlorophyll-a: the golden-brown alga, *Uroglena spp.* and the diatom, *Asterionella formosa v. formosa* (**Figures 12 and 13**). Both organisms occur commonly within Sooke Reservoir, though *Uroglena* is observed much less frequently than *Asterionella*

**Water Quality Complaints**. In 2006, the number of water quality complaints received by the Water Services Department reached a new high albeit only slightly higher than in to 2003 (**Figure 14**). The vast majority of complaints in 2006 were due to a short lived taste and odour event that occurred in May 2006 caused by a bloom of the golden-brown alga called *Uroglena* in Sooke Reservoir. While the metallic taste and fishy odour made the water disagreeable, it continued to be safe to drink.

**RECOMMENDATIONS**

1. In conjunction with the Saanich Peninsula Water Commission and the CRD Environmental Services Department, it is recommended that the chlorination process at the Deep Cove Pumphouse on the Saanich Peninsula be changed to a chloramination process to reduce the levels of disinfection by-products in that portion of the North Saanich distribution system served from the Deep Cove Pumphouse. This work was planned to be completed in 2005. However, the cost of making these treatment changes was substantively higher than budgeted and was subsequently postponed.

**Figure 3. Raw Water Entering Japan Gulch Plant**
**Total Coliforms and Water Temperature in 2006**

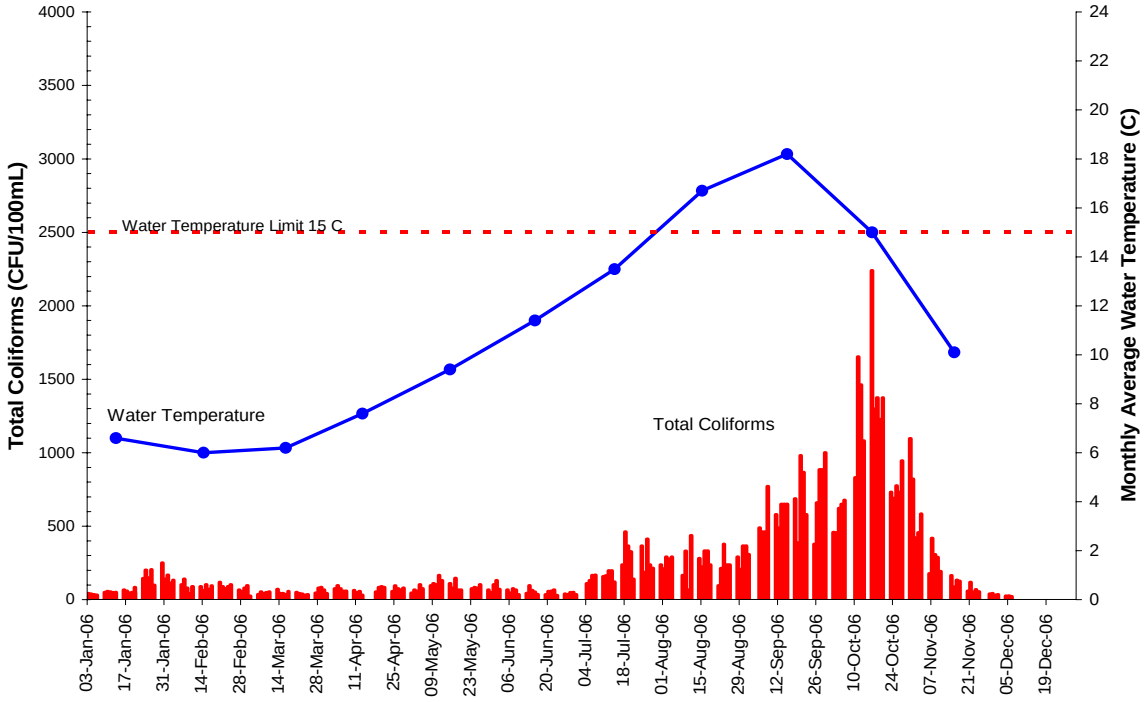



**Figure 3B. Raw Water Entering Japan Gulch Plant**
***E. coli* in 2006**

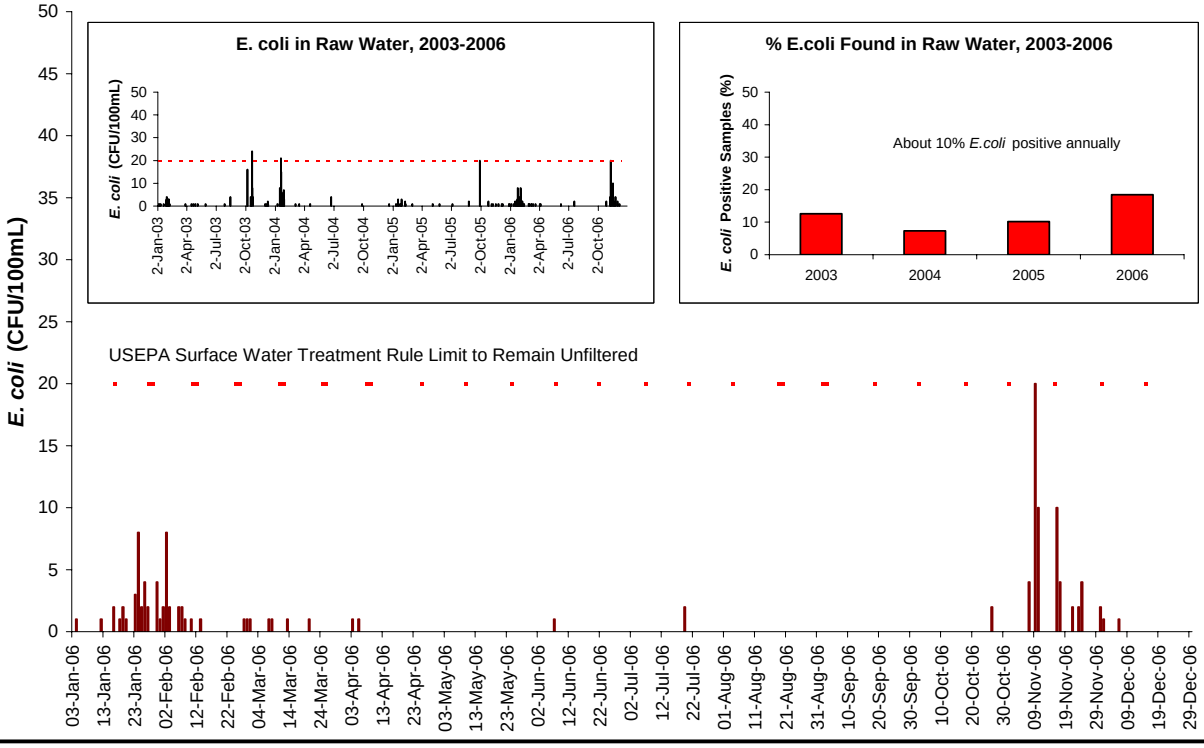


**Figure 4. Treated Water at First Customer Below Japan Gulch Plant**
**Monthly Total Coliforms and Chlorine Residual in 2006**

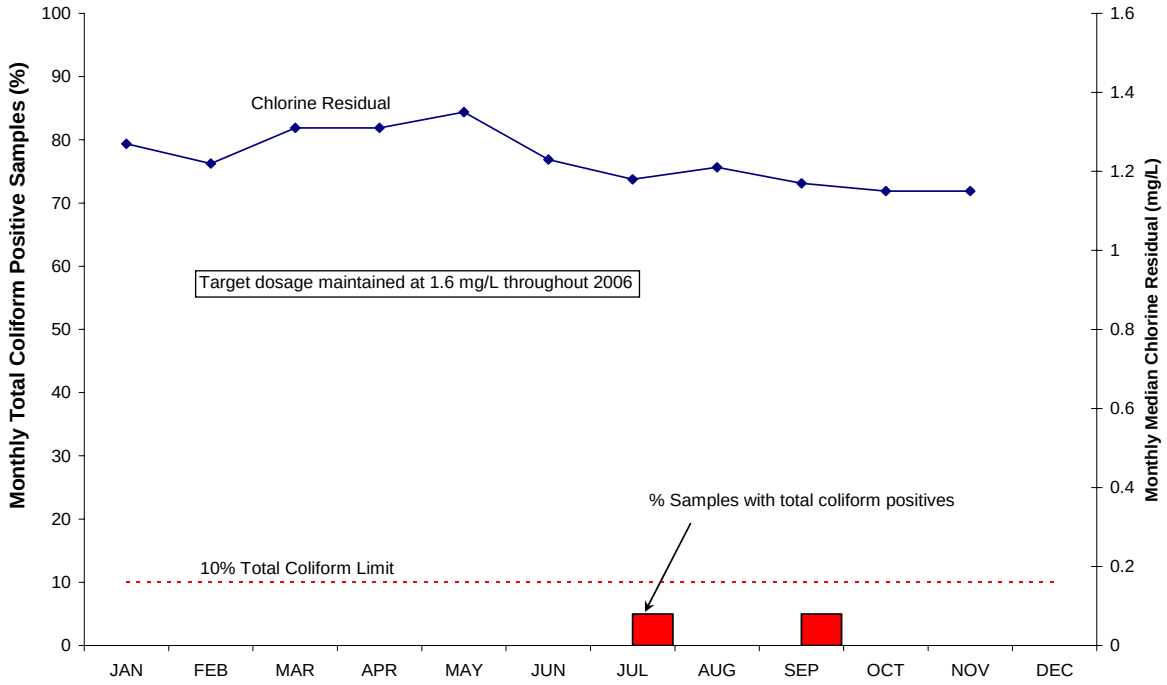



**Figure 5. Greater Victoria Distribution System Combined**
**Annual % Samples with Total Coliforms Present, 1992-2006**

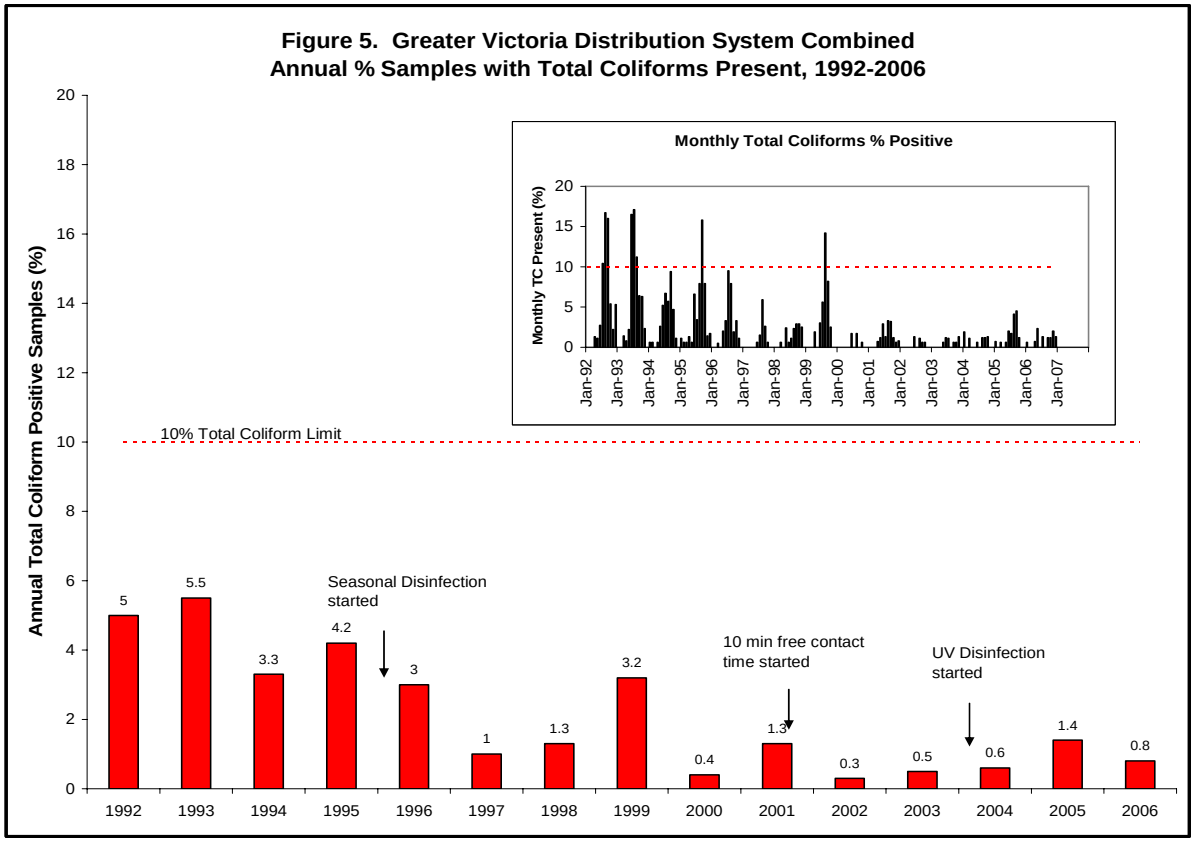
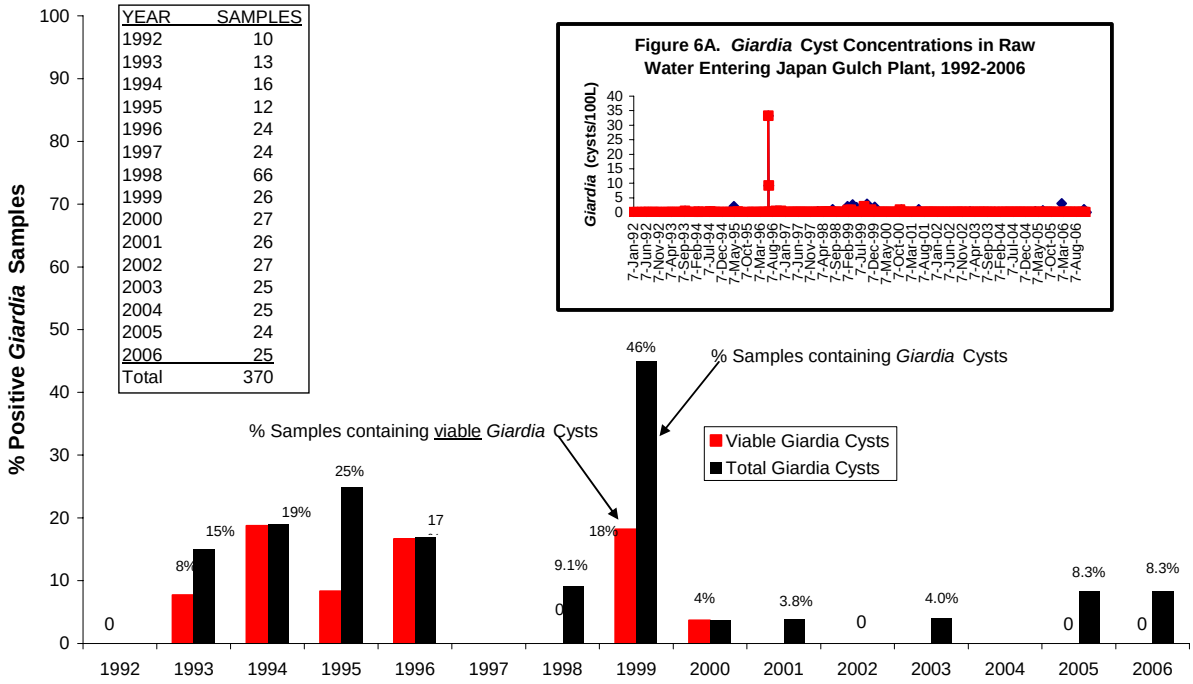


**Figure 6. Percentage of Samples Containing *Giardia* Cysts in Raw Water Entering Japan Gulch Plant, 1992- 2006**




| YEAR | SAMPLES |
|---|---|
| 1992 | 10 |
| 1993 | 13 |
| 1994 | 16 |
| 1995 | 12 |
| 1996 | 24 |
| 1997 | 24 |
| 1998 | 66 |
| 1999 | 26 |
| 2000 | 27 |
| 2001 | 26 |
| 2002 | 27 |
| 2003 | 25 |
| 2004 | 25 |
| 2005 | 24 |
| 2006 | 25 |
| Total | 370 |

**Figure 6A. *Giardia* Cyst Concentrations in Raw Water Entering Japan Gulch Plant, 1992-2006**




**Figure 7. Percentage of Samples Containing *Cryptosporidium* Oocysts in Raw Water Entering Japan Gulch Plant, 1992- 2006**

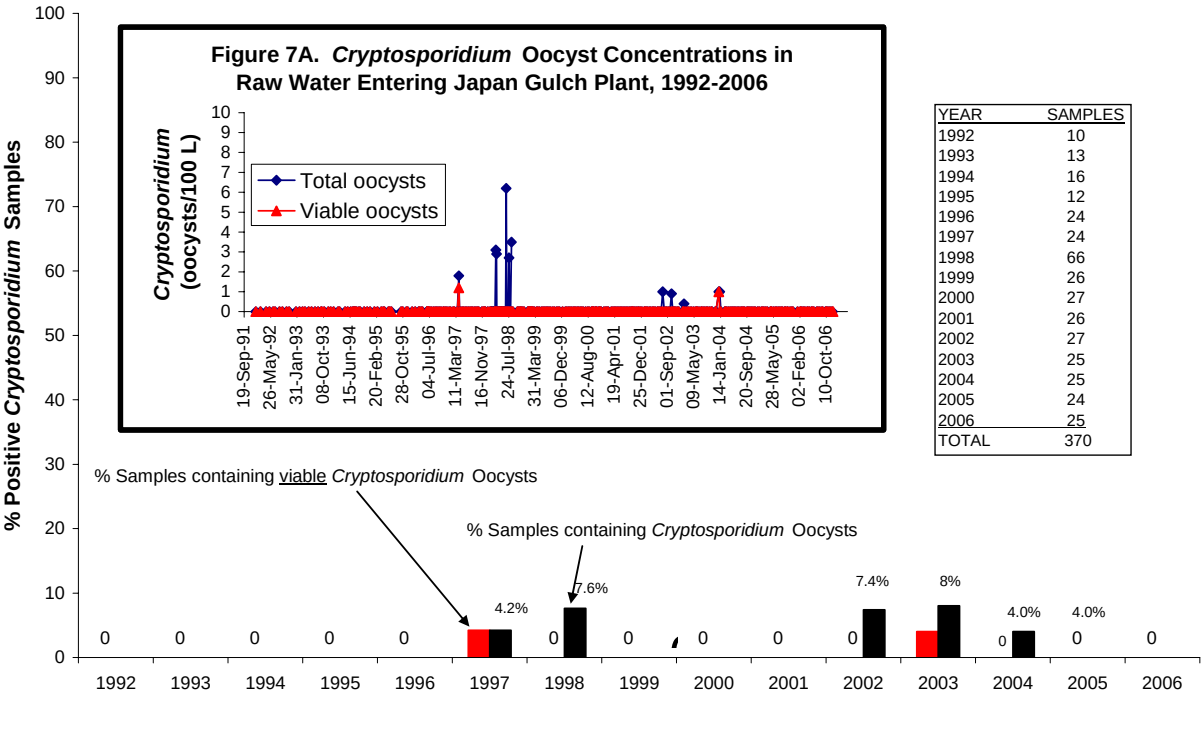



**Figure 7A. *Cryptosporidium* Oocyst Concentrations in Raw Water Entering Japan Gulch Plant, 1992-2006**




| YEAR | SAMPLES |
|---|---|
| 1992 | 10 |
| 1993 | 13 |
| 1994 | 16 |
| 1995 | 12 |
| 1996 | 24 |
| 1997 | 24 |
| 1998 | 66 |
| 1999 | 26 |
| 2000 | 27 |
| 2001 | 26 |
| 2002 | 27 |
| 2003 | 25 |
| 2004 | 25 |
| 2005 | 24 |
| 2006 | 25 |
| TOTAL | 370 |

**Figure 8A. 2006 Trihalomethanes in Greater Victoria Distribution System (Delivery Point and Rechlorinated Locations)**

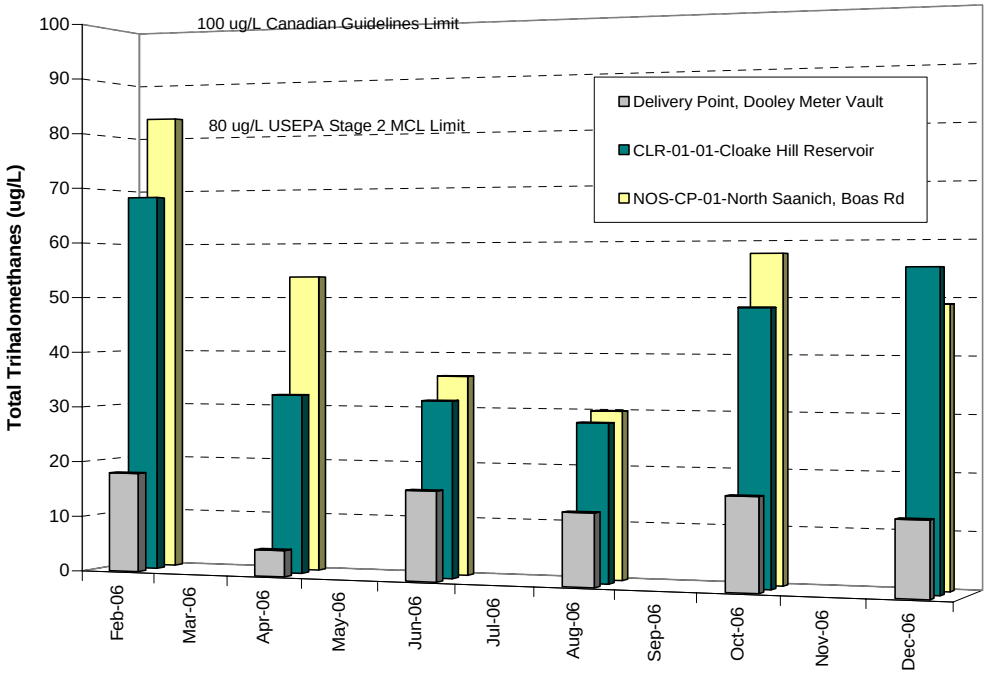



**Figure 8B. 2006 Haloacetic Acids in Greater Victoria Distribution System (Delivery Point and Rechlorinated Locations)**

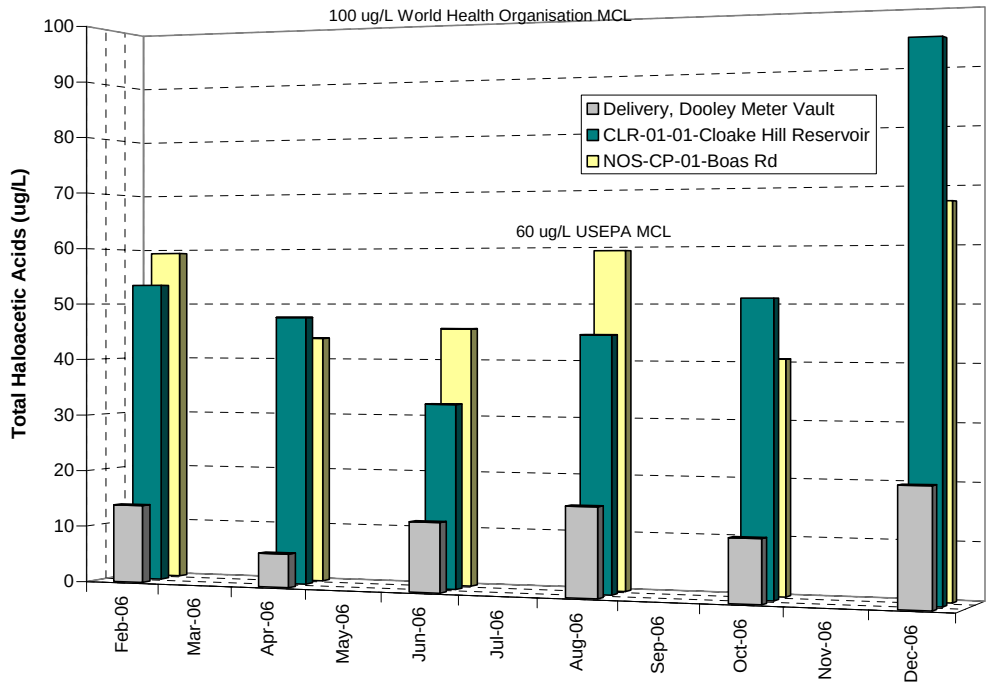


**Figure 9. 2006 Chlorophyll-a in Sooke Reservoir**
**South Basin, 1 m depth (SOL-01-01)**

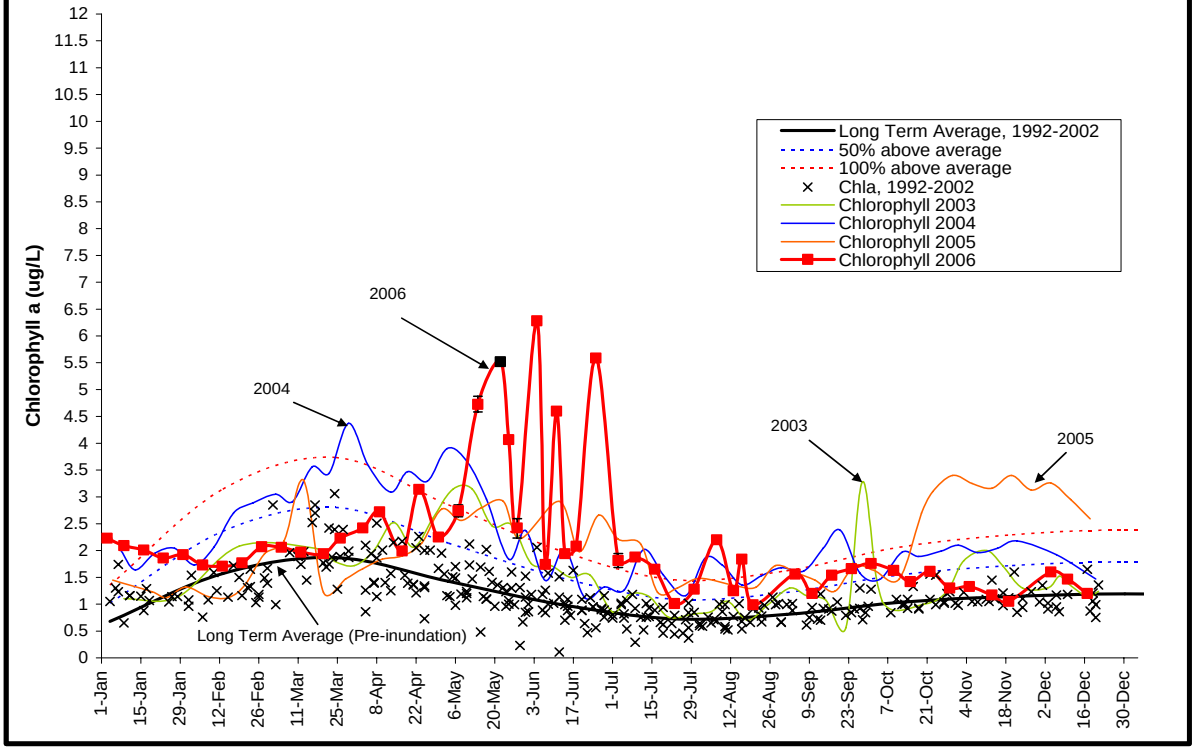



**Figure 10. Chlorophyll-a in Sooke Reservoir, 1995-2006**

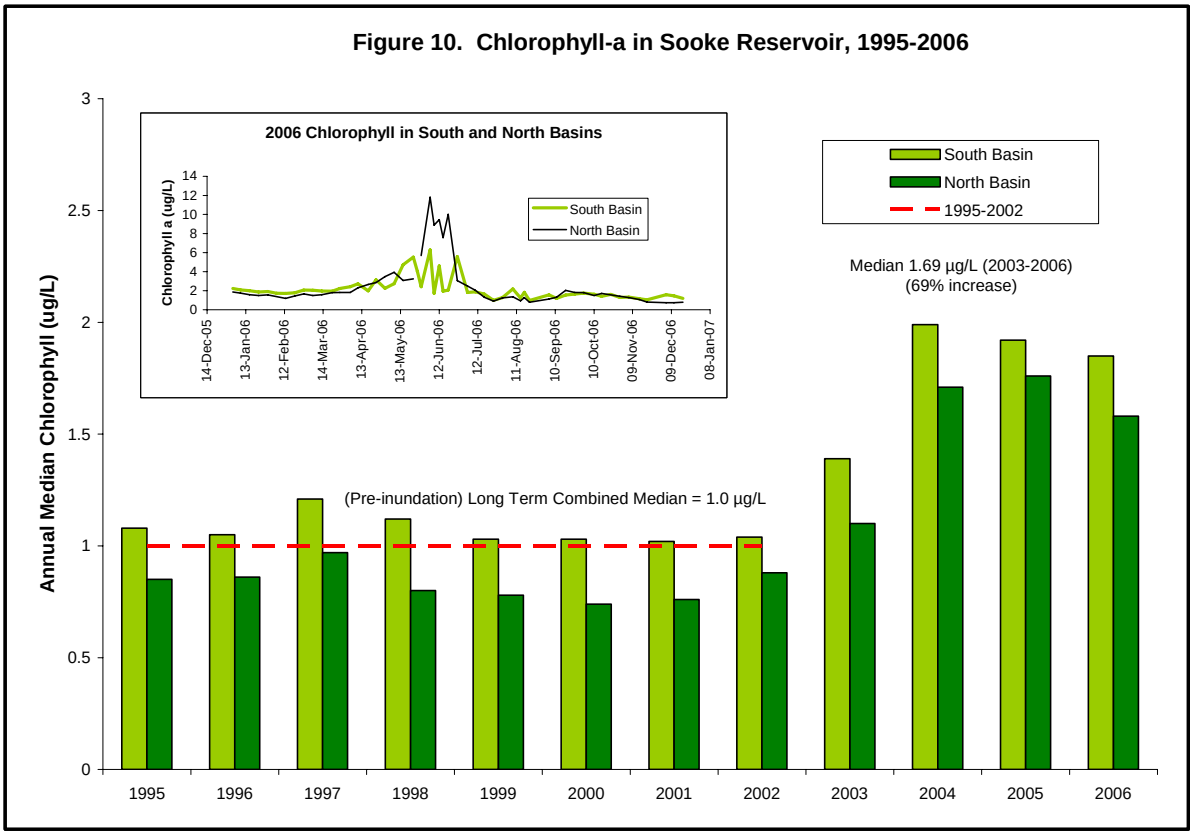


**Figure 11. Total Phosphorus Concentrations in Sooke Reservoir 1992-2006**

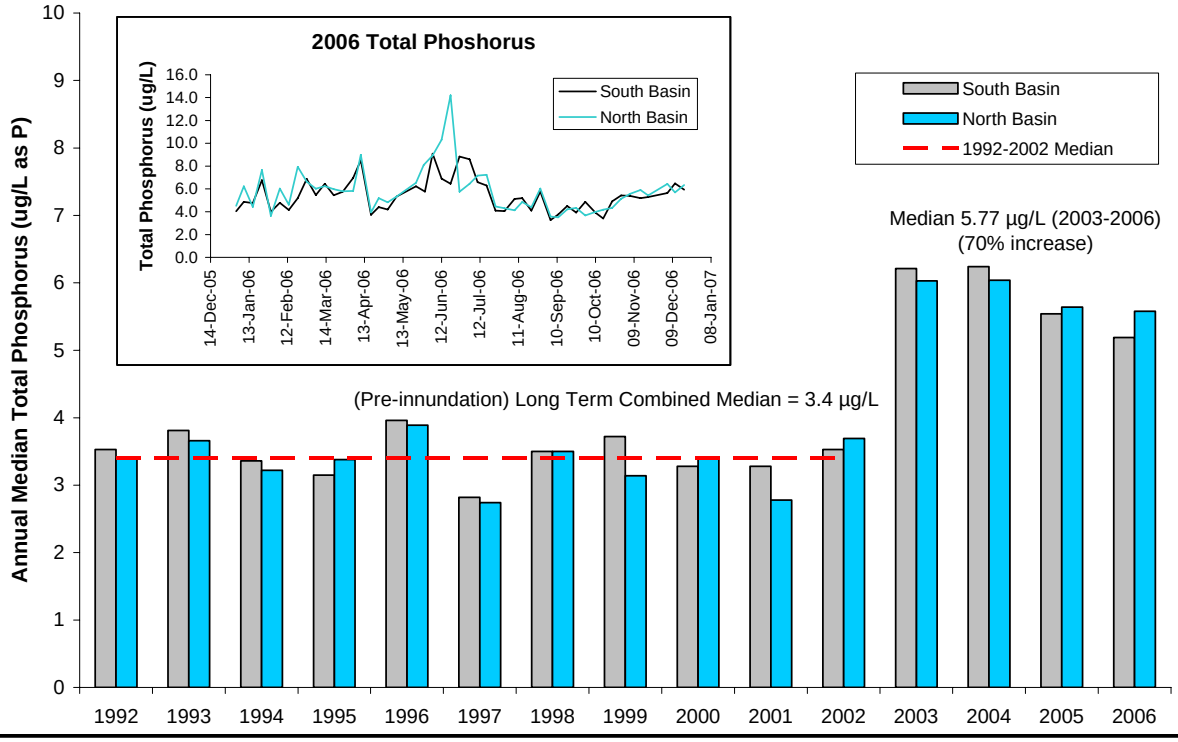



**Figure 12. *Uroglena spp.* in Sooke Reservoir, Intake Forebay (SOL-00), 2006**

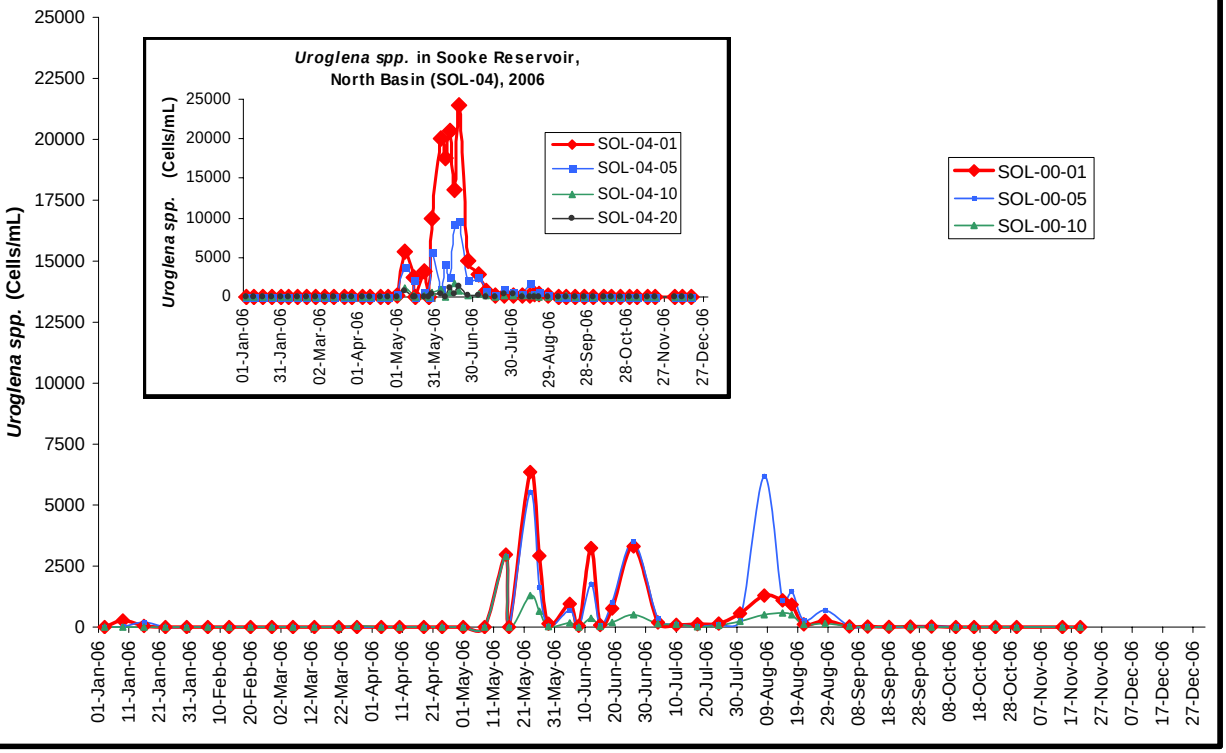


**Figure 13. *Asterionella spp*. in Sooke Reservoir, Intake Forebay, 1m depth (SOL-00-01)**

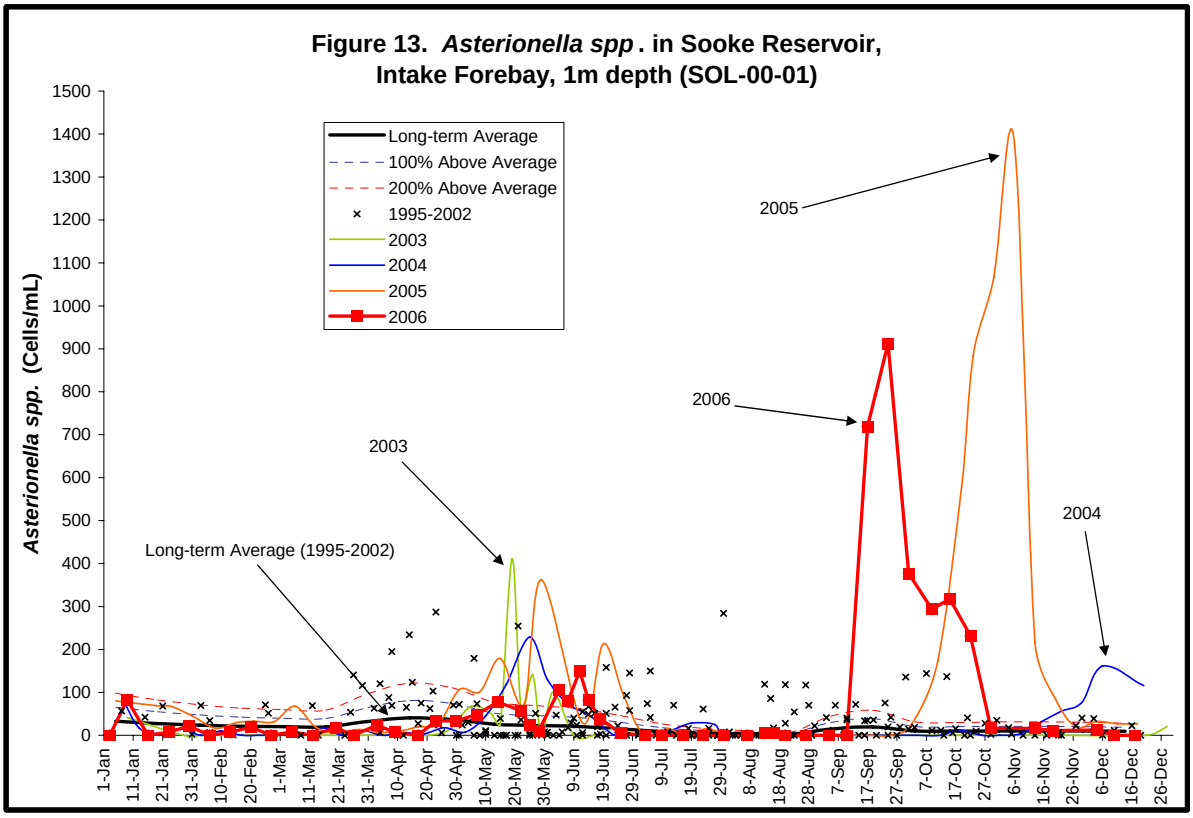



**Figure 14. Annual Water Quality Complaints from the Greater Victoria Drinking Water System, 1992-2006**