



Capital Regional District Water Department

Final Report on the Water Efficiency Pilot Program For three schools in the Greater Victoria Area

Prepared by:



CH2MHILL

**March 2003
Final Report**

28 March 2003

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**Subject: Water Efficiency Pilot Program for Capital Regional District (CRD)
Area Schools. Final Report – March 2003**

Dear Deborah:

Please find enclosed two copies of the Final Report for the Water Efficiency Pilot Program – one bound, and one camera-ready.

We thank you for the opportunity to assist the CRD Water Department with this important program. In our view, this project serves as an excellent example of how successful collaboration between CRD staff and CH2M HILL Engineers can provide cost-effectiveness and high quality work.

We trust that this final report will assist the CRD Water Department in developing a more comprehensive water efficiency program for the ICI sector.

Sincerely,

Thomas Robinson, P.Eng.
Project Manager

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Executive Summary

The Capital Regional District (CRD) initiated a Water Efficiency Pilot Program to evaluate the water savings achieved by upgrading select washroom fixtures with newer, more water-efficient fixtures in three schools.

The goal of the CRD's Water Efficiency Pilot Program was to assess the effectiveness of water-efficient washroom fixtures, and specifically determine whether a water efficiency pilot program such as this can achieve the following objectives:

- ❑ significant water savings,
- ❑ affordable costs that offer a reasonable payback, and
- ❑ overall acceptance and satisfaction from the end users and from operation/maintenance staff.

The program was jointly funded by the CRD and each of the school boards that participated. The CRD provided funding for the purchase of newer, more water-efficient washroom fixtures and ancillary equipment, while each school board covered the material and labour costs for installation. The CRD also retained CH2M HILL to evaluate the changes in water consumption due to the upgrades of the washroom fixtures, and assess the Program against its stated goals.

The schools chosen for the pilot program were Dunsmuir Middle School (Sooke), Spectrum Community School (Greater Victoria), and Stellys High School (Central Saanich). The maintenance yard for School District No. 61 (Greater Victoria) was also included in the pilot program.

After the new fixtures were installed, monitoring of water consumption in the schools indicated a significant decrease in indoor water use. At Spectrum Community School, water use decreased by 83 percent, or 13.8 million L/year. This is equivalent to the annual per capita consumption of 110 people (based on the Canadian average of 343 L/day/person). Water savings at Dunsmuir Middle School and Stellys High School were also significant.

As a result, the schools will realize cost savings (as high as \$11,600 for Spectrum Community School) with relatively short payback periods of one to five years on the initial capital investment.

These results indicate that a wider program to upgrade washroom fixtures in the industrial/commercial/institutional (ICI) would be worthwhile, resulting in significant water savings. The largest water savings are a result of replacing continuous-flush urinals with motion-sensor activated urinals.

SECTION 1

Introduction

The Capital Regional District (CRD) initiated a Water Efficiency Pilot Program to evaluate the water savings achieved by upgrading select washroom fixtures with newer, more water-efficient fixtures in three schools. The Water Efficiency Pilot Program was jointly funded by the CRD and each of the school boards that participated. The CRD provided funding for the purchase of newer, more water-efficient washroom fixtures and ancillary equipment, while each school board covered the material and labour costs for installation.

The goal of the CRD's Water Efficiency Pilot Program was to assess the effectiveness of water-efficient washroom fixtures, and specifically determine whether a water efficiency pilot program such as this can achieve the following objectives:

- ❑ significant water savings,
- ❑ affordable costs that offer a reasonable payback, and
- ❑ overall acceptance and satisfaction from the end users and from operation/maintenance staff.

Three school districts agreed to participate in the pilot program with the CRD, and each selected one school for the pilot program. In addition, a maintenance yard from one of the school districts was included. The participating schools were:

- ❑ Dunsmuir Middle School (School District No. 62 – Sooke)
- ❑ Spectrum Community School (School District No. 61 – Greater Victoria)
- ❑ Stellys High School (School District No. 63 – Central Saanich)
- ❑ A maintenance yard (School District No. 61 – Greater Victoria)

The Capital Regional District (CRD) retained CH2M HILL to evaluate the effectiveness of a Water Efficiency Pilot Program and specifically to quantify the water savings arising from the installation of water-efficient washroom fixtures.

CH2M HILL engineers and CRD staff visited each of the schools in June 2002 to determine the general feasibility of the proposed upgrades, and to identify major water uses in the schools. Subsequently, a monitoring program was implemented to observe and quantify the water use before and after the upgrades were completed. The results of the monitoring program were then used to estimate water savings and cost savings for each of the pilot schools. Finally, a survey was completed by each of the participating schools to determine the level of satisfaction with the washroom upgrades from a operations and maintenance perspective. This report presents the findings of the pilot program.

The CRD's Water Efficiency Pilot Program focused specifically on water-efficient washroom fixtures; measures for reducing irrigation water were not included in the program. Nevertheless, estimates of irrigation water consumption have been derived as part of this study, and are presented herein to provide a broader understanding of school water use.

The CRD intends to use the results of this pilot program to promote water reduction measures in schools and potentially in the wider industrial/commercial/institutional (ICI) sector throughout the CRD.

Pilot Program

The following sections describe the washroom fixture upgrades that were completed during the pilot program, and the monitoring program that was implemented to determine the effectiveness of those upgrades.

2.1 Washroom Fixture Upgrades

Throughout the summer of 2002, three schools and one school facility in the CRD underwent upgrades to select washroom fixtures in their buildings. Two schools installed motion sensor activated urinals, two schools installed waterless urinals, and one school installed several 6L toilets.

Below is a detailed description of the upgrades:

- ❑ **Dunsmuir Middle School:**
 - Retrofitting of 17 continuous-flush urinals with motion sensors. The seven tanks that flush the urinals were also retrofitted. The urinals now flush only in response to motion sensed in front of the urinals.
- ❑ **Stellys High School:**
 - Replacement of 34 conventional toilets (15 having 13L tanks and 19 having 20L tanks) with 6L Toto toilets.
 - Replacement of two continuous-flush urinals with two waterless urinals. The associated urinal flush tank was removed.
- ❑ **Spectrum Community School:**
 - Retrofitting of 14 continuous-flush urinals with motion sensors, which function as described above.
- ❑ **School District No. 61 Maintenance Yard:**
 - Replacement of three continuous-flush urinals (one in the tractor shed and two in the main building) with three waterless urinals. The associated urinal flush tank was removed.

2.2 Monitoring Program

A monitoring program was put into place to measure water usage at the schools, and determine the effectiveness of the washroom fixture upgrades described in Section 2.1. CRD staff carried out the monitoring from June to September 2002.

Understanding the historical water use at each school prior to the implementation of the washroom fixture upgrades was necessary to have a baseline from which to compare.

Following the site visit to each school, a water use inventory/balance was prepared to quantify the major water uses in each school. This was confirmed using daily water meter readings.

Following the washroom fixture upgrades, each school's water use inventory/balance was then readjusted, and compared to the initial water use inventory/balance to evaluate water savings.

Details of the types of records and data collected during the monitoring program are outlined below:

2.2.1 Historical Water Meter Readings

Water billing records (based on water meter readings) from each school were assembled to evaluate annual water use. These readings show general trends in water use at each of the schools over the last few years. However, these data are limited because water meter readings are recorded only two to three times per year. For the purposes of this pilot program, more frequent and detailed readings were required. These are described in Section 2.2.2.

Summaries of the historical meter readings from the billing records are included in Appendix A.

2.2.2 Daily Water Meter Readings

To determine daily water consumption at the schools, water meter readings were collected daily before and after the washroom fixture upgrades were completed. In general, daily readings were collected for two weeks in June 2002, two weeks during the summer vacation (one week before upgrades and one week after), and again for two weeks in September 2002, when school was back in session.

CRD staff collected daily readings from the following water meters:

□ **Dunsmuir Middle School:**

- *Meter #48710043* - measures cumulative flow to the school in cubic meters.
- *Meter #48710038* - measures cumulative flow to irrigation of the school's playing fields in cubic meters.

□ **Spectrum Community School:**

- *Meter #570 162 050 7001* - measures cumulative flow to the school in imperial gallons.
- *Meter #510 120 120 7003* - measures cumulative flow to irrigation of the school's playing fields in imperial gallons.

❑ **Stellys High School:**

- *Meter #46696093* - measures cumulative flow to the school in cubic meters. This meter measures all water use in the school including irrigation water for the school's playing fields.

❑ **School District No. 61 Maintenance Yard:**

- *Meter (to tractor shed and main building)* - measures cumulative flow to the shed and main building in imperial gallons.

The daily readings collected from the above meters are included in Appendix B.

2.2.3 Water Flow Measurements

In addition to daily water meter readings, a portable flow meter was used to measure water consumption on a continuous basis. In most cases, the portable flow meter was in place at each of the school water meters for a period of one week prior to the washroom fixture upgrades and again for one week after the upgrades.

These data were used to verify that each school water meter was calibrated by comparing flow measurements with meter readings over the same time period. Because the water flow data was collected on a continuous basis, it also provides a better understanding of daily water use patterns.

Graphic samples of the water flow records are included in Appendix C.

2.2.4 Measurement of Urinal Flush Intervals

In order to estimate the amount of water used by the continuous-flush urinals, CRD staff timed the flush intervals (i.e. time between flushes). These measurements were very important for developing the water inventory/balance for each school. The flush interval measurements and corresponding water use calculations are summarized in Appendix E.

SECTION 3

Water Savings and Cost Savings

The goal of the CRD's Water Efficiency Pilot Program is to assess the effectiveness of newer, more water-efficient washroom fixtures, and specifically determine whether significant water savings could be achieved in an affordable manner that offered a reasonable payback.

The CRD's Water Efficiency Pilot Program focused specifically on water-efficient washroom fixtures; measures for reducing irrigation water were not included in the program.

Nevertheless, estimates of irrigation water consumption have been derived as part of this study, and are presented herein to provide a broader understanding of school water use.

The results are organized into sections by school. Within each section, the following topics are discussed:

- ❑ **Historical water use** – a description of the water meter readings taken over the last few years. Generally the schools demonstrated an increase in water consumption over the years of recorded data.
- ❑ **Water use inventory/balance** – a water use inventory/balance has been developed for the major water uses in each school.

The water use inventory was developed using information gathered during the site visit to each school. Water use estimates for each of the major uses were developed, and then compared to daily water meter readings and the urinal flush interval readings to formulate a water balance for each school. The balance is presented both as the total volume of water used annually for each major use (L/year) and as the percentage of the total water consumed in the school. Generally, the major water uses prior to the upgrades were categorized as follows: urinals, other washroom uses, and all other indoor water uses, with urinals usually accounting for the largest proportion of water use. Water consumed for irrigation purposes is also included for comparison.

- ❑ **Water use inventory/balance – After upgrades** – a water use inventory/balance was developed after the washroom fixture upgrades were completed using the same procedure. Generally, there is a significant drop in the proportion of water used by urinals.
- ❑ **Estimated water savings** – for each school, an estimate of total water savings was determined by evaluating water consumption before and after the washroom fixture upgrades. Billing rates were subsequently applied to the water savings to estimate the cost savings that would be obtained. The payback for the cost of the new fixtures has also been estimated (not including labour and incremental material costs for installation). In all cases, the water and cost savings are considerable, with the various payback periods ranging from less than one year to five years.

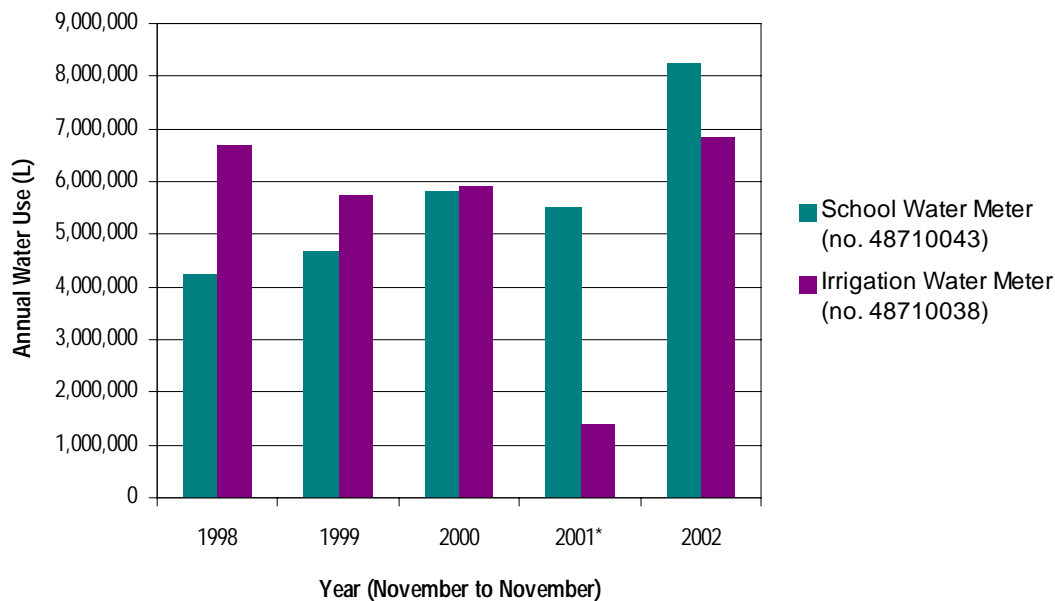
3.1 Dunsmuir Middle School

3.1.1 Historical Water Use

There are two water meters that measure the cumulative volume of water used by Dunsmuir Middle School. The first meter (no. 48710043) measures the volume of water supplied to the school building and the second meter (no. 48710038) measures the volume of water used for irrigating the school's playing field. Historically, readings from these two meters have been manually recorded three times per year. These records are provided in Table A-1 of Appendix A.

The total amount of water used in the school ranges from 4.2 million to 8.2 million L/year, as shown in Figure 3-1a. From 1998 to 2002, there appears to be trend of increasing consumption.

FIGURE 3-1A
 Total Annual Metered Water Use for Dunsmuir Middle School



Irrigation water, also shown in Figure 3-1a, accounts for approximately 6.3 million L/year. Note that less water was used for irrigation in 2001, when lawn sprinkling was prohibited from April to December 2001 due to a drought.

3.1.2 Water Use Inventory / Balance

Procedure

A water use inventory has been developed for Dunsmuir Middle School. Major water fixtures in the school were identified on a site tour conducted on June 6th 2002 and attended by Deborah Walker and Donna Punt of CRD Water, school maintenance personnel, and

Tom Robinson and Patrick Graham of CH2M HILL. Subsequently, water-use estimates were derived for each fixture and summarized in a spreadsheet. The total water use inventory was then compared to the actual metered water consumption to establish the water balance. For water use inventories developed using this methodology, reconciliation to within 10 to 15 percent of the water meter is generally achieved. This level of accuracy is appropriate to make a reasonable cost-benefit determination of water conservation measures.

In order to provide a higher level of confidence with the water use inventory/balance, CRD staff took daily readings of the school water meter during the study period. In addition, a portable flow meter was used to record the volume of water used by the school on a continuous basis, and was summarized into hourly measurements. These data together were used to verify that the water meter was calibrated, and they provided additional insights into daily water consumption patterns at the school.

School (Indoor) Uses

The total school water use was estimated at 25,000 L/day on school days and 13,000 L/day on non-school days. With a population of 862 at Dunsmuir Middle School, the average consumption is 29 L/person/day. This amounts to an annual consumption of 7.1 million L/year.

The continuous-flush urinals accounted for nearly two-thirds (63 percent) of the school water use. Other washroom uses represent most of the remaining water use (32 percent), and all other indoor water uses are relatively minor (5 percent). Table C-1a in Appendix C demonstrates the methods and assumptions used to derive these estimates. Both the historical and daily water meter readings confirm the school water use inventory/balance.

Irrigation Uses

Approximately 60,000 L/day was used between June 15 and September 25 for irrigation of the playing field. This is more than twice that used for school (indoor) uses during the same time period, as would be expected during summer holidays.

Total Water Uses

The total amount of water used at Dunsmuir Middle School was estimated to be 13 million L/year. Over half of the water use was indoor use (55 percent or 7.1 million L/year) and the remainder was irrigation (45 percent, or 6 million L/year).

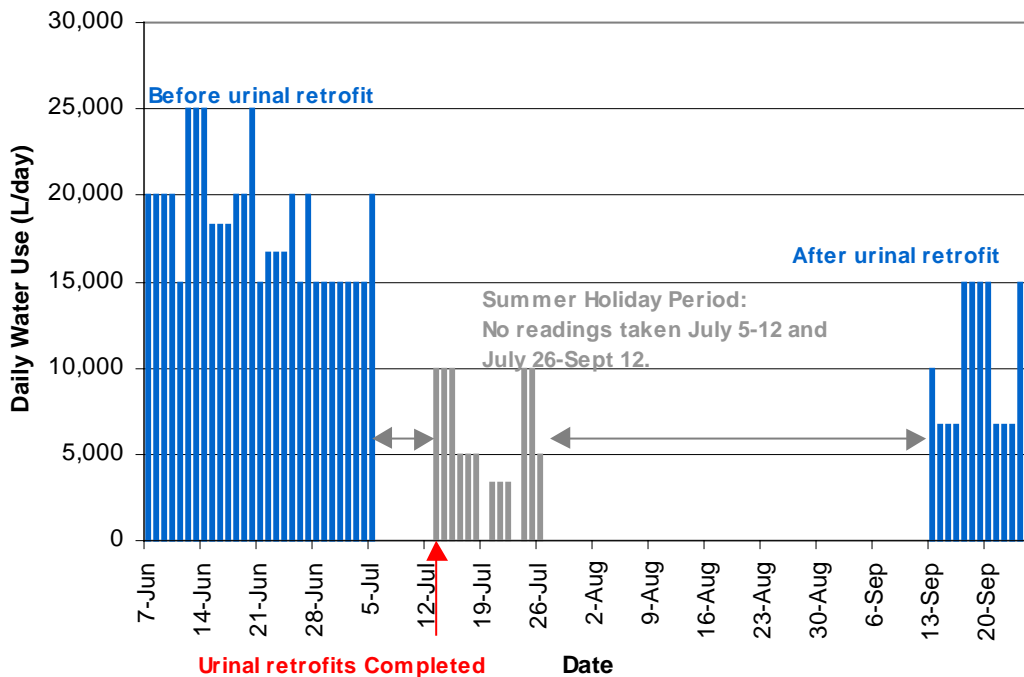
3.1.3 Water Use Inventory / Balance - After Upgrades

A total of 17 urinals at Dunsmuir Middle School were retrofitted with motion sensor-activated flushing units in early July 2002. Table C-1b in Appendix C shows an inventory of the estimated water uses after the new installations.

Daily meter readings demonstrate that a substantial reduction in water use occurred after the urinal retrofits were completed (Figure 3-1b). School water use dropped to an average of 14,000 L/day on school days and 3,000 L/day on non-school days.

Total water use (school plus irrigation) is now estimated to be 9.3 million L/year (Table C-1b in Appendix C). Roughly one third of this water is used indoors (about 36 percent, or 3.3 million L/year) and two thirds for irrigation use (about 64 percent, or 6 million L/year).

FIGURE 3-1B
Daily Metered School Water Use for Dunsmuir Middle School (2002)



Note that the daily water consumption presented in Figure 3-1b is lacking in precision, because the minimum increment on the meter scale is equivalent to 5,000 L. Furthermore, the accuracy of the water use inventory/balance is limited by the following:

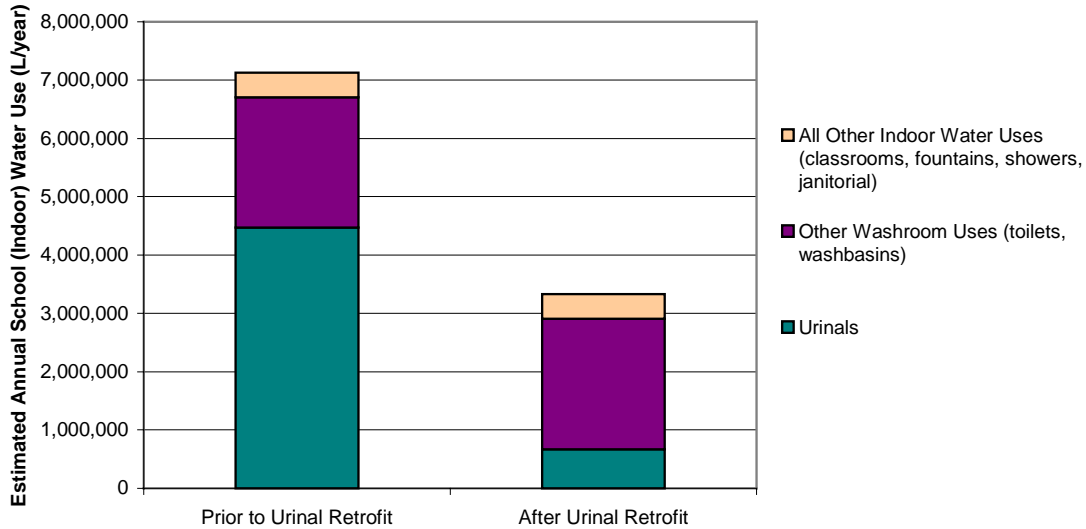
- ❑ Some of the water is used for irrigation at the front of the school. This is estimated to be about 2,000 L/day on average (based on an analysis of continuous flow records), but may vary.
- ❑ Community groups frequently use the school during the evenings and on non-school days, and there is no basis for estimated water consumption at these times.

3.1.4 Estimated Water Savings

The urinal retrofits have reduced indoor school water use by approximately 54 percent to 16,000 L/day on school days and 1,000 L/day on non-school days (from 25,000 L/day and 13,000 L/day, respectively). On an annual basis, this amounts to savings of 3.8 million L (+/- 20 percent), as shown in Figure 3-1c.

Irrigation is now the largest water use on the school property. Prior to the upgrades irrigation accounted for 45 percent of the water use, while after it accounts for 64 percent of the water use at Dunsmuir Middle School.

FIGURE 3-1C
Estimated Water Savings for Dunsmuir Middle School



Due to these water savings, Dunsmuir Middle School will realize significant cost savings. Annual cost savings are estimated at \$3,800, as shown in Table 3-1. The simple payback period for the purchase cost of the new motion sensor equipment is 2 years.

TABLE 3-1
Estimated Cost Savings for Dunsmuir Middle School

Estimated Water Savings (L/year)	Cost of Water (\$/m ³)	Estimated Cost Savings (\$/year)	Equipment Cost* (\$)	Simple Payback Period (years)
3,800,000	0.99	3,800	7,753	2.0

* Does not include costs for labour, installation, audit/report by CH2M HILL.

3.1.5 Other Potential Opportunities for Water Savings

Other potential opportunities for reducing water use at Dunsmuir Middle School include:

- ❑ **Improve Irrigation Efficiency** - It is estimated that irrigation now comprises roughly two thirds of the total water use at Dunsmuir Middle School (about 6 million L/year). There are likely opportunities to reduce irrigation water use, for example, through improved landscaping, and irrigation technology/scheduling.
- ❑ **Install 6L Toilets** – Installing motion sensors on the urinals has reduced indoor school water use significantly. However, a significant amount of water is used for flushing toilets (estimated at 2.1 million L/year). Replacement of existing toilets with 6L toilets could further reduce water consumption at Dunsmuir Middle School by over 1 million L/year.

3.2 Spectrum Community School

3.2.1 Historical Water Use

There are two water meters that measure the cumulative volume of water used by Spectrum Community School. The first meter (no. 004617452) measures the volume of water supplied to the school building and the second meter (no. 004554768) measures the volume of water used by the irrigating the school's playing field. The available historical water meter readings are included in Appendix A (see Table A-2).

The total amount of water used by the school ranges from 8.5 million to 13.5 million L/year, as shown in Figure 3-2a. This graph indicates that school water use has increased significantly over the last three years.

FIGURE 3-2A
Total Annual Metered Water Use for Spectrum Community School

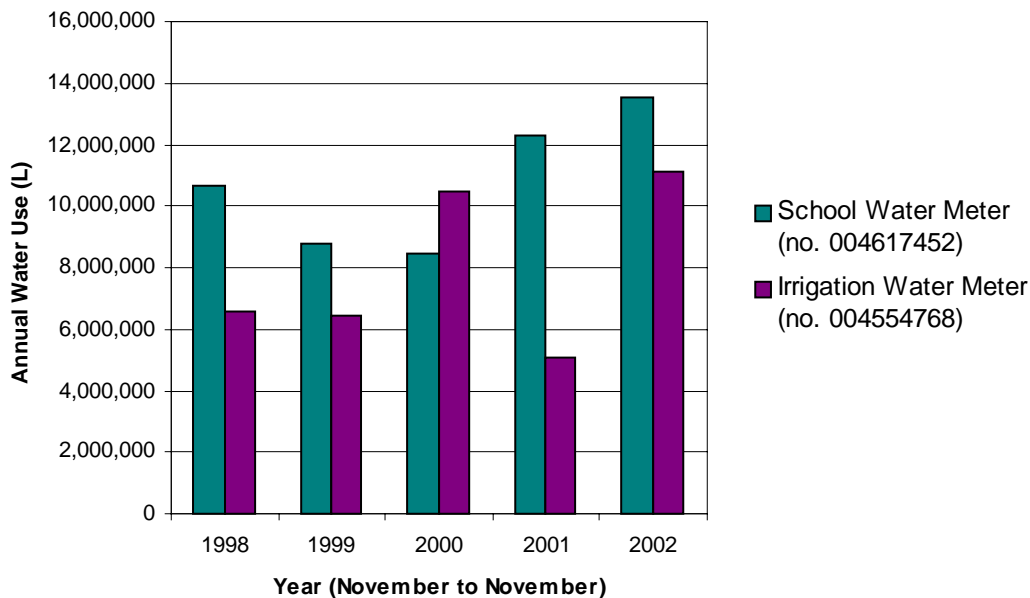


Figure 3-2a also shows that the total amount of irrigation water used by the school ranges from 6.4 million to 11 million L/year (excluding 2001). Note that less water was used for irrigation in 2001, when lawn sprinkling was prohibited from April to December 2001 due to a drought.

3.2.2 Water Use Inventory / Balance

Procedure

A water use inventory has been developed for Spectrum Community School in the same manner as that outlined in Section 3.1.2 for Dunsmuir Middle School. Patrick Graham conducted the site tour on June 7th 2002.

During the pilot study period, CRD staff took daily readings of the school building water meter. In addition, a portable flow meter was used to measure the volume of water used on a continuous basis, and record the average flow every 15-minutes. These data together were used to verify that the water meter was calibrated, and they provided additional insights into daily water consumption patterns at the school.

School (Indoor) Uses

The total school water use was estimated at 51,000 L/day on school days and 40,000 L/day on non-school days. With a population of 716 at Spectrum Community School, the average consumption is 71 L/person/day. This amounts to an annual consumption of 16.7 million L/year.

Continuous flush urinals represented the vast majority (88 percent) of the indoor school water use, prior to installation of the motion sensor-activated urinals. Much less water was used for toilets and other washroom uses (8 percent). All other indoor water uses represented a relatively minor portion of the total water use (4 percent). Both the historical and daily water meter readings confirm the school water use inventory/balance.

Irrigation Uses

The irrigation meter readings show average water use of 70,000 L/day between June 11 and September 13, 2002. During the same period, school (indoor) water use was lower than that measured for irrigation.

Total Water Uses

The total amount of water used at Spectrum Community School was estimated to be 24.6 million L/year. Prior to the upgrades, irrigation water use was nearly twice as much as the school's indoor water use during the same time period.

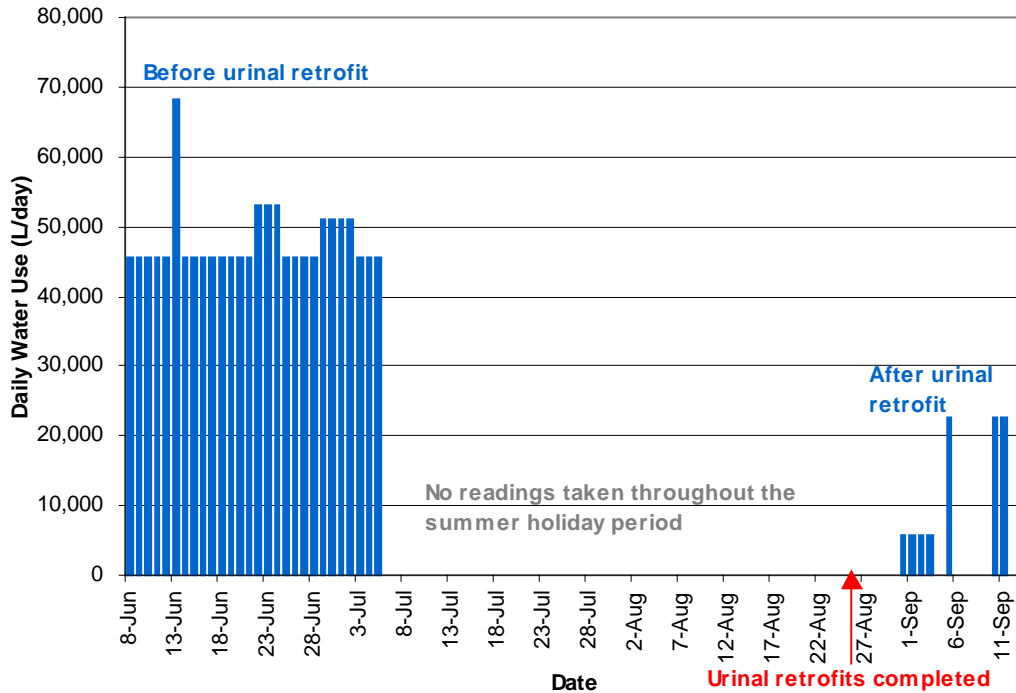
3.2.3 Water Use Inventory / Balance - After Upgrades

A total of 14 urinals at Spectrum Community School were retrofitted with motion sensor-activated flushing units in late August 2002. Table C-2b in Appendix C shows an inventory of the estimated water uses after the upgrades.

Daily meter readings demonstrate that a substantial reduction in water use occurred after the urinal retrofits were completed (Figure 3-2b). School water use dropped to an average of 11,000 L/day on school days and 1,500L/day on non-school days. School water use is now estimated to be 2.9 million L/year. These daily meter readings validate the conclusion that continuous flush urinals represented the majority of the school's total water use.

Figure 3-2b shows the daily meter readings collected from the water meter in the school, between June 6 and September 25, 2002. The complete set of meter readings is included in Appendix B, Table B-2.

FIGURE 3-2B
Daily Metered School Water Use for Spectrum Community School (2002)



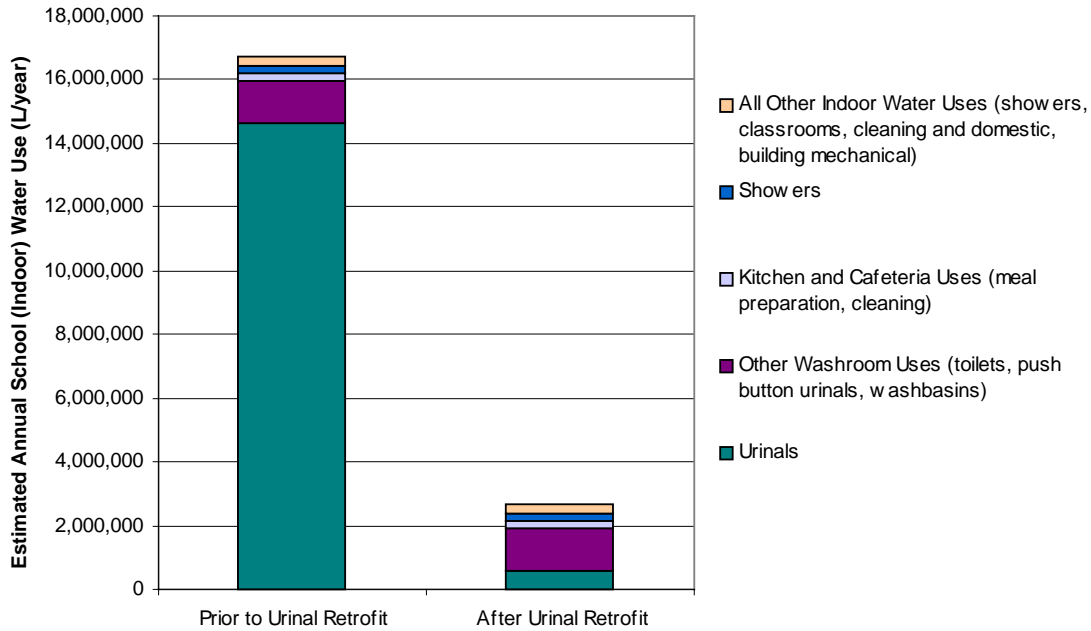
Note that the daily water consumption presented in Figure 3-1b is lacking in precision, because the minimum increment on the meter scale is equivalent to 22,700 L.

3.2.4 Estimated Water Savings

The urinal retrofits have reduced indoor school water use by approximately 83 percent to 15,000 L/day on school days and 300 L/day on non-school days (from 51,000 L/day and 40,000 L/day, respectively). On an annual basis, this amounts to savings of 13.8 million L (+/- 20 percent), as shown in Figure 3-2c.

Irrigation is now the largest water use on the school property. Prior to the upgrades irrigation accounted for 32 percent of the water use, while after it accounts for 73 percent of the water use at Spectrum Community School.

FIGURE 3-2C
Estimated Water Savings for Spectrum Community School



Due to these water savings, Spectrum Community School will benefit from significant cost savings. Annual cost savings are estimated at \$11,600, as shown in Table 3-2. The simple payback period for the cost of purchasing the new motion sensor-activated urinals is less than one year.

TABLE 3-2
Estimated Cost Savings for Spectrum Community School

Estimated Water Savings (L/year)	Cost of Water (\$/m ³)	Estimated Cost Savings (\$/year)	Equipment Cost* (\$)	Simple Payback Period (years)
13,800,000	0.84	11,600	9,625	Less than 1

* Does not include costs for labour, installation, audit/report by CH2M HILL.

3.2.5 Other Potential Opportunities for Water Savings

Most of the toilets at Spectrum operate using flush valves, and have relatively low water use compared with conventional tank toilets. Therefore, the potential water savings that could be achieved through installation of 6L toilets are likely relatively small.

Other opportunities to further reduce water use at Spectrum Community School include:

- ❑ **Improve Irrigation Efficiency** – This is the most significant opportunity to further reduce water use at Spectrum Community School. It is estimated that irrigation now

comprises nearly three-quarters of the total water use at Spectrum (about 7.8 million L/year). There are likely opportunities to reduce irrigation water use, for example, through improved landscaping, and irrigation technology/scheduling.

3.3 Stellys High School

3.3.1 Historical Water Use

A single water meter measures the cumulative volume of water used by Stellys High School. Readings from this meter include both school (indoor) and irrigation use. The total amount of water used ranges from 7.4 million to 16.5 million L/year, as shown in Figure 3-3a. The available historical water meter readings are included in Appendix A (see Table A-3).

FIGURE 3-3A
 Total Annual Metered Water Use for Stellys High School

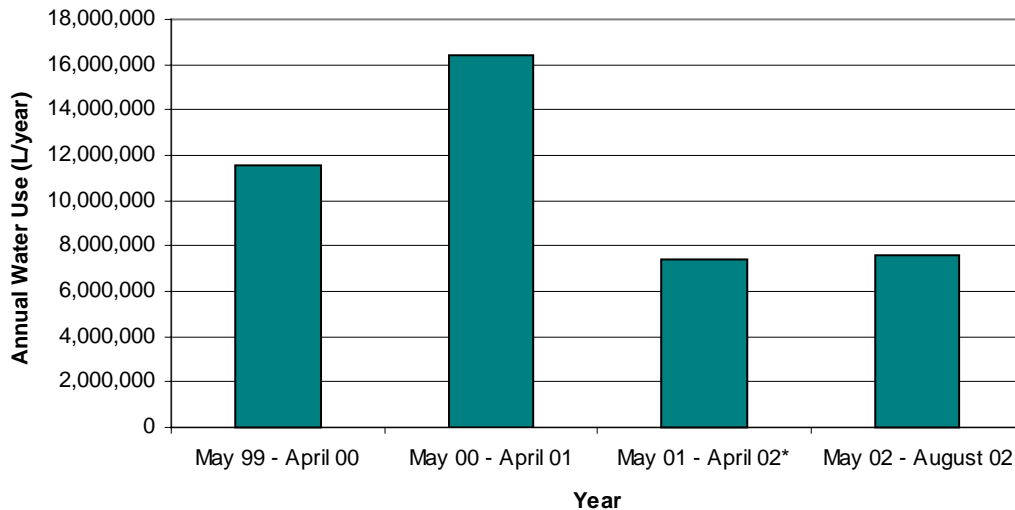


Figure 3-3a shows that the annual water use from May 2001 to April 2002 was significantly less than the previous two years, most likely due to the ban on irrigation during the period of water shortage during the summer and fall of 2001. More water was used from May to August 2002 than in the entire previous year. This indicates that irrigation can be a large portion of total water use, possibly greater than 50 percent in some years.

3.3.2 Water Use Inventory / Balance

Procedure

A water use inventory has been developed for Stellys High School in the same manner as that outlined in Section 3.1.2 for Dunsmuir Middle School. During the pilot study period, CRD staff took daily readings of the school building water meter. In addition, a portable flow meter was used to measure the volume of water used on a continuous basis, and record the average flow every 15-minutes. These data together were used to verify that the

water meter was calibrated, and they provided additional insights into daily water consumption patterns at the school.

Some years prior to this pilot study, Stellys High School converted urinals from continuous flush to manual flush, and reduced the water consumption in this area. For this reason, the CRD Water Efficiency Pilot Program focused on replacing the existing toilets with 6L toilets at this school. Two waterless urinals were also installed.

School (Indoor) Uses

The total school water use was estimated at 58,000 L/day on school days and 15,000 L/day on non-school days. With a population of 1200 at Stellys High School, the average consumption is 48 L/person/day. This amounts to an annual consumption of 13.7 million L/year.

Flushing toilets represented over one-third (37 percent) of the indoor school water use. The heat pump for the computer lab air conditioner and the once through cooling water (OTCW) for the walk-in refrigerator in the school kitchen used high proportions of the water (27 percent and 20 percent, respectively). Other indoor water uses (showers, kitchen, cleaning, etc.) use 10 percent. Other washroom uses (push button urinals, washbasins) represent another 7 percent. The single continuous flush urinal tank used 4 percent.

Irrigation Uses

There is no separate water meter for monitoring irrigation water use at Stellys High School. Estimates were made by an irrigation consultant that an average of 57,000 L/day is used for irrigation during the summer months. This equates to a total use of 5.6 million L. Although irrigation contributes significantly to the total water use, potential measures for reduction of irrigation water have not been included in the CRD's Water Efficiency Pilot Program at this time.

Total Water Uses

The total amount of water used at Stellys High School was estimated to be 19.3 million L/year. Over 70 percent of the water was for indoor use (13.7 million L/year) and the rest for irrigation (5.6 million L/year).

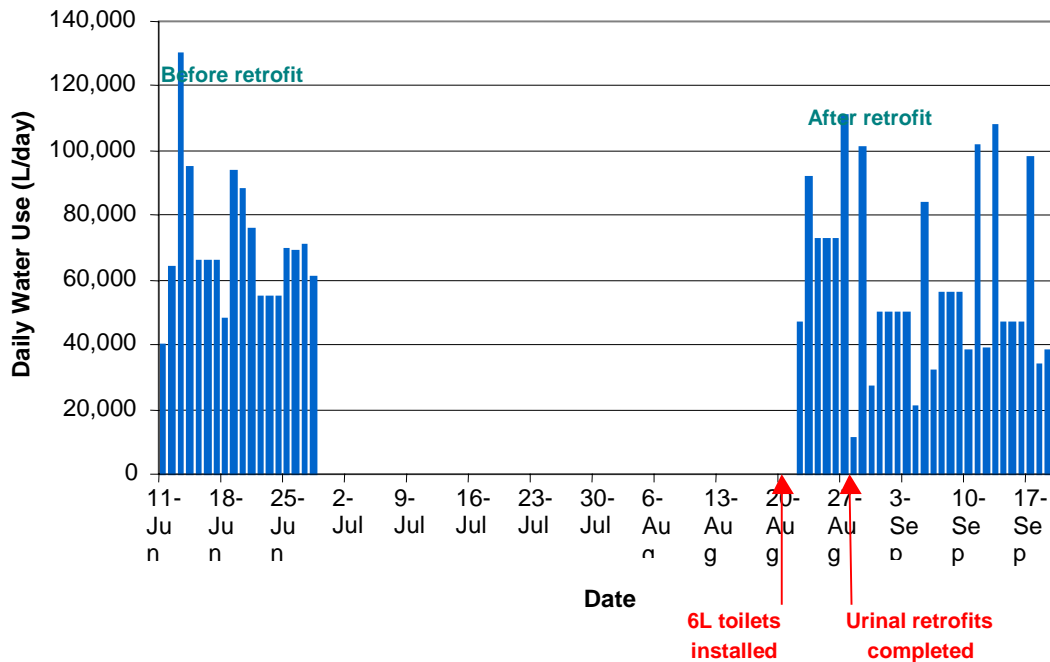
3.3.3 Water Use Inventory / Balance - After Upgrades

A total of 34 toilets were replaced with 6L toilets, and two urinals replaced with waterless urinals at Stellys High School in late August 2002. Table C-3b in Appendix C shows an inventory of the estimated water uses after the new installations.

Daily meter readings demonstrated that a reduction in water use occurred after the urinal and toilet upgrades were completed (Figure 3-1b). School water use dropped to an average of 39,000 L/day on school days and 13,000 L/day on non-school days.

Total water use (school plus irrigation) is now expected to be 15.4 million L/year. Approximately 64 percent of this water is used in the school (9.8 million L/year), and 36 percent for irrigation (5.6 million L/year).

FIGURE 3-3B
Daily Metered School Water Use for Stellys High School (2002)



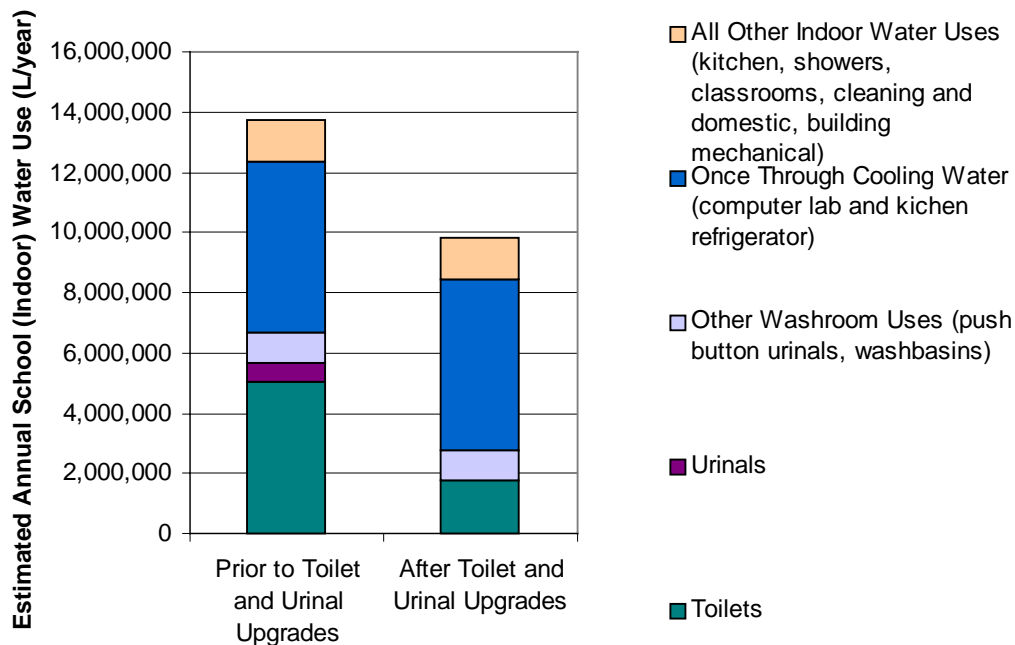
Note that the daily water consumption presented in Figure 3-1b is lacking in precision, because the minimum increment on the meter scale is equivalent to 1,000 L. Furthermore, the accuracy of water use the inventory/balance is limited by the following:

- ❑ The only water meter providing consumption data is the main water supply to the facility.
- ❑ The meter readings do not separate indoor school water use from irrigation water use. An analysis of flow records indicates that typical irrigation use could be close to 50,000 L/day. Because irrigation is a substantial portion of the water use, the reduction in school building water use is less pronounced (in comparison to Figures 3-1b and 3-2b).
- ❑ Due to the numerous water uses and the complexity of the water distribution system within the school, it was not possible to provide accurate estimates for each of the many water uses.
- ❑ There is a high level of uncertainty and variability in the amount of once through cooling water (OTCW) used. There is evidence that OTCW use can be very high during warm weather (i.e. 130,000 L/day was observed on June 13th), but is used less during winter months.
- ❑ Community groups frequently use the school during the evenings and on non-school days, and there is no basis for estimated water consumption at these times.

3.3.4 Estimated Water Savings

Toilet and urinal replacements have reduced indoor school water use by approximately 29 percent to 39,000 L/day on school days and 13,000 L/day on non-school days (from 58,000 L/day and 15,000 L/day, respectively). On an annual basis, this amounts to savings of 3.9 million L (+/- 20 percent), as shown in Figure 3-3c. These water savings are not as substantial when compared to the two previous schools. However, this is due in part to the fact that Stellys High School had already converted continuous flush urinals to manual flush, and had realized these water savings prior to this pilot study.

FIGURE 3-3c
Estimated Water Savings for Stellys High School



Due to these water savings, Stellys High School will benefit from cost savings. Annual cost savings are estimated at \$2,200, as shown in Table 3-3. The simple payback period for the cost of purchasing the new 6L toilets and waterless urinals is 4.6 years. This payback period is longer than other schools because the volume of water saved is lower, and because Stellys pays a lower cost per unit of water consumed (due to a fixed monthly service connection fee).

TABLE 3-3
Estimated Cost Savings for Stellys High School

Estimated Water Savings (L/year)	Cost of Water (\$/m ³)	Estimated Cost Savings (\$/year)	Equipment Cost* (\$)	Simple Payback Period (years)
3,900,000	0.56	2,200	10,019	4.6

* Does not include costs for labour, installation, audit/report by CH2M HILL.

3.3.5 Other Potential Opportunities for Water Savings

Other opportunities to further reduce water use at Stellys High School include:

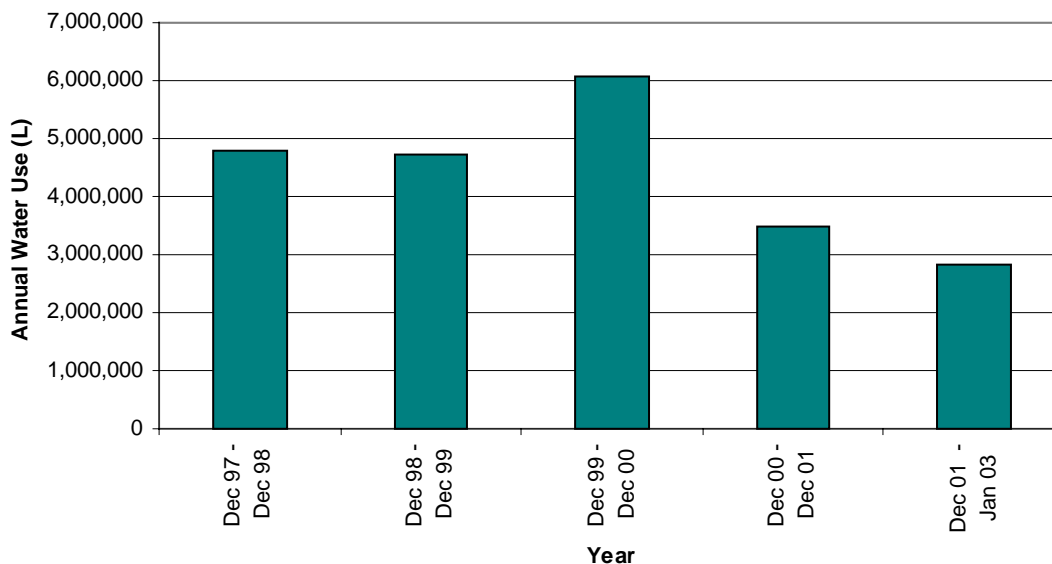
- ❑ **Reducing or Eliminating Use of Once Through Cooling Water (OTCW)** - The OTCW used for computer lab heat pump and for the kitchen refrigerator is likely the largest indoor water use at Stellys High School. OTCW is an inefficient cooling method and accounts for about 5.7 million L/year of water use, which is nearly 60 percent of the total indoor school water. Replacing OTCW with cooling systems that recycle water and use evaporation as a cooling mechanism could reduce water use at Stellys High School significantly. This would also improve the energy efficiency of the school.
- ❑ **Reducing Irrigation Water Use** - It is estimated that irrigation now comprises roughly one-third of the total water use at Stellys (about 5.6 million L/year). There are likely opportunities to reduce irrigation water use, for example, through improved landscaping, and irrigation technology/scheduling.

3.4 School District No. 61 Maintenance Yard

3.4.1 Historical Water Use

The total amount of water used by the maintenance yard ranges from 3.5 million to 6 million L/year, as shown in Figure 3-4a. The available historical water meter readings are included in Appendix A (see Table A-4).

FIGURE 3-4A
 Total Annual Metered Water Use for School District No. 61 Maintenance Yard



The maintenance yard water use decreased significantly in 2001, compared with the previous three years. The water use in 2002 is expected to be even less, about 3.2 million L at the current rate of use. The historical water use records are provided in Table A-4 of Appendix A.

3.4.2 Water Use Inventory / Balance

Procedure

A water use inventory has been developed for the maintenance yard in the same manner described in Section 3.1.2 for Dunsmuir Middle School. Deborah Walker, Donna Punt and Patrick Graham conducted the site tour on June 7th 2002. During the pilot study, CRD staff took daily readings of the water meter in the maintenance yard.

Total Water Uses

The total water use was estimated at 8,500 L/day on workdays and 7,300 L/day on non-workdays. This amounts to approximately 3 million L/year. These estimates include water used in the main building, in the truck shed, and at the washing station.

The continuous-flush urinals accounted for the majority of the water use (60 percent). Pressure washing, miscellaneous cleaning in the truck shed, and other non-washroom uses accounted for 23 percent. Other washroom uses accounted for 9 percent, and the washing station adjacent to the truck shed used the remaining 7 percent.

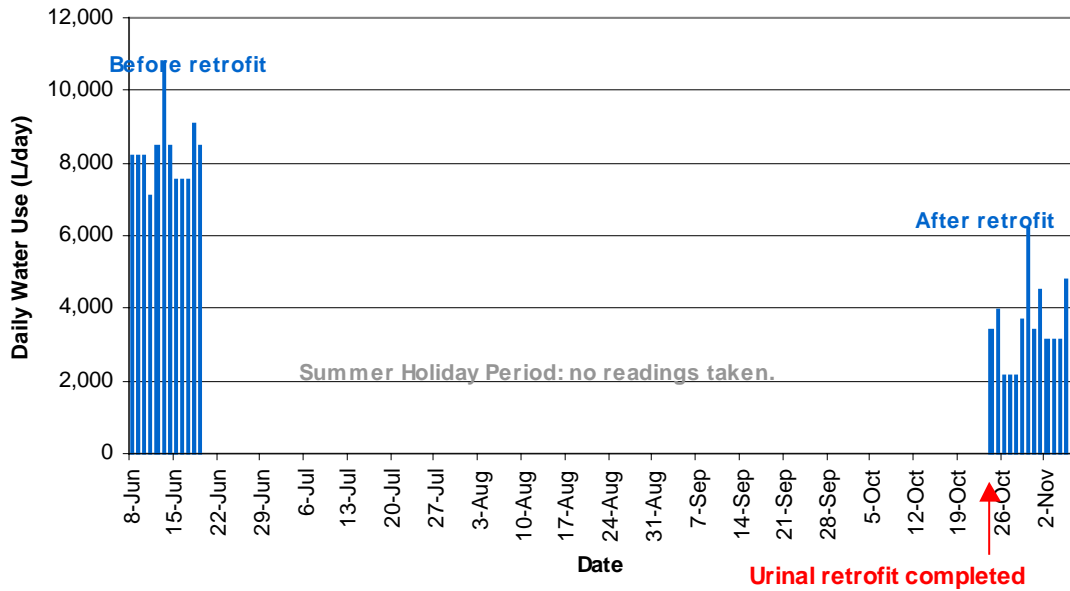
3.4.3 Water Use Inventory / Balance - After Upgrades

Three waterless urinals replaced three continuous-flush urinals in mid-October. Two urinals were in the main building and one was in the truck shed.

Daily meter readings collected from the water meter at the maintenance yard during the pilot period are shown in Figure 3-4b. The figure indicates a substantial drop in water use (close to 5,000 L/day) as a result of urinal replacement. Daily water use is now estimated at 4,000 L on workdays and 2,600 L on non-workdays. The complete set of meter readings is included in Appendix B (see Table B-4).

Total water use is now estimated at 1.2 million L/year.

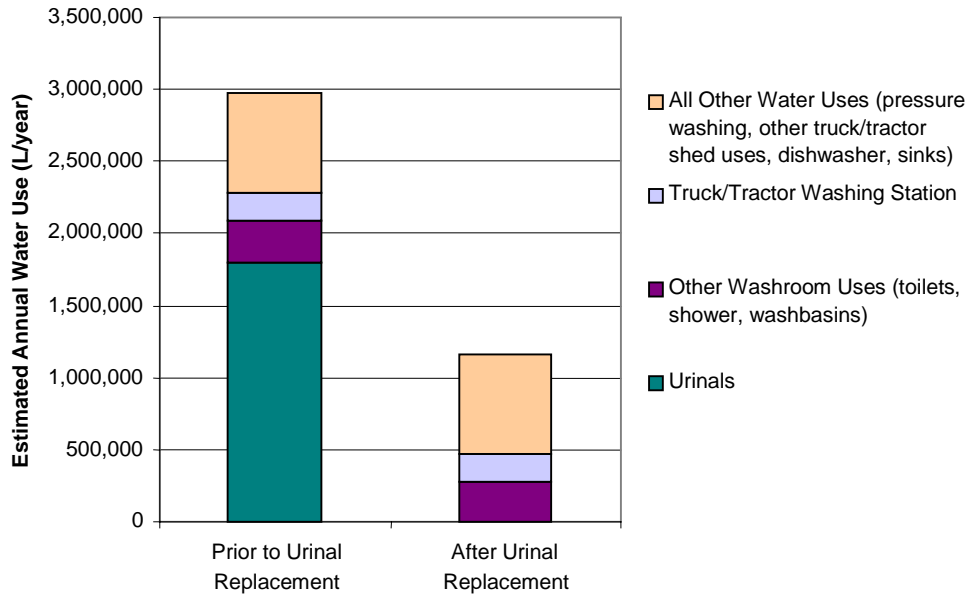
FIGURE 3-4B
Daily Metered School Water Use for School District No.61 School Maintenance Yard (2002)



3.4.4 Estimated Water Savings

Replacing the continuous flush urinals with waterless urinals will save approximately 1.8 million L/year (+/- 20percent), thus reducing the total amount of water used in the maintenance yard by 61 percent (Figure 3-4c).

FIGURE 3-4C
Estimated Water Savings for School District No. 61 Maintenance Yard



Due to these water savings, the maintenance yard will realize significant cost savings. Annual cost savings are estimated at \$1,500, as shown in Table 3-4. The simple payback period for the cost of purchasing the new waterless urinals is 1.2 years.

TABLE 3-4
Estimated Cost Savings for School District No. 61 Maintenance Yard

Estimated Water Savings (L/year)	Cost of Water (\$/m ³)	Estimated Cost Savings (\$/year)	Equipment Cost* (\$)	Simple Payback Period (years)
1,800,000	0.84	1,500	1,831	1.2

* Does not include costs for labour, installation, audit/report by CH2M HILL.

3.4.5 Other Potential Opportunities for Water Savings

Other opportunities to further reduce water use at School District No. 61 Maintenance Yard include:

- **Non-workday Water Use** – Meter readings indicated that water use on non-workdays (weekends) was quite high at approximately two-thirds the use on workdays. This may be due to significant use on non-workdays. However, if the maintenance yard does not experience high use on weekdays, the water system should be checked for leakage.

SECTION 4

Feedback from Schools

To determine the overall level of satisfaction with the CRD Water Efficiency Pilot Program, the CRD conducted a survey of the maintenance supervisors at each of the participating school boards. The results of this survey are presented in this section.

4.1 Installation Costs

The CRD provided funding to purchase new water-efficient washroom fixtures for each of the schools; however, each school board was responsible for all labour and incremental materials costs to complete the installation. To perform the installations, Dunsmuir Middle School used a school district staff plumber, Spectrum Community School hired both a contract plumber and a contract electrician, Stellys High School used a school maintenance staff worker, and the maintenance yard contracted a plumber. These installation costs were not reported, but should be considered when evaluating the total installed cost of the upgrades.

4.2 Toilet Replacements

Stellys High School was the only school that replaced toilets with 6L toilets. Table 4-1 summarizes the results of the survey, which indicates a high level of satisfaction with the new toilets and also with the CRD's program.

TABLE 4-1
Satisfaction with 6L Toilets

School	Satisfaction Level	Install more units without an incentive?	Why not?
Stellys High School	Very Satisfied	Maybe	Only on an as-needed basis when old toilets cannot be repaired. Or during a renovation project.

4.3 Urinal Retrofits

At two of the schools (Dunsmuir and Spectrum), continuous-flush urinals were retrofitted with motion sensor-activated urinals. At Stellys school and the maintenance yard, continuous flush urinals were replaced with waterless urinals. The completed surveys indicate that schools with the motion sensor activated urinals are very satisfied both with the retrofits and the CRD Program (refer to Table 4-2).

TABLE 4-2
Satisfaction with Motion Sensor-Activated Urinals

School	Satisfaction Level	Install more units without an incentive?	Why not?
Dunsmuir Middle School	Very Satisfied	No	No budget
Spectrum Community School	Very Satisfied	Yes	-

Table 4-3 shows that waterless urinals did not achieve the same level of satisfaction. Both facilities rated the performance of the waterless urinals as neutral. Reasons are given as to why further upgrades might not be considered.

TABLE 4-3
Satisfaction with Waterless Urinals

School	Satisfaction Level	Install more units without an incentive?	Why not?
Stellys High School	Neutral	Maybe	They require frequent cleaning with chemicals and staff must receive training to do this.
School District No. 61 maintenance yard	Neutral	Yes	Some staff have concerns about whether sanitation is adequate

4.4 Feedback Regarding CRD Program

Included in the survey were several queries regarding the CRD Water Efficiency Pilot Program and the manner in which it was delivered. The survey asked how well the logistics of the pilot program were executed, including communications, payments, appointment handling, etc. All four evaluators indicated a very high satisfaction rating with the program. The evaluator for Stellys High School suggested that a wider scope for water reduction targets would be a possible improvement to the pilot program. For example, heat pump units could be included in a future analysis of water efficiency.

4.5 Summary

Feedback from the schools indicates that there is a high level of satisfaction with the upgrades and with the CRD Water Efficiency Pilot Program as a whole. The installation of 6L toilets and motion sensor-activated urinals both achieved a very high level of satisfaction, with budget constraints identified as the only deterrent for installing more of these units. The waterless urinals achieved a “neutral” level of satisfaction. In this case, concerns were raised concerning increased maintenance costs and reduced sanitation.

SECTION 5

Conclusions

Based on the foregoing, it is concluded that:

1. The Water Efficiency Pilot Program undertaken by the CRD at three schools (and a maintenance building) demonstrated the potential for water reduction.
2. Each school in the pilot program showed significant water and cost savings as a result of the upgrades to select washroom fixtures. Estimated water savings range from 3,800,000 L/year at Dunsmuir Middle School to 13,800,000 L/year at Spectrum Community School. These water savings will bring about annual cost savings in the range of \$2,200 to \$11,600. A summary of these savings and a calculated payback period for each school is found in Table 5-1.
3. Each school demonstrated a high level of satisfaction with the execution of the pilot program and with the performance of the 6L toilets and motion sensor activated urinals. The satisfaction level with the waterless urinals was lower.
4. Although the pilot program was successful at reducing indoor water consumption at each of the schools, outdoor water use was not addressed.
5. The use of Once Through Cooling Water (OTCW) in the computer laboratory at Stellys High School is high, and should be considered for water reductions.
6. Continuous-flow urinals consume large amounts of water. Retrofitting conventional urinals with motion sensors, or replacing them with waterless urinals is effective at reducing water consumption in these units.
7. Water savings arising from replacing older toilets with newer, 6L toilets may also be worthwhile, but results are less dramatic than with urinal retrofits.
8. Implementation of a full-scale program should yield significant water savings.

TABLE 5-1
Summary of Water and Cost Savings for Each School

School	Estimated Water Savings (L/year)	Estimated Per Capita Water Savings (L/year/person)	Estimated Cost Savings (\$/year)	Simple Payback Period* (years)
Dunsmuir Middle School	3,800,000	4,400	3,800	2.0
Spectrum Community School	13,800,000	19,300	11,600	Less than 1
Stellys High School	3,900,000	3,300	2,200	4.6
School District No. 61 Maintenance Yard	1,800,000	72,000	1,500	1.2

* Does not include costs for labour, installation, audit/report by CH2M HILL.

Appendix A

Historical Water Meter Readings

TABLE A-1 Historical Meter Readings for Dunsmuir Middle School

Reading Date	Meter Readings		Water Use During		Average Daily Water	
	School Water Meter	Irrigation Meter	School Water Supply Meter	Irrigation Meter	School Water Meter	Irrigation Meter
5-Nov-97	10530	16740				
18-Mar-98	12410		1,880,000		14,135	
8-Jul-98	13625	20010	1,215,000	3,270,000	10,848	13,347
11-Nov-98	14775	23425	1,150,000	3,415,000	9,127	27,103
17-Mar-99	16090		1,315,000		10,437	
7-Jul-99	17700	25915	1,610,000	2,490,000	14,375	10,462
10-Nov-99	19435	29150	1,735,000	3,235,000	13,770	25,675
15-Mar-00	21575		2,140,000		16,984	
5-Jul-00	23225	30670	1,650,000	1,520,000	14,732	6,387
8-Nov-00	25235	35080	2,010,000	4,410,000	15,952	35,000
14-Mar-01	27500		2,265,000		17,976	
4-Jul-01	28960	35880	1,460,000	800,000	13,036	3,361
7-Nov-01	30755	36495	1,795,000	615,000	14,246	4,881
13-Mar-02	33795		3,040,000		24,127	
19-Jun-02	35855	37305	2,060,000	810,000	21,020	3,616
13-Aug-02	36645	40825	790,000	3,520,000	14,364	64,000
22-Oct-02	37210	43315	565,000	2,490,000	8,071	35,571

Daily average 14,575 20,855

Total Annual Water Use from Historical Records

Year (Nov - Nov)	School Meter	Irrigation Meter
1998	4,245,000	6,685,000
1999	4,660,000	5,725,000
2000	5,800,000	5,930,000
2001*	5,520,000	1,415,000
2002	8,250,000	6,820,000

Average Annual 5,056,250 5,315,000

Water Use 6,290,000 (excluding 2001)

* there was a ban on irrigation from April to December 2001

TABLE A-2 Historical Meter Readings for Spectrum Community School

Reading Date	School Meter Reading	Irrigation Meter Reading	Water Use During Time Period (L)		Average Daily Water Use During Time Period (L/day)	
			School Meter	Irrigation Meter	School Meter	Irrigation Meter
23-Mar-97	12,700	0				
17-Jul-97	19,900	2,640	3,273,120	1,200,144	28,217	10,346
18-Nov-97	27,650	11,540	3,523,150	4,045,940	28,413	32,629
19-Mar-98	34,900	11,540	3,295,850	0	27,238	0
21-Jul-98	42,800	16,560	3,591,340	2,282,092	28,962	18,404
18-Nov-98	51,100	26,000	3,773,180	4,291,424	31,443	35,762
18-Mar-99	57,900	26,000	3,091,280	0	25,761	0
21-Jul-99	64,600	26,130	3,045,820	59,098	24,367	473
18-Nov-99	70,400	40,130	2,636,680	6,364,400	21,972	53,037
20-Mar-00	76,200	40,130	2,636,680	0	21,436	0
19-Jul-00	81,950	48,500	2,613,950	3,805,002	21,603	31,446
16-Nov-00	89,000	63,150	3,204,930	6,659,890	26,708	55,499
14-Mar-01	95,900	63,150	3,136,740	0	26,583	0
13-Jul-01	104,400	66,720	3,864,100	1,622,922	31,935	13,413
16-Nov-01	116,000	74,320	5,273,360	3,454,960	41,852	27,420
19-Mar-02	128,200	74,350	5,546,120	13,638	45,090	111
17-Jul-02	141,050	84,260	5,841,610	4,505,086	48,680	37,542
20-Nov-02	145,750	98,750	2,136,620	6,587,154	16,957	52,279

Average Daily Water Use: 30,016 19,755

Total Annual Water Use From Historical Records (L)

Year (Nov-Nov)	School Water Meter (no. 004617452)	Irrigation Water Meter (no. 004554768)
1998	10,660,370	6,573,516
1999	8,773,780	6,423,498
2000	8,455,560	10,464,892
2001	12,274,200	5,077,882
2002	13,524,350	11,105,878

Average Annual: 10,737,652 7,929,133
Water Use (L)

* There was an irrigation ban from Apr. to Dec. 2001

TABLE A-3 Historical Meter Readings for Stellys High School

Reading Date	Meter Reading	Water Use During Time Period (L)	Average Daily Water Use During Time Period (L/day)
9-Dec-98	64,467		
28-Apr-99	66,987	2,520,000	18,000
25-Aug-99	72,165	5,178,000	43,513
23-Dec-99	76,170	4,005,000	33,375
27-Apr-00	78,507	2,337,000	18,548
5-Sep-00	86,815	8,308,000	63,420
8-Jan-01	92,724	5,909,000	47,272
26-Apr-01	94,959	2,235,000	20,694
28-Aug-01	97,476	2,517,000	20,298
31-Dec-01	100,359	2,883,000	23,064
19-Apr-02	102,361	2,002,000	18,367
28-Aug-02	109,906	7,545,000	57,595

Average Daily Water Use: 28,004

Total Annual Water Use From Historical Records (L)

Year	Total Annual Metered Water Use (L)
May 99 - April 00	11,520,000
May 00 - April 01	16,452,000
May 01 - April 02*	7,402,000
May 02 - August 02	7,545,000

* there was a ban on irrigation from April to December 2001

**TABLE A-4 Historical Water Use Records for
School District No. 61 Maintenance Yard**

Reading Date	Water Consumption During Time Period (units = 100 ft³)	Water Consumption During Time Period (L)	Average Daily Water Use During Period (L)
11-Dec-97			
27-Mar-98	685	1,939,920	18,301
28-Jul-98	589	1,668,048	13,561
25-Nov-98	422	1,195,104	9,959
25-Mar-99	541	1,532,112	12,768
28-Jul-99	623	1,764,336	14,115
3-Dec-99	505	1,430,160	11,173
6-Apr-00	1,301	3,684,432	29,475
14-Aug-00	423	1,197,936	9,215
5-Dec-00	417	1,180,944	10,451
17-Apr-01	431	1,220,592	9,177
14-Aug-01	435	1,231,920	10,352
11-Dec-01	368	1,042,176	8,758
19-Apr-02	356	1,008,192	7,815
15-Aug-02	396	1,121,472	9,504
3-Jan-03	242	685,344	4,861

Average Daily Water Use: 11,966

Total Annual Water Use from Historical Records (L)

Year	Metered Water Use (L)
Dec 97 - Dec 98	4,803,072
Dec 98 - Dec 99	4,726,608
Dec 99 - Dec 00	6,063,312
Dec 00 - Dec 01	3,494,688
Dec 01 - Jan 03	2,815,008

Appendix B

Daily Water Meter Readings

TABLE B-1 Daily Meter Readings for Dunsmuir Middle School
June to September 2002

Date	School Meter		Room 110 Meter		Irrigation Meter		School Water Supply Meter	Room 110 Meter	Irrigation Meter
	Reading time	Meter Reading (m ³)	Reading time	Meter Reading (hours)	Reading time	Meter Reading (m ³)			
6-Jun	10:00	35,855		380.47			20,000	7,334	
7-Jun							20,000	7,334	
8-Jun							20,000	7,334	
9-Jun							20,000	7,334	
10-Jun	13:47	35,935	13:40	382.73			20,000	7,334	
11-Jun	11:06	35,950	11:05	384.29			15,000	20,249	
12-Jun	10:43	35,975	10:40	385.47			25,000	15,316	
13-Jun	11:00	36,000	11:05	386.65			25,000	15,316	
14-Jun	10:53	36,025	10:50	387.86	15:30	37,346	25,000	15,706	
15-Jun							18,333	7,182	12,400
16-Jun							18,333	7,182	12,400
17-Jun	10:59	36,080	11:04	389.52	10:55	37,470	18,333	7,182	12,400
18-Jun	10:53	36,100	10:49	390.06	11:10	37,470	20,000	7,009	0
19-Jun	10:47	36,120	10:53	392.25	11:02	37,470	20,000	28,426	0
20-Jun	11:58	36,145	12:38	392.48	11:54	37,470	25,000	2,985	0
21-Jun	11:17	36,160	11:22	393.34	11:05	37,470	15,000	11,163	0
22-Jun							16,667	11,768	80,000
23-Jun							16,667	11,768	80,000
24-Jun	10:40	36,210	10:44	396.06	10:50	37,710	16,667	11,768	80,000
25-Jun	11:50	36,230	11:59	396.92	11:40	37,720	20,000	11,163	10,000
26-Jun	10:35	36,245	10:31	397.50	10:41	37,785	15,000	7,528	65,000
27-Jun	11:40	36,265	11:45	398.36	11:28	37,850	20,000	11,163	65,000
28-Jun	11:17	36,280	11:13	398.94	11:21	37,915	15,000	7,528	65,000
29-Jun							15,000	8,340	65,000
30-Jun							15,000	8,340	65,000
1-Jul							15,000	8,340	65,000
2-Jul	9:48	36,340	9:55	401.51	9:42	38,175	15,000	8,340	65,000
3-Jul	10:23	36,355	10:17	402.08	10:25	38,240	15,000	7,399	65,000
4-Jul	9:42	36,370	9:53	402.65	9:39	38,305	15,000	7,399	65,000
5-Jul	10:35	36,390	10:40	403.51	10:46	38,370	20,000	11,163	65,000
12-Jul	13:15	36,475			13:20	38,385			
13-Jul							10,000	17,047	220,000
14-Jul							10,000	17,047	220,000
15-Jul	10:07	36,505	10:15	407.45	10:20	39,045	10,000	17,047	220,000
16-Jul	9:22	36,510	9:25	407.45	9:31	39,115	5,000	0	70,000
17-Jul	8:52	36,515	9:10	407.45	8:55	39,185	5,000	0	70,000
18-Jul	10:36	36,520	10:39	407.45	10:44	39,255	5,000	0	70,000
19-Jul	8:45	36,520	8:47	407.73	8:51	39,325	0	3,634	70,000
20-Jul							3,333	0	70,000
21-Jul							3,333	0	70,000
22-Jul	9:05	36,530	9:01	407.73	9:09	39,535	3,333	0	70,000
23-Jul	8:55	36,530	8:59	407.73	9:04	39,605	0	0	70,000
24-Jul	9:02	36,540	9:05	407.73	9:11	39,680	10,000	0	75,000
25-Jul	8:53	36,550	8:55	407.73	9:03	39,750	10,000	0	70,000
26-Jul	9:07	36,555	9:10	407.73	9:20	39,820	5,000	0	70,000
12-Sep	10:31	36,840			10:36	42825	10,000		40,000
13-Sep	9:52	36,850			9:56	42865	6,667		45,000
14-Sep							6,667		45,000
15-Sep							6,667		45,000
16-Sep	11:50	36,870			12:00	43000	6,667		45,000
17-Sep	7:50	36,885			7:55	43045	15,000		45,000
18-Sep	7:36	36,900			7:40	43045	15,000		0
19-Sep	7:50	36,915			7:55	43090	15,000		45,000
20-Sep	9:33	36,930			9:38	43090	15,000		0
21-Sep							6,667		30,000
22-Sep							6,667		30,000
23-Sep	7:55	36,950			7:58	43180	6,667		30,000
24-Sep	7:51	36,965			7:56	43180	15,000		0
25-Sep	8:05	36,980			8:08	43180	15,000		0

Notes:

- (1) Last day of school
- (2) urinal retrofit completed
- (3) washrooms washed
- (4) ESL students in the school for the following week

Gray indicates non-school days

Average Daily School Water Use (L)

	School day	Non-school day
Before Urinal Retrofit	23,333	17,059
After Urinal Retrofit	14,286	3,125

Average Daily Irrigation Water Use:

back of school (irrigation meter)
56,817 L/day
front of school (school meter)
2,000 L/day

**TABLE B-2 Daily Meter Readings for Spectrum Community School
June to September 2002**

Date	Water Meter Readings				Estimated Water Use	
	School Meter		Irrigation Meter		<small>(Italicized water use estimates are based on meter readings averaged over several days)</small> Daily School Water Use (L) Daily Irrigation Water Use (L)	
	Reading time	Meter Reading (1000 imperial gallons)	Reading time	Meter Reading (100 imperial gallons)		
7-Jun	10:00	13,685				
8-Jun					<i>45,460</i>	
9-Jun					<i>45,460</i>	
10-Jun	14:10	13,715	14:19	7,547	<i>45,460</i>	
11-Jun	9:05	13,725	9:07	7,558	45,460	50,006
12-Jun	9:07	13,735	9:09	7,570	45,460	54,552
13-Jun	9:30	13,750	9:35	7,582	68,190	54,552
14-Jun	9:01	13,760	9:03	7,594	45,460	54,552
15-Jun					<i>45,460</i>	<i>36,368</i>
16-Jun					<i>45,460</i>	<i>36,368</i>
17-Jun	9:22	13,790	9:24	7,618	<i>45,460</i>	<i>36,368</i>
18-Jun	9:07	13,800	9:11	7,641	45,460	104,558
19-Jun	9:00	13,810	9:03	7,665	45,460	109,104
20-Jun	9:25	13,820	9:30	7,689	45,460	109,104
21-Jun	8:52	13,830	8:53	7,713	45,460	109,104
22-Jun					<i>53,037</i>	<i>71,221</i>
23-Jun					<i>53,037</i>	<i>71,221</i>
24-Jun	9:29	13,865	9:31	7,760	<i>53,037</i>	<i>71,221</i>
25-Jun	9:10	13,875	9:11	7,784	45,460	109,104
26-Jun	9:10	13,885	9:12	7,807	45,460	104,558
27-Jun	9:41	13,895	9:45	7,832	45,460	113,650
28-Jun	9:16	13,905	9:18	7856	45,460	109,104
29-Jun					<i>51,143</i>	<i>85,238</i>
30-Jun					<i>51,143</i>	<i>85,238</i>
1-Jul					<i>51,143</i>	<i>85,238</i>
2-Jul	10:11	13,950	10:12	7,931	<i>51,143</i>	<i>85,238</i>
3-Jul	9:39	13,960	9:41	7,961	45,460	136,380
4-Jul	10:22	13,970	10:32	7,991	45,460	136,380
5-Jul	9:43	13,980	9:45	8,022	45,460	140,926
21-Aug	10:11	14410	10:13	9438		
22-Aug	9:37	14410	9:39	9461	0	104,558
23-Aug	9:31	14410	9:33	9492	0	140,926
24-Aug					0	87,889
25-Aug					0	87,889
26-Aug	10:30	14410	10:31	9550	0	87,889
27-Aug	9:25	14410	9:27	9561	0	50,006
28-Aug	9:41	14410	9:43	9561	0	0
29-Aug	9:15	14410	9:16	9561	0	0
30-Aug	10:31	14410	10:32	9572	0	50,006
31-Aug					<i>5,683</i>	<i>50,006</i>
1-Sep					<i>5,683</i>	<i>50,006</i>
2-Sep					<i>5,683</i>	<i>50,006</i>
3-Sep	9:35	14415	9:37	9616	<i>5,683</i>	<i>50,006</i>
4-Sep	11:19	14415	11:18	9616	0	0
5-Sep	8:51	14420	8:52	9616	22,730	0
6-Sep	8:53	14420	8:54	9627	0	50,006
7-Sep					0	48,491
8-Sep					0	48,491
9-Sep	8:52	14420	8:54	9659	0	48,491
10-Sep	9:50	14425	9:51	9671	22,730	54,552
11-Sep	9:27	14430	9:28	9671	22,730	0
12-Sep	9:20	14430	9:21	9671	0	0
13-Sep	8:55	14435	8:56	9682	22,730	50,006

Notes:

- (1) last day of school
- (2) urinal retrofits were completed by this date
- (3) first day of school

Average Daily School Water Use (L/day)

	School days	Non-school days
Before Urinal Retrofit	47,986	47,853
After Urinal Retrofit	11,365	1,515

Gray indicates non-school days

Average Daily Irrigation Water Use:
68,095 L/day

**TABLE B-3 Daily Meter Readings for Stellys High School
June to September 2002**

Reading Date	Reading time	Meter Reading (m ³)	Daily Water Use (L)
10-Jun	11:17	103,728	
11-Jun	9:50	103,768	40,000
12-Jun	9:44	103,832	64,000
(1) 13-Jun	10:15	103,962	130,000
14-Jun	9:32	104,057	95,000
15-Jun			66,000
16-Jun			66,000
17-Jun	9:51	104,255	66,000
(2) 18-Jun	9:41	104,303	48,000
19-Jun	9:25	104,397	94,000
(3) 20-Jun	11:02	104,485	88,000
21-Jun	9:15	104,561	76,000
22-Jun			54,667
23-Jun			54,667
24-Jun	9:55	104,725	54,667
25-Jun	9:45	104,795	70,000
26-Jun	9:35	104,864	69,000
27-Jun	10:10	104,935	71,000
28-Jun	9:41	104,996	61,000
21-Aug	10:44	109441	
(4) 22-Aug	10:20	109488	47,000
23-Aug	9:54	109580	92,000
24-Aug			72,667
25-Aug			72,667
26-Aug	11:00	109798	72,667
27-Aug	9:59	109909	111,000
(5) 28-Aug	10:07	109920	11,000
29-Aug	9:40	110021	101,000
30-Aug	10:50	110048	27,000
31-Aug			50,250
1-Sep			50,250
2-Sep			50,250
(6) 3-Sep	9:57	110249	50,250
4-Sep	10:54	110270	21,000
5-Sep	9:10	110354	84,000
6-Sep	9:21	110386	32,000
7-Sep			56,000
8-Sep			56,000
9-Sep	9:15	110554	56,000
10-Sep	10:10	110592	38,000
11-Sep	9:46	110694	102,000
12-Sep	9:45	110733	39,000
13-Sep	9:25	110841	108,000
14-Sep			46,667
15-Sep			46,667
16-Sep	11:00	110981	46,667
17-Sep	9:50	111079	98,000
18-Sep	9:42	111113	34,000
19-Sep	9:58	111151	38,000
20-Sep	9:42	111189	38,000

Notes:

- (1) one of the hottest days of the year
- (2) June 17th was a Pro D day - very few students at school
- (3) last day of school
- (4) low flow toilets installed
- (5) waterless urinals installed
- (6) first day of school

Gray indicates non-school days

Average Daily Total Water Use (L/day)

	School days	Non-school days
Before Urinal Retrofit	94,200	66,000
After Urinal Retrofit	57,455	49,576

Estimated Average Daily Irrigation Water Use:

25,000 L/day (most days, automatic system)
57,000 L/day (a few days, automatic system
sprinkler fed by hose from scl)

Estimated Average Daily School Water Use:

	School days	Non-school days
Before Urinal Retrofit	69,200	41,000
After Urinal Retrofit	32,455	24,576

**Table B-4 Daily Meter Readings for
School District No. 61 Maintenance Yard
June to November 2002**

Date	Water Supply Meter		Estimated Daily Water Use (L)
	Reading time	Meter Reading (ft ³)	
7-Jun	10:00	760,890	
8-Jun			8,213
9-Jun			8,213
10-Jun	14:37	761,760	8,213
11-Jun	10:15	762,010	7,080
12-Jun	10:15	762,310	8,496
13-Jun	10:45	762,690	10,762
14-Jun	10:24	762,990	8,496
15-Jun			7,552
16-Jun			7,552
17-Jun	10:19	763,790	7,552
18-Jun	10:20	764,110	9,062
19-Jun	9:50	764,410	8,496
(1) 23-Oct	9:23	798,460	
24-Oct	10:09	798,580	3,398
25-Oct	11:25	798,720	3,965
26-Oct			2,171
27-Oct			2,171
28-Oct	~11:00	798,950	2,171
29-Oct	9:17	799,080	3,682
30-Oct	13:50	799,300	6,230
31-Oct	11:03	799,420	3,398
1-Nov	9:58	799,580	4,531
2-Nov			3,115
3-Nov			3,115
4-Nov	11:15	799,910	3,115
5-Nov	11:32	800,080	4,814
6-Nov	10:30	800,250	4,814

Notes:

(1) waterless urinals installed by this date

Gray indicates non-workdays

Average Daily Water Use (L)

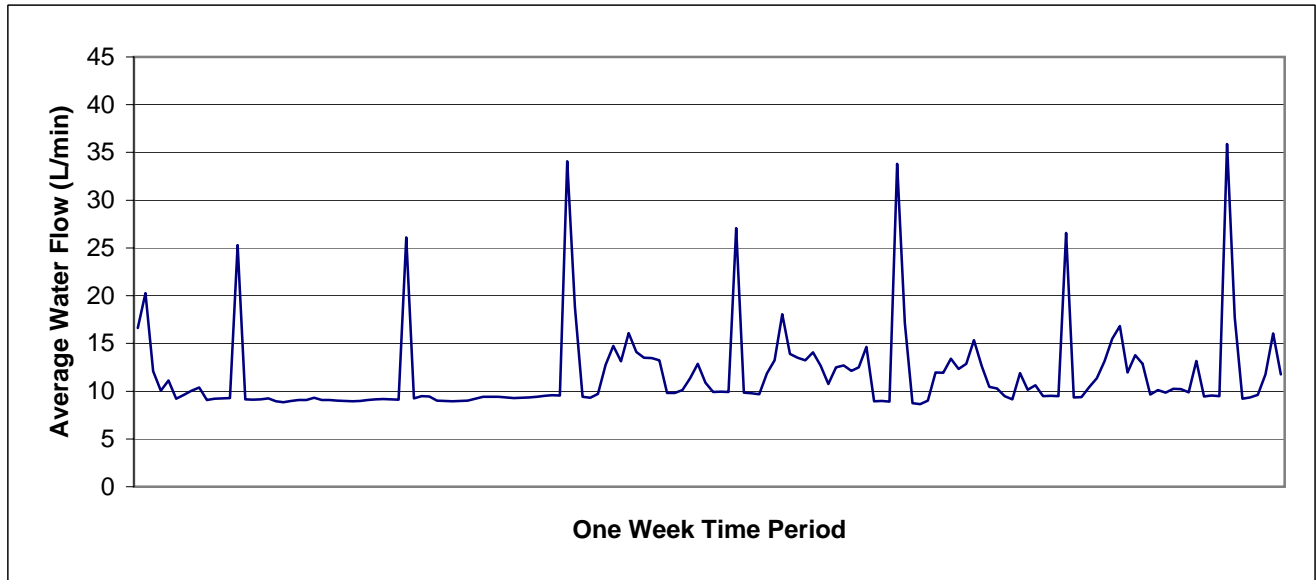
	Workday	Non-workday
Before urinal replacement:	8,520	7,882
After urinal replacement:	4,012	2,643

Appendix C

Water Flow Meter Readings

FIGURE C-1: Water Flow Meter Readings for Dunsmuir Middle School

BEFORE Retrofits: One Week Time Period: June 21 - June 28



AFTER Retrofits: One Week Time Period: July 15 - July 22

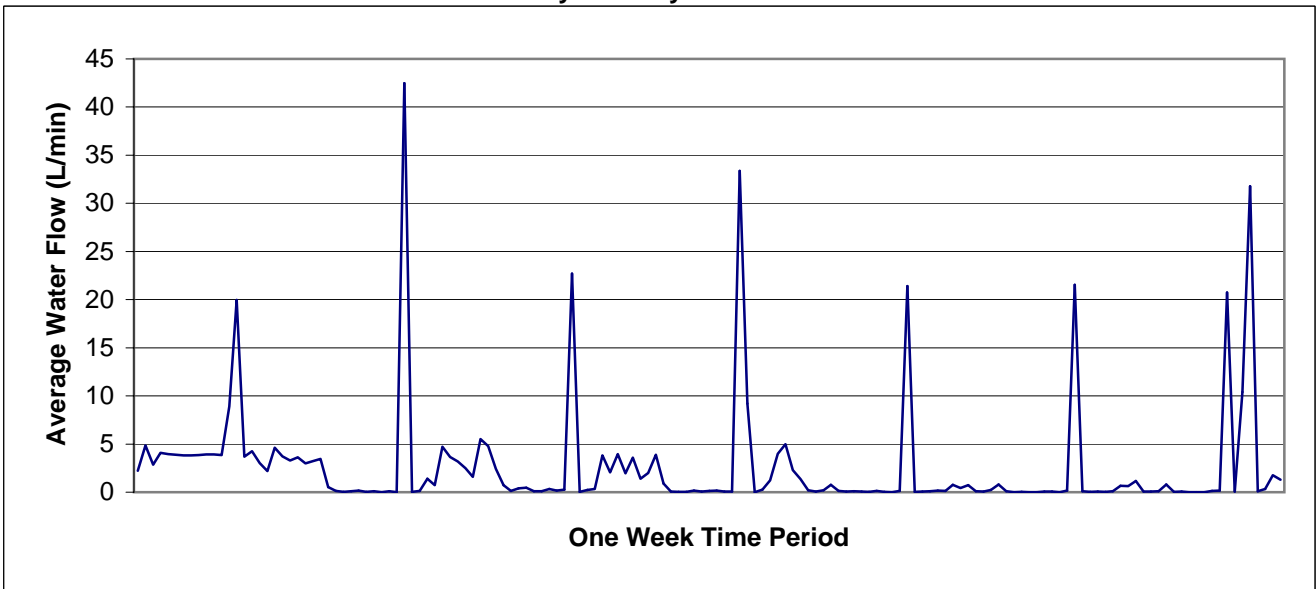


FIGURE C-2: Water Flow Meter Readings for Spectrum Community School

One Week During Pilot Period: Aug. 23 - Aug. 30

After urinal retrofits:

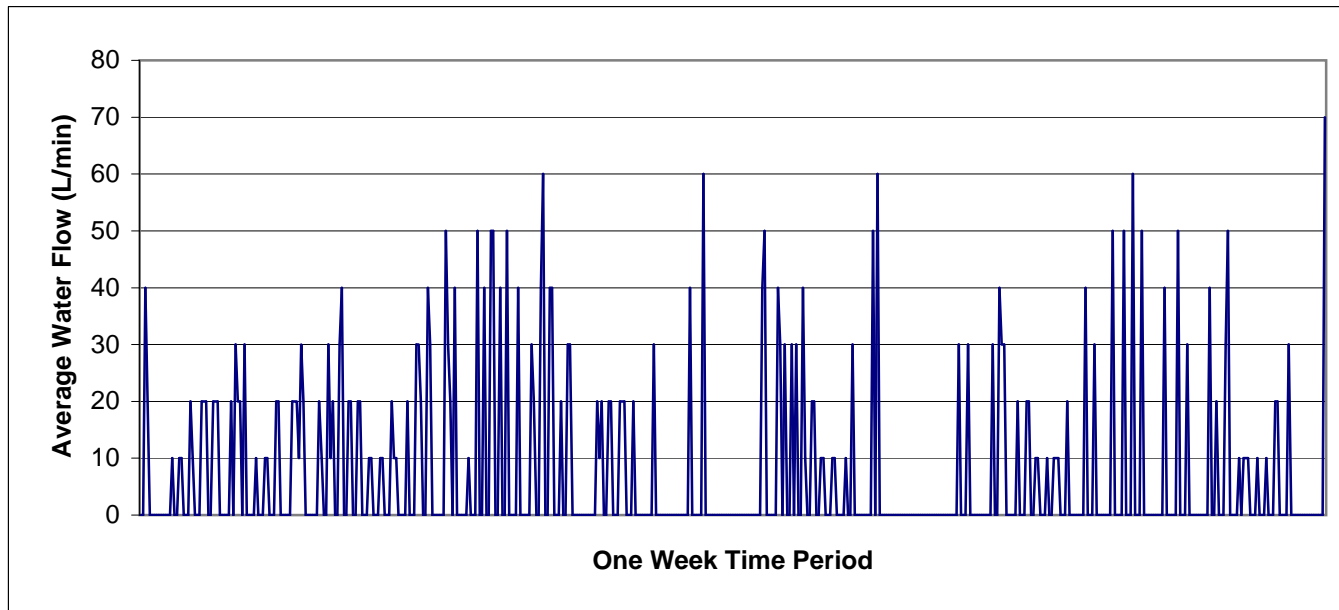
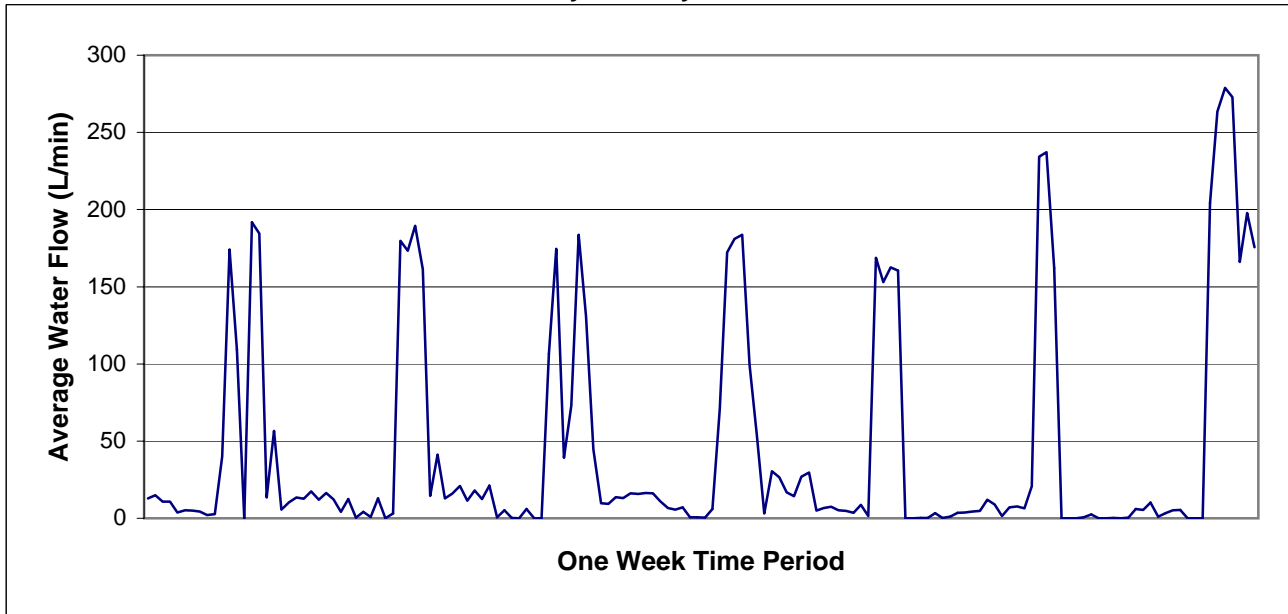
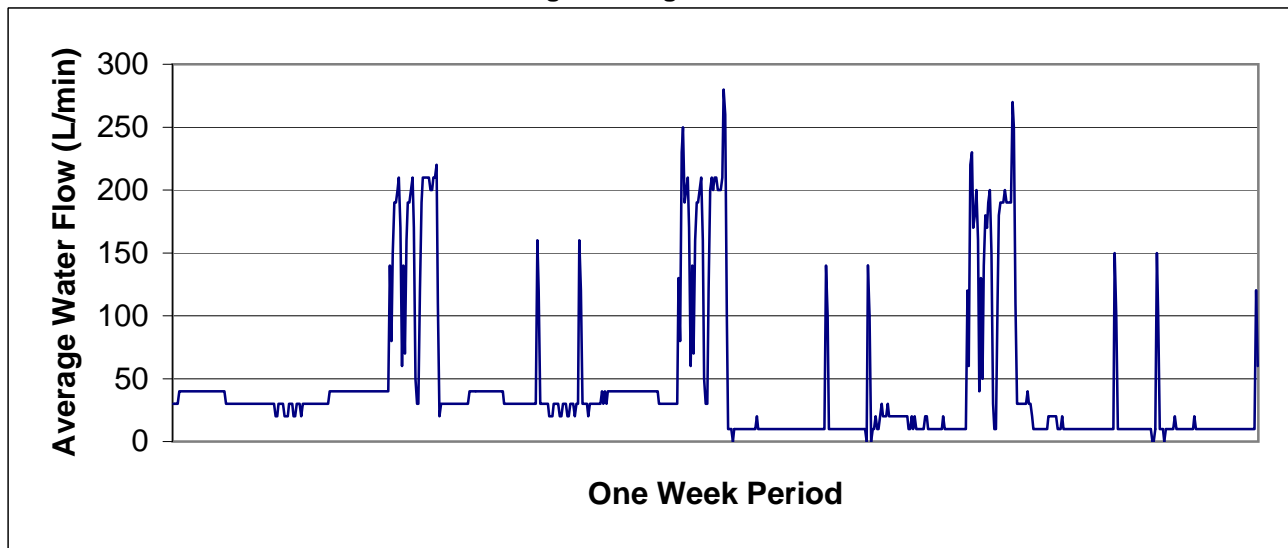


FIGURE C-3: Water Flow Meter Readings for Stellys High School

BEFORE Retrofits: One Week Time Period: July 15 - July 22



AFTER Retrofits: One Week Time Period: Aug. 23 - Aug. 30



Appendix D

Water Use Inventories: Before and After Upgrades

**TABLE D-1A Water Use Inventory - Before Urinal Replacement for
Dunsmuir Middle School**

School Population			
	Male	Female	Total
Students	406	416	822
Staff	20	20	40
Total	426	436	862

Water Usage	Water Use Estimate Method and Assumptions	Water Use Estimate		
		L/school day (194 per year)	L/non-school day (171 per year)	L/year
Indoor School Water Uses				
Male Washrooms				
- Continuous flush urinals (5 19L tanks, 2 11L tanks, 18 urinals)	Total of 510 L/hour ⁽¹⁾ x 24 h/day. Flow rates were estimated by: (1) measuring urinal flush intervals and multiplying by tank sizes (see Table C-1), and (2) analyzing continuous flow records	12,240	12,240	4,467,600
- Toilets (8 13L tank)	243 males x 0.5 flush/day x 13 L/flush	1,580	0	306,423
- Toilets (6 flush valve)	183 males x 0.5 flush/day x 6 L/flush	549	0	106,506
- Washbasins (12 sinks)	426 males x 2 washes/day x 0.4 L/wash	341	0	66,115
Female Washrooms				
- Toilets (8 13L tank)	249 females x 2 flush/day x 13 L/flush	6,474	0	1,255,956
- Toilets (6 flush valve)	187 females x 2 flush/day x 6 L/flush	2,244	0	435,336
- Washbasins (12 sinks)	436 females x 2 washes/day x 0.4 L/wash	349	0	67,667
Science Room				
- Washbasins (2 sinks)	5 uses/sink/day x 5 L per use	50	0	9,700
Home Economics/Art Room				
- Washbasins (6 sinks)	5 uses/sink/day x 5 L per use	150	0	29,100
Miscellaneous Uses				
- Drinking fountains	892 people x 0.2 L/day	178	0	34,610
- Showers	2 showers per day (only staff typically use showers, likely to be mostly in summer) x 100 L/shower	200	0	38,800
- Janitorial uses	100 L per day. Cleaning occurs on school days and during school closures	100	100	36,500
- Miscellaneous water use during community events in school	750 L per day, on average (coarse estimate based on flow records)	750	750	273,750
Total School Indoor Water Use		25,205	13,090	7,128,063
Average Daily Water Use				19,529
		Water use (L/day)		Water use (L/year)
Irrigation Water Use⁽²⁾	irrigation for 14 weeks of the year x 60,000 L per day	60,000		5,880,000
Total School Water Use (Indoor Use + Irrigation)				13,008,063

Notes:

⁽¹⁾ Based on measurement of urinal flush frequency the continuous flush urinal water use was estimated to be about 480 L/day water use. Based on analysis of continuous flow records, urinal water use was estimated to be about 540 L/day. Flush rates for the continuous flush urinals are adjustable by hand and can be highly variable.

⁽²⁾ Summer months only. The majority of irrigation is on the field at the back of the school, which is measured on a separate irrigation meter. A small amount of irrigation takes place at the front of the school and is measured on the school water meter.

**TABLE D-1B Water Use Inventory - After Urinal Replacement for
Dunsmuir Middle School**

School Population

	Male	Female	Total
Students	406	416	822
Staff	20	20	40
<i>Total</i>	426	436	862

Water Usage	Water Use Estimate Method and Assumptions	Water Use Estimate		
		L/school day (194 per year)	L/non-school day (171 per year)	L/year
Indoor School Water Uses				
Male Washrooms				
- Urinals with UTC Sentinel Units (5 19L tanks, 2 11L tanks, 18 urinals)	10 min flush cycle, activation during 70% of cycles during 7 hour school day	3,440	0	667,321
- Toilets (8 13L tank)	243 males x 0.5 flush/day x 13 L/flush	1,580	0	306,423
- Toilets (6 flush valve)	183 males x 0.5 flush/day x 6 L/flush	549	0	106,506
- Washbasins (12 sinks)	426 males x 2 washes/day x 0.4 L/wash	341	0	66,115
Female Washrooms				
- Toilets (8 13L tank)	249 females x 2 flush/day x 13 L/flush	6,474	0	1,255,956
- Toilets (6 flush valve)	187 females x 2 flush/day x 6 L/flush	2,244	0	435,336
- Washbasins (12 sinks)	436 females x 2 washes/day x 0.4 L/wash	349	0	67,667
Science Room				
- Washbasins (2 sinks)	5 uses/sink/day x 5 L per use	50	0	9,700
Home Economics/Art Room				
- Washbasins (6 sinks)	5 uses/sink/day x 5 L per use	150	0	29,100
Miscellaneous Uses				
- Drinking fountains	892 people x 0.2 L/day	178	0	34,610
- Showers	2 showers per day (only staff typically use showers, likely to be mostly in summer) x 100 L/shower	200	0	38,800
- Janitorial uses	100 L per day. Cleaning occurs on school days and during school closures	100	100	36,500
- Miscellaneous water use during community events in school	750 L per day, on average (coarse estimate based on flow records)	750	750	273,750
Total School Indoor Water Use		16,404	850	3,327,784
Average Daily Water Use		9,117		
		Water use (L/day)	Water use (L/year)	
Irrigation Water Use⁽¹⁾	irrigation for 14 weeks of the year x 60,000 L per day	60,000		5,880,000
Total School Water Use (Indoor Use + Irrigation)		9,207,784		

Notes:

⁽¹⁾ Summer months only. The majority of irrigation is on the field at the back of the school, which is measured on a separate irrigation meter. A small amount of irrigation takes place at the front of the school and is measured on the school water meter.

**TABLE D-2A Water Use Inventory - Before Urinal Replacement for
Spectrum Community School**

	School Population		
	Male	Female	Total
Students	349	317	666
Staff (full time equivalent)	30	20	50
Total	379	337	716

Water Usage	Water Use Estimate Method and Assumptions	Water Use Estimate		
		L/school day (194 per year)	L/non-school day (171 per year)	L/year
Indoor School Water Uses				
Male Washrooms				
	Total of 1670 L/hour⁽¹⁾ x 24 h/day. Flow rates obtained by counting urinal flush intervals and multiplying by tank sizes (see Table C-2).			
- Continuous flush urinals (5 11L tanks, 2 19L tanks, 16 urinals)		40,080	40,080	14,629,200
- Push button urinals (2 urinals, 1 flusher)	48 males x 1.5 flushes/day x 6L/flush	432	0	83,808
- Toilets (1 13L tank)	25 males x 0.5 flush/day x 13 L/flush	250	0	48,500
- Toilets (6 14 flush valve)	354 males x 0.5 flush/day x 6 L/flush	1,062	0	206,028
- Washbasins ⁽²⁾	379 males x 2 washes/day x 0.5 L/wash	379	0	73,526
Female Washrooms				
- Toilets (3 13L tank)	35 females x 2 flush/day x 13 L/flush	910	0	176,540
- Toilets (26 flush valve)	302 females x 2 flush/day x 6 L/flush	3,624	0	703,056
- Washbasins ⁽²⁾	337 females x 2 washes/day x 0.5 L/wash	337	0	65,378
Kitchen/Cafeteria Uses				
- meal preparation and cleanup (large dishwasher, ~10 sinks, washing hose)	100 meals per day x 10 L per meal	1,000	0	194,000
- Ice Machine	25 L per day	25	0	4,850
Showers				
- Gym showers (low flow shower heads, 11 men's, 8 women's)	30 showers per day x 40 L/shower	1,200	0	232,800
Classroom/Lab Water Uses				
- Metal shop (2 large 'Bradley' sinks, machine steam cleaner)	5 uses/sink/day x 10 L per use + 3 steam cleaner uses/day x 50 L/use	250	0	48,500
- Home Economics Room (15 sinks, 1 dishwasher)	3 uses/sink/day x 5 L per use + 3 dishwasher loads/day x 60 L/cycle	405	0	78,570
- Biology Classroom/Lab (4 sinks)	2 uses/sink/day x 2 L per use	16	0	3,104
- Chemistry Classroom/Lab (4 sinks)	5 uses/sink/day x 2 L per use	40	0	7,760
- Art Room/Dark Room (5 sinks)	3 uses/sink/day x 5 L per use	75	0	14,550
- Wood Shop, Drafting Room (1 large "Bradley" sink per room)	2 uses/sink/day x 5 L per use	20	0	3,880
- Multi-media Room (1 sink, 1 flush valve toilet)	5 sink uses/day x 2 L per use + 10 toilet flushes/day x 6L/flush	70	0	13,580
- Other Classrooms (total of 3 sinks)	2 use/sink/day x 2 L per use	12	0	2,328
- Drinking Fountains	716 people x 0.2 L/day	143	0	27,781
Miscellaneous Cleaning and Domestic				
- Medical Room (2 sinks, 1 flush valve toilet)	3 uses/sink/day x 2 L per use + 10 toilet flushes/day x 6L/flush	72	0	13,968
- Janitorial Room (1 large sink)	5 uses/day x 20 L per use	100	100	36,500
- Pressure washing of school entrance	3 times per year x 1000 L each time			3,000
Building Mechanical				
- Boiler Makeup Water (3 boilers)	200 L/day	200	200	73,000
Total School Indoor Water Use		50,702	40,380	16,744,207
Average Daily Indoor Water Use (L/day)		45,875		
		Water use (L/day)		Water use (L/year)
Irrigation Water Use⁽³⁾	equivalent of 16 weeks per year x 70,000 L per day	70,000		7,840,000
Total School Water Use (Indoor Use + Irrigation)		24,584,207		

Notes:

⁽¹⁾ 1 of the small urinal tanks was observed to have no flush during a site visit by CRD staff on June 20th. The flow rate was increased to a 4:00 flush interval on this date. Prior to this adjustment the total continuous flush urinal water use was about 36,000 L/day.

⁽²⁾ During the site visit, 2 leaky taps were observed (one in women's washroom and one in men's washroom).

⁽³⁾ Only during summer. Separate meter from indoor uses

**TABLE D-2B Water Use Inventory - After Urinal Replacement for
Spectrum Community School**

	School Population		
	Male	Female	Total
Students	349	317	666
Staff (full time equivalent)	30	20	50
Total	379	337	716

Water Usage	Water Use Estimate Method and Assumptions	Water Use Estimate		
		L/school day (194 per year)	L/non-school day (171 per year)	L/year
Indoor School Water Uses				
Boys Washrooms				
- Urinals with UTC Sentinel Units (5 11L tanks, 2 19L tanks, 16 urinals)	5 x 11 L tanks, 2 x 19 L tanks, 10 min flush cycle, 75% activation during 7 hour school day	2,930	0	568,323
- Push button urinals (2 urinals, 1 flusher)	48 males x 1.5 flushes/day x 6L/flush	432	0	83,808
- Toilets (1 13L tank)	25 males x 0.5 flush/day x 13 L/flush	250	0	48,500
- Toilets (14 flush valve)	354 males x 0.5 flush/day x 6 L/flush	1,062	0	206,028
- Washbasins ⁽¹⁾	379 males x 2 washes/day x 0.5 L/wash	379	0	73,526
Girls Washrooms				
- Toilets (3 13L tank)	35 females x 2 flush/day x 13 L/flush	910	0	176,540
- Toilets (26 flush valve)	302 females x 2 flush/day x 6 L/flush	3,624	0	703,056
- Washbasins ⁽¹⁾	337 females x 2 washes/day x 0.5 L/wash	337	0	65,378
Kitchen/Cafeteria Uses				
- meal preparation and cleanup (large dishwasher, ~10 sinks, washing hose)	200 meals per day x 10 L per meal	2,000	0	388,000
- Ice Machine	25 L per day	25	0	4,850
Showers				
- Gym showers (low flow shower heads, 11 men's, 8 women's)	30 showers per day x 40 L/shower	1,200	0	232,800
Classroom/Lab Water Uses				
- Metal shop (2 large 'Bradley' sinks, machine steam cleaner)	5 uses/sink/day x 10 L per use + 3 steam cleaner uses/day x 50 L/use	250	0	48,500
- Home Economics Room (15 sinks, 1 dishwasher)	3 uses/sink/day x 5 L per use + 3 dishwasher loads/day x 60 L/cycle	405	0	78,570
- Biology Classroom/Lab (4 sinks)	2 uses/sink/day x 2 L per use	16	0	3,104
- Chemistry Classroom/Lab (4 sinks)	5 uses/sink/day x 2 L per use	40	0	7,760
- Art Room/Dark Room (5 sinks)	3 uses/sink/day x 5 L per use	75	0	14,550
- Wood Shop, Drafting Room (1 large "Bradley" sink per room)	2 uses/sink/day x 5 L per use	20	0	3,880
- Multi-media Room (1 sink, 1 flush valve toilet)	5 sink uses/day x 2 L per use + 10 toilet flushes/day x 6L/flush	70	0	13,580
- Other Classrooms (total of 3 sinks)	2 use/sink/day x 2 L per use	12	0	2,328
- Drinking Fountains	716 people x 0.2 L/day	143	0	27,781
Miscellaneous Cleaning and Domestic				
- Medical Room (2 sinks, 1 flush valve toilet)	3 uses/sink/day x 2 L per use + 10 toilet flushes/day x 6L/flush	72	0	13,968
- Janitorial Room (1 large sink)	5 uses/day x 20 L per use	100	100	36,500
- Pressure washing of school	3 times per year x 1000 L each time			3,000
Building Mechanical				
- Boiler Makeup Water (3 boilers)	200 L/day	200	200	73,000
Total School Indoor Water Use		14,552	300	2,877,330
Average Daily Water Use (L/day)		7,883		
		Water use (L/day)		Water use (L/year)
Irrigation Water Use⁽²⁾	equivalent of 16 weeks per year x 70,000 L per day	70,000		7,840,000
Total School Water Use (Indoor Use + Irrigation)				10,717,330

Notes:

⁽¹⁾ During the site visit, 2 leaky taps were observed (one in women's washroom and one in men's washroom).

⁽²⁾ Only during summer. Separate meter from indoor uses

TABLE D-3A Water Use Inventory - Before Urinal Replacement for Stellys High School

	School Population		
	Male	Female	Total
Students	553	555	1108
Staff (full time equivalent)	47	45	92
Total	600	600	1200

Water Usage	Water Use Estimate Method and Assumptions	Water Use Estimate		
		L/school day (194 per year)	L/non-school day (171 per year)	L/year
Male Washrooms				
- Continuous flush urinals (2 urinals, 1 11L tank)	70 L/hour x 24 h/day. Flow rates obtained by counting urinal flush intervals and multiplying by tank sizes (see Table C-3).	1,680	1,680	613,200
- Push button urinals (10 urinals, 4 buttons)	480 males x 1.5 flushes/day x 6L/flush	4,320	0	838,080
- Toilets (5 20L tank)	273 males x 0.5 flush/day x 20 L/flush	2,730	0	529,620
- Toilets (6 13L tank)	327 males x 0.5 flush/day x 13 L/flush	2,126	0	412,347
- Washbasins	600 males x 2 washes/day x 0.4 L/wash	480	0	93,120
Female Washrooms				
- Toilets ⁽¹⁾ (14 20L tank)	400 females x 2 flush/day x 20 L/flush	16,000	0	3,104,000
- Toilets (7 13L tank)	200 females x 2 flush/day x 13 L/flush	5,200	0	1,008,800
- Washbasins	600 females x 2 washes/day x 0.4 L/wash	480	0	93,120
Once Through Cooling Water (OTCW)				
- Computer room heat pump ⁽²⁾	Temperature controlled unit. Flow rate range = 11 L/min to 112 L/min (manufacturers specifications). Based on bucket and stopwatch tests, typical rate = 20 L/min, assumed to be running for an average of 8 hours/day. Assume it runs half as much on non-school days.	9,600	4,800	2,683,200
- Walk-in refrigerator in kitchen	Based on bucket and stopwatch test and analysis of continuous flow records from, average flow rate = 340 L/hour (continuous all year)	8,160	8,160	2,978,400
Other Kitchen Uses				
- meal preparation and cleanup (large dishwasher, ~10 sinks, garberator)	120 meals per day x 8 L per meal	1,200	0	232,800
- Washing Machine	2 loads per day x 220 L/load	440	0	85,360
- Ice Machine	25 L per day	25	0	4,850
Showers				
- Gym showers (8 mens, 5 womens)	30 showers per day x 50 L/shower	1,500	0	291,000
Classroom/Lab Water Uses				
- Metal shop (2 sinks, machine steam cleaner)	5 use/sink/day x 5 L per use + 3 steam cleaner uses/day x 50 L/use	300	0	58,200
- Home Economics Room (6 sinks, 1 dishwasher)	5 use/sink/day x 5 L per use + 5 dishwasher loads/day x 60 L/cycle	450	0	87,300
- Science Lab (~35 sinks)	2 use/sink/day x 2 L per use	140	0	27,160
- Art Room (3 sinks)	5 use/sink/day x 5 L per use	75	0	14,550
- Math Room, Music Room, Drafting Room, Library (1 sink per room)	2 use/sink/day x 2 L per use	20	0	3,880
- Drinking Fountains	1200 people x 0.2 L/day	240	0	46,560
Miscellaneous Cleaning and Domestic				
- Staff Room (2 washing machines, 1 dishwasher)	1 laundry load/day/machine x 220 L/load + 2 dishwasher loads/day x 60 L/load	560	0	108,640
- Day Care (1 washing machine, 1 dishwasher, 5 sinks, 1 6L toilet)	3 laundry loads/day x 220 L/load + 2 dishwasher loads/day x 60 L/load + 1 uses/sink/day x 2 L per use + 20 toilet flushes/day x 6L/flush	920	0	178,480
- Special Needs Room (1 13L toilet, 1 shower, 1 sink)	5 sink uses/day x 5 L per use + 20 toilet flushes/day x 13L/flush + 5 showers/day x 100 L/shower	785	0	152,290
- Janitorial cupboards (2 large sinks)	5 uses/sink/day x 10 L per use	100	0	19,400
Building Mechanical				
- Boiler Makeup Water	200 L/day	200	200	73,000
- Sprinkler system flushing	500 L/year			500
Total School Indoor Water Use		57,731	14,840	13,737,857
Average Daily Water Use (L/day)				37,638
		Water use (L/day)		Water use (L/year)
Irrigation⁽³⁾	1) Underground irrigation system: 25,000 L per day (from irrigation consultant) for equivalent of 28 weeks of the year + 2) a sprinkler hose: 32,000 (27 L/min for 1 hose x about 20 hours) for equivalent of 3 weeks of the year	25,000 usually,	57,000 occasionally	5,572,000

Notes:

⁽¹⁾ During the site visit, one of the toilets in the women's change rooms was observed to be flowing non-stop (broken seal).

⁽²⁾ The flow rate for the computer lab heat pump varies depending on temperature, and may be highly variable. Running at the maximum rate (112 L/min) the heat pump could use up to 54,000 L during an 8 hour school day.

⁽³⁾ Only during summer and early fall. Measured on the same meter as indoor uses.

TABLE D-3B Water Use Inventory - After Urinal Replacement for Stellys High School

	School Population		
	Male	Female	Total
Students	553	555	1108
Staff (full time equivalent)	46	46	92
Total	599	601	1200

Water Usage	Water Use Estimate Method and Assumptions	Water Use Estimate		
		L/school day (194 per year)	L/non-school day (171 per year)	L/year
Male Washrooms				
- Waterless Urinals (2)	Negligible water use	0	0	0
- Push button urinals (10 urinals, 4 buttons)	480 males x 1.5 flushes/day x 6L/flush	4,320	0	838,080
- Toilets (11 6L tank)	600 males x 0.5 flush/day x 6 L/flush	1,800	0	349,200
- Washbasins	600 males x 2 washes/day x 0.4 L/wash	480	0	93,120
Female Washrooms				
- Toilets (21 6L tank)	600 females x 2 flush/day x 6 L/flush	7,200	0	1,396,800
- Washbasins	600 females x 2 washes/day x 0.4 L/wash	480	0	93,120
Once Through Cooling Water (OTCW)				
- Computer room heat pump ⁽²⁾	Temperature controlled unit. Flow rate range = 11 L/min to 112 L/min (manufacturers specifications). Based on bucket and stopwatch tests, typical rate = 20 L/min, assumed to be running for an average of 8 hours/day. Assume it runs half as much on non-school days.	9,600	4,800	2,683,200
- Walk-in refrigerator in kitchen	Based on bucket and stopwatch test and analysis of continuous flow records from, average flow rate = 340 L/hour (continuous all year)	8,160	8,160	2,978,400
Other Kitchen Uses				
- meal preparation and cleanup (large dishwasher, ~10 sinks, garberator)	120 meals per day x 8 L per meal	1,200	0	232,800
- Washing Machine	2 loads per day x 220 L/load	440	0	85,360
- Ice Machine	25 L per day	25	0	4,850
Showers				
- Gym showers (8 mens, 5 womens)	30 showers per day x 50 L/shower	1,500	0	291,000
Classroom/Lab Water Uses				
- Metal shop (2 sinks, machine steam cleaner)	5 use/sink/day x 5 L per use + 3 steam cleaner uses/day x 50 L/use	300	0	58,200
- Home Economics Room (6 sinks, 1 dishwasher)	5 use/sink/day x 5 L per use + 5 dishwasher loads/day x 60 L/cycle	450	0	87,300
- Science Lab (~35 sinks)	2 use/sink/day x 2 L per use	140	0	27,160
- Art Room (3 sinks)	5 use/sink/day x 5 L per use	75	0	14,550
- Math Room, Music Room, Drafting Room, Library (1 sink per room)	2 use/sink/day x 2 L per use	20	0	3,880
- Drinking Fountains	1200 people x 0.2 L/day	240	0	46,560
Miscellaneous Cleaning and Domestic				
- Staff Room (2 washing machines, 1 dishwasher)	1 laundry load/day/machine x 220 L/load + 2 dishwasher loads/day x 60 L/load	560	0	108,640
- Day Care (1 washing machine, 1 dishwasher, 5 sinks, 1 6L toilet)	3 laundry loads/day x 220 L/load + 2 dishwasher loads/day x 60 L/load + 2 uses/sink/day x 2 L per use + 20 toilet flushes/day x 6L/flush	920	0	178,480
- Special Needs Room (1 13L toilet, 1 shower, 1 sink)	5 sink uses/day x 5 L per use + 20 toilet flushes/day x 13L/flush + 5 showers/day x 100 L/shower	785	0	152,290
- Janitorial cupboards (2 large sinks)	5 uses/sink/day x 10 L per use	100	0	19,400
Building Mechanical				
- Boiler Makeup Water	200 L/day	200	200	73,000
- Sprinkler system flushing	500 L/year			500
Total School Indoor Water Use		38,995	13,160	9,815,890
Average Daily Water Use (L/day)				26,893
		Water use (L/day)		Water use (L/year)
Irrigation⁽²⁾	1) Underground irrigation system: 25,000 L per day (from irrigation consultant) for equivalent of 28 weeks of the year + 2) a sprinkler hose: 32,000 (27 L/min for 1 hose x about 20 hours) for equivalent of 3 weeks of the year	25,000 usually, occasionally	57,000	5,572,000

Notes:

⁽²⁾ The flow rate for the computer lab heat pump varies depending on temperature, and may be highly variable. Running at the maximum rate (112 L/min) the heat pump could use up to 54,000 L during an 8 hour school day.

⁽³⁾ Only during summer and early fall. Measured on the same meter as indoor uses.

**TABLE D-4A Water Use Inventory - Before Urinal Replacement for School
District No. 61 Maintenance Yard**

Average number of employees on-site: 25
- 20 men
- 5 women

Water Usage ⁽¹⁾	Water Use Estimate Method and Assumptions	Water Use Estimate		
		Litres per work day (254 per year)	Litres per non-work day ⁽¹⁾ (111 per year)	L/year
Men's Washrooms (1 in Truck/Tractor Shed, 1 in Main Building)				
- Continuous flush urinals (3 urinals, 2 11L tanks)	Total of 206 L/hour x 24 h/day. Flow rates obtained by counting urinal flush intervals and multiplying by tank sizes (refer to Table C-4).	4,944	4,944	1,804,560
- Toilets (1 13L tank)	7 men x 1 flush/day x 20 L/flush	91	60	29,781
- Toilets (2 flush valve)	13 men x 1 flush/day x 6 L/flush	78	51	25,526
- Washbasins (2 sinks)	20 men x 2 washes/day x 1 L/wash	40	26	13,090
- Shower	5 uses per day x 100 L/use	500	330	163,630
Women's Washroom				
- Toilets (1 flush valve, high flow)	5 women x 2 flush/day x 13 L/flush	130	86	42,544
- Washbasins (1 sink)	5 females x 2 washes/day x 1 L/wash	10	7	3,273
Truck/Tractor Washing Station	12 L/min x 5 min/use x 10 uses/day	600	396	196,356
Other Main Building Water Uses				
- dishwasher	3 loads/day x 60 L/load	180	119	58,907
- 5 sinks	5 uses/sink/day x 5 L per use	125	83	40,908
Other Truck/Tractor Shed Uses				
- pressure washing ⁽²⁾	assume about 1200 L per day on average (on work days)	1,200	792	392,712
- miscellaneous cleaning tasks	assume about 500 L per day on average (on work days)	600	396	196,356
Total Water Use		8,498	7,290	2,967,642

⁽¹⁾ It is assumed that the maintenance yard is used about two thirds as much on non-work days as on regular work days, and therefore, water uses are multiplied by 66%.

⁽²⁾ pressure washing of the outside of the building was observed during site visit on June 7. The pressure washer was also being used to clean leaves off pavement.

**TABLE D-4B Water Use Inventory - After Urinal Replacement for School
District No. 61 Maintenance Yard**

Average number of employees on-site: 25
 - 20 men
 - 5 women

Water Usage	Water Use Estimate Method and Assumptions	Water Use Estimate		
		Litres per work day (254 per year)	Litres per non-work day ⁽¹⁾ (111 per year)	L/year
Men's Washrooms (1 in Tractor Shed, 1 in Main Building)				
- Waterless Urinals (3)	Negligible water use	0	0	0
- Toilets (1 13L tank)	7 men x 1 flush/day x 20 L/flush	91	60	29,781
- Toilets (2 flush valve)	13 men x 1 flush/day x 6 L/flush	78	51	25,526
- Washbasins (2 sinks)	20 men x 2 washes/day x 1 L/wash	40	26	13,090
- Shower	5 uses per day x 100 L/use	500	330	163,630
Women's Washroom				
- Toilets (1 flush valve, high flow)	5 women x 2 flush/day x 13 L/flush	130	86	42,544
- Washbasins (1 sink)	5 females x 2 washes/day x 1 L/wash	10	7	3,273
Truck/Tractor Washing Station	12 L/min x 5 min/use x 10 uses/day	600	396	196,356
Other Main Building Water Uses				
- dishwasher	3 loads/day x 60 L/load	180	119	58,907
- 5 sinks	5 uses/sink/day x 5 L per use	125	83	40,908
Other Truck/Tractor Shed Uses				
- pressure washing ⁽²⁾	assume about 1200 L per day on average (on work days)	1,200	792	392,712
- miscellaneous cleaning tasks	assume about 500 L per day on average (on work days)	600	396	196,356
Total Water Use		3,554	2,346	1,163,082

⁽¹⁾ It is assumed that the maintenance yard is used about two thirds as much on non-work days as on regular work days, and therefore, water uses are multiplied by 66%.

⁽²⁾ pressure washing of the outside of the building was observed during site visit on June 7. The pressure washer was also being used to clean leaves off pavement.

Appendix E

Summary Water Use by Continuous Flush Urinals

Summary of Water Use by Continuous Flush Urinals

TABLE E-1 Dunsmuir Middle School

Urinal Tank No.	Tank Size (L)	# of Urinals Flushed	Flush Interval Time (minutes)	Flushes/hour	Rate of Water Use (L/h)
1	19	3	23:00	2.6	49
2	11	2	4:46	12.6	138
3	19	3	14:23	4.2	79
4	19	3	44:04	1.4	26
5	11	2	9:07	6.6	72
6	19	3	13:52	4.3	82
7	19	1	37:05	1.6	30

Total Water Use = 478 L/h = 4,186,404 L/year

TABLE E-2 Spectrum Community School

Urinal Tank No.	Tank Size (L)	# of Urinals Flushed	Flush Interval Time (minutes)	Flushes/hour	Rate of Water Use (L/h)
1	19	3	2:50	21.2	403
2	11	2	1:25	42.4	466
3	11	2	4:00 ⁽¹⁾	15.0	165
4	19	3	12:10	4.9	94
5	11	2	5:07	11.7	129
6	11	2	2:30	24.0	264
7	11	2	4:30	13.3	146

Total Water Use = 1,667 L/h = 14,598,890 L/year

⁽¹⁾ This tank was not observed to be flushing during a site visit on 20th June. The flush interval was increased to 4:00 on this date. The total continuous flush urinal water use was 1502 L/h prior to this adjustment

TABLE E-3 Stellys High School

Urinal Tank No.	Tank Size (L)	# of Urinals Flushed	Flush Interval Time (minutes)	Flushes/hour	Rate of Water Use (L/h)
1	11	2	9:25	6.4	70

Total Water Use = 70 L/h = 613,200 L/year

TABLE E-4 Greater Victoria School District Maintenance Yard

Urinal Tank No.	Tank Size (L)	# of Urinals Flushed	Flush Interval Time (minutes)	Flushes/hour	Rate of Water Use (L/h)
1	11	2	3:54	15.4	169
2	11	1	18:00	3.3	37

Total Water Use = 206 L/h = 1,802,896 L/year