Recycling Water

A Conservation Strategy

for the

21st Century

Water Advisory Committee

Capital Regional District

April 2003

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APPENDICES

Appendix A: Wastewater Treatment Systems

<u>Attachments:</u>

SCOPE OF STUDY

At the May 2002 Water Advisory Committee meeting the authors of this overview were asked by the Water Advisory Committee to investigate and to report on alternate water supply sources for the Capital Regional District (CRD).

Since there is an agreement between the Capital Regional District and the T'Sou-ke Nation to complete the Leech River Diversion to Deception and Sooke Reservoirs by 2015, we decided to investigate water reuse and recycling systems rather than searching for another watershed as an alternate water source. This approach is also in keeping with the CRD blue box environmental ethic of reduce, reuse, and recycle and follows a global trend toward more effective and efficient potable water management.

The focus is primarily on recycling water as a conservation strategy.

ACKNOWLEDGMENTS

The authors wish to thank the following for their contribution to this report: CRD Water Department staff; Sinclair Philippe, the owner of the Sooke Harbour House, for letting us examine the ZenoGem treatment system used on his site; John Rowse, Land Use Consultant, Ministry of Health Planning; Gary Gibson, Chief Environmental Health Officer for the Capital Health Region; Dr. Asit Mazumder, NSERC Senior Research Chair/Professor Water and Watershed Ecology; Eric Bonham, Director of Engineering Services Branch, Ministry of Community, Aboriginal and Women's Services; Andrew Weaver School of Earth and Ocean Sciences, University of Victoria; Richard Hebda, Curator of Botany and Earth History, BC Royal Museum; Sharon Peters, Demand Side Management, Greater Vancouver Regional District; David Jackson for providing information on Hydroxl Systems; Dr. Doug A. Bright, Applied Research at the Royal Roads University; Michael Bodman, Environmental Coordinator, Royal Roads University; Joe Van Belleghem, Vancouver Island Technology Park; Joan van der Goes for her Clivus Multrum and Grey Water Irrigation System demonstration; Robert Davey, Davey Consulting and Engineering; Katrina Tiongson, Climate Services Specialist, Meteorological Service of Canada; George E. Mortimer for his articles on wastewater systems; Brian Anderson, Oak Bay Building Inspector and to Fiona Hamersley Chambers, environmental educator and consultant, for reviewing and editing of this report.

EXECUTIVE SUMMARY

DEFINITIONS

Recycling is defined as an alternate water source in California, Florida, Australia, Hawaii the Quayside Village in Vancouver, B.C., and other places. We have accepted that definition in this report. For the purposes of this report, we have made no distinction between reuse and recycling.

Grey water is defined as water coming from baths, showers, sinks, and washing machines. Black water is from toilets. Only treated grey water is considered for recycling purposes in this report.

WATER REUSE/RECYCLING

Water reuse is global: applications occur on Vancouver Island, the mainland of British Columbia, Canada, the United States, and the other continents. Recycled water supplies agricultural fields, golf courses, industry, and small-scale applications. Case studies demonstrate that water recycling is acceptable to populations with the CRD's living standard. Recycling grey water indoors and outdoors in the CRD has two applications in Sooke. One is a Country Inn and the other is a government office.

POPULATION GROWTH AND CONSUMPTION

An approximate population growth rate of approximate 2.3% increases demand on the water supply. From approximately 2013 to 2015 supply will begin to descend below the accepted 96% reliability level. (A 96% reliability means that 96% of the time, a minimum of 3500 million gallons is required to be in storage, or 4 years out of every 100 years, the total storage could go below 3500 mgal. The Regional Water Supply Commission adopted a 96% reliability as a minimum requirement for the water supply system.)

Compared to other provinces and countries, CRD's per capita consumption is slightly below the highest user in the world, the USA. Each person in the CRD uses two and a half times more water than the average European. Although per capita consumption is decreasing overall consumption is increasing due to population growth.

REPORTS, INTERVIEWS, AND APPLICATIONS

Dayton and Knight Limited produced a report for the Greater Vancouver District entitled *Study on Potential Rainwater and Grey Water Reuse in the GVRD*. The report covers

- Current and emerging technologies for collection, treatment and distribution of recycled water.
- Reuse projects in the GVRD and elsewhere.

- Standards and permitted uses for reclaimed water.
- Feasibility of implementing rainwater and grey water reuse systems in the GVRD.
- Evaluation of feasible reuse options.
- Recommendations

The report contains 9 recommendations. The two most significant recommendations are

1. in developing a demonstration project at a small multi-residential or commercial complex and

2. establishing a public information and education program in support of the other components of its water reuse initiatives and as a linkage to other GVRD sustainability objectives.

Davey Consulting and Engineering (DCE) issued a report outlining some of the problems associated with gaining approval from the Ministry of Health Planning (MOHP) and the Ministry of Water, Land and Air Protection (MWLAP); the governing bodies for recycling permits.

Each governing body has its own distinct set of regulations. According to DCE, "MWLAP seems to be more accommodating with their regulations and relies heavily on professional design and accreditation, but requires a longer time period." DCE suggests "if the system employed by the MWLAP was incorporated into a simplified system and downsized by the CRD, and by using qualified professionals; reuse of water could be significant for initially irrigation of land and the ultimately reuse into households systems."

Canada Mortgage and Housing Corporation produced a series (17) of research reports on water reuse. The reports discuss national, provincial and municipal regulatory barriers but states that the *National Plumbing Code* (NPC) provides alternative systems such as dual water distribution within sites which makes it possible to apply reuse technology.

Although barriers in the NPC are carried over to provinces, the reports noted these barriers can be overcome as provincial codes allow innovation.

One report, the *Regulatory Barriers to On-Site Water Reuse,* concludes that "water reuse meets with positive interest" and that "Reuse applications will most likely be considered for more widespread application in the near future.

Another report recommends "developing a *Code of Practice* guiding policy makers and addressing public misconceptions."

HEALTH ISSUES

A number of important health issues must be addressed when considering grey water recycling. The BC *Municipal Sewage Regulation* (MSR) specifies standards reclaimed water providers must meet to protect human health and the environment. A *Code of Practice for the Use of Reclaimed Water* by the Pollution Prevention and Remediation Branch supports the regulations in the MSR.

Although the Ministry of Health Planning does not endorse the use of reclaimed water for recycling in residential homes due to a lack of knowledge about the systems, it can be done at community controlled facilities that meets the requirements of the MSR. They also recommend moving forward in “measured steps and a conservative approach to eventually facilitate the use of reclaimed water”.

Some commercial ventures are permitted to recycling water by the Ministry of Health Planning if it is compliant with the MSR and if the system is monitored and maintained by professionals.

APPLICATIONS

Six treatment systems reviewed in Appendix A and Attachments A-W of this report. They are the

- Cycle-Let®/ZenoGem™ System
- Hydroxl System
- Solar Aquatics Systems®
- Waterloo Biofilter™
- Clivus Toilet and Grey Water Irrigation System
- Living Machines System

Applications for the reclamation and reuse/recycling of treated water are reviewed in Appendix B and in Attachments A-W.

- The Children and Family Services Building in Sooke
- Sooke Harbour House
- The Okanagan communities of Vernon, Osoyoos, Oliver, Armstrong, Pentiction, Cranbrook and Kamloops. (Agriculture, recreational lands, & golf courses)
- Other applications:
    - Conservation Co-op Residential Water Reclamation Project, Ottawa, Ont.
    - Golf Courses, Resorts, residences in Ontario
    - Elk Grove/Laguna, Sacramento, California (Community)
    - Tribune Bay Constructed Wetland, Hornby Island, BC
    - Quayside Village, Vancouver, BC
    - CK Choi Building, UBC, Vancouver, BC

- Waterloo Region Green Home, Ont.

HORTICULTURAL APPLICATIONS

A review of potential benefits and problems in horticultural applications considers xeriscaping (landscaping with minimal water use). Some plants may not accept treated grey water and therefore it does not suit all situations. [See Appendix C].

The report also discusses grey water irrigation of golf courses. The practice is widespread in the USA with Florida irrigating 401 golf courses and other courses Australia. Successful Canadian examples include Vernon and Tumbler Ridge, BC, as well as a number of courses in Ontario. [Appendix A, Attachments V, V-1 and V-2]

Irrigation is considered the most viable option currently acceptable to health authorities, whereas, indoor recycling applications for reuse requires dual plumbing which is currently more expensive but costs could be lowered with increased acceptance and the number of applications.

RAINWATER HARVESTING

Captured rainwater in cisterns is not recycled water; however, since it can be a component of a complete water recycling system it is suggested that the CRD Water Department include this system in their water conservation program. The CRD's Water Department's Demand Management Coordinator produced a paper on Cisterns/Rainwater Harvesting Systems. It provides excellent information on cisterns. [Attachment E-1]. It's available on the website www.advancebuildingings.or/main_t_plumbing_cisterns.htm

It is recommended that the CRD Water Department initiate a rainwater harvesting program that uses cisterns for toilet flushing in private homes.

CLIMATE WARMING

Victoria is in the rain shadow from the Olympic Mountains and to a small extent from the Sooke hills and, therefore, receives less rainfall than Vancouver. Hence, Victoria is drier and is subject to greater drought-like conditions than Vancouver.

The Dayton & Knight Ltd. report *Study on Potential Rainwater and Grey Water Reuse in the Greater Vancouver Regional District* includes climate change information from an Environment Canada report by Eric Taylor and Darlene Langlois entitled *Climate Change and the Greater Vancouver Regional District*. Although the GVRD receives more rainfall than Victoria, it included climate change estimated impacts in their reports.

The Water Department does not have a similar report for the CRD.

The CRD *Strategic Plan for Water Management* states "if hotter and drier summers continue to occur due to the influences of global warming, then per capita consumption is likely to increase”. [*Strategic Plan for Water Management, Volume 1 of 4, Supply Management and Demand Management, March 1999, section 4.9.2, Reid Crowther*]

Water supply systems are designed using past records and may assume that the future climate will look like the past climate. Reticence to include climate change projections is based on uncertainties of estimates. However, scientific uncertainty associated with climate change is not very different than the other sources of uncertainty associated with the management of water supply systems such as population growth and economic activity. Therefore, uncertainty should not preclude the inclusion of climate change as part of an integrated risk management strategy.

PUBLIC EDUCATION

The Ministry of Health Planning suggest taking “measured steps” and a “conservative approach” to educate the public on the use of reclaimed water for reuse and recycling.

As a first measured step, there is an opportunity for the CRD to incorporate wastewater treatment systems in new buildings and retrofit others that meets the requirements under the MSR. (Perhaps the new CRD Headquarters building might be a candidate?) This can be acceptable by the Ministry of Health Planning. Other educational initiatives are list in the recommendations.

Demand on our water supply sources will increase as the population grows in the coming decades and the potential impact from climate change. Educating the public on the reclamation of water for safe applications is a prudent long-term conservation strategy for the CRD. Recycling is one key factor for a sustainable water supply for the Capital Regional District. Continuing to access new water sources requiring inter-basin transfers impacts their ecosystems and is not sustainable in the long-term.

ADAPTATIONS

Adaptation and changing behaviours on water use are required to address long-term strategies for future water supply. Our consumption rate is still high and supply will continue to diminish unless stronger conservation measures are implemented.

The CRD’s population will continue to increase adding extra stress on our water resource. Additionally, climate change will necessitate increases in irrigation for commercial and private uses. Warming trends may foreshadow increasing stresses on our watersheds.

Of first priority is to increase water use efficiency to make the best use of our water supply. Accessing new watersheds without upscaling water efficiency is not sustainable and will have environmental impacts on those watersheds.

Introducing water recycling as a long-term strategy to sustain our water source is beneficial by

1. reducing withdrawal amounts from the Sooke Lake reservoir
2. reducing withdrawal amounts from Leech River
3. reducing our vulnerability to future water shortages and
4. slowing or preventing the necessity of accessing new watersheds for future supply.

Hence, water recycling should be introduced as part of the CRD's long-term water conservation strategy.

CONCLUSIONS

This report briefly examines many of the issues about recycling water. Our conclusions are that

1. The Ministry of Health Planning does permit recycling water provided the *Code of Practice for the Use of Reclaimed Water* under the *Municipal Sewage Regulation* is followed. Examples are the Sooke Harbour House and the Children and Family Services Building in the Capital Regional District (CRD) and other applications province wide. Hence, there are possibilities to promote and encourage recycling practices in commercial applications to conserve water within the CRD.

2. Although the Ministry of Health Planning have concerns about public health due to a lack of training and eduction to operate and maintain equipment for water reuse in homeowner applications they do suggest "moving forward with measured steps and a conservative approach to facilitate the acceptabililty on the use of reclaimed water."

3. In order for the Ministry of Health Planning to begin to accept recycling of water in residences, there is a need for public education on the requirements to have a safe and reliable system for recycling water.

4. The reclamation of grey water for reuse and recycling should be part of the long-term water conservation strategy for the Capital Regional District.

5. There is a need to work co-operatively with municipal levels of government on bylaws permitting the use of treated grey water. Mutually developing a *Code of Practice Guide* would benefit municipal policy makers and those who carry out those policies.

6. Continued research on reclaiming water for reuse and recycling should be included in the long-term management of our water supply for the Captial Regional District.

RECOMMENDATIONS

1. **Reclamation, reuse and recycling water should be incorporated into the Strategic Plan for Water Management.**

2. **Establish an Intermunicipal Committee to develop a *Code of Practice Guide* on water reclamation, reuse and recycling for municipal policy makers.**

3. **The CRD start education initiatives on reclamation, reuse and recycling by**

    a. **expanding the water conservation education program to include public forums on reclamation, reuse and recycling for residential and commercial properties.**

    b. **developing a demonstration project at a small multi-residential or commercial complex to evaluate technologies and support educational programs for rainwater harvesting, storage, disinfection, and reuse for toilet flushing and outdoor non-potable use.**

    c. **organizing a conference on reclamation, reuse and recycling water.**

    d. **recycling water information on the CRD webpage.**

    e. **introducing recycling water as a new category in the annual Water Stewardship Award**

4. **The RWSC provide a report on grey water reuse similar to Dayton & Knight's report *Study on Potential Rainwater and Grey Water Reuse in the GVRD* to be completed by December 31, 2004.**

Peter Dixon   Gordon Robe

Alternate Water Source Sub-committee
Capital Regional District Water Advisory Committee

1.0 RECYCLING AS AN ALTERNATIVE WATER SOURCE

1.1 CONSERVATION

Recycling water is accepted and widely practiced in North America and other parts of the world where there are supply shortages. (In Tokyo, the use of reclaimed water for toilet flushing is mandated in buildings larger than 10,000 square metres (100,000 square feet). Recycling extends the life of existing infrastructures and defers future large-scale treatment plants.

Globally, recycling is often referred to as an alternate water source. Hence, to address future water shortages in the Capital Regional District, this report reviews recycling as an alternative water source.

Water reclamation and recycling are long-term strategies ensuring an adequate water supply for the CRD. Properly treated recycled water is safe and reliable for purposes other than drinking and supplies insurance against future droughts or shortages.

Consumer acceptance of treated water in the USA (Kaperson 1977) shows this practice is acceptable to populations with the CRD's living standard.

1.2 POPULATION GROWTH AND CONSUMPTION COMPARISONS

From 2002 to 2026 the population is projected to increase by 2.3%. [Figure 1] According to the Strategic Plan for Water Management, Volume 1 of 4, March 1999 the "per capita consumption has decreased but due to population increases, overall consumption has slowly increased."

Although per capita consumption has improved it still does not compare favourably with the Canadian average and with other countries.

Compared with other provinces in Canada and in Europe, the CRD's water consumption rates appear high. For example, the CRD per capita residential consumption rate, 380 litres (545 litres for all uses) (includes leakage and flushing water mains), appears to be higher than the Canadian national average, (350 litres), and second to the USA average, 420 litres, the highest in the world. Europe's rate is only 150 litres. [Figure 2]

In British Columbia, many municipalities reuse water. Okanagan communities such as Vernon, Osoyoos, Oliver, Armstrong and Penticton, as well as Cranbrook and Kamloops practice water reuse. Vernon reclaims 100% of its treated municipal wastewater for irrigating it on 2,500 acres of agriculture, forestry and recreational lands. The annual sewage volume of over 1 billion gallons from a population of 38,000 supplies treated irrigated water during the summer months following advanced treatment, storage and disinfection.

Sooke has two buildings that reuse water.

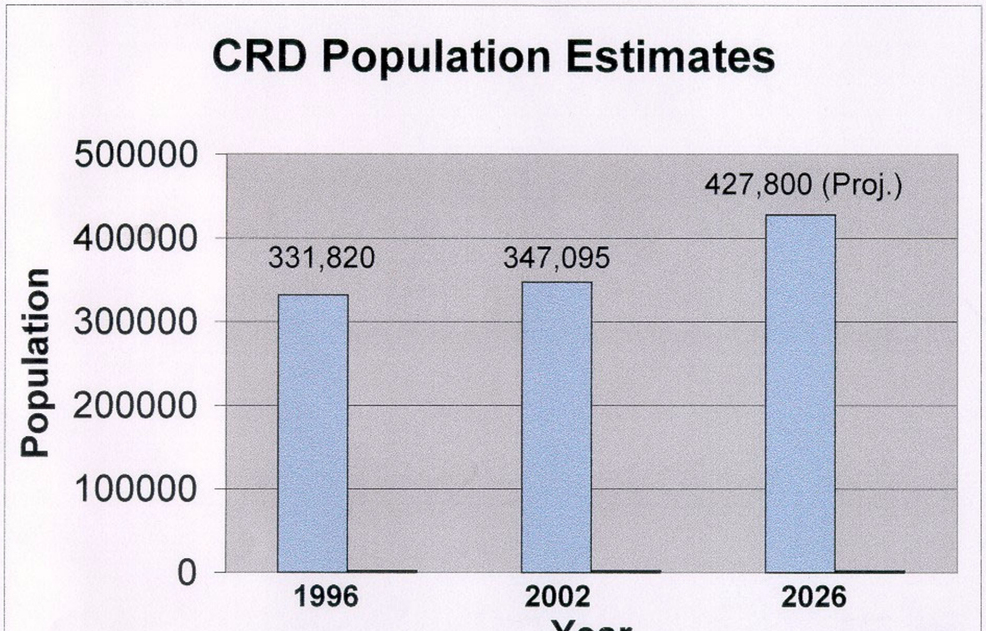


Figure 1

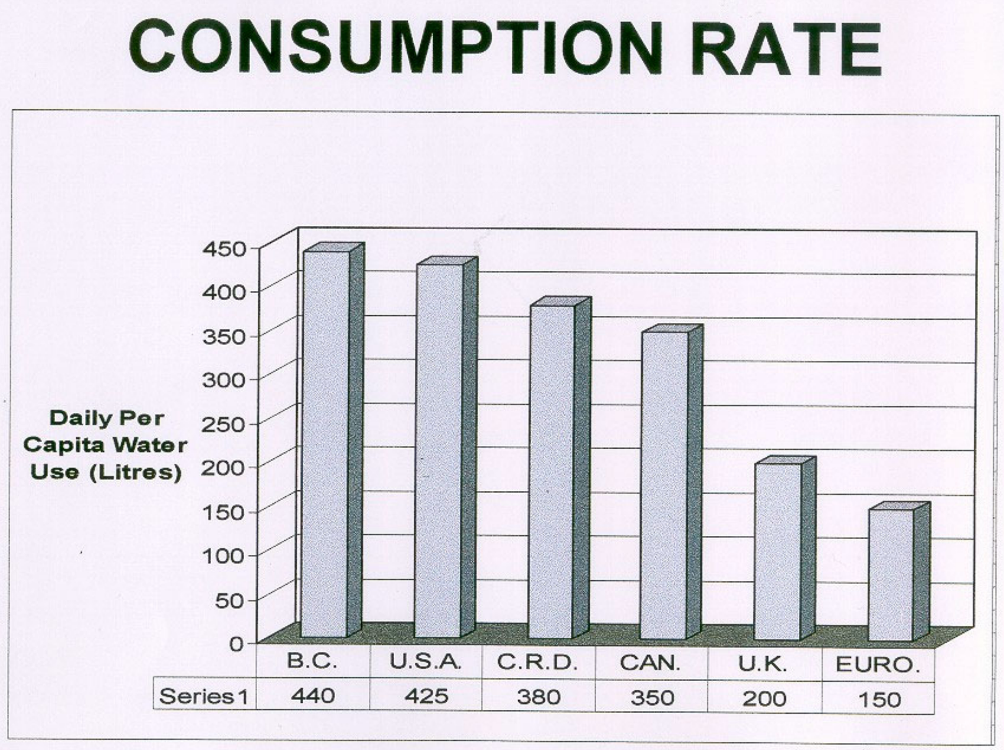


Figure 2

1.3 SUPPLY AND DEMAND

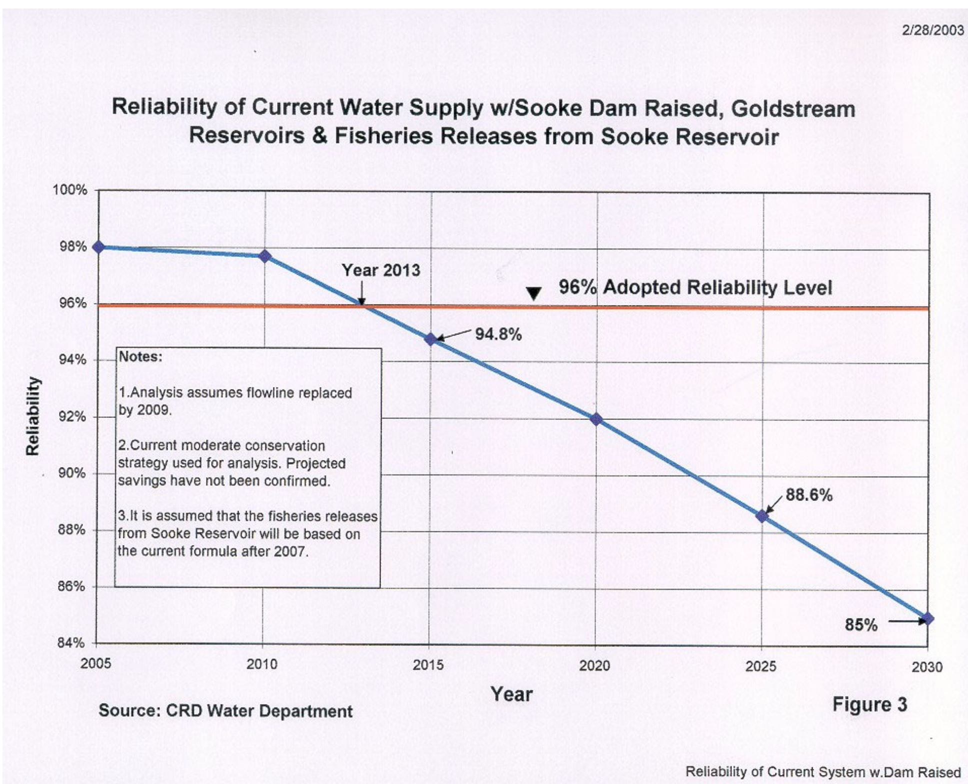
There are no continental rivers and lakes in the Capital Region. Snowpack in the watershed is minimal—unlike Vancouver's water supply. Annual precipitation replenishes the reservoirs. By summer's end all creeks, except Rithet, in the watershed run dry.

The average annual inflow into Sooke Reservoir with Council Creek contributing is about 20,000 million gallons (mgal). The reservoir will hold 20,400 mgal when the raised Sooke Dam is completed. However, there is a limit to the yield from the watershed. The completed dam in 2002 is considered optimal so far as providing maximum storage capacity in relation to watershed yield.

The current annual consumption is 13,600 mgal and average annual fish releases will be 1,280 mgal for a total annual withdrawal of 14,880 mgal. Sooke Lake Reservoir will spill 60% of the time until approximately 2010.

The raised Sooke dam increases the storage to a 98% reliability until approximately 2005. Then reliability decreases to the adopted 96% reliability by approximately 2013. With current moderate conservation strategies, the reliability begins to decrease from 2013, reaching 92% in 2020 and plunging to 85% reliability by about 2030. [Figure 3]

The combination of increasing population, high consumption rates, and a diminishing supply of water, necessitates accessing an alternate source of water by about 2013.



2.0 REPORTS, INTERVIEWS, AND APPLICATIONS

2.1 GREATER VANCOUVER REGIONAL DISTRICT REPORT

Dayton and Knight Limited produced a report for the Greater Vancouver Regional District entitled *Study on Potential Rainwater and Grey Water Reuse in the GVRD*. The report covers

- Current and emerging technologies for collection, treatment and distribution of recycled water.
- Reuse projects in the GVRD and elsewhere.
- Standards and permitted uses for reclaimed water.
- Feasibility of implementing rainwater and grey water reuse systems in the GVRD.
- Evaluation of feasible reuse options.
- Recommendations

The report also included a section on climate warming and acknowledges expected temperature rises by 3^0C to 4^0C in all months by the late 21st century. (NOTE: The data quoted in the report is based on the 1995 Intergovernmental Panel on Climate Change. The 2000 report by the IPCC upgraded the temperature rise to 5.8^0C by the late 21st century).

Excerpts

The MSR standards for use of reclaimed sewage effluent would apply to treated and recycled grey water as well as to reclaimed sewage. The standards for water reuse in British Columbia dictate that effluent used as reclaimed water must meet either of the two requirements described below, depending on the use of the reclaimed water.

- **Unrestricted Public Access Category**. Permitted uses include irrigation (of golf courses, parks, playgrounds, school yards, cemeteries, residential lawns, food crops eaten raw), stream augmentation, impoundments for fishing and boating, aquaculture, toilet flushing, and street and driveway cleaning.
- **Restricted Public Access Category.** Permitted uses include irrigation (of pasture, silviculture, and commercially processed food crops. Nurseries, sod farms), landscape impoundments, soil compaction, dust control, aggregate washing, concrete production, industrial process water and wetlands augmentation.

Environmental impact studies are required under both categories of reclaimed water.

Although the *Sewage Disposal Regulation* prohibits onsite irrigation using untreated grey water, onsite systems for treatment and reuse of grey water that rely on individual homeowners for operation and maintenance appear to be legally feasible provided that MSR criteria are met, but the Ministry of Health Planning would not endorse this type of application.

The report concluded with 9 recommendations. Excerpts from the report's recommendation are listed as follows.

1. For the most part, the unit cost of recycled water produced from water reuse systems using current technologies will be substantially greater than the cost of potable water for the foreseeable future (the exception is intensive agricultural such as commercial nursery/greenhouse operations). However, rainwater and grey water reuse provide other public benefits and they should be explored and promoted in the GVRD as beneficial practices to conserve existing water supplies to defer infrastructure improvements, and to promote other aspects of environmental awareness (e.g. water conservation, wastewater reduction, stormwater management, global warming).
2. The GVRD should consider beginning a program to promote rainwater harvesting and reuse for residential properties. In addition to the rain barrel program, the GVRD should pursue the implementation of a demonstration project for single home rainwater harvesting systems that include cistern storage.
3. Rainwater harvesting for intensive agriculture in the GVRD (e.g. nurseries) should be promoted on the basis of cost savings.
4. The GVRD should consider developing a demonstration project at a small multi-residential or commercial complex to evaluate technologies and support educational programs for rainwater harvesting, storage, disinfection, and reuse for toilet flushing and outdoor non-potable use. This project should be planned for new construction, with separate rainwater piping to toilets and outdoor irrigation.
5. The GVRD should consider participating in a demonstration/research project for evaluating grey water treatment systems.
6. Existing and future stormwater detention facilities in the GVRD should be viewed as potential storage ponds for harvested rainwater.
7. The GVRD should consider seeking partners in developing both the technical and educational aspects of water reuse.
8. Monetary incentives for water reuse should be considered, since in most cases the water savings associated with installing water reuse systems will not recover capital and operating costs. Incentives could take the form of subsidies for system installation (as with existing rain barrel program), or reductions in water rates for participants in water recycling programs.
9. The GVRD should consider establishing a public information and education program in support of the other components of its water reuse initiatives, and as a linkage to other GVRD sustainability objectives. Other actions could include adding rainwater information to the GVRD website, producing short education programs for presentation to schools and community groups, encouraging and participating in local studies carried out by local academic institutions or private suppliers/installers, and production of a local users guide.

The authors of this report (*Recycling Water in the 21st Century* (Dixon and Robe)) suggest that many of the GVRD recommendations should be considered for the CRD.

2.2 DAVEY CONSULTING AND ENGINEERING REPORT

According to Davey Consulting and Engineering Company, "there are two governing bodies regarding the disposal of septic effluent; the Ministry of Health regulates, permits and oversees septic flows and ground disposals up to 4999 Imperial gallons (22.72 m^3) per day, while the Ministry of Water Lands and Air Protection [MWLAP] regulates, approves, and oversees flows greater than 5000 gallons per day, or flows less than 5000 gallons per day with disposal of the effluent to water sources. Each governing body has is own distinct set of regulations, although the MWLAP seems to be more accommodating with their regulations and relies heavily on professional design and accreditation, but requires a longer time period."

Under the Ministry of Health Act Regulation and Policy it "expressly forbids the use of "Grey water"; separation of water into either "Blackwater" or "Grey water" streams and the use of a portion of either system." The Ministry does not permit water discharges.

Other methods are available and considered "under the Ministry of Water, Land and Air protection, regulations including irrigation, reclaimed water use, and drip irrigation to a land base for reuse." Under the provisions of this Ministry a larger degree of variation is possible and engineered designs, standards, and applications are necessary."

*[*Source: Davey Consulting and Engineering letter to Peter Dixon*]*

2.3 CANADA MORTGAGE AND HOUSING CORP. (CMHC) RESEARCH REPORTS

The Canada Mortgage and Housing Corporation (CMHC) published a series of research reports on water reuse. Two reports are reviewed below.

***2.31 Regulatory Barriers to On-Site Water Reuse** examines national, provincial and municipal regulatory barriers to on-site water reuse technologies. The report reviews health, environment, plumbing/building codes and municipal bylaws. Four categories of reuse were identified—potable (drinking and cooking), human contact (bathing and house cleaning), indirect uses (toilet flushing), and irrigation.*

This CMHC report concludes water reuse meets with positive interest, particularly for sustaining water supply. Water reuse resistance is mainly a preference issue, rather than a current technical or procedural one. Reuse applications will most likely be considered for more widespread application in the near future.

Section 3.0 Regulatory Barriers to On-Site Water Reuse: General Results *states in part "there is no outright prohibition of on-site water reuse;…. A number of jurisdictions have bylaws or codes which define all "used" household water (both grey water and black water) as "sewage", and direct that all sewage must be discharged to the municipal sewer system or to a private sewage disposal system. However, since these bylaws do not specifically prohibit recirculation of some or all of the wastewater before discharge, they are open to an interpretation that would be favourable to water reuse applications."*

However, three national regulations restrict water reuse:

- *Guidelines for Canadian Drinking Water Quality (1996)*
- *Guidelines for Canadian Recreational Water Quality (1992)*
- *National Plumbing Code of Canada.*

The report notes water quality guidelines both for drinking water and recreational water may "impede the implementation of on-site water reuse technology by imposing unrealistic or inappropriate quality standards."

*The report also states "*The National Plumbing Code *(NPC) provides for alternative systems such as dual water distribution within sites; this provision makes it possible to apply reuse technology. However, other provisions call for every water distribution system to be connected to a potable water supply. The NPC also prohibits the discharge of non-potable water through outlets such as faucets or toilets."*

Barriers in the NPC are carried over to provinces through their plumbing codes. However, the report noted these barriers can be overcome as provincial codes allow innovation. There are few barriers to on-site water reuse in Canada for individual buildings.

The NPC (and provincial codes based on it) provides for alternate systems, such as dual water distribution systems within sites. Most health regulations, because they require case-by case approval, are flexible in meeting required standards.

The report recommends developing a Code of Practice *guiding policy makers and addressing public misconceptions.*

2.32 Case Studies of Potential Applications of Innovative Residential and Wastewater Technologies *examine reuse technology potentials in 5 case studies in Nova Scotia. In each case the project compared traditional servicing alternatives with all or part of the alternative technologies that are incorporated in the Toronto Healthy House: water conservation, wastewater recycling and reuse, and a rainwater cistern system. (Toronto Healthy House: Appendix A, Attachment L)*

The costs and benefits of traditional and innovative systems are compared. The objective is to find solutions for cost-effective and environmentally friendly housing.

Cost comparisons show reuse/reclamation technology economically feasible in:

1. *new urban developments serviced by central water and wastewater systems if fire protection by municipal hydrants is not required*

2. *existing non-urban areas where new wells, new on-site systems, and a cluster (decentralized waste water treatment systems e.g. sewers and sub-surface disposal systems) system are proposed to replace failing on-site systems and contaminated wells and*

3. *a community where a central sewerage system has been proposed to replace failing on-site systems.*

Reuse technologies would not be cost-competitive:

1. *Where fire protection provided by a public distribution system is required and*

2. *where it is possible to install or replace on-site wells and septic tank systems with conventional on-site systems.*

2.4 MUNICIPAL PERSPECTIVES

A political patchwork of 13 jurisdictions makes up the CRD: Central Saanich; Colwood; Esquimalt; Highlands; Langford; Metchosin; North Saanich; Oak Bay; Saanich; Sidney; Sooke; Victoria; and View Royal. Grey water irrigation is illegal under current municipal, regional, and provincial regulations. In telephone conversations, CRD health regulations were the most frequently cited reasons making grey water irrigation illegal. Health concerns were raised in Colwood (David Reay, Municipal Engineer), Metchosin (Charles Nash, Deputy Administrator and Planner), North Saanich (Jack Parry, Municipal Engineer), Sooke (Bill Hadikin, Building Inspector), and the Highlands (Heins Birke, Building Inspector). The BC Building Code was the next most frequently cited reason making grey water irrigation illegal. Code issues were raised in Central Saanich (Nirmal Bhattacharya, Municipal Engineer), Langford (Nigel Beattie, Chief Building Inspector), Sidney (Gord Pearson, Chief Building Official), and Oak Bay (Stuart Pitt, Municipal Engineer).

NOTE: Under the Canadian Association of Home and Property Inspectors British Columbia, Standards of Practice, Section 6.2, Property Inspectors are required to inspect the interior water supply and distribution systems including all fixtures and faucets but are not required to inspect private waste disposal systems.

In Victoria, Steve Fifield (Senior Technician for Water and Environment) cited the City's Storm Water Bylaw as a legal barrier. The Bylaw's purpose: "to regulate the discharge of waste into the storm sewers and watercourses." The Bylaw's key passage: "no person shall discharge or allow to be discharged into a storm drain or watercourse any domestic waste, trucked liquid waste, or prohibited waste." The Bylaw defines domestic waste as "waste, sanitary waste, and the water-carried wastes from drinking, culinary uses, washing, bathing, laundering or food processing which is produced on a residential property." Grey water irrigation is deemed illegal given wayward grey water could contaminate storm sewers.

However, as inspectors note, they have latitude in interpreting bylaws and building codes. A key issue is inspectors' flexibility on interpreting Section 7.1.4.1 in the BC Building Code: "Every sanitary drainage system shall be connected to a public sanitary sewer, a public combined sewer, or a private sewage disposal system." (Appendix A)

The code states: "Compliance with the *Municipal Regulation* (MSR) and this code enable the use of reclaimed water in BC. " (Section 1.5)

The following section on BC's *Water Conservation Strategy* elaborates on related objectives including:

- Accommodating population growth
- Deferring expanding water delivery, treatment, and disposal
- Maintaining riparian habitats.

This section concludes: "Through its cautious rules for the use of reclaimed water, the MSR provides for local governments and others to help address these long-term goals of water conservation." The key is municipal acceptance of systems turning untreated grey water into treated grey water and the treatment must be adequate for its intended purpose.

Overall, officials are positive about the concept of grey water recycling. Oak Bay's Stuart Pitt noted grey water irrigation is common in Europe. In the Highlands, Heins Birke, and in Central Saanich, Nirmal Bhattacharya, were notably positive. In Saanich, Municipal engineer Hugh McKay noted that while the bylaws are "silent on uses of grey water", the municipality supports the concept.

There are sharp contrasts in population density and wastewater infrastructure within the CRD. At one extreme, Metchosin and the Highlands are 'Rural' districts. The Highlands are exclusively on wells for supply and septic fields for disposal (future growth could change this) whereas some areas of Metchosin are supplied with water by the municipal system and in other areas they are on wells. At the other extreme, Oak Bay and Victoria are 'Urban'. Within the core municipalities there are again sharp contrasts in population density. In Fernwood, very old and new in-fill housing stands on lots 380 square meters (4000 square feet) or smaller, while in the Uplands houses sit on small acreages. Dramatic differences in lot size and soil quality make predicting the outcome of large-scale grey water irrigation difficult.

Some BC municipalities can pass bylaws encouraging/discouraging on-site reuse. The City of Vancouver's charter allows bylaws regulating installation or alteration of plumbing and heating facilities, including connections with sewers and water mains (Vancouver Charter, Part IX, S. 306). The City of Vernon used treated municipal water for irrigation since 1977.

Several municipal officials revealed they use grey water irrigation in their own gardens.

2.5 TECHNICAL ISSUES

Technical issues include secondary domestic waste systems, and in some applications, pumps and filters. Before installation, comparisons should be made between grey water treatment systems to 'Big Pipe' solutions (conventional sewers). A cost-benefit analysis must include hidden subsidies and the need to reduce demand.

How treated irrigation water is applied depends on when and where it is used. Above ground, access is restricted during daytime spraying. In the middle of the night applications limit human contact. Treated grey water irrigation with on u/g trickle system is the safest at anytime, day or night.

Grey water irrigation is an accepted practice in North America's and Australia's arid zones. In these areas with extreme water shortages, a risk ratio is calculated for using treated grey water. Potable water is more expensive because of complex treatment and distribution systems. Cost comparisons may include imported water.

Recycling water for indoor reuse requires plumbing systems that separate potable water from grey water and black water. Here several plumbing systems are required:

1. The initial fresh but treated potable water, supplying sinks, and dishwashers.
2. The treated grey water supplying toilets, laundry, and tubs/showers (with bathing standards).
3. The waste system collecting grey water from bathroom sinks, laundry, and tub/showers for recycling into potable water.
4. The waste system collecting black (toilet) water for recycling into irrigation water.
5. The waste system collecting kitchen sink and dishwasher water (grey water with a high grease content) for recycling using grease traps.

The purpose and number of these water collection and distribution systems vary according to system design. They become cost beneficial when a diminishing supply compels increased system production. Cost depends on treatment complexity. Market demand may make these technologies cost-competitive.

End-users who maintain systems have lower costs. Consumers not involved in maintenance need more expensive automated systems.

In all cases, treatment systems must comply with the *Municipal Sewage Regulation* (Attachment B-1) and the *Code of Practice for the Use of Reclaimed Water*. Systems must also follow the *BC Plumbing Code*, which permits dual distribution systems.

2.6 PLUMBING CODES

In 1995 Hill Murray & Associates Inc. proposed allowing dual water distribution systems in all occupancy classifications. The *BC Plumbing Code Advisory Committee* recommended acceptance of the amendment to the Building Standards Branch (BSB) of the then BC Ministry of Municipal Affairs. The Ministry informed Hill Murray & Associates the 1997 revisions included the amendment. (Attachment B)

The Building Standards Branch confirmed that local building and plumbing officials have the authority to approve water reuse systems. The BSB recommended that water reuse systems comply with AWWA Manual M24 and NSF Standard No. 41 *Wastewater Recycle/Reuse and Water Conservation Devices.* However, the BSB was dissolved before the amendment was implemented and Standard No. 41 was revised in 1999 to exclude the section on grey water devices.

A more recent grey water recycling initiative is *Policy—Innovative Designs and Technology New to British Columbia with respect to On-Site Sewage Disposal* administered by the BC Ministry of Health. The policy's purposes: promote alternative technology replacing standard sewage systems; and increase acceptance of on-site reuse.

In two major applications of this policy, a new 300-pupil elementary school and a new provincial government building incorporated on-site water reuse with the Cycle-Let® system.

In these systems, all grey and black water is captured, treated and reused. Black water, a predictable fluid, is easier to treat than grey water, a pot pourri of chemicals. Overcoming prejudice against blackwater reuse eliminates a major barrier to the success of reclamation systems for reuse applications. The elementary school only uses 5% of the total water use for drinking purposes.

The *BC Municipal Sewage Regulation* guides on-site reuse. The legislation authorizes treated wastewater use ranging from agricultural irrigation and toilet flushing, to snowmaking and stream augmentation.

[Source: Excerpts from the *Regulatory Barriers to On-Site Water Reuse* by CMHC]

2.7 HEALTH ISSUES

2.71 Regulations

There are also regulatory barriers at the provincial and municipal levels that must be addressed. Health officials examine the safety of on-site reuse applications and can deny applications for water reuse that pose a public health threat.

Health and building authorities must consider the BC Sewage Regulations *and the* Building Code *before approving a recycling system. An approved grey water recycling system must follow Ministry of Health guidelines. Approval requires service agents maintaining the system or training the owner in maintenance.*

Currently, the Ministry of Health Planning (MOHP) does not endorse the use of reclaimed water for residential indoor use or residential irrigation. The primary reason is that the public in British Columbia lack the knowledge to understand the risks and issues related to dual plumbing and reclaimed water use. However, wastewater treatment for reclaimed water must be done at a community controlled facility that meets the requirements of the Municipal Sewage Regulation *(MSR) which allows for the proper ongoing maintenance controls and sampling necessary to ensure the safety of the public and the environment.*

However, MOHP says that "moving forward with measured steps and a conservative approach will facilitate the acceptability of the use of reclaimed water."

Under the *Waste Management Act,* the *MSR, Schedule 2* specifies standards reclaimed water providers must meet to protect human health and the environment. The schedule includes outdoor uses such as agricultural and park irrigation and fire-fighting, and indoor uses such as flushing toilets and urinals, primarily in commercial or office buildings. The *Code of Practice for the Use of Reclaimed Water* supports the regulatory requirements prescribed in the MSR (the MSR does not replace the *Waste Management Act.*)

Under the *Waste Management Act* is the *Contaminated Sites Regulation*. Part 5, Section 11 (1) (b) states "the surface water or groundwater which is located on the site, or flows from the site, is used, or has a reasonable probability of being used, for aquatic life, irrigation, livestock or drinking water use, and the concentration of any substance in the surface water or groundwater is greater than or equal to the concentration of that substance specified for that use in Schedule 6."

The CRD is developing a model bylaw regulating waste discharges into storm sewers and watercourses. Section 2 (1) states "No person shall discharge or allow or cause to be discharged into a storm sewer or watercourse any domestic waste, trucked liquid waste or prohibited waste." Prohibitions include waste water containing oil, suspended solids, fecal coliforms, and fill.

2.72 Indoor Uses

The most probable indoor use for recycled grey water is toilet and urinal flushing (CMHC 1999). While the water quality standard required is not equal to potable (drinkable) guidelines, consumer acceptance issues remain. Grey water, when stored more than 72 hours or in quantities less than 50 gallons (200 litres), rapidly reaches the bacteria level of black or toilet water.

Water collected for toilet flushing traditionally is treated with chlorine. The toilet tank is a natural incubator for bacterial growth. Malfunctioning systems lead to odorous and contaminated tanks and bowls – a health issue. Water quality for toilet flushing should therefore equal bathing body contact criteria.

Monitoring water quality is essential on a daily and/or weekly basis. To protect users, homeowners need training in monitoring system performance.

CMHC recommends computer-controlled monitoring systems costing $500 - $1000 per unit. Monitoring systems, in addition to pipes rerouting grey water to toilet tanks, make this reuse option expensive for individual homes. However, a cost-benefit analysis of treatment and distribution systems for a cluster of homes, subdivisions, and businesses in specific locations, such as rural communities, merits research.

2.8 RAINWATER HARVESTING

The collection and reuse of rainwater has been a standard practice in many parts of the world for decades. Rainbarrels and cisterns are common technologies to harvest rainwater. Supplemental rainwater systems in both new construction and retrofit situations are becoming increasingly popular where ground water supplies are limited or irregular.

Cisterns supplied from roof rain water avoid the problems of wells, but do need filtration and some form of treatment for algae. Bluestone, iodine, and other treatments are available, but the cistern should remain cool and dark.

The CRD Water Department website lists local rainbarrel suppliers under its water efficiency category. Although rainbarrels help to conserve water, according to the CRD Water Department, they are less effective than other conservation methods such as low-flush toilets.

Deborah Walker, the CRD's Water Department's Demand Management Coordinator produced a paper on Cisterns/Rainwater Harvesting Systems. It provides excellent information on cisterns. [Attachment E-1]. It's available on the website www.advancebuildingings.or/main_t_plumbing_cisterns.htm

The City of Vancouver's 5-year program developed a prototype rainbarrel and distributed them to 1500 for home garden irrigation.

The United States Environmental Protection Agency has estimated that approximately 200,000 cisterns are in use in the U.S. collecting and storing rainwater.

Residents on Gabriola Island can apply for cisterns in the construction of new homes. They are permitted to "prove" the 270 gal per day supply of potable water by constructing a cistern large enough to hold a 7 day supply. Twenty percent of cases of rainwater systems are installed instead of drilling for a well.

An environmental health officer does not need to approve these private source systems; they recommend the BC Safe Drinking Water Guidelines. They do not monitor or test water quality.

The Toronto Healthy House project is not connected to municipal water supply. Instead, their entire source of water is from rainfall and snow. Rainwater from the roof of the house is collected in a 20,000 litre concrete cistern.

The city of Los Angeles has a demonstration site for a double cistern made of Polypropylene plastic. The unit holds nearly 4,000 gallons of water and is recycling locally by ARCO. The water is pumped out by an electric pump on a timer system to irrigate the yard. It also has a flood control device. When a series of catastrophic storm occurs, cisterns can be drained and filled to regulate the flow of water into the flood control system.

For a more comprehensive description and evaluation of rainwater harvesting systems consult Dayton and Knights Ltd. report *Study on Potential Rainwater and Grey Water Reuse in the Greater Vancouver Regional District*.

2.9 GOLF COURSE APPLICATIONS

Golf courses recycled water may be from on site sources – clubhouses, recreational facilities – and off site sources – surrounding subdivisions.

Effluent, after primary and secondary treatment, may be collected in oxidation ponds. Here oxygenating plants remove remaining pollutants and supply turf irrigation quality water (Kasperson 1977). This practice is widespread in southern USA. In Florida, 401 golf courses account for 42% of all reuse systems. These systems process 19% of all water reclaimed in Florida. (Appendix V).

An estimated 1000 golf courses in the United States use recycled water.

BC golf courses using treated water for are in Vernon, Kamloops, and Tumbler Ridge. During Vernon's 125-day dry season the city's entire yearly wastewater flow is used for field irrigation. Since 1977 the city has discharge almost no treated wastewater in Okanagan Lake. At Tumbler Ridge using treated municipal effluent has reduced fertilizer applications.

In Ontario, ClubLink golf clubs are treating sewage wastewater with a Waterloo Biofilter Treatment System and reusing the treated effluent for golf course irrigation. The system is approved by the Ontario Ministry of Environment for large flows with subsurface or surface discharge. (Attachment V-1)

The Anglesea treatment plant along the coast of Australia produces clear effluent suitable for reuse. The Anglesea Golf Club at Baron Water uses the reclaimed water for sub-surface irrigation.

In Sydney, Australia, the Dunheved Golf Club recycles water as an alternative water supply for irrigation. The system is "environmentally friendly" and has been cost effective.

Although not a golf course application, the CK Choi Building at UBC (Appendix E) illustrates the plants as water purifiers' principle. Here phragmites, or tall reed grasses, clean a grey water trench. Wastewater is from sinks and composting toilets. This grass treated water contains 10 parts coliform per 100 ml. The swimming standard is 22 parts per 100 ml. Golf course ponds provide similar treatment potential.

Schedule 2 of the *Municipal Regulation Act* describes the standards for using recycled water on golf courses.

3.0 CLIMATE

3.1 CLIMATE CHANGE

Water supply systems are designed and are operated on the assumption that future climate will look like the past climate.

Reticence to include climate change projections is based on uncertainties of estimates. However, scientific uncertainty associated with climate change is not very different than the other sources of uncertainty associated with the management of water supply systems such as population growth and economic activity. Therefore, uncertainty should not preclude the inclusion of climate change as part of an integrated risk management strategy.

Dr. Andrew Weaver, Chairman of Atmospheric Science, School of Earth and Ocean Sciences, University of Victoria, said **"it is clear that climate change is upon us and**

that there will be an increased likelihood (90-99%) of summer drought in mid-latitudes and an increase in extreme precipitation events."

Victoria is in the rain shadow from the Olympic Mountains and to a small extent from the Sooke hills and, therefore, receives less rainfall than Vancouver. Hence, Victoria is drier and is subject to greater drought-like conditions than Vancouver. The position and form of the mountains surrounding the Fraser Valley cause lifting of moist Pacific air resulting in relatively large amounts of precipitation to the district.

The Victoria Gonzales annual mean maximum and minimum temperatures show a rise in temperature between 1899 and 2000 [Figure 4] whereas from 1902 to 1987 there is a downward trend in precipitation [Figure 5]. Precipitation records at the Sooke Lake reservoir show no trend. Between 1967 and 2002 there is an increase in amplitude of dry and wet years occurring more frequently. [Figure 6]

The combination of rising temperatures combined with no increase in precipitation will increase evapotranspiration. Irrigation of crops and gardens will increase as a result causing a greater demand on water supply.

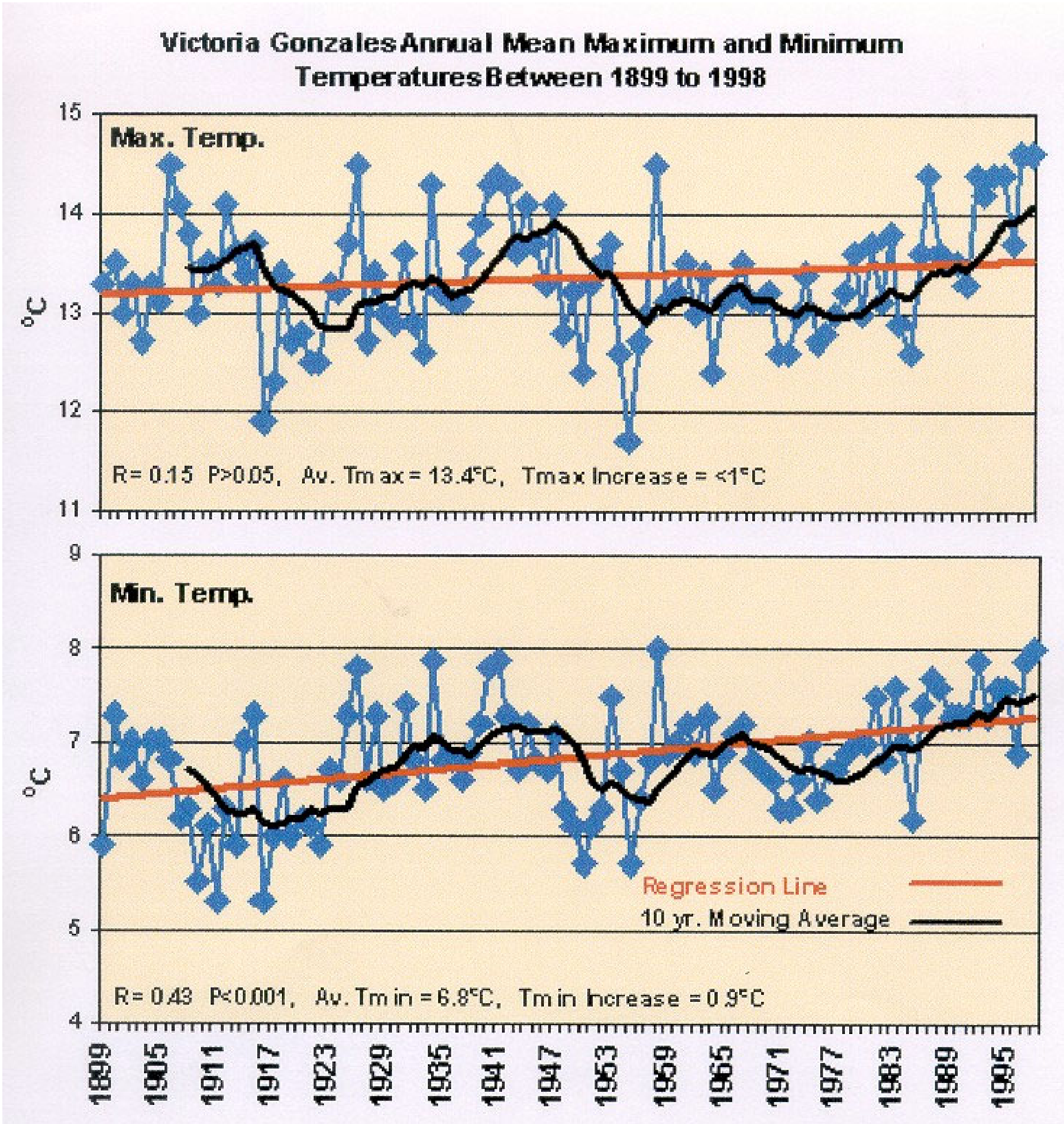

Victoria Gonzales Annual Mean Maximum and Minimum Temperatures Between 1899 to 1998
Max. Temp.
R= 0.15 P>0.05, Av. Tmax = 13.4°C, Tmax Increase = <1°C
Min. Temp.
Regression Line
10 yr. Moving Average
R= 0.43 P<0.001, Av. Tmin = 6.8°C, Tmin Increase = 0.9°C
°C
1899
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Figure 4

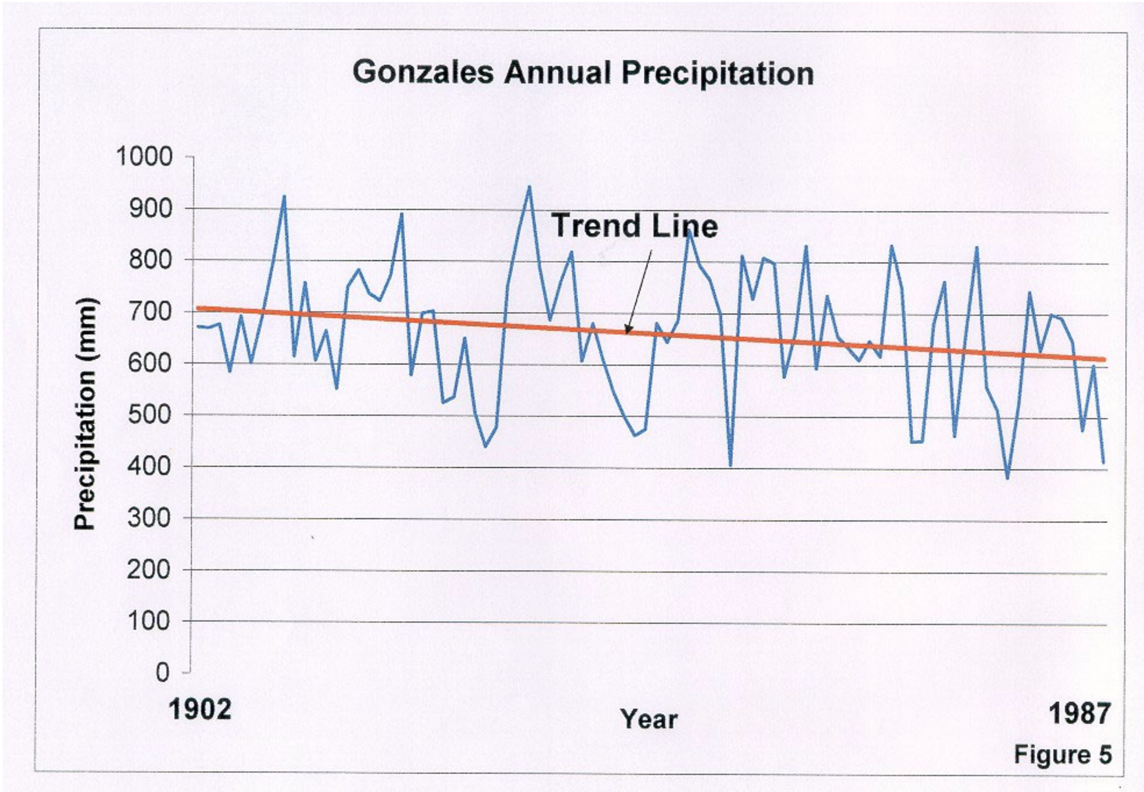

Figure 5

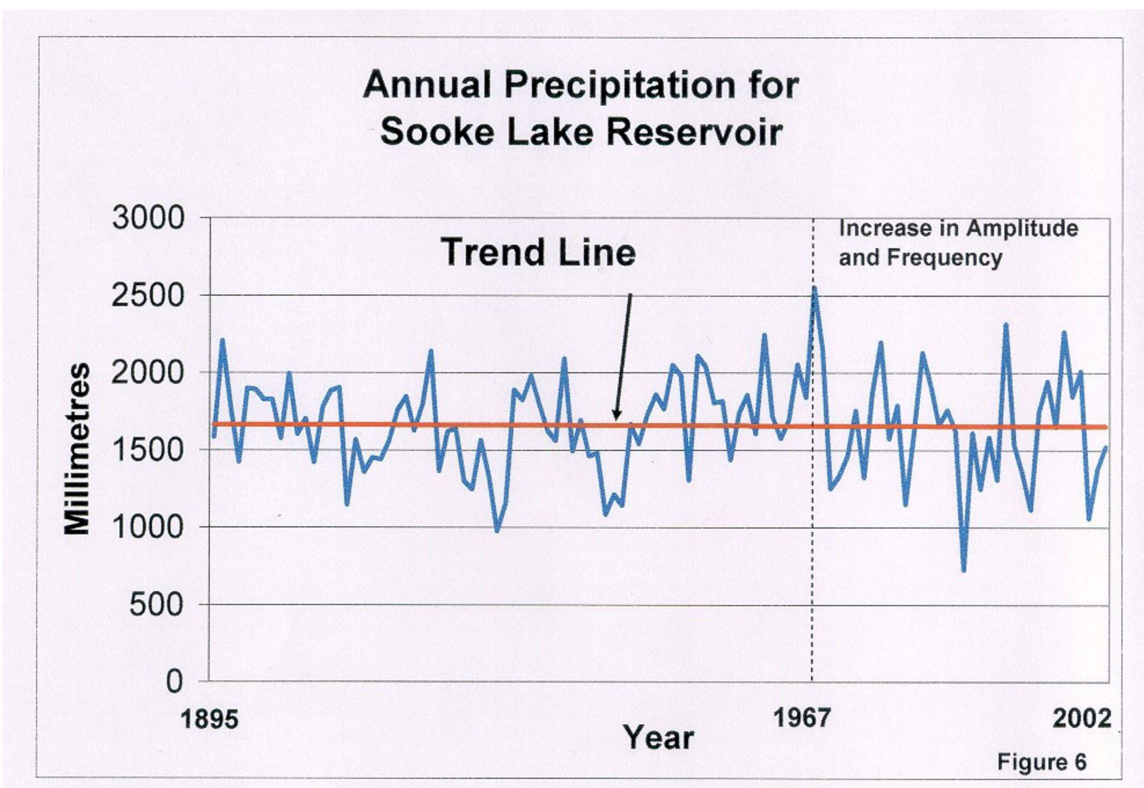

Figure 6

In the second driest summer of Victoria in 2002, a local farmer said "he has soaked his plants with more than 450 million litres of water since July." That's more water than he has ever used.

In Greater Victoria the mean temperature in Greater Victoria for January 2003 was 6.8^{0}C, which is a new record. The average daytime high of 10.1^{0}C was above the normal high of 6.9^{0}C for January. Other individual daytime records were set for January.

3.2 REPORTS AND INTERVIEWS ON CLIMATE CHANGE

A report, *Climate Change and the Greater Vancouver Regional District* [Eric Taylor & Darlene Langlois, Environment Canada], states that from April to June a 10% to 30% reduction in precipitation and no change in July and August is expected due to climate change. But in the fall months precipitation would increase 10-30% and in the winter months 10-20%. Spring and summer are drier, fall and winter wetter. Per capita summer water use will still increase by 3-5% by the late 21st century.

The information is included in another report *Study on Potential Rainwater and Grey Water Reuse in the Greater Vancouver Regional District* [Dayton & Knight Ltd.] to assist the GVRD in developing appropriate climate change adaptation strategies for long-term utility planning.

The *GVRD Climate Change* report concludes that

- The GVRD temperatures have risen gradually over the last 60 to 100 years.
- General minimum temperatures in the GVRD have risen at the rate of about 2^{0}C per 100 years.
- Extreme rainfall events have increased in frequency on the west coast of Vancouver Island.

Although the Greater Vancouver Regional District receives more rainfall than Victoria, it included climate change estimated impacts in their reports. The Water Department does not have a similar report for the CRD.

The Canadian Water Resources Association (CWRA) stated that the "incidence of extreme hydrological events and new and unforeseen climatic records is on the increase…" The CWRA will address water supply impacts due to climate change at their 2003 Annual Conference in Vancouver, B.C.

Environment Canada financed the *Climate Change Action Fund* (CCAF) for a study on the impacts of climate change on water supply and demand in the Okanagan Basin. A University of Calgary project, funded by CCAF, is on *Enhancing Water Supply Infrastructure Investment Planning Practices for a Changing Climate*. The projects aim: improve infrastructures protecting supply systems from hydrological and consumption changes due to global warming.

The United States Environment Protection Agency (EPA) stated in reference to climate change said "Irrigation demand is likely to increase because drier soils will force some farmers to irrigate land that currently can be cultivated relying solely on rainfall. Increased evaporation and transpiration by plants at higher temperatures will tend to increase the amount of irrigation water required in areas that are already irrigated."

"Municipalities are also likely to have higher demands for water, primarily because more water will be needed for watering lawns and gardens. The most widely discussed potential impact of climate change is the impact on water supply and demand. A decline in runoff would translate directly to a reduced supply of water."

The impacts of climate change will also affect water quality.

Richard Hebda, Curator of Botany and Earth History at the British Columbia Royal Museum said "Wetlands will certainly be affected by climate change. ….We must expect major shifts in forest ecosystems to the dry side at least as far north and west as Port Renfrew. These shifts imply strong decline in future water supply even in the next 25-50 years in places such as the Leech River watershed. ….A comprehensive water balance model that factors in climate change must be developed. ….The way to do this is to do a palaeoecological study (hindcasting) in a wetland-lake pair (two cores). The lake will provide the landscape scale data the wetland core will tell us how wetlands might change with effectively less moisture." See website: http://www.royalbcmuseum.bc.ca/nh_papers/atmospheric.html for more information.

Chapter 3*, Canadian Inland Wetlands and Climate Change, Canada Country Study: Climate Impacts and Adaptation* reports that "wetlands are important natural modifiers of water quality and are highly sensitive to climate change and that "Hydrologic functions [of wetlands] include: …contaminant reduction and water conservation." Also,"Stream flow in late summer and fall will likely decrease along the south coast and the southern interior, while stream temperatures will rise. Without access to more reservoir capacity, water supply will be reduced in the dry summer season when irrigation and domestic water use is greatest."
Websites http://www.ec.gc.ca/climate/ccs/ccs_e.htm and http://www.ec.gc.ca/climate/ccs/bcy_summ.htm

The following are based on contemporary measurements of atmospheric concentration of carbon dioxide including proxy records from air trapped ice cores, tree rings, pollen and sediment deposits, etc.

- Carbon Dioxide (CO_2) (a greenhouse gas) has increased 31% since 1750. [*International Panel on Climate Change (IPCC) Third Assessment – 2000*] See website http://www.ipcc.ch/pub/spm22-01.pdf and http://www.grida.no/climate/ipcc_tar/wg1/index.htm
- The present CO_2 concentration has not been exceeded during the past 420,000 years and not likely during the past 20 million years. [*IPCC Third Assessment – 2000*]
- The rate of increase in CO_2 concentration, according to the IPCC, is without precedent in the past 20,000 years.
- Over the past 140 years the 0.6^0C average temperature increase along the BC Coast is the same as the global estimate. [Figure 3] This is the largest increase in any century over the past 1000 years. [*IPCC Third Assessment – 2000*]
- The 1990's were the warmest decade and 1998 the warmest year. [*IPCC Third Assessment – 2000*] and *Indicators of Climate Change for British Columbia 2002, Ministry of Water, Land and Air Protection*]. [Figure 4] See website http://wlapwww.gov.bc.ca/air/climate/indicat/pdf/indcc.pdf [*On Jan. 4, 2003,

high temperatures reached record-setting levels all around Vancouver Island. *Times Colonist*]

- A January 2000 *National Academy of Sciences* (USA) study concluded that "the warming trend in global-surface temperature observations during the past 20 years is undoubtedly real and is substantially greater than the average rate of warming during the 20th century"…and "the rate of warming is accelerating."
- El Nino events have become more frequent in recent years, and four of the ten strongest El Nino events of the 20th century have occurred since 1980. [*Indicators of Climate Change for British Columbia 2002, Ministry of Water, Land and Air Protection*]

What are the projections based on past records?

- The *International Panel on Climate Change Project*, (using past records, with a confidence level of 90-99% chance of more frequent extreme high temperatures) estimate a global increase up to 5.8°C by the end of the 21st century. [*Source: IPCC Third Assessment – 2000*]
- There is a 90-99% chance of more intense precipitation events. [*Source: IPCC Third Assessment – 2000*] [Figure 7]

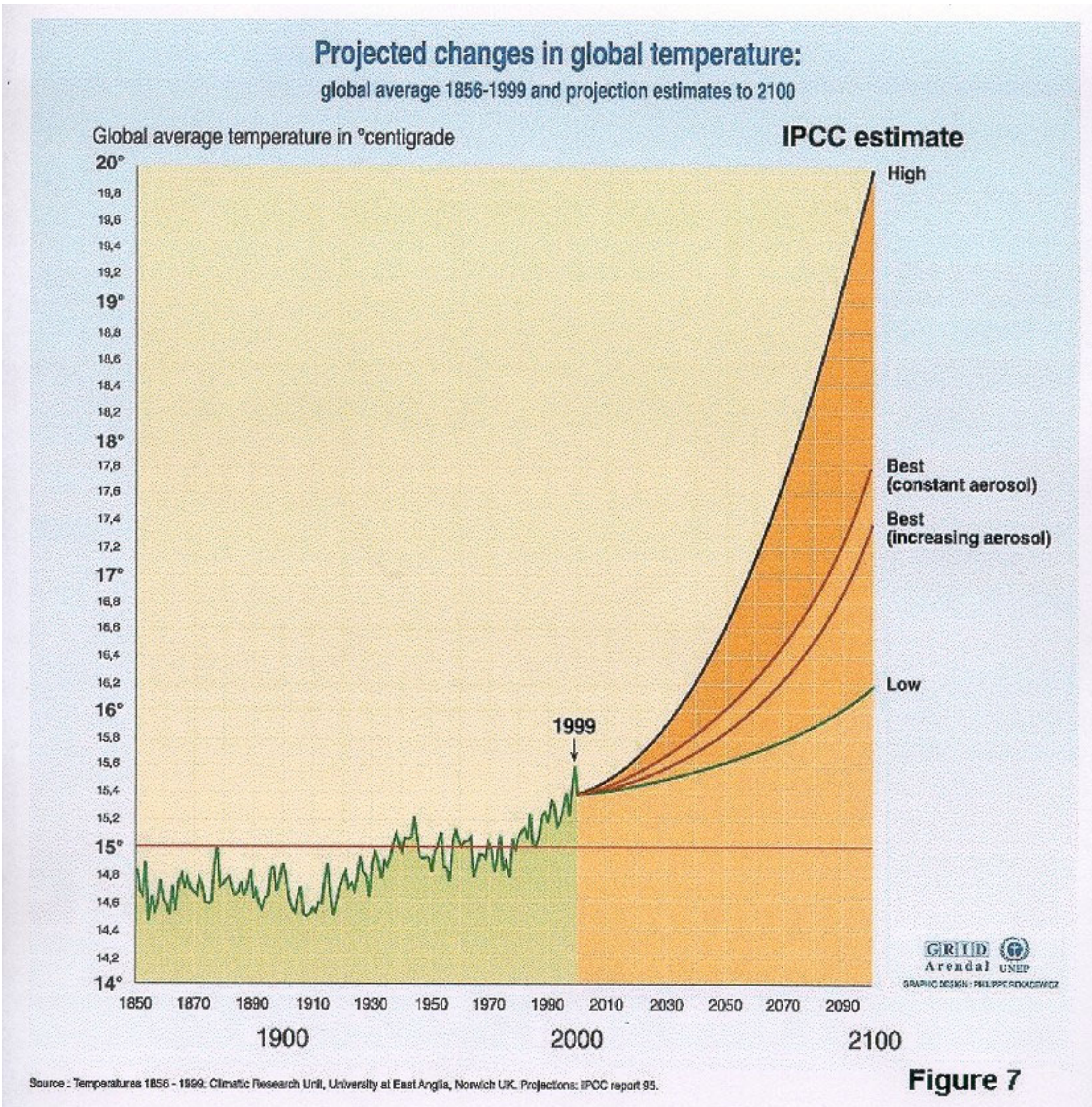

Figure 7

4.0 RECYCLING, EDUCATION, AND RECOMMENDATIONS

4.1 ADAPTATION

Adaptation and changing behaviours on water use are required to address long-term strategies for future water supply. Our consumption rate is still high and supply will continue to diminish unless stronger conservation measures are implemented.

The CRD's population will continue to increase adding extra stress on our water resource. Additionally, climate change could necessitate increases in irrigation for commercial and private uses.

Of first priority is to increase water use efficiency to make the best use of our water supply. Accessing new watersheds without upscaling water efficiency is not sustainable and will have environmental impacts on those watersheds.

Introducing water recycling as a long-term strategy to sustain our water source is beneficial by

5. reducing withdrawal amounts from the Sooke Lake reservoir
6. reducing withdrawal amounts from Leech River
7. reducing our vulnerability to future water shortages and
8. slowing or preventing the necessity of accessing new watersheds for future supply.

Hence, water recycling should be introduced as part of the CRD's long-term water conservation strategy.

4.2 PUBLIC EDUCATION

The reason the British Columbia Ministry of Health Planning is deeply concerned about the use of reclaimed water for residential use is the lack of knowledge and its attendant health risks. They suggest "measured steps" and a "conservative approach" to educate the public on the use of reclaimed water that will eventually lead to acceptance.

In the United States and other countries education programs promote water reclamation and reuse. For example, the Elk Grove/Laguna community in Sacramento, California, have a public outreach program to educate the public about water recycling. The program consists of several components including a community advisory committee, media outreach, speaking engagements, school outreach, a community event booth and participation in community events.

In British Columbia, there is a need for public education before the reclamation and recycling of water for residential use is acceptable by health authorities. A program similar to the Elk Grove/Laguna outreach would be useful to educate the public in the CRD about reclamation, reuse, and the recycling of water.

As a first measured step, since the Code of Practice for the Use of Reclaimed Water *supports the regulatory requirements prescribed in the MSR, there is an opportunity for the CRD to incorporate wastewater treatment systems in new buildings and retrofit others that meets the requirements under the MSR. This is currently acceptable by the Ministry of Health Planning.*

These innovative technologies in buildings acceptable under the MSR could be demonstration sites to facilitate the development of educational programs as steps toward the introduction of recycling water in community controlled subdivisions and *eventually individual residences. An informed and educated public is more prepared to accept and take on the responsibility of using reclaimed water for reuse than those who are unfamiliar with the concept. This would address the Ministry of Health Planning concerns in the long term.*

Demand on our water supply sources will increase as the population grows in the coming decades and possibly exacerbated by climate change. Educating the public on the reclamation of water and safe its applications is a prudent long-term conservation strategy for the CRD.

Recycling is one key factor for a sustainable water supply for the Capital Regional District. Accessing new water sources is not sustainable in the long-term.

4.3 CONCLUSIONS

This report briefly examines many of the issues about recycling water. Our conclusions show that

1. The reclamation of grey water for reuse and recycling should be part of the long-term water conservation strategy.

2. The Ministry of Health Planning have concerns about public health due to a lack of training and eduction to operate and maintain equipment for water reuse but do suggest "moving forward with measured steps and a conservative approach to facilitate the acceptabililty on the use of reclaimed water".

3. There is a need for public education in the CRD on the requirements to have a safe and reliable system for recycling water.

4. There is a need to work co-operatively with Municipal levels of government on bylaws permitting the use of treated grey water. Mutually developing a *Code of Practice Guide* for reclamation, reuse, and recycling water would benefit municipal policy makers and those who carry out those policies.

5. Continued research on reclaiming water for reuse and recycling should be included in the long-term management of our water supply for the Capital Regional District.

a. RECOMMENDATIONS

1. **Reclamation, reuse and recycling water should be incorporated into the Strategic Plan for Water Management.**

2. **Establish an Intermunicipal Committee to develop a *Code of Practice Guide* on water reclamation, reuse and recycling for municipal policy makers.**

3. **The CRD start education initiatives on reclamation, reuse and recycling by**

    a. **expanding the water conservation education program to include public forums on reclamation, reuse and recycling for residential and commercial properties.**

    b. **developing a demonstration project at a small multi-residential or commercial complex to evaluate technologies and support educational programs for rainwater harvesting, storage, disinfection, and reuse for toilet flushing and outdoor non-potable use.**

    c. **organizing a conference on reclamation, reuse and recycling water.**

    d. **recycling water information on the CRD webpage.**

    e. **introducing recycling water as a new category in the annual Water Stewardship Award**

4. **The RWSC provide a report on grey water reuse similar to Dayton & Knight's report *Study on Potential Rainwater and Grey Water Reuse in the GVRD* to be completed by December 31, 2004.**

4.5 REFERENCES

- Study on Potential Rainwater and Grey Water Reuse in the GVRD by Dayton & Knight Ltd.
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- Accelerating the Implementation of Innovative Water and Wastewater Management and Technology (CMHC)
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- Ministry of Water, Land and Air Protection: Municipal Sewage Regulation webpage
- Hydroxl Systems
- Zenon Systems
- Waterloo Biofilter System
- Clivus Grey water Irrigation System
- The Tribune Bay Outdoor Education Centre Constructed Wetland Project
- Indicators for Climate Change in British Columbia; Ministry of Air, Land & Air Protection
- Summary of Policymakers: A Report of Working Group 1 of the Intergovernmental Panel on Climate Change
- Canadian Inland Wetlands and Climate Change, Environment Canada, University of Waterloo, Ducks Unlimited.
- The Ice Chronicles by Paul Andrew Mayewski and Frank White

APPENDIX A

WASTEWATER TREATMENT SYSTEMS

This report refers to wastewater treatment systems: Cycle-Let®/ZenoGem™, Hydroxl; Ecotech Wastewater Treatment Solar Aquatics; Waterloo Biofilter™; the Clivus Grey water System, and Living Machine. Other technologies are viable including the Massachusetts Alternative Septic with the Eco-Ruck System; the MicroFAST System; and a number of other grey water treatment systems. Website www.buzzardsbay.org/ for details.

The British Columbia Ministry of Water, Land and Air Protection accepts the Hydroxl, Cycle-Let®/ZenoGem™, and Ecotech Wastewater Treatment Solar-Aquatics Systems. All must follow the *Municipal Sewage Regulation* and the *Code of Practice for the Use of Reclaimed Water.*

(a) Cycle-Let®/Zeno ZenoGem™ Treatment System

The Cycle-Let process consists of three steps: aerobic biological treatment, membrane-based ultrafiltration, and final polishing/disinfection. The technology combines bio-oxidation and membrane separations. Treated effluent is for toilet flushing and landscape irrigation.

The technology, tested by the National Sanitation Foundation, is certified for performance and reliability under NSF Standard 41.

The system was installed in March 1996 at the Children and Family Services Building in Sooke. (Attachment E)

Cycle-Let technology is now owned by Zenon Environmental Inc. and marketed as the ZenoGem™ System. (Att. C)

As of 1997, Sooke Harbour House uses the ZenoGem™ System for toilet flushing and irrigation. (Attachment D). It is also used in the Kingfisher Oceanside Resort and Mt. Washington Ski Resort [Att. D-1] on Vancouver Island.

Mt. Washington ski resort ZenoGem treatment plant has the capacity to process 650,000 imperial gallons per day. Two smaller treatment plants process 45 cu. metres per day.

(b) Hydroxl Systems

The Hydroxl Water Treatment Systems are used for industrial, marine, and non-hazardous liquid waste applications. The process for reclamation consists of flow equalization, solids flotation, biological treatment, and disinfection.

Hydroxl Systems installed a system in the Columbia Icefield Centre in Jasper National Park treating 250,000 litres of wastewater per day. Drain water is filtered and recycled through low-volume toilets, then pumped to the Centre's treatment plant. (Att. F)

Hydroxl also installed a treatment system in the Sustainable Technology Center at Friday Harbour, San Juan Island in Washington. The treated non-potable water is used for toilet flushing and landscape irrigating. (Att. G)

Hydroxl processes effluent at the Terpine Refinery in Northwestern Washington State for reuse in the plant's cooling towers. (Att. H)

Website www.hydroxl.com

On Vancouver Island, Hydroxl Systems installed a sewage system at the Valleyview Shopping Mall in Cobble Hill. The treated outflow is for landscape watering. (Att. I)

According to David Jackson of Hydroxl Systems in Sidney, B.C., "…local treatment and reuse (such as golf courses) is very practical. One big advantage of treating closer to source is that the water can be more easily redistributed to reuse applications. With a fully centralized system, the cost of re-distribution could be prohibitive."

(c) Solar Aquatics Systems®

The Solar Aquatics System treats effluent to advanced secondary and tertiary standards through a series of aerated translucent tanks hosting plant communities and aerobic micro-organisms.

Natural purification processes of freshwater wetlands are duplicated. Wastewater circulates inside a greenhouse series of clear tanks, each with aquatic ecosystems, like marshes. Sunlight, oxygen, bacteria, algae, plants, and snails work together to purify water. Tanks are aerated and mixed to prevent sludge from settling. This enhanced degradation results in fewer solids than conventional systems.

Super-clean effluent is for irrigation or groundwater restoration. Disinfected effluent supplies toilets.

Englishman River Falls mobile home park in Errington, BC uses the Solar Aquatics system with septic flows of 10,000 gallons per day (gpd) from 200 people. The system is also used Bear River, Nova Scotia. Septic flows of 55,000 gpd are treated. (Att. J)

Website **www.ecological-engineering.com/solarquatics.html**

(d) Waterloo Biofilter®

The Waterloo Biofilter™ is an aerobic biological process which removes organic matter and affects nitrification. Nitrification is the biological conversion of ammonia nitrogen to nitrate nitrogen. (Att. K)

The National Sanitation Foundation has tested this system and approval is expected. The system already has approval from Ontario, Massachusetts, and limited approval in Michigan.

Website **www.waterloo-biofilter.com/**

This system is used in the Toronto Healthy House Project (Att. L) (See section D. (a) for a complete description)

The Toronto Healthy House is a joint project of Martin Liefhebber Architect, Creative Communities Research Inc., Canada Mortgage and Housing Corporation, City of Toronto Public Health, Ontario Ministry of Health, and Ontario Ministry of Environment and Energy. The project won the Healthy Housing Design Competition in 1991.

Website http://mha-net.org/msb/html/papers-n/palo01/wastewa.htm and http://healthyhousesystem.com/history.html

(e) Clivus Grey Water Irrigation System

The Clivus Water System is a simple method of using grey water for irrigation. The system consists of a dosing basin, effluent pump, water level controls, and covered irrigation troughs. Joan van der Goes, of Cedar, Vancouver Island, has a demonstration of the Clivus System and the Clivus Multrum composting toilet. (Att. M)

Website www.greywater.com/treatment.htm

The Clivus Multrum composting toilet conforms to all requirements of the NSF Standard 41 for Wastewater Recycle/Reuse and Water Conservation Systems and has Seal No. 8551 (National Sanitation Evaluation and Testing from 1982) but the grey water system does not conform to the Standard No. 41 requirements.

Website www.multrum.com/testing.htm & www.nst.org

However, as of 1999, Standard No. 41 no longer includes a section on grey water recycling.

For an analysis of the Clivus Multrum System see the CMHC's Biological Toilets and Grey Water Systems. *A Critical Evaluation of Their Application in Canadian Housing.*

(f) The Living Machine

The Living Machine was designed by John Todd at the Centre for the Restoration of Waters at Ocean Arks International. This engineered biological system to treats wastewater and sewage. Website www.livingmachines.com/htm/how_works/step1.htm

The system is in use at the Body Shop in Toronto (Att. N), South Burlington, Vermont, and Findhorn, Scotland.

Website **www.livingmachines.com/htm/home.htm**

(g) Other Systems

Grey water is treated and reused in other examples such as the Quayside Village in West Vancouver (Att. O), the CK Choi Building at the University of British Columbia (Att. P), and the Waterloo Region Green Home in Ontario (Att. Q).

The Vancouver Island Technology Park in Victoria does not recycle water but has separate plumbing lines directing rainwater to toilet tanks. (Att. R)

Under the Comox Valley Citizens Action for Recycling and the Environment (CVCARE), three sites in the Comox area test grey water planters with 100 square feet of soil surface. The planters can purify 200 imperial gallons a day. The Ministry of Health classifies non-sewage grey water as a biohazard, because it sometimes contains serious amounts of fecal coliforms. Test trials, begun in December of 2001, are favourable. CVCARE hopes the Ministry of Health will allow grey water planters combined with composting toilets to serve rural homes.

Website **http://care.comoxvalley.com/**

APPENDIX B

GREYWATER APPLICATIONS

(a) INTRODUCTION

Recycled domestic wastewater from bathroom sinks, tub/showers, dishwashers, and washing machines have several potential reuses. These include:

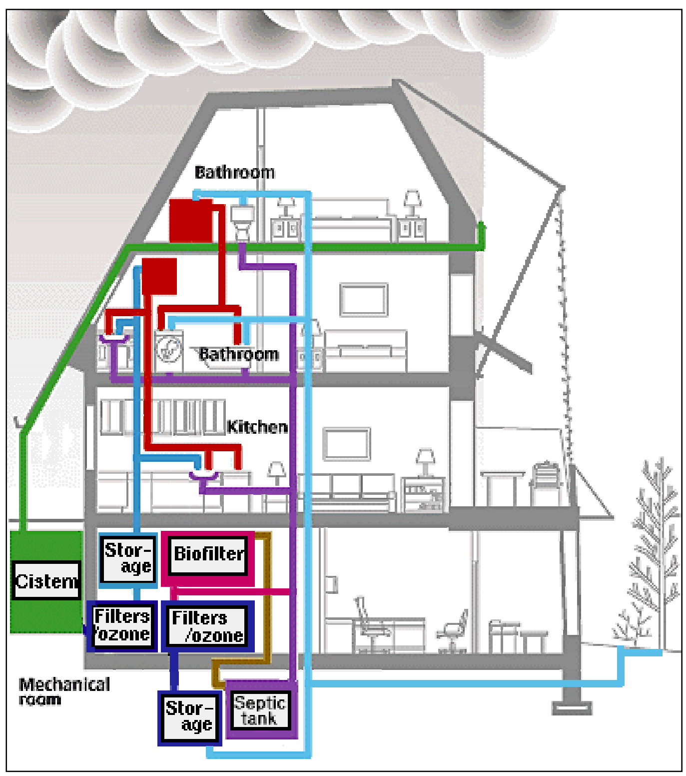
- irrigation
- toilet flushing
- fire protection
- construction
- landscape impoundments (ponds, lakes)
- street cleaning

(Kasperson 1977)

Currently, irrigation is the most viable reuse application for homeowners. Equipment for garden watering is technically and financially the most accessible recycling system.

(i)Toronto Healthy House

The most advanced example of indoor domestic water reuse in Canada is probably CMHC's Healthy House in Toronto. Criteria included being affordable for the occupants and reducing resource demands. Chris Ives, project manager for CMHC said "This house may appear revolutionary, but it is actually based on ideas that are not new or hightech. The result is not a demonstration house of tomorrow, but rather a demonstration of housing choices do-able and affordable today." The builder and owner of the house anticipates that residential application of the system would cost about $10,000, or less if demand warranted mass production of the system.



This three-bedroom single family dwelling has <u>NO</u> connections to city water, <u>sewer</u>, or gas systems. The source of water is rainfall and snow stored in a 20,000 litre underground cistern. Rainwater is treated to remove acid rain, odour, organics and low levels of hydrogen sulphide and then treated with ozone.

Using a Waterloo Biofilter, Ozone Disinfection Unit, and Sand Filter Leaching System, the house recycles 100% of wastewater produced. Potable and wastewater streams are completely separate. Purified rainwater is for drinking, bathing, sinks and dishwashers, while reclaimed water used for secondary purposes.

Water consumption is approximately 120 litres per day for a family of three. Normal consumption for a family of three is 1,050 litres, or 350 litres per person per day. No chlorine, aluminum or other additives are used to make the water safe potable.

Potable water supplies all sinks and the dishwasher. By recycling 600 litres of the 720 litres available for daily consumption, disposed water is only 120 litres per day. The reclaimed water supplies tubs, showers, toilets and washing machine. Water is reclaimed and recycled 3 to 5 times. The purified surplus daily —120 litres—waters the front garden. Water consumption is therefore reduced to one-tenth of that in a typical household.

Cost

The systems as built in the Toronto Healthy House project cost in the region of $15,000 per house. If this self-contained approach proves feasible then estimated costs drop to $10,000 per house.

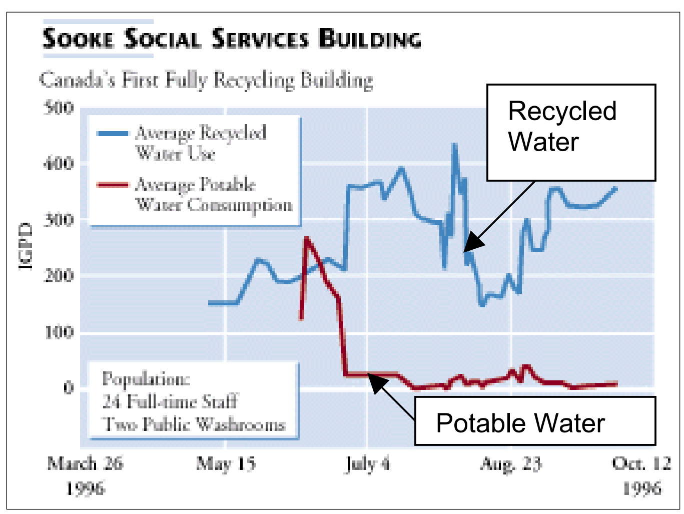
If manufactured in quantities over a 1000 per year, estimated cost drops to $7500 per house. That is competitive, even cheaper than servicing new subdivisions in many cases. It is also comparable to a conventional septic system on a flat site.

The cost of the systems in the Toronto Healthy House project has been partially subsidized by the participation of the suppliers as sponsors. The sponsors of the water systems in addition to CMHC include Wilkinson Heavy Precast who sponsored tanks in part, RAL Engineering, Trojan Technologies Inc., and Waterloo Biofilter.

Consult website **www.cmhc-schl.gc.ca/publications/en/rh-pr/tech/01-115-e.html** for details.

(ii) Family and Children Services Building (Formerly the Sooke Social Services Building) in Sooke

Grey water is recycled throughout the building for toilet and urinal flushing. The result: a water consumption reduced to only 82 litres per day from 1,818 litres per day with an annual saving of 272,760 litres of potable water. (See graph)



The system cost $80,000 to install and has an annual operations budget of $11,400. Since the site topography/soil conditions limited conventional septic fields, it is economically viable.

Benefits accrued of this project included a reduced water demand on the local aquifer of 600 m^3 per year, a saving in the disposal field cost of $15,000 to $18,000, and a larger building and parking lot, with a 40 percent increase in revenue.

Technical descriptions and diagrams of the Cycle-Let® membrane bioreactor system is in Appendix E.

(iii) Sooke Harbour House

This famous country inn uses the same technology as the Children and Family Services Building to reclaim grey water for toilet flushing, but also uses treated water for irrigation. The cost is significantly higher at $320,000 with an annual operating budget of $11,400.

All grey and black water is treated and recycled for toilet and urinal flushing. Excess renovated wastewater is used in a drip irrigation system, resulting in a demand reduction of 2,300 m^3 per year. This reduced consumption (about 70% of the water is recycled) decreases discharges to the disposal fields. Fields are considerably smaller than conventional sewage treatment systems'.

(iv) Husband Park Elementary School, Courtenay

Husband Park Elementary School in Courtenay uses the ZenoGem™ system

with dual pipes for irrigation and urinals.

(v) Conservation Co-op Residential Water Reclamation Project (CCRWRP), Ottawa

The CCRWRP is a four story 84 unit apartment building located in Ottawa. Unique features reduce energy consumption and environmental impacts. The Co-op was originally constructed with a dual plumbing system in eight (8) apartment units to facilitate a residential water reuse project.

The treatment facility is as a pilot project with the support of Canada Mortgage and Housing Corporation.

Dual plumbing supplies a small grey water reclamation system. The system demonstrates grey water reclamation by reducing water demand and waste discharge. The Regional Health Department accepts the system on the condition reused water is strictly for toilet flushing. Grey water is from bathing, clothes washer, and dishwasher rinse cycles. Machine washwater, and kitchen and toilet wastewater is excluded.

Estimated daily water use in the 8 apartments, based on preliminary flow monitoring, is 640 litres for toilets and 2,000 litres for other uses. The reuse plant treats up to 1,000 litres daily accommodating maximum day toilet use. The average bath /shower water flow is 1,300 litres per day.

Water consumption of 11,900 m^3/year is 27% less than conventional buildings.

Website **www.advancebuildings.org/main_cs_coop.htm**

(vi) Elk Grove/Laguna, Sacramento

Water recycling is an alternative supply for Elk Grove/Laguna at Sacramento. Recycled water is treated by the Regional Wastewater Treatment Plant owned by the Sacramento

Regional County Sanitation District. It is carefully regulated by the California Department of Health Services and the California Regional Water Quality Control Board.

Wastewater is diverted through sewer pipes and directed to the Regional Wastewater Treatment Plant. Treatment removes solids and organic materials. The water is filtered and disinfected to destroy bacteria, viruses and other pathogens. Then treated water is distributed to the community through purple pipes, completely separate from the drinking water system. The recycled water is clean, clear and safe. No health problems have been linked to the use of recycled water. (Excerpts from their brochure. (Att. T))

Website **www.srcsd.com/pdf/srcsdbrc.pdf**

(vii) Simple Methods for Toilet Water Conservation

Alternatives to complex indoor recycling systems are readily available.

- install low flush toilets, or waterless composting toilets
- alter consumer use patterns – "If it's yellow, let it mellow…"
- Flushing toilets with buckets supplied by collected bathwater. While not an easy flush, in severe droughts or if the inhabitant(s) are committed to low environmental-impact lifestyle, this is feasible.

(c) OUTDOOR USES

Using grey water for outdoor irrigation offers the major advantage or NOT requiring disinfection with chlorine, ozone, or biofilters. The basic principal of grey water irrigation is natural microbes in healthy soil efficiently and safely destroys potentially harmful bacteria and pathogens.

(i) The Tribune Bay Constructed Wetland, Hornby Island

The GreenHouse Organic Sewage Treatment Society, a non-profit society formed in 1993, promotes groundwater protection and alternative on-site sewage treatment. In 1996 the Society joined the Citizens for Action on Recycling and the Environment (a Comox Valley group working on the Baynes Sound Stewardship Initiative) in a demonstration dedicated to researching innovative sewage treatment.

Hornby Island's Tribune Bay *Outdoor Education Centre*, owned by the (then) Ministry of Parks, Lands, and Housing, serves the School District's pupils. The 14 hectare site tests and demonstrates alternative systems.

The Baynes Sound Action Group (a coalition of government agencies, community organizations, and the shellfish industry) and the (then) Ministry of Environment, Lands and Parks, support the project.

From 1998 to 2000 these groups built and evaluated demonstration gardens using wastewater from outdoor kitchens and washbasins in camping areas. They also built and evaluated gardens using for shower facilities.

From 1999 to 2000 water was reused for toilet flushing and landscaping. From 2000 to 2002 a greenhouse with a complex eco-system treats septic effluent and shows the interplay of eco-systems and food chains. Summer wastewater from the lodge and council cabins supply the greenhouse. (Att. U) Website
http://mars.ark.com/~hoeppner/

(ii) Technology Available

Preliminary research indicates the CLIVUS Grey Water Irrigation System is the simplest and most effective garden watering equipment available. The system is easy to maintain.

This simplest technology still requires two wastewater systems: One for black (toilet) water connected to conventional sewers; and one for grey water (bathroom sinks, tub/showers, and laundry) connected to irrigation outlets. Kitchen wastewater containing grease, oil, food particles, and detergents is technically and economically best disposed with black water. Grease traps are required with kitchen wastewater recycling for homeowners to clean/change. Harsh kitchen detergents are also incompatible with healthy soil organisms required to treat grey water.

APPENDIX C

HORTICULTURAL APPLICATIONS

(a) Potential Benefits

1. The load on existing sewer systems is reduced. In new developments, the size of sewer systems required is reduced or eliminated (e.g. Sooke Harbour House).
2. Demand on potable water supplies is reduced.
3. Organic nutrients in grey water are naturally returned to the earth.
4. Raised beds used in the CLIVUS Grey Water Irrigation System are potentially an asset in landscape design if carefully integrated with the site's plan.
5. *With sufficient filtering*, grey water can irrigate lawns. Although processing is costly during droughts, this recycled water can save turf installations worth thousands of dollars.
6. With sufficient filtering, grey water can irrigate choice ornamentals. Again, although processing is costly, during droughts this recycled water can save landscapes worth thousands of dollars.
7. Where soil/topographic conditions are difficult, grey and black water recycling is the only method of effectively sewering a site (e.g. Children and Family Services Building).

(b) Potential Problems

1. Raised beds used in the CLIVUS Grey Water Irrigation System are not suitable in some landscape designs.
2. Mulch Basin Distribution Systems (Santa Barbara Study – Attachment Q) are also not suitable in some landscape designs. Retrofitting a landscape with either raised beds or mulch basins is difficult and expensive.
3. Thick, chunky mulches which assist microbial activity do not suit some landscapes.
4. Many choice trees and shrubs do not tolerate and/or require constantly moist, nutrient-rich growing conditions. These include native and exotic species. A few of many indigenous species not tolerating grey water irrigation:

   - ARBUTUS menziesii (Madrona)
   - BRODIAEA coronaria (Harvest Brodiaea)
   - CAMASSIA quamash (Camas Lily)
   - QUERCUS garryana (Garry Oak)

   A few examples of exotic species commonly used in CRD landscapes not requiring routine dry-season irrigation are:

   - ARBUTUS unedo (Strawberry Tree)
   - CISTUS purpureus (Purple Rockrose)

- PINUS nigra (Black Pine)
- SENECIO greyii

Grey water irrigation systems must be carefully sited to prevent conflict with XERISCAPES. (Xeriscape: a landscape designed using low water demand trees, shrubs, perennials and bulbs. Hardscaping, a built area with paving and/or gravel, also plays a key role in Xeriscapes)

5. Users of grey water irrigation systems must be careful with detergents/cleaners. Many detergents are sodium-based. Residual salt build-up in soils is fatal to most plants. A few genera commonly grown in Victoria gardens particularly susceptible to salt damage:

    - AZALEA
    - CAMELLIA
    - MAGNOLIA
    - RHODODENDRON

    Acid-loving genera are most susceptible. Damage appears as burnt, black leaf margins.

6. Only established plantings can tolerate grey water contaminants. Seedlings, as in newly planted vegetable gardens, may be burned by grey water.
7. Lingering health concerns limit grey water applications to food crops where only above ground portions are eaten, e.g. corn, tomatoes, squash. Similar concerns limit use on leafy vegetables, e.g. lettuce, cabbage, spinach, eaten raw.
8. Difficult site conditions limit grey water irrigation applications. These conditions include:

    (a) Waste water discharge points below areas needing irrigation. Here pumps with filters must be used. Filters require attention to avoid clogging.

    (b) Similarly, steep slopes create run-off problems.

    (c) Sandy soils with low microbial activity are inadequate. Porous conditions allow grey water to run through without sufficient time for beneficial bacteria to break down harmful bacteria.

    (d) Clay soils with low absorption capacity are inadequate. Non-porous conditions do not absorb grey water fast enough for prompt breakdown of bacteria – surface pooling may result.

9. Storing grey water for more than 24 hours creates a bacterial breeding tank. This need for prompt distribution means irrigating plants whether they need it or not.
10. Special conditions will overload the grey water irrigation system. A house full of overnight guests, heavy duty seasonal cleaning, or abnormally heavy rains strain a distribution system.
11. Grey Water cannot safely SURFACE sprinkle lawns. The problems are: potential pathogens are aerosolized making inhalation possible. The safe method of grey

water lawn irrigation is underground drip tubing using a sand filter system. These systems are $1500 plus. Turf roots may ultimately clog the tubing.

Grey water sources, particularly those including linty laundry water, rapidly clog perforated irrigation pipes, micro-drip tubes, and garden soaker hoses. Filters preventing downstream blockage clog just as rapidly with human hair, lint, etc. Frequently changing/cleaning filters exposes consumers to potentially harmful pathogens and is time-consuming. Consumer training reduces this health hazard.

Note: Attachments A to W are NOT part of the digital document. They may be obtained by calling the CRD Water Department at (250) 474-9606.