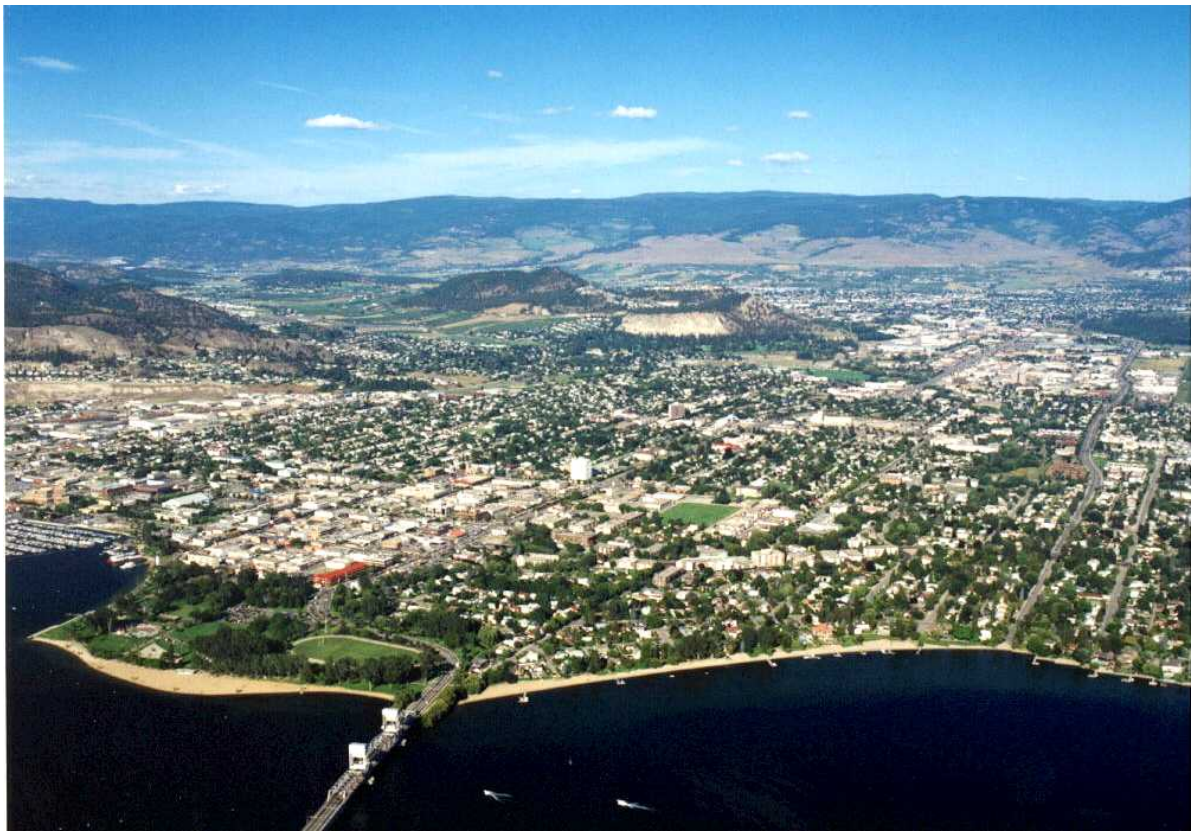
CITY OF KELOWNA
STATE OF THE ENVIRONMENT REPORT
2003



Environmental Division
City of Kelowna

City of Kelowna

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STATE OF THE ENVIRONMENT EXECUTIVE SUMMARY

Purpose of the Report

The City of Kelowna Environment Division has been conducting State of Environment Reporting since 1995. Two reports were previously compiled in 1995 and 1998. The goal of the 2003 report is to review change of environmental condition since 1998 and provide information that will assist in the development of recommendations for enhancement of environmental policy. Ultimately, the State of Environment Report is a tool to influence planning that further establishes environmental fundamentals for our growing city. The next step is to tabulate the public environmental indicators and provide recommendations for City Council. This will then complete the role of the State of Environment Report for the term ending 2003.

Introduction

The City of Kelowna is located on the easterly shore of Okanagan Lake in the Ponderosa Pine Biogeoclimatic zone, the warmest and driest forest zone in the province. The favourable climate has fostered a strong agricultural setting. Today, Kelowna is home to approximately 103,425 people and continues to be one of the fastest growing areas in the province.

The preservation and enhancement of the quality of the natural environment continues to be a central issue for many Kelowna residents. The Strategic Plan (1992) identified the environment as being the primary issue of concern to City residents.

State of the Air

The state of Central Okanagan air quality is generally good. Minor improvements have become evident due to policies and strategies developed through the Central Okanagan Air Quality Management Plan. Burning practices and increasing population are of greatest concern for maintaining good air quality throughout the region.

State of the Water

Significant steps have been taken to improve protection of source water and water conservation within the City Water Utility. However, population growth once again is a source of concern to sustainable management within the City. As well, local purveyors and all levels of government need to develop integrated management of the resource to improve water quality and conservation of the resource.

State of the Land

Increasing urbanization is creating several negative impacts on our land base. Agricultural land has been well protected through the Agricultural Land Reserve (ALR); however, the urban footprint is increasing. The health of our watersheds is still in need of improvement. Restoration efforts have made a positive impact, but insufficient funding is impeding restoration progress.

Organization of the Report

The report is organized into three main chapters, which review the state of air, water and land. Supplemental chapters include City education initiatives, environmental indicators and the 2003 Okanagan Mountain Park Fire.

2003 OKANAGAN MOUNTAIN FIRE EXECUTIVE SUMMARY

In August 2003 the Okanagan Mountain Fire burned 239 homes, as fire swept through the South Slopes area of Kelowna. The fire not only destroyed homes, but it also impacted hydrology, terrain stability and wildlife habitat in the area.

The 256,000 acre Okanagan Mountain Fire impacted several watersheds which have been partially or completely burned, including:

Watershed	Area and Percent Burned
Deeper Creek	100%
Bertram Creek	100%
Bellevue Creek	40%
Priest Creek	50%
Lebanon Creek	100%
Varty Creek	100%
KLO Creek	41%

(Dobson Engineering, 2003)

Hazard and geotechnical assessment work was performed by Dobson Engineering Ltd. and initial mitigation works to reduce the risk within the fire impacted areas has begun. Severe impacts to stream and wildlife habitats have been noted.

The loss of trees, shrubs and grasses due to the fire was the immediate impact of the fire. With the loss of vegetative matter, water normally intercepted and absorbed is now available to become runoff. The lack of vegetative cover will also increase the snowmelt rate in the spring, thus contributing more water to become surface runoff. When a tree dies the root structure also begins to decay. The decaying roots are no longer able to hold soil on the surface, making the soils highly erodible. Burned out roots also contribute to erodible soils and unstable slopes.

Due to the intense heat of the fire and the amount of burned understory and litter, the Okanagan Mountain Fire also created hydrophobic soils in the burned watersheds. These hydrophobic soils repel water, reducing the amount of water infiltrating the soil. This decreased soil infiltration results in increased erosion and therefore increased sediment into the streams. The estimated time for breakdown of the hydrophobic conditions in burned soils is 3 to 5 years.

The increased availability of water and the hydrophobic nature of the soils will undoubtedly increase the rate and amount of soil erosion in the watersheds. The soil erosion will lead to increased levels of turbidity in streams which decreases water quality.

The loss of habitat is expected to be high for fish and wildlife habitat, including several species at risk. In general, streams and stream corridors provide habitat for more than 85% of our wildlife species (Department of Fisheries and Oceans, 1993). In addition to habitat loss, impacts will also be seen due to anthropogenic activities associated with the fire. Surface erosion, from increased water flows and lack of vegetative cover, will potentially result in increased sediment loads to creeks, impairing water

quality, creek habitat, and Okanagan Lake foreshore kokanee-spawning habitat. Slower vegetative recovery of the area can also result due to the loss of forest soils from erosion.

Okanagan Mountain Fire, 2003

Beginning in 2004, the Environmental Division will lead the *Central Okanagan Post Fire Habitat Rehabilitation Project* to address these losses. Initial strategies will include erosion control, which will assist these forest and riparian areas to re-grow and stabilize over the next several years. As demonstrated by the October 2003 storm event, there is a high likelihood of debris flows following intense rainstorms as long as the hydrophobic soils exist. Water quality will be degraded due to increased sedimentation of streams. Increased erosion rates and sedimentation are anticipated in the larger watersheds such as Priest and Lebanon Creeks. Additionally, the impacts will be evident in Okanagan Lake, particularly near the mouth of the larger streams (Dobson, 2003).

There are numerous techniques utilized for erosion control. Some of the techniques that will be used include: contour logging, replanting and seeding, silt fencing and instream structures. Contour logging involves the placement of felled or fire-burned trees and woody debris running adjacent to the contours of the hillslope. This can help lessen the impacts of mudflows and erosion caused by increased surface runoff. Replanting and grass seeding are done as soon as possible following a fire in an effort to stabilize soils. Fast growing native species can be planted to stabilize soils and to act as a filter for sediment. Silt fences and instream structures are used to trap sediment either before the sediment enters a stream (silt fences) or by forming sediment deposition areas in the streams (instream structures).

The objective of the multi-year *Central Okanagan Fire Habitat Rehabilitation Project* is to rehabilitate riparian and terrestrial communities impacted by the Okanagan Mountain Fire by utilizing restoration and enhancement techniques that will accelerate the re-establishment of terrestrial and riparian habitats. Rehabilitation of anthropogenic sites and the use of sediment and erosion control will subsequently conserve nesting, spawning, and feeding areas of the various species that utilize them.

Although the *Central Okanagan Fire Habitat Rehabilitation Project* is in place, natural recovery has already started. Fire is a natural disturbance in the Ponderosa Pine / Bunchgrass Biogeoclimatic Zone. Trees such as the Ponderosa Pine and Interior Douglas Fir have developed a thick bark that protects them from low intensity fires, which are a part of the natural disturbance regime. The Lodgepole Pine needs fire to open up its cones so seeds can be released. One month after the fire was extinguished, one foot alder chutes were already growing out of burned out stumps and native grasses were already sprouting from the ashes.

The impact of the Okanagan Mountain Fire on the City of Kelowna's Environmental Indicators is somewhat evident in 2003 data in areas such as air quality; however, the full extent of the environmental impacts of this event will become evident over time.

1.0 AIR QUALITY EXECUTIVE SUMMARY

The Central Okanagan is one of the fastest growing regions in British Columbia. Currently, the regional population is approximately 158, 562. Projections estimate the population will reach approximately 220,000 by 2020. Population growth, coupled with topographic characteristics and weather patterns, increases the potential for degraded air quality in the Central Okanagan.

Smoke from burning, as well as vehicle and industrial emissions, are the three main air pollutant sources in the Central Okanagan. The noticeable increase of urban "smog", public complaints about smoke, increased awareness about the harmful effects of low level pollutants, and persistent "fair" and "poor" air quality index ratings led the region to take action on the issue of air quality.

To achieve a greater understanding of air quality issues, the Regional Air Quality Committee staff drafted an Air Quality Discussion Paper in 2001 with assistance from the Central Okanagan Regional Growth Strategy. The discussion paper serves as the directing framework for Central Okanagan air quality management planning and is the cornerstone to policy development and management strategies concerning the region's air quality.

The four main objectives of the Central Okanagan Air Quality Management Plan are as follows:

- To assure that citizens of the Central Okanagan have healthy air to breathe
- To integrate regional air quality goals into all policies, including land use and transportation planning
- To encourage behaviour that will endorse air quality protection
- To harmonize initiatives with other agencies and all levels of government

Applications such as the Air Quality and Ventilation Indices, as well as air quality monitoring, have provided data from which direction of proactive plans can take place. Degraded air quality affected the Central Okanagan for an average of 1226 hours per year from 1996 to 1998. Since 1998, emission reduction measures and educational programs brought forward through the management plan have helped to reduce degraded air quality hours to approximately 832 per year. More importantly, the frequency of severe "poor" air quality episodes has dramatically decreased. From 1999 to 2002, air quality in the Central Okanagan has been rated "good" 90.5% of the time, "fair" 9.5%, and "poor" less than 0.1% of the time (MWLAP, 2003a). In 2003 smoke from the Okanagan Mountain Park forest fire caused the only poor air quality of the year; it also contributed to a 58% increase over the number of fair air quality hours recorded in 2002.

The City of Kelowna and the Central Okanagan Regional District recognize that integration of cooperative sustainable practices between key stakeholders and all levels of government is imperative to maintaining good air quality and achieving goals to reduce pollutant and greenhouse gas emissions.

Several steps have been taken to advocate cooperative management practices, such as:

- Joining the Partners for Climate Program (City of Kelowna/Central Okanagan Regional District) in 2001
- Endorsement of the Kyoto Protocol by the City of Kelowna's municipal council in March of 2002
- Adoption of the Federation of Canadian Municipalities resolution towards reduction of greenhouse gas emissions in September of 2002

The City of Kelowna and the Central Okanagan Regional District plan to continue delivery of their air quality mandate utilizing the Central Okanagan Air Quality Management Plan. Several research recommendations and initiatives have been identified and prioritized. Public motivation, as well as the extent and source of project funding, will bear influence on the rate and sequence of progression that initiatives will be accomplished.

1.1 STATE OF THE AIR

Airborne pollutants are not confined to political borders. Therefore, air quality improvement is considerably dependent upon cooperation between regional, national and international governments and organizations (Christopherson, 2000). The City of Kelowna has joined in a cooperative partnership with the Regional District of the Central Okanagan (RDCO) to address air quality issues in the Central Okanagan.

The air quality chapter is organized into four broad sections, which include background information, monitored data, initiatives and research, and policy development.

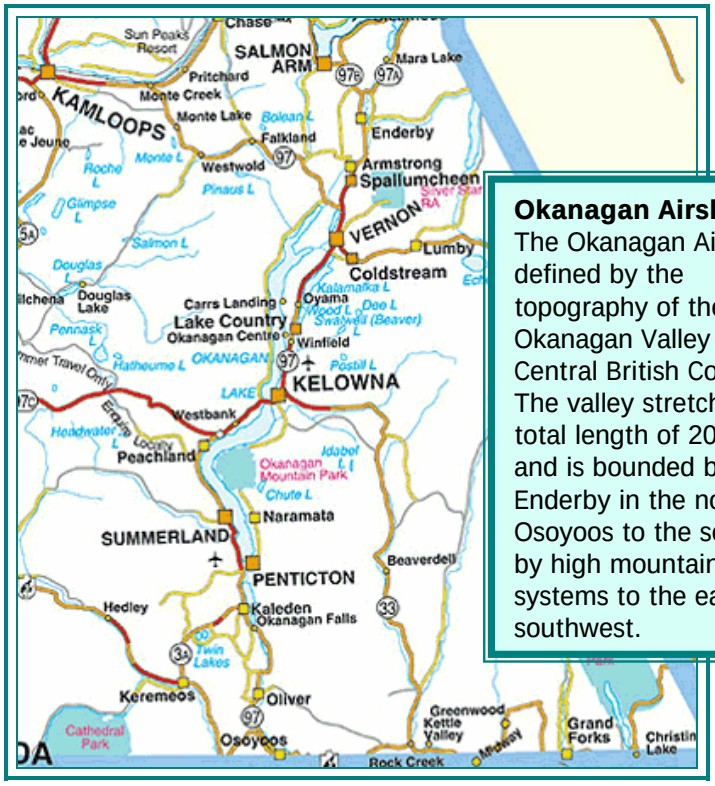
1.1.1 BACKGROUND

1.1.1.1 Air Quality

Central Okanagan air quality is primarily driven by factors within local communities. Since airsheds do not have distinct boundaries, depending on airflow and ocean currents, activities and occurrences from as far south as the northwestern United States and west as Asia, may also affect our local atmosphere.

1.1.1.1.1 Regional Factors that Influence Air Quality

Several regional characteristics contribute to episodic air pollution in the Okanagan Valley:



Okanagan Airshed
The Okanagan Airshed is defined by the topography of the Okanagan Valley in south Central British Columbia. The valley stretches a total length of 200km and is bounded by Enderby in the north, Osoyoos to the south and by high mountain systems to the east and southwest.

Okanagan Airshed

Topography

The Okanagan Valley lies perpendicular to prevailing winds, resulting in an increased number of calms and therefore, greater air stagnation (Josefowich, pers. comm., 1998).

Weather Patterns

Warmer temperatures during summer months contribute to increased concentrations of ground level ozone. During the winter, temperature inversions are common in the Okanagan Valley.

Q. What is a temperature inversion?

A. A temperature inversion occurs when cold air is trapped below a layer of warmer air, which inhibits the dispersion of pollutants.

A temperature inversion in the Central Okanagan

Population Growth

Population within the City of Kelowna has surged from approximately 20,000 in 1970 to 103, 425 in 2004. An increased number of registered vehicles have accompanied population growth. Registered vehicles in Kelowna rose from 79,482 in 1998 to 82,309 in 2001 (ICBC, 2001). The rising number of registered vehicles contributes to deterioration of air quality in the Okanagan Valley.

1.1.1.2 Health and Costs Due to Air Pollution

Outdoor air pollutants, primarily fine particles, are causing some health problems in our region. Currently, 10% of the population is considered most “at risk”; however, the entire population will be affected to some degree if conditions worsen.

People most affected by air pollution include the very young (ages 0-5) and the elderly. People with respiratory conditions, such as asthma, bronchitis and emphysema are particularly sensitive, as well as people with heart conditions and those with sensitive eyes.

Estimated costs of “symptom days” due to outdoor air quality in the Okanagan-Similkameen Region range from $1.5-1.7 million per year, while loss of work time is estimated at $1.0-1.5 million per year. There is a small, but measurable increase in premature deaths due to respiratory and cardiac conditions aggravated by poor air quality (OSHR, 1998; Krupa, 2001).

1.1.1.3 Describing Air Quality

1.1.1.3.1 Air Quality Index

The Air Quality Index (AQI) is an application that transforms complex air quality measurements into a single number or descriptive term. The single pollutant with the highest AQI number represents the total AQI value; it is not an amalgamated measurement of all pollutants. Table 1.0 is a general interpretation of Provincial Air Quality Index values relating to health effects.

When the AQI reaches 25 (fair) and forecasted weather conditions indicate that further deterioration in air quality is likely to occur, a preventative public advisory is issued by the Ministry of Water, Land and Air Protection (MWLAP) in Kamloops and the Interior Health Authority (IHA) in Kelowna. A second "action" advisory is sent out when the AQI reaches 50 (poor). This advisory calls for reduction of vehicular use, cessation of burning practices, and provides advice for self-care.

Table 1.0 General interpretation of Provincial Air Quality Index Values (MWLAP, 2003a)

AIR QUALITY INDEX	GENERAL HEALTH EFFECTS	CAUTIONARY STATEMENTS
GOOD: 0-25	No measured effects are associated with air quality in this range.	No precautions are necessary for the general population.
FAIR: 26-50	When index values are in this range, there is adequate protection against effects on the general population.	No precautions are necessary for the general population.
POOR: 51-100	Short-term exposure may result in irritation or mild aggravation of symptoms in sensitive persons.	Persons with existing heart or respiratory ailments should reduce physical exertion and outdoor activity.
VERY POOR: 101+	Significant aggravation of persons with heart and lung disease. Many people in the general population may notice symptoms.	Persons with respiratory and cardiovascular diseases should stay indoors and minimize physical activity.

The following photos taken from Knox Mountain approximately two weeks apart in August of 1998 demonstrate the visible difference between "good" and "poor" air quality days.

The photo on the left was taken in 1998 and illustrates a "good" air quality day (AQI = 23) in the Okanagan, while the photo on the right is a "poor" day (AQI = 51)

1.1.1.4 Activities that Contribute to "Fair" and "Poor" Air Quality Days

Vehicular traffic in the City of Kelowna

1.1.1.4.1 Vehicular Traffic

Vehicle exhaust is a significant contributing source to ozone formation. Growth projection patterns estimate Kelowna's population to increase to 153, 222 in 2020. A growing population contributes to increased vehicle usage, which results in additional vehicle emissions.

Assuming travel habits and modes of transport remain the same, Kelowna's personal automobile use during peak travel periods is expected to increase by 77% by 2013. Also, considering additional demand from adjoining communities, the City's peak hour traffic demands are actually expected to double (City of Kelowna, 2002a). Figure 1.0 shows the number of registered vehicles in the City of Kelowna from 1998 to 2003.

Dust from vehicular traffic is estimated to be the largest source of particulate matter (PM_{10}) emitted into the Central Okanagan's atmosphere. Particulate concentrations are greatest during February, March and April each year, due to sand accumulations from winter road maintenance and dry conditions. In response, the City has successfully

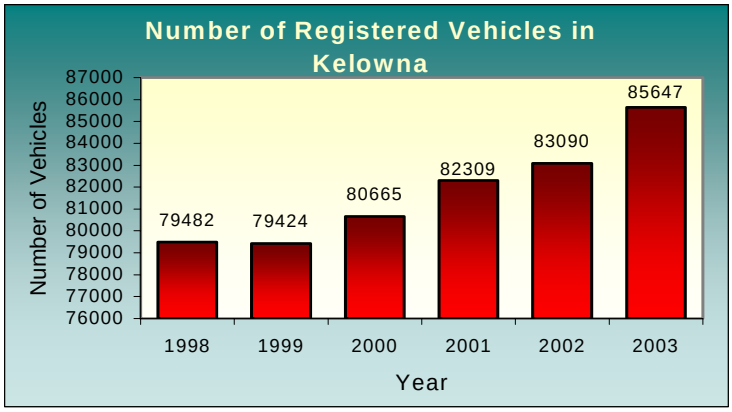


Figure 1.0 Registered vehicles within the City of Kelowna (ICBC, 2004)

reduced the volume of winter sand application by 58% since 1998 by adopting magnesium chloride spray technology. Less sand on roadways helps to maintain good air quality in the region.

1.1.1.4.2 Burning

Several types of burning practices occur throughout the Okanagan. The following paragraphs identify these burning practices and outline their significance to air quality degradation.


Excessive chimney smoke

Indoor Wood Burning Appliances

Indoor wood burning appliances account for approximately 215 tonnes of fine particulate ($PM_{2.5}$) emissions into the Central Okanagan atmosphere each year (RDCO, 2001). The Okanagan Indoor Wood Burning Appliance Survey stated that approximately 18.7% (11,720 households) of Central Okanagan residents use indoor wood burning appliances (RDCO, 2001). The survey data suggests that smoke emissions from wood burning appliances is a significant contributor to particulate pollution in the Central Okanagan.

Agricultural Burning

A substantial amount of agricultural burning occurs in the valley during the spring and fall of each year. Over 1000 agricultural fires occur annually in the Central Okanagan, which releases significant amounts of smoke particulate ($PM_{2.5}$) into the atmosphere. Local bylaws regulate when burning can occur to ensure proper venting, allowing for dispersal of smoke out of the valley. However, weather conditions limit the number of optimum burning days. As a result, many fires often burn simultaneously, creating unhealthy levels of smoke particulate in the valley.


Agricultural prunings to be burned

Forestry Burning

According to the Ministry of Water, Land and Air Protection, burning of forest harvesting waste piles (slash burning) is not considered to be a significant air quality issue for the Central Okanagan. These burns are carried out at high altitudes when ventilation is good, thus preventing smoke from reaching the lower altitudes of the valley. The Ministry of Forests carefully manages slash burning to reduce the smoke impact on urban areas (Adams, pers. comm., 2001).

Land Clearing Burning

In 2002, the Regional District of the Central Okanagan introduced a bylaw banning open burning of development land-clearing debris. Contractors are now required to use other alternatives, such as chipping or incineration burning to remove land-clearing debris.

Backyard Burning

Backyard burning has been banned in the City of Kelowna since 1988. In 1998 a burning ban was implemented for all properties under 2.5 acres throughout the Regional District of the Central Okanagan, to decrease smoke-load in the region.

1.1.1.4.3 Industry Emissions

The Ministry of Water, Land and Air Protection does not consider industry emissions to be a priority source of air pollution in the Central Okanagan. Nonetheless, some local industries have made efforts to reduce their smoke impacts on the community. For example, Riverside Forest Products, a local sawmill, chips a portion of their slash material instead of burning it. Industrial operations with large emissions under permit include municipal and regional district landfills, the Kelowna Airport, and local sawmills.

1.1.2 AIR QUALITY MONITORING

Degraded air quality affected the Central Okanagan for an average of 1226 hours per year from 1996 to 1998. A noticeable increase in urban "smog", public complaints about smoke, increased awareness about the harmful effects of low level pollutants, and the persistent "fair" and "poor" air quality index ratings led the region to take action on the issue of air quality. Figure 1.1 displays average annual percentages of good, fair and poor air quality in the Central Okanagan from 1996 to 2003. Since 1998, emission reduction measures have reduced degraded air quality from a high of 1226 hours per year to approximately 832 hours per year. More importantly, the number of severe "poor" air quality episodes has dramatically decreased. From 1999 to 2003 air quality in the Central Okanagan was, on average, rated "good" 88.1% of the time, "fair" 11% and "poor" 0.94% of the time (MWLAP, 2004). Implementation of burning bans, alternative methods such as wood chipping, and improved winter road maintenance practices have all contributed to improved air quality.

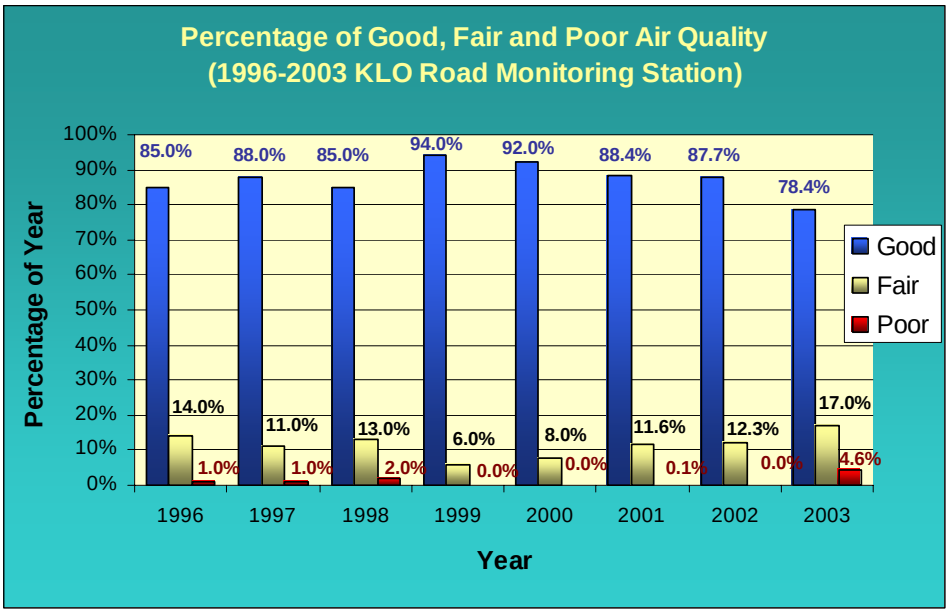


Figure 1.1 Distribution of air quality ratings for the Central Okanagan from 1996 to 2003 (MWLAP, 2004).

In 2003 smoke from the Okanagan Mountain Park forest fire caused the only poor air quality of the year; it also contributed to a 58% increase over the number of fair air quality hours recorded in 2002.

1.1.2.1 Air Quality Monitoring Station

The Central Okanagan air quality monitoring station is located at the KLO Road campus of Okanagan University College and operated by the Ministry of Water, Land and Air Protection (MWLAP). The station continuously monitors:

- Fine particulates ($PM_{2.5}$ and PM_{10})
- Ground level ozone
- Nitrogen oxide (NO)
- Nitrogen dioxide (NO_2)
- Carbon monoxide (CO)
- Sulfur dioxide ($S0_2$)

Q. What are fine particulates?

A. Particulate matter (PM) is tiny solid or liquid particles of various sizes that originate from various sources.

Fine particulate matter is similar in size to bacteria, invisible to the naked eye, and small enough to be inhaled into our lungs.

The station also possesses a meteorological tower that measures wind speed and direction, temperature, and relative humidity.

1.1.2.2 Pollutants of Concern

Fine particulates ($PM_{2.5}$ and PM_{10}) and ground level ozone are the only pollutants to exceed provincial guidelines; therefore, these two pollutants are of greatest concern. This section provides a description of fine particulate and ground level ozone, as well as pertinent data, which depicts annual trends of these pollutants.

Q. What health effects are associated with particulate matter that is less than 2.5μm in diameter?

A. Health ailments associated with fine particulates:

- Runny nose
- Emphysema
- Coughing
- Bronchitis
- Asthma
- Pneumonia
- Death

1.1.2.2.1 Fine Particulates

There are two classifications of fine particulates in the atmosphere - $PM_{2.5}$ and PM_{10}.

$PM_{2.5}$

- Usually associated with combustion. Smoke and vehicle emissions are the primary source of $PM_{2.5}$
- Less than 2.5μm (micrometer) in diameter
- Remains in the atmosphere from days to weeks, thereby increasing the chance of inhalation and transport to other airsheds
- Can penetrate deep into the lungs causing breathing difficulties or permanent lung damage
- The consensus of the medical community is that, of all fine particulate matter, $PM_{2.5}$ formed during combustion has the greatest impact on human health

$PM_{2.5}$ has been continuously measured in Kelowna since 1997 at the KLO Road Air Quality Monitoring Station. MWLAP records hourly average data via computer in Victoria, BC. Figure 1.2 indicates the number of hours $PM_{2.5}$ exceeded the Reference Health Level (RHL) of 15μg/m³. The RHL is defined in scientific assessment documents for the Canada Wide Standards (CWS) Agreement as the lowest level of $PM_{2.5}$ at which it can be demonstrated that negative health effects occur in humans (MWLAP, 2004).

Analysis of the data from 1998 to 2003 reveals that smoke from outdoor burning was the primary factor causing $PM_{2.5}$ to exceed the RHL. In August and September 2003, smoke from the Okanagan Mountain Park forest fire was the direct cause of $PM_{2.5}$ to exceed the RHL.

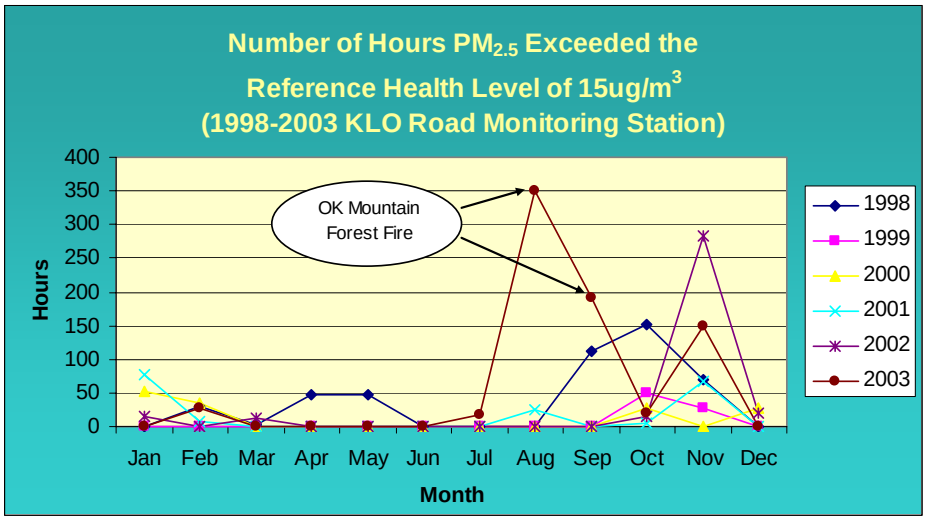


Figure 1.2 Amount of time $PM_{2.5}$ levels exceeded the Reference Health Level at the KLO Air Quality Monitoring Station between 1998 and 2003 (MWLAP, 2004).

PM_{10}

- Can remain in the atmosphere for a few hours to a few days, causing a reduction in visibility of the atmosphere
- Less than 10μm in diameter with an aerodynamic shape

Coarse PM_{10} Particles

- Road dust, wind blown soil, and burning are typical sources of coarse PM_{10}
- Particles are commonly composed of finely ground rock and clay
- Range from 2.5μm to 10μm in diameter
- These particles are removed in the upper respiratory system when inhaled

Fine PM_{10} Particles

- Smoke and vehicle exhausts are typical constituents of fine PM_{10} particles

- Range from 0μm to 2.5μm in diameter

PM_{10} has been continuously measured in Kelowna since 1994 at the KLO Road Air Station. Average data is recorded hourly by the Ministry of Water, Land and Air Protection (MWLAP) in the same manner as $PM_{2.5}$.

Smoke from burning and dusts from road traction materials are major contributing sources that cause PM_{10} concentrations to increase. Figure 1.3 illustrates the history of hours per month that PM_{10} degraded air quality into the "fair" range.

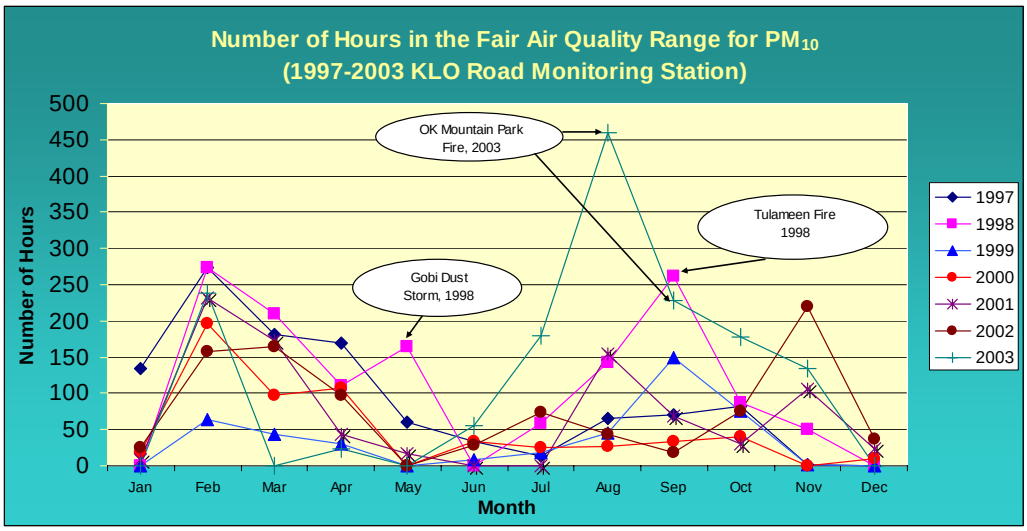


Figure 1.3 Amount of time PM_{10} degraded air quality to "fair" between 1997 and 2003 at the KLO Air Quality Monitoring Station (MWLAP, 2004).

Figure 1.4 shows a 'snapshot' of "fair" and "poor" air quality hours over a seven-year period caused by PM_{10}. In 1998, the addition of the Smoke Control Bylaw and the Venting Index played a significant role in reducing the number of "fair" and "poor" PM_{10} air quality hours in the Central Okanagan. More importantly, the number of severe "poor" $PM_{2.5}$ and PM_{10} air quality episodes has dramatically decreased since 1998. Implementation of burning bans, public education, and new methods of winter road maintenance contributed to reducing PM_{10} levels.

Over short periods of time (i.e. individual years) stochastic events such as weather conditions and forest fires will significantly influence the ambient air quality of a particular year (Davis, pers. comm., 2003). This was particularly evident in 2003 when the Okanagan Mountain Park forest fire caused the only poor air quality of the year, as well as contributed to a 58% increase over the number of fair air quality hours recorded in 2002. However, the general long-term trend over the past decade is one of improvement for PM_{10} in the Central Okanagan.

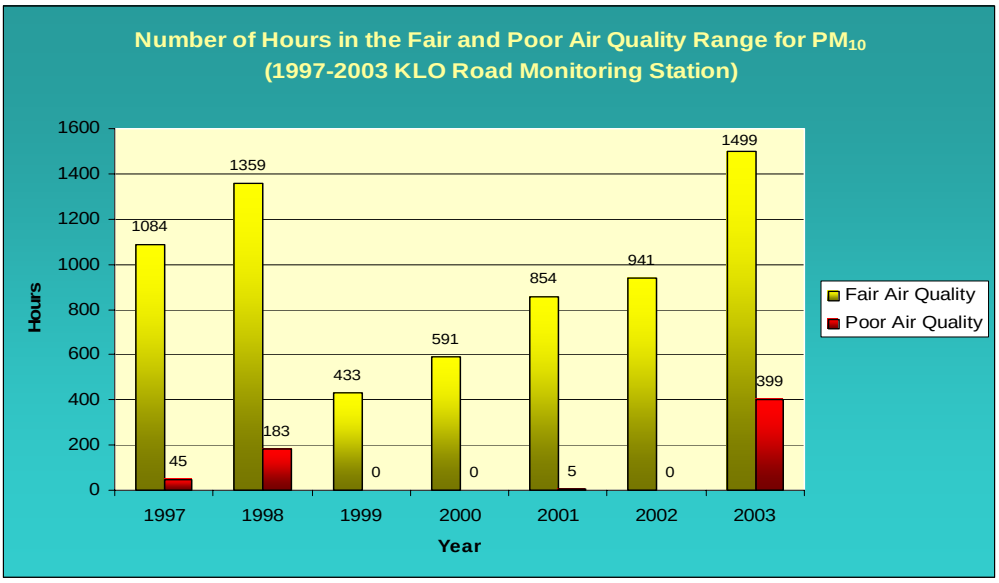


Figure 1.4 Amount of time PM_{10} contributed to "fair" and "poor" air quality between 1997 and 2003 (MWLAP, 2004)

1.1.2.2.2 Ground Level Ozone

Ozone is comprised of several organic compounds. The lists below state some quick facts about these compounds:

Volatile Organic Compounds (VOCs)

- Also known as hydrocarbons
- Constituents of trees, oil and natural gas
- Motor vehicles are the major source of human-made VOC emissions
- Other significant sources include evaporates of adhesives, gasoline, solvents, some aerosol propellants, oil-based paints and hydrocarbons from the petrochemical industry

Q. What is ground level ozone?

A. Ground level ozone forms near the surface of the earth by the reaction of volatile organic compounds (VOCs) and nitrogen oxides (NO) in the presence of sunlight and warm temperatures. VOC's, NO_x and ozone do occur naturally in the lower atmosphere; however, human activities – fossil fuel use in particular – may increase the presence of these pollutants. In the Central Okanagan, ideal conditions for ozone accumulation occurs from late spring to early fall.

Nitrogen Oxides (NO):

- Mainly produced by the burning of oil and gas
- Primary source: fossil fuel combustion
- Other sources: fuel burning in homes, businesses, factories, and power plants

An abundance of intense sunlight hours and low wind speeds are common during the summer months in the Central Okanagan. These factors create ideal conditions for ground level ozone formation. Ozone emissions from human activity can become trapped in the valley and contribute to elevated ozone levels. Figure 1.5 displays the annual cyclical pattern of ozone levels, as well as the hours of fair air quality due to elevated ozone in

the Central Okanagan. Figure 1.6 displays the number of hours ozone drove the air quality into the "fair" and "poor" range from 1996 to 2003.

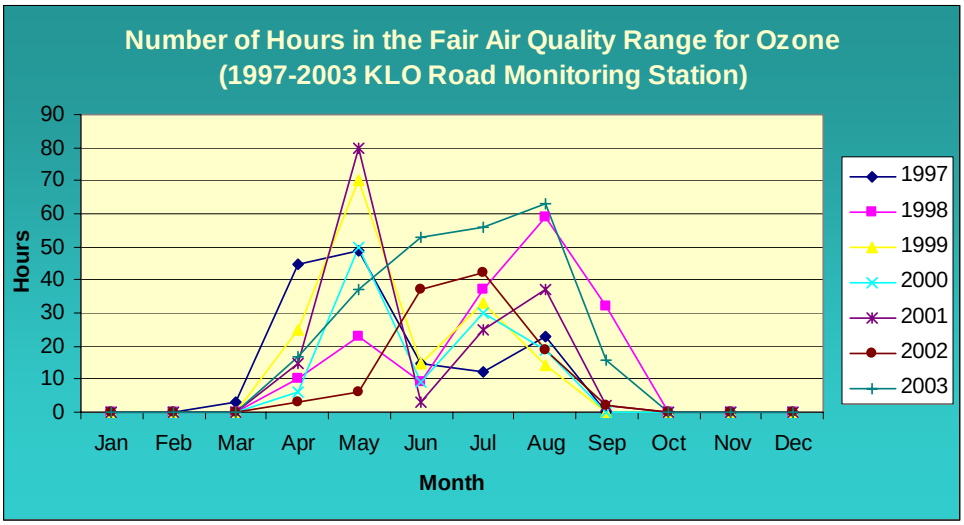


Figure 1.5 Hours spent in "fair" air quality range due to elevated levels of ozone (MWLAP, 2004).

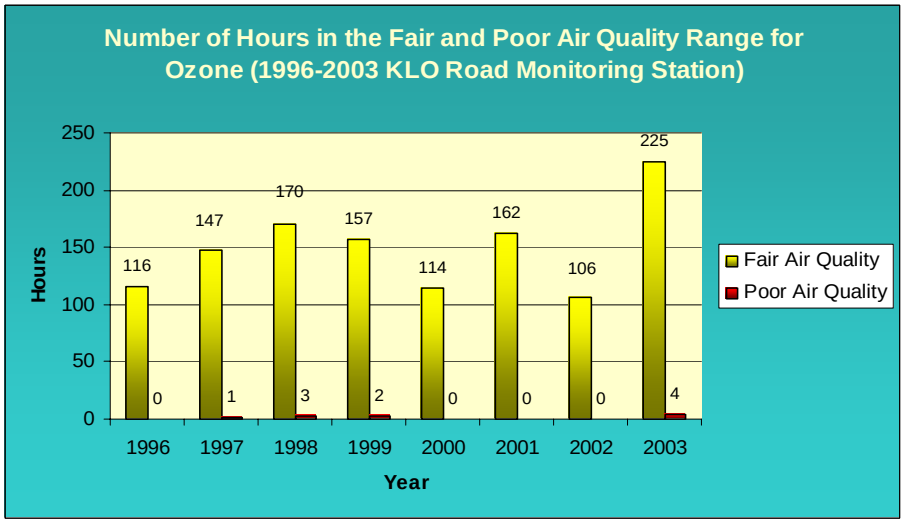


Figure 1.6 Hours spent in "poor" and "fair" air quality range due to elevated levels of ozone (MWLAP, 2004).

There is little evidence of any trend showing rising levels of ozone due to anthropogenic (human caused) emissions (MWLAP, 2001a). The Ministry of Water Land and Air Protection (MWALP) and the Meteorological Service of Canada are currently working to determine what proportion of observed ozone levels are caused by anthropogenic emissions.

1.1.3 INITIATIVES

1.1.3.1 Background

The earth's atmosphere contains gases that act as an insulating blanket by trapping heat from the sun. These gases are known as 'greenhouse gases' (GHGs) and include water vapour,

carbon dioxide, methane, nitrous oxide and halocarbons, with carbon dioxide being the most significant.

Over the past 100 years the earth has warmed, on average, by 0.6°C. The southern interior of BC has experienced an increase of 1.1°C during this time period (MWLAP, 2002a). Practices that burn fossil fuels, such as motor vehicle operation, heating residential and commercial buildings, and industrial operations, impact air quality and release additional greenhouse gases into the atmosphere. The global warming trend may be partially attributed to geologic cycles, where the earth experiences oscillating warming and cooling periods. However, scientists are concerned that human activities are accelerating the rate of warming.

Warmer temperatures will disrupt the present hydrologic cycle by diminishing snowpacks and glaciers, promoting earlier spring runoff and increasing weather variability. As a result, landscape alterations, such as increased erosion of watersheds, will create challenging conditions for aquatic and terrestrial life. Warmer temperatures also provide a favourable habitat for many insect populations, which raises concerns regarding insect-related disease. An increase in human respiratory illness is also expected due to greater presence of pollen and moulds. These influences will not only impact humans and the environment, but will be reflected in the economy as well (MWLAP, 2002a).

Fossil fuel burning is the primary human activity that is contributing to increased greenhouse gases. Automobile emissions are the number one source of greenhouse gases in BC, representing 42% of total provincial greenhouse gas emissions (MWLAP, 2002a). Vehicle emissions and natural gas burning have been identified as the two most concerning GHG emissions in the Central Okanagan (Federation of Municipalities, 2003).

What are we doing?

To urge and support the acceleration of a Clean Air Action Plan, the municipal council of the City of Kelowna endorsed the Kyoto Protocol in March of 2002 and adopted the resolution provided by the Federation of Canadian Municipalities in September 2002. The resolution recognizes that polluting activities are affecting climate change and threatening citizens' health and quality of life and that education, proactive pollution reduction and research actions are needed to decrease greenhouse gas emissions.

To facilitate greenhouse gas reduction, the City of Kelowna and the Central Okanagan Regional District joined the Partners for Climate Protection Program (PCP) in 2001. This program supports Canadian municipal governments in preparing and implementing local climate change action. The PCP is a partnership between the Federation of Canadian Municipalities and the International Council for Local Environmental Issues (ICLEI). The initiative of the program is to reduce greenhouse gas emissions from municipal operations by twenty percent and at least six percent (the Kyoto target) within the community as a whole, preferably within ten years.

Members of the PCP Program are encouraged to:

- Develop and finalize a local action plan that aims to initially reduce emissions and energy use in municipal operations and then expand to reduce emissions in the

community. This local action plan will also incorporate public awareness and education campaigns.

- Begin implementation of the local action plan.

The City of Kelowna and the Central Okanagan Regional District are currently working towards completing the goals of the PCP program. To date, a baseline inventory of greenhouse gas emissions has been completed for City and Regional District operations, which provides targeting and tracking mechanisms for greenhouse gas reduction measures. As well, a community greenhouse gas emissions inventory will be complete in the fall of 2004.

The City of Kelowna has also developed a draft "Sustainable Building Action Plan" for its operations to provide consistent policy for designing, constructing, and operating buildings in a manner that incorporates energy efficiency, water conservation, waste minimization, pollution prevention and resource efficient materials in all phases of a building's life.

Reducing greenhouse gas emissions is not only good for the environment; it can also save money on energy costs. Retrofitting buildings, improving street lighting, and using efficient vehicles for fleets, for example, can save thousands of dollars in energy costs every year. The payback period on capital investments to improve energy efficiency is often short and the savings can be reinvested in the community.

To take advantage of these cost savings, the City of Kelowna formed the Energy Management Committee (EMC) in 1995. The purpose of the Energy Management Committee was to provide a more unified approach to energy management in the areas of electrical, water, sewer and civic building operations. West Kootenay Power, at that time, also requested representation on the committee to ensure that all reduction opportunities identified were assessed on the basis of "best value for money spent" and to ensure energy reduction rebates were provided, where applicable. Since 1995, a number of energy reduction initiatives have been identified and implemented within the electrical, water, sewer and civic building operating areas. These initiatives saved 3,300,000-Kilowatt hours of energy, representing an annual power cost savings of $210,672 to the City of Kelowna. Fortis BC, formerly Aquila Power, has also provided energy efficiency rebates totaling $155,000.

1.1.3.2 Clean Air Programs

The following projects are primarily collaborative efforts between the Regional District of the Central Okanagan (RDCO), District of Peachland, City of Kelowna, Environment Canada, Ministry of Water, Land and Air Protection (MWLAP), Interior Health Authority and the BC Lung Association Regional Asthma Program.

1.1.3.2.1 Vehicle Emissions Clinics

A free light-duty vehicle emissions clinic is sponsored and operated for three days every year by Environment Canada, in partnership with the Regional Air Quality Program. During the past six years, the number of vehicles tested ranged from 500 to 778. Of the 600 vehicles participating in the 2004 clinic, 80% passed and 20% failed. The clinics, for both passenger vehicles and light-duty trucks, promote the benefits of emission control

Gas cap check at vehicle emissions clinic

systems to reduce tailpipe emissions, combat pollution, and improve air quality. The clinics include measurements of carbon monoxide and hydrocarbon concentrations from tail pipe emissions, as well as tire pressure and gas cap checks.

A heavy-duty vehicle inspection clinic, which focused on diesel emissions, was held between 1999 and 2001. Unfortunately, provincial budget cutbacks have removed this program from service.

1.1.3.2.2 Go Green Commuter Challenge

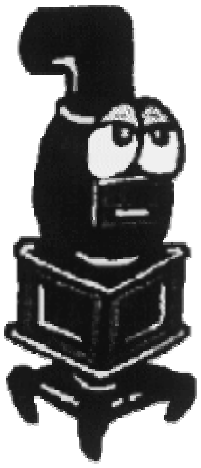
Each year the Regional Transportation Demand Management Division (TDM) organizes and promotes a week-long event and national competition called the "Go Green Commuter Challenge". The challenge encourages environmentally conscious modes of transportation such as walking, cycling, public transit use, car-pooling, and tele-commuting.

Central Okanagan residents were the national champions in 2002, 2003, and 2004, for the City's population size. Participation levels have continued to increase, providing a good indicator of heightened public awareness regarding transportation and air quality issues.

Through planning and implementation of programs such as the "Go Green Commuter Challenge", the City's Transportation Demand Management Division is committed to reducing vehicle emissions, the demand for roadway space, and peak period automobile traffic. The Transportation Demand Management Division's chief goal is to reduce peak period automobile traffic in the region by 12% by the year 2013, relative to trend growth in traffic volumes.

1.1.3.2.3 Great Okanagan Wood Stove Exchange Program

This annual six-week program aims to reduce wood stove smoke pollution by raising public awareness of the importance of smoke-free burning. The program provides consumers with an opportunity to replace older wood stoves with EPA/CSA emission-approved wood, gas, or pellet appliances. EPA emission-approved stoves burn up to 90% cleaner than stoves without emission controls.



Consumers receive cash discounts valued from $100 to $500, as an incentive to relinquish their old stoves. Four wood stove exchanges to date have resulted in the exchange of 567 wood stoves. The amount of smoke particulate removed from the airshed each year due to the 567 exchanges is estimated to be 22,403 kilograms of PM_{10}. This reduction in smoke particulate will improve localized air quality in many neighbourhoods throughout the Okanagan Valley.

1.1.3.2.4 Cash for Clunkers – Clean Air Rewards Program

This is a voluntary program designed to encourage Central Okanagan residents to trade their older, higher polluting vehicles in for incentives providing cleaner forms of transportation. Older vehicles traded in to

the program are recycled according to environmental guidelines. Residents qualify for the program if they currently operate a 1993 or older car or light-duty truck. The purpose of the program is to: 1) Get older vehicles off the road, as older vehicles emit 30 times more smog-related emissions than newer vehicles; 2) Reduce smog-causing emissions and greenhouse gas emissions from vehicles; and 3) increase the awareness of Central Okanagan drivers about vehicle emissions and how older, poorly-maintained vehicles contribute to air pollution and greenhouse gases.

1.1.3.2.5 Informational Brochures

Several brochures have been developed to provide the public and industries with information about cleaner burning practices and alternative methods, such as chipping, that will reduce the need for burning altogether.

1.1.3.2.6 Ventilation Index

Since 1996, Environment Canada has provided free information regarding the Ventilation Index (VI). The VI rates the atmosphere's ability to disperse smoke and is based on a scale from 0 to 100. A value of zero indicates that pollutants are unable to disperse in the atmosphere, whereas a value of one hundred represents conditions when pollutants are easily dispersed. The VI and the Air Quality Index (AQI) are utilized in conjunction to regulate burning practices. Regulations were introduced throughout the Regional District in 1998 to restrict open burning when the VI is below 55.

1.1.3.2.7 Outdoor Burning Hotline

Environment Canada and the Regional District of Central Okanagan (RDCO) introduced an improved outdoor burning hotline in 2002. The phone-in hotline message enables outdoor burning permit holders to easily determine if outdoor burning is authorized on any particular day. Weather and air quality conditions are taken into account to determine if outdoor burning is permitted. If either the Ventilation Index or the Air Quality Index is "fair" or "poor", outdoor burning will not be permitted on that day. This system helps prevent buildup of unhealthy concentrations of smoke within the Central Okanagan, thereby protecting the public's health. The outdoor burning hotline can be accessed by phoning Environment Canada at 491-1500 and following the prompts.

1.1.3.2.8 Ozone Forecasting Program

Environment Canada has developed a computer modeling program to forecast ground-level ozone levels within the Central Okanagan. Information is relayed to the community through the media to encourage citizens to take action and reduce emissions that contribute to ozone formation.

1.1.3.2.9 Education

As mentioned previously, many of the educational programs and venues provided by the City integrate all aspects of environmental issues. An air quality program is actively involved in a majority of these initiatives. For detailed information, refer to section 4.0, Education.

1.1.3.2.10 Agricultural Wood Residue Pilot Project

The Regional Air Quality Program and the agricultural community have been working together to develop alternatives to outdoor burning. A pilot project has been completed to analyze costs of wood waste disposal techniques, such as chipping, that would either eliminate or greatly reduce the smoke impact typically seen from traditional outdoor burning.

Pilot Project – Agricultural Wood Chipping

1.1.3.3 Research

Research is essential for obtaining a more complete understanding of current and future air quality issues. Several research projects pertaining to air quality have been completed in the Okanagan Valley to gain a better understanding of air movement, weather patterns, and impacts of vehicle emissions and burning practices.

Information gaps currently exist in our understanding of the mechanisms that degrade the Okanagan's air quality. Continual research development is needed to identify management priorities. Research recommendations outlined in the Air Quality Management Plan include speciation analysis, dispersion modeling, and a health effects and costs study. The sequence in which research and initiatives are completed will remain flexible and responsive to funding, public priorities, and the results of research activities.

Research projects performed to date on air quality in the Okanagan Valley are as follows:

Transportation Emissions Study (1995)
In 1995 the City of Kelowna commissioned a Transportation Study on Atmospheric Emissions Modeling. Motor vehicle emissions of carbon monoxide, total organic gases, nitrogen oxides, sulfur dioxide and particulate matter were estimated for 1991 and 2013.

Wind and Air Movement in the Central Okanagan (1999)
In 1999, the Mountain Weather Services Office used modeling and display software to impart a deeper understanding of low-level winds in the Okanagan Valley. This information is necessary to explain the local transport and diffusion of pollutants in the airshed.

RDCO Wood Residue Survey (1999)
A survey was conducted in 1999 to identify sources and quantify amounts of wood residue materials within the Central Okanagan Regional District. The survey also estimated the amount of wood residue material that is burned each year in the Regional District.

Time-lapse Video Study (1999-Present)
A time-lapse video recorder was set up in the spring of 1999 on the west side of Okanagan Lake overlooking Kelowna. Video footage is recorded 24 hours a day, 7 days a week. The video provides data for education, confirmation of meteorological predictions for scientists, and analysis of daily pollutant development and transport.

Kelowna Regional Transit System Survey (2000)
A public opinion survey regarding the Regional Transit System was conducted during the spring of 2000 to gain information, which will be used to develop and improve transit in the Central Okanagan.

Visual Opacity Assessment of Diesel Powered Heavy Duty Vehicles (2001)
A visual study to assess emission levels related to diesel trucks, buses, and light-duty fleet vehicles travelling within the Okanagan Valley was completed in the summer of 2001. The survey showed that 9.1% of vehicles observed had the potential to fail the roadside inspection. This study is part of an overall assessment of the impact vehicles have on the Okanagan's air quality and will provide baseline data that can be used in making air quality management decisions.

Emissions Inventory (2002)
The project is coordinated by Environment Canada and is a comprehensive inventory of all point, area, and mobile sources, which is essential to an air quality management plan. Relative contributions from permitted and non-permitted sources provide an indication of mechanisms that will be required to achieve emission reductions. The 1995 and 2000 inventories are currently being developed and should be completed by early 2005.

1.1.4 POLICY DEVELOPMENT

1.1.4.1 Policy Development Committees

Prior to 1991 the Central Okanagan lacked long-term air quality planning, air quality information and data, and regulation and commitment from government stakeholders. To create a foundation and provide direction for managing air quality in the Central Okanagan, the Okanagan Air Quality Technical Steering Committee (OAQTSC), the Central Okanagan Regional Air Quality Committee, and the Okanagan Airshed Coalition were formed.

Okanagan Air Quality Technical Steering Committee (OAQTSC)
The OAQTSC was formed in 1995 and is comprised of staff and technical representatives from municipalities, Regional Districts (including North Okanagan and Okanagan Similkameen Regional Districts), provincial and federal agencies, institutions, and industries in the Okanagan Airshed. Working together with the Central Okanagan Regional Air Quality Committee, the OAQTSC provides technical information and research regarding local air quality.

Central Okanagan Regional Air Quality Committee
The Central Okanagan Regional Air Quality Committee was formed in 1998 and consists of a group of elected officials from municipalities and areas of the Central Okanagan Regional District. The Committee developed and implemented the Air Quality Management Plan, a living document, for the Regional District of Central Okanagan and is also responsible for air quality monitoring, education, and public awareness.

Okanagan Airshed Coalition
The Central, North, and Okanagan-Similkameen Regional Districts entered into partnership on June 6, 2003 with the goal of further improving outdoor air quality in the Okanagan Airshed, thereby improving residents' overall health and quality of life. The Okanagan Airshed Coalition will develop a comprehensive management strategy to assess issues, prioritize problems, and develop appropriate actions to protect public health and the environment.

1.1.4.2 Bylaws

In 1998, the Regional District of the Central Okanagan (RDCO) implemented Bylaw 773 to reduce emissions from open burning, campfires, and wood burning appliances. The introduction of this bylaw essentially eliminated backyard burning throughout the Regional District. Amendments made to the bylaw in 2002 now prohibit burning of land clearing debris and restrict permitted burning practices from occurring on "poor" and "fair" air quality days.

On March 22, 2004 the Central Okanagan Regional District Board adopted amendments to the Smoke Control Bylaw pertaining to the use of indoor wood burning appliances. The changes now allow ticketing and fines for homeowners who are burning unseasoned wood or for those creating nuisance amounts of smoke from the use of their wood stove or fireplace. The bylaw amendments are meant to be an educational tool in situations where nuisance amounts of smoke is severely affecting someone's household. Issuing a fine will only occur as a last resort option for enforcement officers. Complaints received from the public prompted the Regional Air Quality Committee to develop a solution to these problems.

1.1.4.3 The Central Okanagan Air Quality Management Plan

A management plan is imperative to systematically identify air quality priorities and goals and to coordinate the implementation of management measures between all levels of government.

In 1998, the Okanagan Air Quality Technical Steering Committee investigated Airshed Management Plans from other communities across North America in order to allow effective construction of the Regional District's own Air Quality Management Plan.

The Regional Growth Strategy Air Quality Discussion Paper, completed in 2001, currently stands as the Central Okanagan Air Quality Management Plan and acts as the cornerstone of the City's policies by providing direction and identifying priorities. This management plan is a living document and remains flexible and responsive to changing public priorities, financial partnerships, new program opportunities, and the result of research activities.

The four major goals of the Air Quality Management Plan include:

- Ensure citizens in the Central Okanagan have healthy air to breathe
- Integrate regional air quality goals into all policies, including land use and transportation planning
- Lead by example and bring about changes in behavior as needed to protect air quality
- Harmonize regional air quality initiatives with objectives of other agencies and levels of government

2.0 WATER EXECUTIVE SUMMARY

Protection of our water sources is of primary importance to sustain a healthy society and economy. The City of Kelowna has adopted a 'source to tap' management program that is considered to be one of the best in Canada. The plan collectively addresses water issues at several levels to ensure that the quality of drinking water provided meets provincial and federal drinking water guidelines.

Rigorous testing of both raw and treated water is performed by qualified technicians at numerous sites including tributaries, Okanagan Lake, pumphouses, booster stations, reservoirs, and various points throughout the distribution system. Online monitoring equipment installed at four pumphouses record continuous data to show water quality trends and aid in early detection of any quality deviation that may occur. Since 1996 all parameters of drinking water, physical, chemical and microbiological, have continually met Canadian Drinking Water Guidelines. To further enhance water treatment, the Water Utility plans to install UV disinfection equipment at all pumphouses by the end of 2005. UV disinfection inhibits the ability of bacteria (including Cryptosporidium and Giardia) to reproduce and does not utilize chemicals or generate by-products.

Maintenance practices have been improved (e.g. upgrades to the Water Network Flushing Program) and new programs, such as Cross Connection Control, have been introduced to enhance the safety of our drinking water during its delivery.

Kelowna manages a state-of-the-art Wastewater Treatment Facility (WWTF) where wastewater is cleaned through biological phosphorus process and UV treatment. During treatment, 97% of phosphorous is removed from wastewater. Installation of a new generator and bioreactor upgrades since 1999 have helped to further improve effluent quality. The wastewater treatment facility currently produces effluent that meets Canadian Drinking Water Guidelines. In addition, accumulated biosolids are composted to produce Ogogrow, a soil conditioner.

Kelowna's residential water consumption rate is one of the highest in North America and is approximately one and a half times greater than the Canadian average (Environment Canada, 2004). Rapid population growth and climatic conditions are the two most concerning factors regarding reliable water delivery. The City Water Utility has addressed this concern through two main initiatives- water metering and the Water Smart Program.

Kelowna's flourishing population places severe demand on the City's water distribution system. Continual infrastructure expansion bears substantial expense, in the magnitude of multimillions. Water meters, in conjunction with education and appropriate fee structures, are an effective method that encourages water conservation, decreases water demand, and defers infrastructure costs. The City Water Utility introduced meter billing in Kelowna at the end of 1998, reducing water demands in the City-serviced area; trends will become more apparent with time. To discourage a 'rebound effect', the City Water Utility plans to implement an increasing block water rate structure, where the volume of water consumed reflects the customer's billing rate. This fee structure promotes equity between users and encourages reduction of peak demand; it will be going to council for review and approval in late 2004 for implementation in early 2005 (Degen, pers. comm., 2004).

Water Smart has been working with Kelowna residents since 2001 to reduce water demands caused by inefficient irrigation and household practices. Education initiatives have helped to reduce peak demand by up to 24% in some areas of the City. The success of the program has earned an

admirable reputation throughout the country. Program expansion is hoped for the future, but will be dictated by funding availability.

The City Water Utility plans to continue management in a manner that ensures a reliable and safe water supply and encourages sustainable water use, while simultaneously conserving capital expense and enhancing the quality of life for the citizens of Kelowna.

2.1 STATE OF THE WATER

Freshwater is vital to human existence, all living organisms, and the environment. If resources become overly taxed, negative impacts such as watershed damage, deteriorated water quality and loss of biodiversity become progressively evident. As well, functional and financial management concerns arise regarding both water quality and quantity. The Okanagan's rapid population growth, coupled with climatic and geologic characteristics, increases the importance of sustainable freshwater management in Kelowna.

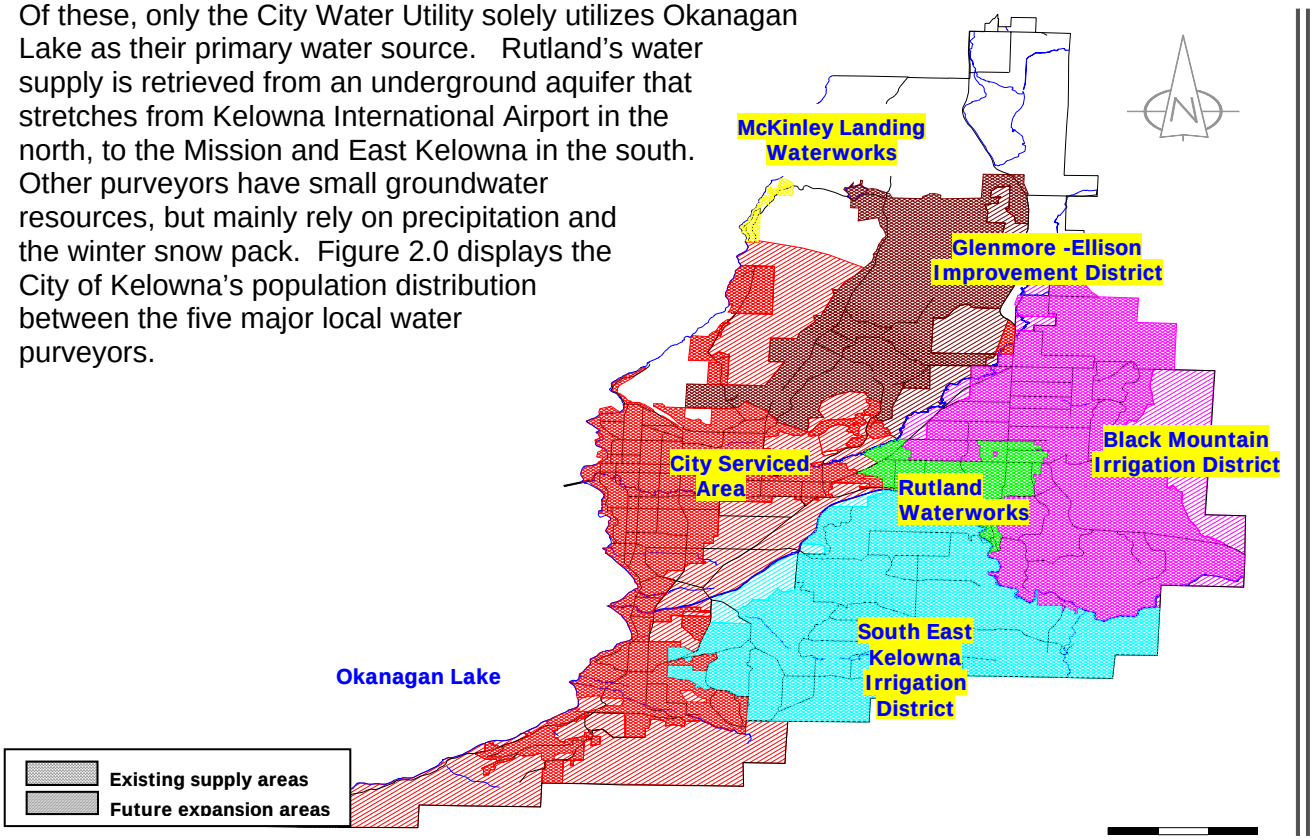
The topic of water is comprehensive, therefore, this chapter is organized into the following six sections: drinking water, water quantity, surface water, storm water, groundwater, and wastewater.

2.2 DRINKING WATER

2.2.1 BACKGROUND

2.2.1.1 Water Purveyors

Five major water purveyors provide water to City of Kelowna residents (see map below). Of these, only the City Water Utility solely utilizes Okanagan Lake as their primary water source. Rutland's water supply is retrieved from an underground aquifer that stretches from Kelowna International Airport in the north, to the Mission and East Kelowna in the south. Other purveyors have small groundwater resources, but mainly rely on precipitation and the winter snow pack. Figure 2.0 displays the City of Kelowna's population distribution between the five major local water purveyors.



Kelowna's Drinking Water Sources (City of Kelowna, 2003)
*This map is for general information only. The City of Kelowna does not guarantee its accuracy. All information should be verified.

This segment of the report focuses on the City Water Utility's efforts to provide safe and high quality drinking water to its customers. Information concerning other irrigation districts may be obtained through the Kelowna Joint Water Committee (KJWC) at www.kjwc.org, or from each individual purveyor.

The City Water Utility supplies approximately 53,000 customers with drinking water from Okanagan Lake and remains committed to continuous improvement of its services to achieve its primary mandate, which is to provide water that meets federal and provincial drinking water guidelines.

2.2.1.2 Water Quality Task Force

The 1996 cryptosporidium outbreak prompted the City Water Utility to reconstruct their approach to water management. Kelowna City Council formed a Water Quality Task Force in 1997, which included 16 community members. The mandate of the committee was "to review all available information, recommend new studies, analyze all information gathered, determine costs, consider alternatives and make recommendations to the Council Water Committee as to how to prioritize expenditures and improve the water quality of the Kelowna Water Utility" (Water Quality task Force, 2002).

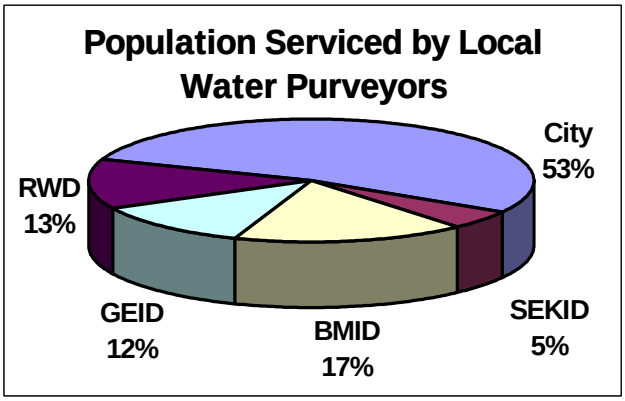


Figure 2.0 Distribution of population serviced by local water purveyors (KJWC, 2004)

After thorough assessment, the Water Quality Task Force recommended full-scale installation of UV water treatment technology and the following final 13 recommendations. Having fulfilled its mandated role, the committee subsequently disbanded in June of 2002.

1. Continue to move forward to further reduce risk by <u>proactively</u> reviewing and participating in new technologies to control and monitor Giardia and Cryptosporidium.

2. Prepare a long-term implementation strategy to allow for the eventual construction of a water treatment technology, which will provide for a minimum of 99.9% (3-log) removal of Giardia. In addition, the long-term implementation strategy should allow for the installation of Cryptosporidium treatment as required or if financially feasible. The long-term implementation strategy should be prepared and approved within 12 months from the date of acceptance of these recommendations by Council.

3. Continue further analysis of potential risk reduction improvements such as deeper intakes, ground water usage, and limnology surveys to obtain a better understanding of Okanagan Lake dynamics. Implement these options only if the studies indicate the expenditures are warranted and are consistent with the approved long-term implementation strategy.

4. Explore the availability of grant monies for water quality improvements and determine whether there is significant financial benefit to the Kelowna Water Utility and its customers to warrant an accelerated implementation of the options chosen.

5. Implement a public mechanism to monitor the progress of the approved long term water quality improvement strategy to ensure that it is implemented in the most cost effective and timely manner. One option would be to have the existing Task Force review and comment on the long-term implementation strategy.

6. Continue and increase the financial support of watershed improvement programs, recognizing the contribution of the watershed to the quality of drinking water. The success of watershed improvement programs could be facilitated as follows:

   - The City in partnership with the Regional District and other stakeholders should engage independent watershed protection experts to review options and costs to determine if this can be accomplished. A long-range protection program should be developed, which should be incorporated with the long-range implementation strategy being developed for the utility.

   - Immediately correct any obvious risks, including the establishment of strategies to limit the access of livestock and their waste to creeks.

   - Require the appropriate City staff to regularly report on the maintenance, improvement and preservation of the watersheds of Mill and Mission Creeks.

   - Recognize that population growth has a negative impact on the watersheds and establish appropriate policies for zoning, buffer zones, etc. to protect the watersheds.

   - Expand the existing City Watershed Improvement Program to encompass the entire Central Okanagan Regional District.

7. Ensure controls are in place within the Kelowna Water Utility to minimize the risk of city water being contaminated through human error or faulty procedures or processes. This should include, but not be limited to, ISO Certification and/or utilizing the AWWA Utility Review Process.

8. Give consideration to increasing the Water Quality Surcharge in anticipation of the long-term capital expenditures that will be required.

9. Give consideration to installing some form of giardia treatment for the outfall from the City's Wastewater Treatment plant.

10. Work with the Kelowna Joint Water Committee and the Ministry of Health to update the Water Quality Deviation Response Plan to incorporate a response based on Cryptosporidium levels.

11. Water quality issues must be considered in a basin-wide context. The City should strongly request an update by the Provincial and Federal Government and the Okanagan Basin Board of the recommendations made in the Okanagan Basin Report in 1974. Review recommendations and encourage implementation, if warranted, basin-wide.

12. Ensure that this report and recommendations be reviewed by the Kelowna Joint Water Committee with the view of taking any necessary steps to ensure that all five City of Kelowna water purveyors have a consistent application of all operating procedures and policies and the Canadian Drinking Water Guidelines.

13. That the City continues efforts to reduce water consumption through its "Water Smart" program

(Water Quality Task Force, 2002)

2.2.1.3 QualServe

The City Water Utility adopted QualServe, a water quality improvement program, to perform a thorough assessment of its water delivery infrastructure and management practices. Strengths and improvement opportunities were identified and the Quality Improvement Plan 2001, a working document, was composed to provide guidance for all utility staff. Seven task teams were also created to provide reviews and improvement recommendations at regular quarterly meetings.

Currently, approximately 85% of the improvement opportunities stated within the Quality Improvement Plan have been assessed (Degen, pers. comm., 2003). In 2004, the teams will reevaluate their progress and move to a national benchmarking exercise that firmly establishes specific performance measures where the measures are quantitatively tracked. The City Water Utility is recognized as being within the top 5% of the best water purveyors in the country.

2.2.2 WATER QUALITY MONITORING

2.2.2.1 Sampling Frequency and Collection

Qualified technicians perform over 5000 tests monthly on source water and water within the distribution system. To properly assess drinking water quality, samples are taken from source (Okanagan Lake) to tap (terminating points) throughout the distribution system. Sample sites include pump stations, reservoirs, booster stations, dead ends, and fire hydrants. The minimum number of sample sites required for the City is fifty; however, typically over sixty operations of the system determine the number of sites actually sampled.

The City is required to contract a private lab to perform duplicate testing of total and faecal coliform samples from 13 sites. Data results are entered into WaterTrax, an information database that simultaneously alerts public health authorities, water operation staff, and management if microbiological parameters exceed guidelines.

2.2.2.2 Online Monitoring

2.2.2.2.1 Raw Water

Online monitoring equipment provides continuous pH, temperature, and turbidity data on the raw water at Poplar Point, Eldorado and Swick Road pumpstations. This data allows prompt detection of any deviations in water quality. If any significant change occurs, either a moderate or high response is generated. These responses require additional microbiological

testing and or cryptosporidium and giardia testing. To maintain accurate data, manual samples are collected and analyzed by City staff twice per week.

2.2.2.2.2 Treated Water

Online chlorine analyzers on treated water provide a database that is used to determine accurate treatment requirements. Chlorine analyzers are also installed on strategic points in the distribution grid, providing disinfection data throughout the drinking water system. Manual sampling is performed daily to ensure the online equipment is operating correctly and disinfection has occurred.

2.2.2.3 Water Quality Analysis

2.2.2.3.1 Temperature

Certain lake activities such as seasonal mixing can cause water quality to degrade. The City Water Utility continuously monitors raw water intake temperatures to gain information about Okanagan Lake's seasonal and mixing trends. Temperature of treated water varies with seasonal temperature, as does the raw water. Treated water temperatures have continued to remain well below the Federal Health Guideline of 15°C, since 1991.

2.2.2.3.2 Turbidity

Turbidity is an indirect measure of suspended material in water. The unit of measurement is NTU (nephelometric turbidity unit) and describes the amount of light that is scattered and absorbed, rather than transmitted, through a water sample. There is a direct relationship between the amount of scattered light and the turbidity of water. Suspended matter can include clay, silt, fine organic and inorganic matter, coloured soluble organic compounds, and microscopic organisms such as plankton.

Monitoring turbidity of drinking water is critical because sediment and silt cover bacteria, preventing complete disinfection. Health Canada's guideline for water entering a distribution system is 1.0 NTU.

2.2.2.3.3 Treated Water

Treated water has consistently remained below 1.0 NTU, meeting the Canadian Drinking Water Guidelines. Increased maintenance practices, reservoir cleaning, disinfecting, and flushing of water mains have all contributed to improved turbidity.

2.2.2.3.4 pH

The Federal Health Guideline stipulates a pH range between 6.5 and 8.5 for drinking water. The pH of both raw and treated water continues to remain within the accepted range. A certified lab routinely performs additional water chemistry analysis, which is part of Provincial and Federal Guidelines and Regulations. These potability scans include nutrients, trihalomethanes, pesticides, herbicides, dissolved and heavy metals and microbiological organisms.

2.2.2.4 Nutrient Analysis

Nutrient analysis of potable water is conducted annually and includes total nitrogen, total phosphorous, nitrite, and nitrate. Ammonia is used as a water quality indicator; therefore, it is analyzed twice a week. All nutrient levels have continued to consistently meet federal and provincial guidelines.

2.2.2.5 Microbiological Analysis

Microbiological analysis includes:

- Total and faecal coliforms
- Cryptosporidium
- Giardia cysts
- Heterotrophic plate counts

2.2.2.5.1 Faecal Coliforms

Treated water Health Guidelines for faecal colifoms are set at 0 CFU/100ml (CFU = colony forming units).

All treated water is sampled daily by the City Water Utility's trained Water Quality technicians and has continued to show no presence of coliforms.

Q. What are coliforms?

A. **Total Coliform**

- Includes bacteria found naturally in soil and decaying vegetation, as well as faecal coliforms

Faecal Coliform

- Refers exclusively to intestinal bacteria (e.g. *E.Coli*)
- Used to indicate the probability of the presence of pathogens (disease causing bacteria)

2.2.2.5.2 Cryptosporidium and Giardia Cysts

Federal guidelines are set at <30 Oocysts/100L and <3 Giardia cysts/100L. When turbidity deviates at raw water intakes, cryptosporidium and giardia cyst sampling is elicited.

Microbiological sampling is performed twice a week at primary pumphouses on both raw and treated water and is used as an indicator for the possible presence of pathogens. These tests determine the proper amount of chlorine required for adequate disinfection.

Monthly testing is performed in reservoirs. If results are positive, the Deviation Response Plan calls for immediate disinfection and or flushing of the affected reservoirs.

Q. What is cryptosporidium?

A. Cryptosporidium is an infectious parasite that causes Cryptosporidiosis, an illness characterized by diarrhea and cramping. Cryptosporidium has a protective cyst, which makes the parasite resistant to treatment. Cryptosporidium testing has a low accuracy and no current methods are able to distinguish infectious and non-infectious species (City of Kelowna, 1996). Analysing data trends instead of specific samples is common because of such uncertainty in testing (Weaden, pers. comm., 2003).

Kelowna's potable water supply complies with microbiological parameters set by the Federal Health Guidelines. There have been no incidences of viable cryptosporidium or giardia reports since 1996.

2.2.2.5.3 Trihalomethanes

Trihalomethanes (THM) are a suspected cancer causing substance that can form in chlorinated water where significant amounts of organic material are present. The Federal Health Guidelines have set a strict maximum contaminant level to 100 ppb (µg/L). The City of Kelowna THM data falls well below federal guidelines for potable water supply of 100 ppb. The 2002 twelve-month average was 42 ppb. Detailed THM data is available from the City of Kelowna Water Reports.

Since Kelowna's THM levels have consistently remained well below guidelines, the Interior Health Authority has approved a reduction in the frequency of testing to twice per year to provide minimum and maximum THM concentrations. Samples are taken once in August to reflect warm water and once in November to reflect cold water.

2.2.2.5.4 Pesticides and Herbicides

Tests scan for sixty-seven different pesticides and herbicides. No pesticides or herbicides have been detected in any samples collected from Okanagan Lake throughout the history of monitoring. Detailed data are available in the monthly City of Kelowna Water Quality Reports.

2.2.2.5.5 Dissolved and Heavy Metals

Scans are performed to detect seventeen different metals. Results consistently show concentrations that fall far below the 5% guideline. Seven of the seventeen parameters have never been detected. The seven undetected parameters are all heavy metals.

2.2.2.5.6 Fluoridation

The City's main drinking water supply was fluoridated from 1954 to 1996. A public vote regarding fluoridation was incorporated into the 1996 municipal election and resulted in a "No" vote (City of Kelowna, 1996). Hence, fluoridation ceased in November of 1996 when the remaining supply of fluorosilicic acid was depleted (Toma, pers. comm., 1997). Fluoride concentrations were monitored regularly at Poplar Point until October of 1997 to determine background levels. Concentrations are still determined annually and when requested by a customer.

Table 2.0 Summary of the City Water Utility's chemical and physical data for drinking water quality from 1991-2003 (City of Kelowna, 2004c).

Parameter*	Temperature °C	Turbidity NTU	pH	Conductivity µS/cm	Colour TCU	Iron mg/L	Ammonia mg/L	Chloride mg/L	Hardness $CaCO_3$ mg/L
1991	16	1.92	7.61	N/A	7	0.03	0.1	2.7	106
1992	14	0.64	8.08	N/A	6	0.04	.01	3.7	105
1993	11	0.69	7.88	280	12	0.05	0.09	4.1	102
1994	11	0.98	7.90	291	9	0.05	0.05	3.9	96
1995	10	0.81	7.90	287	8	0.03	0.03	▪	▪
1996	10	0.73	7.90	291	6	0.05	0.06	▪	▪
1997	9	0.57	▪	▪	7	▪	▪	▪	▪
1998	10	0.47	▪	▪	6	▪	▪	▪	▪
1999	10	0.47	7.9	▪	6	▪	▪	▪	▪
2000	10	0.44	8.0	▪	5	▪	▪	▪	▪
2001	10	0.41	8.0	▪	5	▪	▪	▪	▪
2002	9.5	0.392	7.9	285	4	0.02	0.02	2.8	108
2003	10.6	0.41	8.0	▪	5	▪	0.032	▪	▪
Guideline**	<15	<1.00	6.5 to 8.5	<500	<15	<0.3	<0.1	<250	<200

* Values are City wide averages on treated water system
** Canadian Water Quality Guidelines for Drinking Water
• Parameter discontinued (but included in the Federal Health guideline once per year)

2.2.3 INITIATIVES

Through recommendations from the Water Quality Task Force and QualServe, the Water Utility has accomplished numerous operational improvements and upgrades since the 1996 cryptosporidium outbreak. Initiatives to date and future initiatives are as follows.

2.2.3.1 Disinfection

Disinfection levels of the entire distribution system have been assessed to ensure adequate treatment occurs at all times. Chlorine pumps are now installed at locations that experience periods of water stagnation to ensure adequate disinfection.

2.2.3.2 Cross-connection Control

When water pressure drops in a distribution system, backflow can occur through cross connections (the link between potable and non-potable water supplies). Cross-connection Control Programs assure proper devices are in place to prevent backflow.

Each water purveyor in Kelowna is required to enforce installation and maintenance of backflow devices for all industrial, commercial, institutional, and agricultural water customers. The Interior Health Authority will not otherwise grant a water license.

All customers in the City of Kelowna are recorded in a central database, which is managed by the City Water Utility. The City Water Utility sends annual maintenance reminder letters to all customers. However, customer compliance is the responsibility of each purveyor. The City Water Utility has assessed approximately 600 establishments in its service area; 541 of them required some type of backflow device. To date, a total of 1154 backflow devices have been

installed in the City service area and approximately 1700 throughout the entire city (Moody, pers. comm., 2003).

2.2.3.3 Water Network Flushing Program

The City Water Utility's distribution system has undergone rigorous upgrades. Unidirectional flushing is performed to meet AWAA standards. Water is flushed through mains at a pressure high enough to abrade sediment attached to pipe walls. The entire network is completely flushed over a 2-year period and areas susceptible to water stagnation are flushed annually.

2.2.3.4 Water Quality Deviation Response Plan

The Kelowna Joint Water Committee (KJWC) and South Okanagan Health Region (SOHR) formed the Water Quality Deviation Response Plan to establish minimum water quality requirements in each district. Specific protocols were developed to provide guidance for water purveyors if deviation from accepted standards occurs.

2.2.3.5 Access Quality Water Advisory (AQWA)

The Kelowna Joint Water Committee (KJWC) has recently established the Access Quality Water Advisory (AQWA) where 24-hour access to water quality conditions is available via home computer or telephone hotline. The public may also sign up to receive immediate notification of water emergencies via email. *Weblink*: www.kjwc.org

2.2.3.6 Future Initiatives

As recommended by the Water Quality Task Force, the City Water Utility examined several new water treatment technologies including ozone, low-pressure membrane technology, microorganism detection, PCR and viability method, magnetic beads, foam filters, and UV irradiation.

City technical and operating staff participated in a UV water treatment research project with the University of Alberta, the National Science and Energy Research Council, and Epcor Utilities during 2000 and 2001.

UV light technology denatures protozoa DNA (including Cryptosporidium and Giardia), which inhibits their ability to reproduce. As well, the process does not require chemicals or generate byproducts. After a thorough assessment, Water Quality Task Force members unanimously recommended implementation of UV technology on the basis of treatment effectiveness and feasibility.

Total installation costs within the City Water Utility are estimated to be $6.2 million. A grant application was submitted in 2002 to the Canada/BC Infrastructure Program for two-thirds of the funding and the Water Quality Enhancement Reserve will contribute approximately $1 million. Remaining funding will be obtained through long-term debenture borrowing. Installation of equipment at all pump stations is scheduled for completion by 2005.

2.3 WATER QUANTITY

This portion of the report concentrates on the City Water Utility's initiatives to reduce water demand in its service area. Information concerning other local water purveyors may be obtained through the Kelowna Joint Water Committee (KJWC) at www.kjwc.org, or each individual purveyor.

Okanagan hillside

2.3.1 BACKGROUND

Regional Climate

The Okanagan is situated in a semi-desert where summer temperatures typically exceed 35°C and annual precipitation receipts are less than 26 centimeters. These climatic conditions, combined with rapid population growth, increase demand on our water sources.

Water Supplies and Sources

Upper watershed snow packs supply the majority of water to Okanagan Lake. Spring runoff provides surplus water, sustaining Okanagan Lake and watershed reservoirs. During years of minimal snowpack, such as the winter of 2002/2003, the water supply is extremely limited.

2.3.2 WATER UTILITY DEMAND

Figure 2.1 displays the percentage of each community's sector of water consumption. The City Water Utility's largest source of demand is the residential sector. 'Unaccounted' represents water utilized for main flushing, fires, reservoir storage maintenance, parks irrigation, and system leakage. Typically, unaccounted water represents 15-20% of a water utility's demand.

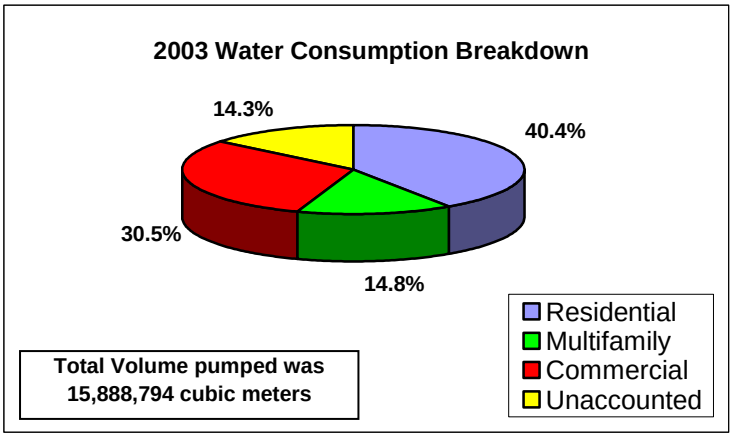


Figure 2.1 Community water consumption (Weaden, 2003)

2.3.2.1 Residential Demand

In 2003, the national average of daily water consumption was 343 liters per person (Environment Canada, 2004a). In comparison, Kelowna's 1998 daily average was 570 liters, one of the highest consumptive rates in North America. In 2003, Kelowna's daily average was 525 liters/day, remaining one of the highest consumption rates in the world. Figure 2.2 compares Kelowna's rate of daily water use to provincial, national, and various international consumption rates.

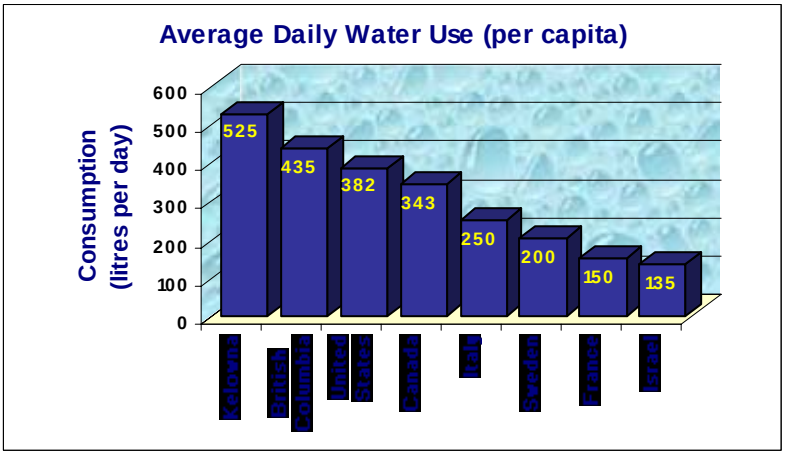


Figure 2.2 Average daily water use (Environment Canada, 2004a; City of Kelowna, 2003)

Crawford Estates, Dilworth Mountain and Okaview/Timberline residents are the largest water consumers in the City Water Utility, utilizing up to three times more water than other areas within the City serviced area.

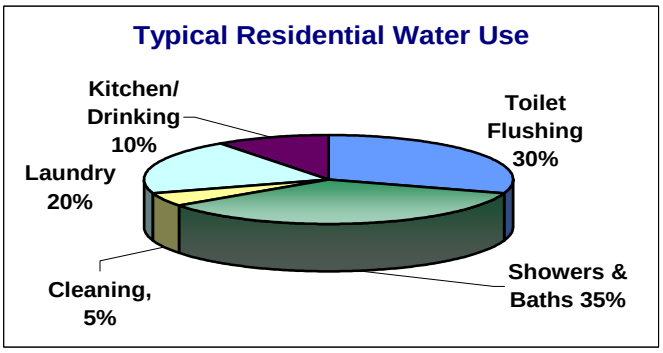


Figure 2.3 Residential water use (Environment Canada, 2004b)

Domestic consumption represents 59.5% of water distributed from Okanagan Lake. Showering, bathing, toilet flushing, and laundry comprise the majority of indoor residential water use (see Figure 2.3).

In addition to indoor water use, irrigation represents a significant portion of residential water demand during summer months.

Figure 2.4 displays the volumetric average of residential water consumption within the City Water Utility during the previous six years. The data has been segregated into average use from October to March, average per day throughout the year, and maximum days in July and August, to show the magnitude of demand between seasons.

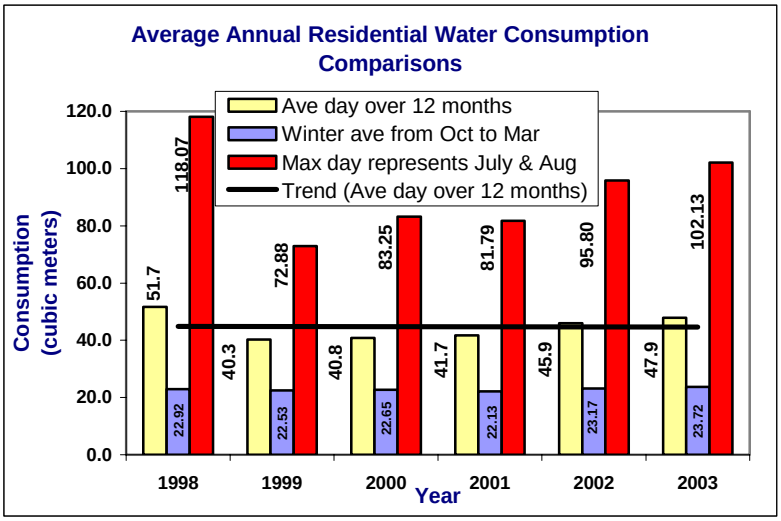


Figure 2.4 Water consumption (m^3/month) from 1998 to 2003 (Crisfield, 2003)

The City Water Utility's record indicates that total residential summer consumption rates have unambiguously decreased since 1998. From 1999 onward, implementation of water meters, public education and efforts of the Water Smart Program helped to substantially reduce water consumption. Details of the City's efforts to reduce water demand are discussed under INITIATIVES.

2.3.2.2 Agricultural Demand

Water is essential to the agriculture industry for crop production and livestock. Rising temperatures create greater evaporation rates and increase water requirements for farming practices, which allows little water to return to its original source and places additional strain on water supplies. This makes agriculture a high water consumptive industry (Environment Canada, 2004c).

Agriculture is the largest type of primary industry in the City of Kelowna. However, agriculture represents a very small portion of water consumption in the City Water Utility (Degen, pers. comm., 2003).

2.3.2.3 Commercial and Industrial Demand

Industrial, commercial, and institutional water use currently accounts for 29% of the City Water Utility's total water consumption. With continued monitoring, a general trend should become apparent.

2.3.3 WATER UTILITY SUPPLY

The City of Kelowna Water Utility extracts water from Okanagan Lake in several locations. The Poplar Point pumphouse represents 90% of the entire distribution system's intake. The Eldorado, Cedar Creek, and Swick Road pumphouses account for the remaining 10%. Two other pumphouses, R&E and Okaview, are utilized during periods of high demand (e.g. forest fires). Total volumes of water pumped through the distribution system remained relatively constant until 1998. The reduction of water production in 1999 is attributed to the introduction of water meter billing in combination with education and seasonal weather conditions. Table 2.1 lists monthly and annual volumes of water pumped through the distribution system between 1996 and 2003.

Table 2.1 Water Utility supply volumes (Weaden, 2003)

Water Utility Supply (m^3)								
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Jan	719,949	693,443	675,193	734,772	756,450	725,215	749,554	742,927
Feb	665,748	630,898	650,639	674,045	723,108	664,996	697,534	678,402
Mar	793,449	714,748	730,666	786,526	789,678	768,893	773,118	780,545
Apr	899,897	951,241	889,623	1,050,426	943,151	922,623	976,018	965,367
May	1,302,745	1,423,660	1,502,572	1,376,417	1,333,145	1,481,621	1,492,884	1,498,258
Jun	1,857,098	1,454,882	1,661,051	1,711,657	1,634,356	1,513,200	1,945,236	1,957,442
Jul	2,516,983	1,761,741	2,439,496	1,879,829	1,853248	2,095,104	2,314,107	2,593,660
Aug	2,240,996	1,982,408	2,536,046	1,882,588	2,031,776	1,967,942	2,103,597	2,406,700
Sep	1,184,760	1,215,678	1,768,694	1,613,969	1,126,686	1,449,378	1,546,160	1,573,056
Oct	851,907	856,444	925,551	951,621	948,059	922,157	1,012,439	1,133,167
Nov	705,205	682,981	757,189	769,335	724,919	817,980	747,857	776,928
Dec	674,161	662,420	722,892	749,721	688,404	752,091	723,479	782,342
Total	**14,414,892**	**13,032,539**	**15,261,611**	**12,300,660**	**13,554,980**	**14,083,201**	**15,081,973**	**15,888,794**

2.3.4 INITIATIVES

Reducing water consumption is one of the recommendations made by the Water Quality Task Force in order to reduce water demand within the utility. To address water demand, the City Water Utility has focused its efforts on two main initiatives- water meters and the Water Smart Program.

Q. What major factors affect water demands?

A. Major factors influencing water demand:

- Efficient water use through education, incentives, and pricing rates
- Seasonal and annual weather fluctuations
- Community growth

2.3.4.1 WATER METERS

The City Water Utility is fortunate to have access to a large and reliable water source, Okanagan Lake. However, Kelowna's flourishing population places extenuating demands on the water distribution system. Continual infrastructure expansion bears substantial expense, in the magnitude of multimillions. Water metering, in conjunction with education and proper pricing structures, defers infrastructure costs, decreases water distribution demands, and encourages water conservation practices. In 1999, a Canadian assessment conducted by Environment Canada suggested that households paying for water by volume (i.e. regulated by water meters) use less than 50% of those who pay a flat rate (Environment Canada, 2003).

The City Water Utility began the process of implementing water metering in 1996. By the end of 1996, the majority of infrastructure installations and repairs were complete. Throughout 1997, informational notices were mailed to educate residents of their monthly water consumption and the associated cost. These notices were informational only; meter billing did not commence until 1998. It has been estimated that water metering, in conjunction with education and pricing based on user pay, will provide several millions of dollars in savings of infrastructure costs over a ten-year period.

Water meters appear to have reduced water demand in the City serviced area; a significant reduction is evident between 1998 and 1999 when meter billing was initiated (see Table 2.1).

1996
- 3,000 commercial water meters were repaired or replaced
- 13,000 residential water meters were installed

1997
- Informational notices mailed to educate residents about metering

1998
- Water meter billing commenced

Studies show that after initial introduction of water meter billing, water consumption dramatically drops (Environment Canada, 2003). However, without continual provision of incentives, over time water meter patrons tend to become accustomed to metering and consumption rates gradually increase, creating a 'rebound effect'.

To discourage the 'rebound effect', the City Water Utility will be introducing an increasing fee block structure comprised of three billing tiers, in 2004. Essentially, the volume of water consumed reflects the rate billed. If water conservation methods are practiced, each consumer will remain in lower fee tiers. The increasing block structure promotes equity between users and also encourages reduction of 'peak demand'; it will be going to council for review and approval in late 2004 for implementation in early 2005

(Degen, pers. comm., 2004). The concept of 'peak demand' is discussed in conjunction with the Water Smart Program (refer to the subsequent section).

2.3.4.2 WATER MAIN PILOT STUDY

The City Water Utility has also made efforts to increase efficiency of water mains. During 2001 and 2002, pilot studies were conducted to assess the condition of the City's water mains. The study concluded that the majority of the water mains were leak-proof, with most of the water loss occurring at fire hydrants and service connections. Proactive projects like these will help to reduce any unaccounted volume.

2.3.4.3 CITY OF KELOWNA WATER SMART PROGRAM

In 1996, the City of Kelowna and Schlumburger (now Neptune Technology Group) inaugurated the Water Smart Public Education Program. The program targets residential, commercial, and institutional (e.g. schools) sectors by providing incentives and public education on efficient water use.

Water Smart has been working directly with residents since 2001 to reduce water demands caused by inefficient irrigation and household practices. Crawford Estates was chosen as the first study area to initiate residential water reduction during the peak demand period in July. The area was chosen for the preliminary study because it exhibited a history of the highest residential water consumption rates in the City Water Utility.

The 2001 study set a goal to reduce participants' peak water use by 16%, which represents a significant savings to infrastructure upgrades and expansions. Education and incentives such as Ogogrow, aeration, rain sensors, and sprinkler upgrades were provided to participants free of cost. Results from the study were significant and promising. Peak period water use was reduced by 24%, surpassing the prescribed goal of 16%.

Because of encouraging results in 2001, the 2002 program expanded to other high water use areas within the City Water Utility. Residents of Crawford Estates, Dilworth Mountain and Okaview/Timberline were invited to participate in the 2002 study.

Participants chose one of the following three incentives to aid their water reduction efforts:

- Ogogrow
- A water efficient irrigation timer
- Education

For the second year in a row, the study was a great success. All areas reported

Table 2.2 Water consumption results for 2002 study (Klassen, 2003)

	INCENTIVES		
Area	**New Timer**	**Ogogrow**	**Education**
Crawford Estates	+ 0.01 %	- 16%	- 13%
Dilworth Mountain	- 25%	- 2%	- 23%
Okaview/ Timberline	- 4%	- 14%	- 9%
Average Reduction	- 14%	- 10%	- 15%

an average water reduction, as shown in Table 2.2. Specific incentives appeared to be more successful in some areas than others. This information allows Water Smart to provide tailored incentives to each area.

In 2003, participants again included residents of Crawford Estates, Dilworth Mountain and Okaview/Timberline. However, this year the top 130 water consumers were identified and invited to participate in the study. Some of these customers use 600 m^3 to 700 m^3 daily, where the city's average consumption for July is 100 m^3.

Participants in 2003 were provided with:

- Personal water consumption histories, charts comparing personal usage to neighbours usage, and a neighbourhood ranking (e.g. 3rd highest consumer in the area)
- A professional irrigation assessment
- A water audit
- Glenmore Grow (the City's newest top dressing). Participants purchase the top dressing and Water Smart subsidizes delivery and labour costs of application.
- Educational information
- A one-month follow up visit

Q. What is peak demand?

A. Peak demand is the period of time where a water distribution system experiences its greatest demand. In Kelowna, annual peak demand occurs during the month of July and daily peak demand is from 2:00 am to 3:00 am due to automatic irrigation systems.

2.3.4.3.1 Peak Demand

Figure 2.5 displays a typical demand curve for the City Water Utility during the month of July. The 10 pm peak is caused by sprinklers and hoses, whereas the 6 am peak represents automatic irrigation systems. Staggering watering times is an easily applied method that effectively reduces peak water demand (Klassen, pers. comm., 2003). Even if the amount of water demanded remains the same, flattening peaks in the demand curve aids to alleviate stress on the City's water distribution system.

To maintain a reliable water supply, the distribution system must be able to accommodate its peak demand, no matter how short in duration. Conservation practices that diminish water use and lower peak demand defers upgrades to the City's water distribution system, thereby saving millions of dollars (Klassen, pers. comm., 2003).

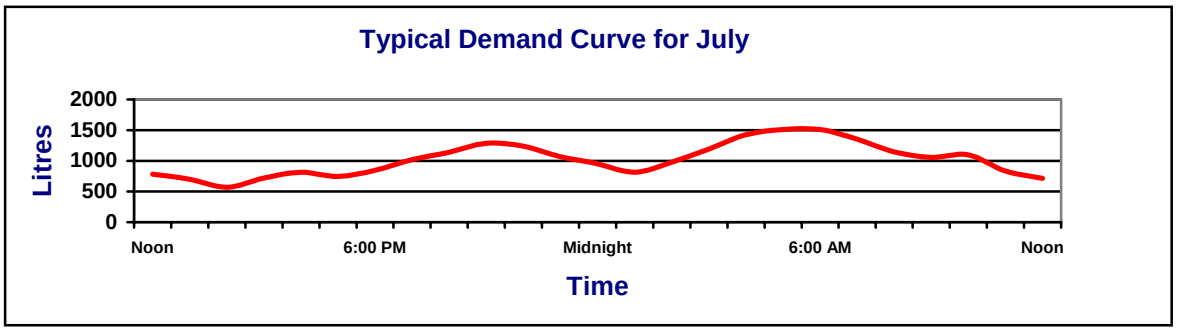


Figure 2.5 Typical demand curve for the City Water Utility for July (Klassen, 2003)

(Note: The graphs exhibit the lag time between actual demand and when recorded)

2.3.4.3.2 Water Demand Study

Water Smart conducted a peak demand study in the Mission in 2003, with hope to decrease peak water demand in the area. Mission residents received letters that requested even numbered addresses to set irrigation timers for watering between 11:00 pm and 2:00 am and for odd numbered addresses to water from 2:00 am to 4:00 am.

2.3.4.3.3 Educational Material and Presentations

Education is a fundamental part of the Water Smart Program. Educational tools such as interactive displays, brochures, student workbooks, and fridge magnets are provided to students and the public concerning water conservation practices.

2.3.4.3.4 Awards and Recognition

Water Smart was recognized for its tremendous efforts at a water conservation competition held by Ontario Waterworks in 2002. Water Smart received two awards, "Overall Best Water Conservation Program" and "Specialized Award Winner for Peak Demand Study". This accomplishment proved to be quite an upset, as Kelowna beat out larger cities such as Toronto, Ottawa and Kitchener-Waterloo, all of which have higher funded budgets.

Water Smart is still considered a pilot project. With continued accomplishments and acquisition of sufficient data, future plans include expanding the program throughout the City Water Utility. Funding availability will dictate growth of the program.

2.4 SURFACE WATER

Humans, animals and plants, as well as several industries, are dependent on high quality surface water. Protection of this resource is vital to the health of our environment, society, and economy.

Surface water, storm water, and watersheds are extremely interrelated topics. To avoid repetition, storm and surface water INITIATIVES have been amalgamated and are located in the storm water section (section 2.5). A detailed discussion of Kelowna's watershed is located in section 3.3.

Mill Creek

Surface waters addressed in this report include Okanagan Lake, waters off the shores of local public beaches and the five tributaries monitored by the City of Kelowna.

2.4.1 BACKGROUND

2.4.1.1 Provincial Water Quality Index

In BC, surface water quality is graded according to the Provincial Water Quality Index. The rating system is as follows (MWLAP, 2002c):

- **Excellent:** Conditions very close to natural or pristine. All uses are protected and none are threatened or impaired.
- **Good:** Conditions rarely depart from natural or desirable levels. All uses are protected, with only minor threats or impairment.
- **Fair:** Conditions sometimes depart from natural or desirable levels. Most uses are protected, but a few are threatened or impaired.
- **Borderline:** Conditions often depart from natural or desirable levels. Several uses are threatened or impaired.
- **Poor:** Conditions usually depart from natural or desirable levels. Most uses are threatened, impaired or even lost

2.4.1.2 Water Quality Monitoring Parameters

Monitoring creek water quality aids in determining impact from storm water and activities such as development and agriculture. As well, monitoring provides necessary information to assess water quality trends. The City of Kelowna began monitoring physical, chemical and biological parameters of Mission, Mill, Brandt's and Fascieux Creeks in 1992, and Bellevue Creek in 2000.
Since 1993, Kelowna has abided by the Ministry of Water, Land, and Air Protection (MWLAP) sampling method standards, which entails five samples within a thirty-day period.

A variety of parameters are screened in surface water test samples. For simplification, only pH, turbidity, dissolved oxygen and dissolved metals are discussed in the MONITORING section. These parameters were chosen because they provide a general impression of creek health, and show seasonal variations that many creeks experience.

Mission Creek runoff

2.4.1.2.1 pH

Seasonal patterns of pH are evident in many of Kelowna's Creeks. Pollutants that accumulate in the snow pack over the winter cause the melt water in the spring freshet (runoff) to be more acidic.

British Columbia Approved Guidelines for pH are as follows:

- Aquatic Life: 6.5-9.0
- Drinking Water: 6.5-8.5
- Recreation: 5.0-9.0

2.4.1.2.2 Turbidity

Raw water can range from 0-100 NTU.

British Columbia Approved Guidelines for turbidity are as follows:
- Aquatic Life: increase of <20% of background
- Drinking Water: 1 NTU
- Recreation: 50 NTU

Common causes of high turbidity values are microorganisms, spring freshet, activities that induce soil erosion (e.g. construction, logging), and improper care of riparian zones. During surface runoff, NTU values can change quickly and dramatically.

2.4.1.2.3 Dissolved Oxygen (DO)

DO is a measurement of the amount of oxygen dissolved in water. Oxygen diffuses into water by physical means via tumbling fast flowing water or by chemical means (the waste product of photosynthesis).

DO levels are influenced by:

- Temperature
  As temperature increases oxygen becomes less soluble in water, therefore, warmer water temperatures are associated with lower DO concentrations

- Nature of water flow
  Greater velocity and turbulence increases the surface area of the water to air, which promotes higher DO levels

- Abundance of organic material present
  Decomposing organic material depletes dissolved oxygen in water. Therefore, greater amounts of organic material are associated with lower DO levels.

British Columbia Approved Guidelines for DO for aquatic life are 11 for buried alevin and 8 for other life stages.

2.4.1.2.4 Dissolved Metals

Trace amounts of dissolved metals in water are beneficial to aquatic plants and animals. However, excess quantities can have detrimental effects. Conditions that cause elevated dissolved metal readings in local surface waters include:

- Groundwater
  Groundwater sources in Kelowna are shallow and contain elevated levels of iron and manganese. When groundwater leaches into local tributaries, their metal concentrations often increase.

- Spring Freshet
  Fast flow velocities and heavy sediment load during spring runoff commonly affects several water quality parameters, including dissolved metal concentrations.

Periodically, certain metal concentrations are exceeded during spring freshet in Kelowna's creeks. However, no single metal concentration is found to be consistently high.

2.4.2 MONITORING

2.4.2.1 Okanagan Lake

Okanagan Lake is the City Water Utility's primary water source. It takes a minimum of 52 years to exchange all the water in the lake. This lengthy residence time raises concerns regarding the rate of pollution discharge.

Okanagan Lake is classified as oligotrophic (Pinsent and Stockner, 1974).

Okanagan Lake

Q. What does trophic status mean?

A. Regarding bodies of water, trophic status refers to the amount of nutrients (mainly phosphorous and nitrogen) present.

Trophic States of Lakes

Oligotrophic Lakes

- Deep lakes with clear water
- Water appears blue-green in the sunlight
- Low nutrient content
- Typically have high dissolved oxygen concentration levels

Eutrophic Lakes

- Shallow lakes with murky water
- Abundant nutrients
- Heavy growth of algae and aquatic plants, create a murky green surface layer decreasing light penetration and limiting biological reproduction
- Contains insufficient dissolved oxygen concentrations to allow sustainable life

(Smith & Smith, 2001; MWLAP, 1996)

2.4.2.1.1 Phosphorous

Phosphorous is a limiting factor to plant growth. Excess deposition of phosphorous, combined with nutrient sources such as agriculture, municipal waste, storm water discharge, forestry and upstream inputs, can cause nutrient loading (MWLAP, 1996). Phosphorous is the main pollutant of concern in Okanagan Lake.

Prior to 1983, phosphorous levels ranged from 0.008 to 0.016 mg/L at the Ministry sampling site near the outfall of the wastewater treatment facility (#0500242). After the commissioning of the Bardenpho treatment system in 1983, phosphorous levels dropped, ranging from 0.006 to 0.008 mg/L between 1983 and 1988 (Bryan, pers. comm., 1997). Since 1998 phosphorous levels have remained relatively stable.

The BC Water Quality Status Report graded Okanagan Lake as 'fair' in 2002 (based on data from 1999 and 2000). This rating refers to the Provincial Water Quality Index. Only the Armstrong Arm portrays a history that regularly exceeds Ministry of Water, Land and Air Protection (MWLAP) phosphorous objectives of 0.010 mg/L. Effluent discharges from the

Armstrong Treatment Facility and agricultural practices have been the most concerning pollutant sources. Redirection of treated wastewater to spray irrigation in 2000 and improved manure handling is expected to decrease phosphorous levels over time. However, phosphorous levels will remain higher in the Armstrong Arm than other areas of the lake due to shallow depths and sheltered characteristics (Jensen, pers. comm., 2003).

Total phosphorous levels in Okanagan Lake vary with yearly runoff patterns. No clear trend of nutrient reduction is evident due to decreased phosphorous inputs into the lake. To control eutrophication, further reductions from non-point sources such as urban run-off, agriculture, septic tanks, and forestry are required. MWLAP is currently reviewing Okanagan Lake water quality objectives, with the intent to broaden the suite of indicators and better guide lake management in the future (Jensen pers. comm., 2003).

Table 2.3 summarizes phosphorous objective sampling data of Okanagan Lake from 1995 to 2003. Shaded cells exceed BC MWLAP objective of 0.010 mg/L. Samples are averages of surface (1-10m) and deep (20-45m) waters from a number of sites in each basin, with the exception of Armstrong and Vernon Arms, which are single deep sites.

Table 2.3 Phosphorous sampling data (Jensen pers. Comm., 2003)

Year	Armstrong Arm	Vernon Arm	North Basin	Central Basin	South Basin
1995	April 11 0.013	March 14 0.004	March 14 0.005	February 22 0.006	March 12 0.003
1996	May 1 0.030	April 24 0.014	March 12 0.008	March 11 0.006	February 28 0.010
1997	April 15 0.045	March 15 0.009	April 15 0.015	April 16 0.010	April 10 0.010
1998	April 2 0.022	February 3 0.012	February 3 0.012	February 2 0.011	March 31 0.004
1999	February 26 0.029	March 2 0.009	March 2 0.010	February 23 0.006	February 18 0.007
2000	April 12 0.014	February 29 0.011	February 29 0.010	February 23 0.011	February 21 0.012
2001	March 26 0.018	March 14 0.011	March 14 0.014	Feb 22 0.011	Feb 21 0.007
2002	April 17 0.003	Feb 19 0.009	Feb 19 0.007	Feb 21 0.006	Feb 12 0.002
2003	Spring 0.015	Spring 0.006	Spring 0.007	Spring 0.006	Spring 0.005

2.4.2.2 Local Beaches

Rotary Beach looking North

The Health Region routinely monitors water quality from May through September at many local public beaches for the presence of faecal coliform bacteria to assure the water's safety for recreational use.

2.4.2.2.1 Faecal Coliform

When observing water quality data, it must be remembered that samples are taken at a specific point in time and only provide a 'snapshot' of conditions. An occurrence such as

duck feces in a sample will result in an extremely high faecal coliform count. Data from a sequence of samples over time provides a more appropriate representation of conditions (Browne, pers. comm., 2003).

Table 2.4 exhibits the coliform counts at local beaches from 1993 to 2003. The shaded cells exceed the Canadian Water Quality Guideline for recreational use (200 Colony Forming Units (CFU) per 100mL). Beaches with north and south samples are averaged to obtain a single value for recreational guidelines.

Table 2.4 Faecal coliform counts at local beaches (Interior Health Authority, 2004)

Year	Bertram Creek	Cedar Creek	Sarsons Park	Rotary Park	Gyro Park	Strathcona Park	Kinsmen Park	Hot Sands North	Hot Sands South	Tugboat North	Tugboat South	Sutherland Park
1993	7	na	37	74	46	41	62	53	Na	na	na	50
1994	8	na	159	41	55	451	50	48	Na	299	570	298
1995	na	na	165	127	50	17	109	38	Na	186	na	443
1996	32	na	39	32	26	32	34	114	Na	28	14	na
1997	21	30	44	95	22	35	47	43	59	112	73	na
1998	59	46	31	67	63	44	86	41	153	140	121	124
1999	47	42	19	44	83	51	132	100	13	168	150	71
2000	8	17	12	33	33	42	33	151	82	87	77	266
2001	7	17	76	72	26	40	45	97	216	120	112	na
2002	42	39	46	87	68	71	62	113	115	79	97	na
2003	10	74	58	216	44	228	140	143	156	118	107	na

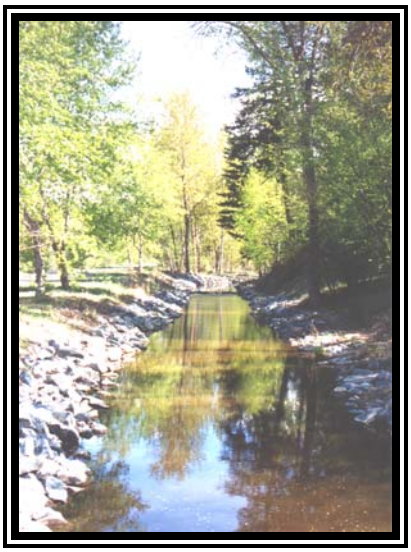
Sutherland Park has a history of high bacterial counts caused by several factors, including poor bay water circulation and abundant waterfowl. Consequently, the beach has been closed for recreational use since 1995.

To keep faecal coliform counts down, informational pamphlets are distributed to the public explaining the importance of not feeding wildlife in local parks. The City's Parks Department also regularly patrols public parks to discourage the presence of ducks, gulls and geese.

Q. What are coliform bacteria?

A. Coliform bacteria are relatively harmless microorganisms commonly found in intestines of many animals. Faecal coliforms (e.g. *E. Coli*) are a specific subgroup associated with fecal matter and can be dangerous to human health.

Coliform counts from water samples are used as an indicator to estimate the probability of the presence of pathogens (disease causing organisms). Sources that transport faecal coliform from non-point sources to local beaches include waterfowl, pet feces, organic sources (food waste) and initial storm runoff .



Mission Creek Spawning Channel

2.4.2.3 Tributaries

A general summary of each creek monitored by the City of Kelowna is discussed in the following paragraphs. Graphs of pH, turbidity and dissolved oxygen are displayed, as these qualities provide a general impression of creek health and show the seasonal variations that many creeks experience. A summary table of dissolved metal data for each creek is also provided. Metals that have remained below detection limits have been excluded for simplification. Detailed sediment and dissolved metal data is available through the City's Water Quality reports.

2.4.2.3.1 Mission Creek

The BC Water Quality Status Report gave Mission Creek a grade of 'fair' in 2000. Water quality of Mission Creek has remained relatively consistent for several years (See Figures 2.6, 2.7, 2.8, and Table 2.5) (Browne, pers. comm., 2003).

As the water passes through urban areas of Mission Creek, dissolved oxygen levels tend to decrease, whereas coliform, phosphorous, conductivity and sodium concentrations typically increase. These trends indicate that water quality deteriorates in Mission Creek through urbanized areas.

Mission Creek does not contain storm drain outfalls; therefore, factors such as groundwater may be influencing change in water quality within the city limits.

Activities in the upper Mission Creek watershed, such as forestry and agriculture (mainly cattle grazing) also have a negative impact on Mission Creek's water quality. The City does not have jurisdiction to regulate practices that occur outside City limits. Therefore, integrated management between all levels of government and applicable stakeholders is highly important.

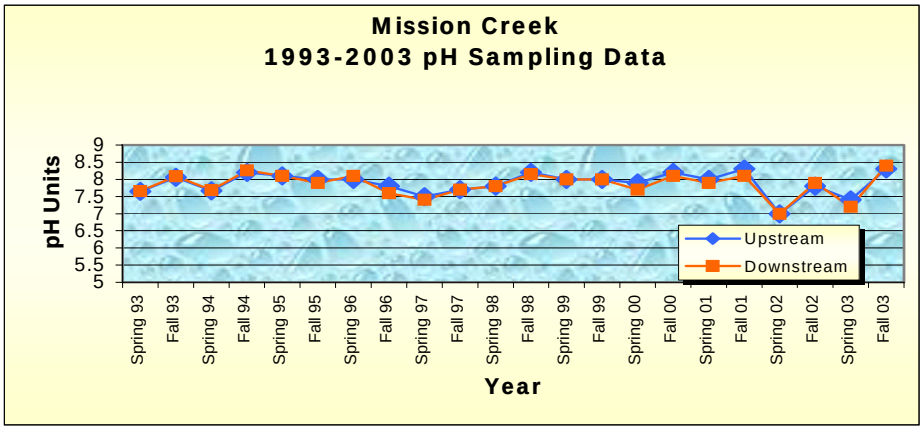


Figure 2.6 Mission Creek pH results (City of Kelowna, 2004a)

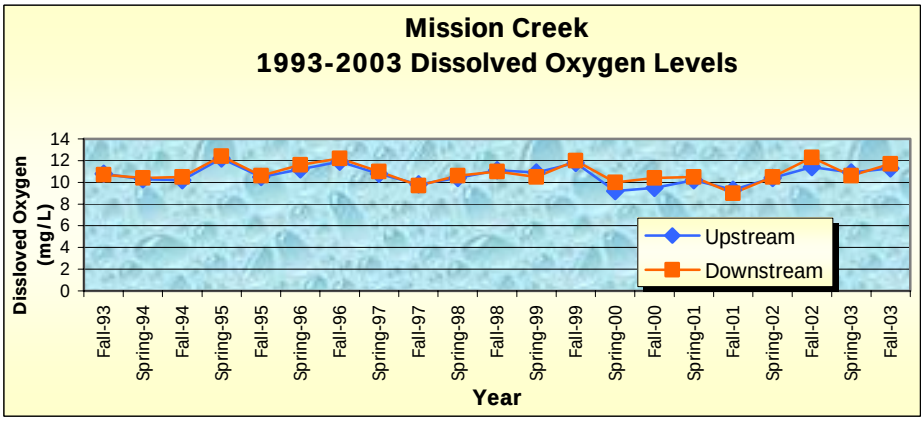


Figure 2.7 Mission Creek dissolved oxygen results (City of Kelowna, 2004a)

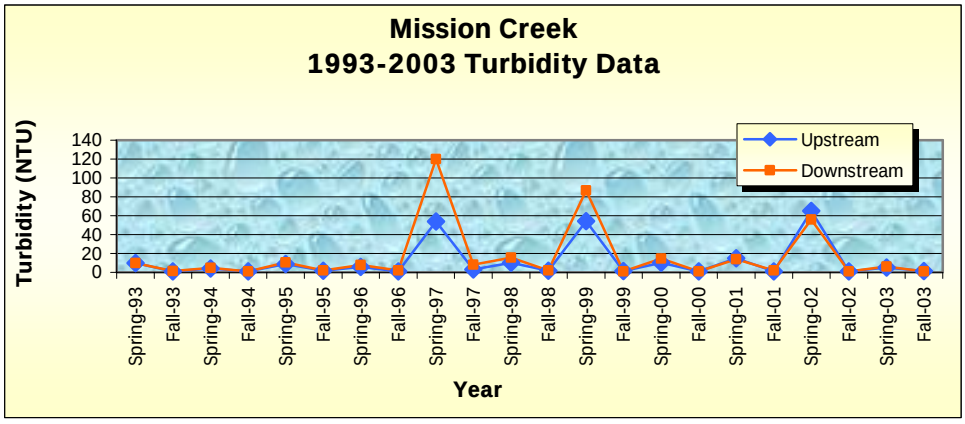


Figure 2.8 Mission Creek turbidity data (City of Kelowna, 2004a)

Table 2.5 Mission Creek dissolved metal data (mg/L) Highlighted cells indicate periods when dissolved metals exceeded guidelines (City of Kelowna, 2004a)

Element	Site	Trend	Year						Guidelines		
			1998	1999	2000	2001	2002	2003	Irrigation	Aquatic Life	Drinking
Aluminum	Up	Min	.01	0.034	0.031	0.025	<0.005	0.007	5.0	0.1	0.20
		Max	0.10	0.393	0.353	0.407	0.203	0.125			
	Down	Min	0.02	0.031	0.027	0.017	<0.005	<0.005			
		Max	0.09	0.472	0.446	0.297	0.237	0.155			
Arsenic	Up	Min	<0.0002	0.0006	<0.0002	<0.01	<0.0002	<0.0002	0.1	0.05	0.05
		Max	0.0002	0.0008	<0.01	<0.01	0.0002	<0.0002			
	Down	Min	<0.0002	0.0008	<0.0002	<0.01	<0.0002	<0.0002			
		Max	**0.0006**	**0.0009**	**<0.01**	**<0.01**	**<0.0002**	**<0.0002**			
Zinc	Up	Min	<0.001	<0.0006	<0.0006	<0.0006	<0.001	<0.001	5.00	0.03	5.00
		Max	0.003	0.0037	0.0007	0.0081	0.002	0.002			
	Down	Min	<0.001	<0.0006	<0.0006	<0.0006	<0.001	<0.001			
		Max	0.002	0.0037	0.0013	0.0111	0.002	0.001			
Manganese	Up	Min	0.001	0.0025	0.0024	0.0015	0.0022	<0.005	0.2	0.1-1.0	0.05
		Max	0.0026	0.0105	0.0089	0.0032	0.0027	<0.005			
	Down	Min	0.0008	0.0052	0.0041	0.0026	0.0033	<0.005			
		Max	0.0033	0.0084	0.0112	0.0043	0.0160	<0.005			
Iron	Up	Min	0.027	0.058	0.048	0.033	0.030	0.030	5.00	0.3	0.3
		Max	0.098	0.519	0.356	0.382	0.167	0.140			
	Down	Min	0.033	0.072	0.051	0.043	0.060	0.050			
		Max	0.098	0.478	0.464	0.265	0.217	0.150			

2.4.2.3.2 Mill Creek

Mill Creek received a "fair" grade in the 2000 BC Water Quality Status Report. Similar to Mission Creek, water quality tends to degrade as water migrates through urbanized areas. In contrast to Mission Creek, Mill Creek has over forty storm drainage outfalls that empty into the creek and approximately 25% of the watershed is impervious (Watt, pers. comm., 1998). These factors, in addition to groundwater contributions, may be directly or indirectly related to the influence of the creek's water quality. The pH, turbidity and dissolved oxygen values for Mill Creek typically fall within the parameters of provincial guidelines (See Figures 2.9, 2.10, and 2.11). However, some concern regarding turbidity still exists.

Several activities occurring in and around Mill Creek contribute to increased turbidity. Some of these activities include outdoor recreation (e.g. off road vehicles), forestry practices and natural landslides, which elevate sediment loads and erosion rates. In addition, cattle grazing promotes nutrient loading.

Restoration of riparian zones, the transition from septic to sewer systems and installation of drainage structures (e.g. dykes and storm receptors) is hoped to generate improvement of Mill Creek's water quality. As the data history of Mill Creek lengthens, seasonal differences are becoming apparent, such as increased conductivity during autumn months. Other trends are expected to become evident with time.

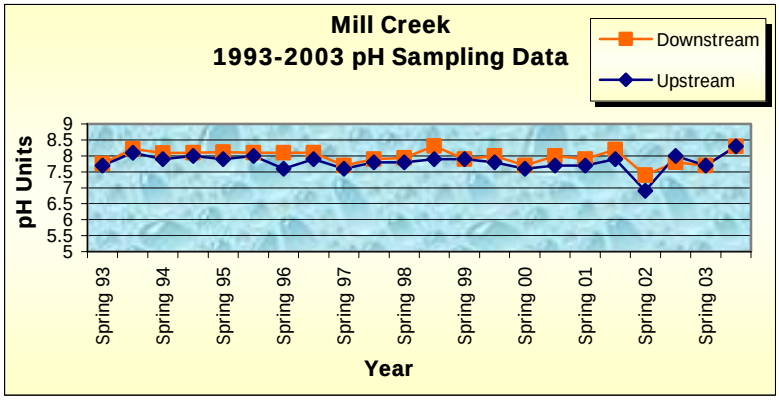


Figure 2.9 Mill Creek pH results (City of Kelowna, 2004a)

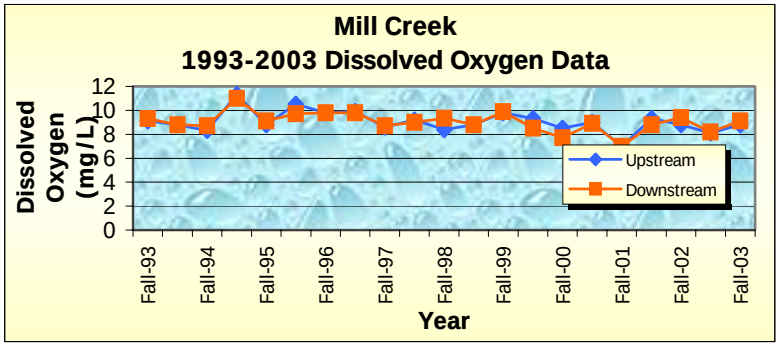


Figure 2.10 Mill Creek dissolved oxygen results (City of Kelowna, 2004a)

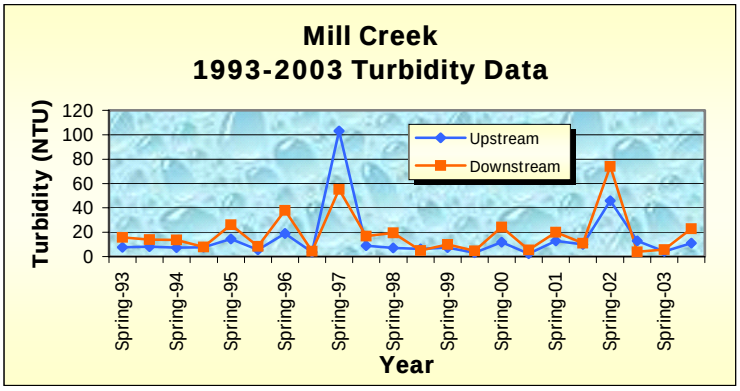


Figure 2.11 Mill Creek turbidity results (City of Kelowna, 2004a)

Table 2.6 Mill Creek dissolved metal data (mg/L) Highlighted cells indicate periods when dissolved metals exceeded guidelines (City of Kelowna, 2004a)

Element	Site	Trend	Year						Guidelines		
			1998	1999	2000	2001	2002	2003	Irrigation	Aquatic Life	Drinking
Aluminum	Up	Min	<0.01	0.055	0.036	0.022	<0.005	<0.005	5.0	0.1	0.20
		Max	0.06	0.236	0.613	0.480	0.538	0.327			
	Down	Min	<0.01	0.029	0.023	0.016	<0.005	<0.005			
		Max	0.03	0.233	0.731	0.187	0.365	0.196			
Arsenic	Up	Min	<0.0002	0.0008	<0.0002	<0.01	0.0006	0.0005	0.1	0.05	0.05
		Max	0.0016	0.0009	<0.01	<0.01	0.0010	0.0014			
	Down	Min	0.0002	0.0007	<0.0002	<0.01	0.0005	0.0006			
		Max	0.0009	0.0010	<0.01	<0.01	0.0006	0.0010			
Zinc	Up	Min	<0.001	0.0009	0.0006	<0.0006	0.001	0.001	5.00	0.03	5.00
		Max	0.006	0.0065	0.0034	0.0145	0.0051	0.011			
	Down	Min	<0.001	0.0008	<0.0006	0.0006	0.001	0.001			
		Max	0.007	0.0010	0.0009	0.0441	0.0042	0.002			
Manganese	Up	Min	0.0024	0.0077	0.0178	0.0106	<0.005	<0.005	0.2	0.1-1.0	0.05
		Max	0.0290	0.0676	0.0602	0.0521	0.1260	0.0490			
	Down	Min	0.0014	0.0066	0.0064	0.0051	<0.005	<0.005			
		Max	0.0038	0.0262	0.0373	0.0247	0.0350	0.0380			
Iron	Up	Min	0.018	0.154	0.181	0.079	<0.01	0.030	5.00	0.3	0.3
		Max	0.165	0.307	0.728	0.537	0.486	0.420			
	Down	Min	0.006	0.116	0.148	0.045	0.020	0.030			
		Max	0.144	0.32	0.915	0.371	0.464	0.350			

2.4.2.3.2 Brandt's Creek

The BC Water Quality Status Report rated Brandt's Creek as "poor" in 2000. Several sediment and metal samples have reached ratings of moderate or heavy (See Table 2.7). However, many other parameters have consistently remained at low concentrations and are rated as "good". See figures 2.12, 2.13, and 2.14 for pH, dissolved oxygen, and turbidity of Brandt's Creek over time.

Agricultural activities at the headwaters of Brandt's Creek and natural alkaline soils are often the source of high sediment and dissolved metal concentrations. As water migrates downstream towards the city centre, parameters such as pH, turbidity, conductivity, ammonia, total phosphorous, sodium and occasionally faecal coliform tend to improve due to contaminant settling and filtering.

A lack of natural riparian vegetation and direct sunlight contribute to diminished water quality as well. A significant amount of riparian restoration work has been completed in Brandt's

Creek (See Section 3.3 Watershed). Improvements in water quality are expected with maturation of the Glenmore Wetlands and continuation of watershed restoration. Brandt's Creek is not utilized as a drinking water source, nor is it a significant fisheries creek; therefore, water quality issues are of lower priority than in areas such as Mill Creek or Mission Creek.

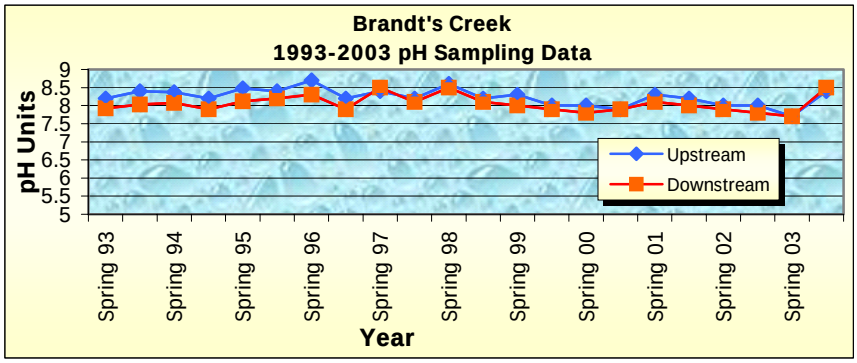


Figure 2.12 Brandt's Creek pH results (City of Kelowna, 2004a)

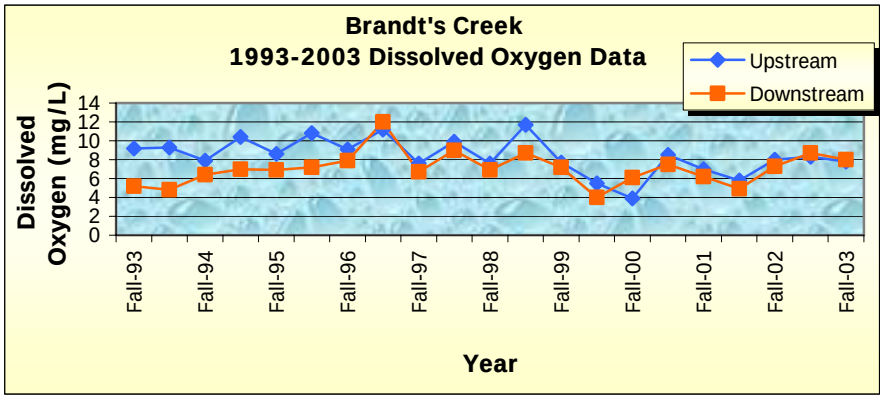


Figure 2.13 Brandt's Creek dissolved oxygen results (City of Kelowna, 2004a)

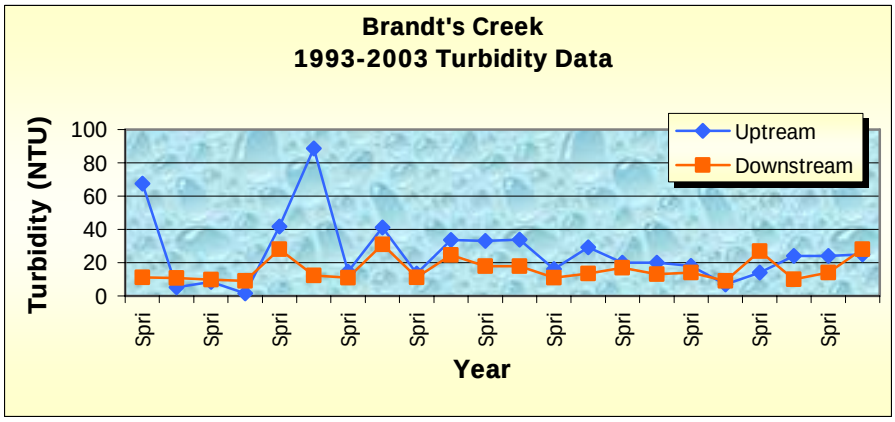


Figure 2.14 Brandt's Creek turbidity results (City of Kelowna, 2004a)

Table 2.7 Brandt's Creek dissolved metal data (mg/L) Highlighted cells indicate periods when dissolved metals exceeded guidelines (City of Kelowna, 2004a)

Element	Site	Trend	Year						Guidelines		
			1998	1999	2000	2001	2002	2003	Irrigation	Aquatic Life	Drinking
Aluminum	Up	Min	<0.01	0.089	0.048	0.017	<0.03	0.015	5.0	0.1	0.20
		Max	0.451	0.202	0.191	0.100	0.110	0.055			
	Down	Min	<0.01	0.077	0.037	0.031	0.018	0.013			
		Max	0.268	0.342	0.174	0.091	0.057	0.096			
Arsenic	Up	Min	0.0020	0.0100	0.0022	<0.0005	0.0016	0.0020	0.1	0.05	0.05
		Max	0.0042	0.0016	<0.01	0.01	0.0056	0.0029			
	Down	Min	0.0016	0.0009	0.0012	<0.01	<0.001	0.0012			
		Max	0.0036	0.0012	<0.01	<0.01	0.0019	0.0025			
Zinc	Up	Min	0.003	0.0009	<0.0006	0.0009	0.005	<0.001	5.00	0.03	5.00
		Max	0.008	0.0039	0.0128	0.0100	0.020	0.008			
	Down	Min	0.004	0.0047	0.0038	0.0036	0.009	0.003			
		Max	0.028	0.025	0.0196	0.0159	0.043	0.012			
Manganese	Up	Min	0.001	0.0308	0.0065	0.0144	<0.02	0.0090	0.2	0.1-1.0	0.05
		Max	0.284	0.280	0.278	0.0570	0.208	0.1370			
	Down	Min	0.001	0.0390	0.0112	0.002	0.0035	<0.005			
		Max	0.310	0.104	0.0630	0.0745	0.0520	0.124			
Iron	Up	Min	<0.003	0.110	0.052	0.011	<0.02	0.030	5.00	0.3	0.3
		Max	0.361	0.193	0.229	0.336	0.050	0.100			
	Down	Min	0.01	0.124	0.042	<0.003	0.010	0.030			
		Max	0.261	0.333	0.279	0.322	0.102	0.060			

2.4.2.3.3 Fascieux Creek

Fascieux Creek water quality samples often show elevated turbidity and dissolved metal concentrations (See Figures 2.15, 2.16, 2.17, and Table 2.8). Several naturally occurring and human influences affect the creek's water quality.

- Groundwater is the creek's primary water source; therefore, metal concentrations are often higher than other local creeks. In addition, groundwater does not create high velocity flows and minimal flushing action occurs in the creek.

- The lack of riparian vegetation in lower reaches of the creek contributes to increased temperatures and sediment loads (Browne, pers. comm., 2003).

- Storm drain outfalls emptying into Fascieux Creek further degrade the creek's water quality

Some watershed restoration has been accomplished along Fascieux Creek in an attempt to improve habitat and water quality conditions. However, the majority of land surrounding the creek is privately owned, therefore, City access is somewhat limited.

Fascieux Creek is not recognized as a fishery creek or utilized for drinking water.

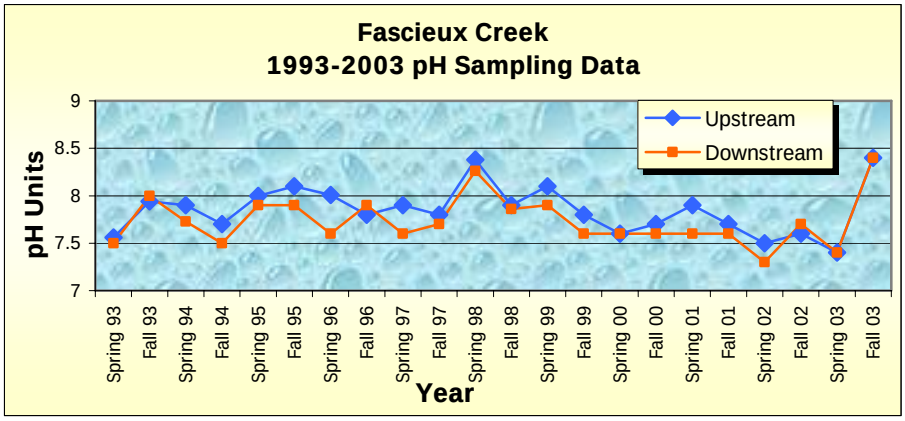


Figure 2.15 Fascieux Creek pH results (City of Kelowna, 2004a)

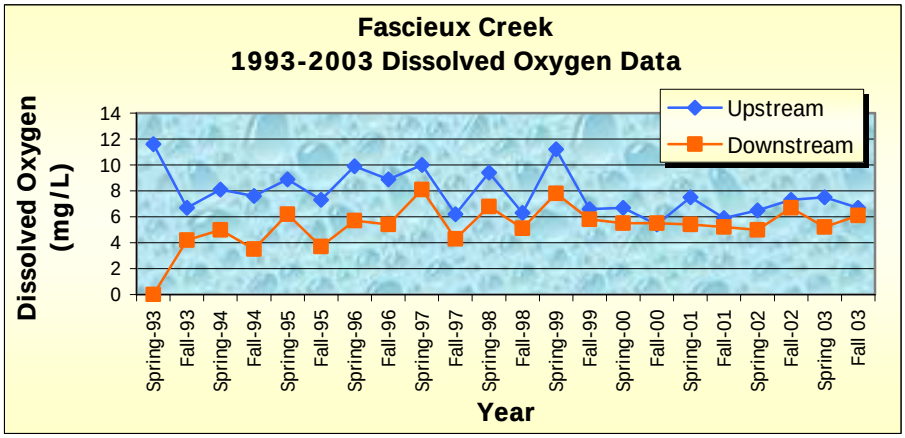


Figure 2.16 Fascieux Creek dissolved oxygen results (City of Kelowna, 2004a)

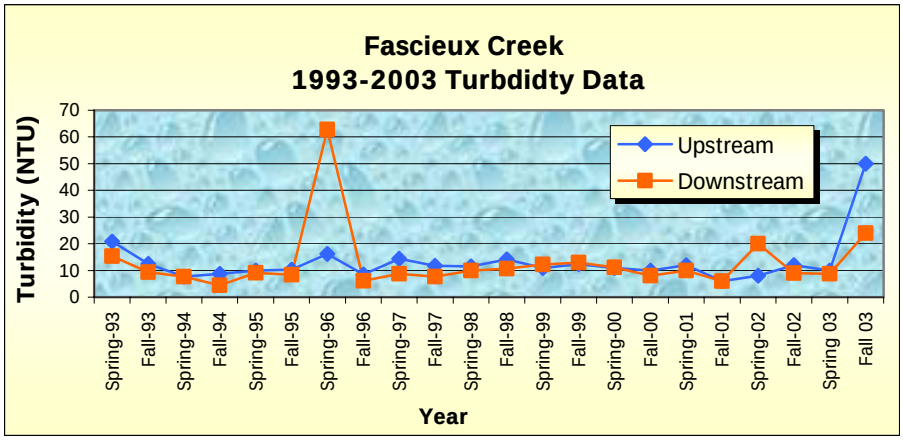


Figure 2.17 Fascieux Creek turbidity results (City of Kelowna, 2004a)

Table 2.8 Fascieux Creek dissolved metal data (mg/L) Highlighted cells indicate periods when dissolved metals exceeded guidelines (City of Kelowna, 2004a)

Element	Site	Trend	Year						Guidelines		
			1998	1999	2000	2001	2002	2003	Irrigation	Aquatic Life	Drinking
Aluminum	Up	Min	<0.01	0.036	0.013	0.019	<0.005	<0.005	5.0	0.1	0.20
		Max	0.068	0.23	0.182	0.056	0.053	0.092			
	Down	Min	<0.01	0.019	0.028	0.015	<0.005	<0.005			
		Max	0.042	0.154	0.089	0.028	0.056	0.034			
Arsenic	Up	Min	<0.0002	0.0002	<0.0002	<0.01	<0.0002	0.0003	0.1	0.05	0.05
		Max	0.0003	0.0008	<0.01	<0.01	0.0003	0.0004			
	Down	Min	<0.0002	0.0002	<0.0002	<0.01	<0.0002	<0.0002			
		Max	<0.002	0.0009	<0.01	<0.01	0.0003	0.0003			
Zinc	Up	Min	0.001	0.0012	0.0006	0.0014	<0.001	<0.001	5.00	0.03	5.00
		Max	0.004	0.0041	0.0022	0.0114	0.0020	0.019			
	Down	Min	0.001	0.0009	0.0011	0.0009	<0.001	<0.001			
		Max	0.005	0.0050	0.0031	0.0090	0.0020	0.004			
Manganese	Up	Min	0.001	0.054	0.0313	0.0262	0.0010	<0.005	0.2	0.1-1.0	0.05
		Max	0.207	0.201	0.201	0.108	0.273	0.099			
	Down	Min	0.032	0.197	0.1060	0.0166	0.0008	<0.005			
		Max	0.229	0.218	0.161	0.168	0.290	<0.005			
Iron	Up	Min	0.008	0.585	0.261	0.064	0.060	0.010	5.00	0.3	0.3
		Max	0.742	0.902	0.904	0.524	0.587	0.340			
	Down	Min	0.011	0.392	0.448	0.027	0.060	0.010			
		Max	0.592	1.21	0.900	0.673	0.876	0.280			

2.4.2.3.4 Bellevue Creek

The City of Kelowna began monitoring Bellevue Creek in 2000. Urbanization and development on the creek's south slopes triggered the City to begin water quality monitoring to obtain baseline data. Once sufficient data is accumulated, it will provide information that will indicate if development activities are hindering water quality in the creek.

Water quality of Bellevue Creek is currently very good. There is very little variation between upstream and downstream water quality (See Figures 2.18, 2.19, 2.20, and Table 2.9) (Browne, pers. comm., 2003).

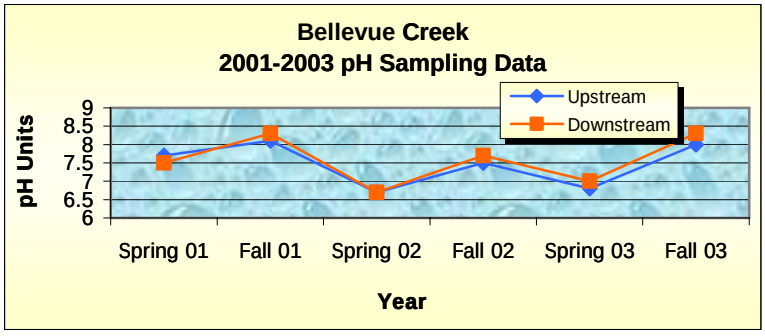


Figure 2.18 Bellevue Creek pH results (City of Kelowna, 2004a)

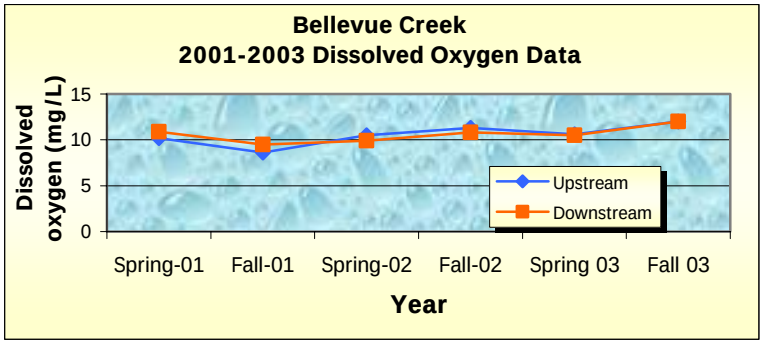


Figure 2.19 Bellevue Creek Dissolved Oxygen results (City of Kelowna, 2004a)

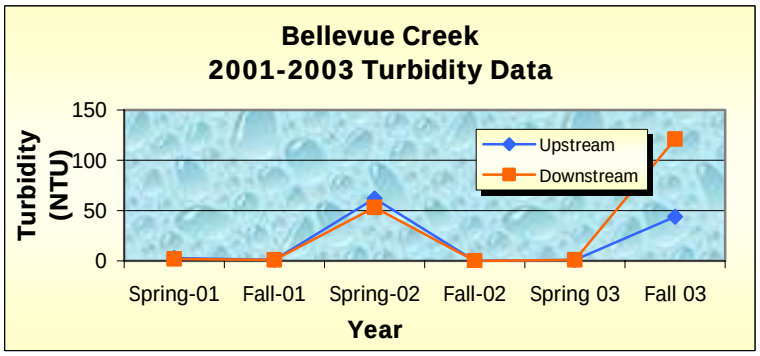


Figure 2.20 Bellevue Creek turbidity results (City of Kelowna, 2004a)

Table 2.9 Bellevue Creek dissolved metal data (mg/L) Highlighted cells indicate periods when dissolved metals exceeded guidelines (City of Kelowna, 2004a)

Element	Site	Trend	Year			Guidelines		
			2001	2002	2003	Irrigation	Aquatic Life	Drinking
Aluminum	Up	Min	0.032	0.008	0.019	5.0	0.1	0.20
		Max	0.397	0.473	0.274			
	Down	Min	0.02	<0.005	0.023			
		Max	0.382	0.467	0.255			
Arsenic	Up	Min	<0.01	<0.0002	<0.0002	0.1	0.05	0.05
		Max	<0.01	<0.0002	<0.0002			
	Down	Min	<0.01	<0.0002	<0.0002			
		Max	<0.01	<0.0002	0.0003			
Zinc	Up	Min	<0.0006	<0.001	<0.001	5.00	0.03	5.00
		Max	0.0121	0.0150	0.022			
	Down	Min	<0.0006	<0.001	<0.001			
		Max	0.0055	0.009	0.013			
Manganese	Up	Min	0.0008	0.0010	<0.005	0.2	0.1-1.0	0.05
		Max	0.0029	0.006	0.099			
	Down	Min	0.0011	0.0008	<0.005			
		Max	0.0032	0.007	<0.005			
Iron	Up	Min	0.011	<0.01	0.160	5.00	0.3	0.3
		Max	0.336	0.321	0.140			
	Down	Min	<0.003	<0.01	0.02			
		Max	0.322	0.313	0.02			

2.5 STORMWATER

2.5.1 BACKGROUND

2.5.1.1 Urban Runoff

The majority of precipitation in urban environments falls on impervious surfaces. Rather than infiltrating into the ground, water is rapidly transferred through drainage networks via curbs, gutters, and storm drains. Impervious surfaces generate rapid storm runoff velocities, higher peak flows, and increased runoff volume, which leads to stream erosion, flooding, and/or drought. The quickflow hydrograph in Figure 2.21 illustrates some hydrologic impacts caused by urban drainage systems.

Stormwater erosion

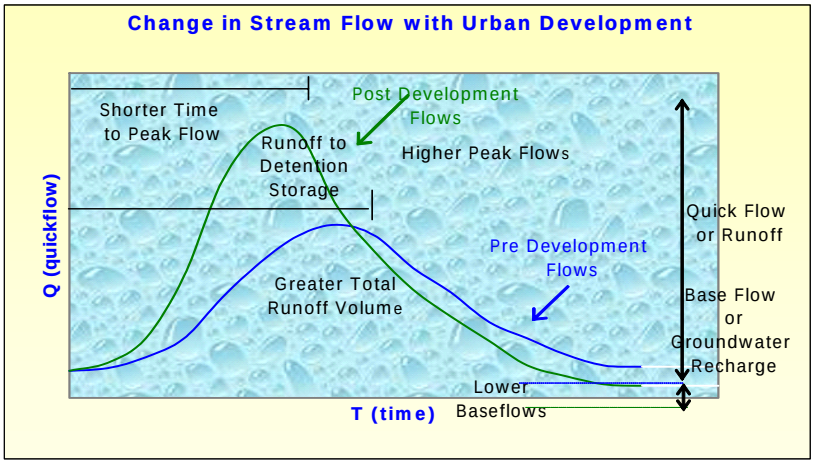


Figure 2.21 Hydrologic impacts caused by urban drainage systems (DFO, 1993).

2.5.1.2 Pollution

Stormwater runoff is a non-point source (NPS) pollutant. NPS pollutants originate from a wide variety of sources and can be as obvious as sand and silt, or as inconspicuous as dissolved metals, pesticides and nutrients.

Spring, summer and autumn storms in Kelowna are generally intense and short in duration. An interval between storms can last several weeks, which allows contaminates to accumulate in the drainage area. The initial stormwater flush generally contains greater concentrations of pollutants that can be detrimental to habitat.

2.5.1.3 Storm Drainage System

Kelowna's storm drainage network is comprised of approximately 7000 catch basins, 250 km of storm mains, 3900 manholes/drywells, 70 creek, and 8 lake outfalls. Curbs and gutters collect stormwater and direct it into storm drains, which lead to streams and lakes. Mill, Brandt's and Fascieux Creeks are among those that receive stormwater via storm drains in the City of Kelowna.

Pollutant sources:

Point source pollution
- Pollutants originate from a specific identifiable source
- Examples: sewers, factory outfalls

Non-point source pollution (NPS)
- Pollutants generated from various unspecified sources
- Examples: Stormwater runoff, septic fields and agriculture

Stormwater often enters streams untreated; therefore, pollutants accumulated on land impact the quality of stormwater received by our water resources. In an attempt to control non-point source pollution and hydrological changes, the City of Kelowna is taking a multi-faceted approach using an amalgamation of education, monitoring, alternative treatments, watershed management, and enforcement (Watt and Gow, 1997).

2.5.2 STORMWATER MONITORING AND CREEK HEALTH

2.5.2.1 Benthic Monitoring

Prior to 1998, stormwater data was collected in Kelowna as consistently as possible. However, stochasticity of storm events made adequate sampling difficult. The City decided to introduce benthic monitoring in 1998 to monitor stormwater in a manner that was more reflective of quality and quantity changes.

Q. What are benthic invertebrates?

A. Benthic invertebrates are animals such as aquatic insects, worms and snails that live at the bottom of streams and lakes.

Benthic monitoring samples the variety and abundance of benthic invertebrates in a body of water such as a creek or lake.

A sampler is placed in the stream. The streambed upstream of the sampler is disturbed, sending organisms into the net. The samples are collected, preserved and analyzed for diversity and abundance of benthic invertebrate organisms. (Paillé, 1998)

Many benthic microorganisms are relatively sensitive to their environment, which often makes benthic monitoring more responsive to water quality fluctuations than traditional water analysis. As a stream's chemical and physical characteristics change, so do the dynamics of the benthic invertebrate population. Healthy creeks tend to possess diverse benthic invertebrate populations, whereas creeks with high sediment loads (poor water quality) typically contain only a few tolerant species. Therefore, benthic monitoring may protect the environment by providing early detection of water quality changes, preventing extensive damage and avoiding expensive recovery costs.

2.5.2.1.1 Benthic Index of Biological Integrity (B-IBI)

The Benthic Index of Biological Integrity (B-IBI) is a biotic index that uses ten metrics to evaluate creek health. Each metric is graded as 5 (good), 3 (fair) or 1 (poor). The B-IBI is calculated by totaling scores of the ten metrics. The maximum attainable score is 50, which represents a pristine site, whereas a severely contaminated site would receive the minimum score of 10. To perform proper B-IBI grading, background information must be known about the sites and the inhabiting communities prior to sampling.

The initial benthic study focused on Mill Creek and expanded to include Brandt's Creek in 1999 and 2000. Information from Salmon Web, a community based volunteer stream benthic program in Washington State, acted as a framework for Kelowna's program.

B-IBI monitoring, physical characteristic evaluations, water quality testing and habitat assessments were performed to provide a complete interpretation of each site.

2.5.2.1.2 Study Results

Mill Creek

Table 2.10 lists B-IBI average scores beginning in 1999. Results for 1998 are not listed because the biotic index Biological Condition Score (BCS) was used, and the two indices are not directly comparable.

In the 2000 study, all but four sites received B-IBI grades above 50%. Central Park received the highest score, which is likely reflective of the watershed restoration efforts that have occurred in the area.

Table 2.10 Mill Creek B-IBI Scores (City of Kelowna, 1999b; City of Kelowna, 2000)

Year	Mill Creek Average B-IBI Score
1999	32
2000	30.1

Two sites of concern include:

- Rutland Feedlot

Impacts from livestock at the feedlot are suspected to be negatively influencing stream health. Increased rates of erosion and sediment deposits in streams are often associated with agricultural practices. Biotic integrity declined at the downstream feedlot site each year in 1998 and 1999. Further study is required to confirm the true influential factors at the site.

- Kelowna International Airport

Riprap in Mill Creek near the airport has improved erosion levels, but has also inhibited natural vegetation growth, directly exposing the creek to sunlight. Rising water temperatures can be harmful to aquatic life. The 2000 study indicated improved conditions compared to previous years. Further sampling is recommended to confirm activities that are influencing the creek's health.

Brandt's Creek

All sites, but one, received B-IBI scores below 50% in the 2000 study. Low scores were somewhat anticipated because large portions of the stream have been channelized and riparian zones are generally in poor condition.

Table 2.11 Brandt's Creek B-IBI Scores (City of Kelowna, 1999b; City of Kelowna, 2000)

Year	Brandt's Creek Average B-IBI Score
1999	20.3
2000	17.5

Some areas of particular concern include Summit Drive/Valley Road, upstream of Glenmore Wetlands, between Sun Rype and Brandt's Creek Tradewaste Treatment Plant (BCTTP)(effluent discharge sites), and downstream of BCTTP.

- Summit Drive/Valley Road
  Riprap appears to be hindering riparian vegetation growth and causing water temperatures to rise, thereby causing benthic integrity to decline.

- Glenmore Wetlands
  Significant amounts of mud on the streambed and high erosion rates contribute to the impaired conditions. An improvement of water quality is expected as the wetland habitat matures.

- Sun Rype and the BCTTP
  A significant amount of stream erosion and minimal riparian vegetation are believed to be the major impacts influencing benthic integrity at the Sun Rype and the BCTTP sites.

- Benthic communities also appear to be negatively affected in areas where the creek diverts into underground storm sewers; continued monitoring is recommended.

The health of riparian vegetation appears to be the most influential factor affecting benthic health in both Mill and Brandt's Creeks. A healthy riparian zone improves water quality and provides ideal conditions for aquatic life and wildlife. Restoration and planting projects conducted by City of Kelowna staff and volunteers are expected to improve local riparian conditions. Restoration efforts are discussed further in section 3.3 Watershed.

Information obtained from the three benthic studies has provided a good baseline of data. Unfortunately, provincial funding cuts in 2001 prevented continuation of annual sampling. The City of Kelowna hopes to conduct benthic sampling every three to five years so that stormwater quality trends in Kelowna continue to be adequately monitored.

2.5.3 INITIATIVES

The City's Drainage Division conducted an environmental review of urban drainage in 1998. The purpose of the study was to review the storm drainage system and determine the best actions to reduce negative impacts of stormwater on local creeks and Okanagan Lake.

The study identified sediment as being one of the major impacts affecting stormwater quality. Several initiatives and "Best Management Practices" (BMPs) were recommended to maintain the condition of the City's storm drainage system. Infiltration mechanisms such as storage ponds,

drywells, perforated pipes and wetlands significantly reduce peak flows and allow sediment and pollutants to settle. These methods are encouraged over directly piping stormwater into creeks. The following section outlines initiatives recently accomplished by the City of Kelowna.

2.5.3.1 Catch Basin/Drywell Cleaning and Main/Manhole Cleaning

Catch basins trap debris, reducing sediment loads downstream. The frequency with which these structures are cleaned reflects the quality of stormwater entering local streams and Okanagan Lake.

Previously, catch basin/drywell cleaning was performed once every five years. To further improve stormwater quality, the City's Drainage Department set a goal to increase catch basin/drywell cleaning to an annual basis and storm mains and manholes on a four-year rotation. To facilitate this initiative, a new flusher-vacuum truck was purchased, increasing the department's inventory to a total of two. Proper maintenance is crucial to efficiently capture and provide sufficient capacity for sediment and pollutants.

2.5.3.2 Interceptors

Interceptors remove sediments and suspended material from water, such as oil and grease. An interceptor was installed in 1995 at Parkinson Recreation Center. Fifteen additional collection devices have been installed in the last five years. Annual installations are performed according to the Drainage Division's yearly program. Installation locations are determined according to accident statistics and proximity to receiving water bodies (Newcombe, pers. comm., 2003). Water quality data obtained from collection devices are difficult to interpret because of the stochastic characteristics of storm events. However, it is known that interceptors are an effective method of reducing sediment and other pollutants because accumulations have been occurring.

2.5.3.3 Groundwater Infiltration

The Drainage Division has implemented several groundwater infiltration methods to treat stormwater. Recent projects include:

- Two storage ponds located in the new South Ridge development area. The ponds retard stormwater flow into an infiltration pond.
- Drywells and perforated pipes that filter and trap sediment

2.5.3.4 Wetland Construction

Wetlands act as a filter, trapping pollutants and preventing them from travelling further through creeks. Constructed wetlands trap sediments most effectively in smaller creeks. The following wetlands have been constructed in the City of Kelowna for several reasons, with stormwater quality improvement being one of them.

- Valley-Glen Wetland on Brandt's Creek adjacent to Valley/Kane Rd

- Rotary Marshes at the mouth of Brandt's Creek
- Michaelbrook Marsh at Mission Sports Fields along Gordon Drive
- Oasis Marsh on Fascieux Creek at Richter Street
- Chichester Ponds on the Gopher Creek drainage system near Chichester Court
- Mission District Park
- Enterprise, near the Automall

Q. What benefits do wetlands provide?

A. Wetlands can provide a variety of benefits such as:

- Act as a filter to enhance storm water quality
- Prevent flooding
- Help to reduce green house gases by trapping carbon dioxide
- Contain crucial habitat and rare species
- Provide shoreline habitat for wildlife
- Provide staging areas for many migratory birds
- Recreational/educational area for wildlife observation

Wetlands and catch basins are periodically dredged to remove settled pollutants. The City properly disposes of the dredged material into a designated area or landfill.

2.5.3.5 Road Maintenance

Winter

The City has successfully reduced the volume of winter road sand applications by 58% since 1998. Adoption of magnesium chloride spray technology and improved road maintenance methods has contributed to reduction of road sand, which translates to less sediment in storm drains.

Summer

The City was utilizing the least toxic material (lignosulfonate) for road dust suppression, but switched to MC-30, an asphalt derivative, which has little to no leaching ability (Gow and Watt, 1997).

2.5.3.6 Educational Programs

The City and its partners have introduced several educational initiatives to increase public awareness about non-point source pollution, such as the Environment Division's Pollution Prevention "Living Greener Program". The Pollution Prevention Program encourages various business sectors and the general public to control non-point source pollutants at their source, as well as proper use, storage and disposal of hazardous materials.

Several 'Stormwater Bulletins' are available from the City of Kelowna (www.city.kelowna.bc.ca) including commercial cleaning, painting, mixing concrete, sand blasting, small lot development, food preparation facilities, photo-finishing stores, dental offices, furniture refinishing, hazardous material storage, masonry, dry wall, and pool and spa maintenance.

Several other City educational programs also bring awareness to non-point source pollution. For example, the Environmental Division's Watershed Stewardship Program educates the public about practices that pollute our streams (see section 3.3). Other educational programs that address non-point source pollutants can be found in section 4.0, which addresses education.

2.6 GROUNDWATER

2.6.1 BACKGROUND

Groundwater provides a substantial amount of potable water to City of Kelowna residents. Rutland Waterworks Irrigation District's potable water supply is exclusively groundwater. Black Mountain, Southeast Kelowna and Glenmore Irrigation Districts utilize groundwater to supplement their supplies, but to a lesser extent than Rutland Waterworks. Several small communities' systems and private wells also depend on groundwater for a potable source.

Local groundwater sources are not yet completely understood. A better understanding of this resource will provide the City with insight to enhance land use planning. This will help to ensure proper zoning and development permits are in place to protect areas susceptible to leaching, thereby preventing contamination of our potable water supplies.

2.6.2 SOURCE

The most utilized groundwater source in the City of Kelowna is a confined aquifer which extends from the Kelowna International Airport in the north to areas of the Mission and East Kelowna in the south. The aquifer holds groundwater within gravel formations that are approximately 100 meters thick. The full extent of the recharge zone is currently unknown.

2.6.3 GROUNDWATER WITHIN THE CITY WATER UTILITY

The City's Water Utility does not use groundwater as a potable water source; surface supplies have been always available. Hence, groundwater within the City Water Utility boundaries is not regularly monitored.

A groundwater study performed in 1996 by Agra Earth and Environmental Ltd. concluded that there was enough groundwater within the City Water Utility limits to supply 30% of the required water. Suitable well locations were identified in the study. Some concerns raised included high manganese and iron concentrations, but it was also suggested that regular use would dilute the metal concentrations.

2.6.4 CURRENT RESEARCH

Golder Associates is currently conducting a groundwater study in Kelowna to characterise the water-bearing zones (aquifers) in the valley and to develop a plan for the monitoring and protection of groundwater in these aquifers, specifically for public water supply wells (Allard, pers. comm., 2003). The study area extends from Ellison Lake in the north to southeast Kelowna. Eastern watersheds that provide runoff and recharge to the aquifers are also included.

The Kelowna Joint Water Committee (KJWC) currently provides funding for this project and has also applied for additional funding through the BC Local Government Program. The first and second of the project's six stages has just begun. Project completion is expected to take a minimum of two years. Available funding and technical demands will have a considerable influence on the rate of progression.

2.7 WASTEWATER

2.7.1 BACKGROUND

The City of Kelowna is committed to expanding Kelowna's sanitary sewer system to all development areas and existing urban areas without current connections, thereby minimizing the hazard of contaminating our water source.

Kelowna's Wastewater Treatment Facility (WWTF)

2.7.1.1 Sewer vs. Septic Systems

Sewage treatment systems remove biological nutrients such as phosphorous and nitrogen from wastewater. The result is a high quality effluent. Treated effluent leaving Kelowna's Wastewater Treatment Facility (WWTF) is of high enough quality to meet Canadian Drinking Water Quality Guidelines.

Septic systems situated in large enough areas with appropriate soil conditions can provide adequate treatment (Berry, pers. comm., 2000). However, if these conditions are not met, contaminants may leach into the ground, finding their way into our drinking wells, lakes and streams. If septic systems fail, sewage rises to the surface, creating a potentially serious health risk.

In essence, the greater the percentage of urban population serviced by sanitary sewer, the more reliable and protected our environment and society

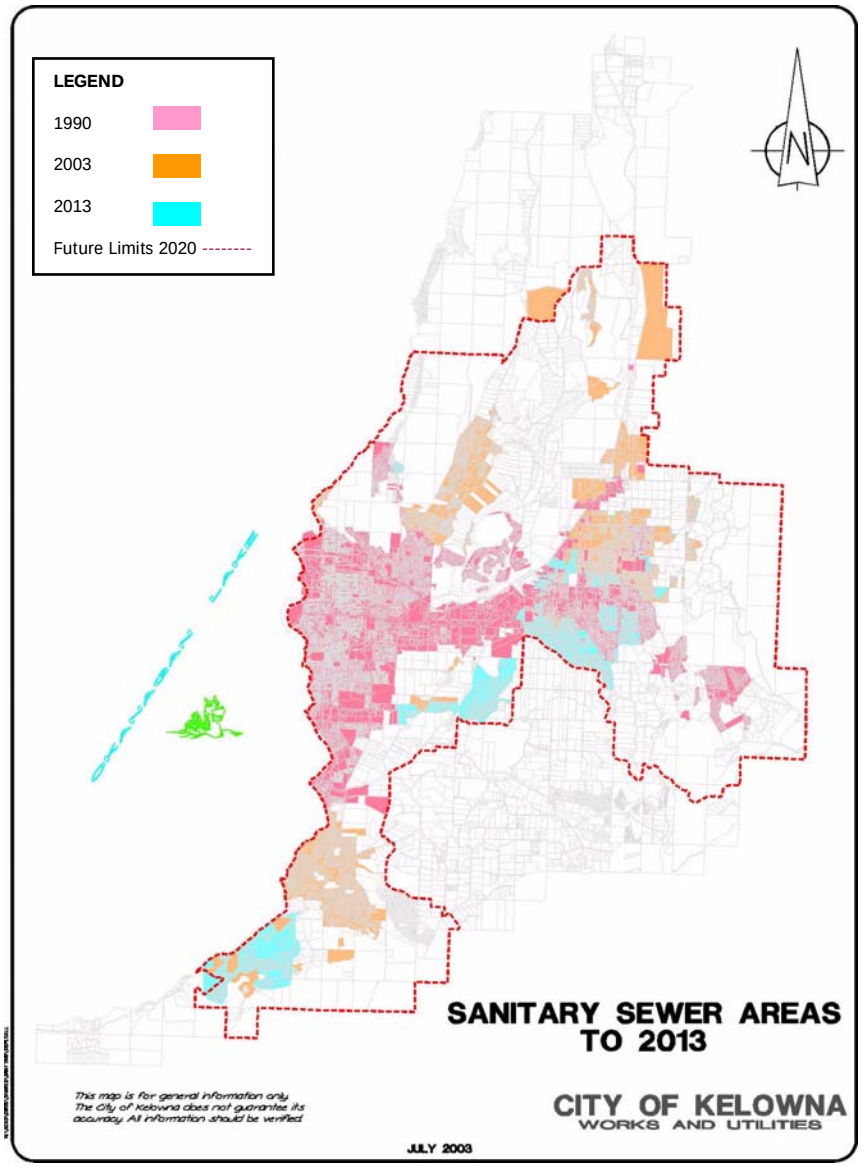


Figure 2.22 Sanitary Sewer Areas to 2013 (Cmolik, 2003)

will be from contaminants of untreated wastewater.

2.7.1.2 Kelowna's Sanitary Sewer System

Kelowna's sanitary sewer system currently consists of over 400km of sewage pipe, 28 pumping stations and two treatment plants - the Kelowna Wastewater Treatment Facility (WWTF) and Brandt's Creek Tradewaste Treatment Plant (BCTTP). Figure 2.22 displays the current sanitary sewer system, as well as future expansions planned to be completed by 2013 (refer to INITIATIVES for details).

2.7.1.3 Wastewater Treatment Process

Kelowna has played a pioneering role in municipal sewage treatment. It was one of the first Canadian communities to operate a 'secondary treatment' plant in 1913 and the first in Canada to use a biological phosphorous removal process in 1982. Today, the Wastewater Treatment Facility is recognized as one of the best in North America. The following diagram summarizes the wastewater treatment process, which is a modified Bardenpho design for biological removal of phosphorous and nitrogen.

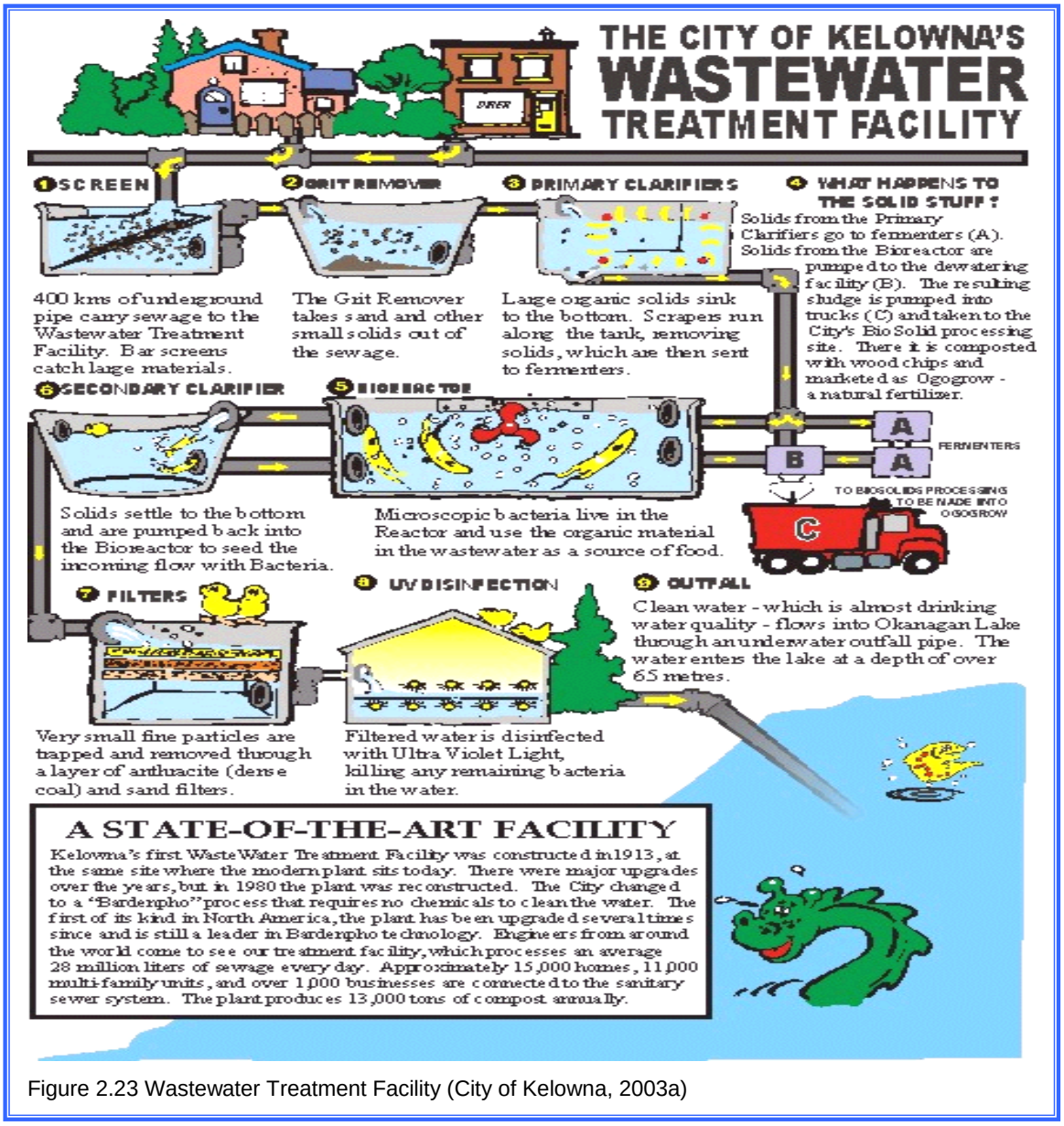


Figure 2.23 Wastewater Treatment Facility (City of Kelowna, 2003a)

2.7.1.4 Population Serviced by Sewer

Kelowna's sewer infrastructure currently services approximately 65% of the city's population (estimated 70,000 customers), with the majority of the accounts being residential. Accounts apply to a property or building, rather than the number of people living within them; therefore, the actual number of customers is perpetual. Deriving customer numbers from billing records is the most feasible way to track the serviced population. Customer numbers only began to be tracked in 1999. Since this time, the Kelowna Sewer Utility has seen approximately a 9.5% increase of customers, which are primarily residential accounts.

Table 2.12 Sewer Utility Customer Account History (Berry, 2003)

Year End	ICI Accounts	Residential Accounts		Estimated no. of Families Represented		Estimated Population Serviced		
		Single Family	Multi-family	Single Family	Multi-family	Single Family	Multi-family	Total
1999	1,013	14,753	346	16,231	13,116	45,447	21,066	**66,512**
2000	1,040	14,967	348	16,748	13,323	46,894	21,317	**68,211**
2001	1,050	15,280	354	16,981	13,867	47,547	22,187	**69,734**
2002*	1,080	•	•	16,750	14,560	46,900	23,296	**70,196**
2003	1,109	•	•	17,565	14,801	49,182	23,682	**72,864**

*In 2002 the City's billing service was contracted to CustomerWorks, and there was a slight shift in account types; from Single Family to Multi-family.

2.7.2 WASTEWATER TREATMENT FACILITY (WWTF)

Kelowna's Wastewater Treatment Facility (WWTF)

Kelowna's Wastewater Treatment Facility is located on Raymer Avenue. The facility is ten hectares in size and is capable of treating up to 40 million liters of wastewater daily.

2.7.2.1 Volume of Treated Wastewater

Treated wastewater volumes have been recorded since 1991. Data indicates volumes have increased on average by 5% annually. The volume of treated wastewater continues to increase annually, but at a decelerating rate. Water conservation education and/or a slowed rate of new customers may be contributing to the diminishing growth. The Wastewater Treatment Facility currently treats approximately 27 million liters of wastewater daily.

2.7.2.2 Effluent Monitoring

2.7.2.2.1 Phosphorous

Kelowna's population has increased five-fold over the past thirty years. Still, the Wastewater Treatment Facility has successfully decreased phosphorous discharge more than ten-fold during the same time period (See Figure 2.24).

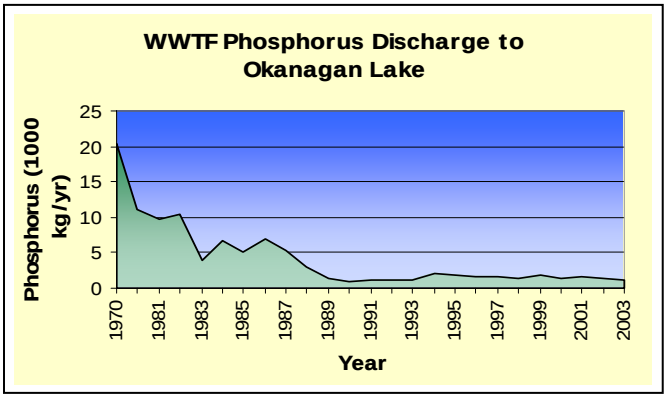


Figure 2.24 Phosphorous discharge to Okanagan Lake (Carey, 2004)

Currently, the Wastewater Treatment Facility removes 97% of phosphorous from wastewater during treatment before it is discharged into Okanagan Lake. Intensive public education discouraging use of phosphorus containing detergents, in conjunction with biological phosphorous removal, has helped to significantly reduce phosphorous discharge into Okanagan Lake from 1970 to 2003 (Carey, pers. comm. 2004).

Q. Why is the removal of phosphorous from wastewater important?

A. Phosphorous is a limiting nutrient for plants. If excess phosphorous is introduced into a lake ecosystem, excessive plant growth commonly occurs. Decomposers consume the abundant dead algae and deplete the waters oxygen levels, resulting in *eutrophication*. This affects drinking water quality, aquatic habitat, and recreation.

2.7.2.2.2 Nitrogen

Nitrogen concentrations vary the most out of all monitored parameters. If the amount of aeration during treatment decreases, the proportion of ammonia in total nitrogen increases. Ammonia can be toxic to aquatic life; therefore, this parameter is carefully monitored during the treatment process.

In the past, nitrogen levels at the Wastewater Treatment Facility were of some concern. The plant experienced numerous power failures until late 1999, which impacted the aeration process and, subsequently, nitrogen levels. A new 1.5 MW generator capable of supplying sufficient power to the entire plant has since been installed. In addition, bioreactor upgrades from 1992 to 2000 caused frequent "upsets" that resulted in high levels of effluent nitrogen. Now that upgrades are complete and the generator is in place, disturbances caused by power or mechanical failure are rare (Carey, pers. comm., 2003).

Poisons such as heavy metals, antibiotics, or other compounds toxic to bacteria can also cause loss of nitrification. Poisoning is the suspected cause of occasional and brief losses of nitrification. Unfortunately, it is nearly impossible to detect the source or chemical involved.

On average, total annual nitrogen concentrations are typically two-thirds of the permitted value (6.00mg/L). Figure 2.25 shows the history of nitrogen levels at the Wastewater Treatment Facility since 1990.

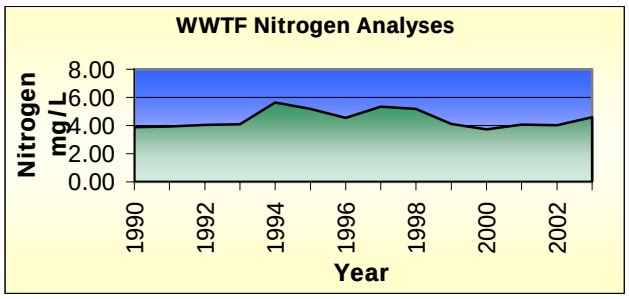


Figure 2.25 Wastewater Treatment Facility Nitrogen Analyses (Carey, 2004)

2.7.2.2.3 Other Monitored Parameters

Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), pH, Suspended Solids (SS) and coliform levels in wastewater treatment facility effluent continue to remain relatively constant. For any of these parameters to exceed permitted limits would be an extremely rare occurrence (Carey, pers. comm., 2003).

Effluent discharged from the Wastewater Treatment Facility into Okanagan Lake is of high enough quality to meet Canadian Drinking Water Guidelines. If effluent parameters were to exceed permitted levels, the Ministry of Water, Land and Air Protection (MWLAP) would be informed immediately.

2.7.3 BRANDT'S CREEK TRADEWASTE TREATMENT PLANT (BCTTP)

BCTTP is located on Clement Road and services effluent from Calona Wines, SunRype, and Mission Hills Winery. These businesses typically produce effluent that contains an abundant amount of suspended solids and has high chemical oxygen demand, which justifies the need for a dedicated treatment facility.

2.7.3.1 Effluent Monitoring

Table 2.13 MWLAP Effluent Quality Standards (MWLAP, 2003)

MWLAP Effluent Quality Standards	Permit Limit
Phosphorous	2.00 mg/L
Nitrogen	6.00 mg/L
BOD	20 mg/L
SS	35 mg/L

Table 2.13 lists MWLAP permitted limits for phosphorous, nitrogen, biological oxygen demand (BOD), and suspended solids (SS). The City of Kelowna implemented a phosphorous operational limit of 0.50 mg/L at BCTTP, which is substantially below the provincial permitted limit of 2.00 mg/L. Hence, a large buffer is created to assure only high quality effluent is discharged from the facility. The operational limit is measured in units of Orthophosphate, which is the bioavailable portion of the total phosphorous present.

Q. What is metal bioavailability?

A. Bioavailability is defined as "the fraction of the total chemical in the surrounding environment, which is available for uptake by organisms. The environment may include water, sediment, suspended particles and food items". With respect to metals and particularly heavy metals, the fraction available to organisms is very difficult to determine. Dissolved metals in the water and metals in sediments may be too strongly bound to become free for uptake. Metals will readily adhere to organic material and clay suspended in the water or contained in sediments. Changes in pH, salinity and temperature are some factors that can affect the availability of previously bound metals. Acidification of lakes and streams is one environmental change that can release metals. In some cases it was found that the sediments so strongly attracted metals and other chemicals that there was almost a competition for chemicals between the sediments and organisms (Rand and Petrolelli, 1985).

2.7.3.2 BCTTP Wastewater Treatment

Effluent is monitored twice daily to ensure wastewater standards are met. The strict operational limits at BCTTP (discussed above) continue to keep monitored parameters well below provincial standards. The treated effluent is routinely discharged into Brandt's Creek. If upper operational limits are approached, effluent is rerouted to the Wastewater Treatment Facility for further treatment.

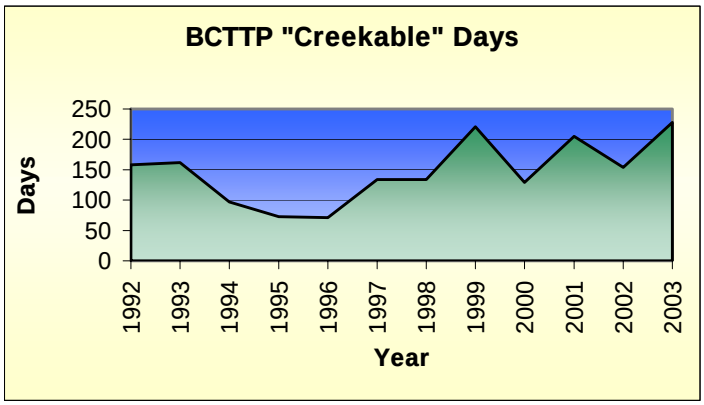


Figure 2.26 Number of days effluent was directed to Brandt's Creek without further treatment (Carey, 2004; MWLAP, 2003b)

Figure 2.26 indicates the number of days in each year (from 1992 to 2003) that effluent could be directed into Brandt's Creek without receiving further treatment from WWTF.

2.7.4 INITIATIVES

The Wastewater Division's commitment to reduce the risk of source water contamination is evident through several accomplishments, such as structural expansions/improvements, enhanced maintenance, and long range planning initiatives. The most notable activities include:

2.7.4.1 Sanitary Sewer Installation

Sewer expansion objectives are prioritized in the OCP to provide the Wastewater Division with a framework to accommodate the City's growth and provide efficient and cost-effective sewer access to existing areas currently without sewer hookups. Ten expansion areas have been prioritized according to three criteria. Listed in order of priority, the criteria are safety of public

health, environmental impacts, and economic benefit. Refer to the OCP Staging Plan Map (Map 13-2) for an outline of all ten priority areas.

- The Rutland area is identified as the top priority area in the Sewer Staging Plan. The City is currently working in the vicinity of Fitzpatrick Road. Rutland will remain the City's primary focus area of sewer installation for the next five years.

- A major sewer project was also conducted in the northern limits of the city. This area was not identified in the OCP Staging Plan, but an opportunity arose for the City to partner with a contractor to install sewer in the area. Sewer installation is expected to attract more industry, which will help to strengthen the local economy.

- Several other Sewer Specified Area projects have commenced and/or have been completed on time and under budget, such as the Gerstmar Road area in 2001.

2.7.4.2 Wastewater Treatment Facility (WWTF)

- Throughout the 1990's refinements to the air handling capacity (aeration) and the bioreactor at the WWTF allowed treatment capacity to increase from 23 million litres/day to 40million litres/day

- UV light disinfection replaced chlorine disinfection methods in 1997

- A new 1.5 MW generator capable of reliably supplying power to the entire WWTF was installed in 2000

- As an initiative of the Energy Efficiency Committee to improve energy efficiency,$1,000,000 of upgrades were made to the WWTF

2.7.4.3 Future Initiatives

- Continual expansion of the sanitary sewer system according to the OCP Staging Plan

- Industries funding BCTTP and the City of Kelowna drafted an improvement/replacement plan for the plant in 2002. Decisions made from this plan indicated plant replacement would be the best option. Preliminary planning is currently being developed.

- The City's Wastewater Division is in the process of implementing a customer education, monitoring, and control plan that will inform industrial and commercial users about materials that are permitted into the sanitary system.

2.8 WATER POLICY DEVELOPMENT

2.8.1 POLICY DEVELOPMENT GROUPS

City of Kelowna Water Utility

Contact Information:
1435 Water Street
Kelowna, BC V1Y 1J4
Phone: (250) 862 5510
Email: ask@city.kelowna.bc.ca

Water Smart Program

The City of Kelowna and Schlumberger (Neptune Technology Group since 2001) introduced the Water Smart Program in 1996. The purpose of the program is to educate and encourage the public to reduce water use through efficient practices.

Contact information:
Phone: (250) 868 3339
Website: www.getwatersmart.com

Kelowna Joint Water Committee (KJWC)

KJWC formed in 1991 to develop cooperative water management in the City of Kelowna. The committee is comprised of the following five major local water purveyors: City Water Utility, Rutland Waterworks, Glenmore Ellison Improvement District, South East Kelowna Irrigation District, and Black Mountain Irrigation District.

Contact Information:
Website: www.kjwc.org

2.8.2 POLICY DEVELOPMENT

2.8.2.1 Water Division

The 1996 Cryptosporidium outbreak created a significant shift of water policy development within the City Water Utility. The 'source to tap' management style adopted by the Water Utility collectively addresses all issues concerning water resources within the City serviced area. Through the guidance of QualServe, the Quality Improvement Plan (2001) is providing the utility with the ability to address policies identified in the Official Community Plan (OCP), which

ultimately assists the Water Utility in achieving its primary mandate of meeting Federal and Provincial Drinking Water guidelines. The Official Community Plan water policies are as follows:

- To ensure the potable water supply meets existing and future domestic, agricultural, industrial, commercial, and fire-protection requirements
- To ensure City-supplied water meets Canadian Drinking Water Quality Guidelines and provincial standards
- To promote water-use efficiency through metering and ongoing public education via the WaterSmart Program
- To incorporate principles of risk management into all utility functions that will minimize potential water quality events and water supply interruptions
- To provide utility customers with value for service through efficient and effective use of resources and program management
- To establish long-term infrastructure improvement programs
- To continue to investigate future water treatment alternatives

2.8.2.2 Drainage Division

The Drainage Division strives to preserve drinking water quality by controlling the quality of storm and creek waters impacting water supply sources which are under the City's direct control. The Storm Water Management Strategy currently provides direction and allows for timely and cost-effective projects and maintenance.

The Official Community Plan Stormwater Management policies include the following:

- Complete the Storm Water Management Strategy and prioritize projects for the next twenty years
- Continue to focus capital construction on priority problem areas
- Coordinate projects with other utilities and roadways to minimize environmental impacts
- Increase maintenance to further reduce environmental impacts

2.8.2.3 Wastewater Division

The City's Wastewater Division remains committed to protecting source water quality through environmentally sound methods of municipal sewage treatment and controlling all City effluent that may potentially affect regular sampling and analysis.

Goals set forth by the Wastewater Department include:

- Provide a safe, reliable and efficient sanitary sewer system and treatment facilities through sound management and planning

- Determine long-range requirements that will serve our present and future populations and to initiate and carry out construction of adequate facilities

- Continue to investigate the condition of existing collection mains and recommend repairs and/or maintenance and perform the work in a cost-effective and environmentally responsible manner

2.8.2.4 Environmental Division

The City of Kelowna's Environment Division has been working since 1996 to promote watershed health within the City, through education, stewardship, and restoration and enhancement initiatives. Environment staff have developed hands-on interactive educational programs for the public and students of School District #23. The Environment Division has also been enhancing and restoring local watersheds since 1997. Restoration and enhancement projects have been implemented to control erosion, establish a natural buffer zone along the creek, increase instream habitat complexity, remove invasive vegetation from riparian areas, and to restrict livestock access. Further details on the Watershed Stewardship Program and the Environment Division's commitment to conserving Kelowna's watershed and fostering a sense of environmental stewardship in the community are located in section 3.3.

2.8.2.5 Okanagan Basin and Regional Planning

In addition to internal policies and standards, the City of Kelowna encourages integration between regulating bodies and water suppliers. Political borders do not define our water resources; therefore, management of this resource must be a joint effort to achieve sustainability.

In the early 1970's an Okanagan Basin Water Plan made 70 recommendations for ensuring future resource viability. The Okanagan Basin Water Board (OBWB) was formed to address recommendations and took on the priority of sewage treatment to protect Okanagan Lake. The board has assisted with funding of major sewage facility upgrades throughout the 1970's and 1980's. With its ability to tax the entire basin population, it was thought that many other recommendations would be addressed. However, the crisis of future water supply and quality has not yet produced a strong political willingness to increase levies.

The board has completed studies on Water Stewardship and has identified the need for further cooperation to solve water resource issues.

The Central Okanagan Regional District, through its Growth Management Strategy Mandate (1999 bylaw), reviewed and reported on water resources in 2000. The recommendations from the discussion paper, Water Resources in the Central Okanagan, were directed at further cooperation from all levels of government. This was consistent with OBWB (Water Stewardship Discussion Paper) and provincial recommendations.

More recently, a federal study on Sustainable Environment for the Okanagan Valley (2002) took an economic review of the importance of the environment to the Okanagan and singled out the water resource as a priority issue requiring further work.
Science is ahead of policy regarding our water resources. The gap between science and action needs to be narrowed to increase actions at the basin and local level. The pending crisis management path we are on will not encourage good resource policy.

3.0 Land Use Executive Summary

A city's ability to grow with its natural environment is imperative to achieving environmental and economic sustainability. Kelowna's rapid rate of urbanization has raised several land use concerns including preservation of agricultural land, watersheds, parks and landfills. The Regional Growth Management Strategy provides the City of Kelowna with necessary tools to conduct sustainable community planning.

Agricultural practices contributed to early stages of Kelowna's development and are still a significant part of the landscape and economy today. Agricultural land became protected under the Agricultural Land Reserve (ALR) in 1973 to preserve farmlands from urban encroachment. Since legislation, Kelowna has lost only 8% of its ALR land to urbanization. Considering that Kelowna's population growth rate was 52% over the same time period and that a limited amount of developable land exists within City limits, the amount of ALR lost to urbanization is minute.

To impede urban sprawl, the City encourages multifamily housing in urban centres. Housing densification is beginning to become more apparent, but changing development patterns, such as suburbanization, is a slow and challenging process.

Urban encroachment and other human activities have negatively impacted Kelowna's watershed. Damaged riparian zones, deterioration of water quality and reduction in aquatic and terrestrial species have been observed in local tributaries. To improve watershed conditions and increase public awareness, the Watershed Stewardship Program was created in 1996. The program focuses on restoration and enhancement, education, and stewardship. During the past five years, City of Kelowna staff and valued volunteers have planted approximately 25,000 native plants and restored over 10,000 meters of Kelowna's watershed. Most efforts have been focused on Mill Creek where improvements are becoming evident. Public education represents a significant part of the Watershed Stewardship Program. City staff members provide numerous educational presentations and activities to students and the general public through community events, school presentations, and workshops, encouraging adoption of environmentally friendly habits. Since 1997, over 16,000 students have received presentations from City of Kelowna staff regarding watershed and other environmental issues.

Noteworthy accomplishments have also been made within Kelowna's park areas and natural open spaces. Efforts include a 14% reduction of pesticide application, connecting additional parks to the computer irrigation system to increase water efficiency, and implementation of the tree protection bylaw. In addition, park designs have begun to incorporate the natural landscape and utilize native vegetation. These practices promote water conservation and decrease park maintenance requirements.

Waste management has undergone a paradigm shift through the past several decades. Proper resource management and waste reduction are of primary importance. The City of Kelowna, Regional District of Central Okanagan, and the Districts of Peachland and Lake Country have made a united effort to minimize solid waste entering local landfills. Regional waste has been reduced by 41% on average since 1991 (RWRO, 2003). Initiatives such as the Blue Bag Program, composting, a computer recycling program, and Ogogrow have helped to reduce waste entering the landfills. Future initiatives include a pilot project that will assess ways to reduce construction and demolition waste (which is currently the largest source of waste entering the landfill) and extension of the 'mandatory recycle' list.

3.1 LAND USE

3.1.1 BACKGROUND

Land is a human commodity, but simultaneously is an integral part of the ecosystem. Public opinion and economic influence are two major factors that determine how land is utilized within a city.

Education, communication, and a clear comprehension of land issues are rudimentary to creating a balance between environmental and societal needs.

This chapter examines several land use issues within the City of Kelowna. Topics addressed include agriculture, urbanization, watersheds, parks and natural open spaces, as well as the sanitary landfill and solid waste management.

3.1.2 LAND ALLOCATION

The City of Kelowna is currently one of the fastest growing communities in the province. It is the largest city in the Okanagan Valley and currently encompasses an area of 211.22 km² (Statistics Canada, 2001). The City's land is utilized for a multitude of purposes; however, the majority of land area is allocated to rural/agriculture use.

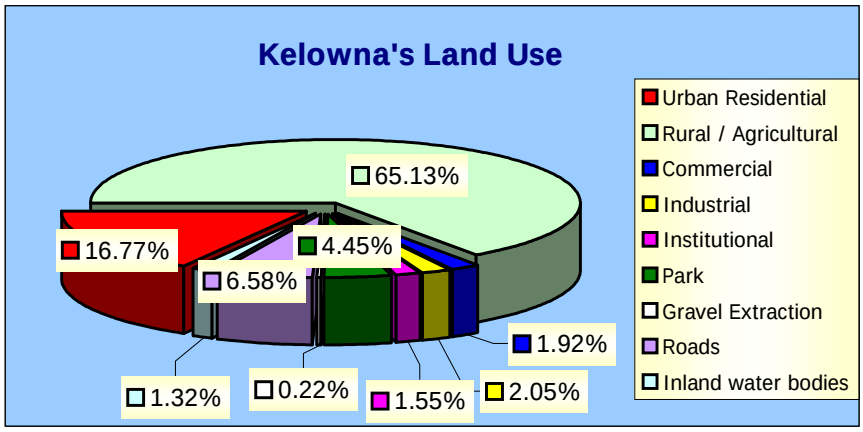


Figure 3.1 Kelowna's land use (Routley, 2003)

3.1.3 AGRICULTURE

Agricultural practices contributed to early economic and urban development in the Okanagan. Currently, agriculture represents approximately 4% of the region's employment (BC Stats, 1996).

The Okanagan is one of three major fruit- producing and one of two major grape-producing areas in the country. Apples are the region's primary crop, while soft fruits, vegetables, poultry and livestock make up the remainder of local agricultural commodities.

Rapid rates of urbanization raised concerns regarding the preservation of agricultural land throughout British Columbia. In 1973, the Provincial Agricultural Land Commission introduced the Agricultural Land Reserve (ALR) and zoned suitable areas throughout the province as farmland to protect agriculture from urban encroachment.

3.1.3.1 State of the Agricultural Land Reserve

Since 1975, 8% of Kelowna's ALR has been lost to urbanization. However, this amount is minuscule relative to the population growth rate of 52% during the same time period. Figures 3.2 and 3.3 compare the percentage of ALR within City limits between 1975 and 2003. Figure 3.4 illustrates the percentage of original ALR lands which have remained in ALR designation over time.

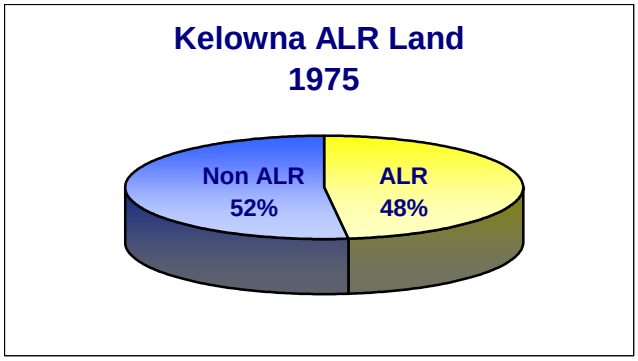


Figure 3.2 Distribution of ALR land in Kelowna City limits in 1975 (Stephen, 2004)

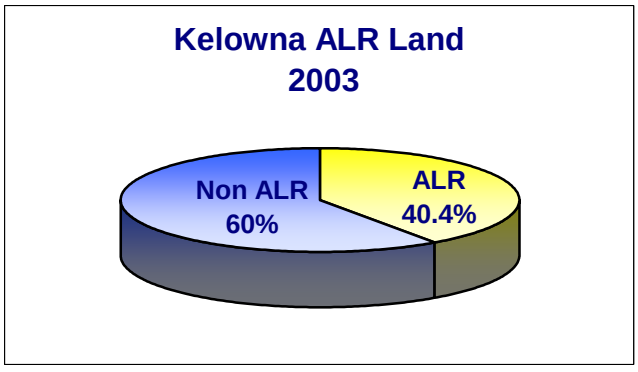


Figure 3.3 Distribution of ALR land in Kelowna City limits in 2003 (Stephen, 2004)

ALR land currently represents 40.4 % of Kelowna's land base (Stephen, pers. comm., 2004). However, not all ALR land is actively farmed. During the late 1980's, segments of the ALR were approved for specified non-agricultural use such as golf courses.

Urbanization continues to increase demands for land removal from the ALR. Preservation of the ALR provides several benefits to a

community. Farmland is aesthetically pleasing, contributes environmental and economic benefits, provides greenspace and wildlife habitat, and is a good method of controlling urban sprawl (Westland Resource Group, 1998).

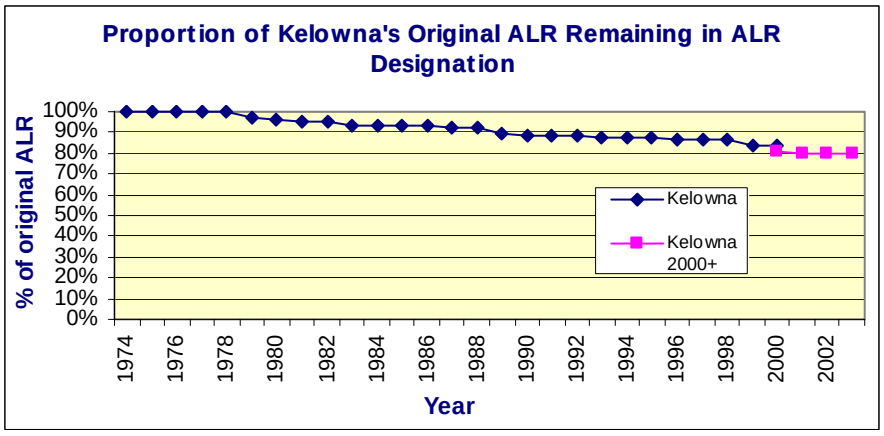


Figure 3.4 Proportion of original ALR remaining in ALR designation (Agricultural Land Commission, 2003)

3.1.3.2 Policy Development

3.1.3.2.1 Official Community Plan (OCP)

As stated in the Official Community Plan (OCP), the City intends to "encourage the retention of diverse agricultural uses through limits on urban development and non-farm use on lands of sustainable protection capability" (City of Kelowna, 2002a). The OCP discourages subdivision of agricultural land unless agriculture receives the benefit. Objectives outlined in the OCP regarding agriculture include:

- Providing education to the public and farm owners
- Supporting industry advertisement
- Promoting local purchasing
- Encouraging financial support from senior levels of government

3.1.3.2.2 Agricultural Plan

The City's Planning and Development Department formed an Agricultural Plan in 1998, which was adopted into the OCP to act as a refinement and reduce conflict between urban and agricultural land use (City of Kelowna, 1998a).

Environmental objectives of the plan include:

- *Educate the public and farm operators on the impact of pesticide and fertilizer use*
  The plan provides reference information to farm owners regarding suitability of pesticides/fertilizers, appropriate spraying times, and recommends farmers have a detailed consultation with crop experts prior to pesticide application. Educating the public regarding pesticides/fertilizers is also encouraged to increase understanding and diffuse some of the negative connotation associated with spraying.

- *Monitor and maintain water quality in local water courses and Okanagan Lake*
  Agriculture contributes to non-point source pollution. Adequate water quality monitoring is recommended to ensure minimal non-point source pollution from agricultural sources.

- *Protect from further water quality impacts due to intensive agricultural uses*
  Agricultural lands located near watercourses are encouraged to follow Code of Agricultural Practice for Waste Management.

- *Consider stream corridor wetland habitat protection and public access in a manner sensitive to the needs of the agricultural community*
  The plan brings awareness to the balance that must be achieved between a farmer's operating requirements and environmentally sensitive operating practices.

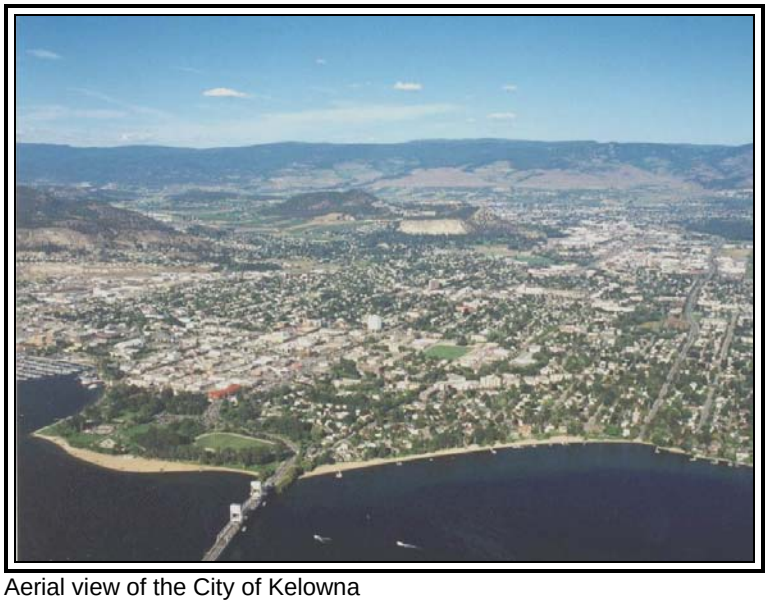
- *Reduce wildlife impacts on farm operations*
  Activities that disturb wildlife corridors can indirectly cause a substantial amount of damage to farm crops. Most activities of these sorts are located outside the City boundary. However, the City does encourage the Central Okanagan Regional District and Ministry of Forests to maintain proper development in these areas, to reduce fragmentation of wildlife habitat.

- *Reduce burning impact on air quality*
  Information should be made readily available to farmers concerning proper burning practices and preferred burning conditions. The plan also encourages non-polluting clean-up practices, such as chipping.

3.2 URBANIZATION

3.2.1 BACKGROUND

A city's ability to grow compatibly with its natural environment is imperative for environmental and economic sustainability. The City of Kelowna faces some challenging conditions concerning sustainable growth. Fortunately, a number of policies, such as the Zoning Bylaw (No. 8000) and Development Permit System, are in place to help protect the City's environment and provide citizens with a high quality of life.



Aerial view of the City of Kelowna

3.2.1.1 Zoning Bylaw

Zoning Bylaw No. 8000 was adopted in 1998 to govern "orderly, economic, beneficial, equitable and environmentally sensitive use, development and redevelopment" within City boundaries (City of Kelowna, 2002c). The bylaw segregates the city into commercial, agricultural, institutional, and water zones; each zone has its own specific regulations.

3.2.1.2 Development Permit System (DP)

Two categories of development permits are designated within the OCP. The first category influences the final form and placement of certain building structures and the second controls the impact of development on the natural environment. Developers are required under the Development Permit System (DP) to properly manage designated environmentally sensitive areas during construction. For example, Riparian Management Areas are DP requirements that specify setback distances on both sides of a stream to provide adequate protection of riparian areas (see Figure 3.5). Development of these areas is handled on a site-specific basis.

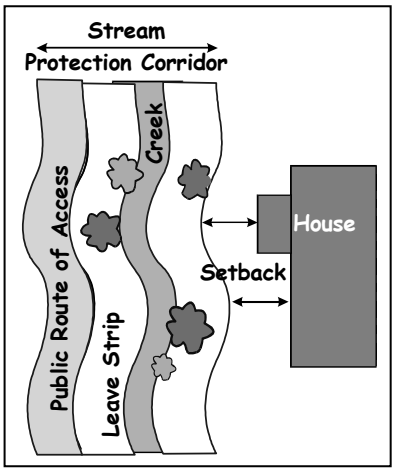


Figure 3.5 Example of a stream protection corridor to be taken into consideration in development (Schaad, 1997)

3.2.1.3 Kelowna's Challenges to Sustainable Growth

3.2.1.3.1 Population Growth

Kelowna has continually experienced population growth rates well above the provincial average. Figure 3.6 compares the City of Kelowna and provincial population growth rates since 1981.

Rapid population growth causes development to proceed at a higher rate, which increases the importance of planning efficient urban growth.

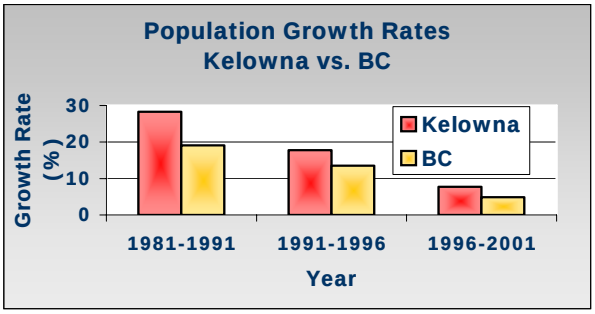


Figure 3.6 Kelowna vs BC population growth rates (Statistics Canada, 2001)

3.2.1.3.2 Land Available for Development

Developable land is quickly becoming a valuable commodity in the City of Kelowna. 40% of land is protected in the Agricultural Land Reserve (ALR) and an additional 17% contain steep slopes (over 30°) that cannot be utilized for development. The limited availability of

developable land, combined with rapid population growth, increase the importance of housing densification.

Building multi-family residential housing close to a city's core and urban town centres allows a greater proportion of the population to decrease commute distances, which translates to less pollution emissions and increased use of alternative travel modes, such as walking, public transit, and biking. In addition, multi-family housing minimizes development of open space and creates a more efficient and sustainable city.

3.2.2 RESIDENTIAL DEVELOPMENT

3.2.2.1 Development Areas

Altering development growth patterns, such as suburbanization, is a slow process. However, increased residential development in urban centres is becoming more prevalent in Kelowna, which is assisting to reduce urban sprawl. Figure 3.7 shows residential urban centre and suburban growth since 2000.

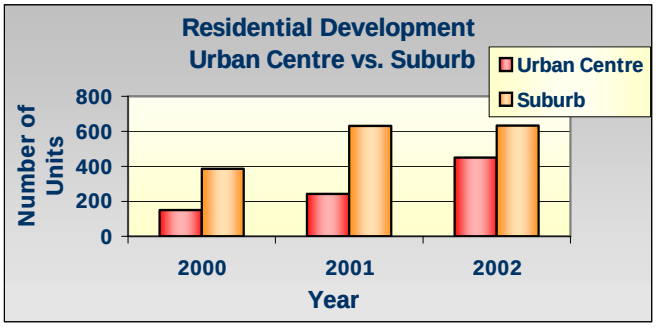


Figure 3.7 Urban vs suburban development (City of Kelowna, 2003)

Sectors that experienced greatest residential development in 2002 include Glenmore/Clifton/Dilworth (24%), Central City (22%) and Southwest Mission (12%) (City of Kelowna, 2003b).

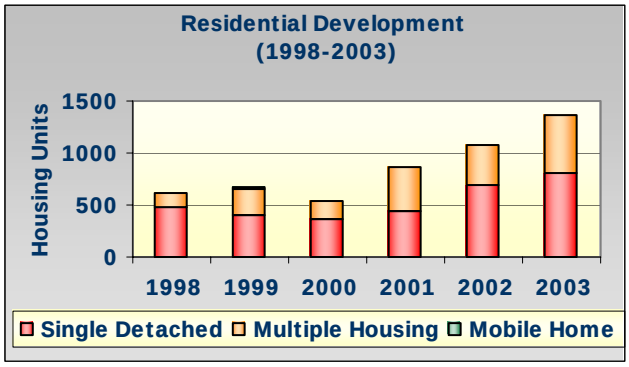


Figure 3.8 Residential development (City of Kelowna, 2004b)

3.2.2.2 Housing Type

Since 1998, the proportion of multiple housing units approved for development has increased each year, with the exception of 2002. In 2001, the number of multiple housing unit approvals superseded single detached units. Figure 3.8 illustrates the distribution of single detached and multiple housing units between 1998 and 2003.

The 2003 housing split in the City of Kelowna was 59% single/semi detached housing units and 41% multiple housing units (City of Kelowna, 2004b). The average split since 1993 is 58% single/semi detached and 42% multiple housing.

In 2003, the majority of multiple housing unit approvals were issued in the City Centre (77%), followed by the North Mission Crawford sector at 8%, the Glenmore/Clifton/Dilworth sector at 7%, and the South Pandosy/KLO sector at 7% (City of Kelowna, 2004b).

3.2.3 CITY CENTRE DEVELOPMENT

The downtown core performs many fundamental city activities and experiences heavy use, therefore, requires detailed attention. The Okanagan Lake Shore Zone Plan and the Inner City Shore Zone Concept Plan are tools developed and utilized by the City's Planning and Development Department to guide sustainable growth within the city centre.

The inner city shore zone

Environmentally conscious goals and objectives of the Okanagan Lake Shore Zone Plan and the Inner City Shore Zone Concept Plan that have been incorporated into the Official Community Plan include:

- Designate the Shore Zone as a Natural Environment/Hazardous Condition Area that is subject to development permits
- Reduce the presence of automobiles and promote pedestrian friendly environments
- Consolidate parking in the downtown core
- Provide safe and secure bicycle storage facilities
- Provide accessible and convenient transit
- Connect waterfront pathways to community-wide trail systems

3.2.3.1 Okanagan Lake Shore Zone Plan

The City of Kelowna's Council endorsed the Okanagan Lake Shore Zone Plan in 1997 to provide guidance for sustainable lakefront development along Okanagan Lake within the City limits.

3.2.3.2 Inner City Shore Zone Concept Plan

The Inner City Shore Zone Concept Plan was drafted to accompany the Okanagan Lake Shore Zone Plan. The study area extends from the sails at the foot of Bernard Avenue to Rotary Marsh at Brandt's Creek (City of Kelowna, 1998b).

3.2.4 POLICY DEVELOPMENT

3.2.4.1 Official Community Plan (OCP)

Development planning initiatives outlined in the OCP encourages smaller residential units and an increasing density grid towards the city centre and village centres. In suburbs, lot sizes will preferably become smaller, with secondary suites and multi-family units being encouraged. The City has set a goal of 67% for all residential units to be in the form of multi-family housing (e.g. apartments, townhouses, cluster housing) by 2013. Since 1993, the average percent of multi-unit housing is 42%. The Planning and Development Services Department has revised the draft OCP to set the 2013 multi-family housing share to 53%, in order to make the goal more achievable.

3.2.4.2 Growth Management Strategy

The Regional Growth Strategy provides the Regional District of Central Okanagan, City of Kelowna, District of Peachland, District of Lake Country, and provincial agencies with necessary tools for future community planning. The plan addresses fundamental issues regarding regional governance and delivery, housing, environmental protection, water resources, air quality, economic development, and transportation.

Polices of the Growth Management Strategy include:

- Emphasis of growth in existing urban areas and town centres, to reduce urban sprawl
- Residential development includes a wide range of housing type, density and affordability options
- Urban services, such as potable water supply, sewage treatment, solid waste disposal and an appropriate means of access, must be available prior to development
- New growth areas must consider impacts on existing services and facilities, as well as fiscal impacts
- Environmental impact assessments must be completed prior to development to determine if the land, watershed, and other natural resources will be able to accommodate the proposed development
- Urban development is discouraged near hazardous areas, sensitive environmental areas, resource extraction areas and farmlands, to reduce land use conflicts and development encroachment

3.3 WATERSHED

3.3.1 BACKGROUND

Kelowna's watershed is comprised of seven major drainage basins - Vernon, Clifton-McKinley, Brandt's Creek, Mill/Gopher, Mission, Fascieux, and Okanagan Mission. Each basin is located either completely or partially within the City's boundaries. The City of Kelowna encompasses 14.8% of the 1445 km² total watershed area.

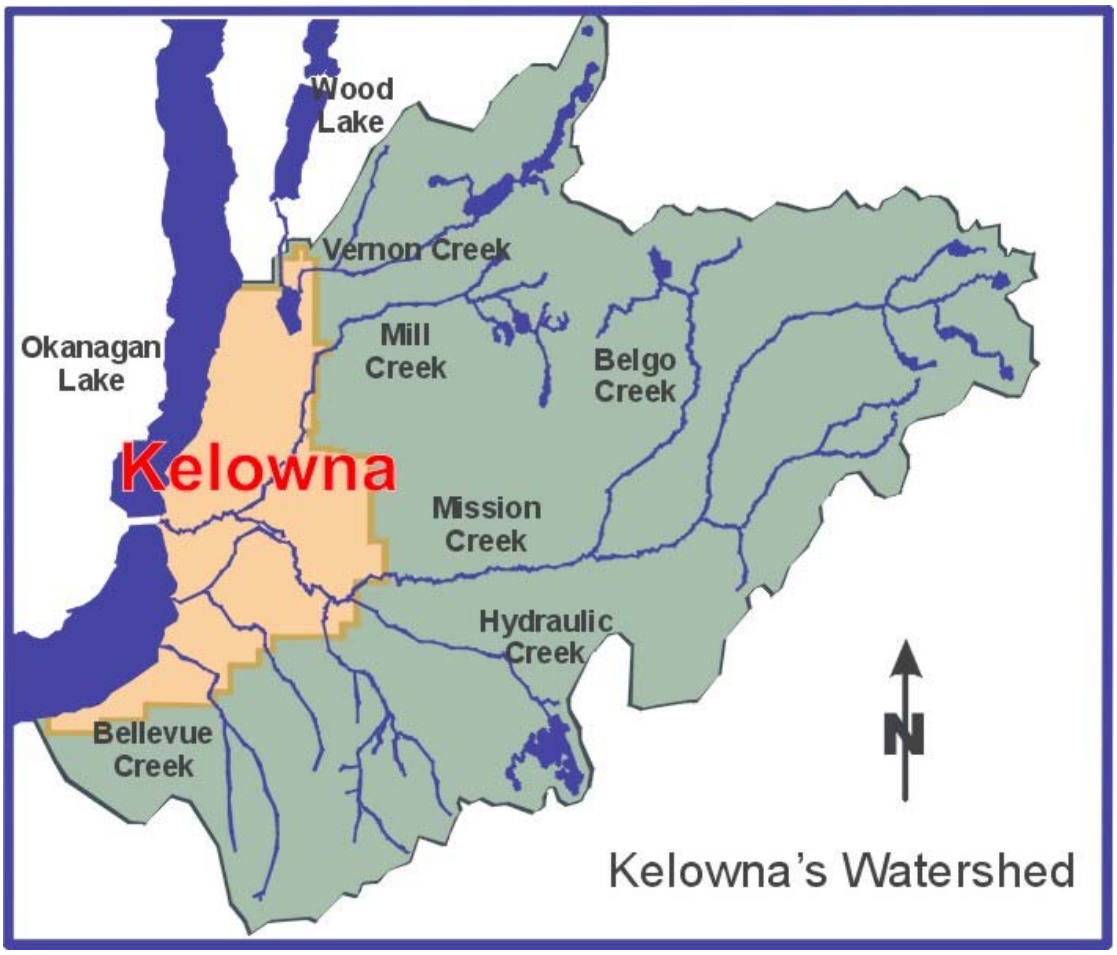
Q. What is a watershed?

A. A watershed is the entire region which contributes water via drainage into a body of water, such as a lake or reservoir (Smith and Smith, 2001).

Five notable functions of watersheds:

- Water collection
- Water storage
- Water discharge
- Habitat for flora and fauna
- Provides pathways for necessary chemical reactions

(Black, 1996)



Kelowna's Watershed (Gow, 1997)

3.3.1.1 Tributaries

Twenty-seven tributaries flow through the City of Kelowna into Okanagan Lake. The City has performed restoration and enhancement work on many of these tributaries to improve aquatic and terrestrial habitat. The table below summarizes characteristics of the five tributaries regularly monitored for water quality.

Table 3.0 Kelowna tributaries (MELP, 1996; City of Kelowna, 2003)

	Watershed Area	% Area Within City Boundaries	Designated Water Use	Designated Land Use	Storm Drain Outfalls	Quick Facts
Mission Creek	882.7 km²	7%	• Aquatic life • Wildlife • Drinking • Livestock • Irrigation • Recreation	• Urban • Agriculture • Parkland • Forestry	None	Spring runoff can be diverted from Mill Creek to prevent downstream flooding
Mill Creek	223.5 km²	28%	• Aquatic life • Wildlife • Drinking • Livestock • Irrigation • Recreation	• Urban • Agriculture • Parkland • Forestry	40	Has been endowed with five names. The creek name has officially been Mill Creek since 1998
Brandt's Creek	44 km²	96%	• Wildlife • Irrigation	• Urban • Agriculture • Parkland	22+	96% of the basin is located within City limits
Fascieux Creek	2 km²	100%	• Irrigation	• Urban • Agriculture • Parkland	8	Entire basin is located within City limits
Bellevue Creek	77 km²	9.5%	• Aquatic Life • Irrigation	• Urban • Agriculture • Parkland	None	Supports rainbow trout

3.3.1.2 Concerning Issues

Kelowna's watershed faces many challenges, as do many of the watersheds in North America. Urban, industrial, agricultural and many daily human activities are creating negative and sometimes acute impacts on our watersheds. Increased streambank erosion, deteriorated water quality and loss of fish and wildlife habitat have all been observed at various locations in Kelowna's tributaries.

Mill Creek – Streambank erosion

The following sections outline common problems associated with Kelowna's watershed.

3.3.1.2.1 Riparian Areas

Streams are often negatively impacted by human activities which occur in riparian areas. Some widespread problems include:

- Removal of native vegetation/riparian habitat
- Increase in water temperature due to lack of streamside vegetation
- Alteration of streambeds, stream courses, and water flow
- Dumping of grass clippings and garbage
- Chemical dumping
- Recreational activities

3.3.1.2.2 Home and Garden

Careless handling of home and garden products can be extremely harmful to nearby watercourses. Common issues include:

- Misuse and over application of pesticides, herbicides, and fertilizers
- Overuse of bark mulch
- Draining of pools and/or hot tubs into storm drains or water courses
- Dumping of household chemicals into ditches and drains

3.3.1.2.3 Automobile

Automobile-related pollutants are regularly deposited on driveways and roads, where they are often flushed down storm drains, entering watercourses untreated. Actions which amplify this problem include:

- Allowing automobile leaks to go unchecked
- Washing vehicles on driveways and streets, where soap, oil, etc will enter storm drains
- Hosing sidewalks and driveways, rather than sweeping
- Overuse of road salt and de-icing chemicals

3.3.1.2.4 Commercial

Examples of commercial industries and development which can lead to watershed degradation are as follows:

- Urban development – roadways, infrastructure, and associated impacts
- Forestry – increased surface runoff, erosion, and habitat loss
- Agriculture – pesticides, herbicides, and livestock

3.3.2 INITIATIVES

The City of Kelowna's Environment Division introduced a Watershed Stewardship Program in 1996 to restore riparian areas within the City of Kelowna and reduce negative anthropogenic impacts. The program has three areas of focus:

- Restoration and Enhancement
- Stewardship
- Education

3.3.2.1 Restoration and Enhancement

The City's Environmental Division has been actively restoring local streams since 1997 to decrease erosion, improve water quality, and enhance riparian habitat. Over the past seven years, the Environmental Division has restored 4030 meters of riparian area throughout the City of Kelowna.

Mill Creek has been the primary focus of the Watershed Stewardship Program's restoration efforts. A channel assessment completed in 1998 identified high priority sites and provided a framework for future projects along the creek. Additional projects, such as the former Central Park Golf Course, were undertaken as land became available.

3.3.2.1.1 Central Park Golf Course

The Environment Division was given the opportunity to restore a section of Mill Creek that runs through the property of the former Central Park Golf Course from 1999 to 2000, while the lot was undergoing development. Several restoration and enhancement procedures were applied to the

EXAMPLES OF STREAM RESTORATION

TO PREVENT STREAMBANK EROSION...

Erosion control blankets

Erosion control blankets, in conjunction with seeding, planting, or livestaking, are an alternative method of stabilizing stream banks.

Tree Revetment

A restoration technique involving bioengineering, which aids in controlling erosion and improving water quality. The revetment below utilized conifer trees which were anchored into the bank; it was completed in 1997 along Mill Creek near Bulman Road.

To create more stream complexity and enhance the riparian zone...

In-stream Complexing

Rock placement and molding of streambeds creates riffles and pools that would naturally be found in an undisturbed stream.

Habitat Development

Activities such as strategic placement of rocks and woody debris help to provide conditions that will encourage the establishment of habitat.

Native Plant Species

Introducing native plants along the creekside is a major factor to restoring riparian health.

To prevent livestock from accessing the creek...

Fence Installation

Fences restrict livestock access to creeks, which prevents further destruction of the riparian zone and reduces the amount of faecal matter entering the water.

creek, including erosion control blankets, in-stream complexing, and livestaking. Four off-channel habitats were also reintroduced. Over the two-year period, 3,601 native plants were introduced along the creek.

3.3.2.1.2 Urban Enhancement Project

In 2001 and 2002, the Mill Creek Urban Enhancement Project was conducted to restore degraded kokanee habitat. The Habitat Conservation Trust Fund provided approximately 46% of project funding over the two-year period.

Thirty-three locations received various treatments, such as bank stabilization, gravel addition, rock and log weirs, and plantings. After one year's work, kokanee enumerators working for the Ministry of Water, Land and Air Protection noted that "active spawning within the newly installed weirs in Mill Creek was very noticeable". Although there was no formal tally of kokanee using the enhanced sections, there was an increase of fish numbers in these sections of about 100%" (MWLAP, 2001b).

In recent years, efforts have begun to focus more on other creeks, such as Bellevue and Thompson.

3.3.2.1.3 Enhancement Summary

The City's Parks Division and developers have also contributed to watershed restoration efforts throughout the city.

Since 1997, 6775 meters of watershed have been restored and 10,942 native plants have been planted in the Mill Creek Watershed through joint efforts of various developers, volunteers, the City's Environment, Parks and Drainage Divisions.

Table 3.1 Watershed enhancement summary (Kam, 2004)

Watercourse	Environment Division		Parks Division		Development		Volunteers		Total	
	Linear Meters Restored	Plants Added	Linear Meters Restored	Plants Added	Linear Meters Restored	Plants Added	Linear Meters Restored	Plants Added	Linear Meters Restored	Plants Added
Bellevue Creek	85	344	20	85	300	1,734	65	99	470	2,262
Blair Pond					0.2 hectare	700				
Brandt's Creek			750	650	350	7,568	700	800	1,800	9,018
Duggan Brook					300	1,616			300	1,616
Mill Creek	3,815	5,907	1,030	1,825	1,855	2,710	75	500	6,775	10,942
Okanagan Shoreline	30		320		200	674	73	125	623	799
Rembler Creek			-		5	90	0		5	90
Thomson Creek	100	68	8-9 hectares*						100	68
Upper Vernon Creek					120	125			120	125
TOTALS	**4030**	**6,319**	**2,120**	**2,560**	**3,130**	**15,217**	**913**	**1,524**	**10,093**	**24,920**

3.3.2.1.4 Partnerships

The City has formed several partnerships with funding organizations, landowners, businesses, local governments, and volunteer groups. These partnerships have made a large portion of the City's restoration and enhancement projects possible.

To accomplish more of the much-needed work, the City's Environment Division has hired a student summer watershed crew since1999.

2003 Watershed Crew

The team performs a variety of tasks that focus on improving watershed health. Tasks include removal of invasive weeds, spawning gravel cleaning, assisting in restoration and enhancement projects, maintenance of past projects, and public education.

The program has been run as a partnership between the City and the Regional District of Central Okanagan (RDCO) since 2003.

A success story

In 2001, Telus Communications Inc. partnered with the City of Kelowna to restore the stretch of Mill Creek adjacent to their business. Telus provided $2500 in funding and staff volunteers to replant the riparian area. One of the major accomplishments of the projects included the construction of a spawning channel. Efforts of the project not only restored the integrity of the creek, but also gave the employees a place to enjoy.

The recent provincial cutbacks have affected funding programs, such as Fisheries Renewal BC. It has become increasingly difficult to accomplish the same amount of work that was completed prior to funding cuts. To help with funding cutbacks the Environmental Division has actively sought partnerships with local businesses.

Several landowners and volunteers have also contributed various in-kind and monetary donations to creek restoration. These types of partnerships help to build community awareness, contribute to the cause, and ensure long-term health of our watersheds.

3.3.2.2 Stewardship

"Stewardship is the act of taking responsibility for the well-being of the environment and doing something to restore and protect that well-being" (Environment Canada et. al, 1995). The City of Kelowna has initiated several

stewardship programs and provides funding, equipment, and education, to encourage active public participation in restoring Kelowna's watershed. Between 1997 and 2003, volunteers have donated approximately 7974 hours of time to environmental stewardship initiatives.

Watershed enhancement initiatives include replanting native riparian vegetation, garbage removal along local creeks, storm drain marking, and removal of invasive weeds. The Yellow-Fish Road and Adopt A Stream Programs are two examples of how volunteers can become involved.

3.3.2.2.1 Yellow-Fish Road Program

Volunteers use environmentally friendly paints to mark storm drains with a yellow fish, reminding people that storm drains directly access streams which lead to Okanagan Lake. The City of Kelowna, the Regional District of Central Okanagan, Okanagan Nation Fisheries Commission, and Cloverdale Paints jointly sponsor the program.

3.3.2.2.2 Adopt a Stream Program

In 2001, City Council endorsed the Adopt a Stream Program to encourage families, organizations, clubs, schools, and community groups to help look after Kelowna's streams.

Each group is responsible for an assigned portion of a local stream for a minimum of two years. Mandatory tasks include going out twice per year and painting storm drains adjacent to the assigned creek area, litter pick-up, and invasive weed removal. Other tasks can be performed, such as replanting, watering plants and restoration, all of which depend on the group's available time and enthusiasm. Each site contains a sign that publicly recognizes the adoption group working in the area.

Twenty-one groups have adopted over 6600 m of streams and the Maude Roxby bird sanctuary since the program's introduction. Stewards have committed a total of 1467.25 hours valued at $14672.50, from 2001 to 2003.

3.3.2.3 Education

This section outlines various education programs developed by, and directly associated with, the Watershed Stewardship Program. Specific details are discussed in conjunction with all educational initiatives in Section 4.0.

3.3.2.3.1 Student Education

Since 1997, the City of Kelowna Environment Division staff have provided students and residents with educational presentations, outdoor workshops and public venues concerning environmental issues, including watershed health. Between February 1997 and June 2004, 19 592 students have participated in Environment Division school presentations.

3.3.2.3.2 Targeted Educational Campaigns

The City's Environment Division utilizes targeted educational campaigns to address a certain sector of the community, which are aimed at changing that sector's behaviour. Several campaigns include experts from the Ministry of Water, Land, and Air protection (MWLAP), Department of Fisheries and Oceans (DFO), and local environmental consultants.

- Promoting Healthy Waterfront Properties (2000)
  Workshop for realtors to educate them regarding healthy waterfront properties, city processes and bylaws, and provincial foreshore regulations.

- Living by Water Dessert Evening (2002)
  150 homeowners attended this evening workshop to learn about the responsibilities of living next to water and tips on how to protect the resource.

- Caring for Streamside Workshop (2002)
  Landscapers, arborists and pest control representatives were educated about legislation and guidelines of working around water during this informative workshop.

- Status of Central Okanagan Watershed (2002, 2003)
  The purpose of the 2003 session was to update key watershed providers on restoration programs and innovative programs that help to protect our valuable resource. Due to the success of the workshop, plans are being made to make this an annual event.

- Group Meetings
  Watershed presentations are offered to groups such as strata councils, resident associations or special interest groups interested in helping restore and/or protect a stream in their neighbourhood.

3.2.2.3.3 Public Venues

Numerous public events are organized by the City to increase awareness and understanding of watershed and other environmental issues. Some of these public events include the Environmental Mind Grind, the Mayor's Environmental Expo, Family Environment Day, BC Rivers and Fisheries Awareness Day, and the Go Green Commuter Challenge, which is organized by the transportation division.

3.3.3 POLICY DEVELOPMENT

Several watershed policies have been established in the Official Community Plan (OCP) to provide a framework that will assist in the maintenance and improvement of watershed conditions within the city.

These policies include:

- Encourage senior levels of government to exercise their authority and enforce regulations pertaining to watershed issues
- Encourage cooperative partnerships for integrated and consistent watershed management
- Continue public education regarding watershed health
- Encourage regional expansion of watershed programs, policies, and basin-wide ecosystem planning

(City of Kelowna, 2002a)

3.4 PARKS AND OPEN SPACES

3.4.1 BACKGROUND

Parkland provides numerous social, economic, and environmental benefits to a community. Urban park space promotes social gathering, positively impacts nearby businesses and real estate values, helps to control urban sprawl, improves air quality, and preserves habitat for wildlife. Parkland currently represents 4.45% of the City of Kelowna's land area (Routley, pers. comm., 2003).

City Park

3.4.1.1 Park Classifications

Parks can take a variety of different forms, each serving a distinct purpose within a community. The City of Kelowna classifies its parkland into five different categories: neighbourhood parks, linear parks, city parks, community parks, and district parks. Neighbourhood parks, such as Cameron Park, provide playgrounds, informal play areas, passive walkways, and seating areas. Linear parks are corridors that run adjacent to natural features, such as waterways. They provide public access, recreational opportunities, and connect points of interest. The Mission Creek Greenway is a well-known example. City Parks are areas of special significance to the entire city population and have a variety of amenities, such as beaches or wildlife habitats. Community Parks serve a larger area composed of many neighbourhoods, and may be associated with a school to provide play fields, passive open space, and community facilities. District Parks provide high-activity sports fields, tennis courts, change facilities, and major indoor facilities.

Mission Creek Greenway

Apple Bowl

Cameron Park

City Park playground

3.4.2 INITIATIVES

Notable accomplishments have been made within Kelowna's park areas and open spaces to reduce environmental impacts. Efforts include pesticide management, efficient irrigation, bylaw implementation, and formation of partnerships.

3.4.2.1 Integrated Pest Management (IPM) Program

The IPM program is a part of the Urban Forest Management Plan that has been managed by the City of Kelowna's Parks Department for over twenty years. The program was one of the first municipal programs of its kind to be introduced in Canada. The program's primary objective is to reduce urban pesticide use.

3.4.2.1.1 Pesticide Use

Recent accomplishments of the IPM Program include a 14% reduction of pesticide application (by volume of active ingredient) from 2001 to 2002 and elimination of all insecticides (diazinon, chlorypyrifos, malathion, carbaryl) currently under review by the Pesticide Management Regulatory Agency (PMRA), see Figures 3.9 and 3.10.

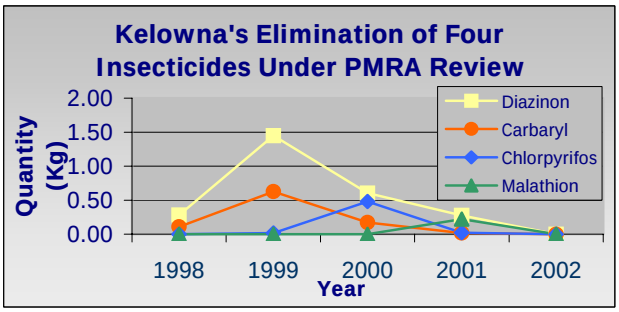


Figure 3.9 Pesticide use reduction (Wilson, 2003)

An impressive 90% of pesticides utilized by the Parks Division are 'environmentally friendly'. Examples include dormant oil, fatty acids, and soaps. These products are considered to be safe enough that the provincial government is considering eliminating them from the Pesticide Control Act.

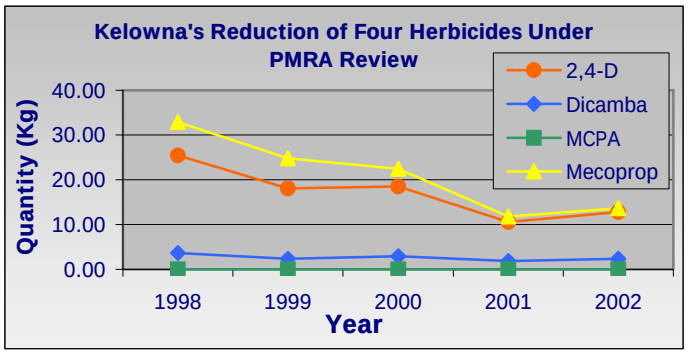


Figure 3.10 Herbicide use reduction (Wilson, 2003)

3.4.2.1.2 Alternative Treatments

City Park's Department employees have recently adopted and tested several alternative pest management strategies, which include:

- Hot Water Weed Machine

Trials were performed with machines that eliminate weeds with steam and boiling water. Test trials are also planned for propane operated burners.

- Micro-injection

  A new micro-injection tool is utilized by Park staff to treat stumps and brush without spraying.

- Biological Controls

  Biological controls such as beetles, weevils and other beneficial insects have been introduced into areas infested with invasive weeds, aphids, and mites.

- Mechanical Control

  The Parks and Environment Division hire summer students to manually remove weeds in local watersheds and other natural areas.

- Tolerance Thresholds

  Tolerance thresholds have increased for certain pests, where treatment has been reduced or eliminated (e.g. leaf-roller caterpillars).

- Weed Control in Turf
  Park's employees are currently performing test trials that include over-seeding, increased fertilization, and aeration, to examine if these types of cultural practices reduce broadleaf weeds in turf as effectively as conventional methods.

- Natural Fertilizers
  The Parks Division is participating in a research study with Olds College at the Prairie Turfgrass Research Centre in Olds, Alberta to examine natural fertilizers (e.g. corn gluten meal) and their effect on weed populations.

3.4.2.1.3 Future Goals and Initiatives

- To continue investigation of alternative methods that will further reduce pesticide use
- To develop a public IMP Education Program which incorporates other local governments
- Continue tree inventory to better track tree health

3.4.2.2 Tree Protection

The Tree Protection Bylaw No. 8041 prohibits tree removal from steep slopes and environmentally sensitive areas (e.g. riparian zones) without a permit. Any tree removed under permit must be replaced with two trees within one growing season.

3.4.2.3 Irrigation and Water Conservation

City efforts are assisting to enhance water efficiency and decrease maintenance costs in our city parks. The Parks Department is continuing to connect City irrigated parks to a centralized computerized irrigation system (MAXICOM). The system contains a weather station that is linked to the central computer to ensure water is utilized efficiently and effectively. New park designs focus on conservation of natural landscape and native vegetation, which promotes water conservation and decreases maintenance requirements.

3.4.2.4 Partnerships

3.4.2.4.1 Partners in Parks Program

Partners in Parks is a volunteer based program that encourages community involvement in creating and maintaining parkland in the City of Kelowna. Numerous individuals, community groups and private-sector businesses have generously contributed their time, talent, gifts, and monetary donations, which attributes to the success of the program and reduces reliance on taxation. In 2002, parkland in the City received 3900 hours of care from 600 Partners in Parks volunteers.

3.4.2.4.2 Mission Creek Greenway

One of the most notable volunteer partnership projects is the Mission Creek Greenway, a linear park that stretches 7km along Mission Creek. The project is organized by the volunteer group Friends of Mission Creek, in partnership with the City's Partners in Parks Program, Regional District of Central Okanagan (RDCO), the Central Okanagan Parks and

Mission Creek Greenway signage

Wildlife Trust, the Westbank First Nation, and the Ministry of Sustainable Resource Management.

With over $700 000 raised, land donations of more than 41 hectares by landowners (valued at approximately $ 800,000), over 10 hectares donated by the First Nations, and countless volunteer hours, the Mission Creek Greenway project has become the most successful community funded project in Kelowna's history. Plans are to eventually extend the trails to a total of 22km, stretching from Okanagan Lake to Mission Creek Falls.

3.4.2.4.3 Rails With Trails

In 2002, a study was conducted to assess the feasibility of developing a cycling trail adjacent to the existing railway line. The purpose of the trail would be to promote increased bicycle commuting in a safe environment. The study proposed a trail that would extend from the downtown core to the north end city limits. The route design would merge with other exciting bike routes to increase trail connectivity and ease mobility for biking commuters.

3.4.2.5 Awards and Recognition

The City's Parks Department has compiled reports and entered the City of Kelowna into two annual competitions- Communities in Bloom and Nations in Bloom.

3.4.2.5.1 Communities in Bloom

Communities in Bloom is a national competition based on a city's environmental efforts, aesthetics, and community spirit. The City of Kelowna participated in 1996 and 1997 placing second, in 1998 and 1999 placing first for its population category, and in 2000, jointly winning the International Challenge team competition with Solihull, England for the large city category. Kelowna was also the 2002 Host City for the Communities in Bloom Convention that welcomed 600 delegates from around the world.


Guisachan Park

3.4.2.5.2 Nations in Bloom

Kelowna entered Nations in Bloom in 2001, an international competition that assesses a community's heritage management, environmental practices, community spirit, and future planning. The competition was held in Shenzhen, China where Kelowna placed second. Kelowna was also a recipient of a Gold Award, the only one of two cities with a population of 50,001 to 300,000 to do so.

3.4.3 POLICY DEVELOPMENT

Policy objectives outlined in the Official Community Plan (OCP) pertaining to environmental practices and preservation of City parkland and natural open spaces include:

- To protect a minimum of 5% of City land area that is publicly owned and a natural open space
- To provide a minimum of 2.2 hectares of park space per 1000 population growth

- To develop a comprehensive trail plan that will provide city-wide connectivity, thereby promoting alternative methods of transportation
- To preserve significant natural areas for public use in development areas

3.5 SANITARY LANDFILLS AND SOLID WASTE

3.5.1 BACKGROUND

Waste management has undergone a paradigm shift through the past several decades. Proper resource management and waste reduction are of primary importance. The City of Kelowna's Solid Waste Division, Regional District of Central Okanagan and the Districts of Peachland and Lake Country have made a united effort to minimize negative environmental impacts created by solid waste in the region. The following section reports activity of the Glenmore Landfill and examines regional trends of solid waste production, recycling, compost, and hazardous materials.

3.5.1.1 Glenmore Sanitary Landfill

3.5.1.1.1 History

The Glenmore Landfill has been under City operation since 1966 and is the official waste disposal site for Kelowna's refuse. The City of Kelowna purchased property on which the landfill is situated from two local farmers in 2000. In the same year, the provincial government granted the City with an Operational Certificate for the Glenmore Landfill, binding the City to manage the landfill according to regulations outlined in the Waste Management Act.

Glenmore Landfill weigh scale

3.5.1.1.2 Location and Physical Characteristics

The Glenmore Landfill is located on Glenmore Road in a flat valley bottom and encompasses a total area of 435 acres. The landfill does not contain surface water outlets and is the receiving point of all surface runoff for the valley. The silt/clay soil below the landfill acts as a naturally low-permeable liner, which helps to contain leachate. These characteristics make the location ideal for a municipal landfill (City of Kelowna, 2001b).

Q. What is leachate?

A. Leachate is a solution that contains dissolved nutrients, metals and/or contaminants. Leachate forms when water percolates through soil, litter or organic matter.

In landfills, water that comes into contact with refuse is considered to be leachate.

3.5.1.1.3 Environmental Protection Measures

In order to minimize negative environmental impacts of buried waste, the Glenmore Landfill employs several safety features and monitoring protocols.

- Liners are placed on ground surfaces receiving waste to decrease contaminate leaching. Protocol for liner placement is dependent on soil type.
- To minimize surface water contamination, diversion ditches have been created around the landfill's perimeter to guide runoff into collection ponds. Local farmers utilize water from these ponds for irrigation during the growing season.
- Leachate is collected into pipes and directed to an on-site pumphouse for pretreatment. The water is then diverted to the Wastewater Treatment Plant for full treatment.
- Routine monitoring is conducted for metals, general quality, and biological contamination. Annual samples are taken from twenty-four on-site wells at various depths below the landfill, in the aquifer, and within the refuse. Collection ponds are also regularly monitored when utilized for irrigation (from spring to fall), and as a safety measure, the pretreated leachate is sampled weekly prior to transport to the Wastewater Treatment Facility for final treatment.

3.5.1.1.4 Avocet Enhancement Area

The American avocet (*Recurvirostra americana*) is a rare bird that chose to inhabit the landfill's northeast detention pond. Accommodations were made to provide habitat for the bird population. However, the detention pond has dried over the past few years due to warm weather conditions and increased leachate pumping. As a result, avocets slowly emigrated. The pond is now completely dry and no avocets currently inhabit the area.

American avocet

3.5.1.2 The Regional Waste Reduction Office

The Regional Waste Reduction Office formed in 1993 through efforts of the City of Kelowna, the Regional District of Central Okanagan (RDCO) and the Districts of Peachland and Lake Country, with the mandate of reducing waste entering local landfills by 50% (based on 1991 figures).

The program is designed to assist the public in reducing the amount of waste entering local landfills, by encouraging adoption of environmentally favourable practices, such as recycling and composting. Several incentives and educational programs/events have been created by the Regional Waste Reduction Office to achieve and maintain their mandate.

The Waste Reduction Office reported a steady decrease of landfill waste from 1991 to 1996 (See figure 3.11). Unofficially, the 50% waste reduction goal was met in 1996. However, the officially recorded percentage is 48%.

An increase of commercial waste production since 1997 is attributed to the attenuation of waste reduction and is creating some concern. A pilot project is planned for early 2005 to address commercial and demolition waste handling.

Figure 3.11 Regional Waste Reduction Progress (Suhan, 2004)

Reducing waste through recycling and compost practices conserves natural resources and energy, while prolonging the life of the landfill. Based on current waste volume, the Glenmore Landfill is expected to remain operational until 2050 (City of Kelowna, 2001b).

3.5.2 INITIATIVES

3.5.2.1 Recycling

Recycling provides numerous benefits to our community's environment and economy. Materials that are reused help to diminish waste entering our landfills, reduce pollutants and greenhouse gases, save energy, conserve natural resources, and provide a 'new' source of raw material.

3.5.2.1.1 The Blue Bag Program

The Blue Bag Program is a curbside service that collects recycled materials from residents that receive regular garbage collection. Recycled material is picked up bi-weekly in conjunction with garbage pick-up. An unlimited number of blue bags are accepted and no sorting is required, which makes participation easy and has contributed to the program's success. The Blue Bag Program achieved an 80-85% participation rate in 2002 and has increased recycled material collected by 40%, in comparison to the depot only system.

Boy with blue bags

Several materials are deemed recyclable in the regional Blue Bag Curbside Pick-Up Program and at recycling depots in Kelowna and the surrounding region:

- Tin cans
- Phone books
- Newspapers
- Corrugated cardboard
- Writing paper
- Aluminum products
- Boxboard and heavy paper
- Books and magazines
- Glass jars and bottles
- No. 2 plastics (cloudy containers)

3.5.2.1.2 Electronic Waste Roundup

Outdated electronic equipment is becoming a substantial source of waste. Computers, monitors, and televisions contain hazardous materials such as lead and mercury. The Regional Waste Reduction Office conducted the first E-Waste Roundup in fall of 2003; the event resulted in 28 tonnes of e-waste collected. All computers turned in were recycled. The next E-Waste Roundup is scheduled for October 23, 2004

3.5.2.1.3 Recycling Depots

Recycling depots provide service to the public without curbside collection. Three recycling depots and three bottle depots operate in the City of Kelowna.

Additional materials, such as batteries, metals, propane tanks, tires, yard and garden waste, wood chips, asphalt, concrete, and construction drywall can be recycled at landfill sites.

Glenmore Landfill's mandatory recyclable materials list includes:

- Corrugated cardboard
- Newspapers
- Writing paper
- Concrete
- Construction drywall
- Asphalt

These materials are not accepted into the landfill; additional tipping fees are charged if these items are incorporated into garbage loads.

3.5.2.1.4 Quantity of Waste Recycled

Figure 3.12 displays the escalating trend of recycled material collected in the region from 1994 to 2003.

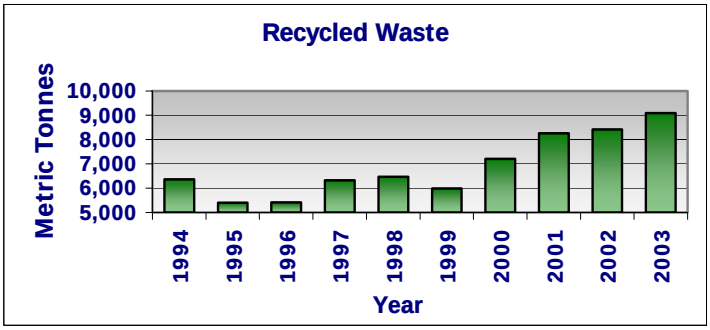


Figure 3.12 Quantity of waste recycled in the region between 1994 and 2003 (Suhan, 2004)

3.5.2.2 Compost Programs

The Waste Reduction Office provides several residential yard waste services to reduce the amount of waste entering our landfill and discourage backyard burning, which is banned in the City of Kelowna and the Regional District of Central Okanagan.

3.5.2.2.1 Yard Waste Pick-up

A yard waste pick-up service is provided four times a year (twice each spring and fall) for residents that receive regular garbage collection service. Items such as grass clippings, leaves, pine needles, and small prunings up to 1cm in diameter are picked up free of charge.

3.5.2.2.2 Drop-off Service

Residents may also drop off yard waste, such as grass clippings, pine needles, leaves, cones, and prunings up to 8" in diameter, to local landfills free of charge at any time of the year.

3.5.2.2.3 Christmas Tree Chipping

Residents may bring undecorated Christmas trees to local landfills and designated 'chip it' sites. The Christmas trees are chipped and composted to make the City's Glenmore Grow. The free service operates for approximately 20 days after Christmas Day.

3.5.2.3 Composted Products

The City of Kelowna produces two high-quality compost products, which are available for public sale. Both products reutilize waste materials that would otherwise end up in our landfills. These products exemplify the City's commitment to waste reduction.

3.5.2.3.1 Ogogrow

Ogogrow is a high-quality soil conditioner that is derived from recycled biosolids from the Wastewater Treatment Facility and wood waste. It can be utilized as soil conditioner, fertilizer, potting mix or top dressing, and is safe enough to apply directly to vegetable gardens. The high quality of Ogogrow is reflective of minimal light industry in the region, 'clean' bio-waste recovered from the Wastewater Treatment Facility, and the City's effective sewer bylaws (Cavers, pers. comm., 2003).

Manufacturing Process

Biosolids are mixed with wood chips and water and then placed in windrows. Heat that is naturally generated during the aerobic process and air circulation treatments destroys pathogens and promotes effective decomposition. In approximately four months Ogogrow is ready for sale. Previous methods took upwards of two years to reach a finished product. Prior to sale, Ogogrow is screened and quality tested.

Chipping process

Safety Guidelines

Temperature is monitored daily and must reach a minimum of 55°C for three consecutive days to ensure pathogens are destroyed. Climatic conditions in Kelowna commonly keep the compost around 70°C for an entire month, which well exceeds guidelines.

Heavy metal sampling is conducted four to five times a year. Test results constantly remain far below guidelines.

Annual Sales

On average, 13,000 metric tonnes of de-watered biosolids are utilized to create over 15,000 m^3 of Ogogrow annually. The program has been extremely successful, as demand continues to excede supply.

Sales in 2002 generated approximately $140 000 of revenue, recovering approximately 20% of program costs, with tipping fees increasing this proportion by 6%. Even though the program creates a negative profit, it is inarguably one of the best compost management alternatives. Other options are either extremely costly or not environmentally responsible (Cavers, pers. comm., 2003).

3.5.2.3.2 Glenmore Grow

Glenmore Grow is nutrient-rich horticultural compost produced from organic material, such as yard waste and Christmas tree clippings.

Manufacturing Process

The manufacturing process is quite similar to that of Ogogrow. The compost is mixed with water, placed into large windrows and rotated five to six times. Temperature and quality tests are also performed prior to sale.

Glenmore Grow

Annual Sales

Glenmore Grow was first available for sale in 2003. Response has been excellent since sales began in the spring. As of July 2003, 718 m^3 of Glenmore Grow had been sold, generating $17,000 of revenue.

3.5.2.3.3 Amount of Waste Composted

Figure 3.13 displays annual volumes of organic material retrieved from the Glenmore Landfill for compost from 1999 to 2003.

Between 11,000 and 14,000 metric tonnes of biosolids from the Wastewater Treatment Facility are composted annually.

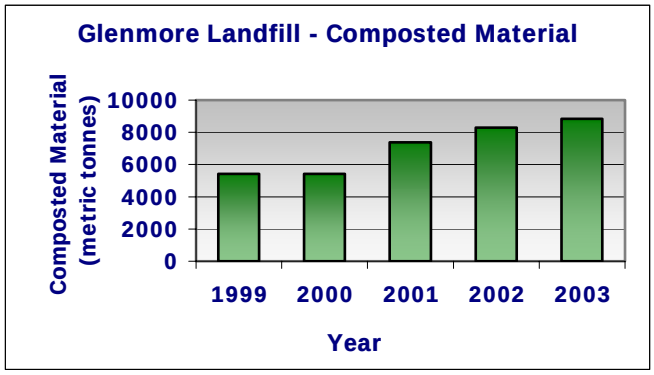


Figure 3.13 Organic material composted from Glenmore Landfill (Suhan, 2004)

3.5.2.4 Hazardous Waste Programs

3.5.2.4.1 Post-Consumer Residual Stewardship Program

The provincial government implemented the Post-Consumer Residual Stewardship Program in 1997 to place responsibility of safe hazardous waste disposal on manufacturers. The authorized Post-Consumer Residual Stewardship Program depot is located in Kelowna at the Battery Doctor and has been in operation since 1998. Program funding is generated through an "eco-fee" which is incorporated into the purchase price of the product. The eco-fee is often itemized on sales receipts to increase consumer awareness.

3.5.2.4.2 Hazardous Waste Roundup Program

The Hazardous Waste Roundup Program is held by the Regional Waste Reduction Office to invite local residents to drop off hazardous wastes for proper disposal. Hazardous materials that are not normally accepted year-round are permitted during the event. Program funding is provided through residential taxes.

Materials accepted at the roundup include:

- Antifreeze
- Waste motor oil
- Propane tanks
- Oil filters
- Household batteries
- Consumer grade pesticides
- Waste paint
- Automotive batteries
- Other household hazardous wastes

Proper disposal of hazardous waste has continued to increase in the region (See figure 3.14). During the 2003 Hazardous Waste Roundup, 949 vehicles dropped off 152 drums of hazardous waste (Suhan, pers. comm., 2004).

The escalating trend suggests public awareness of proper hazardous waste disposal is occurring.

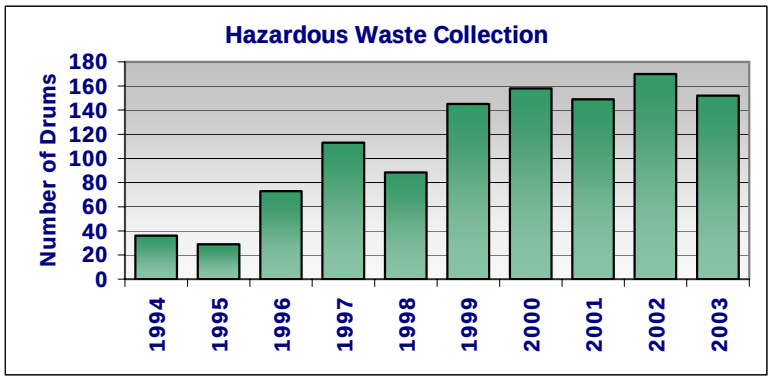


Figure 3.14 Hazardous Waste Collection results (Suhan, 2004)

(Note: Regional population growth also influences the escalating trend to some extent).

3.5.2.5 Refuse

The City of Kelowna provides weekly garbage collection service to City residents. To encourage reduction of residential refuse, each household is limited to two bags of garbage per week (91 liters). A maximum of four bags is permitted, but two of these bags must be labeled with 'Tag-a-Bag' stickers at a cost of $1.50 each.

3.5.2.5.1 Waste Production

The Glenmore Landfill received approximately 97 707 metric tonnes of waste in 2003. Figure 3.15 displays the percentage each community sector contributed.

Each resident in the region currently produces approximately 0.755 metric tonnes of buried waste annually, a significant improvement since 1990, when the per capita production rate was 1.15 metric tonnes per year (Suhan, pers. comm., 2003).

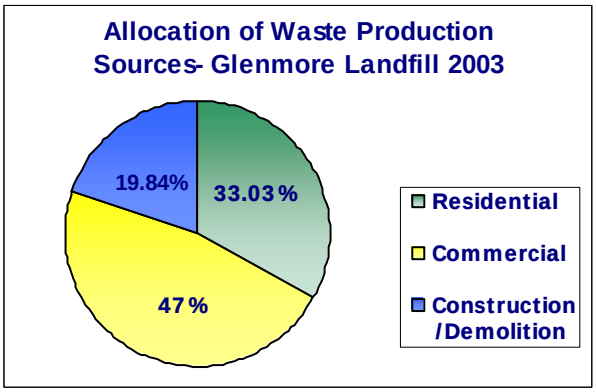


Figure 3.15 Allocation of waste sources (Suhan, 2004)

Commercial waste is the largest refuse source, representing approximately half of the total waste received at the landfill. Increased contributions of commercial waste have been apparent since 1997.

3.5.3 FUTURE INITIATIVES

3.5.3.1 Construction and Demolition Project

A pilot project is scheduled for early 2005 to investigate recycling collection, sorting systems, variable tipping fees, and other incentives that will reduce construction and demolition waste in the landfill.

3.5.3.2 Materials Ban

Additional materials are being considered for addition to the 'mandatory recycle' list, where materials on the list are banned from the landfill. Materials under consideration include all paper types, metal, No. 2 plastics, and tires.

3.5.3.3 Recycling of Coloured Plastics

Coloured plastic containers, such as yoghurt containers and ice cream buckets will be accepted in fall of 2004 at recycling depots at 1988 Kirschner Road, 144 Cambro Road, and the Westside and Glenmore landfills. These depots will accept all household plastic containers (Suhan, 2004).

3.5.3.4 Gas Collection at Glenmore Landfill

As Glenmore Landfill increases in size, gas production from refuse becomes a concern. The City's Solid Waste Division is currently installing a gas collection system. Phase one, a piping network, is to be completed within one year. Implementation of a fully operational system is tentatively scheduled for 2005.

3.5.4 POLICY DEVELOPMENT

3.5.4.1 Official Community Plan

Objectives and polices listed in the OCP regarding solid waste management and planning include:

- Promote reuse, recycle and compost practices, to divert as much waste material as possible from landfills
- Support educational programs of the Regional Waste Reduction Office
- Investigate cost-effective methods of controlling environmental impacts from the Glenmore Landfill

3.5.4.2 Bylaw 7173

Bylaw 7173 mandates that all City of Kelowna residents must utilize the garbage and recyclable material collection service by the City. Collection services increase efficiency by reducing the number of individual vehicle trips to the landfill. The service also ensures that all citizens have the means to keep their property in sanitary order.

The bylaw prohibits the placement of recyclable materials in the same container as garbage waste, and forbids intentional contamination of recyclable materials so that they are deemed non-recyclable.

4.0 EDUCATION AND EVENTS

4.0.1 BACKGROUND

Public education is an extremely effective tool to increase awareness of local environmental issues and encourage increased adoption of sustainable habits. Education provides communities with the ability to accomplish goals that will meet sustainable conditions.

Public education is an integral part of the City's environmental philosophies and policy development. Many of the City's divisions provide comprehensive environmental educational information through public events, participation programs, brochures, school presentations and workshops.

Ecosaurus entertaining spectators

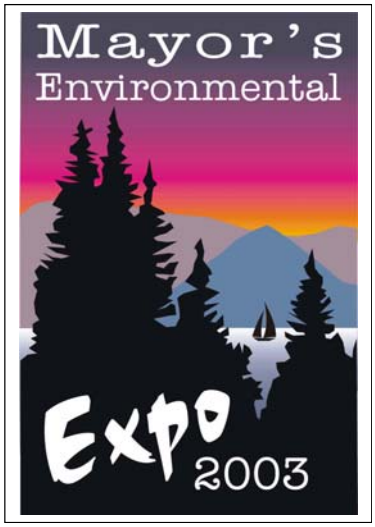
4.0.2 PUBLIC EVENTS

4.0.2.1 Family Environment Day

Family Environment Day has been organized by the City Environment Division and Central Okanagan Regional Parks since 1998 and runs in coordination with National Wildlife Week. Booths provide information regarding endangered species and their habitat, as well as other local environmental issues.

Free activities include games, face painting, scavenger hunts and crafts.

4.0.2.2 Mayor's Environmental Expo



The Expo is a free two-day community event held in City Park each spring during Environment Week. The event is hosted by the City of Kelowna and has been running for five years.

Numerous interactive and informational booths are on display along with showcases of environmental initiatives accomplished by local businesses, government and community groups. Organized events and games are also provided for school groups and families.

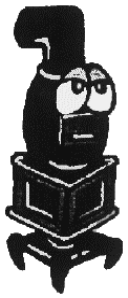
The Mayor's Environmental Achievement Awards are presented during the Expo and recognize individuals, groups, businesses and schools that have made significant contributions to the local environment.

Awards presented include:

- Most Environmentally Innovative Business Initiative
- Most Environmentally Dedicated Group
- Most Environmentally Friendly Commuter
- Most Environmentally Dedicated Individual
- Most Environmentally Friendly Classroom or School

4.0.2.3 Great Okanagan Wood Stove Exchange Program

This annual six-week program aims to reduce wood smoke pollution through raising public awareness of the importance of smoke-free burning. The program provides consumers with an opportunity to replace older wood stoves with EPA/CSA emission approved wood, gas or pellet appliances. Consumers receive cash discounts valued from $100 to $500, as an incentive to relinquish their old stove.



4.0.2.4 Vehicle Emissions Clinic

A free light-duty vehicle emissions clinic is sponsored and operated for three days of every year by Environment Canada, in partnership with the Regional Air Quality Program.

The clinic provides measurements of carbon monoxide and hydrocarbon concentrations from tail pipe emissions, as well as tire pressure and gas cap checks. Information on actions that reduce vehicle emissions is also provided to all participants.

4.0.2.5 Go Green Commuter Challenge

Each year the Regional Transportation Demand Management Division (TDM) organizes and promotes a weeklong event and national competition called the "Go Green Commuter Challenge". The challenge encourages environmentally conscious modes of transportation, such as walking, cycling, public transit use, car-pooling, and tele-commuting.

For the City's population size, Central Okanagan residents were the national champions of the contest in 2002, 2003, and 2004.

4.0.2.6 Clean Air Day

Local residents are given an opportunity to commute via local transit free of charge on a specified day during Environment Week. Passengers must obtain a 'Go Green' button from the Regional Transportation Demand Management Division to participate in the event.

4.0.2.7 BC Rivers and Fisheries Awareness Day

The City of Kelowna Environmental Division and Regional Parks and Recreation organize this annual event. It is held the last Sunday in September, coinciding with BC Rivers Day celebrations across the province, which are coordinated by the Outdoor Recreation Council and have been taking place since 1980. Land-locked kokanee salmon and their habitat are the focus of the local event. Visitors can watch Kokanee spawn, take an interpretive tour, visit informational displays, and participate in activities and games.

4.0.2.8 Arbour Day

Arbour Day celebrations are held in City Park each year and are organized by the City Parks Division. Information is provided on tree health, local native plant species, and watershed vegetation. The event has adopted an educational focus for local elementary schools. School group tours, interactive displays and educational games/activities are provided for students.

4.0.2.9 Hazardous Waste Roundup

The Regional Waste Reduction office holds an annual 'Hazardous Waste Roundup' event, where local residents are invited to drop off hazardous household waste for proper disposal. Waste material that would not normally be accepted year round is permitted during the event. Program funding is provided through residential taxes.

4.0.3 SCHOOL EVENTS

4.0.3.1 International Walk to School Day

Students and parents from around the world are encouraged to walk to school to show support for a cleaner environment, healthier students, and strong communities. A local award, the Golden Shoe Trophy, is offered to a school in the Central Okanagan with the most participation.

4.0.3.2 Environmental Mind Grind

The City of Kelowna and the Regional Waste Reduction Office organize the Mind Grind, an annual environment trivia competition between schools throughout the Southern Interior. Students (grades 4 to 12) are tested on their knowledge of air quality, watershed health, waste reduction, water conservation, endangered species, pond ecosystems, and forestry. The popular event continues to expand each year and now includes regional and interior playoffs.

4.0.4 SCHOOL PRESENTATIONS AND ACTIVITIES

The City's Environment and Transportation Divisions, as well as the Regional Waste Reduction Office and Regional Parks Department offer numerous free presentations and activities to schools throughout School District #23. Students, teachers, and parents are informed about topics such as watersheds, air quality, tree health, transportation alternatives, waste reduction, recycling, and composting.

A few of the presentations and activities that are offered to students of School District #23 are as follows:

- Wading through the Watershed
  Students learn about local watersheds and related issues, including activities that are harmful to watersheds, creek health, the importance of riparian vegetation, and fish and wildlife that depend on a healthy watershed.

- Gliding through the Airshed
  This is an interactive air quality program that examines causes of poor air quality in the Central Okanagan and provides examples of ways to reduce air pollution emissions. Other educational sessions also provide information about the greenhouse effect, human impacts on the climate of southwestern British Columbia, and effects of some of the major air pollutants of automobiles.

- Discover Your Transportation Alternatives
  Students learn about negative impacts of vehicles on our environment, health, and community. Alternative environmentally friendly modes of transportation are also discussed. Several interactive participation activities are offered through the program, such as the "how slow can you go" bike race.

"How slow can you go" bike race

- Where Does Our Recycling Go
  Students take a tour of the recycling plant and follow the path recycled materials take from curbside to finished product. Students learn what types of products are made from recyclable materials and have the opportunity to make their own recycled paper.

Other presentations provided from the Regional Waste Reduction Office include:

- The Waste Stream
- Colour of Compost
- Recycling
- The Three R's
- Careers in Waste Management

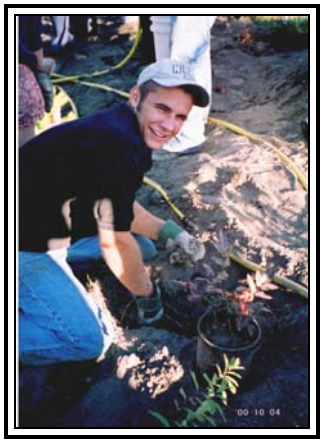
Outdoor education

A wide range of youth educational programs are also provided at the Mission Creek Regional Park EECO Centre by the City of Kelowna Environment Division, Regional District of Central Okanagan, the Regional Waste Reduction Office, and the Kokanee Interpreters.

Between February 1997 and June 2004, approximately 19 592 students have received educational school presentations from City of Kelowna Environment and Transportation Division staff.

4.0.5 COMMUNITY PROGRAMS

4.0.5.1 School Participation Programs



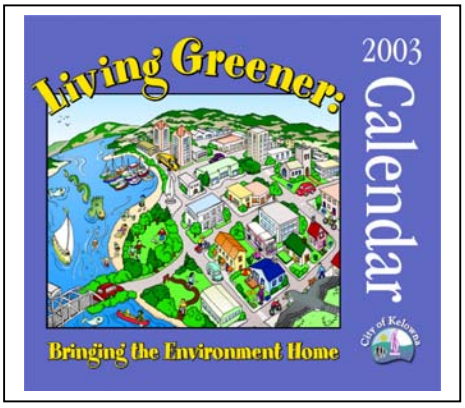
Rutland Senior planting along Mill Creek

The City's Environment Division offers several programs where schools can become active in the community through 'hands-on' learning experiences.

- Creek Clean-up
- Yellow-Fish Road Storm Drain Marking Program
- Weed Removal
- Planting Native Vegetation
- Adopt a Stream Program

Several of Kelowna's 27 streams have received helping hands from local schools through these interactive programs since 1997.

4.0.5.2 Living Greener



The Living Greener program aims to increase awareness about non-point source pollution, stressing that each individual pollutant source, such as homes and small businesses, combines to create a significant impact on a community. Information about non-point source pollution and 'living greener' tips are provided through radio advertisements, newspaper articles, and the Living Greener Calendar, which is mailed out to 50,000 households annually.

4.0.5.3 'Go Natural' Home Garden Parties

The Regional District of Central Okanagan, Regional Parks, and Water Smart offer 'Go Natural' parties, where residents organize a group of friends and neighbours to learn about grass cycling, composting, water conservation and other environmentally conscious practices. The City of Kelowna has been a guest presenter at several Garden Parties since the program's beginning in 2002.

To book a garden party, contact the Waste Reduction Office at 862-5250.

4.0.5.4 Living by Water Dessert Evening

The Living by Water Dessert Evening is an informative session for streamside and lakeside landowners. Tips on how to properly care for land next to water sources are provided to ensure residents understand the importance of protecting water sources from pollution. In 2002, over 150 participants attended the evening workshop.

4.0.6 BROCHURES

Brochures are educational tools that provide accessible information to the public that can be taken home for reference. A wide variety of environmental information brochures are made readily available at City Hall and at all environmental events organized or attended by City of Kelowna staff.

5.0 ENVIRONMENTAL INDICATORS

5.0.1 WHAT IS AN ENVIRONMENTAL INDICATOR?

An environmental indicator is a way to measure the current conditions of our community's environmental health. Indicators highlight trends to show whether things are getting worse, getting better, or staying the same. If there is a problem, an indicator may help us determine what direction to take to solve the problem. They can also tell us whether the City's planning processes and strategies are leading towards desired goals.

5.0.2 CHARACTERISTICS OF EFFECTIVE INDICATORS

An indicator is something that points to a problem or condition. Its purpose is to show you how well a system is working. Indicators are as varied as the types of systems they monitor. However, there are certain characteristics that effective indicators have in common:

- Understandable to the community at large
- Developed and accepted by the people in the community
- Link economy, society and environment
- Focus on long-range view
- Based on reliable information
- Based on timely information

5.0.3 DEVELOPING EFFECTIVE INDICATORS

Finding indicators that meet all the criteria for effectiveness can be extremely difficult. None of the criteria are absolute, and at times a less desirable indicator may be selected when there are no reliable data sources for a better indicator. However, it is important to remember that setting target goals is a long-term concept and indicators are not just a statement of what exists, they show the community's vision of the future.

5.0.4 HOW MANY INDICATORS IS ENOUGH?

The number of indicators that a community selects depends on a number of factors, including the size of the community, the number of critical issues, and the resources available to track and report on the indicators.

The final list should not be so short that critical problems or important areas are overlooked. The list should also not be so long that measuring and reporting them is an overwhelming task. What is more important than the number of indicators selected is the mix of indicators—the areas or categories that are covered by the indicators.

5.0.5 HOW KELOWNA'S INDICATORS WERE CREATED

The City of Kelowna's Environment Division engaged Benchmark Research Inc. to conduct a telephone survey of 300 random households within Kelowna (October 1998). The survey was intended to aid in the understanding of how Kelowna residents currently rank environmental issues. The survey information was used to augment environmental issues the City had identified in the *Official Community Plan, 1995*, and issues the public and media have brought to the forefront in recent years.

The top five environmental concerns identified by Kelowna residents in the October 1998 telephone survey were:

1. Air Quality
2. Drinking Water Quality
3. Waste Disposal
4. Loss of Natural Space
5. Water Supply

Following the top five environmental concerns were: Water Quality for Wildlife, Ecology and Biodiversity, Noise, and 'Other.'

On November 14, 1998, the City of Kelowna invited the community to participate in a workshop to assist in selecting environmental indicators. A diverse group of over 40 citizens representing the academic community, environmental and health professionals, outdoor and wildlife recreation enthusiasts, neighbourhood associations, and the general public attended the workshop.

The workshop's participants recommended approximately 45 environmental indicators and delegated a small working group to trim the number of indicators to a manageable number.

The resulting 'short-list' of environmental indicators elicited extensive discussions with staff from a variety of City departments. To be included in the State of Environment Report, the indicators had to:

- Relate directly to Kelowna's environmental priorities
- Be able to measure environmental change, and/or tell us something about the effectiveness of City programs
- Have data that is obtainable and is understandable to the public
- Be repeatable in future years

5.0.6 HOW ENVIRONMENTAL INDICATORS CAN HELP US SOLVE PROBLEMS

The City of Kelowna currently records information pertaining to the suggested indicators. But we need to rely on other levels of government and various non-government groups for information in other areas. Information on indicators that is not currently tracked will require allocation of additional resources to implement. Once the information pertaining to each indicator is organised and reported to the public in an easily understood format, baselines and trends will become apparent.

The next step is to ***set targets***, or goals, that best describe the ideal scenario for each topic of concern. Following targets, the next step involves ***developing actions*** so policies and objectives as determined by the community—as stated in the Strategic Plan and Official Community Plan—can be realised and sustained.

Many indicators can be directly influenced by implementation of appropriate actions by the City and by Kelowna's citizens. In some cases, a City action such as improved wastewater treatment and recycling methods may already influence an indicator to varying degrees. In other areas, actions by individuals can have a substantial benefit, such as, improved vehicle maintenance and reduced frequency of trips travelled, installation of water-saving devices, and reduction in open burning, to name just a few.

In addition, resources are increasingly limited and taxation cannot be continually increased; therefore, we need ways to set priorities for action. To enhance general priority setting, the indicators for each topic have been rated according to public importance, both current and historical, and the extent to which the City can reasonably influence the indicator.

The final step is ***monitoring the effectiveness*** of the actions implemented. Monitoring will tell us if our actions are working or not. Actions that are working should be continued, those that are not, will need to be revised.

5.0.7 HOW ENVIRONMENTAL INDICATORS AFFECT THE OFFICIAL COMMUNITY PLAN

As previously noted, the objectives and policies in the City's Official Community Plan (OCP) have influenced the priorities in selecting indicators. As baselines and trends are established from each of the indicators, the information will, in turn, affect the determination of targets and goals for those indicators; the information will also influence the selection and implementation of programs and initiatives to achieve those targets and goals.

Depending upon the level of success and effectiveness of the action plans, programs, and initiatives the City implements, there could be a re-focusing of resources to areas that remain a concern. Areas of concern with objectives that have not been met or sustained may become elevated to a higher priority in a future OCP.

5.0.8 KELOWNA'S ENVIRONMENTAL INDICATORS

Table 5.0 lists the topics and indicators that have been monitored by the City of Kelowna since 1999. They are listed in order of public importance and the extent to which the City can reasonably influence the indicator (High, Medium, and Low).

Public Importance:

Indicators with a '**high**' public importance ranking met two or more of the following criteria:

- The indicator directly monitors an issue that was identified as a concern or high priority for action by the public telephone survey.
- The indicator directly relates to an issue that received high priority in the Strategic Plan, 1992 and/or is a City priority identified in the Official Community Plan, 1995. For example, adopted policies, objectives, and Council approved programs.
- The indicator directly relates to an issue that has had local media attention in the last five years.

Indicators with a '**medium**' ranking met only one of the above criteria. Those receiving a '**low**' ranking did not meet any of the above criteria, but were included due to a strong connection to another indicator of medium or high priority.

City Influence:

Indicators with a '**high**' ranking are:

- Those for which the City has primary jurisdiction, or has a strong degree of control over the indicator performance.
- Those that the City provides services, fees, or approvals which will very likely influence individual behaviours that affect an issue.

For those indicators with a '**medium**' ranking, the City's influence is moderated by other factors:

- Other government agencies have a major interest in the issue, but still work in partnership with Kelowna through joint funding, or extensive consultation (e.g., transit planning, drinking water and wastewater treatment)
- Individual choices. For this type of indicator, the City can still play a role, but it is limited to providing outreach and other education programs designed to influence individual actions.

'**Low**' ranking topics or indicators are those where the City has minimal influence due to either:

- The strong influence of personal choices on performance or the jurisdiction of a senior government. For example, an individual's choice in vehicle fuel-type or the Farm Practices Protection Act.
- The complex nature of the issue of concern. For example, lake water quality, air quality or biodiversity, which are issues influenced by not just other levels of government but by global and regional factors as well.

Table 5.0 Environmental Indicators and Relative Significance

Topics & Indicators	Public Priority	Level of Direct City Influence	Non-City Influence	Related Topics
Air Quality				
Air Quality Index (Ventilation Index, Weather Cam)[1]	**H**	**L**	Private Sector, Senior Gov't, Individuals, and Global Factors	Land Use, Transportation, & Waste Management
Drinking Water				
Water Quality	**H**	**M**	Private Sector, Senior Gov't, and Individuals	Land Use, Surface Water Quality, Transportation, and Waste Management
Solid Waste Management				
Waste Buried	**H**	**M**	Private Sector & Individuals	Air Quality, Surface Water Quality, and Groundwater Quality
Waste Recycled	**H**	**M**		
Hazardous Waste Collected	**H**	**L**	Private Sector, Senior Gov't, and Individuals	
Wastewater Management				
Population Serviced	**H**	**M**	Private Sector, Senior Gov't, and Individuals	Land Use, Surface Water Quality, and Water Quantity
Waste Volume Treated	**H**	**M**		
Treatment Efficiency	**H**	**H**		
Land Use				
Private Open Space	**H**	**M**	Private Sector, Senior Gov't, and Individuals	Transportation, Air Quality, Surface Water Quality, and Ecology
Public Park and Open Space	**H**	**M**		
Single-Family Housing (%)	**L**	**L M**		
Water Quantity				
Water Metered	**H**	**M**	Private Sector and Individuals	Land Use, Air Quality, Surface Water Quality, and Ecology
Water Pumped	**H**	**M**		
Surface Water Quality				
Local Streams	**H**	**L M**	Private Sector, Senior Gov't, Individuals, and Global/Regional Factors	Drinking Water, Land Use, Waste Management, Transportation, Water Quantity, and Ecology
Local Beaches	**H**	**L M**		
Lake Okanagan	**H**	**L**		
Ecology & Biodiversity				
Kokanee Count	**H**	**L**	Senior Gov't, Individuals, and Global/Regional Factors	Land Use, Waste Management, Surface Water Quality, and Water Quantity
Christmas Bird Count	**M**	**L**		
Transportation				
Vehicle Volumes (SOV)	**H**	**L M**	Private Sector, Senior Gov't, and Individuals	Air Quality, Surface Water Quality, and Ecology
Vehicle Ownership	**L**	**L**		
Vehicle Fuel Type and Age of Fleet	**L**	**L**		
Mode of Travel	**L**	**LM**		

[1] Generally, as information for educational and awareness enhancement opportunities.

5.0.9 Implementation Plan

The City has been monitoring the outlined environmental indicators annually since 1999 and has strived to report the data and trends in a meaningful and understandable way. A written report describing background information on the chosen environmental indicators, as well as an inter-active *web page* are available to the public. This information can be viewed by clicking on the following link:

http://www.kelowna.ca/cm/page441.aspx

Continued monitoring will ensure that the City makes good progress in meeting its targets. Data trends will be identified and examined to determine past successes and where improvements can be made in the future. To ensure that we stay on track, the indicators monitored in this report should be re-assessed in three to five years time. New indicators may also be developed in the interim to help broaden our understanding of our environmental health.

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