Population and Economic Activities

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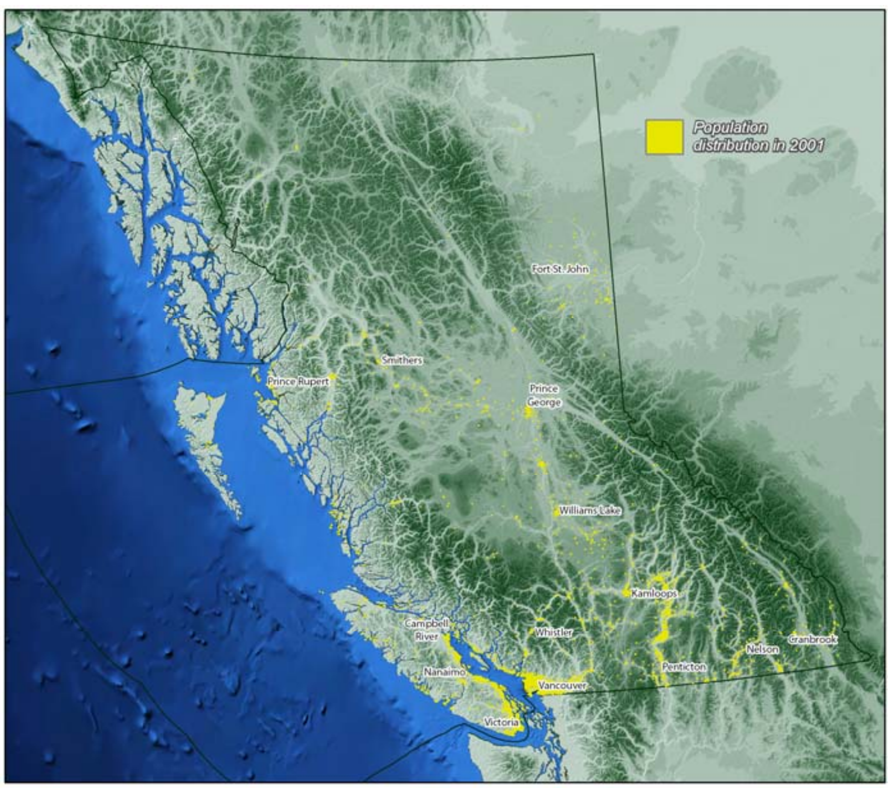
BACKGOUND

The Growing Provincial Population

Estimates of the pre-European population of British Columbia range from 60,000 to 200,000 (Glavin 1996; Harris 1997). Diseases brought by Spanish and British explorers decimated the Aboriginal populations of B.C. and by the middle of the 19th century their numbers had dropped to a fraction of their former size. As the Aboriginal population declined, European settlement along the coast continued to grow. In 1851 the population of B.C. as a whole was 55,000; in 1951 it was more than one million, and by 2006 it was over 4.3 million (Statistics Canada 2005; BC Stats 2006). By 2001, most (76%) of the province's population, or just over 3 million people, lived in the coast regions, mainly in the Lower Mainland and southern and eastern parts of Vancouver Island (Figure 1). In 2001, the Aboriginal population was 170,025 and accounted for 4.4% of the total B.C. population.

The provincial population has been growing faster than Canada as a whole; from 1996 to 2001, B.C.'s population increased by 4.9%, while Canada's population increased by 4.0% (BC Stats 2003). From 2004 to 2005, B.C.'s population grew by 1.3% (BC Stats 2006).

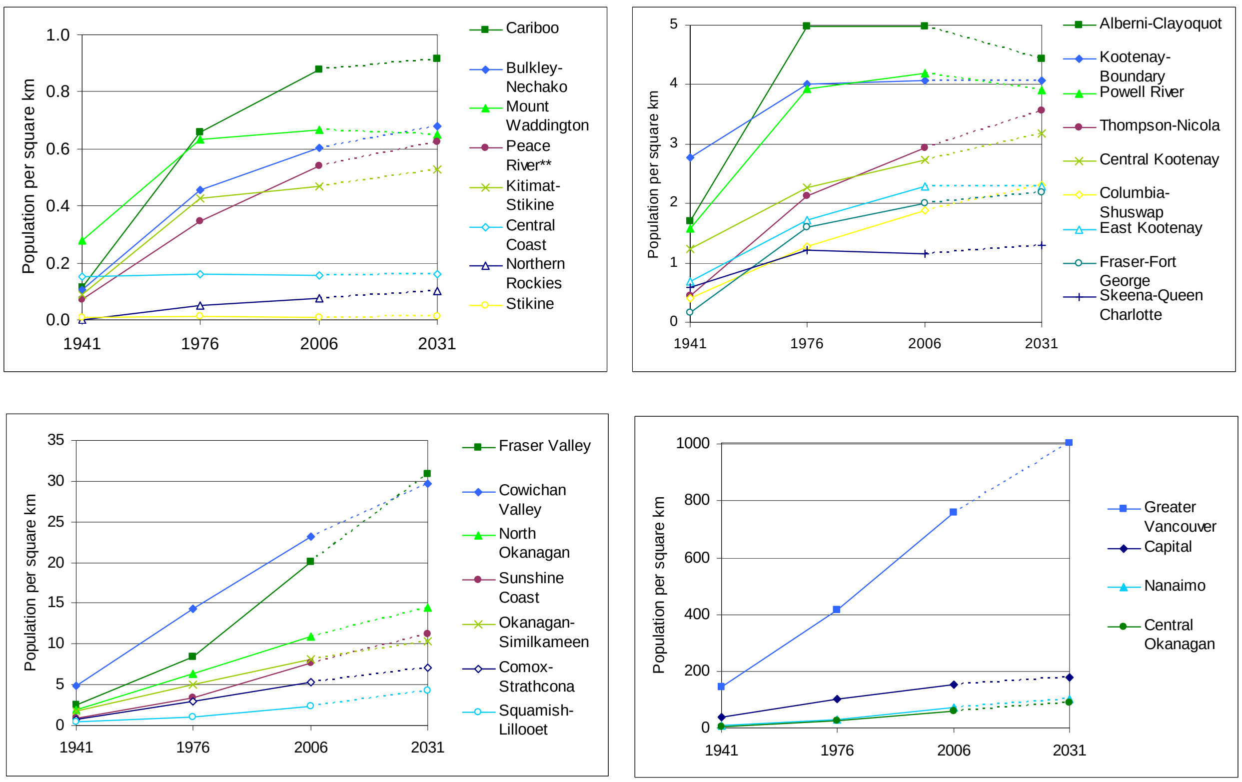
Figure 1. Population distribution in B.C., 2001 (one dot equals 50 persons).



Source: BC Stats 2004.

As the number of people living in the province increases, pressure on the environment inevitably will increase, whether through land use changes, increasing water demand, waste production, or emissions of pollutants. Population density projections, calculated as the number of people per square kilometre, show where the greatest pressures on land and marine areas are likely to be. Patterns of change in population density in regional districts, along with projected density in 2025, are shown in Figure 2 and Table 1. The four graphs have different scales on the vertical axis to account for the great difference in relative size of the districts.

Figure 2. Population density (people/km^2) in the regional districts of B.C. for 1941, 1976, and 2006, and projected for 2031. Note the different scales on the graphs.



[View graph data in excel.]

Sources: 1941 population figures from the census as published by Statistics Canada with adjustments to align with current boundaries; figures for 1976 and 2006 from the most current BC Stats estimates (Dec. 2006); 1976 data from internal documents at BC Stats; projections for 2031 from the PEOPLE 31 projection run, which is benchmarked to 2005 population estimates.

Table 1. Population density in the regional districts of B.C. for 1941, 1976, and 2006, and projected for 2031.

	Population density (people/km^2)			
Regional district	1941	1976	2006	2031
Stikine	0.01	0.01	0.01	0.01
Northern Rockies	nd	0.05	0.08	0.10
Central Coast	0.15	0.16	0.16	0.16
Kitimat-Stikine	0.09	0.43	0.47	0.53
Peace River**	0.07	0.35	0.54	0.62
Mount Waddington	0.28	0.63	0.67	0.65
Bulkley-Nechako	0.11	0.46	0.60	0.68
Cariboo	0.11	0.66	0.88	0.92
Skeena-Queen Charlotte	0.58	1.21	1.15	1.29
Fraser-Fort George	0.15	1.60	1.99	2.18
East Kootenay	0.68	1.73	2.29	2.29
Columbia-Shuswap	0.40	1.27	1.88	2.31
Central Kootenay	1.24	2.27	2.74	3.17
Thompson-Nicola	0.45	2.13	2.94	3.55
Powell River	1.59	3.92	4.20	3.91
Kootenay-Boundary	2.78	4.01	4.06	4.06
Squamish-Lillooet	0.44	0.99	2.31	4.25
Alberni-Clayoquot	1.70	4.97	4.99	4.44
Comox-Strathcona	0.81	2.93	5.36	7.13
Okanagan-Similkameen	1.77	5.06	8.15	10.40
Sunshine Coast	0.94	3.40	7.75	11.18
North Okanagan	1.99	6.39	10.90	14.51
Cowichan Valley	4.85	14.34	23.12	29.69
Fraser Valley	2.46	8.45	20.15	30.81
Central Okanagan	4.34	25.11	59.58	87.57
Nanaimo	8.00	30.44	70.66	101.77
Capital	36.94	100.91	151.09	178.94
Greater Vancouver	142.18	417.40	757.59	1004.72
B.C. total	0.88	2.73	4.65	6.06

Sources: 1941 population figures from census as published by Statistics Canada, adjusted to align with current boundaries; 1976 and 2006 figures from the most current BC Stats estimates (Dec. 2006); 1976 data from BC Stats internal documents; 2031 projections from PEOPLE 31 projection run, which is benchmarked to 2005 population estimates.

Notes: Peace River includes Northern Rockies in 1941. Regional District names are those used in 2006; those in bold have been adjusted to conform to 2006 categories.

The most rapid growth rates have occurred in the largest metropolitan area of Vancouver. Not surprisingly, Metro Vancouver (formerly the Greater Vancouver Regional District) also has the greatest population density. In the 30 years between 1976 and 2006, the population nearly doubled and the population density is projected to continue increasing. The Capital Regional District (Victoria), and the Nanaimo and Central Okanagan regional districts are the next fastest growing areas. They are all projected to continue increasing, but at a markedly slower rate than Metro Vancouver. The Fraser Valley and Cowichan Valley, are also fast-growing areas. Population density is increasing markedly in the North Okanagan, Sunshine Coast, Okanagan-Similkameen, Comox-Strathcona, and Squamish-Lillooet regional districts. The increase in the latter area is due mainly to the recent rapid growth around Whistler.

Although the provincial population continues to rise, and density is increasing in the southern parts of the province, the populations of some regional districts have not grown. In Skeena-Queen Charlotte, density actually decreased somewhat between 1976 and 2006, probably because of the downturn in the forest industry in these communities. The 2031 projections show that population density for Alberni-Clayoquot, Powell River, Mount Waddington, and East Kootenay may drop slightly.

The population patterns reflect both the continual expansion of urban centres and a shift in the economic and industrial activity within the province. Population declines in rural and remote areas are associated with the decline in relative importance of traditional labour-intensive resource industries such as forestry and fisheries.

Impacts of a Growing Population on the Provincial Environment

Most state of the environment indicators, including those in this report, show the impacts of increasing provincial, national, and global populations. According to the most recent population estimates, the total B.C. population is expected to exceed 5.5 million by 2030 (BC Stats 2007b). The most visible impact on the environment from the growing population is the permanent loss of habitat to industrial and residential development in the areas with the highest populations. Forested land, grasslands, wetlands, estuaries, and the riparian zones along streams, lakes, and seashores have all been disturbed or lost to provide housing, employment, recreation, and transportation for people. Increasing use of urban and suburban land brings expanding transportation and utility corridors to move goods and people between urban centres and suburbs. As development spreads out or “sprawls” in an unplanned manner beyond existing urban centres, it encroaches on natural habitats and agricultural lands. Urban sprawl also means that people travel farther from homes to work or shopping areas, leading to heavier reliance on roads and cars. As natural land cover, which has a greater capacity to filter water from rainfall and snowmelt, is replaced by pavement and other impervious surfaces such as buildings, precipitation that should percolate into the soil is rapidly carried away into storm sewers. This means that the rain water is not available to recharge underground aquifers or replenish natural watercourses.

Another consequence of increasing population and density is increasing air and water pollution and release of other contaminants from human activities. Both fresh and marine water quality are affected by the release of excess nutrients and contaminants into the environment from sewage, agricultural and surface runoff, and vehicle and marine vessel traffic. The growing scale of sewage and solid waste disposal problems, as well as release of smog-forming chemicals and greenhouse gases, strains both local and global ecosystems.

Concern about the negative environmental and social impacts of urban and suburban sprawl has given rise to "smart growth" approaches to land-use planning and development. Smart growth is defined as land use and development practices that enhance the quality of life in communities, preserve the natural environment, and also save money over time (Curran and Leung 2000). Local governments are applying smart growth principles to regional growth strategies and official community plans. Smart growth strategies have been found to increase the liveability and economic vitality of developed areas, especially in larger municipalities (Smart Growth BC 2004).

Paradoxically, declining populations in rural and remote communities also create pressure on the surrounding environment. Many communities are struggling with the loss of natural resource industries (e.g., logging, fishing) and are working toward diversifying their economy. The issues facing these communities in transition include job loss, shrinking tax base, school closures, loss of health services, deteriorating infrastructure, and less government funding.

INDICATORS

The indicators in this paper show selected pressures on B.C.'s environment from population growth, distribution, and density, and from human activities, as well as responses that address those pressures.

The indicators fall into three general categories: patterns of use on land and sea, liquid and solid waste management, and economy and the environment. The latter category reflects the fact that the economy is a strong driving force for both positive and negative change in the environment. Gross domestic product (GDP) measures the total value of goods and services produced in Canada. This includes goods-producing industries (such as manufacturing, construction, and resource extraction enterprises) and service-producing industries (such as wholesale and retail trade and health care).

Patterns of Use on Land and Sea

1. Key Indicator: Rate of change of selected land uses in Metro Vancouver, 1986 to 2002

This is an impact indicator. It was developed as one of several indicators addressing the impact of increasing population on the coast; it specifically reports on land use changes and impacts of "smart growth" strategies in the Vancouver area.

Changes in land use patterns show the pressures that expanding human population and economic activities are placing on the surrounding environment. Tracking the rate of change over time can help determine whether efforts to limit urban sprawl are effective. This indicator reports the results of an analysis of land use changes in Metro Vancouver (formerly the Greater Vancouver Regional District or GVRD) between 1986 and 2002 (BCMSRM 2004). The results were reported in the B.C. Coastal Environment: 2006 report (BCMOE 2006a) and are summarized in this paper. (For the full report, see *www.env.gov.bc.ca/soe/bcce/01_population_economic/landuse_changes.html*.)

Methodology and Data

In 2004/05, a pilot project was undertaken to map changes in land-use patterns in Metro Vancouver using satellite imagery. The project was funded jointly by the provincial government, the Biodiversity Conservation Strategy for the Greater Vancouver Region initiative, Environment Canada, and Natural Resources Canada. It was managed by the Business Solutions Branch of the B.C. Ministry of Sustainable Resource Management (now the Integrated Land Management Bureau, Ministry of Agriculture and Lands).

This study examined changes over time in the characteristics of land use at a broad or regional level, as reflected in land cover visible in satellite imagery. The type of land cover (composition and characteristics of land surface) is a result of a mixture of natural and human influences. Land use, however, is characterized by the economic uses of land and people's relationships with the environment. This means that determining land use change from satellite photographs, which show land cover, is complex and requires cross-referencing with other data sources.

The study area covered a total of 375,456 ha, consisting of the Metro Vancouver area plus a 2-km buffer (except along the US border) and only areas above the high water mark.

Land-use maps at an overview level and land-use change maps were produced for four time points (1986, 1993, 1998, and 2002) primarily from Landsat satellite imagery. Other sources of information, including existing maps, digital orthophotographs, air photographs, and supplementary inventory datasets, were used to complete the maps.

Results for all years are shown in Table 2 and Figure 3, which shows the net change in each category, for each period, and for the entire study (1986 to 2002).

Table 2. Change in land use in Metro Vancouver (GVRD), 1986 to 2002, and net change for the entire study period.

	Land use (ha)							
	1986	1993	Change 1986-1993	1998	Change 1993-1998	2002	Change 1998-2002	Net change[a] 1986-2002
Agriculture/urban mix[b]	16,511	16,511	0	17,430	919	17,393	–37	+882
Agriculture	31,728	31,684	–44	31,712	28	31,733	21	–7
Forest								–2996[c]
Old (≥140 yrs)	70,245	68,691	–1555	68,459	–231	68,436	–23	
Young (<140 yrs)	66,634	66,627	–6	66,772	145	67,399	627	
Recently logged	7,499	8,760	1261	6,530	–2230	5,806	–724	
Selective logged	559	559	0	0	–559	0	0	
Mines (gravel pits)	2,009	2,077	68	2,139	63	2,132	–7	+124
Recreation	707	707	0	1,182	475	1,178	–4	+479
Urban	93,660	93,936	276	95,761	1826	95,910	149	+2251

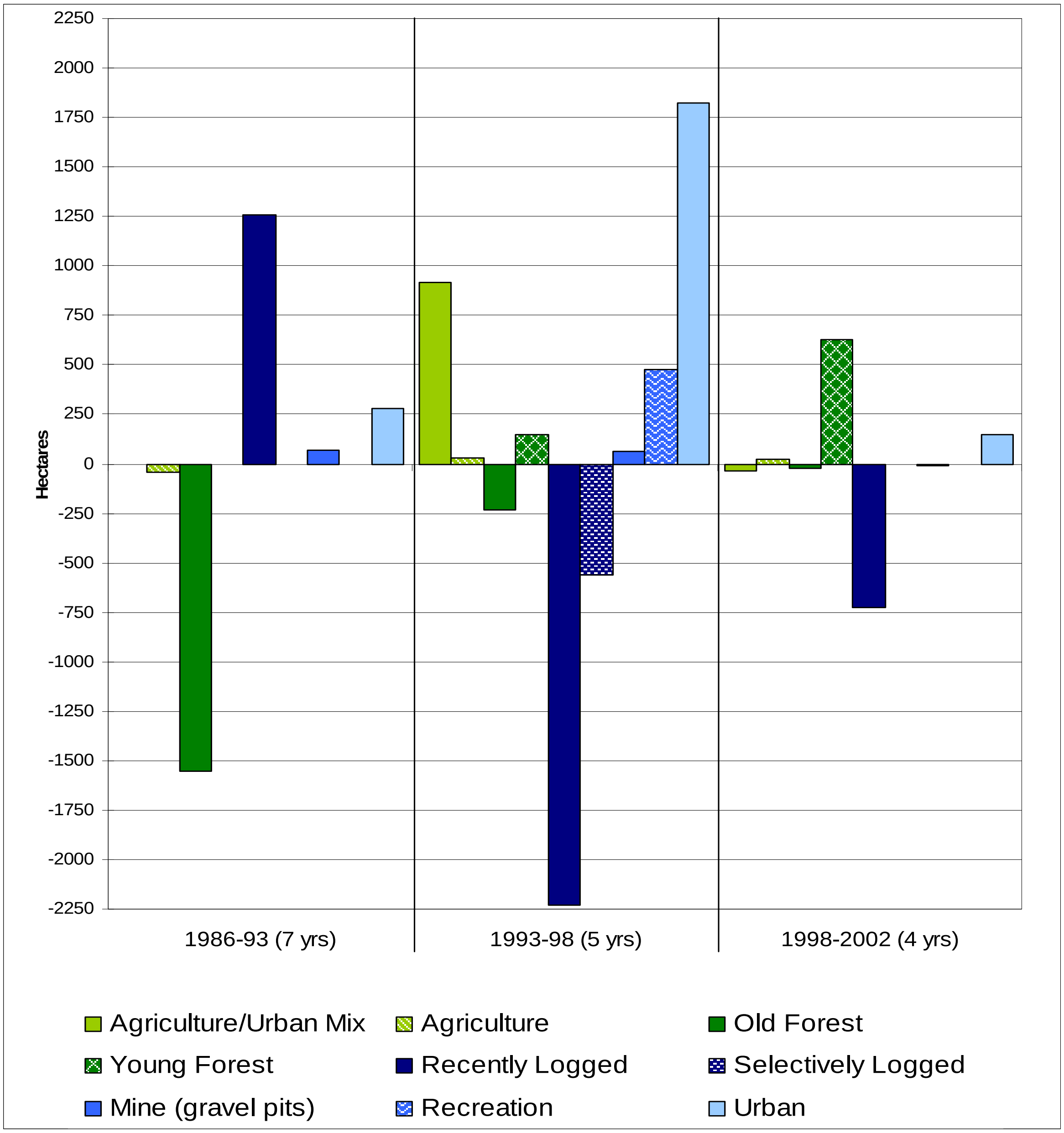
Source: BCMSRM 2004.

[a] Net change is the sum of positive and negative changes in area, thus does not show whether a particular use may have gained area in one location while losing it in another location.

[b] Due to the relatively coarse mapping level, small changes, such as in density of housing, may not be detectable in this category.

[c] Figures for the four forest classes were combined to calculate the total net change in forestry land use. This takes into account the fact that some areas moved from “recently logged” to “young forest” (<140 yrs) and others moved from young to old forest (≥140 yrs) over the 16-year period.

Figure 3. Net change in land use (ha) in Metro Vancouver (GVRD), 1986–2003, by land cover and land use type.



Source: BCMSRM 2004.

View graph data in excel.

Most of the land use changes between 1986 and 2002 actually occurred in the 1993 to 1998 period. During this period, a rapid rate of urbanization of the region is shown by the higher rate of change to more urbanized land uses in this time. A more detailed analysis of the land use conversions showed net losses of forests and agricultural land, mostly to urbanization. The urban land use category grew by 1826 ha. During 1993–1998, 2332 ha of young forest were converted to other uses, most (1,721 ha) to urban or mixed agriculture/urban use. This conversion is not evident from the net change figures for the period because it is masked by a large area that moved from "recently logged" to "young forest."

All selectively logged lands recorded in 1986 were converted to mixed agricultural/urban land use by 1998. The agriculture/urban mix category increased by 919 ha (an increase of more than 5%), compared to no change in area during the previous period.

Another related land use change brought about by increasing population and consumer demand was the conversion of lands outside of urban use areas (agriculture and young forest) to recreational uses such as ski areas, golf courses, and large waterfront cottage areas. Recreational-use land increased by 67% (475 ha).

After 1998 the rate of conversion to urban use fell to one-tenth of the previous five years, with some of the new urban hectares coming from agriculture/urban mixed use land (i.e., from already urbanizing areas), and from young forest lands. The largest net change was a total of 850 ha that was re-established as young forest after appearing in the previous period as "recently logged."

Interpretation

Overall, land use change accelerated during the 1993 to 1998 period, after which the rate of change slowed considerably. These statistics show that most of the expanded urban area came from forest land (1113 ha), with conversion of agricultural land second (373 ha). Although the percentage increase in urban use area (about 2%) since 1986, and in agriculture/urban mix use area (about 5%), may seem small compared to the size of the region, these changes took place over a relatively short period.

Given the continued increase in population—more than 25% during a similar time period (1991–2001) for Metro Vancouver (BC Stats 2004)—these trends appear to confirm the success of urban containment or smart growth strategies within the Greater Vancouver Regional District. A 2002 study by Northwest Environment Watch and Smart Growth BC compared urban sprawl for Greater Vancouver (including most municipalities in Metro Vancouver) and Greater Seattle and reported that, despite a very high growth rate, Vancouver's policies had resulted in 62% of its population living in compact communities (30 persons per ha or more) in 2001 (Northwest Environment Watch 2002). Five years earlier, 57% of the Vancouver population lived in compact communities. In comparison, 25% of Seattle residents lived in compact communities in 2000. This means that Seattle residents take up more land per capita, with greater impacts on the regional environment, than Vancouver residents.

In the Lower Mainland, policies at the regional level, such as the Greater Vancouver Regional District's Liveable Region Strategic Plan, coupled with municipal land-use policies and the provincial Agricultural Land Reserve (ALR), appear to have restrained suburban sprawl and slowed the loss of rural land and open space over the last 30 years (Northwest Environment Watch 2002). Population and density, however, continue to increase on the B.C. coast, particularly in the areas north and east of Metro Vancouver (BC Stats 2004).

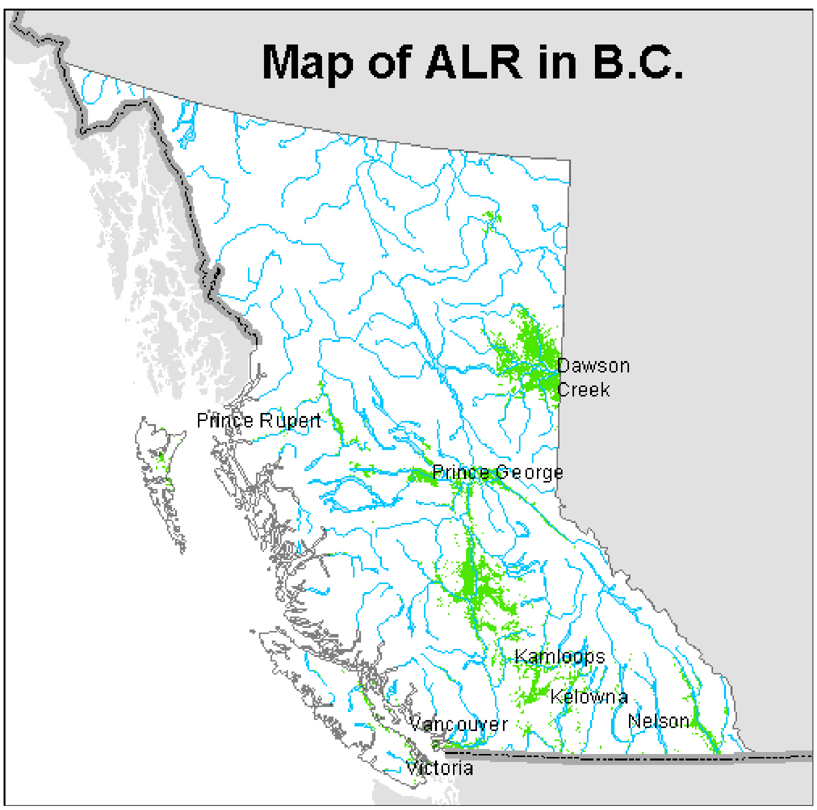
2. Key Indicator: Changes in area of the Agricultural Land Reserve in B.C. since 1974

This is a pressure indicator showing the change in area and quality of land in the Agricultural Land Reserve (ALR) since its inception in 1974. It answers the questions: How much has the total area of the ALR changed? How has this change affected the quality of ALR lands?

Until the 1970s nearly 6000 hectares of prime agricultural land were lost each year to urban and other uses. In response, the provincial government introduced the B.C. *Agricultural Land Commission Act* on April 18, 1973.

The Agricultural Land Commission (ALC), appointed by the provincial government, established a special land use zone called the Agricultural Land Reserve (ALR) to protect the dwindling supply of agricultural land. The ALR was established between 1974 and 1976 through cooperative efforts with regional districts and member municipalities, and included a public hearing process for local input. Initially it comprised 4.7 million hectares (5% of the province) (Figure 4).

Figure 4. Distribution of Agricultural Land Reserve in B.C.



Source: Agricultural Land Commission website, *www.alc.gov.bc.ca/mapping/Provincial_Map.htm*.

The ALR includes private and public lands that may be farmed, grazed, forested, or vacant. Some ALR blocks cover thousands of hectares, but others are small pockets of only a few hectares. Although the area of ALR in the province has remained approximately the same, boundary changes have been made over the decades.

The chair of the ALC reports to the Minister of Agriculture and Lands, but the Commission operates independently within the framework of the *Agricultural Land Commission Act*.

The Commission has the authority to include or exclude land from the ALR. As a quasi-judicial organization, it reviews applications case-by-case, taking into consideration the following information: agricultural capability, suitability, current land use, the property in relation to surrounding lands, related agricultural concerns, community planning objectives, any other pertinent information specific to the property under application or proposal, and the broader provincial interest.

Agricultural land is used primarily for the production of food for human and livestock consumption. Agricultural activities also include growing plants for fibre and fuels (including wood), and for other products (e.g., pharmaceuticals, plant nursery stock).

All agricultural land is not equally capable of producing agricultural products. The main limiting factors in British Columbia are climate, topography, and soils. Climate determines the heat energy and moisture available for agricultural production. Topography restricts the ability to use cultivation equipment. In B.C., the inherent ability of land to produce agricultural crops is assessed through a classification system known as the “Land Capability Classification for Agriculture in British Columbia” (Kenk and Cotic 1983). Table 3 describes the seven agriculture land capability classes used in to the Canada Land Inventory (CLI) and the equivalent classes used by the ALC.

Table 3. Agricultural capability classes of the Canada Land Inventory (CLI) and the equivalent categories used by the Agricultural Land Commission (ALC)

Canada Land Inventory		Agricultural Land Commission	
Class	Capability for agricultural production	Category	Relation to CLI Capability Class
1	The very widest range of crops. Soil and climate conditions are optimum, resulting in easy management.	Prime	The entire unit is Class 1–3 inclusive
2	A wide range of crops. Minor restrictions of soil or climate may reduce capability but pose no major difficulties in management.	Prime Dominant	Over 50% of the unit is Class 1–3
3	A fairly wide range of crops under good management practices. Soil and/or climate limitations are somewhat restrictive.	Prime Subordinate	Less than 50% of the unit is Class 1–3
4	A restricted range of crops. Soil and climate conditions require special management considerations.	Secondary	Entire unit is Class 4–7
5	Cultivated perennial forage crops and specially adapted crops. Soil and/or climate conditions severely limit capability.		
6	Important in its natural state as grazing land. These lands cannot be cultivated due to soil and/or climate limitations.		
7	No capability for soil-bound agriculture.	Unclassified	No ratings have been assigned

Sources: Canada Land Inventory agricultural capability classes (Kenk and Cotic 1983) and ALC categories from ALC website: *www.alc.gov.bc.ca/alr/Ag_Capability.htm*.

Methodology and Data

All data for this indicator are from the ALC. Data on the total area of the ALR from 1974 to 2007 was updated by the ALC in May 2007 (Figure 5). The net change in ALR by agricultural capability category (Figure 6) was determined through an analysis of the tables in the ALC statistics report (ALC 2000). Areas included in the ALR are from Table B-6 (*www.alc.gov.bc.ca/publications/ALR_Stats/mar00/Part_B/Table_B-6.htm*). Areas excluded from the ALR were calculated by adding the totals for the two exclusion categories provided in Table C-6 (*www.alc.gov.bc.ca/publications/ALR_Stats/mar00/Part_C/Table_C-6.htm*) and Table E-6 (*www.alc.gov.bc.ca/publications/ALR_Stats/mar00/Part_C/Table_C-6.htm*).

Regional summaries of exclusions and inclusions and net changes by capability category (Figure 7) were also produced from these tables. For this analysis, the regional districts were grouped into six larger regions following the map on the ALC webpage: *www.alc.gov.bc.ca/contacts/regions.htm*.

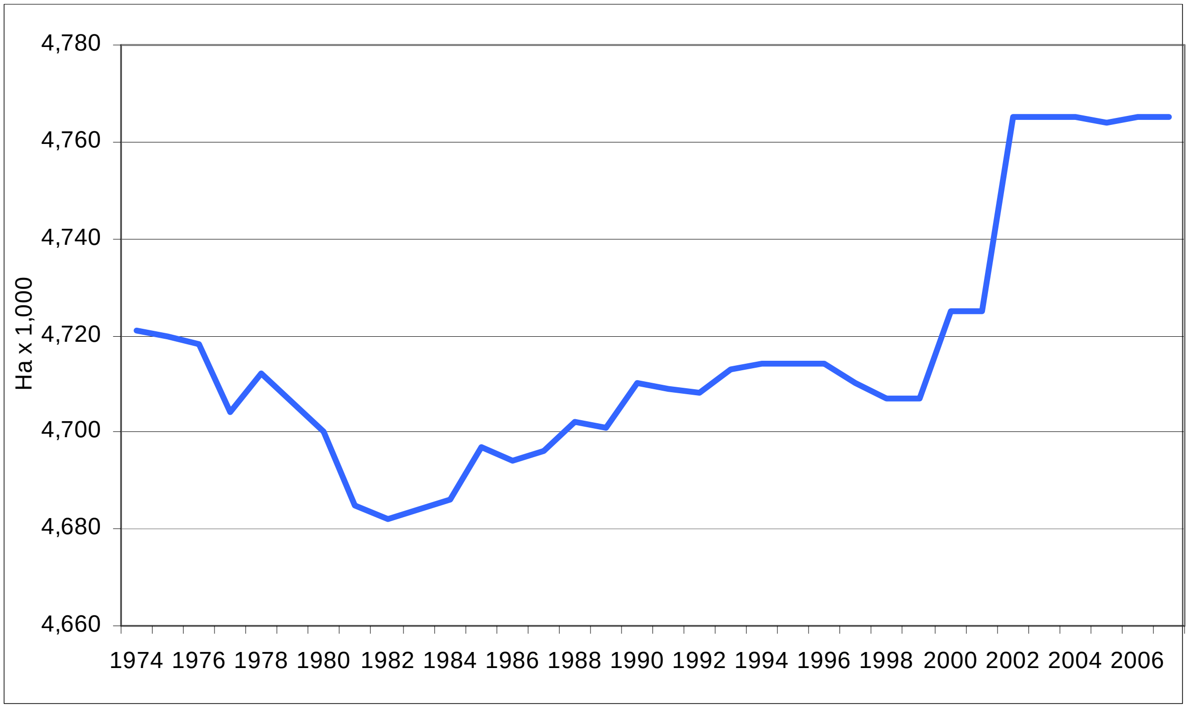
The total area in the ALR (Table 4, Figure 5) increased by 1% (43,903 ha) between 1974 and 2007. Most (26,729 ha) of this increase was in lands in the secondary capability category, but there was some decrease in the prime and prime subordinate capability categories (Figure 6). The largest inclusion of secondary capability agricultural lands (81,052 ha) was in northern B.C.; there were losses in this category in the southern part of the province, especially in the Okanagan (18,228 ha) and on Vancouver Island (15,727 ha) (Figure 7, Table 5). There was a net decrease (7,914 ha) in prime agricultural land in all regions of the province, but mostly in the Okanagan and the South Coast. The unclassified lands (Figure 7) in the interior and northern parts of the province are all likely secondary capability lands that have not yet been classified (S. Runka, ALC, pers. comm.).

Table 4. Total area (cumulative ha) in the ALR, 1974 to 2007.

Year	Area of ALR (ha)		Year	Area of ALR (ha)
1974	4,720,675.9		1991	4,708,687.1
1975	4,720,038.5		1992	4,707,609.4
1976	4,718,197.1		1993	4,712,629.7
1977	4,703,572.6		1994	4,713,864.5
1978	4,712,177.0		1995	4,713,789.1
1979	4,705,675.3		1996	4,714,083.3
1980	4,699,786.1		1997	4,709,700.8
1981	4,684,594.4		1998	4,707,431.7
1982	4,682,016.6		1999	4,707,528.5
1983	4,684,005.3		2000	4,724,950.9
1984	4,686,503.0		2001	4,725,371.0
1985	4,696,715.8		2002	4,765,202.7
1986	4,693,860.1		2003	4,764,884.7
1987	4,696,143.5		2004	4,765,076.1
1988	4,701,619.0		2005	4,764,539.0
1989	4,701,386.3		2006	4,764,754.5
1990	4,709,993.4		2007	4,764,579.0

Source: Data provided by the Agricultural Land Commission, 2006. Data for 2007 is from 2006/07 ALC Annual Service Plan Report: *www.bcbudget.gov.bc.ca/Annual_Reports/2006_2007/alc/alc.pdf*.

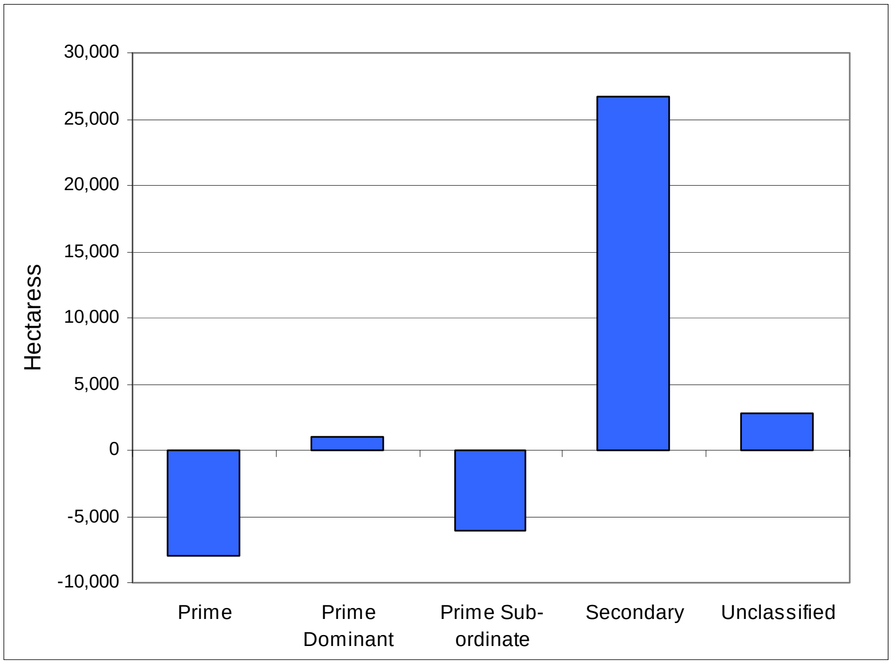
Figure 5. Total area (ha) in the ALR from 1974 to 2007.



Source: Data provided by the Agricultural Land Commission, 2006. Data for 2007 is from 2006/07 ALC Annual Service Plan Report: *www.bcbudget.gov.bc.ca/Annual_Reports/2006_2007/alc/alc.pdf*.

View graph data in excel.

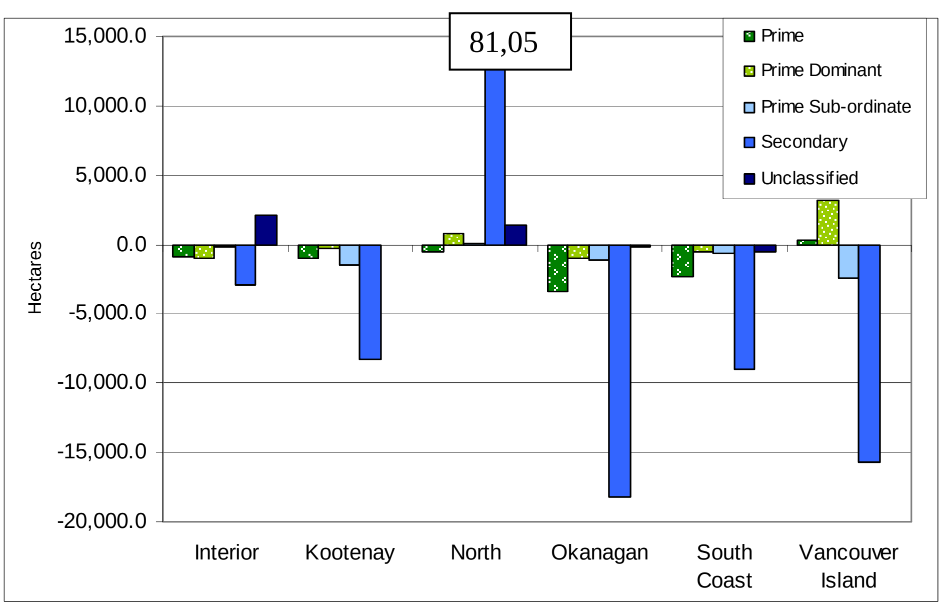
Figure 6. Net change in ALR by agricultural capability category, 1974 to March 2000.



Source: ALC 2000.

View graph data in excel.

Figure 7. Net change in agricultural capability category of the ALR, by region, 1974 to March 2000.



Source: ALC 2000.

View graph data in excel.

Table 5. Net change in total area of ALR from 1979 to 31 March 2000, by region and agricultural capability category.

		Area by agricultural capability category (ha)				
Region	Total area (ha)	Prime	Prime Dominant	Prime Subordinate	Secondary	Unclassified
Interior						
Inclusion	17,565.8	461.2	343.2	926.0	13,705.3	2,130.1
Exclusion	20,251.7	1313.6	1,334.4	1,037.3	16,566.4	0.0
Net change	–2,685.9	–852.4	–991.2	–111.3	–2,861.1	2,130.1
Kootenay						
Inclusion	1,316.0	356.6	44.7	190.0	721.2	3.5
Exclusion	12,536.4	1,365.6	371.1	1,732.8	9,048.4	18.5
Net change	–11,220.4	–1,009.0	–326.4	–1,542.8	–8,327.2	–15.0
North						
Inclusion	98,123.5	628.6	1,315.0	885.1	93,930.3	1,364.5
Exclusion	15,418.5	1,178.6	532.4	829.4	12,878.1	0.0
Net change	82,705.0	–550.0	782.6	55.7	81,052.2	1,364.5
Okanagan						
Inclusion	3,028.2	504.8	71.1	164.1	2,288.2	0.0
Exclusion	27,001.2	3,884.8	1,111.7	1,327.1	20,516.0	161.6
Net change	–23,973.0	–3,380.0	–1,040.6	–1,163.0	–18,227.8	–161.6
South Coast						
Inclusion	1,608.8	856.3	161.5	120.5	440.5	30.0
Exclusion	14,744.0	3,236.5	678.6	804.8	9,497.3	526.8
Net change	–13,135.2	–2,380.2	–517.1	–684.3	–9,056.8	–496.8
Vancouver Island						
Inclusion	8,040.8	2,638.8	3,523.0	217.2	1,661.8	0.0
Exclusion	22,777.4	2,381.2	344.7	2,639.9	17,389.1	22.5
Net change	–14,736.6	257.6	3,178.3	–2,422.7	–15,727.3	–22.5
B.C. Total						
Inclusion	129,683.1	5,446.3	5,458.5	2,502.9	112,747.3	3,528.1
Exclusion	113,116.5	13,360.3	4,392.9	8,615.3	86,018.6	729.4
Net change	16,566.6	–7,914.0	1,065.6	–6,112.4	26,728.7	2,798.7

Source: Agricultural Land Reserve Statistics 31 March 2000: *www.alc.gov.bc.ca/publications/ALR_Stats/mar00/Part_E/Table_E-6.htm*.

Interpretation

The net change in the size of the ALR is an indicator of the stability of the agricultural land base. A relatively stable or increasing net size of the ALR would indicate that lands suitable for agriculture are being retained in the ALR (ALC 2007). There was a decline in area of the ALR between 1974 and the mid 1980s. Much of this loss was likely due to adjustments to the initial boundaries (which were based on preliminary technical maps from the Canada Land Inventory) as more detailed technical land capability information became available (Runka 2006). Between 1999 and 2002, the total area of land within the ALR increased above the initial area at the inception of the ALR in 1974. This change resulted from a large inclusion of Crown land in 2002 in the northern part of the province as recommended by provincial land and resource use planning tables. Since 2002, the total amount of land in the ALR has remained essentially unchanged.

The agricultural capability of the land that has moved into or out of the ALR is significant as it indicates the overall agricultural value of the lands in the ALR. Although lands with secondary agricultural capability cannot grow as wide a range of crops as can prime capability lands, they are important for many agricultural uses, such as grazing and growing feed crops. Much of the secondary capability lands added to the northern part of the province are likely used for these purposes.

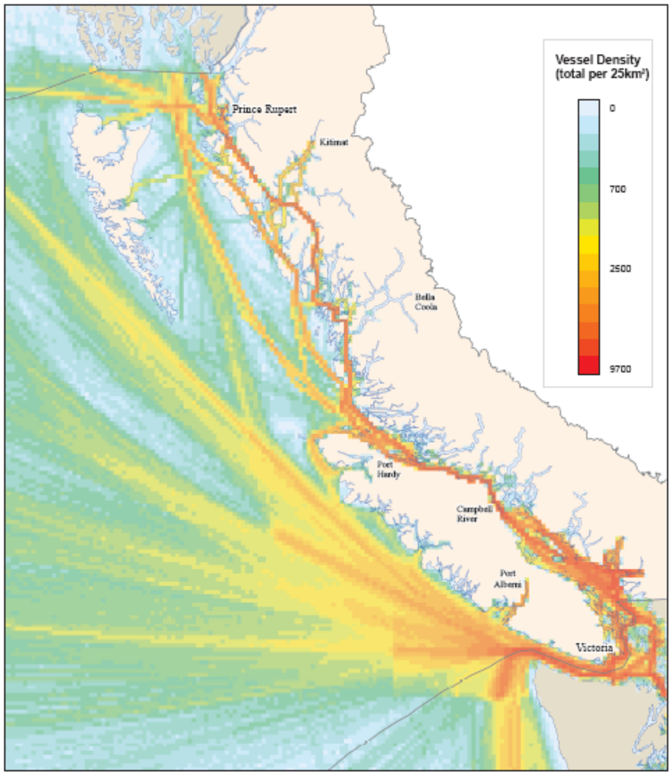
The loss of prime agricultural land in the ALR is particularly noticeable in the Okanagan and South Coast where the population is highest and the demand for land for development is the greatest. However, the loss of agricultural land undoubtedly would have been significantly higher if the ALR did not exist. For example, according to Smart Growth BC, although the population in Metro Vancouver has consistently increased since the mid-1970s, the region’s annual rate of ALR loss has declined steadily since 1983. In effect, without the ALR, Metro Vancouver would have converted approximately 7000 additional hectares to urban development (Smart Growth BC 2005).

Supplementary Information: Density of marine traffic on the B.C. coast

On the coast, marine traffic is as essential a mode of transport for people and goods as the highways are for land-based traffic. Marine traffic, however, affects marine ecosystems when it is a source of disturbance and pollutants, whether from sewage discharge or bilge cleaning, or from accidents and spills. Noise from motors and activity can disturb wildlife, particularly marine mammals and birds. Recreational use of marine parks, ecological zones, and other areas can also disturb wildlife and habitats. Marine vessel motors emit pollutants that contribute to regional and local air pollution in airsheds such as the lower Fraser Valley. As well, international shipping traffic increases the risk of introducing exotic and invasive species carried on ship hulls and in ballast water.

The following is a summary of an analysis of vessel movement patterns that was reported in the B.C. Coastal Environment 2006 report (BCMOE 2006a) (see *www.env.gov.bc.ca/soe/bcce/01_population_economic/marine_traffic.html*).

Figure 8: Marine traffic vessel density (per 25 km^2) along the coast of B.C. in 2003.



Source: Marine Communications and Traffic Service, Canadian Coast Guard.

An analysis of the average annual vessel movements for the different types of vessels found that passenger vessels (ferries and cruise ships) accounted for about 300,000 vessel movements per year or 56% of the total. Tugs towing or propelling barges accounted for more than 117,000 movements per year, or 29% of the marine traffic on the coast. Oil, gas, and chemical tankers accounted for around 4,000 vessel movements annually, or around 1% of traffic.

Victoria, Vancouver, and Juan de Fuca Strait VTS zones have the highest traffic volumes. In this area, with the province's highest population, high marine traffic volumes are one more of many stresses on marine ecosystems. This region is also critical habitat for the southern resident population of killer whales, which range through this area throughout the year, but especially during salmon migrations.

Three other shipping routes—the Inside Passage, Hecate Strait, and the west coasts of Vancouver Island and the Queen Charlotte Islands—have considerable activity, but are not as heavily used as the southern routes. With the expansion of the port at Prince Rupert, traffic volume along the north coast will continue to increase in future.

The impact of shipping, in terms of number and type of ships, can also vary seasonally on some routes. The Marine Communications and Traffic Service (MCTS) annual summary data show that overall shipping traffic is greater in summer than in winter and varies according to vessel type (P. O'Hara, UVic/CWS/DFO, pers. comm., 2005). The distribution of bulk carrier, cargo, and tanker traffic does not change much seasonally, but fishing vessel traffic is seasonal because it depends on fishery openings. Cruise ship traffic is also seasonal, with the heaviest traffic during the summer. Seasonality of marine traffic is important because of its potential impacts on wildlife seasonal habitats, such as nesting seabirds, migrating salmon, and coastal wintering birds.

Liquid and Solid Waste Management

4. Key Indicator: Level of municipal wastewater treatment in B.C.

Wastewater treatment is a response indicator. It shows the management response to wastewater (also referred to as sewage) disposal in B.C. Ideally, as more of the population is served by higher levels of wastewater treatment, there is potential reduction in environmental impact.

By volume, municipal sewage and combined sewer overflows are one of the largest point sources of pollution to Canadian waters. In addition to human waste, wastewater may also contain motor oil, paint thinner, antifreeze, pesticide residues, pharmaceuticals, solvents, heavy metals, and other pollutants. The release of untreated or inadequately treated wastewater may put people at risk if drinking water becomes contaminated with micro-organisms or toxic substances. People are also put at risk from consuming fish and shellfish from contaminated waters (see Indicator 5: Trends in shellfish closures).

The main sources of wastewater are households, industrial operations, commercial operations, and stormwater runoff. In Canada, it is estimated that 80% of marine pollution comes from terrestrial activities, including industrial and agricultural runoff (DFO 1997).

The purpose of wastewater treatment is primarily to protect human health and to reduce stress on the receiving environment. Before sewage is discharged to the environment, it is treated to remove some impurities and to reduce the biological oxygen demand (BOD) and total suspended solids (TSS). The level of treatment used by a municipality is an indicator of the amount of pollutants being discharged to the environment in sewage effluent. With each increase in the level of treatment, the BOD and TSS are further reduced.

This indicator shows the proportion of the municipal population with sewage treatment that is served by preliminary, primary, secondary, or tertiary wastewater treatment.

Methodology and Data

The 2004 data come from the Municipal Water and Wastewater Survey (MWWS; Environment Canada 2005a), formerly Canada's Municipal Water Use Database (MUD). Data for 1999 and previous years come from the MUD and the B.C. government's *Summary of Municipal Treatment Facilities* (BCMWLAP 2001).

Although the survey database underwent changes in 2004, when MWWS replaced the previous MUD surveys, the phrasing of key questions in the 2004 survey conformed as closely as possible to that of previous years so as not to obscure emerging trends. (For details on changes, see *www.ec.gc.ca/water/en/info/pubs/sss/e_mun2001.htm*.)

MWWS lists a host of water and sewage data for all municipalities that have a population of 1,000 or more. This includes the population served by preliminary, primary, secondary (includes ponds and lagoons), and tertiary treatment.

The treatment levels are defined as follows:

- **Preliminary:** Grit and solid material are screened out before the sewage is treated or released into the environment.
- **Primary:** Solids are separated from the liquids; floatable solids, oil, and grease are usually skimmed off the surface of the wastewater.
- **Secondary:** After primary treatment, further treatment may include biological treatment. It further reduces the amount of contaminants by fostering the consumption of organic material by organisms in the wastewater. Infiltration ponds and lagoons are included as secondary treatment.
- **Tertiary:** Further treatment to reduce TSS and BOD and remove specific contaminants. The particular technologies used depend on the characteristics of the sewage.

The data in MWWS are from a self-reporting survey, therefore the quality of the data depends on the accuracy of the respondents, their interpretation of the questions, the response rate of municipalities, and the number of municipalities surveyed. At times individual municipalities report their figures as estimated values or carry over figures from a previous year's report.

Earlier MUD surveys (1999 and previous years) included preliminary treatment with the primary treatment category. Because of the differences in impact on the receiving environment, it is important to separate preliminary treatment from primary treatment. Therefore, for 1999 and previous years, data for municipalities served by preliminary treatment were obtained from the *Summary of Municipal Treatment Facilities* (BCMWLAP 2001) or by contacting individual municipalities. Although a category for preliminary treatment was included in the 2004 MWWS, the population in the core of Victoria, which is served by preliminary treatment only, did not show up in this category.

The data in Table 6 and Figure 9 were derived by dividing the population served for each treatment type by the total population serviced by wastewater treatment and converting to percentages. The total population is an aggregation of all those served by preliminary, primary, secondary, and tertiary treatment for all of the listed municipalities.

Table 6. Population of B.C. served by each level of waste treatment facility.

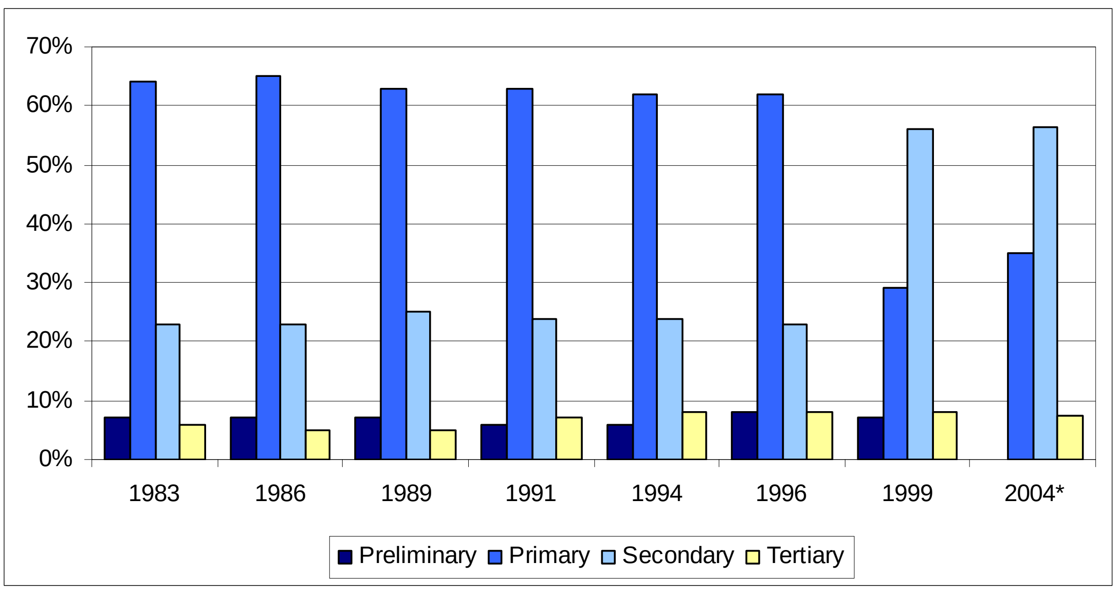
Year	Municipal population with treatment**	Proportion of municipal population with			
		Preliminary	Primary	Secondary	Tertiary
1983	1,990,863	7%	64%	23%	6%
1986	2,007,356	7%	65%	23%	5%
1989	2,264,064	7%	63%	25%	5%
1991	2,422,783	6%	63%	24%	7%
1994	2,626,018	6%	62%	24%	8%
1996	2,865,142	8%	62%	23%	8%
1999	2,986,973	7%	29%	56%	8%
2004*	3,059,509	0	35%	56.4%	7.5%

Sources: 2004 data, Environment Canada Municipal Wastewater and Water Survey 2005a; 1983–99 data, Environment Canada, Municipal Water Use Database (MUD), and BCMWLAP 2001.

* Although MWWS 2004 methodology was similar to previous surveys, it does not show a figure for population with preliminary treatment (as currently in place for the core of Victoria).

** Total population served by wastewater treatment facilities; remaining population (approximately 20%) has on-site sewer systems regulated under the Ministry of Health.

Figure 9. Proportion of the B.C. population served by each level of waste treatment (1983–1999 and 2004).



Sources: 2004 data, Environment Canada 2005a; 1983–99 data, Environment Canada, Municipal Water Use Database (MUD), and BCMWLAP 2001.

View graph data in excel.

Interpretation

This indicator was last reported in the previous Environmental Trends report (BCMWLAP 2002), citing 1999 data from the Environment Canada Municipal Water Use Database. In 1999, there was a large increase in the population with secondary treatment because the Annacis Island treatment plant was upgraded from primary to secondary treatment. Since that time, there has been little change, because there have been no major treatment plant upgrades or construction of new facilities. The slight differences between the reported 1999 and 2004 figures for secondary and tertiary treatment are not likely significant; in particular, the slight reduction in population with tertiary treatment over those two surveys likely does not reflect a real decrease in treatment level.

The proportion of population with higher levels of treatment is not expected to change until the core area of Victoria, which currently has preliminary treatment, is served by a treatment plant or until there are upgrades to other large treatment plants.

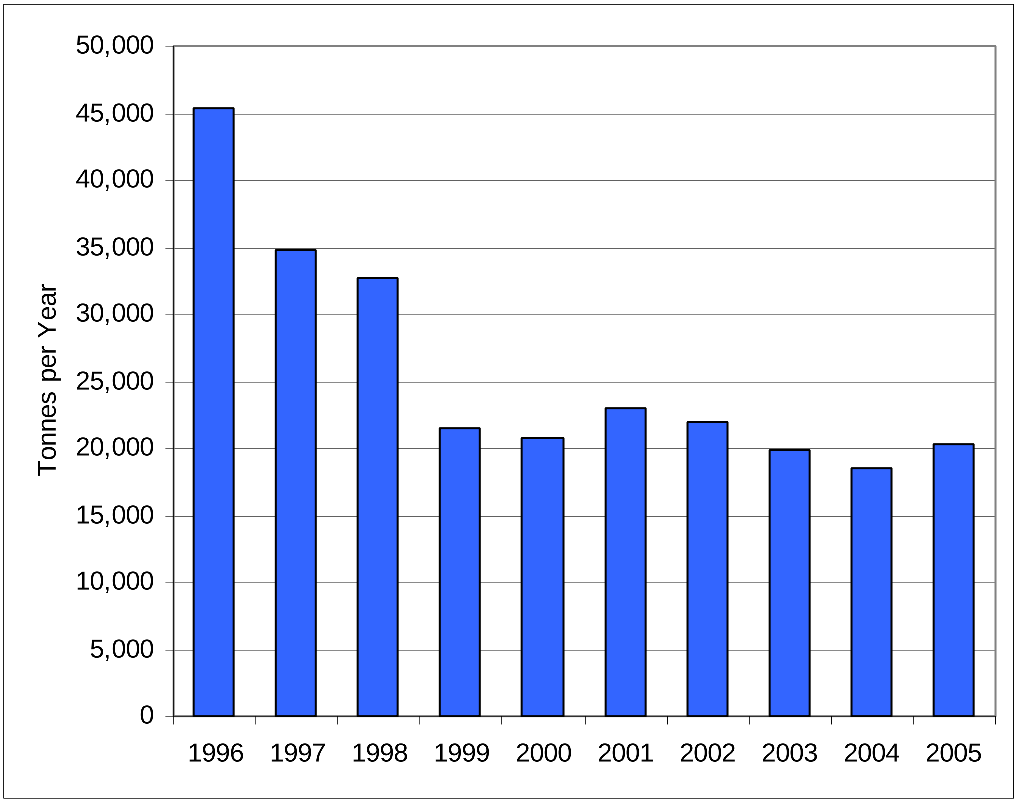
Supplementary Information: Reducing the impact of sewage discharge in Metro Vancouver

Metro Vancouver (formerly the GVRD) is serviced by five wastewater treatment plants that together treat an average of 1.2 billion litres of wastewater per day. About half of this volume receives primary treatment at the Iona and Lions Gate plants, which discharge to the marine environment. The remaining three plants (Annacis, Lulu, and Langley) provide secondary treatment and discharge to the Fraser River. Even though the population of the region has increased over the past 10 years, the total discharge of wastewater has remained fairly consistent at 1.2 billon litres per day. This is mostly explained by the separation of some of the combined sewer systems in Metro Vancouver during this period.

Biological oxygen demand (BOD) is a measure of how much oxygen is needed by micro-organisms to break down organic matter present in wastewater. It is an indicator of the effectiveness of the treatment process, with lower BOD indicating improving conditions. Figure 10 shows the trend in annual wastewater BOD from Metro Vancouver treatment plants.

The dramatic drop in BOD after 1996 was a result of the upgrade of the Annacis and Lulu plants from primary to secondary treatment. In addition to the decrease in BOD, the switch to secondary treatment was found to have significantly reduced the concentrations of copper, lead, manganese, zinc, chromium, oil and grease, and phenol in the effluent.

Figure 10. Trend in BOD from effluent discharge in Metro Vancouver (tonnes per year).



Source: GVRD 2006.

View graph data in excel.

5. Secondary Indicator: Trends in shellfish closures due to sewage contamination

This is an impact indicator. It addresses the question: What are the impacts of human activities on coastal ecosystems? The area of shellfish beds closed due to fecal contamination is used as a surrogate for the area of impact from sewage and other human sources.

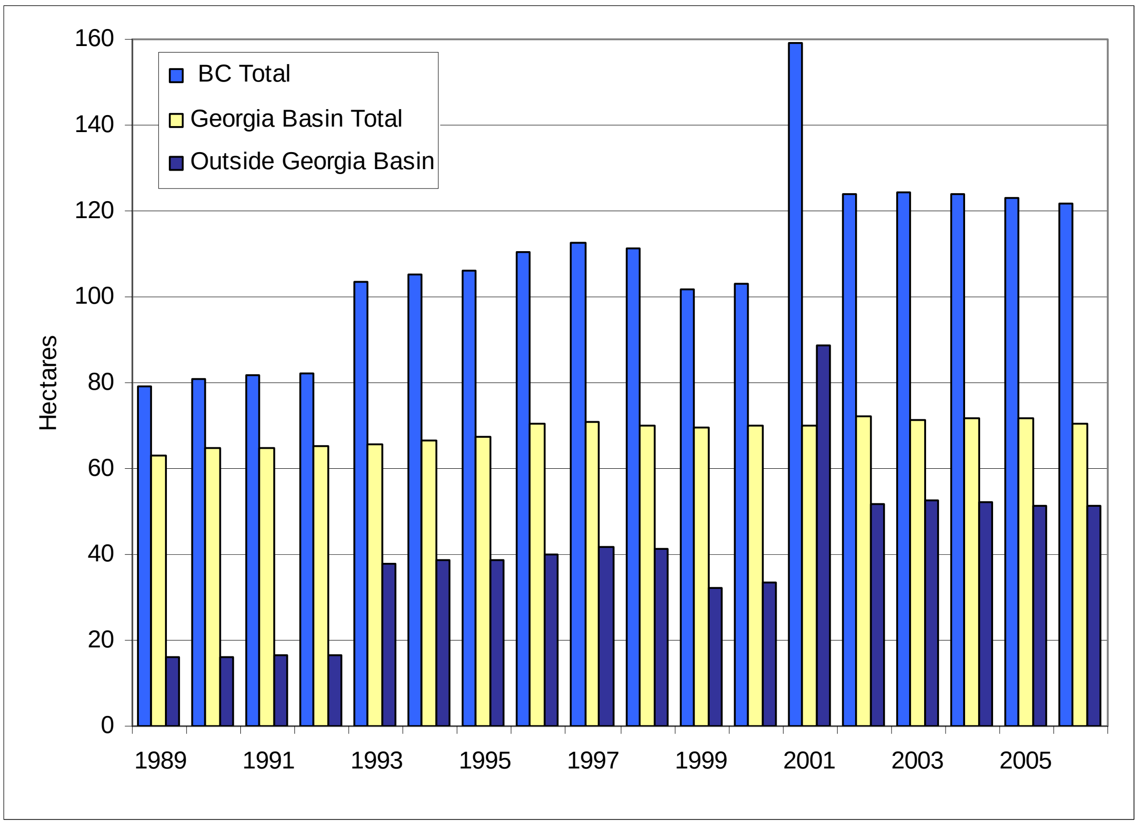
Fecal coliform bacteria indicate the presence of human or animal wastes and the possible presence of other disease-causing organisms. Areas of shellfish beds are closed when they are found to be contaminated with fecal coliform bacteria. Marine contamination from these bacteria comes from a variety of sources, including urban runoff, sewage discharge, and agricultural drainage. Sporadic outbreaks of contamination also come from wildlife sources.

This indicator was reported in detail in the B.C. Coastal Environment 2006 report (BCMOE 2006a) and is updated here (see: *www.env.gov.bc.ca/soe/bcce/01_population_economic/shellfish_closures.html*).

Methodology and Data

Data were obtained from Environment Canada, Ecosystem Information Section, and Fisheries and Oceans Canada. Environment Canada monitors the sanitary quality of shellfish-growing waters on the B.C. south coast, including 2600 ha of coastal waters used for shellfish aquaculture and about 750,000 ha used for wild shellfish harvesting. Areas are closed to harvesting if fecal coliform counts exceed specified standards. (Note that the data do not include closures for paralytic shellfish poisoning.)

Figure 11. Trends in the area (ha) of shellfish beds closed to harvesting in B.C., 1989–2006.



Source: Environment Canada 2005b.

View graph data in excel.

Interpretation

The increase in area of shellfish closures is primarily a result of increasing population and associated sewage discharges. Before 1976, less than 60,000 ha of shellfish growing area was under closure orders. The area increased to about 80,000 ha in 1990, and continues at about 121,000–124,000 ha since 2002.

Outside of the Georgia Basin, the shellfish harvest area under closure increased more than threefold from 1989 to 2004, partly a result of expanded monitoring programs, as well as growing development along shorelines (Environment Canada 2005b). The spike in 2001 reflects a 46,000-ha temporary seasonal closure in Clayoquot and Barkley sounds that is believed to have been caused by contamination from wildlife sources.

Georgia Basin locations represented 58% (72,000 ha) of the area closed to shellfish harvesting in 2004. The closure area within the Georgia Basin has remained stable partly because an extensive area was already closed, particularly in the Burrard Inlet, Fraser River estuary, and Boundary Bay areas. Remedial programs have removed only small areas from the sanitary closure restrictions.

In some locations (such as the Queen Charlotte Islands), new closures are a result of an increase in the extent of monitoring and assessment of shellfish areas. In other instances, reductions in area are due to water quality restoration initiatives and the reassessment of temporary closures.

Inadequate sewage treatment is only one cause of elevated levels of fecal coliform bacteria. Often multiple and complex sources are responsible, particularly in the lower Georgia Basin; sources include non-point sources such as poorly placed or maintained septic tanks outside of the sewered areas, agricultural and urban runoff, and discharge from marine vessels.

6. Key Indicator: Municipal solid waste disposed and recycled per person in regional districts in B.C.

The annual amount of solid waste disposed of per capita is a pressure indicator. The disposal of solid waste directly reflects consumption patterns by British Columbians and represents a lost opportunity to collect material resources that are being landfilled.

The materials entering our landfills consist of waste that is composed of organic, in-organic material, and toxic substances contained in products. The waste sent to landfill is a potential source of contamination for groundwater, soil, and air. Landfills also use large tracts of land, which are becoming difficult to accommodate in densely populated areas.

Disposal of solid waste in landfills indicates wasted resources and wasted energy embodied in the discarded material. For example, over-packaging results in energy and resources being spent on materials that are used briefly, then enter the waste stream. Many plastic goods also represent wasted energy and resources because recycling them really means “down-cycling” and just prolonging the life of plastic through one more product cycle before it is too degraded to re-use (i.e., Mcdonough and Braungart 2002).

In 2004, it was estimated that residential waste accounted for 35% of the municipal waste stream in B.C., with the rest coming from industrial, commercial, and institutional sources (Statistics Canada 2004). Programs to reduce the amount of disposed waste and increase recycled waste have been in place in the province for more than 15 years, longer in some areas. In 1989, the government of British Columbia adopted a goal established by the Canadian Council for Ministers of the Environment to cut municipal waste by 50% per capita by the year 2000 (compared to 1990 levels). At the same time the province introduced the requirement for regional districts to develop and submit Solid Waste Management Plans for approval.

Methodology and Data

In 1990, when the province established the requirement for regional districts to develop and implement Solid Waste Management Plans, it became important to track the waste being disposed and diverted for recycling.

Data for this indicator are from provincial waste tracking reports which, since 1996, have been prepared by the Recycling Council of British Columbia (RCBC) under contract to the Ministry of Environment. Reports are available at: *www.env.gov.bc.ca/epd/epdpa/mpp/reduction.htm*. The waste tracking reports do not include recycled data after 2000 because the material diverted through municipal recycling programs is not tracked consistently by local governments. The diversion of materials recycled through industry stewardship programs for paints, beverage containers, etc., is reported separately later in this report.

It is important to note that data submitted by regional districts vary in accuracy and completeness, depending on factors such as the availability of staff or weigh scales at disposal sites. Information is generally more accurate for urban areas than for rural areas, because the former are mostly served by larger and more sophisticated waste facilities that have weigh scales and tipping fees. In contrast, many rural facilities are not staffed and/or lack scales or tipping fees (RCBC 2007).

Of the 27 regional districts 25 supplied municipal solid waste disposal data for 2003 to 2005. Comox-Strathcona did not provide data and Okanagan-Similkameen provided partial data; their combined population is 4.4% of the provincial total. Data for these two districts were estimated by multiplying their 2003, 2004, and 2005 populations by the 2002 disposal rate. Provincial and regional district population figures were obtained from BC Stats (2006). Disposed and recycled municipal solid waste for 1990 and 1996–2005 is shown in Figures 12 and 13 and Table 7.

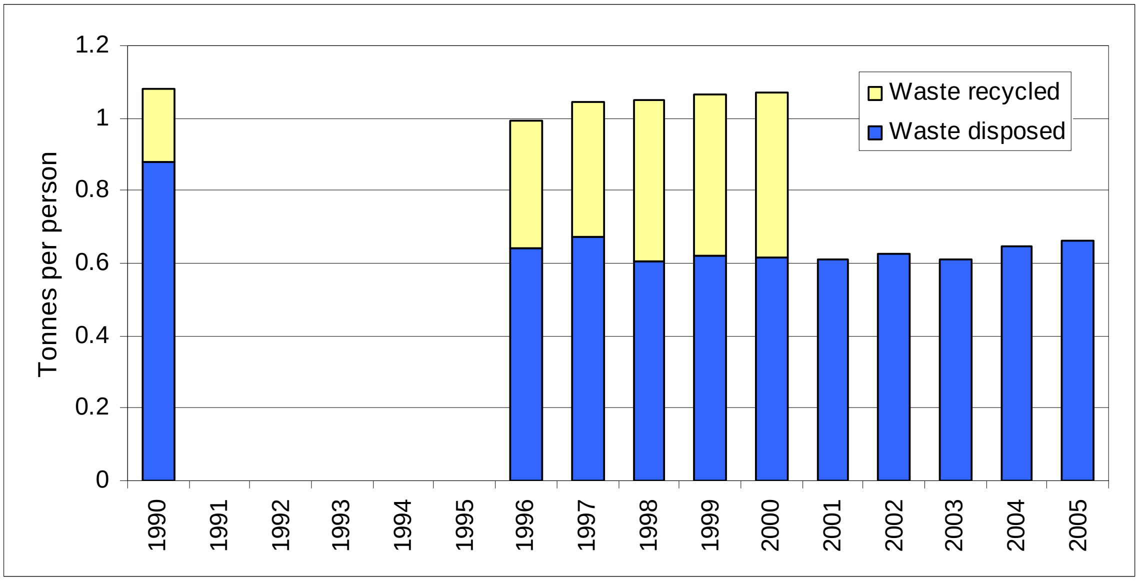
Table 7. Municipal solid waste disposed and recycled in B.C., 1990–2005.

		Municipal solid waste (tonnes)			
Year	Population	Total disposed to landfills & incinerators	Total recycled	Disposed per capita	Recycled per capita
1990	3,289,259	2,890,516	659,764	0.879	0.2005813
1996	3,880,593	2,448,741	1,363,721	0.641	0.3514208
1997	3,958,217	2,650,108	1,493,022	0.67	0.3771956
1998	3,996,030	2,423,524	1,771,813	0.606	0.4433933
1999	4,026,657	2,504,667	1,790,666	0.622	0.4447029
2000	4,062,270	2,509,112	1,837,381	0.618	0.452304
2001	4,101,579	2,509,088	*	0.612	*
2002	4,141,272	2,602,716	*	0.628	*
2003	4,154,591	2,529,251	*	0.609	*
2004	4,201,867	2,714,172	*	0.646	*
2005	4,254,522	2,822,067	*	0.663	*

Sources: Municipal solid waste data: RCBC 2004, 2007; population statistics: BC Stats 2006.

* Data for total waste recycled have not been collected by MOE from the regional districts since 2000.

Figure 12. Municipal solid waste (in tonnes) disposed and recycled per person in B.C., 1990–2005.

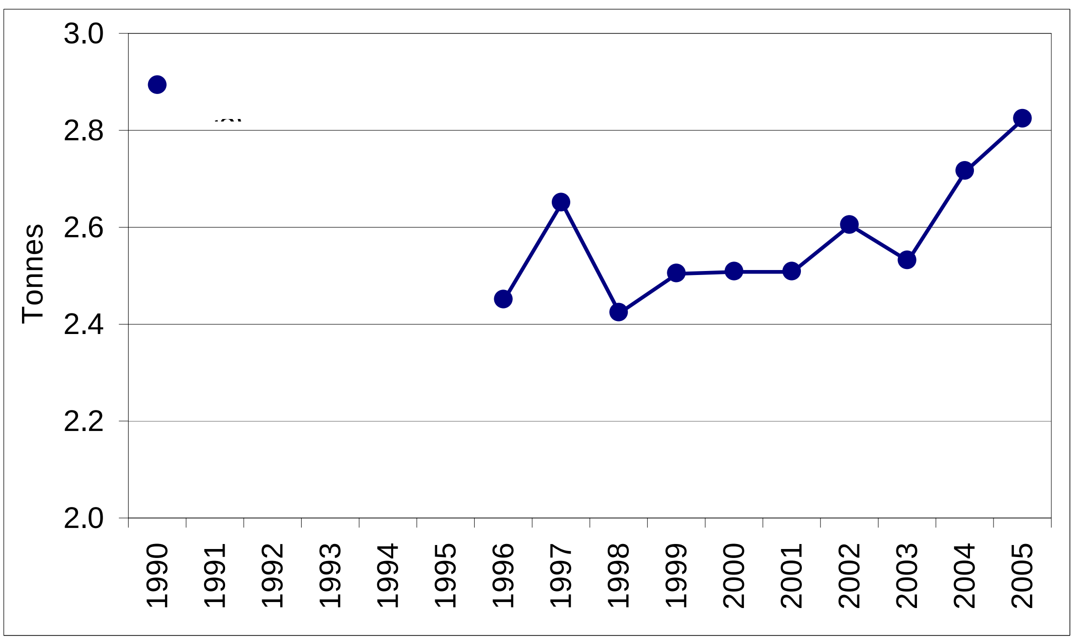


Sources: Municipal solid waste data, RCBC 2004 and RCBC 2007; population statistics, BC Stats 2006.

* Data for total waste recycled have not been collected by MOE from the regional districts since 2000.

View graph data in excel.

Figure 13. Total municipal solid waste (in tonnes) disposed (to landfills and incinerators) in B.C., 1990–2005.



Sources: RCBC 2004, 2007.

View graph data in excel.

This indicator is limited to one aspect of the waste stream: municipal waste. It does not address hazardous, biomedical, or other wastes that may be considered part of the larger waste stream.

Interpretation

In 2005, the overall provincial disposal rate was 0.663 tonnes per person, down from 0.879 tonnes per person in 1990. This is a 24.5% reduction in the per capita amount of municipal solid waste disposed between 1990 and 2005. Between 1990 and 2005, there was a slight drop (2.4%) in the amount of total waste disposed per year, from 2,890,516 tonnes to 2,822,067 tonnes. During that same period the provincial population increased by 29%. Waste reduction initiatives were successful in keeping the total amount of waste disposed of annually to essentially the same volume that it was in 1990, despite a substantial increase in population over the 15 years.

In recent years, however, the rate of municipal solid waste disposal has been increasing faster than the population increase, resulting in increasing amounts of waste disposed per person. Between 2003 and 2004, the B.C. population increased by only 1.1%, but there was a 7.3% increase in the total amount of waste disposed. Between 2004 and 2005, the population increased by 1.25%, but there was a 3.9% increase in the amount of waste that ended up in landfills and incinerators.

Supplementary Information: Municipal solid waste disposal per capita in regional districts in B.C.

Trends in municipal solid waste reduction vary widely between regional districts. Over the 15 years from 1990 to 2005 trends ranged from a 66% decrease in waste per person (Powell River) to an increase of more than 60% per person (Alberni-Clayoquot). Trends depend on municipal solid waste reduction initiatives undertaken by each regional district and on the capability of each regional district to track disposal. The disposal rate is generally a function of the waste reduction plans put in place by each regional district, as well as the recycling facilities and programs available to residents in that regional district.

Generally, regional districts in areas with higher population density are under the most pressure to reduce the per capita disposal rates of municipal solid waste. Areas with high populations generate a relatively large amount of solid waste per area, yet there is less land available to set aside as landfill for this waste. In these areas, regional districts generally have a longer history of actively pursuing recycling initiatives and education programs to reduce waste generation.

Table 8. Net change in regional district disposal rates per capita (tonnes of waste going to incinerators and landfills), 1990 to 2005.

Regional District	1990	2005	% change, 1990–2005	Rank
Powell River	0.66	0.23	–66.1	1
Squamish-Lillooet	1.20	0.55	–53.8	2
Fraser Valley	1.08	0.50	–53.7	3
Cowichan Valley	0.89	0.42	–53.4	4
Kootenay-Boundary	0.82	0.47	–42.5	5
Sunshine Coast	0.84	0.49	–41.3	6
Mount Waddington	0.87	0.53	–39.2	7
North Okanagan	0.98	0.65	–33.3	8
Central Coast	0.38	0.26	–32.8	9
Bulkley-Nechako	0.66	0.47	–29.2	10
Greater Vancouver*	1.03	0.73	–29.0	11
Comox-Strathcona	0.65	0.47	–28.7	12
Central Kootenay	0.68	0.49	–26.9	13
Kitimat-Stikine	0.65	0.48	–26.2	14
Capital (Victoria area)	0.60	0.45	–24.8	15
Okanagan-Similkameen	1.21	1.00	–17.0	16
Columbia-Shuswap	0.69	0.60	–12.1	17
Central Okanagan	0.55	0.49	–11.2	18
Northern Rockies	1.80	1.70	–5.8	19
Nanaimo	0.51	0.50	–3.5	20
Thompson-Nicola	0.66	0.69	+4.1	21
Cariboo	0.37	0.41	+8.6	22
Peace River	0.85	0.97	+13.5	23
Fraser-Fort George	0.65	0.81	+24.9	24
East Kootenay	0.63	0.87	+38.1	25
Alberni-Clayoquot	0.52	0.84	+61.0	26
Skeena-Queen Charlotte	0.74	no data**		

Sources: RCBC 2004, 2007; population statistics, BC Stats 2006.

* For their own comparisons, Metro Vancouver (GVRD) prefers to calculate total disposal reductions based on waste generation (rather than waste disposed) to reflect the higher amount of recycling that may

have been done in the regional district before 1990 than in other regional districts. That method shows a 48% reduction in the Metro Vancouver per capita disposal rate.

** Due to a substantial discrepancy between 2002 and 2003–2005 disposal data provided by Skeena-Queen Charlotte, figures were not reported to avoid under- or over-estimating disposal rate.

7. Secondary Indicator: Trends in waste diversion through industry-led product stewardship programs

This is a response indicator. It answers the questions: What is the result of product stewardship programs in B.C.? How much waste is successfully collected and diverted from landfills?

The history of product stewardship programs dates back to 1991 when B.C. started recycling programs for scrap tires and lead-acid batteries. Over the next several years, the province implemented a recycling program for used lubricating oil and established a network of collection depots for household hazardous waste. However, these early programs were government operated and consumer funded, with little industry involvement.

Industry-led product stewardship programs began in 1997, when two regulations were approved: (1) the Post-Consumer Residual Stewardship Program Regulation, requiring producers and consumers to manage leftover and waste flammable liquids, gasoline, domestic pesticides, and pharmaceuticals; and (2) the Beverage Container Stewardship Program Regulation, requiring brand-owners to collect ready-to-serve beverage containers (excluding milk and milk substitutes) with a deposit–refund system.

In 2004, after input from stakeholders, a streamlined Recycling Regulation was enacted to replace previous regulations and paved the way to expand industry product stewardship programs in B.C. The intent of the Regulation is to make regulated producers entirely responsible for managing the lifecycle of their products.

The province reviews the stewardship plans after satisfactory public consultation is complete. For approved plans the industry implements its program by collecting end-of-life products from the consumer at retail or through a depot system.

Internationally, product stewardship is commonly referred to as extended producer responsibility (EPR). The Organization for Economic Co-operation and Development has developed four goals for EPR:

- Reduce waste at the source to conserve natural resources and materials.
- Prevent waste.
- Design products to be more compatible with the environment.
- Promote sustainable development by closing materials-use loops.

EPR strategies have been implemented in many jurisdictions, including Canada. For more information on EPR see *www.ec.gc.ca/epr/ and www.env.gov.bc.ca/epd/epdpa/ips/*.

In British Columbia, there are currently eight stewardship programs that deal with collection and processing of products at the end of their useful life.

- Household paint, solvents, flammable liquids and gasoline, and pesticides. The Product Care Association, an industry-sponsored, not-for-profit association, operates collection depots across B.C. to collect leftover (residual) household paints, solvents, flammable liquids, gasoline, and pesticides. Paint is managed in one of three ways: reused by giving them to other consumers through the Paint Exchange program (4% of collected paint in 2005); recycled by reprocessing as paint or using it in concrete or cement manufacture (62% in 2005); or used for energy recovery by using the product as an alternative energy source in cement kilns and other operations (34% in 2005). In 2005, all solvents, flammable liquids, and gasoline were used for energy recovery, and all pesticides were incinerated in licensed facilities due to contamination (Product Care 2006). None of the collected products went to landfill facilities. Wherever possible, metal and plastic containers were recycled.
- Tree-marking paint. Tree-marking paint is used in the forest industry and by surveyors to identify trees, cutting boundaries, roads, and other surfaces. Ninety percent of this product category is tree-marking paint, but the category also includes "upside-down paint" (sometimes called survey paint), which is sprayed in an inverted position. Household paints are not included in this stewardship program. The program is run by the Tree-Marking-Paint Stewardship Association, a not-for-profit, industry-sponsored agency.

  Recovered tree-marking paint containers are processed either by the forest company itself or by the brand owner. Processing involves evacuating paint from cans and burning the residuals (estimated at 200 litres of residual paint for every 7000 empty containers) for energy recovery (2005 Annual Report; TSA 2006). Once the residual paint has been processed, the containers go to local community facilities for plastic and cardboard recycling, and cans are recycled for scrap metal.
- Used oil, oil filters, and oil containers. The British Columbia Used Oil Management Association (BCUOMA) manages a stewardship program to collect used oil, oil filters, and oil containers. The program is based on brand owners paying an Environmental Handling Fee to BCUOMA, which then subsidizes the transport of used oil, filters, and containers through Return Incentives (RIs). Recovery rates for 2006 were 70.7% of the oil available for collection (BCUOMA 2006 Annual Report). About half of the recovered oil is re-refined to restore its original lubricating characteristics, and the remainder is used as fuel in pulp mills and asphalt plants. Oil filters are shredded, centrifuged to recover oil, then washed and mixed with other plastics. The pelletized product is then sold for use in manufacturing new oil containers or other plastic products.
- Scrap tires. In 2006, a tire product category was added to the Recycling Regulation to transfer the government-operated Financial Incentives for Recycling Scrap Tires program to an industry stewardship program. On January 1, 2007, Tire Stewardship BC began managing B.C.'s scrap tire recycling program. Most of the collected scrap tires are either used as fuel in cement kilns (typically, less than one-third of the tires are used in this way), or converted into crumb rubber and then used to manufacture products such as sport floors and playground surfaces (TSBC, undated).
- Lead-acid batteries. In 1991, the B.C. Ministry of Environment began a battery collection program to provide incentives for industry to recover used lead-acid batteries. Transportation

incentives for registered collectors are based on the world market price of lead and the relative distance to processing, so that if world lead prices are high, as they are now, government incentives are low. The Ministry estimates that nearly 100% of all batteries are collected, and virtually all of the lead-acid batteries are recycled. Plastic casings are washed and pelletized for plastics recycling, sulphuric acid is neutralized and/or re-used in industrial processes, and the lead is smelted and refined for use in new lead-acid batteries (60%) or other lead products (BCMWLAP 2004).

- Beverage containers. When the provincial *Litter Act* came into effect in 1970, B.C. set up a deposit–refund system for soft drink and beer containers. In 1997, the province replaced the *Litter Act* with the Beverage Container Stewardship Program Regulation, because of the many other types of beverage containers contributing to litter and being sent to landfills. Under the regulation, all brand-owners of ready-to-drink beverages (except milk, milk substitutes, liquid-meal replacements, and infant formula) were obligated to take back empty containers with a deposit–refund system, and the containers had to be either refilled or recycled. The regulation set a goal of recovering 85% of sold containers (BCMOE 2005). The regulation was later repealed and, as of October 2004, beverage containers have been included in the Recycling Regulation, which set the recovery target for beverage containers at 75%.

  Three stewardship agencies are responsible for the different types of beverage containers: Encorp Pacific (Canada) collects non-alcoholic beverage containers (57% of containers sold in 2004), Brewers Distributors Ltd. collects refillable glass bottles and aluminium cans for domestic beer, ciders, and coolers (33% in 2004), and the Liquor Distribution Branch collects wine, spirit, and non-refillable beer, cider, and cooler containers (10% in 2004) (BCP 2005). The Liquor Branch is currently in the process of turning over its container collection to the other two agencies.

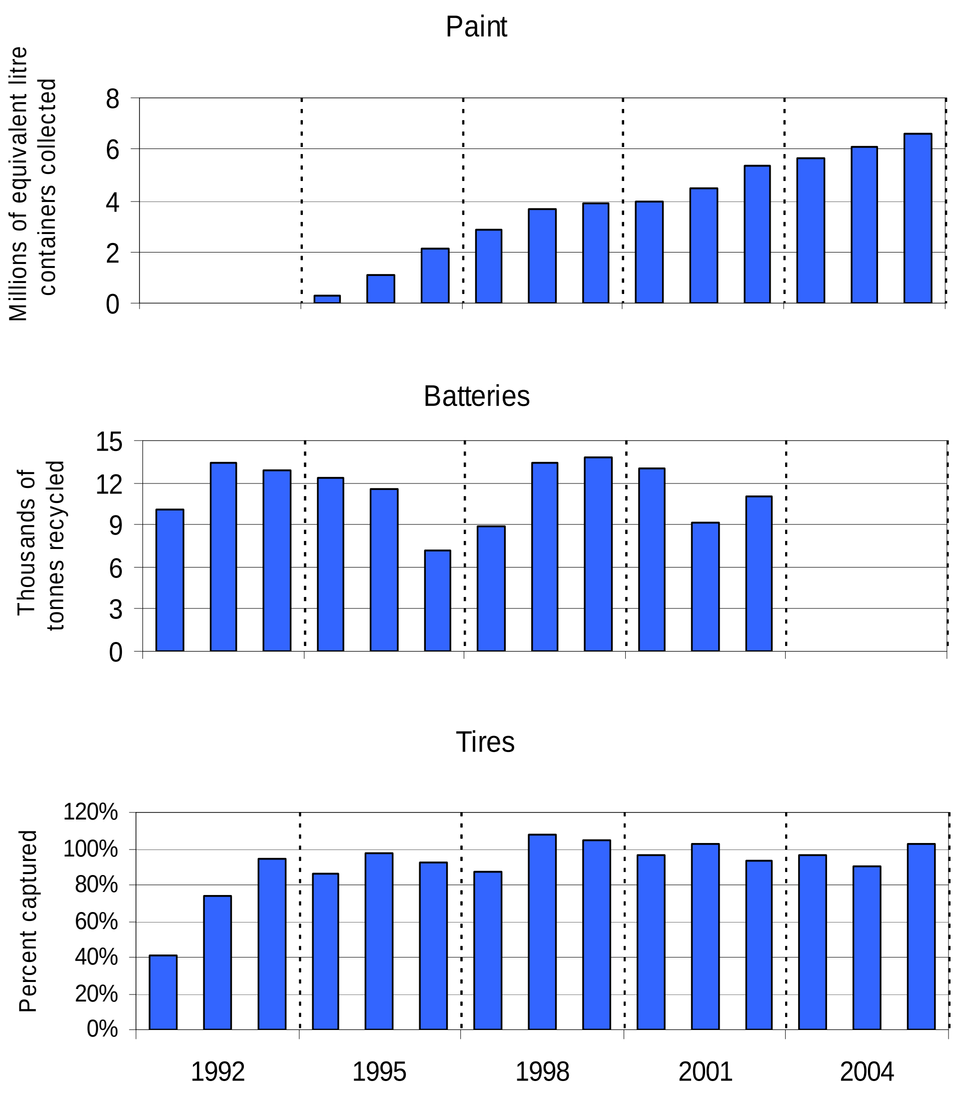
- Medications. Unused and expired medications are hazards both to human health and safety and to the environment if they are disposed of in landfills or in the sewer system. In an effort to prevent inappropriate disposal, the pharmaceutical industry voluntarily established a Medications Return Program in 1996, and in 1997, the province included the pharmaceutical industry in the Post-Consumer Residual Stewardship Program Regulation. Since October 2004, the industry has been regulated under the Recycling Regulation. The stewardship program allows consumers to return residual medications (including all prescription drugs, non-prescription medications, herbal products, mineral and vitamin supplements, and throat lozenges) to a pharmacy at no charge to the consumer. Most B.C. pharmacies participate in the program (PCPSA, undated). The medications are stored in a container at the pharmacy. When the container is full it is picked up and shipped to licensed incineration facility for safe destruction.

- Electronic products. The most recent addition to B.C.'s Recycling Regulation is for selected electronic products, including computer equipment and televisions. The Electronics Stewardship Association of British Columbia and Encorp Pacific will deliver the product stewardship program, which was initiated in August 2007 (for details see the Electronics links at *www.recycling.gov.bc.ca*). New computer equipment and televisions sold in the province will be subject to an environmental handling fee, which will pay for the cost of the program. The collected electronic products will be processed to recover raw materials, including lead, mercury, cadmium, copper, gold, glass, and plastics.

Methodology and Data

Data for seven B.C. product stewardship programs (excluding the recently launched electronic products program) were extracted from the Product Stewardship Agency reports, most of which are available under product or stewardship agency links on the Ministry of Environment's website (*www.recycling.gov.bc.ca*). Specific methodology is presented separately for each program, along with collection and recycling data (Figure 14 and Tables 9 to 15).

Figure 14. Trends in product recycling from key industry stewardship programs (paint, lead-acid batteries, tires) in B.C. (Note different quantities on *y*-axis.)



Source: See Tables 7 to 9 for sources of data for each type of product shown in this overview.

Note: The 1991 year for tires was for 9 months of records; some years tire recovery was more than 100% of tires sold because previously stockpiled tires were recycled.

View graph data in excel.

Household paint, flammable liquids and gasoline, and pesticides. Paint collection began in 1994, and the number of containers (measured as the equivalent number of one-litre containers, or elc) has increased steadily, reaching 6.6 million elc in 2005 (Table 9). Note that this figure does not indicate the volume of paint collected, only the volume of containers collected.

Collection of solvents, flammable liquids, gasoline, and pesticides began in 1998. For flammable liquids and gasoline, collection has fluctuated between 71,023 and 147,688 elc, with a steady increase since 2000. For pesticides, collection has fluctuated between 16,334 and 31,968 elc, peaking in 2004.

Data on volume of product sold versus volume of product recovered are available only for 2005. In that year, 6.2% (by volume) of paint sold was recovered; 1% of flammables sold was recovered (recovered flammables included both flammable liquids and gasoline, but flammables sold did not include gasoline); and 6.1% of pesticides sold was recovered (Product Care Association 2006).

Table 9. Equivalent litre containers (elc) of household paint, flammable liquids and gasoline, and pesticides recovered.

Year	Paint collected (elc)*	Flammables collected (elc)	Pesticides collected (elc)
1994	284,000	–	–
1995	1,099,000	–	–
1996	2,111,000	–	–
1997	2,889,000	–	–
1998	3,702,000	98,928	30,850
1999	3,900,000	105,065	22,464
2000	4,000,000	71,023	16,334
2001	4,500,000	87,696	19,008
2002	5,386,993	93,170	25,056
2003	5,683,337	121,746	31,536
2004	6,120,203	139,141	31,968
2005	6,604,252	147,688	28,512

Source: Product Care Association annual reports: *www.productcare.org/BCpublications.html*.

* elc = equivalent litre container. This is a measure of the original container capacity, not the volume of contents recovered.

Tree-marking paint. Data for tree-marking paint products sold and then recovered for processing are available for 2001 to 2005. They show that 35–41% of containers sold were recovered and processed each year (Table 10). The percentage increased for the first 4 years of reporting and declined in 2005 because fewer containers were processed at one processing location on Vancouver Island (TSA 2006).

Table 10. Number of containers of tree-marking paint sold and processed.

Year	Containers sold	Containers processed	% processed
2001	481,305	170,618	35
2002	440,375	173,517	39
2003	378,066	156,111	41
2004	381,109	156,017	41
2005	418,955	146,751	35

Source: TSA 2006.

Used oil, oil filters, and oil containers. The British Columbia Used Oil Management Association (BCUOMA) reports the amount of used oil, filters, and containers collected, as well as the percentage that were recovered. In 2005 and 2006, more than 47 million litres of used oil, nearly 5 million used filters, and 1.2 million kilograms of used containers were collected (Table 11). This represents approximately 70% of the oil sold (total sales minus the amount consumed in use, which is estimated at 30.1% of the volume; Spence 2005), approximately 80% of the filters sold, and 51–57% of the containers sold. The BCUOMA does not report the amount or percentages of collected products that are subsequently recycled.

Table 11. Used oil, oil filters, and oil containers collected.

	Oil collected		Oil filters collected		Oil containers collected	
Year	(litres)	(%)[a]	(number)	(%)[b]	(kg)	(%)[b]
2003[c]	17,084,490	60	1,750,521	18	264,871	12
2004	44,119,202	72	4,721,232	82	1,055,969	42
2005	47,740,794	73	4,925,339	81	1,241,032	51
2006	47,554,996	71	4,729,007	77	1,254,001	57

[a] % litres sold minus litres consumed during use (estimated at 30.1%).

[b] % number or kg sold.

[c] 6 months.

Source: BCUOMA 2006 report (*www.usedoilrecycling.com/uploads/2006BCUOMAAnnualReport.pdf*); previous years available from B.C. Ministry of Environment internal data.

Scrap tires. Under the FIRST program, the number of scrap tires collected increased steadily from 1991–92 to 2005–06. Over the past 8 years, at least 90% of the collected tires have been converted to end-use products or fuel (Table 12). In some years, the percentage of converted tires exceeded 100% because processors recycled tires stockpiled from previous years.

Table 12. Scrap tires collected and converted to end-use products.

Year	Scrap tires collected (tonnes)	Scrap tires converted to end-use products and fuel (tonnes)	Tires converted as % of collected *
1991–92	11,134	4,526	41
1992–93	17,059	12,546	74
1993–94	20,683	19,590	95
1994–95	22,353	19,353	87
1995–96	20,952	20,442	98
1996–97	26,584	24,673	93
1997–98	25,338	22,107	87
1998–99	25,016	27,041	108
1999–00	27,257	28,598	105
2000–01	28,074	27,047	96
2001–02	27,953	28,660	103
2002–03	28,881	26,867	93
2003–04	29,387	28,346	97
2004–05	31,618	28,679	91
2005–06	31,836	32,573	102

Source: Annual Performance Statistics, Min of Environment, FIRST Program, Update to Feb 2006.

* Percentages exceed 100% in some years when processors converted tires stockpiled from previous years.

Lead-acid batteries. Data are available from the beginning of the B.C. Lead-Acid Battery Collection Program in 1991 to the end of the 2002–03 fiscal year. They show that between 7,000 and nearly 14,000 tonnes of batteries are recycled each year (Table 13). The peak was in 1999–2000, when 13,744 tonnes of batteries were recycled.

The program aims to recover at least 98% of all used lead-acid batteries in BC annually (BCMWLAP 2004). Although the Ministry of Environment Hazardous Waste manifest system tracks lead-acid battery shipments weighing over 1000 kg, data are not collected on battery sales, so it is not possible to determine the actual percentage of recovery. BCMWLAP (2004) estimated that nearly 100% of batteries are recovered when market conditions are ideal. For example, lead prices are currently high enough to provide market incentives to collect batteries and process them to extract the lead for re-use. The fact that municipalities and regional districts are not detecting inappropriate disposal of batteries in land-fills supports the assumption that there is a high level of recovery. The federal government closely monitors the risk of illegal export to Asian markets.

Table 13. Lead-acid batteries recycled.

Year	Batteries recycled (tonnes)
1991–92*	10,137
1992–93	13,406
1993–94	12,850
1994–95	12,398
1995–96	11,502
1996–97	7,168
1997–98	8,950
1998–99	13,382
1999–00	13,744
2000–01	12,943
2001–02	9,188
2002–03	10,953

Source: MWLAP 2004.

* 10 months

Beverage containers. In this indicator, the data from the three industry stewards (Encorp Pacific, Liquor Distribution Branch, and Brewers Distributors Ltd.) have been amalgamated; comparable data from all three have been available only since 1998. From 2001 to 2005, the number of containers sold increased from 1.5 million to 1.8 million, and 81 to 84% of these containers were recovered each year (Table 14). The decrease in 2004 from the previous year's recovery rate is attributed to several factors, including difficulties in finding additional depot sites in Vancouver because of zoning issues; increased sales of bottled water in <1-litre containers, which are sold and distributed in different ways than juices and soft drinks; and growth in the number of private liquor stores whose large start-up inventories are counted as sales even though they have not yet been sold to the public (BCP 2005).

Table 14. Beverage containers* sold and recovered in B.C. (includes wine, spirits, beer, cider, coolers, and non-alcoholic beverage containers)**.**

Year*	Number sold	Number recovered	% recovered
2001	1,545,837,587	1,252,168,334	81
2002	1,602,339,106	1,341,842,780	84
2003	1,688,947,095	1,415,077,851	84
2004	1,771,286,403	1,440,601,233	81
2005	1,824,050,525	1,476,102,022	81

Source: Beverage Container Stewardship Program annual reports.

*Encorp Pacific (Canada) reports by calendar year (1 Jan.–31 Dec.), but Liquor Distribution Branch and Brewers Distributors Ltd. report year as 1 April–31 March, thus, for example in 2001, their data are for 2001–02.

Medications. The amount of pharmaceuticals collected by pharmacies has increased since the program began in 1996. There have been fluctuations over the years as reporting periods changed and when a new container system was implemented in 2002. In 2005, more than 18,000 kg of medications were collected (Table 15). This weight includes the packaging of liquid medications and non-liquid medications (unless plastic recycling services are available in the participating pharmacy's community). The number of participating pharmacies has increased from about 650 at the beginning of the program to more than 850 in 2007. Although final numbers are not available, the Post-Consumer Pharmaceutical Stewardship Association reports that the number of collected containers and weight of medications was higher in 2006 than in 2005, and they expect further growth by as much as 25% in 2007 (PCPSA 2007).

Table 15. Residual medications collected and the number of participating pharmacies in B.C.

Year	Medications collected (kg)	Number of pharmacies
1996-98[a]	6,703	–
1998-99[b]	10,105	643
1999-00[b]	11,479	650
2000[c]	4,490	550
2001	10,500	680
2002[d]	18,881	719
2003[d]	10,094	734
2004	15,503	802
2005	18,012	845

Source: Medications Return Program Annual Reports, 1998–2005.

[a] = 18 months reporting period.

[b] = 12 months.

[c] = 9 months.

[d] Due to change to UN-approved collection containers, medications that would normally have been reported for 2003 were included in 2002 results.

Interpretation

The seven established product stewardship programs in B.C. have a variety of data collection and reporting formats, making it difficult to assess the success of some programs and to compare results. If there is no tracking of total sales of a product or another similar measure, it is not possible to determine the significance of the number, volume, or weight of recovered and/or recycled product. In addition, few of the industry stewardship programs report targets for the amount or percentage of end-of-life product they aim to recover. Nevertheless, the data in this indicator suggest that a large volume of hazardous and non-biodegradable products are diverted from landfills in B.C. each year.

Despite the reporting challenges, British Columbia has been a leader in many of the industry stewardship programs that are currently in place in the province. For example, in 1970, B.C. was the first jurisdiction in North America to introduce a mandatory deposit–refund system for beverage containers, and the Lead-Acid Battery Program introduced in 1991 was the first of its type in Canada (BCMOE 2006b). New product categories continue to be considered for addition to the group of programs already underway.

At the national level, the Canadian Council of Ministers of the Environment (CCME) has an active task group examining issues of extended producer responsibility. The group's mandate is to guide extended producer responsibility and product stewardship programs. Its first priority is to work on designing packaging that takes environmental impact into account (Marbeck Resource Consultants 2007).

Economy and the Environment

8. Key Indicator: Intensity of conventional energy use in economic activity in B.C.

Economic activity uses energy and all energy production, transmission, and use has some type of environmental impact. For example, burning fossil fuels emits air pollutants and greenhouse gases; large hydroelectric dams flood large areas of land.

This is a pressure indicator. It shows how much energy from conventional sources is consumed per unit of the province's gross domestic product (GDP). The GDP is a measure of the total value of goods and services produced by the province's economy.

Conventional energy sources include all of the sources for which data are available, including fossil fuels and large hydroelectric facilities. Ideally, all types of energy resources should be accounted for in an energy intensity indicator. However, limited data are available on biomass energy sources, small-scale hydroelectric, and other small or "alternative" energy sources.

Improvements in energy efficiency and a move toward greater use of solar or wind energy would cause energy intensity to decrease. This equates to lower environmental impact per unit of economic activity (GDP).

Methodology and Data

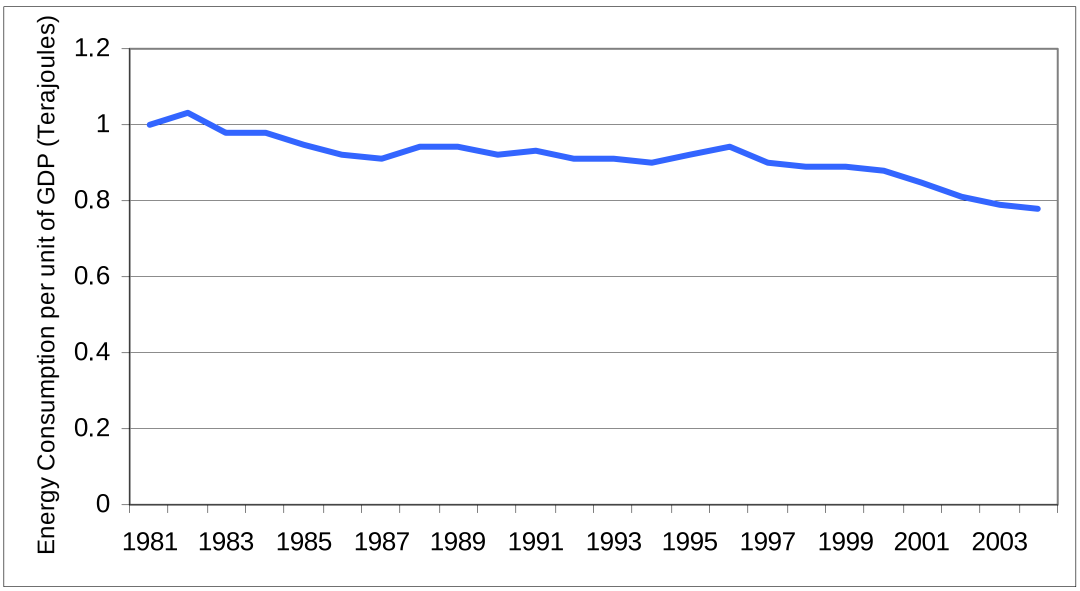
Energy intensity is calculated as a ratio of economy-wide conventional energy consumption (in terajoules) to the GDP. The GDP values were obtained from BC Stats (2007a) and are measured in constant dollars (i.e., GDP values are adjusted for inflation using 1997 as the base year), which allows different years to be compared.

The data are presented both as a ratio of terajoules per dollar of GDP and as an index to make the percentage change in energy intensity for each year readily apparent (Table 16, Figure 15). The index for each year was calculated by dividing the energy consumption to GDP ratio for that year by the energy consumption to GDP ratio for 1981 (the base year for the index).

For this indicator, conventional energy consumption includes the consumption of petroleum, natural gas, coal, and coke, and hydroelectricity. It includes energy used by final consumers for residential, agricultural, commercial, industrial, and transportation purposes, as well as energy used in transforming one energy form to another (e.g., coal burning to produce electricity), and energy used by suppliers in providing energy to the market (e.g., pipeline fuel) (NRC 2006).

Results for years before 2000 in the current report are not exactly as reported in the previous Environmental Trends (BCMWLAP 2002). GDP numbers have changed because they are now based on a 1997 base year, rather than a base year of 1992, as in previous reporting. Also, as new information is obtained each year there may be changes in definitions, industry coverage (e.g., steam was not included in 2002), and methodology. Historical time series data is updated to reflect current methods and make it possible to compare past and present results.

Figure 15. Consumption of conventional energy in B.C. per unit of Gross Domestic Product (GDP).



Sources: Energy data, Statistics Canada; GDP data, BC Stats 2007.

Table 16. Consumption of energy in B.C. from conventional[a] sources and intensity of use from conventional sources.

Year	Energy consumption from each source (in terajoules): Coal and coke	Natural gas	Primary electricity hydro	Steam[b]	Petroleum products	Total [c]	GDP (millions of 1997 constant dollars)	Total energy consumption (terajoules/GDP[d])	Intensity of energy use (index = 1.00 in 1981)
1981	4,753	165,796	140,079	0	360,898	671,526	79,745	8.4	1.00
1982	2,909	178,231	142,064	0	323,603	646,807	74,877	8.6	1.03
1983	3,267	186,029	148,576	0	284,007	621,879	75,349	8.2	0.98
1984	3,549	190,670	151,755	0	279,295	625,269	75,930	8.2	0.98
1985	3,332	207,001	161,100	13	275,126	646,572	81,203	8.0	0.95
1986	6,253	187,204	162,785	0	275,899	632,141	81,355	7.8	0.92
1987	3,821	205,335	167,239	0	289,055	665,450	86,373	7.7	0.91
1988	4,686	225,968	178,195	0	310,921	719,770	91,395	7.9	0.94
1989	4,795	237,551	181,029	0	325,890	749,265	94,400	7.9	0.94
1990	4,104	229,775	188,313	0	318,699	740,891	95,722	7.7	0.92
1991	5,164	237.464	189,829	0	315,719	748,176	95,897	7.8	0.93
1992	7,761	241,132	192,056	0	312,920	753,869	98,373	7.7	0.91
1993	7,684	264,011	198,842	0	316,797	787,334	102,770	7.7	0.91
1994	7,919	269,252	197,814	59	324,437	799,481	105,669	7.6	0.90
1995	8,135	282,558	205,864	15	343,761	840,333	108,194	7.8	0.92
1996	7,930	308,381	207,558	17	357,214	881,100	110,857	7.9	0.94
1997	6,793	290,097	203,071	9	370,072	870,042	114,383	7.6	0.90
1998	5,635	281,971	207,124	0	372,447	867,177	115,883	7.5	0.89
1999	6,740	288,553	212,330	2,816	384,043	894,482	119,604	7.5	0.89
2000	9,384	307,298	219,385	2,865	387,340	926,272	125,145	7.4	0.88
2001 [e]	10,080	293,859	211,549	2,680	381,986	900,154	125,924	7.1	0.85
2002 [e]	10,776	280,420	212,953	201	381,516	885,866	130,445	6.8	0.81
2003	11,473	266,982	214,635	297	394,262	887,649	134,131	6.6	0.79
2004	14,263	265,047	222,096	2,031	416,615	920,052	140,263	6.6	0.78

Sources: Energy data, Statistics Canada (CANSIM - Canadian Socio-economic Information Database); GDP data, BC Stats 2007.

[a] Conventional energy sources include fossil fuels and hydroelectric sources.

[b] Known steam sales of large producers only.

[c] Discrepancies between row totals and total shown in this column are due to rounding.

[d] Conventional energy intensity is calculated as the ratio of total conventional energy consumption to GDP.

[e] Energy consumption data for 2001 and 2002 was incomplete, as it was suppressed to meet the confidentiality requirements of the *Statistics Act*. Gaps were filled by extrapolating the information.

Interpretation

During the nearly 25 years for which this indicator has been calculated, energy intensity has decreased steadily although total energy consumption has continually increased (Figure 15). Reductions in energy intensity are due to a combination of factors, including a shift in the structure of the economy toward less energy-intensive sectors (e.g., knowledge-based, service, tourism), increased energy efficiency of existing activities, and a larger amount of energy consumption from alternative energy sources.

A concern regarding the reliability of this indicator is that some factors have the potential to change energy intensity estimates even when there has been no change in the amount of energy consumed to produce goods and services. For example, energy consumption is affected by weather conditions; therefore, with all other factors constant, changes in weather conditions alone could affect economy-wide energy intensity estimates, even though there has been no change in the production of goods and services. Another factor would be the production of non-market goods and services that are not included in the GDP. Since the energy consumed to produce them is included in the energy consumption estimate, the calculations could somewhat overestimate the energy intensity.

Energy intensity calculations are more reliable when they are done at a sectoral level, rather than at the economy-wide level, because it is easier to account for factors that affect energy intensity estimates. This results in a more accurate link between the estimates of sectoral energy consumption and the value of goods and services produced using that energy and makes it possible to draw more meaningful conclusions about energy use in the sector. Using the transportation sector as an example, energy intensity would change due to factors such as variations in the proportions of vehicle types in use, energy efficiency of the vehicles, and energy sources.

9. Secondary Indicator: Trends in greenhouse gas intensity in B.C.

Greenhouse gas intensity is the ratio of greenhouse gas (GHG) emissions to economic output (measured as Gross Domestic Product or GDP). The GDP is the total dollar value of all goods and services made and purchased within one year by individuals and households, government, and businesses.

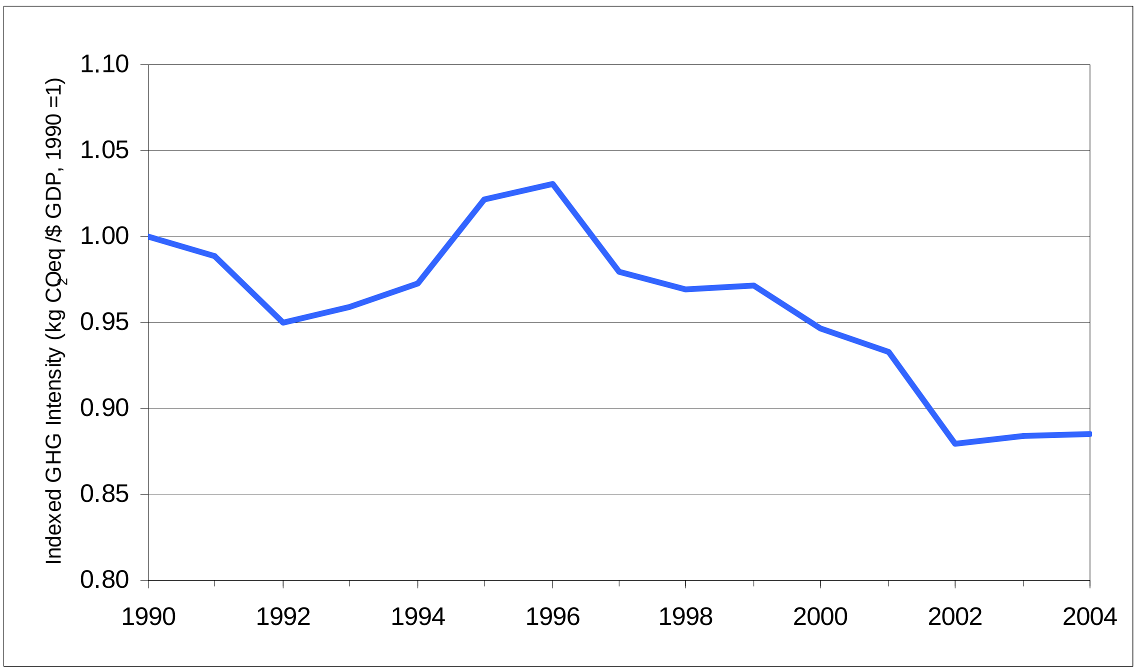
As long as economic output is constant or increasing, GHG intensity decreases with increases in efficiency and use of renewable energy. Factors that decrease (thus improve) greenhouse gas intensity include:

- Technological changes that improve the overall energy efficiency of processes.
- Increased use of renewable energy, such as wind power, solar energy, and hydroelectric or other water-power sources.
- Substitution of natural gas for coal and oil as an energy source.
- Use of fuels with a higher biofuel content, such as ethanol.

Methodology and Data

Greenhouse gas intensity (Figure 16 and Table 17) is calculated by dividing the amount of greenhouse gases produced in tonnes (Environment Canada 2006) by the GDP (BC Stats 2007; dollar values converted to 1997 equivalents so years could be compared). Greenhouse gas intensity calculations include all greenhouse gases, which are converted into CO_2 equivalents (CO_2e). In Canada in 2004, carbon dioxide contributed the largest share of greenhouse gas emissions at 78%, methane accounted for 15%, nitrous oxide accounted for 6%, and miscellaneous other gases contributed the remaining 1% (Environment Canada 2006).

Figure 16. Trends in greenhouse gas intensity in B.C., 1990–2004, as the ratio of greenhouse gas (GHG) emissions to gross domestic product (GDP) relative to a 1990 baseline.



Sources: GHG data, Environment Canada 2006; GDP, BC Stats 2007.

Table 17. Trends in greenhouse gas intensity in B.C., 1990–2004, shown as the ratio of greenhouse gas (GHG) emissions to gross domestic product (GDP).

Year	GHG (thousand tonnes of CO_2e)	GDP (chained $1997 million)	GHG intensity (tonnes CO_2e per $ of 1997)	GHG intensity (kg CO_2e per $ of 1997)
1990	51500	95,722	0.00054	0.54
1991	51000	95,897	0.00053	0.53
1992	50300	98,373	0.00051	0.51
1993	53000	102,770	0.00052	0.52
1994	55300	105,669	0.00052	0.52
1995	59500	108,194	0.00055	0.55
1996	61500	110,857	0.00055	0.55
1997	60300	114,383	0.00053	0.53
1998	60400	115,883	0.00052	0.52
1999	62500	119,604	0.00052	0.52
2000	63700	125,145	0.00051	0.51
2001	63200	125,924	0.00050	0.50
2002	61700	130,445	0.00047	0.47`
2003	63800	134,131	0.00048	0.48
2004	66800	140,263	0.00048	0.48

Sources: GHG data, Environment Canada 2006; GDP, BC Stats 2007.

For Canada, from 1990 to 2004, GHG emissions per unit of GDP decreased by 13.8% while the total GHG emissions rose by approximately 27%. The rate of GHG emissions rose faster than the population (which grew by 15%) during the 14-year period and was about equal to the increase in energy use. Because the growth in total emissions was less than the 47% growth in GDP between 1990 and 2004, GHG intensity decreased by about 14% over the period (Environment Canada 2006).

Interpretation

Intensity-based targets for GHGs means that the environmental impact is calculated relative to the economic output of the country. Being able to produce lower emissions per barrel of oil accomplishes a target of decreasing greenhouse gas intensity, even though a growing economy may mean that more barrels of oil are used. Intensity targets are more palatable for the most affected industries, because it allows economic growth to continue. However, because intensity targets are tied to economic growth, total greenhouse gas emissions can continue to rise as long as they decrease relative to economic growth.

Calculating GHG intensity can be quite complex. A recent study found that for many Canadian manufacturing sectors, trade with the United States increased their greenhouse gas intensity

(Norman et al. 2007). This is because resource and manufacturing sectors in the US are more energy- and GHG-intensive than in Canada, due to a greater reliance in the US on fossil fuels and on electricity generated by fossil fuels.

Supplementary Information: Economic value versus environmental value

Currently, the Gross Domestic Product (GDP), which estimates the value of goods and services exchanged in the marketplace, is a widely used, primary measure of economic activity. The GDP is also widely used as a proxy measure of economic health, of human well-being or of social progress. As the GDP was not intended for this use, it can be both inadequate and misleading when used for these purposes. For example, expenditures as a result of crime, natural disasters, or environmental pollution are counted in the GDP, so a local economy can appear to benefit from polluting activities and clean-up costs. Furthermore, the GDP does not include non-monetary values or ways of measuring environmental condition, so it ignores the depletion or degradation of natural resources. It also does not value the non-market economy of households, communities, and volunteer work.

Worldwide, governments have begun to recognize the importance of including a valuation of natural or environmental capital in measures of national economic welfare. Natural capital is the stock of renewable and nonrenewable natural resources, including water, soil, air, living organisms, minerals, and other environmental assets. These provide “ecosystem services” such as water purification, waste treatment, nutrient cycling, oxygen production, climate regulation, flood protection, erosion control, soil formation, and aesthetic enjoyment (MEA 2005). Although ecosystem services support life on the planet, their value is poorly understood and traditionally ignored in decision-making processes that use the economic value of a good or service as the basis for comparisons (Emerton and Bos 2004).

Since the 1990s, the concept of a “green GDP” that adjusts the traditional GDP measure to take into account environmental costs and the value of ecosystem goods and services has attracted the interest of governments around the world (Perman et al., 2003). Economists have developed a variety of methods for measuring the contribution of ecosystem services to the economy and have been exploring how to integrate these values into the systems of national accounts. The “green GDP” concept also has been taken up by businesses that see bottom-line benefits to behaving in socially and environmentally responsible ways. Corporate social responsibility (CSR) has become attractive as a concept and is backed up by ranking systems that judge companies on such criteria as human rights, environmental impacts, and contributions to the well-being of community and society (e.g., see in Canada, Brearton et al. 2005).

It is exceedingly difficult to measure the benefits provided by the environment and there is no consensus on how to calculate such a “green GDP” or whether it should be attempted at all (UN European Commission et al. 2003). Several frameworks for measuring economic well-being and sustainability have been developed over the past 30 years. Although each approach has strengths, there is no agreement on a single model that combines measures of economic well-being (in monetary terms) and quality of life indicators (in non-monetary terms).

Numerous attempts have been made to value the benefits to the financial economy and to human health and well-being from ecosystem services. Among the more prominent of these efforts are:

- **Environment and Sustainable Development Indicators (ESDI) Initiative.** In 2000, the National Roundtable on the Environment and the Economy, in partnership with Environment Canada and Statistics Canada, produced a small set of indicators to track natural capital (i.e., air quality, freshwater quality, greenhouse gas emissions, forest cover, and extent of wetlands), and human capital (i.e., educational attainment). The national roundtable also recommended that the government expand the system of National Accounts and improve the national environmental information systems.
- **Genuine Progress Index (GPI).** The GPI was proposed in 1994. It broadens the conventional accounting framework to include economic contributions of families, community, and natural habitat. It measures factors that contribute to a decline in the well-being of society, and quantifies their cost to society. It also takes into account more than 20 aspects of people's lives that the GDP does not and integrates them into a composite measure so the benefits of economic activity can be weighed against the costs. This is intended to provide citizens and policy-makers with a more accurate measure of the overall health of the economy, and of how national conditions change over time (Cobb et al. 1995). See *www.rprogress.org/newprograms/sustIndi/gpi/index.shtml*.

  In Canada, the non-profit research group GPI Atlantic has developed a Genuine Progress Index for Nova Scotia, and the Pembina Institute has completed a major project to develop a GPI for Alberta (Taylor 2006).

- **Environmental Sustainability Index (ESI)** is an initiative of the Yale Center for Environmental Law and Policy and the Center for International Earth Science Information Network of Columbia University. The ESI benchmarks the ability of nations to protect the environment over the next several decades. It does so by integrating 76 data sets (tracking natural resource endowments, past and present pollution levels, environmental management efforts, and a society's capacity to improve its environmental performance) into 21 indicators. See *http://sedac.ciesin.columbia.edu/es/esi/*.
- **Environmental Performance Index (EPI).** Another initiative from the same source as the ESI (above), the EPI provides benchmarks for current national pollution control and natural resource management results. The issue-by-issue and aggregate rankings facilitate between-country comparisons both globally and within relevant peer groups. Environmental health and ecosystem vitality are gauged using indicators of environmental health, air quality, water resources, biodiversity and habitat, productive natural resources, and sustainable energy. See *www.yale.edu/epi/*.
- **Adjusted Net Savings (or Genuine Savings).** An initiative of the World Bank, adjusted net savings measure the "true" rate of savings in an economy after taking into account investments in human capital (i.e., education), depletion of natural resources, and damage caused by pollution. The World Bank has been publishing estimates of adjusted net savings since 1999 for more than 100 countries. See: *http://go.worldbank.org/EPMTVTZOM0*.

WHAT IS HAPPENING IN THE ENVIRONMENT?

In 2007, more than 4.6 million people lived in British Columbia. According to the most recent estimates, the B.C. population is expected to grow to 5.5 million people in 2030. As the number of people living in the province grows, pressure on the environment inevitably increases. Loss of natural habitat to development and agriculture, increasing demand for water, lumber and other resources, the release of pollutants, and production of waste all have environmental impacts.

The most rapid growth rates in B.C. have taken place in Metro Vancouver (formerly the Greater Vancouver Regional District), with the population density nearly doubling between 1976 and 2006. The Capital Regional District (Victoria), and the Nanaimo and Central Okanagan regional districts are the next fastest growing regions. Population patterns reflect both the continual expansion of urban centres and a shift in the economic and industrial activity within the province. In a few rural regional districts, such as Skeena-Queen Charlotte, the population density has decreased slightly, probably linked to the downturn in natural resource industries.

In the Lower Mainland, policies at the regional level and provincial level (i.e., the Agricultural Land Reserve) appear to have restrained suburban sprawl and slowed the loss of rural land. Between 1991 and 2001 the population of the region increased by 25%, yet the area of land converted to urban uses only increased about 2%.

The Agricultural Land Reserve (ALR) was put in place at the provincial level to protect agricultural land in 1974. Since then the total area, province-wide, has increased slightly (1%). Most of the movement of land in and out of the ALR has been "secondary capability land," meaning that it is suitable mainly for grazing or forage crops and is not prime agricultural land. The loss of prime agricultural land in the ALR is most noticeable in the Okanagan and South Coast where the population is highest and the demand for land for development is the greatest. However, the loss of agricultural land undoubtedly would have been higher if the ALR did not exist. For example, according to Smart Growth BC, although the population in Metro Vancouver has consistently increased since the mid-1970s, the region's annual rate of ALR loss has declined steadily since 1983. They estimate that without the ALR, Metro Vancouver might have converted as much as 7000 additional hectares to urban development (Smart Growth BC 2005).

As the level of sewage treatment increases, fewer contaminants are released into the environment. The proportion of the B.C. population with primary sewage treatment (35%), secondary treatment (56%), and tertiary treatment (8%) has remained the same since 1999. These proportion are not expected to change until there are major upgrades to treatment plants, as happened with the Annacis and Lulu Island facilities in 1999. The importance of providing adequate sewage treatment is shown by the large area of shellfish beds closed due to contamination with fecal coliform bacteria. The area increased by about 40,000 hectares from 1990 to 2006, primarily as a result of increasing population and associated sewage discharges. Other sources of fecal contamination include poorly placed or maintained septic tanks, agricultural and urban runoff, and discharge from marine vessels.

Pressure on the environment also comes from disposal of waste. B.C. now has eight industry-led product stewardship programs that divert recyclable materials and hazardous materials from landfills. Seven established programs cover used oil, scrap tires, lead-acid batteries, beverage containers, medications, tree-marking and household paint, solvents and pesticides. The newest is the Electronic Products Waste Program, set up in 2007. Records from the established programs show that a large volume of hazardous and non-biodegradable products have been diverted from landfills. Recycling and waste diversion programs have succeeded in keeping the total amount of disposed waste in B.C. today to about the same total volume as in 1990, despite the increasing population. Although the amount of waste disposed per person is still lower than it was in 1990, it has not improved over the last decade, despite recycling and disposal programs.

Since 1981, the energy intensity for economic activity in B.C. (energy consumed per unit of gross domestic product or GDP) has decreased, even though total energy consumption has continued to increase. This equates to a lower environmental impact per unit of economic activity, as it takes less energy to accomplish the same activity. Reductions in energy intensity are due to a combination of factors, including increased energy efficiency, a shift toward less energy-intensive activities (e.g., knowledge-based, service, tourism), and the use of more energy from alternative energy sources. Similar factors led to a reduction in greenhouse gas (GHG) intensity (the ratio of GHG emissions to economic output or GDP) in B.C. between 1990 and 2004.

WHAT IS BEING DONE ABOUT IT?

The negative impacts of population growth can be mitigated by strong growth-management policies and strategies, as well as by adoption of technology and participation in initiatives that reduce consumption or emissions to the environment.

Policies that reduce the impact of urban growth on the natural environment include limiting growth outside of urban core areas, increasing densification of these core areas, providing mass transit, supplying incentives for using environmentally sound technology, and encouraging low-impact development infrastructure and green building strategies. The impact of such efforts are shown as trends in the indicators reported in this paper. For example “smart growth” strategies appear to be slowing the rate at which land is converted to urban uses in Metro Vancouver. The Agricultural Land Reserve has also slowed the loss of prime agricultural land in Metro Vancouver, although losses still occur in the South Coast region as a whole, and in the Okanagan.

Another indication of effort to reduce human impacts is that the proportion of the province’s population served by secondary sewage treatment facilities increased substantially between 1983 and 1999, reflecting a significant investment in environmental infrastructure. Since 1999, however, there have been no significant changes in the proportion of the population served by higher levels of wastewater treatment.

Programs to reduce the amount of solid waste disposed of in landfills—including industry-led product stewardship and recycling programs—have been in place for more than 15 years in B.C. They have succeeded in keeping the amount of disposed waste per person lower than it was in 1990. However, the initial downward trend over the 1990s in the amount of waste disposed per person annually has not continued, and over the last 10 years there has been essentially no change in the waste disposed per person. Despite an increasing population, the recycling and waste diversion programs did succeed in keeping the total amount of disposed waste today to essentially the same total volume as in 1990. Also, a range of hazardous and non-biodegradable items have been diverted from landfills and either recycled or disposed of appropriately.

Some other important initiatives and programs aimed at protecting the province's environment and managing the impacts of human population and economic activities are described below.

Environmental Farm Plans and Beneficial Management Practices

In 2004, the governments of Canada and B.C., in cooperation with industry, initiated a program to help B.C. agricultural producers develop and implement Environmental Farm Plans (EFPs). Environmental farm planning is a voluntary process that producers can use to identify environmental strengths and potential risks on their farms. The current program—funded under the Canada-British Columbia Agriculture Policy Framework Agreement—ends in March 2008. In British Columbia, the program is delivered by the B.C. Agriculture Council.

Although the EFP program is open to all farms in the province, its primary target is commercial farms. According to Stats Canada (2001) there were about 4850 commercial farms (defined as farms with more than $50K in farm gate sales) in B.C. in 2000.

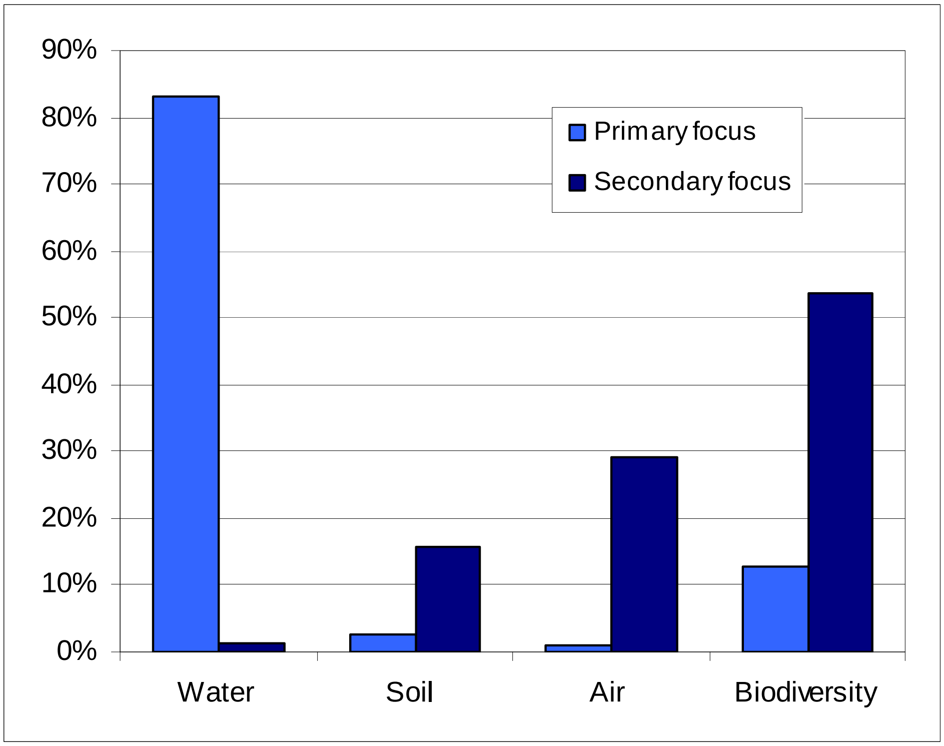
Between 2004 and 2006, a total of 1302 EFPs were completed (BCAC 2007), well above the target of 800 EFPs set by the B.C. Ministry of Agriculture and Lands.

A beneficial management practice (BMP) is a farm practice that enhances environmental benefits and/or reduces environmental risk. Producers who have completed an EFP are eligible for cost-shared incentives to help them implement specific BMPs related to the Agriculture Policy Framework (Agriculture and Agri-Food Canada 2005) priorities of soil, water, air, and biodiversity. BMPs may be primarily directed at one priority, but most provide additional benefits to one or more other priority areas (G. Hughes-Games, Provincial Soil Specialist, B.C. Ministry of Agriculture and Lands, Abbotsford, pers. comm.).

Most (80% or 367 projects) of the 441 BMP projects implemented since the program's inception in 2004 aimed at protecting water quality or quantity (Figure 17). Of these, just under half dealt with water quantity, primarily irrigation management. The rest of the projects (74) were directed at biodiversity, soil, and air priorities. Most projects (292) also had secondary benefits for biodiversity, soil, and air.

Biodiversity projects funded as of December 2006 included invasive species control (2 projects), wildlife habitat enhancement (5 projects), and preventing wildlife damage (50 projects). Projects focussing on soil included shelterbelt establishment (10 projects) and soil erosion control planning (2 projects). BMPs that addressed air quality concerns (contaminants, dusts, and particulates) included manure treatment (4 projects) and manure land application (1 project).

Figure 17. The primary and secondary focus of Beneficial Management Practice projects funded 2004 to 2006 under the Agriculture Policy Framework's four strategic priorities of water, soil, air, and biodiversity.



Source: BCAC 2007.

Collaborative Management of Marine Fisheries

Worldwide, there is a movement toward collaborative management of fisheries by multiple stakeholders. Such fisheries tend to have healthier stocks, can be more profitable, have lower levels of resource conflicts, and provide a wider array of social and economic benefits to local communities (e.g., Pearce and McRae 2004; Wiber et al. 2004). Therefore, the number of fisheries managed through a collaborative decision-making process has been proposed as a measure of progress in managing fisheries resources sustainably (e.g., BCMOE 2007).

There are many stakeholders in B.C. fisheries, including Canadian federal and provincial agencies, First Nations, and nongovernmental groups representing the fishing industry and other resource users. The management of Pacific marine fisheries falls under federal jurisdiction (Fisheries and Oceans Canada), but once harvested, the resource is largely under provincial jurisdiction. The province is a partner in federal management of marine fisheries. Because many B.C. fisheries (e.g., tuna, halibut, salmon, hake, and sardines) have transboundary stocks, US agencies are also partners in managing the fisheries.

The collaborative management process involves advisory committee meetings and industry consultations, and ongoing interactions with industry and stakeholder groups to address issues and challenges in the management of a fishery. A key product of such collaborative efforts is an Integrated Fisheries Management Plan as required by Fisheries and Oceans Canada. These plans incorporate management measures and activities related to a specific fishery for a given year. They are created for important fisheries such as tuna, salmon, groundfish, and prawn and shrimp caught by trap.

Several commercial and recreational fisheries in B.C. are in various stages of evolution toward management through collaborative decision-making processes. Although the hake, herring, and tuna fisheries (see Table 18) are the most advanced, there is a high degree of collaboration among participants in some other fisheries, including those for Strait of Georgia rockfish and lingcod, and for sardines.

Table 18. Summary of key Pacific fisheries under collaborative management.

Fishery	Fishing method	Products	Advisory Processes / Partners	Wholesale value
Tuna	Hook and line	Albacore tuna is available fresh, frozen-at-sea (whole fish, steaks and loins), hot and cold smoked, and canned. Markets include Canada, US, EU, and Japan.	1. Canadian Highly Migratory Species Foundation 2. BC Tuna Fishermen's Association 3. Canadian Advisors to DFO on International/Bilateral Issues 4. Integrated Tuna Advisory Board	$30 M (2005)
Herring (spawn-on-kelp; roe herring and other uses)	Gillnets and seine nets	Herring roe/eggs packed in brine. Market for herring roe is primarily in Japan.	Co-managed through three main advisory processes: 1. Herring Industry Advisory Board 2. Integrated Herring Harvest Planning Committee 3. Spawn on Kelp Operators Association	Roe herring $78.7 M (2005) Total herring $85.8 M (2005)
Hake	Groundfish trawl	Pacific hake is available frozen-at-sea and as surimi. Markets include EU, Asia, Russia, and US.	Two main advisory groups: 1. Groundfish Trawl Advisory Committee 2. In-Season Advisory Committee	$58.4 M (2005)
Rockfish and Lingcod	Hook and line	Live, fresh, and frozen products. Markets are primarily Canada and US.	One main governments / stakeholder advisory group: 1. DFO Inshore Rockfish/Lingcod Recovery Strategy Other bodies that are consulted on management measures 2. Sport Fish Advisory Board 3. Groundfish Hook & Line Committee	All rockfish $40 M (2005) All lingcod $10.2 M (2005)

Sources: Oceans and Marine Fisheries Division, B.C. Ministry of Environment; Wholesale value: BCMOE 2006c.

Forestry Certification Initiatives

Certification of products provides an incentive to industries to operate sustainably by developing standards and monitoring programs that can be used by consumers who want to support environmentally responsible industries. Third-party certification programs to identify and label forest products that originate in sustainably managed forests began in the 1990s and have been expanding since then. Programs exist at the national and international levels and have spread globally.

In Canada, at least four voluntary programs certify forests according to a set of environmental and social standards. Producers and manufacturers along the supply chain also can be certified to ensure that the final product bearing the logo originated from a certified forest. Programs include:

- **The Forest Stewardship Council.** An international system covering forest management practices and the tracking and labelling of certified products and paper products with recycled content.
- **The Sustainable Forestry Initiative® Program.** A sustainable forest management standard that targets large industrial operations in Canada and the United States.
- **The Canadian Standards Association.** The CSA covers operations in Canada, setting national standards for sustainable forest management and for tracking and labelling of certified material.
- **The Program for the Endorsement of Forest Certification Schemes.** A global umbrella organization for mutual recognition of national products that meet international forest certification standards.

For more information about forestry certification and the details of each certification system, see *www.metafore.org/index.php?p=Introduction_to_Certification_Programs&s=167*.

The most rapid growth rates in B.C. have taken place in Metro Vancouver (formerly the Greater Vancouver Regional District), with the population density nearly doubling between 1976 and

WHAT YOU CAN DO

The actions of individuals count, whether it is a positive or negative contribution. For example, more than half of the oil pollution in the world's oceans comes from land-based runoff entering storm drains and streams that empty into the ocean (Smithsonian Institution 1995). Much of this is oil from vehicles that drip oil on road surfaces—the oily road runoff from a city of 5 million people can contribute as much oil to the marine environment as one large tanker spill.

British Columbians can reduce their impact on the environment and participate in programs to protect it in many ways:

- Drive less: walk, take public transit, join a car pool, ride a bicycle, or buy a fuel-efficient vehicle.

- Reduce consumption and disposal of unnecessary goods.
- Recycle materials and reduce waste. See the RCBC Recycling Hotline for recycling information and locations in your community *www.rcbc.bc.ca/services/recycling_hotline.htm* or call 1-800-667-4321 (Lower Mainland: 604-732-9253
- Get involved in local stewardship projects. Seek out community groups and get involved, or help form a group. Stewardship Centre for British Columbia (*www.stewardshipcentre.bc.ca/stewardshipcanada/home/scnBCIndex.asp*).

Support "Green" Businesses: Consumers can choose to support businesses that offer products or services with reduced environmental impacts, for example, by buying locally grown food. Also look for certification initiatives, such as:

- Independent forestry certification programs are described and compared at (*www.metafore.org/index*).
- Wild fisheries certification by the Marine Stewardship Council (MSC). The B.C. Salmon Marketing Council, acting for both harvesters and processors of wild salmon, initiated the MSC certification process in September 2001. (*www.msc.org/*).
- The Audubon Green Leaf Eco-Rating Program. Hotels and other lodgings that enrol in this program receive a rating based on an evaluation of their policies and principles around water and energy conservation, waste reduction, and the use of hazardous substances. (*www.terrachoice.ca/hotelwebsite/indexcanada.htm*).

Going Green at Work or School: There are many opportunities for action at your workplace or school:

- Instead of relying on single passenger cars to travel to and from work or school, use mass transit, car or van pools, bicycles, and other alternatives to relieve traffic pressure on the environment.
- Make an effort to recycle, conserve energy and water, and reduce waste. For example, the Government of New Brunswick has a useful factsheet providing tips on "greening" your office (*www.gnb.ca/0009/0372/0003/0020-e.asp*)
- At several universities in B.C., networks of students, faculty, staff, and community stakeholders are working together to move their institutions "beyond climate neutral." (*www.commonenergy.org/*).

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