Burrard Inlet Environmental Action Program

BIEAP

FREMP

Fraser River Estuary Management Program

Fraser River Estuary Management Program (FREMP)

Monitoring the Estuary Management Plan, 2006:

BACKGROUNDER

September 2006

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EXECUTIVE SUMMARY

The Fraser River Estuary Management Program (FREMP) is an intergovernmental partnership program for environmental management of the Fraser River estuary. Agency partners include Environment Canada, Fisheries and Oceans Canada, Transport Canada, BC Ministry of Environment, Fraser River Port Authority, North Fraser Port Authority and the Greater Vancouver Regional District. Since its inception in 1985, FREMP has coordinated environmental review of foreshore projects and policy and planning through the *Estuary Management Plan: A Living, Working River.* The Plan was revised in 2003.

The FREMP Monitoring Report first issued in 2001 used indicators to report on the success of FREMP partners in implementing the Estuary Management Plan. This updated Monitoring Report (2006) provides a status update on these and other indicators, in connection with the Action Programs of the Estuary Management Plan. A total of eight indicators are used for the Monitoring Report, with data compiled from FREMP partners and municipalities.

The indicators show that progress has been made since 2001 on implementing the Estuary Management Plan. Monitoring shows that water quality in the estuary is within established provincial scientific objectives, and fecal coliforms continue to be within safe levels. Habitat gains have been made for marsh habitat, though somewhat tempered in recent years by conversions of sub-tidal habitat. On the "working" side of the river, marine cargo volumes continue to increase at the ports and maintenance dredging of sediment from the main navigation channel of the estuary remains within sustainable levels established through FREMP. A baseline of industrial lands shows that almost 29% of the estuary shoreline is being used or is allocated for industrial purposes. With an increasing population in the region, recreational use of regional parks along the river has increased substantially over the past several years, while the length of corridors established along the estuary for recreational use has also grown slightly.

While providing a snapshot of conditions in the Fraser River estuary since 2001, these trends show that the FREMP partnership continues to make progress in implementing the vision of a "living, working river" - balancing the region's recreational and economic needs with key environmental objectives for water quality and fish and wildlife habitat. FREMP will continue this monitoring effort in the coming years, using the indicator trends to inform agency decision-making and policy initiatives, and inform stakeholders and the public about the health of the "living, working river'.

ACKNOWLEDGEMENTS

This report is the work of the FREMP Water and Land Use Committee (WLUC), comprised of FREMP partner agency staff, municipal and First Nation representatives. The WLUC guided the development of this updated Estuary Management Plan Monitoring Report, with overall direction provided by the BIEAP-FREMP Management Committee. The assistance and expertise of many FREMP partner staff and municipal staff was critical to data collection and indicator analysis, with particular thanks to staff at GVRD, DFO, Fraser Port and Environment Canada.

Report writing and development was coordinated by FREMP staff with consulting assistance from Patrick Yarnell and Associates, Dovetail Consulting and PacificaBlue Consulting. Graphic design for the summary brochure was provided by Lisa Marshall of Zero9 design, with printing by Mack Printers.

The following WLUC members guided the preparation of this Report:

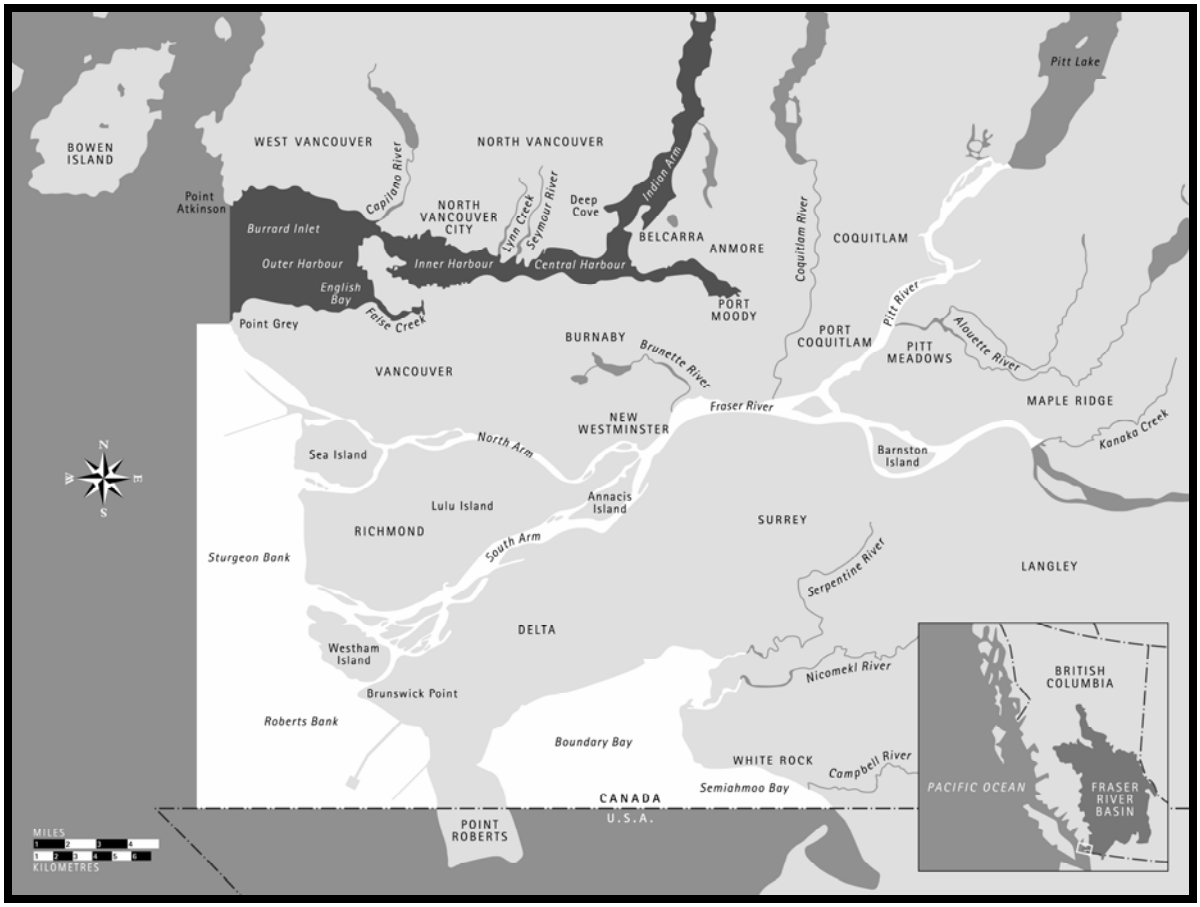
Robyn Wark, City of Burnaby
Hagen Hohndorf, City of Coquitlam
Stephen Scheving, City of New Westminster
Helen Popple, City of Port Coquitlam
David Brownlee, City of Richmond
Nicholas Lai, City of Surrey
Don Brynildsen, City of Vancouver
Andy Coupland, City of Vancouver
Nathalie Horn, City of White Rock
Greg Ambrozic, Environment Canada (Georgia Basin Action Plan)
Janice Richmond/Marcy Sangret, Corporation of Delta
Jim Charlebois/Rod Stott, District of Maple Ridge
Dana Parr, District of Pitt Meadows
Ken Brock/Greg Mallette, Environment Canada (Canadian Wildlife Service)
Brian Naito, Fisheries and Oceans Canada, Habitat & Enhancement
Wayne Dutchak, Fisheries and Oceans Canada Coast Guard
Nures Kara, Fraser River Port Authority
Susan Haid/Chris De Marco, GVRD Policy & Planning
Bonnie Blue, GVRD Parks
Debbie Miller, Katzie First Nation
Kathleen Zimmerman, Ministry of Agriculture and Lands
Ross Neuman, Ministry of Environment
Nolan Charles/Ryan Mathison, Musqueam First Nation
Gary Williams, North Fraser Port Authority
Alex Fakidis, Public Works and Government Services Canada
Paul Crawford, Township of Langley
Andrew Bak, Tsawwassen First Nation
Simon Robinson, Vancouver International Airport Authority
Alicia Blancarte, Vancouver Port Authority

FREMP

Since 1985, the Fraser River Estuary Management Program (FREMP) has been coordinating decision making on conservation and development in the estuary among more than 30 agencies representing federal, provincial and local governments, port authorities and First Nations. Seven decision-making authorities contribute financial resources and manage the FREMP partnership:

- Environment Canada
- Fisheries and Oceans Canada
- Transport Canada
- BC Ministry of Environment
- Fraser River Port Authority
- North Fraser Port Authority
- Greater Vancouver Regional District

The FREMP area encompasses 155 square kilometres of water and land that are outside the Fraser River dykes (on the wet side of the high water marks). The entire Fraser River Basin, approximately one quarter of British Columbia, drains into the FREMP area.



Map 1: The FREMP area of interest, shown in white.

THE FRASER RIVER ESTUARY

Nowhere in British Columbia are the environmental pressures and competing demands for space and resources greater than in the fertile and heavily populated Lower Mainland. Over the next 20 years, more than 600,000 people are expected to be added to the region, raising the total population to 2.8 million people. A rapidly growing population will be looking to the estuary and adjacent lands to satisfy demands for housing, commercial developments, port expansion, industrial development, and recreation. At the same time, the region's residents will want to protect the estuary's natural fish and wildlife habitats and maintain or improve its environmental quality.

The Fraser River estuary is a magnificent natural area with some of the most productive biological systems in the world. The intermingling of fresh and salt water through tidal action produces an estuarine habitat that is unique in its scope and diversity on the West Coast of North America and provides an essential

rearing area for juvenile salmon en route to the sea. In turn the marshes and bogs of the estuary create important resting areas for migratory birds on the Pacific Flyway. The estuary is one of the largest open spaces in Greater Vancouver, offering diverse recreational assets for residents and visitors to the region. It is also home to three port authorities and provides the region's longest natural transportation system.

Protecting the estuary's environmental quality while sustaining its role in economic development and accommodating recreational needs is an ongoing challenge.

A LIVING, WORKING RIVER

In 1994, the FREMP partner agencies adopted a coordinated plan for managing the estuary's environment and the sectors of the economy that depend on the river for their success or survival. Called *A Living Working River*, the Estuary Management Plan (EMP) was created with the help of municipalities, industries, non-governmental organizations and First Nations, and provides a common basis for reviewing development proposals in the estuary and undertaking local planning and resource management activities. All municipalities bordering the estuary endorsed the EMP.

In 2003, the Estuary Management Plan was updated to reflect change in the estuary over the years and identify new actions that the partnership would work towards. The updated EMP is now being implemented under the guidance of the Management Committee and the FREMP Water and Land Use Committee.

Similar in scope and purpose to an Official Community Plan for a municipality, *A Living Working River* reflects a consensus among a broad range of stakeholders on how and where use of the water, shoreline and adjacent upland areas will occur. The Plan includes a vision, goals, and action programs to help the region balance the estuary's economic and biological productivity and recreational resources.

Vision:

A sustainable Fraser River estuary characterized by a healthy ecosystem, economic development opportunities and continued quality of life in and around the estuary.

Goals:

- Conserve and enhance the environmental quality of the estuary to sustain healthy fish, wildlife, plants and people.
- Respect and further the estuary's role as the social, cultural, recreational and economic heart of the region.
- Encourage human activities and economic development that protect and enhance the environmental quality of the estuary.

Action Programs

Integration

Water and Sediment Quality

Fish and Wildlife Habitat

Dredging and Navigation

Log Management

Industrial and Urban Development

Recreation

Each of the indicators in this report are grouped according to the above Action Programs. The Integration and Log Management Action Programs do not have indicators in this report.

USING INDICATORS TO MONITOR THE ESTUARY MANAGEMENT PLAN

From the outset, *A Living Working River* was intended to incorporate processes to monitor, evaluate and improve successful aspects of the Plan and identify areas that require change. While this kind of dynamic process occurs through the FREMP committees like the Water & Land Use Committee, indicator-based monitoring provides a more systematic approach intended to inform policy makers, planners, and the general public. Linking the monitoring program to the Estuary Management Plan is also an excellent way to keep the EMP relevant - this

"adaptive management" approach will help FREMP with the implementation of the action programs and help refine decision making in the long run.

Comprehensive monitoring is a key component of the updated Estuary Management Plan to assess progress and ensure that appropriate corrections can be made along the way. The FREMP 2001 Monitoring Report *"Monitoring the Estuary Management Plan: A report on the performance of FREMP and its partners"* began the process of reporting on the state of the estuary using a number of indicators. The updated EMP committed to continuing this work. The EMP also includes a number of success measures to assess specific progress in completing the actions, as a form of implementation monitoring. Many of the success measures are conditions that need to be met or tasks that need to be completed, such as the completion of a recommended report or database. These success measures are reported on in the BIEAP-FREMP Annual Report and on the website.

Monitoring through indicators and success measures will allow FREMP to evaluate progress in implementing EMP objectives and in meeting the Plan's goals of balancing the living and working aspects of the river.

This report also provides information on what the partners are doing to improve issues in the Fraser River estuary.

LIMITATIONS OF INDICATORS

Indicators are by their nature simplifications of a complex system and they are not intended by any means give the whole story of the Fraser River estuary. Further, indicators address only those issues that can be readily quantified and aggregated in a meaningful way. While they provide useful and broad snapshots on progress made through the FREMP partnership and on the state of the estuary, making policy decisions relating to the implementation of the FREMP partners' mandates depends on an array of information about the state of the estuary and the factors that impact on it. The indicators presented here are only one mechanism to help achieve this.

PURPOSE OF THIS DOCUMENT

The primary purpose of this Monitoring Report is to measure the performance of FREMP and its partners in implementing the Estuary Management Plan. As a means of gauging FREMP performance, indicators have been selected to measure environmental, economic and recreational conditions in the estuary.

The report is intended primarily for stakeholders interested in FREMP, the ports, the estuary and sustainable development. It is also presented as an outreach tool to inform the public about FREMP activities. Behind the scenes, the technical documents and knowledge that went into creating this report help FREMP partner staff keep abreast of data and identify trends. The process itself helps managers identify information gaps and policies or programs that need to be strengthened, and the trends presented by the indicators will help inform decision-making in the estuary.

HOW TO READ THIS DOCUMENT

The Monitoring Report is organized to synchronize with the Action Programs of the Estuary Management Plan. For each Action Program, the Report introduces the background and relevant indicators. For each indicator, the report then identifies the relevant goals and/or targets from *A Living,Working River*, and where possible conveys the status or trend relevant to a starting point or "baseline". The baseline is the starting point from which data has been interpreted. For some indicators, data was only collected recently for the first time and in those cases, this document cannot yet reveal any trends, only baseline conditions. By quantifying trends over time, the main objective of the indicators on the following pages is to measure progress toward achieving the Estuary Management Plan actions, goals, and vision.

Each section includes information on why we are tracking the indicator, how the data was collected, and what the FREMP partners are doing to improve conditions in the estuary.

We have endeavoured to acknowledge linkages between indicators where possible, including tradeoffs that may exist such as those involved in various land uses along the shoreline. Limitations are also identified; some improvements in environmental quality cannot be directly linked to the adoption of the Estuary Management Plan after 1994 but may be the result of a combination of policies and programs including FREMP.

HOW THE INDICATORS WERE SELECTED

The 2001 Monitoring Report used a total of 16 indicators to report on the performance of FREMP partners in achieving progress on the Estuary Management Plan vision, goals and objectives. In 2004, FREMP evaluated these indicators and identified seven indicators for updating: Fecal Coliform Levels, Fish & Wildlife Habitat Gains/Losses, Sediment Removal, Marine Cargo, Land Available for Industry, Recreational Corridors along the Shoreline, and Visits to

Regional Parks along the estuary. Several new issues were identified for further exploration including metals in water and sediment and endocrine-disrupting compounds, which had been raised at a public forum held in November 2001.

In some cases, the other indicators used in 2001 were no longer relevant for monitoring and reporting on progress (e.g. the log storage guidelines are in 100% compliance and that has not changed), or resources were not available within FREMP to engage in extensive data collection to identify trends (e.g. to determine trends in employment in water-dependent industry or the amount of log debris in the estuary). The FREMP Water and Land Use Committee confirmed a new broader Water Quality indicator to replace the former indicator on Contaminants in Great Blue Heron Eggs.

In 2005, with assistance from consultants and partner staff, FREMP began collecting and analyzing data for eight selected indicators:

1. Nutrients and Metals (Water Quality)
2. Fecal Coliform Levels
3. Habitat Gains and Losses
4. Sediment Removal
5. Marine Cargo
6. Land Available for Industry/Foreshore Land Use Trends
7. Recreational Shoreline Corridors
8. Visits to Regional Parks Along Estuary

HOW THIS REPORT LINKS WITH OTHER INDICATOR INITIATIVES

Following the release of the first Monitoring Report in 2001, public feedback raised questions about how the FREMP indicator initiative links with those of the FREMP partners and other organizations like the Fraser Basin Council. As a result of public feedback, during the update of this Monitoring Report we looked at whether we could build on or use these other indicators.

While we are informed of the programs and indicators of the other organizations, reporting on the EMP falls between the very broad themes of the sustainability reporting like that from Fraser Basin Council, and the single-focus reporting of environmental indicators used by partner agencies. In addition, the FREMP geographic scope of the estuary is unique, and data collected at provincial or national scales was not immediately relevant to the estuary or responsive to

FREMP actions. The reporting of the GVRD on the *Liquid Waste Management Plan* was identified as most relevant to the themes and scale of FREMP, and as a result was utilized in this report for indicators on fecal coliform and water quality.

The indicators presented in the report are uniquely linked to the Action Programs of the FREMP Estuary Management Plan, exploring progress in meeting the Plan's vision, goals and objectives.

WATER AND SEDIMENT QUALITY

The Water and Sediment Quality Action Program emphasizes the management direction set out in the Estuary Management Plan to improve water and sediment quality. In particular, the EMP directs FREMP partners to:

- Develop an integrated water quality monitoring framework for the estuary that identified ongoing water quality monitoring and how monitoring efforts might be coordinated; and
- Improve water and sediment quality in the estuary by working to prevent pollution at its source, minimizing the discharge of pollutants, and remediating contaminated sediments.

Water quality is a central issue in environmental management of the estuary. Water is the one element that directly links urban development – including municipal wastewater treatment – agricultural practices, and industrial operations with aquatic life, wildlife, irrigation and recreation opportunities.

Ensuring that the waters of the Fraser River are sufficiently clean to support fish and wildlife, meet irrigation needs, and provide recreational opportunities is the responsibility of federal, provincial, regional and municipal governments. Together, these orders of government manage sewage and industrial effluents, agricultural and urban runoff, groundwater and surface water contamination, and environmental emergencies.

Measures such as nutrients, metals and fecal coliforms are important to monitor against water quality objectives. The Water and Sediment Quality indicators are chosen because they provide a snapshot of whether conditions in the estuary are getting better, getting worse, or staying the same.

NUTRIENTS & METALS

Are measurements of nutrients and metals in the estuary below maximum levels set in the provincial water quality objectives? *YES.*

Relevant goals in *A Living Working River*	Conserve and enhance the environmental quality of the estuary to sustain healthy fish, wildlife, plants and people.
Relevant Targets and Objectives	The EMP Water and Sediment Quality Action Program has the following objectives: (1) Develop an integrated water quality monitoring framework for the estuary that identifies ongoing water quality monitoring and how monitoring efforts might be coordinated, and (2) Improve water and sediment quality in the estuary by working to prevent pollution at its source, minimizing the discharge of pollutants, and remediating contaminated sediments. The British Columbia Ministry of Environment has established Water Quality Objectives for the Lower Fraser River that set out acceptable levels for nutrients and metals in the water column.
Baseline	In the 2001 EMP Monitoring Report, we used as an indicator PCB levels in Great Blue Heron eggs. The measurement of contaminants in the eggs of Great Blue Herons provided a "big picture" on the presence of persistent organic chemicals in the ecosystem of the estuary. However the indicator was critiqued because heron populations are transient and not the best indicator of the estuary's environmental quality.[i] In this updated Monitoring Report, new Water Quality measures have been selected to provide a better picture of water quality in the estuary. This report reviews nutrients and metals (and briefly, organic compounds) sampled in the estuary and compares these results against provincial Water Quality Objectives. This new focus reflects public interest in the possible impacts from these parameters.[ii]
2001 Report	Between 1985 and 1998, PCB levels in Great Blue Heron eggs had decreased significantly in and around the estuary.
Conditions and Trends	In 2003 and 2004, ammonia, nitrate, nitrite and metals typically were below the maximum water quality objectives or guidelines (i.e. *better* than the objective). Maximum concentrations of ammonia, nitrate, nitrite, arsenic, cobalt, lead, manganese, nickel and zinc were less than 20% of the water quality objective or guideline values. No samples contained levels of these substances above the objectives or guidelines.

Why Measure Nutrients and Metals?

Nitrogen is widely distributed in the environment. As a component of protein, it is present in all living things. Natural sources of nitrogen in water include decomposition of plants and wastes from fish and other aquatic life. The major human sources of nitrogen are municipal and industrial wastewater, septic tanks, animal wastes, fertilized field and lawn runoff, and vehicle exhaust.

Nitrogen forms such as nitrate, ammonia and nitrite act as nutrients in rivers and estuaries. However, high levels of ammonia and nitrite can be harmful to fish and other aquatic life.

Many metals also are widely distributed in the environment. Metals are present in rocks and soils. They enter rivers when rocks and soils erode, and they are carried downstream with suspended soil particles. The major human sources of metals in water include municipal and industrial wastewater and stormwater runoff.

In the right concentrations some metals, such as copper, iron, manganese, nickel and zinc are essential to life. Other metals such as arsenic, cadmium, lead and silver are not essential to life. Metals associated with suspended particles generally are not available for living things to use. Dissolved metals can be biologically available. In excess, all biologically available metals can be harmful to aquatic life.

Scientists use the levels of ammonia, nitrite and metals as indicators of the suitability of water for various uses including fish habitat. The B.C. Ministry of Environment sets water quality objectives and guidelines. Objectives are intended to protect the most sensitive use in a specific river or lake. Uses include aquatic life, wildlife, livestock watering, irrigation water supplies, and recreation. Water quality objectives usually are set for substances of concern in a specific water body.

Water quality guidelines also protect sensitive water uses. Guidelines apply to all rivers and lakes in British Columbia that do not have objectives for a particular substance.

The Ministry of Environment has set Water Quality Objectives for ammonia, nitrite, copper, manganese, lead and zinc in the lower Fraser River. For most parameters, the objective is presented as a range depending on salinity and the reach of the river. For more information on the Water Quality Objectives, visit the provincial website at http://www.env.gov.bc.ca/wat/wq/wq_objectives.html. The objectives for aquatic life are levels of these substances that will protect fish and other aquatic species. British Columbia water quality guidelines include levels of other metals that will protect fish and aquatic life.

How Are the Data Collected?

As part of its Liquid Waste Management Plan, the Greater Vancouver Regional District (GVRD) has committed to monitoring in areas where water quality may be

affected by wastewater and/or stormwater. The GVRD's water quality monitoring program includes sampling once per week for five weeks during the winter low flow period for the Fraser River (late January to early March). Samples are collected at seven sites along the lower Fraser River. The sites are located in the Main Stem, Main Arm and North Arm between Langley and the river's mouth. The samples are sent to a chemistry laboratory, which measures the levels of ammonia, nitrogen, metals and other substances including suspended solids.

The sampling program began in 2003 and is repeated once each year. However, the river flows were abnormally high during the 2005 monitoring period, and the 2005 data do not reflect the conditions that the monitoring program is intended to capture. GVRD will also be undertaking fish tissue and sediment sampling in future years as part of this program.

Status and Trends

As there are only two years of valid monitoring data, it is too early to look for trends. However, comparing the data with water quality objectives and guidelines gives an idea of the status of the river. Most water quality objectives have two values, a 30-day average and a maximum value. The 30-day average is calculated from five samples collected over 30 days. The water quality guidelines and objectives for some substances have only a maximum value.

Figure 1 compares 2003 and 2004 average concentrations of ammonia, nitrite, copper, lead and zinc with the 30-day average objectives. It shows that the average levels of these substances were less than 65%, and in most cases, less than 40% of the objective value.

Ammonia, nitrate, nitrite and metals typically were below (i.e. *better than*) the maximum water quality objectives or guidelines, as shown in Table 1 and Figures 2 and 3. In 2003, a single sample exceeded the maximum objective for copper. However, averaged over the seven sampling sites, the maximum copper concentrations in both 2003 and 2004 were less than 30% of the objective value. Maximum concentrations of ammonia, nitrate, nitrite, arsenic, cobalt, lead, manganese, nickel and zinc were less than 20% of the objective or guideline values. No samples contained levels of these substances above the objectives or guidelines.

The water quality data shows that water quality in the lower Fraser River is acceptable to protect aquatic life.

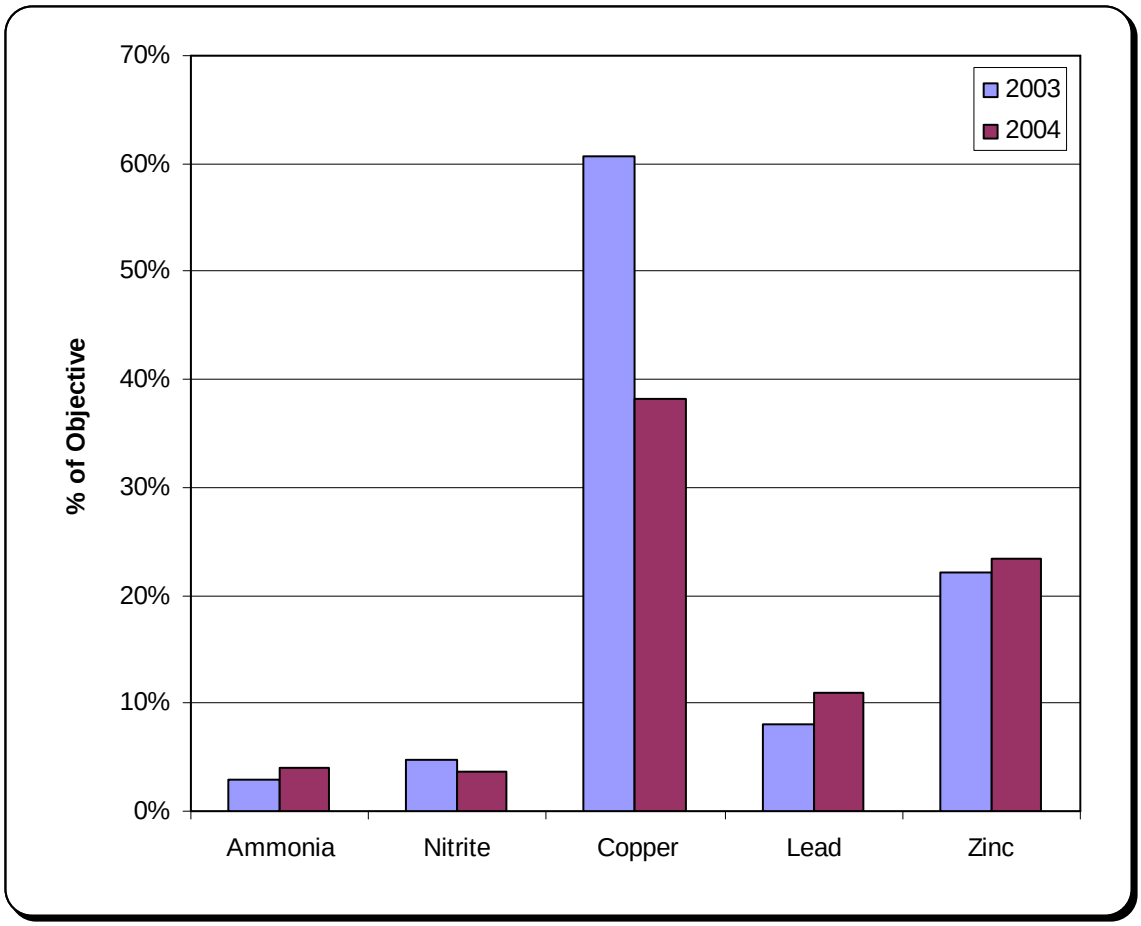


Figure 1 Average Water Quality Results for 2003 and 2004 as Percent of the 30-Day Average Objective

Table 1 Percent of Water Quality Samples That Were Higher than Objectives or Guidelines, 2003-2004

Ammonia	0%
Nitrite	0%
Arsenic	0%
Cobalt	0%
Copper	2%
Lead	0%
Manganese	0%
Nickel	0%
Silver	0%
Zinc	0%

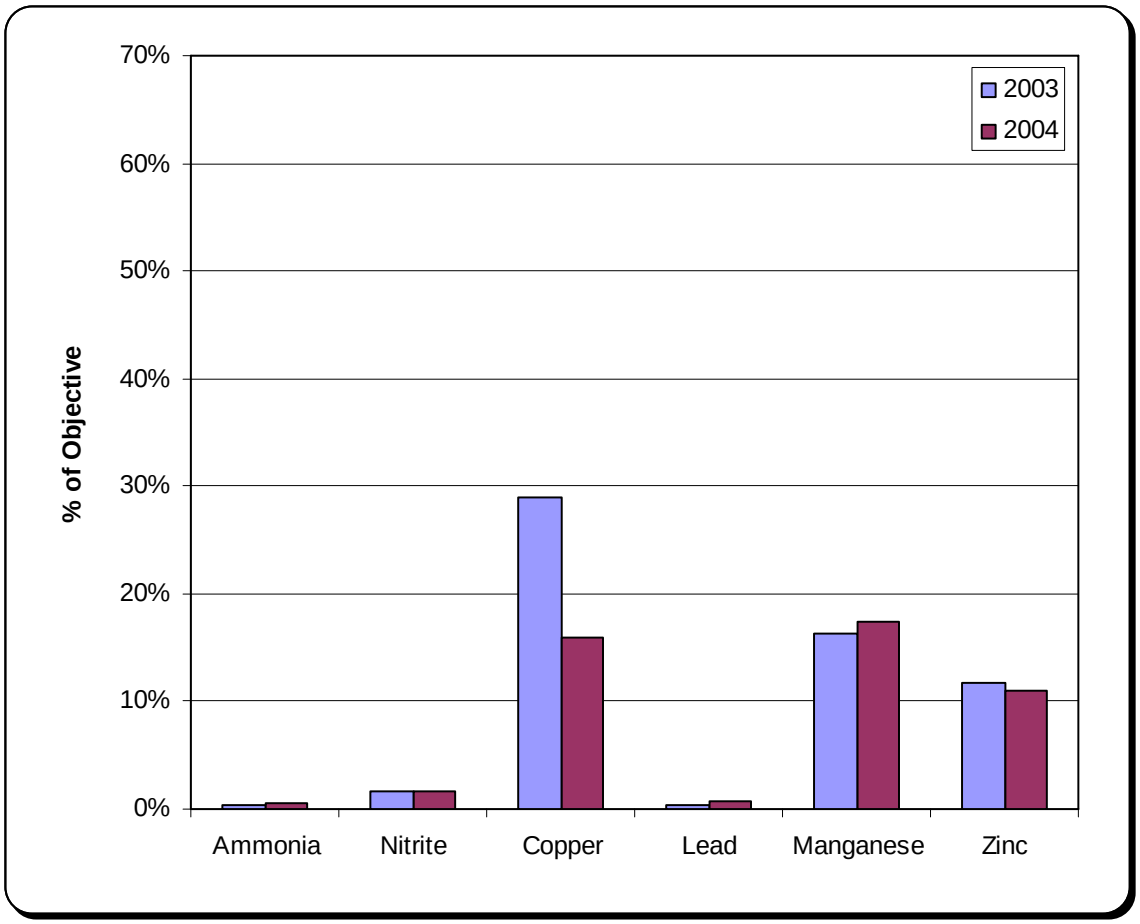


Figure 2 Water Quality Results for 2003 and 2004 as Percent of the Maximum Objective

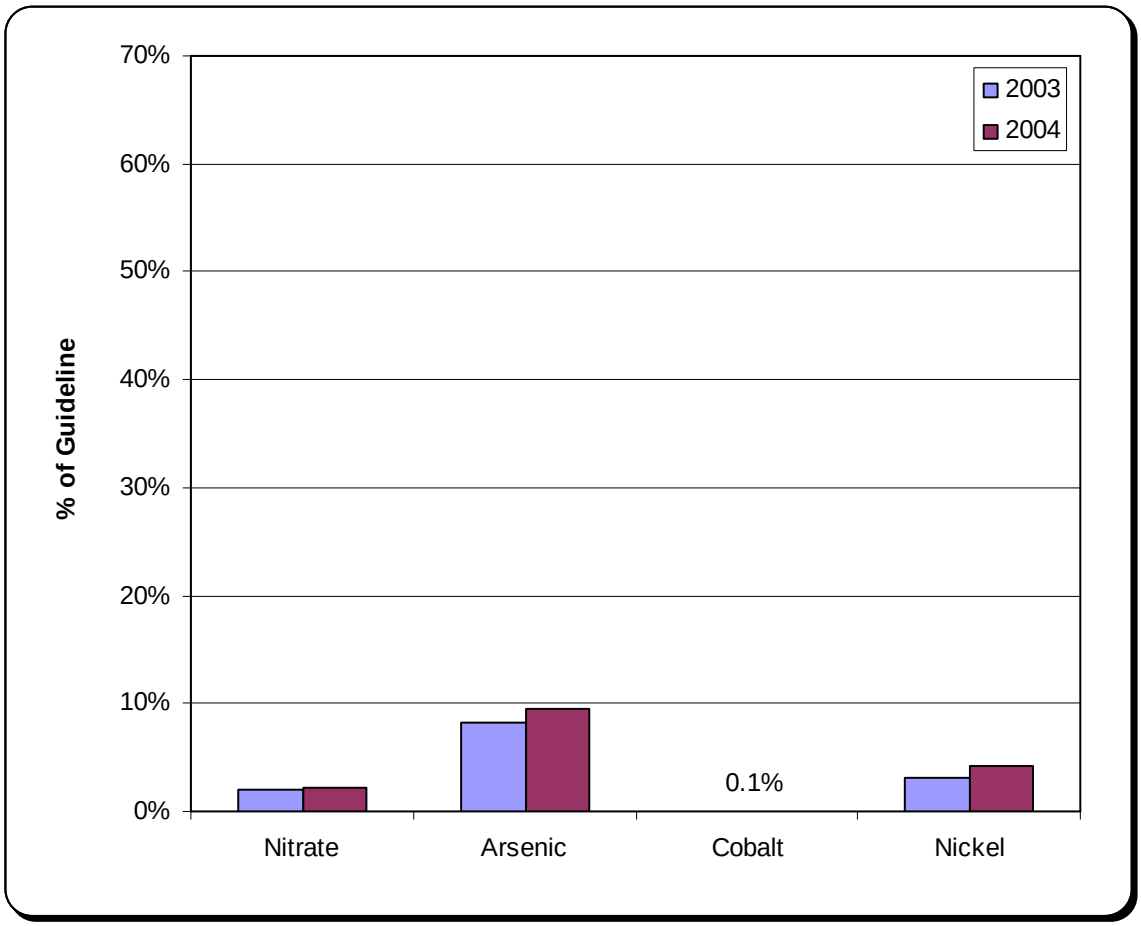


Figure 3 Water Quality Results for 2003 and 2004 as Percent of the Maximum Guideline

Environment Canada - Fraser River Estuary Monitoring

Water quality sampling conducted in the Fraser River estuary in the 1970s and 1990s, and by the GVRD for the ongoing Fraser River Ambient Water Quality Monitoring Program, demonstrates the difficulty in accurately measuring water quality in the complex estuarine environment. The high salinity and conductivity measurements in samples collected during low flow periods in the winter, indicates that these samples are mixed with water from the Georgia Strait. Water quality monitoring in the estuary presents significant challenges because of the tidal influence, particularly apparent during river low flow, and the heterogeneous water quality conditions due to numerous inputs from discharges and shore-based run-off along the length of the lower river. It is these inputs, and their potential effect on the river's water quality that make it so important to understand this water quality and its potential effect on the Strait of Georgia.

Through the Georgia Basin Action Plan, Environment Canada scientists are investigating monitoring approaches that will make it possible to accurately assess fresh water quality in the lower reaches of the North and Main arms of the Fraser River. Specifically, the goals of this investigation are to design an approach for sampling fresh water in the estuary during all seasons in a manner that captures the water quality variability across the river and with depth. The new approach being investigated includes collection of depth integrated cross-sectional samples and tidal cycle-triggered sampling.

The water quality information produced by this program will provide needed data for assessing the estuary relative to Water Quality Objectives or guidelines, and for assessing effects of discharges from point and non point sources in the river. Two examples of the initial monitoring results obtained through this research are provided below; these results are still being assessed as new data is collected. Reporting to the public will be through scientific publications and the Environment Canada water quality web site at www.waterquality.ec.gc.ca.

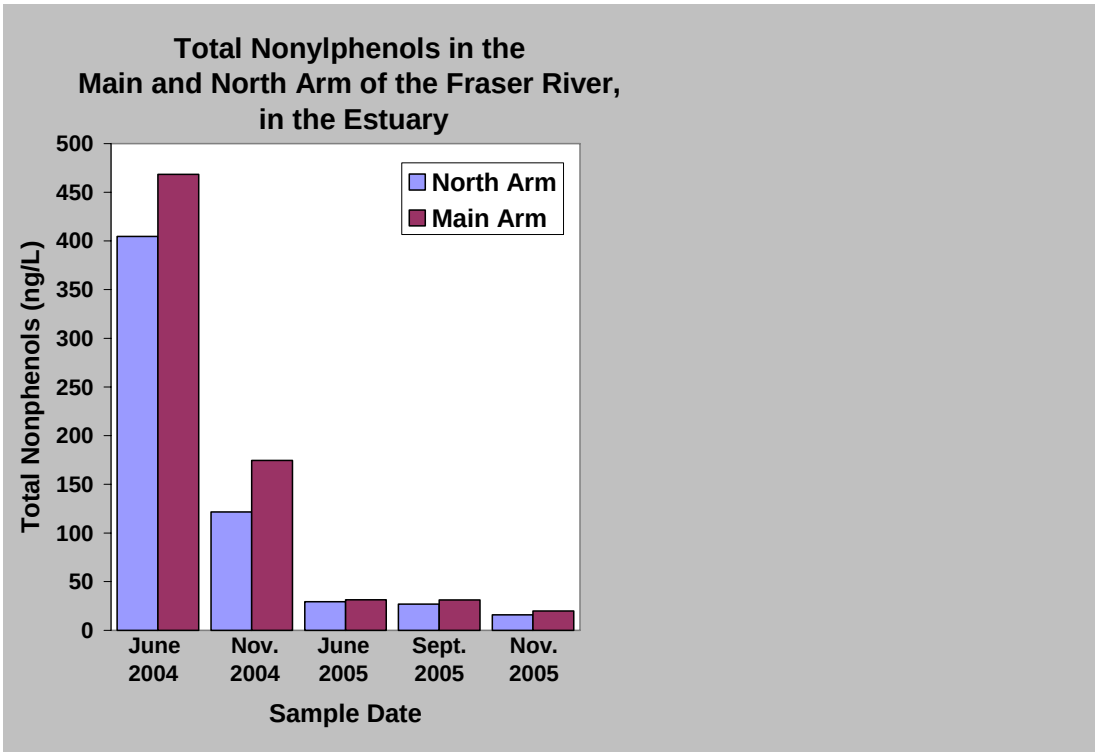


Figure 4 - Total Nonylphenols in the Main and North Arm of the Fraser River, in the Estuary, 2004 and 2005

Nonylphenols are household and industrial pollutants that can enter the estuary through wastewater treatment plant effluents as well as other human activities. The levels measured in the Fraser River estuary are below the 1000ng/L guideline established in the Canadian Water Quality Guideline for the protection of aquatic life.

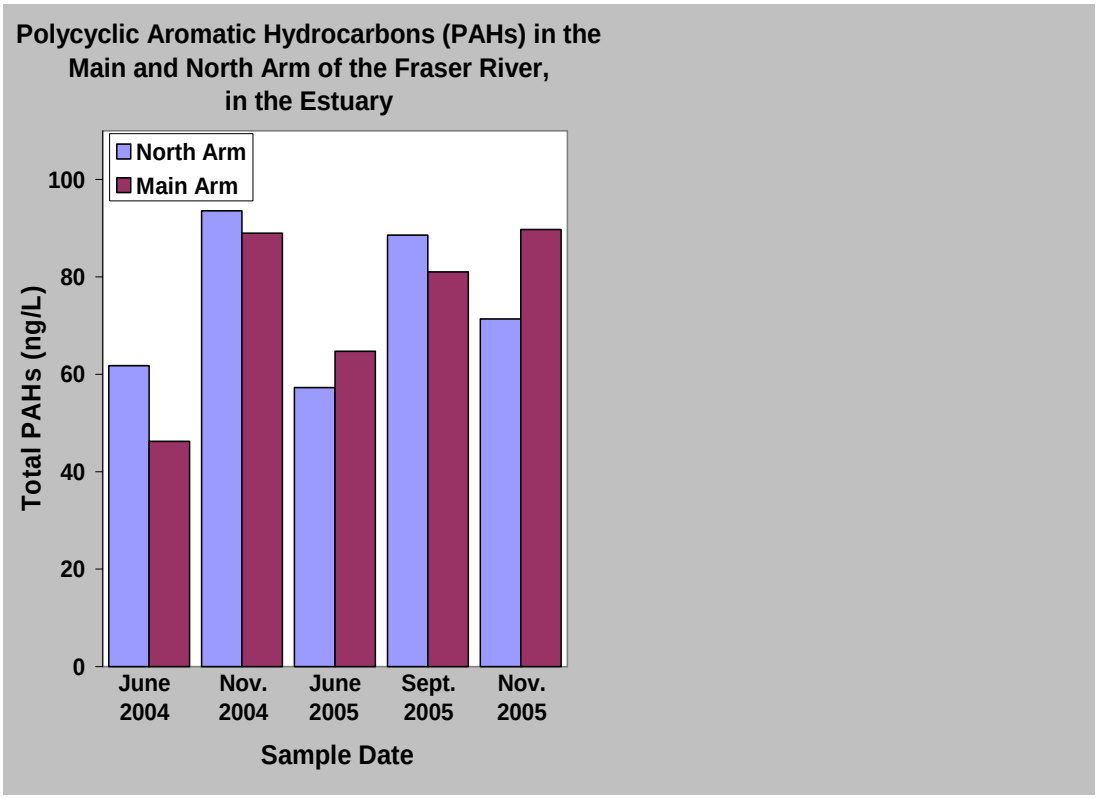


Figure 5 – Polycyclic Aromatic Hydrocarbons (PAHs) in the Main and North Arm of the Fraser River, in the Estuary, 2004 and 2005

Polycyclic Aromatic Hydrocarbons (PAHs) are pollutants associated with industrial activity and automobiles. These pollutants can enter the estuary through storm sewers and wastewater treatment plant effluents. The total PAH values represented in the graph above are a mixture of 17 individual contaminants. Currently, Canadian Water Quality Guidelines exist for only nine of the individual PAHs. None of the PAHs exceeded the guidelines.

FECAL COLIFORM LEVELS

Is the estuary becoming safer for human health and recreation? *YES*

Relevant goals in *A Living, Working River*	Conserve and enhance the environmental quality of the estuary to sustain healthy fish, wildlife, plants and people. Respect and further the estuary's role as the social, cultural, recreational and economic heart of the region.
Relevant Targets and Objectives	The EMP Water and Sediment Quality Action Program has as an objective, to improve water and sediment quality in the estuary by working to prevent pollution at its source, minimizing the discharge of pollutants, and remediating contaminated sediments. Because water from parts of the estuary is used for irrigation of crops eaten raw, in 1998 the BC Ministry of the Environment, Lands and Parks set the fecal coliform guideline at a maximum of 200 [CFU[iii]] fecal coliforms per 100ml geometric mean. However it should be noted that this objective only applies between April and October. Another common target for other recreational uses (non-swimming) is 1,000 fecal coliforms per 100ml, which may be more relevant to some parts of the estuary and for sampling done outside of the summer months.[iv]
Baseline	In 1993 fecal coliform levels reached a maximum of 60,000 fecal coliforms per 100 ml in winter months in the Main Arm of the estuary. The count in summer months peaked in 1996 when it reached as high as 24,000 fecal coliforms per 100 ml.
2001 Report	From the end of 1998 to 2000, fecal coliform levels were drastically reduced in the Main Arm of the estuary. Levels never exceeded 1,300 fecal coliforms per 100 ml, and were consistently below 200 fecal coliforms per 100ml in summer months.
Conditions and Trends since 2001	Fecal coliform counts have continued to drop since 2001. Preliminary water column results from the GVRD Fraser River Ambient Water Quality Monitoring Program show mean counts consistently below 1,000 MPN (Most Probable Number)/100ml at all monitoring sites. All but one site had mean counts below 200 MPN/100ml. That these results come from wintertime sampling – during the "worst case" periods of low river flow, high rainfall and runoff - is further encouraging.

Why measure fecal coliform levels?

Fecal Coliforms are a group of bacteria associated with the feces of warm-blooded animals. High levels of fecal coliform in the water can signal the presence of disease-causing organisms. Along with E. coli (Escherichia coli) and Enterococcus, they are one of several common indicators used to determine the suitability of water for a variety of domestic, recreational, agricultural and other purposes.

Fecal coliforms can enter the estuary from a variety of sources:

- Three wastewater treatment plants in the Main Arm of the estuary discharge primary and secondary treated wastewater. Lulu, Annacis and Northwest Langley wastewater treatment plants (WWTP) are secondary treatment plants.[v]
- Older sewerage systems have combined storm and sanitary sewers. During high rainfall periods, these systems can become overloaded, bypass treatment, and discharge combined storm and untreated wastewater into the estuary.
- Agricultural practices such as allowing animal wastes to wash into nearby streams during the rainy season, spreading manure on fields during rainy periods or when fields are frozen, and allowing livestock watering in streams can all contribute to fecal coliform discharges.
- Runoff from roads, parking lots, and yards can carry animal wastes to the estuary through storm sewers. This can include waste from birds, dogs and other animals.
- Individual home septic tanks, if not maintained properly, can become overloaded and allow untreated human wastes to flow into drainage ditches and nearby waterways.
- Wastes can enter the water if they are inadequately captured by commercial vessels, recreational boats and houseboats.

Coliform counts vary over seasonal cycles as impacted by temperature, rainfall , disinfection, and other factors. Fecal coliform counts can increase during the winter when rainfall is highest and some of the regional wastewater treatment plants suspend disinfection of effluent water. In contrast, during the summer, coliform density in the estuary is the lowest as a consequence of dry weather and the disinfection of wastewater treatment effluent that takes place during these months of peak recreational and irrigation activity.

In themselves, fecal coliforms generally do not pose a direct threat to people or animals. However, where fecal coliforms are present, disease-causing bacteria may also be present. Scientists and public health officials use fecal coliforms as an indicator of the suitability of water for domestic, irrigation, recreation and other purposes. Although the estuary is not used as a drinking-water source and is only used for limited contact recreation, water from the river is used to irrigate crops, including those that are eaten raw.

How is the data collected?

Up to 2003:

Monitoring of fecal coliform during the 1990s and into the new millenium was conducted in accordance with the Water Quality Plan for the Fraser River Estuary developed by a intergovernmental Standing Committee in 1991. This program was conducted in three year cycles, and involved both discharge-targeted and ambient monitoring and included a mix of exposure indicators (water and sediment chemistry) and biological response indicators.

Five locations in the Main Arm were monitored every two months: one kilometre up and downstream from the Annacis and Lulu Island wastewater treatment plants, and at Steveston. Data was collected over three seasons: February-April, June-August and October-December. Fecal coliform levels were measured by using the Most Probable Number (MPN) analysis, which is a statistical method based on the random disperson of micro-organisms per volume in a given sample. The data was represented as minimum and maximum 30-day geometric mean coliform counts[vi].

From 2003 on:

After 2003, monitoring of fecal coliform in the estuary changed and is now included under the GVRD Fraser River Ambient Monitoring Program. This program was developed in 2002 to fulfill the GVRD's commitment to environmental monitoring programs, as outlined in the approved Liquid Waste Management Plan (2002).

This monitoring program is carried out on a five year cycle with water column monitoring annually in the January-March period. The program includes seven monitoring sites in the Fraser River within the GVRD, from Kanaka Creek in the Main Stem downstream to the mouths of the North Arm and Main Arm. Six of these sites fall within the FREMP area of interest. Whereas the sites under the previous GVRD monitoring program were chosen to monitor exposure to fecal coliform resulting from a specific source of effluent, those under the new program have been selected to measure environmental quality more generally in the lower river.

Under the Fraser River Ambient Monitoring Program, fecal coliform data is collected during the historical low flow period of mid January to mid March and presented as geometric mean and maximum counts in MPN per 100ml. The provincial water quality objectives also relate to the mean counts, but were intended to monitor summer fecal coliform counts. Provincial objectives do not apply between November 1st and March 31st and do not represent a valid target for data collected through the Ambient Program. As a result, we are comparing against a non-swimming level of 1,000 MPN/100ml as a measure of environmental quality.

Note that there was some overlap between the two sampling programs, and so the graphs below provide results for both the "old" monitoring method with data collected up to February 2004, and the "new" fecal coliform data from 2003 through 2005.

Status and Trends

Following approval of the Estuary Management Plan in 1994, fecal coliform counts in the Main Arm showed a significant decrease. The sudden decrease was a direct result of GVRD upgrading the Annacis Island and Lulu Island wastewater treatment plants to secondary treatment in 1998 and 1999. Since the last EMP Monitoring Report in 2001, and based on sampling up to 2004 using the "old" monitoring method, levels remained low and fecal coliform counts were below 1,000 MPN/100ml in all three seasons of monitoring within each year.

Results from the first two years of the new Ambient water column monitoring are presented in the graphs below. **Mean fecal coliform counts** at all monitoring stations were consistently below 1,000 MPN/100ml in both 2003 and 2004. In fact, mean counts decreased significantly from 2003 to 2004 at the North Arm (Boundary Road) and Main Arm (Ewen Slough) stations. Mean counts exceeded 200 MPN/100ml at only one site, North Arm near McDonald Slough, and will be further assessed as new data is analyzed.

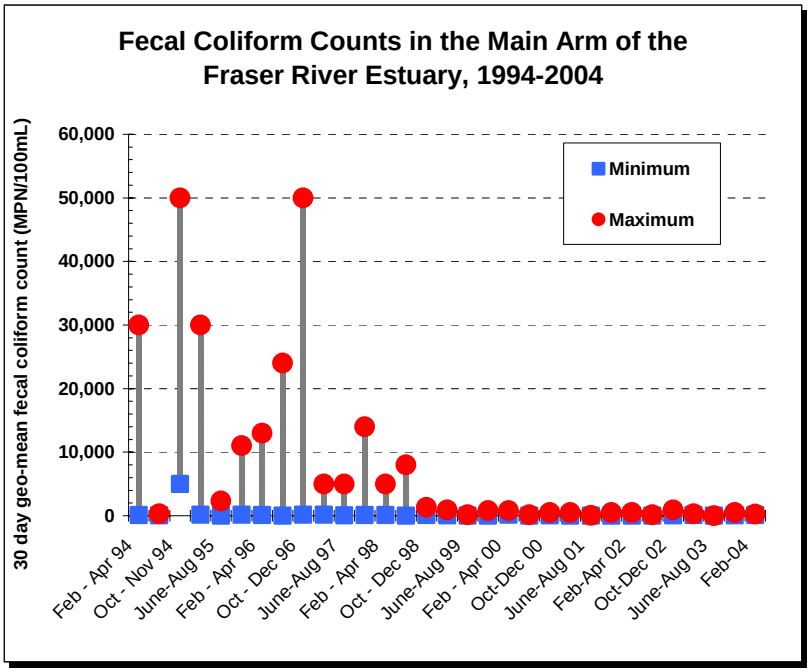


Figure 6: Fecal Coliform Counts in the Main Arm of the Fraser River Estuary, 1994-2004 (old data collection method)

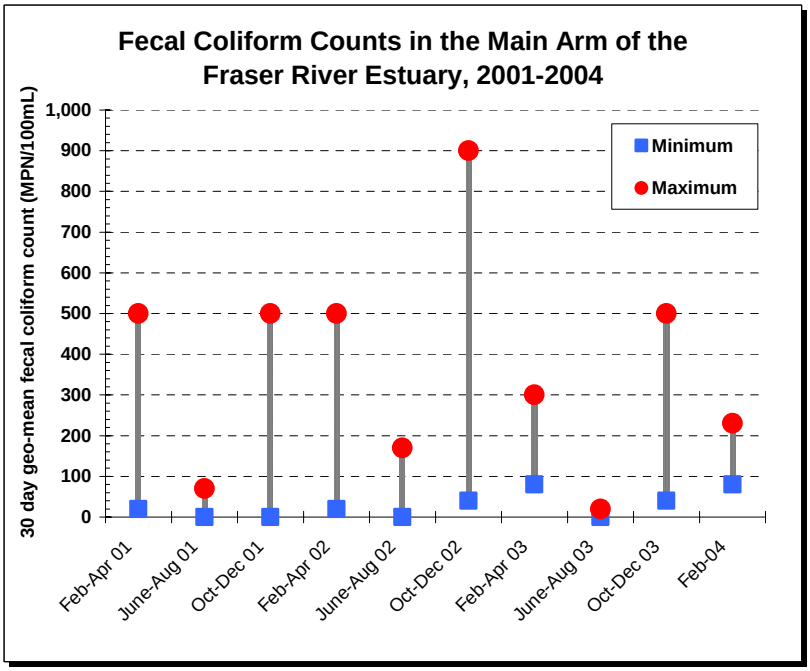


Figure 7: Fecal Coliform Counts in the Main Arm of the Fraser River Estuary, 2001-2004 (old data collection method)

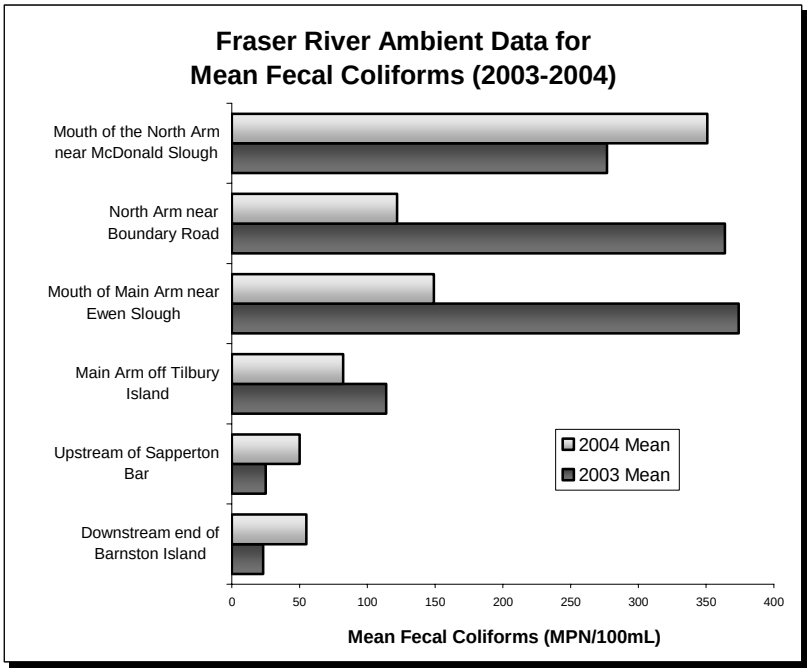


Figure 8: Fraser River Estuary Ambient Data for Mean Fecal Coliforms, 2003-2004 (new data collection method)

What are the FREMP partners doing to maintain and improve water quality in the estuary?

Ongoing monitoring is important to understanding trends in water quality. The GVRD Fraser Ambient Monitoring Program (done in conjunction with BC Ministry of Environment), along with Environment Canada's water quality monitoring in the estuary will improve our scientific understanding of ambient water quality.

Impacts from stormwater and agricultural runoff are minimized through a number of **best management practices** such as industry specific (e.g. boat maintenance facilities) practices, or Nutrient Management Plans for farms. A number of best management practices are available on the BIEAP-FREMP toolbox at http://www.bieapfremp.org/toolbox/index.cfm. As well, the BC Agriculture Council is promoting voluntary **Environmental Farm Plans** that would help to minimize run-off into the estuary and other water bodies.

Many urban **stormwater management initiatives** are ongoing in the region, including Integrated Stormwater Management Plans (ISMPs) being developed by municipalities, which outline stormwater management strategies and monitoring techniques that help to minimize the impact of urban development on watersheds in the region (for more information go to www.gvrd.bc.ca/sewerage/stormwater_reports.htm). Other ongoing initiatives in the region, such as the development of best management practices and source controls, also address the impacts of urban stormwater. More information can be found on websites like the Water Bucket www.waterbucket.ca, Environment Canada www.ec.gc.ca/water and www.waterbalance.ca.

In 2002, the **GVRD Liquid Waste Management Plan was approved** by the Province and is now being implemented. A risk assessment conducted in accordance with the Liquid Waste Management Plan resulted in an extension of the period of effluent disinfection from May 1 – September 30 to April 1 – October 31 to coincide with the irrigation/harvest period for crops that are eaten raw. The river will therefore benefit from a longer period of low fecal coliform concentrations.

A plan is in place to separate the remaining combined sewer systems in the region in accordance with the LWMP.

FISH AND WILDLIFE HABITAT

The Fish and Wildlife Action Program emphasizes the management direction set out in the Estuary Management Plan (EMP) to ensure that the remaining habitat in the Fraser River Estuary is maintained and that new habitat is allowed to develop. In particular, the EMP directs FREMP partners to:

- Conserve and enhance the existing habitat base in the estuary, and secure protection for additional habitat areas with high ecological and biodiversity significance; and
- Monitor habitat losses and gains.

Habitat is therefore a key component for fish and wildlife. The habitat of an organism can be simply defined as the place or home where it lives or is expected to live. Habitats provide everything that a plant or animal needs to live and reproduce—food, nesting sites, protection for offspring, and resting and shelter sites for adults. The physical characteristics of estuarine habitats include sediment texture, water salinity (saltiness) and light. The living parts of the habitat in this context consist of a host of different organisms, including bacteria, plants, fish and birds. A wide diversity of organisms, fish and birds rely on the habitat in the estuary for their survival, including salmon, resident fish such as Starry Flounder, waterfowl and shorebirds.

The following indicator is monitored to reveal how well FREMP and its partners have been doing in maintaining and improving fish and wildlife habitat in the estuary.

FISH & WILDLIFE HABITAT GAINS/ LOSSES

Has productive fish and wildlife habitat increased or decreased in the estuary? *Increase in productive marsh habitat from 2000-2005 and increase overall since 1986.*

Relevant goals in *A Living working River*	To conserve and enhance the environmental quality of the estuary to sustain healthy fish, wildlife, plants and people.
Relevant Targets and Objective	The EMP Fish and Wildlife Habitat Action Program has the following objectives: (1) Conserve and enhance the existing habitat base in the estuary. Secure protection for additional habitat areas with high ecological and biodiversity significance, and (2) Monitor habitat losses and gains.
2001 Report	In the 2001 Report, we reported that from 1986—the year that FREMP's Environmental Review Committee began its work—to 2000, there was a net gain of 92,332 square meters (9.2 hectares) of productive habitat from compensation and enhancement projects.
Conditions and Trends since 2001	Since 2000, habitat gains have been achieved in square metres of highly productive marsh habitat; this gain has mainly been through the conversion of unvegetated intertidal mudflats and sandflats to marsh habitat. Despite some changes in the last five years that tempered previous gains, cumulative habitat gain from 1986 to 2005 still stands at over 88,000 square meters (or 8.8 hectares). Between 1994 - when the Estuary Management Plan was first approved - and 2005, over 26,000 square meters of habitat was gained.

Why measure fish and wildlife habitat gains and losses?

The Fraser River estuary is home or an essential conduit for a diverse abundance of fish and wildlife species. Each spring, hundreds of millions of juvenile salmon spend several weeks feeding in the brackish shallow waters and sloughs of the estuary before migrating to the ocean. Other fish species such as the Starry Flounder spawn and rear in the protected waters of the estuary. Over two million waterfowl and shorebirds also stop in the estuary during their summer and winter migrations along the Pacific Flyway.

Over time, the variety and distribution of animal life has been impacted by changes in land use, land conversions and urban development in the growing Greater Vancouver region. Much of what was previously natural shoreline has

been channelled and modified for industrial, recreational and residential use for a variety of reasons including flood protection. Dyking, draining, filling, and dredging activities have also resulted in losses in the quantity and quality of natural habitats. However habitat enhancement and creation projects initiated in the early 1980s have had the effect of increasing the amount of protected habitat in the estuary, thereby providing food, nesting sites and resting and shelter rises needed by many of the region's fish and wildlife species.

The purpose of this indicator is to monitor and describe losses and gains of each habitat type along the estuary shoreline. Two targets in the EMP relate to the losses and gains in fish and wildlife habitat: (1) to conserve and enhance the existing habitat base in the estuary and where possible secure additional protection for areas of high ecological significance, and (2) to monitor habitat losses and gains. Most of the actions under these objectives continue work begun in earlier years, including the ongoing Coordinated Project Review process through FREMP and annual updates to the Habitat Project Database developed by DFO in the mid-1980s.

For each year since 1986, the indicator describes the square meters of gain or loss in habitat along the estuary as a result of habitat enhancement and creation projects. This information is intended to inform us of how well FREMP has been delivering on the actions in the EMP related to monitoring, maintaining and improving the existing habitat base in the estuary, and how effective those actions have been improving the status quo for habitat. Maintaining and improving the status quo is also consistent with the DFO policy objective for "no net loss" and "net gain" of habitat.

How is the data collected?

Habitat losses and gains resulting from project development in the estuary are recorded and monitored in a database, called the Habitat Project Database. This database, created by Fisheries and Oceans Canada, is housed and maintained by FREMP and updated annually. It contains a mix of qualitative and quantitative information about compensation sites created along the estuary as a requirement of the FREMP Coordinated Project Review process. The database also includes information about habitat enhancement and creation projects that improve the productivity of existing habitats.

The database uses seven categories of habitat to calculate the amount of habitat gained or lost in compensation and enhancement projects in the estuary. These are:

- **Riparian vegetation** comprises streamside tree or shrub and grassy vegetation and plays an important role in filtering and purifying water in the watershed and providing forest-dwelling animals an opportunity to venture into sunnier and more open areas to feed. Trees and shrubs on the banks of river channels and sloughs protect against erosion and provide cover as well as a source of

food for organisms living in the water. Juvenile fish, especially salmonids, benefit from the cooler water provided by the shade of wooded areas along sloughs. As they shed their leaves each year, deciduous trees contribute organic material and nutrients to the estuary, which is a food source for small benthic or bottom-dwelling invertebrates living in marine or riverine sediments. These invertebrates are the main source of food for fish.

- **Estuarine marsh habitat** consists of intertidal areas dominated by marsh plant species such as sedge, bulrush and cat tail. Not only are these the most extensive marshes in the estuary, but they are also the most productive. Marshes provide a food source for wildlife (including waterfowl). They also contribute organic material to the estuary that decomposes to create detritus. This detritus is a food source for benthic invertebrates, which are a food source for fish.
- **Intertidal channels** are small drainage channels that provide low water refuge or feeding areas for juvenile fish and wildlife. Channels also assist in transporting organic material from marshes to other parts of the estuary.
- **Subtidal or intertidal rock** in marine areas typically grows algae and provides cover or hiding places for fish. Algae also provide organic material, which is a food source for small invertebrates, which in turn are a food source for fish.
- **Eelgrass beds** are situated at low intertidal to subtidal elevations in the outer estuarine areas with more marine influence. Eelgrass provides cover or hiding places for fish such as crabs and juvenile salmonids. Eelgrass is also a food source for waterfowl and provides organic material that is a food source for small invertebrates that in turn are a food source for fish.
- **Unvegetated intertidal mudflats and sandflats** provide habitat for small invertebrates such as copepods, ragworms and lugworms, burrowing shrimp and mollusks. Tideflats are used by the largest number of shorebirds on the British Columbia coast. These birds feed on the tideflats by probing and searching in the mud with their beaks. Fish, particularly juvenile salmonids, also feed upon small invertebrates living in the intertidal mud and sand flats.
- **Subtidal habitats** provide living or rearing space for fish by providing and by supporting benthic invertebrates which are a food source for fish.

It should be noted that the relative productivity of intertidal marsh over intertidal mud or sand flat may be more applicable to more freshwater parts of the estuary. In the more marine areas such as Roberts Bank or Sturgeon Bank, intertidal mudflats can be colonized by biofilm which may result in mudflats being as productive as adjacent intertidal marshes. Shorebirds are dependent on energy rich biofilm for food and mudflats are clearly ecologically important to some bird

species. However this indicator is based on fish habitat compensation data and is therefore focused on productivity as it relates to fish and fish habitat.

Status and Trends

Since 1986—the year that FREMP's environmental review committee began its work—the estuary has seen a **net gain from compensation projects of over 88,000 square meters** of productive habitat from compensation and enhancement projects.

As land in and around the estuary has become more developed, however, our capacity to maintain different habitats has become more difficult. Habitat in the estuary is limited and gains in habitat have to be achieved through conversion of less productive habitat types to more highly productive habitat types. If less productive habitats are not able to be converted to highly productive habitats, habitat gains can only be achieved through the creation of habitat from previously disturbed upland sites.

In the freshwater part of the estuary, subtidal habitat is generally less productive habitat than unvegetated intertidal and similarly, unvegetated intertidal habitat is less productive than intertidal marsh. In these areas, marsh is viewed as twice as productive as intertidal mudflats. In light of these differences between habitat types, development projects are usually directed to less productive areas (e.g. subtidal) in order to minimize adverse impacts. If adverse impacts do occur, Fisheries and Oceans Canada requires that efforts be made to compensate for the losses by either constructing habitat similar to that which will be impacted or, if not possible, constructing habitat of higher productivity such as intertidal marsh.

In recent years, habitat gain through compensation has been at the expense of, or through the conversion of less productive freshwater intertidal and subtidal habitat, approximately 11,000 square meters of which was converted in the period between 2000 and 2005. And while these conversions served to temper cumulative gains from previous years, from when the Estuary Management Plan was approved in 1994 up to 2005, net habitat gain in the estuary still stands at over 26,000 square meters.

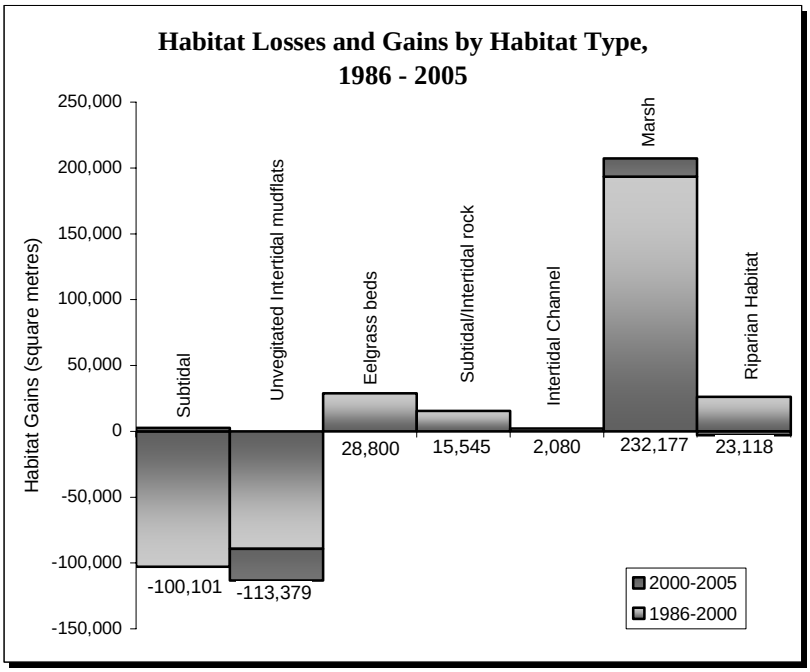


Figure 9: Habitat Losses and Gains by Habitat Type, 1986-2005 (based on habitat compensation data)

As shown in the graph, the habitat types where overall area (square meters) has been lost have been mainly those in subtidal and intertidal mudflats, whereas the greatest gains in habitat over that same time period have been with respect to highly productive marshes which generally host a larger and broader range of species. There was no change (gain or loss) over the past five years in the amount of eelgrass beds, subtidal/intertidal rock, and intertidal channel habitat.

It should be noted that riparian vegetation gains and losses, as recorded in the habitat database, only reflect development projects that involve some loss of riparian habitat. A development, for example, that includes a setback along the river and is planted with riparian vegetation with the effect of only enhancing habitat, would not be included in the Habitat Project database even though it results in a riparian habitat gain.

Link to the FREMP Habitat Classification

The FREMP Habitat Classification System is a three-tiered "colour coding" that classifies intertidal and riparian areas in the estuary on the basis of the relative values of their habitat features and functions. The classifications are based on a habitat inventory mapping of the estuary first done in the late 1980s and recently updated in 2003.

Red-coding indicates an area of high habitat productivity, yellow-coding moderate productivity, and green-coding low productivity. These classifications are an important tool in the review of shoreline projects by the FREMP Environmental Review Committee as part of the Coordinated Project Review process. In general, shoreline development is directed away from red-coded areas where

compensation is not an option; in yellow-coded areas, habitat mitigation and/or compensation are pursued; and in green-coded areas, mitigation is the focus.

The inventory and colour coding are key tools to identify and protect areas of high habitat value and to help conserve the existing habitat base in the estuary.

The FREMP habitat classifications were reviewed and updated in 2005, based on the updated habitat inventory. Total shoreline measurements for red, yellow and green-coded shoreline are provided below.

Summary of FREMP Shoreline Colour Code Measurements at 2005 (in meters)

Red	Yellow	Green
381,979 (73%)	**73,181 (14%)**	**69,867 (13%)**

What are FREMP partners doing to preserve or enhance fish and wildlife habitat in the estuary?

The FREMP Habitat Classification System or "colour coding" is based on the habitat inventory which covers 540 km of shoreline in the Fraser River estuary. In 2003, the **habitat inventory was updated** based on an ecological features and functions approach which looks to reveal and protect the underlying needs of the system (e.g., tall trees for bird nesting and deep water for ship moorage).

Based on this new inventory mapping, the **FREMP habitat classifications were then updated** in 2005 per the commitment in the EMP. The updates reflect natural changes along the river, and ensure that a key decision-making tool and FREMP product remains useful and relevant to partners and proponents along the river.

The **habitat inventory and classification can now be viewed in a web-based FREMP Atlas** available on the Community Mapping Network at http://www.shim.bc.ca/atlases/atlas.html#frem.

Through the **FREMP Environmental Review Committee and the Coordinated Project Review process**, FREMP partners including the Fisheries and Oceans Canada work with developers to ensure that net gains are made where possible and that any impacts or habitat losses are adequately mitigated or compensated. More information on the Coordinated Project Review process is available at http://www.bieapfremp.org/fremp/projectreview/index.html.

A **Biodiversity Conservation Strategy for the Greater Vancouver Region is under development** and being coordinated through the GVRD with a number of partners. The Strategy will identify key areas of biodiversity significance in the region and propose tools for biodiversity conservation.

NAVIGATION AND DREDGING

The Fraser River has long been an important transportation route for the province. Its length, breadth, and outlet to the sea have fostered continued growth in settlement and development along the estuary. Commercial shipping plays a major role in the continued vitality of the Lower Mainland economy. At the same time, natural processes occurring along the 1,400-kilometer length of the Fraser River cause it to carry a substantial sediment load transporting millions of cubic meters of gravel, sand and silt from the interior of BC to the ocean. While the sediment load is responsible for the rich agricultural lands in the delta and productive aquatic habitats in the estuary, these sediments can also constrict navigation channels and contribute to the risk of flooding along the river. Each year, therefore, the main navigation channel in the estuary is dredged to prevent it from becoming too narrow and too shallow for vessel traffic.

The Dredging and Navigation Action Program emphasizes the management direction set out in the Estuary Management Plan to maintain the careful balance between shipping and habitat needs. In particular, the EMP directs FREMP partners to:

- develop and maintain a functional navigation system that supports water-dependent development in a manner that protects environmental quality; and,
- manage sediment removal from the river in a manner that balances with all components of the sediment budget of the river system.

All agencies concerned with dredging recognize the need to minimize the environmental impacts of this activity. For this reason, FREMP partners have agreed that the amount of dredging must be sustainable while still maintaining existing navigation channels between New Westminster and the river's mouth. The following indicator provides evidence of how well FREMP and its partners are balancing economic development and environmental management.

SEDIMENT REMOVAL

Has the amount of sediment removed from the estuary been within the limits of the river to replenish itself? *YES.*

Relevant goals in *A Living Working River*	Conserve and enhance the environmental quality of the river and estuary to sustain healthy fish, wildlife, plants and people. Respect and further the estuary's role as the social, cultural, recreational and economic heart of the region. Encourage human activities and economic development that protect and enhance the environmental quality of the estuary.
Relevant Targets and Objectives	The EMP Navigation and Dredging Action Program has the following objectives: (1) Develop and maintain a functional navigation system that supports water-dependent development in a manner that protects environmental quality, and (2) Manage sediment removal from the river in a manner that balances with all components of the sediment budget of the river system. The amount of sediment removed over a ten year period should not exceed the Sediment Budget set through the FREMP Water and Land Use Committee.
Baseline	In 1997, the year that FREMP begin calculating a Sediment Budget, the amount of sediment (specifically, sand) removed from the estuary was 1.83 million cubic meters less than the Sediment Budget.
2001 Report	By the year 2000, the accumulative average amount of sediment removed from the estuary since 1997 was 2.66 million cubic meters less than the accumulative Sediment Budget.
Condition and Trends since 2001	The volume of sediment dredged over the last eight years in the estuary has remained within sustainable levels. Since 2001-2002, the amount of sediment removed from the estuary exceeded the annual Sediment Budget but the accumulative average amount of sediment removed between 1997 and 2005 is still 480,000 cubic meters less than the accumulative Sediment Budget.

Why track the amount of sediment removed from the estuary against the Sediment Budget?

The Fraser River delta comprises three main channels: the South Arm which carries up to 85% of the river flow below New Westminster; the North Arm (15%), and the Middle Arm (which carries 1/3 of the North Arm flow). Within these river

channels, there are designated navigation channels to support a variety of marine transportation.

The river serves as an important conduit for deep sea vessels in the South Arm, coastal vessels (e.g. tugs and barges) in the North Arm, log storage areas, commercial fishing boats and recreational boats. As shipping and port activity increases in the region, the main navigation channel has been deepened over recent years (2001-2005) to accommodate larger ships that can bring in greater volumes of goods to our ports. This channel deepening, along with ongoing maintenance dredging to ensure the riverbed does not aggrade, are critical to the local, regional and global shipping industry and the role of the estuary as the economic heart of the region.

At the same time, the unique hydrology and sedimentation that occurs in the estuary supports a rich diversity of valuable fish and wildlife populations. The maintenance and improvement of navigation channels on the river through dredging, river training and marine navigation services must therefore take into consideration a wide range of river uses and values.

The purpose of this indicator is to monitor and maintain the careful balance between shipping and habitat needs. It monitors sediment removal in relation to the Sediment Budget which is forecast annually by the FREMP Water and Land Use Committee. The FREMP Sediment Budget is a measure of the net change in sediment stored in the river as a function of the total inflow of sediment at Mission minus the outflow of sediment into the Strait of Georgia.

The Sediment Budget is derived from a mathematical model described in detail in a report entitled "Lower Fraser River Sediment Budget Analysis" prepared for FREMP by Northwest Hydraulic Consultants in 1999 and reviewed in 2002. The model shows that a long-term equilibrium in the riverbed can be maintained if the net dredging volumes are maintained at about 70% of the incoming bed material load. The objective of the Sediment Budget is to ensure that the average amount of sediment - specifically sand-size grains between 0.177 and 2.0mm - removed over a five- to ten-year period does not cause a net change of degradation in the riverbed that would have long-term impacts on the hydraulics of the river, reducing the river's capacity to transport sediment.

The Sediment Budget is calculated annually for what is called the "freshet" or "dredging" year. This is the period of time between freshets (high water flow caused by snow melt, usually from May through July) during which dredging may occur. Generally, the dredging year runs from August of one calendar year to March of the next calendar year.

Together with the FREMP Dredge Management Guidelines, the Sediment Budget helps the FREMP partners work towards the goal of balancing sediment removals with the estuary Sediment Budget.

How is the data collected?

The amount of sediment removed through dredging operations is collected by the Port Authorities (for dredging in the estuary) and Environment Canada (for ocean disposal). Records of the amount of sediment removed from the river are maintained in a database called the Sediment Registry which resides at the FREMP office. Annual database updates are undertaken through the FREMP office, based on data provided by the Fraser River Port Authority.

Status and Trends

The following table outlines the quantity of dredging conducted per year in the estuary, in relation to the Sediment Budget. It shows the total amount of sediment removed per year, as well as the amount removed less capital dredging volumes beginning in 2001. The shaded rows indicate data used in the 2001 Monitoring Report; newer data is included in the rows that follow.

Sediment Budget, Dredging Activity, and Shortfall or Surplus, 1997-2005[vii]

Fiscal Year	Sediment Budget (m^3)	Sediment Dredged	Sediment Dredged Less Capital Dredging	Shortfall/ Surplus each year	Cumulative Avg Shortfall Since 1997
1997-1998	3,300,000	1,320,000	1,320,000	1,980,000	1,980,000
1998-1999	780,000	1,000,000	1,000,000	-220,000	1,760,000
1999-2000	3,150,000	1,850,000	1,850,000	1,300,000	3,060,000
2000-2001	1,190,000	1,200,000	1,200,000	-10,000	3,050,000
2001-2002	500,000	760,000	550,000	-50,000	2,900,000
2002-2003	2,090,000	2,790,000	2,310,000	-220,000	2,680,000
2003-2004	430,000	1,610,000	1,450,000	-1,020,000	1,660,000
2004-2005	390,000	1,960,000	1,670,000	-1,280,000	480,000
Total	**11,830,000**	**12,490,000**	**11,350,000**	**480,000**	

The distinction between maintenance and capital dredging is that maintenance dredging is to maintain the pre-established dimensions (width and depth) of the main navigation channel, while capital dredging is an economic decision intended to increase the dimensions of the navigation channel in order to accommodate

larger ships. Both types of dredging go through an environmental review by agencies. The annual and cumulative shortfalls in this table are based only on the quantities removed through maintenance dredging, as it is this form of dredging to which the Sediment Budget and the principle of "sustainable sediment removal" applies.

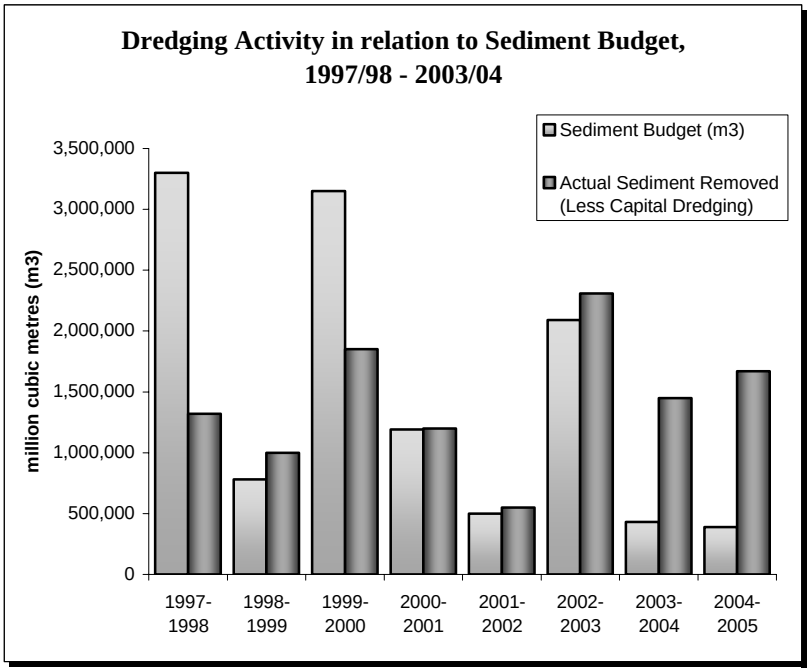


Figure 10: Dredging Activity in relation to FREMP Sediment Budget, 1997-2004

The volume of sand-size grain material dredged over the last eight years in the estuary amounts to 67% of the forecasted bed material load and therefore has remained within sustainable levels (below 70%). The net infill in the navigation channel during the past eight years is estimated to be 0.48 million cubic metres.

Since 2000, the amount of sediment removed annually has exceeded the Sediment Budget, with the greatest departures occurring in 2003-2004 and 2004-2005. However freshet volumes were uncommonly low in both these years – below 450,000 m^3 and the Sediment Budget model does not work as effectively in predicting sediment volumes in years of very high or very low flows. As a result, dredging efforts in recent years were also guided by Port-funded hydrographic surveys of the riverbed pre- and post-dredging, showing areas of scour and infill.

What are the FREMP partners doing to ensure sustainable sediment removal?

- **FREMP uses the Sediment Budget** to monitor the amount of sediment dredged from the estuary each year and ensure that the average amount of removed over a five to ten year period will not change the shape of the river bed.
- With the assistance of Public Works Canada, **Fraser River Port Authority conducts hydrographic surveys of the estuary** to determine areas of scour and infill, which informs their annual dredging efforts. Fraser Port has also undertaken a number of studies on the potential biological impacts of dredging in parts of the estuary, which have found benthic and fish communities show resilience and recovery within a short time frame after dredging.
- The **FREMP Dredge Management Guidelines, recently updated in 2005**, provide an important framework for managing sediment removals in a sustainable manner. The guidelines reflect a consensus among the regulatory agencies, and provide guidance to proponents along the river on the dredging application and review process.
- In 2006, the FREMP Water and Land Use Committee developed an **Environmental Management Strategy for Dredging in the Fraser River Estuary** that identifies our environmental knowledge for each channel segment of the estuary and data gaps regarding the potential biological impacts of dredging.

INDUSTRIAL AND URBAN DEVELOPMENT

The Fraser River estuary is a natural transportation corridor that flows through Greater Vancouver and connects the Lower Mainland to BC's coastal communities. The estuary plays a significant role in international and domestic (coastal) shipping: it hosts the largest shipping ports in the country and represents a pivotal gateway for BC's and Canada's international trade throughout the Pacific Rim. Port activities that take place in the estuary generate thousands of jobs in BC and across the country. They also produce billions of dollars in economic output and make a key contribution to the Gross Domestic Product.

Many national and international companies have been drawn to the Fraser River estuary because of the excellent port facilities, abundant hydroelectric power, efficient intermodal transportation and the large pool of skilled people in the surrounding communities. As a result, the largest industrial area in BC has been established along the Fraser River estuary.

The Industrial and Urban Development Action Program emphasizes the management direction set out in the Estuary Management Plan to:

- Protect strategic land and water areas for water-related industries and encourage new industries to locate in the estuary;
- Encourage industrial and urban development to locate in areas in the estuary where conflicts with habitat protection and incompatible uses are minimized;
- Incorporate water-based transportation for goods and people movement into the regional transportation system.

The following two indicators are monitored to reveal how well FREMP partners have been doing in meeting these objectives.

MARINE CARGO

Have total cargo volumes in the estuary increased or decreased? *INCREASED.*

Relevant goals in *A Living Working River*	Respect and further the estuary's role as the social, cultural, recreation and economic heart of the region.
Relevant Targets and Objectives	The EMP Industrial and Urban Development Action Program has objectives to protect strategic land and water areas for water-related industries, and incorporate water-based transportation for goods and people movement into the regional transportation system.
Baseline	In 1985, FREMP-area cargo (both coastal and international cargo) volumes totalled 42.38 million tonnes. This represented 52% of all regional marine cargo.
2001 Report	In 2000 FREMP area's share of the total regional marine cargo was 64% and FREMP-area cargo volumes totalled 89.60 million tonnes.
Conditions and Trends since 2001	The estuary's share of the total regional marine cargo has increased significantly since 2000, particularly with respect to international cargo volumes. In 2004, FREMP-area cargo volumes totalled 109.97 million tonnes. This represented 71% of all regional marine cargo.

Why measure and track the regional marine cargo volumes?

Greater Vancouver is home to one of the largest ports in North America and some of the most modern container terminals in the world. The trans-pacific container trade has grown dramatically in recent years, and this growth is not expected to subside significantly over the next two decades. Container handling facilities on the Lower Mainland are being expanded and developed to capitalize on this major market opportunity. The region's container terminals are well positioned to capture a large share of the growth in container imports from and exports to Asia.

Industries that use the river for the movement of goods contribute to the sustainability of the FREMP area in a number of ways. The marine cargo and shipping industry represents a key source of growth and activity and growth for the region. As a major employer and supplier of goods, it also supports the social fabric of Greater Vancouver and coastal British Columbia.

This indicator tracks the total volumes of cargo imported from and exported to international and coastal destinations through terminals in the FREMP area. The

movement of goods through the estuary bears significance for the economic, social and environmental quality of region. It is particularly relevant in illustrating the goal of the Estuary Management Plan related to promoting the "working river" and the FREMP area as the "economic heart" of the region.

How is the data collected?

Three port authorities operate in the FREMP area: North Fraser Port Authority, Fraser River Port Authority and Vancouver Port Authority operations at the Roberts Bank terminal, and each of these organizations has been collecting cargo volume information on an annual basis at least as far back as 1985. Data for Deltaport/TSI was collected starting in 1996.

Before 1991, Statistics Canada collected cargo statistics for Fraser Port, and included only cargoes pulled by tugs weighing over 5 tonnes. This significantly under-counted the volume of trade in the Fraser River Port Authority jurisdiction, and created a significant jump between pre-1991 and post-1991 cargo statistics, now collected by the Port Authority. To permit analysis of change over time, the pre-1991 statistics have been adjusted by comparing trends with those from the North Fraser Port Authority (whose records are accurate) and Fraser Port's since 1991. About 60% of all logs towed through the North Fraser Port Authority also enter the waters of the Fraser River Port Authority. The statistics for coastal cargo have been adjusted to reflect this double counting.

Status and Trends

Over the last decade, FREMP-area cargo volumes have grown substantially. Total cargo volumes in the FREMP area include coastal cargo and international cargo along the Fraser River, as well as international cargo volumes for Westshore Terminals and Deltaport/TSI along Roberts Bank. Total FREMP-area cargo volumes have risen from 42.38 million tonnes in 1985, to 89.60 million tonnes in 2000, reaching 109.97 million tonnes in 2004 as shown in the graph below.

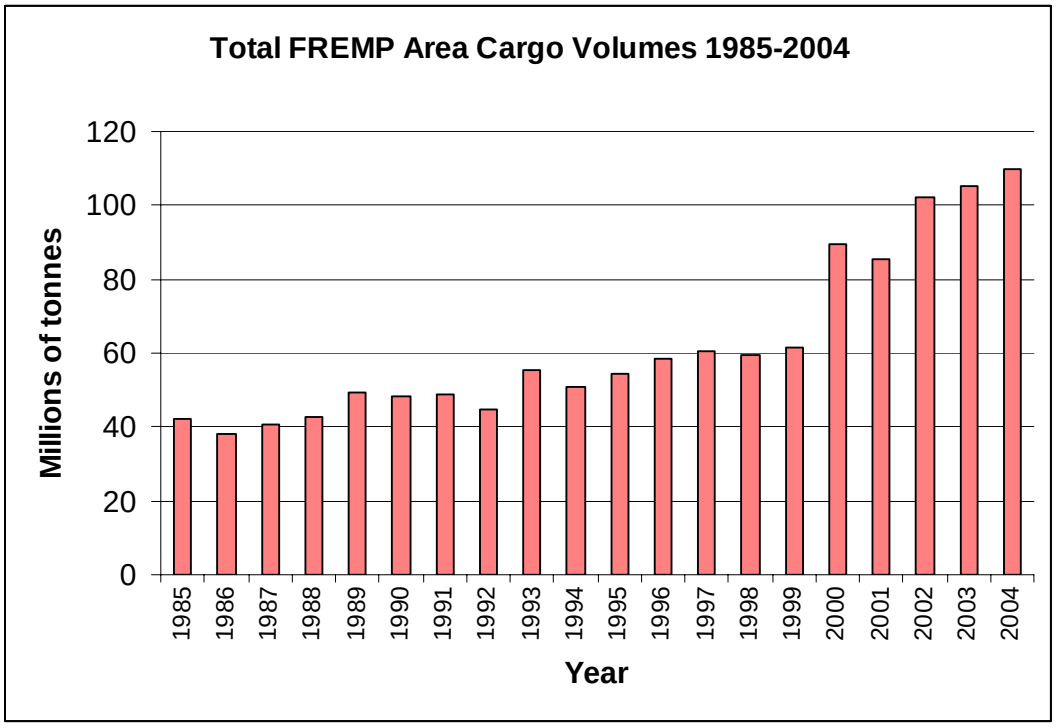


Figure 11: Total FREMP area Cargo Volumes, 1985-2004

The estuary's contribution to the movement of coastal cargo also remains significant. Total coastal cargos between the estuary and BC's coastal communities have grown steadily since 1994. Coastal cargo volumes rose from 23.19 million tonnes in 1985, to 30.6 million tonnes in 2000, to 38.8 million tonnes in 2004. The more recent growth from 1994 to 2004 is shown in the graph below.

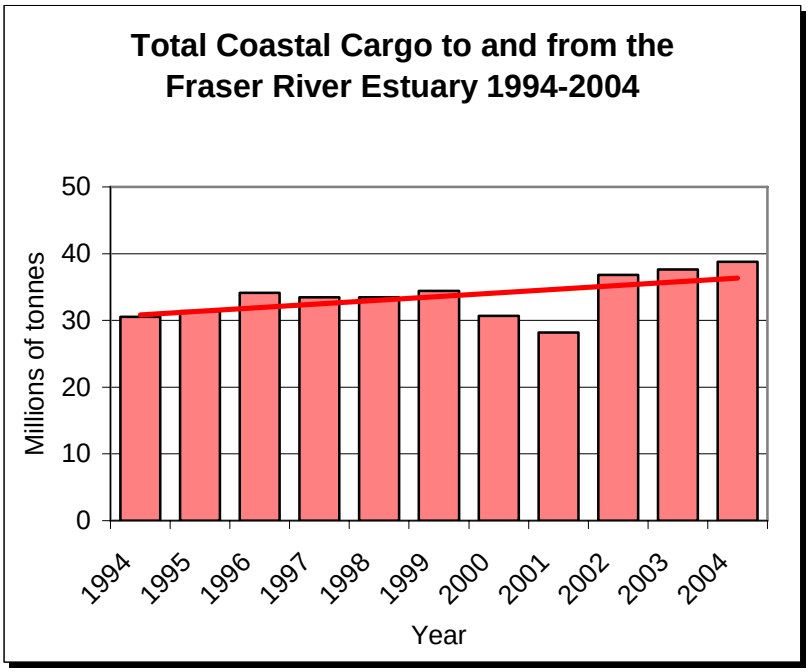


Figure 12: Total Coastal Cargo to and from the Fraser River estuary, 1994-2004

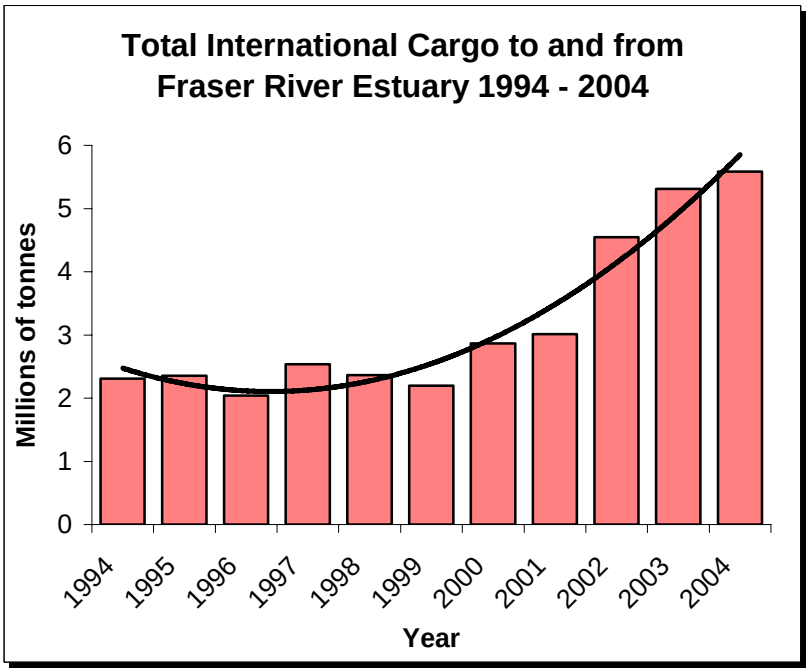


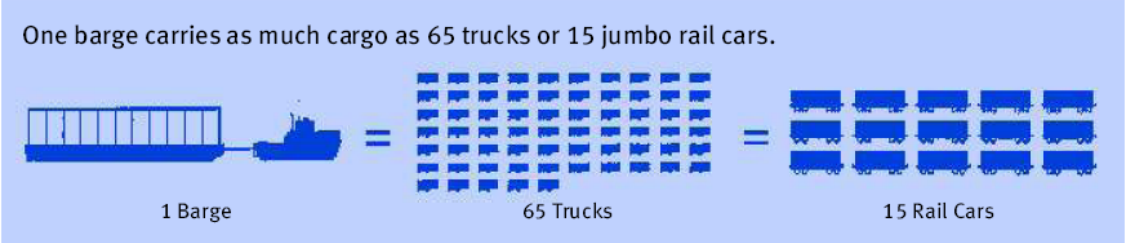
Figure 13: Total International Cargo to and from the Fraser River estuary, 1994-2004

The FREMP area has also experienced considerable growth in the volume of international, trans-pacific cargo as shown above. In 2004, 5.59 million tonnes of international cargo was imported or exported into the estuary, compared with 2.31 million tonnes in 1994 - more than double the cargo that moved through the estuary when the original Estuary Management Plan was first approved.

Short Sea Shipping

Currently, about 65% of Greater Vancouver's containers leave or arrive at the deep sea terminals by rail. The remaining 35% are transported within the region by truck to a wide variety of container industry businesses. The regional road network is already congested, especially during peak periods and primarily because of increasing commuter traffic. Despite major road transportation improvements planned in the Lower Mainland as part of the Gateway Program, trucking companies are expected to face increasing challenges in the future with respect to moving containers in a timely manner.

As such, short-sea shipping or moving goods by barge may play a greater role in the regional transportation system in the coming years, with containers and other goods being moved from deep sea ports by barge rather than truck. A FREMP 2002 report found that compared to trucking, barging represented approximately one-tenth the costs of transport and one-twentieth the environmental costs for the same scenario. With continued growth in cargo volumes, expected increases in environmental emissions from the intra-regional transfer of containers by truck could be moderated to the extent that short-sea operations absorb some of the future container volume growth. This is particularly true of the key greenhouse gas emission (CO_2) as well as Volatile Organic Compounds (VOC) emissions.



In 2004, FREMP partnered with VPA, FRPA, NFPA and Transport Canada to explore the feasibility of barging containers between the regional deep sea ports and container-related nodes located close to the river. The study found that intra-regional short-sea shipping in Greater Vancouver offers promising, commercially viable, private sector opportunities in the short to medium-term for several short-sea container terminals on the Fraser River - specifically in the Fraser Surrey area and at Coast 2000 (Modalink) based on a volume of 200 containers per round trip or greater (i.e. a minimum of 20,000 to 40,000 containers annually). Short-sea container operations have proven to be successful in many parts of the world, including Europe and Asia, and could help alleviate road traffic congestion and lower greenhouse gas emissions in the region.

FORESHORE LAND AVAILABLE FOR INDUSTRY

Is the amount of estuary shoreline available for industrial use increasing or decreasing? *TO BE DETERMINED.*

Relevant goals in *A Living Working River*	Respect and further the estuary's role as the social, cultural, recreational and economic heart of the region.
Relevant Targets and Objectives	The EMP Industrial and Urban Development Action Program has objectives to protect strategic land and water areas for water-related industries and encourage new industries to locate in the estuary, and to encourage industrial and urban development to locate in areas in the estuary where conflicts with habitat protection and incompatible uses are minimized.
Baseline	In 2001, we used 1997 data to report on land available for water-dependent industry by looking at the percent of FREMP green-coded shoreline that was occupied industrial land, or unoccupied but available for industrial use. The focus of this analysis was related to water-dependent industry that required proximity to the river. In 2006, we are reporting on this metric using the GVRD *Industrial Lands Inventory for Greater Vancouver* completed in 2005. By applying this data to the shoreline in the FREMP area, we can identify metres of shoreline that are currently used for industrial purposes (whether water related or not), or that are vacant but will be developed for industrial purposes according to municipal Official Community Plans. The inventory forms a new baseline for this indicator; the data will be updated over time and allow trends to be established for industrial use along the foreshore.
2001 Report/ 2002 Economic Vision Report	In 2001, just over 40,000 meters or 7.4% of green-coded shoreline in the estuary was classified as occupied industrial land or unoccupied but available for industrial use.[viii] Over 69,000 meters or 12.8% of the estuary shoreline was deemed related in some way to industrial use. In 2002, using a more comparable shoreline measurement based on GVRD land use maps, we reported that 73,015 meters of shoreline was categorized as industrial use and over 34,000m of shoreline was open/undeveloped; these two numbers combined represented approximately 34% of the total shoreline.
Conditions and Trends	At 2005, 101,958 meters or 29.5% of the total estuary shoreline was developed or vacant industrial land frontage within a 100m buffer of the shoreline. Of this amount, 79,738 m represented developed industrial land frontage and 22,220 m was vacant land that will be developed for industrial purposes.

Why measure land available for industry?

Water-related industry provides many benefits to communities, the region, and the country, contributing to the region's industrial diversity and making use of the most environmentally sustainable form of cargo transportation. Water-related industry includes those industries that need proximity to the river to do their business (including lumber mills, fish processing plants, ship building/repair and marinas), and industries that provide support or assistance to the first set of industries (including bulk distribution and storage, loading and transfer intermodal yards, and shipping services, and marine terminals). Studies have shown that there are over 700 firms that have a direct relationship with the operations of the Fraser River; of these, about 222 firms are water related to their economic function.

In recent years, the location of industrial activity continues to decentralize from the traditional areas and relocate eastward or outside the region. As well, the replacement of industrial activities on the river by other land uses is a pressure that has shaped the foreshore, and market forces from non-related water uses may erode the future potential of sites to serve the Fraser River estuary economy.[ix] Consolidation of industrial operations, such as in the forest sector, has led to land uses changes along the river, in some cases with new residential developments replacing former sawmills. More parks have been established in the estuary, along the water or in park reserves like Douglas Island. The focus has moved from preserving industrial lands along the river to focusing on critical strategic nodes for intermodal movements and short-sea shipping.

Opportunities are offered by increasing the role of water-based transportation within the region to reduce highway congestion and help achieve a reduction in greenhouse gas emissions. And as a result of the decline in the forest sector and other primary industries along the foreshore, opportunities exist for large redevelopment on strategic sites for "water-based nodes".

So while a FREMP goal remains to identify and increase market demand for water-related business in the estuary, the focus on preserving waterfront lands for water-dependent industry has shifted to protecting *strategic nodes* for water-related industries. These sites provide critical access points to the river for goods movement and are important pieces in the promotion of water-based intermodal transportation – short-sea shipping or barging - as part of the regional transportation system.

The working waterfront plays as an important part of a community's maritime heritage and economy, and the viability of these industries depends in part on the availability of suitable waterfront land. However, because the waterfront is also an attractive place to live, there is competition for the limited land area that surrounds ports and for redevelopment that can endanger these important uses.

Some industrial sites along the estuary that were used previously for primary industry and manufacturing have been redeveloped over recent years for other uses like housing. With these land use changes, the supply of riverfront land for industrial uses may be diminishing.

In addition, there are portions of the estuary shoreline where urban development is not encouraged. The FREMP habitat classification, or colour coding system, classifies the overall habitat value of the river shoreline and specifies requirements for human use and development. These requirements are based on federal and provincial policies and legislation to protect aquatic and riparian habitat:

- In the areas with low productivity, coloured green, development is permitted subject to environmentally-sound design and timing restrictions.
- In the most productive habitat areas, coloured red, development is only permitted if the proponent can show that no alteration to or alienation of the habitat will occur.
- In moderately productive areas, coloured yellow, development is permitted subject to satisfactory mitigation and/or compensation actions.

This indicator relates to the amount of river frontage currently in use by industry or planned for industrial use. The purpose of monitoring this indicator is to identify the different types or categories of land use along the estuary foreshore; changes in this estuary foreshore land use over time; and more specifically to industrial use, the length of developed or vacant industrial lands along the Fraser River estuary foreshore. Monitoring foreshore land use provides a useful snapshot of the "working river".

How is the data collected?

In 2002, the FREMP Economic Development Task Group prepared an Economic Vision for the Fraser River, whose objectives were captured in the updated Estuary Management Plan. The 2002 Report compared GVRD land use maps to examine the change in the estuary foreshore land use from 1979 to 2001 (see table below). It should be noted that GVRD land use maps are compiled based on municipal Official Community Plans that outline designated land uses; they are not based on actual land use or zoning.

Shoreline Length along Fraser River Estuary Foreshore, by Land Use Type

Metres of Foreshore	1979	1996	2001	Change 1979-2001
Commercial	2,060	3,010	3,590	+1,530
Agricultural	67,230	53,300	53,300	-13,930
Industrial	71,430	74,420	73,015	+1,585
Open	93,320	44,030	34,590	-58,730
Recreational	43,110	95,110	99,800	+56,690
Residential	10,000	14,980	15,700	+5,700
Transportation	24,060	26,360	31,215	+7,155
TOTAL	311,210	311,210	311,210	0

Source: *Toward an Economic Vision for the Fraser River Estuary, 2002*

The above table showed that foreshore trends were characterized by increasing commercial, residential, transportation and recreational uses. In total, the largest foreshore use in 2001 continued to be recreational functions, followed closely by industrial and agricultural lands. While industrial use along the foreshore had increased from 1979 to 1996, it declined slightly from 1996 to 2001.

While the 2002 FREMP report provided data on foreshore land use and specifically industrial use along the foreshore – indicating a possible trend to declining industrial lands along the Fraser River estuary - a more detailed dataset was available for this Monitoring Report. FREMP opted to make use of this more recent and rigorous data, and on the understanding that it will be updated in the future and allow us to see foreshore land use trends over time.

The *Industrial Lands Inventory for Greater Vancouver* (2005) was prepared by the GVRD in support of the Livable Region Strategic Plan update. The detailed GIS and parcel-based Industrial Lands Inventory estimates how much and where land is allocated for industrial use in the region, how much of the industrial land base is

currently utilized by industry, and how much is vacant (not currently utilized by industry, but designated for future industrial development). As part of the study, information on all potential development constraints was not readily available. Where available, such as the FREMP red-coded areas, this information was captured and these parcels were excluded. Steep slopes, setbacks from streams and water bodies, environmental constraints or sensitive areas, and lands prone to natural hazards all reduce the amount of land that is potentially developable for industrial purposes.

Status and Trends

The GVRD Industrial Lands Inventory found that in 2005, there were 26,089 acres (10,558 ha) of industrial land in Greater Vancouver. Approximately 74% of the industrial land, or 19,230 acres (7,782 ha), has been developed. The remaining 26% of industrial land supply, or 6,859 acres (2,775 ha), is vacant. The region's federal port-related lands (Vancouver International Airport, Vancouver Port Authority, Fraser River Port Authority and North Fraser Port Authority) account for 700 acres or roughly 10% of the vacant inventory, and approximately 60% (445 acres) of these are deemed to be market ready in status.

To establish how much of this area relates to the Fraser River estuary shoreline, the inventory results were analyzed for a 100m buffer of the shoreline. The Industrial Lands Inventory is a parcel or polygon-based data set, and in order to develop an appropriate measure of industrial use or potential along the estuary, a buffer had to be established. This buffer captures industrial lands right on the shoreline as well as those that are set back from the river, often by a dyke or road. A smaller buffer would omit large industrial parcels most would consider as "waterfront" properties; a larger buffer of, for example 200m would capture "upland" properties not connected with the river.

The summary of this analysis is presented below for both developed lands (either designated and used as industrial, or zoned industrial and used for industrial purposes) and undeveloped or vacant lands (that will be developed for industrial purposes, according to municipal OCPs). Percentages are based on a total estuary shoreline measurement of 345,227m, representing a straight line parallel to the shoreline and not the natural, variable shoreline which would be longer. The outer banks including Boundary Bay and Roberts Bank are not included in these shoreline measurements.

Developed and Vacant Industrial Lands within 100m of Shoreline

Industrial Lands	Meters of shoreline	% of total estuary shoreline
Developed Land	79,738	23.1%
Vacant Land	22,220	6.4%
TOTAL	101,958	29.5%

It is important to note that these numbers are not directly comparable to the earlier results from the 2001 EMP Monitoring Report or 2002 Economic Vision Report, because different methodology was used to collect and analyze foreshore land use data. As noted above, GVRD plans to update the Industrial Lands Inventory for Greater Vancouver in the future, and from this update, trends can be determined for industrial land use along the estuary shoreline.

What are FREMP partners doing to support industrial and urban development in the estuary?

Plans to **expand existing port facilities** in the estuary are currently underway. It is estimated container shipments to Vancouver will grow by 200% over the next 15 years, ultimately leading to more than 5 million containers being processed through the ports each year.

Since 2000, the marine industry has received considerable attention in relation to air quality. Among the anthropogenic emission sources in the region, marine vessels have been identified as significant sources of Sulphur Oxides (SOX) and Nitrogen Oxides (NOX). Systems are in place to **monitor shipping emissions** and a number of initiatives are underway to improve local data on fuel quality and engine characteristics of vessels operating in the region, and to develop cost-effective emission reduction measures. The International Maritime Organization **Sulphur Emissions Control Area is under development** for the west coast of North America that would limit the sulphur content of marine fuels burned in these areas from 4.5% to 1.5%. The Vancouver Port Authority also recently tested a fuel additive on its cargo-handling equipment which showed promise for lowering emissions.

FREMP partners and municipalities negotiate **Area Designation Agreements** that outline a shared understanding of current and future water and land uses, in order to link foreshore habitat colour coding with upland uses and protect areas of the

shoreline for specific uses. To date, six agreements have been reached and an agreement with Delta is pending.

FREMP is also **developing Reach Overviews** for ten reaches of the estuary, as outlined in the updated Estuary Management Plan. Reach Overviews are a planning tool to integrate water and upland uses and promote a "features and functions" approach along the river. An ecological features and functions approach identifies the natural and human processes that need to be preserved in any given location, then identifies the types of activities that can occur in the places without compromising these processes. Rather than focusing on specific resources, the approach attempts to reveal and protect the underlying needs within a system. The Pitt River Reach Overview was the first to be completed, in October 2005.

RECREATION

One of the primary ways in which people experience and appreciate the Fraser River Estuary today is through recreation. As one of the largest open spaces in Greater Vancouver, the estuary provides a critical area for people to get outside and enjoy nature. The waters of the estuary currently support pleasure boaters, sports fishing, canoeing, kayaking and a variety of other water sports. The regional and municipal parks established along the estuary shorelines represent prime areas for walking, jogging, bicycling and viewing wildlife.

These spaces are also rich in historical and cultural significance. Since people have lived in this region, the Fraser River has been a lifeline for food, transportation and trade. The lands around the estuary contain a number of heritage buildings that attest to our historical relationship with the river.

The Recreation Action Program emphasizes the management direction set out in the Estuary Management Plan (EMP) to:

- create new parks and green spaces along the estuary and develop greenways to link these; and
- develop a water-based recreation plan for the estuary.

The following two indicators are monitored to reveal how well FREMP partners have been doing in improving recreational access to the river.

RECREATIONAL CORRIDORS ALONG THE SHORELINE

Has the length of recreational corridors along the estuary increased or decreased? *INCREASED.*

Relevant goal in *A Living Working River*	Respect and further the estuary's role as the social, cultural, recreational and economic heart of the region.
Relevant Targets and Objectives	The EMP Recreation Action Program has the objectives to create new parks and green spaces along the estuary, and to develop regional greenways between parks, open spaces and green spaces.
Baseline	Prior to 1985, there were 108 kilometres of recreational corridors along the estuary.
2001 Report	In 2000 there were 138 kilometres of recreational corridors along the estuary. With minor corrections to this dataset made in 2005 as part of this report, that total rises to 141.8 km.
Conditions and Trends since 2001	In 2005, there were 146.7 kilometres of recreational corridors along the estuary, an increase of 4.9km since 2000.

Why measure the length of recreational corridors along the shoreline?

While the estuary itself represents a critical habitat for fish and wildlife and a strategic transportation corridor for marine-dependent industry, the land adjacent to the estuary is also a key recreational asset. The water's edge is an attractive area for walking, running, cycling and other recreational activities. Public access to the shoreline also helps to contribute to the public's knowledge and appreciation for the linkages between the "living" and the "working" river.

Recreational corridors along the estuary - often located on top of river dykes – provide public access to the waterfront without demanding a larger amount of land or facilities. Regional greenways are additional important corridors that connect natural open spaces throughout the urban area for wildlife and people. Many greenways provide recreational opportunities as well as habitat for fish and wildlife, a further example of integrating ecological and human functions.

In the interest of promoting the recreational attributes of the Fraser River estuary and increasing opportunities for people in the region to experience the outdoors, one of the objectives outlined in *A Living Working River* is to create new parks and green spaces along the estuary. Building on the FREMP 1990 proposed Recreation Plan and the concept of linear units to link recreation sites on the river, the EMP

encourages FREMP partners to develop regional greenways between parks, open spaces and green spaces in the FREMP area where possible. This indicator is therefore intended to provide a snapshot of the amount of the estuary shoreline that is accessible for public recreation and to signal whether recreational corridors along the shoreline are increasing or decreasing over time.

How is the data collected?

This data was compiled with the help of parks planners from the GVRD and local governments in the FREMP area. Using data from the FREMP GIS system, GVRD Parks staff mapped and measured the length of recreational corridors situated along the shoreline and accessible to the public, and compared the lengths of these corridors between 2000 and 2005. As part of this exercise, some corrections to the 2000 total were also made. The numbers as shown do not reflect the length of recreational paths, but rather the shoreline length, which will almost certainly be slightly greater than the length of the path.

Recreational corridors were defined to include waterside paths, paths on dykes and walkable beaches. They do not include roads along the estuary, or areas of recreational use where there is no access along the waterfront (like Westham Island), or conservation reserves where access is restricted.

Status and Trends

Public access to the Fraser River estuary shoreline has increased since 2001. The following new shoreline corridors have been identified:

- Coquitlam saw the creation of Don Robertson Park near Como Creek, acquisition of a thin strip of land near the Port Mann Bridge (Maquebeak Park), and creation of a small trail and boardwalk near Brigantine.
- A trail along the waterfront in the Imperial Landing area in Richmond was established.
- Sapperton Park located at Columbia Street & Sherbrooke in New Westminster was established.
- Tannery Park north of 104 Ave in Surrey was created. Also in Surrey, Brownsville Bar Park was established at the foot of Old Yale Rd at Portage Rd.
- A new trail was established adjacent to Deas Slough in Delta, with a small section directly adjacent to the water under the slough bridge.
- The regional Pitt Meadows greenway was formalized, including through GVRD's acquisition of land parcels along the proposed greenway.

Recent consultations revealed minor inaccuracies with the location and length of recreational corridors used in the 2001 report; with these small corrections the length of shoreline recreational corridors in 2000 was 141.8km.

With the above additions to parks along the shoreline, the estimated length of shoreline corridors in the estuary that were created between 2000 and 2005 is 4.9km, for a total length in 2005 of 146.7km.

VISITS TO REGIONAL PARKS ALONG THE ESTUARY

Has the number of visits to regional parks along the estuary increased or decreased? *INCREASED.*

Relevant goal in *A Living Working River*	Respect and further the estuary's role as the social, cultural, recreational and economic heart of the region.
Relevant Targets and Objectives	The EMP Recreation Action Program has the objectives to create new parks and green spaces along the estuary, and to develop regional greenways between parks, open spaces and green spaces.
Baseline	For every 1,000 residents in Greater Vancouver in 1989, there were 670 visits to six of the regional parks that bordered the estuary.
2001 Report	The number of visits to six of the regional parks along the estuary grew from 670 per 1,000 residents in 1989 to 1,155 in 1999. While the population grew by 27% in the region, the number of people using the parks grew by 118%.
Conditions and Trends since 2001	The number of visits to the six regional parks grew to 1,587 per 1000 residents in 2004. Overall park visits continue to grow faster than the population, growing by 28% since 2001. An increased number of infrared counters in the parks are also contributing to better information by which to track these trends.

Why measure regional park visits?

The Fraser River estuary is bordered by eight regional parks. These sites, located at Boundary Bay Regional Park, Deas Island, Surrey Bend, Derby Reach Regional Park, Pacific Spirit Regional Park, Kanaka Creek, Grant Narrows, and Iona Beach comprise a rich diversity of marine, wetland and upland habitat. They constitute an important part of the region's heritage and provide vital opportunities for people in the region to interact with the natural environment and experience the estuary. Note that regional Greenways along the estuary such as the Pitt River Greenway are not included in this indicator, nor are regional park reserves like Widgeon Slough.

This indicator is intended to speak to people's use and experience of the natural environment and appreciation of the culture and history along the estuary. It is premised on the belief that these experiences can significantly contribute to the well-being of individuals living in and around the FREMP area.

The number of park visits stands to be impacted by an increase in the number of parks; development of new facilities at the parks; an increase in the public's desire

to be at the river's edge; a shift toward a more physically fit lifestyle; and an increased appreciation of the estuary's beauty culture and historic significance. The increasing number of visits to regional parks in the estuary has therefore been interpreted as a positive trend. The degree to which this increase translates to greater public awareness and a stronger appreciation of nature is however much more difficult to assess.

Limits do exist to the positive impacts of this trend. Clearly, having too many people in the parks will eventually detract from the experience of being in the parks and possibly the environmental integrity of these areas as well. An increase in park use could also result from a decreasing quantity of other public green spaces around the region. Ongoing public discussion and dialogue about this trend is therefore necessary.

How is the data collected?

GVRD Parks staff have estimated monthly visitor use for six of the regional parks along the estuary since 1989, although methods of counting have become increasingly sophisticated over time. Originally, estimates were derived by staff counts of vehicles entering the parks, but more recently, the number of visitors is recorded by a growing network of trail counters (infrared signals at trail heads) which count the number of individuals walking in the parks. These estimates are all adjusted to take into consideration unmonitored use. However, it must also be acknowledged that the number of trail counters in operation in a park typically corresponds to a direct increase in the visitations recorded, as discussed below.

Visits to the many municipal parks located along the estuary is not included here, but should be noted as an important recreational resource. Similarly, Wreck Beach near UBC is a major recreational point along the estuary that can draw over 200,000 visitors per year.

Status and Trends

Over the past decade, the number of visits per 1,000 residents has increased in each of the six regional parks monitored by the GVRD with the exception of Deas Island. This trend is the same looking at the records since 2000.

Pacific Spirit Park and Iona Beach have seen exceptional increases of 135% and 415% respectively since 1994 and the number of visits to Boundary Bay has grown by 80% since 2000.

Overall, the total number of visits to all six parks per 1,000 residents has risen steadily since 1994 at an average annual rate of 5%. Since 2000, the number of

visits per 1,000 residents has grown by from 1,242 to 1,587, which means that the number of visits to the regional parks along the estuary has been growing faster than the population. While the regional population grew by 4% between 2000 and 2004, the number of visits to these parks increased by 28% during the same period.

Although these results are considerable, as noted above, it is important to note that the increases in visits also relate to the installation of a more accurate and extensive network of trail counters. While in 2000, 11 counters were in use in the six regional parks featured, in 2004 this number rose to 17 and in 2005, to 19 counters.

As a result, the spikes in parks visits shown in the data between 2002 and 2003 in Pacific Spirit Park and between 2003 and 2004 in Boundary Bay are at least partly attributable to the installation of more counters in these locations. Notwithstanding the increased number of counters, visits as tracked by one of the counters located at Beach and 12th Avenue at Boundary Bay Regional Park over this entire period of time still show growth of 27% in the number of visits since 1994 and 19% since 2001.

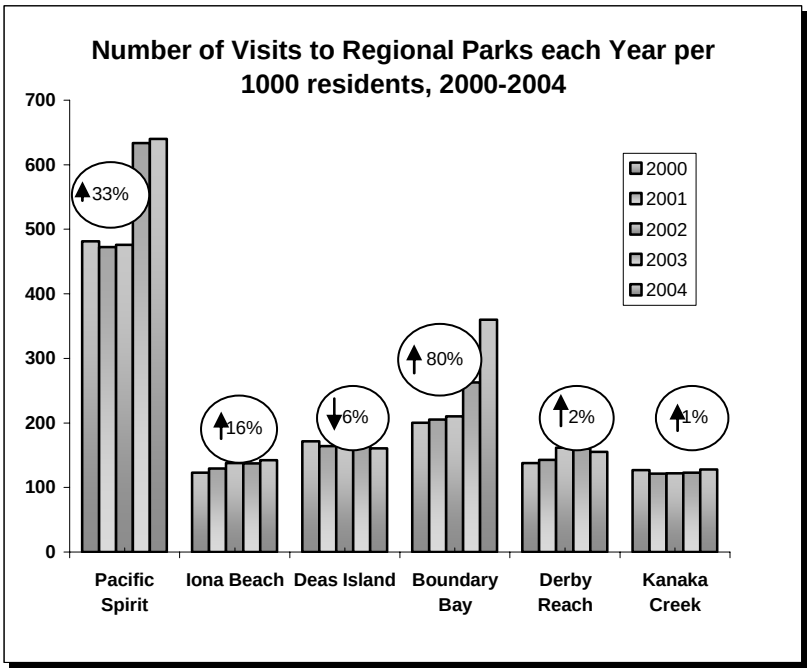


Figure 13: Number of Visits to Regional Parks each year per 1000 Residents, 2000-2004

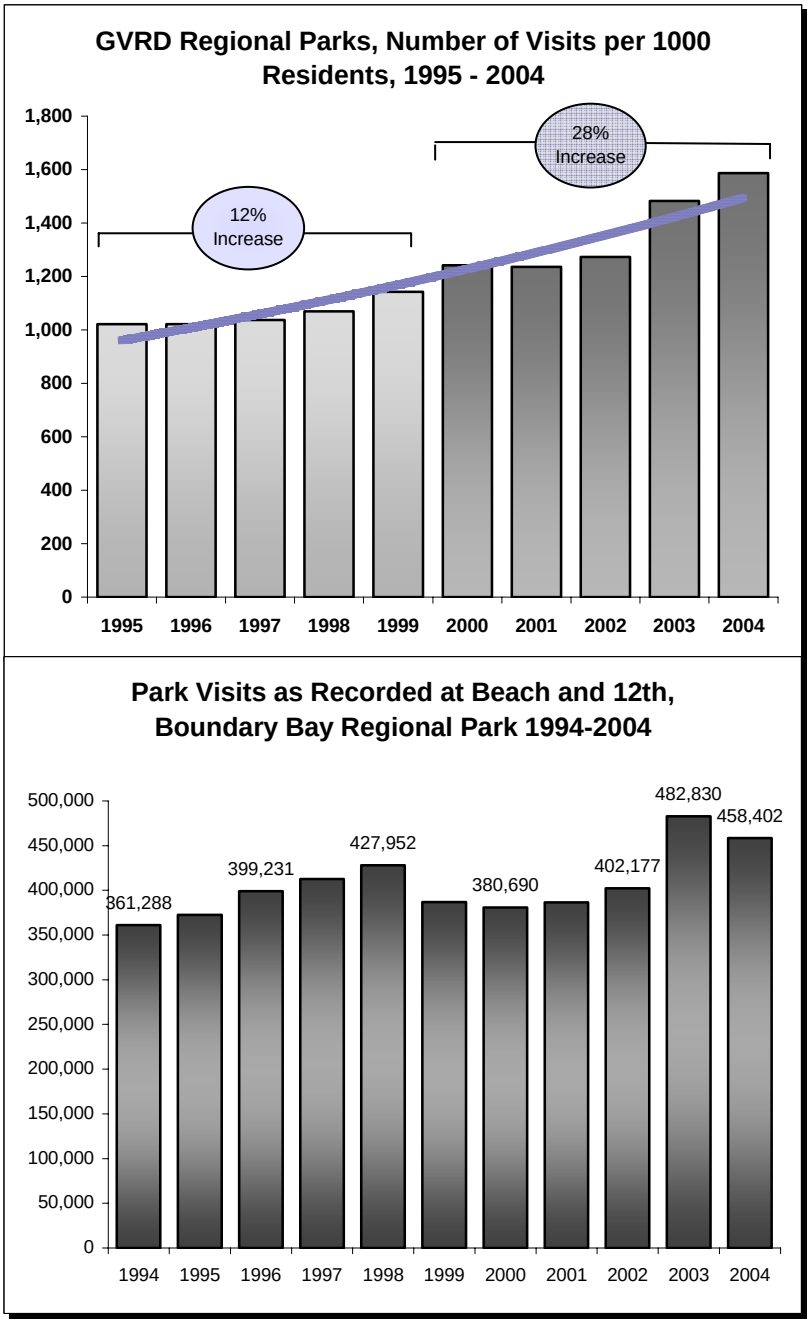


Figure 14: GVRD Regional Parks, Number of Visits per 1000 Residents, 1995-2004

Figure 15: Park Visits as Recorded at Beach and 12th, Boundary Bay Regional Park, 1994-2004

What are FREMP partners doing to further the estuary's role as the recreational heart of the region?

The GVRD **Livable Region Strategic Plan** (LRSP) outlines a Green Zone that acts as a containment boundary for urban development, thus protecting areas for parks and preservation. The LRSP is currently being updated, and is supported by regional context statements with all municipalities. Municipal **Official Community Plans** further outline areas for parks and protected areas within their jurisdiction, as do the Port Authority land use plans.

GVRD Parks continues to offer a variety of **programs to engage and teach people about our regional parks**. These programs are customized for school and community groups. More than 10,000 people participate in these programs annually. A number of regional parks also have **Park Associations** which are actively involved in outdoor education, special events, stewardship and restoration projects in the park. These Associations are comprised of local residents and park user groups. Some community groups host visitor centres, operate equestrian facilities, hatcheries or recreation facilities and cultivate special gardens. Volunteers are also encouraged to take part in park management planning, participate in work bees, deliver educational programs and events and conduct stewardship projects.

In September 2005, the GVRD Board endorsed a new **Regional Parks and Greenways Plan** (RPGP) with a series of goals, strategies and actions to ensure that the resources used today are still available for future generations. Specifically, the RPGP proposes to:

- Protect and enhance regional landscapes, biodiversity and heritage features;
- Provide outdoor recreation opportunities and education programs, and foster community stewardship; and
- Support economic development and quality of life in the region.

CONCLUSION

The Fraser River estuary is a vibrant centre of the Greater Vancouver region, providing a source of economic development for the Ports and local businesses and critical, world-renowned habitat for fish and migratory birds. The Estuary Management Plan for the Fraser River provides a policy coordination framework for environmental management of the lower river, and monitoring the success of that Plan is critical to an adaptive management approach.

The eight indicators presented in this Monitoring Report show that the FREMP partnership continues to make progress in implementing the Plan, with gains in marsh habitat, improved recreational access to the estuary, and sediment removal in balance with natural replenishment. While some trends like increases in marine cargo volumes and satisfactory water quality results may not be directly attributable to the FREMP partnership, they do illustrate the healthy state of the estuary, and the balance that continues to be struck between environmental protection and human activities.

The Fraser River estuary is a critical ecosystem and transportation corridor in the middle of a growing urban region that will continue to experience development and public pressures for different land and water uses over the coming years. Future challenges will include major changes in the transportation chain, preserving industrial lands for development, changing foreshore land uses, large development projects planned for the estuary, and continued public demand for recreational corridors along the shoreline. The ongoing challenge for FREMP partners is to protect the estuary's environmental quality while sustaining its critical role as a working river. The FREMP partnership has proven itself as a sound framework for managing the estuary, and has achieved great successes in balancing human activities with the Fraser River estuary's natural environment. In the coming years, FREMP will continue to monitor the estuary's health and suggest ways to enjoy and sustain our living, working river.

The indicators can only provide a snapshot of the estuary, and cannot reflect all trends in the estuary. Thus issues like climate change and sea level rise, the beneficial use of dredgeate, and the cumulative effects of development will continue to be tackled by FREMP within the framework of the EMP. The FREMP partners and Water and Land Use Committee members will use the results of this Monitoring Report to inform the public, educate residents about the estuary, and help inform decision-making in the estuary. A continued commitment exists to report on Plan implementation using these and new indicators in the coming years.

WEB RESOURCES

More information can be found on the BIEAP-FREMP website, FREMP partner websites and other useful links:

www.bieapfremp.org

www.bieapfremp.org/toolbox

www.ec.gc.ca/water

www.env.gov.bc.ca

www.env.gov.bc.ca/wat/wq/wq_objectives.html

www.fraserbasin.bc.ca

www.fraserportauthority.com

www.gov.bc.ca

www.gvrd.bc.ca

www.gvrd.bc.ca/parks/

www.gvrd.bc.ca/sewerage/stormwater_reports.htm

www.nfpa.ca

www.pac.dfo-mpo.gc.ca/pages/default_e.htm

www.shim.bc.ca/atlases/atlas.html#frem.

www.tc.gc.ca

www.waterbalance.ca

www.waterbucket.ca

www.waterquality.ec.gc.ca

[i] Prof Ken Hall from UBC also noted that regarding the decrease in toxic equivalents (TEQs) in Great Blue Heron eggs, the cause was mostly a result of the elimination of dioxins in the environment (FREMP, February 2002).
[ii] At a FREMP public forum held in November 2001, some of the suggestions included looking at PCB loadings and trends, Polycyclic Aromatic Hydrocarbons (PAHs) found in fish tissue, and contaminants that have the ability to disrupt endocrine systems.
[iii] CFU, or colony forming units.

[iv] Prior to 1998, provisional Water Quality Objectives for the Fraser River from Kanaka Creek to the mouth had been set for Fraser River main stem and north arm at less than or equal to 1000 MPN/100 mL geometic mean from April to October, and at 4000 MPN/100 mL maximum from April to October. For Roberts and Sturgeon Bank, it was less than or equal to 200 MPN/100 mL geometic mean and 400 MPN/100 mL maximum at bathing beaches, June through August.

[v] Effluent from the Iona WWTP discharges into Georgia Strait through a 7.5km deep-sea outfall.
[vi] A 30-day average concentration of geometric mean is a value that should not be exceeded during a period of 30 days when five or more samples are collected at approximately equal time intervals (Swain, 1998, 16).
[vii] The numbers in this table do not mirror exactly those in the 2001 Monitoring Report; this is because the earlier numbers have been updated based on the five-year review of the Sediment Budget that took place in 2002.
[viii] These percentages were based on a total estuary shoreline measurement of 538,300 meters.
[ix] FREMP, 2002.