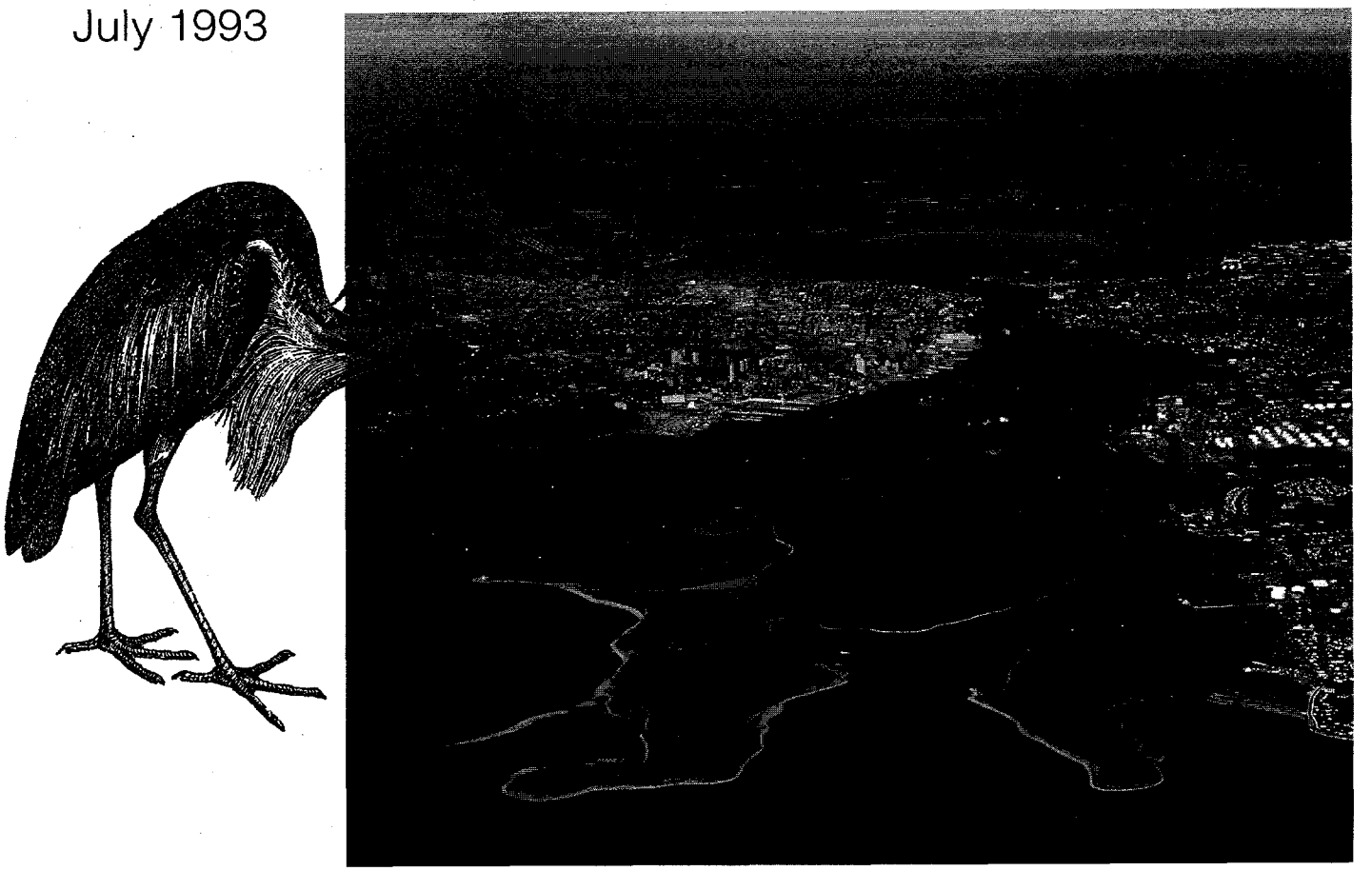
Halifax Harbour Cleanup Project

Report of the Federal-Provincial Environmental Assessment Review Panel for the Halifax-Dartmouth Metropolitan Wastewater Management System

July 1993



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Dear Ministers:

In accordance with the mandate issued November, 1990, and the subsequent letter of clarification dated July 3, 1991, the Federal-Provincial Environmental Assessment Panel has completed its review of the Halifax-Dartmouth Metropolitan Wastewater Management System. We are pleased to submit the final Panel report for your consideration.

The proposal to design, construct and operate a wastewater management system for the Halifax-Dartmouth Metropolitan area, has been examined and public hearings have been held in Halifax, Dartmouth, Eastern Passage, and Herring Cove.

The Panel recommends that the wastewater management system as described by Halifax Harbour Cleanup Inc. in its Environmental Assessment Report, Supplementary Information documents, and clarified in its written and oral responses to the Panel, be allowed to proceed under the conditions described within the report.

Respectfully,

Shirley Conover
Chairpefkon

Robert Parker

Dan Thirumurthi

Lesley Griffiths

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1. SUMMARY

In November 1990, the federal and provincial Ministers of the Environment jointly appointed an independent Environmental Assessment Panel to conduct a review of the proposal by Halifax Harbour Cleanup Inc. (HHCI) to design and construct a Halifax-Dartmouth Metropolitan Sewage Treatment Facility (the "Project"). Further instructions from the Ministers made it clear that the Panel would also address the broader issue of regional wastewater management. The four-member Panel was asked to make recommendations on the terms and conditions under which the Project could proceed without causing unacceptable adverse effects on the environment. Moreover, the scope of the review was to include matters relating to the environmental and community impacts of the design, construction and operation of the proposed sewage system, tunnels, sewage-treatment and sludge-handling facilties, and other ancillary structures, buildings and facilities associated with the Project.

Throughout the review, the Panel gathered information on the environmental and related socio-economic effects of the proposed Project. The proponent, HHCI, carried out an extensive public information program which greatly assisted the public and the Panel to understand the Project, related issues and possible alternative solutions for selected components of the wastewater management system.

The proposal to clean up Halifax Harbour dates back to the late 1980s. The provincial, federal and municipal governments have conducted studies, initiated proposals and recommended steps toward establishing a wastewater management strategy for the Harbour, including appropriate sewage treatment. A federal-provincial agreement signed in 1988 set out the role for HHCI to implement a Halifax Harbour Cleanup Program. An agreement the following year between the Province and the municipalities of the City of Halifax, the City of Dartmouth and the County of Halifax stipulated how the committed funds for the Project of **$195,700,000** were to be contributed by the federal, provincial and municipal governments. HHCI was established as a corporate body with representation on its Board of Directors from the three municipalities of Halifax, Dartmouth, and the County of Halifax, the Province of Nova Scotia and the Government of Canada. The Halifax Harbour Task Force, commissioned by the Government of Nova Scotia in 1989 to review the feasibility of such a project, recommended that a full federal-provincial review be carried out. The.Task Force also established water quality objectives for Halifax Harbour which were to be met by the Project, the optimum location for the diffuser and criteria for selecting a sewage treatment plant site; and recommended that controls-at-source programs be developed as part of the 'Project.

The Halifax Harbour Cleanup Project is essentially an environmental remediation project to eliminate the practice of disposing raw untreated sewage into Halifax Harbour, which has been taking place over the past 250 years. The **$385,000,000** Project presented by HHCI includes an extensive sewage collection system, an artificial island to provide a site for a single regional sewage treatment plant (STP) with an oil-from-sludge (OFS) facility for sludge management, and an underwater diffuser for dispersing the treated effluent into a deep channel to the west of McNabs Island.

During the course of the review, participants raised a variety of concerns relating to potential environmental and related socio-economic effects of the Project. The major concerns were the way in which the site-selection process was carried out and the choice of Ives Cove at McNabs Island as the preferred location to site the STP/OFS facility, which would be constructed on an artificial island. Other significant concerns were the biophysical and socio-economic impacts associated with

- the lack of controls-at-source programs in the Project
- the diffuser location and potential impacts on marine and human environments
- the level of treatment proposed
- the high costs and risks associated with the construction of a tunnel across the Purcells Cove Backlands to collect sewage from Mainland South and Herring Cove
- the location and scale of the proposed collection system and overflows for Herring Cove
- the aesthetic impact of the STP/OFS facility on McNabs Island and other Harbour areas
- the estimated $142 million shortfall for the Project

After careful consideration of these and other issues and concerns, the Panel has reached the following main conclusions:

1 It is time to proceed with the Project under the considerations and recommendations in this Report. The "No Project" alternative is unacceptable.

2 The Wastewater Management System for Halifax Harbour and the Project must be planned and implemented to meet sustainable development principles.

3 The Project is one important part of an overall strategy for regional harbour management. Halifax Harbour is the receiving body for the outputs of the treated effluent, and the ability of the Harbour to receive these outputs must be based on a thorough understanding of its assimilative capacity. Moreover, the Harbour must support a full range of activities and interests, including the commercial fisheries. There must be no irreversible harm to the Harbour as a result of the Project, and conditions must be improved and enhanced.

4 The Project as proposed may proceed under certain conditions, but the Panel believes that there may be a more advantageous site for locating the STP/OFS facility, paired with a different diffuser site, which needs to be examined before the Project proceeds, for these principal reasons:

   - The alternative diffuser site is supported by the major recommendation of the Halifax Harbour Task Force to

locate the diffuser in an area which has the highest possibility of containing toxics associated with sewage particulates, and by its location more than 2 kilometres from swimming beaches which reduces the possibility of swimmers contacting numbers of sewage-derived pathogens. The diffuser site proposed by HHCI is closer to both swimming and fisheries areas.

- The alternative STP/OFS facility site is onshore and is in an industrially zoned area.
- These paired sites could result in significantly lower costs for site development, construction of facilities and operations.

The Panel has concluded that in order to make an informed decision on the appropriateness of these alternative sites, only a minor amount of additional information is needed, and although public consultation is required, another full environmental assessment by a panel does not appear to be necessary. All of the major issues to date have been addressed by this review. In order to expedite the decision-making process on the possible use of these sites, the Panel has outlined a concise and short process which should not significantly delay the Project.

The Panel in its independent status feels that it cannot ethically give a blanket endorsement of the Project without HHCI first giving serious consideration and applying due process to the evaluation of this pair of alternative sites.

5 Controls-at-source programs need to be part of the Halifax-Dartmouth Metropolitan Wastewater Management System and must begin immediately. The programs should be initiated by the Province as the lead agency, with the participation of HHCI, the federal and municipal governments and the public. The municipalities should administer the various programs. Controls-at-source programs should address toxic and hazardous substances, water use and conservation, reduction of groundwater infiltration and stormwater inflows to the wastewater collection system, and stormwater management.

6 The components of the Project proposed for Mainland South and Herring Cove need to be re-examined in consultation with the affected communities, in light of their concerns about impacts on future growth in the areas and related environmental issues. Alternatives to the components as proposed within the Project may be appropriate in some instances.

7 If the STP/OFS facility is to be located on an artificial island adjacent to McNabs Island, then the development of the proposed regional park on McNabs Island must be a parallel part of the Project and its funding ensured in an amended agreement.

8 The technology proposed for the Project, including its collection system, the STP/OFS facility, and diffuser; is confirmed as appropriate for meeting the water quality objectives established by the Halifax Harbour Task Force, subject to consideration being given to designing the initial treatment facility for "chemically enhanced", (advanced) primary treatment. Consideration should also be given to decommissioning the Eastern Passage Treatment Plant and incorporating its collection system into the Project at an early date. The proposed OFS facility could benefit from an independent audit of its technology, outputs and operational procedures.

9 Compensation must be made to persons and for environments adversely affected by the Project, to reduce individual burdens by spreading the costs of remediation across the whole Project and to all users.

10 The use of capacity rights, which govern the amount of allowable wastewater flows into the system by each of the municipalities, is an appropriate mechanism for sharing the costs of treatment on an equitable basis between users. It will also encourage water conservation and sewer rehabilitation.

11 The Province should establish the regulations that will govern the licensing and operation of the Project.

12 An Environmental Management Plan for the construction and operation of the facilities needs to be structured. in a holistic manner, thus placing the Project within the context of broader regional Harbour management. Ongoing public involvement, and reporting and accountability by HHCI and the future owners and operator will help to ensure the Halifax-Dartmouth Metropolitan Wastewater Management System adheres to the principles of sustainable development.

The foregoing major conclusions are reflected in the detailed recommendations in the Panel Report. These recommendations include appropriate terms and conditions which should be put in place before and during construction and operation programs to minimize adverse effects and.to address issues requiring further investigation and study. Also included in the Panel Report are recommendations on the establishment and structure of a management system to deal with ongoing environmental, socioeconomic and monitoring matters.

2. PROJECT AND REVIEW PERSPECTIVE

2.1 HISTORY

In addition to being a major shipping port, industrial centre, naval centre and research centre, Halifax Harbour is surrounded by one of the fastest growing urban regions in Atlantic Canada. Nova Scotians and tourists value the Harbour's recreational opportunities and the aesthetic dimension it adds to this urban centre.

increasingly, the Harbour's ecosystems have been placed under stress by the results of intensive human activity along its shorelines. Since the colonization of the area 250 years ago, Halifax Harbour has been a receptacle for raw sewage and industrial wastes. As early as 1924, a report on the physical oceanography of the Harbour as the receiving body for untreated sewage was prepared by the federal department of Marine and Fisheries.

Since the late 1960s, the provincial, federal and municipal governments have conducted studies, initiated proposals and recommended steps toward establishing a waste management strategy for the Harbour, including appropriate sewage treatment. The Halifax Harbour Task Force, commissioned by the Government of Nova Scotia in 1989 to review the feasibility of such a project, recommended that a full federal-provincial environmental assessment review be carried out.

Table 1 summa&es the steps leading up to the appointment of the Environmental Assessment Review Panel.

Table 1 Chronology of Steps Leading to Panel Appointment

Year	Body	Conclusions	Action
1970	City of Halifax	Presents four locations for a sewage treatment plant facility	Installation of interceptor, Fairview Cove to Duffus Street
1977	Metro Area Planning Commission	One regional sewage treatment facility providing primary treatment be built at Sandwich Point	None
1987	Metro Area Planning Commission	Concurred with previous finding - one regional sewage treatment facility at Sandwich Point	Leads to Subsidiary Agreement
1988	Federal Government and Province of Nova Scotia		Subsidiary Agreement on Halifax-Dartmouth Metropolitan Area Development. One initiative is installation of regional sewage treatment facility.
1988	Cities of Halifax and Dartmouth and Municipality of the County of Halifax	Environmental impact study on effects of outfall from proposed Sandwich Point sewage treatment facility on Herring Cove fishery	Nova Scotia Minister of Environment refers recommendation to Environmental Control Council
1988	Environmental Control Council		Appointment of Halifax Harbour Cleanup Review Committee, which conducts study
1989	Halifax Harbour Cleanup Review Committee	Additional information and public participation essential	Halifax Harbour Task Force established by provincial government
1989	Province of Nova Scotia, Cities of Halifax and Dartmouth and Municipality of the County of Halifax		Memorandum of Agreement: commitment to regional sewage management, municipal cost-sharing arrangements, establishment of Halifax Harbour Cleanup Inc.
1989	Province of Nova Scotia, Halifax Harbour Cleanup Inc.		Memorandum of Agreement: responsible for'executing defined tasks in accordance with Subsidiary Agreement
1990	Halifax Harbour Task Force (established 1989)	18 recommendations on Harbour management, including full federal-provincial environmental assessment review	Report published
1990	Nova Scotia Minister of the Environment		Accepts Task Force recommendations
1990	Federal' Minister responsible for Atlantic Canada Opportunities Agency (ACOA), Canada and Nova Scotia Ministers of the Environment	ACOA Minister refers proposal to Federal Minister of the Environment, decision to appoint joint federal-provincial panel	Appointment of joint federal-provincial Environmental Assessment Review Panel

2.2 THE PROPOSED PROJECT

2.2.1 Summary

In July 1989, Halifax Harbour Cleanup Inc. (HHCI) was given the mandate to plan, design and construct a system of sewage collection and treatment for the Halifax-Dartmouth metropolitan area. Over the period of the environmental assessment review, the Project continued to evolve.

The Project consists of the design and construction of a sewage collection, treatment and disposal system. As proposed by HHCI, it includes

- a collection system of interceptor sewers, tunnels, pumping stations, and combined sewer overflows (CSOs) to intercept wastewater from 39 existing outfalls around the Harbour
- a single regional STP/OFS facility providing primary treatment, disinfection and sludge conversion to be located on an artificial island to be constructed in Ives Cove, and
- a diffuser to discharge treated sewage to the Harbour

Currently, 39 municipal outfalls sewing a developed area of about 7,000 hectares and about 225,000 people discharge approximately 135 million litres of raw sewage per day into Halifax Harbour (Figure 1). The raw sewage outfall at Watleys Cove, sewing Halifax Mainland South and Herring Cove, discharges about 10 million litres per day. There are also about 60 commercial, institutional and industrial outfalls discharging into Halifax Harbour. These private outfalls are not part of the Project, although a number of them may be connected to the collection system in the future.

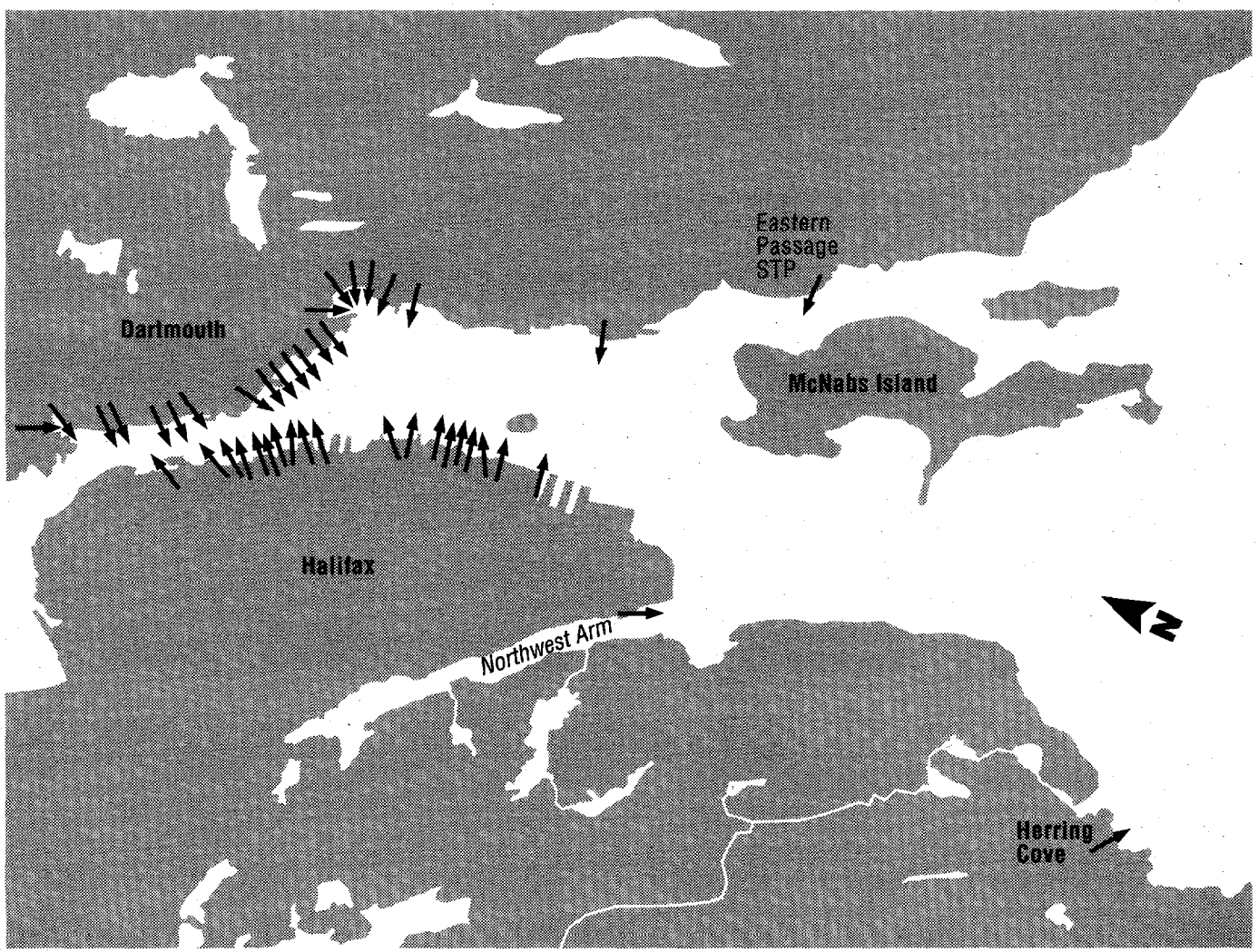

Figure 1 Existing Municipal **Sewage Outfalls.** *Source: After Halifax Harbour Cleanup Inc.*

2.2.2 The Collection System

The sewage collection system requires the construction of tunnels, pumping stations and CSOs along the Dartmouth and Halifax waterfronts and from Mainland South and Herring Cove. The collection system will be over 25 kilometres long, of which about 75% will be tunnelled. The existing municipal outfalls throughout the collection area will be intercepted, and the sewage transported to a treatment plant situated on an artificial island at Ives Cove, off McNabs Island (Figure 2).

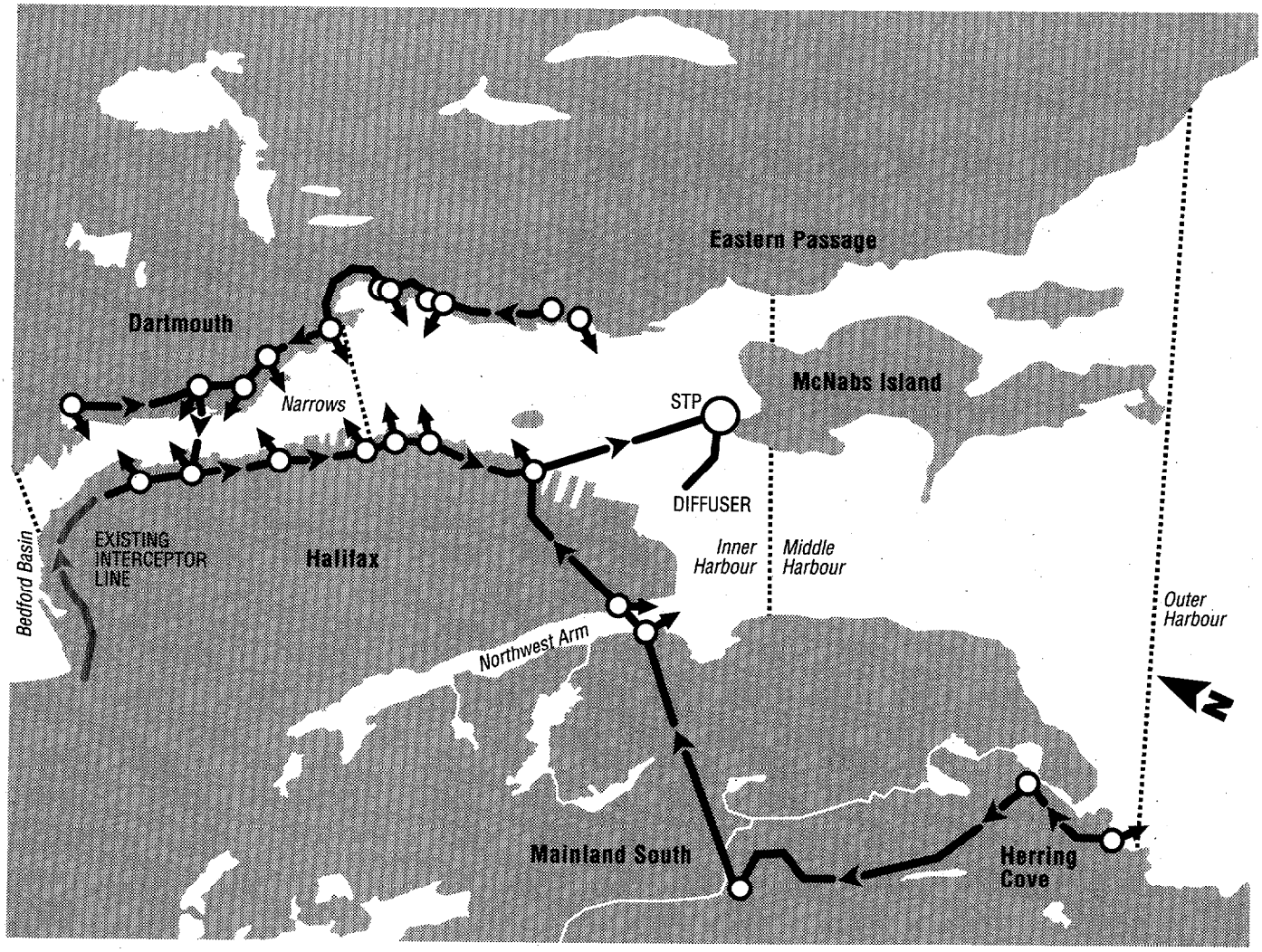

Figure **2 Project Description**

Source: After Halifax Harbour Cleanup Inc. Harbour Divisions after Halifax Harbour Task Force

The collection tunnels will be designed to carry all the dry-weather sewage flow and a portion of the stormwater. During storms, there will be overflows into the Harbour from approximately 17 CSOs. The CSOs will provide preliminary treatment to remove floatables and some solids before discharging the effluent into the Harbour. Disinfection will be provided at the 2 Northwest Arm CSOs. On a yearly average, 75% of the raw sewage and stormwater currently discharged into the Harbour from existing outfalls will be intercepted and conveyed to the treatment plant. HHCI proposes collecting all flows from Mainland South and Herring Cove as part of the regional collection and treatment system. Provision has been made to accept septage from the County of Halifax. Sewage from existing treatment plants at Eastern Passage and Mill Cove can be incorporated into an expanded system at a future date.

2.2.3 Sewage Treatment Plant and Oil-from-Sludge Facility

The STP/OFS facility will be located on a Qd-hectare artificial island, "Ives Island," to be constructed at Ives Cove, 30 metres off the north end of McNabs Island. About 1.1 million cubic metres of fill will be used to create the island, which will be drumlin-shaped to simulate the contours of surrounding landforms. The STP/OFS facility will be completely enclosed.

The artificial island will be large enough to accommodate ultimate design capacity for primary treatment. Upgrading to secondary treatment will require island expansion.

Sewage will be brought to the site by an under-Harbour tunnel and lifted 60 metres into the plant by the main pumping station. The sewage will undergo preliminary treatment at the headworks, which consists of screening, and removal of grit, scum and grease. After processing, solid wastes (screenings and grit) will be disposed of, and the grease and scum will be pumped to the OFS facility. The sewage itself will flow to the primary clarifiers.

Primary clarifiers will remove about 50% of the suspended solids at peak flow and about 65% at average dry weather flow. The sludge that accumulates at the bottom of the clarifiers will be moved to the OFS facility for processing. The wastewater will undergo disinfection by chlorination, and the effluent will be carried through a tunnel under the Harbour floor; it will then be discharged from a diffuser in 30 metres of water to the west of McNabs Island. This will result in a 66:1 seawater-to-effluent dilution at the Harbour surface.

The OFS process consists of dewatering and drying the sludge, then heafing it to 450°C without oxygen. This yields an oil product, a coal-like product called char, non-condensable gases and ash. The oil product has several potential applications, including use in the asphalt industry. Char and non-condensable gases are burned in a fluidized bed furnace to produce the heated air used in the sludge-drying process. Ash will be disposed of in an approved manner.

2.3 THE ENVIRONMENTAL ASSESSMENT REVIEW PANEL

The governments of Nova Scotia and Canada agreed that a full environmental assessment review of the proposed regional sewage treatment system was necessary. They realized that two separate reviews would result in a great deal of. duplication. Therefore, a joint review process was developed to satisfy requirements of both the Nova Scotia Environmental Assessment Act and Regulations, and the federal Environmental Assessment and Review Process.

In November 1990, the Ministers of the Environment for Nova Scotia and Canada announced the appointment of an independent Environmental Assessment Review Panel, consisting of Dr. Shirley Conover (Chair), Ms. Lesley Griffiths, Mr. Robert Parker and Dr. Dan Thirumurthi. Biographies of the Panel members are included as Appendix A.

The Panel's mandate was, to conduct a public review process to examine the potential environmental, social and economic impacts of the design, construction, operation and maintenance of the Halifax-Dartmouth Metropolitan Wastewater Management System. The scope of the review was to include the collection system, sewage treatment and sludge-handling facilities, diffuser, and associated activities. In July of 1991 the Panel received confirmation from the Ministers of the Environment for Nova Scotia and Canada that controls at source of wastewater quality and quantity, stormwater runoff, compliance and effects monitoring, and cultural and heritage considerations were included in the Panel's mandate. A complete description of the Panel's mandate and supplementary clarification are included as Appendix B.

Two technical specialists were hired to advise the Panel. Dr. Donald Hodgins advised in the area of physical oceanography, including containment-dispersion and sediment transport, and Dr. Isobel Heathcote advised in the areas of controls at source, wastewater characterization and wastewater management. Biographies of these consultants are included as Appendix C.

2.4 THE REVIEW PROCESS

Figure 3 is a summary of the review process. As shown, input from the public and interested parties was invited and incorporated into the process at several stages, including preparation of the Guidelines, review of the adequacy of the Environmental Assessment Report and supplements, and public hearings.

Funding was made available to assist interest groups wishing to participate in the review process. An independent funding committee, administered by the Federal Environmental Assessment Review Office (FEARO), assessed the applications and in July 1992 a total of $128,500 was awarded to three groups: Metro Coalition for Harbour Cleanup, Eastern Passage & Cow Bay Ratepayers and Residents Association, and the Williams Lake Conservation Company.

Guidelines for the preparation of the Terms of Reference for an Environmental Assessment Report were prepared by the Nova Scotia Environmental Assessment Administrator in consultation with the Panel, interested federal and provincial government agencies, and the public. These were finalized, submitted to HHCI and made public at the end of March 1991.

HHCI prepared Terms of Reference to demonstrate the corporation's understanding of the instructions contained in the Guidelines and to specify how it intended to meet the Guidelines' information requirements. The Terms of Reference were approved by the Nova Scotia Minister of the Environment in June 1991.

HHCI's Environmental Assessment Report was made available to the Panel and the public on August 7, 1992. At this stage of the process, two separate activities commenced simultaneously: a review of the adequacy of the Environmental Assessment Report by the Panel, and a technical review by the Nova Scotia Environmental Assessment Administrator.

The Administrator's review will ba submitted to the Nova Scotia Minister of the Environment at the same time that the Panel submits its Report.

The Panel reviewed the Environmental Assessment Report and received comments from the public, government representatives and the Panel's technical specialists. It announced on November 3, 1992, that additional information was required from HHCI before the Panel could proceed with public hearings.

On January 15, 1993, the Panel received Supplementary Information 1, which was made available to the public. The Panel invited written comments on the sufficiency of this report by February 15, 1993. The Panel reviewed this report, along with comments of the technical specialists and submissions from government representatives and members of the public. The Panel determined that some of the questions had not been fully addressed. Having received assurance from HHCI that the additional information would be provided by March 15, 1993, the Panel decided that it could proceed with public hearings and on February 23, 1993, announced dates and locations for 17 hearing sessions. The Panel received HHCI's Supplementary Information 2 on March 12, 1993, and Supplementary Information 3 on March 15, 1993.

Public hearings were held in the communities of Herring Cove, Eastern Passage, Dartmouth and Halifax from March 22 to April 3, 1993. Appendix D provides dates, locations, and a list of presenters at the hearings. The Panel heard presentations from individuals, community and special interest groups, businesses, and representatives from federal and provincial governments.

Transcripts of the proceedings and copies of the written submissions were made available to the public.

During the review process, the Panel Secretariat maintained a public file which contained all correspondence and material received by the Panel from its formation to the end of public hearings on April 3, 1993. The file was available for public scrutiny throughout the review process, at the offices of the Nova Scotia Department of the Environment (NSDOE) in Halifax, Nova Scotia,. and the Federal Environmental Assessment Review Office (FEARO) in Hull, Quebec. A list identifying key documents produced during the review is provided in Appendix E.

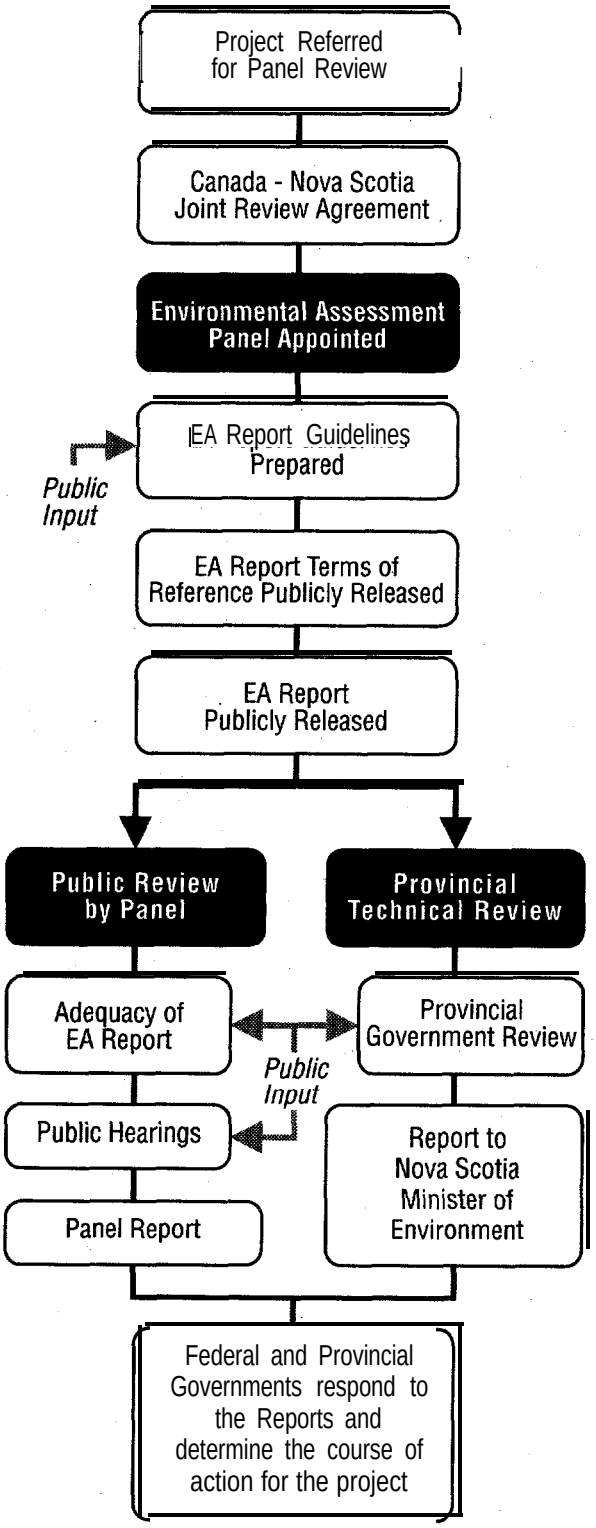

Figure 3 Source: Environmental Review Panel

Panel and Secretariat Visit McNabs Island

3. HALIFAX HARBOUR: THE RECEIVING ENVIRONMENT

What follows is a brief summary of aspects of Halifax Harbour that are relevant to its role as the receiving environment for the outputs of the proposed Project. The Harbour itself serves as an important component of the treatment system, as do the waters and sediments of the Scotian Shelf for any outputs that escape from the confines of the Harbour.

3.1 GEOGRAPHY

Halifax Harbour is a long, irregular, narrow bay on the Atlantic Coast of Nova Scotia (Figure 4). The Harbour is relatively shallow (20 metres) in the Inner Harbour and the Narrows, and then opens into the deep waters of the Bedford Basin (70 metres). Three islands are prominent features in the Middle and Inner Harbour: McNabs, Lawlor and Georges. A deep narrow inlet, the Northwest Arm, delineates the west side of the Halifax peninsula. The main shipping channel in the Harbour represents the original bed of the Sackville River and is therefore deeper than most Harbour areas.

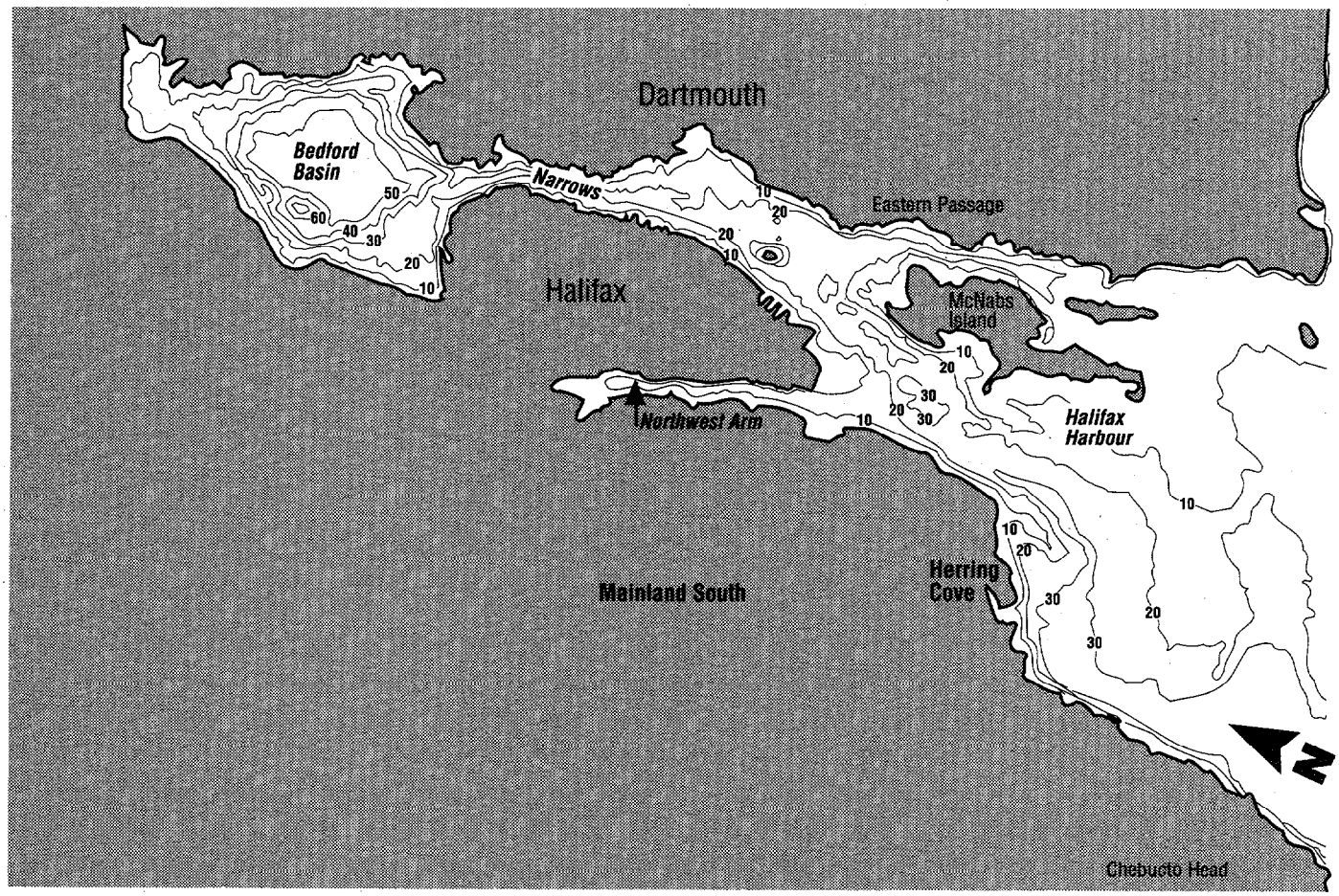

Figure **4 Halifax Harbour. Contours are at intervals of 10 metres below sea level.** *Source: After Halifax Harbour Task Force*

European settlements in the area were first established on the Halifax peninsula, at Dartmouth Cove and in Bedford. Settlements have since spread around much of the periphery of the Harbour and back inland, although there are still tracts of unsettled land which are allocated to park or military purposes. Approximately 225,000 people occupy the Halifax-Dartmouth metropolitan sewersheds that presently empty untreated wastewater into Halifax Harbour. A population

double this size could occupy the same area 50 years from now.

3.2 PHYSICAL OCEANOGRAPHY

Halifax Harbour generally behaves as an estuary, with fresh water from the Sackville River and other minor sources mixing with surface sea water to create a two-layered flow system. Fresher, lighter surface water flows out of the Harbour, while saltier, heavier water flows in along the bottom. Vertical mixing takes place at the interface **between** these two layers (Figure 5).

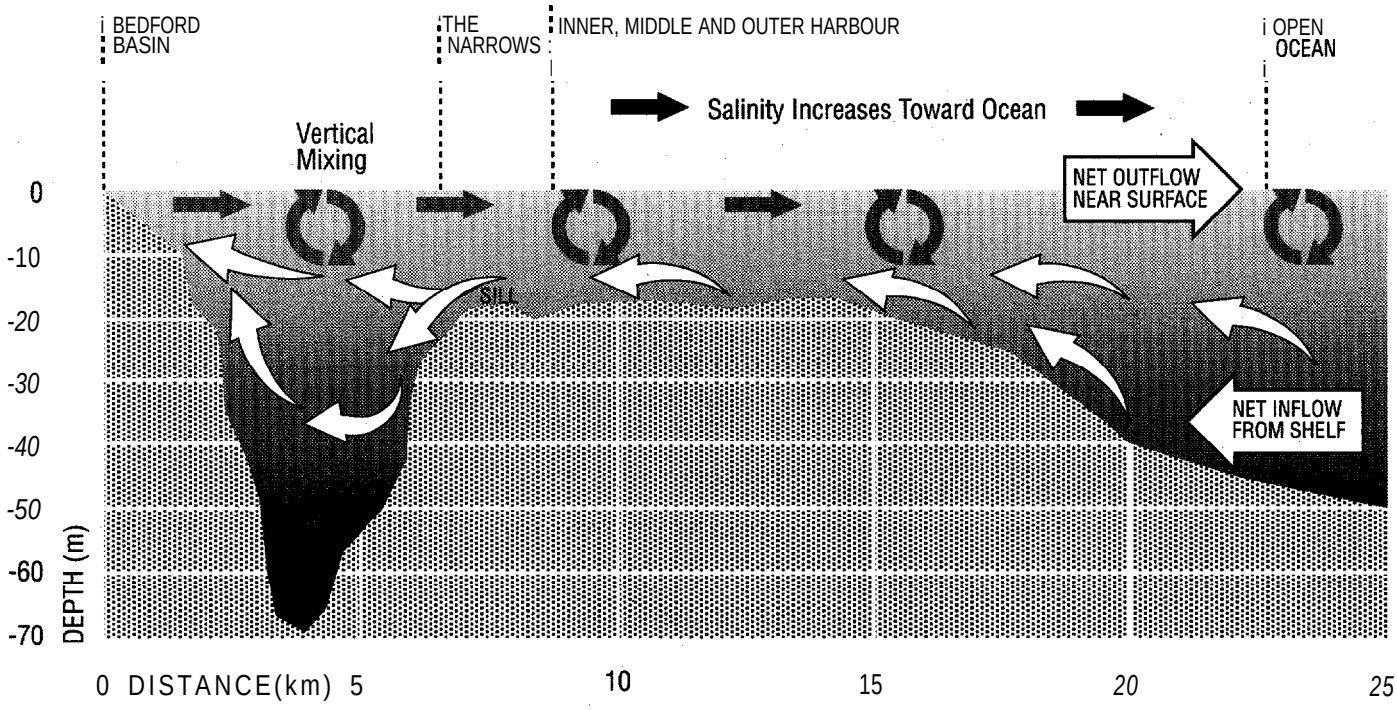

Figure **5 Circulation in Halifax Harbour**

Source: After Halifax Harbour Task Force

Because of the shallow bottom at the Narrows (the "sill") and the resulting water structure, water exchange in Bedford Basin is slow. In years of strong summer stratification of the water **layers,** the bottom water of the Basin becomes oxygen-depleted and unable to support most marine life. For this reason, the capacity of Bedford Basin to handle sewage loadings has always been a concern.

The Harbour's two-layer flow regime is modified by various factors, including tides, winds, and water exchanges between the Harbour and the Scotian Shelf caused by atmospheric pressure changes, variations in volumes of freshwater input, and rates of vertical mixing. The time required for, Harbour water to be completely exchanged (flushed) is uncertain; estimates range from 4 to more than 80 days. Water flows also vary with location in the Harbour. Currents are strongest in the Narrows, especially in the bottom layer (0.08-0.22 kilometres/hour), and off Sandwich Point. The weakest currents are found in Bedford Basin. Currents are also weak along the shoreline between Herring Cove and Halibut Bay - a significant factor in sewage outfall and dispersion problems in the H&ring Cove area.

The atmospheric pressure-driven water exchanges have recently been found to significantly influence currents and exchange rates. These exchanges occur over a period of from three to eight days. During the atmospheric pressure-driven water exchanges, flows can be either out at the surface and in at the bottom or vice versa, and can exceed the magnitude of the tidal flow rates. These exchanges can result in current flows in the same direction that do not turn with the tides.

The resulting water exchanges are very efficient at transporting material such as sewage-derived particulates. They can carry contaminants much farther than the tides which tend to move particulates only about 2 kilometres with each tidal cycle. These events greatly enhance the flushing of the Harbour, representing a critical exchange mechanism for the Harbour waters. They mix contaminants through large volumes of water, which is an important reason why water quality in the

Harbour is as good as it is, considering the quantity of raw sewage being dumped into it.

As a result of the physical oceanography of Halifax Harbour, water quality standards are expected to be met when treated sewage effluent is released from the proposed Project's diffuser, except in the immediate vicinity of the discharge, and occasionally in the vicinity of Black Rock Beach.

3.3 SEDIMENTS

Bedford Basin and the Inner Harbour trap sediments which erode off the surrounding land, as well as "natural" particles derived'from plankton and other organisms. Fresh water entering salt water also typically produces fine chemical particles called floes. Historical and ongoing land-use changes in the Halifax Harbour basin have had a profound effect on Harbour sediments. Eroded soils from land clearance, and municipal and industrial wastes have all resulted in polluted Harbour sediments. Sediment thickness on the Harbour and Bedford Basin bottoms vary from a few centimetres to more than 20 metres. Sediment types range from fine clays to sand and gravel, and there are some areas of bare bedrock.

Sediment distribution reflects water current patterns and strengths. The finest clay particles settle where the currents are weakest, while the strongest currents sweep all sediments away. The distribution of sediments in the Harbour shows where the fine sewage-derived particles, many with toxic organic compounds or heavy metals attached, are most likely to ultimately settle. These particles can be resuspended and deposited many times until they come to their final resting place.

Recent extensive studies of the geochemistry of contaminated surface sediments in Halifax Harbour have contributed significantly to the understanding of the distribution and movements of toxic metals and other contaminants. Due to the heavy metal concentrations in its sediments,, -Halifax Harbour ranks as one of the most contaminated marine harbours in the industrialized world.

The heaviest concentrations of contaminated sediments are associated with major sewage and industrial outfalls. The upper end of Bedford Basin and the inner portion of the Inner Harbour are dominated by sediments derived from surface runoff, with some outfall-associated "hot spots." The outer portion of the Inner Harbour and the channels to either side of McNabs Island are characterized by sediments undergoing slow chemical changes equivalent to rotting compost. In organically rich sediments, these changes will be driven by microorganisms, while in sediments with low organic content, chemical reactions will predominate.

The distribution of organic carbon in the inlet is similar to that of the fine clay particles. Organic carbon matter is derived from a variety of sources: living and dead organisms, sewage effluents, incomplete combustion products from the Tufts Cove oil-fired power generating station, terrestrial vegetation material, and treated effluents from the refineries and the two sewage treatment plants at Mill Cove and Eastern Passage. High concentrations of organic carbon are associated with chemically contaminated sediments, again suggesting their sewage origins.

Approximately 95% of the heavy metal contaminants found in sediments are believed to have arrived there attached to or bound in particulates. Metals dissolved in the water column make relatively small contributions to the sediments, with the exception of zinc, lead, manganese and mercury, which are removed from the sea water by the sediments.

It has been suggested that if present loading patterns change due to the Project, sediment surface chemistry associated with the old banks of sewage sludge at the ends of abandoned outfalls will allow some of the contaminants in these sediments to leach back into the sea water. Eventually this situation will stabilize, once the sludge deposits are capped through natural processes.

The proposed STP/OFS facility will reduce the loadings of chemical contaminants that are associated with sewage particulates, disperse these particles more widely, and should result in improved sutficial sediment quality. This will result in a better functioning of biological and chemical assimilation processes associated with the sediments.

3.4 MARINE LIFE

The Halifax Harbour inlet undergoes annual marine biological cycles typical of North Atlantic temperate coastal waters. In the winter, wind-driven mixing of the water column and low light conditions suppress the growth of phytoplankton (microscopic plants). The return of light and more stable conditions in late winter give rise to the spring phytoplankton bloom, which begins in March, and continues until the supplies of nutrients, notably nitrogen, are consumed. After nutrients are depleted, phytoplankton populations substantially decrease in number, and the species composition changes.

Phytoplankton growth continues throughout the summer and fall months, but numbers and species composition continue to be influenced by nutrient limitation. With the onset of fall and winter storms and low light, the population returns to winter conditions, allowing nutrient supplies to build up. Phytoplankton populations are likely to be higher in the sheltered waters of Bedford Basin than in the Inner Harbour, and numbers are likely to decrease as the deeper and more turbulent waters of the open coast are approached.

Phytoplankton and seaweeds constitute the base of the marine food chain; all marine animals are directly or indirectly dependent on them. Annual cycles of zooplankton abundance are closely tied to those of the phytoplankton, as are distributions and migrations of plankton-eating fish such as mackerel and herring.

Benthic animals living in the Harbour sediments, such as lobsters and clams, are dependent, in one way or another, on the "rain" of organic matter provided by the plankton as faeces or dead bodies, and on organic matter derived from land sources and seaweeds in shallow waters around the shoreline.. Organically rich and often contaminated sewage-derived particles are also harvested by benthic organisms living in the bottom

muds. Some benthic animals burrow in the mud but feed in the layer of water just above the seabed which concentrates suspended particles of all types. Others burrow in the organically rich and oxygen-depleted muds, passing the sediments through their guts just as earthworms do on land. Lobsters and groundfish (cod, haddock and winter flounder) feed on other benthic organisms and offal found on the bottom.

Certain birds and animals depend on the food resources of the sea. The ospreys and blue herons of McNabs Island are fish feeders and shallow shoreline feeders, respectively. Porpoises and seals are fish eaters. These animals are at the top of the marine food chain and are most vulnerable to accumulating and magnifying contaminants present in their food.

Microbes in great variety are present wherever there is organic material in water and sediments, under both oxygenated and deoxygenated conditions. Microbes process nutrients and chemical contaminants, and the overall assimilative capacity of the Harbour is determined mainly by the ability of microbes in the sediments to process contaminated particles. Phytoplankton and seaweeds respond to nutrient enrichment, both natural and sewage-derived; but too much nutrient enrichment in an enclosed waterbody can lead to an overabundance of phytoplankton and seaweed, resulting in a lowering of the assimilative capacity of the Harbour, and other environmental problems.

Benthic animals feeding on suspended particles or on sediments are useful in monitoring programs for sewage contaminants, to test contaminant body burdens and other effects. For example, the lesions observed in winter flounder caught in the Inner Harbour are an effect of chemical contamination from sewage and other sources. This species spends much of its life on or in the surface sediments. Because it moves over a very restricted geographical area, it may remain exposed to local sediment contamination for its entire lifetime. Fish and shellfish consumed by humans should be monitored for accumulations of chemical contaminants of concern, since seafood consumers accumulate and magnify these' same contaminants.

These are just a few examples of the contribution the living ecosystem of the Harbour provides in the assimilation of the products from sewage treatment. It also shows how the assimilative capacity of the Harbour can be overwhelmed if too many poorly treated or untreated wastes are disposed of in an uncontrolled manner. These are some of the many factors to be considered in assessing the performance of the proposed sewage treatment system.

4. ISSUES

4.1 THE PROJECT VERSUS THE "NO PROJECT" ALTERNATIVE

The "No Project" alternative for the Halifax-Dartmouth Metropolitan Wastewater Management System was universally rejected by all concerned interests: residents, all levels of government, HHCI and the Panel. Continuing to dump raw sewage into Halifax Harbour was considered intolerable, irresponsible and unsustainable.

Concerns about costs, site location, appropriate technologies, and mitigation of potential impacts were raised within the context of questions about how, where and by whom the Project would be built and operated. Whether it should proceed was not questioned.

The concerns. heard by the Panel included the following:

- The level of environmental remediation and protection that may be achieved does not merit the Project's high costs.
- The Project lacks technological flexibility and therefore does not sufficiently accommodate the need for future improvement or expansion. Upgrading to secondary treatment requires expansion of the artificial island and restarting the landscaping and visual remediation process.
- By not including controls at source in the Project, sustainable development is not satisfactorily addressed.
- The site-selection process was inadequate, as alternatives were not thoroughly considered and public input not prop erly included.
- The unproven OFS technology is the only option proposed for sludge management; it is a locked-in component of the agreement.
- Designing for primary treatment is an outmoded approach.
- HHCI has missed opportunities to optimize treatment, minimize capacity, and employ more environmentally beneficial and economical means of treatment and disposal for some parts of the system, such as Mainland South and Herring Cove.
- The single-plant solution eliminates multiple-plant options for Halifax, Dartmouth and Mainland South, which may be environmentally and economically more attractive in the long term; multiple-plant options would also lead each community to accept responsibility for its own sewage treatment.

Nevertheless, the Panel believes the Project must proceed under the conditions specified throughout this Report.

Generally, the Panel acknowledges that it is difficult to achieve an ideal cost-benefit ratio between expenditures and improvements for all aspects of the Project, given its magnitude and complexity. Some of the high costs associated with components of the Project (for example, the collection system) are necessary to correct long-standing environmental and social problems. Costs are also attributable to such pm-existing factors as dispersed and low-density development patterns, and problems imposed by geography.

The Panel agrees with HHCI that from an environmental standpoint the Project will bring about a significant long term improvement in the health of the Harbour, its ecosystems and adjacent terrestrial environments. Specifically,

- 50% of sewage solids will be removed and put through the OFS process for conversion to energy and a marketable oil resource
- a portion of the toxic organics and metals bound to settleable particles will be removed by primary treatment
- some pathogens will remain with the sludge at the STP/OFS facility, while others will be destroyed by disinfection prior to release of effluent to the environment, thereby significantly decreasing the number of viable pathogens entering the Harbour
- a portion of the nutrients will remain with the sludge at the STP/OFS facility, while those that travel with the effluent to the receiving waters will be diluted and dispersed more efficiently than at present
- plastics and floatables will be removed at the combined sewer overflows (CSOs) or by screens at the STP/OFS facility
- biochemical oxygen demand (SOD), chemical oxygen demand (COD), and toxics will be reduced in amounts and more widely dispersed, leading to significant long-term improvements in sediment quality
- controls at source (although not a part of HHCI's Project as presently defined) can markedly reduce inputs of toxic organics and metals to the Harbour

HHCI has also racognized the Project carries implications for many economic sectors. The Project's construction stage will mean job creation and other immediate economic benefits for the Halifax-Dartmouth metropolitan region, Nova Scotia and Canada.

The Panel examined the case for a single regional STP/OFS facility versus the multiple-plant approach and concluded that for reasons of cost, operational, management and regulatory efficiencies, a single regional treatment plant is appropriate. An exception to this is possible alternatives for the Mainland South and Herring Cove areas, which are dealt with in more detail later in the Report. The Panel therefore confirms the decisions of the Halifax Harbour Task Force and HHCI for a single regional plant.

The Panel endorses the implementation of an overall wastewater management system that includes water conservation, controls at source, and appropriate levels and methods of

treatment necessary to meet the water quality objectives stipulated by the Halifax Harbour Task Force. It also recognizes that some of the Task Force objectives and recommendations may be subject to revision in light of recent scientific and economic information.

For example, it may be appropriate to implement a higher level of treatment at the initial stage, e.g., advanced primary treatment. This will result in significantly higher rates of removal for solids and associated heavy metals, toxic organics, pathogens and nutrients for relatively small increases in capital and operating costs. It may also be appropriate to plan for the inclusion of the Eastern Passage Treatment Plant into the system at the initial stage, given future costs, ongoing environmental problems, and social equity -issues in Eastern Passage.

1. The Panel recommends that the Ministers reject the "No Project" alternative.

4.2 CHOOSING THE SITE

4.2.1 Introduction

During the public hearings, it became obvious that choosing' the location of the STP/OFS facility and diffuser were two of the most critical decisions to be made. HHCI was faced with the challenge of balancing a number of factors, including

- relative cost of installation, construction and operation
- impact on neighbouring communities
- compatibility with existing Harbour uses, and criteria and restrictions established by the Halifax Harbour Task Force, the Canadian Coast Guard, the Halifax Port Corporation, the Department of Fisheries and Oceans, and others
- water depth at the diffuser
- mixing and dispersion characteristics of the receiving water
- contaminant-retention capability of seabed sediments

It was soon obvious that the location of the STP/OFS facility was tied to the location of the diffuser, primarily for economic reasons. The greater the distance between them, the longer the outfall tunnel, and the higher the costs for the Project.

While recognizing that the site locations are tied together as a pair, the Panel will first describe issues surrounding the location of each facility separately.

4.2.2 The STP/OFS Site

It is relevant that the Task Force did not specifically recommend a site for a regional STP/OFS facility. Instead it developed criteria for evaluating candidate STP/OFS sites; namely, that the site be

- within 1.6 kilometres of the shoreline or inside the watershed boundary
- vacant or underused
- a minimum size of 6 hectares
- created by infilling at the water's edge to a depth of 10 metres (the Panel believes this last criterion should not be applied in an overly restrictive fashion)

The Task Force also listed an initial 16 candidate sites, which it later reduced to 5 sites, for detailed evaluation by HHCI.

Supplementary criteria used by the Task Force to reduce the list of candidate sites included consideration of

- ownership
- potential for expansion
- residential buffer
- access to receiving waters
- length of outfall
- highway, rail and sea access
- availability of municipal services
- prevailing winds
- physical conditions
- significant cultural or environmental resources
- visual impacts
- land values
- population density
- replacement value

In its initial Guidelines to HHCI, the Panel stressed the need for the proponent to describe the criteria used to identify and evaluate sites, and to describe how the siting process would take social equity issues into account. The Panel also acknowledged that the Task Force criteria were relevant.

In the spring of 1991, when HHCI undertook its initial site-selection process, the five candidate locations suggested by the Task Force were assessed, although the terms of its Agreement did not restrict HHCI to these five sites.

A major element of HHCI's site-selection process was public consultation. Information sessions were held in communities potentially affected by each of the candidate sites. Considerable opposition to locating the plant anywhere near a residential area was registered. As a result of this evaluation process, an artificial island ("Ives Island") off the northern tip of McNabs Island was chosen as HHCI's preferred site for the STP/OFS facility early in May 1991, very soon after completion of the public consultation process. Shortly thereafter, the Project registration was altered to include this site.

It is the Panel's view that the decision-making process that led to the selection of the site was inadequate. The decision was made very early in the review process (May 1991) by the Board of HHCI without adequate public involvement. It was made before HHCI had even completed its Terms of Reference in response to the Panel's Guidelines. Only one other sea-level site was considered, the Halifax Railyards, and this

was rejected on the basis of economic considerations. The public and the Panel believe the proper consideration of alternative sites was cut off much too early.

The designation of Ives Island as the STP/OFS site met with opposition from a number of interests and many individuals, and repeated requests were communicated to the Panel throughout the review process that alternative sites should be sought and seriously evaluated by HHCI.

As HHCI refined its design for the regional STP/OFS facilii a number of improvements were made. The plant became much smaller and more efficient in design. It became completely enclosed, significantly reducing the attributes that make sewage treatment plants unattractive as neighbours.

During the initial site-selection process, the STP/OFS facility was assumed to require a site of at least 50 hectares, whereas a smaller, covered plant would need approximately 10 hectares. Also, an enclosed plant with odour control, air conditioning and noise control could be situated closer to residential areas; the original, unenclosed plant had required a **150-metre** buffer consistent with Nova Scotia Department of the Environment Guidelines for the Collection, Treatment and Disposal of Sanitary Sewage.

The Panel became concerned that a closer examination of the alternatives which incorporated the implications of the design revisions might lead to the conclusion that an onshore site would be more appropriate.

Because of widespread concern from the public and the Panel about the STP/OFS site-selection process and absence of sufficient information about alternatives in the Environmental Assessment Report, in November 1992 the Panel requested that HHCI evaluate three additional sea-level sites: Sandy Cove, Dartmouth Ocean Terminal, and the **FIOR** site, all in the Woodside-Imperoyal area of Dartmouth. Those evaluation results are contained in Supplementary Information 3 of the Environmental Assessment Report. HHCI concluded that Ives Island was still the preferred site for a number of reasons:

- community opposition in Dartmouth and Shearwater to siting an STP/OFS **facility** in their midst
- proximity of these sites to residential neighbourhoods
- disruption of existing land uses at the three sites
- greater distance from the STP/OFS facility to HHCI's proposed diffuser site off McNabs Island
- no advantage in capital and life-cycle costs for the alternative sites when compared to Ives Island

Although HHCI concedes that it is physically possible to locate a regional STP/OFS facility at any one of the three alternative sites, none meets the HHCI siting criteria and each presents potential social drawbacks. None of the three sites had been the subject of public consultation prior to the hearings, and the Dartmouth Ocean Terminal site had not been identified as a possible candidate until the Panel's direction to HHCI in November 1992. HHCI remains of the opinion that there is no significant difference among the three alternative sites, and that Ives Island is the best of all imperfect sites around the Inner Harbour.

Interest groups and members of the public at the hearings, however, expressed strong disagreement with the site-selection process and the resulting choice of Ives Island as the location for the STPIOFS facility. This dissension centred on the following issues:

- The site-selection process was completed before the design changes were made to the STP/OFS facility and site size (enclosed plant requiring a smaller area), so these revisions were not reflected in the site-selection process.
- Land acquisition from the federal or provincial governments was not suitably taken into consideration.
- Establishing an STP/OFS facility on the doorstep of McNabs Island could set a dangerous precedent for future industrial development on the island, and seriously compromise its viability as a provincial park.
- It is inappropriate to locate an STP/OFS facility immediately adjacent to designated parklands and historic sites.
- Little detail was given on how community concerns such as quality of life and property values were incorporated into the site-selection evaluation.
- Site-selection and rejection criteria were not applied uniformly; criteria used early on to eliminate Point Pleasant Shoal as a candidate site should have equally eliminated Ives Island.
- Site access, servicing by utilities, and emergency response considerations raised concerns about convenience, feasibility and safety.
- The Ives Island location is relatively close to commercial fishing locations.
- The not-in-my-back-yard (NIMBY) syndrome had driven HHCl's site-selection process, with inadequate weight having been given to social, cultural and ecological equity issues associated with McNabs Island.

Many called the site-selection process undertaken by HHCI an imperfect process and called for a re-evaluation of the site-selection matrix results. Other sites were suggested as possible alternatives to Ives Island, and some sites such as the Department of National Defence parking lot in downtown Halifax were presented in conjunction with alternative technologies.

The Panel also heard from the communities that would be affected by siting the STP/OFS facility at the three alternative locations. The.Nova Scotia Hospital raised a serious objection to the Sandy Cove site based on social equity considerations for their patients. Residents of North Woodside were explicit that the views from their homes contributed significantly to property values, and that the Sandy Cove area was intensively used as a local park. Shearwater and Dartmouth residents also objected to consideration of the **FIOR** site and Dartmouth Ocean Terminal. Very clearly, the same issues

that were of concern regarding McNabs Island - aesthetics, loss of alternative land-use opportunities, park/community compatibility, and odour control - were also of concern to these communities.

One of the more significant recommendations of the Task Force was Recommendation 5, Public Consultation on Site Selection: "Halifax Harbour Cleanup Inc. should provide information on the short list of viable sites and, in association with the three municipalities, consult with interest groups and the public on the factors to be used in evaluating these potential locations."

The Task Force's Recommendation 6, Community Siting Agreement, states that before a final site is selected, HHCI should open discussions with the community or neighbourhood adjacent to the proposed site in preparation for the development of a siting agreement. There is little evidence that HHCI consulted with the community of interest for McNabs Island.

Sufficient information has been presented to lead the Panel to the conclusion that the Ives Island site is suitable for the regional STP/OFS facility under certain conditions outlined in Section 4.2.4. The Panel agrees with HHCI and the communities in rejecting the Sandy Cove and FIOR onshore sites. However, the Dartmouth Ocean Terminal site (Figure 6) appears to have a number of advantages over the proposed Ives Island site, and the Panel concludes that this onshore site should receive additional consideration before the Project proceeds.

After reviewing and evaluating the documentation presented during the entire site-selection process, as well as the views expressed in submissions to the Panel during the hearings, the Panel is of the opinion that the site-selection process undertaken by HHCI was an imperfect one. The Panel's suggested way of dealing with this concern in an efficient manner is described in Section 4.2.5.

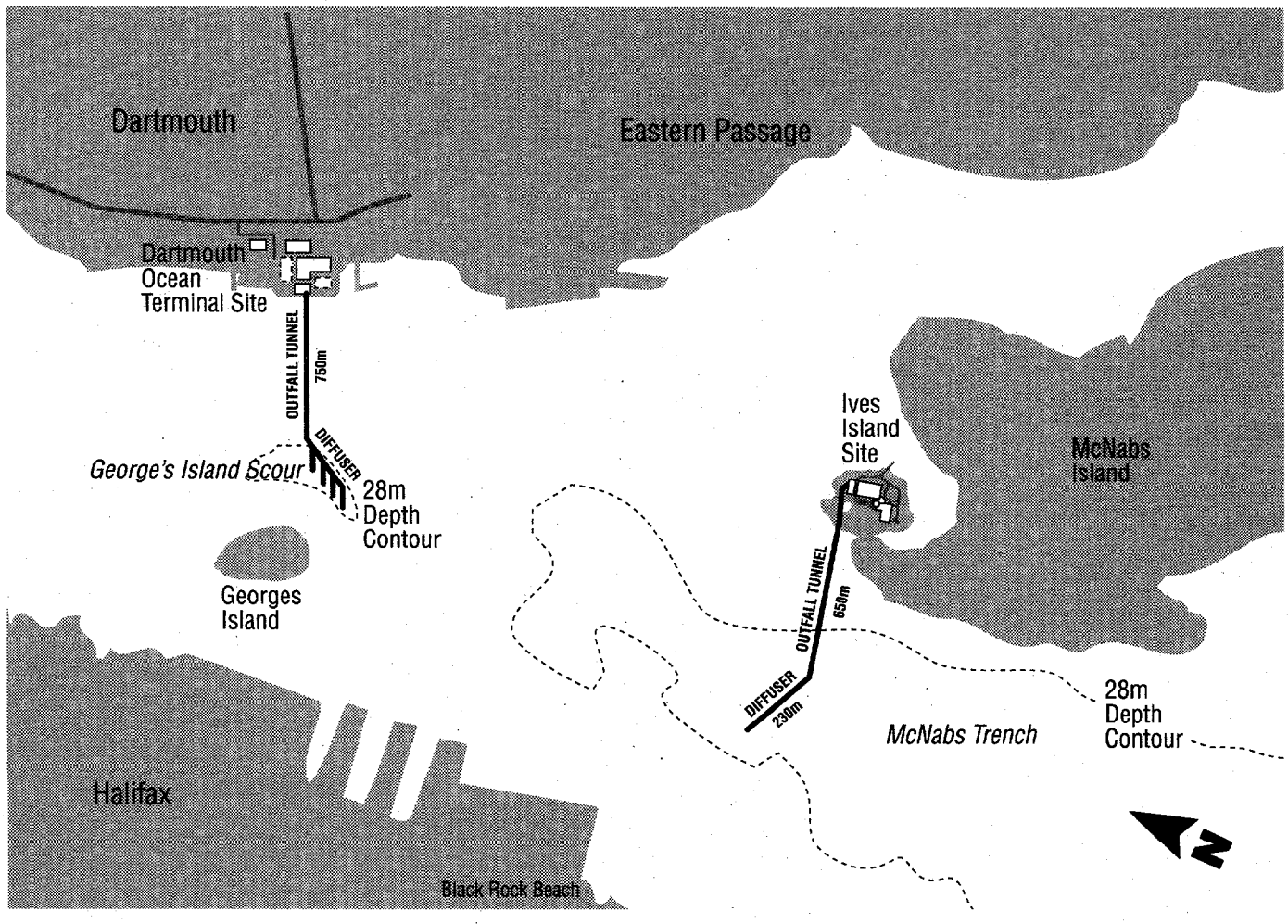

Figure **6 Alternative Pairs of Sites for Sewage Treatment Plant and Diffuser.** *Source: Environmental Review Panel*

4.2.3 The Diffuser Site

According to the description of the proposed Project, after wastewater from the STP/OFS facility has undergone primary treatment and disinfection, it will be discharged via an under-Harbour tunnel through a diffuser to the marine environment.

The location of the diffuser site has been a major issue in the review process, because of potential impacts of the large volume of treated effluent to be released somewhere within Halifax Harbour. In particular, there is concern about the dispersal of toxic and hazardous wastes into the marine environment. To summa&e, the wastewater constituents of greatest concern are

- persistent toxic organic chemicals and metals associated with sewage particles
- pathogens such as viruses and enterococci bacteria, which will not be entirely eliminated by the disinfection process
- nutrient loadings which promote excessive growth of phytoplankton

The Task Force used the following criteria in making its selection of the diffuser location:

- Harbour use objectives
- principles established following consultation, with the community
- available scientific information on dilution and dispersion rates
- human and ecological health hazards posed by particulate-borne toxics that would settle on the Harbour floor
- possible distribution and impacts of effluent-derived sediments
- the need to locate the diffuser a minimum of 2 kilometres from swimming beaches, to avoid possible human contact with sewage-derived pathogens

One important factor was apparently not considered by the Task Force: the relationship between the diffuser location and designated shipping anchorages.

The Task Force adopted Guideline 6 of the Guidelines for the Protection of the Marine Environment Against Pollution From Land-Based Sources (Montreal Guidelines):

> *In taking measures to prevent, reduce and control pollution from land-based sources, States have the duty to act so* as *not to transfer directly or indirectly, damage or hazards from one area to another or* ***transform*** *such pollution into another type of* ***pollution****. (Guideline 6 does not prevent transfer or transformation of* ***pollution*** *in order to prevent, reduce and control* ***pollution*** *of the environment as a whole.)*

On the grounds that the responsible way to address sewage treatment and disposal is to clean it up at home, and based on community consultation, resulting Harbour use criteria, and critical scientific and engineering information, the Task Force concluded that the optimum location of the diffuser was in the Inner Harbour at a minimum depth of 20 metres, on the hard bottom between Georges Island and the Dartmouth shore.

In coming to this conclusion, the Task Force deliberately opted for a strategy that would promote retention of sewage particulates in the Inner Harbour sediments, while at the same time providing adequate dilution and dispersal of dissolved contaminants and pathogens remaining in the effluent. Containment of sewage-derived particulates contaminated with toxics within the already polluted Inner Harbour was thus made the priority concern. This decision recognized that the Inner Harbour waters and sediments would continue to serve as an "extended natural treatment system" for the Halifax-Dartmouth metropolitan area, although the sewage loadings in the effluent from the new regional treatment system would be much reduced over the present situation.

The virtual absence of commercial fishing in the Inner Harbour, the distance from swimming beaches, and the relative ease of monitoring also contributed to the decision by the Task Force to locate the diffuser by Georges Island.

With Ives Island designated as the preferred STP/OFS site, HHCI then examined potential locations for the diffuser site. Four sites were proposed to the port authority (Halifax Port Corporation) and the Canadian Coast Guard, who also involved the Atlantic Pilotage Authority. It appears from the correspondence made public by HHCI and information presented at the hearings that only these three agencies made the September-October 1991 decision to reject the Task Force's recommended diffuser site on the grounds of navigational safety and access to designated anchorages. They identified "the only acceptable" diffuser site as the one within the main shipping channel to the west of McNabs Island. Other Harbour interests were not consulted in this decision.

At the public hearings, the diffuser location decision was challenged by a number of review participants. The Halifax Port Corporation and the Canadian Coast Guard defended retention of existing anchorages for reasons of economics and marine safety.

Concern was expressed for both diffuser integrity and ship safety if an anchor caught on the diffuser. The Coast Guard referenced the primacy of the Navigable Waters Protection Act over all other uses. At public hearings they acknowledged that if an alternative diffuser site was put forward they would need to carry out a more detailed examination, including consultation with other government departments.

After reviewing all the information provided, the Panel confirms that a diffuser location off Georges Island would better meet the requirements of Inner Harbour containment recommended by the Task Force.

At any diffuser site, consideration should be given to the alternative diffuser design recommended in the Halifax Harbour Cleanup Project Quality and Value Engineering Audit by Gore and Storrie. It provides for greater security of operations, less

potential for deleterious interaction with ship anchors, and less danger to both shipping and the diffuser.

4.2.4 Evaluation of Alternative Pairs of Sites

The environmental assessment process provides for the examination of alternatives for major aspects of a given undertaking, because the advantages and disadvantages of each decision must be carefully weighed and judged by all interested parties, including the public. The Panel was careful to include a requirement to consider alternative sites for the STP/OFS facility into the Guidelines for the environmental assessment early in 1991. At that point, the location for the diffuser was a given as the result of the recently completed work of the Halifax Harbour Task Force.

In this section, the Panel sets out the relative advantages and disadvantages of two pairs of sites:

- Ives Island STPlOFS site with diffuser west of McNabs Island (Tables 2a and 2b)
- Dartmouth Ocean Terminal STP/OFS site with diffuser off Georges Island (Tables 3a and 3b)

Other combinations of STP/OFS and diffuser sites were eliminated on economic and engineering grounds.

Having weighed the relative advantages and disadvantages of the pairs of sites, the Panel concludes that the Ives Island STP/OFS facility and diffuser west of McNabs Island pair of sites is acceptable with the following conditions:

1. The planning and implementation of the proposed park for McNabs Island, under the direction of the Nova Scotia Department of Natural Resources, must be an integral part of the Project and of an amended funding agreement.
2. HHCI should cooperate with the Department of Natural Resources to consider and resolve issues of concern in the development and implementation of the park plan.
3. HHCI should work in partnership with the Eastern Passage community to resolve land-use planning issues relative to the development of the STP/OFS facility in the District 6 Municipal Planning Strategy.
4. There should be no Project construction or operations activities on McNabs Island.

However, the Panel also concludes that the Dartmouth Ocean Terminal STPlOFS and Georges Island diffuser pair of sites has some significant advantages over the Ives Island/west of McNabs Island pair, and deserves serious evaluation.

Like the Task Force, the Panel confirms the greater potential for containment in the Inner Harbour at the Georges Island diffuser site. This, along with many advantages of an onshore STP/OFS facility location and concerns about the basic incompatibility of the Ives Island development with the planned McNabs Island park, causes the Panel to favour an examination of the Dartmouth Ocean Terminal/Georges Island pair.

Table 2a Advantages and Disadvantages,of Ives Island STP/OFS Site

Advantages	Disadvantages
• Site is at sea level • Remoteness from residential communities • Proximity to diffuser site (650 m) • Some economic benefits to Eastern Passage which might not otherwise accrue • Acceptance of site by municipalities	• High costs for construction of artificial island • High plant construction, servicing, energy, and transport costs due to island location . Transportation and community impacts from importing fill to create island • Zoning conflict: industrial use versus adjacent parkland zone • Impacts on McNabs Island parkland and cultural resources • More difficult access during construction and operation and for emergency response • Residual visual impacts of STP/OFS facility in relation to McNabs Island and Harbour • Future expansion is costly; visual mitigation process begins all over again . If the OFS technology fails, alternative sludge management is complicated by size of island and transport to shore • Loss of marine recreational, anchorage and archaeological sites in Ives Cove • Halifax Co. District 6 (Eastern Passage) would have to accept two sewage treatment plants

Table 2b Advantages and Disadvantages of Diffuser Site West of McNabs Island

Advantages	Disadvantages
• Cleared by port authorities for use • Offers good dilution and dispersion characteristics • Little chance of deleterious phytoplankton blooms • Liffle danger of impacts from anchoring	. Fewer toxic organic and metal contaminants associated with fine particulates will be contained in the Inner Harbour • Toxic organic and metal contaminants associated with fine particulates coming to rest in the Outer Harbour have potential for long-term bioaccumulation and biomagnification in commercially important fish and lobsters, and other marine species • Located less than 1 km from Black Rock Beach and 2 km from Maugher Beach, so higher probability of swimming beach closure

Table 3a Advantages and Disadvantages of Dartmouth Ocean Terminal STP/OFS Site

Advantages	Disadvantages
• Site is at sea level • Lower site development costs • Lower operating costs • Area zoned industrial, and has been surrounded by industrial and commercial sites for many years • Site is underutilized • Direct access from major transportation routes • STP could be built into site, backsloped, tiered and landscaped to mitigate aesthetic impacts • Services, including utilities and emergency response, nearby • Lower operating costs for energy • Should OFS technology fail, onshore site provides flexibility for alternative sludge management systems • When expansion is required, site can be filled out to approximately 12 m depth using wharf retaining walls instead of creating earth-filled site out to greater depths • Proximity to Georges Island diffuser site (750 m) • Overland collection system from Eastern Passage to STP is less costly and safer than from Eastern Passage to Ives Island • Good opportunity for public education and interpretation of STP/OFS facility, as access is not a problem	• Availability of site is unknown • Existing land uses will have to be replaced • Community acceptance may be difficult • Site has not been subject to full environmental assessment and public consultation

Table 3b Advantages and Disadvantages of Georges Island Diffuser Site

Advantages	Disadvantages
• Most likely to contain toxic organic and metal contaminants associated with fine particulates in the Inner Harbour sediments • Less possibility of toxic organic and metal contaminants associated with fine particulates coming to rest in the Outer Harbour, with potential for long-term bioaccumulation and blornagnification in commercially important fish and lobsters • More than 2 km from nearest swimming beach, so less possibility of beach closures	• Not cleared for use by Harbour authorities • Lower water exchange potential may promote retention of nutrients which stimulate phytoplankton blooms • Dilution and dispersion less effective • Probable higher cost for diffuser

4.2.5 Completion of the Process

In order to complete the process of examining these altemative sites, it must first be determined whether there are any absolute constraints regarding their availability. This process of establishing whether there is an absolute constraint on either member of the pair should involve a full technical and jurisdictional review, including review by relevant government agencies, and should be documented and made public.

If no absolute constraint is found, the Panel believes the engineering, environmental and cost-benefit assessment should be completed. A proper public consultation process should be undertaken, and a report submitted to the Ministers. The Ministers should then make their final decision on which pair of sites should be used for the Project.

The Panel has taken into account the following:

- Almost, but not quite, enough information is available to complete the decision process.
- The issues are clearly defined, and maximum efficiency is desirable; a further full panel review including public hearings does not seem warranted.
- An evaluation, a public consultation process, and a report containing a recommendation to the Ministers needs to be developed and made public.
- This process must maximize efficiency without sacrificing fairness, credibility, public input and discussion, and a completion of the overall assessment process.
- Time is of the essence: the Halifax-Dartmouth metropolitan area has waited too long for the implementation of this system.
- The business and job opportunities associated with the Project are eagerly awaited in many sectors.
- The Panel accepts HHCI's overall concept for the design and implementation of the Halifax-Dartmouth Metropolitan Sewage Treatment Facility with the conditions as discussed in this Report. Some of the design and preliminary construction activity for the collection system could commence, with the Ministers' approval, while this final process is being completed.

Both the federal and provincial environmental assessment processes contain enough flexibility that a process which meets the above criteria may be developed. For instance, a Commissioner (or other "competent authority") can be jointly appointed by the federal and provincial governments. The Commissioner can oversee the completion of the process and submit the report to the Ministers.

The Panel advises that the following process, or equivalent, should be undertaken:

1. A Commissioner is jointly appointed by the relevant provincial and federal Ministers to oversee the process.
2. The Commissioner shall convene an intergovernmental consultation with HHCI to determine whether an absolute constraint exists for the alternative pair of sites. If an absolute constraint is found, the process ceases at this point, and the Ministers advise HHCI under what conditions the Ives Island/west of McNabs-based Project can proceed.
3. If the alternative pair of sites is cleared by the Commissioner for further consideration, the process continues. HHCI is directed to complete the assessment of the Dartmouth Ocean Terminal/Georges Island pair of sites, and submits its report to the Commissioner for review by governments, relevant communities and the general public.
4. The Commissioner with HHCI initiates a public consultation process which concentrates *on/y* on the alternative pair of sites in question, *not* the entire Project. This consultation process should permit full discussion of the issues.
5. On the basis of the information received, the Commissioner deliberates, writes a report and submits a recommendation to the relevant Ministers on whether or not the alternative pair of sites is acceptable.
6. The Ministers complete their decision and recommendation process, advise HHCI, and release the Commissioner's report to the public.

2. The Panel recommends that the Ministers approve the Project, subject to the conditions outlined in this Report.

3. **The Panel recommends that the Dartmouth Ocean TerminaVGeorges island alternative pair of sites be evaluated in accordance with the process outlined in Section 4.2.5.**

4. **The Panel recommends that should a decision be made by the Ministers to proceed with the Dartmouth Ocean TerminaVGeorges Island alternative pair of sites that the recommendations contained in this Report be applied to the Project with the exception of those specific recommendations for Ives Cove, Ives Island, McNabs Island and the diffuser site west of McNabs Island.**

4.3 AN INTEGRATED APPROACH

4.3.1 The Principle of Sustainable Development

Sustainable development "meets the needs of the present without compromising the ability of future generations to meet their own needs" (UN World Commission on Environment and Development, Our Common Future, 1967).

In order to achieve sustainable development in the planning and implementation of a wastewater management system for the Halifax-Dartmouth metropolitan region, it is necessary to take an integrated approach to the economic, natural and social environments of the region. Figure 7 illustrates how the Project fits within this broader context.

The seven principles for sustainable development drafted by the Nova Scotia Round Table on Environment and Economy, and reported in the Nova Scotia Sustainable Development Strategy (Feb. 1992) are relevant to many of the concerns and elements of the Project. These principles, which encompass the recommendations of the Panel, are excerpted below.

- Stewardship

  Nova Scotians must take responsibility for the impacts [of] our activities...[and] ensure future generations have the opportunity to achieve a quality of life equal to or greater than that which we now enjoy.

- Ecological Value

  Nova Scotians must allow essential ecological processes, biological diversity, and the life support systems of our environment to flourish in as natural a manner as possible. Directly or indirectly, our natural environment supports all aspects of our economic and social activities.

- Living Off the Interest

  Nova Scotians must manage our activities so that our renewable resources are being utilized within their ability to replenish themselves, both in the short and long term. This principle requires that every attempt be made to

  (a) reduce our consumption,
  (b) reuse whenever possible, and
  (c) recycle.

- Global Implications and Responsibility

  Nova Scotians must think globally and act locally. This requires recognizing that there are no boundaries to our environment and that cooperation by all governments is needed.

- Full Cost Accounting

  No resource can be considered in isolation. It is important these resources be valued so that the cost to the user is a reasonable reflection of the benefits and costs to society. The value of our air and water resources must be included when determining total costs.

- Informed and Accountable Decision Making

  Government, industry, and individuals must incorporate environmental and economic considerations into decision-making processes. [All] must become informed about and involved in sustainable development issues and must be held accountable for decisions made.

- Scientific and Technological Innovations

  Nova Scotia must research, develop, test, and market new efficient technologies and processes and shift to products and services that have minimum impact on the environment over their life cycles.

In developing a strategy for sustainable development for Nova Scotia, the concept of carrying capacity is also relevant. In this context, sustainable development means "improving the quality of life while living within the carrying capacity of supporting ecosystems" (World Conservation Strategy, 1980). Natural resources are limited, and the ability of the biosphere to support life and human economic activity (i.e., its carrying capacity) is also limited.

In order to be sustainable, the Project must address and respond to the concept of carrying capacity for the marine ecosystem, the terrestrial environment and the human social and economic environments. According to the principle of capacity rights, the municipalities or an assigned utility would regulate the inflows to the system and then allocate treatment costs according to use.

The federal, provincial and municipal governments' agreements to install the infrastructure required to treat sewage generated in the Halifax-Dartmouth metropolitan area is recognized as a crucial step in actualizing the principles contained in the Nova Scotia Sustainable Development Strategy.

5. **The Panel recommends that HHCI commission an independent sustainable development audit on all Project components, which will evaluate and rate the components for both environmental and economic benefits, and suggest alternatives where appropriate.**

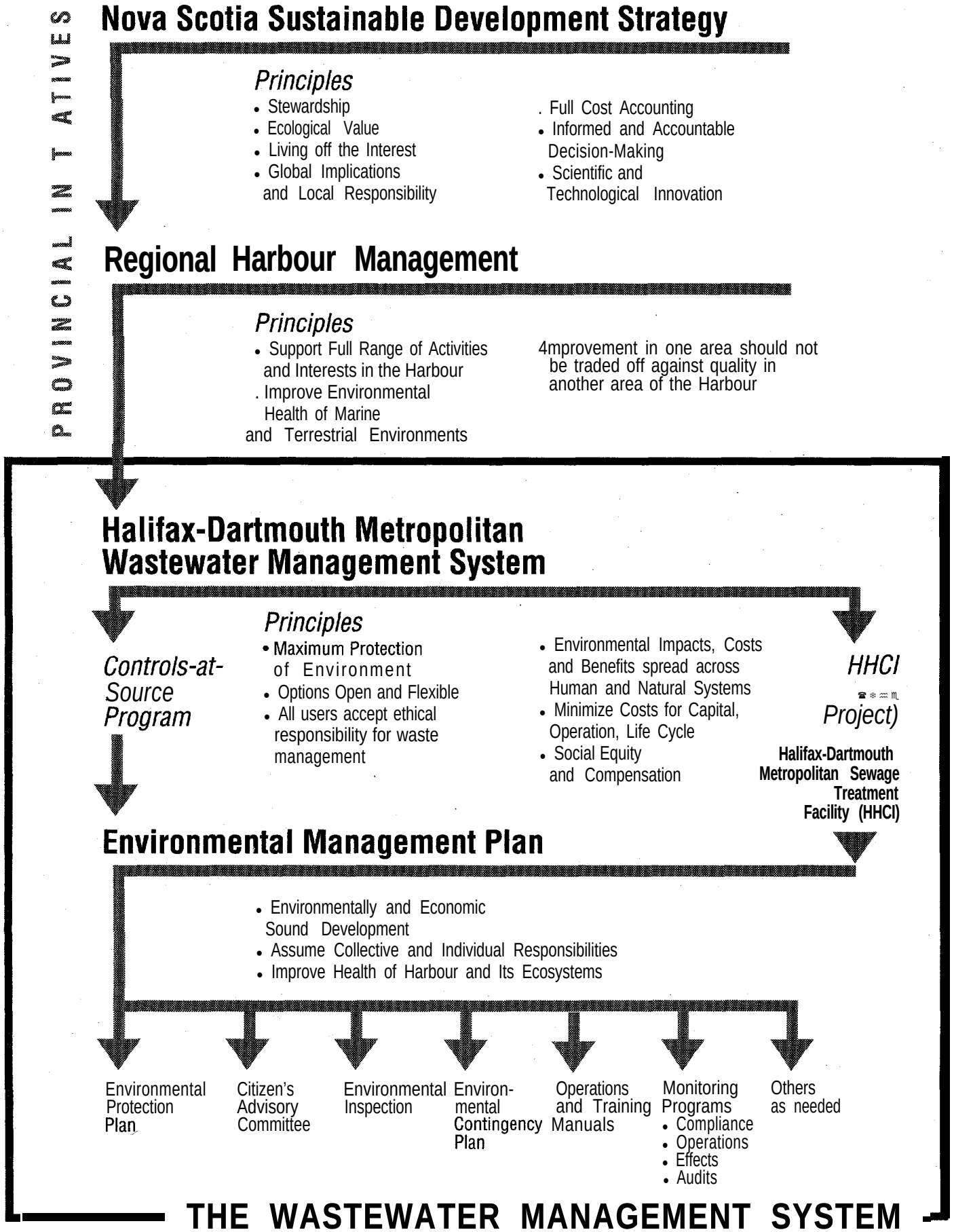

Figure 7 **The Sustainable Development Framework for The Project** Source: Environmental Review Panel

4.3.2 Regional Harbour Management

A sewage treatment facility for the Halifax-Dartmouth metropolitan area must be planned in the context of a broader management framework, which views Halifax Harbour and its related watersheds as a regional coastal zone. The Panel's view is consistent with one of the key principles recorded by the Halifax Harbour Task Force: the full range of activities in the Harbour should be maintained and supported, both commercial and recreational. The principle that no area in the Harbour should be reduced in quality because of the effects of a sewage treatment system, and that an improvement in one part of the Harbour should not be traded off against a drop in quality in another, is also pertinent.

The Sustainable Development Strategy for Nova Scotia references the need for a "comprehensive coastal zone management plan for Nova Scotia" and integrated agency planning. The Nova Scotia Department of the Environment also views coastal zone management as a high priority. The federal government endorses the concept of coastal management through a number of recent initiatives, such as Environment Canada's Atlantic Coastal Action Program. Common to all such coastal management strategies is an integrated approach whereby the coastal inlet is managed as a holistic entity.

The Panel concurs with an integrated approach to regional harbour management, with the Province as the lead agency. The proposed Project is one very important part of a larger strategy for managing the Harbour and its related watersheds. It is no accident that at its first meeting in 1990 the Panel adopted the name "The Halifax-Dartmouth Metropolitan Wastewater Management System" for itself, in recognition of the fact that regional sewage treatment is not an isolated issue. Wastewater management and the proposed Project deal with land-based waste inputs, which become outputs to the marine environment. The Project is intended to serve the industries, commercial establishments, institutions, governments, and residents of the region - in short, the total human population and their activities - for at least the next century; and it calls on the marine environment itself to assist with the remediation process. Ethics, responsible care, and commitments to sustainable development demand this perspective.

A Halifax Harbour regional management strategy should address the following issues, among others:

- land, seabed and water use controls
- reduction of the volume and toxicity of wastes
- recovery of materials where feasible
- treatment and stabilization of wastes that cannot be recovered
- non-point controls-at-source programs
- adequate disposal of those wastes that can be safely assimilated by the environment
- a thorough monitoring program

These issues, which are all consistent with Halifax Harbour Task Force recommendations, need policies and implementation procedures. Such procedures would address pollution from non-point sources entering the Harbour as stormwater runoff, dredging and dumping, and land-use planning with supportive by-laws to prevent pollution from land-based activities.

The Panel believes that a Halifax Harbour regional management strategy is a desirable goal but does not advise that the Project halt while such a development is undertaken. Rather, the Panel shares the view of the Task Force that development and installation of the Metropolitan Wastewater Management System itself, and the activities of HHCI in designing and constructing the system, can play a key role in demonstrating the requirement for a holistic and integrative approach to Harbour management in which many interests and activities are accommodated.

6. The Panel recommends that the Province foster the development of a regional harbour management strategy for Halifax Harbour, including its marine and terrestrial environments, shorelines and watersheds. This strategy should be based on sustainable development principles and designed to maintain and enhance the integrity of the Harbour ecosystems. Other levels of government, HHCI, and community and institutional interests should be active participants in the development and implementation of the strategy.

7. The Panel recommends that the Ministers ensure that the Project is Implemented within a regional harbour management approach for Halifax Harbour.

4.3.3 Environmental Management Plan

A major project such as the design, construction and commissioning of the Halifax-Dartmouth Metropolitan Sewage Treatment Facility will necessarily control, and be controlled by, many of the elements that are integral aspects of the Harbour management "plan," even if it does not exist in a formal sense as yet.

Many waste treatment remediation plans and projects are under way in Canada, and some have a comprehensive vision of how their projects fit into the larger ecosystem and administrative units within which they are located, which support them, and which are affected in both near- and far-fields by project activities. Those that have this larger vision see themselves in a sustainable development context, and have usually developed the equivalent of environmental management plans to guide their development and operations. An environmental management plan covers construction and operations phases while maiiitaining overall objectives. It is a proactive prevention and rehabilitation plan, incorporating the best management practices to ensure that the objectives are met.

The Metro Toronto and Region Remedial Action Plan provides a good example of an environmental management plan.

Some objectives from their draft Action Plan Stage 2, paraphrased below, are relevant to the Halifax Harbour Cleanup Project.

- Stormwater must be viewed in the context of a resource to be managed and used in support of societal benefits.
- The discharge of untreated sanitary wastes must be eliminated.
- The discharge of untreatable contaminants to the sanitary system must be eliminated.
- The efficiency of the treatment systems must be improved, by:
  - reducing the hydraulic load,
  - optimization of the treatment plant and system design and operation.
- Degraded and lost aquatic habitats should be restored where possible and feasible.
- Ecosystem-based remedial actions and their implementation must be supported by the adoption and development of appropriate policy and legislation.
- Remedial actions must be supported by an integrated and coordinated program of environmental monitoring, and reporting of progress.

The Toronto-Action Plan also states that treatment systems must not further contaminate receiving waters, and that public participation must be an integral part of a remedial action plan.

The Panel believes that HHCI, its government promoters and regulators, and its ultimate owners and operator should be cognizant of where and how the Metropolitan Wastewater Management System fits into the Harbour basin system, the ecosystems that contain and support all human activity in the. basin, and sustainable development for the region.

In addition to all the design work completed to date, HHCI has committed itself to the development of several types of environmental management plans and the procedures that follow from them. Responsibilities for implementation and ongoing improvement of these during the operations phase will devolve to the system owners and operator. Plans specifically identified for construction and operational phases include

- Environmental Protection Plan
- Citizens' Advisory Committee
- Employee Education and Orientation
- Environmental Inspection
- Emergency Response Plans
- Environmental Compliance Monitoring Plan
- Environmental Effects Monitoring Plan and Advisory Committee

While all these plans are seen as contributing to effective environmental management, they are presented as independent "measures" and do not incorporate the desirable and more comprehensive "strategies" and "objectives" of a well-structured management plan. These plans need to be seen as integral parts and supports for the proposed Metropolitan Wastewater Management System Environmental Management Plan, and beyond that, as part of a comprehensive Harbour management plan for the region.

While HHCI will be responsible for plans and changes during the construction phase and can make commitments accordingly, both compliance and effects monitoring programs and use of their results will be even more important during the operational phase. During the operations phase, special care must be exercised to protect the receiving waters and marine ecosystem of Halifax Harbour. Some elements that should be included in the marine compliance and effects monitoring plans are described in Section 4.12.4.

8. The Panel recommends that HHCI develop a detailed and explicit Environmental Management Plan for the Metropolitan Wastewater Management System which Is

- **consistent with the principles of sustainable development**
- **developed in consultation and cooperation with relevant stakeholders (governments, technical experts and members of the public)**
- **reviewed and approved by regulatory agencies before Project construction begins**

The Panel therefore suggests that as part of the Project's Environmental Management Plan and its ongoing implementation, the sustainability of all Project elements and actions be periodically monitored.

9. The Panel recommends that the future owners and operator periodically commission independent sustainable development audits on all Project components which will evaluate and rate the components for both environmental and economic benefits, and suggest alternatives where appropriate. This could in-. elude such aspects as operational policies, disinfection and landscaping regimes.

4.4 CONTROLS AT SOURCE

4.4.1 Introduction

Toxic chemicals from land-based sources are a major concern in Halifax Harbour waters, sediments and marine-based food webs. Urban stormwater runoff, CSO discharges, sewage effluents from sanitary sewers, and uncontrolled and/or untreated industrial and institutional discharges are major and

continuing sources of inputs to the Harbour waters and sediments. The quality and quantity of wastewater entering the collection system and the Harbour are important issues.

The Halifax Harbour Task Force established a set of water quality objectives and guidelines for the Harbour, and concluded that a reasonable strategy for meeting these was "to begin with primary treatmant, a rigorous controls-at-source program, and a monitoring program." Upgrading to chemically enhanced (advanced) primary treatment or secondary treatment could be implemented in the future if environmental considerations demanded it.

The public, all levels of government, HHCI and the Panel endorsed the requirement for controls at source for

- toxic and hazardous substances from industrial, commercial, domestic, and institutional sources
- water use through implementation of water conservation measures by all users
- extraneous flows (infiltration/inflow) into sanitary and combined sewer systems
- stormwater inflows to various catchment areas and retention-at-source systems

Instead of the traditional engineering practice' of attempting to solve problems at the end of the pipe, the present approach, is to focus on the concept of controls at source. Although everyone subscribes to this philosophy, the modes of achieving these worthwhile objectives constitute complex, challeng ing and controversial issues and requirements.

4.4.2 Whose Responsibility?

HHCI repeatedly pointed out that developing controls-at-source programs was not within its mandate. As presently structured in the Province of Nova Scotia, the municipalities are responsible for the management of all four areas requiring controls at source listed above, with the exception of toxic and hazardous discharges that enter the receiving environment directly (as opposed to those discharged into a wastewater collection system). Direct discharges to the environment are provincially controlled under the Nova Scotia Environmental Protection Act.

The failure to include the development of controls-at-source programs in HHCI's mandate was heavily criticized by the public. HHCI emphasized that it was prepared to work with the three levels of government and other institutions to encourage the implementation of programs related to controls at source.

The burden of evidence and experience in other jurisdictions indicates that it is most appropriate to designate the Province as the lead agency in developing controls-at-source programs, although all stakeholders must participate.. Relative to the development, implementation and monitoring of controls at source for the Halifax Harbour sewersheds, the federal, provincial and municipal governments need to sort out their respective jurisdictional responsibilities and how they will integrate their regulatory, technical and public educational roles. Universities and other research institutions have research and educational roles. Harbour users who dispose of waste materials into the Harbour, such as HHCI, have design, prevention (implementation) and monitoring roles. Other interested stakeholders have monitoring and public education roles.

The Panel believes that controls-at-source programs are the foundation for maximizing the environmental protection and enhancement of the Project.

10. The Panel recommends that comprehensive controls-at-source programs be developed and implemented in the Halifax Harbour sewersheds. The Province should be the lead agency, but the'devetopment of the programs should include HHCI and other public and private organizations with pollution control and Harbour enhancement interests. Regular reporting to the public should be an integral feature of the controls-at-source programs.

11. The Panel recommends that provision of funds for the development of the controls-at-source programs be a condition of the decision to proceed with the Halifax-Dartmouth Metropolitan Sewage Treatment Facility Project, and that agreements be amended as appropriate.

12. The Panel recommends that the years between 1993 and the commissioning of the Project be used by the Province and municipalities to implement the controls-at-source programs as outlined in this Report. The Province should be the lead agency. The controls-at-source programs should include education of all participants, and develop ment of mutually consistent municipal by-laws and initiatives.

4.4.3 Characteriring the Wastewater Streams

When undertaking development of new wastewater treatment systems, as for Halifax Harbour, or when instituting remediation procedures for old and damaged systems, it is important to know what is being disposed of where, when, by whom and in what quantity.

This knowledge is essential for the protection of living organisms in the receiving waters and sediments, including organisms eaten by people, as well as for process and performance purposes and to establish certain design criteria. Pollution charges, regulatory standards and programs are based on these considerations; they are not abstract numbers and activities.

The inputs of toxic and hazardous chemicals are the primary reason to undertake detailed wastewater characterization, because of the following risks:

- deleterious acute, chronic, and/or cumulative effects on marine life, caused by persistent toxics which can bioaccumulate in marine organisms and biomagnify in marine and marine-based food chains
- health risks to people eating large amounts of fish and shellfish (lobsters with elevated contaminants content, though not yet to the level of endangering human health; and winter flounder, with lesions typical of contact with polluted sediments, have been found in Halifax Harbour)
- worker hazards from explosive or corrosive materials
- negative effects of radioactive wastes on human and environmental health and safety
- damage or blockages to collection systems
- process upsets

Wastewater characterization is also an important component in the regulatory process. It plays a central role in

- monitoring total pollutant loading from discharge of dilute but high-volume wastewater containing toxics which accumulate in the environment
- monitoring occasional episodes of very high concentrations which greatly exceed regulatory criteria
- evaluating against performance standards for process adjustment or regulatory adjustment purposes
- enforcing regulations, including the levy of pollution charges
- determining whether there is potential to "reduce, reuse, recycle or replace"
- identifying mandatory participants in controls-at-source programs

Ideally, comprehensive inventories of industrial, commercial and institutional facilities and their waste inputs are undertaken as the first step in sewer use controls. This has not yet been done in the Halifax-Dartmouth metropolitan area, so HHCI did not have this information available when design of the system was initiated. However, the Panel's technical adviser on controls at source suggested ways in which first estimates can be made and priorities for detailed investigation established, using secondary information sources.

In determining what suite of chemicals to sample for, use should be made of existing information on

- known pollutant accumulations causing impacts on biota in receiving waters and sediments
- relevant investigations and studies carried out by others
- previous studies of STP effluents (one study in Ontario analyzed for 81 compounds; 50 of these were found to occur in primary effluents and 35 of these were organics of concern) (Prepared for OMOE, *Thirty Seven Municipal Water Pollution Control Plants: Pilot Monitoring Study,* July 1989)

In spite of the limitations of HHCI's wastewater characterization program, it was possible to establish that the Halifax-Dartmouth metropolitan region's wastewater is typical of an urban industrial area. Of the 11 sewersheds sampled, 3 warrant further investigation to determine what might be causing elevated levels of zinc (Tufts Cove), mercury (Smith Street), and cadmium (Old Ferry Road). Such elevated concentrations signal the need for determining whether and what remediation measures might be in order. Many more unsampled sewersheds require characterization of their wastewater streams.

Wastewater characterization programs should be designed for well-defined purposes and to yield the spectrum of information required in a cost-effective manner. Candidate trace organic contaminants would include halogenated aliphatics, phenolic compounds, monocyclic aromatics, ethers, nitrosamines, polycyclic aromatic hydrocarbons (PAHs), pesticide residues and polychlorinated biphenyls (PCBs).

13. The Panel recommends that, given that toxic organics in the marine environment constitute the highest priority environmental concern associated with effluent disposal In Halifax Harbour, HHCI should conduct timely and more extensive wastewater characterization programs which include analysis for reievant priority toxic organics and metals. Concentrations of these toxlcs in receiving waters and sediments should also be determined to provide a better baseline, and to assist with the design of monitoring programs.

4.4.4 Toxic and Hazardous Waste Control

Hazardous substances (many of which are also toxic) are those substances that endanger human life or health, or the operation of the wastewater collection and treatment system (explosives, poisonous volatiles, materials that create obstructions, etc.), and should not enter the waste stream.

Toxic contaminants in wastewaters are of two types: organic compounds and inorganic compounds, such as heavy metals. In each category, a portion of the chemicals is in soluble form, while the remainder is in insoluble form or associated with suspended particulates.

Depending on the chemicals involved, primary treatment can remove 04% of the toxics, and secondary treatment can remove 1565%; both treatment levels retain only those toxics attached to particulates. Advanced primary treatment can remove as much suspended particulate matter and toxics as secondary treatment. Only certain types of costly tertiary treatment can remove up to 96% of the toxic metals, doing less well with toxic organics. Furthermore, removal from the waste stream does not solve all the problem, as the toxics are then contained in the sludges. The sludges, too, must be disposed of in an environmentally acceptable manner. The cheapest and most effective means of dealing with toxics in the waste stream is to prevent putting them there in the first place. Alternatively, although not necessarily as effective,

they can be subjected to pretreatment processes. Once into the sewage waste stream, some portion of the toxic constituents will ultimately be released to the environment, with the environment and its users bearing the costs in terms of environmental degradation and activation of its assimilative capacity. As one review participant noted, "There is no free ride."

Review participants recognized that the level of treatment planned for Halifax Harbour will not adequately deal with toxits of concern, although HHCI investigations predict that all conventional water quality objectives and guidelines will normally be met.

Due to concerns about toxics, these alternative recommendations were made by members of the public:

- go to secondary treatment immediately
- implement effective controls at source and preliminary treatment at the CSOs, thus eliminating the need for an STP which is very costly and proposes only primary treatment, at least initially

Dilution is not a solution for toxic and hazardous contaminants in wastewater effluents. Prevention and industrial pretreatment, i.e., controls at source, are the only practical option. Controls-at-source programs are a manifestation of individual and collective responsibilities to engage in environmentally sound development that integrates ecological, economic and social goals, and provide for the long-term health of all species.

Compulsory, comprehensive inventories are expensive in staff time and other costs, as are full-scale inspection and enforcement. However, so are the costs of not implementing controls at source. There are means of initiating programs cost-effectively using secondary information sources, such as industrial directories and knowledge of process outputs, and concentrating on priority areas. "Worst first" and "do it right" are good principles to use in establishing controls-at-source programs for toxic and hazardous substances. The Halifax-Dartmouth Metropolitan Authority is planning to install one or more permanent household hazardous waste depots, so a start is already being made.

Controls-at-source programs for toxics and hazardous wastes can be developed at any time, even in the absence of any other form of waste treatment. There is no impediment to starting immediately. Such a program could be initiated in the Halifax-Dartmouth metropolitan region very quickly.

Important elements in controls-at-source programs for toxic and hazardous wastes should include

- involvement of all stakeholders, including individual residents and government, commercial, institutional, industrial, and public advocacy and educational groups
- widespread public, institutional, industrial and commercial education
- application of the "four Rs" to toxics management: reduction, reuse, recycling, replacement
- development of effective regulatory instruments
- use of economic instruments such as input pricing (e.g., effluent volume, chemicals) to induce waste reduction and better conservation practices
- technical assistance to industries, institutions or commercial establishments to improve processes as needed
- pretreatment of industrial waste streams to remove priority pollutants at source; this can include collective waste management services and facilities, as in industrial parks
- establishment and operation of hazardous waste collection depots for households and small industries
- monitoring and auditing
- enforcement

The Panel believes that the regulation of sewer use and wastewater treatment plant discharges should be undertaken at the provincial level. In Nova Scotia as in other provinces, municipal powers and capabilities for inspection and enforcement are limited, as are the fines or other sanctions that might be imposed for infractions. Such powers are considerably increased at the provincial level; therefore, monitoring and enforcement should reside at the provincial level, with assistance from the federal level as appropriate. It should be uniform province-wide. The uniform regulation of province-wide standards is fair, equitable and efficient.

14. The Panel recommends that the Province ensure that controls-at-source programs for toxic and hazardous substances be implemented in the Halifax Harbour sewersheds immediately, as a parallel part of the Project.

4.4.5 Water Conservation

During the public hearings and in the written submissions, there was universal agreement that conservation of water is beneficial both to the environment and to the performance and longevity of the sewage treatment facilities. Water conservation leads to reductions in

- flow rate of wastewater into sewers
- energy costs related to operation of pumping stations and other equipment
- costs of required chemicals for treatment and disinfection

Other benefits of conservation are enhanced efficiencies of sewage treatment at the STP/OFS facility and planned CSO facilities (vortex separators and disinfection). Moreover, the tunnels, pumping facilities and other system components designed and constructed in the mid to late 1990s will have a longer life.

One presenter stated that the cities of Ottawa and Kitchener/Waterloo have implemented water conservation measures. Moreover, the Canadian Water and Wastewater

Association has developed a computerized model that municipalities can use to estimate full cost-based rates, which- build in operating as well as capital requirements. HHCI or the Province should immediately investigate these case studies and explore the feasibility of applications in the Metro area.

HHCI pointed out that water use conservation will demand a lengthy program of public education, and that a change in the structure of rates charged for the use of treated (potable) water will be required to reverse the current practice of rewarding users with lower rates for greater quantities used. Changes in plumbing codes would also lead to water conservation. Consideration should be given to complete metering of areas that may be connected at a future date or are not already metered, such as the sewersheds of the Mill Cove and Eastern Passage treatment plants.

The Panel's technical adviser presented three possible models for implementing a water conservation program, summarized below. The Panel also considered the Provincial Limits and Administration Model and the Federal Limits with Municipal Administration Model but concluded neither was suitable in the Canadian context.

1. Standard Municipal By-law Model

   The municipality organizes and institutes a model, and it acts as the lead agency as well as the administrator. This tool or model is often in response to external pressures such as failing water supply. The municipality conducts education programs and supplies free/discounted water conservation devices and meters.

'2. Provincial Limits with Municipal Administration Model

   The provincial government develops and institutes this model, and acts as the lead agency (i.e., it sets the overall formal policy). The municipalities administer the program. This has been found to be a powerful way to encourage province-wide action.

3. Grassroots Model

   In the absence of initiatives at provincial or municipal levels, another group initiates an information/education program. This model is less effective than either of the first two.

The Panel has concluded that the Provincial Limits with Municipal Administration Model is the most suitable one for implementing a water conservation program for the Halifax-Dartmouth metropolitan area. Such a program can be implemented more effectively by a "central agency" than by the individual municipalities.

4.4.6 Extraneous Flows

Extraneous flows consist of two types:

- groundwater infiltration into old and poorly built sanitary, storm and combined sewers and sewer laterals (connections from buildings to the public sewers)
- direct entry of stormwater *inflows* into sanitary sewers, including from unauthorized connections of roof drains, foundation drains and area or yard drains; and through manhole covers

The HHCI Environmental Assessment Report estimates that "in the Metro area, sewage contributes only about 50% or less of the total flow in dry weather," the balance being infiltration. Sewer rehabilitation programs and other associated projects were brought to the attention of the Panel for the purposes of instituting controls at source for extraneous flows. However, HHCI subsequently stated that measures to reduce inflow/infiltration are not cost-effective. It also indicated that concentrating on sewer rehabilitation presented "a practical difficulty, if the Project is to proceed according to the current schedule, [because ofj the time required to complete remedial work on the existing sewers." The Panel is of the opinion, however, that the proposed Project as well as priority "remedial projects" should be accomplished in parallel. HHCI should benefii from the experiences in other areas of Canada and the United States.

Closer examination of the cost-benefits of sewer remediation in priority problem areas may produce favourable results. Candidate sewersheds selected and evaluated by HHCI and the municipalities should immediately be subjected to a value engineering audit by a third patty to verify the degree of cost-effectiveness of remedial measures. These measures would not delay the main Project because they can be completed in parallel. The focus should be on the long-term benefits of these measures.

15. The Panel recommends that HHCI, the municipalities and a third-party auditor undertake cost-benefit studies for reduction in inflows (by stormwater management) and infiltration (by sewer rehabilitation) in selected areas, especially in the following sewersheds, which, according to HHCI, have the most significant problems:

- **Smith Street, Halifax**
- **Chain Rock Diive (Northwest Arm. sewershed), Halifax**
- **Joseph Howe Drive (Armdale system), Halifax**
- **Jamieson Street, Dartmouth**
- **Mainland South and Herring Cove**

4.4.7 Stormwater Management

"Stormwater" is that portion of rain or melting snow that runs off the surface of the land. Stormwater is easily assimilated into the soil and groundwater systems in well-vegetated natural areas, but it becomes a problem when it runs off highly developed areas, erosion-prone bare ground, roads and other paved surfaces, fertilized or pesticide-contaminated lawns and farmlands, and contaminated industrial sites. Stormwater

can be collected in sewer pipes (for stormwater only, or combined with sanitary wastes), or can run off uncollected into rivers and harbours.

For this Project, it is estimated that 60-75% of the inflow to the collection system will be stormwater. Unmanaged stormwater carries toxic and hazardous substances and can produce the following detrimental effects:

- increased rates of runoff, land erosion and siftation of receiving waters
- receiving waters loaded with toxic and hazardous substances, including salts, hydrocarbons, metals, nutrients and pesticides
- reduced efficiencies of sewage treatment processes
- decreased life of sewage collection and treatment infrastructure
- impacts transported from point of origin to other environments
- increased costs for remediation of degraded environments

Stormwater management that is based on the principle of controlling and reducing the quantity of **stormwater,** and improving the quality of stormwater runoff at its points of origin, reduces overall costs for treatment and remediation throughout the watershed.

The approach of returning stormwater to the natural groundwater system at points of source whenever feasible is an accepted principle of good stormwater management in many jurisdictions throughout North America. As a principle it also supports the Montreal Guidelines for the Protection of the Marine Environment Against Pollution From Land-Based Sources, issued by the United Nations Environment Program and endorsed by Canada. These Guidelines establish the policy that waters and wastes should be contained and treated at their source and not transported elsewhere.

Until the **1970s,** most of the sewers in the metropolitan area were combined, carrying both sanitary sewage and stormwater. However, all Metro municipalities now require new developments to use separate sewers. HHCI observed that replacing existing combined sewers with new separate sanitary and storm sewer systems would be very expensive. The Halifax Harbour Task Force also subscribed to the concept of not separating the combined sewers because of cost, disruption and limited effectiveness. Not one Canadian city has opted to separate and rebuild combined sewers. The Panel concurs with the conclusions of HHCI and the Task Force that the separation of the old combined sewers need not be undertaken at this time.

The Panel encourages the municipalities and HHCI to investigate stormwater management strategies which are site-specific and employ innovative techniques to reduce stormwater entering the system. Management ideas may include one or a combination of the following techniques:

- reduce piped stormwater systems in new subdivisions
- use holding tanks, retention tanks, ponds, or siltation and recharge basins to temporarily store the peak flows, where adequate land is available
- in areas where sufficient land is available between neighbouring properties, discharge roof 'drains on the land surface instead of connecting them into combined sewers: in such cases care should be exercised to prevent local flooding and other problems
- reduce the number and frequency of **CSOs** discharging into the receiving water by enlarging the collection/interceptor tunnels, as suggested by the Quality and Value Engineering Audii
- increase use of pervious surfaces
- provide landscaped common areas to receive non-point sources of surface runoff
- employ alternatives to, and minimize use of, road salt
- retain natural vegetation in new developments and encourage planting in existing developments
- use alternative road construction standards to increase pervious surfaces and decrease right-of-way widths and clearing of natural vegetation

4.4.6 Action Plan

The concerns and requirements relating to toxic and hazardous waste control, water conservation, extraneous flows and stormwater management, as described above, all involve controls at source.

Funding to develop and implement controls-at-source programs will be essential, but programs can be initiated before funds are totally available. Indeed, for some programs such as sewer rehabilitation, a phased approach focusing on "worst first," coordinated with routine maintenance programs, would be much preferred. In the case of toxics, pilot and demonstration controls-at-source projects centred on particular chemicals, particular industries, or particular locations, again based on the worst first principle, can be undertaken with modest costs and efforts. Such initiatives are extremely valuable in increasing public awareness and commitment, and in turn influencing the essential political will.

The Panel's chosen model for an Action Plan dealing with controls-at-source programs for toxic and hazardous substances is the Provincial Limits with Municipal Administration Model (provincial limits with municipal administration) described in Section 4.4.5.

Six steps toward developing an Action Plan for toxic and hazardous substance controls-at-source programs are outlined below. Similar approaches are applicable for controls-at-source programs dealing with water conservation, extraneous flows and stormwater management.

1. Initiate a province-wide program, dith the Province accepting a leadership role.

2. Identify key actors and define their roles. The key actors include

   - provincial and federal governments
   - municipalities
   - the stakeholders: industry, commercial facilities, institutions and residents
   - . support groups such as training and technology transfer centres, industrial associations, environmental interest groups, and community organizations

3. Define and ptioritize problems by determining the nature, cause and extent of the problems within the defined areas. Further wastewater characterization as described in Section 4.4.3 is essential for toxic and hazardous substance control. An inventory of all industries which produce, or have potential to produce, use and/or discard toxic and hazardous substances into sewer systems should be developed; the industries should then be directed to prepare environmental audits of all such materials. Priorities should then be established to control "worst first" contaminants.

4. Evaluate control options. Examine the various altematives for instituting pollution control and remediation actions in each problem contaminant area, including resulting benefits or negative effects on the environment. This may involve

   - developing priority substances lists
   - establishing collection depots for residents and small businesses
   - installing pretreatment technologies
   - instituting "good housekeeping" procedures
   - making use of the "four R's"
   - using estimation and modelling techniques

5. Develop pollution control and remediation plans. The results of the evaluations of the control options should be packaged into an integrated, comprehensive plan of the most acceptable and cost-effective options for the remedial programs. This should include the stipulation that all commercial and industrial dischargers to sewers be issued with discharge permits that will lapse every three to five years and are revocable in'the case of persistent non-compliance, unless a better instrument is found. Public reporting is also essential. Rationales and criteria for the proposed actions should be subject to ongoing public scrutiny, and should include positive and negative impacts on the environment. Strategies for long-term funding of the program will need to be considered. The "polluter pays" principle, full cost pricing, economic incentives, cost recovery and cost sharing will have to be examined, and responsibilities assigned.

6. Implement the pollution control and remediation plans. At this point, the physical process of implementation begins, be it education and training programs, development of new regulations, establishing permitting and input fee collection systems, assistance with industrial process modification, expanding the toxic and hazardous waste collection, storage and disposal program and other initiatives. The Panel endorses the President of HHCI's recommendation that

   - the Province prepare a province-wide, uniform sewer by-law and standards with overseeing authority vested in the Province; for those municipal units governed by their own Charters, the Province enact enabling legislation for the appropriate municipal by-laws
   - it is essential to obtain a long-term commitment from the municipalities which will be involved in the program
   - certain aspects of the program involve other provincial departments, federal government departments, or other stakeholders, and they should be included on a consultative basis

16. The Panel recommends that an Action Plan for implementation of controls at source in regard to toxic and hazardous substances, water use conservation, extraneous flows and stormwater, similar to or derived from the one presented in this Report, be designed, developed and funded by the Province as the lead agency in cooperation with the municipalities, the federal government and relevant stakeholders. The Action Plan should include a definition of provisions for funding on a long-term basis.

4.4.9 The Role of Monitoring

Monitoring, and the public reporting of monitoring results, encourages improved performance on the part of parties responsible for contributing contaminants, particularly toxic and hazardous substances, at source.

For instance, the Toxic Releases Inventory National Report issued annually in the United States by the Environmental Protection Agency provides a good model, consisting of

- an audit of existing conditions
- an inventory of the toxic and hazardous substances entering the environment
- a listing of the polluters and the types and quantities of pollutants they release
- a description of remediation efforts and their effects

Public exposure, legal liability and insurance implications all induce polluters to make rapid strides toward correcting their pollution problems. Environment Canada is in the process of developing similar legislation. A similar program covering the many Harbour users would be the best means for determining cumulative impacts and their remediation.

17. The Panel recommends that a monitoring and public reportlng instrument be established by the provincial and federal governments, involving other interested parties, which will address the ways in which Harbour conditions are improving as a result of the Project, controls-at-source programs and other initiatives.

4.5 ENERGY CONSERVATION

Energy conservation is a fundamental component of the Project and its goal of sustainable development, and it should be incorporated as a specific element in the Project's Environmental Management Plan.

To achieve sustainable development from the standpoint of energy consumption, a careful audit of all energy uses and demands should be undertaken for all aspects of the Project, and alternatives chosen to minimize energy use when appropriate.

There are 'two main areas where energy can be conserved:

- energy required to produce and assemble materials used in the initial construction of the Project (embodied energy)
- energy required for the ongoing operation and management of the Project

HHCI took advantage of a number of design and operating options that have potential for energy conservation, including

- selection of a sea-level site, to reduce energy costs from pumping to higher land elevations
- ventilation design
- use of heat exchangers at the STP, to recapture waste heat for interior space heating and other operations
- minimizing hydraulic losses in the collection and outfall/diffuser systems
- use of fixed-speed pumps to maximize energy/maintenance efficiencies
- minimizing the number of pumping stations for the collection system
- use of OFS process, which captures and uses some of its by-product as a fuel source for sludge drying
- use of cistern and freshwater pond for landscape irrigation on artificial island

It remains unclear whether the initial siting criteria for selecting a sea-level site to reduce pumping (energy) costs is being met, given the W-metre lift required at the headworks of the STP from the intake tunnel.

The Panel did not hear from many participants about energy implications for the Project, with the exception of some comments regarding energy demand for the OFS process and the main pumping station at the STP. Nevertheless, the Panel believes that energy conservation is fundamental to the Project's ability to meet the goal of sustainable development.

While HHCI has taken steps to reduce operating energy, clearly the first priority for a project of this magnitude, it also makes sense to look at options that will minimize the initial energy investment (embodied energy). It is an accepted fact that construction materials such as cement, concrete, aluminum and steel have high energy requirements for production relative to some other materials, such as wood and many plastics. While it may not be feasible or appropriate to eliminate the use of concrete in many project components (tunnel liners, foundations, basic STP infrastructure, etc.), it is appropriate to examine ways in which these high-embodied-energy materials and fabrication processes can be held to a minimum. Alternative designs, reduced capacities and value engineering audits are ways in which embodied energy can be optimized.

Another area deserving attention is transportation, which also consumes extensive amounts of energy, especially the transport of fill, spoils, construction material and equipment, and personnel.

The Panel concludes that conservation of energy, including embodied energy, is important for all aspects of the Project: construction, operation, maintenance and replacement cycles.

It is noted that while the Quality and Value Engineering Audit Report prepared for HHCI evaluated some Project components from an energy and economic standpoint, it did not address other aspects of sustainability; nor did it address operating energy consumption for all Project components or embodied energy.

18. The Panel recommends that HHCI commission an independent energy audit to evaluate and make recommendations on both embodied and operating energy consumption, with the objective of minimizing overall energy demands.

19. The Panel recommends that HHCI examine the alternatives presented in the Quality and Value Engineering Audit in light of their energy demands, relative to existing Project design components, as one of the criteria for selecting final design solutions.

4.6 THE COLLECTION SYSTEM

4.6.1 introduction

At the present time, 39 municipal outfalls along the waterfronts of Halifax and Dartmouth, and overflows from 4 pump ing stations discharge raw, untreated sewage from Halifax, Dartmouth and the County of Halifax into Halifax Harbour (see Figure 1).

The proposed system will intercept and consolidate most of this sewage, transporting it to the regional treatment plant.

Those existing outfalls that continue to be used as overflows will provide a dilution of at least 2O:l. On the basis of its initial evaluation, HHCI concluded that the number of municipal outfall locations in the Harbour could be reduced from 29 to about 17.

The main collection tunnels will extend 18 kilometres along the Dartmouth and Halifax waterfronts, conveying raw sewage to the STP/OFS facility. A further 7 kilometres of sewers and tunnels will collect sewage from Mainland South and Herring Cove.

If the STP/OFS site is located on Ives Island, as proposed by HHCI, the direction of flow will be generally counter-clockwise. Should the Dartmouth Ocean Terminal site be chosen for the STP/OFS site (Section **4.2.5),** the direction of flow will be generally clockwise. The Mainland South-Herring Cove sewage could either enter the main collection system at Pier A as presently proposed by HHCI, or be treated at a separate facility located within that area (Section 4.7).

4.6.2 Capacity and Overflows

The proposed collection system is designed to convey a maximum of four times the average dry weather flow (ADWF) to the STP/OFS facility. The tunnels have been sized for the minimum expected design life of 100 years, to serve the maximum sustainable sewershed population as projected by the municipalities, and to handle flows from the existing Mill Cove and Eastern Passage sewage treatment plants, in the event that those plants are decommissioned at some future time. Table 4 shows **HHCI's** estimated rates of regional wastewater flows for the years 2011 and 2041.

The collected wastewater will be pumped into the STP/OFS facility, with the exception of excess flows (peak wet weather flows minus the maximum intercepted flows), which will be discharged into Halifax Harbour at several CSOs after receiving "full," "partial" or "no" treatment, defined as follows by HHCI:

- "full treatment": removes floatables and approximately 45% of the total suspended solids, and includes disinfection using sodium hypochlorite during summer (swimming) months
- "partial treatment*: removes floatables and approximately 25% of the total suspended solids
- "no treatment": removes some floatables and some gross solids only

HHCI estimates that about 17 CSO **locations** around the Harbour will receive partial treatment, and 4 locations will receive no treatment other than screening. These "no treatment" **locations** include the Maritime Museum and Duke Street in Halifax, and Maitland and Canal streets in Dartmouth.

The two recommended full treatment locations, both of which discharge into the Northwest Arm, are Chain Rock Drive and Roachs Pond. The Quality and Value Engineering Report suggests omitting disinfection at these two sites if a larger tunnel size is used (Section **4.6.4),** since discharges from the two CSOs will be reduced to two or three times per year. This report suggests that if these discharges occurred during swimming season, the beaches could be closed until the bacterial contamination dissipates (perhaps one or two days). Closing the beaches even for one day is not acceptable to the Panel, and probably not acceptable to most residents of the affected areas. The Panel supports disinfection for these two CSOs.

Since overflows contain low concentrations of suspended solids, the Panel suggests that consideration be given to alternative methods of disinfection other than chlorine, such as ultraviolet light.

20. The Panel recommends that HHCI design the overflows from the Roachs Pond (discharged at the Northwest Arm) and Chain Rock Drive combined sewer overflows (CSOs) to include disinfection. Consideration should be given to ultraviolet disinfection.

Table 4 Projected Rates of Wastewater Flows for the Years 2011 and 2041

	2011 Flows (m^3/sec)		2041 Flows (m^3/sec)	
	Average Dry Weather Flow	Maximum Intercepted Flow	Average Dry Weather Flow	Maximum Intercepted Flow
Halifax Subtotal (includes Mainland South and Herring Cove)	1.06	3.66	1.52	4.76
Dartmouth Subtotal	0.49	2.20	0.68	2.49
Total Flows	1.55	5.86	2.20	7.27

4.6.3 Mill Cove and Eastern Passage Sewage Treatment Plants

The **Panel** is of the opinion that the **secondary treatment** facility at Mill Cove is capable of generating better effluent than the proposed STP. Furthermore, the treated effluent from the regional plant at Ives Island will be discharged into marine waters that are closer to commercial fishing activity than Mill Cove plant discharges:

If the Mill Cove **treatment** plant was decommissioned **and** these flows included in the regional system, this would necessitate expanding the treatment facilities. If this were to take place some years after the regional STP/OFS was built, it would potentially trigger a new round of community and visual impacts. The County of Halifax and the Town of Bedford should therefore carefully consider future options at this time, and elect either to join the system as it is initially being built, or when future expansion takes place. Such consideration should take into account the following factors:

- water and sediment qualities and assimilative capacity of Bedford Basin
- relative cost-effectiveness
- adjacent land uses (remembering that the Mill Cove sewage treatment plant was in place before current developments)
- the effects of increased discharge to the marine environment from the diffuser west of McNabs Island
- relative treatment levels
- projected growth in the Mill Cove plant's Bedford-Sackville sewersheds, and any plans for locally based subsidiary treatment facilities

The Eastern Passage plant, which services a rapidly growing sewershed, provides primary treatment, and generates an effluent that is comparable in quality to that expected from the proposed regional plant. Occasional odour problems have been reported by the plant's neighbours. Historically the plant has had other problems which appear to have been corrected. The effluent from this plant is discharged into Eastern Passage in shallow water in a relatively confined area, where mixing and dispersal are much more limited than will be the case at **HHCI's** proposed diffuser site.

The Panel is of the opinion that, subject to community and County of Halifax consultations and cost-benefit analysis, serious consideration should be given to decommissioning the Eastern Passage sewage treatment plant and integrating the Eastern Passage flows into the regional treatment facility at the initial stage. Should that decision be made, consideration must also be given to the safest, most cost-effective, and environmentally benign means of conveying sewage flows from Eastern Passage to Ives Island. HHCI has suggested a subsea pipeline which may or may not be shallow trenched. Active shipping lanes to the refineries, the Coast Guard Dock and the Autoport, and vessels from Eastern Passage itself would, however, cross the pipeline route between the Eastern Passage sewage treatment plant and Ives Island. Anchor dragging would be a concern. Gas-charged sediments, which are generally avoided in subsea pipelining. are common throughout that area of the Harbour. A pipeline routed very close to the eastern shore of McNabs Island would also be a concern for environmental, safety and aesthetic reasons. An overland route to join the rest of the collection system at Melva Street in Dartmouth may have greater merit.

21. The Panel recommends that the County of Halifax and the Eastern Passage community jointly determine whether the Eastern Passage sewage treatment plant should be integrated into the Project at the initial stage.

22. The Panel recommends that the County of Halifax and Town of Bedford determine whether the flows from the Mill Cove sewage treatment plant should be integrated into the Project as it is being built, or when future Project expansion takes place.

4.6.4 Tunnel Design and Value Engineering Options

The Halifax Harbour Cleanup Project Quality and Value Engineering Audit by Gore and Storrie suggests several items of potential cost savings associated with the proposed 'collection system and CSO design. The option that results in the single greatest cost savings (**$29.4** million, provided there is no increase in cost for the tunnelling machines) involves increasing the tunnel diameter to provide overflow storage, with elimination of the following:

- vortex separators at a number of the CSOs
- the west consolidation tunnel at Lower Water Street in Halifax
- coarse screening prior to combined sewer discharge into the interceptor system

The advantages and disadvantages of the alternative options have been discussed by HHCI. Those identified by the Panel from the Quality and Value Engineering Audit are provided in Table 5.

23. The Panel recommends that HHCI evaluate the Value Engineering option to increase the size of the tunnels for stormwater retention. This evaluation should also include costs for construction, spoils removal and disposal solutions, and energy consumption.

Table 5 Advantages and--Disadvantages of Increased Interceptor Tunnel Diameter

Advantages	Disadvantages
• Substantial savings in initial costs ($29.4 million) • Increased tunnel spoils may be beneficially used as fill material to create the artificial island • Reduction in maintenance requirements by eliminating a number of CSOs • Overflows reduced from 20–60 events per year to 3-5 events per year	• Approximately three times more tunnel spoils will be disposed of because of increased tunnel size • HHCI may have to adjust the construction schedule for tunnels to rnaximize the availability of spoils for use as fill at the island • If some of the spoil material is acid-forming, potential environmental problems must be prevented or carefully mitigated • Halifax Harbour water quality guidelines for suspended particulates will be exceeded 3-5 times per year

4.6.5 Private Outfalls

As the Environmental Assessment Report was being prepared, the presence of about 60 "private outfalls" was identified by HHCI; however, their characteristics were not investigated. A subsequent study identified 72 outfalls from 22 or 23 developments along the waterfront that are not connected to the municipal collection systems. The quantity of untreated wastewater (ADWF) discharged by these outfalls amounts to 1.7 million litres/day. Two developments, the Department of National Defence residential community of Shannon Park and the Nova Scotia Hospital complex, discharge more than 84% of this total. While the former does not treat its wastewater, the latter is listed as "untreated" due to the ineffectiveness of the sewage treatment plant on its grounds.

The Panel is concerned that only 4 of the 22 or 23 develop ments have treatment systems, and information is lacking on concentrations of toxic and hazardous chemicals discharged through these private outfalls.

The Panel suggests the following strategies to deal with the private outfalls:

- samples from private outfalls be tested for various chemicals, as described in Sections 4.4.3 and 4.4.8; this should be done immediately
- appropriate actions be taken by government agencies if the discharges are found to violate any environmental regulations
- industries and institutions should be required to implement controls at source and other remedial actions, such as pre-treatment
- untreated sanitary sewage flows should be connected to the collection system so that they can be processed at the regional STP
- stormwater discharges should be handled by site-specific techniques; at some industrial sites, high potential exists for the presence of toxic chemicals, and innovative site-specific methods should be employed to eliminate these direct discharges to the Harbour

Reasonable costs and minimal environmental damage should be the key concerns in implementing the appropriate strategy.

24. The Panel recommends that all private outfalls be monitored to obtain qualitative and quantitative data, with the lead for this program taken by the Province. After a set time period, no more discharges of untreated sanitary, industrial and Institutional wastewaters should be permitted. Site-specific decisions should be made for handling stormwater surface runoff. Private outfalls should be connected to the regional collection and treatment system as soon as possible, unless In specific cases there are compelling reasons why this is not feasible.

4.7 MAINLAND SOUTH AND HERRING COVE

4.7.1 Proposed Facilities

The need to rectify what is generally perceived as a socially inequitable situation for Herring Cove residents, where untreated sewage from Halifax Mainland South flows into the waters off Herring Cove at Watleys Cove, has been one of the driving forces behind the entire Halifax Harbour Cleanup Project. This problem has a particular priority in the design and construction of the regional STP/OFS facility. HHCI examined two principal methods of handling the sewage from Halifax Mainland South and Herring Cove:

1. Pump sewage from Herring Cove to the Roachs Pond pumping station, and convey it by tunnel, together with the flows from Mainland South, under the Purcells Cove Backlands and underneath the Northwest Arm, to join the main collection tunnel at the Halifax Ocean Terminals. From there it would be pumped to the regional STP/OFS facility (Figure 8).
2. Treat the sewage in the Herring Cove area. One option includes a primary treatment plant in the Herring Cove vicinity for all Mainland South and Herring Cove flows, which would discharge into Watleys Cove. A second option includes a tertiary treatment plant at Roachs Pond, discharging to McIntosh Run, to treat sewage flows from

Halifax Mainland South, coupled with a secondary treatment plant at Herring Cove.

Other treatment options had been considered at an earlier date and rejected. At that time, the community had said no to a sewage treatment plant on the grounds that the Nova Scotia Minster of Health had declared that it was no longer acceptable to have tertiary treatment plants discharging into a freshwater body and because ft was felt that a **sewage** treatment plant would destroy the character of the village.

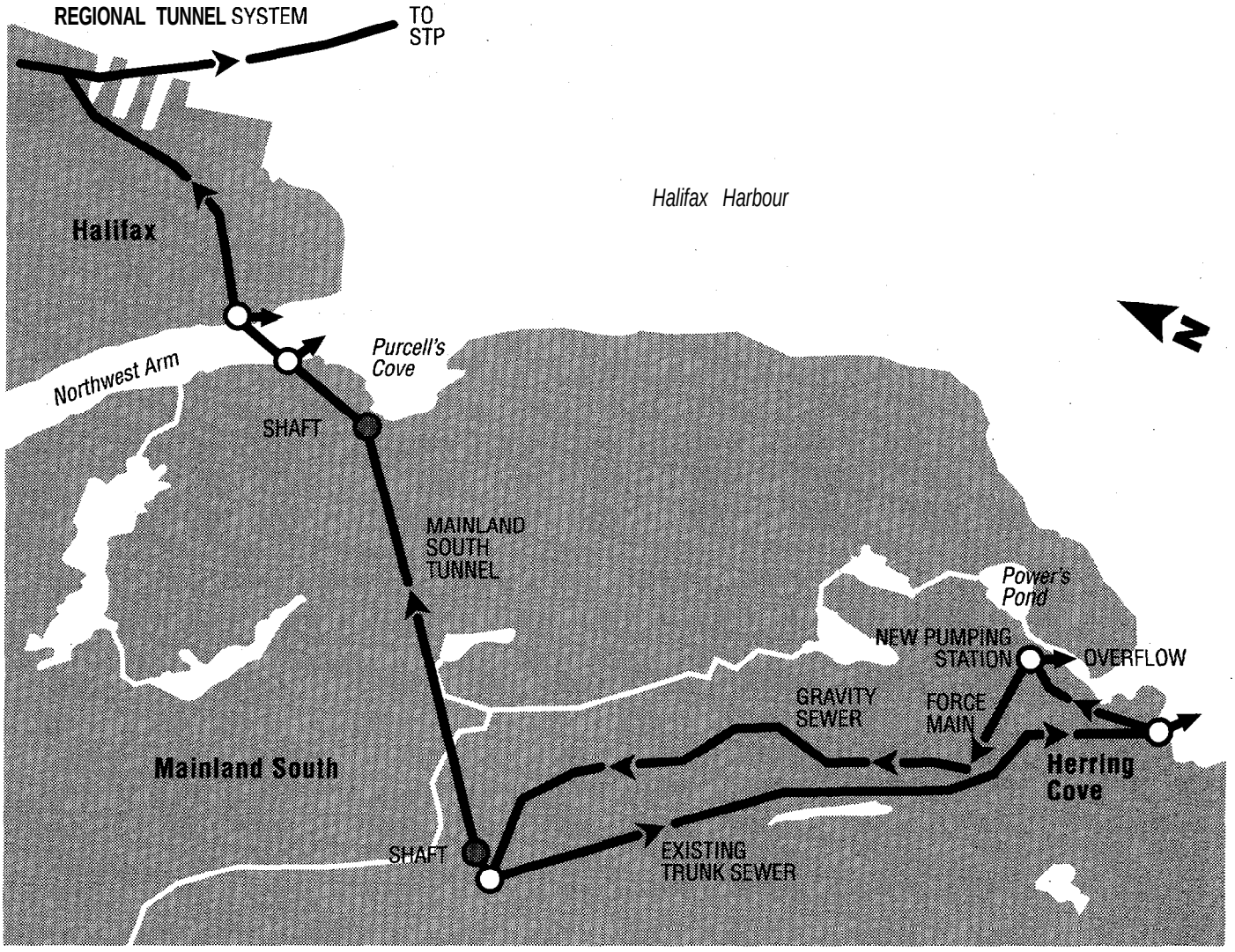

Figure 8 Mainland South - Herring Cove System

Source: After Halifax Harbour Cleanup Inc.

HHCI's recommended option is the first one above. This option was seen as causing the least environmental disturbance to the ecologically sensitive Backlands, while meeting the objective of Herring Cove residents to avoid sewage treatment and disposal in their community. All sewage flows into McIntosh Run at the Roachs Pond overflow would be eliminated; however there may be overflows into Powers Pond and possibly into Watleys Cove, depending on the volumes of flows remaining in the Herring Cove sewershed once Mainland South is cut off. Initially the collection system was to be surface trenched across the Backlands, but this was changed to the deep-tunnel design due to the community concerns about the ecological integrity of the Backlands. Diverting sewage flows into the regional system would also eliminate the need for a local sewage treatment plant in Mainland South.

Having made this recommendation, a great many public concerns remained, including the following:

- Options for treatment plants were originally presented to the community without consideration of the tunnelling cost estimates, or the related potential environmental impacts.

- The Herring Cove community was unaware of plans to install a pumping station and overflow at Powers Pond, and concern was expressed over its potential impacts on Herring Cove lobster cars, fisheries, and effects on the local landscape as well as the village character.

- The Powers Pond pumping station, which was designed to service the whole village of Herring Cove, and the proposed plan to transport sewage via forcemain and gravity flows to Roachs Pond were new concepts to most Herring Cove residents. Most objected not only to the Powers Pond pumping station but also to the design and routing of the collection system to Roachs Pond, since it involved trenching through presently undisturbed crown land and had the potential to open up that land to further settlement.

- Some Herring Cove residents advocated a design for the collection system to Roachs Pond that reversed the flow through a forcemain installed within the existing trunk sewer. Others wished to reconsider options, in light of the new proposal.

- Blasting could have adverse effects on wells in the Mainland South and Herring Cove area.

- The use of a drill-and-blast construction technique for the installation of the tunnel could permanently alter the Backlands' groundwater regime.

- According to most Herring Cove residents, a low-growth option is the only suitable one for the area; the District 5 Municipal Development Strategy for Herring Cove anticipates a low-growth scenario, whereas HHCI used a high growth option in developing their Mainland South and Herring Cove deep-tunnel option.

- Putting a sewer collection system through the Backlands would predispose that area to further development by introducing potential sewer service into an undeveloped area.

- According to many Halifax Mainland South residents, the high-growth scenario for their area and the prospect of development in the Backlands would bring an unwanted alteration to quality of life and the natural environment.

- A more cost-conscious approach is required for Halifax Mainland South and Herring Cove sewage; the cost of the proposed deep tunnel is disproportionately high in relation to the size of population currently served.

In conclusion, the affected communities advocated that HHCI seriously readdress the question of regional treatment options for Halifax Mainland South and Herring Cove.

HHCI defended their revised design as being the one best able to solve the problem of collection of all sewage wastes from the area while preventing and mitigating environmental impacts on the area. HHCI did not agree that their proposed solution would encourage development in the Mainland South area. Under existing planning instruments, no development is anticipated for the next 20 years, and before development could occur all land designated as "holding zone" would first have to be rezoned. Further, a sewage collection tunnel, and especially one 45 to 80 metres below the surface, would not in itself result in development; water supply and transportation infrastructure would also be required.

The Panel learned that a communication from the City of Halifax supported future development in the Backlands, and that once the tunnel was installed, this would in fact encourage growth in the area. Many residents felt that current planning controls and growth projections were out-of-date and out-of-touch with prevailing wishes of the communities. Most felt that there was a demand for the low-growth scenario, with substantial portions of the Backlands to remain undeveloped, and that an up-to-date plan for Mainland South was urgently needed before any major infrastructure such as a tunnel was to be constructed.

A local interest group strongly recommended that the collection tunnel not be permitted to cross the Backlands. Failing this, it recommended that- (1) the public lands and Backlands be rezoned as park reserve, (2) a core recreational area be protected, (3) hydrological studies be undertaken, and (4) genetic and ecological characteristics, especially with regard to Jackpine associations, be protected. Other participants suggested that the route should by-pass the Backlands and instead follow existing roads.

The existing Mainland South trunk sewer currently carries very high levels of stormwater, and is also suspected to have high levels of inflow and infiltration, as sanitary sewage comprises only about 10% of the total flow. Although HHCI recognizes that the Halifax Harbour Task Force recommended that this area be scheduled for servicing first to eliminate flows to Watleys Cove, requirements in the construction schedule will delay it. A detailed design cannot be started for the Halifax Mainland South and Herring Cove portion of the system until the flows at Roachs Pond pumping station are diverted to the regional STP/OFS facility when it becomes operational in about 1998. It will then be possible to measure remaining sewage flows more accurately and design a system to meet the requirements.

The cost of the tunnel, coupled with the expressed desire for low growth and a conservation policy for the Backlands and Herring Cove area, indicates that alternative approaches to the collection and treatment of sewage from the Mainland' South and Herring Cove areas must be examined. The consideration of such alternatives must acknowledge the social inequity that continues to be endured by the residents of Herring Cove. Future discharges from any form of alternative treatment must be acceptable to that community.

Because the proposed system for Herring Cove cannot be designed and constructed until the Project is commissioned in 1998, because of stated concerns by Herring Cove residents, and because the City of Halifax planning instruments for Mainland South do not seem to reflect the current priorities of that community, the Panel makes the following recommendations.

25. **The Panel recommends that HHCI reexamine the Project as It applies to Mainland South and Herring Cove, in the context of a new Detailed Area Plan for Mainland South. The development of the Detailed Area Plan should be immediately initiated by the City of Halifax through consultation with the community and HHCI, In order to resolve future growth projections, servicing, transportation, land use and environmental Issues for Mainland South and the Backlands.**

28. **The Panel recommends that the County of Halifax, Herring Cove residents and HHCI cooperatively determine the preferred solution for sewage collection and treatment for the Herring Cove area, given the low-growth provisions of the District 5 Municipal Planning Strategy and desires of the community.**

Because raw sewage will continue to be discharged into Watleys Cove until 1998 or later, and given the impacts on community life and the environment under the Mainland South-Herring Cove project as proposed, the Panel feels it is highly desirable to implement a temporary mitigation measure.

27. **The Panel recommends that HHCI ensure that discharges at Watleys Cove immediately receive preliminary treatment. This Interim solution should be developed under a time-limited site agreement between HHCI and the Herring Cove community. This Interim measure is to be used only until the regional system, or an alternative treatment facility for Mainland South-Herring Cove, is in place. Likewise, HHCI should examine the operation of the existing CSO at Roachs Pond and arrange for Interim mitigation measures. These mitigation measures should be installed by HHCI or the appropriate authority.**

4.7.2 Alternative Treatment Technologies

Several participants suggested that alternative sewage-treatment technologies to those proposed for various parts of the Project could prove to be less expensive on the basis of life-cycle costs and which in some cases could provide a better level of treatment.

One participant suggested using only screens and dynamic storm separators in conjunction with ultraviolet light treatment at CSOs, as a preferred alternative to a regional primary treatment plant. An interest group submitted an extensive report on alternative sites and treatment technologies. Included were suggestions to consider rotating biological contactors or solar aquatics for Halifax Mainland South; a cyclic activated sludge system (sequencing batch reactor) for the Dartmouth area; and a multi-story treatment facility for an STP to be located in part of the Naval Dockyard parking area in Halifax. These three technologies would all provide at least secondary level treatment.

The proposal that an engineered wetland be considered for the Mainland South area attracted the most interest. After being collected and conveyed to the proposed site, the wastewater would be pretreated by screening and grit removal before being discharged into the designated wetland area. A number of participants argued that engineered wetlands are a viable alternative for the Mainland South area, especially when compared to HHCI's cost-intensive proposal to install a deep collection tunnel to transport small volumes of sewage to the regional STP/OFS facility. Participants proposed that engineered wetlands would provide a better level of treatment and offer greater environmental protection at a much lower cost. Specifically, the wetlands alternative

- supports the principle of sustainable development; it is an environmentally responsible means of dealing with sewage
- can be scaled up and expanded without major consequences
- has substantially higher rates of removal for solids, toxics, metals and nutrients relative to primary treatment
- removes more than 99% of pathogens in effluent without disinfection

The Panel also heard a wide range of concerns, from both HHCI and the public, relative to engineered wetlands in general, and in the context of its application to Mainland South specifically. These included concerns about the

- potential accumulation of toxic substances in the biomass and sediments of the wetlands
- unknown fate of contaminants in the biomass harvested from the wetlands
- extent of required land area to achieve'desired result, which may be substantially greater than anticipated by the review participants
- ability of the proposed wetlands to function during the cold and wet seasons
- possibility of contaminating groundwater; given the fractured granitic geology of the proposed site, an impervious clay seal would likely have to be installed under the wetland
- suitability of the terrain, which is undulating with large areas of exposed bedrock
- odour
- ultimate fate and effects of effluent discharged into McIntosh Run or to other environments
- local hydrology, particularly the assimilative capacity of McIntosh Run and the fact that treated sewage effluent might become the predominant flow in the Run throughout the year

- limited opportunities to compensate for loss of fish habitat in McIntosh Run, should the wetlands fail
- acceptability to area residents

Several participants indicated that although engineered wetlands can be effective and work in certain climates, more hydrological, environmental and design information is required before an engineered wetland should be seriously considered as an option. Any proposal for an engineered wetland should be stringently assessed, and should involve input from area residents.

The Panel is supportive of the engineered wetlands approach as a good sustainable development option for dealing with sewage treatment and disposal in many situations, but has serious reservations about its appropriateness for Mainland South and Herring Cove. Many of the Panel's reservations parallel those documented above. Solutions that involve discharge to McIntosh Run must be preceded by detailed study of predicted impacts of the effluent on fisheries and freshwater and marine environments, including remediation measures. Any proposed alternative treatment solutions have to recognize the need for appropriate sludge management.

28. The Panel recommends that, in the context of preparing a new Detailed Area Plan for Mainland South and in seeking alternative soiutions for sewage treatment and disposal for the area, both conventional and alternative approaches be explored. These should include advanced primary or secondary treatments with direct discharge to the ocean, tertiary or equivalent level effluent discharge Into McIntosh Run, and technologies such aS englneered wetlands, rotatlng biological contactors and others. Any proposal for englneered wetlands should be seriously examined In light of the stated concerns relating to performance and environmental impacts, and should Include a detailed cost-benefit analysis.

4.8 SEWAGE TREATMENT AND SLUDGE MANAGEMENT FACILITIES

4.8.1 Introduction

According to HHCI's proposal, the sewage that is intercepted and consolidated by the collection system will be transported to a single regional STP/OFS facility which will provide primary treatment and disinfection of the effluent on an artificial island to be constructed at Ives Cove. A diffuser will then discharge the effluent into the Harbour to the west of McNabs Island.

The plant will be located on a 9.5–hectare artificial island, "Ives Island," off the northern end of McNabs Island. The island will require expansion if secondary treatment is to be provided (Figure 9).

Fill will be used to create the island. Sources of fill to construct the island were undetermined at the time of the hearings; suggestions included local quarries, the quarry at the Strait of Canso and tunnel spoils. To mitigate concern over siltation entering the marine environment during construction, HHCI has proposed the use of silt curtains to confine the sediment plume to the construction site.

The site's main pumping station will lift sewage from the deep-tunnel collection system into the plant. The sewage will then undergo preliminary treatment, consisting of screening, grit removal, and scum and grease removal. Screenings and grit will be barged and trucked away for disposal. Grease and scum will be pumped to the OFS facility. The sewage itself flows through preliminary treatment to the primary clarifiers.

Primary clarifiers will remove about 50% of the suspended solids at peak flow and about 85% at average dry weather flow. The plate clarifier system, which was chosen over a conventional clarifier system, comprises a series of individual clarifying chambers operating in pairs. The clarifier plates are inclined and operate at a higher rate of flow than conventional clarifiers, thus allowing a reduction in the size of the tanks and residence time of the sewage. They also reduce space requirements over conventional clarifiers by about 50%. Because plate clarifiers are a relatively new technology, some concern has been expressed that they may prove to be less reliable or cost-effective than conventional clarifiers.

The sludge that accumulates in the clarifiers will be moved to the OFS facility for processing. Following primary treatment the wastewater will undergo disinfection by chlorination in a chlorine contact chamber. The effluent will be discharged into the Harbour via a tunnel to the diffuser. To avoid problems with transporting chlorine in either its liquid or gaseous form to the island, chlorine will be generated as sodium hypochlorite from sea water.

All solid wastes generated on-site are expected to be transported off, island and disposed of or recycled at approved municipal facilities: land fill, incinerator or recycling depots. Solid wastes from the facilities will consist primarily of screenings and grit, ash from the OFS process, and solid waste generated from administration offices. HHCI has stated that solid-waste disposal must conform to applicable regulations and permitting processes, and the Panel concludes that the provisions set out for solid waste disposal by HHCI are sufficient.

Some of the major issues surrounding the proposed STP/OFS facility relate to its island location, and these have been discussed in Section 4.2, Choosing the Site. Generally, an offshore facility involves greater costs associated with construction, servicing and transportation, and a greater visibility profile from points around the. Harbour, and from McNabs Island.

Other issues focusing on treatment level and method, the OFS technology, and social and environmental impacts are discussed in the following sections. Particular concerns about the impact of the proposed facilities on McNabs Island's designated parkland is discussed in Section 4.8.9.

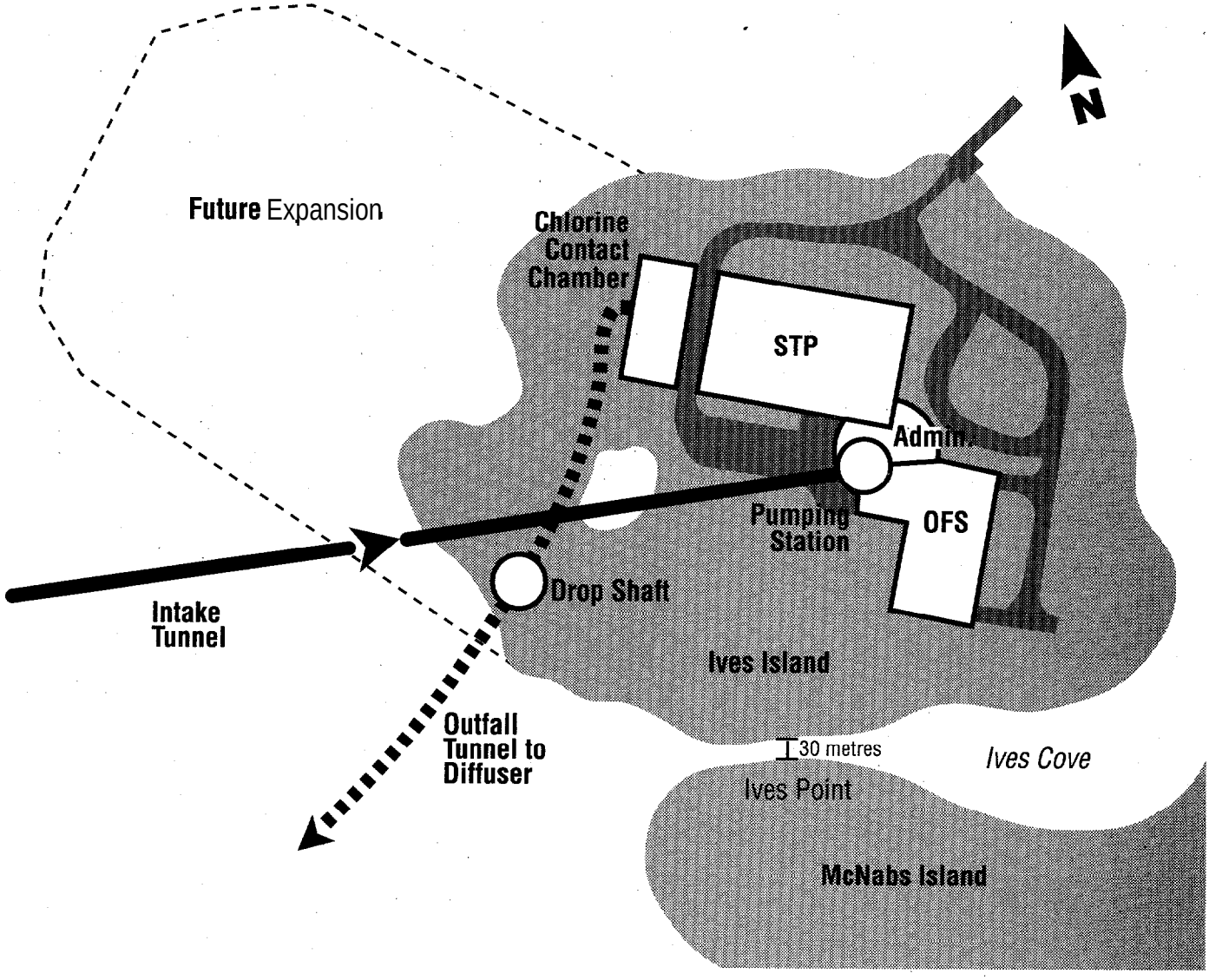

Figure 9 **Ives Island Sewage Treatment Plant and Oil-from-Sludge** Facility

Source: After Halifax Harbour Cleanup Inc.

4.8.2 Level of Treatment

The Panel has examined the question of treatment levels - primary, advanced primary or secondary - in terms of potential benefits to Halifax Harbour, disinfection methods and costs (Figure 10).

Some review participants expressed the following criticism of the decision to employ primary treatment:

- Primary treatment is outmoded; most coastal jurisdictions now require secondary treatment.
- The cost of a primary treatment facility is high in relation to projected improvements to the Harbour's marine environment.

In setting its water quality objectives, the Halifax Harbour Task Force recognized that current regulations elsewhere require secondary treatment for effluent discharges into coastal waters. However, it understood that it was questionable whether the costs associated with secondary treatment would produce any substantial improvement to Harbour conditions relative to the benefits achieved by primary treatment. The Panel concurs.

In the proposed treatment system, suspended solids will be removed at efficiencies of 66% and 50% for average dry weather flows and peak flows, respectively. The Panel accepts these to be the normal values for the proposed design with primary treatment. It was pointed out by one participant at the hearings that primary treatment removes the particulates that have the fastest settling rates. The finer material that is not removed has from four to ten times greater absorption capacity, which translates as capacity to carry toxic organic and metal contaminants.

There is an increased trend toward advanced primary treatment (also known as chemically enhanced treatment) through the introduction of chemical coagulants/flocculents and pH adjustment. Several other factors such as duration of rapid mixing, and flocculation can greatly increase the quality of the final effluent without secondary treatment. Table 6 compares the performance of advanced primary treatment to primary treatment. Figure 10 illustrates the advanced primary treatment process.

HHCI pointed out that advanced primary treatment "requires little additional space and infrastructure over the primary plant installation and is readily retrofitted for upgrading primary effluents." Some care must be exercised with the choice of chemicals to avoid heavy inorganic loading, thus ensuring best performance of the OFS facility, but several viable options remain. Such a system, although slightly more expensive, would generate a superior effluent.

In considering the addition of advanced primary treatment, two options might be evaluated:

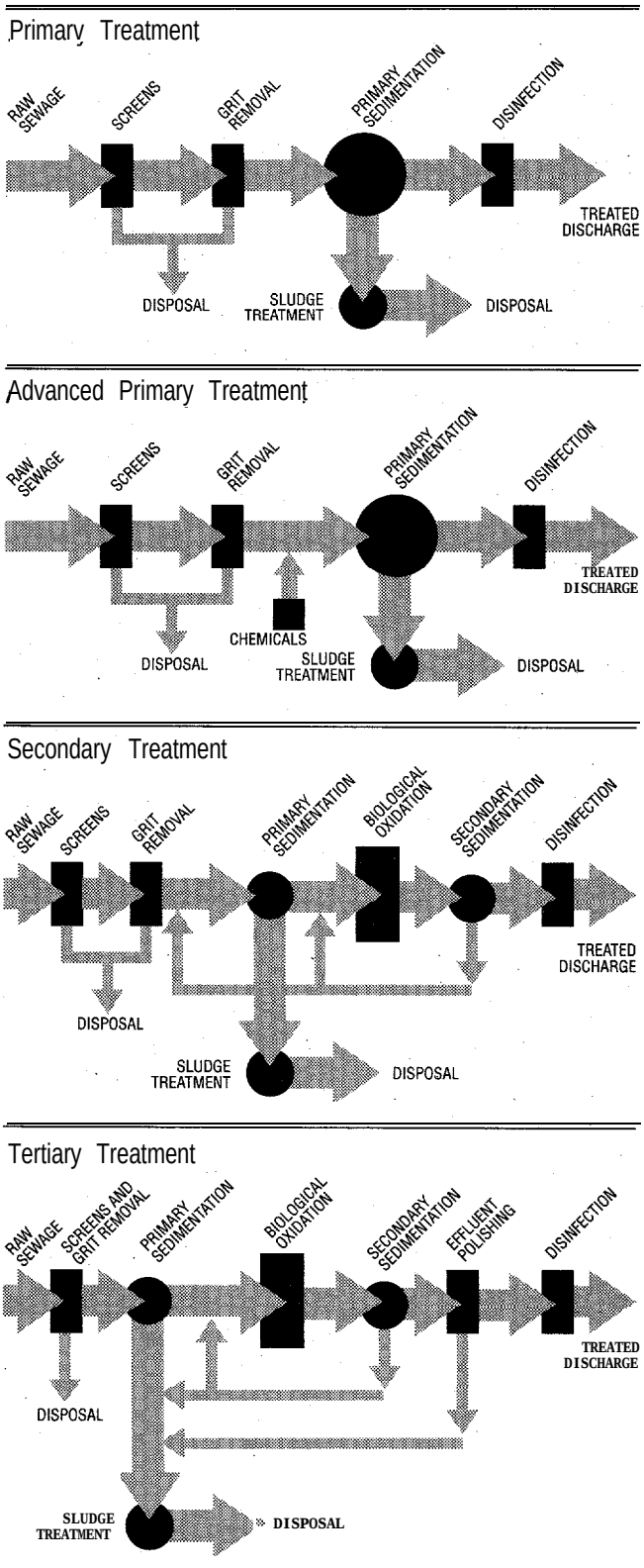

Figure IO **Sewage Treatment Processes**

Source: After Halifax Harbour Task Force

- Treatment of all flows by advanced primary treatment. This would require more chemicals, and hence would be more expensive than the second option.
- Treatment of part of the flows by advanced primary treatment. Since the maximum concentrations of all pollutants are normally expected during dry weather flow, this option would provide advanced primary treatment to a volume of influent comparable to average dry weather flow. The balance of the flow (up to three times average dry weather flow) would bypass advanced primary treatment and be treated by plain sedimentation, as originally proposed by HHCI. A very rough schematic is shown in Figure 11.

HHCI should examine both options, conduct laboratory-model treatability studies, commission a predesign study, and subject the results to a value engineering audit before reaching a conclusion.

29. The Panel recommends that HHCI give serious consideration to designing the sewage treatment plant/Oil-from-Sludge (STPIOFS) facility to include advanced primary treatment at the initial stage, irrespective of site location. The analysts should consider Initial capital Investment, operating costs, effects on sludge-management technology, and Impacts on and benefits to human and natural environments.

The recommendation to consider advanced primary treatment is also supported by concern expressed by review participants over the proposed disinfection method, as described in the following section. The inclusion of advanced primary treatment would also allow consideration of alternative disinfection methods.

4.8.3 Disinfection

HHCI proposes to use chlorination (sodium hypochlorite derived from sea water) to disinfect the primary treated effluent before discharging it into the Harbour. The Panel agrees with HHCI's assessment that given the characteristics of primary treatment, few other disinfection technologies are appropriate. However, much concern was registered by participants over the potential negative impacts of chlorination on both human and environmental health. It was felt that alternative disinfection methods should be considered, including ultraviolet light and ozonation.

The Panel is aware that chlorine and chlorinated wastewater discharges are currently being evaluated on the Priority Substances List under the Canadian Environmental Protection Act. Chlorine is considered by many to be an unacceptable disinfectant due to the production of organochlorine compounds during treatment and the potential for their bioaccumulation in the marine food chain. This has the ultimate potential of impacting the health of top levels of the food chain, including humans.

Recent toxicity tests with freshwater fish demonstrated that certain non-chlorinated wastewater treatment plant effluents were not toxic to fish, but chlorinated effluents from the same sources were toxic when above certain concentrations. Threshold levels of effect varied with the nature of the effluent tested (GM Szal, et a/. Research Journal Water Pollution Control Federation 63, Sept/Oct. 1991). The effects of disinfection-generated organochlorines in the marine environment are relatively undocumented.

It should be noted that dechlorination procedures are capable of removing free chlorine but do not to remove the organochlorines associated with suspended particulates.

Chlorination could conceivably be limited to the swimming season, since the main reason to chlorinate the effluent is to protect swimmers and others engaging in body-seawater contact sports such as windsurfing. Provincial regulations may have to be altered to allow for this.

If chlorine is deemed unfit for effluent disinfection in the future, the proponent may have to consider alternatives. Also, the initial costs ($4.7 million) associated with the chlorine-based technology (chlorine contact chambers) indicates the need to consider other options. HHCI should be prepared to participate in directed research for developing alternatives to chlorine-based disinfection.

Table 6 Comparison **of Advanced Primary and Primary Sewage Treatment Levels: Contaminant Removal Efficiency**

Advanced Primary	Primary
• Up to 90% of suspended solids	. 40–60% of suspended solids
• Greater levels of toxic organics associated with suspended solids	• Lesser levels of toxic organics associated with suspended solids
. Up to 90% of heavy metals	. 15% of heavy metals
• 80-90% of bacteria, greater levels of removal of other pathogens associated with suspended solids	• Lesser levels of bacteria and other pathogens associated with suspended sdids
• Greater levels of phosphorous and other nutrients	• Lesser levels of nutrients
• Greater levels of biochemical and chemical oxygen demand (BOD and COD)	. Lesser levels of BOD and COD

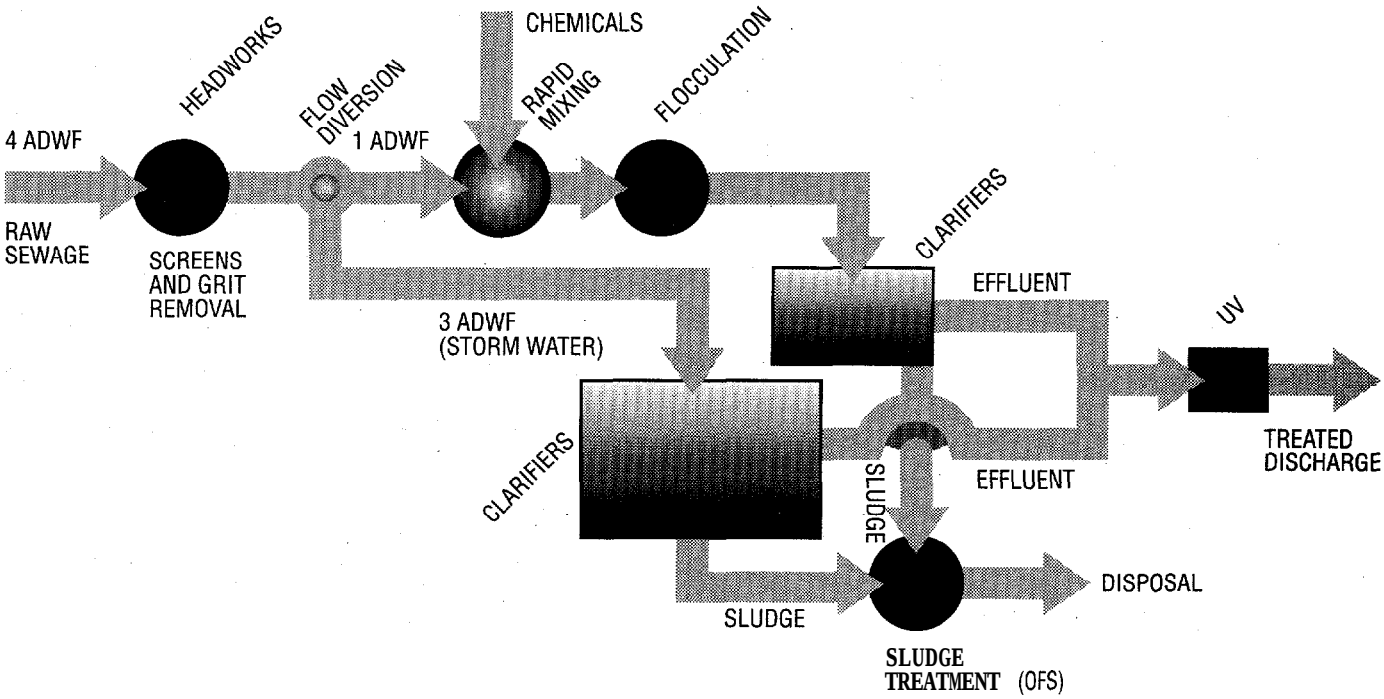

Figure **11 Advanced Primary Treatment with UV Disinfection Option** *Source: Environmental Review Pane/*

Ultraviolet disinfection is a physical process in which ultraviolet radiation is absorbed in the DNA of microbes and prevents their propagation. It is considered an effective alternative to chlorination for effluents containing. low levels of suspended solids, as the light is able to penetrate the effluent efficiently and without major scum build-up on the light tubes. For this reason ultraviolet technology requires at least advanced primary or secondary treatment.

HHCI informed the Panel that a manufacturer of ultraviolet disinfection equipment had conducted research on effluent from advanced primary treatment effluents and was confident that ultraviolet disinfection of such effluents would provide virtually pathogen-free discharges without toxic chemical by-product formation.

Because of the foregoing concerns regarding chlorination and the potential benefits to be derived from advanced primary treatment, the Panel makes the following recommendation.

30. The Panel recommends that alternative methods of effluent disinfection should be evaluated by HHCI on an ongoing basis, including chlorination (using sodium hypochlorite), ultraviolet radiation, ozonation, and others as available and practical. These should be considered in relation to both primary and advanced primary treatment.

4.8.4 The Oil-from-Sludge Process

The primary STP will initially be producing 310,000 litres of liquid sludge a day. HHCI is proposing to use a new thermal process to manage the sludge. OFS technology is being developed by Environment Canada's Wastewater Technology Centre in partnership with SNC Lavalin. The Federal-Provincial Subsidiary Agreement specified that the federal government's contribution of approximately $74 million to the funding of the project is contingent on the use of this technology.

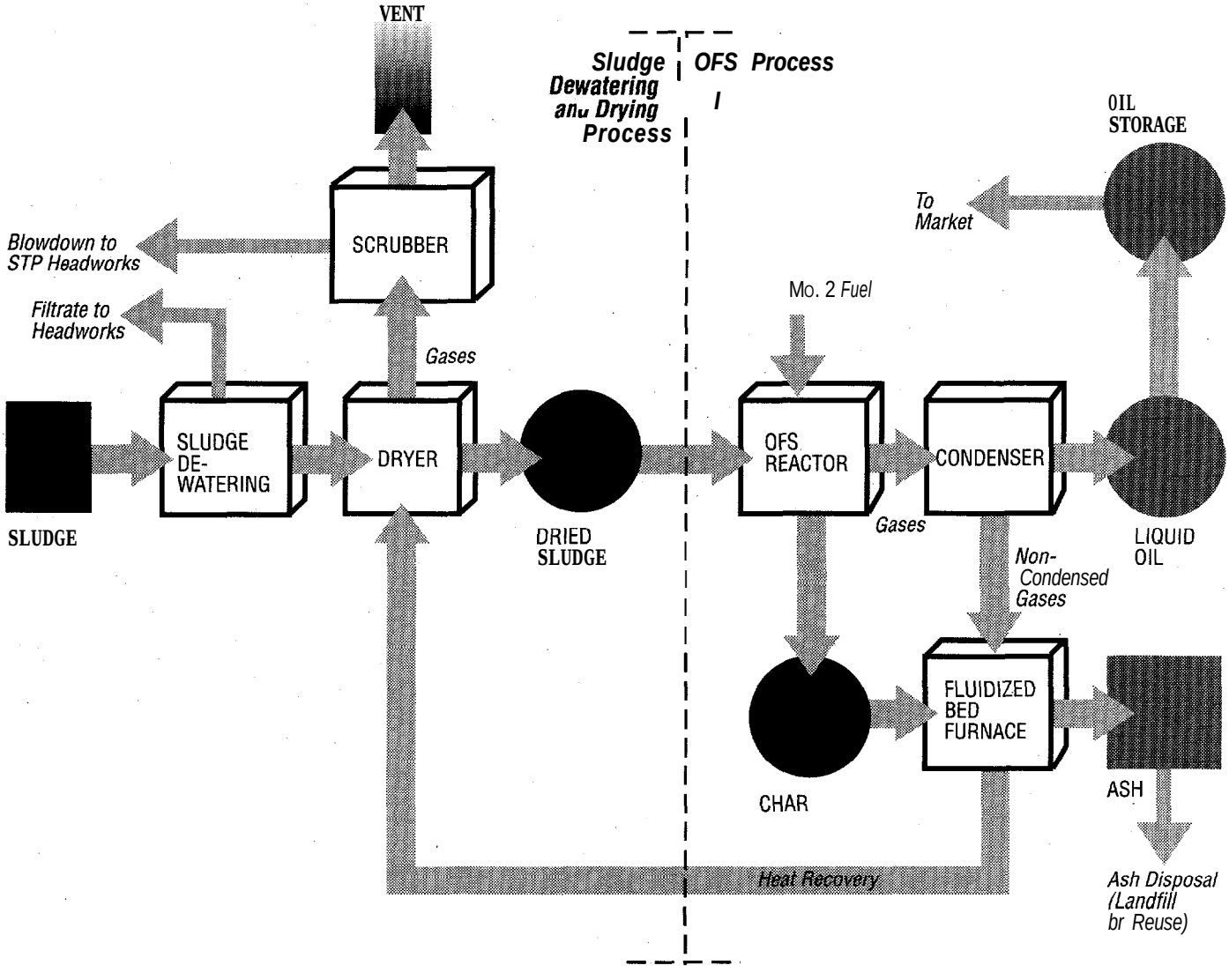

Figure **12 Oil-from-Sludge (OFS) Process**

Source: After Halifax Harbour Cleanup Inc.

Figure 12 shows the entire sludge management process, its products and residuals. The process involves seven main steps:

1. The liquid sludge from the primary clarifiers, containing 4-5% solids by weight, is stored in an underground retention tank.
2. The sludge is mechanically dewatered to increase the solids content to **30–35%.**
3. This thicker sludge is then dried to increase the solids content to 95%.
4. The dried sludge is heated in the OFS reactor to **450°C** in an oxygen-free (nitrogen) environment. This converts the sludge into three products: liquid hydrocarbons, non-condensable gases and char. No. 2 fuel oil is used to power the reactor.
5. The gases and char from the OFS reactor are burned in a fluidized bed furnace to produce the heat to run the sludge dryer.
6. Ash from the fluidized bed furnace is taken away for disposal.

7. Exhaust gases from the sludge dryer, the OFS reactor and the fluidized bed furnace pass through a high-efficiency cyclone and a wet chemical scrubber before being vented to the atmosphere.

Based on the proposed plant capacity of 20 tonnes of dried sludge a day, the OFS process will produce 5 tonnes per day of liquid hydrocarbon and 7 tonnes per day of ash.

As a sludge management technology, the OFS process has the following features:

- The OFS technology can be effectively used in conjunction with primary, advanced primary or secondary treatment.
- The process works more efficiently using raw sludge, therefore sludge digesters are not required, which saves space. The process can handle digested sludge if necessary, but less of the oil product will be produced per tonne of sludge processed.
- The OFS process is not particularly sensitive to the quality of the sludge, with respect to toxic contamination. It has been suggested that some level of heavy metals in the sludge may be required to enable the OFS reaction to take place. However, the process has been proven using relatively "clean" residential sludges. The developers of the process therefore maintain that OFS is entirely compatible with stringent controls-at-source programs.
- The sludge can be processed relatively quickly. The technology is therefore more compact because the sludge residence time is shorter.
- 99% of the energy required to run the sludge drying process is recovered as hot flue gas from combustion of char and non-condensable gases in the fluidized bed furnace. The remaining 10% is provided by combustion of No. 2 fuel oil.
- No. 2 fuel oil is used for OFS reactor heating. 855,000 litres per year are required for the process (reactor, fluidized bed furnace).
- Approximately 59% of the gross energy in the sludge can be recovered in the form of an oil product which can be easily stored and transported. Specialized commercial uses are being evaluated for this oil product.
- The OFS facility and its associated air pollution control equipment can be designed to eliminate the need for a stack.
- The OFS technology has not been scaled up for application at a full-size STP yet. However, an OFS facility is being installed in the Highland Creek Sewage Treatment Plant in Scarborough,. Ontario, and is scheduled to be in operation by 1995.

All the major components in the sludge management facility (the dewatering and drying units, the OFS reactor, and the fluidized bed,furnace) will be duplicated, and each train will have capacity for 20 tonnes a day, thus initially providing 100% excess capacity. As the volume of sewage increases over the years, this back-up capacity will gradually be eroded until it is necessary to install a third train. The sludge dewatering units are crucial to the whole operation. Should both dewatering units go down, it would be necessary to remove over 1 .l million litres of liquid sludge a day from the artificial island. However, after the dewatering stage, considerable flexibility is built into the system. If both sludge dryers were out of commission, the dewatered sludge cake (30% solids) could be removed for landfilling. If both OFS reactors were to go down for a prolonged period of time, the dried sludge could be stored under cover and processed later. This would be HHCI's preferred option, in order to recover as much oil as possible. Once the storage option was exhausted, the dried sludge could either be incinerated in the fluidized bed furnace or trucked away to landfill.

Both HHCI and other presenters provided information about alternative forms of sludge management, including direct land-application of digested sludge, landfilling digested sludge, composting and marketing, marketing of dried digested sludge, and incineration with or separate from municipal solid waste.

In evaluating these options, it is necessary to take into consideration the following issues:

- land requirements
- volumes of material requiring transportation
- volumes of wastes requiring disposal
- ability to market end products such as oil products or finished compost
- ability to meet environmental regulatory requiremants for air quality, soil and groundwater protection, and for the use of end products
- ultimate fate of persistent toxic contaminants
- contingency measures
- ▯

. public acceptability

In the hearings, HHCI stated that the OFS technology would have been preferred even without federal funding, because it is a complete sludge management system which potentially allows all the by-products to be reused or recycled without damage to the environment (this assumes that the ash could be approved for reuse as inert fill or for other uses).

Energy, in the form of methane gas, can be recovered from other sludge management processes, but often as much as half of it must be flared off in the summer months because it cannot be conveniently used. The OFS process recovers energy in three forms, two of which (gases and char) can be used to run part of the. sludge management process, while the remaining energy form (the oil product) can be stored and marketed.

The oil produced by the OFS process could be used as a low-grade diesel fuel oil, but the developers of the process suggest that it should be marketable as an anti-stripping agent

to be used in the production or recycling of asphalt. Commercially available anti-stripping agents currently sell for $2-3 per litre; tests have shown that the OFS product works equally well. Because of the unique chemical properties of the OFS oil, its developers are confident that other applications will be found as research continues. However, priority chemicals (PCBs and others) may be contained in the product, so applicable regulations should be complied with. Firm markets cannot be developed until a full-scale plant is in operation and producing larger quantities than the existing pilot plant.

HHCI also stated the belief that OFS was an efficient, cost-effective means of sludge management for the Halifax Harbour Cleanup Project, even if the new markets for the oil did not materialize and it had to be used as a fuel.

Participants expressed a number of concerns about the choice of the OFS process:

- The technology is very new. It has only been operated at the pilot-plant level, and has yet to be proven to operate successfully at a full-scale plant.
- The choice of the OFS technology was driven by the federal funding, not by its intrinsic merits.
- If the OFS technology were to be used, it would be better to wait until the Highland Creek plant had been built and was operating for some time.
- Other sludge management approaches allow for beneficial reuse of some of the organic matter and nutrients in sewage through agricultural or forestry applications.
- Where sludge is ultimately applied to the land in some form through direct application or cornposting, the public will be much more aware of the necessity to keep toxics out of the wastewater. The OFS technology appears to "hide" the ultimate fate of the toxics. The public will be more inclined to think that there is no problem.
- One of the contingency alternatives involves burning the dried sludge in the fluidized bed furnace, should both OFS reactors go down. Therefore there is the possibility that sludge incineration will take place, even if only on a very intermittent basis.
- HHCI would be proceeding with OFS while markets were still very tentative. If markets did exist for this new product, could they be flooded once both the Scarborough and Halifax projects came onstream? Would there be local markets for the oil as an anti-stripping agent?

4.8.5 Oil-from-Sludge Waste Disposal and Emissions

Based on a design rate of 20 tonnes of sludge a day, the OFS process will produce approximately 7 tonnes of ash per day which would be removed weekly. HHCI intends to landfill the ash, preferably in a municipal facility, although no landfill operator has yet made any commitment to take this material. Alternative uses will also be considered.

Based on analysis of other raw sludges and leaching tests performed on the resulting OFS ash, the developers of the process believe that most of the heavy metals present in the sludge will be concentrated in the ash, immobilized in the form of aluminates and silicates. The Wastewater Technology Centre (developers of the process) provided, information on leachate tests performed on five different sludges. All easily met both Ontario and U.S. Environmental Protection Agency regulatory requirements for ash disposal.

If tests prove otherwise once the regional facility is operating, the ash will be solidified before disposal. HHCI also raised the possibility of being able to use the ash as clean fill if test results and provincial regulations permitted this.

Presenters, including Environment Canada, expressed unease that a specific ash disposal facility had not been identified. Other concerns expressed by the public at the hearings included the following:

- The Metropolitan Authority has given no indication that it will accept this material; and the implementation of its new solid waste management plan, which includes an ashfill for its own municipal solid waste incinerator, is facing considerable.opposition and may well be delayed.
- If HHCI had to develop its own landfill for the ash, there should be assurances that this would not be located on f&Nabs island.

The OFS technology is an enclosed process with built-in controls for odours and other air emissions. Comparing their design with current Ontario regulations in the absence of specific Nova Scotia regulations, HHCI is confident that all emissions can be controlled to meet requirements, and it has altered the plans for the OFS facility to eliminate the need for a stack. This presumably indicates that HHCI is undertaking to satisfy air quality stipulations at the exhaust vents without benefit of additional dilution and dispersal.

Because predicted contaminant emissions were very low, HHCI only carried out air dispersal modelling for volatile organic compounds, which indicated that these would have no impact on the closest communities. HHCI has committed to monitor air quality and to include representatives from neighbouring communities on its advisory committees.

Concerns presented by the public included the following:

- The OFS process is, at least in part, sludge incineration by another name. While the OFS reactor itself operates without oxygen and is therefore not a combustion process, two of the reactors products - non-condensable gases and the char - are then burned in the fluidized bed furnace. Presenters alluded to air pollution problems associated with sludge incineration technology, and in particular mercury emissions.
- The sludge drying process, using the products of the OFS reactor as fuel, may incorporate all of the conditions required to produce dioxins and furans: the organics in the sludge, chlorine in the sludge and sodium hypochlorite from the scrubbers, metals in the gases from the reactor and a temperature range around 450%.

- The predesign report for the OFS facility indicated that a stack would be used. HHCI now plans to eliminate the stack, but there are no guarantees that this will be possible. If a stack is indeed required, this would have an additional visual impact on McNabs Island and elsewhere, which would be hard to mitigate.

- HHCI plans to pump the blowdown material from the wet scrubbers back to the headworks in the STP. It is possible that this material will have concentrated certain heavy metals from the sludge, particularly mercury. These would not be removed by the clarifiers and would therefore be discharged into the Harbour in a possibly more bioavailabfe form.

4.8.6 Sources of Sludge and Transportation

HHCI intends to treat the digested sludge from the Mill Cove and Eastern Passage plants and the smaller Lakeside plant at the OFS facility. Septage from the whole of the County of Halifax would also be accepted. The County of Halifax currently disposes of its sludge and septage in a lagoon at the AeroTech Park. Once the regional facility is constructed, the sludge and septage will be discharged into the collection system at a sludge tipping station in an industrial area at Fairview Cove. The solids will then be removed by the primary clarifiers at the regional plant.

HHCI stated that efficient operation of the OFS facility does not depend on this additional input of sludge, but the process will be able to handle it with ease.

There were two main sets of concerns expressed by the public:

- It makes no sense to reintroduce treated sludge into the collection system, especially as the secondary sludges from Mill Cove and Lakeside would be reprocessed by a primary plant.

- Assuming that reprocessing sludge would result in a net loss of solids from the system because the primary plant would not be able to recapture all of the particles originally removed by the secondary treatment plant, there was also concern about adding to the load of contaminants discharged at the diffuser in the Harbour, especially as some of these solids would have originated from areas outside the Harbour's natural watershed boundary.

4.8.7 Sludge Management

While the Panel would have been more comfortable had the OFS process been proven in operation at a full-scale sewage treatment plant, the advantages of the technology are acknowledged to be an effective, efficient and compact means of managing sludge and its by-products, especially if it is to be used at an island location.

On the basis of available information, it also appears that OFS technology is consistent with the principle of maximizing the containment of toxic contaminants, since most of the heavy metals are retained, either in the ash or in the oil product. The ultimate fate of toxic organic contaminants needs more analysis, but again it would appear that the process either destroys them or retains them where they can be monitored and controlled. The Panel recognizes the benefits of other sludge management methods which involve land-based application of sludges in various forms, but is concerned that these methods rely heavily on the day-to-day effectiveness of controls at source to avoid distributing toxic contaminants widely in the environment. Handling, transportation and ultimate disposal of sludge with other systems are also much less convenient than with the OFS process.

Selecting a new technology is not without risk, especially when it has not been scaled up to full-plant operating size. Since the technology does not have a full track record yet, and since many problems (not necessarily unsolvable ones) are likely to arise just in the natural course of events, and recognizing that HHCI will otherwise be very dependent on the expertise of the developers of the OFS process, the Panel believes that HHCI should proceed cautiously and with the benefit of third party advice. This is also advisable to counter any perception that there could be some conflict of interest because Environment Canada is both a regulatory body and the holder of the OFS patent. HHCI should also take'every advantage of the knowledge to be gleaned from the construction and operation of the OFS facility at the Highland Creek Sewage Treatment Plant in Scarborough, Ontario.

The Panel agrees with the original sludge management report prepared for HHCI in 1989 by UMA Engineering Ltd. that the economic and environmental feasibility of direct land application of sludge should be investigated as a way to handle the County of Halifax's sludges. This would reduce the dependence on just one form of sludge management and would be a more effiiient way to reuse these organic materials. It would also be useful to obtain definitive knowledge about direct land application of sludge, in terms of its advantages and disadvantages as a sludge management option, its environmental effects, and as the subject of an associated cost-benefit analysis.

The Panel has a number of remaining concerns:

- Although preliminary results seem promising, more definitive information is needed to determine the path of the toxic organic chemicals and heavy metals through the OFS process and their ultimate fate.

- Considerable development work in engineering design remains to be done to scale up the OFS process from pilot plant to full-size plant, particularly in terms of the interconnections between the various elements of the facility.

- Although the Province is' beginning to implement the recent recommendations of the Minister's Task Force on Clean Air, the regulation of airborne contaminants from industrial sources is still at a rudimentary stage in Nova Scotia.

. HHCI's proposal to route the blowdown from the wet scrubbers through the headworks at the STP may be removing certain contaminants from the air, only to discharge them into water. These wastes need to be characterfzed, especially with respect to potential changes in bioavailability.

- Should the OFS technology for any reason prove to be unworkable, alternative forms of sludge management such as direct land application or cornposting may be constrained by the choice of an island site for the regional facility because of increased land and transportation requirements.
- While recognizing that the County of Halifax is looking for a more permanent sludge management solution than the AeroTech lagoon, it is inefficient to reprocess digested sludges - especially secondary and tertiary sludges - through a primary treatment plant.

31. In regard to sludge management, the Panel recommends that HHCI proceed with the design and development of an oil-from-sludge (OFS) facility to manage the sludge generated by the Project, with the ultimate goal of mlnimlzlng the release of toxic contaminants to the environment while at the same time recovering a useful product.

32. The Panel recommends that HHCI prepare a mass balance for the OFS facility, in order to predict the ultimate fate of ail constituents of the raw sludge used as feedstock. This mass balance should be verified by actual performance data once operations begin, and the lnformation used by the regulatory agencies to develop emission standards and performance controls.

33. The Panel recommends that the Nova Scotia Department of the Environment regulate the OFS facility in accordance with the Fiecommended Policy for the Management of Stationery Sources of Air Contaminants developed by the Minister's Task Force on Clean Air. Regulations used in other jurisdictions should be reviewed In the context of this poiicy, which would require that the OFS facility, as a potential emitter of toxic contaminants, be equipped with Best Available Control Technology (or its equivalent) and that its emissions meet ambient air quality objectives and relevant national and provincial targets.

34. **The Panel recommends that HHCI re-examine its intention to pump the biowdown from the wet scrubbers into the headworks of the STP to determine whether this method of treating and disposing of the wastes from the scrubbers is consistent with the goal of minimlzing the release of toxic contaminants to the environment. if necessary, an alternative disposal method should be selected.**

35. The Panel recommends that HHCI be required to provide a detailed ash management plan before the STP/OFS facility is given operating permits. The plan should Indicate what the characteristics of the ash will be, exactly where the ash will be landfilled, and how regulatory requirements will be met. Because the OFS process is new, the Panel believes that at least until operating data have been collected over several years, the ash should be disposed of in a secure landfill rather than being reused as fill or for other purposes.

36. The Panel recommends that HHCI be required to commission an independent body to carry out an Initial and ongoing assessment of the technical design, a risk assessment, and a value engineering analysis for the OFS system. The results of this analysis should be made available to the Citizens' Advisory Committee.

37. The Panel recommends that within two years and with funding provided under this Project, a study should be carried out by the County of Halifax to determine the feasibility of applying the digested sludges from certain of its treatment plants directly onto lands used for growing trees or non-food crops. The study should consist of an initial cost-benefit analysis and value engineering audit, to be followed by a demonstration project, which would attempt to determine (1) the fate and effects of toxics in the digested sludge, (2) the potential benefits to the soil and to plant growth and (3) public acceptability. if, as a result of this study, it is determined that having access to the OFS process is still the preferred option for the County, the Panel recommends that HHCI re-evaluate the possibility of delivering the sludges from the County of Halifax sources directly to the OFS facility, either before or after digestion, In order to avoid reprocessing already-processed sludge through the primary STP.

4.8.8 Facility and Artificial Island

HHCI has proposed extensive landscaping on Ives Island to visually mitigate the impacts of the STP/OFS facility and island in relation to McNabs Island and other vantage points around the Harbour. HHCI has presented considerable written information, oral description and visual depiction of the visual impact of the facility, acknowledging that during construction the visual impact will be significant but that this should gradually diminish as the vegetation on the site matures. HHCI predicts that approximately ten years after initial plantings (landscaping), the visual impact will be insignificant, and the artificial island will blend naturally with the surrounding landscape, especially that of McNabs Island.

The proposed architectural design of the facility's exterior is also meant to reduce the prominence of the structures, and low-intrusion lighting will be employed to minimize the plant's night-time profile.

Concerns about the visual impact of the artificial island and the STP/OFS facility are shared by governments, agencies, interest groups, other participants and the Panel. The preoccupations include the impact on National Historic Sites (Fort Ives and Georges Island), the views from the downtown areas of Halifax and Dartmouth, approaches to McNabs Island, and views from **McNabs** Island itself. The Panel remains unconvinced about the effectiveness of the proposed landscape treatment and facility design to mitigate these visual and aesthetic concerns for the following reasons:

- the anticipated difficulty of establishing vegetation plantations in a hostile coastal environment and to a level which will achieve sufficient maturity within ten years
- the visual prominence of a partially vegetated island and facility which will remain exposed for quite a few years
- the fact that the process of visual mitigation will have to be started over again if the artificial island and the facilities are expanded

The visual impacts associated with a project of this size must be managed with great sensitivity if they are to be effectively mitigated. A number of techniques are identified by the Panel to assist with mitigation of visual impacts:

- reducing the size of the artificial island as recommended in the Quality and Value Engineering Audit only if the proposed landscaping treatment and visual mitigation techniques to be employed are equal to or better than those **presently** proposed
- constructing earth berms around the perimeter of the island to visually conceal the profiles of STP/OFS facilities
- increasing the overall landscaping treatment and density of plant materials, and using a greater proportion of semi-mature and mature plantings to provide for further mitigation of visual impact of the facilities from all directions
- establishing the landscaping regime prior to or at the commencement of **facilities construction**
- using effluent from the clarifiers for irrigation provided that contaminated loadings are within acceptable limits, and nutrient loadings can be demonstrated to be beneficial to the plant materials and soil regime
- reducing the amounts of glazed surfaces' in the STP/OFS facilities to minimize the potential reflectance from night lighting
- choosing exterior colours on the facades and roofs of facilities that will blend and blur visually with the natural vegetation and landform colours
- limiting heights of roof profiles for the STP/OFS facility as much as possible, preferably keeping them below the heights of tree canopies and perimeter berms
- establishing and maintaining a natural visual screening on McNabs Island to prevent visual contact between the northem end of McNabs Island and the artifiiial island (area from Fort Ives eastward to Indian Point and inland for a distance of 100 metres beyond the tops of shoreline slopes of **McNabs** Island)

38. The Panel recommends that mitigation measures for landscaping, facilities design and visual impacts as described in Section 4.8.8 of this Report be employed by HHCI in the development of the present Project, and in future expansion phases.

4.8.9 McNabs Island

HHCI spent considerable time and effort to describe the potential impacts on McNabs Island from construction and operation of the STP/OFS facility on Ives Island, and to outline mitigation measures that it would employ. It recognized that McNabs Island enjoys the status of being designated as a future provincial park and stated that it does not perceive any significant impacts on the future park development from siting the **STP/OFS** facility on Ives Island. HHCI is prepared to work with the Nova Scotia Department of Natural Resources and the Canadian Parks Service in resolving any jurisdictional, land transfer, or use issues. Because the STP/OFS facility will be located on an artificial island separated from McNabs Island, HHCI believes there are few potential conflicts or impacts generated between the facility and the terrestrial environment of McNabs Island.

The entire plant, including the OFS facility, will be enclosed and will employ state-of-the-art odour control technology. HHCI believes the odour control mechanisms will virtually eliminate the emission of any noxious odours to the outside environment. By enclosing the plant, venting the headworks through dry scrubbers, treating interior ventilation air through odour control equipment and other methods, HHCI is confident that there will be no odour impacts on McNabs Island or onshore communities. HHCI expects to treat air through use of either wet (sodium hypochlorite) or dry (activated carbon or proprietary resins) methods. Episodic events or equipment failure could generate temporary odour impacts on ambient odour levels adjacent to the facility, but this is not expected to be a major concern. HHCI has committed to monitor air quality and to include representatives from nearby communities on the Citizens' Advisory Committee.

HHCI, aware of many concerns over McNabs Island from the outset, endeavoured to deal with them by separating the artificial island by a 30-metre-wide saltwater channel from the shore of McNabs Island; by designing the island and the facility in such a way that it would blend with the landscape of **McNabs** Island; and by proposing education, research and interpretive centres at the plant. HHCI stated on several occasions that complementary educational and interpretive centres at McNabs Island Provincial Park and at the **STP/OFS** facility could become a unique tourism opportunity and could be an integral part of a Halifax Harbour tourism plan. It also maintains that legal and jurisdictional matters for creating an artificial island are not in conflict with prevailing legislation, nor are these matters procedurally difficult to resolve.

Others, however, challenged this view. The Panel heard from a number of participants and interest groups concerning probable conflicts between the designation and development of McNabs Island as a provincial park and the proposed Project. It was pointed out that McNabs Island has been long designated as parkland, and that this was a condition of the initial transfer of federal lands to the Province. Its proposed development as a park has established the intent of the three levels of government to maintain its status as a park, and the Province has been actively acquiring holdings for this purpose. At the present time, plans for the park's development have been placed on hold by the provincial government, pending the outcome of the Environmental Review process. Participants therefore expressed concern over the following perceived risks and concerns associated with the Project:

- the possibility that the Province may drop or diminish the provincial park status and its development if the regional STP/OFS facility is located on Ives Island, as proposed
- contradictory interests: jurisdictional land ownership and planning instruments are at odds with Project interests, including those of the federal, municipal and provincial governments
- lack of a voice or a vote on the part of the silent stakeholders of McNabs Island - the trees and wildlife - regarding their future destiny
- risk of setting a development precedent for other industrial or high-impact uses of McNabs Island
- fundamental visual incompatibility between an STP/OFS facility and McNabs Island, which is primarily a visual wildscape
- diminished solitude and spiritual values currently experienced by visitors to McNabs island
- inability of McNabs Island and its environments to absorb the impacts associated with potential increased access via Ives Island
- loss of Ives Cove as a recreational boating and sheltered harbour as well as access to the Ives Cove wharf
- loss of access or destruction of Ives Cove archaeological resources such as the careening yard, the concrete hut associated with Canadian military history, and possibly the Mi'kmaq historical site at Indian Point
- noise and odour during construction and operation, which will adversely affect park users and possibly wildlife
- difficulty of achieving and maintaining visual screening at the north end of McNabs Island, especially if Fort Ives should be restored and its sight lines to Georges Island reinstated
- diminished tourism potential of the Inner Harbour and McNabs Island
- diminished use of existing tourism facilities - the private ferry service and the tea room - and therefore negative impacts on these two McNabs Island-based businesses
- impacts on the terrestrial environments of McNabs Island and the marine ecosystems of Halifax Harbour
- inability of any amount of mitigation to conceal the presence of an STP/OFS facility on the doorstep of McNabs Island

The, Nova Scotia Department of Natural Resources as one of the principal landholders on McNabs Island expressed the belief that an STP/OFS facility at Ives Island was fundamentally incompatible with park development, but that if the regional facility Project should proceed at this location, it was prepared to work with HHCI to minimize impacts on the park.

The Canadian Parks Service, as custodians of Fort McNabs and other holdings on McNabs Island, also expressed concern over the compatibility of an STP/OFS facility located on Ives Island and problems associated with transference of parts of Ives Cove lands from the federal government to the Project owners.

The Panel concludes that many of the concerns expressed by the public and government interests for McNabs Island are legitimate. The Panel feels some potential impacts may be a matter of degree of interpretation. Nevertheless, the Panel believes that the development of McNabs Island as a park is important and should proceed as soon as possible in light of the long history of waiting for its development as parkland. The Panel also recognizes there is a long-term tourism and park visitation potential for McNabs Island which is economically important to the area. If this potential is to be realized, the visual environment of McNabs Island and its ecosystems must be conserved and enhanced. The planning of the STP/OFS facility must be a parallel process with the planning of the park. McNabs Island is a unique and'irreplaceable resource for the metropolitan region, the province, and Canada.

Therefore, if the STP/OFS facility is to be located on an artificial island at Ives Cove, the Panel makes the following recommendations to the three levels of government and HHCI.

39. in regard to McNabs Island, the Panel recommends that the three levels of government and HHCI ensure that

a) the planning, implementation and management of McNabs island as a park take piece in parallel to the overall Project

b) HHCI, at the request of the Nova Scotia Department of Natural Resources, participate in the planning process of the park

c) funding for the formation, implementation and ongoing management of the park be provided as mitigation for initial and ongoing impacts from locating the STP/OFS facility at Ives Cove

d) the Project agreements be amended to Inciude funding sources for the deveiopment of the park

e) public interests participate in the pianning, implementation and management of the park

9 the entire properties of McNabs and Lawior islands continue to maintain their parkland designation in perpetuity, and this designation be part of ail planning instruments

g) use of these islands be restricted to low-impact park and recreation activities

h) no direct access from the artificial island to McNabs island be permitted until such time as the park management plan can accommodate the impacts of increased access

I) permissible odour and noise levels on McNabs island during the construction and operation of the STP/OFS facility meet standards comparable to ones for locating an STP in close proximity to residential neighbourhoods

j) a wharf for access to McNabs island to replace the Ives Cove wharf be provided in a suitable location as part of the Park management plan

k) a camouflage principle to visually screen the STP/OFS facility from the northern end of McNabs island be adopted to preclude filtered views from the Lynch, **Conrad and Fort Ives properties**

l) a survey and full documentation of previous **uses of Ives** Cove, including the iden**tified naval careening yard, be undertaken**

m) the balance of Ives Cove be maintained for recreational boating and anchorage

n) no construction or routine operations access from the STP/OFS facility be permltted on McNabs island

4.8.10 Visitor Centre and Public Education

HHCI is making provision for a visitor centre and public education program to be located on-site at the STP/OFS facility. The Panel endorses this proposal and believes that an excellent opportunity exists for furthering these efforts.

40. The Panel recommends that, given the educational and technology-demonstration potential of this Project, HHCI develop a visitors' centre and interoretative program on-site for the faciiitiea. Part of the education/interpretation program should recognixe and interpret the broader context of regional Harbour management.

4.9 PROJECT COST AND FUNDING

The overall cost of the Project at $385.2 million as currently estimated by HHCI was repeatedly brought to the attention of the Panel by members of the concerned public. The original cost estimates and therefore the total committed budget for the Project is $195.7 million, 37.5% contributed by each of the federal and provincial governments, and the remaining 25% by the combination of Halifax, Dartmouth and the County of Halifax. HHCI estimates that in the period 1992-98 when the Project will be completed, an additional $47.1 million can be contributed by the Halifax and Dartmouth Pollution Funds derived from surcharges on water consumption, provided **none** of these funds are allocated to other pollution control purposes in that period. An estimated shortfall of $142.4 million remains unaccounted for (Table 7). HHCI emphasizes that the predesign and environmental assessment stages must be completed before cost-sharing can be negotiated. Funding sources could be public or private, and will be at the discretion of the individual governments.

Concerns by members of the public centred around

- perceived limited level of improvement to the Harbour
- absence of funding for controls-at-source programs in the Project budgets
- potential tax burdens (direct or indirect) on municipal taxpayers for cost overruns
- high cost ($35 million) for construction of the artificial island
- high cost ($27 million) relative to the volume of wastewater carried for the tunnel across the Backlands to service Mainland South and Herring Cove
- high cost (833 million) for the OFS facility as an unproven technology for sludge management
- need to include the private outfalls
- exclusion of the existing Eastern Passage Treatment Plant from the initial Project
- exclusion of the existing Mill Cove Treatment Plant from the initial Project
- perceived potential for reducing costs and increasing levels of improvement to the Harbour through use of alternative technologies and other treatment plant sites

Table 7 Sources **of Funding**

Estimated Project Cost				**$385,180,000**
Funds Committed				
FEDERAL CONTRIBUTION (ACOA)		37.50%	$73397,500	
PROVINCIAL CONTRIBUTION		37.50%	$73337,500	
TOTAL MUNICIPAL COntribution		25.00%	$48,925,000	
Halifax	16.65%			
Dartmouth	9.20%			
County of Halifax	0.15%			
Halifax and Dartmouth from pollution surcharge, County of Halifax from property tax assessment.				
Total Committed Funds				**$195,700,000**
Additional Pollution Control Funds				
Estimated funds from Pollution Funds (Halifax and Dartmcuth -- water consumption Isurcharge); Halifax est. @ $4.42 million&; Dartmouth est. @ $2.71 million&.			$96,000,000	
minus funds already committed			$48,925,000	
Accumulated revenue with interest available at commissioning in 1998, assuming none used for other purposes				**$47,075,000**
Total Known Sources of Funds				**$242,775,000**
Estimated Shortfall (sources as yet unknown)				**$142,405,000**

Most people recognized that costs associated with the collection system ($168 million including Mainland South and Herring Cove) were an inevitable component of the Project costs regardless of the form and location of the treatment facilities.

HHCI stated on numerous occasions that money spent on this Project would significantly improve Harbour conditions, that the costs for creating an artificial island were not much greater than those for developing alternative onshore sites, and that the use of alternative technologies presented by some interest groups would not greatly reduce costs. The costs for the OFS technology were stated to be an integral part of the funding agreement.

In responding to concerns about the funding shortfall, HHCI maintained that the current agreements would in all likelihood be amended to cover funding shortfalls beyond those allowed for in the agreements. That is, the municipal share would be limited to 25% of the total cost of the Project. Furthermore, the Pollution Control Funds already established by Halifax and Dartmouth would be sufficient to cover these municipalities' contributions to the total costs without incurring additional fees or tax burdens on their residents. What remains unknown is the method of raising the remaining shortfall of $142.4 million. The Panel was disappointed that the municipalities, as Project contributors and future owners of the system, chose not to participate in the environmental assessment process. The municipalities' inputs might have helped to clarify certain funding and management issues.

After examining Project costs, considering alternative approaches, and reviewing potential cost savings described in the Quality and Value Engineering Audit, the Panel believes there is potential to reduce costs for specific aspects of the Project. Nevertheless, it also recognizes that the implementation of controls at source, the possibility of providing higher levels of treatment, the possible inclusion of either or both the Eastern Passage and Mill Cove Treatment Plants into the system at an early phase, and social equity compensation costs will probably mean that overall Project costs remain near to, or higher than, present estimates. The Panel advises that potential cost savings associated with its recommendations and those of the Quality and Value Engineering Audit be carefully assessed and incorporated when deemed appropriate.

41. The Panel recommends that the three levels of government amend the funding agreements to provide adequate funding for the Project, allocate costs in accordance with present social equity considerations, and avoid transferring the burden of coats for installation to the next generation.

42. The Panel recommends that HHCI carefully assess and incorporate, when appropriate, potential cost savings associated with the recommendations contained in the Quality and Value Engineering Audit.

4.10 CONSTRUCTION OF THE SYSTEM.

4.10.1 Environmental Management Plan

An Environmental Management Plan will be developed by HHCI for the construction and monitoring phases of the Project. This Plan will apply an integrated approach to the many elements of the Project, just as the plan itself should be one component of a regional Harbour management plan (Figure 7).

The Environmental Management Plan for the Project's construction phase is made up of a number of components as described in Section 4.3.3.

One of these components is the Environmental Protection Plan which will comprise four main sections: introductory material, environmental inspection procedures, contingency plans and environmental inspections. The Plan is intended to "provide the tools for the practical application of mitigation measures, outline policies and programs for. employee environmental orientation, environmental inspection, reporting procedures, contingency planning, and mechanisms for environmental decision making". Examples of relevant Project information and environmental factors include topography, sensitive environmental areas, archaeological sites, commercial fishing areas, and tourism and recreation areas. A list of key contact persons should be included. The Environmental Protection Plan should be a dynamic document, incorporating additional sections as planning and experience require. It should be developed in close consultation with regulatory authorities and affected stakeholders.

The construction phase section of the Plan should list construction activities on a site-by-site basis, such as clearing, grubbing, excavation, dewatering, formwork, and concrete pouring, along with the mitigation measures to be applied. The Plan should be prepared in conjunction with the final design of the Project, and HHCI has stated that the requirement to comply with the Plan will be incorporated into all tender documents. Regulatory permits, approvals and authorizations will have been issued by regulatory agencies, and a list of these should be included in the Plan for the use of contractors and staff. Wells and groundwater that may be negatively affected by tunnelling or other Project activities are a particular concern, and mitigation was addressed in some detail by HHCI in the Environmental Assessment Report.

HHCI has evaluated the occupational health and safety measures during the construction phase of the STP/OFS facility and collection system. There are statutory regulations and permitting processes governing the various stages. Contracts should oblige the contractors to observe the statutory requirements 'of Nova Scotia Labour Standard Code and Regulations.

HHCI expects all workers, especially the technicians and operational personnel, to be property trained to operate and maintain various system components safely. Professional training of the operational personnel will be essential. Moreover, the design, operation and maintenance of all components of the system should eliminate potential occupational health hazards to all workers. Worker injury risk can be minimized by a comprehensive worker safety training program. HHCI's objective is to include in its program the Workplace Hazardous Materials Information System (WHMIS) which is required by the Nova Scotia Occupational Health and Safety Act.

Potential spills of petroleum products or hazardous materials into the environment, marine accidents or collisions, vehicle accidents, and fires are some of the accidental risks that should be taken into account for contingency planning and emergency response.

Monitoring plans, which are another key component of the Environmental Management Plan, Operations Phase are described in Section 4.11.3.

43. The Panel recommends that HHCI continue to develop the Environmental Management Plan for the construction and monitoring phases of the Project to Include responses to concerns raised in Section 4.10.1.

4.10.2 Construction Elements and Schedule

HHCI anticipates that actual construction of the Project will extend over five years. The main components are as follows:

- artificial island, to be created by infilling (17 months);
- STP/OFS facility (18 months);
- sewers and tunnels (46 months);
- CSOs (52 months);
- main pumping station (28 months);
- diffuser (22 months);

Originally it was assumed that the Herring Cove facilities would be installed in 1994-95. HHCI's present design (the tunnel under the Backlands in Mainland South) requires that the ultimate solution of the Herring Cove situation wait until the tunnel is operational before the specific requirements of the Herring Cove system can be measured, designed and constructed.

The main construction activities will include

- quarrying (assumed to take place at existing quarry sites)
- transportation of fill by road and barge
- tunnelling by either tunnel-boring machine (in Halifax and across the Purcells Cove Backlands) or drill-and-blast methods (Dartmouth and a short distance in Halifax)
- sewer installation by surface trenching (Dartmouth and Herring Cove)
- removal and disposal of fill excavated from the tunnels
- construction of the various facilities including pumping stations, CSOs, and the STP/OFS facility

Table 8 Truck Movements at Project Construction Sites

Type of Slte	No. of Sites	No. of Trucks/Day	Duration
Minehead sites	**2**	100	**2** years
Pumping stations	**5**	**20**	**6** months
Open trenching locations	9	50	6 months
Drill-and-blast sites	**6**	**50**	**6** months
Tunnelling sites	**6**	**20**	**6** months

- dredging to create the channel between the artificial island and McNabs Island, and to install the diffuser
- disposal of the dredge spoils

The collection system may require up to 30 construction sites. The STP/OFS facility will require a staging area and a new permanent wharf for the transportation of workers on the Dartmouth side, but actual construction will take place on the artificial island. The outfall from Ives Island to the diffuser consists of a drop shaft, tunnel, riser and the diffuser head itself. Construction will be based on the artificial island (drop shaft and tunnel) and on a barge (riser, diffuser) working in the Harbour shipping channel.

4.10.3 Impacts of Construction on Communities

Construction sites will range in scale from 350–600 square metres (interception points), where construction will take approximately three weeks, to 2,000 square metres (two major minehead shafts, located at the intersection of Hanover and Barrington streets, and at Berth 22 at Halifax Ocean Terminals), where construction will extend over two years and involve extensive truck movements. The construction of the CSOs will take six months each, with the exception of the CSO facilities at King Street in Dartmouth and Balmoral Road in Halifax, both of which will take one year.

The anticipated levels of truck movements are shown in Table 8.

HHCI has taken the position that the construction of the Project will involve activities and disturbances commonly associated with routine public works in urban areas, and that, while residents will experience inconvenience and some nuisance effects, particularly in terms of increased truck traffic and noise, these will be minimized as much as possible. With the assistance of local advisory committees, HHCI proposes to control disturbances through appropriate scheduling, careful management of construction operations, implementation of an Environmental Protection Plan and adequate site rehabilitation.

HHCI has already made a number of changes to the collection system to respond to community concerns. The forcemain and gravity sewer along Pleasant Street has been relocated to the Dartmouth waterfront to avoid surface trenching along a busy roadway. No construction sites will be located in downtown Halifax between Salter and Cogswell streets, and access to the Chain Rock Drive CSO site will be by water, to minimize truck traffic though residential areas. No houses will need to be removed at the Chain Rock Drive location.

Community profiles were prepared for 16 communities in 1991, and issues were identified through key informant interviews. At that stage in the Project's development, flows in the collection system were planned to proceed from Halifax to Dartmouth. Concerns were expressed regarding

- siltation resulting from dredging (Eastern Passage)
- noise and dust
- construction traffic
- temporary loss of access or parking, or disruption of bus routes
- safety, particularly with respect to children
- impacts on local businesses in downtown Halifax, especially those relying on off-the-street sales and a short tourist season such as those along Lower Water Street
- impacts on wells caused by blasting (Mainland South, Herring Cove and Purcells Cove)

Subsequently the direction of flow in the collection system was reversed and the Project description changed. In some communities this will reduce construction impacts. The major exceptions are the two minehead sites, now both located in Halifax. Residents and businesses in the vicinity of these sites were not consulted after the Project description changed, and this was, in itself, identified as a significant concern by a number of presenters. The Panel did not hear directly from affected residents and businesses on this issue. The Halifax Port Corporation's first submission indicated that it was unaware that a minehead shaft was still proposed for Berth 22. It indicated that any disruption lasting longer than a few weeks would have a serious effect on the operation of the Port.

Additional concerns raised by the public at the hearings included

- the impacts of truck traffic on Pleasant Street and at the intersection with the Circumferential Highway, which are both at or near capacity
- the impacts of truck traffic on roads in Eastern Passage

- negative effects during construction (and subsequently during operation) on the McNabs Island Ferry and the McNabs Island Tea House -the only two businesses currently operating on a regular basis on McNabs Island.

The Panel believes that HHCI is only partially correct in stating that the construction of the collection system is essentially an extension of the types of public works with which urban residents are generally familiar. In fact, what is being proposed is a major mining operation mainly within the urban core which will extract 130,000 cubic metres of subterranean material.

The Panel acknowledges HHCI's commitment to mitigate the impacts arising from this operation and recognizes that there is .now a significant body of experience, knowledge and management practices regarding the minimization of construction impacts, but the Panel is concerned that there appears to be generally a low level of community knowledge about the proposed activities and their impacts, and virtually no knowledge of the implications of the two minehead sites. The public information and consultation process should therefore proceed as soon as possible to ensure that community concerns are built into the predesign and final design stages.

While, to a degree, each community will have its own distinct concerns, the Panel also encourages HHCI to facilitate contacts between communities, so that affected residents will be able to share their knowledge and experiences.

44. The Panel recommends that HHCI supplement the community profiles study by identifying the community concerns relating to the two new mlnehead locations at Hanover-Barrington streets and Berth 22.

45. The Panel recommends that HHCI prepare public Information materials that clearly explain all construction locations and activities, timing, probable Impacts and proposed mitigation measures.

46. The Panel recommends that HHCI appoint a contact person for the duration of the construction phase, to respond quickly to residents' day-to-day concerns with respect to constructlon impacts.

4.10.4 Spoils Storage and Disposal, and Control of Acid Drainage

The material excavated during tunnel construction will be temporarily stored in surge piles at the minehead and construction shaft sites. Tunnel excavation will be carried out 24 hours a day, but the excavated material will only be trucked away during regular daytime working hours. At the two minehead sites the surge piles will need to accommodate an average of 225 cubic metres of material at any one time.

Where this material is suitable and the timing is appropriate, HHCI plans to use the spoils excavated from the tunnels as fill to create the artificial island. HHCI has not been able to estimate how much of the excavated material could be used in this way. Limiting factors include

- timing; the construction of the island will begin before tunnelling starts
- whether the tunnels are bored or excavated by drilling and blasting; the spoils created by the boring machine are likely to be in a more usable form
- the incidence of sulphide-bearing slates; these could only be used for the part of the island that will be permanently submerged

The only other disposal option identified so far for non-sulphide-bearing material is the possibility of using it to armour part of the shoreline at Point Pleasant Park.

On the Halifax peninsula, the interceptor tunnel will pass through slates, and it is probable that some of the spoils from tunnel construction will contain acid-producing sulphide minerals. HHCI is not able to predict the quantities of this material and has also not indicated how they will be disposed of to avoid risks of acid drainage. A number of control options were described, some experimental. The most likely choices appear to be some form of landfilling with a soil cover to exclude oxygen and reduce infiltration, or disposal into either a lake or the ocean, well below the waterline. According to HHCI, all three methods have drawbacks and associated uncertainties. The effectiveness of soil covers over long periods remains untested. Disposal in water raises questions about damage to bottom habitat, turbidity and leaching characteristics; it is questionable that lake disposal would be permitted.

Environment Canada indicated that the excavation, transportation, storage and disposal of sulphide-bearing slates and associated drainage **must satisfy** the Nova Scotia Department of the Environment Guidelines for Development on Slates in Nova Scotia and the requirements for ocean dumping under the Canadian Environmental Protection Act.

The Panel is concerned that HHCI appears to have no firm plans yet regarding the use or disposal of materials excavated during tunnel construction, including measures to prevent the development of acid drainage problems.

47. The Panel recommends that HHCI examine the construction schedule for the collection system to maximize the availability and use of tunnel spoils **as fill to create the artificial island.**

48. The Panel recommends that HHCI investigate options for spoils disposal, including the safe disposal of acid-generating materials, and develop a management plan that will satisfy all regulatory requirements before construction is allowed to begin. This management plan should be made public before construction starts.

4.10.5 Wells and Groundwater

Residents in the Herring Cove and Purcells Cove area expressed considerable concern at the hearings about the impacts of tunnel construction on their wells. Issues identified by both HHCI and the residents included

- physical damage to wells
- disruption of groundwater flow and subsequent loss of well yield
- degradation of well-water quality
- acidification of groundwater due to blasting and exposure of sulphide-bearing slates

HHCI rated two impacts as significant: the risk that well water would be acidified because blasting had opened up new fractures in the granite/slate contact area near the Purcells Cove Road, and actual direct physical damage caused to wells by blasting.

HHCI proposes to carry out a well survey before construction starts. This survey would focus mostly on wells within 30 metres of the construction activity, although some information would be gathered on wells further away (100-200 metres and perhaps further). HHCI also plans to develop an agreement with the community regarding groundwater concerns and to ensure that contractors provide temporary or permanent alternative water supplies to any affected residents. HHCI will also mitigate groundwater impacts by installing flow barriers, using buffer materials, aligning the tunnel to avoid surface water bodies, using pressure grouting during tunnel construction and installing tunnel liners.

The following concerns about HHCI's well-survey plans were raised by residents:

- The impacts of blasting on both groundwater flow and directly on well structures can extend well beyond 30 metres and even beyond 200 metres; therefore detailed well surveys must be carried out over a much greater area.
- The baseline well survey should be carried out over the course of a full year.
- Neither HHCI nor their contractors should carry out these well surveys. The information needs to be independently collected to protect both residents and the proponent.
- Many wells are shared, and therefore the loss of one well can affect several families.
- There is no clear process to ensure that well owners would be guaranteed prompt restoration of their water supply without having to take legal action.
- HHCI should follow the Ontario Ministry of Environment guidelines for construction and protection of wells. These make provision for a contingency fund, and no-fault insurance claims.

The Panel acknowledges the concerns of Mainland South, Herring Cove and Purcells Cove residents with respect to their well water, especially as many of these residents provide their own water and sewage disposal services and stand to reap no direct gains from the Project. The Panel also acknowledges that HHCI is committed to minimizing impacts and rectifying problems as quickly as possible. It is nevertheless important that suffiiient guarantees be in place to set residents' minds at rest. Therefore the Panel makes the following recommendations.

49. The Panel recommends that HHCI consult with representatives of Mainland South, Herring Cove and Purcells Cove to determine how the baseline well study should be carried out, by whom, and over what area.

50. The Panel recommends that HHCI in consultation with the local residents develop a clear and accountable grievance settlement procedure and compensation plan to ensure speedy and satisfactory resolution of adverse impacts to water supplies caused by construction activities. HHCI and local residents should review the Ontario process and other approaches. The grievance settlement process and the compensation plan should be in place before construction is allowed to begin in the potentially affected areas.

4.10.6 Sediment and Sediment Deposition

Three construction activities may lead to increased sediment deposition in the marine environment. The fill used to create the artificial island will be primarily large rock, but HHCI estimates that about 3% will be fine grained sand and silt. If all this material were to be deposited evenly within one kilometre of the island, HHCI predicts that the increased rate of sedimentation would have a temporary but significant impact on marine. benthic communities. Therefore HHCI proposes to use silt curtains at the site of the artificial island to contain the suspended sediment. This technique was used recently during construction at the Bedford waterfront and was shown to reduce the transport of sediment away from the site dramatically.

There will also be two dredging operations. About 9,600 cubic metres of sediments will be removed to create the channel between the new Ives Island and McNabs Island, and 2,190 cubic metres will be dredged at the site of the diffuser. Based on the results of dredging exercises of similar scale in the Harbour, HHCI predicts that the sedimentation impacts will be insignificant.

Public concern was expressed regarding

- impacts of a sediment plume on commercial fisheries
- sediment deposition in the shipping channels and in Eastern Passage
- aesthetic impacts caused by visibility of sediment plumes to visitors on McNabs Island

The Panel approves of HHCI's plans to control sedimentation during the construction phase and does not anticipate serious problems arising from residual effects. However, these activities should be monitored to ensure compliance with all applicable regulations.

4.10.7 Harbour Uses

As noted earlier, one principle recorded by the Halifax Harbour Task Force was that all activities in the Harbour should be maintained and supported (both commercial and recreational). Special mention was made of the commercial and recreational fisheries. The principle that no area in the Harbour should be reduced in quality because of the sewage treatment system, and that an improvement in one part of the Harbour should not be traded off against a drop in quality in another, is also pertinent.

During diffuser construction, tunnel spoil will be taken out of the shaft on the artificial island. Work from the surface of the Harbour is necessary for the riser and diffuser itself, requiring the use of a barge stationed over the riser location for about three months, and to traverse the length of the diffuser for up to seven months. The effect on shipping will be minimal, as vessels will be able to set course to either side of the barge. Also, the Coast Guard will likely issue a shipping advisory to the effect that the construction barge will be operating in the area.

While difficult to quantify, impacts on fish and marine mammals during construction are not expected to be significant, as much tunnel construction noise and vibration will be attenuated by the overlying seabed. When operational, the diffuser will contribute only a small part of the anthropogenic noise in this major shipping port.

4.10.8 Archaeological and Heritage Resources

During a survey of known archaeological resources likely to be disturbed or destroyed by construction of the collection system, artificial island and diffuser, HHCI predicted that significant impacts would occur at the following sites:

- Maitland Street; up to 75% of a 19th-century wharf possibly destroyed by shaft construction
- Ferguson Road; up to 50% of a site containing mid-19th~century materials possibly disrupted
- Ives Island; a seawall complex dating from 1860 and a concrete hut to be completely covered by the artificial island
- Ives Island; remains of a late 19th- or early 20th-century clinker-built boat possibly disturbed by construction activities

HHCI rated the potential for subsequent discovery of archaeological and heritage resources in the area of the collection system route. It considered that the Duke Street, Lower Water Street and Salter Street locations in downtown Halifax would have the highest potential. Moderate potential exists along the Northwest Arm, through Mainland South, in Herring Cove and in Purcells Cove.

Public concern focused mainly on archaeological and heritage resources at the site of the artificial island in Ives Cove and in the vicinity of the diffuser. Although HHCI had carried out marine archaeological surveys, additional information came to light during the course of the review process. Participants suggested that additional archaeological research should be done in the Ives Cove area, as the Cove was formerly used as a Mi'kmaq campsite; an ancient fishing area: and, in the late 18th and early 19th centuries, a ship careening area. The careening yard site will be at least partially covered over during construction.

The creation of the artificial island will also eliminate access to three wooden shipwrecks in the shallow water of Ives Cove, which are now accessible on foot from the beach at low tide. Two significant wreck sites are located near the diiuser site, but HHCI believes they will not be affected by construction. The diiuser site itself has not been surveyed to determine its archaeological significance. There was concern that the remains of historic vessels in the shipping channel could be lost due to diffuser construction.

Proposed mitigation measures for terrestrial archaeological concerns include preliminary mechanical excavation of high-potential sites with an archaeologist in attendance, regular inspections of construction sites for archaeological significance, documentation of resources in place, and excavation by hand by skilled personnel. Site-specific mitigation recommendations have also been made for sites in Halifax and at the Ives Cove/Ives Island site.

Underwater archaeological surveys should be conducted to professional standards prior to marine construction on any previously unsuweyed area, particularly since dredging at the proposed diffuser location could destroy any archaeological materials in the sediments. One participant strongly recommended that the underwater archaeological survey in the vicinity of the diffuser should involve the coordinated use of visual/video, side scan sonar, magnetometer, and sub-bottom profiler techniques, and that all transects be spaced closely enough that a wreck of less than 20 metres in maximum dimension could be detected. HHCI committed to do further archaeological surveys of the diffuser area before construction.

51. The Panel recommends that HHCI carry out additional professional archaeological research and surveys In the Ives Cove area, given the extensive dredging associated with the creation of the artificial Island, and the additional information provided through the public review process.

52. The Panel recommends that HHCI undertake professional subsea archaeological surveys at the diffuser location and any other previously unsurveyed areas prior to initiation of construction work. Technology should be used that will yield maximum knowledge about any undiscovered remains.

4.11 OWNERSHIP, MANAGEMENT AND OPERATION

4.11 .l Division of Responsibilities

At various points during the course of the environmental assessment, both the Panel and the public raised the concern that the eventual owners and operator of the regional system had not been identified and were not participating in the process. HHCl is responsible only for the design and construction of the system, up until the time that the system is commissioned and ready to begin operating. The Panel's mandate, however, requires it to examine the Project through the design, construction and operations phases. HHCl's stated position was that the system would be owned by the three participating municipalities, and that a suitable operating body would be selected later. All commitments made by HHCl would then be assumed by the new owners and made a requirement for the system operator.

HHCI commissioned a report by Peat Marwick Stevenson Kellogg on management options, which made the following recommendations:

- Ownership, operation and regulation should remain separate responsibilities. While ownership and operation could in theory be combined, an entirely separate agency should have responsibility for regulation. The Province is seen as the primary regulator. This means that the Province must remain at arm's length from the owners and operator of the system.

- Ownership should be taken over by either the existing Metropolitan Authority or a new, single-purpose utility which woukl be directly accountable to the three participating municipalities. If a separate utility was formed, its operations should be subject to the scrutiny of the Public Utilities Board. This would require an amendment to the Public Utilities Board legislation.

- The major components of the system (the interceptor tunnels, the CSOs, the STP/OFS facility and the diffuser) should come under the jurisdiction of this single regional agency in order to facilitate planning and decision making, and to ensure that the use of the system is adequately monitored.

- The owner of this single regional agency need not operate the system. Each function - ownership and operation - requires different types of decisions, responsibilities and risks, and there are probably considerable savings to be had in hiring an experienced firm or agency as the operator.

The concerns presented during the hearings mainly centred around "the missing owner and operator," and Peat Matwick's suggestion that the Metropolitan Authority could take over ownership of the regional system. Following are specific concerns raised at the hearings:

- Certain responsibilities, such as the development of controls-at-source programs, are legitimately part of the regional wastewater management system but are not presently incorporated in HHCl's mandate. Action to develop the controls-at-source programs needs to be taken as soon as possible, but the eventual owners of the system are not organized to do so.

- The Metropolitan Authority should not be the owner of the system. Presenters cited current dissension within the Authority over implementation of the solid waste management plan, and a lack of opportunities for public involvement in the Authority's procedures.

- Individual municipalities are often not equipped with the financial and personnel resources to properly operate, maintain and regulate an STP even within their own jurisdiction, let alone such a large and complex system as this, which must sewe the metropolitan area including at least three municipalities.

- Stakeholders, such as public interest groups, should have a role to play in the organization ultimately selected to own and direct the management of the system. The activities of this body should be open to public scrutiny. It should be accountable to the stakeholders to whom it provides sewices.

- Municipal governments in the province may be facing major reorganization, which could impact on future arrangements.

The Panel believes that the owners of the regional system will face a significant management challenge. They will not only be providing a basic service to over 200,000 people, but they will also be a major Harbour user with responsibilities to all other users of the Harbour (both human and non-human) and may eventually be a close neighbour of a large new provincial park.

The Panel agrees with the recommendation of the Peat Marwick Stevenson Kellogg Report that the ownership of the system, and therefore the overall decision-making capacity, should be vested in the three municipalities. The operation should be contracted out to an experienced company or agency. The Panel also agrees that the Province, as one of the regulating bodies, should not participate in the agency which eventually assumes ownership, in order to remain at arm's length.

The Panel recognizes that the proposed municipal reorganization, if it takes place, would change the management context, but in the current context favours the creation of a new single-purpose utility, rather than trying to expand the mandate of the Metropolitan Authority. This would allow for a concentration of expertise and experience. The Panel believes that the management of the system will be sufficiently complex to warrant the creation of a new utility, rather than adding the job to the Metropolitan Authority's responsibilities.

The Panel believes that the interests of both the system's users and of the local communities affected by the Project can be adequately represented on the Board of Directors for'this new utility by the representatives of the three municipalities. However, the "interests" of both the Harbour and McNabs Island (even though the latter is technically part of the County

of Halifax) may be left in limbo, and should therefore be represented by two directors appointed specifically for this purpose. The new utility would need to define the responsibilities of these two "public interest" directors very carefully, and would need to provide for some type of accountability, perhaps in the form of regular reports to, and consultation with, the relevant groups of stakeholders.

53. The Panel recommends to the Ministers that the ownership of the regional system be taken over by a new, single-purpose utility.

54. The Panel recommends to the Ministers that the new wastewater management utility be governed by a board of directors with representation from the three participating munlcipaiities. The board should also Include at least one director with a mandate to represent the Interests of the Harbour Itself in terms of both environmental quality and Harbour users, and one director representing McNabs island, again in terms of both its natural environment and its users.

4.11.2 Paying for the Service

The costs of constructing the new system will be divided between the federal and provincial governments and the three participating municipalities according to the federal-provincial and provincial-municipalities agreements.

HHCI has taken no formal stance on how the costs of operation and maintenance, and of system expansion should be divided, assuming that these will be determined by the eventual owners of the regional system.

The Peat Marwick Stevenson Kellogg report recommends that the regional system sell wastewater collection and treatment services to the municipalities on a wholesale basis, and that the cost of operating the plant be divided between the three municipalities on the basis of actual usage. This would require monitoring flows at key locations in the collection system. It would provide direct feedback to the municipalities, which would remain in control of the existing collection system infrastructure, and might provide sufficient incentive to reduce flows by taking steps to prevent inflow and infiltration. The report acknowledged, however, that such monitoring could be difficult and costly, and if it was, it might not be warranted.

Expansion of the system would be funded by a surcharge applied to each municipality, based on capacity rights established by each municipality's share of the capital costs.

The report did not identify the method for recovering the costs of the controls-at-source programs other than to suggest that it would be the responsibility of the individual municipalities. The Panel and others have concluded that responsibility and accountability for the development of the controls-at-source programs, should reside with the Province as the lead agency.

Public concerns focused on the relationship between rate structures and incentives to reduce flows through water conservation practices and through remediation engineering. Suggestions included the following:

- Municipalities should apply full-cost pricing to the consumers as an incentive to conserve water. This would have a beneficial impact on the system by reducing wastewater flows, limiting overflows at CSOs and decreasing wear on equipment in the collection system and at the STP/OFS facility.

- The management of potable water and wastewater should be combined under one agency in order to integrate water conservation measures into the regional system and to facilitate effective rate-setting for both water and sewage treatment services.

Since the provincial and federal governments are sharing 75% of the capital costs of the Project, it is unlikely that true full-cost priiing (including capital and operating costs) would actually be applied. However, the Panel agrees with the principle that, as far as possible, the costs to the users of the system should reflect the costs of building and operating that system, including costs over and above the capital costs originally established in the federal-provincial funding formula.

Difficulty arises because the system in fact has two sets of users, with two sets of responsibilities. Residential, institutional and commercial consumers purchase potable water, use it and discharge it as wastewater into the sewer system. This usage can be monitored through water meters. However, they may also be responsible for discharging stormwater into the system through illegally connected roof and basement drains and for allowing groundwater to enter the system through leaks in the lateral sewer connections from their buildings to the street. This usage is more difficult to detect and monitor.

Municipalities are the other "users" because they use the system to transport stormwater in those areas where the sewers are combined, and because they are responsible for the construction and upkeep of the collection system. Leaky sewer lines permit significant quantities of groundwater to infiltrate the system.

If the operators of the system charge the municipalities a wholesale rate for the costs of the treatment services based on flows, and the municipalities then charge that cost back to the consumers as a surcharge based only on the quantity of potable water consumed, consumers will be paying extra for the treatment of flows that are not within their control.

The Panel agrees with the Peat Marwick Stevenson Kellogg Report that combining water and sewers under the management of a single utility probably offers few operational advantages, since the skills and equipment involved in each operation are largely distinct. However, some form of mechanism to encourage collaboration in terms of promoting water conservation and sewer rehabilitation, and of setting water and sewer charges is obviously essential.

The Panel recognizes that progress in water conservation and sewer remediation will not be driven by cost structures alone, but believes that costs should be allocated in such a way as to provide significant feedback to the users of the system and to provide some measure of incentive to reduce water consumption and extraneous flows. Therefore the Panel suggests that cost allocation formulas and the development of consumer price structures for both water and sewer reflect

- the full cost of operation, maintenance and essential system expansion

. actual flows originating from each municipality

- the division of responsibilities for certain elements of the wastewater between residences and businesses on the one hand, and the municipalities on the other

55. The Panel recommends to the Ministers that the new wastewater management utility wholesale its treatment services to the participating municipaiities on the basis of actual flows contributed to the system by each municipaiity. The cost structure should differentiate between flows contributed by individual residences and businesses (as metered through potable water consumption) and those largely contributed by extraneous flows. A surcharge should be applied to the latter flows as a direct Incentive to the municipalities to undertake sewer remediation and stormwater management.

56. The Panel recommends to the Ministers that the new wastewater management utility cooperate with the Halifax Water Commission and with the City of Dartmouth to establish complementary water conservation, flow reduction objectives and effective rate structures for both water and sewers that will promote these objectives.

57. The Panel recommends to the Ministers that municipalities own capacity rights in the syb tern, as recommended by the Peat Marwick Stevenson Kellogg Report. A surcharge should be applied when the flows from a municipality exceed its capacity rights. These surcharge funds might be used to finance system expansion if necessary or conservation programs. The new wastewater management utility should investigate the possibility of capacity rights being tradeable between municipaiities, in order to create more capacity for one municipality by financing sewer remediation or conservation projects In another municipality, thereby delaying the need for system expansion.

4.11.3 Environmental Management Plan, Operations Phase

The second component of the Project's Environmental Management Plan applies to operations. HHCI should design the Plan so that the operator will have a full understanding of operating procedures. Areas of the Plan requiring further development during the operational phase should also be identified by HHCI. Assistance could be provided by HHCI as it 'hands the Project over to the operator during the commissioning phase. Responsibilities for implementation and ongoing management of planned activities during the operations phase will devolve to the system owners and operator.

The Environmental Management Plan for the operation phase of the Project should be developed as an integral part of regional Harbour management and the Metropolitan Wastewater Management System. Operations monitoring and environmental audits should also be included.

The front-end section of the Environmental Management Plan for operations should include all the relevant regulatory permit clauses. Contingency plans should be developed for both routine and accidental events. Application of standard operating procedures for environmental protection should be described for overflows, emissions, waste disposal, ash disposal and other Project elements. A Chemical Management Plan should be included. Accidental events such as chemical spills or treatment bypasses should be covered by contingency plans. Monitoring programs, which will be very important during the operations phase, are described in Section 4.12. As was the case with the construction phase, the Environmental Management Plan for the operations phase should be an evolving document.

A government agency recommended, and the Panel concurs, that a waste management plan be developed to ensure the proper use, transportation, storage and disposal of hazardous substances at the STP/OFS facility through all phases of the Project, and that this plan be incorporated into the Environmental Protection Plan.

Occupational health and safety, accidental events, emergency response procedures and other aspects of operations as described in Section 4.10.1 that should be included in the Environmental Management Plan should be developed by the operator.

56. The Panel recommends that HHCi and the future operator continue to develop the Environmental Management Plan for the operation phase of the Project to include responses to concerns raised in Section 4.11.3.

4.11.4 Regulating the Project

The construction and operation of the regional system will be governed by an extensive range of regulatory requirements, at all three levels of government. The various regulations, policies, guidelines and by-laws have been developed at different times, for different purposes, by different agencies.

HHCI has provided a listing of the relevant statutes, regulations and controls, and has stated that it will comply with all stipulations. What is missing is a comprehensive review which integrates the existing regulatory framework with the various phases of the proposed Project and with its Environmental Management Plan to determine whether regulatory oversight will be sufficient to protect both the environment and the interests of affected communities. In certain cases there may also be potential duplication of effort. Such a review process would help to sewe the interests of consistency, social equity, integrated Harbour management, and would streamline the process for the owners, the operator and the regulators.

Provincial oversight of the operation of the STP/OFS facility under the terms of the Nova Scotia Environmental Protection Act is a key factor in maintaining and enhancing the quality of the Harbour environment. The Halifax Harbour Task Force recommended that the permitting process be revised to include an operating certificate, renewable at regular intervals, which would stipulate effluent quality standards for BOD removal, faecal coliform (enterococci now preferred), heavy metals, toxic organic chemicals, nutrients and other key parameters. To a certain extent, enforcement of effluent quality standards would also play a role in ensuring that the municipalities are carrying out their responsibilities to exercise control of toxics at source.

The STP/OFS facility itself will be required to obtain a permit from the Nova Scotia Department of the Environment. At present, the Department issues a single permit to construct a sewage treatment plant and does not require a separate operating permit. If a sewage treatment plant fails to perform satisfactorily, the Department must obtain a Ministerial order in order to enforce compliance. If the operators still fail to comply with the order, the Department must gather evidence and take the operators to court. This complex process needs to be made direct, efficient and effective; hence the Panel recommends that the Province develop a system of renewable and enforceable operating certificates.

The Panel recognizes that the proposed Project is one intended to improve the environment by cleaning up the Harbour; however, the Panel, the proponent and the public have also recognized that, because of the Project's size and because it involves the diversion and concentration of wastes as well as reduction and treatment, there is also the potential to harm certain aspects of the environment. Therefore monitoring, oversight and the enforcement of regulations will play an important role in the Project's success. Because a piecemeal approach to the regulation of the Project may result in gaps and overlaps, the Panel wishes to see a collaborative effort by all regulatory agencies to ensure a comprehensive program.

59. The Panel recommends that the Nova Scotia Department of the Environment, in cooperation with other regulatory bodies, prepare a comprehensive review of ail regulatory instruments to be applied to the Project,'with the purpose of (1) identifying gaps, overlaps, and opportunities for streamlining the process and (2) determining how best to ensure that environmental quality goals and standards will be met. The results of the review should be made public.

60. The Panel recommends that the Province maintain its role as prime regulator for the regional facility, involving the other levels of government as appropriate. in addition to Issuing permits to construct sewage treatment facilities, the Province should also develop and issue renewable and enforceable operating certificates for sewage treatment facilities, Including the Halifax-Dartmouth Metropolitan Wastewater Management System.

4.11.5 Stakeholder Involvement

HHCI has committed to develop public and technical advisory committees:

- a Citizens' Advisory Committee, which would involve a broad range of stakeholders and deal with all issues relating to the construction and operation of the regional system
- local advisory groups to deal with specific issues such as construction impacts at a specific location
- Environmental Effects Monitoring Advisory Committee (Section 4.12)

HHCI also intends to continue its public information program throughout the predesign, design, construction and commissioning phases.

In general, the concept of an advisory committee system was endorsed by members of the public. Representatives from several communities were seeking assurances from HHCI that they would be consulted directly regarding the ongoing issues that affect them. However, some presenters questioned the potential effectiveness of the overall Citizens Advisory Committee. Would this Committee be able to exercise any real influence over the Project, or would it be largely a public relations measure?

The Panel believes that stakeholder involvement will ultimately result in a better regional system, just as the involvement of the public, and particularly that of the publicly-funded interest groups, results in better environmental assessment. The Panel recognizes the concern that advisory groups may have limited effectiveness but also believes that potential exists for HHCI (or the subsequent owners) and the Project stakeholders jointly to work out a system for stakeholder involvement which will meet the needs of all participants, given that everyone shares the objective of cleaning up the Harbour.

The Panel believes that a stakeholder involvement program, developed jointly by all the parties involved through a coliaborative process, will serve everyone's interests better than one developed solely by HHCI. The collaborative effort should address the issues of public information, consultation, co-management, reporting and accountability (both for HHCI and for the stakeholders).

61. The Panel recommends that HHCI enter into an independently mediated, collaborative process with other Project stakeholders (rep resenting, for example, affected communities, Harbour users, supporters of McNabs island, and environmental organizations) to develop a system for timely and effective stakeholder involvement. This collaborative process should begin immediately. issues to be determined would include membership, funding, access to information, public feedback mechanisms, reporting requirements and evaluation.

4.11.6 Compensation

HHCI has committed itself and the future operator of the regional system to negotiate with the affected parties where compensation is warranted. However, no compensation plan or grievance settlement procedure has yet been provided.

The issue of compensation was raised in connection with four types of adverse impacts: on the McNabs Island-based local fisheries; on groundwater resources in the Mainland South, Herring Cove and Purcells Cove area; on local businesses affected by construction activity; and on McNabs Island's potential to become a full-fledged provincial park. Other compensation issues could arise during construction and operation phases.

The residents of Herring Cove and Purcells Cove were concerned that HHCI had made no provision to compensate for impacts on wells; the affected parties would therefore have to initiate legal action, and this might be difficult once HHCI had been disbanded. Therefore they wanted to see a compensation program established before any construction took place that could affect their wells. This program would include adequate baseline studies, a clear compensation plan, an arbitration board, a contingency fund and an appeal process.

Others raised the question of compensation for adverse impacts on McNabs Island caused by the construction and operation of the STP/OFS facility. These impacts could include possible abandonment of the park concept or restrictions on the size of the park and its usage (Section 4.8.9).

The Panel believes that a well-planned, proactive grievance settlement procedure will also sewe to protect the interests of the proponent and future Project owners.

62. The Panel recommends that as part of the development of a stakeholder involvement program, HHCI negotiate an independent grievance settlement process with the stakeholders, including detailed guidelines for determining under what circumstances compensation would be required, and how the affected parties and the level of compensation would be determined.

4.11.7 Education and Research

As described in Section 4.8.10, HHCI is making provision for public access to the artificial island and tours of the STP/OFS facility through its visitors' centre. HHCI has suggested the possibility of including a laboratory to demonstrate sewage treatment within the environmental learning centre proposed for McNabs Island, and has also responded favourably to a proposal from the Centre for Water Resources Studies at the Technical' University of Nova Scotia to incorporate a research laboratory in the facilities at Ives Island.

63. The Panel recommends that Ministers ensure that the wastewater management utility allocates a certain percentage of its annual operating budget to--support research and education programs relating to (1) the existing sewage treatment system, (2) the development of progressive alternatives for both treatment and reduction at source, and (3) the Harbour environment. in consultation with local research and educational Institutions, HHCI and the eventual owners and operator of the system should also develop a protocol to guide decisions regarding access to faciljties and information for research purposes.

4.12 MONITORING PROGRAMS

4.12.1 Introduction

Monitoring is defined as the process of maintaining regular surveillance over a particular activity or factor to determine whether it stays the same or changes; and if it changes, to measure to what extent, in what direction (larger or smaller, warmer or colder, etc.), and in what period of time (at what rate) this change takes place. The primary purpose of monitoring the environment is for the protection of the environment, and the prevention of present or future harmful effects.

HHCI described its monitoring programs for the Project's construction and operation phases in terms of potential impacts on the terrestrial and marine environments. It indicated that the owners and operator of the facility would be responsible to carry out the 'monitoring programs identified for the operational phase. Government agencies and the public verified HHCI's list, and identified additional factors or sets of factors that required monitoring.

There are three basic types of monitoring that are designed to directly or indirectly protect the environment: compliance monitoring, operations monitoring and environmental effects monitoring. HHCI has committed to using all three types. Compliance monitoring, which monitors compliance with external or self-imposed environmental requirements, may be done by regulatory or in-house authorities.

HHCI has also committed itself or the future owners and operator to operations monitoring. These programs will be undertaken by HHCI or its contractors to help ensure that standards

for the integrity of construction and operation of equipment and processes are met. HHCI has further committed that the activities or performance will represent best practice, whether or not existing regulations require this.

Environmental effects monitoring is done to validate predictions and to determine effectiveness or the need to improve mitigatory and compensatory measures. This includes both fate and effects monitoring (of toxics, for instance) and monitoring to determine the nature and magnitude of residual effects after all practical mitigation measures have been implemented. In the context of the Project, environmental effects monitoring may be done by HHCI and the owners and operator, regulatory agencies requiring additional information, or as the subject of investigations by interested parties to determine the performance or fate of the monitored entity.

The results of these monitoring programs should be anaiyzed and used to confirm performance, or to provide guidance as to where and how processes or performance can be improved. If the results are not used, the monitoring effort is wasted. Monitoring results are also used for communication about the operations of the Project, and the state of the environment and the Project's effects on it. These results should be provided to the Project operator, to regulatory authorities, to technical and advisory committees, and to the public.

More recently, the practice of environmental audits has been developed as a particular type of compliance and operations monitoring. Environment Canada recommended that HHCI develop an environmental audit mechanism in order to determine whether all environmental and resource management issues identified in the Environmental Management and Protection Plans have been considered and resolved.

4.12.2 System Inputs and Outputs

Compliance monitoring requirements are directly related to the metropolitan area's wastewater inputs and outputs. HHCI committed to compliance monitoring of a number of factors during the construction and operation phases, including

- volumes, flows, composition and concentration of waste stream inputs
- discharges from CSOs, pumping stations and treatment facilities
- effluent quality and quantity
- solid waste disposal, including ash disposal and the fates and effects of ash constituents
- atmospheric emissions, including odour from the STP/OFS facility (air quality, scrubbers performance and related wastes)
- detection of hazardous or toxic materials in waste stream inputs
- sediment outwash from spoils piles and other construction activities, including artificial island construction

Examples of construction and operations monitoring described by HHCI include

- noise and dust
- truck equipment and vessel operations
- hours of operation during construction
- blasting activities and movements during construction
- wells and groundwater resources in areas where blasting and tunnelling must take place, notably in the Mainland South, Herring Cove and Purcells Cove areas
- electronic monitoring of pumping stations, with warning to a central control facility if any aspect of the operation is faulty
- monitoring performance of flow regulators at CSOs as part of controlling flows in the collection system

Technical advisers, government participants and the public suggested additional monitoring requirements for HHCI, the owners and operator, relevant industries, or appropriate regulators:

- characterization of toxics in wastewater for the purpose of developing and making controls-at-source programs effective
- industrial discharges
- results of water conservation programs
- results of sewer rehabilitation programs

4.12.3 Terrestrial Environment

A number of potential environmental impacts during construction and operation can be handled routinely with mitigation measures. HHCI has committed to monitoring the osprey and great blue heron populations of McNabs and Lawlor islands during both construction and operation to help ensure their undisturbed well-being. An important monitoring program should assess the establishment of trees and other vegetation on Ives island; mitigation of any unsuccessful efforts should include rectifying soil and drainage conditions, and planting additional trees and plants.

A number of community residents, notably those in Eastern Passage, expressed concern about air emissions including odour - from the STP/OFS facility. HHCI's air quality modelling predicted that negligible quantities of airborne pollutants would be emitted from the facilities and would be dispersed very rapidly; however Eastern Passage residents wished to be certain that this would be the case. They requested public reporting of the results once the facilities were in operation and asked that representatives of their community be included on the proposed Environmental Effects Monitoring Advisory Committee.

The only other set of terrestrial impacts identified by the public which require monitoring and reporting are the impacts on parkland and heritage resources resulting from visitor use of

McNabs Island, and these would not be the direct responsibility of the proponents during either construction or operation. As the park is developed by the Nova Scotia Department of Natural Resources, a park management plan should give direction on prevention of impacts from improper and excessive use of the park, and provide mitigation measures for remaining impacts.

4.12.4 Marine Environment

The primary concerns raised by the public and scientific community about environmental effects on the marine environment included the following:

- Physical oceanographic measurements were not made at the diffuser location to help predict the fate of the effluent stream.
- Visual (aesthetic) effects of the diffuser plume may be visible from shoreline locations, especially McNabs Island, and from recreational boating.
- The containment strategy cannot be conclusively demonstrated at either potential diffuser site, but especially the one west of McNabs Island.
- If an effective controls-at-source program for toxics is not put in place, toxic organic compounds and metals will still be disposed of in the Harbour.
- Dilution of effluent being discharged into the Harbour will not render persistent bioaccumulative toxics more benign.
- Although presently within "safe" levels for human consumption, elevated levels of toxics in Harbour lobsters could increase to levels where consumption is unadvisable and fishing may have to be curtailed.
- Final deposition sites of fine particulates are not known.

While some members of the public stated that the Project will not result in a significant improvement to the marine environment, the Panel agrees with HHCI and the Halifax Harbour Task Force that the overall water and sediment quality of the Harbour will be improved.

Of the effects that review participants advised should be monitored, the majority had to do with the marine environment. In response to these concerns the Panel advises that the following environmental factors be monitored once the Project is operational:

- oceanographic behaviour of effluent plume dilution and dispersion during both average dry weather and storm events
- aesthetics of the plume
- localized environmental effects at CSOs during both average dry weather and storm events, including cumulative effects (iocalized assimilative capacity of the Harbour)
- water quality at key locations in the Harbour, including fish- and lobster-holding facilities, and marine research establishments
- sediment quality at key locations in the Harbour
- disinfection by-products in the discharged effluent (chlorine, chlorinated and bromated organic compounds)
- survival and dispersal of human pathogens, such as enterococci, in Harbour waters relative to swimming beaches
- loss of fish and lobster habitat and effectiveness of the replacement habitats
- effects of construction and operation on access to traditional fishing grounds, and effects on fish landings
- bioaccumulation and biomagnification of effluent-derived toxics in commercial fish and seafood species, and in key indicator organisms in Harbour marine food chains
- cumulative environmentai effects

All monitoring results should routinely be made public in a timely fashion.

One of the primary goals of regional Harbour management is maintaining and enhancing the assimilative capacity of the Harbour. Cumulative effects monitoring is the primary suweiilance tool.

It is important to recognize that impacts on Harbour waters, sediments and living organisms originate from many sources. Major industrial sites such as the refineries and the power generating station are obvious examples. Less obvious sources are stormwater runoff from industrial sites and paved areas, marine shipping, activities at piers and docks, and existing sewage treatment plants, to name just a few. All of these make their contributions to the cumulative effects of human activities on the Harbour's marine and terrestrial environments. It is difficult to separate out the relative contribution of each impact generator, as well as to attribute specific cause-and-effect relationships to specific sources when the Harbour is under stress from inputs from so many sources. It is critical that the assimilative capacity of the Harbour not be exceeded, and this should be the primary objective of a cumulative effects monitoring program.

Suggested indicator organisms to use in monitoring programs include lobster, winter flounder and benthic organisms. Monitoring of shellfish would provide very useful trend analyses even though it is doubtful that Halifax Harbour shellfish will be fit for human consumption for a long time to come, due to contamination by pathogens and pollution residuals in sediments. It is fully recognized that a proper balance between "essential to know" and "desirable to know" information must be exercised in designing and implementing monitoring programs. On the other hand, governments and the public want to know how effectively the Project, controls at source, and other initiatives designed to improve Harbour conditions are operating.

Certain constituents of fine sewage particulates might be used as tracers to study depositional patterns, if they can be distinguished from sediments deposited prior to the operational phase of the Project. If such constituents can be identified, scientists could begin this work in preparation for instituting monitoring programs.

Loss of lobster fishing access may be a serious concern for certain fishermen, since there may be no replacement location, given the local organization of the fishery. HHCI should pay particular attention to this issue through monitoring programs and be prepared to compensate as necessaty.

In order to monitor change, a reliable baseline for the present status must be established. It is essential that Project monitoring programs be carefully considered and designed immediately, so that baseline measurements can commence. Since these measurements are made in the natural environment, the ranges of seasonal and annual variations must be accounted for. In some cases, the information base needs to be improved prior to construction, as in the case of physical oceanographic measurements at the chosen diffuser site.

HHCI and the Environmental Effects Monitoring Committee will have to decide jointly whether HHCI will be responsible for the entire monitoring program, or whether and how it will be shared between HHCI and government bodies represented on the Committee. It should also be recognized that local universities and research organizations can make substantial contributions to this program, and they should be involved in both planning and execution stages as appropriate.

The results of the monitoring programs must be effectively communicated to the regulatory agencies and the public. Knowing what is happening in the Harbour has a positive effect on human behaviour and attitudes. A powerful example is provided by the Ontario program of fish advisories which issues reports on body burdens of toxics in fish and advises on the number of fish an individual can safely consume in a year. This has had an important effect in instituting Great Lakes cleanup programs.

64. The Panel recommends that the Ministers amend the funding agreements for the Project to provide adequate monies for the recommended monitoring programs during planning, construction and operations.

65. The Panel recommends that additional current meter and other physical oceanographic work should be undertaken by HHCI at the selected diffuser site to refine the predictions of diffuser plume behaviour and dispersal. Additional information on plume behaviour relative to effluent constituents of concern should be provided as a result of this analysis.

66. The Panel recommends that HHCi establish the Environmental Effects Monitoring Committee which should then design the monitoring plans, making use of literature In this field. impiementatioh should begin as soon as possible and well before the construction and operation of the regional sewage treatment system begins in order to establish baselines for comparative purposes.

67. The Panel recommends that once the diffuser. site is established, HHCI and the Environmental Effects Monitoring Committee should plan and implement an efficient baseline monitoring program. Baseline studies on body burdens and other chronic effects of selected toxic organic8 and metals in Halifax Harbour blota should be expanded. From the results of these studies indicator species and key analyses at strategic locations should be selected to establish baselines for future trend analysis prior to the Project coming Into operation. Levels of the same contaminants in water and sediments should also be determined. An investigation within and outside the predicted zone of influence of the nutrient plume should also be undertaken, including nutrient and phytopiankton measurements to compare with those obtained following installation and operation of the diffuser. This should include annual cycles over several years.

66. The Panel recommends that systematic beach monitoring programs for pathogens using the enterococcl test be initiated by HHCI in 1993 and be continued thereafter to build the baseline data that will be required by the operator to monitor trends following the installation of the facilities at Ives island.

69. The Panel recommends that once the diffuser is operational, monitoring of the plume should be instituted on a year-round basis by the operator to assess near-field aesthetics. Once the aesthetic effects are well defined, monitoring can cease, unless there are other reasons to continue it.

70. The Panel recommends that HHCI investigate further the potential effects of construction and operation on traditional fishing grounds In terms of reduced catches, and in terms of loss of access to fishing berths for individual fishermen.

71. The Panel recommends that HHCI and the operator monitor the effectiveness of the replacement of lobster habitat at Ives island.

72. The Panel recommends that HHCI and the Environmental Effects Monitoring Committee design supplemental monitoring programs as necessary to provide a well-rounded cumulative effects monitoring program that addresses the assimilative capacity of Halifax Harbour over the life of the Project.

73. The Panel recommends that HHCI and the Environmental Effects Monitoring Committee routinely report ail monitoring results to the public in a timely fashion. They should devise an effective communications strategy based on the monitoring programs, which is designed to encourage positive attitudes and actions on the pert of the public to do their share in the Halifax Harbour Cleanup Project.

5. RECOMMENDATIONS

THE PROJECT VERSUS "NO PROJECT" ALTERNATIVE

1. The Panel recommends that the Ministers reject the "No Project" alternative.

CHOOSING THE SITE

2. The Panel recommends that the Ministers approve the Project, subject to the conditions outlined in this Report.

3. The Panel recommends that the Dartmouth Ocean Terminal/Georges Island alternative pair of sites be evaluated in accordance with the process outlined in Section 4.2.5.

4. The Panel recommends that should a decision be made by the Ministers to proceed with the Dartmouth Ocean Terminal/Georges Island alternative pair of sites that the recommendations contained in this Report be applied to the Project with the exception of those specific recommendations for Ives Cove, Ives Island, McNabs Island and the diffuser site west of McNabs Island.

AN INTEGRATED APPROACH

5. The Panel recommends that HHCI commission an independent sustainable development audit on all Project components, which will evaluate and rate the components for both environmental and economic benefits, and suggest alternatives where appropriate.

6. The Panel recommends that the Province foster the development of a regional harbour management strategy for Halifax Harbour, including its marine and terrestrial environments, shorelines and watersheds. This strategy should be based on sustainable development principles and designed to maintain and enhance the integrity of the Harbour ecosystems. Other levels of government, HHCI, and community and institutional interests should be active participants in the development and implementation of the strategy.

7. The Panel recommends that the Ministers ensure that the Project is implemented within a regional harbour management approach for Halifax Harbour.

8. The Panel recommends that HHCI develop a detailed and explicit Environmental Management Plan for the Metropolitan Wastewater Management System which is

   - consistent with the principles of sustainable development
   - developed in consultation and cooperation with relevant stakeholders (governments, technical experts and members of the public)
   - reviewed and approved by regulatory agencies before Project construction begins

9. The Panel recommends that the future owners and operator periodically commission independent sustainable development audits on all Project components which will evaluate and rate the components for both environmental and economic benefits, and suggest alternatives where appropriate. This could include such aspects as operational policies, disinfection and landscaping regimes.

CONTROLS AT SOURCE

10. The Panel recommends that comprehensive controls-at-source programs be developed and implemented in the Halifax Harbour sewersheds. The Province should be the lead agency, but the development of the programs should include HHCI and other public and private organizations with pollution control and Harbour enhancement interests. Regular reporting to the public should be an integral feature of the controls-at-source programs.

11. The Panel recommends that provision of funds for the development of the controls-at-source programs be a condition of the decision to proceed with the Halifax-Dartmouth Metropolitan Sewage Treatment Facility Project, and that agreements be amended as appropriate.

12. The Panel recommends that the years between 1993 and the commissioning of the Project be used by the Province and municipalities to implement the controls-at-source programs as outlined in this Report. The Province should be the lead agency. The controls-at-source programs should include education of all participants, and development of mutually consistent municipal by-laws and initiatives.

13; The Panel recommends that, given that toxic organics in the marine environment constitute the highest priority environmental concern associated with effluent disposal in Halifax Harbour, HHCI should conduct timely and more extensive wastewater characterization programs which include analysis for relevant priority toxic organics and metals. Concentrations of these toxics in receiving waters and sediments should also be determined to provide a better baseline, and to assist with the design of monitoring programs.

14. The Panel recommends that the Province ensure that controls-at-source programs for toxic and hazardous substances be implemented in the Halifax Harbour sewersheds immediately, as a parallel part of the Project.

15. The Panel recommends that HHCI, the municipalities and a third-party auditor undertake cost-benefit studies for reduction in inflows (by stormwater management) and infiltration (by sewer rehabilitation) in selected areas, especially in the following sewersheds, which, according to HHCI, have the most significant problems:

   - Smith Street, Halifax
   - Chain Rock Drive (Northwest Arm sewershed), Halifax
   - Joseph Howe Drive (Armdale system), Halifax
   - Jamieson Street, Dartmouth
   - Mainland South and Herring Cove

16. The Panel recommends that an Action Plan for implementation of controls at source in regard to toxic and hazardous substances, water use conservation, extraneous flows and stormwater, similar to or derived from the one presented in this Report, be designed, developed and funded by the Province as the lead agency in cooperation with the municipalities, the federal government and relevant stakeholders. The Action Plan should include a definition of provisions for funding on a long-term basis.

17. The Panel recommends that a monitoring and public reporting instrument be established by the provincial and federal governments, involving other interested parties, which will address the ways in which Harbour conditions are improving as a result of the Project, controls-at-source programs and other initiatives.

ENERGY CONSERVATION

18. The Panel recommends that HHCI commission an independent energy audit to evaluate and make recommendations on both embodied and operating energy consumption, with the objective of minimizing overall energy demands.

19. The Panel recommends that HHCI examine the alternatives presented in the Quality and Value Engineering Audi in light of their energy demands, relative to existing Project design components, as one of the criteria for selecting final design solutions.

THE COLLECTION SYSTEM

20. The Panel recommends that HHCI design the overflows from the Roachs Pond (discharged at the Northwest Arm) and Chain Rock Drive combined sewer overflows (CSOs) to include disinfection. Consideration should be given to ultraviolet disinfection.

21. The Panel recommends that the County of Halifax and the Eastern Passage community jointly determine whether the Eastern Passage sewage treatment plant should be integrated into the Project at the initial stage.

22. The Panel recommends that the County of Halifax and Town of Bedford determine whether the flows from the Mill Cove sewage treatment plant should be integrated into the Project as it is being built, or when future Project expansion takes place.

23. The Panel recommends that HHCI evaluate the Value Engineering option to increase the size of the tunnels for stormwater retention. This evaluation should also include costs for construction, spoils removal and disposal solutions, and energy consumption.

24. The Panel recommends that all private outfalls be monitored to obtain qualitative and quantitative data, with the lead for this program taken by the Province. After a set time period, no more discharges of untreated sanitary, industrial and institutional wastewaters should be permitted. Site-specific decisions should be made for handling stormwater surface runoff. Private outfalls should be connected to the regional collection and treatment system as soon as possible, unless in specific cases there are compelling reasons why this is not feasible.

MAINLAND SOUTH AND HERRING COVE

25. The Panel recommends that HHCI re-.examine the Project as it applies to Mainland South and Herring Cove, in the context of a new Detailed Area Plan for Mainland South. The development of the Detailed Area Plan should be immediately inftiated by the City of Halifax through consultation with the community and HHCI, in order to resolve future growth projections, servicing, transportation, land use and environmental issues for Mainland South and the Backlands.

28. The Panel recommends that the County of Halifax, Herring Cove residents and HHCI cooperatively determine the preferred solution for sewage collection and treatment for the Herring Cove area, given the low-growth provisions of the District 5 Municipal Planning Strategy and desires of the community.

27. The Panel recommends that HHCI ensure that discharges at Watleys Cove immediately receive preliminary treatment. This interim solution should be developed under a time-limited site agreement between HHCI and the Herring Cove community. This interim measure is to be used only until the regional system, or an alternative treatment facility for Mainland South-Herring Cove, is in place. Likewise, HHCI should examine the operation of the existing CSO at Roachs Pond and arrange for interim mitigation measures. These mitigation measures should be installed by HHCI or the appropriate authority.

28. The Panel recommends that, in the context of preparing a new Detailed Area Plan for Mainland South and in seeking alternative solutions for sewage treatment and disposal for the area, both conventional and alternative approaches be explored. These should include advanced primary or secondary treatments with direct discharge to the ocean, tertiary or equivalent level effluent discharge into Macintosh Run, and technologies such as engineered wetlands, rotating biological contactors and others. Any proposal for engineered wetlands should be seriously examined in light of the stated concerns relating to performance and environmental impacts, and should include a detailed cost-benefit analysis.

SEWAGE TREATMENT AND SLUDGE MANAGEMENT FACILITIES

29. The Panel recommends that HHCI give serious consideration to designing the sewage treatment plant/oil-from-sludge (STP/OFS) facility to include advanced primary treatment at the initial stage, irrespective of site location. The analysis should consider initial capital investment, operating costs, effects on sludge-management technology, and impacts on and benefits to human and natural environments.

30. The Panel recommends that alternative methods of effluent disinfection should be evaluated by HHCI on an ongoing basis, including chlorination (using sodium hypochlorite), ultraviolet radiation, ozonation, and others

as available and practical. These should be considered in relation to both primary and advanced primary treatment.

31. In regard to sludge management, the Panel recommends that HHCI proceed with the design and development of an oil-from-sludge (OFS) facility to manage the sludge generated by the Project, with the ultimate goal of minimizing the release of toxic contaminants to the environment while at the same time recovering a useful product.

32. The Panel recommends that HHCI prepare a mass balance for the OFS facility, in order to predict the ultimate fate of all constituents of the raw sludge used as feedstock. This mass balance should be verified by actual performance data once operations begin, and the information used by the regulatory agencies to develop emission standards and performance controls.

33. The Panel recommends that the Nova Scotia Department of the Environment regulate the OFS facility in accordance with the Recommended Policy for the Management of Stationary Sources of Air Contaminants developed by the Minister's Task Force on Clean Air. Regulations used in other jurisdictions should be reviewed in the context of this policy, which would require that the OFS facility, as a potential emitter of toxic contaminants, be equipped with Best Available Control Technology (or its equivalent) and that its emissions meet ambient air quality objectives and relevant national and provincial targets.

34. The Panel recommends that HHCI re-examine its intention to pump the blowdown from the wet scrubbers into the headworks of the STP to determine whether this method of treating and disposing of the wastes from the scrubbers is consistent with the goal of minimizing the release of toxic contaminants to the environment. If necessary, an alternative disposal method should be selected.

35. The Panel recommends that HHCI be required to provide a detailed ash management plan before the STP/OFS facility is given operating permits. The plan should indicate what the characteristics of the ash will be, exactly where the ash will be landfilled, and how regulatory requirements will be met. Because the OFS process is new, the Panel believes that at least until operating data have been collected over several years, the ash should be disposed of in a secure landfill rather than being reused as fill or for other purposes.

36. The Panel recommends that HHCI be required to corn: mission an independent body to carry out an initial and ongoing assessment of the technical design, a risk assessment, and a value engineering analysis for the OFS system. The results of this analysis should be made available to the Citizens' Advisory Committee.

37. The Panel recommends that within two years and with funding provided under this Project, a study should be carried out by the County of Halifax to determine the feasibility of applying the digested sludges from certain of its treatment plants directly onto lands used for growing trees or non-food crops. The study should consist of an initial cost-benefit analysis and value engineering audit, to be followed by a demonstration project, which would attempt to determine (1) the fate and effects of toxics in the digested sludge, (2) the potential benefits to the soil and to plant growth and (3) public acceptability. If, as a result of this study, it is determined that having access to the OFS process is still the preferred option for the County, the Panel recommends that HHCI re-evaluate the possibility of delivering the sludges from the County of Halifax sources directly to the OFS facility, either before or after digestion, in order to avoid reprocessing already-processed sludge through the primary STP.

38. The Panel recommends that mitigation measures for landscaping, facilities design and visual impacts as described in Section 4.8.8 of this Report be employed by HHCI in the development of the present Project, and in future expansion phases.

39. In regard to McNabs Island, the Panel recommends that the three levels of government and HHCI ensure that

a) the planning, implementation and management of McNabs Island as a park take place in parallel to the overall Project

b) HHCI, at the request of the Nova Scotia Department of Natural Resources, participate in the planning process of the park

c) funding for the formation, implementation and ongoing management of the park be provided as mitigation for initial and ongoing impacts from locating the STP/OFS facility at Ives Cove

d) the Project agreements be amended to include funding sources for the development of the park

e) public interests participate in the planning, implementation and management of the park

f) the entire properties of McNabs and Lawlor islands continue to maintain their parkland designation in perpetuity, and this designation be part of all planning instruments

g) use of these islands be restricted to low-impact park and recreation activities

h) no direct access from the artificial island to McNabs Island be permitted until such time as the park management plan can accommodate the impacts of increased access

i) permissible odour and noise levels on McNabs Island during the construction and operation of the STP/OFS facility meet standards comparable to ones for locating an STP in close proximity to residential neighbourhoods

j) a wharf for access to McNabs Island to replace the Ives Cove wharf be provided in a suitable location as part of the park management plan

k) a camouflage principle to visually screen the STP/OFS facility from the northern end of McNabs Island be adopted to preclude filtered views from the Lynch, Conrad and Fort Ives properties

l) a survey and full documentation of previous uses of Ives Cove, including the identified naval careening yard, be undertaken

m) the balance of Ives Cove be maintained for recreational boating and anchorage

n) no construction or routine operations access from the STP/OFS facility be permitted on McNabs Island

40. The Panel recommends that, given the educational and technology-demonstration potential of this Project, HHCI develop a visitors' centre and interpretative program' on-site for the facilities. Part of the education/interpretation program should recognize and interpret the broader context of regional Harbour management.

PROJECT COST AND FUNDING

41. The Panel recommends that the three levels of government amend the funding agreements to provide adequate funding for the Project, allocate costs in accordance with present social equity considerations, and avoid transferring the burden of costs for installation to the next generation.

42. The Panel recommends that HHCI carefully assess and incorporate, when appropriate, potential cost savings associated with the recommendations contained in the Quality and Value Engineering Audi.

CONSTRUCTION OF THE SYSTEM

43. The Panel recommends that HHCI continue to develop the Environmental Management Plan for the construction and monitoring phases of the Project to include responses to concerns raised in Section 4.10.1.

44. The Panel recommends that HHCI supplement the community profiles study by identifying the community concerns relating to the two new minehead locations at Hanover-Barrington streets and Berth 22.

45. The Panel recommends that HHCI prepare public information materials that clearly explain all construction locations and activities, timing, probable impacts and proposed mitigation measures.

46. The Panel recommends that HHCI appoint a contact person for the duration of the construction phase, to respond quickly to residents' day-to-day concerns with respect to construction impacts.

47. The Panel recommends that HHCI examine the construction schedule for the collection system to maximize the availability and use of tunnel spoils as fill to create the artificial island.

46. The Panel recommends that HHCI investigate options for spoils disposal, including the safe disposal of acid-generating materials, and develop a management plan that will satisfy all regulatory requirements before construction is allowed to begin. This management plan should be made public before construction starts.

49. The Panel recommends that HHCI consult with representatives of Mainland South, Herring Cove and Purcells Cove to determine how the baseline well study should be carried out, by whom, and over what area.

50. The Panel recommends that HHCI in consultation with the local residents develop a clear and accountable grievance settlement procedure and compensation plan to ensure speedy and satisfactory resolution of adverse impacts to water supplies caused by construction activities. HHCI and local residents should review the Ontario process and other approaches. The grievance settlement process and the compensation plan should be in place before construction is allowed to begin in the potentially affected areas.

51. The Panel recommends that HHCI carry out additional professional archaeological research and surveys in the Ives Cove area, given the extensive dredging associated with the creation of the artificial island, and the additional information provided through the public review process.

52. The Panel recommends that HHCI undertake professional subsea archaeological surveys at the diffuser location and any other previously unsurveyed areas prior to initiation of construction work. Technology should be used that will yield maximum knowledge about any undiscovered remains.

OWNERSHIP, MANAGEMENT AND OPERATION

53. The Panel recommends to the Ministers that the ownership of the regional system be taken over by a new, single-purpose utility.

54. The Panel recommends to the Ministers that the new wastewater management utility be governed by a board of directors with representation from the three participating municipalities. The board should also include at least one director with a mandate to represent the interests of the Harbour itself in terms of both environmental quality and Harbour users, and one director representing McNabs Island, again in terms of both its natural environment and its users.

55. The Panel recommends to the Ministers that the new wastewater management utility wholesale its treatment services to the participating municipalities on the basis of actual flows contributed to the system by each municipality. The cost structure should differentiate between flows contributed by individual residences and businesses (as metered through potable water consumption) and those largely contributed by extraneous flows. A surcharge should be applied to the latter flows as a direct incentive to the municipalities to undertake sewer remediation and stormwater management.

56. The Panel recommends to the Ministers that the new wastewater management utility cooperate with the Halifax Water Commission and with the City of Dartmouth to .establish complementary water conservation, flow reduction objectives and effective rate structures for both water and sewers that will promote these objectives.

57. The Panel recommends to the Ministers that municipalities own capacity rights in the system, as recommended by the Peat Marwick Stevenson Kellogg Report. A

surcharge should be applied when the flows from a municipality exceed its capacity rights. These surcharge funds might be used to finance system expansion if necessary or conservation programs. The new wastewater management utility should investigate the possibility of capacity rights being tradeable between municipalities, in order to create more capacity for one municipality by financing sewer remediation or consewation projects in another municipality, thereby delaying the need for system expansion.

58. The Panel recommends that HHCI and the future operator continue to develop the Environmental Management Plan for the operations phase of the Project to include responses to concerns raised in Section 4.11.3.

59. The Panel recommends that the Nova Scotia Department of the Environment, in cooperation with other regulatory bodies, prepare a comprehensive review of all regulatory instruments to be applied to the Project, with the purpose of (1) identifying gaps, overlaps, and opportunities for streamlining the process and (2) determining how best to ensure that environmental quality goals and standards will be met. The results of the review should be made public.

60. The Panel recommends that the Province maintain its role as prime regulator for the regional facility, involving the other levels of government as appropriate. In addition to issuing permits to construct sewage treatment facilities, the Province should also develop and issue renewable and enforceable operating certificates for sewage treatment facilities, including the Halifax-Dartmouth Metropolitan Wastewater Management System.

81. The Panel recommends that HHCI enter into an independently mediated, collaborative process with other Project stakeholders (representing, for example, affected communities, Harbour users, supporters of McNabs Island, and environmental organizations) to develop a system for timely and effective stakeholder involvement. This collaborative process should begin immediately. Issues to be determined would include membership, funding, access to information, public feedback mechanisms, reporting requirements and evaluation.

62. The Panel recommends that as part of the development of a stakeholder involvement program, HHCI negotiate an independent grievance settlement process with the stakeholders, including detailed guidelines for determining under what circumstances compensation would be required, and how the affected parties and the level of compensation would be determined.

63. The Panel recommends that Ministers ensure that the wastewater management utility allocates a certain percentage of its annual operating budget to support research and education programs relating to (1) the existing sewage treatment system, (2) the development of progressive alternatives for both treatment and reduction at source, and (3) the Harbour environment. In consultation with local research and educational institutions, HHCI and the eventual owners and operator of the system should also develop a protocol to guide decisions regarding access to facilities and infomtation for research purposes.

MONITORING PROGRAMS

64. The Panel recommends that the Ministers amend the funding agreements for the Project to provide adequate monies for the recommended monitoring programs during planning, construction and operations.

85. The Panel recommends that additional current meter and other physical oceanographic work should be undertaken by HHCI at the selected diffuser site to refine the predictions of diffuser plume behaviour and dispersal. Additional information on plume behaviour relative to effluent constituents of concern should be provided as a result of this analysis.

88. The Panel recommends that HHCI establish the Environmental Effects Monitoring Committee which should then design the monitoring plans, making use of literature in this field. Implementation should begin as soon as possible and well before the construction and operation of the regional sewage treatment system begins in order to establish baselines for comparative purposes.

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APPENDIX A

PANEL BIOGRAPHIES

Dr. Shirley Conover (Chairperson)

Dr. Conover is currently the Lester Pearson Senior Fellow at Dalhousie University, and Project Director of the University's Environment and Resource Management Philippines Project. Since 1988 she has held senior level positions in the Environmental Management Development in Indonesia Project, and is presently writing a book about the Project. These projects involve policy and program development, substantive work, and education and training in environmental management areas. Environmental assessment, resource management, pollution control, environmental law and regulatory systems, spatial planning, marine and coastal management, and population-environment interactions are included. Prior to joining Dalhousie University, she worked for 12 years as a private sector environmental consultant on major Canadian East Coast development projects.

Dr. Conover has a Ph.D. from Dalhousie University in Halifax and an M.Sc. from Yale University, both in biological oceanography; undergraduate work was in terrestrial ecology. She sewed on the Canadian Environmental Advisory Council (CEAC) for 8 years, the Energy, Mines and Resources Regulatory Review Panel, and as a member of the Strategic Grants in Oceans Panel, Natural Sciences and Engineering Research Council (NSERC) for 3 years. She is a member of the International Association for Impact Assessment, the American Society of Limnology and Oceanography, and the International Society for Ecological Economics.

Leslev Grifffths

Ms. Griffiths is a co-principal in Griffiths Muecke Associates. Her firm specializes in environmental impact assessment, so&-economic research, community development and planning as well as waste management and watershed management. Some of the projects she has been associated with are: public involvement in the Waste Management Planning Process for the Halifax-Dartmouth Metropolitan Authority; provision of a secretariat and consulting services to the Halifax Harbour Task Force: a study to examine the role of watershed advisory groups in Nova Scotia; and the Socio-economic Impact Assessment Study for the Hibernia Project.

Ms.. Grfffiths has a Bachelor of Design in Environmental Planning from the Nova Scotia College of Art and Design, a Bachelor of Arts (English) from the University of Birmingham in England and a Master of -Library Science from Dalhousie University.

Robert Parker

Mr. Parker is an architect and planner based in Halifax. He is president of Robert Parker Associates Ltd., a firm which undertakes a wide range of works for private, government, and institutional clients. The practice specializes in municipal, community, recreational, and environmental planning with a strong experience base in community consultation, environmental assessment, resource management and open space planning. The archiiectural portion of the consultancy includes research in energy effiiient and sustainable housing, building accessibility, re-adoptive use, and historic restoration.

Mr. Parker holds an undergraduate degree in architecture and a master's degree in architecture-planning from Massachusetts Institute of Technology. He is a former head and professor of Environmental Planning at the Nova Scotia College of Art and Design from 1970-1999.

Dr. Dan Thirumurthi

Dr. Thirumurthi is a Professor of Civil Engineering at the Technical University of Nova Scotia. He holds a Bachelor's degree in Civil Engineering, an M.Sc. in Public Health Engineering from the University of Madras, and a Ph.D. in Environmental Engineering from the University of Texas.

Dr. Thirumurthi specializes in environmental management as well as water and wastewater treatment. He has published extensively on wastewater treatment systems, and the concepts he has presented have been incorporated into scientific journals and numerous texts in this field.

APPENDIX B

MANDATE FOR THE PANEL REVIEW AND LETTER OF CLARIFICATION OF THE PANEL'S MANDATE

Introductlon

The Environmental Assessment Panel (Panel) has been jointly established by the Ministers of Environment for Nova Scotia' and Canada in accordance with the provisions of the Nova Scotia Environmental Assessment Act and under the authority of the federal Environmental Assessment and Review Process (EARP). The Proponent of the proposal under review is Halifax Harbour Cleanup Incorporated.

Purpose

The purpose of this document is to define the mandate and responsibilities of the panel.

Mandate of the Panel

The Panel is mandated to conduct a public environmental review of the proposed Halifax Harbour Cleanup Project. Following its review the Panel will advise the Ministers of Environment from Nova Scotia and Canada and the Minister responsible for the Atlantic Canada Opportunities Agency whether the Project can be carried out in the proposed manner without causing unacceptable adverse effects to the environment. The Panel shall make every reasonable effort to submit its final report to the Ministers within eighteen. (18) months of its appointment.

Scope of the Review

The scope of the review shall include matters relating to the environmental and community impacts of the design, construction and operation of the proposed sewerage system, tunnels, sewage treatment and sludge handling facilities, and other ancillary structures, buildings and activities associated with the Project.

Issues to be Addressed by the Panel

The Panel review shall address the environmental and directly related socioeconomic effects of the project. The review shall include, but not be limited to the following matters:

1) Comparison of reasonable alternatives to the proposed project, specifiilly in regard to:

. no project,

- collection, screening and discharge to deep offshore marine water ("long pipe"),
- primary versus secondary and tertiary treatment, and
- outfall(s) located in Bedford Basin, the Narrows, middle Harbour, outer Harbour, and Harbour approaches.

2) Community impacts associated with construction and op eration of the collection system, specifically in regard to:

- alteration of established residential and commercial traffic patterns including access to commercial recreational and residential areas,
- . enhanced noise levels (heavy equipment and truck traffii),
- public safety and property protection,
- dust,
- property values,
- ernployment, and
- maintenance.

3) Community impacts associated with the construction and operation of a wastewater treatment plant, specifically in regard to:

- visual impact (screening),
- odour,
- noise,
- aesthetics,
- land use,
- property values,
- public acceptance/image, and
- employment.

4) Implications of an inner Harbour outfall on water quality, fish resources and current water uses, specifically in regard to:

- recreational and commercial fishing,
- tourism,
- existing water intakes for such applications as cooling and research,
- Harbour ecosystem, and
- dissolved oxygen, heavy metals, and hazardous substances in the water column and sediments.

5) The environmental effects of sludge management primarily involving sludge-to-oil technology, including contingencies

such as land application and co-disposal with municipal solid wastes, specifically in regard to:

- truck traffic,
- odour,
- aesthetics,
- noise,
- property values,
- terrestrial ecosystems,
- groundwater supplies,
- human health

. oil combustion and chemical characteristics, and

- plant emissions.

Canada

NOVA SCOTIA

JUL 3 1991

Dr. Shirley Conover
chairperson
Federal-Provincial Environmental
Review Panel
c/o School for Resource and
Environmental Studies
Dalhousie University
1312 Robie Street
Halifax, Nova Scotia
B3H 3E2

Dear Dr. Conover:

Thank you for your letter of January 23, 1991 requesting clarification of the scope of the Panel's mandate. We apologize for the delay in responding. Having considered this matter in consultation with the federal initiating agency, we are pleased to provide the following for the guidance of the Panel.

We fully agree that the questions of "control at source" and "stormwater runoff", insofar as they influence project design, operation and the associated potential for environmental impact, are to be included in the Panel's mandate.

The items dealing with "monitoring" and "cultural and heritage implications! must be addressed in the Nova Scotia environmental assessment procedure and can be dealt with in federal reviews. Therefore, these items are also included in the mandate .of the Panel.

We trust this clarifies your understanding of the scope of the Panel's mandate.

Yours sincerely,

Jean dharest
Minister

John G. Leefe
Minister

APPENDIX C

TECHNICAL SPECIALISTS

Dr. Isobel Heathcote is an associate professor of environmental engineering and environmental science at University of Guelph, and Chair of the Municipal-Industrial Strategy for Abatement (MISA) Advisory Committee. The committee advises the Ontario Minister of the Environment on the development of new regulations for the control of effluents from municipal and industrial dischargers. Her most recent work involves considerations of how to best implement a "virtual elimination" (of persistent toxic substances) strategy for direct and indirect dischargers. Dr. Heathcote provided expertise on issues related to controls at source.

Dr. Donald Hodgins is the President of Seaconsult Marine Research Limited. He is experienced in physical cceanography, plume behaviour and dispersion from subsurface diiusers and surface discharges, modelling of near-field dispersion and flushing processes, sedimentation processes, and stability and fate of materials on the seabed. He has been involved in wastewater dispersion issues in the Greater Vancouver Regional District and the Victoria Regional District. Dr. Hodgins provided expertise on issues related to physical oceanography, modelling of containment and dispersion, and sediment transport.

APPENDIX D

LIST OF PRESENTERS AT PUBLIC HEARINGS

MARCH 22, 1993
HALIFAX, NOVA SCOTIA

AFTERNOON SESSION

Environment Canada:
Desmond O'Neill, Michael Guilcher, Dan Mullaly, David Kelly, Ken Hamilton

Metro Coalition for Harbour Cleanup:
Alan Ruffman, Candace Malcolm

EVENING SESSIONS

Halifax Field Naturalists:
Colin Stewart

Metro Coalition for Harbour Cleanup:
Dr. Patricia A. Lane, Dr. David Patriquin

Environmental Engineering Consultants:
Sherwood C. Reed, P.E.

Nova Scotia New Democratic Party:
John Holm, MLA

North Woodside Residents Association:
Grant MacDonald

MARCH 23, 1993
HERRING COVE, NOVA SCOTIA

AFTERNOON SESSION

No formal presentations

EVENING SESSION

Constituency MLA:
Robert Chisholm

Private Citizen:
P. Douglas MacKinlay

Private Citizen:
Peter Pelham

District 5 County Councillor:
R. Ball

MARCH 25, 1993
EASTERN PASSAGE, NOVA SCOTIA

AFTERNOON SESSION

Private Citizen:
Donald Grady

EVENING SESSION

District 6 County Councillor:
Eugene Deveaux

Nova Scotia Hospital:
David Higgins, Marty Townsend

Eastern Passage & Cow Bay Residents & Ratepayers Association:
Bill Stanbrook, Liz Kwindt, Jim Wies

Private Citizen:
Veronica Guitard

District 6 Planning Committee:
Tom Harmes

MARCH 26, 1993
DARTMOUTH, NOVA SCOTIA

AFTERNOON SESSION

Wastewater Technology Centre:
Herb Campbell

Metro Coalition for Harbour Cleanup:
Dr. Patricia A. Lane, G. Lakshman,
Dr. Richard J. Palczynski

The Its not Garbage Coalition:
David Wimberly

MARCH 27, 1993
DARTMOUTH, NOVA SCOTIA

AFTERNOON SESSION

Private Citizen:
Colin Stewart

Private Citizen:
Mike Tilley

Friends of McNabs Island Society
Royce Walker

Private Citizen:
Catherine McCarthy

Private Citizen:
Douglas Trider

MARCH 29, 1993
HALIFAX, NOVA SCOTIA

AFTERNOON SESSION

Technical Adviser to Panel:
Dr. lsobel Heathcote

Ecology Action Centre's Harbour Cleanup Committee:
Mike Ruxton

The Its Not Garbage Coalition:
David Wimberly

Private Citizen:
Liz Cracker

EVENING SESSION

Metro Coalition for Harbour Cleanup:
Alan Ruff man

Friends of McNabs Island Society:
Royce Walker.

Halifax Shipping Association:
Jim Stoneman, Gary Wendt

North Woodside Residents Association:
Susan MacEachern

Halifax Port Corporation:
Captain Claude Ball, Don Carter,
Captain Randy Sherman

Canadian Coast Guard:
John Major

MARCH 30, 1993
HALIFAX, NOVA SCOTIA

AFTERNOON SESSION

Williams Lake Conservation Company:
Kathleen Hall, Dr. Patricia Manual,
Dr. Martin Willison

The McNabs Island Ferry Company:
John Jenkins

EVENING SESSION

Halifax Field Naturalists:
Colin Stewart

Private Citizen:
Dr. Dusan Soudek

Private Citizen:
David Smith

Friends of McNabs Island Society:
lnez Caldwell, Royce Walker

APRIL 1. 1993
HALIFAX, NOVA SCOTIA

AFTERNOON SESSION

Canadian Parks Service:
Andre **d'Entremont,** Dan Mullaly,
Rob Thompson

Private Citizen:
Roger Pocklington

The McNabs Island Ferry Company:
John Jenkins

Private Citizen:
Alan Jean-Joyce

Private Citizen:
Barry Edwards

EVENING SESSION

Metro Coalition For Harbour Cleanup
Alan Ruffman

Private Citizen:
Dr. Roger Pocklington

The Its Not Garbage Coalition:
David Wimberfy

Fisheries and Oceans Canada:
Steven **MacPhee,** Dr. Brian Nicholls,
Gerald Siebert, Dr. Jim Elliot,
Brian Thompson, Dr. Don Gordon,
Don Lawrence

Energy, Mines and Resources:
Ronald Edwards,
Kumiko Azetsu-Scott,
Gordon Fader, Dale Buckley

APRIL 2, 1993
HALIFAX, NOVA SCOTIA

AFTERNOON SESSION

Private Citizen:
Duncan **MacAdams**

Private Citizen:
Peter Kidd

L.S. McCarty, Scientific Research and Consulting:
Dr. Lynn S. McCarty

APRIL 3, 1993
HALIFAX, NOVA SCOTIA

MORNING SESSION

Ecology Action Centre:
Rosalie Lydon

Woodside Home and School:
Kim Carver, Grant MacDonald, Colin **McKeown**

Private Citizen:
Elizabeth Johnson

Private Ciiizen:
Candace Malcolm

Nova Scotia Department of Natural Resources, Parks and Recreation:
Barry Diamond, Brian Kinsman

AFTERNOON SESSION

Eastern Passage & Cow Bay Residents & Ratepayers Association:
Bill Stanbrook

Purcells Cove Concerned Citizens
Rod Giffen

Private Citizen:
Paul Arnold

Dartmouth Constituency MP
Ronald MacDonald

CLOSING STATEMENTS

Private Citizen:
Veronica Guitard

Metro Coalition for Harbour Cleanup:
Howard Epstein

Halifax Harbour Cleanup Inc.
Paul Calda

APPENDIX E

KEY REVIEW DOCUMENTS

- Halifax Harbour Task Force Final Report and Appendices, August 1990
- Project Registration Document submitted by Halifax Harbour Cleanup Inc. (HHCI), September 10, 1990
- Draft Guidelines for preparation of the Terms of Reference, February 6, 1991
- Final Guidelines for preparation of the Terms of Reference, March 30, 1991
- Final Terms of Reference submitted by HHCI, June 25, 1991
- Environmental Assessment Report Volumes 1 & 2 with set of 24 component studies submitted by HHCI, July 31, 1992
- Additional Information Requirements Document, November 3, 1992
- Evaluation of Options for the Operation and Maintenance of the Halifax-Dartmouth Metropolitan Sewage Treatment Facility, Peat Marwick Stevenson & Kellogg submitted by, HHCI, December 8, 1992
- Environmental Assessment Report Supplementary Information 1 submitted by HHCI, January 13, 1993
- Request to provide supplementary information prior to public hearings, February 17, 1993
- Response by HHCI to Panel's letter of request, February 19, 1993
- Environmental Assessment Report Supplementary Information 2 submitted by HHCI, March 12, 1993
- Environmental Assessment Report Supplementary Information 3 submitted by HHCI, March 15, 1993
- Public File Volumes 1 to 14 containing documents related to the environmental assessment review, September 10, 1990 to April 3, 1993
- Transcripts of Public Hearings, March 22, 1993 to April 3, 1993

APPENDIX F

GLOSSARY

assimilative capacity	the capacity of the envlronmental and biological systems to process, absorb and render harmless foreign substances, such as pollutants while these systems remain unimpaired
average dry weather flow	the average rate of wastewater flow (as a function of time and volume) through the collection system during dry weather; in combined sewer systems, average dry weather flows include sanitary sewage and groundwater infiltration, but exclude stormwater
benthic organisms	plant and animal life found on or in the bottom of the sea, a lake, or a river

biochemical oxygen demand (BOD)	a measure of the amount of oxygen needed to satisfy the requirements of microorganisms to decompose organic material
blowdown	the liquid waste from certain types of air pollution equipment (chemical scrubbers), which contains the fine particulate matter removed from gases before they are discharged to the atmosphere
carrying capacity	the capacity of physical, chemical and biological systems acting together to support functional ecosye-terns
chemical oxygen demand (COD)	a measure of the amount of oxygen needed to satisfy the requirements of chemical reactions associated wlth the decomposition of organic and inorganic matter
chemically enhanced primary treatment	primary sewage treatment that includes the addition of certain chemicals to increase the quantity of particulates that settle out in the clarifier tanks. This additional step in the treatment process, also known as advanced primary treatment, can remove approximately twice as much suspended solids as conven-tlonal primary treatment
combined sewer overffow (CSO)	a point in the sewage collection system where wastewater flows exceeding the capacity of the collection tunnel are allowed to overflow into a nearby body of water
controls at source	in the context of wastewater management, preventing the entry of toxics, hazardous materials and extraneous flows (stormwater and infiltration) into the waetewater stream
cumulative effect	the result of a series of successive actions or impacts; in the context of environment, a succession of impacts from the same or different sources that, taken together, result in a change to an ecosystem
diffuser	in the context of wastewater treatment, a structure on the seafloor attached to the end of a sewage outfall, designed to maximize dilution of sewage effluent by discharging the effluent through a series of ports; as the effluent rises to the surface, it is further diluted by turbulent mixing with the receiving water
digested sludge	as part of a wastewater system, sludge that has been decomposed by biological processes
ecosystem	a discrete organized complex of living organisms which interact with each other and their supporting environment
effluent	in the context of wastewater treatment, the treated wastewater stream from a sewage treatment plant or outfall
embodied energy	the energy consumed in the production of a particular product or material together with energy needed to assemble these materials into a product
extraneous flow	groundwater that enters the collection system through leaks in the pipes or manhole cracks, and inflow of surface water that enters through illegal connections to the sewers such ae roof and foundation drains
flocculation	a chemical added to water or wastewater so that larger particles are formed from smaller particles as the result of a physical-chemical reaction
forcemain	a sewer pipe carrying wastewater under pressure from a pumping station
headworks	in the context of wastewater treatment, the location at which the first elements of treatment take place in the sewage treatment plant, including flow distribution, screening, and grit removal
infiltration	groundwater that enters the collection system through cracks in the pipes and manholes
inflow	surface water that enters the collection system through the illegal connection of roof and foundation drains
mass balance (of pollutants)	the mass of pollutants coming into a system, plus the net changes of pollutants within the system, minus the mass of pollutants being discharged from the system
outfall	the pipe or other point at which wastewater or treated effluents are discharged into the Harbour
pathogen	a disease-causing microorganism
raw sludge	seffleable soiids, separated out of the wastewater, which have not been subjected to further processing
sanitary sewer	a pipe that carries household and commercial waste only (not stormwater)
septage	the sludge residue which collects in septic tanks
sludge	the accumulated solids that are removed from wastewater by gravitational seffling

social equity	the fair distribution of the social and environmental costs and benefits associated with major projects between communities or between groups of people
stormwater	water accumulated as rain or from snow melt prior to incorporation in streams, lakes or the ocean or filtration into soils and fissures in bedrock
suspended particulate matter	particles of physical substances floating between the top and bottom of a column of water or air; in the present context, particles of sewage floating between the surface and bottom of a column of water
volatiles	substances which, if unconfined, will evaporate and disperse into the atmosphere
vortex separator	a type of equipment used at combined sewer overflows to separate out floatables and between 25-45% of the suspended solids before the overflow is discharged

APPENDIX G

LIST OF ABBREVIATIONS

ACOA	Atlantic Canada Opportunities Agency
ADWF	Average Dry Weather Flow
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
CSO(s)	Combined Sewer Overflow(s)
HHCI	Halifax Harbour Cleanup Inc.
OFS	oil from sludge
STP	sewage treatment plant

APPENDIX H

ACKNOWLEDGEMENTS

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Jim Clarke - Federal Co-executive Secretary
Dennis Ryan - Provincial Co-executive Secretary
Patriiia Murray - Panel Office Manager
Catherine Badke - Secretariat
Jean Blanc - Secretariat