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**ENVIRONMENTAL IMPACTS OF INTERNATIONAL SHIPPING: A CASE STUDY OF THE PORT
OF VANCOUVER**

This case study was prepared by Bryan McEwen of SNC-Lavalin Environment Inc., Canada, as part of the project "Environmental Impacts of International Shipping: the role of ports". The study focuses on the way Port Metro Vancouver and the Canadian authorities address the environmental impacts of the port and its interactions with the hinterlands.

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NOTE FROM THE SECRETARIAT

This case study was prepared by Bryan McEwen of SNC-Lavalin Environment Inc., Canada, as part of the project “Environmental Impacts of International Shipping: the role of ports”. The study focuses on the way Port Metro Vancouver and the Canadian authorities address the environmental impacts of the port and its interactions with the hinterlands.

This project also includes case studies of the environmental impacts on the ports of Los Angeles and Long Beach in the United States [ENV/EPOC/WPNEP/T(2009)5/FINAL], Rotterdam in the Netherlands [ENV/EPOC/WPNEP/T(2009)6/FINAL] and Busan in Korea [ENV/EPOC/WPNEP/T(2010)2/FINAL].

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EXECUTIVE SUMMARY

Environmental management of ports in Canada occurs through collaboration with government agencies and industry, supported by specific standards or requirements for industry operators. During the past five years, the level of co-operation between ports, government and industry (shipping lines and associations in particular) has increased substantially, representing a high level of willingness for the commercial marine operators to participate in policy development, rather than simply be subject to it. Part of this willingness stems from an industry understanding that internationally oriented policies and practices will be more efficient, less costly and potentially achieve greater effects compared to policies that could substantially differ across national borders.

An overview of the operational framework for ports in Canada is provided in this report, with focus on Port Metro Vancouver, to provide a Canadian case study as a contribution to the project *Environmental Impacts of International Shipping: the Role of Ports*. Port Metro Vancouver is Canada's largest port and the fourth largest port in North America by total tonnage handled. As such, there are many examples of environmental programmes and policies at the port that relate to the environmental issues of focus for the project: criteria air contaminant (CAC) emissions and air quality, greenhouse gases (GHGs) and climate change, water quality and ecosystem integrity, noise, dust and land use and resource conservation.

Day-to-Day Operations

Management of day-to-day marine-related operations, including environmental management, occurs with a mix of federal government agencies, notably Transport Canada and the Department of Fisheries and Oceans (who operate the Canadian Coast Guard). Environment Canada, as a science-based department, also often participates in marine and port studies and has high-level responsibility for developing international agreements with other governmental agencies. A Canadian port authority (CPA) is required to facilitate the laws of the land within its jurisdiction and additionally conduct appropriate environmental management. The *Canada Marine Act* empowers the CPAs to develop their own policies and procedures for managing ship activities while within their jurisdiction. Vancouver Fraser Port Authority has a legal designation under the *Canada Marine Act* as Canada Port Authority (CPA).

Development of effective ballast management practices and policies is ongoing in Canada to address a greater number of alien invasive species identified in Canadian coastal waters (and the inland Great Lakes) in recent years. At the present time, the Canadian national ballast management programme is consistent with developing IMO guidelines and contains mandatory handling requirements (e.g., mid-ocean exchange). Transport Canada is working towards ratifying the IMO Ballast Water Convention. Management of oil spills and leaks is inherently a simpler issue to understand and the legislative and policy actions that have been taken at the national level have resulted in development of clear expectations and penalties that are communicated to the shipping lines. Shipper requirements are governed by a comprehensive regulatory regime under the *Canada Shipping Act (2001)*, and are enforced through flag and port State control inspection regimes. There has been a high level of coordination at the international level, as shipping companies have responded to developed policies that have originated in part or whole from the IMO or other international working groups.

Port Metro Vancouver has an Air Action Program, developed in 2006, that has an incentive programme to reward shippers that voluntarily choose to engage in practices that lead to lower emissions while in the port region. The programme also has components to address on- and off-road trucking, including idle reduction programmes as well as a mandatory reservation system for container trucks to reduce additional emissions that can be associated with traffic congestion. This programme helps to achieve emission reductions beyond those that would be attributed to national and international requirements, such as sulphur-in-fuel regulations and on-road and off-road engine emission regulations.

Major Port Developments

Currently, many ports around the world are engaged in expansion activities associated with container terminals. Regulated environmental assessment (EA) in Canada has evolved to the point where CPAs are required to ensure that EAs are conducted for triggered projects and activities within their jurisdiction, that are not otherwise specifically excluded by regulation. This recent change in Canadian policy does not remove the ultimate review responsibilities of government, but shifts the responsibility for developing appropriate project-level environmental mitigation strategies to the CPAs. This is a case of Canadian ports taking on the role of local expert. The ability of a particular CPA to develop refined and effective mitigation strategies depends in part on the quality of environmental data that may or may not be available. Project development and operation plans are expected to incorporate current environmental best practices. National environmental standards, such as the Canada Wide Standards (CWS), require avoidance of unnecessary environmental releases. For engine exhaust emissions, the 'Continuous Improvement' and 'Keeping Clean Areas Clean' provisions of the CWS require that emissions of particulate matter (PM) and (indirectly) emissions of NO_x and SO_x must be minimized to the degree possible, regardless of the existing local air quality.

Each CPA is required under the *Canada Marine Act* to develop a land-use plan for the lands under its management. Land-use planning efforts for Port Metro Vancouver have facilitated development of an off-dock container re-handling facility to reduce the number of empty container truck trips in the region and investigations of the potential for short-sea shipping to reduce local trucking intensities. Investigation of traffic intensities is on-going, as this has been a key area of concern for community and government representatives, for both trucking and rail.

The Canadian government has a responsibility to ensure that adequate waste facilities are available to service ships based on traffic characteristics. Port development projects require accompanying capacity to collect oily wastes, chemical wastes, sewage sludges, cargo residues and garbage.

Strategic Environmental Planning

The direct participation of marine operators in Canadian environmental studies has been very successful, partly due to commitments at the port and federal level (Transport Canada) for confidentiality of potentially sensitive operational details. Data collected from shipping agents and terminal operators through directed surveys is managed through confidentiality agreements signed by a port or government official (or both). The result of Canadian vessel and terminal surveys has provided a good base level of information to characterize marine movements and dockside operations across the country. This base of work allows a Canadian port and government agencies to refine local strategies and policies to fill data gaps or facilitate development of management programmes that refer to specific operational criteria such as vessel speeds, fuel types, engine standards and electrification of necessary dockside equipment.

The development and use of incentive programmes has played an important role in national environmental policy for the marine sector. In particular, a federal ecoFREIGHT programme (from the larger ecoTRANSPORT programme) has provided financing for projects involving efficiency, CAC and/or GHG improvement for transportation. Strategic environmental planning for a port in Canada usually involves consideration of the context for each issue. If a clearly established national programme exists for a particular issue (e.g., ballast water management, oil spills) then support

and facilitation of the national programme may be a key focus. If an environmental issue is more local in context (e.g., management of marine habitat, noise, dust, sewage or wastes), a potentially unique, focussed port programme may be of considerable benefit. An informal 'First Responder' programme at Port Metro Vancouver allows the CPA to effectively facilitate the national environmental programmes and also places communications as a key responsibility, which is becoming much more important to ports around the world, as the public develops a keen awareness of environmental issues.

Components of Port Metro Vancouver's Air Action Program (in particular, the Northwest Ports Clean Air Strategy) provide a good example of effective air policy, as management strategies utilize direct actions and performance measures for sources the port has a greater level of influence on (dockside equipment, trucking) and incentives and goals for sources that are effectively managed at the international level (ocean going vessels in particular). The Program benefits from a robust quantitative baseline and has strategies that account for the baseline conditions, as well as upcoming national and international standards. The Clean Air Strategy also utilizes annual performance measures that are quantifiable, such as a defined fraction of in-use equipment fleets that meet set emissions criteria. Similar to air action policies that have been developed by large U.S. ports (e.g., the San Pedro Bay Ports Clean Air Action Plan), some of the reduction strategies in the Northwest Ports Clean Air Strategy appear aggressive, but in fact have a good likelihood of success since they were developed in partnership with industry.

Given Canada's resource-based economy, achieving substantial GHG reductions is considered a real challenge. Although Port Metro Vancouver currently has no requirements for assessing and reporting its GHG emissions, the port authority has commenced a corporate emissions inventory and development of a GHG reduction plan, to provide it with information needed to make appropriate environmental management decisions, and so that it may be ready for future reporting requirements. Although the port's corporate emissions are low compared to the industrial emissions of its tenants, a baseline assessment and determination of practical emission reduction opportunities are consistent with the climate change component of its Air Action Program and the assessment may provide practical examples that will be of use to other groups.

With the considerable container expansion activities expected at Port Metro Vancouver (as well as other ports in Canada), related infrastructure developments have become very important. Container handling requires relatively high levels of dockside activity compared to other commodities and often may require high levels of trucking activity. The expected increase in trucking and rail traffic levels and associated infrastructure developments, noise, dust and air emissions has raised the environmental profile of port activities in the province of British Columbia. In Metro Vancouver, there is considerable interest in and scrutiny of the expected port developments. Future environmental pressures will include the level of responsibility that may be attributed to the CPAs due to the expected increases in GHG emissions for port-related activities that include the ocean-going vessel movements.

LIST OF ACRONYMS

AIS	Automatic Identification System
CACs	Criteria air contaminants
CEAA	Canadian Environmental Assessment Act
CI/KCAC	Continuous Improvement/Keeping Clean Areas Clean (provisions of the CWS)
CO₂	Carbon dioxide
CO₂e	Carbon dioxide equivalent
CPA	Canadian Port Authority
CWS	Canada Wide Standards
DFO	Department of Fisheries and Oceans (Canada)
ECA	Emission Control Area under IMO. Previously termed SECA before NO _x restrictions were included with SO _x .
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EPA	U.S. Environmental Protection Agency
GB-PS	Georgia Basin – Puget Sound
GHG	Greenhouse gases
GRT	Gross Registered Tonnage
HC	Hydrocarbons
HFO	Heavy Fuel Oil, also called residual oil
IMO	International Maritime Organization
KPUI	Key Port Utilization Indicators
NO_x	Oxides of nitrogen
PM	Suspended particulate matter
PM₁₀	Suspended particulate matter of diameter ten microns or less
PM_{2.5}	Suspended particulate matter of diameter of 2.5 microns or less
RAC	Railway Association of Canada

ENVIRONMENTAL IMPACTS OF INTERNATIONAL SHIPPING: A CASE STUDY OF THE PORT OF VANCOUVER

1. Introduction

1. This Canadian case study is an input to the project *Environmental Impacts of International Shipping: the Role of Ports* of the Working Group on Transport under OECD's Environment Policy Committee. The environmental impacts of focus have been identified in a scoping paper (Kågeson, 2008) and consist of the following:

- Exhausts of nitrogen oxides (NO_x), sulphur oxides (SO_x) and suspended particulate matter (PM);
- Dust emissions;
- Energy use and emissions of carbon dioxide (CO₂) as well as other greenhouse gases (GHGs);
- Noise;
- Ballast handling;
- Oil spills;
- Sludge, sewage and garbage disposal;
- Snow and rain water removal;
- Handling of hazardous cargo;
- Use of anti-fouling paints;
- Dredging and contaminated soils; and,
- Land-use and resource conservation.

2. Given the considerable attention currently being applied to air emissions from commercial marine traffic, this report contains many references to Canadian emissions legislation and related policies that target atmospheric releases. To simplify the discussion, NO_x, SO_x and PM are often referred to as 'criteria air contaminants' (CACs) to accompany the GHG category of atmospheric pollutants. CACs include other contaminants such as carbon monoxide and hydrocarbons, although there is less concern associated with these air contaminants compared to NO_x, SO_x and PM.

3. The port of Metro Vancouver was chosen to highlight port operations and related policies and programmes in Canada. Port Metro Vancouver is Canada's largest port by tonnage of commodities handled.

4. Canadian port authorities (CPAs) have recently been assigned greater responsibility for management of the local environment, leaving government agencies the role of developing national policies and programmes that support and complement the work the CPAs may do. Given the international context of shipping, Canadian government agencies additionally participate in cross border assessments and studies as well as international working groups to help shape broader marine policy.

1.1 *Institutional and Policy Context*

5. Management and regulation of marine vessels and the marine environment occurs at the national level in Canada, with provincial representation for waters within provincial jurisdiction. Three federal governmental agencies have a mandate that includes stewardship of the marine environment. Environment Canada has a broad mandate to preserve and enhance the quality of the natural environment, including water, air and soil quality. However, Environment Canada is a science-based department and often conducts studies to help other governmental agencies establish appropriate environmental programmes, policies and requirements.

6. The Department of Fisheries and Oceans (DFO) manages Canada's oceans and freshwater resources. The DFO operates the Canadian Coast Guard, which has an environmental response programme to deal with all marine pollution incidents (*e.g.*, fuel or cargo spills) in Canadian waters. The DFO additionally manages fisheries, habitat and aquaculture and conducts related research in a similar capacity to Environment Canada.

7. Transport Canada is directly responsible for the nation's transportation system, including the security and environmental performance of Canadian ports. This responsibility includes regulation of vessels for environmental protection, including pollution prevention, environmental response and liability. Transport Canada also plays a role in administering international commercial maritime rules in Canada. Under the 1995 National Marine Policy, 19 major Canadian ports were deemed vital to Canada's domestic and international trade. These 19 ports were designated Canada Port Authorities (CPAs) under The *Canada Marine Act* which received Royal Assent on 11 June 1998.

8. Transport Canada is the lead agency responsible for the national *Oil Spill Preparedness and Response Regime* (origin 1995), which is an active partnership between government and industry that provides a clear structure to respond to marine oil and fuel spills. This policy serves two main purposes: to ensure that adequate legislation exists for managing fuel spills in Canadian waters and to establish a cascading response programme on a region by region basis. Transport Canada administers liability through the *Marine Liability Act*, which will additionally provide the basis for future regimes to cover liability from hazardous noxious substances incidents.

9. Transport Canada additionally conducts research, primarily on marine policy and standards (including environmental standards) but also on emerging technologies and transportation systems. As such, policies, strategies and programmes are developed to advise and/or assist the CPAs take locally-appropriate actions regarding environmental stewardship. These studies often involve Environment Canada and the Department of Fisheries and Oceans in a technical advisory role.

10. Given the overlap of environmental responsibilities between federal departments, such as Environment Canada, the DFO and Transport Canada, federal departments commonly collaborate to support and develop policies and regulations to protect the air, land and water resources. For this reason, many environmental programmes and policies that have been developed over the past years have involved the several federal departments as well as individual port authorities.

11. Transport Canada and the CPAs often collaborate on issues that relate to national security or transfer of ownership of port lands. Other issues are largely managed by the CPAs, who must adhere to the laws of the land as do their tenants.

12. In addition to the *Canada Marine Act*, several other Acts of Canadian legislation have particular significance to the operation of Canadian ports. The *Canada Shipping Act, 2001* (CSA 2001) is the principal legislation governing protection of the marine environment. The CSA applies to all vessels in

waters under Canadian jurisdiction and to Canadian vessels everywhere. The CSA includes Canadian provisions related to pollution from ships and additionally implements Canada's obligations under international conventions, such as the International Maritime Organization (IMO) MARPOL Convention. The CSA provides the basis for enforcement of marine laws and establishes penalties for polluting. Transport Canada, and the CPAs within port jurisdictions, are responsible for upholding the CSA.

13. The *Canadian Fisheries Act* deals with the management of fisheries resources and protection of fish and fish habitat. This Act applies to the whole of Canada, including private property in every province and territory. Fish habitat is defined as spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly to carry out their life processes. The Fisheries Act is often cited for day-to-day management of port operations as well as development activities. In particular, Section 35 of the Act prohibits the harmful alteration, disruption or destruction of fish habitat.

14. The *Canadian Environmental Protection Act* (CEPA), designed to protect the environment and human health, provides a wide range of tools to manage toxic substances, other pollution and wastes and ensures that the most harmful substances are phased out or not released into the environment in any measurable quantity. Environment Canada administers and enforces regulations that have been made under this act, such as the Disposal at Sea Programme for the management of dredged materials.

15. An additional piece of Canadian legislation has significance for CPAs, although practically only during project planning and construction activities. The *Canadian Environmental Assessment Act* (CEAA) establishes a process by which acceptable construction/expansion activities are determined for facility design and, if necessary, mitigative steps that can be incorporated into a commercial operations permit. The CEAA was formally introduced in 1995 and influenced the generation of related provincial environmental assessment (EA) legislation and practices. The EA process facilitates stakeholder participation in project design and permitting and identifies national, provincial and local environmental standards and requirements that have particular relevance to the project. The number of governmental agencies involved in a project EA depends on the magnitude of the project and the expected impacts to the environment. For large scale projects, the various agencies often develop a collaborative framework (and a written agreement for cooperation) before enacting the various stages of the process, which can take up to two or more years to complete in some cases. In other cases, an EA may be completed with a conclusion that the project cannot proceed with its current design and/or project rationale.

1.2 Focus: Port Metro Vancouver

16. Port Metro Vancouver is situated on the west coast of North America, in the Canadian province of British Columbia (see Figure 1). This Canadian port, together with the Port of Prince Rupert to the north and U.S. ports to the south (Seattle, Tacoma, Los Angeles, Long Beach) are considered 'gateway' ports to Asia, since large volumes of goods that originate from or are destined to Asia pass through these locations. Aside from relatively high marine traffic levels at and near the ports, rail transport (and to a lesser degree trucking) is actively utilized to move goods to/from inland locations.

17. Port Metro Vancouver has long served as the dominant Canadian port for access to Asia-Pacific markets. In recent years, the flow of containerized goods has been dramatically increasing at the port, as this mode of shipping has increased in popularity. There have been recent container terminal expansion activities at the port to meet the expected increase in container shipments in the future.

Figure 1. Location of Vancouver



18. Port Metro Vancouver is self-described as ‘Canada’s largest and busiest port’ and is the fourth largest port in North America based on total tonnage. It is also a highly diversified port, with five main business sectors, including automobiles, break-bulk, bulk, container and cruise. Port operations include 28 major marine cargo terminals and over 50 smaller marine-related facilities. In 2008, the Vancouver Port Authority amalgamated with the Fraser River Port Authority and the North Fraser Port Authority to become the Vancouver Fraser Port Authority. As such, Port Metro Vancouver’s marine facilities extend along the two arms of the Fraser River in addition to its terminals in the Burrard Inlet and the Georgia Strait (see Figure 2).

19. Port Metro Vancouver handled 115 million tonnes of cargo in 2008, down approximately 10% from 2007. As shown in Table 1, the port handles a great deal of bulk goods, notably coal, minerals, fertilizers and grains.¹ The largest decrease in handling from 2007 to 2008 occurred with break-bulk goods (25% decline).

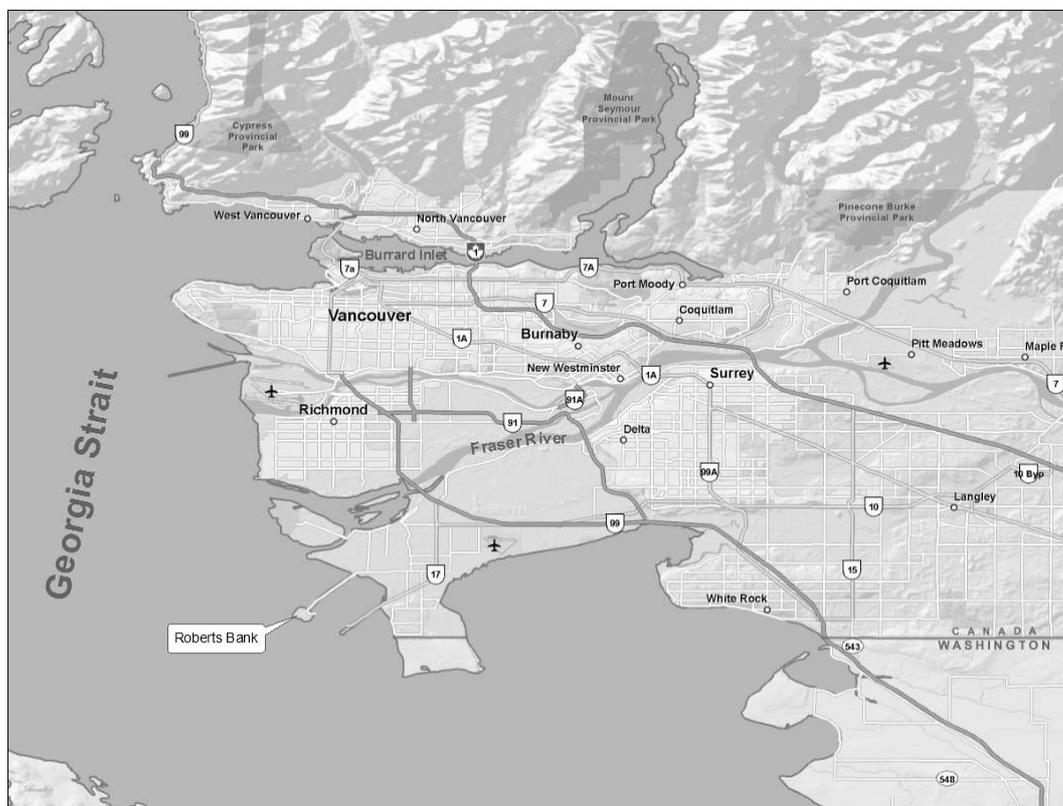
¹ Data from *Port Metro Vancouver Statistics Overview, 2008*.

Table 1. Annual Commodity Statistics for Port Metro Vancouver
2007-2008

Category	Unit of measure	2007	2008
Auto	Millions of tonnes	0.46	0.46
Break-bulk	Millions of tonnes	27.39	20.56
Bulk	Millions of tonnes	78.95	73.08
Container	TEU	2,495,522	2,492,107
Cruise	Revenue Passengers	960,554	854,493

20. The port borders 16 municipalities and therefore works with municipal and regional government officials as well as provincial and federal agencies. The port also successfully partners with industry and industry associations to plan and implement environmental studies or programmes.

Figure 2. Port Metro Vancouver Waterways



2. Identification of Environmental Issues

21. Environmental working groups typically have a mandate to study an identified environmental issue through determination of the existing state of environment (*e.g.*, a baseline determination) and investigation of feasible opportunities to both track environmental performance and achieve positive

change. For marine related issues, these working groups often include Environment Canada, the DFO or Transport Canada (or both) and additionally may involve the participation of provincial and regional government staff. Port Metro Vancouver may participate in an active or an observer role for regional studies and may lead or even initiate study within more localized areas. Depending on the issue and region, a port authority may also be represented within a working group. During recent years, working groups have also involved industry and/or industry associations.

22. A scoping paper was prepared for the OECD to identify issues of focus for the case studies (Kågeson, 2008). This paper identified a number of environmental issues that can be considered to fall under the following categories: Air, Climate, Water, Land Use and Other. The scoping paper provided a summary of the focus issues, including the expected degree of concern for three generalized areas – within a port area, at sea and in the hinterland. The summary table from the Kågeson scoping paper is provided in Table 3.

23. The scoping paper summary provided in Table 2 shows a clear focus on air emissions and this is consistent with the discussion provided in the paper itself. A similar hierarchy of concern to that shown in Table 3 exists in Canada, with some exceptions. Air quality issues tend to be of a primary focus, both in densely populated areas such as Vancouver as well as more sparsely populated areas outside of the Canadian portion of the Fraser Valley. However, air quality is considered both a local and regional issue near Vancouver.

Table 2. Summary of Environmental Issues

Environmental Concern	In Port Area	At sea	In hinterland
Exhausts of NO _x	x	X	x
Exhausts of SO _x	x	X	(x)
Exhausts of PM	X	x	x
Energy use and emissions of CO ₂	x	X	X
Emissions of other GHG	(x)	x	(x)
Noise	X	-	x
Ballast handling	X	x	-
Oil Spill	x	-	-
Disposal of sludge	X	-	-
Disposal of sewage	X	-	-
Disposal of garbage	X	x	-
Snow and rain water removal	x	x	-
Dust prevention	x	-	-
Handling of hazardous cargo	x	x	x
Use of anti-fouling paints	X	x	-
Dredging and contaminated soils	X	-	-
Land-use and resource conservation	X	-	(x)

Source: Kågeson (2008). X: Large; x: Medium; (x): Minor.

24. Staff from Port Metro Vancouver were shown the preliminary list of environmental issues in Table 3 and in general noted a greater level of concern for near port exhaust emissions, ballast handling at sea and oil spills in all regions, to that implied in the table. In addition, a lesser degree of concern was expressed for near port issues regarding anti-fouling paints.

25. There have been considerable efforts both nationally and internationally to assess and understand the (exhaust) emissions from commercial ships and what actions, policies and standards could be enacted to affect positive change. Canada (through Environment Canada and Transport Canada) has taken a number of steps to assess current emissions and expected future trends and to facilitate or participate in international working groups focusing on shipping emissions. Much of the interest in ship exhaust emissions stems from government expectation that shipping emissions will increase in the near future, as

emissions from land transportation will hold steady or decrease (for CACs of primary concern) due to widespread use of engine emission control technologies and federal regulations for vehicles, engines and fuels. Recent emission inventory assessments in Canada have forecast increases in NO_x, SO_x, PM and CO₂ from ocean going vessels in Canadian waters. On 26 March 2010, the IMO adopted the North American Emission Control Area (ECA) proposed by Canada and the United States with the support of France. Large ships within the North American Emission Control Area, covering waters of Canada, the United States and France (Saint-Pierre and Miquelon), south of 60 degrees North, extending 200 nautical miles offshore, will be subject to environmental standards that will limit air pollution. The new measures are expected to dramatically reduce both nitrogen and sulphur oxide emissions, as well as emissions of fine particles from exhaust. Enforcement within the North American Emission Control Area will begin in 2012. The ECA locations being considered for North America are indicated by the green lines in Figure 1.

26. The Government of Canada has committed to reducing Canada's total GHG emissions by 17% from 2005 levels by 2020. The *Canada Wide Standards*² identify other air contaminants that are of significant concern across the country as well as at the local or regional scale. These Standards specifically address suspended particulate matter (PM) within the 'respirable' size fraction (PM_{2.5}) and ground level ozone, among other air contaminants (toxics) that are not included in the summary in Table 3 (and generally would not be released in appreciable quantities from ships). There are two provisions in the Canada Wide Standards for PM_{2.5} and ground level ozone that have implications beyond ambient limits 'not to be exceeded'. These provisions are called *Continuous Improvement* and *Keeping Clean Areas Clean*, which acknowledge the potential risk to human health and the environment at levels below the ambient limits. These provisions include the precursor emissions for PM_{2.5} and ground level ozone, meaning that NO_x and SO_x are additionally represented. Therefore, a clear national objective to avoid or reduce emissions of GHGs, PM_{2.5}, NO_x and SO_x exists for all regions of Canada, including each port. How these provisions are interpreted and stressed in Canada can differ by region of the country and assessment agency involved.

27. Oil spill preparedness and response is an additional national concern that has held a strong focus over the last two decades. A defined framework has been in place since 1995, backed by legislation and mutual agreements between government agencies and industry. The national oil spill management framework has been updated very recently, consistent with international strategies and agreements between countries engaging in high levels of trans-oceanic trade.

28. Disposal of sludge, sewage and garbage, snow and rain water removal, use of anti-fouling paints and land use and resource conservation are regionally-oriented issues that CPAs deal with, often in collaboration with municipal or regional government officials.

29. The environmental concerns identified in Table 2 tend to have greater attention in the higher population density areas, since for these areas there are many additional environmental pressures beyond those that could be attributed to marine activities. In the regional district of Metro Vancouver, there has been considerable public attention applied to commercial marine emissions of both GHGs and CACs during the last several years. This is due to two main reasons, both of which are associated with the well-publicized expectation that the port will greatly increase its level of container handling during the next decade: aggregate emissions from ships are expected to increase both at the port and offshore, and large-scale infrastructure projects will be required to facilitate the additional land-based traffic (rail, trucking).

30. The Regional District of Metro Vancouver has its own air quality management programme, with ambient objectives that, for some air contaminants, are more stringent than the provincial and federal standards (such as the Canada Wide Standards). The 2007 Lower Fraser Valley Air Quality Report

² See www.ccme.ca/ for the Canada Wide Standards.

identifies ground-level ozone and PM_{2.5} as ‘priority pollutants’, with diesel-related PM_{2.5} (sometimes referred to as DPM) of ‘particular concern’ (Metro Vancouver, 2008a). The air quality management programme is performance-based, with four performance measures established (as of 2005):

1. Reduce emissions of inhalable particulate matter (PM10), fine particulate matter (PM2.5), and precursors to PM10, PM2.5, and ozone formation;
2. Reduce regional ambient PM10, PM2.5 and ground-level ozone levels;
3. Improve local air quality; and,
4. Reduce regional greenhouse gas emissions.

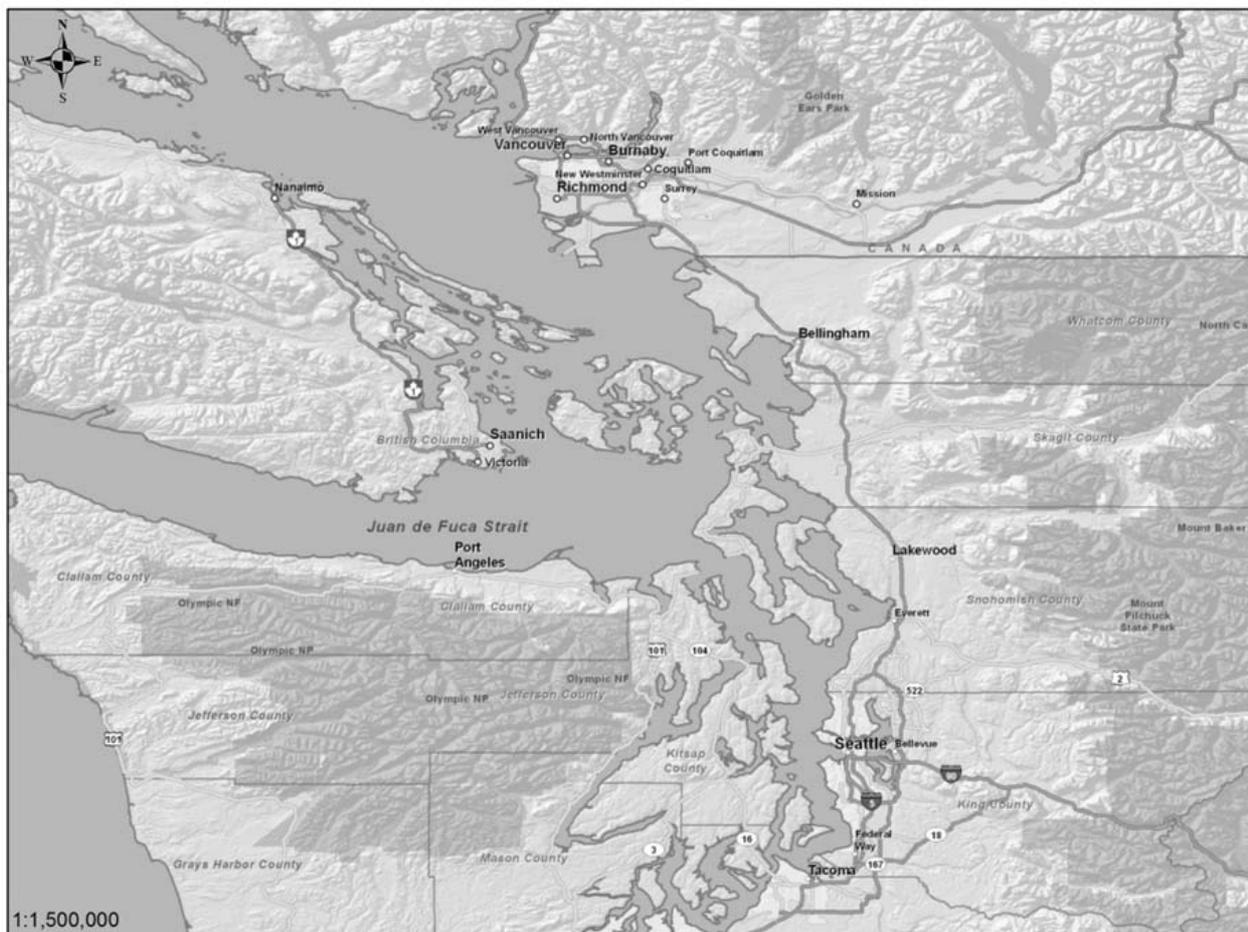
31. The 2008 progress report on the air quality management programme (Metro Vancouver, 2008b) identifies a first key ‘Action’ to reduce emissions from major regional sources. The first detailed strategy targets marine sources. For this reason, Metro Vancouver has taken a keen interest in recent marine and port emissions studies and has been an active participant in the BC Marine Vessel Air Quality Work Group.

32. Metro Vancouver has a population that is often described as ‘green’ when compared to other Canadian communities. Some of the local media, and many of the populace in general, have developed an opinion that a potential doubling of marine associated GHG emissions at and near the port is irresponsible and should not be supported. There is also a clear understanding at all government levels that marine engine emissions of CACs are high on an energy output basis when compared to other forms of transportation and that effective action should result in a substantial lowering of emission levels. These issues have been identified and expressed publicly, which has served as some of the impetus for a high level of participation in the BC Marine Vessel Air Quality Work Group, which includes federal government representation, the port authority and the local shipping association (BC Chamber of Shipping) in addition to the Metro Vancouver regional government.

33. There has also been concern expressed about the landside infrastructure developments that will be necessary to support increased rail and truck container traffic for Port Metro Vancouver. In Metro Vancouver the planned developments are encompassed within the ‘Gateway Program’ and include development of several rail overpasses and, more contentiously, an additional highway corridor. These developments introduce concerns for other environmental issues in Table 3, notably noise, dust and land use conservation.

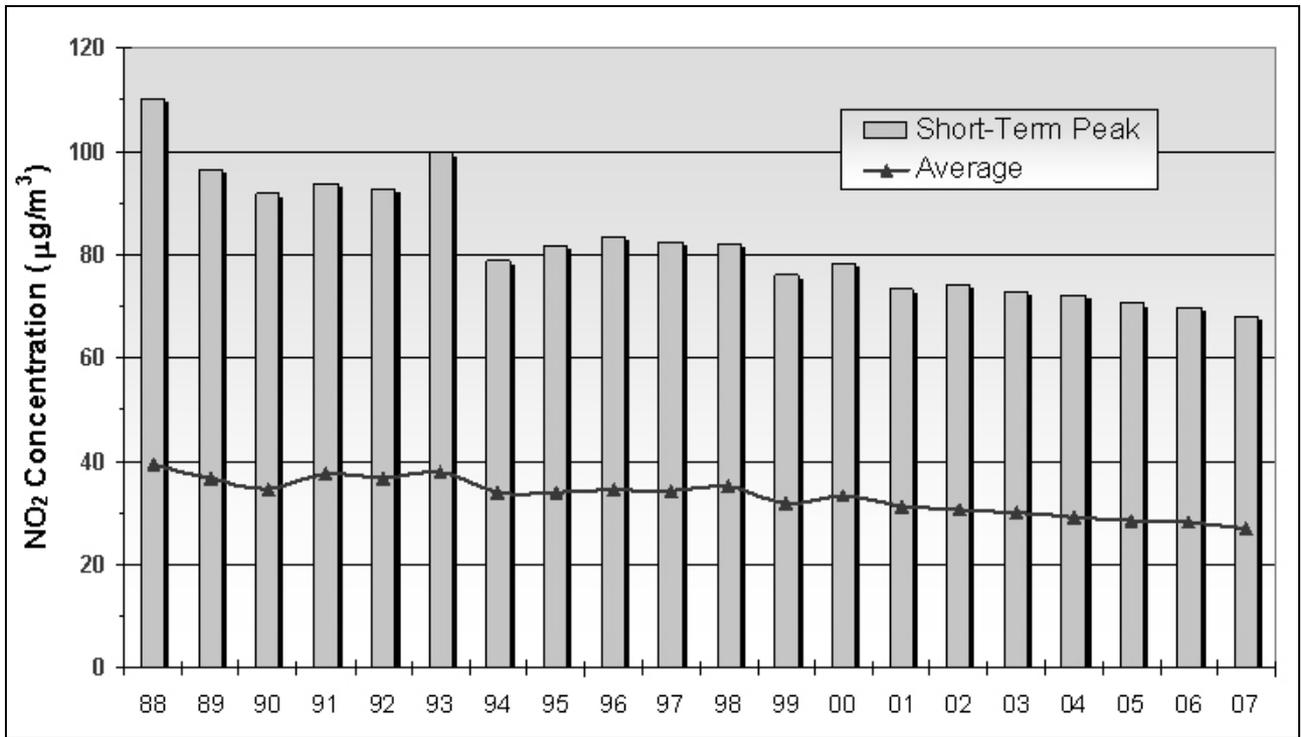
34. Port Metro Vancouver is situated in the Georgia Basin – Puget Sound (GB-PS) bi-national area. Marine traffic to the ports of Metro Vancouver, Seattle and Tacoma share the common transport corridor along the Strait of Juan de Fuca, as shown in Figure 3. Both the GB-PS airshed and watershed are studied by Canadian provincial and federal agencies and U.S. federal and state agencies in a collaborative manner.

Figure 3. Georgia Basin - Puget Sound Bi-National Area



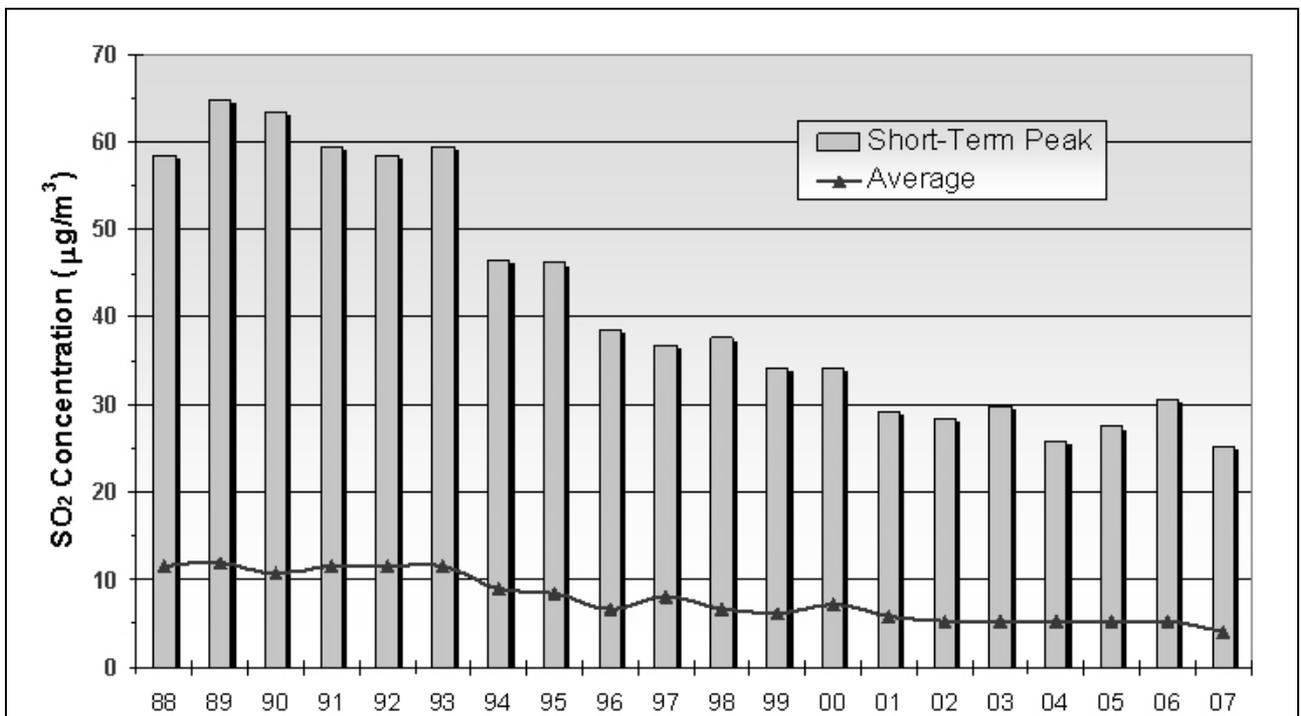
35. Although air quality in the Canadian portion of the GB-PS area is usually described as ‘good’, there is a strong desire at the community and local government level to reduce emissions and improve air quality over time. Figures 4-7 show that ambient air quality has improved in Metro Vancouver over the last two decades (these charts represent averaged results from several air quality monitoring stations in the region). Continued improvement is desired and the slight increasing trend in ground-level ozone over the last decade is considered a regional issue of concern. Presently, this increasing trend is believed to be due to a general rising trend in regional background ozone levels and not due to an increase in locally-produced ozone precursor contaminants (NO_x and hydrocarbons in particular) (Metro Vancouver, 2008a). It is also possible that the region is a hydrocarbon limited area, meaning that reductions in NO_x emissions over time may not have a lowering effect on ambient ozone.

Figure 4. Ambient Air Quality Trends for NO_x in the Lower Fraser Valley



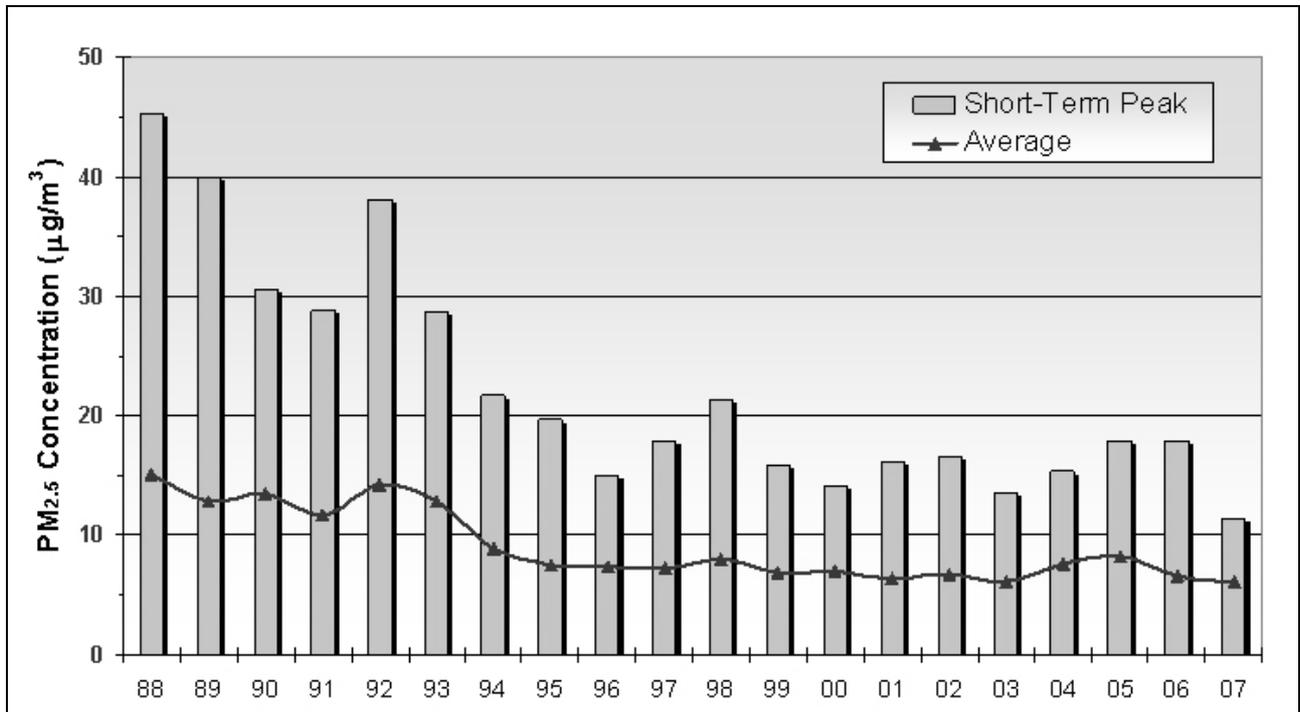
Source: Metro Vancouver (2008a).

Figure 5. Ambient Air Quality Trends for SO_x in the Lower Fraser Valley



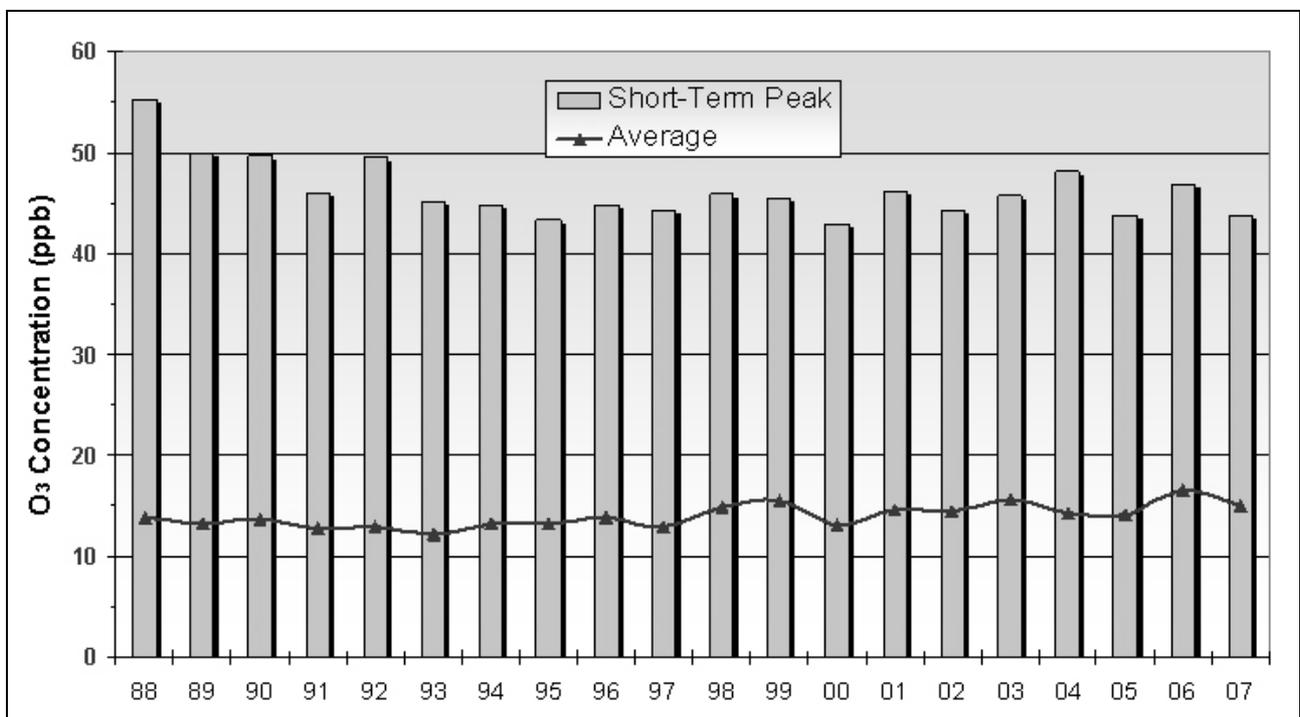
Source: Metro Vancouver (2008a).

Figure 6. Ambient Air Quality Trends for PM in the Lower Fraser Valley



Source: Metro Vancouver (2008a).

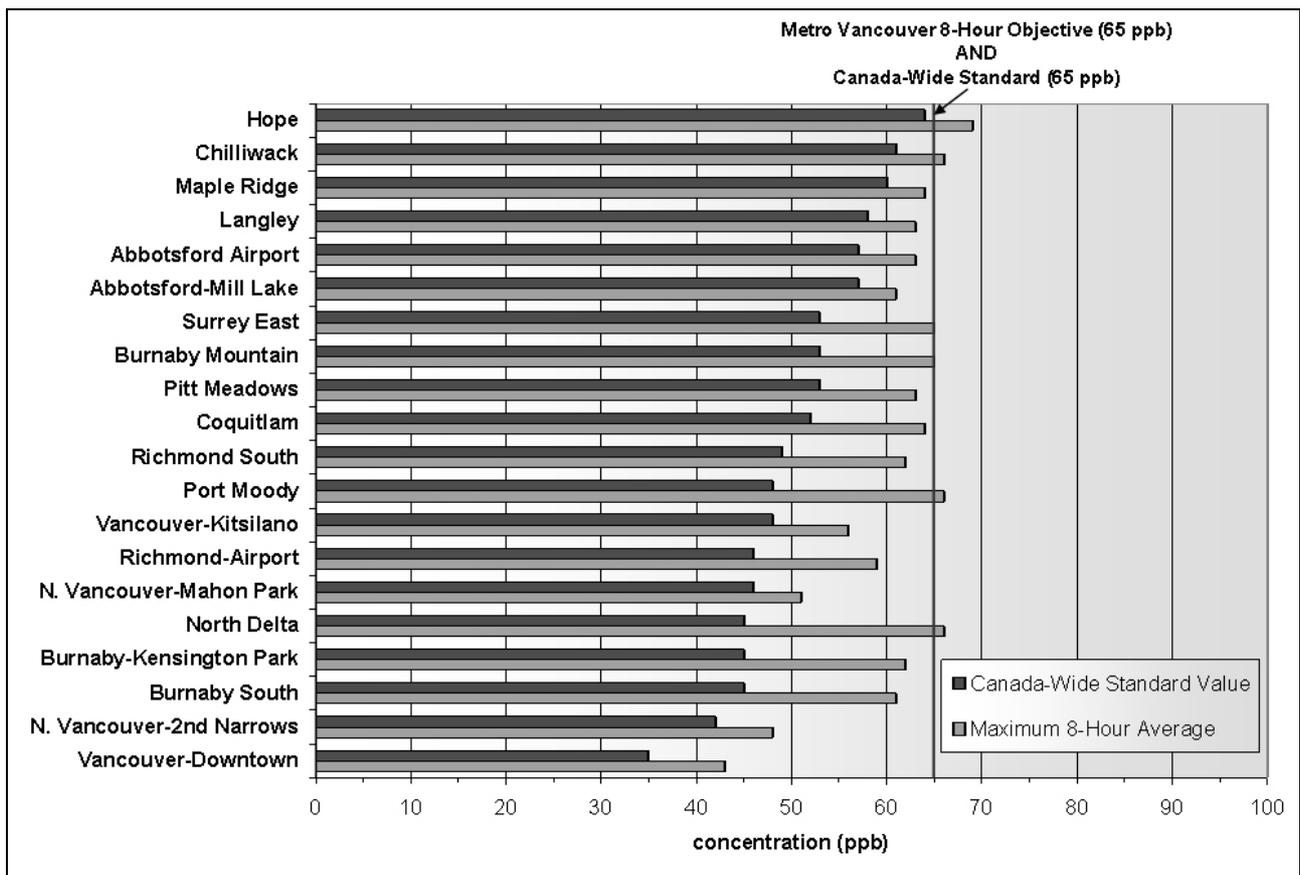
Figure 7. Ambient Air Quality Trends for O₃ in the Lower Fraser Valley



Source: Metro Vancouver (2008a).

36. Figure 8 provides an illustration of an air quality issue that is somewhat unique to the Lower Fraser Valley of British Columbia. Communities east of the Metro Vancouver municipalities experience the highest levels of ground-level ozone in the region, even though the eastern communities release relatively little of the ozone precursor contaminants. Regional flow patterns move NO_x and hydrocarbon emissions released in Metro Vancouver east to communities such as Hope and Chilliwack, where photochemical reactions during the summer months lead to short-term ozone concentrations that are very near the CWS standard and cause infrequent exceedences of the Metro Vancouver 8-hour ambient ozone objective.

Figure 8. Ground-level Ozone Concentrations for Stations in the Lower Fraser Valley



Source: Metro Vancouver (2008a).

37. Environment Canada, the U.S. Environmental Protection Agency (EPA), the governments of the Province of British Columbia and the State of Washington have adopted a science-based approach to managing the long-term environmental (and economic) sustainability of the region, acknowledging the growing population levels on both sides of the international border and associated ecosystem pressures. The *Transboundary Georgia Basin-Puget Sound Environmental Indicators Working Group* has existed since 2002, coordinating and publishing assessment reports identifying environmental indicators developed to both assess current ecosystem health and facilitate ongoing management.^{3,4}

³ www.pyr.ec.gc.ca/georgiabasin/.

⁴ www.epa.gov/r10earth/psgb/indicators/harbor_seals/references.htm.

38. The GB-PS Environmental Indicators Working Group addresses the following issues of importance to Port Metro Vancouver and the U.S. ports of Seattle and Tacoma:

- Maintenance of ecosystem integrity
- International Airshed Strategy (includes Marine Vessel and Port Emission Reduction Initiative)
- Participation in IMO, related emissions assessments
- Support and communication of demonstration projects, including fuel additives, use of biofuels, engine retrofits

39. The working group has developed greater attention for air emissions in the region, which has led to a number of studies (that are continuing) of marine emissions and their impacts to ambient air quality. An ‘International Airshed Strategy’ has since been developed with U.S. authorities, which was precipitated by some of the earlier studies (and related publications) in the region (Environment Canada *et al.* 2002, Levelton, 2004).

40. Environment Canada also participates in the *West Coast Collaborative*, which is a public-private partnership to reduce diesel emissions on the west coast of North America. The group largely is focused on raising awareness of the need for emissions reductions from diesel engines by supporting six sector workgroups including:

- Locomotives and Rail
- Trucking
- Construction and Distributed Generation
- Agriculture and Biofuels
- Marine Vessels and Ports
- Public Fleets

41. The Marine Vessels and Ports sector has a clearinghouse⁵ that provides a list of studies, management options and programmes/policies related to diesel emission reductions. The West Coast Collaborative has grown considerably in (informal) membership and includes government agencies and port representatives.

42. There are several ecosystem management or ‘action’ programmes that exist for marine areas within the jurisdiction of Port Metro Vancouver. These areas experience a high degree of traffic from ocean-going ships and other commercial vessels, as well as personal watercraft. Two of the largest programmes include the Burrard Inlet Environmental Action Program and the Fraser River Estuary Management Program. These programmes adopt a risk-based management approach based on select environmental indicators (similar to the approach used for the much larger scale GB-PS programme). The existence of these programmes shows that there is considerable concern for the aquatic environment at the local level as well as for the entire GB – PS area.

3. National Policies and Programmes

43. A number of national policies and programmes are in place to monitor environmental performance and achieve improvement over time. A particular CPA has the basis to develop its own

⁵ www.westcoastdiesel.org/wkgrp-marine.htm.

policies and related programmes. In general, the larger the port and its revenue stream, the greater its ability to develop and manage locally developed environmental policies and programmes.

3.1 *Project Developments*

44. The Canadian Environmental Assessment Act (CEAA) was formally introduced into legislation in 1995, after several years of nation-wide consultations and parliamentary review. This act provides the basis for environmental assessment (EA) at the federal level, with the objective to ensure that developmental projects do not cause significant adverse environmental impacts. The act is encompassing of other environmental legislation, including legislation that was passed since 1995 (such as the Canada Wide Standards). Therefore, this act and the federal agency created to support the act and related policy (the Canadian Environmental Assessment Agency) provides governmental agencies a broad and flexible mandate to participate and influence project developments, including port construction and expansion projects.

45. Currently, project proponents are required to identify all applicable federal and provincial standards that may have significance to the construction and operation of a planned project. Table 3 shows the potential federal and provincial agencies that could be involved in a project EA in the province of British Columbia, where Port Metro Vancouver is located. The related acts and regulations for the various agencies are additionally shown. CEAA and the related provincial agency place much of the responsibility for environmental study on the project proponent. Considerable responsibility and effort remains with the EA agencies to carefully review project studies and identify environmental concerns that may not have been adequately addressed by a proponent.

Table 3. Regulatory Agencies and Legislation Associated with Project Environmental Assessment

British Columbia

Regulatory Agency	Legislation or Regulation
<i>Federal</i>	
Canadian Environmental Assessment Agency	<i>Canadian Environmental Assessment Act (CEAA)</i>
Fisheries and Oceans Canada	<i>Fisheries Act</i>
Environment Canada	<i>Species at Risk Act (SARA)</i>
	<i>Canadian Environmental Protection Act (CEPA)</i>
	<i>Migratory Bird Convention Act</i>
	<i>Migratory Birds Regulations</i>
Transport Canada	<i>Transport of Dangerous Goods Act</i>
	<i>Navigable Waters Protection Act</i>
<i>Provincial (British Columbia)</i>	
BC Environmental Assessment Office	<i>BC Environmental Assessment Act S.B.C. 2002 c. 43</i>
Integrated Lands Management Bureau	<i>Land Act</i>
Agricultural Land Commission	<i>Agricultural Land Commission Act</i>
Ministry of Forests and Range	<i>Forests and Range Practices Act</i>
	<i>Forest Act</i>
	<i>Wildfire Act</i>
Ministry of Environment	<i>Environmental Management Act & Regulation</i>
	<i>Fish Protection Act</i>
	<i>Water Act & Water Act Regulation</i>
	<i>Wildlife Act</i>
Ministry of Tourism, Sport and Arts	<i>Heritage Conservation Act (HCA)</i>
Ministry of Agriculture and Lands	<i>Weed Control Act</i>

3.2 Existing Operations

3.2.1 Exhaust Emissions (CAC and GHG)

46. Under a nation-wide accord for environmental harmonization, the Canada Wide Standards (CWS) were developed to address environmental contaminants of national concern. Canada has long had a wide set of national objectives targeting environmental pollutants (including those addressed in the CWS) and therefore the CWS go further in meeting Canadians expectation of a common high degree of environmental quality. In general, the Standards are developed through a risk-based approach using scientific principles. Socio-economic factors and technical feasibility are also accounted for. The Standards contain a numeric limit (e.g., concentration in air or soil), but additionally may include a timetable for attainment of the Standard, a framework for monitoring progress and a list of actions to attain the Standard.

47. Current environmental contaminants in the CWS include:
- Benzene;
 - Dioxin and Furan emissions (specifically from conical waste combustion of municipal waste, incineration, coastal pulp and paper boilers, iron sintering plants and steel manufacturing electric arc furnaces);
 - Mercury emissions (specifically from waste incineration, base metal smelting, mercury-containing lamps and dental amalgam waste);
 - Petroleum Hydrocarbons in soil; and,
 - Particulate Matter and Ground-level Ozone.

48. The CWS include additional, related provisions of *Continuous Improvement* and *Keeping Clean Areas Clean* (CI/KCAC). These provisions relate to the PM_{2.5} and ground level ozone (and ozone precursor compounds) standards only, and not other air contaminants addressed in the CWS. The rationale for the CI/KCAC provisions are expressed below:⁶

To ensure that, in the vast areas of Canada with air quality better than the CWS numerical targets for PM and ozone, air quality is not significantly degraded and is maintained or improved to the extent practicable, to minimize risk to human health and the environment for the benefit of future generations.

49. The existence of the CI/KCAC places a unique environmental responsibility for management of PM and ozone (and indirectly NO_x and SO_x) that is subject to interpretation from all stakeholders – regulatory, public and private. The CWS in general require ongoing monitoring activities to ensure the standards are met, while the CI/KCAC provisions have emphasis on project development and avoidance of unnecessary emissions.

50. Similar to other countries, Canada has established the link between fuel quality and emissions from transportation sources. In particular, this has led to sulphur in fuel regulations that are generally harmonized with the U.S., since refineries and fuel suppliers in North America often serve both countries. However, the scheduling of the current sulphur in diesel regulations (see Table 4) is largely driven by the fuel requirements of advanced emission control technologies for diesel engines. Additional time has been allowed for Canada's Northern Supply Area, which includes the national Arctic regions.

Table 4. Environment Canada Sulphur in Fuel Regulations

Sulphur Limit (mg/kg)		On-Road Diesel Fuel	Off-Road Diesel Fuel	Rail and Marine Diesel Fuel
500	Production or Import	Since 1998	01-Jun-07	01-Jun-07
	Sales	Since 1998	01-Oct-07	01-Oct-07
22	Sales	01-Sep-06	N/A	N/A
15	Production or Import	01-Jun-06	01-Jun-10	01-Jun-12
	Sales	15-Oct-06	01-Oct-10	N/A

51. Lower sulphur levels in diesel fuel have been shown to reduce engine emissions of SO_x and PM and may additionally influence NO_x emission rates.

⁶ See www.ccme.ca/assets/pdf/1389_ci_kcac_e.pdf.

52. Canadian investigations of marine exhaust emissions have involved internationally oriented working groups. This acknowledges the need to contribute to and support internationally based regulations from groups such as the IMO. The regulations in Table 5 for marine diesel fuel have a limited effect on international vessels that visit Canadian ports, which may source diesel fuel from areas outside of Canada. In recent years, Canada has been active developing agreements and participating in working groups with related U.S. governmental agencies. An emphasis has been to establish harmonized environmental standards (such as fuel standards).

3.2.2 Fuel Spills

53. Canada's *Marine Liability Act*, first introduced in 2001, is the principal legislation for managing the liability of ship-owners associated with passengers, cargo, pollution and property damage. This Act provides a means to manage oil and fuel spills by way of mandatory insurance requirements for ship-owners and maximum fines that can be applied in the event of an accidental release. Much of the Act was designed to support international strategies and agreements. Canada has been a member of the international *Oil Pollution Compensation Fund* since 1989. A *Supplementary Fund Protocol of 2003* provides an additional tier of compensation for damages due to oil spills from tankers (an increase from \$500 million to \$1.5 billion for a single incident). The *International Convention on Civil Liability for Bunker Oil Pollution Damage, 2001* provides a framework for liability and fines associated with fuel spills (all forms of ship bunker) for all commercial ships other than oil tankers. The *Marine Liability Act*, updated in 2009, utilizes the 'polluter pays' principle and provides a complete framework for liability and compensation due to pollution damages from ships.⁷

54. The Fisheries Act prohibits the release of deleterious substances to waters frequented by fish. This prohibition is applicable to fuel spills as well as other substances and provides the basis for government to lay criminal charges in the event of negligent fuel releases to fish inhabited water.

55. The *Marine Liability Act* provides Transport Canada with the ability to manage all forms of fuel spills in a manner consistent with current international agreements and best practices. This is known by international shipping agencies, which likely influences which ships are active in Canadian waters (*e.g.*, this discourages use of older ships that may have a higher degree of risk for accidents). By requiring mandatory spill insurance for all ship-owners operating in Canadian waters, immediate spill response can be provided by the Canadian government without concerns related to costs.

56. The Response Regime additionally provides Transport Canada with a mandate to identify local industry resources that would be called upon in the event of a spill and supplementary regional industry resources that would be called upon depending on the magnitude of accident. A fully elaborated response plan has been developed for each Canadian port, with identification of industry partners and communication protocols.

3.2.3 Ballast Water

57. Transport Canada operates the Canadian Ballast Water Program⁸ in response to significant national concern with the introduction of alien invasive species by international shipping. The Ballast Program includes management for five Canadian regions – Arctic, Atlantic coast, St. Lawrence Seaway, Great Lakes and Pacific coast. Concern may be greatest for the Great Lakes, as over 170 aquatic alien

⁷ See www.tc.gc.ca/acts-regulations/acts/2001c6/menu.htm.

⁸ www.tc.gc.ca/marinesafety/oep/environment/ballastwater/menu.htm.

invasive species have been established in the region. Of these, over 70% are thought to have been introduced through ship ballast water.

58. The Canadian programme has undertaken studies and actions supportive of the IMO *Global Ballast Water Management Programme*, supporting local investigations and information sharing. Currently, Transport Canada is working towards ratifying IMO's Ballast Water Convention. Given the shared water resources with the United States, collaborative studies have been active with related U.S. agencies. Until recently (2006), Canada had voluntary guidelines for ballast exchange. All ships entering Canadian waters were expected to exchange ballast water outside of the exclusive economic zone (EEZ), with some exceptions during heavy seas. Currently, the Ballast Water Management Program has a mandatory ballast management requirement with four allowed options for ship ballast:

- Exchange at sea (outside of the exclusive economic zone);
- Retain onboard;
- Pump ashore to treatment;
- Use on-board treatment to IMO standards (which are set in the Canadian regulations).

59. Transport Canada currently has an enforcement programme at the national level. Ship inspections occur for approximately 25% of ships arriving to coastal ports and 100% of ships entering the Great Lakes (a shared responsibility with the U.S. Coast Guard and the Canadian and U.S. Seaway Corporations). Inspections include record checks as well as sampling of ballast for salinity to verify the water had been exchanged at sea. Transport Canada enters this information to a database to prioritize future inspection activities⁹.

4. Port-Based Programmes and Policies

60. The environmental mandate of the CPAs has evolved considerably over the past two decades. There is a growing trend towards more direct environmental stewardship as part of the day-to-day management of port operations. This often includes determination of effective collaboration with Transport Canada and the DFO by identifying specific roles the port could assume to increase environmental management performance. For longer-term strategies, actions by the port often would include developing agreements with its tenants and with shipping lines or associations. For day-to-day management, a port authority is the local expert for operational realities within its jurisdiction and therefore is well suited to adopt a 'First Responder' approach within the port jurisdiction for environmental issues such as fuel spills or leaks.

61. Port Metro Vancouver has an Environmental Programs Department to manage environmental issues associated with both developmental projects as well as day-to-day operations. The Department also deals with various agencies and organisations in both Canada and the U.S. in development of harmonized agreements. This report provides some examples of how Port Metro Vancouver addresses environmental issues associated with for example air emissions, discharges to water, dredging, maintenance works, development, habitat and stewardship among others. A more detailed summary can be found on their website at www.portmetrovancover.com.

62. The marine environment in and near the port has been studied by a number of government and academic groups and this has led to a baseline understanding of the current environmental condition and development of indicators to assess and use to track performance. The port has benefitted from the

⁹ Based on discussions with Transport Canada representatives.

knowledge gained through these studies and principally accesses this information by collaborating with agencies such as Environment Canada and the Department of Fisheries and Oceans and participating in working groups that may involve several government agencies and port authorities. A data baseline for marine habitat has been sufficiently developed to support several related policies and programmes, some of which have been in place for more than a decade. In the last 20 years, Port Metro Vancouver and its precursor ports have increasingly been contributors and drivers of environmental research.

63. A data baseline for air quality, including CAC and GHG emissions has been more recently developed for port operations. Currently, it consists of two activity-based emission inventories; one completed for ocean going vessels in 2007, that was led and published by a shipping association (BC Chamber of Shipping, 2007) and one completed for landside mobile sources that was conducted by the port directly (SENES Consultants, 2008).

64. The development of an air quality data baseline has supported a number of direct environmental policies and programmes, as longer-term strategic goals focussing on environmental performance and day-to-day procedures to promote and support programme initiatives. For day-to-day procedures, the port is able to rely upon its Harbour Patrol. The Port Metro Vancouver Harbour Patrol programme operates with five vessels and 13 full time staff members (additional crew are available on a part-time basis). This programme has existed for several decades, with duties largely consisting of investigation of spills, Search and Rescue, hazard removal, assistance to police and assistance for special events in the harbour such as fireworks. During the last 15-20 years, the responsibilities of the Harbour Patrol programme have been extended to support environmental policies and programmes initiated by the port, including application reviews for reduced harbour fee dues associated with use of cleaner fuels or other eligible emission reduction measures.

65. The Harbour Patrol regularly boards up to 98% of the ships that call to the port over any given period (anecdotal estimate by the port).

4.1.1 *Air and Climate*

66. The port has developed an effective programme to deal with its CAC and GHG emissions in a relatively short amount of time. Beginning with identification/clarification of the issue in 2002 (Environment Canada *et al*, 2002) and a regional emissions inventory for the Fraser Valley shortly after (Metro Vancouver, 2003), ship exhaust emissions were identified as a significant, and growing concern for the region. The port's Air Action Program¹⁰ was developed in 2006 to address air quality and climate change issues for the port.

67. A Georgia Basin Marine Vessel Air Quality Work Group was formed in 2004 to formally investigate commercial marine vessel emissions and develop coordinated policies for air quality management. The working group is currently active and involves the port, Environment Canada and Transport Canada (as well as provincial and regional government representation) and substantial participation from industry associations. The B.C. Chamber of Shipping took on the lead role in the working group to ultimately construct a spatially and temporally resolved activity-based emissions inventory of ocean-going vessel emissions off the coast of British Columbia for 2005/2006. (B.C. Chamber of Shipping, 2007). A previous study completed for Environment Canada (SENES Consultants, 2004) had identified the need for industry participation in such assessments and this approach was ultimately adopted by the B.C. Chamber of Shipping, with financial support from Environment Canada and Metro Vancouver. This working group and the resultant emissions assessment present a very good example of the benefit that

¹⁰ Available at www.portmetrovancover.com/environment/initiatives/air.aspx.

can be achieved through partnership between governments, industry and a port authority. The 2005/2006 inventory was recognized in North America for its unprecedented level of detail, which was made possible by use of a comprehensive vessel survey programme managed by the Chamber of Shipping. Over 1700 vessels were surveyed during 2005/2006, enabling identification of engine displacement and usage (engine loads) patterns, as well as boiler fuel consumption. The inventory directly used vessel tracking data from the Canadian Coast Guard. Through ship Automatic Identification System (AIS) fields and other data forms extracted from the Coast Guard tracking system, the B.C. Chamber of Shipping was able to develop a database of ship positional information off the coast of B.C. in 3-7 minute time steps.

68. The B.C. Chamber of Shipping inventory included a number of valuable outputs to facilitate air quality management, including:

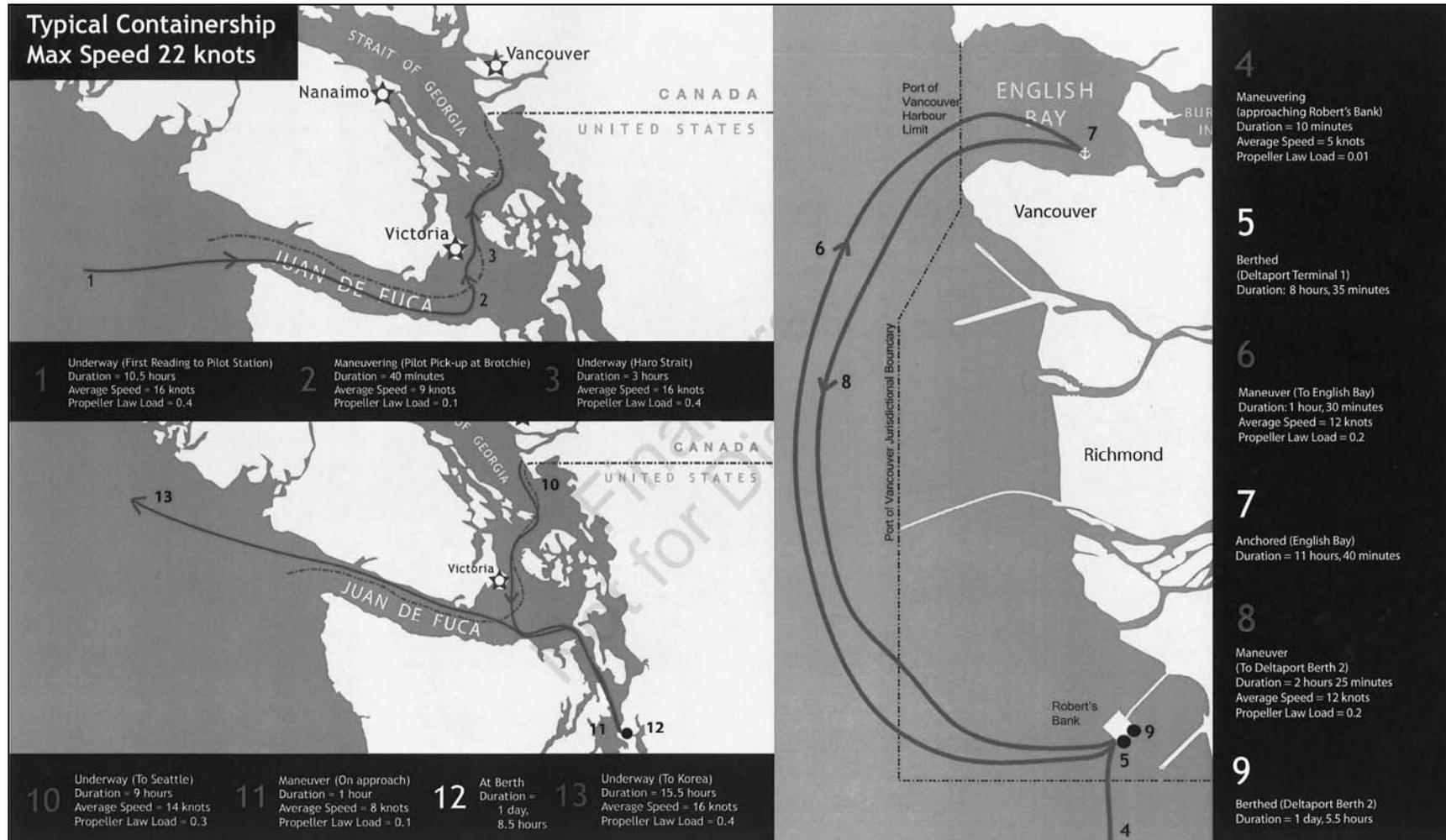
- An accounting of all vessel modes of activity, including intra-harbour movements as well as anchoring and bunkering;
- Distinction of fuel consumption – amounts consumed during different activity modes, amounts of high sulphur versus low sulphur fuels used;
- An accounting of vessel practices by ship class – engine sizes, engine uses, cruising speeds, periods of stay dockside.

69. The graphic shown in Figure 9 showcases the level of detail available from the Chamber of Shipping inventory. Use of the ship positional data provided articulation of actual shipping lanes, times spent awaiting a marine pilot or at anchor and previously un-documented activity, such as additional travel for vessel fuelling and movements related to queuing while awaiting a berth.

70. The ocean-going vessel emissions inventory is representative of current best practices for marine emission inventory development and has been shared with provincial and regional government agencies to help identify smaller-scale initiatives for their communities. Of particular importance, the inventory is fully activity-based and accessible within a database environment, facilitating site-specific summaries of vessel movements. Through data sharing facilitated by the working group, inventory summaries were ultimately used for two regional emission inventories.¹¹

¹¹ The 2005 inventory for the Fraser Valley and an update of the 2004 inventory for the Capital Regional District.

Figure 9. Data Example from 2005-2006 BC Ocean-Going Vessel Emissions Inventory



Source: B.C. Chamber of Shipping (2007).

71. During development of the marine inventory, the port initiated a landside emissions inventory for port-related activities (including over 50 marine terminals and facilities). Similar to the marine inventory, the landside inventory accounted for CAC and GHG emissions on a detailed activity basis, relating specific pieces of equipment to their associated emissions on a terminal-by-terminal basis. Table 5 provides an example summary of the port-related cargo handling equipment activity. Similar summaries can be extracted for fuel(s) consumption and emission amounts.

Table 5. Port Metro Vancouver Cargo Handling Equipment Activity Rates by Terminal Type

Facility Group	Equipment Group	Number in Port	Average Year	Oldest Year	Newest year	Minimum hours of use (year)	Maximum hours of use (year)
Break Bulk	Aux	6	2001	1996	2006	50	1200
	Loader	140	1997	1976	2006	300	1400
	Stack/Crane	6	1980	1979	1982	450	450
Container	Aux	6	2001	1996	2006	100	150
	Loader	28	1998	1975	2006	100	2800
	Stack/Crane	126	2000	1987	2006	500	6240
	Off Road Truck	191	2001	1993	2006	900	6000
Dry Bulk	Aux	14	1997	1991	2004	200	1000
	Loader	85	1998	1973	2006	17	2500
	Stack/Crane	2	1981	1980	1982	300	500
	Off Road Truck	13	1992	1981	2002	400	3380
Liquid Bulk	Loader	5	2001	1996	2005	44	1101
Other	Aux	38	1992	1981	2006	104	2340
	Loader	92	1993	1964	2006	104	6336
	Stack/Crane	14	1980	1961	2005	260	2080

Source: SENES (2008). This summary does not include port-related facilities on the Fraser River.

72. The result of these two activity-based assessments provides a detailed air emissions baseline for the port, with which to plan emission reduction strategies.

73. The port's Air Action Program includes acknowledgment of national and international standards and their effective implementation dates. The Northwest Ports Clean Air Strategy, part of the Air Action Program, identifies specific emission reduction strategies with defined performance metrics and reporting requirements.

74. The Air Action Program has several defined components, including:

- The Northwest Ports Clean Air Strategy (a collaborative strategy with the ports of Seattle and Tacoma);
- The Differentiated Harbour Dues Program (provides incentives for ships to reduce emissions beyond requirements);
- The Canada Place Shore Power Initiative (dockside electrification for cruise ships, involving a partnership between the port, two cruise lines, the provincial and federal government and the provincial power authority);
- The Container Truck Licensing Program (phases out use of older trucks and includes mandatory opacity and idling limits);
- Logistical improvements for container trucking management, including a mandatory reservation system and extended gate hours to reduce congestion;

- On- and off-road vehicle idle reduction programme (including education packages for port tenants);
- A project construction programme to require tenants to commit to emission reduction measures (expressed as part of the permit).

75. The Differentiated Harbour Dues Program, available to vessels calling Burrard Inlet and Roberts Bank (to be rolled out to the entire port in 2010), establishes harbour dues which are payable for the first five visits by a particular vessel during the calendar year, within the following 4 air emission standards:

- Gold: Any one of: Lloyds Register Environmental Protection Classification plus any two of the supplemental notations for SO_x (S), NO_x (N), or Vapour control/recovery (V)-equivalent classification by other societies is also accepted; fuel with ≤ 0.5% S in auxiliary engines within 24 nautical miles of the port's Navigational Jurisdiction Boundary; fuel with ≤ 0.2% S in auxiliary engines at anchor and dock; select engine emission controls in main and/or aux engines; other select fuel options such as use of biodiesel or fuel-borne catalysts in main and/or aux engines; or shore power capability. Dues: \$0.057/GRT.
- Silver: Any one of: Lloyds Register Environmental Protection Classification plus any one of the supplemental notations S, N or V-equivalent classification by other societies is also accepted; or use of fuel with ≤ 1.0% S at anchor and dock in main and/or auxiliary engines. Dues: \$0.067/GRT.
- Bronze: Any one of: Lloyds Register Environmental Protection Classification-equivalent classification by other societies is also accepted; use of fuel with ≤ 2.0% S at anchor and dock in main and/or auxiliary engines; or (for fuel barges and tankers) use of vapour control or recovery system. Dues: \$0.077/GRT.

76. This programme has been described by the port as a recognition programme for those vessels choosing to reduce emissions beyond requirements, more so than an incentive programme. This is because the lowered dues may only make up a portion of the potential increase in operating costs. In 2008, 19% of the vessel calls for which harbour dues were payable within the Burrard Inlet and Roberts Bank experienced the reduced rates.¹²

77. Central to the Air Action Program, the Northwest Ports Clean Air Strategy is a comprehensive initiative that encompasses other local programmes and also involves collaborative efforts and agreements, principally with the ports of Seattle and Tacoma. The Clean Air Strategy targets PM, NO_x and SO_x emissions from diesel engines and has a key goal to stay in attainment of ambient air quality objectives, acknowledging the continuous improvement provision of the Canada Wide Standards. The Strategy also notes a goal to reduce GHG emissions through co-benefits associated with reduction of CAC emissions.

78. The Clean Air Strategy contains policies and related performance measures for the following emission source groups:

- Ocean-going vessels;
- Cargo handling equipment;
- Rail locomotives;
- Trucking (including smaller vehicles);
- Harbour vessels (which currently do not have attributed performance measures); and,

¹² Estimate provided by the port.

- Administration.

79. The performance measures are expressed in terms of fuel and engine standards rather than a total or percent reduction in emissions over time (2010 and 2015 years are used to measure progress in the short term and the long term). For example, the performance measures for cargo handling equipment are expressed as:

By 2010:

Reach the port-wide equivalent PM reduction of Tier 2 or Tier 3 engines operating with ultra low sulphur diesel or a biodiesel blend of an equivalent sulphur level, and promote early implementation of the requirements between now and 2010. All new terminals will be equipped with new CHE equipment meeting the highest standards that are practicable for the anticipated use at the time of purchase.

By 2015:

Reach a port-wide equivalent of Tier 4 engines, for 80% of equipment. Retrofit the remainder of equipment with best available verified retrofit technologies. Purchase of cleanest available cargo handling equipment that is practicable for the anticipated use at the time of scheduled capital upgrades.

80. A ‘menu’ of potential actions to meet the performance measures is also listed for each source group, as well as measurement and reporting criteria to track annual progress.

81. The Air Action Program also serves to incorporate and disseminate the results of past and ongoing initiatives by the port or one or more port tenants (e.g., case studies for dockside equipment or use of gen-set locomotives). Many of these initiatives have included access to the national funding programmes run by Transport Canada, such as ecoFREIGHT.

82. The port authority is currently determining its corporate CAC and GHG footprint for the 2008 year, with additional assessment of future emission reduction opportunities. These actions are also part of the port’s Air Action Program.

4.1.2 Water

83. The port’s policies and actions relating to the marine environment include ongoing collaboration with a number of working groups and actively engaging with several local marine habitat management committees during project reviews.

84. Section 56 of the *Canada Marine Act* provides the CPAs with the ability to monitor ships about to enter a port and establish practices and procedures to be followed. This includes management of safety and efficiency and environmental protection. The port’s Harbour Operations Manual contains a set of local practices to promote and ensure safe and efficient practices and additional actions and requirements to protect the marine environment. This manual provides the Harbour Patrol with its mandate to board ocean-going vessels within the port’s jurisdiction to communicate the port’s environmental policies.

85. The port’s Ballast Water Management Program was one of the first programmes of its kind internationally when it was introduced (1997). The programme had a mandatory requirement for mid-ocean ballast exchange, even while a voluntary programme existed elsewhere in Canada. This programme is now replaced with the current mandatory national programme, which was based in part on the port’s local programme.

86. For visiting ships, the port's Harbour Patrol seals the engine room bilge discharge valve(s) with a tamper-proof seal. Hold washing discharges can be requested and these requests are treated on a case by case basis. Any accidental discharges must be reported to the port immediately. One Harbour Patrol craft has thermal imaging that can be used to identify oil in water.

87. The *Canada Shipping Act* requires vessels to immediately report oil or fuel spills to the Canadian Coast Guard. The port has taken an informal First Responder role for any leak/spill issues and informs each vessel captain of the port's expectations and local communication protocol upon entry to the jurisdictional waters. In the event of an accident, the port is typically the first to respond and facilitate communication with the affected governmental agencies.

88. The port does not permit any discharge of problematic wastes (sludge, sewage, garbage) to the marine environment and discourages non-problematic discharges. Local suppliers are available to receive discharges from ocean going vessels, for limited volumes.

4.1.3 *Noise, Dust and Visibility*

89. Noise, dust and visibility is formally managed by the port for construction and expansion/maintenance projects (often as criteria expressed in project permits) and informally managed for nuisance issues (complaints). For example, the East Vancouver Port Lands planning area, which is an area attached to downtown Vancouver that experiences relatively high levels of trucking and rail activity, has its own 'Area Plan' that was developed with the local stakeholder groups (which included the City of Vancouver and the Burrardview Community Association). For this area, a set of locally-sensitive land-use principles and actions were developed and the key environmental issues of concern were studied (the available land-use base, visibility and views from the residential areas, existing noise levels and associated port policies and air quality) among additional issues of concern, such as safety.

90. The Environmental Programs Department has a response programme for nuisance issues where occurrences of excessive noise, dust and visible stack plume are investigated by port staff to identify the cause and discuss viable options to minimize the issue with the tenant, ship or other source where feasible. For example, the port responds to excessive ship exhaust opacity to ensure a quick remedy is applied (such as a change in engine operation).

91. Infrequently, dust can be a source of complaints by community members near marine terminals. At times, dust from minerals and grains handling can be liberated. Dust controls such as water application and elevated sprays are required for terminals that handle large volumes of materials that can cause dusting and these requirements are expressed in their lease agreements. In some cases, a dusting event may be caused by lack of adherence to a documented dust management programme; the port's response to a dusting event includes contacting the operation to ensure that a resolution is being worked on whenever possible. A detailed port assessment of fugitive dust emissions (*e.g.*, an emissions inventory) is often very difficult to develop compared to an inventory of engine exhaust emissions. Although emission factors are available from the U.S. EPA and other sources, significant variability in potential rates is often possible, depending on the specific commodity attributes for the minerals or grains handled at a terminal. In addition, available emission factors usually relate to 'normal' operational practices and not the atypical conditions that tend to lead to dusting events.

4.1.4 *Harmonized Programmes*

92. The port has developed a project review process with a unique Environmental Assessment Procedure (EAP). All proposed projects involving physical work and potentially problematic activities

(e.g., discharges) on port property require approval through EAP. This would include new structures on land or water, additions or modifications to existing structures, demolitions, dredging or land grading and recreational docks. The EAP and project review process establishes consistency in assessment procedures and provides defined expectations for proponent requirements.

93. The EAP requires a description of all potential environmental impacts associated with a project's construction and operation. Development of a local environmental baseline is required if a suitable baseline assessment has not been prepared in the past. A description of the methods that a project proponent will use to avoid or reduce environmental impacts is also required. Depending on the nature and size of the project, detailed site assessments and development of current and expected future activity levels may be required.

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