

**NATIONAL MARINE  
EMISSIONS INVENTORY TOOL (MEIT)  
V 4.1.0**

**Prepared for:**

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**615307  
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**SNC • LAVALIN**

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## 1.0 INTRODUCTION

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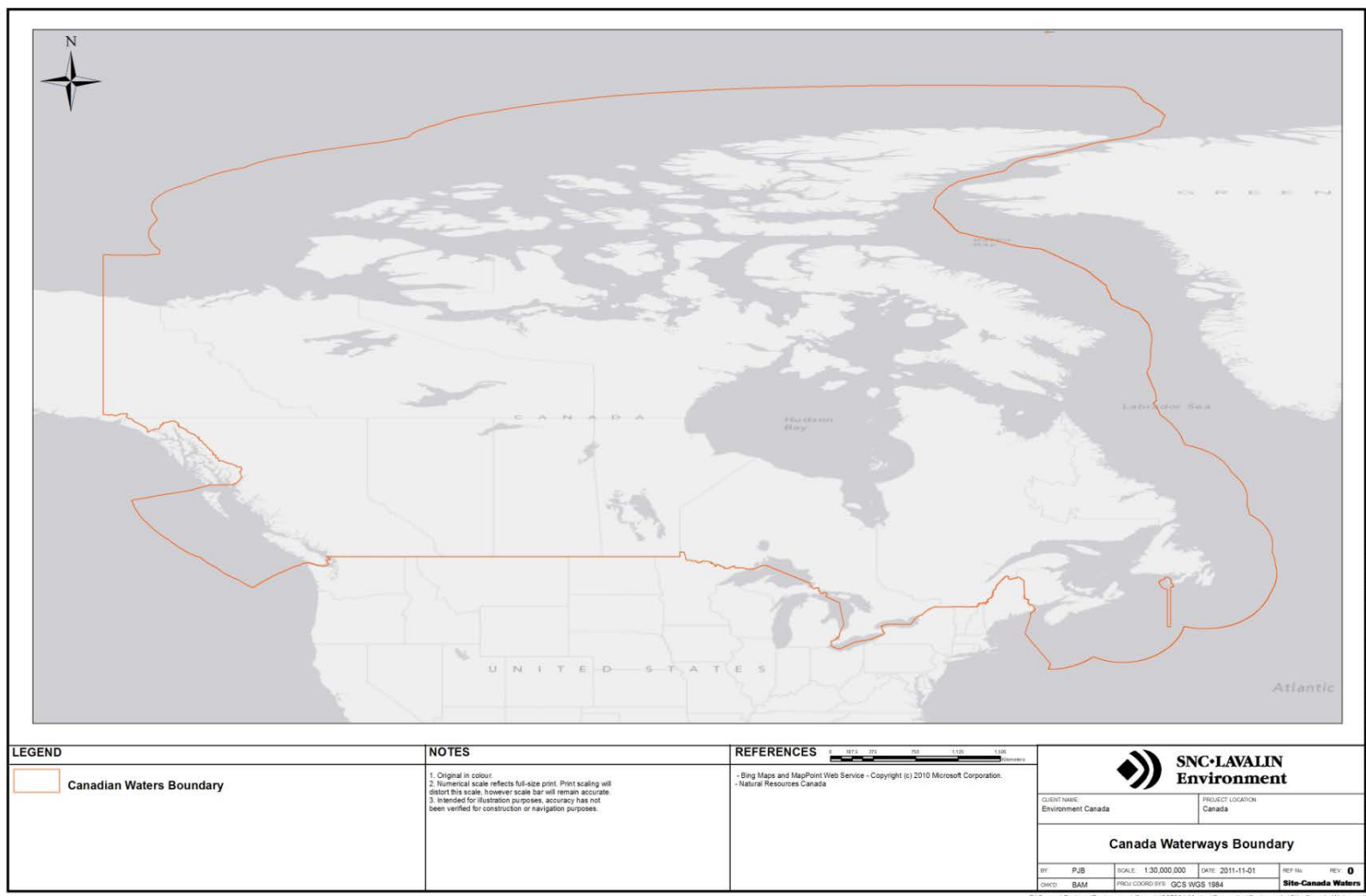
The Environment & Water business unit of SNC-Lavalin Inc. (SNC-Lavalin), in partnership with ClearSky Engineering Inc. (ClearSky) was contracted to complete a national marine emissions inventory for the 2010 calendar year. The inventory includes all commercial marine vessel classes tracked by the Canadian Coast Guard (CG) within Canada's territorial waters, as well as smaller commercial craft such as ferries, tugboats and tourboats that are not fully represented in the CG movement data. All coastal areas as well as inland rivers and lakes are included in the inventory.

Canada has a 'Marine Emissions Inventory Tool' (MEIT) that has been developed and supported by the Canadian government since a 2002 marine inventory was completed for the Great Lakes and east coast of Canada (work completed in 2006). Since this time there has been a history of investigations and developments to improve the model as understanding of ship emissions data as well as Canadian ship movements has increased. MEIT V3.5 was used as a starting point for this project, with the expectation that the model would be updated with additional information and support from the project stakeholders, which include several active shipowners associations. The **2010 Canadian Marine Emissions Inventory** report should be viewed as an additional resource for using MEIT V4.1.

In 2010, CG movement data was available from the CG Information System on Marine Navigation (INNAV) and the Vessel Traffic Operation Support System (VTOSS). 2010 INNAV data is representative of Ocean Going Vessel (OGV) movements in eastern Canada (including the Great Lakes) as well as Canada's Arctic. VTOSS is representative of movements off the coast of British Columbia. As the INNAV system is now supported in all coastal areas of Canada (2011), MEIT updates were developed reflective of INNAV structure and data quality.

A map of Canada's territorial waters is shown in Figure 1.1.

Figure 1-1: Canada's Territorial Waters



## 1.1 Model History

MEIT has a history that dates to 2005. The different versions of the model prior to V4.1, as well as a basic description of functionality is provided in Table 1-1.

**Table 1-1: MEIT History**

| Model Versions                                                              | Model Features                                                                                                                                                                                                                           |
|-----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Version 1.0, September 2005<br>(Levelton Consultants Ltd.)                  | Framework of model developed;<br>MS Access database platform;<br>Lloyd's movement data used to elaborate vessel activities; and<br>Entec 2002 energy based emission factors employed.                                                    |
| Version 1.2, March 2006<br>(Levelton Consultants Ltd.)                      | Vessel movement data structure modified to accept Canadian INNAV data;<br>Ship profiles established based on California studies; and<br>Inventory completed for Eastern Canada / Great Lakes.                                            |
| Version 2.1, March 2007<br>(SENES Consultants Ltd.)                         | New ship profiles developed based on eastern Canadian survey data;<br>Recalculation of inventory for Eastern Canada / Great Lakes.                                                                                                       |
| Version 2.2, March 2008<br>(SENES Consultants Ltd.)                         | User inputs for fuel sulphur;<br>Fuel consumption calculations;<br>Reduced speed regions facilitated;<br>Characterization of ship boilers;<br>Emission factor equations for PM*.                                                         |
| Version 2.5, June 2008<br>(ClearSky Engineering, Levelton Consultants Ltd.) | Full GHG characterization;<br>Vessel routing for West Coast of Canada;<br>Engine characterization by EPA categories.                                                                                                                     |
| Version 3.0, December 2008<br>(ClearSky Engineering)                        | SQL Server platform;<br>Multi-user, network capabilities.                                                                                                                                                                                |
| Version 3.5, March 2010<br>(ClearSky Engineering)                           | Fleet turnover assumptions for forecasts;<br>Fuel based emission rates to complement activity based rates;<br>Revised cruise ship method (based on CoS method, 2006)**;<br>Ammonia (NH3) added to contaminants;<br>Anchoring mode added. |
| Version 4.0, March 2012<br>(SNC Lavalin)                                    | Activity based on coast guard (and other) source data, using GIS to calculate trip lengths                                                                                                                                               |
| Version 4.0a, May 2013<br>(SNC Lavalin)                                     | Arctic specific version of MEIT 4.0. Activity based on coast guard INNAV source data. Three additional forecast activity modifications added (by specific trip, by region and vessel class, by vessel class).                            |
| Version 4.1, December 2013<br>(SNC Lavalin)                                 | Merged MEIT 4.0 and Arctic versions together into single database.<br>Refined emission calculations, splitting out emissions by fuel type.                                                                                               |

Notes: \*PM = suspended particulate matter

\*\* CoS = BC Chamber of Shipping

All versions of MEIT noted in Table 1-1 rely on an Origin – Destination (OD) approach whereby vessel underway activity is simulated by identifying distances attributable to unique OD pairs. By estimating the distance of a voyage and assuming a characteristic cruising speed, an estimated time of travel can be determined. This approach, consistent with similar studies in the U.S. and other regions, was used for the previous marine emissions inventories developed for eastern Canada and the Great Lakes.

## 1.2 Model Scope

### 1.1.1 Air Contaminants

MEIT V4.1 includes numerous air contaminants of interest to Canadian government. Criteria Air Contaminants (CACs), also referred to as 'Common Air Contaminants' by some Canadian jurisdictions, have known effects on either human health or the environment. They are typically included in most large scale inventory efforts in Canada. GHG emissions play a role in climate change and therefore are also typically included in emissions accounting.

Air toxic emissions are more uncertain and tend to be characterized by use of speciation profiles. The list of air toxics included in the inventory are those supported by the U.S. EPA for marine engines in their 2008 National Emission Inventory (NEI).

The following air contaminant species are represented in MEIT V4.1:

#### Criteria Air Contaminants (CACs):

- ◆ Nitrogen oxides (NO<sub>x</sub>), sulphur oxides (SO<sub>x</sub>), carbon monoxide (CO), volatile organic compounds (VOC), particulate matter (PM, as total PM, PM<sub>10</sub> and PM<sub>2.5</sub>, as well as elemental, organic and sulphate fractions) and ammonia (NH<sub>3</sub>).

#### Greenhouse Gases (GHGs):

- ◆ Carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O), as well as equivalent carbon dioxide amounts (eCO<sub>2</sub>).

#### Air Toxics:

- ◆ 10 different metals, including chromium 3 and 6;
- ◆ 13 different 'Hazardous Air Pollutants' (HAPs), including benzene, toluene and formaldehyde;
- ◆ 16 Polycyclic Aromatic Hydrocarbons (PAHs);
- ◆ Combined dioxins; and
- ◆ Combined Polychlorinated biphenyls

### 1.1.2 Supported Regions of Canada

MEIT V4.1 supports 22 defined regions of Canada, consistent with V3.5, with some additions. These regions are shown in Figure 1-2 and are defined below:

0. **Inland Canada:** Area in Canadian Waters boundary not allocated to a region below.
1. **Northern Canada:** Western boundary is between the Northwest Territories and Nunavut. The eastern boundary is the border between Northwest Territories and the Yukon Territory. Primary port: Tuktoyaktuk, NT.
2. **Greater Vancouver Regional District/Lower Fraser Valley:** This region encompasses the area within the jurisdiction of Metro Vancouver. Primary Port: Port Metro Vancouver.
3. **Northern Coast of BC:** Boundary on the western side is the eastern side of Haida Gwaii (formerly the Queen Charlotte Islands) extending north to the international boundary and south to the northern tip of Vancouver Island. Primary Port: Prince Rupert.
4. **West Coast:** Entire West Coast following the 200 nautical mile limit, but excludes regions 2 and 3. Primary Port: Victoria.
5. **Lake Superior:** Includes the entire lake with the eastern boundary being the western side of Sault Ste. Marie. Sault Ste. Marie is not in this region. Primary Port: Thunder Bay.
6. **Lake Huron/Georgian Bay:** Starting at the western side of Sault Ste. Marie this region includes all of Lake Huron and Georgian Bay and extends to the northern end of Sarnia. Sarnia is not included in this region. The eastern side of this region is the Straits of Mackinac separating Mackinaw City and St. Ignace. Primary Port: Sault Ste. Marie.
7. **Lake St. Clair:** Region starts at the northern side of Sarnia and stretches to the southern side of Windsor. Both Sarnia and Windsor are included in this region. Primary Port: Sarnia.
8. **Lake Erie:** Region starts at the southern side of Windsor and includes Lake Erie and the Welland Canal. The eastern boundary is the point where the Welland Canal enters into Lake Ontario. Primary Port: Nanticoke.
9. **Lake Ontario:** Region includes Lake Ontario from the start of the Welland Canal to the Quebec border. Primary Port: Hamilton.
10. **St. Lawrence Seaway:** Region includes the area from the Quebec border to Contrecoeur, Quebec. This area includes the entire port of Montreal. Primary Port: Montreal.
11. **St. Lawrence River:** Region includes the area from Contrecoeur to Les Escoumins.

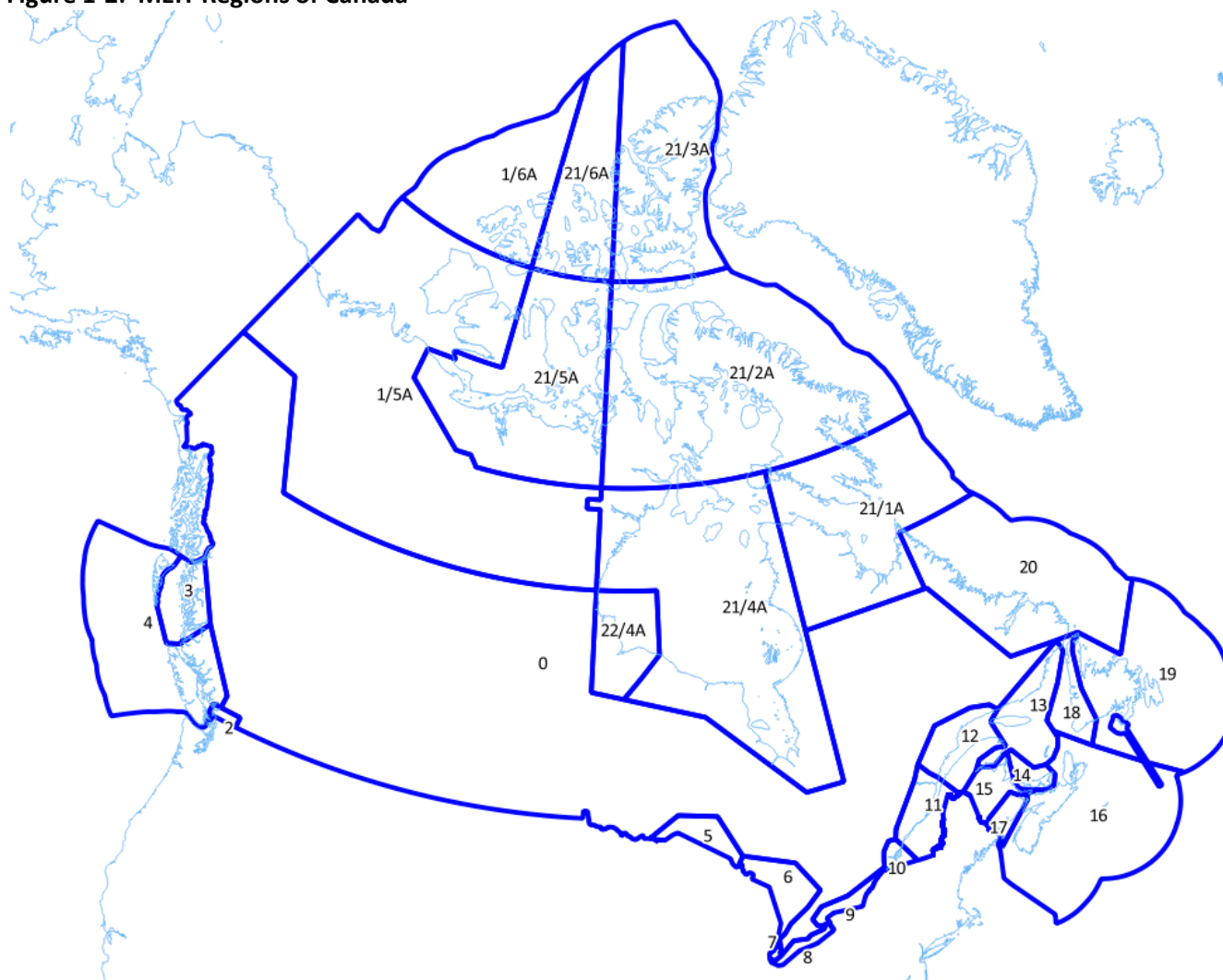
12. **Mouth of St. Lawrence River:** Region extends from Les Escoumins/Trois-Pistoles to the western tip of Anticosti Island. Eastern border is formed by extending a line from Havre-St. Pierre to the eastern tip of Anticosti Island (Port Menier) and then down to the Cape of Gaspé. Primary Port: Sept Îles.
13. **Gulf of St. Lawrence (Quebec Region):** Western boundary of this region is the line between Havre-St. Pierre/Eastern tip of Anticosti/Gaspé. Northern/Eastern boundary is the Quebec/Newfoundland border. Southern boundary is the Quebec border running from Dalhousie (NB) to the Madeleine Islands. Primary Port: Havre St. Pierre.
14. **PEI:** Boundary is the provincial waters around PEI. Primary Port: Charlottetown.
15. **Gulf of St. Lawrence (New Brunswick) Region:** Northern boundary extends from Dalhousie to the point where provincial boundary meets the provincial boundary of PEI and Quebec. South-eastern boundary is the provincial boundary between PEI and NB. Primary Port: Dalhousie.
16. **Nova Scotia (North and Eastern side) Region:** North-western boundary extends to the provincial boundary between PEI/NB/Nova Scotia, around the tip of Cape Breton Island. The eastern boundary is the 200 nautical mile limit. The southern limit is the international border and the western limit will be the provincial boundary extending out of the Bay of Fundy to the international boundary. Primary Port: Halifax
17. **Bay of Fundy (New Brunswick) Region:** This region includes the western portion of the Bay of Fundy from the provincial border to the international boundary. Primary Port: Saint John.
18. **Western Newfoundland Region:** The western boundary for this region is the provincial border between Newfoundland and Quebec. The Northern boundary is the line running between Red Bay and the tip of Newfoundland. The southern boundary is the line running over the northern tip of Cape Breton Island and the eastern boundary is the line running from Burgeo (NF) to the Nova Scotia Border. Primary Port: Corner Brook.
19. **East Shore of Newfoundland Region:** This region is bounded in the south west by the line from Burgeo (NF) to the Nova Scotia Border, in the south by the Nova Scotia Provincial Boundary, in the east by the 200 nautical mile border and in the north west by the line extending from Fogo to the 200 mile limit. Primary Port is St. John's.
20. **North Shore of Newfoundland/Labrador Region:** This region is bounded in the north by the line running northeast from the Labrador/Quebec border to the 200 nautical mile limit, and south by the line running northeast from Fogo to the 200 mile limit. The eastern boundary is the 200 mile limit. Primary Port: Happy Valley Goose Bay.

21. **Iqaluit Region:** The southern boundary is the line connecting the Labrador/ Quebec border with Nuuk, Greenland. The eastern border is the border between Northwest Territories and Nunavut. Primary Port: Iqaluit, NU.
22. **Hudson Bay, Manitoba Region:** The northern boundary is the border between Manitoba and Nunavut extending eastwards. The western boundary is the Ontario/Manitoba border extended northward. Primary port: Churchill, MB.

The arctic regions 1, 21, 22 were split differently for MEIT Version 4.0a to better suit the Arctic inventory. These are defined as follows:

- 1A. Hudson Strait Region: Hudson Strait, Ungava Bay, Labrador Sea. Northern boundary defined by 65 degrees north. Western boundary defined by 76 degrees west. Eastern boundary is the 200 nautical mile limit. Primary port: Iqaluit, NU.
- 2A. Northwestern Passage Region: Davis Strait, Lancaster Sound, Gulf of Boothia, Foxe Basin. Northern boundary defined by 75 degrees latitude.
- 3A. Northeast Region: Area north of 75 degrees, east of 95 degrees. Remainder of boundary the 200 nautical mile limit.
- 4A. Hudson Bay Region: Hudson bay, up to 65 degrees north. Primary Ports: Churchill, MB, Baker Laker, NU.
- 5A. Southwest Region: Beaufort Sea, Amundsen Gulf, McClure Strait, McClintock Channel, Peel Sound. Also includes Great Slave Lake. Northern boundary 75 degrees. Primary port: Tuktoyaktuk, NT.
- 6A. Northwest Region: Norwegian Bay, McDougall Sound, Penny Strait. Southern boundary 75 degrees, eastern boundary 95 degrees. The remainder of the boundary the 200 nautical mile limit.

Figure 1-2: MEIT Regions of Canada



### 1.1.3 Emission Calculations

A commonality in most if not all of the Canadian marine emissions studies since 2000 is an activity-based calculation method that is widely accepted as current best practice for marine EIs. The calculation method can be expressed with the following equation<sup>1</sup>:

$$E = ME * LF * T * EF_{act} + AE * LF * T * EF_{act} + BO * T * EF_{fuel} \quad (1)$$

Each of the variables in equation (1) is identified in Table 1-2.

**Table 1-2: Ship Emission Parameters**

| Parameter          | Description                                                   |
|--------------------|---------------------------------------------------------------|
| E                  | Emissions                                                     |
| ME                 | Main Engine capacity (maximum continuous rating or MCR) in kW |
| AE                 | Auxiliary Engine capacity in kW                               |
| LF                 | Load Factor (on engines, fraction from 0 to 1)                |
| EF <sub>act</sub>  | Emission Factor – activity based factors in g/kWh             |
| EF <sub>fuel</sub> | Emission Factor – fuel based factors in kg/tonne fuel         |
| BO                 | Boiler fuel consumption rate in tonnes/hr                     |
| T                  | Time (hours)                                                  |

Emissions are a result of main engine(s), auxiliary engine(s) and boiler use over time. Application of equation (1) changes for the different modes of ship activity that can be resolved in the movement data used to develop a marine EI. Underway, anchoring and berthing are separate modes of activity accounted for in MEIT, since these modes are defined in the CG INNAV data.

### 1.1.4 Emission Rates

The current set of emission factors in MEIT was reviewed during a project conducted for Transport Canada in 2007<sup>2</sup>. These emission factors were largely sourced from a study prepared for the EPA in 2006<sup>3</sup> and therefore the rates may not fully represent current fleets with newer vessels. The rates are specific to the EPA engine classification. Table 1-3 provides a definition for the EPA engine classification scheme.

<sup>1</sup> The inclusion of boilers to the calculation is new in MEIT V4.0

<sup>2</sup> Weir Marine Engineering, 2008. 2007 Marine Emission Inventory and Forecast Study, Final Draft. Prepared for the Transportation Development Centre of Transport Canada, in partnership with SENES Consultants Ltd.

<sup>3</sup> ICF Consulting, 2006. Current Methodologies and Best Practices in Preparing Port Emission Inventories. Prepared for the U.S. EPA Office of Policy, Economics and Innovation, Sector Strategies Program.

**Table 1-3: EPA Engine Categories**

| Engine Category | Displacement (litres/cyl) | Typical Use               |
|-----------------|---------------------------|---------------------------|
| C1              | < 7                       | Harbour Vessels           |
| C2              | $7 \leq X < 30$           | Auxiliary Engines in OGVs |
| C3              | $\geq 30$                 | Main Engines in OGVs      |

The supported emission factors are provided in Tables 1-4 and 1-5 for engines and boilers, respectively. Table 1-6 provides engine fuel consumption, CO<sub>2</sub> and CO<sub>2</sub>e emission rates developed for the International Maritime Organization (IMO) in 2009<sup>4</sup>. These rates are considered the best available at this time and account for differences by type, size and age of engine.

As evaluated for the US EPA in 2000<sup>5</sup> 'low load' adjustment factors should be used for marine engines at reduced load movements such as maneuvering. The adjustment rates by air contaminant are shown in Table 1-7 for a main engine load of 0.1. These values are used to scale up the emission factors regardless of engine and fuel type.

The IMO *International Convention on the Prevention of Pollution from Ships*, known as MARPOL 73/78 includes Annex VI titled "Regulations for the Prevention of Air Pollution from Ships". MARPOL Annex VI sets limits on NO<sub>x</sub> and SO<sub>x</sub> emissions from ship exhausts as shown in Table 1-8. SO<sub>x</sub> emissions are limited by fuel standards (maximum sulphur content). Currently, the Tier 1 NO<sub>x</sub> standards are applied to every vessel built in 2000 or later (e.g., the NO<sub>x</sub> emission rates are used instead of the rates shown in Table 1-4). The low load scaling factors in Table 1-7 are applied to all vessels, regardless of age.

**Table 1-4: Current MEIT Activity Based Emission Factors (g/kWh) by Engine Classification\***

| Engine                | Cat. | Fuel | NOx<br>(dom/int) | CO  | HC  | NH3   | CH4   | N2O   |
|-----------------------|------|------|------------------|-----|-----|-------|-------|-------|
| Main<br>2-stroke      | C3   | HFO  | 17/18.1          | 1.4 | 0.6 | 0.021 | 0.006 | 0.017 |
|                       |      | MDO  | 17               | 1.1 | 0.6 | 0.02  | 0.006 | 0.017 |
|                       |      | MGO  | 17               | 1.1 | 0.6 | 0.02  | 0.006 | 0.017 |
| Main<br>4-stroke      |      | HFO  | 13.2/14.0        | 1.1 | 0.5 | 0.023 | 0.004 | 0.017 |
|                       |      | MDO  | 13.2             | 1.1 | 0.5 | 0.022 | 0.004 | 0.017 |
|                       |      | MGO  | 13.2             | 1.1 | 0.5 | 0.022 | 0.004 | 0.017 |
| Auxiliary<br>4-stroke | C2   | HFO  | 13.9/14.7        | 1.1 | 0.4 | 0.001 | 0.004 | 0.017 |
|                       |      | MDO  | 13.9             | 1.1 | 0.4 | 0.001 | 0.004 | 0.017 |
|                       |      | MGO  | 13.9             | 1.1 | 0.4 | 0.001 | 0.004 | 0.017 |

\*Note: HFO – heavy fuel oil, MDO – marine distillate oil, MGO – marine gas oil  
NO<sub>x</sub> values are shown for domestic (dom) and international (int) fuel by purchase location. Domestic HFO fuel is lower in sulphur content on average

<sup>4</sup> International Maritime Organization (IMO), 2009. Second IMO GHG Study 2009.

<sup>5</sup> Energy and Environmental Analysis Inc., 2000. Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data. Prepared for the US EPA under contract to Sierra Research. EPA420-R-00-002, February.

**Table 1-5: Boiler Emission Factors (kg/tonne fuel)**

| Fuel        | NOx  | CO  | HC   | NH3   | CO2  | CH4  | N2O   | CO2e |
|-------------|------|-----|------|-------|------|------|-------|------|
| HFO,MDO,MGO | 12.3 | 4.6 | 0.38 | 0.006 | 3188 | 0.29 | 0.081 | 3219 |

**Table 1-6: Current MEIT Activity Based Emission Factors (g/kWh) by Engine Year, Size (IMO 2009)**

| Engine           | Fuel | Engine Year | Engine Size | BSFC | CO2    | CO2e    |
|------------------|------|-------------|-------------|------|--------|---------|
| Main<br>2-stroke | HFO  | <= 1983     | ALL         | 205  | 641.65 | 647.046 |
|                  | MDO  |             |             | 205  | 653.95 | 659.346 |
|                  | MGO  |             |             | 205  | 653.95 | 659.346 |
|                  | HFO  | 1984 - 2000 |             | 185  | 579.05 | 584.446 |
|                  | MDO  |             |             | 185  | 590.15 | 595.546 |
|                  | MGO  |             |             | 185  | 590.15 | 595.546 |
|                  | HFO  | 2001 - 2007 |             | 175  | 547.75 | 553.146 |
|                  | MDO  |             |             | 175  | 558.25 | 563.646 |
|                  | MGO  |             |             | 175  | 558.25 | 563.646 |
|                  | HFO  | 2008+       |             | 175  | 547.75 | 553.146 |
|                  | MDO  |             |             | 175  | 558.25 | 563.646 |
|                  | MGO  |             |             | 175  | 558.25 | 563.646 |
| Main<br>4-stroke | HFO  | <= 1983     | <= 15,000   | 225  | 704.25 | 709.604 |
|                  |      |             | >15,000     | 215  | 672.95 | 678.304 |
|                  | MDO  |             | <= 15,000   | 225  | 717.75 | 723.104 |
|                  |      |             | >15,000     | 215  | 685.85 | 691.204 |
|                  | MGO  |             | <= 15,000   | 225  | 717.75 | 723.104 |
|                  |      |             | >15,000     | 215  | 685.85 | 691.204 |
|                  | HFO  | 1984 - 2000 | <= 15,000   | 205  | 641.65 | 647.004 |
|                  |      |             | >15,000     | 195  | 610.35 | 615.704 |
|                  | MDO  |             | <= 15,000   | 205  | 653.95 | 659.304 |
|                  |      |             | >15,000     | 195  | 622.05 | 627.404 |
|                  | MGO  |             | <= 15,000   | 205  | 653.95 | 659.304 |
|                  |      |             | >15,000     | 195  | 622.05 | 627.404 |
|                  | HFO  | 2001 - 2007 | <= 15,000   | 195  | 610.35 | 615.704 |
|                  |      |             | >15,000     | 185  | 579.05 | 584.404 |
|                  | MDO  |             | <= 15,000   | 195  | 622.05 | 627.404 |
|                  |      |             | >15,000     | 185  | 590.15 | 595.504 |
|                  | MGO  |             | <= 15,000   | 195  | 622.05 | 627.404 |
|                  |      |             | >15,000     | 185  | 590.15 | 595.504 |
|                  | HFO  | 2008+       | <= 15,000   | 195  | 610.35 | 615.704 |
|                  |      |             | >15,000     | 185  | 579.05 | 584.404 |
|                  | MDO  |             | <= 15,000   | 195  | 622.05 | 627.404 |
|                  |      |             | >15,000     | 185  | 590.15 | 595.504 |
|                  | MGO  |             | <= 15,000   | 195  | 622.05 | 627.404 |
|                  |      |             | >15,000     | 185  | 590.15 | 595.504 |

**Table 1-6 (Cont'd): Current MEIT Activity Based Emission Factors (g/kWh) by Engine Year, Size (IMO 2009)**

| Engine                | Fuel | Engine Year | Engine Size | BSFC | CO2   | CO2e    |
|-----------------------|------|-------------|-------------|------|-------|---------|
| Auxiliary<br>4-stroke | HFO  | <= 1983     | ALL         | 220  | 688.6 | 693.954 |
|                       | MDO  |             |             | 220  | 701.8 | 707.154 |
|                       | MGO  |             |             | 220  | 701.8 | 707.154 |
|                       | HFO  | 1984 - 2000 |             | 220  | 688.6 | 693.954 |
|                       | MDO  |             |             | 220  | 701.8 | 707.154 |
|                       | MGO  |             |             | 220  | 701.8 | 707.154 |
|                       | HFO  | 2001 - 2007 |             | 220  | 688.6 | 693.954 |
|                       | MDO  |             |             | 220  | 701.8 | 707.154 |
|                       | MGO  |             |             | 220  | 701.8 | 707.154 |
|                       | HFO  | 2008+       |             | 220  | 688.6 | 693.954 |
|                       | MDO  |             |             | 220  | 701.8 | 707.154 |
|                       | MGO  |             |             | 220  | 701.8 | 707.154 |

**Table 1-7: Low Load (ME load 0.1) Scale Factors for All Emission Factors (unitless)**

| Fuel | NOx  | CO   | HC   | PM   | NH3  | CO2  | CH4  | N2O  | CO2e |
|------|------|------|------|------|------|------|------|------|------|
| 1.0  | 1.22 | 2.00 | 2.83 | 1.38 | 1.22 | 1.22 | 1.22 | 1.22 | 1.22 |

**Table 1-8: IMO NOx and SOx Limits**

| Standard              | Engine RPM 'n' | NOx Emission Standard (g/kWh) | Fuel Standard (max. sulphur content) | Year  | Relevance                                                      |
|-----------------------|----------------|-------------------------------|--------------------------------------|-------|----------------------------------------------------------------|
| Tier 1                | n < 130        | 17.0                          | n/a                                  | 2000  | Applies to all vessels constructed during or after this year   |
|                       | n = 130-2000   | $45 * n^{-0.2}$               |                                      |       |                                                                |
|                       | n > 2000       | 9.8                           |                                      |       |                                                                |
| SO <sub>x</sub> /FUEL | n/a            | n/a                           | 1.00%                                | 2010  | Only applies to ECA areas                                      |
| Tier 2                | n < 130        | 14.4                          | n/a                                  | 2011  | Applies to all vessels constructed during or after this year   |
|                       | n = 130-2000   | $44 * n^{-0.23}$              |                                      |       |                                                                |
|                       | n > 2000       | 7.7                           |                                      |       |                                                                |
| SO <sub>x</sub> /FUEL | n/a            | n/a                           | 0.10%                                | 2015  | Only applies to ECA areas                                      |
| Tier 3                | n < 130        | 3.4                           | n/a                                  | 2016* | Only applies to vessels operating in ECA areas                 |
|                       | n = 130-2000   | $9 * n^{-0.2}$                |                                      |       |                                                                |
|                       | n > 2000       | 1.96                          |                                      |       |                                                                |
| SO <sub>x</sub> /FUEL | n/a            | n/a                           | 0.50%                                | 2020  | Applies to all areas, pending a 2018 fuel availability review. |

\* Database set to use historical value of 2016, although the IMO intends to change this to 2021. See Update\_MEIT\_Emission\_Rates and Update\_MEIT\_Emission\_Rates\_ARCTIC Stored procedures for details.

### 1.1.5 $SO_x$ and PM Emissions Equations

Both  $SO_2$  ( $SO_x$ ) emissions and PM emissions are known to vary with fuel sulphur content. As such, MEIT has accounted for  $SO_x$  and PM emissions in a dynamic manner since V2.2. Each equation assumes a linear relationship with fuel sulphur content as follows:

$SO_x$ :

$$\text{Engines: EF (g/kWh)} = 4.2(S) \quad (2)$$

$$\text{Boilers: EF (kg/tonne)} = 20.0(S) \quad (3)$$

PM:

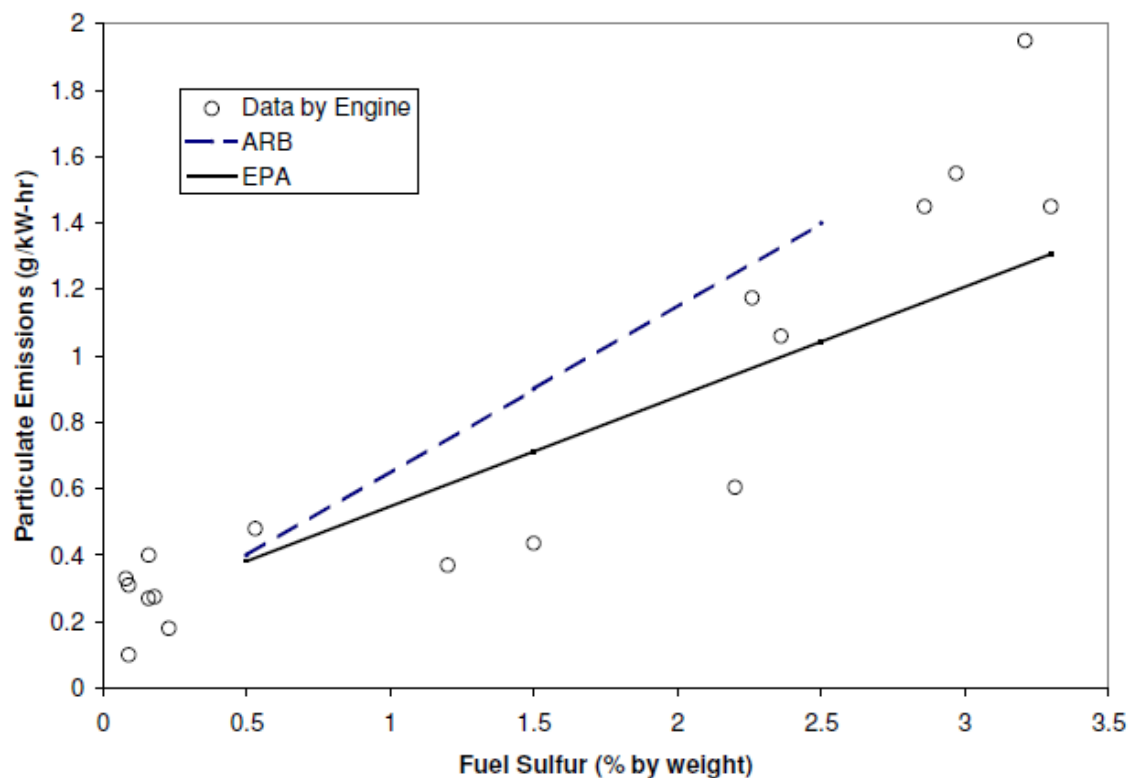
$$\text{Engines: (g/kWh)} = 0.4653(S) + 0.25 \quad (4)$$

$$\text{Boilers: (kg/tonne)} = 1.17(S) + 0.41 \quad (5)$$

where S = sulphur content of fuel in %.

Ratios of 0.96 and 0.92 are applied for  $PM_{10}$  to total PM and  $PM_{2.5}$  to  $PM_{10}$ , respectively. While the  $SO_x$  expressions are based on an assumption of total oxidation of the fuel sulphur to  $SO_2$  in the atmosphere, the PM expressions are based on previous PM emissions tests at different sulphur levels. The boiler PM equation originates from the EPA<sup>6</sup> and the engine PM equation is a result of the California Air Resources Board (CARB) analysis of past emissions data as shown in Figure 1-3.

<sup>6</sup> EPA AP-42 Compilation of Emission Factors, Chapter 1. See <http://www.epa.gov/ttnchie1/ap42/>

**Figure 1-3: PM Emission Rates (g/kWh) by Fuel Sulphur Content\***

\* The CARB analysis ('ARB' in the figure above) is a re-analysis of the data, rejecting several data points that were included in the prior EPA regression analysis. Additional detail can be found in Weir, 2008.

Air toxic emission factors are listed in Appendix A.

### 1.1.6 Fugitive Emissions

Estimates of fugitive VOC emissions is new for V4.0. VOC emissions escape from the tanks of fuel carrying ships during transit and also during loading and unloading activities. The fugitive emission calculations require an estimate of the type and amount of fuel carried in the ships that visit Canadian ports. Since the CG data does not contain cargo tonnages, estimates were achieved by assuming most of a vessel DWT is comprised of fuel cargo, for the appropriate ship classes. More specifically, the equations used to estimate the fugitive emissions are defined below.

Transit:

$$E \text{ (mg)} = \text{DWT} * \text{LF} * \text{TF} * \text{EF}_{\text{transit}} \quad (6)$$

Load/Unload:

$$E \text{ (mg)} = \text{DWT} * \text{LF} * \text{EF}_{\text{load}} \quad (7)$$

Where:

DWT = deadweight tonnage

LF = load factor (assumed to be 0.9 currently)

TF = transit factor (assumed to be 0.5 currently)

$\text{EF}_{\text{transit}}$  = transit emission rate

$\text{EF}_{\text{load}}$  = loading/unloading emission rate

The emission rates for fugitive VOC emissions were taken from the EPA, as defined in Table 1-9<sup>7</sup>.

**Table 1-9: Fugitive VOC Emission Rates**

| Vessel Class          | Transit Emission Rate<br>(mg/week/litre) | Load/Unload Emission Rate<br>(mg/litre) |
|-----------------------|------------------------------------------|-----------------------------------------|
| Crude Oil Tanker      | 150                                      | 73                                      |
| Distillate Oil Tanker | 0.54                                     | 0.55                                    |
| Gasoline Tanker       | 320                                      | 215                                     |
| LNG Tanker            | 0.0                                      | 0.0                                     |

Currently, the model assumes LNG vapours are captured and used as fuel for the vessel engines. As noted above, the load factor (LF) is less than 1.0 since DWT accounts for the mass of engine fuel as well as crew and supplies on board. The transit factor (TF) assumes that the cargo is carried one way only (e.g., the return leg of a voyage is done under ballast). These factors should be investigated further as understanding of the nature of fugitive VOC emissions improves. It may be possible to improve the fugitive methods by use of cargo information in the ship movement details, as well as information at the loading/unloading facilities for vapour recovery units (VRUs).

<sup>7</sup> These rates are published in the US EPA AP-42 Compilation of emission factors, Chapter 5.2

## 2.0 MEIT V4.1 STRUCTURE

---

### 2.1 Model Setup

---

To use MEIT V4.1.0, the user will require the following software:

- ♦ MS Access 2007 or higher; and
- ♦ SQL Server 2008 R2 (10.50.1617).

Other versions of the software noted above have not yet been evaluated with the model.

Once the necessary software is present, the following steps should be taken:

- ♦ Restore database (MEIT\_4\_1\_0.bak) to SQL Server; and
- ♦ Open MEIT41.adp and re-link the connection to the database.

If the setup is completed successfully, the functionality described in Section 2.2 should be fully enabled.

### 2.2 Model Functionality

---

The model welcome screen is shown in Figure 2-1. This screen opens when the (Microsoft Access) utility is opened. The sub-menus are defined in Figures 2-5 to 2-9.

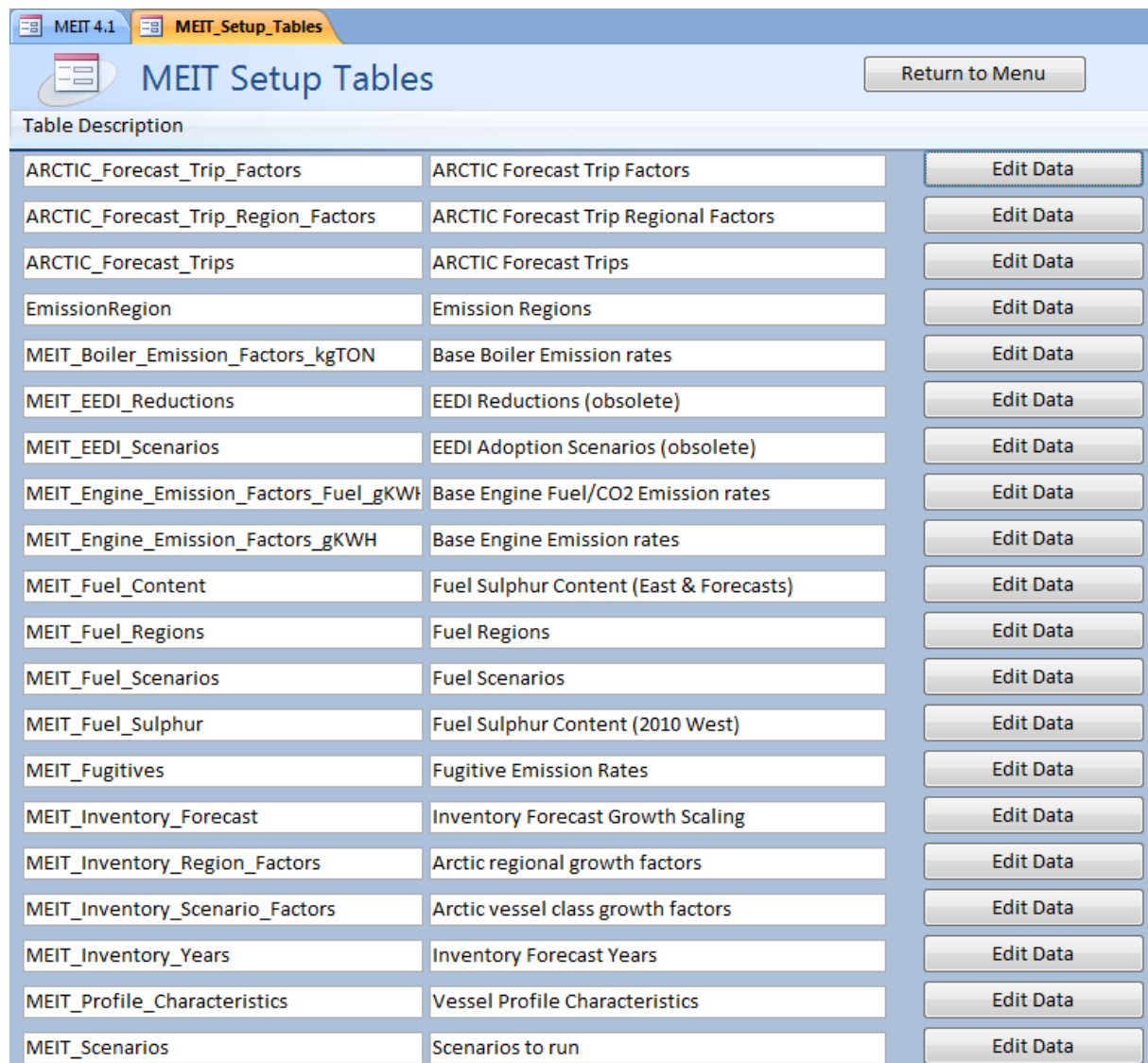
Figure 2-1: MEIT V4.1 Welcome Screen



The functions that can be enabled from the welcome screen are: Edit Setup Tables – Allows for editing of tables that drive the emission calculations (Fuel Sulphur Levels, Vessel profile characteristics, etc.), View Source Tables – Allows for viewing of tables that contain vessel criteria, including trip definition, Run Calculations – Allows for executing the emission calculations, and View Results – Allows for viewing the emission calculation results.

The Edit Setup Tables menu is shown in Figure 2-2. This form allows access to the base emission rates in the model, as well as fuel definitions. Some of the functionality within these tables is used for features of the 2010 emission inventory report, such as forecast scenarios (activity scaling factors) as well as Arctic specific adjustments (Arctic forecast trip factors).

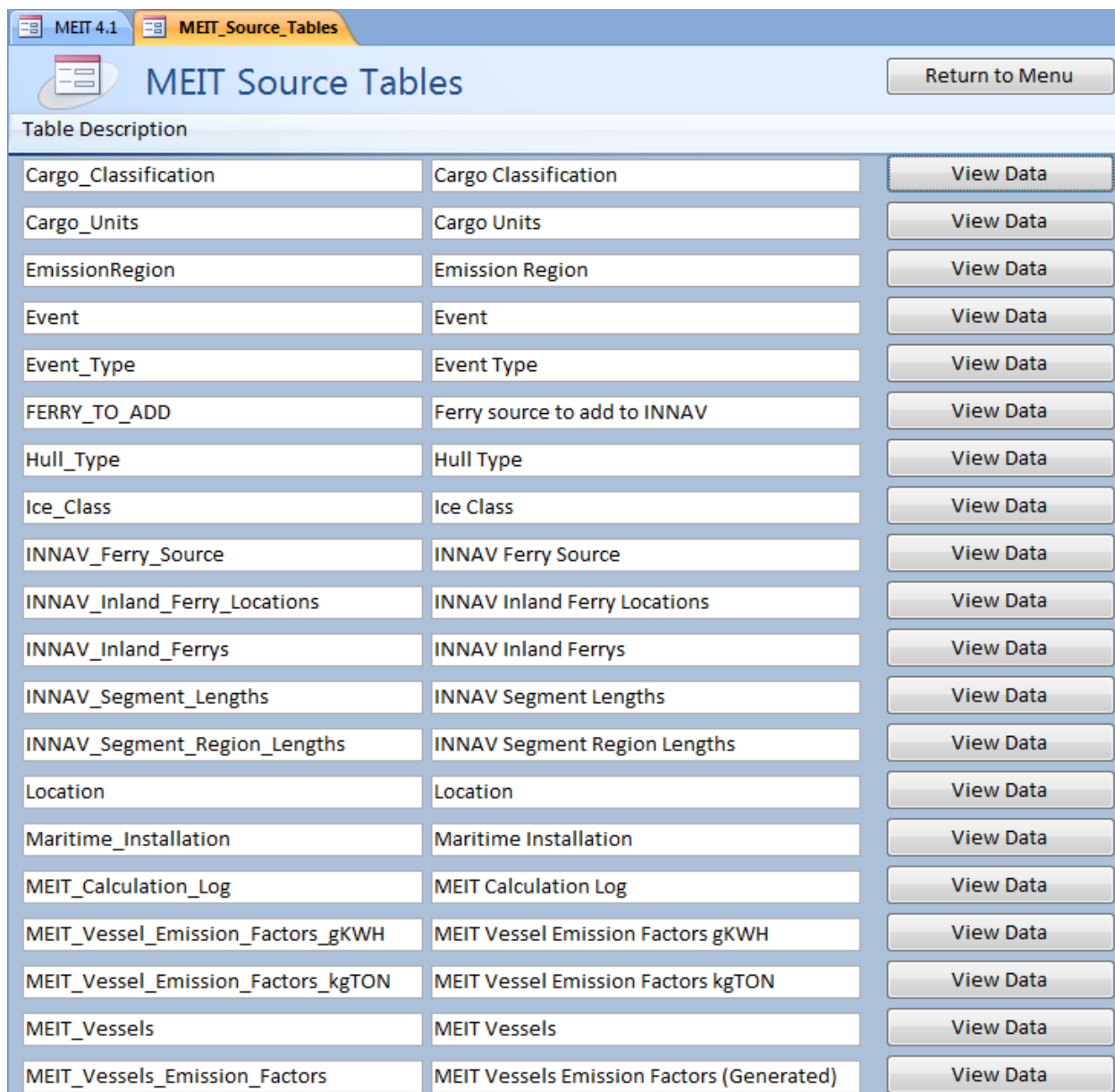
**Figure 2-2: Edit Setup Tables Screen**



| MEIT Setup Tables                     |                                         |           |
|---------------------------------------|-----------------------------------------|-----------|
| Table Description                     |                                         |           |
| ARCTIC_Forecast_Trip_Factors          | ARCTIC Forecast Trip Factors            | Edit Data |
| ARCTIC_Forecast_Trip_Region_Factors   | ARCTIC Forecast Trip Regional Factors   | Edit Data |
| ARCTIC_Forecast_Trips                 | ARCTIC Forecast Trips                   | Edit Data |
| EmissionRegion                        | Emission Regions                        | Edit Data |
| MEIT_Boiler_Emission_Factors_kgTON    | Base Boiler Emission rates              | Edit Data |
| MEIT_EEDI_Reductions                  | EEDI Reductions (obsolete)              | Edit Data |
| MEIT_EEDI_Scenarios                   | EEDI Adoption Scenarios (obsolete)      | Edit Data |
| MEIT_Engine_Emission_Factors_Fuel_gKW | Base Engine Fuel/CO2 Emission rates     | Edit Data |
| MEIT_Engine_Emission_Factors_gKWH     | Base Engine Emission rates              | Edit Data |
| MEIT_Fuel_Content                     | Fuel Sulphur Content (East & Forecasts) | Edit Data |
| MEIT_Fuel_Regions                     | Fuel Regions                            | Edit Data |
| MEIT_Fuel_Scenarios                   | Fuel Scenarios                          | Edit Data |
| MEIT_Fuel_Sulphur                     | Fuel Sulphur Content (2010 West)        | Edit Data |
| MEIT_Fugitives                        | Fugitive Emission Rates                 | Edit Data |
| MEIT_Inventory_Forecast               | Inventory Forecast Growth Scaling       | Edit Data |
| MEIT_Inventory_Region_Factors         | Arctic regional growth factors          | Edit Data |
| MEIT_Inventory_Scenario_Factors       | Arctic vessel class growth factors      | Edit Data |
| MEIT_Inventory_Years                  | Inventory Forecast Years                | Edit Data |
| MEIT_Profile_Characteristics          | Vessel Profile Characteristics          | Edit Data |
| MEIT_Scenarios                        | Scenarios to run                        | Edit Data |

The View Source Tables screen is shown in Figure 2-3. This menu enables access to the trip source data as well as derived data tables (e.g., specific ship class emission factors developed from the base factors and fuels definitions). These tables can be viewed and manipulated through any SQL Server Management tool, such as the Microsoft SQL Server Management Studio.

Figure 2-3: View Source Tables Screen



| MEIT Source Tables                 |                                           |                           |
|------------------------------------|-------------------------------------------|---------------------------|
| Table Description                  |                                           |                           |
| Cargo_Classification               | Cargo Classification                      | <a href="#">View Data</a> |
| Cargo_Units                        | Cargo Units                               | <a href="#">View Data</a> |
| EmissionRegion                     | Emission Region                           | <a href="#">View Data</a> |
| Event                              | Event                                     | <a href="#">View Data</a> |
| Event_Type                         | Event Type                                | <a href="#">View Data</a> |
| FERRY_TO_ADD                       | Ferry source to add to INNAV              | <a href="#">View Data</a> |
| Hull_Type                          | Hull Type                                 | <a href="#">View Data</a> |
| Ice_Class                          | Ice Class                                 | <a href="#">View Data</a> |
| INNAV_Ferry_Source                 | INNAV Ferry Source                        | <a href="#">View Data</a> |
| INNAV_Inland_Ferry_Locations       | INNAV Inland Ferry Locations              | <a href="#">View Data</a> |
| INNAV_Inland_Ferrys                | INNAV Inland Ferrys                       | <a href="#">View Data</a> |
| INNAV_Segment_Lengths              | INNAV Segment Lengths                     | <a href="#">View Data</a> |
| INNAV_Segment_Region_Lengths       | INNAV Segment Region Lengths              | <a href="#">View Data</a> |
| Location                           | Location                                  | <a href="#">View Data</a> |
| Maritime_Installation              | Maritime Installation                     | <a href="#">View Data</a> |
| MEIT_Calculation_Log               | MEIT Calculation Log                      | <a href="#">View Data</a> |
| MEIT_Vessel_Emission_Factors_gKWH  | MEIT Vessel Emission Factors gKWH         | <a href="#">View Data</a> |
| MEIT_Vessel_Emission_Factors_kgTON | MEIT Vessel Emission Factors kgTON        | <a href="#">View Data</a> |
| MEIT_Vessels                       | MEIT Vessels                              | <a href="#">View Data</a> |
| MEIT_Vessels_Emission_Factors      | MEIT Vessels Emission Factors (Generated) | <a href="#">View Data</a> |

The Run Calcs screen is shown in Figure 2-4. This menu enables the emission calculations to be started. A base year run (2010) should complete within several minutes. Currently, if the model is set to 'Run Everything' or 'Run East' for all inventory years, the runtime may span 2 hours or more, since all inventory backcasts and forecasts are initiated.

Figure 2-4: Run Calculations Screen

MEIT 4.0 RunCalcs

Return to Menu Click on a button to begin processing...

**NOTE: These procedures will take some time to complete...**  
**Execution times up to 2 hours (or more) are not unusual**  
**ESPECIALLY for East / Everything**

Run West Set to Inv. Year 2010

Run East Set to ALL Inv. Years

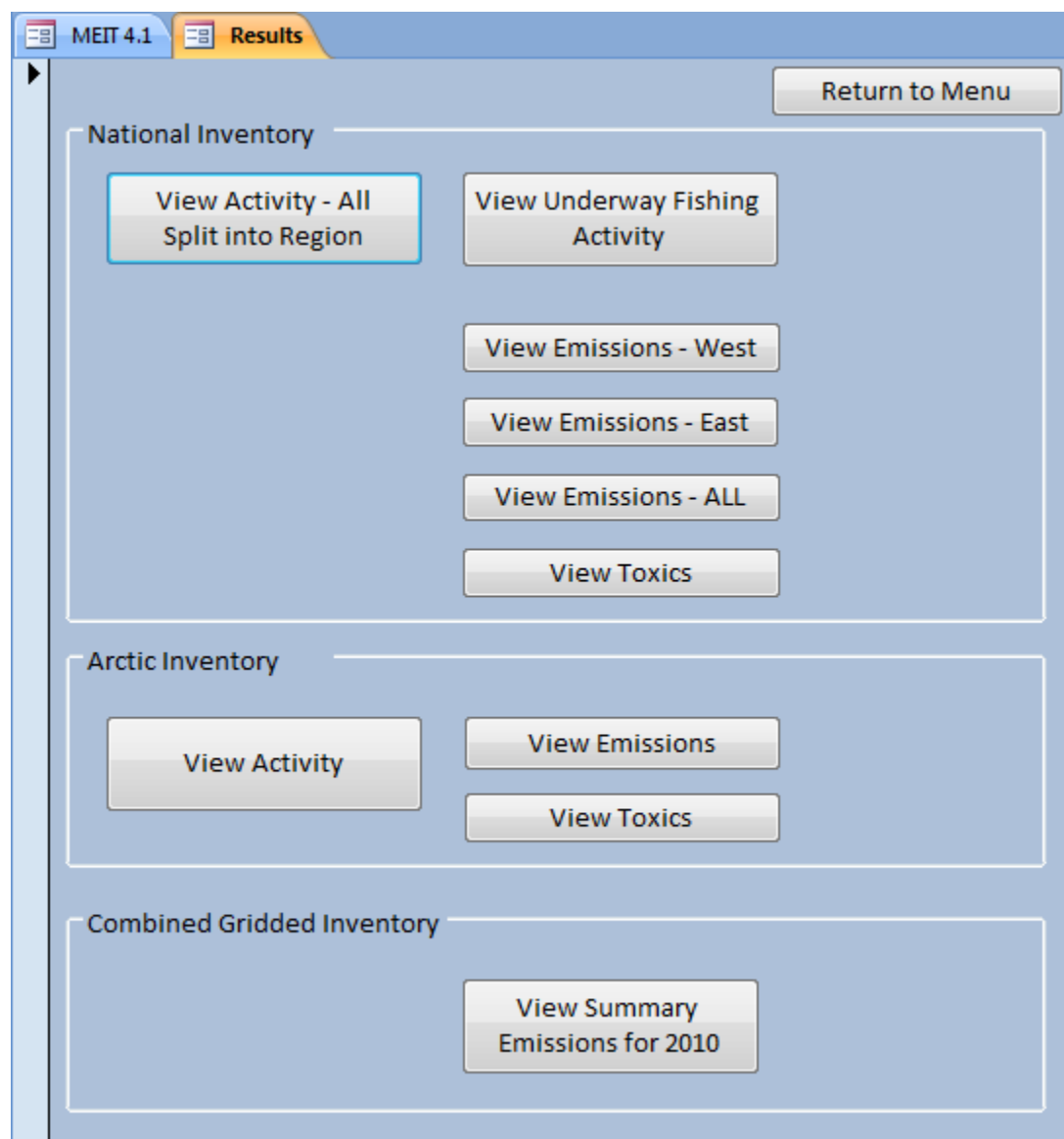
Run Toxics

Run Everything Run ARCTIC

| Log ID | Date/Time | Event |
|--------|-----------|-------|
|--------|-----------|-------|

Record: [Navigation Icons] Filtered Search

The View Results screen allows access to the emission estimates, as shown in Figure 2-5. Currently, 'East' includes the Great Lakes as well as Canada's Arctic (i.e. results from the National Marine Inventory).

**Figure 2-5: View Results Screen**

The View Results action will open a Pivot Table for access to the emission estimates. The Pivot Table enables activity and emission summaries at various levels of detail.

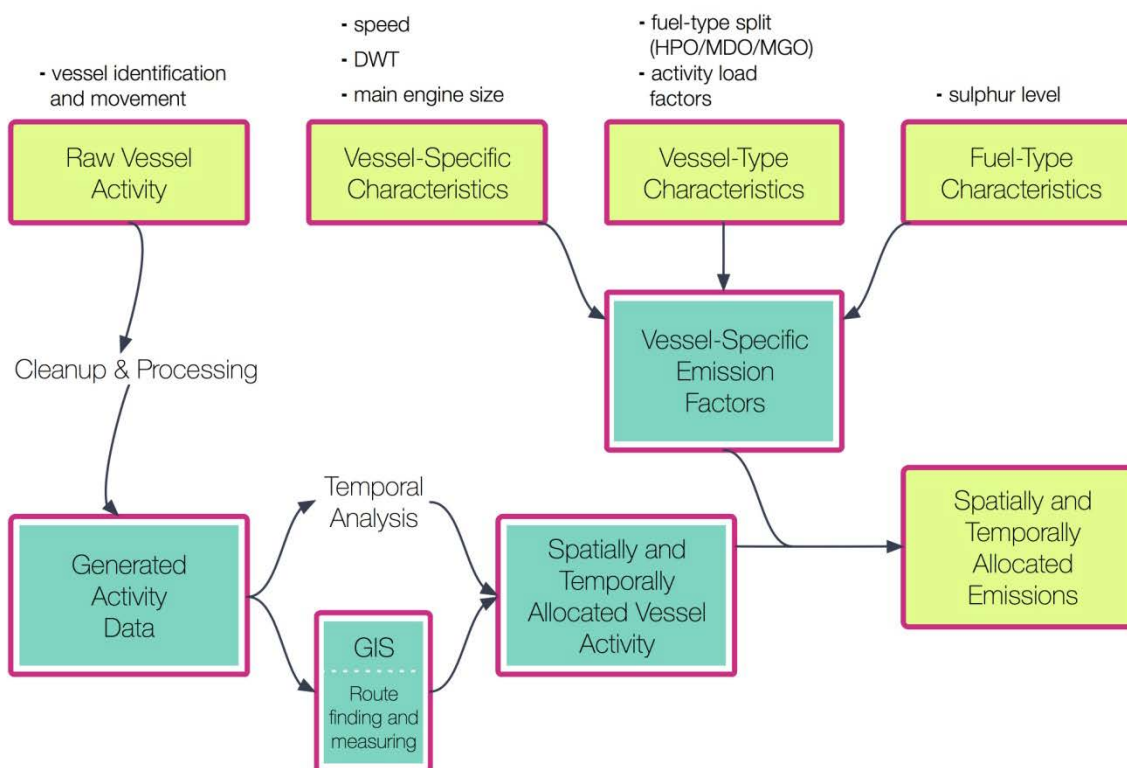
Figure 2-6: Emission Results Pivot Table

| Emission_Region ▾ Emission_Mode ▾ |                 | Drop Column Fields Here |          |                     |         |         |         |                      |                      |                     |                     |                     |                      |                       |           |           |
|-----------------------------------|-----------------|-------------------------|----------|---------------------|---------|---------|---------|----------------------|----------------------|---------------------|---------------------|---------------------|----------------------|-----------------------|-----------|-----------|
| All                               | All             |                         |          |                     |         |         |         |                      |                      |                     |                     |                     |                      |                       |           |           |
| Inventory_Year ▾                  | EEDI_Scenario ▾ | Vessel_Class ▾          | NOx (t)  | SO <sub>2</sub> (t) | CO (t)  | HC (t)  | PM (t)  | PM <sub>10</sub> (t) | PM <sub>25</sub> (t) | NH <sub>3</sub> (t) | CO <sub>2</sub> (t) | CH <sub>4</sub> (t) | N <sub>2</sub> O (t) | CO <sub>2</sub> e (t) | HFO (t)   | MDO (t)   |
| 1980                              | B               | Coast Guard             | 351.5    | 108.3               | 28.4    | 12.8    | 18.4    | 17.7                 | 16.3                 | 0.5                 | 17,072.9            | 1.5                 | 0.4                  | 17,240.9              | 0.0       | 5,352.9   |
|                                   |                 | Fishing                 | 3,752.0  | 813.8               | 308.4   | 173.0   | 162.1   | 155.7                | 143.2                | 3.4                 | 129,321.3           | 11.6                | 3.3                  | 130,583.7             | 0.0       | 40,537.9  |
|                                   |                 | Merchant Bulk           | 16,647.6 | 10,947.1            | 1,438.1 | 577.9   | 1,429.0 | 1,371.8              | 1,262.1              | 17.0                | 687,184.8           | 65.1                | 18.4                 | 694,164.8             | 194,326.0 | 21,358.4  |
|                                   |                 | Merchant Container      | 4,884.4  | 3,222.7             | 409.4   | 172.9   | 427.2   | 410.1                | 377.3                | 5.4                 | 185,489.0           | 17.7                | 5.0                  | 187,391.5             | 55,319.7  | 2,912.1   |
|                                   |                 | Merchant Cruise         | 1,958.0  | 1,059.1             | 163.2   | 74.2    | 154.4   | 148.2                | 136.4                | 3.4                 | 99,385.4            | 8.9                 | 2.5                  | 100,348.7             | 31,150.6  | 0.0       |
|                                   |                 | Merchant Other          | 9,855.4  | 6,649.5             | 839.4   | 340.2   | 873.8   | 838.9                | 771.8                | 9.4                 | 407,894.0           | 38.4                | 10.9                 | 412,012.7             | 113,051.3 | 14,952.1  |
|                                   |                 | Merchant Passenger      | 6,275.9  | 2,460.3             | 549.7   | 236.9   | 382.6   | 367.3                | 337.9                | 9.6                 | 329,521.8           | 29.6                | 8.4                  | 332,721.8             | 26,557.2  | 76,736.6  |
|                                   |                 | Special Purpose         | 63.3     | 14.3                | 5.1     | 2.8     | 2.8     | 2.7                  | 2.4                  | 0.1                 | 2,249.8             | 0.2                 | 0.1                  | 2,272.0               | 0.0       | 705.4     |
|                                   |                 | Tanker                  | 1,723.6  | 1,162.1             | 149.2   | 281.6   | 151.1   | 145.1                | 133.4                | 1.8                 | 70,867.8            | 6.7                 | 1.9                  | 71,587.5              | 20,077.5  | 2,165.5   |
|                                   |                 | Tug Boat                | 4,431.7  | 1,313.3             | 343.8   | 162.3   | 223.6   | 214.7                | 197.5                | 6.3                 | 202,892.0           | 18.7                | 5.3                  | 204,926.6             | 0.0       | 63,647.3  |
|                                   |                 | War                     | 434.0    | 125.4               | 35.1    | 16.4    | 19.2    | 18.4                 | 16.9                 | 0.4                 | 18,497.8            | 1.8                 | 0.5                  | 18,692.2              | 0.0       | 5,811.9   |
|                                   |                 | Total                   | 50,377.6 | 27,875.9            | 4,269.7 | 2,051.0 | 3,844.3 | 3,690.5              | 3,395.3              | 57.3                | 2,150,376.6         | 200.3               | 56.7                 | 2,171,942.3           | 440,482.3 | 234,180.1 |
|                                   |                 |                         | 50,377.6 | 27,875.9            | 4,269.7 | 2,051.0 | 3,844.3 | 3,690.5              | 3,395.3              | 57.3                | 2,150,376.6         | 200.3               | 56.7                 | 2,171,942.3           | 440,482.3 | 234,180.1 |
| 1985                              | B               | Coast Guard             | 351.5    | 108.3               | 28.4    | 12.8    | 18.4    | 17.7                 | 16.3                 | 0.5                 | 17,072.9            | 1.5                 | 0.4                  | 17,240.9              | 0.0       | 5,352.9   |
|                                   |                 | Fishing                 | 3,752.0  | 813.8               | 308.4   | 173.0   | 162.1   | 155.7                | 143.2                | 3.4                 | 129,321.3           | 11.6                | 3.3                  | 130,583.7             | 0.0       | 40,537.9  |
|                                   |                 | Merchant Bulk           | 16,647.6 | 10,947.1            | 1,438.1 | 577.9   | 1,429.0 | 1,371.8              | 1,262.1              | 17.0                | 687,184.8           | 65.1                | 18.4                 | 694,164.8             | 194,326.0 | 21,358.4  |
|                                   |                 | Merchant Container      | 4,884.4  | 3,222.7             | 409.4   | 172.9   | 427.2   | 410.1                | 377.3                | 5.4                 | 185,489.0           | 17.7                | 5.0                  | 187,391.5             | 55,319.7  | 2,912.1   |
|                                   |                 | Merchant Cruise         | 1,958.0  | 1,059.1             | 163.2   | 74.2    | 154.4   | 148.2                | 136.4                | 3.4                 | 99,385.4            | 8.9                 | 2.5                  | 100,348.7             | 31,150.6  | 0.0       |
|                                   |                 | Merchant Other          | 9,855.4  | 6,649.5             | 839.4   | 340.2   | 873.8   | 838.9                | 771.8                | 9.4                 | 407,894.0           | 38.4                | 10.9                 | 412,012.7             | 113,051.3 | 14,952.1  |
|                                   |                 | Merchant Passenger      | 6,595.5  | 2,567.6             | 577.6   | 248.9   | 400.1   | 384.1                | 353.4                | 10.1                | 346,614.3           | 31.1                | 8.8                  | 349,980.7             | 26,557.2  | 82,094.4  |
|                                   |                 | Special Purpose         | 63.3     | 14.3                | 5.1     | 2.8     | 2.8     | 2.7                  | 2.4                  | 0.1                 | 2,249.8             | 0.2                 | 0.1                  | 2,272.0               | 0.0       | 705.4     |
|                                   |                 | Tanker                  | 1,723.6  | 1,162.1             | 149.2   | 281.6   | 151.1   | 145.1                | 133.4                | 1.8                 | 70,867.8            | 6.7                 | 1.9                  | 71,587.5              | 20,077.5  | 2,165.5   |
|                                   |                 | Tug Boat                | 4,431.7  | 1,313.3             | 343.8   | 162.3   | 223.6   | 214.7                | 197.5                | 6.3                 | 202,892.0           | 18.7                | 5.3                  | 204,926.6             | 0.0       | 63,647.3  |
|                                   |                 | War                     | 434.0    | 125.4               | 35.1    | 16.4    | 19.2    | 18.4                 | 16.9                 | 0.4                 | 18,497.8            | 1.8                 | 0.5                  | 18,692.2              | 0.0       | 5,811.9   |
|                                   |                 | Total                   | 50,697.2 | 27,983.1            | 4,297.6 | 2,062.9 | 3,861.8 | 3,707.4              | 3,410.8              | 57.8                | 2,167,469.1         | 201.9               | 57.1                 | 2,189,201.1           | 440,482.3 | 239,537.9 |
|                                   |                 |                         | 50,697.2 | 27,983.1            | 4,297.6 | 2,062.9 | 3,861.8 | 3,707.4              | 3,410.8              | 57.8                | 2,167,469.1         | 201.9               | 57.1                 | 2,189,201.1           | 440,482.3 | 239,537.9 |
| 1987                              | B               | Coast Guard             | 351.5    | 108.3               | 28.4    | 12.8    | 18.4    | 17.7                 | 16.3                 | 0.5                 | 17,072.9            | 1.5                 | 0.4                  | 17,240.9              | 0.0       | 5,352.9   |
|                                   |                 | Fishing                 | 3,752.0  | 813.8               | 308.4   | 173.0   | 162.1   | 155.7                | 143.2                | 3.4                 | 129,321.3           | 11.6                | 3.3                  | 130,583.7             | 0.0       | 40,537.9  |
|                                   |                 | Merchant Bulk           | 16,647.6 | 10,947.1            | 1,438.1 | 577.9   | 1,429.0 | 1,371.8              | 1,262.1              | 17.0                | 687,184.8           | 65.1                | 18.4                 | 694,164.8             | 194,326.0 | 21,358.4  |
|                                   |                 | Merchant Container      | 4,884.4  | 3,222.7             | 409.4   | 172.9   | 427.2   | 410.1                | 377.3                | 5.4                 | 185,489.0           | 17.7                | 5.0                  | 187,391.5             | 55,319.7  | 2,912.1   |
|                                   |                 | Merchant Cruise         | 2,331.0  | 1,260.9             | 194.3   | 88.3    | 183.8   | 176.5                | 162.4                | 4.1                 | 118,315.9           | 10.6                | 3.0                  | 119,462.8             | 37,084.1  | 0.0       |
|                                   |                 | Merchant Other          | 9,855.4  | 6,649.5             | 839.4   | 340.2   | 873.8   | 838.9                | 771.8                | 9.4                 | 407,894.0           | 38.4                | 10.9                 | 412,012.7             | 113,051.3 | 14,952.1  |

## 2.3 Data Model Flow

The general data flow through the model can be visualized in Figure 2-7.

**Figure 2-7: MEIT Data flow**



For 2010, vessel trip source data was used from 3 separate sources – INNAV (East Coast, Great Lakes, and Arctic), VTOSS (West Coast), and BC Pilot's association (West Coast). The trip data was processed to determine vessel anchor, berth & movement activities for the 2010 calendar year. The trip movement data was broken down into trip segments, each that contained a geographic location. A trip segment constitutes two data points for a particular vessel, with an implied route (straight line), distance and speed. These segments were processed in a Geographic Information System (GIS) to correct the implied vessel routing to avoid land masses. The time element of the activity data is also analysed in the model, to create temporal allocations.

Vessel, scenario & inventory year specific emission rates are created by using vessel type characteristic data, scenario & inventory year specific fuel sulphur levels, and marine engine specific base emission factors.

By multiplying the vessel activity (hours) with the emission rates (g/hour) and the vessel characteristic data, emission estimates are produced. These estimates are then split temporally and spatially based on the allocation data.

The data model specifics are described in Appendix B in the following tables: Table B2-1 – MEIT Stored procedures, Table B2-2 – Tables, and Table B2-3 - Queries.

## 2.4 Model Change Specifics

---

MEIT 4.0 (used for Environment Canada's 2010 National Marine Emissions Inventory For Canada) and MEIT 4.0a (used for Transport Canada's 2010 Arctic Marine Emissions Inventory) were merged into a single database (MEIT 4.1.0).

## 2.5 MEIT 4.0 -> MEIT 4.1

---

MEIT 4.0 was used as the basis for 4.1. See the MEIT 4.1 changes listed below for additional changes.

## 2.6 MEIT 4.0a -> MEIT 4.1

---

Tables, queries, and stored procedures that were Arctic specific were imported into the database. Where required, objects that were used both in the national calculations and in the arctic calculations were renamed by appending “\_Arctic” to the end of the object name. See the MEIT 4.1 changes listed below for additional changes.

## 2.7 MEIT 4.1

---

Once the two versions of the database were merged back into a single database, the following changes were made:

- ◆ Table MEIT\_Scenarios was modified to allow for containing both Arctic and National Emission scenarios.
- ◆ Table MEIT\_Fuel\_Scenarios (and associated data) was created to keep track of fuel scenarios used by both versions
- ◆ Table MEIT\_Fuel\_Regions (and associated data) was created to keep track of fuel regions used by both versions

- ◆ The use of the Energy Efficiency Design Index (EEDI)/ Ship Energy Efficiency Management Plan (SEEMP) emission reductions for forecast years has been discontinued.
- ◆ Implemented the IMO 2009 Engine manufacturing age/Fuel consumption rates (in table MEIT\_Engine\_Emission\_Factors\_Fuel\_gKWH)
- ◆ Emission calculations were split out into separate fuels.
- ◆ Trip location end points and segments were corrected in GIS to avoid land using the EPSG:3347 - NAD83 / Statistics Canada Lambert projection, which modified overall trip lengths as well as emission splits between regions.
- ◆ INNAV 2012 data was used to create trip spatial allocation for the west coast. This was done as the 2010 data from VTOSS/BC PILOTS was insufficient for determining appropriate vessel tracks. 2010 emissions were assigned to the 2012 segments using a 'least-cost sum of squares' distance formula. Regional splits of emissions then followed the 2012 data.
- ◆ Arctic forecast trips (from table ARCTIC\_Forecast\_Trips) temporally allocated using ARCTIC\_Forecast\_Trip\_Time\_Distribution
- ◆ Some data exists in the database from working on Transport Canada's East/West coast ports 2010 emission Inventory Study. Tables starting with 'TC\_' and views starting with 'vwTC' remain in the database. These can be deleted/ignored.
- ◆ Emission data at the trip segment level has been regionally allocated and stored in the tables Trip\_Info\_Emissions\_Portioned, PILOT\_Voyage\_Emissions\_Portioned, VT\_Trip\_Emissions\_Portioned, and Trip\_Info\_Emissions\_Arctic\_Portioned. This data is appropriate to be used directly in summaries.
- ◆ Temporal/spatial allocation of emissions for source points as well as underway segments have been calculated and stored in the GRID\_Point and GRID\_Line tables respectively.
- ◆ Additional fields added to help support regional modelling
- ◆ A small number of bug fixes were performed. Among these were:
  - IMO NOx Tier I, II applied to auxiliary engines. Previously, these standards were only applied to Main engines.
  - Correction of an emission calculation query that was using the wrong fuel split.

# APPENDIX A

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## TOXIC Speciation

## TOXIC Speciation

| Pollutant Code | Pollutant Description     | CAS      | Group           | Speciation Basis | Speciation Fuel | Category 1/2 Speciation Factor | Category 3 Speciation Factor |
|----------------|---------------------------|----------|-----------------|------------------|-----------------|--------------------------------|------------------------------|
| 100414         | Ethyl Benzene             | 100414   | HAP             | VOC              |                 | 0.00125                        | 0.00125                      |
| 100425         | Styrene                   | 100425   | HAP             | VOC              |                 | 0.00131                        | 0.00131                      |
| 107028         | Acrolein                  | 107028   | HAP             | VOC              |                 | 0.00219                        | 0.00219                      |
| 108883         | Toluene                   | 108883   | HAP             | VOC              |                 | 0.002                          | 0.002                        |
| 110543         | n-Hexane                  | 110543   | HAP             | VOC              |                 | 0.00344                        | 0.00344                      |
| 118741         | Hexachlorobenzene         | 118741   | HAP             | PM10             |                 | 0.00000004                     | 0.0000000035                 |
| 120127         | Anthracene                | 120127   | PAH             | PM25             |                 | 0.0000231                      | 0.000000525                  |
| 123386         | Propionaldehyde           | 123386   | HAP             | VOC              |                 | 0.00381                        | 0.00381                      |
| 129000         | Pyrene                    | 129000   | PAH             | PM25             |                 | 0.0000244                      | 0.000000553                  |
| 1330207        | Xylene                    | 1330207  | HAP             | VOC              |                 | 0.003                          | 0.003                        |
| 1336363        | Polychlorinated Biphenyls | 1336363  | PCBs            | PM10             |                 | 0.0000005                      | 0.0000000437                 |
| 16065831       | Chromium (Cr3+)           | 16065831 | Metals          | PM10             |                 | 0.000033                       | 0.000127                     |
| 18540299       | Chromium (Cr6+)           | 18540299 | Metals          | PM10             |                 | 0.000017                       | 0.0000653                    |
| 191242         | Benzo(g,h,i)perylene      | 191242   | PAH             | PM25             |                 | 0.00000563                     | 0.000000128                  |
| 193395         | Indeno(1,2,3,c,d)pyrene   | 193395   | PAH             | PM10             |                 | 0.00001                        | 0.000000874                  |
| 205992         | Benzo(b)fluoranthene      | 205992   | PAH             | PM10             |                 | 0.00001                        | 0.000000874                  |
| 206440         | Fluoranthene              | 206440   | PAH             | PM25             |                 | 0.0000138                      | 0.000000312                  |
| 207089         | Benzo(k)fluoranthene      | 207089   | PAH             | PM10             |                 | 0.000005                       | 0.000000437                  |
| 208968         | Acenaphthylene            | 208968   | PAH             | PM25             |                 | 0.0000231                      | 0.000000525                  |
| 218019         | Chrysene                  | 218019   | PAH             | PM25             |                 | 0.00000438                     | 0.0000000993                 |
| 439921         | Lead                      | 439921   | Metals          | PM10             |                 | 0.00015                        | 0.000014                     |
| 50000          | Formaldehyde              | 50000    | HAP             | VOC              |                 | 0.0935                         | 0.00157                      |
| 50328          | Benzo(a)pyrene            | 50328    | PAH             | PM10             |                 | 0.000005                       | 0.000000437                  |
| 53703          | Dibenzo(a,h)anthracene    | 53703    | PAH             | PM25             |                 | 0                              | 0                            |
| 540841         | 2,2,4-Trimethylpentane    | 540841   | HAP             | VOC              |                 | 0.00025                        | 0.00025                      |
| 56553          | Benz(a)anthracene         | 56553    | PAH             | PM25             |                 | 0.000025                       | 0.000000567                  |
| 600            | Dioxin                    | 600      | Dioxins /Furans | PM10             |                 | 0.000000005                    | 0.000000000437               |
| 71432          | Benzene                   | 71432    | HAP             | VOC              |                 | 0.0127                         | 0.0000098                    |
| 7439965        | Manganese                 | 7439965  | Metals          | PM10             |                 | 0.00000128                     | 0.0000573                    |
| 7439976        | Mercury                   | 7439976  | Metals          | PM10             |                 | 0.00000005                     | 0.000000271                  |
| 7440020        | Nickel                    | 7440020  | Metals          | PM10             |                 | 0.001                          | 0.00325                      |
| 7440382        | Arsenic                   | 7440382  | Metals          | PM10             |                 | 0.00003                        | 0.0000874                    |
| 7440417        | Beryllium                 | 7440417  | Metals          | PM10             |                 | 0.000000546                    | 0.000000546                  |
| 7440439        | Cadmium                   | 7440439  | Metals          | PM10             |                 | 0.00000515                     | 0.0000226                    |



| Pollutant Code | Pollutant Description | CAS     | Group  | Speciation Basis | Speciation Fuel | Category 1/2 Speciation Factor | Category 3 Speciation Factor |
|----------------|-----------------------|---------|--------|------------------|-----------------|--------------------------------|------------------------------|
| 7440484        | Cobalt                | 7440484 | Metals | PM10             |                 | 0.0000594                      | 0.0000594                    |
| 75070          | Acetaldehyde          | 75070   | HAP    | VOC              |                 | 0.0464                         | 0.000229                     |
| 7723140        | Phosphorous           | 7723140 | HAP    | PM10             |                 | 0.00179                        | 0.00179                      |
| 7782492        | Selenium              | 7782492 | Metals | PM10             |                 | 0.0000000515                   | 0.00000191                   |
| 83329          | Acenaphthene          | 83329   | PAH    | PM25             |                 | 0.000015                       | 0.00000034                   |
| 85018          | Phenanthrene          | 85018   | PAH    | PM25             |                 | 0.000035                       | 0.000000794                  |
| 86737          | Fluorene              | 86737   | PAH    | PM25             |                 | 0.0000306                      | 0.000000695                  |
| 91203          | Naphthalene           | 91203   | PAH    | PM25             |                 | 0.000876                       | 0.0000199                    |
| ECarb-BO       | Elemental Carbon      | PM      | ADD    | PM25             | BO              | 0.08                           | 0.08                         |
| ECarb-HFO      | Elemental Carbon      | PM      | ADD    | PM25             | HFO             | 0.05                           | 0.05                         |
| ECarb-MDO      | Elemental Carbon      | PM      | ADD    | PM25             | MDO             | 0.34                           | 0.34                         |
| ECarb-MGO      | Elemental Carbon      | PM      | ADD    | PM25             | MGO             | 0.34                           | 0.34                         |
| NH3            | Ammonia               | 7664417 | CAC    | PM10             |                 | 0.0231                         | 0.00238                      |
| OCarb-BO       | Organic Carbon        | PM      | ADD    | PM25             | BO              | 0.02                           | 0.02                         |
| OCarb-HFO      | Organic Carbon        | PM      | ADD    | PM25             | HFO             | 0.15                           | 0.15                         |
| OCarb-MDO      | Organic Carbon        | PM      | ADD    | PM25             | MDO             | 0.43                           | 0.43                         |
| OCarb-MGO      | Organic Carbon        | PM      | ADD    | PM25             | MGO             | 0.43                           | 0.43                         |
| SUL-BO         | Sulphates             | PM      | ADD    | PM25             | BO              | 0.9                            | 0.9                          |
| SUL-HFO        | Sulphates             | PM      | ADD    | PM25             | HFO             | 0.8                            | 0.8                          |
| SUL-MDO        | Sulphates             | PM      | ADD    | PM25             | MDO             | 0.23                           | 0.23                         |
| SUL-MGO        | Sulphates             | PM      | ADD    | PM25             | MGO             | 0.23                           | 0.23                         |

# APPENDIX B

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## MEIT Model details

## MEIT Model details

**Table B2-1: MEIT Stored Procedures**

| Stored Procedure Name            | Purpose                                                      | A* | B | C | D | E | F  | G |
|----------------------------------|--------------------------------------------------------------|----|---|---|---|---|----|---|
| Calc_Activity_Summary            | Summarizes Activity for East & West together                 |    |   |   |   |   | 10 |   |
| Calc_Activity_Summary_ARCTIC     | Summarizes Activity for Arctic                               |    |   |   |   |   |    | 3 |
| Calc_ALL_Emission_Summary        | Summarizes Emissions for East & West together                | 5  |   | 3 |   |   | 6  |   |
| Calc_ALL_Toxics                  | Calculates the Toxic emissions (based on summary data)       | 6  |   | 4 |   | 1 | 7  |   |
| CALC_GRID_Emissions              | Creates Gridded emissions (ready for export)                 |    |   |   |   |   | 11 | 4 |
| Calc_Gridding_Segments_Arctic    | <obsolete> Creates the gridding segments for the Arctic      |    |   |   |   |   |    |   |
| Calc_INNAV_Emissions_ARCTIC_FUEL | Calculates emissions for INNAV Voyages (Arctic)              |    |   |   |   |   |    | 2 |
| Calc_INNAV_Emissions_FUEL        | Calculates emissions for INNAV Voyages (All but West)        |    |   | 2 |   |   | 2  |   |
| Calc_Location_Region             | <obsolete>                                                   |    |   |   |   |   |    |   |
| Calc_PILOT_Emissions_FUEL        | Calculates emissions for Pilot Voyages (BC - Pilot)          | 2  |   |   |   |   | 3  |   |
| Calc_Temporal_Emissions          | Calculates temporal emission split (By using temporal split) |    |   |   |   |   | 9  |   |
| Calc_Temporal_Emissions_Hour     | <obsolete> Could be used again if required                   |    |   |   |   |   |    |   |
| Calc_Temporal_Split              | Calculates Temporal activity split (By Day)                  |    |   |   |   |   | 8  |   |
| Calc_Temporal_Split_Hour         | <obsolete> Could be used again if required                   |    |   |   |   |   |    |   |
| Calc_VESSEL_Defaults             | Updates calculated fields for vessel data                    | 1  |   | 1 |   |   | 1  |   |
| Calc_VESSEL_Defaults_ARCTIC      | Updates calculated fields for vessel data (ARCTIC)           |    |   |   |   |   |    | 1 |
| Calc_VT_Emissions_FUEL           | Calculates emissions for Pilot Voyages (BC - VTOSS)          | 3  |   |   |   |   | 4  |   |
| Calc_WEST_Emission_Summary       | Sums emissions from Pilot/VTOSS into West                    | 4  |   |   |   |   | 5  |   |

**Table B2-1 (Cont'd): MEIT Stored Procedures**

| Stored Procedure Name            | Purpose                                                              | A* | B | C | D | E | F | G |
|----------------------------------|----------------------------------------------------------------------|----|---|---|---|---|---|---|
| Create_INNAV_Anch_Berth_Locs     | <obsolete> Calculates closest port to Anchor/Berth Location          |    |   |   |   |   |   |   |
| Create_Pilot_Gridding_Segments   | Matches PILOT Voyages with INNAV 2012 segment Data                   |    |   |   |   |   |   |   |
| Create_Pilot_Voyage_Midpoints    | Creates/Updates Source data in Pilot_Constructed_Voyages             |    |   |   |   |   |   |   |
| Create_Pilot_Voyages             | Creates/Updates Source data in Pilot_Constructed_Voyages (and VTOSS) |    |   |   |   |   |   |   |
| Create_Trip_Gaps                 | <obsolete> Creates/Updates Source data in Trip_Gaps                  |    |   |   |   |   |   |   |
| Create_Trip_Info                 | Creates/Updates Source data in Trip_Info                             |    |   |   |   |   |   |   |
| Create_VT_AB_Locs                | Creates/Updates Source data in VT_AB_USED                            |    |   |   |   |   |   |   |
| Create_VT_Gridding_Segments      | Creates the gridding segments for VTOSS data                         |    |   |   |   |   |   |   |
| Create_VT_Trip_Distances         | Creates/Updates Source data in VT_Trip                               |    |   |   |   |   |   |   |
| Create_VT_Trip_Locs              | Creates/Updates Source data in VT_Trip                               |    |   |   |   |   |   |   |
| Create_VT_Trip_Locs_PRPA         | Creates/Updates Source data in VT_Trip                               |    |   |   |   |   |   |   |
| Create_VT_Trip_Segment_Sums      | <obsolete> Creates/Updates Source data in VT_Trip                    |    |   |   |   |   |   |   |
| Create_VT_Trips_CDN_Waters       | <obsolete> Creates/Updates Source data in VT_Trip                    |    |   |   |   |   |   |   |
| Create_VT_Used                   | <obsolete> Creates/Updates Source data in VTOSS_Used                 |    |   |   |   |   |   |   |
| Create_VT_Vessels                | <obsolete> Creates/Updates Source data in VT_Vessel                  |    |   |   |   |   |   |   |
| Create_VT_Voyage_Gaps            | <obsolete> Creates/Updates Source data in VT_Voyage_Gap              |    |   |   |   |   |   |   |
| Create_VT_Voyages                | <obsolete> Creates/Updates Source data in VT_Voyage                  |    |   |   |   |   |   |   |
| Create_VTOSS_Trip_Info           | <obsolete> Creates/Updates Source data in VTOSS_Trip_Info            |    |   |   |   |   |   |   |
| Create_VTOSS_Trip_Info_Distances | <obsolete> Creates/Updates Source data in VTOSS_Trip_Info            |    |   |   |   |   |   |   |

**Table B2-1 (Cont'd): MEIT Stored Procedures**

| Stored Procedure Name             | Purpose                                                                                    | A* | B           | C  | D        | E | F  | G  |
|-----------------------------------|--------------------------------------------------------------------------------------------|----|-------------|----|----------|---|----|----|
| INNAV_ADD_FERRIES                 | Adds missing ferry activity to INNAV's Trip_Info                                           |    |             |    |          |   |    |    |
| INNAV_ADD_FISHING                 | Adds missing fishing activity to INNAV's Trip_Info                                         |    |             |    |          |   |    |    |
| INNAV_ADD_TUGS                    | Adds missing tug activity to INNAV's Trip_Info                                             |    |             |    |          |   |    |    |
| INNAV_FUEL_SOURCE                 | Updates Vessel Table with Fuel Source (For NOx Calc)                                       |    |             |    |          |   |    |    |
| SET_CALC_ALL_YEARS                | Sets years to calculate (2010 Only / forecasts, backcasts & 2010)                          |    | 1<br>(2010) |    | 1<br>(1) |   |    |    |
| Update_BC_2010Arrivals            | <obsolete> Creates/Updates Source data in BC_2010_ArrivalsData                             |    |             |    |          |   |    |    |
| Update_INNAV_Trips                | Calculates Rejects for INNAV Trips/Trip_Infos                                              |    |             |    |          |   |    |    |
| Update_MEIT_Emission_Rates        | Creates emission factors for INNAV / West                                                  | 1a |             | 1a |          |   | 1a |    |
| Update_MEIT_Emission_Rates_ARCTIC | Creates emission factors for Arctic                                                        |    |             |    |          |   |    | 1a |
| Update_MEIT_Emission_Rates_WEST   | Creates emission factors for West Coast (Sulphur overrides)                                | 1a |             | 1a |          |   | 1a |    |
| Update_PILOT_Distances            | Updates Pilot_Segment_Lengths, Pilot_Segment_Region_Lengths from Pilot_Constructed_Voyages |    |             |    |          |   |    |    |
| Update_Pilot_Voyages              | Creates/Updates Source data in Pilot_Constructed_Voyages                                   |    |             |    |          |   |    |    |
| Update_Trip_Info_ARTIC            | Determines which Trip_Info segments are Arctic                                             |    |             |    |          |   |    |    |
| Update_Vessel_Location            | Uses VTOSS to update source data in Pilot_Constructed_Voyages                              |    |             |    |          |   |    |    |

| * Code | Called From                        |
|--------|------------------------------------|
| A      | Called from "Run West"             |
| B      | Called from "Set to Inv.Year 2010" |
| C      | Called from "Run East"             |
| D      | Called from "Set to ALL Inv.Year"  |
| E      | Called from "Run Toxics"           |
| F      | Called from "Run Everything"       |
| G      | Called from "Run Arctic"           |

**Table B2-2: Tables**

| Table Name                             | Purpose/Description                              | Region* | Type* |
|----------------------------------------|--------------------------------------------------|---------|-------|
| Activity_Summary                       | Activity                                         | CW      | R     |
| Activity_Summary_Arctic                | Activity                                         | A       | R     |
| Activity_Summary_Fishing               | Activity                                         | CW      | R     |
| ALL_Emission_Summary                   | Emissions                                        | CW      | R     |
| ARCTIC_Churchill_Trips                 | Trips to Churchill                               | A       | G     |
| ARCTIC_Econ_Regions                    | Economic regions in Arctic                       | A       | S     |
| ARCTIC_Forecast_Trip_Factors           | Forecast factors by year/scenario                | A       | S     |
| ARCTIC_Forecast_Trip_Region_Factors    | Forecast factors by region                       | A       | G     |
| ARCTIC_Forecast_Trip_Time_Distribution | Forecast trip time distribution                  | A       | S     |
| ARCTIC_Forecast_Trips                  | Forecast trips                                   | A       | S     |
| ARCTIC_Routing_Trip_Lengths_CDN        | CDN Trip lengths in Arctic                       | A       | G     |
| ARCTIC_Segment_Lengths                 | For Gridding / Calcs by region                   | A       | G     |
| ARCTIC_Segment_Region_Lengths          | For Gridding / Calcs by region                   | A       | G     |
| ARCTIC_Trip_Info_To_Calc               | Trip Info records requiring Calcs for Arctic     | A       | G     |
| ARCTIC_Trip_Locations_Mapping          | Locations of trips for mapping with vessel class | A       | G     |
| ARCTIC_Trip_Points_By_Region           | Mapping of trips to econ regions with details    | A       | G     |
| ARCTIC_Trips_By_Region                 | Mapping of trips to econ regions                 | A       | G     |
| ARCTIC_Trips_To_Calc                   | Trips to Calc for Arctic                         | A       | G     |
| ARCTIC_Unique_Segments                 | <obsolete>                                       | A       | G     |
| Cargo_Classification                   | INNAV Source                                     | ALL     | S     |
| Cargo_Units                            | INNAV Source                                     | ALL     | S     |
| Emission_Summary                       | Rolled-up Emissions                              | CW      | R     |
| Emission_Summary_Arctic                | Rolled-up Emissions                              | A       | R     |
| Emission_Summary_Arctic_Toxics         | Toxic Emissions                                  | A       | R     |
| Emission_Summary_Toxics                | Toxic Emissions                                  | CW      | R     |
| EmissionRegion                         | Emission Regions                                 | ALL     | S     |
| Event                                  | INNAV source for segments                        | ECGLA   | S     |
| Event_Type                             | INNAV Source                                     | ECGLA   | S     |
| FERRY_TO_ADD                           | Ferry activity to add to INNAV                   | ECGLA   | G     |
| GRID_Line                              | Line based emissions                             | ALL     | R     |
| GRID_Point                             | Point based emissions                            | ALL     | R     |
| Hull_Type                              | INNAV Source                                     | ECGLA   | S     |
| Ice_Class                              | INNAV Source                                     | ECGLA   | S     |
| INNAV_2012_Trip_Locations              | INNAV 2012 data                                  | W       | G     |
| INNAV_2012_Trip_Segment_Locations      | INNAV 2012 data                                  | W       | G     |

Table B2-2 (Cont'd): Tables

| Table Name                             | Purpose/Description                                                              | Region*  | Type* |
|----------------------------------------|----------------------------------------------------------------------------------|----------|-------|
| INNAV_2012_Trip_Segment_Region_Split   | INNAV 2012 data                                                                  | W        | G     |
| INNAV_2012_Trip_Segment_Splits         | INNAV 2012 data                                                                  | W        | G     |
| INNAV_2012_Trip_Segments_With_Regions  | INNAV 2012 data                                                                  | W        | G     |
| INNAV_2012_Trips                       | INNAV 2012 data                                                                  | W        | G     |
| INNAV_Ferry_Source                     | Constructed ferry source data                                                    | ECGLA    | S     |
| INNAV_Inland_Ferry_Locations           | Constructed ferry source data                                                    | ECGLA    | S     |
| INNAV_Inland_Ferrys                    | Constructed ferry source data                                                    | ECGLA    | S     |
| INNAV_Segment_Lengths                  | Trip Segment lengths (Calculated in GIS)                                         | ECGLA    | C     |
| INNAV_Segment_Region_Lengths           | Trip Segment lengths split by region (Calculated in GIS)                         | ECGLA    | C     |
| Location                               | Location data (with GIS calculated regions)                                      | ALL      | S     |
| Location_EXTRACT                       | Transport Canada East/West Coast ports Inventory                                 | ECGLA, W | G     |
| Location_Halifax                       | Report investigations                                                            | ECGLA    | S     |
| Location_Montreal                      | Report investigations                                                            | ECGLA    | S     |
| Location_PORT                          | Report investigations                                                            | ECGLA    | S     |
| Location_PrinceRupert                  | Report investigations                                                            | ECGLA    | S     |
| Location_Type                          | INNAV Source                                                                     | ECGLA    | S     |
| Location_VTOSS                         | Locations used in VTOSS                                                          | W        | G     |
| Maritime_Installation                  | INNAV Source                                                                     | ECGLA    | S     |
| MEIT_ActivityProfiles                  | <obsolete>                                                                       | ALL      | C     |
| MEIT_Boiler_Emission_Factors_kgTON     | Base boiler emission rates                                                       | ALL      | C     |
| MEIT_CalcHP                            | HP calculation by vessel type                                                    | ALL      | C     |
| MEIT_Calculation_Log                   | Log of Calculation activities                                                    | ALL      | C     |
| MEIT_EEDI_Reductions                   | <obsolete>                                                                       | ALL      | C     |
| MEIT_EEDI_Scenarios                    | <obsolete>                                                                       | ALL      | C     |
| MEIT_Emission_Equations                | Reference table (not functional)                                                 | ALL      | C     |
| MEIT_Engine_Emission_Factors_Fuel_gKWH | Base vessel fuel/CO2 emission rates                                              | ALL      | C     |
| MEIT_Engine_Emission_Factors_gKWH      | Base engine emission rates                                                       | ALL      | C     |
| MEIT_Fuel_Content                      | Fuel sulphur percentage (by year, region, fuel scenario, fuel type, fuel origin) | ALL      | C     |
| MEIT_Fuel_Regions                      | Fuel regions                                                                     | ALL      | C     |
| MEIT_Fuel_Scenarios                    | Fuel scenarios                                                                   | ALL      | C     |
| MEIT_Fuel_Sulphur                      | Fuel sulphur overrides (west coast)                                              | W        | C     |
| MEIT_Fugitives                         | Fugitive emission rates                                                          | ALL      | C     |
| MEIT_Inventory_Forecast                | Forecast scaling factors                                                         | ECGLA, W | C     |

Table B2-2 (Cont'd): Tables

| Table Name                            | Purpose/Description                                  | Region*  | Type* |
|---------------------------------------|------------------------------------------------------|----------|-------|
| MEIT_Inventory_Region_Factors         | Arctic regional growth factors                       | A        | C     |
| MEIT_Inventory_Scenario_Factors       | Arctic vessel class growth factors                   | A        | C     |
| MEIT_Inventory_Years                  | Inventory Years                                      | ALL      | C     |
| MEIT_Profile_Characteristics          | Vessel Characteristics                               | ALL      | C     |
| MEIT_Scenarios                        | Scenarios to run                                     | ALL      | C     |
| MEIT_Setup_Tables                     | Tables to appear in Access tool (Under Setup)        | ALL      | C     |
| MEIT_Source_Tables                    | Tables to appear in Access tool (Under Source)       | ALL      | C     |
| MEIT_TC_Vessel_Type_To_Desc           | Transport Canada East/West Coast ports Inventory     | ALL      | C     |
| MEIT_Toxic_Substances                 | Toxic Emission Rates                                 | ALL      | C     |
| MEIT_Underway_Modification_Factors    | Underway (low speed) Modification factors            | ECGLA, W | C     |
| MEIT_VESSEL_CHARACTERISTICS           | Vessel Characteristics (OLD)                         | ALL      | C     |
| MEIT_Vessel_Emission_Factors_gKWH     | Base engine emission rates (Sulphur dependent)       | ALL      | C     |
| MEIT_Vessel_Emission_Factors_kgTON    | Base boiler emission rates (Sulphur dependent)       | ALL      | C     |
| MEIT_Vessel_Modelling_Characteristics | Vessel modelling characteristics                     | ALL      | C     |
| MEIT_Vessels                          | Vessel characteristics (calculated)                  | ALL      | G     |
| MEIT_Vessels_Emission_Factors         | Vessel emission factors (calculated)                 | ALL      | G     |
| PCV_INNAV_Match                       | Pilot voyage to INNAV 2012 mapping (working table)   | W        | G     |
| PCV_INNAV_Matches                     | Pilot voyage to INNAV 2012 mapping (working table)   | W        | G     |
| PCV_INNAV_Segment_Match               | Pilot voyage to INNAV 2012 mapping (working table)   | W        | G     |
| Pilot_2010                            | Pilot Source Data                                    | W        | S     |
| Pilot_2010_Full                       | Pilot Source Data                                    | W        | S     |
| Pilot_2010_Full_Duplicates            | Pilot Source Data                                    | W        | S     |
| Pilot_2010_Vessel                     | Pilot Source Data                                    | W        | S     |
| Pilot_Constructed_Voyages             | Pilot voyages generated from source (multiple steps) | W        | G     |
| PILOT_Emission_Summary                | PILOT emissions                                      | W        | R     |
| PILOT_Ferry_To_Add                    | Ferry data to add to West                            | W        | S     |
| PILOT_Fishing_To_Add                  | Fishing data to add to West                          | W        | S     |
| Pilot_Locations                       | Pilot Source Data                                    | W        | G     |
| Pilot_Segment_Lengths                 | For Gridding / Calcs by region                       | W        | G     |
| Pilot_Segment_Region_Lengths          | For Gridding / Calcs by region                       | W        | G     |
| PILOT_Segments_By_Voyage              | Original voyage lengths (Used for emission calcs)    | W        | G     |
| PILOT_Segments_By_Voyage_Region       | Original voyage lengths (Used for emission calcs)    | W        | G     |
| PILOT_Vessel_Unique                   | Pilot Source Data                                    | W        | G     |
| PILOT_Voyage_Emissions                | Pilot voyage emissions                               | W        | R     |

Table B2-2 (Cont'd): Tables

| Table Name                        | Purpose/Description                              | Region*  | Type* |
|-----------------------------------|--------------------------------------------------|----------|-------|
| PILOT_Voyage_Emissions_Portioned  | Pilot voyage emissions (portioned by region)     | W        | R     |
| PILOT_Voyage_Shorepower           | Pilot voyages using shorepower                   | W        | S     |
| Region                            | INNAV Source                                     | ECGLA    | S     |
| Regions_Geog                      | <obsolete>                                       |          |       |
| TC_INNAV_Segment_Lengths          | Transport Canada East/West Coast ports Inventory | ECGLA, W |       |
| TC_Location                       | Transport Canada East/West Coast ports Inventory | ECGLA, W |       |
| TC_Location_Match                 | Transport Canada East/West Coast ports Inventory | ECGLA, W |       |
| TC_MEIT_Used_Locations            | Transport Canada East/West Coast ports Inventory | ECGLA, W |       |
| TC_PMV_Vessel_By_Commodity        | Transport Canada East/West Coast ports Inventory | ECGLA, W |       |
| TC_PRPA_All_INNAV_Points          | Transport Canada East/West Coast ports Inventory | ECGLA, W |       |
| TC_PRPA_Model_Lines_Region        | Transport Canada East/West Coast ports Inventory | ECGLA, W |       |
| TC_PRPA_Model_Lines_Region_Src    | Transport Canada East/West Coast ports Inventory | ECGLA, W |       |
| TC_PRPA_Segment_Model_Lengths     | Transport Canada East/West Coast ports Inventory | ECGLA, W |       |
| TC_Segment_Region_Lengths_West    | Transport Canada East/West Coast ports Inventory | ECGLA, W |       |
| TC_Segment_Region_Lengths_West_VT | Transport Canada East/West Coast ports Inventory | ECGLA, W |       |
| TC_Segments_PRPA                  | Transport Canada East/West Coast ports Inventory | ECGLA, W |       |
| TC_Terminal_Trip_Anchor_Match     | Transport Canada East/West Coast ports Inventory | ECGLA, W |       |
| TC_Terminal_Trip_Match            | Transport Canada East/West Coast ports Inventory | ECGLA, W |       |
| TC_Terminal_Voyage_Anchor_Match   | Transport Canada East/West Coast ports Inventory | ECGLA, W |       |
| TC_Terminal_Voyage_Match          | Transport Canada East/West Coast ports Inventory | ECGLA, W |       |
| TC_Terminals                      | Transport Canada East/West Coast ports Inventory | ECGLA, W |       |
| Temporal_Emissions_Day            | Temporal emissions (by day)                      | ECGLA, W | R     |
| Temporal_Emissions_DayOfWeek      | Temporal emissions (by day of week)              | ECGLA, W | R     |
| Temporal_Emissions_Hour           | <obsolete>                                       |          |       |
| Temporal_Emissions_Month          | Temporal emissions (by month)                    | ECGLA, W | R     |
| Temporal_Split                    | Temporal split (by day)                          | CW       | G     |
| Temporal_Split_Hour               | <obsolete>                                       |          |       |
| Temporal_Split_Month              | Temporal split (by month)                        | CW       | G     |
| Trip                              | INNAV Trips                                      | ECGLA, A | S     |
| TRIP_Gap                          | Trip gaps for analysis                           | ECGLA    | G     |
| TRIP_Info                         | INNAV trip segments                              | ECGLA, A | G     |
| Trip_Info_Activity_ARCTIC         | Arctic Trip activity                             | A        | G     |
| Trip_Info_Emissions               | Trip segment emissions                           | ECGLA    | R     |
| Trip_Info_Emissions_Arctic        | Trip segment emissions                           | A        | R     |

Table B2-2 (Cont'd): Tables

| Table Name                           | Purpose/Description                                  | Region* | Type* |
|--------------------------------------|------------------------------------------------------|---------|-------|
| Trip_Info_Emissions_Arctic_Portioned | Trip segment emissions (portioned by region)         | A       | R     |
| Trip_Info_Emissions_Portioned        | Trip segment emissions (portioned by region)         | ECGLA   | R     |
| TRIP_Info_Rejects                    | Trip segments thrown out                             | ECGLA   | G     |
| TRIP_Rejects                         | Trips thrown out                                     | ECGLA   | G     |
| Trips_For_Investigations             | Trip investigations                                  | ECGLA   | G     |
| UniqueTrips_Canadian_good            | Trip investigations                                  | ECGLA   | G     |
| Vessel                               | Vessels (with calculated fields)                     | CW      | S     |
| Vessel_Activity                      | INNAV reference table                                | ECGLA   | S     |
| Vessel_Class                         | Reference table                                      | CW      | S     |
| Vessel_Equipment                     | INNAV reference table                                | ECGLA   | S     |
| Vessel_Equipment_Type                | INNAV reference table                                | ECGLA   | S     |
| Vessel_SeaWeb                        | Vessel reference table (with IHS Fairplay data)      | ALL     | G     |
| Vessel_Type                          | INNAV reference table                                | ECGLA   | S     |
| VT_AB_Used                           | Anchor/Berth locations used (VTOSS)                  | W       | G     |
| VT_Emission_Summary                  | Emission Summary (VTOSS)                             | W       | R     |
| VT_INNAV_Segment_Match               | VTOSS to INNAV 2012 mapping (working table)          | W       | G     |
| VT_PRPA_Trip                         | Data analysis (OLD)                                  | W       | G     |
| VT_Segment_Lengths                   | VTOSS Segment Lengths                                | W       | G     |
| VT_Trip                              | VTOSS Trip source                                    | W       | S     |
| VT_Trip_Emissions                    | Processed VTOSS trip emissions                       | W       | R     |
| VT_Trip_Emissions_Portioned          | Processed VTOSS trip emissions (Portioned by region) | W       | R     |
| VT_Vessel                            | VTOSS Vessels                                        | W       | S     |
| VT_Vessel_Type                       | VTOSS vessel types                                   | W       | S     |
| VT_Vessel_Unique                     | Unique VTOSS vessels                                 | W       | S     |
| VT_Voyage                            | VTOSS Voyages                                        | W       | S     |
| VT_Voyage_Emissions                  | VTOSS Voyage Emissions (OLD)                         | W       | R     |
| VT_Voyage_Gap                        | Voyage gaps for analysis                             | W       | G     |
| VT_Voyage_Gap_Emissions              | VTOSS Voyage Emissions (OLD)                         | W       | R     |
| VT_Voyage_To_Plot                    | Voyage analysis                                      | W       | G     |
| Waterway_Zone                        | INNAV reference table                                | ECGLA   | S     |
| WEST_Emission_Summary                | PILOT & VTOSS emissions                              | W       | R     |
| Zone_Definition                      | INNAV reference table                                | ECGLA   | S     |

| * Region Code | Region                          |
|---------------|---------------------------------|
| CW            | Canada Wide                     |
| W             | West                            |
| A             | Arctic                          |
| ECGLA         | East Coast, Great Lakes, Arctic |
| ALL           | Canada Wide + Arctic            |

| * Type | Type Description |
|--------|------------------|
| S      | Source           |
| C      | Calculation      |
| G      | Generated        |
| R      | Result           |

Table B2-3: Queries

| Query Name                               | Purpose/Description               | Region* | Type* |
|------------------------------------------|-----------------------------------|---------|-------|
| profile_characteristics                  |                                   | ALL     | C     |
| vwALL_Activity                           |                                   | CW      |       |
| vwALL_Emission_Summary                   |                                   | CW      |       |
| vwALL_Emissions_Rollup                   |                                   | CW      |       |
| vwALL_Emissions_Rollup_Diffs             |                                   | CW      |       |
| vwALL_Fishing_Activity                   |                                   | CW      |       |
| vwALL_Fishing_Vessels                    |                                   | CW      |       |
| vwALL_GRID_Line_2010                     | Emission Gridded Results for 2010 | ALL     | R     |
| vwALL_GRID_Point_2010                    | Emission Gridded Results for 2010 | ALL     | R     |
| vwALL_Temporal_Emissions_Day             |                                   | CW      |       |
| vwALL_Temporal_Emissions_DayOfWeek       |                                   | CW      |       |
| vwALL_Temporal_Emissions_Month           |                                   | CW      |       |
| vwALL_Toxics_Summary                     |                                   | CW      |       |
| vwALL_Vessels                            |                                   | CW      |       |
| vwARCTIC_Activity                        |                                   | A       |       |
| vwARCTIC_All_Fuel_By_TripInfo            |                                   | A       |       |
| vwARCTIC_All_Fuel_By_Vessel              |                                   | A       |       |
| vwARCTIC_Calc_Activity_AnchorBerth       |                                   | A       |       |
| vwARCTIC_Calc_Activity_Underway          |                                   | A       |       |
| vwARCTIC_Churchill_Trips_By_Vessel_Class |                                   | A       |       |
| vwARCTIC_Econ_Regions_Points             |                                   | A       |       |
| vwARCTIC_Emission_Summary                |                                   | A       |       |
| vwARCTIC_Emission_Summary_AB_2010        |                                   | A       |       |
| vwARCTIC_Emissions_AB_2010               |                                   | A       |       |

Table B2-3 (Cont'd): Queries

| Query Name                                         | Purpose/Description           | Region* | Type* |
|----------------------------------------------------|-------------------------------|---------|-------|
| vwARCTIC_Emissions_By_TripInfo_2010_AB             |                               | A       |       |
| vwARCTIC_Emissions_ByVesselType_Day                |                               | A       |       |
| vwARCTIC_Emissions_Gridded_Line                    | * Emission Gridding Results * | A       | R     |
| vwARCTIC_Emissions_Gridded_Point                   | * Emission Gridding Results * | A       | R     |
| vwARCTIC_Forecast_Trip_Region_Factor_MAX           |                               | A       |       |
| vwARCTIC_Grid_Point_Source_Emissions               |                               | A       |       |
| vwARCTIC_Grid_Point_Sources                        |                               | A       |       |
| vwARCTIC_Grid_TripInfo_To_Trip                     |                               | A       |       |
| vwARCTIC_Grid_Underway_Emissions                   |                               | A       |       |
| vwARCTIC_Invest_Berth_Avg_By_Vessel_Type           |                               | A       | I     |
| vwARCTIC_Invest_Comparison                         |                               | A       | I     |
| vwARCTIC_Invest_Comparison_Diffs                   |                               | A       | I     |
| vwARCTIC_Invest_Comparison_New                     |                               | A       | I     |
| vwARCTIC_Invest_ForecastTrips                      |                               | A       | I     |
| vwARCTIC_Invest_Fuel_Source_Trip_Count_Vessel_Type |                               | A       | I     |
| vwARCTIC_Invest_Orig_Underway_Speed                |                               | A       | I     |
| vwARCTIC_Invest_Routing_Speeds                     |                               | A       | I     |
| vwARCTIC_Invest_Routing_Speeds_AVG                 |                               | A       | I     |
| vwARCTIC_Invest_Routing_Speeds_Base                |                               | A       | I     |
| vwARCTIC_Invest_Routing_Speeds_By_Type             |                               | A       | I     |
| vwARCTIC_Invest_Routing_Speeds_Underway            |                               | A       | I     |
| vwARCTIC_Invest_Trip_Selector                      |                               | A       | I     |
| vwARCTIC_Invest_Trip_Selector_NoDetails            |                               | A       | I     |
| vwARCTIC_Invest_Trip_To_Plot_Data                  |                               | A       | I     |
| vwARCTIC_Invest_Trips_To_Be_Added                  |                               | A       | I     |
| vwARCTIC_Invest_Underway_Fuel                      |                               | A       | I     |
| vwARCTIC_Invest_Underway_Fuel_AVG                  |                               | A       | I     |
| vwARCTIC_Invest_Underway_Fuel_AVG_By_Type          |                               | A       | I     |
| vwARCTIC_Invest_Underway_Fuel_By_Type              |                               | A       | I     |
| vwARCTIC_Invest_Underway_Fuel_Daily_AVG            |                               | A       | I     |
| vwARCTIC_Invest_Underway_Fuel_Days                 |                               | A       | I     |
| vwARCTIC_Invest_Underway_Fuel_Days_By_Type         |                               | A       | I     |
| vwARCTIC_Invest_Underway_Fuel_Usage                |                               | A       | I     |
| vwARCTIC_Invest_Unique_Vessels_By_Class            |                               | A       | I     |

Table B2-3 (Cont'd): Queries

| Query Name                                  | Purpose/Description | Region* | Type* |
|---------------------------------------------|---------------------|---------|-------|
| vwARCTIC_Invest_Vessel_Size                 |                     | A       | I     |
| vwARCTIC_Locations                          |                     | A       |       |
| vwARCTIC_Locations_ALL                      |                     | A       |       |
| vwARCTIC_Locations_Trip                     |                     | A       |       |
| vwARCTIC_Locations_TripInfo                 |                     | A       |       |
| vwARCTIC_Missing_Trips_For_Griding          |                     | A       |       |
| vwARCTIC_Sample_Emissions                   |                     | A       |       |
| vwARCTIC_Trip                               |                     | A       |       |
| vwARCTIC_Trip_Info                          |                     | A       |       |
| vwARCTIC_Trip_Info_Emissions                |                     | A       |       |
| vwARCTIC_Trip_Info_Emissions_DIFF_TO_ARCTIC |                     | A       |       |
| vwARCTIC_Trip_Locations_Mapping             |                     | A       |       |
| vwARCTIC_Trip_Segments_Plot                 |                     | A       |       |
| vwARCTIC_Trip_Segments_To_Plot_Missing      |                     | A       |       |
| vwARCTIC_TripInfo_Locations_Mapping         |                     | A       |       |
| vwARCTIC_Trips_By_Int_Dom                   |                     | A       |       |
| vwARCTIC_Trips_Econ_Regions                 |                     | A       |       |
| vwARCTIC_Trips_No_Fishing                   |                     | A       |       |
| vwARCTIC_Trips_No_Fishing_Details           |                     | A       |       |
| vwARCTIC_Unique_Segments                    |                     | A       |       |
| vwARCTIC_Unique_Segments_LatLong            |                     | A       |       |
| vwARCTIC_Vessels_Used                       |                     | A       |       |
| vwBCTrips2010                               |                     |         |       |
| vwBCTrips2010_PRPA                          |                     |         |       |
| vwINNAV__SampleTripsToPlot                  |                     |         |       |
| vwINNAV__SampleTripsToPlot_Data             |                     |         |       |
| vwINNAV__TripSegmentsRemoved                |                     |         |       |
| vwINNAV__TripsForInvestigations             |                     |         |       |
| vwINNAV__TripsForInvestigations_Cruise      |                     |         |       |
| vwINNAV_Activity_By_Vessel_Arctic_AB        |                     | A       |       |
| vwINNAV_Activity_By_Vessel_Arctic_U_Split   |                     | A       |       |
| vwINNAV_Activity_By_Vessel_Region_AB        |                     | ECGLA   |       |
| vwINNAV_Activity_By_Vessel_Region_AB_ARCTIC |                     | A       |       |
| vwINNAV_Activity_By_Vessel_Region_Cruise_AB |                     | ECGLA   |       |

Table B2-3 (Cont'd): Queries

| Query Name                                    | Purpose/Description         | Region*  | Type* |
|-----------------------------------------------|-----------------------------|----------|-------|
| vwINNAV_Activity_By_Vessel_Region_Cruise_U    |                             | ECGLA    |       |
| vwINNAV_Activity_By_Vessel_Region_U_Construct |                             | ECGLA    |       |
| vwINNAV_Activity_By_Vessel_Region_U_Split     |                             | ECGLA    |       |
| vwINNAV_Activity_Cruise_Power_Percent_Grouped |                             | ECGLA    |       |
| vwINNAV_Calc_Anchor_AE                        | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Anchor_AE_HFO                    | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Anchor_AE_MDO                    | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Anchor_AE_MGO                    | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Anchor_BO                        | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Anchor_BO_HFO                    | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Anchor_BO_MDO                    | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Anchor_BO_MGO                    | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Berth_AE                         | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Berth_AE_HFO                     | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Berth_AE_MDO                     | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Berth_AE_MGO                     | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Berth_BO                         | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Berth_BO_Cruise                  | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Berth_BO_Cruise_HFO              | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Berth_BO_Cruise_MDO              | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Berth_BO_Cruise_MGO              | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Berth_BO_HFO                     | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Berth_BO_MDO                     | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Berth_BO_MGO                     | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Berth_Cruise                     | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Berth_Cruise_HFO                 | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Berth_Cruise_MDO                 | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Berth_Cruise_MGO                 | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Berth_Fugitive                   | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Toxic_AE                         | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Toxic_BO                         | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Toxic_ME                         | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_AE                      | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_AE_HFO                  | INNAV Emission Calculations | ECGLA, A | C     |

Table B2-3 (Cont'd): Queries

| Query Name                                  | Purpose/Description         | Region*  | Type* |
|---------------------------------------------|-----------------------------|----------|-------|
| vwINNAV_Calc_Underway_AE_MDO                | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_AE_MGO                | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_BO                    | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_BO_Cruise             | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_BO_Cruise_HFO         | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_BO_Cruise_MDO         | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_BO_Cruise_MGO         | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_BO_HFO                | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_BO_MDO                | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_BO_MGO                | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_Cruise                | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_Cruise_HFO            | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_Cruise_MDO            | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_Cruise_MGO            | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_Fugitive              | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_M2                    | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_M2_HFO                | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_M2_MDO                | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_M2_MGO                | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_M4                    | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_M4_HFO                | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_M4_MDO                | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_Underway_M4_MGO                | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_VesselSpeedPercent_ByRegion    | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Calc_VesselSpeedPercent_BySegment   | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_CalcSplit                           | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_CalcTime                            | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_CalcTime_Cruise                     | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_CalcTime_Cruise_Base                | INNAV Emission Calculations | ECGLA, A | C     |
| vwINNAV_Emission_Base_Data                  |                             |          |       |
| vwINNAV_Emission_Summary_2010_AB            |                             |          |       |
| vwINNAV_Emissions_Base_Point                |                             |          |       |
| vwINNAV_Emissions_Base_Underway             |                             |          |       |
| vwINNAV_Emissions_Base_Underway_Constructed |                             |          |       |

Table B2-3 (Cont'd): Queries

| Query Name                                       | Purpose/Description           | Region* | Type* |
|--------------------------------------------------|-------------------------------|---------|-------|
| vwINNAV_Emissions_Base_Underway_Split            |                               |         |       |
| vwINNAV_Emissions_By_Vessel_Arctic_AB            |                               |         |       |
| vwINNAV_Emissions_By_Vessel_Arctic_U_Split       |                               |         |       |
| vwINNAV_Emissions_By_Vessel_Region_AB            |                               |         |       |
| vwINNAV_Emissions_By_Vessel_Region_U_Construct   |                               |         |       |
| vwINNAV_Emissions_By_Vessel_Region_UWay          |                               |         |       |
| vwINNAV_Emissions_By_Vessel_Trip_Region_AB       |                               |         |       |
| vwINNAV_Emissions_By_Vessel_Trip_Region_Underway |                               |         |       |
| vwINNAV_Emissions_Gridded_Line                   | * Emission Gridding Results * | ECGLA   | R     |
| vwINNAV_Emissions_Gridded_Point                  | * Emission Gridding Results * | ECGLA   | R     |
| vwINNAV_Emissions_Region_Split                   |                               |         |       |
| vwINNAV_Emissions_Region_Split_Arctic            |                               |         |       |
| vwINNAV_Invest_Arctic_Fishing                    |                               | A       | I     |
| vwINNAV_Invest_Arctic_Fishing_ALL                |                               | A       | I     |
| vwINNAV_Invest_Arctic_Fishing_Union              |                               | A       | I     |
| vwINNAV_Invest_Disgard_Segments                  |                               | ECGLA   | I     |
| vwINNAV_Invest_Ferries_Region_Added              |                               | ECGLA   | I     |
| vwINNAV_Invest_Fishing                           |                               | ECGLA   | I     |
| vwINNAV_Invest_Fishing_Hours                     |                               | ECGLA   | I     |
| vwINNAV_Invest_Fishing_Hours_Region              |                               | ECGLA   | I     |
| vwINNAV_Invest_LNG_Tankers                       |                               | ECGLA   | I     |
| vwINNAV_Invest_Passenger_All_Vessels             |                               | ECGLA   | I     |
| vwINNAV_Invest_Passenger_Locations               |                               | ECGLA   | I     |
| vwINNAV_Invest_Passenger_Region_TimeUnderway     |                               | ECGLA   | I     |
| vwINNAV_Invest_Trip_Info_Segment_Desc            |                               | ECGLA   | I     |
| vwINNAV_Invest_Trip_Visualizer_Helper            |                               | ECGLA   | I     |
| vwINNAV_Invest_Tug_Time_Halifax                  |                               | ECGLA   | I     |
| vwINNAV_Invest_Tug_Time_Halifax_Far              |                               | ECGLA   | I     |
| vwINNAV_Invest_Tug_Time_Halifax_Near             |                               | ECGLA   | I     |
| vwINNAV_Invest_Tug_Time_Montreal                 |                               | ECGLA   | I     |
| vwINNAV_Invest_Tug_Time_Montreal_Far             |                               | ECGLA   | I     |
| vwINNAV_Invest_Tug_Time_Montreal_Near            |                               | ECGLA   | I     |
| vwINNAV_Invest_Tug_Trip_Distance                 |                               | ECGLA   | I     |
| vwINNAV_Invest_Tugs_In_Halifax                   |                               | ECGLA   | I     |

Table B2-3 (Cont'd): Queries

| Query Name                                          | Purpose/Description | Region* | Type* |
|-----------------------------------------------------|---------------------|---------|-------|
| vwINNAV_Invest_Tugs_In_Halifax_PLOT                 |                     | ECGLA   | I     |
| vwINNAV_Invest_Tugs_In_Montreal                     |                     | ECGLA   | I     |
| vwINNAV_Invest_Used_CDN_Locations                   |                     | ECGLA   | I     |
| vwINNAV_Invest_Used_Locations                       |                     | ECGLA   | I     |
| vwINNAV_Invest_Vessel_Sample_Gaps                   |                     | ECGLA   | I     |
| vwINNAV_Invest_Vessel_Speeds                        |                     | ECGLA   | I     |
| vwINNAV_Stats_Cruise_Fuel_Usage                     |                     | ECGLA   | S     |
| vwINNAV_Stats_Cruise_Power_Grouped                  |                     | ECGLA   | S     |
| vwINNAV_Stats_Cruise_Power_Usage_Region             |                     | ECGLA   | S     |
| vwINNAV_Stats_Cruise_Power_Usage_Region_Percent     |                     | ECGLA   | S     |
| vwINNAV_Stats_Estimated_Tug_Hrs                     |                     | ECGLA   | S     |
| vwINNAV_Stats_Fishing_Used_By_Length                |                     | ECGLA   | S     |
| vwINNAV_Stats_Innocent_Passage_Base                 |                     | ECGLA   | S     |
| vwINNAV_Stats_Innocent_Passage_Counts               |                     | ECGLA   | S     |
| vwINNAV_Stats_InnocentPassage                       |                     | ECGLA   | S     |
| vwINNAV_Stats_InnocentPassage_Trips_In_CDN          |                     | ECGLA   | S     |
| vwINNAV_Stats_Location_Routing                      |                     | ECGLA   | S     |
| vwINNAV_Stats_Pivot                                 |                     | ECGLA   | S     |
| vwINNAV_Stats_Pivot_Trip                            |                     | ECGLA   | S     |
| vwINNAV_Stats_Pivot_Trip_TimeSummary                |                     | ECGLA   | S     |
| vwINNAV_Stats_Quick_Totals                          |                     | ECGLA   | S     |
| vwINNAV_Stats_Quick_Totals_Arctic                   |                     | ECGLA   | S     |
| vwINNAV_Stats_Quick_Totals_Segments_Arctic          |                     | ECGLA   | S     |
| vwINNAV_Stats_Suspect_Segments_Class                |                     | ECGLA   | S     |
| vwINNAV_Stats_Suspect_Segments_Region               |                     | ECGLA   | S     |
| vwINNAV_Stats_TripCounts_Vessel_OfInterest          |                     | ECGLA   | S     |
| vwINNAV_Stats_Trips_ArrivingInHalifaxByRegion       |                     | ECGLA   | S     |
| vwINNAV_Stats_Trips_ArrivingInMontrealByRegion      |                     | ECGLA   | S     |
| vwINNAV_Stats_Trips_CountsByRegion                  |                     | ECGLA   | S     |
| vwINNAV_Stats_Trips_CountsByRegionArea              |                     | ECGLA   | S     |
| vwINNAV_Stats_TripSegment_Area_UnderwayHour         |                     | ECGLA   | S     |
| vwINNAV_Stats_TripSegment_Area_UnderwayHour_Keepers |                     | ECGLA   | S     |
| vwINNAV_Stats_TripSegment_Area_UnderwayHour_Rejects |                     | ECGLA   | S     |
| vwINNAV_Stats_TripSegment_Load_Factor_Counts        |                     | ECGLA   | S     |

Table B2-3 (Cont'd): Queries

| Query Name                                                 | Purpose/Description | Region* | Type* |
|------------------------------------------------------------|---------------------|---------|-------|
| vwINNAV_Stats_TripSegment_Reject_Reasons                   |                     | ECGLA   | S     |
| vwINNAV_Stats_TripSegment_Rejects                          |                     | ECGLA   | S     |
| vwINNAV_Stats_TripSegment_SpeedsByRegion                   |                     | ECGLA   | S     |
| vwINNAV_Stats_TripSegmentCounts_Vessel_Underway_OfInterest |                     | ECGLA   | S     |
| vwINNAV_Stats_TripTime_Mode_RegionArea                     |                     | ECGLA   | S     |
| vwINNAV_Stats_Tug_Times_Actual                             |                     | ECGLA   | S     |
| vwINNAV_Stats_Tug_Times_By_Class_Region                    |                     | ECGLA   | S     |
| vwINNAV_Stats_UsedLocations                                |                     | ECGLA   | S     |
| vwINNAV_Stats_Vessel_Engine_Criteria                       |                     | ECGLA   | S     |
| vwINNAV_Stats_Vessel_Engine_Sulphur                        |                     | ECGLA   | S     |
| vwINNAV_Stats_Vessel_Fuel_Sulphur                          |                     | ECGLA   | S     |
| vwINNAV_Stats_Vessel_Routing_Base                          |                     | ECGLA   | S     |
| vwINNAV_Stats_Vessel_Routing_Counts                        |                     | ECGLA   | S     |
| vwINNAV_Stats_Vessel_Sulphur                               |                     | ECGLA   | S     |
| vwINNAV_Stats_Vessels                                      |                     | ECGLA   | S     |
| vwINNAV_Stats_Vessels_ALL                                  |                     | ECGLA   | S     |
| vwINNAV_Stats_Vessels_Arctic                               |                     | ECGLA   | S     |
| vwINNAV_Stats_VesselsUsed                                  |                     | ECGLA   | S     |
| vwINNAV_Time_Compare                                       |                     | ECGLA   |       |
| vwINNAV_Trip_Info_Emissions                                |                     | ECGLA   |       |
| vwINNAV_Trip_Segments                                      |                     | ECGLA   |       |
| vwINNAV_Trip_Segments_Diff_Regions                         |                     | ECGLA   |       |
| vwINNAV_Trip_Segments_UNIQUE                               |                     | ECGLA   |       |
| vwINNAV_Trip_Segments_Used_Locations                       |                     | ECGLA   |       |
| vwINNAV_Trip_Segments_Used_UNIQUE                          |                     | ECGLA   |       |
| vwINNAV_Trip_Segments_Useful                               |                     | ECGLA   |       |
| vwINNAV_Trip_Segments_Useful_Cross                         |                     | ECGLA   |       |
| vwINNAV_Trip_Speed_Analysis                                |                     | ECGLA   |       |
| vwINNAV_TripAvgLoad_ByRegion                               |                     | ECGLA   |       |
| vwINNAV_TripEndPointCounts                                 |                     | ECGLA   |       |
| vwINNAV_Trips                                              |                     | ECGLA   |       |
| vwINNAV_Trips_With_Issues                                  |                     | ECGLA   |       |
| vwINNAV_Vessel_Seaweb_Compare                              |                     | ECGLA   |       |
| vwINNAV_Vessels                                            |                     | ECGLA   |       |

Table B2-3 (Cont'd): Queries

| Query Name                                    | Purpose/Description         | Region* | Type* |
|-----------------------------------------------|-----------------------------|---------|-------|
| vwINNAV_Vessels_Count_DWT_CONS                |                             | ECGLA   |       |
| vwInnocentPassage                             |                             |         |       |
| vwMEIT_Boiler_Emission                        |                             |         |       |
| vwMEIT_Engine_Emission                        |                             |         |       |
| vwMEIT_Profile_Characteristics                |                             |         |       |
| vwMEIT_Stats_Vessel_Boiler_Fuel_Usage         |                             |         |       |
| vwMEIT_Stats_Vessels_Stroke_Displace          |                             |         |       |
| vwMEIT_Vessel                                 |                             |         |       |
| vwMEIT_Vessels                                |                             |         |       |
| vwMEIT_Vessels_Emission_Factors_HFO           |                             |         |       |
| vwMEIT_Vessels_Emission_Factors_MDO           |                             |         |       |
| vwMEIT_Vessels_Emission_Factors_MGO           |                             |         |       |
| vwPILOT_Activity_By_Vessel_Region_AB          | PILOT Activity              | W       | C     |
| vwPILOT_Activity_By_Vessel_Region_Cruise      | PILOT Activity              | W       | C     |
| vwPILOT_Activity_By_Vessel_Region_U           | PILOT Activity              | W       | C     |
| vwPILOT_Activity_Cruise_Power_Percent_Grouped | PILOT Activity              | W       | C     |
| vwPILOT_Calc_Anchor_AE                        | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Anchor_AE_HFO                    | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Anchor_AE_MDO                    | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Anchor_AE_MGO                    | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Anchor_BO                        | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Anchor_BO_HFO                    | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Anchor_BO_MDO                    | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Anchor_BO_MGO                    | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Berth_AE                         | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Berth_AE_HFO                     | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Berth_AE_MDO                     | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Berth_AE_MGO                     | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Berth_BO                         | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Berth_BO_HFO                     | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Berth_BO_MDO                     | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Berth_BO_MGO                     | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Berth_Cruise                     | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Berth_Cruise_BO                  | PILOT Emission Calculations | W       | C     |

Table B2-3 (Cont'd): Queries

| Query Name                           | Purpose/Description         | Region* | Type* |
|--------------------------------------|-----------------------------|---------|-------|
| vwPILOT_Calc_Berth_Cruise_BO_HFO     | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Berth_Cruise_BO_MDO     | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Berth_Cruise_BO_MGO     | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Berth_Cruise_HFO        | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Berth_Cruise_MDO        | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Berth_Cruise_MGO        | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Berth_Cruise_Shorepower | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Berth_Fugitive          | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_AE             | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_AE_HFO         | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_AE_MDO         | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_AE_MGO         | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_BO             | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_BO_HFO         | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_BO_MDO         | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_BO_MGO         | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_Cruise         | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_Cruise_BO      | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_Cruise_BO_HFO  | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_Cruise_BO_MDO  | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_Cruise_BO_MGO  | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_Cruise_HFO     | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_Cruise_MDO     | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_Cruise_MGO     | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_Fugitive       | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_M2             | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_M2_HFO         | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_M2_MDO         | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_M2_MGO         | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_M4             | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_M4_HFO         | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_M4_MDO         | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Underway_M4_MGO         | PILOT Emission Calculations | W       | C     |
| vwPILOT_Calc_Vessel_Speed_Percent    | PILOT Emission Calculations | W       | C     |

Table B2-3 (Cont'd): Queries

| Query Name                                 | Purpose/Description           | Region* | Type* |
|--------------------------------------------|-------------------------------|---------|-------|
| vwPILOT_CalcTime                           | PILOT Emission Calculations   | W       | C     |
| vwPILOT_CalcTime_BACKUP                    | PILOT Emission Calculations   | W       | C     |
| vwPILOT_CalcTime_Cruise                    | PILOT Emission Calculations   | W       | C     |
| vwPILOT_CalcTime_Cruise_Base               | PILOT Emission Calculations   | W       | C     |
| vwPILOT_CalcTime_Cruise_Years              | PILOT Emission Calculations   | W       | C     |
| vwPILOT_Constructed_Voyage_Midpoints       |                               | W       | C     |
| vwPILOT_Constructed_Voyage_Unique_Mid      |                               | W       | C     |
| vwPILOT_Emission_Summary                   |                               | W       | C     |
| vwPILOT_EmissionBase                       |                               | W       | C     |
| vwPILOT_Emissions_Gridded_Line             | * Emission Gridding Results * | W       | R     |
| vwPILOT_Emissions_Gridded_Point            | * Emission Gridding Results * | W       | R     |
| vwPILOT_EmissionSummary_ALL                |                               | W       | C     |
| vwPILOT_EmissionSummary_r3                 |                               | W       | C     |
| vwPILOT_EmissionSummary_r4                 |                               | W       | C     |
| vwPilot_Hours_By_Region_By_Vessel_Class    |                               |         |       |
| vwPILOT_Invest_CruiseShips                 |                               |         |       |
| vwPILOT_Invest_INNAV_2012_Used_Trips       |                               |         |       |
| vwPILOT_Invest_Location_Mapping            |                               |         |       |
| vwPILOT_Invest_Suspect_Cruise_Plot         |                               |         |       |
| vwPILOT_Invest_Suspect_Cruise_Trips        |                               |         |       |
| vwPILOT_Invest_TUG_Assist                  |                               |         |       |
| vwPILOT_Invest_Vancouver_Anchs_Berths      |                               |         |       |
| vwPILOT_Invest_Vessels                     |                               |         |       |
| vwPILOT_Locations_Anch_Berth               |                               |         |       |
| vwPILOT_Locations_To_INNAV                 |                               |         |       |
| vwPILOT_Nanaimo_Midpoints                  |                               |         |       |
| vwPILOT_Nanaimo_Midpoints_SUB              |                               |         |       |
| vwPILOT_Nanaimo_Trips_Midpoint_Needed      |                               |         |       |
| vwPILOT_PORTALBERNI_Midpoints              |                               |         |       |
| vwPILOT_PORTALBERNI_Midpoints_Sub          |                               |         |       |
| vwPILOT_PORTALBERNI_Trips_Midpoints_Needed |                               |         |       |
| vwPILOT_PRPA_Midpoints                     |                               |         |       |
| vwPILOT_PRPA_Midpoints_SUB                 |                               |         |       |
| vwPILOT_PRPA_Trips_Midpoints_Needed        |                               |         |       |

Table B2-3 (Cont'd): Queries

| Query Name                                      | Purpose/Description                              | Region*  | Type* |
|-------------------------------------------------|--------------------------------------------------|----------|-------|
| vwPILOT_PRPA_Trips_Midpoints_Needed_End         |                                                  |          |       |
| vwPILOT_PRPA_Trips_Midpoints_Needed_Start       |                                                  |          |       |
| vwPILOT_Stats_BC_Ferries_Base                   |                                                  |          |       |
| vwPILOT_Stats_BC_Ferries_Base_R2                |                                                  |          |       |
| vwPILOT_Stats_BC_Ferries_Summary                |                                                  |          |       |
| vwPILOT_Stats_BC_Ferries_Summary_R2             |                                                  |          |       |
| vwPILOT_Stats_Cruise_Power_Grouped              |                                                  |          |       |
| vwPILOT_Stats_Cruise_Power_Usage_Region         |                                                  |          |       |
| vwPILOT_Stats_Cruise_Power_Usage_Region_Percent |                                                  |          |       |
| vwPILOT_Stats_Cruise_Shorepower_Total           |                                                  |          |       |
| vwPILOT_Stats_EngineLoadByClassRegion           |                                                  |          |       |
| vwPILOT_Stats_Fugitive_Region_2                 |                                                  |          |       |
| vwPILOT_Stats_Time_By_Mode                      |                                                  |          |       |
| vwPILOT_Stats_Trips_From_Warfs                  |                                                  |          |       |
| vwPILOT_Stats_Voyages_To_Plot                   |                                                  |          |       |
| vwPILOT_Trip_Segments_UNIQUE                    |                                                  |          |       |
| vwPILOT_Used_Locations                          |                                                  |          |       |
| vwPILOT_Vancouver_Midpoints                     |                                                  |          |       |
| vwPILOT_Vancouver_Midpoints_SUB                 |                                                  |          |       |
| vwPILOT_Vancouver_Trips_Midpoints_Needed        |                                                  |          |       |
| vwPILOT_Voyage_Data                             |                                                  |          |       |
| vwSeawebData_TCPortModel                        |                                                  |          |       |
| vwSegmentsWithSuspiciousSpeeds                  |                                                  |          |       |
| vwTC_INNAVEmissionSummary                       | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_AB_Times_West                       | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_ABPivot_West                        | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_ABPivot_West_2015                   | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_ABPivot_West_Day                    | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_ABPivot_West_Hour                   | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_MEIT_Trip_Matching                  | Transport Canada East/West Coast ports Inventory | ECGLA, W | I     |

Table B2-3 (Cont'd): Queries

| Query Name                                      | Purpose/Description                              | Region*  | Type* |
|-------------------------------------------------|--------------------------------------------------|----------|-------|
| vwTC_Invest_MEIT_Trip_Matching_All_Recs         | Transport Canada East/West Coast ports Inventory | ECGLA, W | I     |
| vwTC_Invest_MEIT_Used_Locations                 | Transport Canada East/West Coast ports Inventory | ECGLA, W | I     |
| vwTC_Invest_MEIT_Used_Locations_Unique          | Transport Canada East/West Coast ports Inventory | ECGLA, W | I     |
| vwTC_Invest_Port_Locations                      | Transport Canada East/West Coast ports Inventory | ECGLA    | I     |
| vwTC_Invest_Port_Locations_West                 | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_Port_Vessel_Stops                   | Transport Canada East/West Coast ports Inventory | ECGLA    | I     |
| vwTC_Invest_Port_Vessel_Stops_AnchorTime        | Transport Canada East/West Coast ports Inventory | ECGLA    | I     |
| vwTC_Invest_Port_Vessel_Stops_Details           | Transport Canada East/West Coast ports Inventory | ECGLA    | I     |
| vwTC_Invest_Port_Vessel_Stops_Details_Cruise    | Transport Canada East/West Coast ports Inventory | ECGLA    | I     |
| vwTC_Invest_Port_Vessel_Stops_Details_Noncruise | Transport Canada East/West Coast ports Inventory | ECGLA    | I     |
| vwTC_Invest_Port_Vessel_Stops_West              | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_Port_Vessel_Stops_West_2015         | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_Port_Vessel_Stops_West_AnchorTime   | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_Port_Vessel_Stops_West_Details      | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_Port_Vessel_Stops_West_Helper       | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_Port_Vessel_Stops_West_Hourly       | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_Terminal_Extract                    | Transport Canada East/West Coast ports Inventory | ECGLA    | I     |
| vwTC_Invest_Terminal_Extract_Helper             | Transport Canada East/West Coast ports Inventory | ECGLA    | I     |
| vwTC_Invest_Terminal_Extract_West               | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_Terminal_Extract_West_Sub_Berths    | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_Terminal_Extract_West_Sub_TT        | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_Terminal_Matched_Voyages            | Transport Canada East/West Coast ports Inventory | ECGLA, W | I     |
| vwTC_Invest_TripTime_Vessel_Type_Location       | Transport Canada East/West Coast ports Inventory | ECGLA, W | I     |

Table B2-3 (Cont'd): Queries

| Query Name                                    | Purpose/Description                              | Region*  | Type* |
|-----------------------------------------------|--------------------------------------------------|----------|-------|
| vwTC_Invest_Underway                          | Transport Canada East/West Coast ports Inventory | ECGLA, W | I     |
| vwTC_Invest_Underway_Constructed              | Transport Canada East/West Coast ports Inventory | ECGLA, W | I     |
| vwTC_Invest_Underway_PRPA_InnocentPassage     | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_Underway_PRPA_Model               | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_Underway_PRPA_Model_Hour          | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_Underway_Sourced                  | Transport Canada East/West Coast ports Inventory | ECGLA, W | I     |
| vwTC_Invest_Underway_West                     | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_Underway_West_2015                | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_Underway_West_ALL                 | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_Underway_West_ALL_Day             | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_Underway_West_ALL_Hour            | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_Underway_West_Day                 | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_Underway_West_VT                  | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_Underway_West_VT_Day              | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_Invest_Vessel_Stop_All_Extract           | Transport Canada East/West Coast ports Inventory | ECGLA, W | I     |
| vwTC_Invest_Vessel_Stop_All_Location_Extract  | Transport Canada East/West Coast ports Inventory | ECGLA, W | I     |
| vwTC_Invest_Vessel_Stop_Matched_Extract       | Transport Canada East/West Coast ports Inventory | ECGLA, W | I     |
| vwTC_Model_Test_One                           | Transport Canada East/West Coast ports Inventory |          |       |
| vwTC_PILOT_Invest_CalcCruise_Berth_NoPower    | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_PILOT_Invest_CalcCruise_Berth_Shorepower | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_PILOT_Invest_CalcCruise_Berth_WithPower  | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_PILOT_Invest_CalcTime_Cruise_NoPower     | Transport Canada East/West Coast ports Inventory | W        | I     |
| vwTC_PilotVoyageEmissions_2010_Sum            | Transport Canada East/West Coast ports Inventory | W        | R     |

Table B2-3 (Cont'd): Queries

| Query Name                                    | Purpose/Description                              | Region* | Type* |
|-----------------------------------------------|--------------------------------------------------|---------|-------|
| vwTC_PilotVoyageEmissions_2015_Sum            | Transport Canada East/West Coast ports Inventory | W       | R     |
| vwTC_Report_OGV_Calls_West                    | Transport Canada East/West Coast ports Inventory | W       | R     |
| vwTC_Report_OGV_Char_West                     | Transport Canada East/West Coast ports Inventory | W       | R     |
| vwTC_Report_PMV_Activity                      | Transport Canada East/West Coast ports Inventory | W       | R     |
| vwTC_Report_PMV_Activity_Time                 | Transport Canada East/West Coast ports Inventory | W       | R     |
| vwTC_Report_PMV_Emissions                     | Transport Canada East/West Coast ports Inventory | W       | R     |
| vwTC_Report_PMV_Emissions_BySource            | Transport Canada East/West Coast ports Inventory | W       | R     |
| vwTC_Report_PMV_Emissions_Tug                 | Transport Canada East/West Coast ports Inventory | W       | R     |
| vwTC_Report_PMV_Emissions_Tug_Base            | Transport Canada East/West Coast ports Inventory | W       | R     |
| vwTC_Report_PMV_Emissions_Years               | Transport Canada East/West Coast ports Inventory | W       | R     |
| vwTC_Report_PMV_Emissions_Years_Base          | Transport Canada East/West Coast ports Inventory | W       | R     |
| vwTC_Report_PMV_Emissions_Years_Base_BySource | Transport Canada East/West Coast ports Inventory | W       | R     |
| vwTC_Report_PMV_Emissions_Years_BySource      | Transport Canada East/West Coast ports Inventory | W       | R     |
| vwTC_Report_PMV_Tug_Chars                     | Transport Canada East/West Coast ports Inventory | W       | R     |
| vwTC_Report_PMV_Tug_Chars_Fuel                | Transport Canada East/West Coast ports Inventory | W       | R     |
| vwTC_Report_PMV_Vessel_Trips                  | Transport Canada East/West Coast ports Inventory | W       | R     |
| vwTC_VesselNameComparison_Pilot_INNAV         | Transport Canada East/West Coast ports Inventory | W       | R     |
| vwTC_VTTripEmissions_2010_Sum                 | Transport Canada East/West Coast ports Inventory | W       | R     |
| vwTCCFC_Vessels_Container                     | Transport Canada East/West Coast ports Inventory |         |       |
| vwTCECP_Vessel_Stops                          | Transport Canada East/West Coast ports Inventory |         |       |
| vwTimeInTheSamePlace                          |                                                  | ECGLA   | I     |
| vwTripDetails                                 |                                                  | ECGLA   | I     |
| vwTripDetailsWithLocation                     |                                                  | ECGLA   | I     |
| vwTripDetailsWithLocations_NON_PACIFIC        |                                                  | ECGLA   | I     |
| vwTripGaps                                    |                                                  | ECGLA   | I     |

Table B2-3 (Cont'd): Queries

| Query Name                             | Purpose/Description         | Region* | Type* |
|----------------------------------------|-----------------------------|---------|-------|
| vwTripInfoAnchorings                   |                             | ECGLA   | I     |
| vwTripOutAndBackDetails                |                             | ECGLA   | I     |
| vwTrips_Of_Interest_Lat_Long           |                             | ECGLA   | I     |
| vwTripsByLocationType                  |                             | ECGLA   | I     |
| vwTripsFrmHalifaxToMontreal            |                             | ECGLA   | I     |
| vwTripsFrmHalifaxToMontreal_Lat_Long   |                             | ECGLA   | I     |
| vwTripsFromVesselsInHalifaxAndMontreal |                             | ECGLA   | I     |
| vwTripsOutAndBack                      |                             | ECGLA   | I     |
| vwTripStats                            |                             | ECGLA   | I     |
| vwTripStats_BerthAnchTimesByVesselType |                             | ECGLA   | I     |
| vwTripStats_TimeUnderwayByVesselType   |                             | ECGLA   | I     |
| vwTripStatsRaw                         |                             | ECGLA   | I     |
| vwTripStatsRawShipDetails              |                             | ECGLA   | I     |
| vwTripStatsSummary                     |                             | ECGLA   | I     |
| vwTripsToFindGaps                      |                             | ECGLA   | I     |
| vwVT_Activity_By_Vessel_Region         | VTOSS Activity              | W       | C     |
| vwVT_Calc_Anchor_AE                    | VTOSS Emission Calculations | W       | C     |
| vwVT_Calc_Anchor_AE_HFO                | VTOSS Emission Calculations | W       | C     |
| vwVT_Calc_Anchor_AE_MDO                | VTOSS Emission Calculations | W       | C     |
| vwVT_Calc_Anchor_AE_MGO                | VTOSS Emission Calculations | W       | C     |
| vwVT_Calc_Anchor_BO                    | VTOSS Emission Calculations | W       | C     |
| vwVT_Calc_Anchor_BO_HFO                | VTOSS Emission Calculations | W       | C     |
| vwVT_Calc_Anchor_BO_MDO                | VTOSS Emission Calculations | W       | C     |
| vwVT_Calc_Anchor_BO_MGO                | VTOSS Emission Calculations | W       | C     |
| vwVT_Calc_Berth_AE                     | VTOSS Emission Calculations | W       | C     |
| vwVT_Calc_Berth_AE_HFO                 | VTOSS Emission Calculations | W       | C     |
| vwVT_Calc_Berth_AE_MDO                 | VTOSS Emission Calculations | W       | C     |
| vwVT_Calc_Berth_AE_MGO                 | VTOSS Emission Calculations | W       | C     |
| vwVT_Calc_Berth_BO                     | VTOSS Emission Calculations | W       | C     |
| vwVT_Calc_Berth_BO_HFO                 | VTOSS Emission Calculations | W       | C     |
| vwVT_Calc_Berth_BO_MDO                 | VTOSS Emission Calculations | W       | C     |
| vwVT_Calc_Berth_BO_MGO                 | VTOSS Emission Calculations | W       | C     |
| vwVT_Calc_Underway_AE                  | VTOSS Emission Calculations | W       | C     |
| vwVT_Calc_Underway_AE_HFO              | VTOSS Emission Calculations | W       | C     |

Table B2-3 (Cont'd): Queries

| Query Name                        | Purpose/Description           | Region* | Type* |
|-----------------------------------|-------------------------------|---------|-------|
| vwVT_Calc_Underway_AE_MDO         | VTOSS Emission Calculations   | W       | C     |
| vwVT_Calc_Underway_AE_MGO         | VTOSS Emission Calculations   | W       | C     |
| vwVT_Calc_Underway_BO             | VTOSS Emission Calculations   | W       | C     |
| vwVT_Calc_Underway_BO_HFO         | VTOSS Emission Calculations   | W       | C     |
| vwVT_Calc_Underway_BO_MDO         | VTOSS Emission Calculations   | W       | C     |
| vwVT_Calc_Underway_BO_MGO         | VTOSS Emission Calculations   | W       | C     |
| vwVT_Calc_Underway_M2             | VTOSS Emission Calculations   | W       | C     |
| vwVT_Calc_Underway_M2_HFO         | VTOSS Emission Calculations   | W       | C     |
| vwVT_Calc_Underway_M2_MDO         | VTOSS Emission Calculations   | W       | C     |
| vwVT_Calc_Underway_M2_MGO         | VTOSS Emission Calculations   | W       | C     |
| vwVT_Calc_Underway_M4             | VTOSS Emission Calculations   | W       | C     |
| vwVT_Calc_Underway_M4_HFO         | VTOSS Emission Calculations   | W       | C     |
| vwVT_Calc_Underway_M4_MDO         | VTOSS Emission Calculations   | W       | C     |
| vwVT_Calc_Underway_M4_MGO         | VTOSS Emission Calculations   | W       | C     |
| vwVT_CalcTime                     | VTOSS Emission Calculations   | W       | C     |
| vwVT_CalcTime_VesselSpeed         | VTOSS Emission Calculations   | W       | C     |
| vwVT_Emission_Summary             |                               | W       | C     |
| vwVT_Emissions_Gridded_Line       | * Emission Gridding Results * | W       | R     |
| vwVT_Emissions_Gridded_Point      | * Emission Gridding Results * | W       | R     |
| vwVT_EmissionSummary_ALL          |                               | W       | C     |
| vwVT_Hours_By_Vessel_Class        |                               | W       |       |
| vwVT_Hourse_Used_By_Vessel_Class  |                               | W       |       |
| vwVT_Invest_Fishing_Base          |                               | W       |       |
| vwVT_Invest_Fishing_By_Region     |                               | W       |       |
| vwVT_Invest_Fishing_Sub1          |                               | W       |       |
| vwVT_Invest_Fishing_Sub2          |                               | W       |       |
| vwVT_Invest_Fishing_Vessels       |                               | W       |       |
| vwVT_Invest_Fishing_Vessels_Base  |                               | W       |       |
| vwVT_Invest_INNAV_2012_Used_Trips |                               | W       |       |
| vwVT_PRPA_InnocentPassage         |                               | W       |       |
| vwVT_PRPA_Points                  |                               | W       |       |
| vwVT_PRPA_Trip                    |                               | W       |       |
| vwVT_PRPA_Vessels_Of_Interest     |                               | W       |       |
| vwVT_PRPA_Voyage                  |                               | W       |       |

Table B2-3 (Cont'd): Queries

| Query Name                      | Purpose/Description | Region* | Type* |
|---------------------------------|---------------------|---------|-------|
| vwVT_PRPA_Voyage_Arrive         |                     | W       |       |
| vwVT_PRPA_Voyage_Depart         |                     | W       |       |
| vwVT_PRPA_VoyageGaps            |                     | W       |       |
| vwVT_Stats_Non_Pilot_Trips      |                     | W       |       |
| vwVT_Stats_Time_By_Mode         |                     | W       |       |
| vwVT_Stats_Used_Non_Pilot_Trips |                     | W       |       |
| vwVT_Trip_Segments_UNIQUE       |                     | W       |       |
| vwVT_Trips_Of_Interest          |                     | W       |       |
| vwVT_Trips_Of_Interest_Lat_Long |                     | W       |       |
| vwVT_Voyages                    |                     | W       |       |
| vwVT_Voyages_Of_Interest        |                     | W       |       |
| vwVT_VoyageWithInnavLocations   |                     | W       |       |
| vwWEST_Calc_Toxic_AE            |                     | W       | C     |
| vwWEST_Calc_Toxic_BO            |                     | W       | C     |
| vwWEST_Calc_Toxic_ME            |                     | W       | C     |
| vwWEST_Emission_Summary         |                     | W       |       |
| vwWEST_Emission_Summary_Grouped |                     | W       |       |
| vwWEST_Emission_Summary_Sum     |                     | W       |       |
| vwWEST_Stats_Time_By_Mode       |                     | W       |       |

| * Region Code | Region                          |
|---------------|---------------------------------|
| CW            | Canada Wide                     |
| W             | West                            |
| A             | Arctic                          |
| ECGLA         | East Coast, Great Lakes, Arctic |

| * Type | Type Description |
|--------|------------------|
| C      | Calculation      |
| R      | Result           |
| I      | Investigative    |
| S      | Statistical      |