Appendix F
Air Dispersion Modelling - Excerpts from Randle Reef Sediment Remediation Project Comprehensive Study Report October 30, 2013

Construction

Effects Analysis

The construction activities involved in the ECF phase of the Randle Reef Sediment Remediation Project, which have the potential to affect air quality and contribute to regional air pollution include:

- ECF and Turbidity Structure Construction, and Pier 15 stabilization;
- dredging and capping;
- backfilling and capping of the ECF; and
- sub-aqueous capping of the U.S. Steel channel.

These construction activities will require the use of a number of pieces of heavy construction equipment and vehicles including: pile drivers, dump trucks, concrete trucks, excavators, backhoes, front end loaders and miscellaneous smaller contractor equipment.

The large diesel powered equipment will generate combustion gases including: CO_2, CO, NO_x, N_2O, SO_2, VOCs, PAHs, and PM. The use of construction equipment and trucks will also generate airborne PM from road dust as they travel to and from, as well as on, the construction site. PM will also be generated from the delivery, movement and erosion of material stockpiles, which will be required for aggregate and sand requirements for the ECF.

Dredging operations during the construction of the ECF as well as during production dredging will require the use of large barge operated and or land-based mechanical and hydraulic dredging equipment. Dredging activities during construction (e.g., between the ECF walls) will include mechanical and hydraulic dredging. Production dredging activities will occur outside of the ECF and will only include hydraulic dredging. These large diesel powered units will generate combustion gasses, as well as airborne PM.

Furthermore, dredging activities may potentially release VOCs and PAHs from the disturbed contaminated sediments.

An air dispersion modelling assessment was conducted to determine the potential effects on air quality from the volatilization of contaminated sediment due to dredging operations and the placement of sediment into the ECF. Volatilization is the movement or gaseous emission from a liquid surface to the atmospheric environment.

The modelling assessment focused on assessing scenarios that would represent a maximum emissions scenario from volatilization sources during normal operating conditions. For the remediation activities, five volatilization sources were identified:

- the dredging area during hydraulic dredging operations;
- exposed sediment during mechanical dredging operations for the transport and placement of contaminated sediment in the ECF;
- the ECF during active placement of the dredged material;
- the quiescent, ponded ECF; and
- the dewatered capped ECF due to minor vapour migration through the cap.

It is expected that dredging operations will emit more volatile emissions than quiescent ponded conditions or the capped ECF. Therefore, to capture the effect of maximum emitting operation conditions, the following two scenarios were assessed:

1) mechanical dredging operations for 2 mechanical dredges operating simultaneously; and
2) production dredging operations for 2 hydraulic dredges operating simultaneously.

Mechanical dredging between the ECF walls is scheduled to occur before production dredging outside of the ECF. Currently, it is expected that mechanical dredging and production dredging will not occur simultaneously, therefore, the scenarios assessed do not account for this. In addition, both modelling scenarios assumed operations consist of two (2) ten-hour (10) shifts, seven (7) days a week throughout the year.

During the construction phase, mechanical dredging will remove the sediment in between the ECF walls before backfilling activities occur. The dredged material may be exposed to the air as the mechanical dredge bucket moves through the air and over the sheetpile wall for placement of contaminated sediment into the ECF. The exposure of the dredged material to the air may result in the volatilization of chemicals from the sediment. During mechanical dredging, the ECF itself may also be a volatilization source. This is because mechanical dredging causes increased suspended solids in the near-surface water and increased water turbulence as the mechanical dredge bucket breaks the surface of the water.

Hydraulic dredging will be used during production dredging. Volatilization may occur due to increased suspended solids in the water column and increased water turbulence. The volatile sediment emissions from hydraulic dredging will be lower than mechanical dredging. In hydraulic dredging, the increased suspended solids are limited to the water near the mudline (ARCADIS BBL, 2007).

A modelling exercise was previously completed for Hamilton Port Authority (HPA) by ARCADIS BBL. The modelling exercise was a screening analysis, which assessed the potential for volatilization from dredged material by calculating the maximum flux for PAHs and specified VOCs (benzene, toluene, ethylbenzene and xylene (BTEX)). Based on the maximum flux rates, naphthalene (a PAH) and benzene were screened as the parameters of concern for air dispersion modelling. These compounds are deemed to be reasonable indicators of overall air quality due to their high volatility potential. Emission rates for hydraulic dredging activities and ECF emissions rates previously developed by ARCADIS BBL were used in the modelling assessment. The calculation methodology outlined by ARCADIS BBL for mechanical dredging emission rates was used to predict emission rates from mechanical dredging activities. The emission rates of the identified substances of concern are given below in Table 9.4:

Table 9.4: Source Emission Rates

Parameter		**ECF**	**Production Dredge #1**	**Production Dredge #2**	**Mechanical Dredge #1**	**Mechanical Dredge #2**
Source Type		Area	Area	Area	Volume	Volume
Emission Rates (g/s)	Benzene	2.31E-5	2.12E-6	2.12E-6	1.55E-4	1.55E-4
	Naphthalene	3.17E-3	5.63E-4	5.63E-4	8.13E-3	8.13E-3

The ADMGO was used as a guide for this assessment. As per Section 6.6 in the ADMGO, the modelling results were screened to remove meteorological anomalies. Thus the highest eight (8) 1-hr concentration values and the highest one (1) 24-hr concentration values were removed from each year to determine compliance to the ambient air quality criteria. A conversion factor of 1.2 was used to convert AERMOD 1-hour results to 30-minute results for comparison to 30-minute Point of Impingement (POI) guidelines, outlined in Ontario Regulation 419. With respect to the discharge of air contaminants, Ontario's Reg. 419 defines a POI as any that is not located on the same property as the source of the contaminant. However, the regulation further defines POI as a point located on the same property as the source if that point is located on the following:

- a child care facility; or
- a structure, if the primary purpose of the structure is to serve as a
  - health care facility;
  - a senior citizen's residence or long-term care facility; or
  - and educational facility.

As previously stated, the area of modelling coverage focused on a 5 km by 5 km domain surrounding the project Site.

A tiered receptor grid with variable receptor spacing was used for the dispersion modelling assessment, as outlined in the ADMGO. All receptors situated on water were removed from the assessment. Furthermore, the site plan provided by HPA was used to input the dimensions and location of the project.

Isopleths depicting the maximum point of impingement (POI) location for naphthalene and benzene modelling results are shown in **Figure 9.2, Figure 9.3** and **Figure 9.4**. An isopleth is a contour line on a map representing points of equal value. In this context an isopleth represents points of equal air contaminant concentration on ground level. All areas inside the contour lines represent areas with equal or less air contaminant concentrations.

The maximum predicted ground-level concentrations for naphthalene and benzene for the proposed remediation project are presented in Table 9.5 below:

Table 9.5: Maximum Predicted Ground-Level Concentrations

Contaminant	Averaging Period	Ambient Background Concentration (μg/m³)[1]	Maximum Predicted Ground Level Concentration (μg/m³)		Location of Maximum POI	Ambient Air Quality Criteria (μg/m³)[2]
			Before Ambient Background Added	After Ambient Background Added		
Naphthalene	½ hour	NA	332.45	NA	East of ECF, on Pier 15	36.5
	Daily	1.26	137.70	138.96	East of ECF, on Pier 15	22.5
Benzene	Daily	1.56	2.63	4.19	Southeast of ECF, on Pier 15	NA

Notes:
1. Ambient background concentration was determined to be an average of five years of data (2003 – 2007) obtained from the Hillyard air monitoring station
2. Air Quality Guidelines from Ontario Regulation 419/05 (MOE, 2005)

Figure 9.2: Maximum Point of Impingement (POI) Modelling Results (Naphthalene)

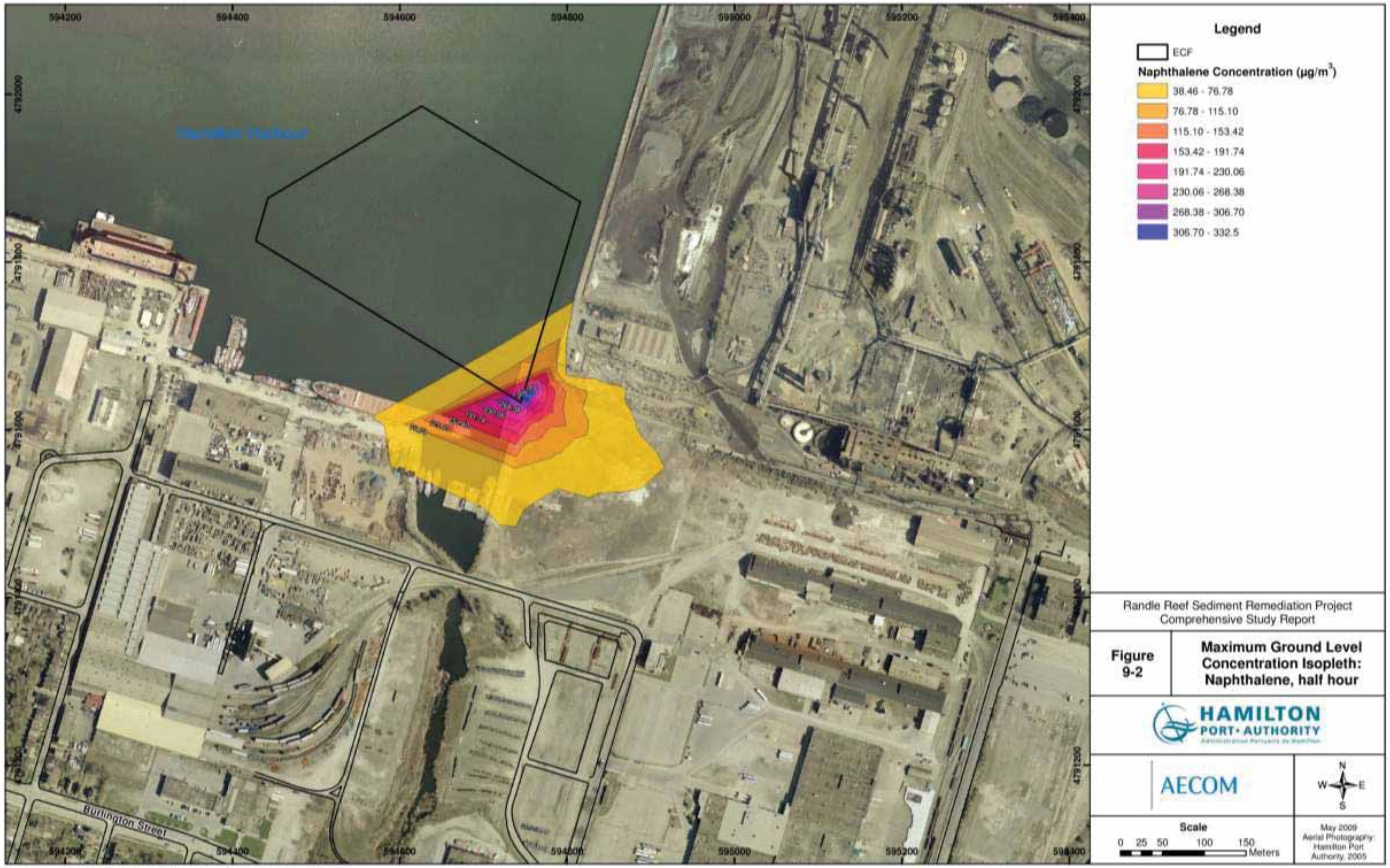

Figure 9.3: Maximum Point of Impingement (POI) Modelling Results (Naphthalene)

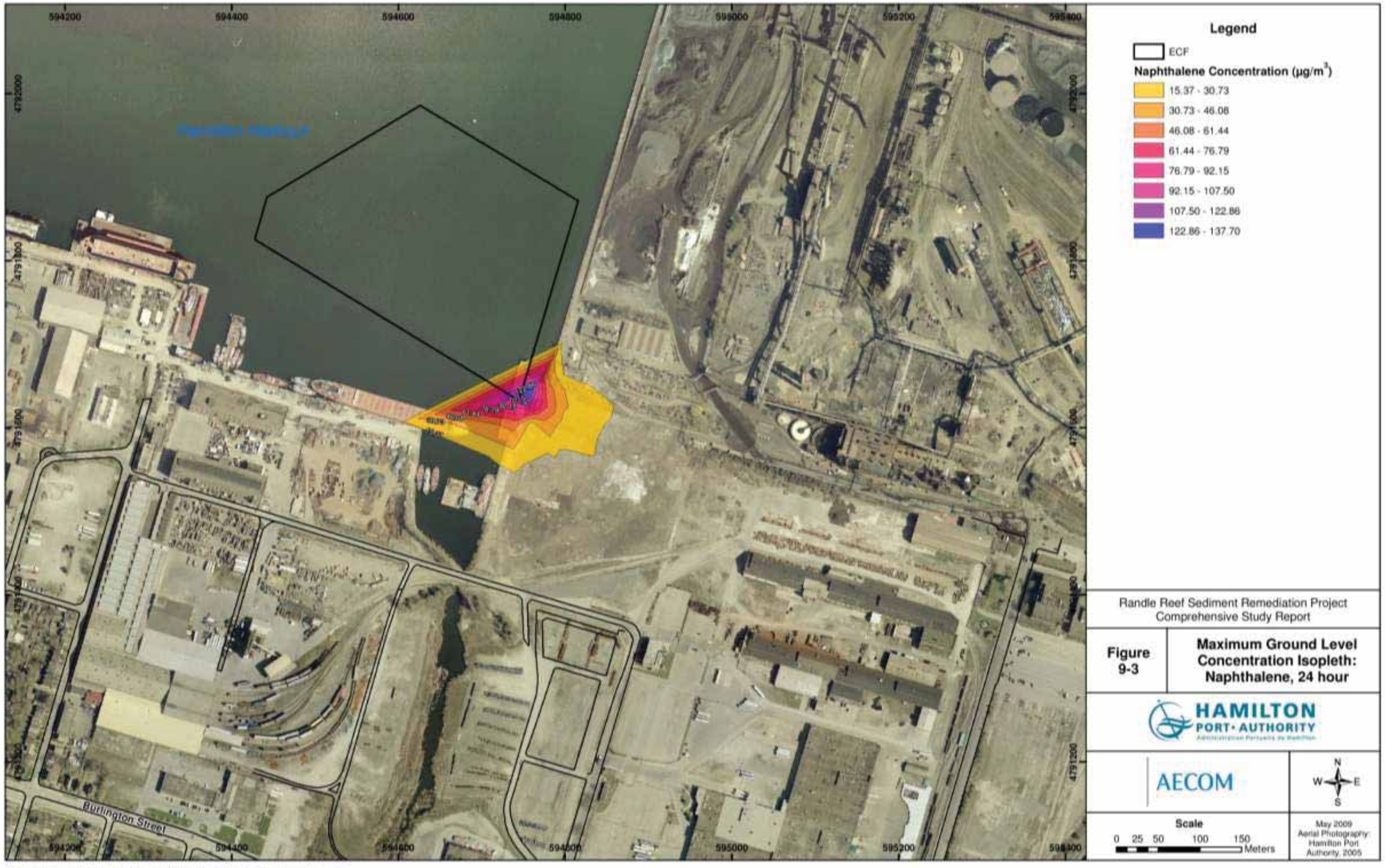

Figure 9.4: Maximum Point of Impingement (POI) Modelling Results (Benzene)