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US ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
Total Environmental Restoration Contract
USACE CONTRACT NUMBER: DACW33-03-D-0006
Task Order No. 0007

FINAL
EVALUATION OF THE IMPACT OF DREDGING AND CAD CELL DISPOSAL ON AIR QUALITY

NEW BEDFORD HARBOR SUPERFUND SITE, NEW BEDFORD, MA

New Bedford Harbor Superfund Site
New Bedford, MA

June 2010

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ACE-J23-35BG0702-M17-0011

SDMS DocID 466822

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ACRONYMS AND ABBREVIATIONS

CAD	confined aquatic disposal
City	City of New Bedford
cy	cubic yards
EPA	U.S. Environmental Protection Agency
FW	Foster Wheeler Environmental Corporation
ISC3	Industrial Source Complex Model
ISCLT3	Long Term Industrial Source Complex Model
ISCST3	Short Term Industrial Source Complex Model
Jacobs	Jacobs Engineering Group, Inc.
LHCC	lower harbor CAD cell
MU	management unit
NAE	U.S. Army Corps of Engineers – New England District
NBH Site	New Bedford Harbor Superfund Site
ng/m^3	nanograms per cubic meter
PCB	polychlorinated biphenyl
ppm	parts per million

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1.0 INTRODUCTION

This report describes the air modeling investigation for the dredging, transport, and disposal activities associated with the proposed lower harbor confined aquatic disposal (CAD) cell (LHCC) at the New Bedford Harbor Superfund Site in New Bedford, Massachusetts (NBH Site). For the purposes of this modeling effort, and to represent high dredging and disposal rates, an $80 million per year funding scenario was used for activity sequence, sediment removal rates, and project duration. Polychlorinated biphenyl (PCB) sediment concentrations were obtained from the *Air Dispersion Modeling of 2009 Dredging Operations* (Jacobs 2009). For this $80 million per year funding scenario, years four and five would involve placement of PCB-contaminated material into the LHCC.

Removal of PCB-contaminated sediments in the harbor was the remedial action selected for operable unit #1 of the NBH Site. The current approach consists of hydraulic dredging, desanding and dewatering of dredged sediments, treatment of the wastewater generated in the dewatering process, and disposal of desanded and dewatered sediment at an approved off-site landfill. The U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers – New England District (NAE) are considering use of an LHCC to shorten the remediation timeframe and lower the overall harbor remediation cost. The investigation documented by this report evaluates the impact to air quality from the mechanical dredging and proposed CAD cell disposal activities.

CAD is the process where dredged material that is unsuitable for unconfined open water disposal is deposited into a marine environment within a confined area or excavation, and then capped with a suitable material. CAD cells are increasingly becoming the selected option for the management of unsuitable dredged material (UDM).

The sediments slated for the proposed LHCC are the relatively lower concentration level PCB-contaminated sediments from approximately the Sawyer Street area south to the Route 6 Bridge. Air dispersion modeling was conducted to estimate the air quality

impacts of mechanically dredging, transporting by scow, and disposing these sediments into the proposed LHCC.

Evaluation of the air quality impacts from dredging operations has been conducted since 2005 using air dispersion modeling efforts (Jacobs 2005, 2006, 2007, 2008, and 2009). The previous modeling efforts have been validated and improved by comparing with field data. This modeling analysis used the same model domain of the previous studies and incorporated the latest site-specific meteorological and design data to predict future impacts.

2.0 BACKGROUND

2.1 SITE INFORMATION

The NBH Site is located in Bristol County, Massachusetts, approximately 55 miles south of Boston, and is bordered by the Towns of Acushnet and Fairhaven on the east side, and by the City of New Bedford (City) on the west. From north to south, the NBH Site extends from the upper reaches of the Acushnet River estuary, through New Bedford's commercial port, and into Buzzards Bay (Figure 1).

Industrial and urban activities surrounding the NBH Site have resulted in sediments becoming contaminated with PCBs and heavy metals, with concentration gradients generally decreasing from north to south. PCB-contaminated sediments and seafood in and around New Bedford Harbor were first identified in the mid-1970s as a result of EPA region-wide sampling programs. Based on these sampling programs, the principle sources of PCB contamination were determined from two electric capacitor manufacturing facilities located adjacent to the Acushnet River/New Bedford Harbor water way. The Aerovox facility was the primary source of PCB contamination and was located near the northern boundary of the site. PCB wastes were discharged from Aerovox's operations directly into the Upper Harbor through open trenches and discharge pipes, or indirectly throughout the site via the City's sewage system. Additional inputs of PCBs were also made from the Cornell Dubilier Electronics, Inc. facility just south of the New Bedford Hurricane Barrier. PCB use at these electric capacitor manufacturing facilities occurred from the 1940s into the 1970s. The NBH Site was added to the Superfund National Priorities List (NPL) in September 1983.

The NBH Site has been divided into three areas - the Upper Harbor, the Lower Harbor, and the Outer Harbor - consistent with geographical features of the area and gradients of contamination (Figure 1). The Upper Harbor, above the Interstate-195 Bridge, comprises approximately 187 acres, with a wide range of PCB concentrations in sediments [below detection to approximately 10,000 parts per million (ppm)]. Prior to the removal of the most contaminated hot spot sediments in 1994 and 1995 as part of the NBH Site's first

cleanup phase, sediment PCB levels were reported higher than 100,000 ppm at isolated locations in the Upper Harbor. The Lower Harbor, from the interstate bridge to the hurricane barrier, comprises approximately 750 acres. In portions of the Lower Harbor, sediment PCB levels range from below detection to over 100 ppm. Sediment PCB levels in the Outer Harbor are generally low, with only localized areas of PCBs in the 50 to 100 ppm range near the Cornell-Dubilier plant and the City's sewage treatment plant outfall pipes (the highest areas of PCB contamination in the Outer Harbor were capped in 2005).

For modeling purposes, the three areas of the NBH Site (Upper Harbor, Lower Harbor, and Outer Harbor), were subdivided into six zones based on PCB concentrations detected in sediment samples during investigation activities. These investigations were performed by Foster Wheeler Environmental Corporation (FW) as part of its pre-design field activities (FW 2001). The six zones, with Zone 1 in the northern portion of the NBH Site and Zone 6 in the southern portion of the NBH Site, are illustrated on Figure 2.

Remedial action at the NBH Site is currently being completed by Jacobs Engineering Group, Inc. (Jacobs) under a Total Environmental Restoration Contract (TERC) from NAE.

2.2 DREDGING AND CAD CELL DESIGN

Since 2004, several of the highly contaminated management units (MU) in Zones 1, 2, and 3 have been hydraulically dredged. The funding and work-sequencing scenario for this modeling exercise includes a five-year dredging plan that incorporates the current hydraulic dredging and off-site disposal for the first three years for the MUs in Zones 1 through 3, and proposed mechanical dredging and LHCC disposal for the last two years for the MUs in Zones 4 and 5. It is these last two years that are the subject of this air modeling investigation.

Figure 3 shows the MUs in the harbor and the dredging composite areas used for LHCC modeling purposes (for both air and water quality). Table 1 lists the MUs and their dredging concentrations, volumes, and relative time frames.

The proposed CAD cell disposal and associated dredging areas are all located in the lower part of the Upper Harbor (Composite Area 4) and Lower Harbor (Composite Area 5) of the NBH Site (Figure 3). The sediment from these areas would be dredged using a mechanical dredging bucket to an open top barge to transport to the CAD cell.

The proposed LHCC would be sited south of the Route 195 Bridge and north of Popes Island (Figure 3). The cell would have a design capacity of about 300,000 cubic yards (cy) to accommodate the dredging volume. An engineered excavation would be created and filled with sediment dredged from an area extending from Sawyer Street south to the Route 6 Bridge. It is assumed that an open top scow would be towed to the CAD cell, and that the dredged sediment would be placed into the LHCC by either a) opening a split-hull scow or b) using a clam shell bucket. After the CAD is filled to its design depth, a cover of clean sandy material would be placed to prevent contact with aquatic life and to prevent migration of contaminants out of the cell. Figure 4 shows the planned dredging scenarios and the assumed LHCC location.

2.3 PREVIOUS EMISSION CALCULATIONS AND AIR DISPERSION MODELING

Mechanical dredging, transport, and CAD cell disposal operations have the potential to expose the sediments to the open air for limited periods of time. As a consequence, vapor phase PCBs (especially lighter, lower molecular weight PCBs) could be released into the atmosphere. These releases would be in addition to on-going “natural” PCB emissions from the NBH Site’s contaminated sediments, especially from contaminated mudflats exposed to open air at low tide.

Air dispersion modeling activities have been conducted by FW (2001) and Jacobs (2005, 2006, 2007, 2008, and 2009). Both FW and Jacobs performed air dispersion modeling

using the Industrial Source Complex Model (ISC3) code (EPA 1995a, b) to estimate the air concentrations of PCBs generated by dredging and treatment facilities for the current remedial dredging activity (i.e., dredging, desanding, dewatering, and offsite disposal). Since 2005, Jacobs has utilized time-specific dredging data and on-site meteorological data to model and estimate the air quality impacts from the dredging operations (Jacobs 2005, 2006, 2007, 2008, and 2009). Air quality monitoring data over the past five years has also been used to substantiate the model assumptions and input parameters. This is done to improve the accuracy of the model predictions.

3.0 AIR DISPERSION MODELING

This section describes the assumptions and input parameter selections used for the proposed dredging and CAD activity air modeling investigation.

3.1 ISC3 MODEL

The ISC3 used for the air dispersion modeling efforts is a steady-state Gaussian plume model that can be used to assess pollutant concentrations from a wide variety of sources associated with industrial and environmental activities. ISC3 models are specifically designed to support the EPA's regulatory modeling programs.

The ISC3 model can be operated in both long-term (ISCLT3) and short-term (ISCST3) modes. The ISCST3 model utilizes hourly meteorological data to model emissions for a given period. The ISCLT3 model is only used to model emissions with long-term averaging periods by utilizing standard stability array meteorological data. The ISC3 model is capable of handling multiple sources; including point, volume, area, and open pit source types. Line sources may also be modeled as a string of volume sources or as elongated area sources. Several source groups may be specified in a single run, with the source contributions combined for each group. The model also contains algorithms for modeling the effects of aerodynamic downwash due to nearby buildings on point source emissions, and algorithms for modeling the effects of settling and removal (through dry deposition) of particulates. The model user may select either rural or urban dispersion parameters, depending on the characteristics of the source location.

Source emission rates can be treated as constant throughout the modeling period, or may be varied by month, season, hour-of-day, or other periods. These variable emission rate factors may be specified for a single source or for a group of sources. For the ISCST3 model, the user may also specify separate, hourly emission rates for some or all of the sources included in a particular model run.

The ISCST3 model accepts hourly meteorological data records to define the conditions for plume rise, transport, diffusion, and deposition. The model estimates the

concentration or deposition value for each source and receptor combination for each hour of input meteorology, and calculates user-selected short-term averages.

The ISCST3 model has considerable flexibility in the specification of receptor locations. The user of the model has the capability of specifying multiple receptor networks in a single run, and may also mix Cartesian grid receptor networks and polar grid receptor networks in the same run.

The ISCST3 model is appropriate for the following air dispersion applications:

- Multiple area or point industrial source complexes;
- Rural or urban areas;
- Flat or rolling terrain;
- Transport distances less than 50 kilometers;
- One hour to annual averaging of exposure duration; and
- Continuous toxic air emissions.

The ISCST3 model includes a wide range of options for modeling air quality impacts of pollution sources, making them popular choices among the modeling community for a variety of applications.

The ISCST3 (version 3) model was used for this air dispersion modeling.

3.2 PCB SEDIMENT SOURCES CHARACTERIZATION

As discussed in Section 2.1, the sediments in the Harbor have been extensively sampled during the pre-design field activities (FW 2001) and the investigation has lead to the grouping of six zones (Figure 2). Zones 1, 2, and 3 in the northern portion of the NBH Site have the highest PCB concentrations (>100 ppm) and are being remediated using hydraulic dredging, on-site treatment, and off-site disposal to lessen the impact to the environment. Zones 4 and 5 have much lower PCB concentrations and are being proposed for mechanical dredging and CAD disposal.

During the remediation process, the Harbor was also divided into many MUs as shown in Figure 3. The PCB concentrations for the MUs proposed for mechanical dredging and CAD disposal are summarized in Table 4.

3.3 MODEL PARAMETERS AND ASSUMPTIONS

ISCST3 allows a wide variety of sources to be presented in a complex terrain setting. Because the Harbor and its surroundings are in a relatively flat area, a flat terrain height option was used for the air dispersion modeling. The modeling was further conducted in a no plume depletion option (no dry or wet deposition) and used a rural dispersion coefficient. All these selected modeling processes and parameters were fairly conservative and would result in higher model predicted values.

Two types of sources were modeled. Area sources were used to represent the MUs, CAD, and background mudflats. Line sources were used to represent barge transport routes. The dredging processes, including bucket and barge exposure, are multiple point sources in the field. However, because the point sources are distributed within the whole MU area during the remediation period in the model, the dredging processes were also represented as area sources adding more conservatism to the model as discussed in later sections.

3.4 PCB EMISSION SOURCES

There are several types of PCB emission sources that could contribute to the air quality at the NBH Site. These sources can be classified into two categories: 1) background emission sources and 2) remediation emission sources. The background emission sources are the relatively long-term, consistent sources that regularly contribute some level of contaminants to the atmosphere. The identified background sources included the following:

- harbor mudflats and inter-tidal sediments, and
- point or area land sources with previous PCB contamination.

All background sources contribute to the baseline air quality.

Remediation emission sources are those sources that only contribute potential emissions during periods of active remediation. For a CAD-based approach this would include the mechanical dredging, transport of sediment, and CAD cell disposal activities. The remediation emission sources are short-term compared to background. Table 2 lists the PCB emission sources that may contribute to aerosol dispersion of contaminants during dredging and CAD activities.

3.5 SOURCE EMISSION MECHANISM AND RATE

There are three potential sources of PCB air emissions that may occur during mechanical dredging:

- the exposed dredge bucket,
- the surface of the open barge, and
- the disturbed water surface.

The contaminated sediment will be dredged by the mechanical arm bucket and dumped into an open barge. During the dredging process, PCBs may be emitted from the disturbed water surface caused by the dredging bucket. PCBs may also be emitted from exposed sediment within the dredging bucket during the transferal of sediment from the water surface to the barge. Because the barge is open to the air, PCBs may be emitted from exposed sediments on the barge during the dredging activity.

After the open barge is filled using the mechanical dredging device, the open barge would be towed to the CAD cell location for sediment disposal. During the transport process, there may be PCBs emitted from the barge along the transport routes.

At the CAD cell location, it is assumed that the dredged sediments would be placed into the CAD cell by either a) releasing them from the bottom of a split-hull scow or b) using a clam shell bucket. Both of these methods have the potential to emit additional airborne

PCBs. There are four potential sources of airborne PCBs that may occur during the filling of the CAD cell:

- the exposed dredge bucket,
- the surface of the open barge,
- the disturbed water surface due to disposal, and
- ponded water/sediment within the CAD cell before capping.

The emission from each of the dredging, transport, and disposal processes will depend on the PCB concentration of the sediment and length of the exposure due to the activity.

Thibodeaux and FW estimated PCB emission rates for activities associated with some remediation scenario operations. The emission rates were derived based on emission calculations using sediment concentrations, field measurements, bench-scale tests, and theoretical calculations (Thibodeaux 1989; FW 2001). The emission rates are important model input parameters to evaluate potential air impacts from remediation activities.

Table 3 lists the theoretical PCB flux rates for background emission sources and remediation emission sources associated with dredging and CAD activities. The theoretical flux rates for processes associated with dredging and disposal activities are based on sediment with a PCB concentration of 432 ppm (Thibodeaux 1989) and 1,031 ppm for ponded sediment (FW 2001). The flux rates for background mudflat areas and Aerovox areas are based on previous modeling calibrations (Jacobs 2005).

To get the proper emission rates for each MU, PCB emission rates for each MU were calculated based on Thibodeaux's PCB emission rate for 432 ppm sediment using the MU-specific PCB concentrations assuming a linear concentration-flux rate relationship for this modeling effort. For example, for exposed sediment with a PCB concentration of 1,000 ppm, the theoretical emission rate would be calculated as the flux from 432 ppm sediment × (1,000 ppm ÷ 432 ppm). Similarly, the yearly-specific emission rates based on composite PCB concentrations for the water body within the CAD were calculated.

The calculated MU-specific emission rates associated with various processes and total emission rate applied in the model are presented in Table 4.

3.6 METEOROLOGICAL DATA

ISCST3 uses hourly meteorological data records to define conditions for plume ascension, transport, diffusion, and deposition and to estimate the concentration or deposition value for receptors. Therefore, site-specific meteorological data are important input parameters for the model.

An initial meteorological monitoring program was conducted at the NBH Site. The on-site meteorological station is located on the confined disposal facility (CDF) site (end of Sawyer Street) adjacent to the harbor. Meteorological data collected from 1996 to 1999 were processed and used in the previous air dispersion modeling (FW 2001).

The on-site meteorological station was restored in 2006. The data collected at the on-site station includes wind speed, wind direction, temperature (2 meters and 10 meters aboveground), relative humidity, barometric pressure, solar radiation, and precipitation. The wind speed and direction are recorded at five-minute intervals. The remaining parameters are recorded at 60-minute intervals.

Figure 5 shows the data summaries of meteorological parameters in 2006, 2007, and 2008. Figure 6 shows the wind rose diagrams summarizing the wind speed and direction at the site for those three years.

3.7 DISCRETE RECEPTORS AND MODELING GRID

Discrete receptors are used in the air dispersion model to represent the air monitoring stations and sensitive residential, school, and industrial locations. The air monitoring locations used in 2008, along with the discrete receptor locations, as previously identified in earlier studies (FW 2001), are presented on Figure 7.

A 100 meter × 100 meter grid system is used to cover the NBH Site for the model. The grid system is used to generate model-predicted PCB concentration contours. This approach is necessary to construct a more precise contour map because the discrete receptors do not have adequate density or distribution. Figure 8 shows the grid system for the NBH Site.

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4.0 SIMULATION OF DREDGING AND CAD ACTIVITIES

Air modeling based on the 2008 meteorological data was used to predict the air quality impact for the proposed dredging and CAD activities. ISC-AERMOD View version 5, an air dispersion modeling software package that incorporates the ISC3 model, was used for this modeling effort (Lake Environmental Software 2006).

All the modeling runs conducted are summarized in Appendix A and the modeling input and output files for these runs are provided on a compact disc (CD) in Appendix B.

4.1 SOURCE-SPECIFIC EMISSION REPRESENTATION AND APPLIED EMISSION RATE

As discussed in Section 3.2, the PCB emission sources include the following:

- harbor mudflats and inter-tidal sediments,
- point or area land sources with previous PCB contamination from former operations, and
- dredging operations and associated transport and disposal processes.

Emission rates from these sources can be constant, intermittent, or singular. The point or area land sources are assumed to be constant, continuous sources. The mudflats are intermittent sources, and are only exposed during low tide periods. Dredging and disposal result in potential point, line, and area sources for which emissions only occur during the hours of the dredging, transport, and disposal activities.

The ISC3 model source input allows great flexibility in the representation of the sources. The ISC3 model provides many source emission options by using an emission factor and/or variable emission rate in the source term. Emission factors or rates may be specified for either individual sources or groups of sources. The factors may vary for different time and wind scales; as a function of season, month, and hour of day; and by wind speed and stability category.

The total emission from a particular source is a function of emission flux rate and emission duration for the modeled period. Because the ISCST3 model is a steady-state Gaussian plume model that incorporates either hourly or periodic meteorological data for its predictions, emission factors are used to account for the total emission for a specific period modeled for a one-time dredge source. The emission factor for a single dredging operation occurring over a specific area and duration is derived as follows:

Emission Mass Released (g) = Flux rate in grams per square meter-hour (g/m^2-h) × Area in square meters (m^2) × Emission duration in hours (h) × Emission factor

Where

Flux rate = PCB mass emitted over a specific time per area

Emission duration = Actual total time of a source emission in the field

Source duration = Source emission time applied in the model

Emission factor = Emission duration/Source duration applied in the modeling

The period of time applied to the model and the calculated result for the modeling period requires consideration. For example, if the one day dredge area is used as a continuous source for a 24 hour simulation and the dredge emission hours are only 12 hours per day, an emission factor of 0.50 days (12 hrs per day) is used to derive the dredging day 24-hour average concentration. However, if the same 12 hour dredging period is used as a source for an annual simulation period in the model, an emission factor of 0.00139 years [12 hrs × (1 day per 24 hrs) × (1 month per 30 days) × (1 year per 12 months)] is used to calculate the annual average concentration.

Table 3 shows the emission duration assumed for the processes used for modeling in terms of total hours for each particular location. For each dredging location, a 12-hour PCB emission from water is assumed to represent the total time of water disturbance associated with dredging activity for a particular area. For the exposed sediment in a dredging bucket, a one-hour emission is assumed as multiple sediment exposures from multiple buckets for a particular location. The open barge is assumed to have a two-hour emission time for each location for the whole footprint of the dredged area. In reality, the barge will likely be in many locations within the footprint during the dredging operation

with longer emission time. However, using the whole dredging area as an emission source for the barge eliminates the specification of the locations and provides a more reliable yearly average estimate. All the durations used for the modeled dredging activities are likely longer than actual dredging activities and will result in more conservative (higher) estimation of emissions.

For barge transport, the emission duration will be extremely short along the transport paths. For the Upper and Lower Harbor, the barge size is assumed to be 1,000 cy and the barge will take about one hour to travel from the MUs to the CAD cell. The total emission durations along the transport paths then are calculated based on the speed and numbers of trips the barges make over the project period.

For the CAD cell disposal, each disposal option by either opening a split-hull scow or using a clam shell bucket only occurs for a particular location and emission duration is very short. For the dredging season emission, a 16-hour and a 12-hour emission duration is assumed for each dump during the two dredging seasons, respectively. Similar to open barge, the whole CAD cell footprint is used as a continuous emission source for the dredging season. Using the whole CAD cell area as an emission source for the disposal will eliminate the specification of the locations and provide a more reliable and conservative yearly average estimate.

The remediation activities are assumed to be 180 and 156 days for the two years of dredging and CAD placement. For the first year, a May to October dredging and disposal season is assumed. The dredging MU and CAD sources are assumed to be continuous area sources for the entire remediation period (180 days). For the second year, a June to October dredging and operation season is assumed (156 days) for the respective dredging MUs and CAD site.

It is assumed that water in the CAD cell is in equilibrium with the disposed sediment. PCBs will be emitted into the air from the CAD cell during the disposal period before the cap is placed. Therefore, for the model simulation, it is assumed that there will be a 270 day CAD cell emission period for the first year (May - December) from start of the

disposal activities to end of the year and a 365 day emission period for the second year (January - December). For the second year, it is assumed that cap will not be placed immediately after end of disposal activities.

For the dredging and CAD activity modeling, the MU-specific emission flux rates for all emission processes are calculated based on the average PCB concentrations in the sediment for each MU. Table 4 shows the detailed emission rates for each process for all the locations. For the transport and CAD disposal process, the composite concentrations for the MUs for each year are used to calculate the emission flux rates for each process. The emission flux rates from the two CAD disposal options are presented in Table 4.

The whole dredging area for each year is used as a continuous emission source during the dredging season for the annual average PCB calculation. The applicable emission rates (total emission rate applied in the model for the activity duration in the year) for dredging at each MU and associated transport and CAD disposal activities are presented in Table 4.

For annual average emission calculations, the remaining intermittent yearly emission from the mud flats in the Upper Harbor is modeled using an hourly intermittent source with the full emission rate occurring in two periods (corresponding with the low tide) per day (12am to 2pm and 12pm to 2am for a four-hour-per-day exposure scenario). It is assumed that all of the contaminated mudflats will be removed during the first year of the operation and they will only contribute to airborne emission during the first half of that year. In addition to the hour emission periods for the mudflats, a 0.5 emission factor is used to represent the total emission for the whole year. This is done because ISC3 does not define hourly and monthly at the same time for a source. The on-land Aerovox source is assumed to be present for the simulation. However, it has no impact to the air quality of the Lower Harbor area.

4.2 CAD CELL DISPOSAL AND DREDGING SIMULATION RESULTS

The modeling runs were set up to provide estimates of total annual average PCB concentrations in air from the remediation activities (dredging, transport, and CAD

disposal/deposition contributions) and the combined background and remediation related sources for each of the two years of operation. The total annual average concentration is the total mass received in a location over a one-year period. It is calculated in the model by the average of the daily (24 hour) maximum concentrations over the one-year period for a location. The 24 hour maximum concentration is the maximum concentration of any defined continuous 24-hour slot for the period considered. The model runs were also performed for the two CAD disposal options: opening a split-hull scow (bottom dump) or using a clam shell bucket.

Isocontours of the model-predicted total annual average PCB concentration at the NBH Site (i.e., including background sources) for the first year are shown in Figure 9. The maximum concentration from all dredging and CAD sources (i.e., excluding the on-land Aerovox site) occurs near the mudflats of the dredging area (MU-25 to MU-30) with a high of about 60 nanograms per cubic meter (ng/m^3). The contribution from the dredging, transporting, and disposal activities (i.e., not including background sources) is shown in the isocontours in Figure 10. The predicted maximum concentration at the dredging area from dredging activities is less than 10 ng/m^3. The predicted maximum concentration from CAD cell disposal is less than 25 ng/m^3. Along the transport paths, the predicted PCB concentration is less than 0.25 ng/m^3. The on-land Aerovox contamination is not related to dredging operations.

Isocontours of the model-predicted total annual average PCB concentration at the NBH Site (i.e., including background sources) for the second year is shown in Figure 11. The maximum concentrations (excluding the on-land Aerovox site) occur near the center of the dredging area (MU-31 and MU-32) with a maximum concentration less than 10 ng/m^3 and at the CAD cell with a maximum concentration less than 25 ng/m^3. Because the background Upper Harbor mudflat sources are assumed to have been remediated in Year 1 (with the exception of the on-land Aerovox site) and none exist in the Lower Harbor, the PCB source is solely from the dredging, transporting, and disposal activities. The detailed distribution for the PCB concentration from dredging and CAD disposal in the second year (i.e., not including background sources) is shown in Figure 12.

Note that Figures 9 through 12 assume an excavator-bucket placement method; Figures 13 and 14 show the similar (low) impacts of this approach versus split-hull scow placement.

The model predicts that the second year will have lower concentrations than the first year because of the lower PCB concentrations in the dredged sediments and a shorter remediation time (156 days vs. 180 days).

Figure 13 shows comparison of the two CAD disposal options for the first year of the operation. The long-term emission from the CAD water surface is not included in the figure as it is the same for both options. The resulting contours are very similar for the two options with the bucket disposal resulting in a slightly larger 2 ng/m^3 contour due to its higher PCB emission rate.

Figure 14 shows the resulting contours of the two CAD disposal options for the second year of the operation. Similarly, the long-term emission from the CAD water surface is not included in the figure as it is the same for both options. The bucket disposal option results in a slightly larger 1 ng/m^3 contour near the CAD footprint. However, the overall impact and extents are about the same for the two disposal options.

Table 5 presents the model-predicted average PCB concentrations for all the discrete receptor locations (Figure 7) for the specific year. The predicted annual average concentrations due to emissions from the dredging and CAD disposal operations are also presented in Table 5.

4.3 CONCLUSIONS

FW (2001) described an approach to track potential cumulative public exposures to PCB concentrations in ambient air during remedial activities at New Bedford Harbor. That document describes the exposure budget as a target ambient air concentration over time that, if achieved, will document that public exposures to PCBs are below acceptable health-based target levels. The slope of the cumulative exposure budget line is the

allowable ambient PCB concentration at the sampling station that is protective of the most sensitive target receptor.

The health endpoint is cancer associated with long term or chronic exposure to PCBs associated with inhalation (FW 2001). FW defined the slope as being quantitatively dependent on the three following primary risk assessment criteria factors:

- The allowable ambient limit assuming a target risk of 1 $x10^{-5}$ (one incremental cancer in 100,000); a cancer slope factor of 0.4 milligrams per kilogram per day $(mg/kg/day)^{-1}$; and the exposure duration of the remediation activity;
- The annual average background concentration of airborne PCBs at the point of potential exposure; and
- The air dispersion factor between the sampling station and the assumed point of exposure.

This approach to measuring ambient air PCB concentrations and tracking the cumulative exposures relative to the health-based target levels has been used by the project since 2004. The allowable ambient PCB concentration limits are 409, 639, and 894 ng/m^3 for children, adult residents, and commercial/industrial workers, respectively, in the communities abutting New Bedford Harbor for a 10-year exposure duration scenario (FW 2001).

Results of the air dispersion modeling of the proposed dredging and CAD activities indicate that the maximum annual impacts from the planned operations, even with background sources included, would remain far below these risk-based ambient air concentrations developed for the NBH Site at any of the locations evaluated, even given the large areas planned for dredging. The two CAD cell disposal options will have minimal impact on airborne PCB levels.

These air dispersion modeling results also point to the significant role that remaining, unremediated PCB-contaminated mudflats (included in the MUs) have on local airborne PCB levels. These unremediated sources are shown to be a larger contributor of airborne PCBs than the proposed dredging and CAD cell disposal operations due to their locations

and wide distribution. Any remedial approach that accelerates the overall schedule of the Superfund harbor cleanup will thus have a positive impact on reducing background airborne PCB levels.

5.0 REFERENCES

EPA (U.S. Environmental Protection Agency). 1995a. *User's Guide For The Industrial Source Complex (ISC3) Dispersion Models, Volume I - User Instructions*. EPA-454/B-95-003a.

———. 1995b. *User's Guide For The Industrial Source Complex (ISC3) Dispersion Models, Volume II - Description Of Model Algorithms*. EPA-454/B-95-003b.

Foster Wheeler, 2001 (December), *Draft Final Development of PCB Air Action Levels for the Protection of the Public*. New Bedford Harbor Superfund Site, New Bedford Harbor, Massachusetts.

Jacobs (Jacobs Engineering Group). 2009 (July). *Air Dispersion Modeling of 2009 Dredging Operations.* New Bedford Harbor Superfund Site, New Bedford Harbor, Massachusetts.

———. 2008 (June). *Air Dispersion Modeling of 2008 Dredging Operations.* New Bedford Harbor Superfund Site, New Bedford Harbor, Massachusetts.

———. 2007 (May). *Air Dispersion Modeling of 2007 Dredging Operations.* New Bedford Harbor Superfund Site, New Bedford Harbor, Massachusetts.

———. 2006 (September). *Air Dispersion Modeling of 2006 Dredging Operations.* New Bedford Harbor Superfund Site, New Bedford Harbor, Massachusetts.

———. 2005 (October). *Air Dispersion Modeling of Emission Sources, 2004 and 2005 Dredging Operations.* New Bedford Harbor Superfund Site, New Bedford Harbor, Massachusetts.

Lake Environmental Software. 2006. *ISC-AERMOD View*. Version 5.

MASSGIS. 2003. Aerial Photograph of Bedford Harbor Area.

Thibodeaux, Louis J. 1989. *Theoretical Models for Evaluation of Volatile Emissions to Air During Dredged material Disposal with Applications to New Bedford Harbor, Massachusetts*. US Army Corps of Engineers Miscellaneous Paper EL-89-3.

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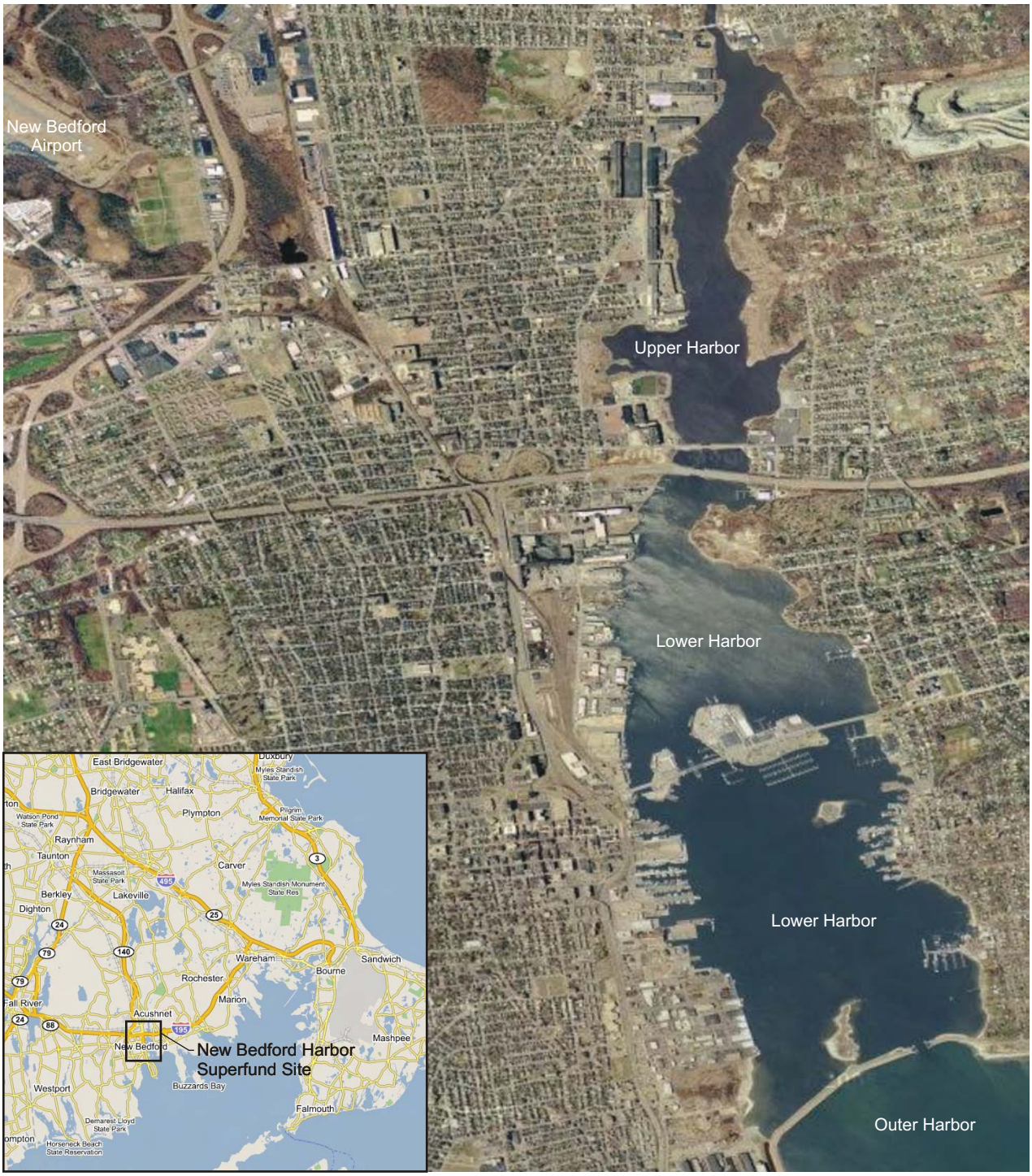
FIGURES



Note:
Aerial photograph source MASSGIS 2003.

N

0 1000

Scale in Meters

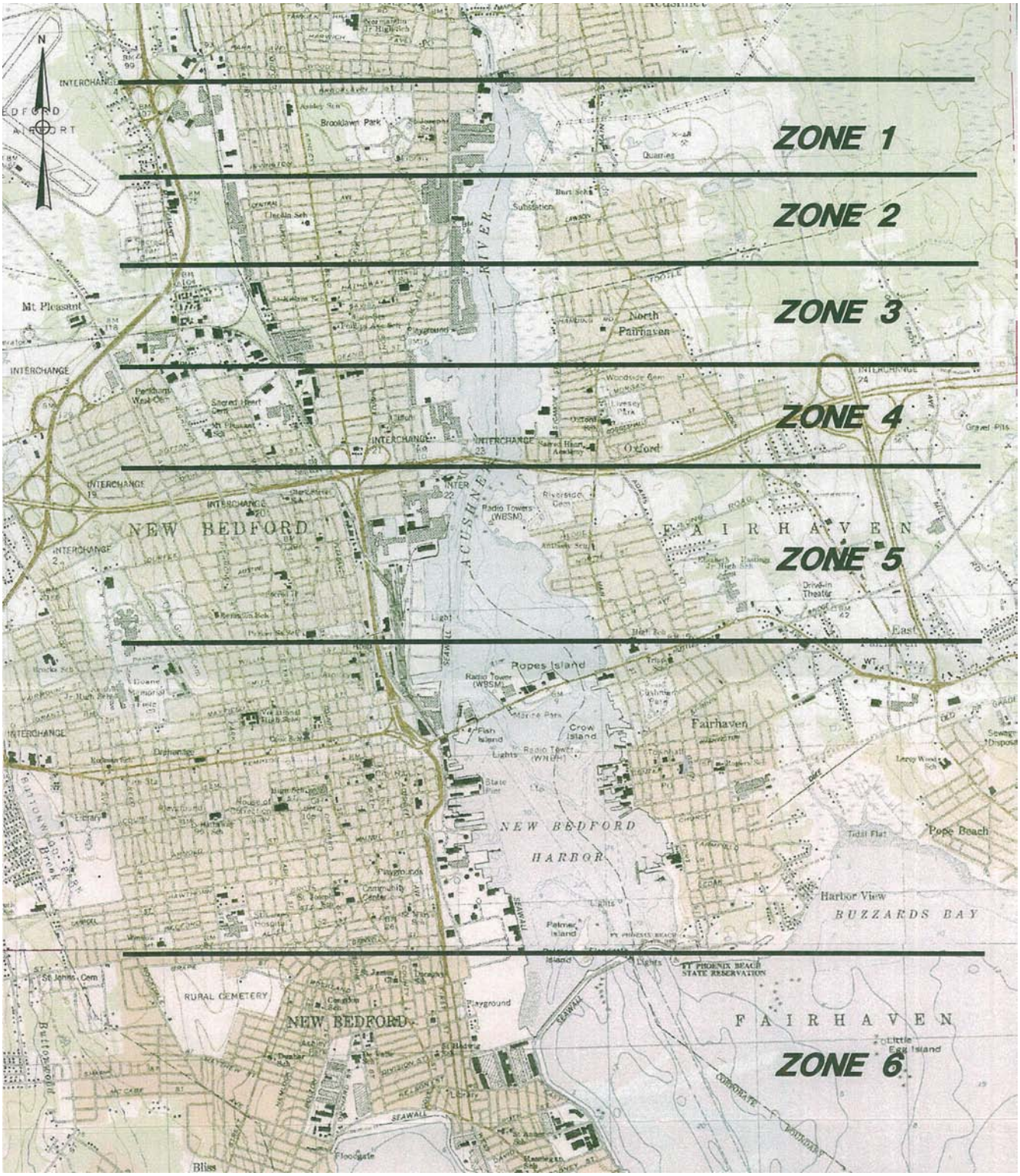
JACOBS™

New Bedford Harbor
Site Location Map

New Bedford Harbor Superfund Site
New Bedford, Massachusetts

02/24/10 dmf Fig01 NBH Loc.cdr

Figure 1



Legend

CDF - Previously Proposed Combined Disposal Facility

Sediment PCB Average Concentration

- Zone 1 - 1031 ppm
- Zone 2 - 843 ppm
- Zone 3 - 256 ppm
- Zone 4 - 89 ppm
- Zone 5 - 155 ppm
- Zone 6 - 150 ppm

Note: Adapted from Foster Wheeler Report (2001).

N

0 1000

Scale in Meters

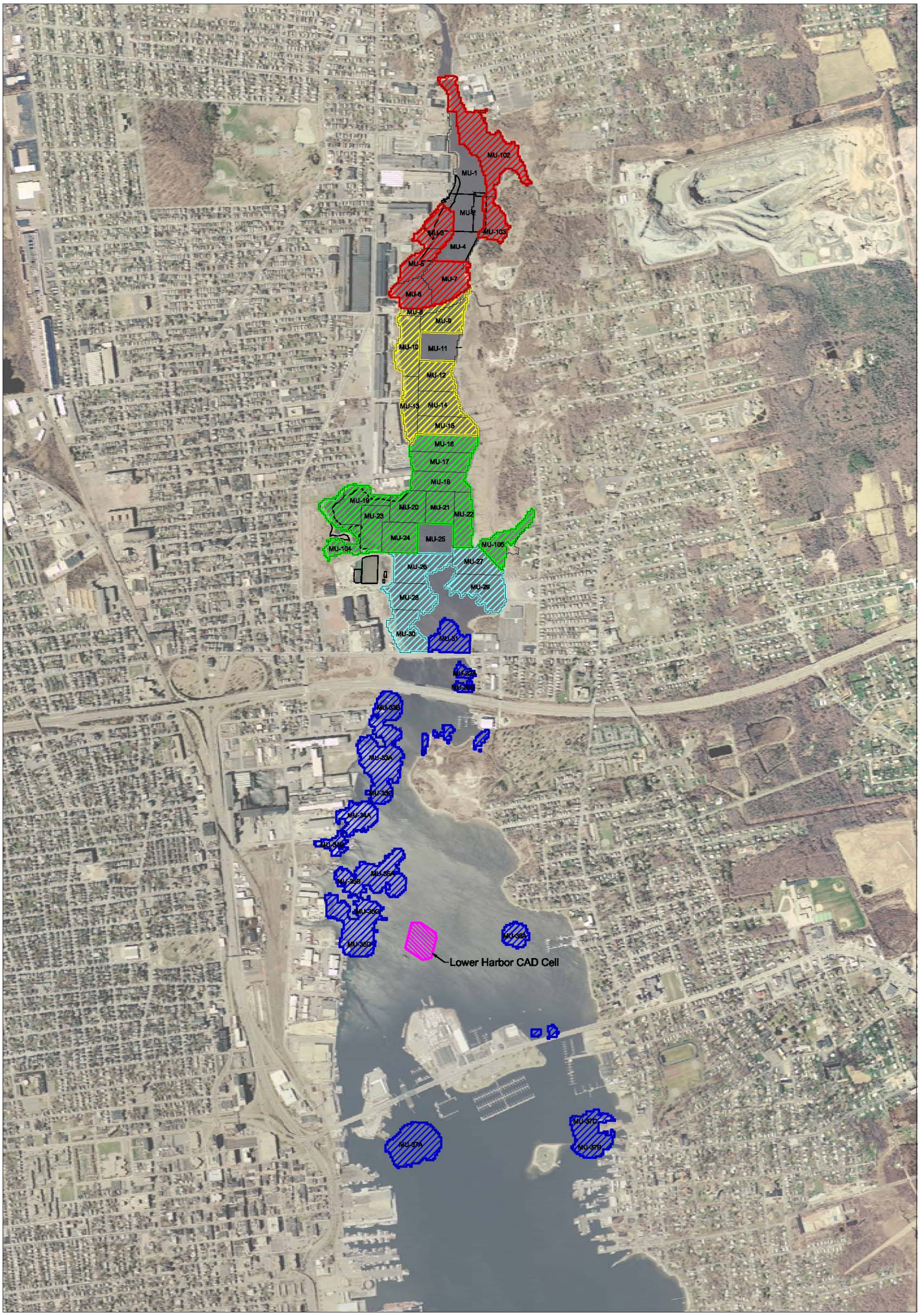
JACOBS™

NBH Sediment Zonation Map

New Bedford Harbor Superfund Site
New Bedford, Massachusetts

06/02/10 dmf
Fig02 NBH Sediment.cdr

Figure 2



Legend

Hydraulic Dredging and Off-Site Disposal
- Composite Area 1
- Composite Area 2
- Composite Area 3

Mechanical Dredging and CAD Disposal
- Composite Area 4
- Composite Area 5

Approximate Location of Proposed Lower Harbor CAD Cell

N

0 400

Scale in Meters

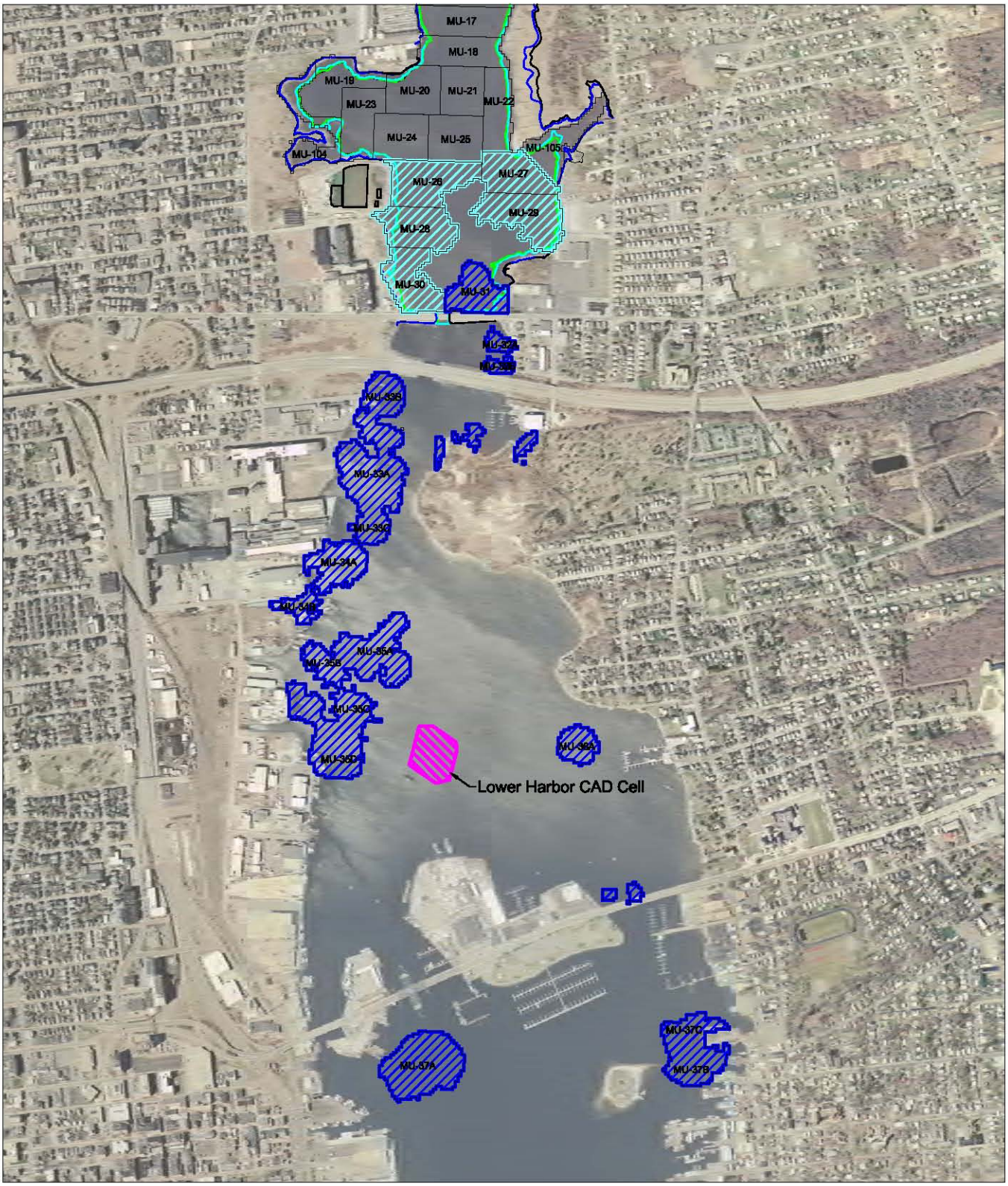
JACOBS

2009 New Bedford Harbor Dredging Plan

New Bedford Harbor Superfund Site
New Bedford, Massachusetts

02/24/10 DF
Fig03 ERDC Locs.dwg

Figure 3



Legend

- Dredging Operations - Year 4
- Dredging Operations - Year 5
- Approximate Location of Proposed Lower Harbor CAD Cell

0 400

Scale in Meters

JACOBS

Proposed Dredging and CAD Activities

New Bedford Harbor Superfund Site
New Bedford, Massachusetts

02/24/10 DF
Fig04 Dredging-LHCAD.dwg

Figure 4

2006 NBH On-Site Data

Statistics	Wind Speed (mph)	Temperature at 10-meters (°F)	Temperature at 2-meters (°F)	Delta-T (°F)	Relative Humidity (%)	Barometric Pressure (inches)	Solar Radiation (Watts/m^2)	Hourly Precipitation (inches)
Max	34.53	97.07	97.87	5.64	100.10	30.66	981.89	0.80
Min	0.78	10.71	11.03	-5.00	13.39	28.99	-5.59	0.00
Average	8.43	52.73	52.83	-0.10	71.83	29.94	154.73	

2007 NBH On-Site Data

Statistics	Wind Speed (mph)	Temperature at 10-meters (°F)	Temperature at 2-meters (°F)	Delta-T (°F)	Relative Humidity (%)	Barometric Pressure (inches)	Solar Radiation (Watts/m^2)	Hourly Precipitation (inches)
Max	35.15	88.33	89.35	3.99	100.34	30.75	960.99	0.77
Min	0.50	4.02	4.43	-9.12	10.59	28.83	-6.00	0.00
Average	8.59	50.77	50.93	-0.15	70.94	29.96	165.28	

2008 NBH On-Site Data

Statistics	Wind Speed (mph)	Temperature at 10-meters (°F)	Temperature at 2-meters (°F) #	Delta-T (°F)	Relative Humidity (%)	Barometric Pressure (inches)	Solar Radiation (Watts/m^2)	Hourly Precipitation (inches)
Max	29.56	94.40	95.30	3.99	102.10	30.59	984.00	2.10
Min	0.59	7.68	8.07	-11.53	13.92	29.08	-8.13	0.00
Average	8.02 *	51.05 *	51.79 *	-0.9 *	73.22 *	29.88 *	179.24*	

* - 2008 data is from 1/1/2008 to 10/29/2008.

- There were errorrous readings after July 6, 2008 due to defective recording device

JACOBS™

Meteorological Data for
NBH On-Site Location

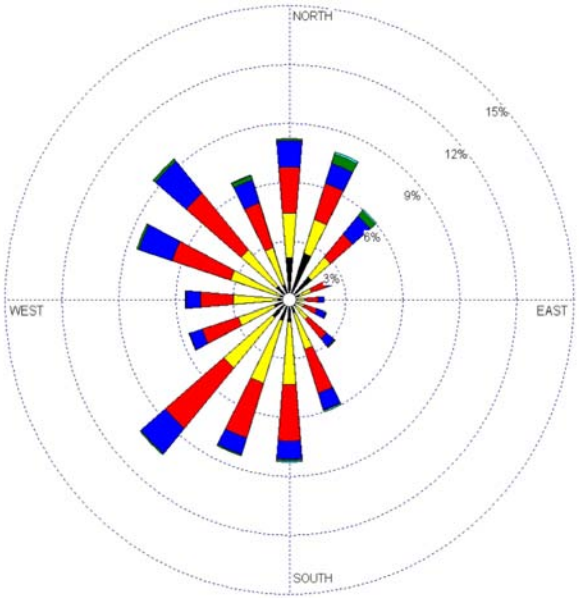
New Bedford Harbor Superfund Site
New Bedford, Massachusetts

02/24/10 dmf
Fig05 MeteorDataComp.cdr

Figure 5

Wind Speed - Direction (blowing from)

2006 Data

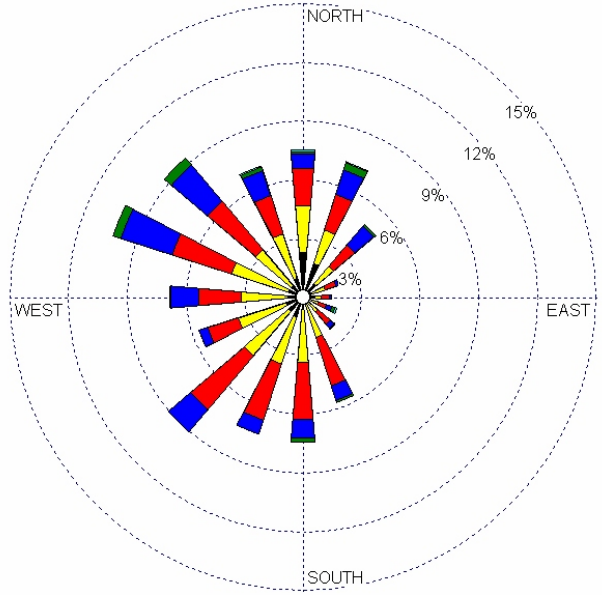


Data File Info	
Total No. of Hours:	8761
Average Wind Speed:	7.32 Knots
Calm Hours:	0
Calm Winds Frequency:	0.00%
Data Availability:	100.00%
Incomplete/Missing Hours:	0
Total Hours Used:	8761

WIND SPEED (Knots)
- >= 22
- 17 - 21
- 11 - 17
- 7 - 11
- 4 - 7
- 1 - 4

Calms: 0.00%

2007 Data

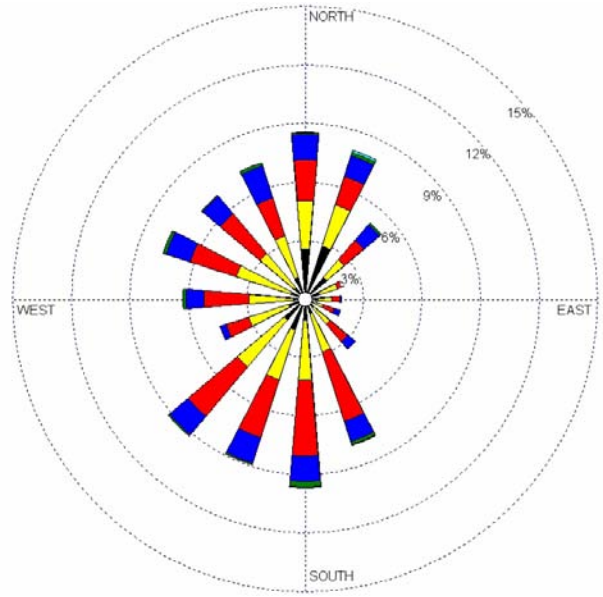


Data File Info	
Total No. of Hours:	8761
Average Wind Speed:	7.44 Knots
Calm Hours:	10
Calm Winds Frequency:	0.11%
Data Availability:	99.36%
Incomplete/Missing Hours:	56
Total Hours Used:	8705

WIND SPEED (Knots)
- >= 22
- 17 - 21
- 11 - 17
- 7 - 11
- 4 - 7
- 1 - 4

Calms: 0.00%

2008 Data



Data File Info	
Total No. of Hours:	8785
Average Wind Speed:	7.00 Knots
Calm Hours:	1
Calm Winds Frequency:	0.01%
Data Availability:	82.62%
Incomplete/Missing Hours:	1527
Total Hours Used:	7258

WIND SPEED (Knots)
- >= 22
- 17 - 21
- 11 - 17
- 7 - 11
- 4 - 7
- 1 - 4

Calms: 0.01%

Note:
North arrow indicates true north.

N

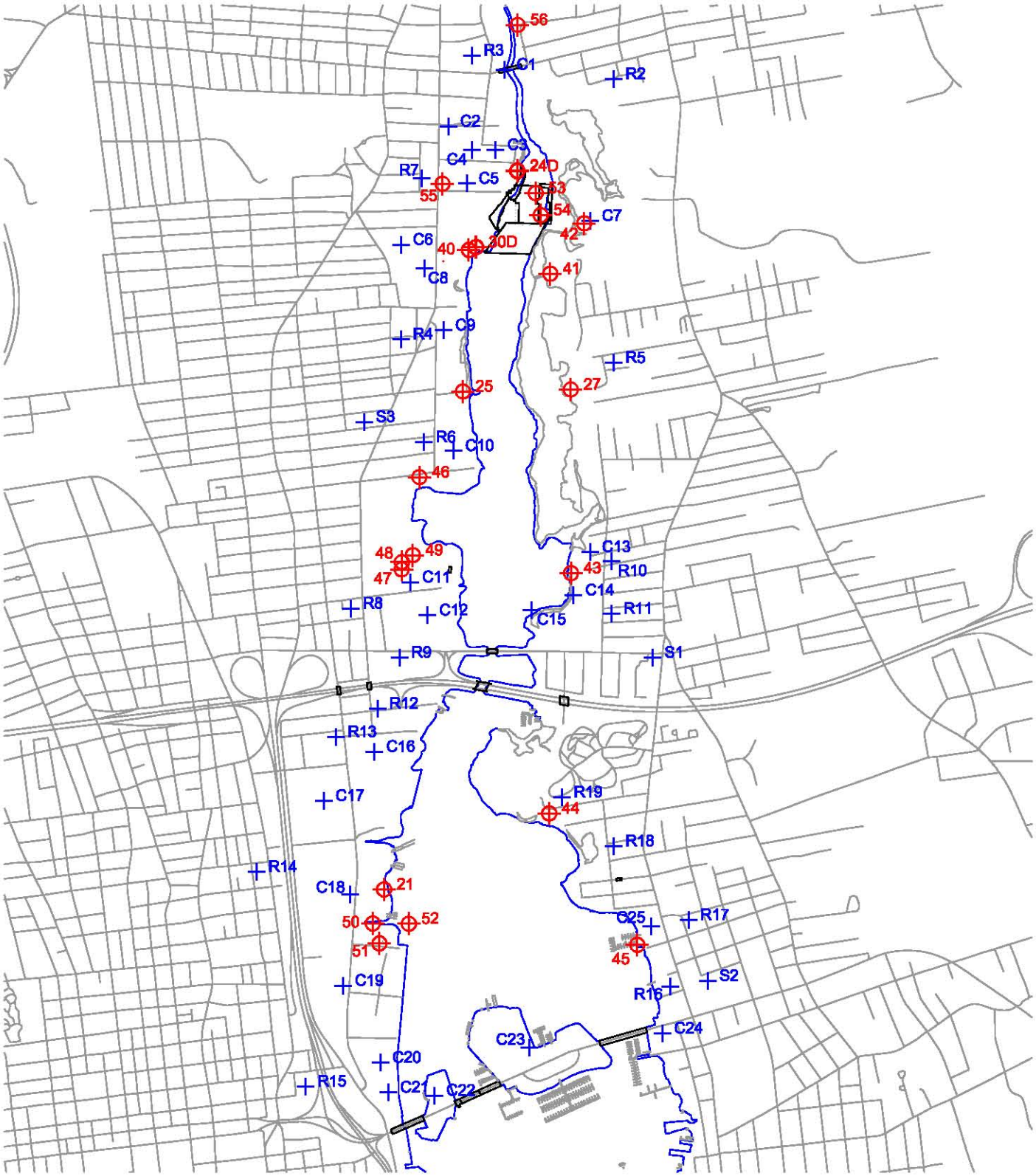
JACOBS™

Wind Rose Diagrams for
NBH On-Site Location

New Bedford Harbor Superfund Site
New Bedford, Massachusetts

02/24/10 dmf
Fig06 2006-08 Windrose Comp.cdr

Figure 6



Legend

- Air Monitoring Station
- Discrete Receptors

0 600

Scale in Meters

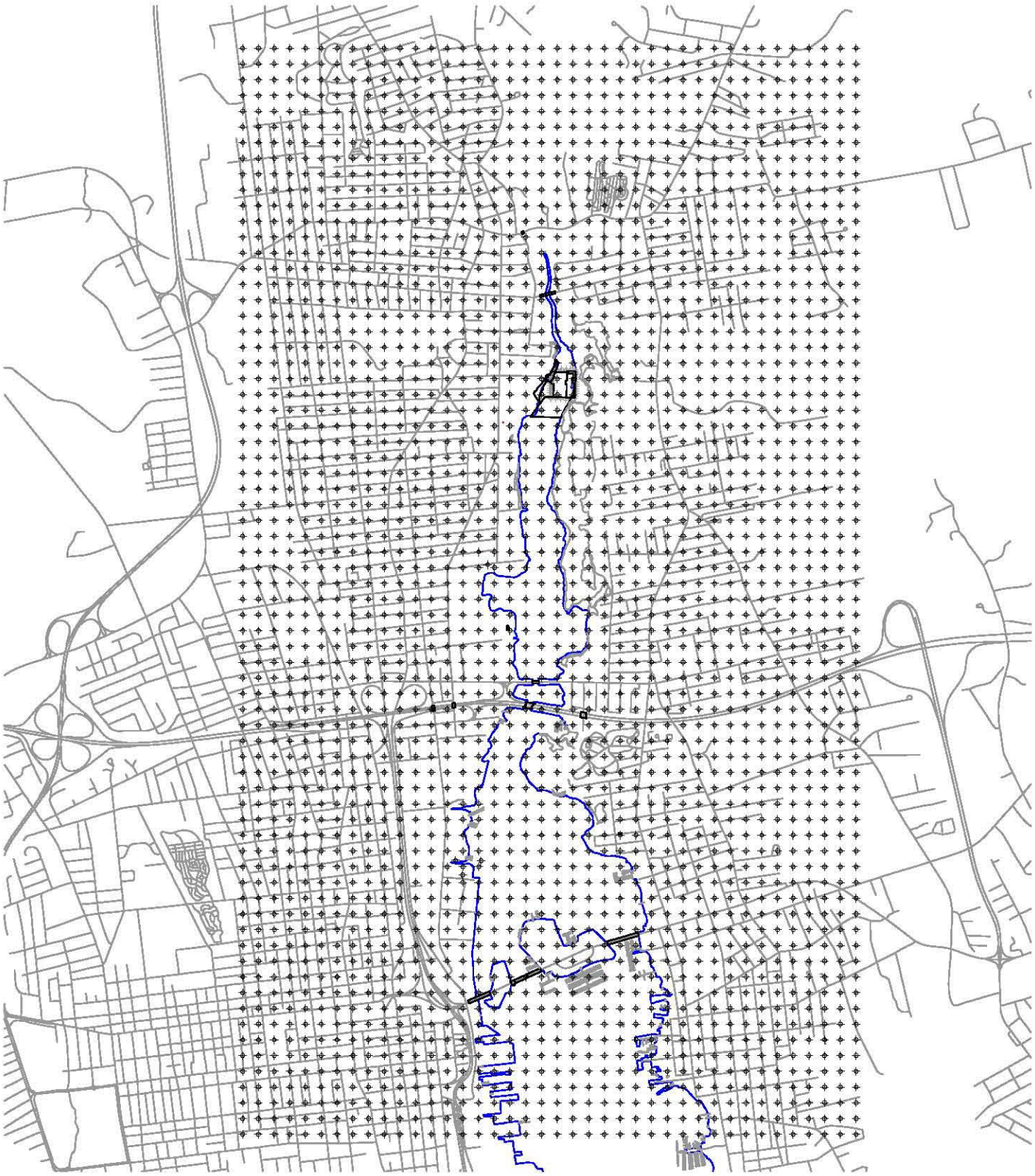
JACOBS™

Discrete Receptors for Air Dispersion Modeling

New Bedford Harbor Superfund Site
New Bedford, Massachusetts

02/24/10 DF
Fig07 Discrete Receptors.dwg

Figure 7



Legend

Model Grid Receptors

0 900

Scale in Meters

JACOBS™

Receptor Grid System for Air Dispersion Modeling

New Bedford Harbor Superfund Site
New Bedford, Massachusetts

02/24/10 DF
Fig08 Grid.dwg

Figure 8

Legend

Water Line

Concentration in ng/m³

2 4 8 16 32 64 128 256 381

ng/m³ = nanograms per cubic meter

N

0 600

Scale in Meters

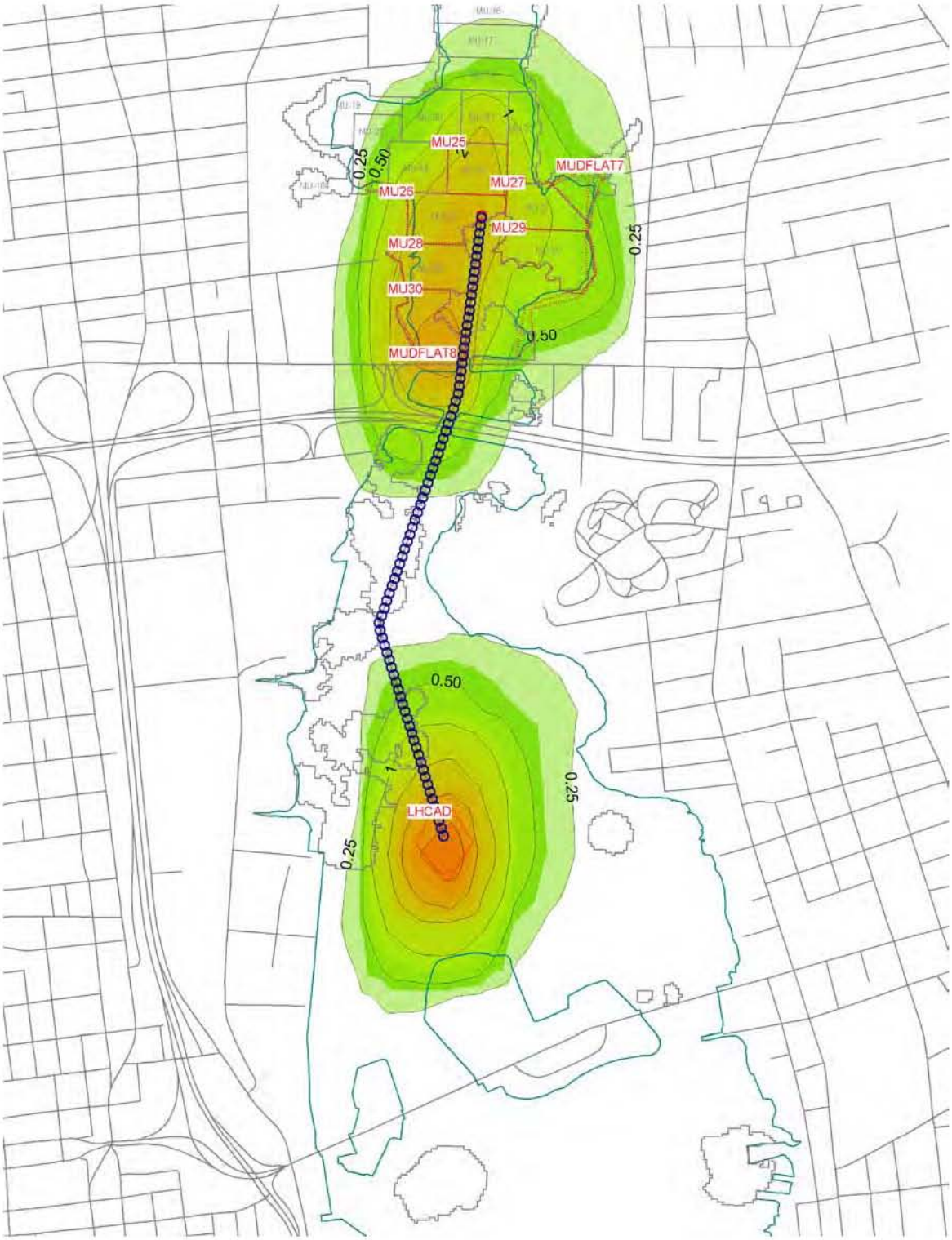
JACOBS™

Model-Predicted Total Annual Average PCB Concentrations for 1st Year of 2-Year Dredging and CAD Activities Including Background Sources

New Bedford Harbor Superfund Site
New Bedford, Massachusetts

05/17/10 DF
Fig09 2-yr_yr-1_all.dwg

Figure 9



Legend

Water Line

MU36A Source Area

Barge Transport Route

Concentration in ng/m³

0.25 0.5 1 2 4 8 16 25

ng/m³ = nanograms per cubic meter

0 400

Scale in Meters

JACOBS

Model-Predicted Annual Average PCB Concentrations Contributed from the 1st Year of 2-Year Dredging and CAD Activities - Background Sources NOT Included

New Bedford Harbor Superfund Site
New Bedford, Massachusetts

05/17/10 DF
Fig10 2-yr_yr-1.dwg

Figure 10

Legend

Water Line

Concentration in ng/m³

2 4 8 16 32 64 128 256 381

ng/m³ = nanograms per cubic meter

0 600

Scale in Meters

JACOBS

Model-Predicted Total Annual Average PCB Concentrations for 2nd Year of 2-Year Dredging and CAD Activities Including Background Sources

New Bedford Harbor Superfund Site

New Bedford, Massachusetts

05/17/10 DF

Fig11 2-yr_yr-2_all.dwg

Figure 11

Legend

Water Line

MU36A Source Area

Barge Transport Route

Concentration in ng/m³

0.25 0.5 1 2 4 8 16 25

ng/m³ = nanograms per cubic meter

0 400

Scale in Meters

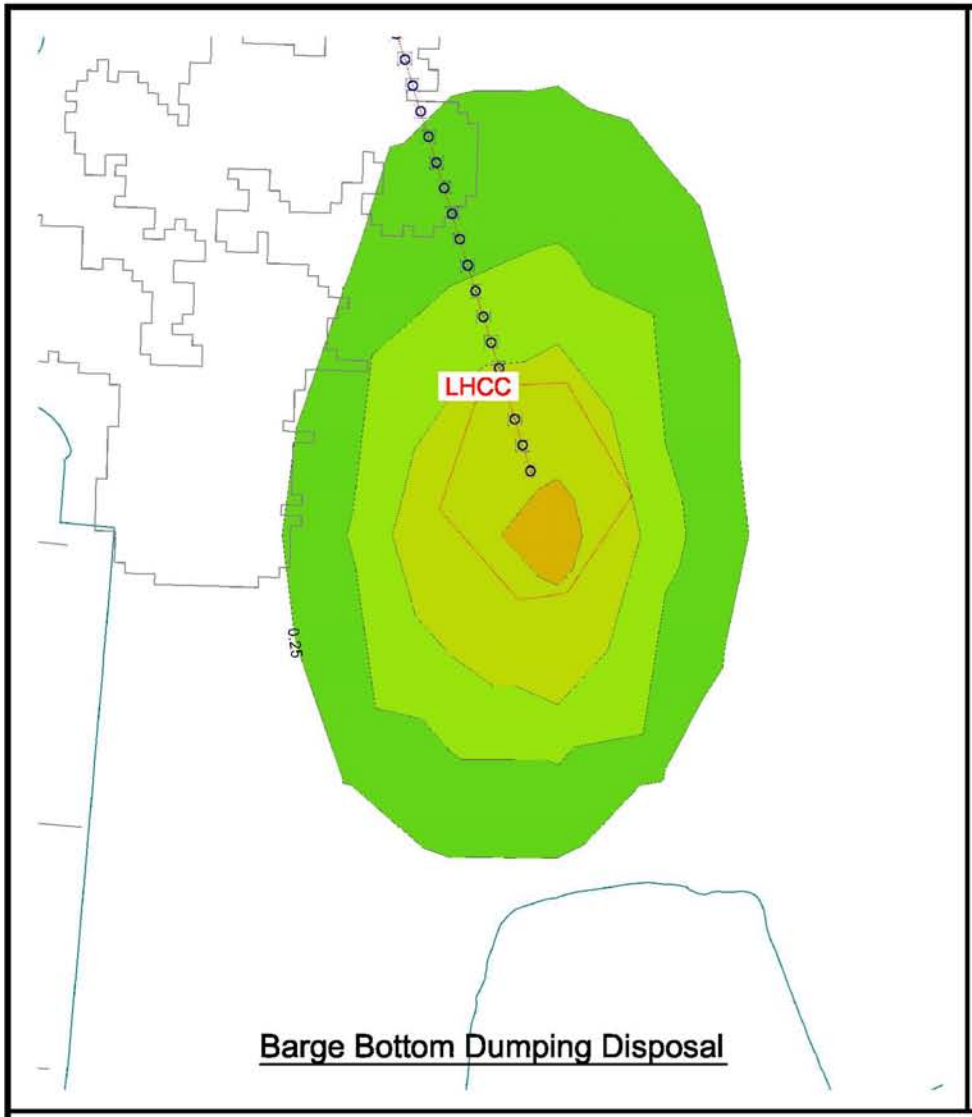
JACOBS

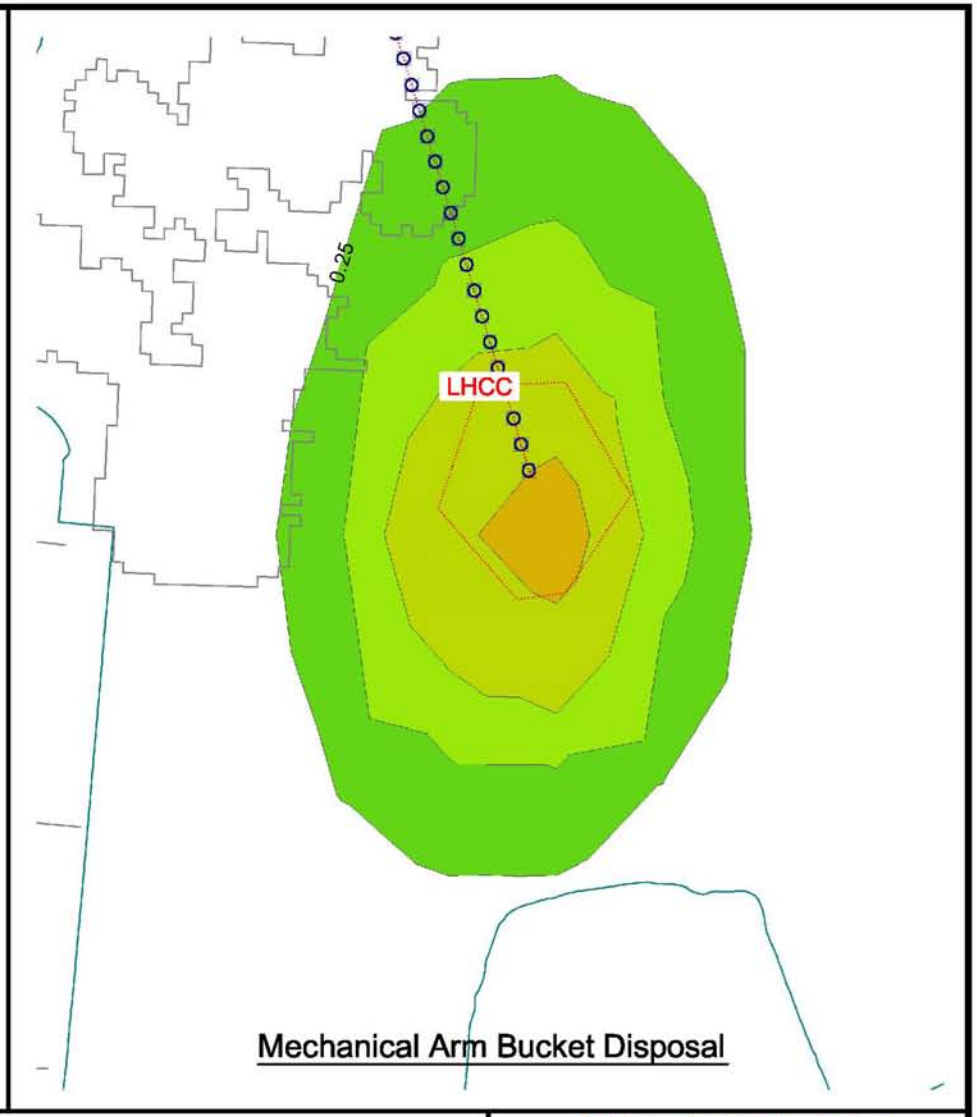
Model-Predicted Annual Average PCB Concentrations Contributed from the 2nd Year of 2-Year Dredging and CAD Activities - Background Sources NOT Included

New Bedford Harbor Superfund Site
New Bedford, Massachusetts

05/17/10 DF
Fig12 2-yr_yr-2.dwg

Figure 12





Legend

Barge Transport Route

Source Area

Management Unit

Concentration in ng/m³

0 0.25 0.5 1 2 4 8 10

ng/m³ = nanograms per cubic meter

N

0 140

Scale in Meters

JACOBS™

Model-Predicted Annual Average PCB Concentrations at the LHCC Area for the Two Disposal Options for the 1st Year

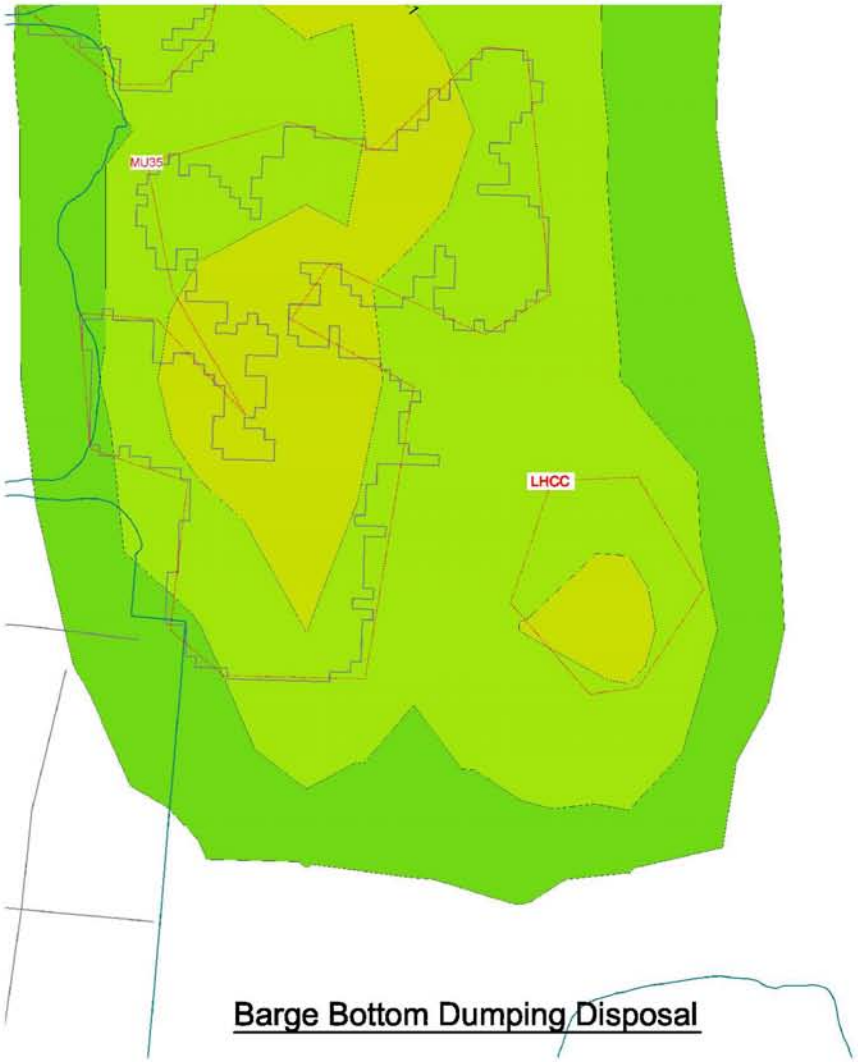
New Bedford Harbor Superfund Site

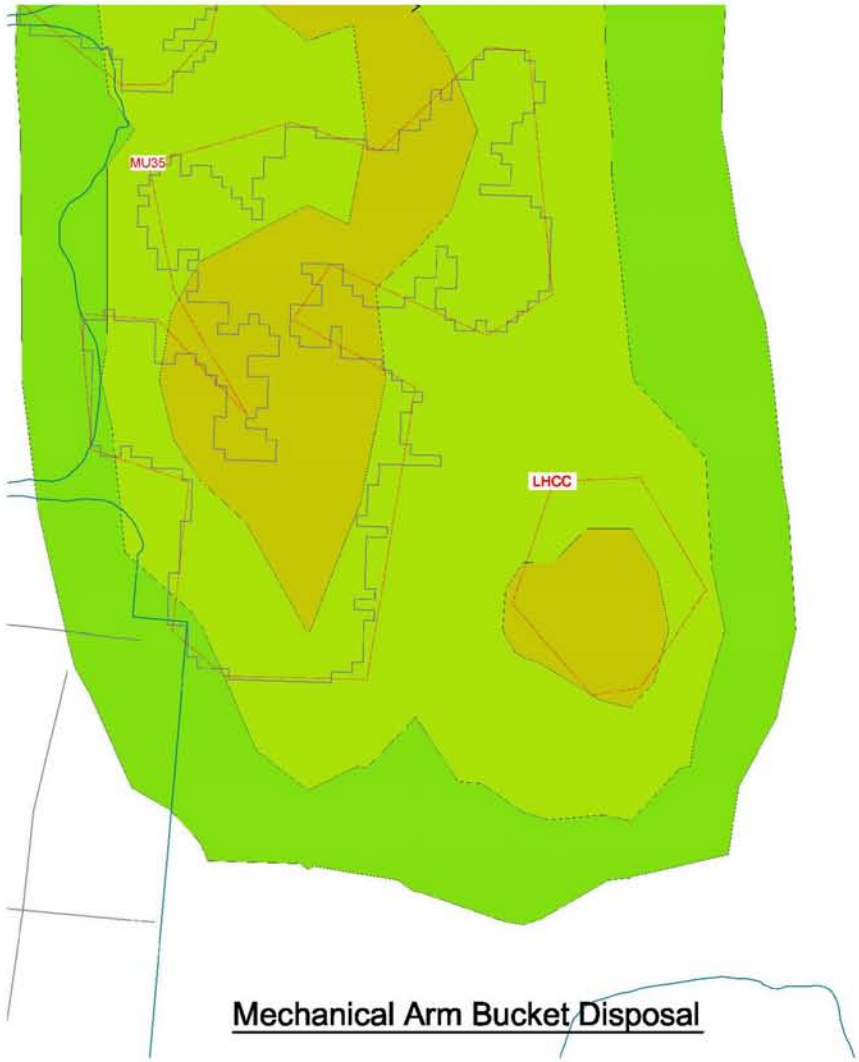
New Bedford, Massachusetts

06/09/10 DF

Fig13 LHCC Opt-1.dwg

Figure 13





Legend

Source Area

Management Unit

Concentration in ng/m³

0 0.25 0.5 1 2 4 8 10

ng/m³ = nanograms per cubic meter

N

0 140

Scale in Meters

JACOBS™

Model-Predicted Annual Average PCB Concentrations at the LHCC Area for the Two Disposal Options for the 2nd Year

New Bedford Harbor Superfund Site

New Bedford, Massachusetts

06/09/10 DF

Fig14 LHCC Opt-2.dwg

Figure 14

TABLES

Table 1
Remediation Scenarios for Proposed Dredging and CAD Activities

	MU Information		Dredging Scenarios						
MU	**Total Volume (cy)**	**PCB Concentration (ppm)**	**Remediation Timeline**	**Planing Dredging Volumes (cy)**	**Composite PCB Source Concentration (ppm)**	**Dredging Volume (cy)**	**Dredging Days**	**Dredge Method**	**Disposal**
MU-1 *	29925	0	Year 1	0	1235	113783	204	Hydraulic	Off-site
MU-2 *	29842	0		0					
MU-3	21642	1691		14428					
MU-102	44299	1172		35439					
MU-103	11185	368		11185					
MU-4 *	14994	0		0					
MU-5	8973	1940		4487					
MU-6	21791	347		21791					
MU-7	26453	2050		26453					
MU-8	9146	2050	Year 2	9146	436	107513	206		
MU-9	15527	271		10351					
MU-10	34859	424		17430					
MU-11 *	17962	0		0					
MU-12	15700	199		15700					
MU-13	16297	147		16297					
MU-14	18954	322		18954					
MU-15	19635	322		19635					
MU-16	22462	212	Year 3	22462	180	111340	124		
MU-17	18948	244		18948					
MU-18	17376	238		17376					
MU-19	15624	182		5208					
MU-104	11462	91		11462					
MU-105	8912	62		8912					
MU-20	14505	166		4835					
MU-21	16953	213		5651					
MU-22	10001	133		3334					
MU-23	18983	91		6328					
MU-24	20475	136		6825					
MU-25	16495	186	Year 4	16495	187	93961	180	Mechanical	CAD cell
MU-26	15877	167		15877					
MU-27	8993	28		8993					
MU-28	15107	68		15107					
MU-29	15062	60		15062					
MU-30	22427	432		22427					
MU-31	16591	606	Year 5	16591	113	187628	156		
MU-32	3815	30		3815					
MU-33	41025	99		41025					
MU-34	20463	61		20463					
MU-35	52094	55		52094					
MU-36	11136	64		11136					
MU-37	42504	51		42504					

Notes:
* -- the MUs have been dredged during 2004-2009.
cy = cubic yards
MU = management unit
PCB = polychlorinated biphenyl
ppm = parts per million

Table 2
PCB Emission Sources at NBH During Dredging and CAD Activities

Category	Location (Process)	Source Type	Emission Duration	Emission Source Group	PCB Emission Rate
Background	Mudflat	Area	Intermittent and Long-Term	Background	Previous modeling
	Hot Spot (Aerovox)	Point	Continuous and Long-Term	Background	Previous modeling
Dredging Operation	Distrurbed Water Surface	Area	Short-Term	Remediation	Based on PCB concentration in sediment
	Exposed Bucket	Area/Point	Short-Term	Remediation	Based on PCB concentration in sediment
	Surface of Barge (uncovered)	Area/Point	Short-Term	Remediation	Based on PCB concentration in sediment
Emissions during barge transport	Open to Area	Line	Very Short-Term	Remediation	Based on PCB concentration in sediment
Emissions during filling of the CAD	Distrurbed Water Surface	Area	Short-Term	Remediation	Based on PCB concentration in sediment
	Exposed Bucket	Area/point	Short-Term	Remediation	Based on PCB concentration in sediment
	Surface of Barge (uncovered)	Area/point	Short-Term	Remediation	Based on PCB concentration in sediment
	CAD Surface Emission	Area	Long-Term	Remediation	Based on PCB concentration in water/sediment

Notes:
CAD = confined aquatic disposal
PCB = polychlorinated biphenyl

Table 3
Process and Emission Rates for Air Dispersion Modeling

Sources	Processes	Theoretical Emission Flux Rate (g/m^2-s)	Calculated Location Specific Emission Flux Rate (g/m^2-s)	Emission Duration	Note
Background Source					
Mud Flat in Harbor		8.84E-08	8.84E-08	Two 2-hour periods per day	Monitoring/model calibrated
Aerovox Parking Area		4.42E-08	4.42E-08	Continuous	Monitoring/model calibrated
Dredged Area					
MUs	Distrurbed water surface	2.56E-07 *	Based on PCB concentration in sediment	12 hours/per location	180 and 156 days for Dredge Season 1 and 2
	Exposed dredging bucket	5.31E-08 *	Based on PCB concentration in sediment	1 hour/per location	
	Surface of barge (uncovered)	1.49E-07 *	Based on PCB concentration in sediment	2 hours/per location	
Transportation					
	Surface of barge (uncovered)	1.49E-07 *	Based on PCB concentration in sediment	0.78 hours/per location along line for years 1 and 2	Assumed a 1,000 cy barge for Upper and Lower Harbor
Disposal					
	Exposed dredging bucket	5.31E-08 *	Based on PCB concentration in sediment	1 hour/per location years 1 and 2	180 and 156 days for Dredge Seasons 1 and 2
	Surface of barge (uncovered)	1.49E-07 *	Based on PCB concentration in sediment	2 hours/per location years 1 and 2	
	Distrurbed water surface	2.56E-07 *	Based on PCB concentration in sediment	16 and 12 hours/per location years 1 and 2	
	Pond water surface	7.35E-09 #	Based on PCB concentration in sediment	Continuous emission before capping	270 and 365 days for dredge seasons 1 and 2

Notes:
*- based on sediment with PCB concentration of 432 ppm.
# - based on sediment with PCB concentration of 1032 ppm.
cy = cubic yards
g/m^2-s = grams per square meters-second
MU = management unit
PCB = polychlorinated biphenyl

Table 4
Emission Rates Applied for Air Dispersion Modeling

MU	PCB Concentration in MU (ppm)	Composite PCB Concentration (ppm)	Site-Specific Emission Flux Rate (g/m^2-s) for Disturbed Surface Water	Site-Specific Emission Flux Rate (g/m^2-s) for Dredge Bucket	Site-Specific Emission Flux Rate (g/m^2-s) for Barge	Site-Specific Emission Flux Rate (g/m^2-s) for Ponded Water/Sediment	Total Emission Rate Applied in Model for Annual Avearge for the Dredging Seasons or the Year (After Emission Factor Consideration)
MU-25	186	187	1.10E-07	2.29E-08	6.42E-08	NA	3.41E-10
MU-26	167		9.90E-08	2.05E-08	5.76E-08	NA	3.06E-10
MU-27	28		1.66E-08	3.44E-09	9.66E-09	NA	5.14E-11
MU-28	68		4.03E-08	8.36E-09	2.35E-08	NA	1.25E-10
MU-29	60		3.56E-08	7.38E-09	2.07E-08	NA	1.10E-10
MU-30	432		2.56E-07	5.31E-08	1.49E-07	NA	7.92E-10
MU-31	606	113	3.59E-07	7.45E-08	2.09E-07	NA	1.28E-09
MU-32	30		1.78E-08	3.69E-09	1.03E-08	NA	6.35E-11
MU-33	99		5.87E-08	1.22E-08	3.41E-08	NA	2.10E-10
MU-34	61		3.61E-08	7.50E-09	2.10E-08	NA	1.29E-10
MU-35	55		3.26E-08	6.76E-09	1.90E-08	NA	1.16E-10
MU-36	64		3.79E-08	7.87E-09	2.21E-08	NA	1.35E-10
MU-37	51		3.02E-08	6.27E-09	1.76E-08	NA	1.08E-10
	Year						
Disposal Transport	1	187	NA	NA	6.46E-08	NA	1.17E-11
	2	113	NA	NA	3.90E-08	NA	2.61E-12
CAD Disposal (Bottom Dump) *	1	187	1.11E-07	NA	NA	1.33E-09	1.75E-09
	2	113	6.70E-08	NA	NA	8.06E-10	1.02E-09
CAD Disposal (Bucket Disposal) *	1	187	1.11E-07	2.30E-08	6.46E-08	1.33E-09	1.78E-09
	2	113	6.70E-08	1.39E-08	3.90E-08	8.06E-10	1.05E-09

Notes:
* -- The CAD cell is assumed to be a continuous emission source after its operation and before the final cap placement.
CAD = confined aquatic disposal
g/m^2-s = grams per square meters-second
MU = management unit
NA = not applicable
ppm = part per million
PCB = polychlorinated biphenyl

Table 5
Model Predicted Daily Average PCB Concentrations for 2-Year Dredging and CAD Activities

ID	Group	Easting UTM83 (m)	Northing UTM83 (m)	Note	Average Annual Concentrations (ng/m^3) from All Sources		Average Annual Concentrations (ng/m^3) from Dredging/Disposal Activities Only	
					Year-1	Year-2	Year-1	Year-2
R1	Residential	340777	4616194	in FW 2001 modeling	0.409	0.138	0.028	0.023
R2	Residential	340877	4615794	in FW 2001 modeling	0.601	0.314	0.031	0.025
R3	Residential	340277	4615894	in FW 2001 modeling	0.650	0.265	0.033	0.024
R4	Residential	339977	4614694	in FW 2001 modeling	0.812	0.141	0.050	0.041
R5	Residential	340877	4614594	in FW 2001 modeling	1.008	0.139	0.096	0.055
R6	Residential	340074	4614258	in FW 2001 modeling	1.363	0.138	0.092	0.064
R7	Residential	340065	4615374	in FW 2001 modeling	0.694	0.153	0.033	0.027
R8	Residential	339765	4613555	in FW 2001 modeling	0.899	0.098	0.081	0.062
R9	Residential	339970	4613347	in FW 2001 modeling	2.130	0.168	0.199	0.132
R10	Residential	340869	4613754	in FW 2001 modeling	4.765	0.186	0.146	0.161
R11	Residential	340869	4613532	in FW 2001 modeling	3.305	0.161	0.144	0.138
R12	Residential	339877	4613131	in FW 2001 modeling	1.512	0.157	0.148	0.127
R13	Residential	339701	4613011	in FW 2001 modeling	1.135	0.107	0.087	0.081
R14	Residential	339365	4612440	in FW 2001 modeling	0.336	0.060	0.033	0.042
R15	Residential	339573	4611532	in FW 2001 modeling	0.281	0.091	0.061	0.076
R16	Residential	341116	4611956	in FW 2001 modeling	0.386	0.113	0.068	0.103
R17	Residential	341194	4612236	in FW 2001 modeling	0.390	0.097	0.062	0.087
R18	Residential	340877	4612549	in FW 2001 modeling	0.622	0.171	0.126	0.157
R19	Residential	340658	4612756	in FW 2001 modeling	1.114	0.224	0.180	0.207
S1	School	341042	4613347	in FW 2001 modeling	1.415	0.124	0.104	0.106
S2	School	341275	4611979	in FW 2001 modeling	0.346	0.083	0.052	0.075
C1	Commercial	340416	4615834	in FW 2001 modeling	0.713	0.368	0.037	0.025
C2	Commercial	340177	4615594	in FW 2001 modeling	0.769	0.215	0.035	0.025
C3	Commercial	340377	4615494	in FW 2001 modeling	1.740	1.288	0.044	0.030
C4	Commercial	340277	4615494	in FW 2001 modeling	0.952	0.397	0.042	0.028
C5	Commercial	340255	4615352	in FW 2001 modeling	1.123	0.463	0.045	0.030
C6	Commercial	339977	4615094	in FW 2001 modeling	0.726	0.230	0.035	0.030
C7	Commercial	340777	4615194	in FW 2001 modeling	0.954	0.488	0.049	0.036
C8	Commercial	340077	4614994	in FW 2001 modeling	0.771	0.188	0.043	0.033
C9	Commercial	340156	4614732	in FW 2001 modeling	0.981	0.196	0.064	0.041
C10	Commercial	340198	4614222	in FW 2001 modeling	1.611	0.158	0.151	0.072

Table 5
Model Predicted Daily Average PCB Concentrations for 2-Year Dredging and CAD Activities

ID	Group	Easting UTM83 (m)	Northing UTM83 (m)	Note	Average Annual Concentrations (ng/m^3) from All Sources		Average Annual Concentrations (ng/m^3) from Dredging/Disposal Activities Only	
					Year-1	Year-2	Year-1	Year-2
C11	Commercial	340016	4613666	in FW 2001 modeling	1.897	0.135	0.162	0.089
C12	Commercial	340088	4613526	in FW 2001 modeling	3.916	0.164	0.286	0.119
C13	Commercial	340777	4613794	in FW 2001 modeling	9.421	0.251	0.233	0.222
C14	Commercial	340707	4613611	in FW 2001 modeling	32.754	0.332	0.614	0.303
C15	Commercial	340528	4613549	in FW 2001 modeling	15.332	1.516	0.506	1.488
C16	Commercial	339864	4612949	in FW 2001 modeling	1.028	0.165	0.115	0.137
C17	Commercial	339649	4612741	in FW 2001 modeling	0.582	0.098	0.061	0.075
C18	Commercial	339762	4612344	in FW 2001 modeling	0.500	0.131	0.063	0.110
C19	Commercial	339731	4611959	in FW 2001 modeling	0.381	0.128	0.067	0.110
C20	Commercial	339890	4611633	in FW 2001 modeling	0.535	0.159	0.101	0.138
C21	Commercial	339923	4611507	in FW 2001 modeling	0.488	0.148	0.093	0.128
C22	Commercial	340119	4611494	in FW 2001 modeling	0.473	0.176	0.127	0.159
C23	Commercial	340520	4611696	in FW 2001 modeling	0.460	0.178	0.124	0.167
C24	Commercial	341083	4611757	in FW 2001 modeling	0.397	0.124	0.081	0.115
C25	Commercial	341035	4612209	in FW 2001 modeling	0.461	0.129	0.083	0.118
CDF-C-n	CDF-C	340169	4613834	in FW 2001 modeling	83.617	0.169	0.348	0.108
CDF-C-w	CDF-C	340170	4613651	in FW 2001 modeling	11.748	0.190	0.836	0.134
CDF-C-s	CDF-C	340246	4613449	in FW 2001 modeling	47.895	0.298	9.235	0.251
CDF-C-e	CDF-C	340273	4613694	in FW 2001 modeling	18.593	0.250	4.241	0.193
CDF-D-n	CDF-D	339987	4612588	in FW 2001 modeling	0.888	1.549	0.125	1.521
CDF-D-w	CDF-D	339877	4612385	in FW 2001 modeling	0.596	0.236	0.085	0.212
CDF-D-e	CDF-D	340092	4612386	in FW 2001 modeling	0.909	1.692	0.194	1.665
CDF-D-s	CDF-D	339983	4612130	in FW 2001 modeling	0.752	0.463	0.137	0.439
HS-w	HS	339992	4613762	in FW 2001 modeling	1.257	0.127	0.114	0.080
HS-n	HS	340047	4613820	in FW 2001 modeling	1.702	0.132	0.147	0.081
HS-s	HS	340047	4613711	in FW 2001 modeling	2.346	0.139	0.174	0.091
HS-e	HS	340104	4613767	in FW 2001 modeling	6.246	0.149	0.247	0.096
S3	School	339820	4614343	Caldwell School	0.459	0.104	0.053	0.043
21	Old Monitoring	339904	4612365	New Bedford Welding	0.622	0.292	0.090	0.268
24D	Old Monitoring	340469	4615404	Aerovox NE Corner duplicate	381.468	381.064	0.050	0.032
30D	Old Monitoring	340295	4615083	Fiber Leather duplicate	1.382	0.568	0.056	0.036

Table 5
Model Predicted Daily Average PCB Concentrations for 2-Year Dredging and CAD Activities

ID	Group	Easting UTM83 (m)	Northing UTM83 (m)	Note	Average Annual Concentrations (ng/m^3) from All Sources		Average Annual Concentrations (ng/m^3) from Dredging/Disposal Activities Only	
					Year-1	Year-2	Year-1	Year-2
27	Old Monitoring	340695	4614480	Franxis St (Porter)	1.474	0.129	0.122	0.064
30	Old Monitoring	340293	4615082	Fiber Leather	1.379	0.563	0.056	0.036
40	Old Monitoring	340263	4615071	Wood St (Titleist)	1.296	0.469	0.055	0.035
43	Old Monitoring	340696	4613704	Bus Terminal Lot	26.538	0.347	0.617	0.316
44	Old Monitoring	340604	4612687	Taber St (Pumping Station)	1.164	0.252	0.208	0.235
45	Old Monitoring	340927	4608484	Cozy Cover Marina	0.081	0.015	0.008	0.010
41	Old Monitoring	340608	4614971	NSTAR substation	0.854	0.280	0.062	0.042
24	Monitoring	340469	4615407	Aerovox NE corner	347.695	347.291	0.050	0.032
25	Monitoring	340238	4614472	Cliftex, Manomet Street	1.318	0.174	0.106	0.054
42	Monitoring	340752	4615183	NSTAR North	0.945	0.460	0.050	0.037
46	Monitoring	340054	4614110	Coffin Ave	1.852	0.133	0.110	0.070
47	Monitoring	339979	4613720	Area C Downwind	1.526	0.127	0.118	0.082
48	Monitoring	339980	4613750	Area C Crosswind	1.277	0.126	0.111	0.080
49	Monitoring	340026	4613780	Area C Upwind	1.638	0.132	0.134	0.083
50	Monitoring	339856	4612222	Area D Downwind	0.517	0.206	0.079	0.184
51	Monitoring	339885	4612137	Area D Crosswind	0.542	0.239	0.099	0.217
52	Monitoring	340009	4612221	Area D Upwind	0.783	1.352	0.123	1.327
55	Monitoring	340152	4615351	Aerovox West (R7 receptor)	0.875	0.236	0.039	0.028
56	Monitoring	340470	4616023	Acushnet Park	0.551	0.246	0.034	0.023

Notes:
CDF = Central Disposal Facility
FW = Foster Wheeler
HS = high school
m = meter
ng/m^3 = nanograms per cubic meter
PCB = polychlorinated biphenyl
UTM = Universal Transverse Mercator coordinate system

APPENDIX A

Modeled Scenarios

Table A-1
Modeled Scenarios

Model Run #		42	52
Run Objective			
		Annual Average	Annual Average
Emission Source Applied			
Mud Flats	Flux Rate (g/m^2-s)	8.84E-08	
	Emission Factor	0.5 (4 hour/day) for whole year	
Aerovox On-Land Hot Spot	Flux Rate (g/m^2-s)	4.42E-08	4.42E-08
	Emission Factor	1.0 (all time)	1.0 (all time)
Dredging Units			
MU-25	Flux Rate (g/m^2-s)	3.41E-10	
	Emission Factor	1.0 (April - October)	
MU-26	Flux Rate (g/m^2-s)	3.06E-10	
	Emission Factor	1.0 (April - October)	
MU-27	Flux Rate (g/m^2-s)	5.14E-11	
	Emission Factor	1.0 (April - October)	
MU-28	Flux Rate (g/m^2-s)	1.25E-10	
	Emission Factor	1.0 (April - October)	
MU-29	Flux Rate (g/m^2-s)	1.10E-10	
	Emission Factor	1.0 (April - October)	
MU-30	Flux Rate (g/m^2-s)	7.92E-10	
	Emission Factor	1.0 (April - October)	
MU-31	Flux Rate (g/m^2-s)		1.28E-09
	Emission Factor		1.0 (May - October)
MU-32	Flux Rate (g/m^2-s)		6.35E-11
	Emission Factor		1.0 (May - October)
MU-33	Flux Rate (g/m^2-s)		2.10E-10
	Emission Factor		1.0 (May - October)
MU-34	Flux Rate (g/m^2-s)		1.29E-10
	Emission Factor		1.0 (May - October)
MU-35	Flux Rate (g/m^2-s)		1.16E-10
	Emission Factor		1.0 (May - October)
MU-36	Flux Rate (g/m^2-s)		1.35E-10
	Emission Factor		1.0 (May - October)
MU-37	Flux Rate (g/m^2-s)		1.08E-10
	Emission Factor		1.0 (May - October)
Barge Transport	Flux Rate (g/m^2-s)	1.17E-11	2.61E-12
	Emission Factor	1.0 (April - October)	1.0 (May - October)
CAD Disposal	Flux Rate (g/m^2-s)	4.11E-10	2.15E-10
	Emission Factor	1.0 (April - October)	1.0 (May - October)
Meteorological Data Used			
	2008 NBH Site-specific Data	All Year	All Year
Receptors			
	Discrete	Yes	Yes
	Grid	Yes	Yes

Notes:
g/m^2-s = grams per square meter-second

APPENDIX B

Modeling Input and Output Files

The CD contains all the air dispersion modeling files of the final runs listed in

Appendix A of the report titled

"FINAL EVALUATION OF THE IMPACT OF DREDGING AND CAD CELL DISPOSAL ON AIR QUALITY, NEW BEDFORD HARBOR SUPERFUND SITE, NEW BEDFORD, MA"

by Jacobs Engineering (2010).

ISCST3 Input files (*.inp) were produced by:

** ISC-AERMOD View Ver. 5.0
** Lakes Environmental Software Inc.

For all simulation,

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****************************************
** ISCST3 Meteorology Pathway
****************************************
   INPUTFIL 2008.MET
```

was used.

Outfile files (*.out) for the final runs are also included.

REPOSITORY TARGET SHEET

US EPA New England
Superfund Document Management System /
RCRA Document Management System
Native Files Target Sheet

SDMS / RDMS Document ID #: 466822

Site Name: NEW BEDFORD

File Break: 04.06

File Type(s) Attached Specify below (Example: Excel file or .jpg):

.met, .INP, .OUT

Document Type this Target Sheet Represents:

☐	Map	☐	Photograph	☐	Graph/Chart
☐	Video	☑	Compact Disc	☐	Other (Specify below)

Description or Comments:
Air Dispersion Modeling Input & Output Files

To view the attached files, click on the "Attachment Panel"

** Please note to view attachments the software corresponding with the specified file type is necessary. **

For any additional assistance please contact the EPA New England Office of Site Remediation and Restoration Records and Information Center-
Telephone (617) 918 1440