PHASE II COMPREHENSIVE SITE ASSESSMENT
SCOPE OF WORK AND
CONCEPTUAL SITE MODEL

BARGE B120 SPILL
BUZZARDS BAY, MASSACHUSETTS
RTN 4-17786

Prepared For:

Bouchard Transportation Company, Inc.
58 South Service Road, Suite 150
Melville, NY 11747

Prepared By:

GeoInsight, Inc.
5 Lan Drive, Suite 200
Westford, Massachusetts 01886
Phone: (978) 692-1114
Fax: (978) 692-1115
www.geoinsightinc.com

August 24, 2005

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

PHASE II COMPREHENSIVE SITE ASSESSMENT SCOPE OF WORK AND CONCEPTUAL SITE MODEL

BARGE B120 SPILL BUZZARDS BAY, MASSACHUSETTS RTN 4-17786

1.0 INTRODUCTION

This Phase II Scope of Work (SOW) was prepared by GeoInsight, Inc. (GeoInsight) and ENTRIX, Inc. (ENTRIX) on behalf of Bouchard Transportation Company, Inc. ("Bouchard" or "RP") to assist in response actions conducted under the Massachusetts Contingency Plan (MCP), 310 CMR 40.0000 associated with the release of Number 6 (No. 6) fuel oil from Bouchard Transportation Company, Inc. ("Bouchard" or "RP") Barge B120 that occurred on April 27, 2003 in Buzzards Bay, Massachusetts. Richard J. Wozmak, P.E., P.H. is the Licensed Site Professional (LSP)-of-record for response actions conducted under the MCP for this release (RTN 4-17786). This Phase II SOW was prepared in response to the July 27, 2004 *Decision to Grant Permit* letter from the Massachusetts Department of Environmental Protection (MADEP) that requested a Phase II SOW with Conceptual Site Model (CSM). This CSM supplements the May 3, 2004 Phase II Conceptual Scope of Work that identified potential receptors associated with shoreline classifications and assessment activities to characterize these shoreline types.

Response actions and cleanup activities have been conducted under both federal and state regulations. Initial cleanup operations were conducted until September 3, 2003 under the direction of the U.S. Coast Guard (USCG), which supervised Unified Command. Response actions conducted after September 3, 2003 have been conducted under the direction of the LSP-of-Record in accordance with Massachusetts regulations, including the MCP. Immediate response action (IRA) activities were requested by MADEP in the May 22, 2003

Notice of Responsibility and September 8, 2003 *Request for Immediate Response Action Plan with Interim Deadline* letters from MADEP to Bouchard.

2.0 BACKGROUND

A summary of background information is presented below. Additional background information is presented in the Updated CSM report attached as Appendix A.

Buzzards Bay is located in southeastern Massachusetts between the western most part of Cape Cod and the Elizabeth Islands. The bay is 28 miles long (45 kilometers), averages about 8 miles (12 kilometers) in width, and has a mean depth of 36 feet (11 meters). The southeastern side of Buzzards Bay, including the Elizabeth Islands, consists of glacial outwash material originally deposited at the glacier's leading edge during the last ice age (over 12,000 years ago). Therefore, the southeastern side has a relatively smooth shoreline composed mostly of sand and gravel. The northwestern side of Buzzards Bay is comprised of bays and inlets formed by the glacier's northern retreat, and these bays and inlets are now sheltered through the formation of barrier spits.

The coastal areas of Buzzards Bay include inner harbors, small islands, public and private beaches, and marinas, which are comprised of various substrates and habitats. The Buzzards Bay shoreline classifications include beaches, salt marshes, tidal streams, tidal flats, rocky shores, and subtidal habitats. The majority of shorelines in Buzzards Bay consist of beaches, especially mixed sand-gravel beaches. These beaches are both publicly and privately owned, and the substrate ranges from fine to coarse-grain sand and sand mixed with gravel to boulder-size rocks. Salt marshes and man-made structures comprise a sizeable portion of the Buzzards Bay shoreline (however, to a lesser extent than sand and mixed sand-gravel beaches). The salt marshes typically are located in intertidal areas behind barrier beaches, bordering pools or quiescent water, or along the banks of tidal rivers. Man-made structures within Buzzards Bay include docks, piers, and jetties. Natural rock outcroppings represent a small portion of the shoreline in Buzzards Bay.

2.1 RELEASE INFORMATION AND CONCEPTUAL SITE MODEL

On April 27, 2003, an unknown amount of No. 6 fuel oil, estimated to range between approximately 22,000 gallons and 98,000 gallons, was released from Barge B120 into Buzzards Bay. Additional information regarding the release, the fate and transport of the released oil, the areas where residual oil impacts may be present, the potential exposure pathways that may exist where residual oil is present, and human and ecological receptors associated with these exposure pathways is presented in the Updated CSM included as Appendix A. This CSM supplements the initial CSM that was included as part of the May 3, 2004 Phase I Initial Site Investigation and Conceptual Site Model Report.

Following the release, Unified Command, which consisted of representatives from the USCG, MADEP, and the RP, divided the Buzzards Bay shoreline into a total of 149 shoreline segments. Subsequent evaluation found that 29 of these segments were not oiled by the release, and were therefore not considered to be part of the "Site," as defined in the MCP, 310 CMR 40.0000. Of the remaining 120 segments that were oiled to varying degrees, a Partial Class A-2 Response Action Outcome (RAO) statement dated May 21, 2004 was filed for the intertidal zone of 57 intertidal segments where the maximum degree of initial oiling was characterized as "light" or "very light," and also to three sandy beach segments where the maximum degree of initial oiling was characterized as "moderate." Therefore, the Site currently includes the remaining 63 intertidal segments and subtidal areas. A summary of the status of the 149 shoreline segments is included in Table 1, and the locations of these segments are shown on Figure 1.

2.2 SHORELINE CLASSIFICATION

The shoreline was initially classified by Unified Command according to substrate type, public use, and sensitive habitat using the scheme presented below.

Shoreline Classification	Shoreline Type
1A	Heavily utilized, public recreational sand beaches
1B	Less utilized, semi-public and private sand beaches
1C	Mixed sand and gravel, gravel (pebble to boulder) and rip rap groins (jetties)
1D	Rip rap seawalls, bulkheads, piers, docks, and pilings
1E	Rocky shorelines
1F	Salt marshes
2	Roseate tern habitat (Ram Island, Bird Island, and Penikese Island, in particular)
3	Piping plover habitat

This Site-specific classification was developed using the Environmental Sensitivity Index (ESI) codes, which were developed by the National Oceanographic and Atmospheric Administration (NOAA) in response to other oil spills in the context of evaluating shoreline habitat classification (NOAA, 1999). This approach for shoreline classification is accepted by the scientific community in responding to and assessing oil spills. Individual shoreline segments were characterized with one primary classification (i.e., the predominant shoreline type); in addition, one or more secondary shoreline classifications were reported for some shoreline segments (for example, a sandy beach with groins and fringing marshes would be primarily 1A or 1B, and secondarily 1D and 1F). Table 2 identifies the primary and secondary shoreline classifications for the 63 remaining shoreline segments.

Initial cleanup activities under Unified Command focused upon meeting cleanup guidelines, known as Immediate Response Action Completion (IRAC) Criteria, that were established in the May 23, 2003 *Immediate Response Action: Treatment and Completion Guidelines Plan* (IRATCGP) developed by the Unified Command. The Unified Command Cleanup focused upon cleaning 1A and 1B shorelines in particular, due to the expected high public use of these sandy beaches during the upcoming summer season. The IRAC cleanup criteria for individual shoreline classes are listed below.

Substrate Classification	Substrate Description	IRAC Cleanup Criteria
A	Heavily Utilized Public Recreational Sand Beaches	• No visible surface or subsurface oil (not detectable by sight, smell, feel), to the maximum extent possible, as rapidly as possible.
B	Less-utilized Semi-public and Private Sand Beaches	• No visible surface, subsurface oil to trace, to the maximum extent possible.
C	Mixed Sand and Gravel, Gravel (pebble to boulder) and Rip Rap Groins (jetties)	• No sheen • Surface: Oil does not come off on the finger when touched • Subsurface: Trace
D	Rip Rap Seawalls, Bulkheads, Piers, Docks and Pilings	• No sheen • Oil does not come off on the finger when touched
E	Rocky Shorelines	• No sheen • Oil does not come off on the finger when touched
F	Salt Marshes	• No sheen

At the completion of Unified Command cleanup operations on September 3, 2003, a total of 91 of the 120 oiled segments met IRAC criteria. Fifteen segments did not pass IRAC criteria and fourteen segments were not surveyed by the IRAC inspection teams, but these segments were subsequently inspected as part of the MCP IRA process.

The September 15, 2003 IRA Plan established additional cleanup criteria for continued response actions pursuant to the MCP, 310 CMR 40.0000, under the direction of the LSP-of-record. The objectives of the IRA Plan are to address potential Imminent Hazards, if present, and to respond to time-critical conditions that necessitate immediate response actions. These objectives were developed to meet the applicable General Provisions for Immediate Response Actions listed in 310 CMR 40.0411(1), which are to assess the release, threat of release, or site conditions and, where appropriate, contain, isolate, remove or secure a release or threat of release of oil in order to:

(a) abate, prevent or eliminate any Imminent Hazard to health, safety, public welfare or the environment; and/or

(b) respond to any other time-critical release, threat of release and/or site conditions.

The IRA response action strategies include:

1. Removing potentially mobile oil (oil that has the potential to mobilize and impact other areas); and
2. Addressing potential Imminent Hazards to human health, public welfare, safety, and the environment, as listed in 310 CMR 40.0321.

IRA cleanup activities were conducted at segments since September 2003 are described in IRA Status reports, including reports submitted to MADEP in February 2004, September 2004, and March 2005.

2.3 CURRENT RESIDUAL OIL IMPACTS

The assessment of current residual oil impacts is based upon visual field inspections, analytical data collected in 2004, and modeling of the oil spill release. This information is presented in the Updated CSM report attached as Appendix A and was supplemented by additional visual inspections in May 2005 at approximately 20 of the remaining 63 segments. These segments were selected for evaluation because they were previously identified as having relatively more evidence of residual oil or the potential for residual oil exists based upon earlier field investigations.

2.3.1 Intertidal Shoreline Segments

The Updated CSM indicates that the large majority of the released oil (approximately 95 percent) floated ashore on the water surface and stranded in the intertidal zone, primarily on south- or west-facing shorelines. Small amounts of oil volatilized (approximately 4 percent) and dissolved into surface water (approximately 1 percent). A very small percentage (less than 0.02 percent) sank to the seafloor. Significant amounts of the oil that stranded in the intertidal zone were removed under the direction of Unified Command during the initial cleanup operations, or as part of additional cleanup that was conducted as part of MCP IRAs.

Residual oil is not currently present in ambient air, surface water, or ground water. Residual oil that exists is generally present in the intertidal zone as infrequent small "splatter" stains on rock surfaces or as minute tarballs, primarily at mixed sand and gravel (1C) shorelines. Small tarballs and oil patches may be present in limited areas of some salt marshes (1F shorelines) that were moderately or heavily oiled during the initial release. Residual oil is not expected to be present in significant quantities at sandy beaches (1A and 1B shorelines) or at shorelines composed primarily of hard substrates (1D and 1E shorelines). Residual oil is expected to attenuate over time through physical and chemical processes that occur naturally in the environment.

Visual inspections of portions of approximately 20 shoreline segments that were initially oiled by the release were conducted in May 2005 to assess current oil conditions at the shoreline classifications listed above (i.e., worst-case segments in regard to the extent and magnitude of residual oiling). In general, where oil was observed at these segments the oil consisted of only trace amounts (typically sporadic dried splatter or oil staining), and oil was not observed at many of the segments that were inspected. Slightly more residual oil was observed at five segments, particularly at W2A-10 (Long Island/Hoppy's Landing), but also at W1F-02 (Brandt Island West-Leisure Shores/Howard's Beach), W2A-02 (Harbor View), W2A-03 (Pope's Beach), and W2A-11 (West Island West). Additional information on the degree of residual oil remaining at these segments is presented below.

2.3.1.1 W2A-10 (Long Island/Hoppy's Landing): The southern point of Long Island consists primarily of mixed sand and gravel (1C) shoreline with areas of fringing salt marshes (1F). This location was one of the areas that had the greatest degree of initial oiling from the release. During the initial cleanup efforts, Unified Command avoided aggressive cleanup efforts in marsh habitat to minimize the impacts on the sensitive marsh resources. Residual oil in the fringing marsh at the southern part of Long Island was the subject of two cleanup projects conducted as part of IRA activities in 2004. However, the amount of cleanup that was conducted was limited in order to avoid causing ecological damage to the fringing marshes from the cleanup operations. The residual oil is present at the southern tip of Long

Island in and on the edge of the fringing marsh vegetation. Residual oil is present in discontinuous areas located on only a small portion of the W2A-10 shoreline; visible oil was not observed in the remainder of the shoreline in this segment (along approximately 5,000 feet of shoreline), due to cleanup operations. The residual oil consists of small discrete areas of solidified oil known as "pavement." These pavement patches are generally 1 to 2 inches in diameter, located in, and on the edge of, some of the fringing marshes. There is also limited splatter present on some rock surfaces, mostly less than 1 inch in diameter.

2.3.1.2 W1F-02 (Brandt Island West-Leisure Shores/Howard's Beach): The Leisure Shores/Howard's Beach portion of this segment is composed primarily of mixed sand and gravel (1C) shoreline. Residual oil at this location consists of small (generally less than 0.25 inch in diameter) flattened particles of oil (identified as "flecks") mixed with the sediment. Small, discontinuous oil sheens (typically less than one inch in diameter) associated with these flecks have been observed on standing water in some test pits that were excavated to a depth of approximately 0.5 to 1 foot below surface grade. Cleanup activities were conducted at this location in September 2004 and July 2005 to remove the oil particles by turning over the sediment (either manually or using rototillers) and using absorbent materials to remove the oil. Post-cleanup inspections indicate that cleanup activities and natural beach process have significantly reduced the extent of oiling and the number and size of oil particles. Only a very small amount of residual oil particles were observed (primarily in three isolated areas) during the post-cleanup inspections and additional response actions in these areas are currently being evaluated. Significant amounts of residual oil are not present along the remainder of the shoreline of this segment (approximately 2,500 feet).

2.3.1.3 W2A-02 (Harbor View): This segment consists primarily of salt marsh (1F), but there are also smaller areas of sandy beach (1A/1B) and mixed sand and gravel (1C) shoreline. In June 2005, GeoInsight and ENTRIX field representatives responded to a citizen report of oil. Oil patches were observed adjacent to several wood timbers in an area of the sandy shoreline, as well as under sheltered crevices in a decaying hummock of marsh peat. Cleanup activities were conducted at this location in August 1995, as described in an IRA

Plan Modification dated August 16, 2005. The cleanup operations were effective in removing the residual oil described above, and significant amounts of residual oil are no longer present.

2.3.1.4 W2A-03 (Pope's Beach): This segment consists primarily of sandy beach (1A/1B) in the eastern portion and salt marsh (1F) in the western portion. Residual oil is not visible on the sandy beach (although a significant amount of slag unrelated to the B120 release is present on the beach surface). Small, discontinuous patches of oil, generally less than four inches in diameter, were observed in localized areas in the salt marsh. The total area of impacted marsh sediment was probably less than 10 square feet. Marsh grass (*Spartina Spp.*) was observed growing through the pavement in some areas, and mussels and snails were also observed in and next to the pavement.

2.3.1.5 W2A-11 (West Island West): This segment consists primarily of mixed sand and gravel (1C) substrate. In August 2004, a small amount of residual splatter was observed in the northwest portion of the segment with one highly localized area of greater residual oiling (approximately 7 feet by 10 feet). This localized area consisted primarily of sand-size sediment with oil present on the particle surfaces. The area of impacted sediment is approximately 3 to 4 inches thick and is not visible on the surface as it is covered with approximately one inch of unoiled sediment. This oiled sediment was removed in July 2005 as described in a July 7, 2005 IRA Plan Modification. Post-cleanup inspections indicate that a significant amount of residual oil is no longer present at this location.

2.3.2 Subtidal Areas

As described in the Updated CSM (attached as Appendix A), qualitative and quantitative field investigations as well as Site-specific fate and transport modeling and literature review indicates that there would be little if any subtidal oiling. Modeling indicates that very little (approximately 0.02 percent) of the released oil would have sunk to the seafloor after the release. Field investigations (including dive surveys conducted by both the RP and MADEP, chain drags, and lobster pot surveys) and laboratory analyses found virtually no evidence of

B120 oil in subtidal areas. During the initial response phase, there was minimal oiling observed offshore of Barney's Joy, although no oiling was observed there during subsequent recent surveys conducted in August 2004. If residual oil were present in the subtidal habitat, it would theoretically be the result of residual oil in the intertidal zone being abraded by normal wave action and then subsequently deposited in the nearshore subtidal zone adjacent to relatively moderately or heavily oiled shoreline segments. As described in the Updated CSM, this phenomenon was observed during investigations associated with the Exxon Valdez release, although the resulting polynuclear aromatic hydrocarbon (PAH) concentrations in subtidal sediment were below ecological thresholds.

2.4 COMPLETED CHARACTERIZATION ACTIVITIES

Extensive characterization has been conducted since the release to evaluate residual oil impacts in both intertidal and subtidal areas. This characterization was initially conducted under the direction of Unified Command as part of the SCAT and IRAC processes, and continued as part of the MCP response actions. The Updated CSM report in Appendix A provides specific information regarding characterization activities, which are summarized below. The characterization included inspections for visible residual oil and sampling and analysis of sediment, surface water, and shellfish tissue. Figures 2 and 3 depict completed characterization activities that were conducted in the intertidal and subtidal zones, respectively.

As part of the sampling activities conducted for the Phase I characterization, over 100 intertidal and marsh composite sediment samples were collected from 27 shoreline segments for laboratory analysis. The analytical results were compared to the Effects Range-Low (ERL) values listed in the Screening Quick Reference Tables (SQuiRT) prepared by National Oceanic and Atmospheric Administration (NOAA 1999). Only two samples of the over 100 sediment samples collected contained concentrations of some individual PAH that exceeded applicable ERLs. The samples were collected from segments W2A-03 (Pope's Beach in Fairhaven) and W1E-06 (Town Beach in Mattapoisett) and the exceedences at each location were observed in only one of the six sediment samples collected. Subsequently, each of the

three aliquot samples that composed the composite samples were analyzed separately to evaluate if the PAH detected were uniformly distributed among the samples. PAH were detected in each of the 3 aliquot samples of the composite sample collected from W2A-03 that exceeded ERLs (sample W2A-03-LIT-02), but the detected concentrations of individual PAH in each aliquot were below applicable ERLs. PAH were also detected in the three aliquots that comprised the W1E-06-UIT-03 composite sample collected from segment W1E-06, but concentrations of four individual PAH slightly exceeded ERLs in only one of the three aliquots. These data indicate that the PAH that exceeded ERLs in the two composite samples are not uniformly distributed in the sampling area.

Additional characterization of marsh sediment was conducted at selected segments (W1C-02, W1F-05, W2A-02, W2A-05, W2A-10, and W2A-14) in August 2004. PAH were detected in several samples, but the concentrations of detected PAH were below ERLs, with the exception of the two sediment samples collected from W2A-02 (Harbor View). At this location, concentrations of four individual PAH slightly exceeded applicable ERLs. Additional characterization will be conducted at this segment as part of Phase II characterization activities, as described below in Section 4.1.4.

Subtidal characterization in 2004 included qualitative and quantitative investigations. No residual oil was observed during qualitative subtidal surveys. There were a total of 61 subtidal sediment samples collected in nearshore subtidal areas. Only one subtidal sampling location (adjacent to Long Island/Hoppy's Landing - Segment W2A-10) was found to have concentrations of PAH above ERLs. Sampling at Hoppy's Landing was conducted at nine sampling locations shortly after active cleanup efforts were conducted at Hoppy's Landing. The location with PAH concentrations greater than ERLs was in the shallow subtidal area immediately adjacent to the boat ramp at Hoppy's Landing (see Appendix A for further details).

In evaluating the sediment samples where PAH concentrations exceeded applicable ERLs, it is important to note that inspection of the distribution of the detected PAH indicates that

these samples were dominated by pyrogenic (i.e., non-B120) hydrocarbons. There are a wide variety of hydrocarbons unrelated to the B120 oil release that are present in some areas in Buzzards Bay. These hydrocarbons are often indicative of combustion products (i.e., pyrogenic) associated with power plants, automobiles, and even firewood, and are the result of atmospheric deposition into the marine environment. Therefore, although there may be some contribution of B120 oil in the samples where the PAH concentrations exceeded ERLs, most of the PAH appear to be associated with combustion products that are not related to the B120 oil release. In addition, there are potential sources of petrogenic (i.e., derived from petroleum) PAH from other sources that are not associated with the B120 release, such as outboard motors, marine engines, car trailers, and previous oil spills into Buzzards Bay. These petrogenic sources are especially expected to be present in the vicinity of harbors, marinas, and boat ramps (e.g., Hoppy's Landing/Long Island in Fairhaven).

3.0 PHASE II SCOPE OF WORK OVERVIEW

The objectives of the response actions proposed in this Phase II SOW are to characterize potential residual oil impacts at the remaining 63 segments and to evaluate potential risk to human health and ecological receptors. Figures for the 12 shoreline segments that will be used to characterize intertidal shoreline classifications and subtidal sediment are attached as Figures 4 through 17. Figures for each of the remaining shoreline segments that are addressed by this Phase II SOW are included in Appendix B. The figures include the maximum degree of initial oiling, existing and proposed sample locations, locations of test pits and trenches excavated during inspections for potentially buried oil, priority habitats for rare and endangered species, wetlands, vernal pools, and nesting areas.

Data collected prior to and during the Phase II activities will be used to characterize potential risks to human health, public welfare, safety, and the environment as part of a Method 3 Risk Characterization that includes a Stage 1 Ecological Risk Characterization.

3.1 OBJECTIVES

The objective of the Phase II SOW is to outline the approach and steps to fulfill the requirements of a Phase II CSA for the remaining 63 shoreline segments and the subtidal area. The primary objectives are to:

1. Characterize the magnitude and distribution of residual oiling using sufficient laboratory analytical data and qualitative surveys; and
2. Evaluate if a condition of No Significant Risk to human health, public welfare, safety, and the environment is present at each remaining segment.

3.2 PHASE II CHARACTERIZATION APPROACH

As described in Section 2.0, portions of the shoreline in Buzzards Bay were initially oiled to different degrees in April 2003, ranging from very light to relatively heavy. Most of the oil that stranded in the intertidal zone was removed during the initial cleanup conducted under

the direction of Unified Command. Of the 120 shoreline segments that were oiled by the release, MCP response actions were completed at 57 segments, as described in the May 2004 Partial RAO. Along the 63 segments that remain, visual surveys and media sampling, including intertidal sediment, subtidal sediment, surface water, and shellfish tissue, have been conducted to provide an initial evaluation of residual oil at these locations. Therefore, the Phase II SOW focuses upon characterizing those areas where residual oil is most likely to be present (as identified in the Updated CSM in Appendix A), to provide a conservative, worst-case evaluation of residual oil impacts.

The Phase II characterization of intertidal sediments focuses on evaluating residual oil at a subset of the shoreline segments, representing the current worst-case conditions. This subset of worst-case segments includes representatives from of each shoreline classification (e.g., the 1A/1B shoreline classification). Please note that characterization for shoreline classifications composed of sand or mixed sand and gravel will also include those classified as 2 (roseate tern habitat) or 3 (piping plover habitat) since the substrates in these classifications are primarily composed of sand and mixed sand and gravel substrates. As described below in Section 4.1, Phase II characterization of intertidal sediment will be conducted at 12 of the remaining 63 segments (approximately 20%); these segments are considered to be worst-case examples. If the results of the characterization of these worst-case shoreline segments indicate that a condition of NSR exists for a particular shoreline classification (e.g., sandy beaches), then the Phase II will conclude that a condition of NSR exists for the other shoreline segments with this classification. Conversely, if the Phase II characterization does not indicate that a condition of NSR is present, then additional characterization will be conducted and/or further IRA remedial actions will be considered. If additional characterization beyond the scope of this Phase II SOW is considered, then an addendum to this Phase II SOW will be prepared.

It is important to note that recent visual inspections did not observe significant amounts of residual B120 oil at most of the remaining segments. As described in Section 2.3.1, a notable exception regarding remaining residual oil is a small portion of Hoppy's Landing in

Fairhaven, which is located on the south side of Long Island in shoreline segment W2A-10. The shoreline near the southern tip of Hoppy's Landing was relatively heavily oiled, and only limited response actions were conducted in this marsh area during the initial cleanup overseen by Unified Command due to the presence of fringing marshes on the shoreline[1]. Additional cleanup operations on the southern portion of Hoppy's Landing were conducted under the MCP IRA in May and July 2004 to remove residual oil where feasible and after taking into account the potential ecological damages that might outweigh the cleanup benefits. Although the cleanup operations removed a significant amount of the remaining residual oil and pavement, post-cleanup inspections in May 2005 indicated that the residual oil and pavement at this location is still not representative of other shoreline segments in Buzzards Bay. Therefore, although this segment will be characterized as part of the Phase II activities, the data from this characterization will not be used as a proxy for other shoreline segments of this shoreline classification because the residual oiling is greater than that of other segments.

Phase II characterization will also be conducted at subtidal locations to validate the Updated CSM attached in Appendix A, which indicates that significant oiling is not expected to be present in the subtidal zone. Site characterization will focus on subtidal areas that would theoretically have the greatest likelihood of residual oil if it did occur, specifically adjacent to and downcurrent from shorelines that were initially heavily oiled. The subtidal sampling will focus on collecting sediment samples from the nearshore subtidal zone, which is defined as the area below the intertidal zone to where the water depth is less than 3 feet below mean low water.

[1] Aggressive cleanup operations, including large-scale rock removal and replacement were conducted on the west side of Hoppy's Landing where marshes were not present.

4.0 PHASE II ASSESSMENT ACTIVITIES

4.1 INTERTIDAL SHORELINE SEGMENTS

A total of 12 of the 63 remaining intertidal shoreline segments (approximately 20%) were selected to characterize particular intertidal shoreline classifications. As described in the Updated CSM report, residual oiling is expected to be greatest in mixed sand and gravel (1C) segments and salt marsh (1F) segments. Therefore, the Phase II characterization activities primarily focus upon 1C and 1F shoreline segments. The number of segments selected for characterization at each shoreline class is as follows:

Primary Shoreline Class	Number of Segments Selected for Phase II Characterization
Sandy Beaches (1A/1B)	2
Mixed Sand and Gravel (1C)	4
Rip Rap Seawalls, Bulkheads, Piers, and Rocky Shores (Bedrock Shores) (1D/1E)	1
Marsh (1F)	5

A summary of the individual segments selected for Phase II characterization is presented in Table 3.

As described above, there are relatively few remaining shorelines segments with visual or analytical evidence of residual oil. To identify which segments were most representative of worst case conditions, the results of qualitative and quantitative surveys conducted between April 2003 and June 2005 were carefully reviewed using the following criteria:

- the extent and magnitude of residual oil along shoreline segments during the most recent field surveys;
- the results of existing field surveys and laboratory analyses of environmental media collected within the Site;
- the initial maximum shoreline oiling levels in the spring of 2003;
- the initial oiling index for each shoreline segment; and
- the IRAC status of each shoreline segment.

In addition, information on environmental resources within the Site was reviewed using these additional criteria:

- shoreline classification based on NOAA's Ecological Sensitivity Index and IRAC designations;
- salt marsh habitat;
- known occurrence of threatened or endangered species;
- presence of NHESP priority habitat; and
- public access/expected human use.

The results of this information review were assimilated to develop segment selection criteria for existing residual oil, initial oiling, ecological ranking, and public access (see Table 4). The primary emphasis was on the extent of residual oil in the most recent surveys since those areas would be the most likely to pose a risk to ecological receptors and humans. This review indicated that most of the 63 segments do not have any evidence of significant residual oil. The residual oil in most segments that have some residual oil remaining consists of highly localized and weathered splatter on a few rocks. Therefore, the segments that had residual splatter on rocks with sporadic "pavement" and/or tar patties or flecks were selected for further characterization. In addition, the two segments where concentrations of PAH in intertidal sediment samples exceeded ERLs were selected for further characterization, even though these exceedences have been determined to be related to other sources unrelated to the B120 oil spill (see Section 2.4). To be conservative, additional segments were selected for further characterization based on the current status of residual oil (albeit most of the residual oil is present as minimal weathered splatter) coupled with relatively high rankings for initial oiling, ecological ranking, and/or public access/use.

As a result, a total of 12 shoreline segments have been identified as representing worst-case conditions for further Phase II characterization of the intertidal zone (Table 3). The Phase II characterization field activities at these selected segments will consist of:

- Visually inspecting shoreline segments for residual oil, tackiness, and human exposure potential;

- Collecting composite sediment samples of sandy or silty sediment from the intertidal zone at selected segments for laboratory analysis of Extractable Petroleum Hydrocarbon (EPH) fractions and PAH;
- Collecting composite samples of marsh sediment for laboratory analysis of EPH fractions and PAH; and
- Visually inspecting marshes and marsh inlets for stressed vegetation and residual oil, and collecting composite samples of marsh sediment if the visual inspections indicate the presence of residual oil.

At locations where sediment samples are collected from the intertidal zone, separate composite samples will be collected from both the upper and lower portions of the intertidal zone (for a total of two composite samples at each intertidal sediment sampling location). Specific information regarding characterization at intertidal locations is discussed below.

4.1.1 Sandy Beaches (1A/1B)

A total of 12 of the remaining 63 segments are characterized as primarily sandy beaches (1A/1B shorelines). Table 5 lists these 12 segments, and includes the relative ranking criteria for each segment. Segments W3C-03 (Barney's Joy, West of Barbed Wire) and W3A-05 (Round Hill Beach West) will be used to characterize shoreline segments where the primary shoreline classification is sandy beach.

A total of nine composite sediment samples were collected from segment W3C-03 during the Phase I characterization in January 2004, and these data are considered to be worst-case because the samples were collected less than one year after the release and the degree of weathering at the time of sampling is less than current conditions. Refer to the map of this segment included as Figure 4 for the sediment sampling locations. The Phase I analytical data set for this segment is sufficient to characterize the degree of residual oil in the sediment, therefore, the Phase II characterization will consist of a visual inspection only and additional samples will not be collected as part of Phase II activities.

At segment W3A-05, a total of six composite sediment samples will be collected from three areas, with one composite sample collected from the upper intertidal zone and one composite sample collected from the lower intertidal zone at each sampling area. The proposed sampling locations are shown on Figure 5. A visual inspection will also be conducted to evaluate for the presence of residual oil.

4.1.2 Mixed Sand and Gravel Shorelines (1C)

A total of 25 segments of the remaining 63 segments are primarily composed of mixed sand and gravel substrate. Table 6 lists these 25 segments and identifies segments W2A-11 (West Island West), W3C-04 (Barney's Joy East of Barbed Wire), and W1E-04 (Crescent Beach) as worst-case representative segments for this shoreline class. In addition, characterization will also be conducted at segment W2A-10 (Long Island/Causeway South) to evaluate conditions associated with the residual oil at this location.

A total of four composite sediment samples will be collected from two additional areas at segment W2A-11 to supplement the six intertidal sediment samples that were collected in January 2004 as part of the Phase I characterization activities. The proposed sampling locations are depicted on the map for segment W2A-11 included as Figure 6. Composite samples from the upper and lower intertidal zone will be collected from an area where IRA cleanup activities were conducted in July 2005 (to remove a small volume of oil-impacted sandy sediment) and also from a location near the southern point of West Island.

A total of four composite sediment samples will be collected from the upper and lower intertidal zone at two additional areas at segment W1E-04 to supplement the six intertidal sediment samples that were collected in January 2004 as part of the Phase I characterization activities. These samples will be collected in the center portion of the segment and the proposed sampling locations are shown on Figure 7. In addition to the sample collection, marsh inlets and a portion of the back-barrier marshes of two marshes will be visually inspected for the presence of residual oil, and composite samples will be collected from these locations if residual oil is encountered.

At segment W2A-10, a total of eight composite samples will be collected from four areas along the shoreline. In addition, four to five composite sediment samples will be collected from the marsh at the southern tip of Long Island to supplement the four marsh sediment samples that were collected in August 2004 from this area. The intertidal sampling locations and the marsh sampling area are shown on Figure 8.

At segment W3C-04, a total of six composite samples will be collected from three locations along the south-facing side of Barney's Joy. These samples will be collected in the area where the maximum degree of initial oiling was characterized as relatively heavy. Refer to Figure 9 for the proposed sampling locations.

In addition, characterization of the 1C shoreline classification will include samples collected from segment W1F-02 (Brandt Island West), which is identified as a segment that is primarily 1D shoreline, but also includes 1C shoreline in the Leisure Shores/Howard's Beach portion of the shoreline.

4.1.3 Rip Rap, Seawalls, Groins, and Bedrock Shorelines (1D/1E)

A total of 14 segments of the remaining 63 segments are classified as having primary shorelines comprised of man-made structures or bedrock shorelines. Refer to Table 7 for a summary of the criteria used to evaluate these segments for Phase II characterization. Because the structures that comprise this shoreline class typically have little to no sediment, the characterization will focus upon visual inspection of the rock surfaces. One segment, W1F-02 (Brandt Island West), which contains Leisure Shores and Howard's Beach, is selected for Phase II characterization, but residual oil was not reported in the portion of the segment classified as 1D substrate. The characterization efforts in this segment will be conducted in the secondary shoreline classifications present at this segment and include intertidal and marsh sediment samples.

A total of four composite sediment samples will be collected from the upper and lower intertidal zone at two intertidal sampling areas to supplement the nine grab sediment samples that were collected from Leisure Shores beach in December 2004. In addition, one composite marsh sediment sample will be collected from the fringing marsh that is located near the border of Leisure Shores and Howard's Beach. This marsh sample will also be used as part of the characterization for 1F shorelines described in Section 4.1.4 below. Refer to Figure 10 for the proposed Phase II sampling locations. In addition, a visual inspection will be conducted of the marsh and marsh inlet to the north of this segment, and composite marsh sediment samples will be collected if residual oil is encountered during this inspection.

4.1.4 Salt Marshes

A total of 11 of the remaining 63 segments are identified as primarily marsh habitat, and these segments are identified in Table 8. Note that segment W2A-03 (Pope's Beach) is also sandy beach, but the Phase II activities will focus upon the marsh portion of this segment because the sandy beach portion of this segment was characterized during the January 2004 Phase I sampling (six intertidal sediment samples were collected). In addition to the marsh sediment sampling described below, visual inspections will be conducted at marsh inlets and back-barrier marshes, and additional composite marsh sediment samples will be collected if residual oil is observed at these locations.

At segments W2A-03 (Pope's Beach) and W1E-02 (Strawberry Cove), a total of five composite marsh sediment samples will be collected from the fringing marshes that are located within the intertidal zone. At segment W2A-02 (Harbor View), a total of four composite marsh sediment samples will be collected; two from locations that were previously sampled in August 2004, and two from new locations at this segment. Three composite marsh sediment samples will be collected from fringing marshes at segment W1F-05 (Mattapoisett Neck West) and two composite marsh sediment samples will be collected at segment W1D-01 (Aucoot Cove). The proposed sampling locations at these segments are shown in Figures 11 through 15. Marsh sediment samples will also be collected from the fringing marsh at segment W1F-02 (Brandt Island West) to characterize marsh conditions,

although the primary shoreline class at this segment is 1D. Refer to Figure 10 for the location of the marsh sediment sample to be collected from this location.

4.2 SUBTIDAL AREAS

Evaluation of potential impacts to subtidal areas will be conducted in nearshore subtidal areas, which is defined as those areas where the water depth is less than or equal to three feet below mean low water. As described in the Updated CSM in Appendix A, residual oil is not expected to be present in the deeper subtidal zone (i.e., water depths greater than 3 feet below mean low water), and therefore Phase II characterization will not be conducted in the deeper subtidal zone. Potential residual oil in the subtidal zone, if it is present at all, would be expected to be present only as small (approximately 1 mm diameter) tarballs mixed with subtidal sediment. Residual oil is not present as large "pools" or "mats" on the seafloor, and, therefore, the characterization will be completed using subtidal sediment samples collected either by hand (in the shallow nearshore subtidal areas) or using a Ponar clamshell-type sampler (for areas that are accessible by boat). Composite samples will be collected for laboratory analysis of EPH fractions and PAH.

Table 9 lists the shoreline segments that are adjacent to the areas where subtidal sediment samples will be used to characterize sediment quality in the subtidal zone. A total of nine areas are selected to characterize potential oil impacts in the subtidal zone. Phase II subtidal characterization has already been completed at five of the nine segments (segments W2A-03, W2A-07, W2A-10, W3C-04, and W3C-05) in the summer of 2004. Phase II characterization will be conducted at the remaining four segments as part of the upcoming Phase II field activities. A description of the characterization activities to be conducted at these segments is presented below.

Composite sediment samples will be collected at two locations adjacent to segments W1C-02 (Planting Island Causeway), W1E-02 (Strawberry Cove), and W1E-03 (Strawberry Point West). Please note that the intertidal shoreline substrate at segments W1C-02 and W1E-03 are composed of gravel and cobbles, and if this substrate is present in the nearshore subtidal

zone then it may not be possible to collect sediment samples. A total of eight composite subtidal sediment samples will be collected adjacent to segment W1F-02 (Brandt Island West). The composite sediment samples will be collected by hand in the nearshore subtidal zone near the intertidal zone boundary. The proposed sampling locations at segments W1F-02 and W1E-02 are shown on Figures 10 and 12, respectively. Figures 16 and 17 depict the proposed subtidal sampling locations at segments W1E-03 and W1C-02, respectively.

4.3 FIELD SAMPLING AND LABORATORY ANALYSIS

At each sediment sampling location (intertidal, marsh, and subtidal), composite samples will be collected from three discrete locations oriented roughly parallel to the shoreline spaced approximately 10 meters apart. The global positioning system (GPS) location of the center of each sampling location will be recorded at the time of sampling. Samples will be collected from the 0- to 6-inch depth interval by hand or using pre-cleaned stainless steel sampling implements into laboratory-supplied glassware. One field duplicate and one matrix spike duplicate will be collected for every 20 samples.

Whole sediment samples (i.e., sediment particulates and associated pore water) will be collected at each sampling location; the analytical results will be presented on a dry weight basis. This is consistent with methodology followed during the sediment toxicity studies conducted as part of NOAA's National Status and Trends Program (NOAA NST Program) (Long and Morgan, 1991). ERLs were developed in this program using the results of dozens of whole sediment toxicity studies that incorporated sediment samples collected from major waterbodies around the U.S. where it was known that a range of chemical contaminants co-occurred in the samples (Long and Morgan, 1991). A variety of benthic infaunal and epibenthic test organisms were used, including various amphipods and bivalve larvae, which are all sensitive to dissolved chemicals in porewater. Because ERLs were developed for organisms exposed to whole sediment, including porewater, ERLs directly address constituents dissolved in sediment porewater.

Sediment samples collected as part of this Phase II CSA will be submitted for laboratory analysis for EPH fractions using MADEP methods and the 17 PAH target analytes (as part of the EPH method) by gas chromatograph/mass spectrometer (GC/MS). Besides the major PAH compounds typically evaluated in sediments, there are dozens of alkylated naphthalene, phenanthrene, fluorene, chrysene, benzothiophene homologs that are present in petroleum distillates, including No. 6 fuel oil. Many of these derivatives have not been well characterized toxicologically. It is important to note that while other alkylated PAH homologs are present in No. 6 fuel oil, these other alkylated PAH will not be specifically analyzed for in this Phase II work because the risk-based toxicity benchmarks were established for the 17 PAH using data from "whole oil" release sites. At the release sites where the toxicological benchmarks were established, analyses of the 17 target PAH were conducted to quantify the threshold for observed ecological risk and these 17 PAH are considered to be indicators of potential risk for the range of PAH that may be present in a fuel oil release. Risk-based toxicity benchmarks are not established for the other alkylated PAH and, therefore, analyses of these alkylated PAH will not be conducted as part of the Phase II field activities.

4.4 CHARACTERIZATION OF BACKGROUND/LOCAL CONDITIONS

Data collected during previous characterization indicated the presence of pyrogenic PAH in some areas, as well as petrogenic PAH that may be derived from oil unrelated to the B120 release. In particular, sampling areas near harbors or marinas have a substantial likelihood of detecting PAH not associated with the B120 release. A study of background conditions, including investigation of other potential source areas and fingerprinting analysis of hydrocarbons detected in sediment samples, may be conducted to differentiate between B120 oil and non-B120 hydrocarbons.

5.0 RISK CHARACTERIZATION METHODS

5.1 RISK ASSESSMENT APPROACH

As described in Section 2.0, the unique nature of the B120 release and prevailing conditions in Buzzards Bay resulted in a discontinuous pattern of oiling along approximately 84 miles of affected Buzzards Bay shoreline. Site characterization efforts have identified the sporadic presence of residual oil-related constituents in highly limited intertidal areas that warrant further characterization. Potential exposures of human and ecological receptors to spill-related constituents would be variable both across and within different shoreline classifications.

Potential risks to human health and the environment associated with exposure to current levels of spill-related constituents will be evaluated using a conservative screening methodology. This methodology will use a combination of established environmental screening benchmarks and site-specific, risk-based threshold values (applicable and suitably analogous standards) for relevant environmental media (surface water, surficial sediments, and biota tissue) to evaluate current site conditions. In order to evaluate whether current residual levels of spill-related constituents in the affected shoreline segments represent a condition of No Significant Risk (NSR),[2] appropriate exposure point concentrations (EPCs) of constituents for the various environmental media measured in representative worst case shoreline segments will be compared with these conservative screening benchmarks. In the event that EPCs for those segments fall below these conservative screening benchmarks, NSR will be concluded for all remaining segments of that shoreline type, no further action will be taken, and those segments will be considered for a Class A RAO closure. Should EPCs exceed these conservative screening benchmarks, indicating the presence of potential risks to either human or ecological receptors for that shoreline segment type, a more refined

[2] As defined by the MCP (310 CMR 40.0006): "No Significant Risk means a level of control of each identified substance of concern at a site or in the surrounding environment such that no such substance of concern shall present a significant risk of harm to health, safety, public welfare or the environment during any foreseeable period of time."

site-specific risk characterization may be warranted to better define specific areas within segments that might need additional response actions.

5.1.1 Human Health Risk Assessment

A Method 3 Risk Characterization will be conducted to assess potential human health risks posed by residual oil on affected reaches of Buzzards Bay. This assessment approach is consistent with the following relevant state and federal risk assessment guidance:

- Massachusetts Department of Environmental Protection (MADEP), *Guidance of Disposal Site Risk Characterization – In support of the Massachusetts Contingency Plan* (WSC/ORS-95-141), and
- U.S. Environmental Protection Agency (USEPA), *Risk Assessment Guidance for Superfund, Volume 1 (Parts A, B, and E)*, Office of Emergency and Remedial Response, Washington, D.C. (EPA/540/R-89/002; EPA/540/R-92/003; EPA/540/R-99/005).

Due to the unique nature of the release and the potential need to assess numerous individual shoreline segments, a traditional Method 3 human health risk assessment for each shoreline segment is not proposed. Rather, risk-based threshold concentrations (RBTC) for relevant environmental media (surface water, surficial sediments, and biota tissue) will be developed relying on the basic structure outlined for MCP Method 3 Risk Characterizations (Subpart I of the MCP). That is, using conservative exposure assumptions, appropriate toxicity and carcinogenicity information, and the target MCP risk limit for carcinogenic (i.e., 1×10^{-5}) and non-carcinogenic (Hazard Index = 1) effects, RBTCs for environmental media will be "back-calculated" and used as screening benchmarks. These RBTCs will represent media-specific maximum acceptable concentrations of constituents of concern (COCs).

The Updated CSM presented in Appendix A has defined site conditions, spill-related COCs, affected environmental media, relevant exposure pathways, and sensitive receptors. This screening assessment will rely on the Updated CSM to guide the analysis.

Hazard Identification

This risk characterization will rely on the analytical data available for the environmental media of concern (sediment, surface water, weathered oil, and biota). The primary detected constituents in these media are PAH associated with No. 6 fuel oil. In addition to the carcinogenic PAH compounds that are commonly encountered in environmental media, there are numerous aliphatic and aromatic petroleum hydrocarbons and dozens of alkylated naphthalene, phenanthrene, fluorene, and chrysene homologs that are common constituents of No. 6 fuel. These latter constituents will be addressed collectively as components of extractable petroleum hydrocarbon (EPH) and volatile petroleum hydrocarbon (VPH) fractions. Although there are limited toxicological data available for these alkylated PAH, MADEP has developed non-cancer reference doses (RfD) for VPH and EPH. By evaluating EPH fractions for non-cancer risks, the potential non-cancer human health risks posed by alkylated PAH homologs are also addressed.

As indicated in the VPH/EPH guidance document (MADEP, 2002), cancer risks are evaluated separately since certain PAHs are designated carcinogens. Currently, there are no cancer slope factors (CSF) available for petroleum hydrocarbon fractions.

Exposure Assessment

A screening level risk assessment is intended to be conservative and err on the side of over-estimating rather than underestimating potential risks to humans. In this risk characterization, the most sensitive human receptor population and potential exposure pathways will be described.

Receptors

In the case of assessing exposure to oil residues on Buzzards Bay shoreline, the people most likely to come into contact with the residues from the No. 6 fuel oil are full-time residents of the coast. These individuals may use the shore recreationally on a regular basis (e.g., beach use, wading, swimming, shellfishing) throughout their lifetime. Both adult and child residents will be evaluated. This “lifetime resident recreational beach-goers” receptor group

is considered to be the most sensitive because of the potential frequency and duration of contact, and extent of potential dermal exposure to any oil residue in intertidal/shallow subtidal beach sand. This group will serve as the benchmark for human health risks associated with the residual impacts of the B120 spill. That is, if it is determined that a condition of NSR has been achieved at the Site for the most sensitive receptor group, then all other receptor groups that experience a lesser degree of exposure to release-related constituents would also be protected. This includes coastline residents who do not live year-round near or on the coast and do not frequent the beach on a regular basis, as well as people who may have incidental exposures to tar splatter on rock or man-made shoreline structures, and those who encounter isolated tarballs or fragmented sections of "pavement" while exploring salt marsh habitats.

Potential Exposure Pathways and Routes of Exposure

The primary exposure routes to media containing release-related COCs are dermal contact with petroleum compounds in beach sediment, and ingestion (i.e., incidental ingestion of environmental media and consumption of shellfish). These media and routes of exposure are addressed below.

Surface Water

Recreational users may ingest small amounts of surface water while swimming in Buzzards Bay. However, this exposure pathway is considered to be incomplete because detected concentrations of spill-related constituents are no longer present in surface water. Additional discussion of elimination of surface water exposure pathways will be included in the Phase II CSA report.

Intertidal Sediment

Coastal residents may visit the beach or other shoreline classifications throughout the year. Exposure is expected to be limited in the early spring, late fall, and winter months when the air and water temperatures are too cold for extensive skin contact. Shoreline recreation during the summer season is expected to account for the bulk of any COC exposure. If spill-

related COCs were present, digging and playing in wet sand or sediment could provide opportunities for exposure to COCs. Sediment may adhere to exposed skin and some sediment particles may subsequently be ingested during the time spent on the beach.

Subtidal Sediment

Beach goers are less likely to spend as much time in contact with nearshore subtidal sediment as they would intertidal sediment because subtidal sediment is, by definition, submerged at all times. In addition, since only the soles of people's feet are likely to contact the subtidal sediment while wading into the water, exposure to any potential spill-related COCs would be considerably less than that predicted for intertidal sediment.

Shellfish

Local residents may consume locally harvested shellfish. By May 2004, the Massachusetts Department of Public Health determined that all chemical residue levels in shellfish in the spill area were below levels of concern (i.e., concentrations of petroleum compounds that were presumably associated with the spill). The rationale for the current closure of small portions of some shellfish beds is based upon concerns regarding public perception of potential intertidal cleanup operations, not upon shellfish tissue chemistry. The concentrations of fuel oil related petroleum hydrocarbons measured in shellfish from Buzzard's Bay will be compared to available information for background concentrations of these same constituents in shellfish from other locations in the Northeastern US. If the screening level risk evaluation described in this SOW indicates that the levels of spill-related petroleum compounds may pose an unacceptable risk to year-round residents, then ingestion of locally caught shellfish will be quantitatively evaluated in the Phase II CSA.

Weathered Oil

Weathered oil has been observed on some rocks or other hard surfaces as well as small pieces of weathered oil in salt marsh habitat. The highly weathered oil on the surfaces of some rocks and manmade structures is referred to as "splatter." This splatter occurs sparsely along some rocky shorelines. Small pieces of weathered oil have been found sporadically on the

marsh fringe in a few shoreline segments. These are referred to as marsh tarmat or tarballs, depending on their physical shape. These can be touched or picked up without resulting in observable transfer of oil to the skin. If oil did adhere to their skin, individuals could incidentally ingest some portion of the oil. Because the tarballs are only present in limited areas, it is unlikely that even local residents encounter these pieces of weathered oil on a frequent basis. Potential exposures to these deposits of weathered oil along rocky or marsh shorelines will be addressed only if the worst case exposures by the "resident recreational beach-goers" yield unacceptably high potential risk estimates.

Exposure Points

According to MCP Guidance, "an exposure point for soil, sediment or surface water should be delineated by the distribution of oil or hazardous material in the environmental medium." However, the residual contamination from the oil spill is not contiguous along the shoreline, but is present in several small areas. From a risk assessment perspective, an exposure point should not be considered a discrete physical location, but rather an area that provides an equal likelihood of exposure, such as an area where people might come into contact with contaminated sediment. If there are areas within the Site which receptors frequent at a higher rate (such as an area designated for swimming), then those areas will be evaluated as separate and distinct exposure points. This screening level assessment is by definition considering the worst-case scenario, specifically recreational use of beaches. The beach segments regarded as representative of worst-case conditions are considered to be exposure points in this assessment.

Exposure Point Concentrations (EPCs)

EPCs represent the environmental medium-specific arithmetic mean concentrations of COCs to which receptors are most likely exposed in an exposure scenario. In a forward-calculating Method 3 risk assessment, EPCs are derived from the concentrations of COCs measured in samples of environmental media. The representative EPCs are factored into equations to estimate daily dose. Daily dose is then combined with toxicity information to yield an estimate of non-cancer Hazard HQ,) or the cancer risk specific to that receptor, COC,

environmental medium, and exposure pathway and route. This approach will ultimately result in an overall risk estimate (hazard index or cancer risk level) for each receptor group to be compared to the MCP risk limits.

Exposure Estimation

Daily doses of COCs will be estimated using standard mathematical equations. The basic equation for estimating daily intake (as a surrogate for daily dose) incorporates parameters that represent certain behaviors (exposure rate, exposure duration, and exposure frequency) and biological attributes (body weight, skin surface area) of typical child and adult receptors. A separate calculation of daily intake is made for each receptor, COC, environmental media, and exposure pathway.

The daily intake as a surrogate for Average Daily Dose (ADD) for each chemical is estimated in units of milligrams of chemical per kilogram body weight of the receptor (mg/kg BW/day), following the basic formula below:

$$ADD = \frac{EPC \times ER \times ED \times EP \times EF \times RAF \times CF}{BW \times AT}$$

Where:

ADD = average daily dose (mg/kg body weight/day)
EPC = exposure point concentration
ER = exposure rate, may be soil or water ingestion rate, skin surface area × adherence factor
ED = exposure duration, for dermal contact and incidental ingestion, ED by definition is 1 day per event
EP = exposure period or the overall time during which exposure may occur
EF = exposure frequency, or number of events in a given time period
RAF = relative absorption factor
CF = conversion factor
BW = body weight of the receptor
AT = averaging time for effects. For cancer as the effect, daily intake is averaged over a representative lifetime-by convention this is 70 years or 25,550 days. For non-cancer threshold toxic effects, the daily intake is averaged over the duration of the exposure expressed in days.

The numerical values assigned to most of the parameters that describe the receptor (i.e., body weight, skin surface area, etc.) in the above equations are generally specified by regulatory agency guidance documents to result in a conservative (high) estimate of daily intake. The values for those site-specific variables (i.e., exposure frequency, exposure rate) will likewise be conservative estimates. MADEP and USEPA risk assessment guidance documents will be relied upon for general risk assessment guidance and selection of exposure parameters, including but not limited to, the following:

- USEPA, *Exposure Factors Handbook, Volume I General Factors*, Office of Research and Development, National Center for Environmental Assessment, Washington, D.C.;
- USEPA, *Risk Assessment Guidance for Superfund, Volume I, Human health Evaluation Manual, Parts A, B, and E*; Office of Emergency and Remedial Response, Washington, D.C.; and
- MADEP, *Guidance for Disposal Site Risk Characterization – In support of the Massachusetts Contingency Plan*, WSC/ORS-95-141.

Dose-Response Assessment

The estimates of daily intake of COCs expressed in milligram chemical per kilogram body weight per day (mg/kg-d) are translated into unitless expressions of non-cancer hazard and cancer risk by applying the appropriate Toxicity Factors. A Toxicity Factor is a representation of the dose-response characteristics of a chemical and is specific to the route of exposure-either oral or inhalation. Oral toxicity factors may be adjusted to estimate risk and hazard from dermal exposure. The RfD characterizes the estimated daily intake (dose) of a chemical that is unlikely to result in threshold toxic effects (adverse health effects other than cancer) over a lifetime. The Cancer Slope Factor (CSF) represents the slope of the dose-response curve for neoplasms produced by exposure to a carcinogen. PAH carcinogenicity will be based on benzo(a)pyrene toxicity equivalents (TEQ), as recommended by USEPA. All other COCs, not specifically identified as carcinogens will be evaluated for threshold toxic effects only.

RfDs and CSFs used in this assessment will be taken from the following guidance documents following the hierarchy prescribed by USEPA (2003):

- **Tier 1- USEPA's** Integrated Risk Information System (**IRIS**), http://www.epa.gov/iris/;
- **Tier 2- USEPA's Provisional Peer Reviewed Toxicity Values (PPRTVs)** – The Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center; and
- **Tier 3- Other Toxicity Values** – Tier 3 includes additional USEPA and non-USEPA sources of toxicity information. Priority should be given to those sources of information that are the most current, the basis for which is transparent and publicly available, and which have been peer reviewed.

As stated previously, No. 6 fuel oil is a mixture of many different compounds, of which only a handful have published Toxicity Factors. The MADEP VPH/EPH Approach Final Policy #WSC-02-411 (October 31, 2002) recommends toxicity and risk assessment parameter values according to carbon fraction. Compounds for which no individual Toxicity Factors are available will be evaluated as recommended in the MADEP policy document.

Relative Contribution of Different Exposure Pathways

The relative contribution to the total contaminant dose of the different exposure pathways must be determined prior to calculating RBTCs. By using the dose equations for intertidal sediments, the relative contribution of each route of exposure to the total dose, and therefore the overall risk, may be estimated, and any insignificant exposure pathways can be eliminated. USEPA has defined "insignificant pathways" as those that contribute less than 1% of the total dose (USEPA 1989).

For this assessment, the relative contribution of the two major exposure pathways, dermal absorption and incidental ingestion, will be calculated using the dose equations presented previously. Based on these calculations, the relative contributions to the total uptake of

different pathways for COCs, under the "lifetime resident recreational beach-goer" scenario will be determined. This ratio will be carried forth into the RBTC calculations.

Risk Characterization

As indicated earlier, the "lifetime resident recreational beach-goers" receptor group is considered to have the greatest potential exposure to spill-related constituents because of the high frequency and duration of contact, and extent of potential dermal exposure to oil residue in intertidal beach sand (i.e., sediment). This group then serves as the benchmark for human health risks associated with the residual impacts of the B120 spill. That is, if exposure to this "worst-case" conditions result in a condition of NSR for this highly exposed receptor, then all other receptor groups that experience a lesser degree of exposure to release-related constituents would also be protected.

This traditional risk characterization approach integrates the dose estimates (ADD and LADD) with the appropriate Toxicity Factors (RfD and CSF) to generate unitless estimates of potential non-cancer hazard and cancer risk for each COC, environmental medium, route of exposure, and receptor group. For non-cancer toxicological endpoints, the estimate is the hazard quotient (HQ). HQs are calculated by dividing the cumulative ADD for a COC by its RfD. In screening assessments, it is common practice to sum HQs for all COCs to produce a hazard index (HI). The HI provides a conservative estimate of non-cancer hazard. HIs that exceed one (1.0) indicate that a potential toxicological hazard may be present, whereas HIs less than 1.0 indicate that chemical exposures in the scenario being evaluated pose NSR.

Cumulative potential carcinogenic risk is estimated using a similar simple calculation. Cancer risk for each COC is calculated by multiplying the LADD by its CSF, which yields a unitless cancer risk estimate. The total excess cancer risk (aggregate) is estimated by summing the individual cancer risks for each COC. In this case, the cancer risk will be associated with a single carcinogenic entity-benzo(a)pyrene Toxicity Equivalents rather than individual carcinogenic chemicals. As specified in the MCP, the cumulative carcinogenic

risk limit is 1 X 10^{-5}. Should the potential cancer risk estimate fall below that benchmark, it will be concluded that chemical exposures in the scenario being evaluated pose NSR.

As explained in the following sections, the RBTC are developed in reverse from the method described above.

Development of Risk-Based Threshold Concentrations

The same algorithms that were used to estimate cancer risk and non-cancer hazard in the forward-calculating risk assessment can also be adapted to calculate the concentration of a chemical in an environmental medium, i.e. intertidal sediment, that corresponds to a pre-determined level of cancer risk or non-cancer hazard. These medium-specific RBTC will be derived to correspond to the MCP cancer risk limit of 1 X 10^{-5} and/or non-cancer hazard index of 1.0 based on the same receptor characteristics as those used to estimate risk and hazard. The resulting concentrations of petroleum hydrocarbons in intertidal sediments will be used as screening values to support management decisions regarding the residual oiling along the shoreline of Buzzard's Bay.

Deriving risk-based concentrations involves reworking the traditional risk algorithm algebraically and solving for the EPC of each constituent in the target medium-intertidal sediments in this case. The risk calculations described previously will suggest the relative importance of incidental ingestion and dermal absorption as routes of exposure to the spill-related petroleum compounds in intertidal sediments. The results of the screening level calculations will also identify the relative importance of cancer risk or threshold toxic effects as the outcome of interest to human health.

Two types of RBTCs will be calculated using the equations below. The RBTC for cancer as the outcome of interest will apply to all of the carcinogenic PAH represented by benzo(a)pyrene equivalents. The RBTC for non-cancer threshold effects will apply to all other petroleum compounds within an MADEP carbon fraction. The relative contribution of each potential pathway to the total dose will be apportioned as described earlier. By

substituting a dose that represents an acceptable level of risk (an apportioned RfD for non-carcinogenic COCs or a dose representing 1 x 10^{-5} excess cancer risk for carcinogenic COCs) in the original exposure equations and solving for $RBTC_S$, a chemical concentration will be derived for intertidal sediments that will result in no adverse health effects.

This can be accomplished as follows:

$$RBTC_C(\text{mg/kg, risk-based}) = \frac{TR \times AT \times 365\ \text{days/yr}}{CSF \times 10^{-6}\ \text{kg/mg} \times EF \times LADD} \qquad \text{Cancer endpoint}$$

$$RBTC_T(\text{mg/kg, risk-based}) = \frac{RfD \times AT \times 365\ \text{days/yr}}{10^{-6}\ \text{kg/mg} \times EF \times ADD} \qquad \text{Non-cancer toxicity endpoint}$$

Where:

$RBTC_C$	= risk based threshold concentration for carcinogenic effects
$RBTC_T$	= risk based threshold concentration for non-carcinogenic effects
TR	= theoretical risk level
ADD	= average daily dose (mg/kg body weight-day)
LADD	= Lifetime average daily dose (mg/kg body weight-day)
RfD	= reference dose (mg/kg body weight-day)
CSF	= cancer slope factor ((mg/kg body weight-day)$^{-1}$)
EF	= exposure frequency, or number of events in a given time period
AT	= averaging time for effects. For cancer as the effect, daily intake is averaged over a representative lifetime-by convention this is 70 years or 25,550 days. For non-cancer threshold toxic effects, the daily intake is averaged over the duration of the exposure expressed in days.

Since the spill-related petroleum compounds have been segregated into two non-overlapping groups (either carcinogenic or non-carcinogenic), both RBTCs will be used to screen contaminants from impacted areas of shoreline. This approach is consistent with that recommended by USEPA for developing risk-based preliminary remediation goals in the Superfund Program (USEPA 1991). Developing these RBTCs to be used to screen EPCs for the various shoreline segments will facilitate potential human health risk screening of each shoreline classification.

In the event that the condition of NSR is concluded for the "lifetime resident recreational beach-goers" receptor group for all representative segments, the human health risk

characterization will also conclude that no further risk evaluation is warranted. It will further conclude that risks associated with other potential exposure scenarios, such as incidental exposure to tar balls and "pavement" in salt marsh also pose no significant health risk to human receptor populations.

Uncertainty Analysis

Risk assessment is the best tool currently available to prioritize and make sense of the potential threats to people and wildlife from environmental contamination, but is built on numerous assumptions. A careful discussion of the situation being evaluated and the attendant sources of uncertainty are critical to the appropriate use of the risk assessment to inform decisions, and will be included in the risk assessment report. The sources of uncertainty surrounding this screening level risk assessment for the Site will be discussed as part of the Risk Characterization included as part of the Phase II CSA report.

5.1.2 Ecological Risk Assessment (ERA)

A Stage 1 Environmental Screening will be performed to evaluate potential risk to ecological receptors. This assessment approach will be consistent with relevant state and federal risk assessment guidance, including:

- MADEP, *Guidance of Disposal Site Risk Characterization, Chapter 9: Method 3 Environmental Risk Characterization*, Interim Final Policy, BWSC/ORS-95-141;
- USEPA, *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments.* EPA/540-R-97-006. Washington, D. C.; and
- USEPA, *Guidelines for Ecological Risk Assessment*. EPA/630/R-95/002F. Washington, D.C.

Ecological Risk Assessment Endpoints

Assessment endpoints are the explicit expressions of the environmental resources or values to be protected. These constitute the Site-specific ecological areas, attributes, or communities

of concern, and will be the focus of the ERA. For the Site, the selected assessment endpoints for the ERA are:

- Protection of the health and stability of marine aquatic biota populations in Buzzards Bay, including benthic macroinvertebrate and fish species;
- Protection of the health and stability of local populations of shorebirds and mammals that frequent intertidal reaches of Buzzards Bay; and
- Protection of the health and stability of intertidal salt marsh habitat in Buzzards Bay.

These assessment endpoints will be evaluated using screening benchmarks and/or risk assessment tools presented as described below.

Stressor Identification

As in the human heath risk assessment, the ecological risk assessment will rely on the analytical data available for the environmental media of concern (sediment, surface water, weathered oil, and shellfish tissue). The primary detected constituents in these media are petroleum hydrocarbons and PAH associated with No. 6 fuel oil. In addition to the major PAH compounds typically evaluated in environmental media, there are numerous alkylated naphthalene, phenanthrene, fluorene, and chrysene homologs that are common constituents of No. 6 fuel oil.

Stressor Response Assessment

Since this is a screening-level assessment, the most sensitive species of concern exposed to the worst case conditions will be evaluated. The following paragraphs identify ecological receptors selected for evaluation, potentially complete exposure pathways, and the assessment methodology.

Ecological Receptors

The intertidal and shallow subtidal zone of the shoreline provides habitat for wildlife species such as shorebirds, fishes, and marine invertebrates. Environmental media of interest include surface water, surficial sediments, and benthic or epibenthic macroinvertebrates that may

bioaccumulate PAH. Key ecological receptors are salt marsh grasses, pelagic fish and macroinvertebrates, benthic and epibenthic fish and macroinvertebrates, shorebirds, and possibly terrestrial mammalian omnivores. PAH and petroleum hydrocarbons do not biomagnify through the foodweb, but may have a direct effect on first order consumers. Consequently, upper trophic level biota such as osprey and terns are not likely to be affected by spill constituents.

Based on field observations and the abundance of life history and toxicity studies on marine species in the literature, the following receptors were chosen for evaluation:

- Salt marsh plants (*Spartina spp*.)
- Marine macroinvertebrates (pelagic and benthic)
- Fish
- Piping Plover (*Charadrius melodus*)
- American Oystercatcher (*Haematopus palliatus*)
- Spotted Sandpiper (*Actitis macularia*)
- Raccoon (*Procyon lotor*)

Potential Ecological Exposure Pathways, Exposure Points, and Exposure Point Concentrations

Ecological receptor exposure is species-specific and may include one or more of the following:

- consumption of prey;
- incidental ingestion of sediments and water; and
- uptake of dissolved COCs from water.

Assuming that each receptor group may contact COCs anywhere within the Site boundaries, the exposure points will be defined by the shoreline segments selected for Site characterization. In order to assess potential population effects associated with contaminated media, media-specific arithmetic average concentrations will be used.

Risk Characterization

Ecological receptors may theoretically be exposed to spill-related constituents in surface water, surficial sediments, and/or via consumption of prey organisms. These environmental media will be screened for their potential to pose significant risks to ecological receptors using the Ecological Effects Quotient approach (EEQ, Suter 1993). EEQs essentially compare the estimated EPC or exposure dose as a ratio to appropriate environmental screening benchmark as described below. An EEQ that is less than 1.0 means that toxic effects are very unlikely under the conditions set in the risk assessment.

The ecological receptors, screening benchmarks, and/or risk assessment tools that will be used in the assessment include the following:

Salt marsh grasses. Assessment of potential adverse impacts to salt marsh grasses associated with residual oil from the spill will be addressed both qualitatively and quantitatively. Shoreline segments under evaluation will be inspected for visual signs of chemical stress and will be photo-documented if encountered. Additionally, EEQs for marsh sediment EPCs of spill-related constituents will be calculated using available phytotoxicity benchmarks from the literature including, but not limited to, Bergen et al. (2000); Lin et al. (2002); and Efroymson et. al (1997).

Aquatic macroinvertebrates and fish. Because concentrations of spill-related constituents are below detection limits in the water column (i.e., detection limits are significantly below USEPA Marine Ambient Water Quality Criteria [2002]), this exposure pathway is incomplete. This exposure pathway will be addressed qualitatively in the screening-level risk assessment.

Benthic and epibenthic macroinvertebrates. Existing individual PAH ERLs and total PAH ERL screening benchmarks developed by Long and Morgan (1991) will be used to evaluate potential sediment toxicity associated with spill-related PAH constituents, including alkylated PAH homologs. Individual ERL values exist for 13 PAH compounds, including 2-methylnaphthalene. NOAA's original analysis of PAH data assessed four other alkylated PAH compounds (1-methylnaphthalene; 2,6-dimethylnaphthalene; 2,3,5-

trimethylnaphthalene; and 1-methylphenanthrene), but concluded that there were insufficient data to develop ERL values. Alkylated PAH comprise a substantial portion of the total PAH in fuel oils, but the lack of ERL values for those compounds does not mean that potential ecological effects will be underestimated using existing 13 individual ERLs and the total PAH ERL values. Those values are still sensitive, conservative values for screening oiled sediments because PAH occur as an assemblage of related chemicals in the environment. The PAH for which ERL values exist (including 2-methylnaphthalene) and the other alkylated PAH are all part of that assemblage. The highly conservative ERL values over the range of two to five-ring PAH compounds serve as surrogates for the entire assemblage.

Fish, shorebirds and mammalian omnivores. Because petroleum hydrocarbons and PAH compounds, the primary COCs, do not biomagnify in upper trophic level organisms, the food web model will consider only first order predators. That is, potential risks to benthic fish, shorebirds, and raccoons feeding on invertebrates in intertidal and nearshore subtidal habitat will be assessed using food web exposure modeling. Estimates of daily contaminant exposure experienced by individual receptor species will be calculated using a modification of the generalized exposure model presented by Sample and Suter (1996). The generalized exposure model is depicted below:

$$ADD_{pot} = \frac{[(IR_{diet} x C_{diet}) + (IR_{sed} x C_{sed}) + (IR_{wat} x C_{wat})] x SUF}{BW}$$

Where:

ADD_{pot}	=	Potential average daily dose (*e.g.*, mg/kg-d)
IR_{diet}	=	Amount of prey or vegetation ingested (kg/d)
C_{diet}	=	Concentration of chemical in prey or vegetation (mg/kg)
IR_{sed}	=	Amount of sediment ingested (kg/d)
C_{sed}	=	Concentration of chemical in sediment (mg/kg)
IR_{wat}	=	Amount of water ingested (kg/d)
C_{wat}	=	Concentration of chemical in water (mg/kg)
SUF	=	Site use factor (unitless) (foraging area/site area)
BW	=	Body weight (kg)

Biota sediment accumulation factors (BSAF) recommended in the U.S. Army Corp of Engineers BSAF Database (http://el.erdc.usace.army.mil/bsaf/bsaf.html) will be used to predict accumulation of COCs in intertidal shellfish and polychaetes. Toxicity reference

values (TRV) obtained from the published literature for spill-related constituents will be used to develop EEQs for COCs. Absent published TRVs, values may be derived using relevant No Observable Adverse Effect Level (NOAEL) or Lowest Observable Adverse Effect Level (LOAEL) values obtained from the literature.

Uncertainty Analysis

Although ecological risk assessment is built on numerous assumptions, it is the best tool currently available to prioritize and make sense of the potential threats to ecological receptors from environmental contamination. A careful discussion of the situation being evaluated and the attendant sources of uncertainty are critical to the appropriate use of the risk assessment to inform decisions, and will be included in the risk assessment report. The sources of uncertainty surrounding this screening level risk assessment for the Site will be discussed in a way that is relevant to this particular situation.

5.2 PUBLIC WELFARE

The risk of harm to public welfare will be evaluated by comparing concentrations of detected petroleum constituents in sediment to the Upper Concentration Limits (UCLs) for soil defined in the MCP and also for the potential of residual oil to create a nuisance condition (e.g., rubbing off on skin when touched) to the degree that limits public or community use (active or passive) of the shoreline segment.

5.3 SAFETY

Potential risks to safety will be evaluated by considering the threat of physical harm or bodily injury due to the presence of oil. The threat to safety will be evaluated using visual observations from shoreline reconnaissances conducted during previous inspections as well as during inspections for Phase II characterizations. It is important to note that previous inspections did not observe the presence of slicks of oil, oiled walkways, and pools of oil, or the potential for slip and fall hazard from oiled rocks. Rusted or corroded drums or containers, open pits, lagoons, or other dangerous structures associated with this release are not present. A threat of fire or explosion, including the presence of explosive vapors, does

not exist. Uncontainerized materials that exhibit corrosive, reactive, or flammable characteristics are not present at the Site.

6.0 DATA INTERPRETATION AND PHASE II REPORT

The Phase II characterization data, including sediment sampling and visual observations, will be summarized and tabulated as part of the Phase II report. Field inspection forms summarizing the field observations will be included in an appendix to the Phase II report. Potential risks to human health, public welfare, safety, and the environment will be characterized with a Method 3 Risk Characterization with a Stage 1 Ecological Screening. The Phase II report will also include an evaluation of the feasibility of achieving background. The validity of the laboratory analytical results will be evaluated in a data evaluation and quality assurance/quality control (QA/QC) section, and this evaluation will include reviewing holding times, surrogate recoveries, relative percent differences (RPDs) between duplicate samples, and a level II data validation.

7.0 SCHEDULE OF IMPLEMENTATION

The schedule for implementing Phase II field activities will be based upon MADEP approval of the Phase II SOW. Field work can be initiated within two weeks of MADEP approval of the Phase II SOW and it is expected that the field activities will be completed within two months of MADEP approval. The Phase II Comprehensive Site Assessment Report will be completed within five months of MADEP approval of the Phase II SOW.

Sampling and inspection activities are scheduled be initiated on August 29, 2005 and will continue into September 2005. Based upon the initial schedule of field activities, it is anticipated that the Phase II Comprehensive Site Assessment report will be completed by November 2006. However, the scope and schedule of the assessment activities for the Phase II Comprehensive Site Assessment will be further evaluated as additional data is obtained and may be revised, if necessary.

8.0 REFERENCES

Bergen, A., C. Alderson, R. Bergors, C. Aquila and M.A. Matsil, 2000. *Restoration of a* Spartina alterniflora *marsh following a fuel oil spill, New York City, NY*. Wetlands Ecology and Management 8: 185-195.

Commonwealth of Massachusetts. October 29, 1999. Massachusetts Contingency Plan. 310 CMR 40.0000 Massachusetts Department of Environmental Protection (MADEP), Bureau of Waste Site Cleanup.

Efroymson R.A., G.W. Suter, B.E. Sample, and D.S. Jones, 1997. *Preliminary Remediation Goals for Ecological Endpoints*, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, TN., ES/ER/TM-162/R2.

GeoInsight, Inc., 2004. Immediate Response Action Status Report. February.

GeoInsight, Inc., 2004. Phase I Initial Site Investigation and Conceptual Site Model Report. May 23, 2004.

GeoInsight, Inc., 2004. Immediate Response Action Status Report. September

GeoInsight, Inc., 2005. Immediate Response Action Status Report. March

Lin, Q., I. Mendelssohn, M. Suidan, K. Lee and A. Venosa, 2002. *The dose-response relationship between No. 2 fuel oil and the growth of salt marsh grass,* Spartina alterniflora. Marine Pollution Bulletin 44: 897-902.

Long, E.R. and L.G. Morgan, 1991. *The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program*. NOAA Technical Memorandum NOS OMA 52.

MADEP, 1995. *Guidance for Disposal Site Risk Characterization – In support of the Massachusetts Contingency Plan,* BWSC/ORS-95-141.

MADEP, 1995. *Guidance for Disposal Site Risk Characterization, Chapter 9: Method 3 Environmental Risk Characterization,* Interim Final Policy, BWSC/ORS-95-141.

MADEP, 2002. *Implementation of the MADEP VPH/EPH Approach.* Policy #WSC-02-411.

MADEP, 2003. Letter to Bouchard Transportation, *Notice of Responsibility,* dated May 3, 2003.

MADEP, 2003. Letter to Bouchard Transportation, *Request for Immediate Response Action Plan with Interim Deadline.* Dated September 8, 2003.

MADEP, 2004. Letter to Bouchard Transportation, *Decision to Grant Permit*. Dated July 27, 2004.

National Oceanic Atmospheric Administration (NOAA), 1999. *Screening Quick Reference Tables* (SQuiRT). Coastal Protection & Restoration Division. September.

Sample, B.E., D.M. Opresko, and G.W. Suter II, 1996. *Toxicological Benchmarks for Wildlife: 1996 Revision*., Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, TN., ES/ER/TM-86/R3

Suter, G.W., 1993. *Ecological Risk Assessment*. Lewis Publishers, Kelsey, Michigan.

Unified Command, 2003. *Immediate Response Action: Treatment and Completion Guidelines Plan*. Dated May 23.

U.S. Army Corp of Engineers Biota-Sediment Accumulation Factor (BSAF) Database (http://el.erdc.usace.army.mil/bsaf/bsaf.html)

U. S. Environmental Protection Agency (USEPA), 1989. *Risk Assessment Guidance for Superfund, Volume I, Human Health health Evaluation Manual, Parts A, B, and E*; Office of Emergency and Remedial Response, Washington, D.C.

USEPA, 1991. *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals)*, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. Pub. 9285.7-01B.

USEPA, 1997. *Exposure Factors Handbook, Volume I General Factors*, Office of Research and Development, National Center for Environmental Assessment, Washington, D.C.

USEPA, 1997. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments.* EPA/540-R-97-006. Washington, D. C.

USEPA, 1998. *Guidelines for Ecological Risk Assessment*. EPA/630/R-95/002F. Washington, D.C.

USEPA, 2002. *National Recommended Water Quality Criteria: 2002*. Office of Water, OST, EPA-822-R-02-047, Washington, D.C.

USEPA, 2003. *Human Health Toxicity Values in Superfund Risk Assessments*. Office of Solid Waste and Emergency Response (OSWER) Directive 9285.7-53. Memorandum dated 12/5/2003.

USEPA, Integrated Risk Information System (IRIS), http://www.epa.gov/iris/

TABLES

TABLE 1
SHORELINE SEGMENT SUMMARY
B120 RELEASE
BUZZARDS BAY, MASSACHUSETTS

Segment	Segment Name	Town	Shoreline Status
E1-01	Grey Gables-Gilder Road Beach	Bourne	Included in May 2004 Partial RAC
E1-02	Mashnee/Hog Islands North	Bourne	Included in May 2004 Partial RAC
E1-03	Mashnee Island	Bourne	Included in May 2004 Partial RAC
E1-04	Mashnee/Hog Islands South	Bourne	Unoiled
E1-05	Monument Beach	Bourne	Unoiled
E1-06	Phinney's Harbor South	Falmouth	Unoiled
E1-07	Wings Neck	Falmouth	Included in May 2004 Partial RAC
E1-08	Barlow's Landing	Bourne	Included in May 2004 Partial RAC
E1-09	Patuisset	Bourne	Included in May 2004 Partial RAC
E1-10	Scraggy Neck North	Bourne	Included in May 2004 Partial RAC
E1-11	Scraggy Neck South	Bourne	MCP Response Actions Ongoing
E1-12	Megansett Beach	Falmouth	Included in May 2004 Partial RAC
E1-13	Nye's Neck	Falmouth	MCP Response Actions Ongoing
E1-14	New Silver Beach (Wild Harbor)	Falmouth	MCP Response Actions Ongoing
E1-15	Crow Point	Falmouth	MCP Response Actions Ongoing
E1-16	Old Silver Beach	Falmouth	Unoiled
E2-01	Falmouth Cliffs	Falmouth	Included in May 2004 Partial RAC
E2-02	West Falmouth Harbor	Falmouth	Included in May 2004 Partial RAC
E2-03	Chappaquoit Beach	Falmouth	Unoiled
E2-04	Black Beach	Falmouth	Unoiled
E2-05	Saconesset Beach	Falmouth	Included in May 2004 Partial RAC
E2-06	Hamlin's Point Beach	Falmouth	Included in May 2004 Partial RAC
E2-07	Wood Neck Beach	Falmouth	Included in May 2004 Partial RAC
E2-08	Racing Beach	Falmouth	Included in May 2004 Partial RAC
E2-09	Quissett Harbor	Falmouth	Included in May 2004 Partial RAC
E2-10	Long Neck to Gansett Point	Woods Hole	Included in May 2004 Partial RAC
E2-11	Penzance Island	Woods Hole	Included in May 2004 Partial RAC
E3-01	Penikese Island	Gosnold	Included in May 2004 Partial RAC
E3-02	Cuttyhunk Island	Gosnold	Included in May 2004 Partial RAC
E3-03	Nashaweena Island	Gosnold	Included in May 2004 Partial RAC
E3-04	Pasque Island	Gosnold	Included in May 2004 Partial RAC
E3-05	Naushon Island	Gosnold	Included in May 2004 Partial RAC
E3-06	Uncatena Island	Gosnold	MCP Response Actions Ongoing
E3-07	Weepecket Islands	Gosnold	Included in May 2004 Partial RAC
W1B-01	Taylor Point Canal	Buzzards Bay	Unoiled
W1B-02	Taylor Point North	Buzzards Bay	Unoiled
W1B-03	Butler Cove	Wareham	Unoiled
W1B-04	Jacob's Neck	Wareham	Unoiled
W1B-05	Pleasant Harbor	Wareham	Unoiled

TABLE 1
SHORELINE SEGMENT SUMMARY
B120 RELEASE
BUZZARDS BAY, MASSACHUSETTS

Segment	Segment Name	Town	Shoreline Status
W1B-06	Broad Cove (+seg 6.5)	Wareham	Unoiled
W1B-07	Stony Point Dike	Wareham	Included in May 2004 Partial RAC
W1B-08	Temples Knob	Wareham	Included in May 2004 Partial RAC
W1B-09	Little Harbor Beach	Wareham	Unoiled
W1B-10	Little Harbor	Wareham	Unoiled
W1B-11	Bourne Cove	Wareham	Unoiled
W1B-12	Warren Point (MA)	Wareham	MCP Response Actions Ongoing
W1B-13	Indian Neck	Wareham	Included in May 2004 Partial RAC
W1B-14	Long Beach	Wareham	Included in May 2004 Partial RAC
W1B-15	Wareham River East Shore	Wareham	MCP Response Actions Ongoing
W1B-16	Minot Forest Beach	Wareham	Included in May 2004 Partial RAC
W1B-17	Wareham Neck North	Wareham	Included in May 2004 Partial RAC
W1B-18	Pinehurst Beach	Wareham	Unoiled
W1B-19	Broad Marsh River East	Wareham	Unoiled
W1B-20	Broad Marsh River West	Wareham	Unoiled
W1B-21	Swift's Neck Beach	Wareham	Included in May 2004 Partial RAC
W1B-22	Swift's Beach	Wareham	Included in May 2004 Partial RAC
W1B-23	Mark's Cove	Wareham	Included in May 2004 Partial RAC
W1B-24	Nobska Beach	Wareham	Included in May 2004 Partial RAC
W1B-25	Cromeset Beach	Wareham	Unoiled
W1B-26	Briarwood Beach	Wareham	Unoiled
W1B-27	Rose Point	Wareham	Unoiled
W1B-28	Weweantic River West Shore	Marion	Included in May 2004 Partial RAC
W1B-29	Delano Road North	Marion	Unoiled
W1B-30	Delano Road South	Marion	Unoiled
W1B-31	Great Hill Point	Marion	MCP Response Actions Ongoing
W1B-32	Piney Point Beach	Marion	Included in May 2004 Partial RAC
W1B-33	Piney Point South	Marion	MCP Response Actions Ongoing
W1C-00	Bird Island	Marion	Included in May 2004 Partial RAC
W1C-01	Butler's Point	Marion	MCP Response Actions Ongoing
W1C-02	Planting Island Causeway	Marion	MCP Response Actions Ongoing
W1C-03	Planting Island Cove	Marion	Unoiled
W1C-04	Blankinship Cove	Marion	MCP Response Actions Ongoing
W1C-05	Sippican Harbor East	Marion	MCP Response Actions Ongoing
W1C-06	Hammet's Cove Beach	Marion	Unoiled
W1C-07	Little Neck	Marion	Unoiled
W1C-08	Tabor Academy Beach	Marion	Unoiled
W1C-09	Marion Town Beach	Marion	Unoiled
W1C-10	Silvershell Beach	Marion	MCP Response Actions Ongoing

TABLE 1
SHORELINE SEGMENT SUMMARY
B120 RELEASE
BUZZARDS BAY, MASSACHUSETTS

Segment	Segment Name	Town	Shoreline Status
W1C-11	Sippican Harbor West	Marion	MCP Response Actions Ongoing
W1C-12	Converse Point East	Marion	MCP Response Actions Ongoing
W1C-13	Little Ram Island	Marion	Included in May 2004 Partial RAC
W1D-01	Aucoot Cove	Mattapoisett	MCP Response Actions Ongoing
W1D-02	Harbor Beach	Mattapoisett	Included in May 2004 Partial RAC
W1D-03	Holly Woods / Hiller Cove	Mattapoisett	MCP Response Actions Ongoing
W1D-04	Holly Woods / Peases Point	Mattapoisett	MCP Response Actions Ongoing
W1D-05	Point Connett Beach	Mattapoisett	MCP Response Actions Ongoing
W1E-01	Nye Cove / Strawberry Cove	Mattapoisett	MCP Response Actions Ongoing
W1E-02	Strawberry Cove	Mattapoisett	MCP Response Actions Ongoing
W1E-03	Strawberry Point West	Mattapoisett	MCP Response Actions Ongoing
W1E-04	Crescent Beach	Mattapoisett	MCP Response Actions Ongoing
W1E-05	Mattapoisett Harbor East	Mattapoisett	MCP Response Actions Ongoing
W1E-06	Mattapoisett Town Beach	Mattapoisett	MCP Response Actions Ongoing
W1F-01	Brandt Beach	Mattapoisett	MCP Response Actions Ongoing
W1F-02	Brandt Island West	Mattapoisett	MCP Response Actions Ongoing
W1F-03	Brandt Island East	Mattapoisett	MCP Response Actions Ongoing
W1F-04	Brandt Island Cove	Mattapoisett	MCP Response Actions Ongoing
W1F-05	Mattapoisett Neck West	Mattapoisett	MCP Response Actions Ongoing
W1F-06	Mattapoisett Neck South	Mattapoisett	MCP Response Actions Ongoing
W1F-07	Mattapoisett Shores	Mattapoisett	MCP Response Actions Ongoing
W1F-08	Mattapoisett Neck East	Mattapoisett	MCP Response Actions Ongoing
W1F-09	Mattapoisett Harbor North	Mattapoisett	MCP Response Actions Ongoing
W1G-00	Ram Island	Mattapoisett	MCP Response Actions Ongoing
W2A-01	Fort Phoenix	Fairhaven	MCP Response Actions Ongoing
W2A-02	Harbor View	Fairhaven	MCP Response Actions Ongoing
W2A-03	Pope's Beach	Fairhaven	MCP Response Actions Ongoing
W2A-04	Manhattan Ave	Fairhaven	MCP Response Actions Ongoing
W2A-05	Sunset Beach	Fairhaven	MCP Response Actions Ongoing
W2A-06	Silver Shell Beach	Fairhaven	MCP Response Actions Ongoing
W2A-07	Sconticut Neck West	Fairhaven	MCP Response Actions Ongoing
W2A-08	Wilbur Point	Fairhaven	MCP Response Actions Ongoing
W2A-09	Sconticut Neck East	Fairhaven	MCP Response Actions Ongoing
W2A-10	Long Island and Causeway South	Fairhaven	MCP Response Actions Ongoing
W2A-11	West Island West	Fairhaven	MCP Response Actions Ongoing
W2A-12	Rocky Point to East Cove	Fairhaven	MCP Response Actions Ongoing
W2A-13	East Cove	Fairhaven	MCP Response Actions Ongoing
W2A-14	Pine Creek to North Point	Fairhaven	MCP Response Actions Ongoing

TABLE 1
SHORELINE SEGMENT SUMMARY
B120 RELEASE
BUZZARDS BAY, MASSACHUSETTS

Segment	Segment Name	Town	Shoreline Status
W2A-15	West Island North	Fairhaven	Included in May 2004 Partial RAC
W2A-16	Long Island and Causeway North	Fairhaven	Included in May 2004 Partial RAC
W2A-17	Sconticut Neck Northeast (Marsh)	Fairhaven	Included in May 2004 Partial RAC
W2A-18	Little Bay (Marsh)	Fairhaven	Included in May 2004 Partial RAC
W2A-19	Shaw Cove	Fairhaven	MCP Response Actions Ongoing
W2B-01	Round Hill to Barekneed Rocks	Dartmouth	Included in May 2004 Partial RAC
W2B-02	Padanaram Harbor	Dartmouth	Included in May 2004 Partial RAC
W2B-03	Clarke's Cove West	Dartmouth/New	Included in May 2004 Partial RAC
W2B-04	Clarke's Cove East	New Bedford	Included in May 2004 Partial RAC
W2B-05	Fort Taber	New Bedford	MCP Response Actions Ongoing
W2B-06	Clarke's Point East	New Bedford	Included in May 2004 Partial RAC
W2B-09	New Bedford Harbor (inner)	New Bedford	Unoiled
W3A-01	Mishaum Point East	Dartmouth	MCP Response Actions Ongoing
W3A-02	Salters Point West	Dartmouth	MCP Response Actions Ongoing
W3A-03	Pier Beach (Salter's Point)	Dartmouth	MCP Response Actions Ongoing
W3A-04	Salters Point East	Dartmouth	MCP Response Actions Ongoing
W3A-05	Round Hill Beach West	Dartmouth	MCP Response Actions Ongoing
W3A-06	Round Hill Beach East	Dartmouth	MCP Response Actions Ongoing
W3B-01	Slocum's River	Dartmouth	Included in May 2004 Partial RAC
W3B-02	Mishaum Point West	Dartmouth	MCP Response Actions Ongoing
W3C-01	East Beach (Westport)	Westport	Included in May 2004 Partial RAC
W3C-02	Little Beach	Dartmouth	Included in May 2004 Partial RAC
W3C-03	Barney's Joy West	Dartmouth	MCP Response Actions Ongoing
W3C-04	Barney's Joy East	Dartmouth	MCP Response Actions Ongoing
W3C-05	Demarest Lloyd State Park Beach	Dartmouth	Included in May 2004 Partial RAC
W3C-06	Demarest Lloyd State Park Marsh	Dartmouth	MCP Response Actions Ongoing
W3D-01	Quicksand Point	Westport	Included in May 2004 Partial RAC
W3D-02	Cockeast Pond Beach	Westport	Included in May 2004 Partial RAC
W3D-03	Elephant Rock Beach	Westport	Included in May 2004 Partial RAC
W3D-04	Horseneck Beach West	Westport	Included in May 2004 Partial RAC
W3D-05	Horseneck Beach East	Westport	Included in May 2004 Partial RAC
W3D-06	Gooseberry Neck East	Westport	Included in May 2004 Partial RAC
W3D-07	Gooseberry Neck West	Westport	MCP Response Actions Ongoing

Notes:
1. MCP response actions are ongoing at the highlighted segments shown above.
2. RAO = Response Action Outcome.

TABLE 2
SUMMARY OF REMAINING SEGMENTS
B 120 RELEASE
BUZZARDS BAY, MASSACHUSETTS

Segment ID	Segment Name	Town	Primary Shoreline Classification	Secondary Shoreline Classification	Maximum Degree of Initial Oiling	Oil Ranking Score	IRAC Status (As of September 3, 2003)
E1-11	Scraggy Neck South	Bourne	1C	1B	Moderate	1.00	FTF
E1-13	Nye's Neck	Falmouth	1C	1B	Heavy	2.92	FTF
E1-14	New Silver Beach (sunset pt)	Falmouth	1A	1C, 1F	Moderate	<1.00	Pass
E1-15	Crow Point	Falmouth	1D	1B, 1C	Heavy	<1.00	Pass
E3-06	Uncatena Island	Gosnold	1C	1D, 1E, 1F	Moderate	2.00	Not Inspected
W1B-12	Warren Point (MA)	Wareham	1C	---	Moderate	3.00	Pass
W1B-15	Wareham River East Shore	Wareham	1F	1B, 1C, 1D	Moderate	1.80	Pass
W1B-31	Great Hill Point	Marion	1C	1B	Moderate	3.00	Pass
W1B-33	Piney Point South	Marion	1C	1C	Moderate	3.00	Pass
W1C-01	Butler's Point	Marion	1D	1C	Moderate	3.00	FTF
W1C-02	Planting Island Causeway	Marion	1D	1B, 1C	Heavy	3.00	Not Inspected
W1C-04	Blankinship Cove	Marion	1F	1E	Moderate	1.46	Pass
W1C-05	Sippican Harbor East	Marion	1D	1F	Moderate	3.00	Pass
W1C-10	Silver Shell Beach	Marion	1A	1F	Moderate	<1.00	NFA
W1C-11	Sippican Harbor West	Marion	1F	---	Very Light	<1.00	Pass
W1C-12	Converse Point East	Marion	1C	1D, 1F	Moderate	2.63	NFA
W1D-01	Aucoot Cove	Mattapoisett	1F	1A, 1C	Moderate	1.46	Pass
W1D-03	Holly Woods / Hiller Cove	Mattapoisett	1C	1B, 1F	Moderate	2.00	Pass
W1D-04	Holly Woods / Peases Point	Mattapoisett	1D	1B, 1C	Moderate	2.23	Pass
W1D-05	Point Connett Beach	Mattapoisett	1B	1C	Heavy	2.00	Pass

TABLE 2
SUMMARY OF REMAINING SEGMENTS
B 120 RELEASE
BUZZARDS BAY, MASSACHUSETTS

Segment ID	Segment Name	Town	Primary Shoreline Classification	Secondary Shoreline Classification	Maximum Degree of Initial Oiling	Oil Ranking Score	IRAC Status (As of September 3, 2003)
W1E-01	Nye Cove / Strawberry Cove	Mattapoisett	1C	1F	Light	1.33	Pass
W1E-02	Strawberry Cove	Mattapoisett	1F	1C	Light	1.46	NFA
W1E-03	Strawberry Point West	Mattapoisett	1C	1F	Moderate	2.28	FTF
W1E-04	Crescent Beach	Mattapoisett	1C	1B	Heavy	3.92	Pass
W1E-05	Mattapoisett Harbor East	Mattapoisett	1D	1B, 1C, 1F	Moderate	1.26	Pass
W1E-06	Mattapoisett Town Beach	Mattapoisett	1D	1A, 1C	Moderate	3.00	Pass
W1F-01	Brandt Beach	Mattapoisett	1D	1B, 1C	Heavy	2.49	Pass
W1F-02	Brandt Island West (Howards Beach)	Mattapoisett	1D	1B, 1C, 1F	Heavy	3.34	NFA
W1F-03	Brandt Island East	Mattapoisett	1D	1B, 1C, 1F	Heavy	3.07	NFA
W1F-04	Brandt Island Cove	Mattapoisett	1F	1C	Heavy	2.19	Pass
W1F-05	Mattapoisett Neck West	Mattapoisett	1F	1C, 1E	Heavy	3.77	Pass
W1F-06	Mattapoisett Neck South	Mattapoisett	1C	1B	Heavy	2.74	NFA
W1F-07	Mattapoisett Shores	Mattapoisett	1B	1C	Moderate	2.94	Pass
W1F-08	Mattapoisett Neck East	Mattapoisett	1C	1B	Heavy	1.08	Pass
W1F-09	Mattapoisett Harbor North	Mattapoisett	1F	1B, 1C	Moderate	1.00	Pass
W1G-00	Ram Island	Mattapoisett	1C	1F, 2	Heavy	4.00	Pass
W2A-01	Fort Phoenix	Fairhaven	1C	1A, 1D	Moderate	1.79	Pass
W2A-02	Harbor View	Fairhaven	1F	1B, 1C	Heavy	3.00	Pass
W2A-03	Pope's Beach	Fairhaven	1F	1A, 1B, 1C, 1D	Moderate	3.00	Pass
W2A-04	Manhattan Ave	Fairhaven	1C	1A, 1B, 1D	Heavy	3.65	Pass

TABLE 2
SUMMARY OF REMAINING SEGMENTS
B 120 RELEASE
BUZZARDS BAY, MASSACHUSETTS

Segment ID	Segment Name	Town	Primary Shoreline Classification	Secondary Shoreline Classification	Maximum Degree of Initial Oiling	Oil Ranking Score	IRAC Status (As of September 3, 2003)
W2A-05	Sunset Beach	Fairhaven	1C	1A, 1D	Moderate	2.00	NFA
W2A-06	Silver Shell Beach	Fairhaven	1C	1D	Light	2.00	NFA
W2A-07	Sconticut Neck West	Fairhaven	1C	1B, 1D, 1E, 1F	Heavy	2.17	Pass
W2A-08	Wilbur Point	Fairhaven	1D	1A, 1B, 1C	Moderate	2.40	Pass
W2A-09	Sconticut Neck East	Fairhaven	1D	1B, 1C, 1F	Heavy	3.00	Pass
W2A-10	Long Island and Causeway South	Fairhaven	1C	1A, 1B, 1D, 1F	Heavy	3.44	NFA
W2A-11	West Island West	Fairhaven	1C	1A, 1B, 1D	Heavy	3.95	Pass
W2A-12	Rocky Point to East Cove (Town Beach)	Fairhaven	1A	1C, 1E	Heavy	1.19	Pass
W2A-13	East Cove	Fairhaven	1A	1C, 1F	Light	1.00	Pass
W2A-14	Pine Creek to North Point	Fairhaven	1C	1B, 1F	Moderate	3.00	Pass
W2A-19	Shaw Cove	Fairhaven	1F	1A, 1B, 1C	Heavy	2.23	Pass
W2B-05	Fort Taber	New Bedford	1D	1A, 1C	Moderate	1.44	FTF
W3A-01	Mishaum Point East	Dartmouth	1C	1B	Heavy	1.05	Pass
W3A-02	Salters Point West	Dartmouth	1B	1C	Moderate	3.00	Pass
W3A-03	Pier Beach (Salter's Point)	Dartmouth	1D	1B, 1C	Moderate	2.44	Pass
W3A-04	Salters Point East	Dartmouth	1B	1C, 1D	Light	2.00	Pass
W3A-05	Round Hill Beach West	Dartmouth	1A	1B, 1C, 1F	Heavy	2.14	Pass
W3A-06	Round Hill Beach East	Dartmouth	1A	1C, 1D, 1E	Heavy	2.77	NFA
W3B-02	Mishaum Point West	Dartmouth	1C	1B, 1D, 1E	Heavy	3.65	Not Inspected
W3C-03	Barney's Joy West	Dartmouth	1B	1C, 3	Heavy	4.00	Pass

TABLE 2
SUMMARY OF REMAINING SEGMENTS
B 120 RELEASE
BUZZARDS BAY, MASSACHUSETTS

Segment ID	Segment Name	Town	Primary Shoreline Classification	Secondary Shoreline Classification	Maximum Degree of Initial Oiling	Oil Ranking Score	IRAC Status (As of September 3, 2003)
W3C-04	Barney's Joy East	Dartmouth	1C	1B, 2, 3	Heavy	2.60	Not Inspected
W3C-06	Demarest Lloyd State Park Marsh	Dartmouth	1F	---	Very Light	1.00	Pass
W3D-07	Gooseberry Neck West	Westport	1C	1E	Moderate	2.05	Pass

FTF = Did not pass IRAC and further treatment was deemed to be feasible.
NFA = Did not pass IRAC and no further action was feasible.
1A = Heavily utilized, public recreational sand beaches.
1B = Less utilized semi-public and private sand beaches.
1C = Mixed sand and gravel, gravel (pebble to boulder) and rip rap groins (jetties).
1D = Rip rap seawalls, bulkheads, piers, docks, and pilings.
1E = Rocky (bedrock) shorelines.
1F = Salt marshes.
2 = Roseate tern habitat (Ram Island, Bird Island, and Penikese Island, in particular).
3 = Piping plover habitat.

TABLE 3
SEGMENTS SELECTED FOR INTERTIDAL CHARACTERIZATION
B120 RELEASE
BUZZARDS BAY, MASSACHUSETTS

Segment ID	Segment Name	Town	Primary Shoreline Classification	Phase I Sampling (January 2004)	Completed Phase II Sampling (August and December 2004)	Proposed Phase II Sampling
W3C-03	Barney's Joy West	Dartmouth	1A/1B	9 intertidal sediment samples	-	None (existing data adequate)
W3A-05	Round Hill Beach West	Dartmouth	1A/1B	-	-	Collect intertidal samples from 3 areas - two transects in western section and 1 transect in eastern section
W2A-11	West Island West	Fairhaven	1C	6 intertidal sediment samples	-	2 additional intertidal sediment sampling transects - one near southern point and one near areas of residual oil area
W1E-04	Crescent Beach	Mattapoisett	1C	6 intertidal sediment samples	-	2 additional intertidal sediment sampling transects and visual inspections of 2 marshes
W2A-10	Long Island and Causeway South	Fairhaven	1C	-	4 marsh sediment samples and 16 subtidal sediment samples	4 intertidal sediment sampling transects and 4 to 5 marsh sediment samples.
W3C-04	Barney's Joy East	Dartmouth	1C	-	8 subtidal sediment samples	3 intertidal sediment sampling transects along southern side to point
W1F-02	Brandt Island West (Howards Beach)	Mattapoisett	1D	-	12 grab samples	2 intertidal sediment sampling transects, one marsh sampling transect, and 8 subtidal sediment sampling transects
W2A-03	Pope's Beach	Fairhaven	1F	6 intertidal sediment samples	8 subtidal sediment samples	5 marsh sediment samples
W1E-02	Strawberry Cove	Mattapoisett	1F	-	-	5 marsh sediment samples and 2 subtidal sediment sampling transects
W1F-05	Mattapoisett Neck West	Mattapoisett	1F	-	1 marsh sediment sample	3 marsh sample transects and visual inspection of marsh
W2A-02	Harbor View	Fairhaven	1F	-	2 marsh sediment samples	Re-sample 2 previous marsh areas and 2 new marsh sample transects
W1D-01	Aucoot Cove	Mattapoisett	1F	3 marsh sediment samples	-	2 marsh sample transects and visual inspection

TABLE 4
SELECTION CRITERIA LEGEND
B120 RELEASE
BUZZARDS BAY, MASSACHUSETTS

Most Recent Residual Oil

1 = No evidence of oil during most recent survey(s)
2 = Minimal weathered splatter on a few surfaces
3 = Splatter plus small pieces of sporadic pavement and/or minimal (partially weathered) tar patties or flecks
4 = Moderate or extensive oil as either separate phase or unweathered tar patties

IRAC Status (2003)

1 = Segment satisfied IRAC criteria during IRAC inspections in 2003
2 = Segment were not surveyed during IRAC inspections due to minimal oiling and survey constraints
3 = Segment failed IRAC inspections, and no further treatment was deemed feasible
4 = Segment either were not surveyed during IRAC inspections due to remaining oil in 2003, or segments failed IRAC inspections and further treatment was deemed feasible.

Initial Oiling Index (2003)

1 = Average initial shoreline oiling in April/May 2003 was very light
2 = Average initial shoreline oiling in April/May 2003 was light
3 = Average initial shoreline oiling in April/May 2003 was moderate
4 = Average initial shoreline oiilng in April/May 2003 was heavy

Ecological Ranking

1 = No known occurrence of threatened or endangered species, salt marsh habitat, or NHESP priority habitat
2 = No known occurrence of threatened or endangered species. NHESP priority habitat <25%; salt marsh <50% of segment
3 = No known occurrence of threatened or threatened species. NHESP priority habitat 25-75% of shoreline, or salt marsh >50%.
4 = Known T&E occurrence and/or NHESP priority habitat >75% of segment

Public Access

1 = semi-private, difficult access due to distance and/or shoreline substrate
2 = semi-private, readily or moderately accessible from private property
3 = semi-public, moderately accessible from public access (e,g, trails or parking lot)
4 = public, ready access

TABLE 5
CRITERIA FOR PHASE II REPRESENTATION OF SHORELINE CLASSIFICATION: SANDY SHORELINES (1A/1B SEGMENTS)
B120 RELEASE
BUZZARDS BAY, MASSACHUSETTS

Segment ID	Segment Name	Town	Most Recent Residual Oil	IRAC Status (2003)	Initial Oiling Index (2003)	Ecological Ranking	Public Access
W3C-03	Barney's Joy West	Dartmouth	2	1	4	4	4
W3A-05	Round Hill Beach West	Dartmouth	2	1	2	4	3
W3A-06	Round Hill Beach East	Dartmouth	2	3	3	4	2
W3A-02	Salters Point West	Dartmouth	2	1	3	4	3
W1F-07	Mattapoisett Shores	Mattapoisett	2	1	3	2	3
W3A-04	Salters Point East	Dartmouth	2	1	2	4	3
W1D-05	Point Connett Beach	Mattapoisett	2	1	2	1	3
W1C-10	Silver Shell Beach	Marion	1	3	1	4	3
W2A-12	Rocky Point to East Cove (Town Beach)	Fairhaven	1	1	1	4	3
W2A-13	East Cove	Fairhaven	1	1	1	4	3
W1B-33	Piney Point South	Marion	1	1	3	2	3
E1-14	New Silver Beach	Falmouth	1	1	1	2	3

Notes:

1. Shaded segments are selected to be representative of this shoreline type.

TABLE 6
CRITERIA FOR PHASE II REPRESENTATION OF SHORELINE CLASSIFICATION: MIXED SAND AND GRAVEL SHORELINES (1C SEGMENTS)
B120 RELEASE
BUZZARDS BAY, MASSACHUSETTS

Segment ID	Segment Name	Town	Most Recent Residual Oil	IRAC Status (2003)	Initial Oiling Index (2003)	Ecological Ranking	Public Access
W2A-10	Long Island / Causeway South	Fairhaven	3	3	3	4	4
W2A-11	West Island West	Fairhaven	3	1	4	3	4
W3C-04	Barney's Joy East	Dartmouth	2	4	3	4	3
W2A-06	Silver Shell Beach	Fairhaven	2	3	2	3	4
W3B-02	Mishaum Point West	Dartmouth	2	4	4	2	2
W1E-04	Crescent Beach	Mattapoisett	2	1	4	2	4
W1E-03	Strawberry Point West	Mattapoisett	2	4	2	4	1
W2A-07	Sconticut Neck West	Fairhaven	2	1	2	3	4
W2A-04	Manhattan Ave	Fairhaven	2	1	4	1	4
W1E-01	Nye Cove / Strawberry Cove	Mattapoisett	2	1	1	3	4
W1C-12	Converse Point East	Marion	2	3	3	4	1
W1B-31	Great Hill Point	Marion	2	1	3	4	2
E1-11	Scraggy Neck South	Bourne	2	4	1	2	1
E1-13	Nye's Neck	Falmouth	1	4	3	2	4
W1F-06	Mattapoisett Neck South	Mattapoisett	1	3	3	2	4
W3D-07	Gooseberry Neck West	Westport	1	1	2	4	4
W1G-00	Ram Island	Mattapoisett	1	1	4	4	1
W2A-14	Pine Creek to North Point	Fairhaven	1	1	3	4	3
W2A-05	Sunset Beach	Fairhaven	1	3	2	2	3
W1F-08	Mattapoisett Neck East	Mattapoisett	1	1	1	4	4
E3-06	Uncatena Island	Gosnold	1	2	2	4	1
W1D-03	Holly Woods / Hiller Cove	Mattapoisett	1	1	2	4	3
W1B-12	Warren Point	Wareham	1	1	3	4	1
W2A-01	Fort Phoenix	Fairhaven	1	1	2	1	4
W3A-01	Mishaum Point East	Dartmouth	1	1	1	2	2

Notes:
1. Shaded segments are selected to be representative of this shoreline type.

TABLE 7
CRITERIA FOR PHASE II REPRESENTATION OF SHORELINE CLASSIFICATION: SEAWALLS, BULKHEADS, PIERS, AND BEDROCK SHORELINES (1D/1E SEGMENTS)
B120 RELEASE
BUZZARDS BAY, MASSACHUSETTS

Segment ID	Segment Name	Town	Most Recent Residual Oil	IRAC Status (2003)	Initial Oiling Index (2003)	Ecological Ranking	Public Access
W1F-02	Brandt Island West (Howards Beach)	Mattapoisett	3	4	3	2	4
W1F-03	Brandt Island East	Mattapoisett	2	4	3	2	4
W1C-02	Planting Island Causeway	Marion	2	4	3	2	4
W1C-01	Butler's Point	Marion	2	4	3	2	3
W3A-03	Pier Beach (Salter's Point)	Dartmouth	2	1	2	4	4
W2B-05	Fort Taber	New Bedford	2	4	1	1	4
W2A-09	Sconticut Neck East	Fairhaven	2	1	3	2	4
W1F-01	Brandt Beach	Mattapoisett	2	1	2	2	4
W1E-06	Mattapoisett Town Beach	Mattapoisett	2	1	3	1	4
W1D-04	Holly Woods / Peases Point	Mattapoisett	2	1	2	2	3
W2A-08	Wilbur Point	Fairhaven	2	1	2	1	3
W1E-05	Mattapoisett Harbor East	Mattapoisett	2	1	1	1	3
W1C-05	Sippican Harbor East	Marion	1	1	3	4	2
E1-15	Crow Point	Falmouth	1	1	1	2	2

Notes:
1. Shaded segments are selected to be representative of this shoreline type.

TABLE 8
CRITERIA FOR PHASE II REPRESENTATION OF SHORELINE CLASSIFICATION: MARSH SHORELINES (1F SEGMENTS)
B120 RELEASE
BUZZARDS BAY, MASSACHUSETTS

Segment ID	Segment Name	Town	Most Recent Residual Oil	IRAC Status (2003)	Initial Oil Index (2003)	Ecological Ranking	Public Access
W2A-03	Pope's Beach	Fairhaven	3	1	3	2	4
W1E-02	Strawberry Cove	Mattapoisett	3	3	1	4	2
W1D-01	Aucoot Cove	Mattapoisett	2	1	1	4	2
W1F-05	Mattapoisett Neck West	Mattapoisett	1	1	4	3	1
W2A-02	Harbor View	Fairhaven	1	1	3	3	1
W2A-19	Shaw Cove	Fairhaven	1	1	2	3	3
W1F-04	Brandt Island Cove	Mattapoisett	1	1	2	3	3
W1B-15	Wareham River East Shore	Wareham	1	1	2	4	3
W1C-04	Blankinship Cove	Marion	1	1	1	4	3
W1C-11	Sippican Harbor West	Marion	1	1	1	4	3
W1F-09	Mattapoisett Harbor North	Mattapoisett	1	1	1	4	2
W3C-06	Demarest Lloyd State Park Marsh	Dartmouth	1	1	1	4	3

Notes:
1. Shaded segments are selected to be representative of this shoreline type.

TABLE 9
SELECTION OF PHASE II SUBTIDAL CHARACTERIZATION LOCATIONS
B120 RELEASE
BUZZARDS BAY, MASSACHUSETTS

Segment	Segment Name	Selection Criteria			Proposed Phase II Subtidal Characterization Field Activities
		Areas where the original slick was present	Adjacent to Moderately or Heavily Oiled Shorelines	Quiescent Areas Near Moderately or Heavily Oiled Shorelines Where Particles Would be Deposited	
W1C-02	Planting Island Causeway		✓		Composite sediment samples collected by hand along two transects on the west side of Planting Island
W1E-02	Strawberry Cove			✓	Composite sediment samples collected by hand along two transects in sandy area in cove.
W1E-03	Strawberry Point West		✓		Composite sediment samples collected by hand along two transects at west side of point (if sediment is present).
W1F-02	Brandt Island West		✓		Composite sediment samples collected by hand at eight locations.
W2A-03	Pope's Beach		✓		Composite sediment samples collected by boat at eight locations (four in the nearshore subtidal and four in the deeper subtidal).
W2A-07	Sconticut Neck West		✓		Composite sediment samples collected by boat at eight locations (four in the nearshore subtidal and four in the deeper subtidal).
W2A-10	Long Island and Causeway South		✓		Composite sediment samples collected by boat at fifteen locations.
W3C-04	Barney's Joy East	✓	✓		Composite sediment samples collected by boat at eight locations (four in the nearshore subtidal and four in the deeper subtidal).
W3C-05	Demarest Lloyd State Park Beach			✓	Composite sediment samples collected by boat at eight locations (four in the nearshore subtidal and four in the deeper subtidal).

Notes:
1. Composite sediment samples collected by hand will be composed of 3 to 5 grab samples collected along a transect parallel to the shoreline.
2. Composite sediment samples collected by boat will be composed of sediment collected using a Ponar clamshell-type sampler.