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Final Report

Task 13
Zone of
Siting Feasibility

RHODE ISLAND REGION LONG-TERM DREDGED MATERIAL DISPOSAL SITE EVALUATION PROJECT

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Rhode Island Region Long-Term Dredged Material Disposal Site Evaluation Project

Contract Number DACW33-01-D-0004
Project Number Delivery Order 0002

To

U.S. Army Corps of Engineers
North Atlantic Division
New England District
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EXECUTIVE SUMMARY

This study supports the Rhode Island Region Long-Term Dredged Material Disposal Site Evaluation Project by evaluating the upland and open water boundaries for a Zone of Siting Feasibility (ZSF). The evaluation initially identified a broad area in which detailed environmental analysis could be conducted to locate specific disposal site(s) for dredged material from Rhode Island and southeastern Massachusetts. The initial area considered for an open (ocean) water disposal site extended from the shorelines of Rhode Island and southeastern Massachusetts to the edge of the continental shelf. Because disposal options available in a region are helpful in determining the boundaries of a ZSF, this study also reviewed upland disposal, Confined Disposal Facilities, and open water disposal options.

The ZSF study incorporated the Dredging Needs Study of the Rhode Island Region Long-Term Dredged Material Disposal Site Evaluation Project (US Army Corps of Engineers, 2002), which projects volumes of dredged material over the next 20 years in the study area, and considered ZSF selection criteria based on the work of Pequegnat (International Maritime Organization, 2001) and the US Environmental Protection Agency (US EPA) (1986) and the US Army Corps of Engineers (Corps) (1999). These criteria are political boundaries, navigation restrictions, type of disposal plant, cost of transporting dredged material, and distance to the continental shelf. Identification of the ZSF boundaries assumed that safe and practical parameters of transporting dredged material to an open water site influence the open water limits of the ZSF.

The Dredging Needs Study (Corps, 2002) established dredging centers, areas where high volumes of dredged material will originate. Dredging centers were based on geographic location and logical points of origin for dredged material. There are four dredging centers in the region: Southern Rhode Island and Block Island Dredging Center, Narragansett Bay Dredging Center, Buzzards Bay Dredging Center, and Southern Cape Cod and the Islands Dredging Center. The projected total volume of dredged material from all four dredging centers over the next 20 years is almost 9 million cubic yards. The study initially assumed that all dredged material has the potential for open water disposal but recognized that future testing will establish acceptability of the material for ocean disposal or beneficial use. The Dredging Needs Study indicated that transport distances are most likely to focus around those dredging locations with the highest projected volume of dredged material, in this case the Narragansett Bay and Buzzards Bay Dredging Centers.

Both upland and open water limits were established for the ZSF. Analysis of the upland limit initially focused on the cost of transport and disposal of dredged material, but because of a wide range in costs (between $42 and more than $200 per cubic yard), transport time was used to establish the upper limit of transport distance. The upland limit of the ZSF was determined to be 50 miles from the study area's coastline. This distance allows for transport of dredged material to a disposal site by truck within an 8-hour workday. The 50-mile limit was modified to exclude the State of Connecticut.

The open water limit of the ZSF based on the five criteria of Pequegnat, US EPA, and the Corps, as well as state policies regarding disposal of dredged material, established the open water boundaries as follows. The northern boundary was set at the Territorial Limits of Rhode Island and Massachusetts. The western limit is based on the southerly projection of the state boundary between Rhode Island and Connecticut and excludes the Long Island Sound (LIS) Region. The LIS region is excluded because a separate Environmental Impact Statement (EIS) evaluating designation of disposal sites in that region is currently in progress. The southern boundary is based on a 20-mile travel distance from the southern-most dredging location on Block Island, which is considered reasonable transport distance considering costs ($15 to $20 per cubic yard of dredged material), safety, practicality, and efficiency within an 8-hour workday. The edge of the continental shelf, approximately 180 miles from the coastline, is not

considered a feasible option due to cost, operational limitations, and safety inherent to the transport of dredged material so far from the dredging locations.

The eastern boundary of the ZSF extends south from the Rhode Island/Massachusetts boundary until the line intersects 3-mile Territorial Limit of Massachusetts west of the Islands. The eastern limit then follows the 3-mile Territorial Limit to a point south of Noman's Land, then extends south approximately 20 miles until it intersects the seaward boundary of the ZSF. This boundary excludes Cape Cod and the Islands from the ZSF. This area is excluded from the ZSF because much of the dredged material from these areas will likely not need to be placed in an open-water disposal site. Five factors support this assumption. First, historic records show that dredged material from Cape Cod and the Islands has been used for beneficial use such as beach nourishment. Second, the Massachusetts state policy regarding reusable dredged material, as outlined in the Massachusetts Coastal Zone Management Plan (CZM) as defined by the Massachusetts Office of Coastal Zone Management 2002, is to use dredged material for beneficial use before considering disposal that results in no benefit. Third, the projected volume of dredged material from this area (2.6 million cubic yards) is relatively small compared to the Narragansett Bay and Buzzards Bay Dredging Centers (6.6 million cubic yards total) and historical experience indicates approximately half of the 2.6 million cubic yards will likely be used for beneficial use. Fourth, the Commonwealth of Massachusetts is currently in the process of designating a Section 404 disposal site in Buzzard's Bay within the state's 3-mile Territorial Limit and the small volume of material from this area that will not be used for beneficial use could utilize this site as a disposal option. Finally, the ZSF should be located within proximity of the areas projected to produce the largest volumes of dredged material to ensure that transportation will be economical, safe and practical, in this case, the Narragansett Bay and Buzzards Bay Dredging Centers.

The resulting ZSF is large enough to evaluate several alternative open water dredged material disposal sites that can be located within cost-effective haul distance for dredging within the Rhode Island and southeastern Massachusetts region.

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1.0 BACKGROUND

This study supports the Rhode Island Region Long-Term Dredged Material Disposal Site Evaluation Project by evaluating the Zone of Siting Feasibility (ZSF) for disposal of dredged material from Rhode Island and southeastern Massachusetts. The objective of the study is to determine the geographic boundaries of the ZSF. A ZSF is determined by general criteria used to identify the physical boundaries where a more detailed environmental analysis will take place to identify specific disposal location(s). The area considered in this study for locating an ocean disposal site extended from the shorelines of Rhode Island and southeastern Massachusetts to the edge of the continental shelf. Because disposal options available in a region are helpful in determining the boundaries of a ZSF, upland disposal, Confined Disposal Facilities, and open water disposal options were factored into the analysis.

2.0 LITERATURE REVIEW

The following sources were used in preparation of this document:

Gloucester Harbor Dredged Material Management Plan Draft Environmental Impact Report (CZM, September 2001). This report identified all the potential options available for the management and disposal of Gloucester Harbor dredged material.

Long Island Sound Dredged Material Disposal Environmental Impact Statement: Site Screening Process Fact Sheet (USEPA and Corps New England District, October 1999). This fact sheet outlined the process used by the two Federal agencies in determining the ZSF and specific alternative sites for dredged material disposal from facilities participating in the Long Island Sound project.

Providence River and Harbor Maintenance Dredging Project Final Environmental Impact Statement (FEIS) (Corps New England District, August 2001). This document evaluated potential dredging and disposal alternatives for the Federal Providence River and Harbor Maintenance Dredging Project and twenty non-Federal projects in Rhode Island. The document examined alternatives to dredging and alternative disposal as well as environmental and economic impacts of such activities.

Designation of Dredged Material Disposal Site(s) for Rhode Island and Southeastern Massachusetts: Task 6 – Delineate Zone of Siting Feasibility For Disposal and *Task 7 – Identify Initial Screening Criteria For Sites and Methods* (Metcalf and Eddy, November 1987). Task 6 examined potential upland, near shore and ocean disposal areas for dredged material from Rhode Island and Southeastern Massachusetts. The primary focus was to designate an area that was located within an economically feasible transport distance. Task 7 established screening criteria to eliminate portions of the study area from consideration for dredged material disposal.

Rhode Island and Southeastern Massachusetts Dredging Needs Survey, 1985 – 1995: Rhode Island Sound Regional Disposal Site Study (SAIC, April 1985). This report compiled data from surveys to various boatyards, marinas, yacht clubs and municipal coastal facilities and compared them to past reports on dredging activities. The intent was to determine future dredging needs in the study area.

Waste Assessment Guidance Training Set: Participants' Manual (International Maritime Organization, October 2001). Although this is an international document, the manual provides guidance in selecting a disposal site for dredged material. They cite W.E. Pequegnat as a source and use his guidelines to

establish principal factors to consider a ZSF such as shipping costs and operational constraints. The section entitled "Step 4 – Selection of A Disposal Site" was used to support this report.

New Bedford/Fairhaven Harbor Dredged Material Management Plan (DMMP) Draft Environmental Impact Report (CZM, April 30, 2002). This report identified all the potential options available for the management and disposal of New Bedford/Fairhaven Harbor dredged material.

Ocean Dumping Site Designation Delegation Handbook. U.S. Environmental Protection Agency, 30 September 1986.

3.0 METHOD

Determination of the ZSF boundaries involved incorporation of the Dredging Needs Study of the Rhode Island Region Long-Term Dredged Material Disposal Site Evaluation Project (Corps, 2002) and an analysis of five criteria based on the work of Pequegnat (International Maritime Organization, 2001), the USEPA,1986 and Corps, 1999. It was assumed that the results of the Dredging Needs Study would affect the open water limits. The Dredging Needs Study shows the projected volumes of dredged material over the next 20 years from surveyed navigation dependent facilities and Federal navigation projects in the region. The examination also applied five ZSF selection criteria recommended by Pequegnat and US EPA and the Corps, which are:

- Political boundaries
- Navigation restrictions
- Type of disposal plant
- Cost of transporting dredged material
- Distance to the Continental Shelf

Environmental windows were considered in the evaluation because they impose additional temporal and economic constraints on dredging operation. Furthermore, it was assumed that safe and practical factors of transporting dredged material to an open water site could influence the outer limits of the ZSF. Factors considered included the size of barges and other equipment, and the distance at sea the barges can operate before operational and safety risks start to increase. Initially, it was assumed that all dredged material has the potential for open water disposal. However, actual volumes will depend on the material proposed for dredging being found acceptable for ocean disposal and other disposal options (e.g. beneficial use) are not appropriate use of the material. These factors were considered during development of the ZSF.

4.0 DISCUSSION

4.1 Dredging Needs Study

The Dredging Needs Study (Corps, 2002) was performed to determine the expected future quantities of dredged material that may be generated from the Rhode Island and southeastern Massachusetts region over the next 20 years. Components of the Dredging Needs Study included:

- Identification of the Universe of Navigation Dependent Facilities in Study Area
- Survey of Navigation Dependent Facilities
- Review of Army Corps of Engineers Permit Data

- Projection of Future Dredging Volumes from Federal Navigation Projects
- Determination of Dredging Needs and Future Quantities

Each component was built on the previous component to project total dredging volumes within the next 20 years. A projection of the volume of dredged material contributes key information for the detailed analysis of alternative disposal locations to be conducted in the Rhode Island Sound Disposal Site Designation Environmental Impact Statement. This information is also central to determine the appropriate region to be evaluated for potential disposal sites.

A database was created that includes contact information for the navigation dependent facilities surveyed and their responses, or lack of, to the questionnaire. The final number of public and private facilities surveyed in this study was 450 (228 in Rhode Island and 222 in Massachusetts). The response rate to the survey was 39.6 percent.

A total of 42 Federal navigation projects were identified in the region, 19 in Rhode Island, and 23 in Massachusetts. However, only 26 of 42 of the projects were used to project dredging volumes. Fifteen of the projects involve beach nourishment and do not require a disposal alternative in the future and one (New Bedford/Fairhaven Harbor) has been determined to have material unacceptable for ocean disposal.

The projections were also used to establish dredging centers. These are areas where high volumes of future dredged material can be identified. The dredging centers are based on geographic location and logical points of origin for dredged material. Four dredging centers were identified for the study area (Figure 1): Southern Rhode Island and Block Island Dredging Center, Narragansett Bay Dredging Center, Buzzards Bay Dredging Center, and Southern Cape Cod and the Islands Dredging Center. Once dredging centers were established, future dredging needs and quantities were projected.

Table 1, summarizes the total dredging needs and future quantities of dredged material for the Rhode Island and southeastern Massachusetts region. The total volume of dredged material over the next 20 years is projected to be 8,771,429 cubic yards and includes maintenance and improvement volumes. The total volume does not include the dredging associated with the proposed construction of a container port at Quonset Point/Davisville in North Kingstown, Rhode Island, which is estimated to be between 8 and 14 million cubic yards within the Narragansett Bay Dredging Center (Corps, 2002).

Approximately two thirds of the projected volume for the Rhode Island and southeastern Massachusetts region is for maintenance dredging (Table 1). Approximately 78% of the future dredging requirement is projected to occur within the first 10 years of the planning horizon.

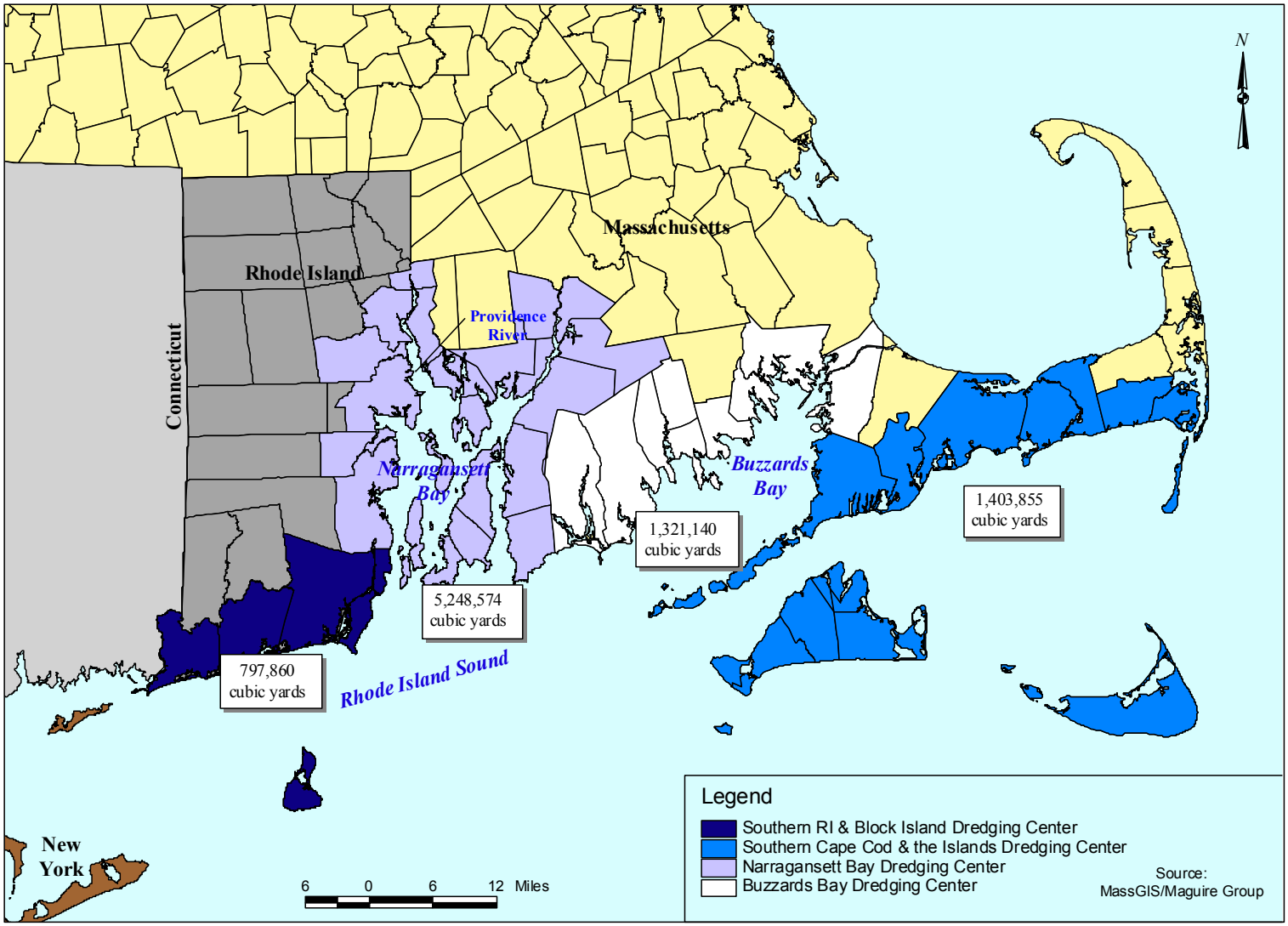

Figure 1. RI Region Long-Term Dredged Material Disposal Site Evaluation Study – Dredging Centers (2002)

Note: These totals do not include known surveyed non-Federal facilities that will incorporate beneficial use of dredged material, such as beach nourishment, which is 1,200,000 cubic yards. Additionally, the totals do not include Federal Navigation Projects that will utilize beneficial use of dredged material, such as beach nourishment, totaling 919,500 cubic yards. Furthermore, the New Bedford/Fairhaven Harbor Project, totaling 1,783,500 cubic yards, is not included because the Corps has already established the material is unsuitable for offshore disposal. Quonset Point/Davisville is excluded because the dredging associated with the proposed container port, between 8 and 14 million cubic yards, is not a Federal project and its realization is not known at this time.

Table 1. Summary of total dredging needs and future quantities of dredged material for the Rhode Island and southeastern Massachusetts region by 2021

Year	Maintenance (cy)	Total (cy)
2002-2006	2,569,574	4,660,744
2007-2011	1,804,650	2,149,350
2012-2016	381,975	627,000
2017-2021	1,135,915	1,334,335
20-year Total	**5,892,114**	**8,771,429**

A dredging needs study completed in 1984 for the Corps by SAIC (1985), projected future volumes of dredged material for the Rhode Island Sound Region between 1985 and 1995. The current and future dredging needs aspects of navigation dependent facilities examined in the SAIC study are similar to those evaluated in the present study. The SAIC surveyed facilities in the region and received respondents from 285 Rhode Island facilities and 163 Massachusetts facilities (448 total). The total projected volume from 1985 to 1995 for both Rhode Island and Massachusetts was 8.77 million cubic yards. Historic permit data from the Corps indicates that only 2.4 million cubic yards was dredged between 1983 and 2002. The current 20-year projection also estimates the future need at 8.77 million cubic yards of dredged material. Comparison of the two projections indicates that the region still needs to dredge an estimated 6.37 million cubic yards of that originally estimated in 1995 and to anticipate an additional 2.4 million cubic yards in dredging volume. In the SAIC study, 44.7% of the respondents anticipated dredging within 10 years. In the current study, most respondents (93.3%) anticipate dredging within 20 years. Between 1985 and 1995, a majority of the facilities responded that dredging would be for improvement of existing facilities (2/3 of Rhode Island facilities surveyed and 87% of Massachusetts facilities surveyed). The Dredging Needs Study's projections to 2021 indicate that nearly all dredging will be for maintenance or a combination of improvement and maintenance.

The distribution of the 20-year projections of dredged material volumes among the dredging centers (Figure 2) shows the Southern Rhode Island and Block Island Dredging Center has the smallest proportion (9.1%) and the Narragansett Bay Dredging Center has the largest (59.8%). The volume for the Narragansett Bay Dredging Center does not include estimates of material that could be generated under the container port concept at Quonset Point/Davisville.

The distribution of dredging needs and range of volumes of dredged material by municipality, or dredging location, within each center is shown in Figure 2. The figure reflects the total volumes for Federal navigation projects and non-Federal facilities responding to the Corps needs survey (Corps 2002). There are several locations throughout the entire study area with projected volumes that are less than 200,000 cubic yards in the next 20 years. The Narragansett Bay Dredging Center has the highest concentration of locations projecting more than 500,000 cubic yards and two locations anticipating 1 to 2 million cubic yards. The Southern Cape Cod and the Islands Dredging Center has one location, Chatham, with a projected dredging volume over 1 million cubic yards, almost entirely from non-Federal facilitates. Historic dredging activities suggest that much of this material may be used for beneficial use such as beach nourishment and not require an offshore disposal site.

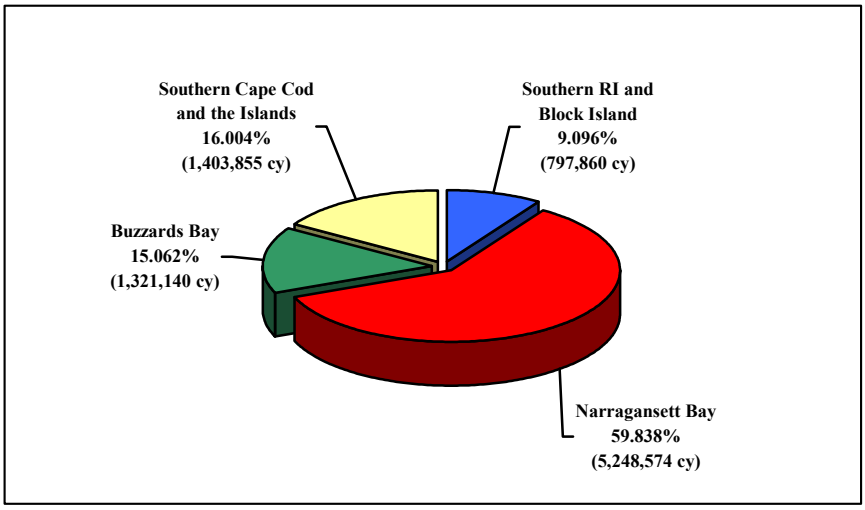

Figure 2. Dredging centers in the Rhode Island and southeastern Massachusetts region: Percent of total volume of dredged material for the region projected between 2002 and 2021 (8,771,429 cy)

Note: This total does not include known surveyed non-Federal facilities that will incorporate beneficial use of dredged material, such as beach nourishment, which is 1,200,000 cubic yards. Additionally, the totals do not include Federal Navigation Projects that will utilize beneficial use of dredged material, such as beach nourishment, totaling 919,500 cubic yards. Furthermore, the New Bedford/Fairhaven Harbor Project, totaling 1,783,500 cubic yards, is not included because the Corps has already established the material is unsuitable for offshore disposal. Volume estimates for the conceptual Quonset Point/Davisville container port are also excluded.

The location at which the largest volumes of dredged material are likely to originate greatly influences the ZSF. Transport distances are most likely to be centered on the dredging locations with the highest projected volume of dredged material. This study identified the Narragansett Bay and Buzzards Bay Dredging Centers as the centers most likely to require an open ocean disposal option.

The rationale for setting the ZSF boundaries is discussed in the following sections

4.2 Upland Limit

The upland limit of the ZSF was calculated based on the Providence River and Harbor Dredging Maintenance FEIS (Corp, 2001) and the New Bedford/Fairhaven Harbor DMMP (CZM, 2002). Two alternatives were considered: creation of a new disposal site and existing sites that would accept dredged material such as a landfill. Table 2 summarizes the data from both plans and shows the new site with two alternative types of liner. Costs to dredge and transport material to an upland site range from $43 to $200 per cubic yard. This large difference is due to the varying fees of individual landfills, which assumes the inclusion of management and monitoring of the disposal site (See Appendix A – Cost Analyses).

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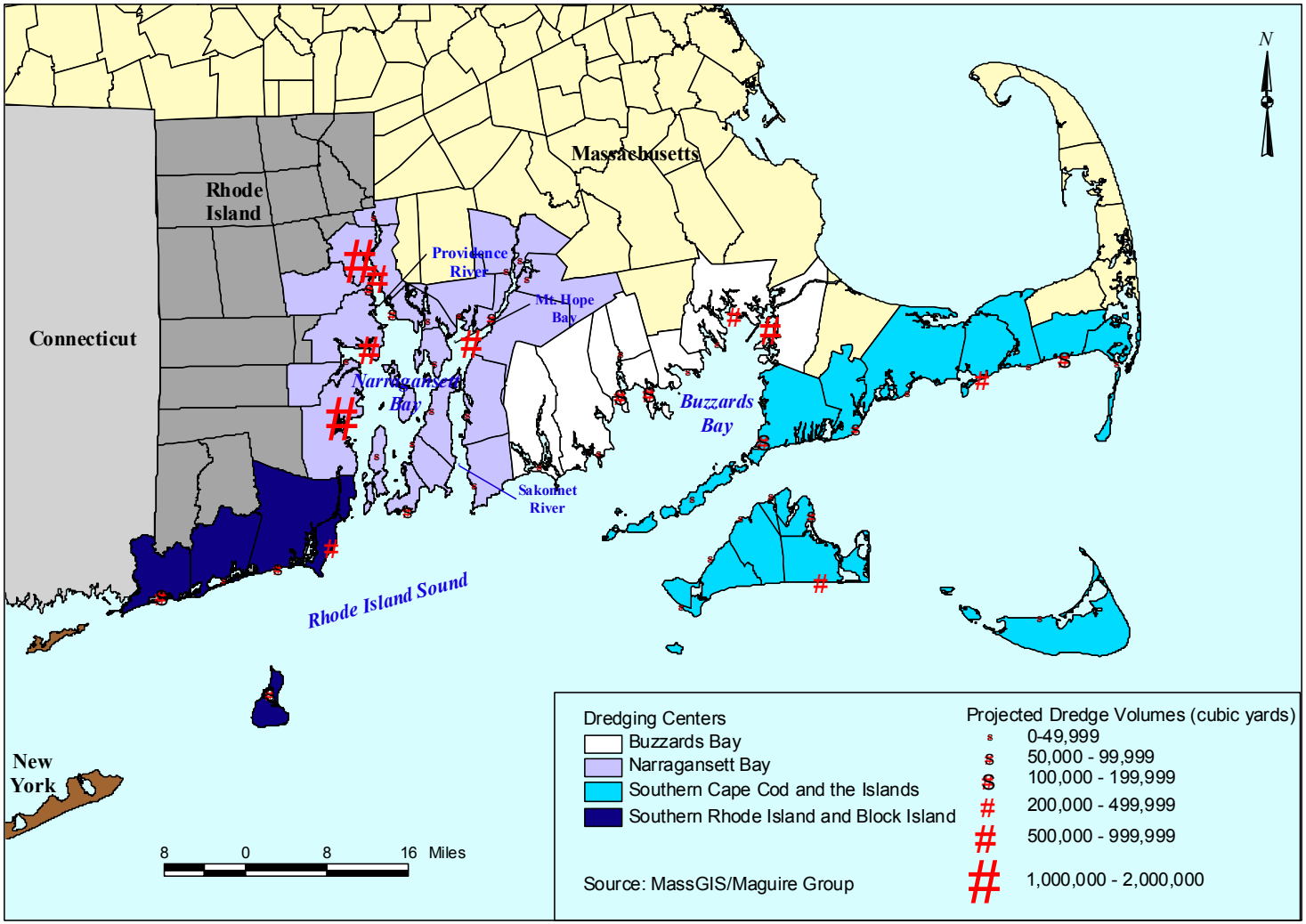

Figure 3. RI Region Long-Term Dredged Material Disposal Site Evaluation Study – Dredging Locations and Projected Volumes of dredged material over the next 20 years (2002)

Note: This total does not include known surveyed non-Federal facilities that will incorporate beneficial use of dredged material, such as beach nourishment, which is 1,200,000 cubic yards. Additionally, the totals do not include Federal Navigation Projects that will utilize beneficial use of dredged material, such as beach nourishment, totaling 919,500 cubic yards. Furthermore, the New Bedford/Fairhaven Harbor Project, totaling 1,783,500 cubic yards, is not included because the Corps has already established the material is unsuitable for offshore disposal. Quonset Point/Davisville is excluded because the dredging associated with the proposed container port, between 8 and 14 million cubic yards, is not a Federal project and its realization is not known at this time.

Table 2. Estimated costs associated with Upland Disposal of Dredged Material in the Rhode Island and southeastern Massachusetts region.

	Unit Cost ($/cy)[a]	Dewatering ($/cy)[b]	Hauling ($/cy)[c]	Dike Fill Unit Cost ($/cy)[d]	Landfill Fee ($/cy)[e]	Total Cost ($/cy)[f]
New site development (not including costs to obtain property)						
No liner	$8.50	$6.00	$5.00	$12.00		$42.53
Thin Liner	$8.50	$6.00	$5.00	$20.00		$53.33
Existing site A*	$8.50	$6.00	$5.50		$57.00	$103.95
Existing site B**		$20.00***	$17.00		$25.00	$62.00
Existing site C**		$20.00***	$17.00		$163.00	$200.00

* Providence River and Harbor Dredging Maintenance FEIS
** New Bedford/Fairhaven DMMP
*** Includes dewatering site preparation, operation and restoration
(a) Unit cost of dredging and disposal including double handling
(b) Dewatering unit cost consists of $1.50 material handling, $1.50 offloading, and $3 temporary dike
(c) Unit cost to transport the disposal material from dewatering site to the upland facility by truck
(d) Upland dike facility cost
(e) Landfill fee for the disposal material
(f) Final unit cost per cubic yard of dredged material, including mark up (x1.35)

Other factors affecting approval of new upland disposal sites is the requirement for lengthy environmental studies as well as time for review and approval by regulatory officials. Costs associated with conducting such studies and receiving required approvals are not included in this analysis.

Because disposal costs vary greatly, the upland portion of the ZSF was analyzed using a travel distance of 50 miles from the region's coastline (Figure 4). The 50 mile limit allows for transport of dredged material to a disposal site by truck within an 8-hour working day. A number of potential sites for dredged material disposal include active landfills in both states and inactive landfills (where material might be used for final grading and landfill closure) in Massachusetts and these sites are contained within the 50-mile upland limit. These facilities range greatly in size and site-specific evaluations would eliminate those that do not meet screening criteria. Landfills within these limits include, but are not limited to, the BFI Fall River Landfill (Fall River, Massachusetts), Northern Disposal BFI Landfill (East Bridgewater, Massachusetts), Bates Quarry (Weymouth, Massachusetts), Cecil Smith Landfill (Dartmouth, Massachusetts) and Central Landfill (Johnston, Rhode Island) (CZM, 2002 and Corps, 2001). This area also contains major roadways by which dredged material can be transported (Figure 5).

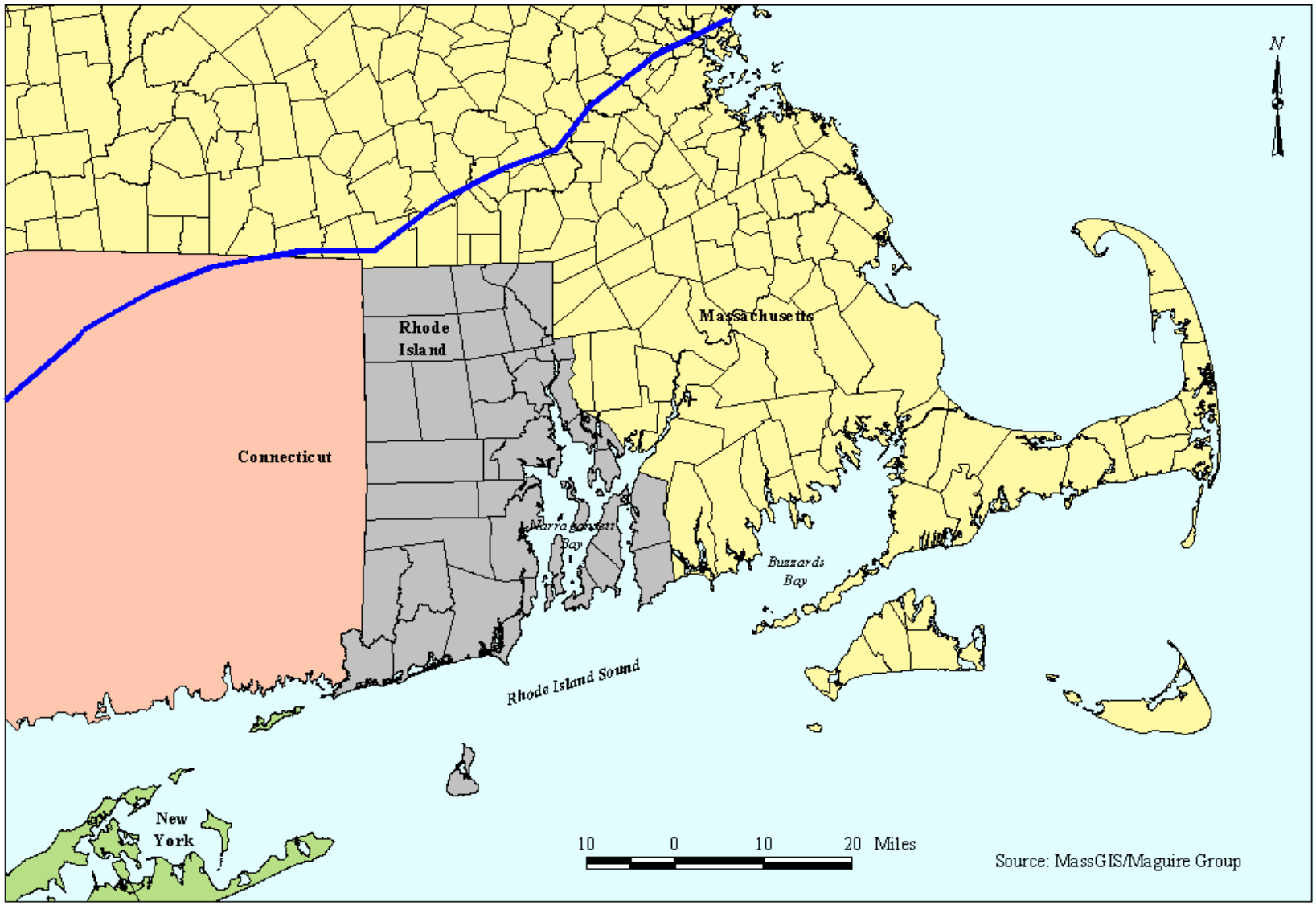

Figure 4. RI Region Long-Term Dredged Material Disposal Site Evaluation Study – Upland Limit: 50 miles from the region's coastline (2002)

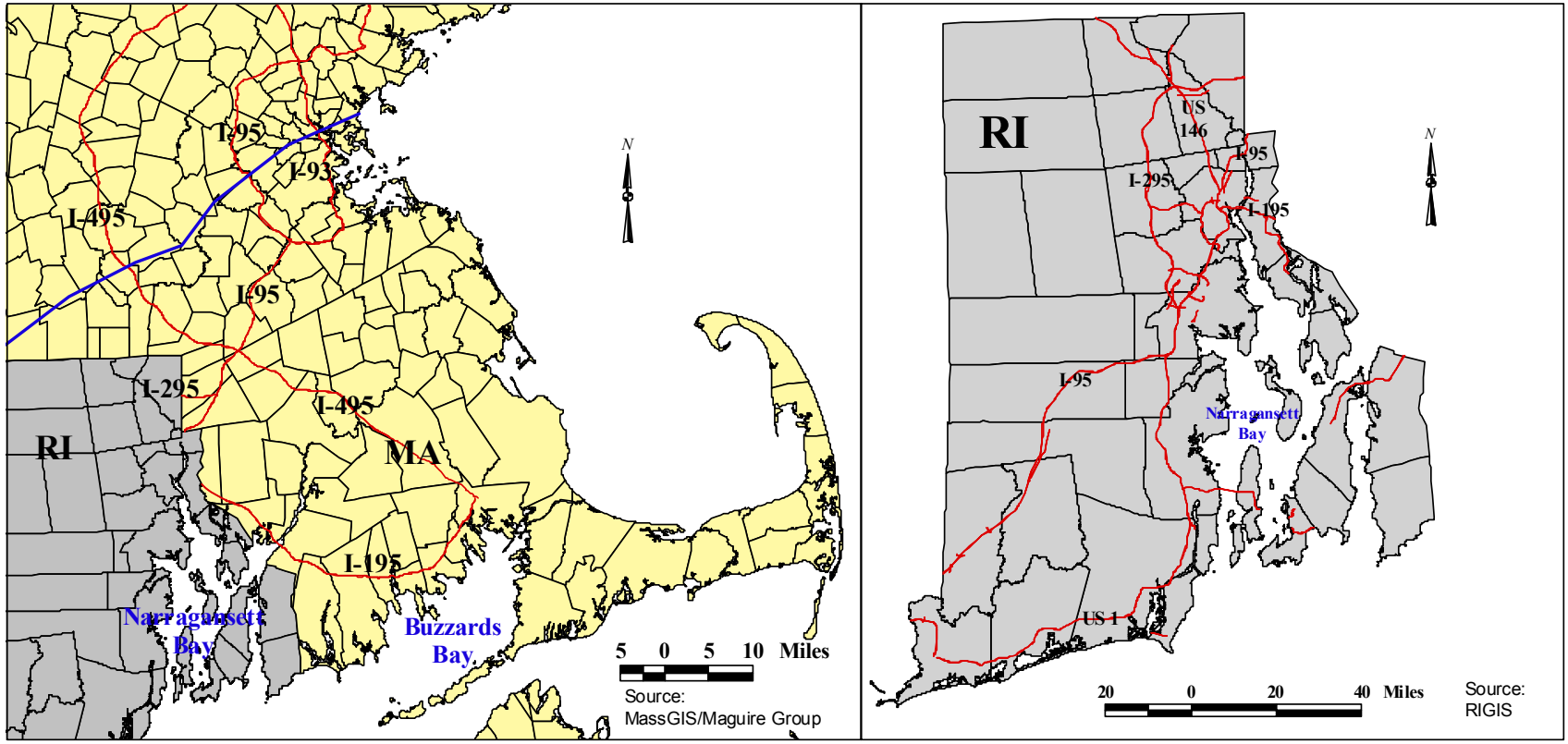

Figure 5. RI Region Long-Term Dredged Material Disposal Site Evaluation Study – Major Highways (2002)

4.3 Combined Disposal Facility

The Confined Disposal Facility (CDF) is defined as a disposal method that isolates the dredged material from the environment (US EPA, 2002). A CDF can be located either in-water or upland and involves the construction of a dike and the disposal of dredged material behind the dike via pipeline or other means. A CDF may be part of a larger restoration project such as beach nourishment, island expansion, or construction of habitats. These sites are most likely to be found within the coastal areas of Rhode Island and southeastern Massachusetts. Navigation restrictions associated with CDFs are minimal since they are not created in traffic lanes.

The Providence River and Harbor Dredging Maintenance FEIS (Corps, 2001) calculated costs for dike construction within the Providence area and loading of dredged material. It is assumed that these costs represent the current typical costs associated with the CDF disposal method (Table 3) and apply to the Rhode Island and southeastern Massachusetts region. Costs associated with dredging and use of a CDF include dike construction, hydroseed costs, dewatering costs, and the cost to transfer the dredged material from the dewatering site to the CDF. It is estimated that it would cost $15.60 per cubic yard for disposal of dredged material from a 250,000 cy project (See Appendix A – Cost Analyses).

The size and design of a CDF is site specific, depending on the location, the type of sediment and nature of contaminants, potential amount of material and how the facility will be used or function once it is full or no longer receiving dredged material (USEPA, 2002). These factors may contribute to the feasibility of using CDFs in this region. Its use may be more appropriate in one area rather than another.

Table 3. Cost of dredging and use of a Combined Disposal Facility

For a Dike 10 feet in height and 49,300 cy quantity	Dike cost ($mil)[(a)]	Hydroseed Cost ($mil)[(b)]	Dewatering Structures Cost ($mil)[(c)]	Subtotal (x1.35) ($mil)[(d)]	Dredge & Transfer Cost ($mil)[(e)]	Total Cost ($mil)[(f)]	Unit Cost ($/cy)[(g)]
250,000 cy of dredged material	$0.60	$0.10	$0.10	$1.10	$2.80	$3.90	$15.60

(a0 Cost of dike construction at $12 per cubic yard
(b) Hydroseeding and slope protection
(c) Cost of weir, piping and related structures
(d) Subtotal cost of columns 1, 2, and 3 for cost sharing including mark up (x 1.35)
(e) Cost of dredging from a CAD cell and loading to dewatering site including mark ups (x 1.35)
(f) Total direct construction cost
(g) The unit cost per cubic yard of the disposal material at a particular crest height
Source: Providence River and Harbor Maintenance Dredging Final Environmental Impact Statement

4.4 Open Water Limit

The following analysis for the open water limit is based on the five criteria of Pequegnat (International Maritime Organization, 2001), and US EPA and the Corps (1999), with the inclusion of environmental windows. It is assumed that all dredged material has the potential for open-water disposal if testing indicates that it meets criteria and alternative analysis indicates that the material is not suitable for beneficial reuse.

4.4.1 Political Boundaries

Political boundaries that impact the ZSF include the limits of the Territorial Sea (baseline), the 3-mile Territorial Sea of Rhode Island, the 3-mile Territorial Sea of southeastern Massachusetts, the boundary between this study and the study occurring in the Long Island Sound Region, and the state borders of Connecticut and Rhode Island. These boundaries relate to the various jurisdictions established by Sections 401 and 404 of the Clean Water Act.

4.4.2 Navigation Restrictions

Commercial and recreational navigation lanes are shown in Figure 6. There are shipping lanes leading to Narragansett Bay and Buzzards Bay. A more detailed analysis of site-specific designation will consider these areas to avoid conflicts using criteria outlined in 40 CFR 228.6.

4.4.3 Type of Disposal Method

Dredge types and sizes depend mainly on availability, job duration, type of material, exposure to the elements, disposal area constraints, environmental constraints, and production requirements (US Army Corps of Engineers, 1994). In this study, mechanical dredging and barging, as well as pumping the material to a disposal site, were analyzed.

4.4.4 Cost of Transporting Dredged Material

The costs associated with transporting dredged material to a disposal site include mobilization and demobilization costs, design and engineering costs, and construction and management costs, as well as escalation, verification and contingency costs. Several factors influence these costs such as the distance to the disposal site, safety measures, and practicality. Unit costs are further influenced by fuel costs, personnel costs, insurance costs and "downtime" at the dredging location. Many sources were consulted to obtain typical costs in the region. They include the Providence River and Harbor Maintenance Dredging Project FEIS (Corps, 2001) and the New Bedford/Fairhaven Harbor DMMP Draft Environmental Impact Report (CMZ, 2002). National dredging companies were also contacted, but information received was extremely general.

The open water limit of the ZSF described below was examined based on a 20-mile transporting distance. This distance is based on the review of the plans mentioned above and the typical costs associated with dredging as discussed with national dredging companies. Results show that overall costs begin at $11.60 per cubic yard for open water disposal by barge within 10 miles and increase to $25 or more per cubic yard for mechanical dredging and disposal by barge at a distance of 40 miles (Table 4). The range in cost of disposal through a pipeline was similar to barging but hydraulic methods are not practical for open water disposal (Table 4). Reasonable costs per cubic yard are assumed to range from $10 to $20, which is supported by navigation dependent facilities in the region. The questionnaire of the Dredging Needs Survey (Corps, 2002) asked respondents what they felt was an affordable cost per cubic yard of dredged material. The average cost cited by those who responded to the question was $17.60 per cubic yard (the mean was $10 per cubic yard) (See Appendix A – Cost Analyses).

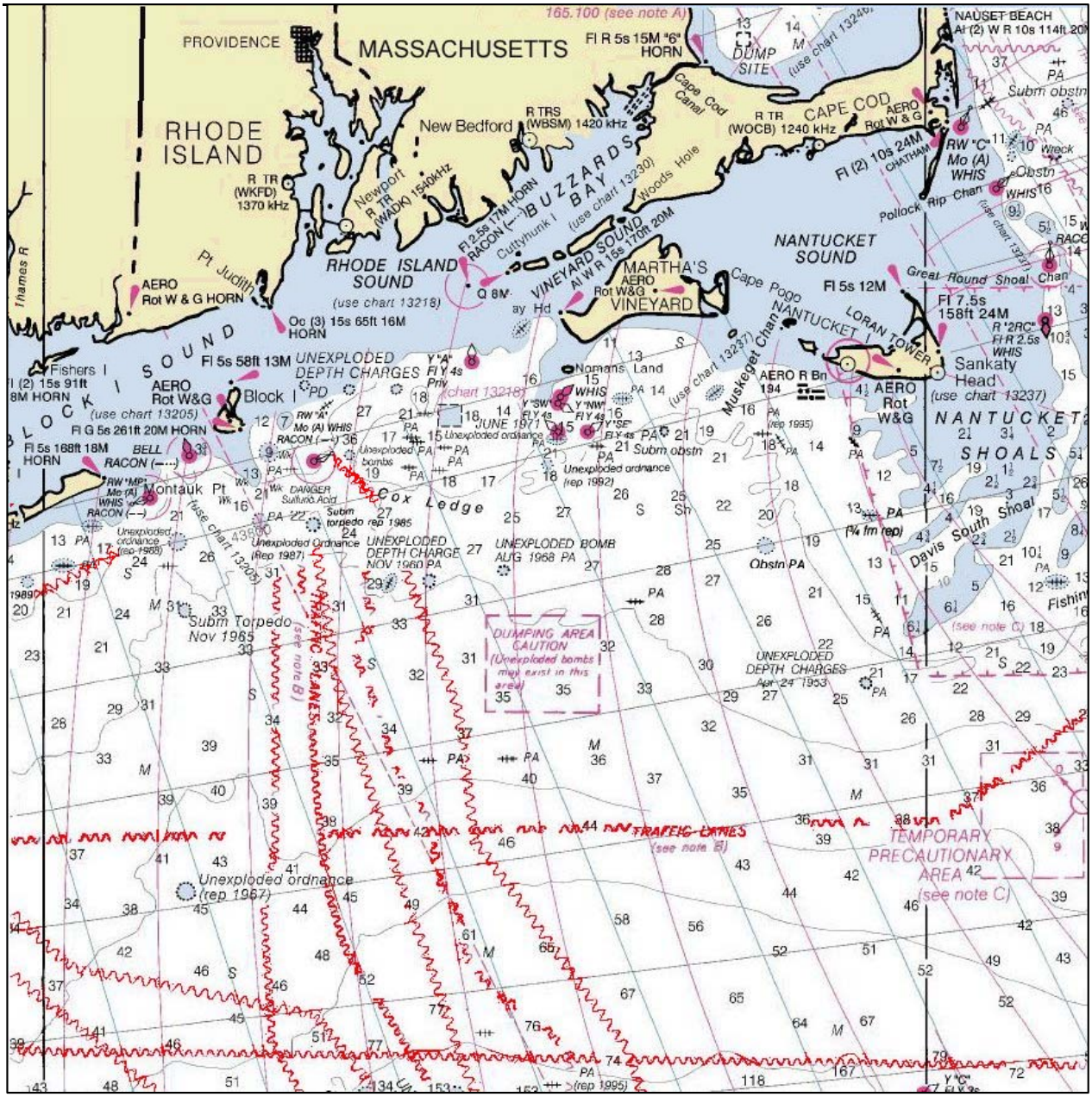

Figure 6. NOAA nautical chart of the general area contained within the Zone of Siting Feasibility (not to scale). Travel lanes in red

The actual costs of dredging will vary based on the actual distance from the dredge site to the disposal site and the volume of material to be dredged, and can greatly influence the unit cost of dredging and disposal. For example, the Providence River channel dredging is located almost 40 miles from the designated disposal site 20 miles offshore. However, because quantity of sediments to be dredged from the Providence channel is large, ocean disposal is still a viable disposal option for Providence dredging. In contrast, a small marina may be located closer to the disposal site, but if it is not accessible to a large capacity ocean-going barge, then ocean disposal may not be practical and costs would vary.

Table 4. Regional costs of open water disposal

Near Shore and Open-water Disposal (Barge)			
Distance (miles)	**Unit Cost ($/cy)[a]**	**Mob/Demob ($/cy)[b]**	**Total Cost ($/cy)[c]**
10	$8.00 - 12.00	$0.60	$11.61 - 17.01
20	$10.00 - 14.00	$0.60	$14.31 - 19.71
30	$12.00 -16.00	$0.60	$17.01 – 22.41
40	$14.00 – 18.00	$0.60	$14.31 – 25.11
Near Shore and Open-water Disposal (Pipeline)			
Distance (miles)	**Unit Cost ($/cy)**	**Mob/Demob ($/cy)**	**Total Cost ($/cy)**
10	$7.00 - 9.00	$0.60	$10.26 -12.96
20	$9.00 - $11.00	$0.60	$12.96 – 15.66
30	$13.00 – 16.00	$0.60	$18.36 – 22.41
40	$18.00 – 20.00	$0.60	$25.11 – 27.00

(a) Estimated unit cost of dredging and disposing based on national dredging companies.
(b) Mobilization and demobilization for dredging
(c) Final cost per cubic yard of dredged material, including mark up (x1.35)

After analyzing costs associated with transporting dredged material and determining an economic, safe and practical distance, the next step was to delineate a 20-mile boundary and mark the open water limits of the ZSF. The analysis involved drawing 20-mile distances from three locations. First, the geographic center of each Dredging Center identified in the Dredging Needs Study was estimated and a 20-mile ring was drawn as a potential outer limit. Second, a 20-mile ring was drawn around each dredging location/municipality in the study area and, again, the outer edge of all the rings was taken as another boundary (See Appendix B for individual 20-mile rings around each dredging location). Finally, a line was drawn 20 miles from the 3-mile Territorial Limit. This limit was selected under a working assumption that open waster disposal should be beyond the states' 3-mile Territorial Sea. Note the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA) establishes the territorial sea baseline as the boundary delimitating disposal regulated under MPRSA.

Figure 7 shows the three potential 20-mile limit boundaries based on these three seawater boundary scenarios. The two most-seaward limits, 20 miles from the dredging locations and 20 miles from the 3-mile Territorial Limit, have the most potential to be an outer limit of the ZSF because they incorporate a larger area, allowing for more options for disposal site(s) selection. The southern-most dredging location, Block Island, is approximately 25 miles from the line drawn 20 miles from the 3-mile Territorial Limit. The additional travel distance of 5 miles may not greatly impact transporting material from this location, which is minimal since most of this material is marked for beach nourishment as identified by the Corps. However, the boundary located 20 miles from the 3-mile Territorial Limit impacts the Narragansett Bay and Buzzards Bay Dredging Centers, which have the highest projected volumes of dredged material. A section of an outer limit of twenty miles from dredging locations/municipalities was considered a safe and practical distance from the dredge centers that incorporates an area in open water meeting the three previous criteria: political boundaries, disposal method, and navigation restrictions.

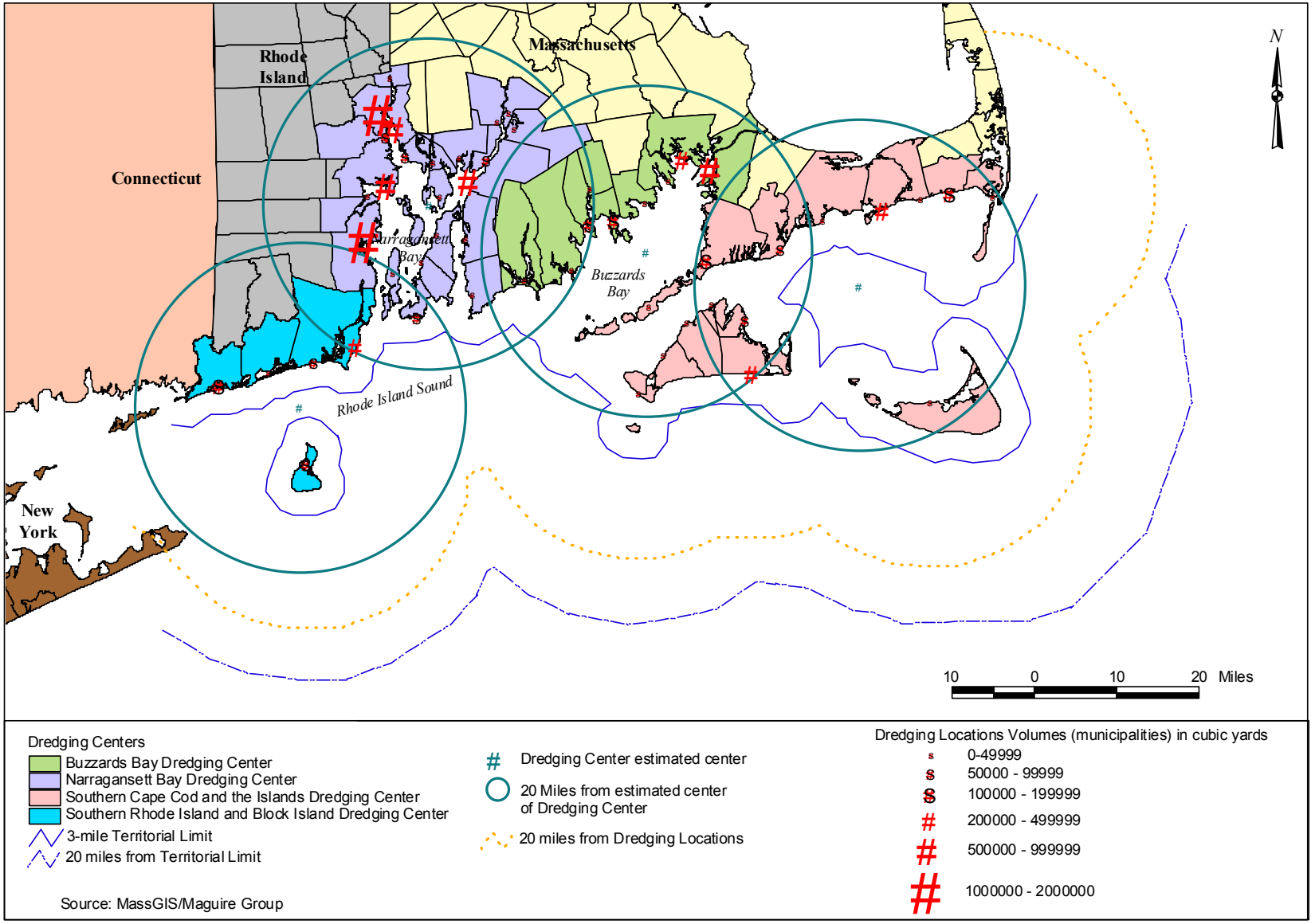

Figure 7. RI Region Long-Term Dredged Material Disposal Site Evaluation Study – Analysis of 20-mile distance for ZSF (2002)

4.4.5 Environmental Windows

Environmental windows are restrictions imposed on dredging projects based on a variety of rationales, which include:

- Disruption of nesting activities
- Sedimentation on fish spawning
- Turbidity on fish spawning
- Sedimentation or turbidity on shellfish spawning
- Entrainment of sea turtles
- Collisions with marine mammals
- Disruption of migration patterns
- Disruption of recreational activities

Environmental windows in the Rhode Island and southeastern Massachusetts region are typically between September and January. Reine *et. al.* (1998) states that New England was one of three Districts of the Corps that had the largest number of requests for temporal restrictions on Federal navigation projects between 1987 and 1996. In addition, they stated that the North Atlantic and South Atlantic Divisions of the Corps had 85% of all Federal dredging projects impacted by windows, indicating the likelihood of environmental windows being imposed on potential dredging projects in the Rhode Island and southeastern Massachusetts region within the next 20 years.

Dickerson *et. al*. (1998) attempted to examine the economic impacts of environmental windows on dredging operations. Many assumptions were made to perform 38 hypothetical dredging project scenarios to address the most common conditions encountered. The data used in this study involved surveying the Districts and Divisions of the Corps regarding types, volumes, and environmental windows of dredging projects. This information was combined with historic data at the Corps to develop the scenarios. Compliance with windows limits the months available for dredging and reduces overall efficiency of projects. Factors that contribute to reduced efficiency include, but are not limited to:

- Increased transport distances to acceptable placement sites
- Increased fuel costs due to seasonal differences in cost or availability or logistical problems
- Increased operational time due to reduced vessel speeds
- Allowances for longer mobilization/demobilization times
- Increased fuel usage during cold month weather conditions
- Precautionary measures to prevent icing hazards
- Other personal safety considerations
- Personnel availability constraints
- Equipment delays due to inclement weather

In their opinion, these factors illustrated the difficulty in examining the costs associated with environmental windows on dredging operations. However, they felt their work showed a strong linkage between temporal constraints and operational costs. In their analysis, dredging costs per cubic yard decreased as both dredging efficiency and months available for dredging increased. Conversely, dredging costs increased as dredging efficiency and environmental windows for project completion decreased.

Environmental windows of the region influence the selection of boundaries for the ZSF by incorporating safety and practical concerns regarding overall dredging operations. It was assumed that most dredging will occur during the colder months and the extent of the open water limit of the ZSF should be within a reasonable travel distance to ensure efficiency, safety, and practicality.

4.4.6 Distance to the Edge of the Continental Shelf

The edge of the continental shelf is to be examined as a potential site for open water disposal of dredged material from the region. The edge is approximately 185 miles from the coastline of the study area (Figure 8). This is not viewed as a reasonable distance to transport dredged material from the various dredging locations. Factors such as safety, costs, and time prohibit the use of the edge of the continental shelf as a potential disposal site. Transporting dredged material to the continental shelf would greatly increase costs such as those associated with fuel, insurance, personnel, and require additional equipment to ensure operational aspects of the dredging are optimized, making the use of a site at the continental shelf uneconomical. Metcalf and Eddy (1987) estimated that reaching the continental shelf from dredge sites in coastal Rhode Island, would cost $15 to $16 per cubic yard using 1987 dredging methods and costs. In 2002, the cost could rise above $25 per cubic yard and increase the transport time of one barge round trip at less than 5 knots to nearly 3 to 4 days (Massachusetts Office of Coastal Zone Management, 2001). This would require additional barges and tugs to maintain project schedules and adding to cost of dredging. Considering environmental windows of the area, traveling 3 to 4 days to the edge of the continental shelf imposes greater risks because of the factors relating to fuel, inclement weather, and personnel and equipment availability.

5.0 RESULTING ZONE OF SITING FEASIBILITY

The analyses in the preceding section were used to delineate the ZSF for the Rhode Island and southeastern Massachusetts region. The upland limit initially focused on costs and showed the transportation of dredged material to existing landfill facilities can start at $42 per cubic yard and can be $200 cy or more. Because of the varying costs, transport time was used to identify the upland limit. Fifty miles allows transport of dredged material to a disposal site by truck within an 8-hour working day (CZM, 2002). This was selected as an appropriate upland boundary. The upland boundary (Figure 9) marked by 50 miles from the region's coastline was modified to exclude the State of Connecticut.

The open water limit of the ZSF (Figure 10) is based on the identified criteria established by Pequegnat (International Maritime Organization, 2001) and USEPA and the Corps (1999), as well as state policies regarding disposal of dredged material. The northern and western limits of the ZSF are based on political boundaries. The limit of the territorial sea delineates the northern boundary to ensure consistency with MPRSA requirements. The western limit is based on the state boundary between Rhode Island and Connecticut and excludes the Long Island Sound Region.

The southern and eastern boundaries of the ZSF were established using systematic application of variables associated with costs of transporting dredged material, distance to the continental shelf, safety and practical concerns of transporting dredged material, and state policies on disposal of dredged material. In the previous discussion, it is assumed, based on the cost analysis, that transporting dredged material 20 miles is a reasonable distance. Therefore, the southern boundary is based on extending the 20-mile travel distance from the southern-most dredging location, Block Island, eastward.

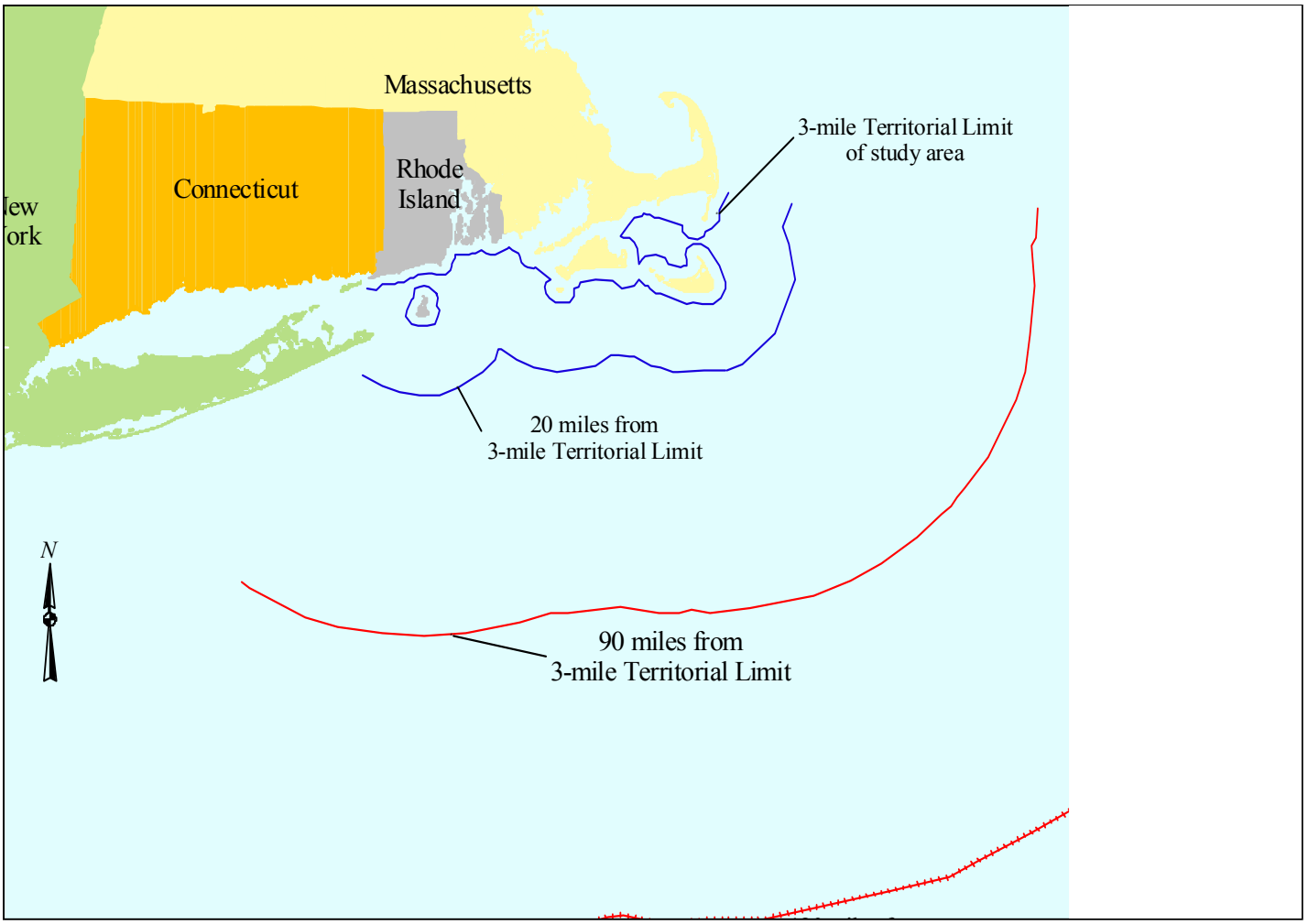

Figure 8. Distance to edge of continental shelf from Rhode Island and southeastern Massachusetts Region (2002)

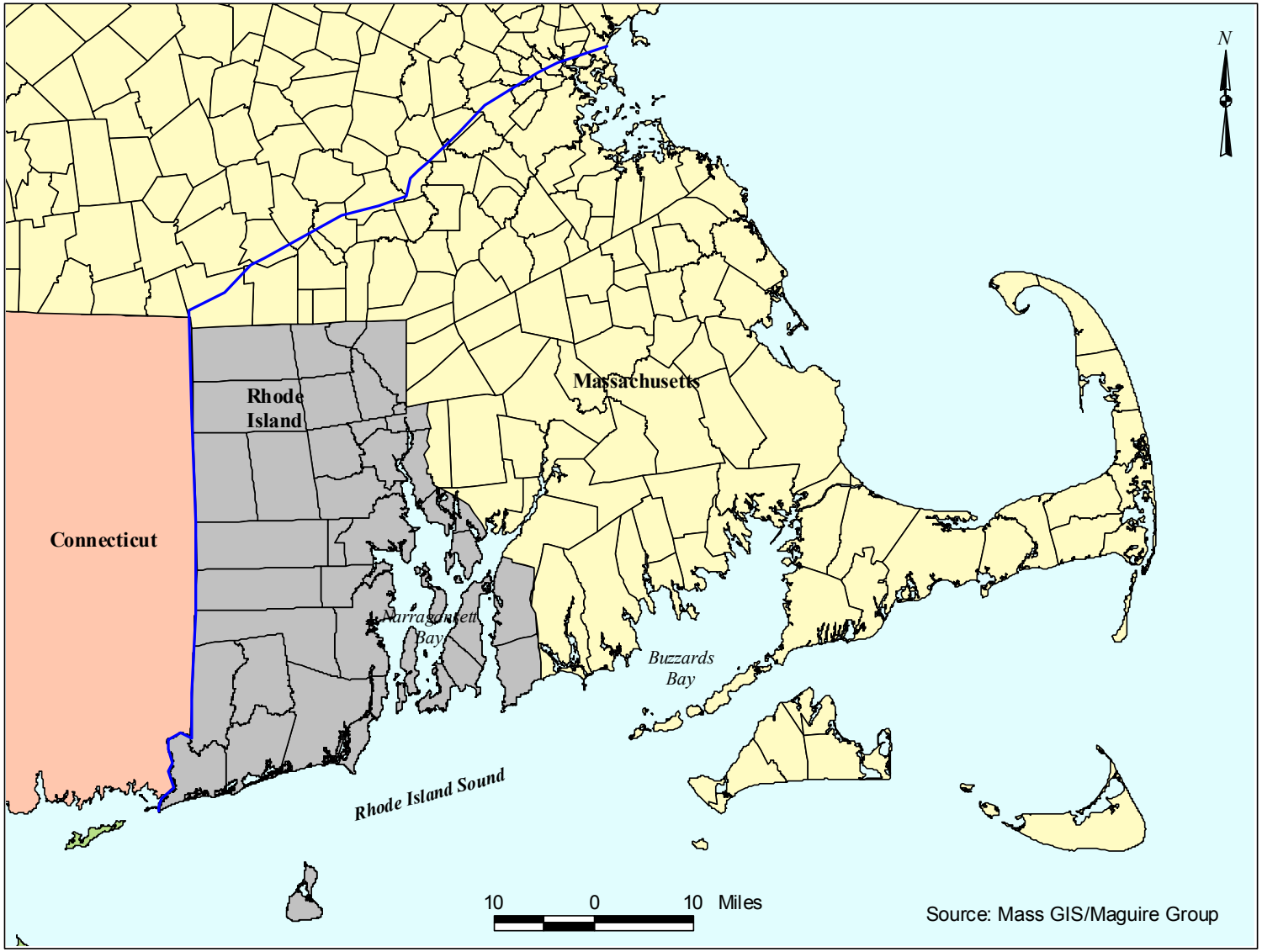

Figure 9. Upland Limit of ZSF (2002) of the RI Region Long-Term Dredged Material Disposal Site Evaluation Study

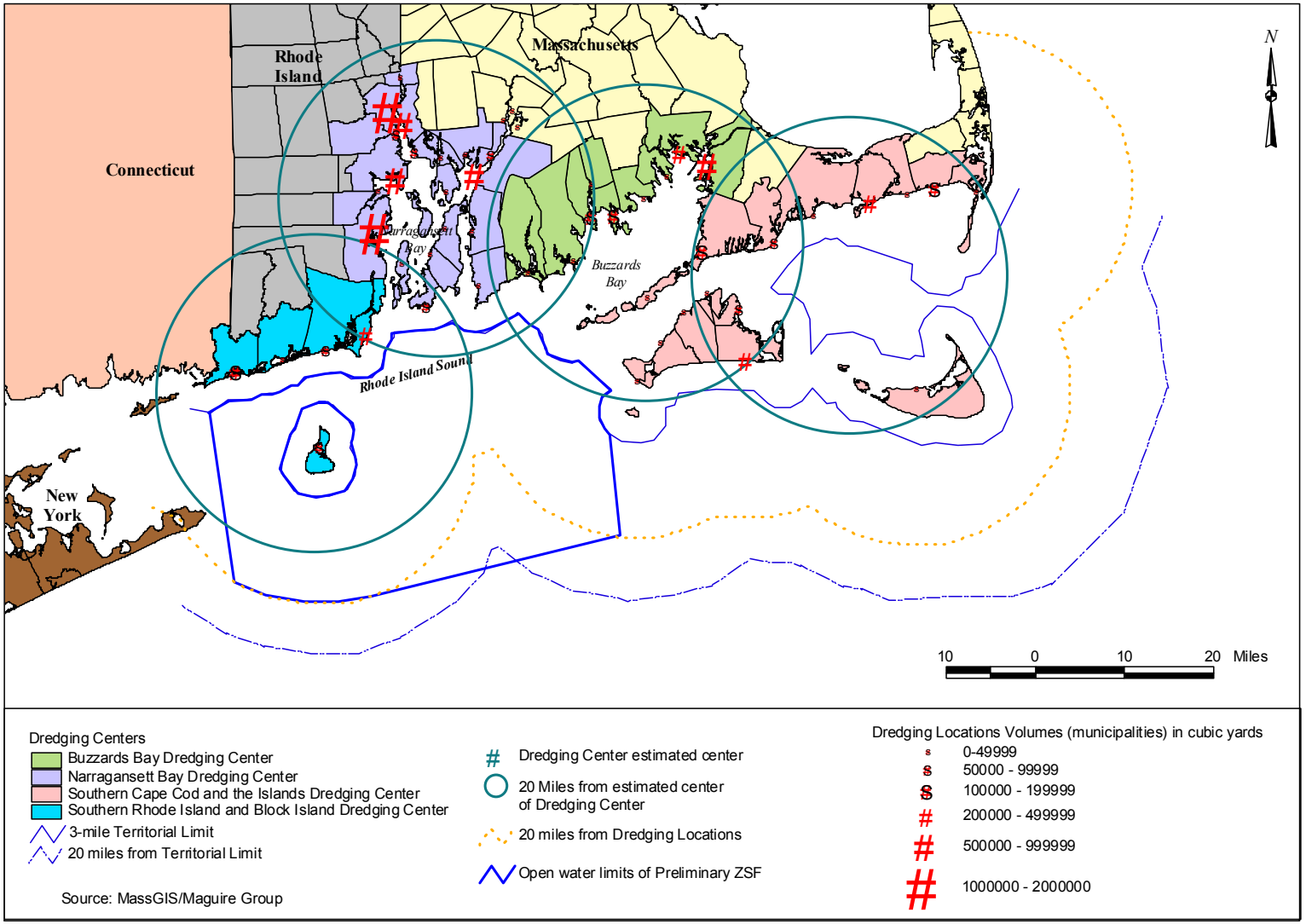

Figure 10. Open water limits of the ZSF compared to 20 mile limits analysis for the RI Region Long-Term Dredged Material Disposal Site Evaluation Study

The eastern boundary of the ZSF was established as a line extending south from the Rhode island/Massachusetts boundary until the line intersects 3-mile Territorial Limit of Massachusetts west of the Islands. The eastern limit then follows the 3-mile territorial sea to a point south of Noman's Land, then extends south approximately 20 miles until it intersects the seaward boundary of the ZSF. This boundary excludes Cape Cod and the Islands from the ZSF. These areas are excluded because much of the future dredged material from this area is assumed to not require an open-water disposal site. There are five reasons support this conclusion. First, historic records show that dredged material from Cape Cod and the Islands has been used for beneficial use and not dumped at a disposal site. Second, the Massachusetts state policy regarding reusable dredged material, as outlined in the state's Coastal Zone Management Plan, is "to manage dredged material as a resource and to dispose of dredged material as a waste only when no beneficial use is practical" (CZM, 2002, page 53). Furthermore, the plan states that since Cape Cod and the Islands produce dredged material that is predominantly sand, there is always a need for beach nourishment locally. The use of this material for beneficial use/beach nourishment is viewed as "the most economical and desirable management option."

The third reason for eliminating the waters off of Cape Cod and the Islands from the ZSF is based on the Dredging Needs Study, which shows that the projected volume of dredged material from this area is relatively small compared to the Narragansett Bay and Buzzards Bay Dredging Centers (Figure 3). Additionally, it is assumed that most of it will be used for beneficial use, as stated above, and not be transported to an open-water disposal site, making the volume of material potentially going to a disposal site even smaller.

Fourth, the State of Massachusetts is currently in the process of designating a Section 404 disposal site within the state's 3-mile Territorial Limit. It is assumed that the small volume of material that is projected for this area that will not be used for beneficial use may use this site as a disposal option.

Finally, the Dredging Needs Study shows the largest projected volume of dredged material being generated from the Narragansett Bay Dredging Center. Although the State of Rhode Island is also in the process of designating a Section 404 disposal site, the amount of future dredged material identified for this area is likely too large for the site to accommodate. The ZSF should be located within proximity of the areas projected to produce the largest volumes of dredged material to ensure that transportation will be economical, safe, and practical.

The eastern limit then follows the 3-mile Territorial Limit to a point south of Noman's Land, then extends south approximately 20 miles until it intersects the seaward boundary of the ZSF.

6.0 CONCLUSION

The ZSF identified for the designation of a dredged material disposal site for Rhode Island and southeastern Massachusetts region is shown in Figure 11. The limits of the ZSF are based on political boundaries within the region, navigation restrictions, type of disposal plant, cost of transporting dredged material, and distance to the edge of the continental shelf, including environmental windows. The upland limit is marked by the state boundary between Connecticut and Rhode Island and the 50-mile limit from the study area's coastline. The open water limit is marked by the Connecticut/Rhode Island border to the west, 20 miles south of Block Island, and the eastern portion of the 3-mile Territorial Limit around Martha's Vineyard.

Inclusion of the region between the seaward boundary and the edge of the Continental Shelf was found not feasible due to potential environmental windows of the region and factors that decrease efficiency of a dredging project, as well as its safety and practicality. The Dredging Needs Study also influenced the demarcation of the ZSF to accommodate those locations where the largest amount of dredged material is projected. The ZSF shown in Figure 11 is large enough to evaluate several alternative sites within cost-effective haul distances for dredged material within the Rhode Island and southeastern Massachusetts region.

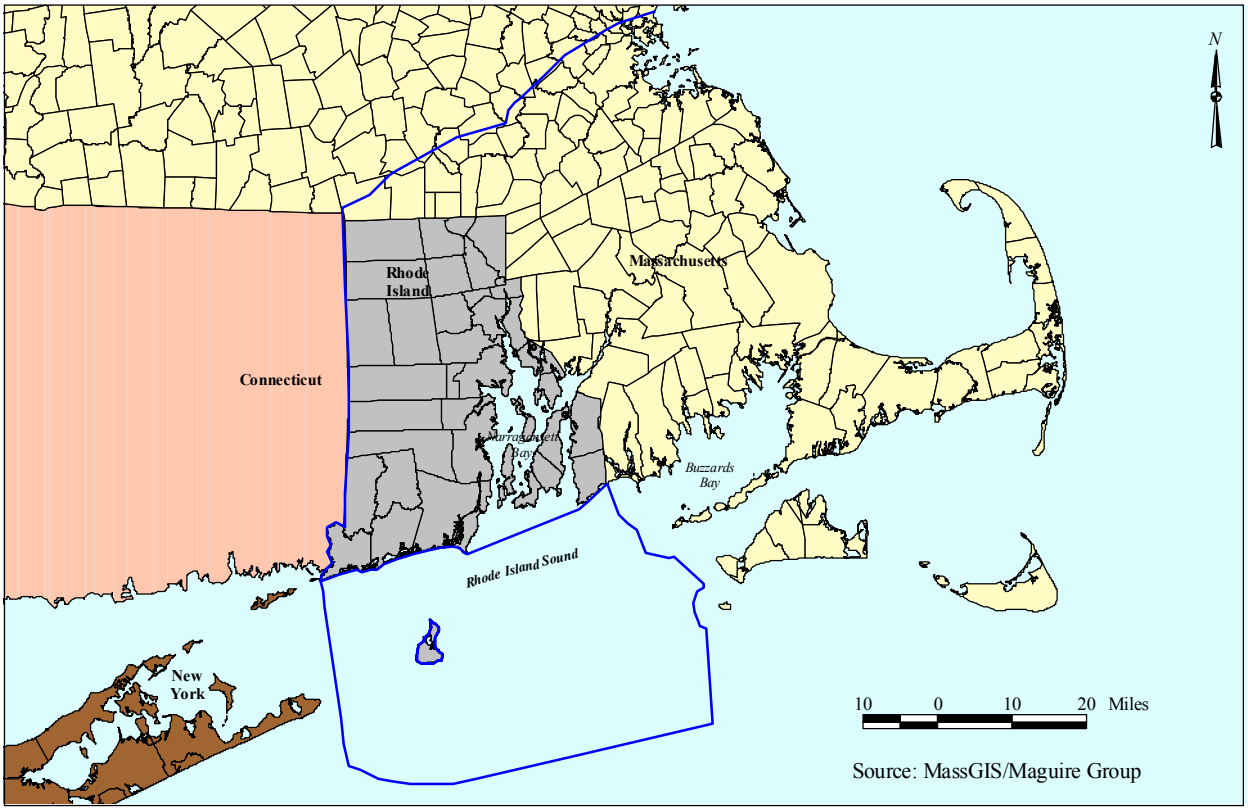

Figure 11. Zone of Siting Feasibility for the RI Region Long-Term Dredged Material Disposal Site Evaluation Study

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APPENDIX A

Cost Analyses

BACKGROUND

To determine the size of the ZSF for the Rhode Island and southeastern Massachusetts region, specifically the open water limit, costs were compared from several sources. The analyses performed in the New Bedford/Fairhaven Harbor Dredged Material Management Plan (DMMP) Draft Environmental Impact Report and the Providence River (CZM, 2002) and Harbor Maintenance Dredging FEIS (US Army Corps of Engineers, 2001) were both used. These documents were referenced because they were current in their calculations and they are both located within the Rhode Island and southeastern Massachusetts region. Additionally, several national dredging companies were contacted to obtain typical dredging costs: Dutra Group, Weeks Marine, Great Lakes Dredging and Dock, and Jay Cushman, Inc (July 8, 2002). Three dredging alternatives are considered: near shore and open-water disposal, upland disposal, and the use of Confined Disposal Facilities (CDF).

METHOD

To compare costs, the tables established in the Providence River and Harbor Maintenance Dredging FEIS (Corps, 2001) were used as a base. These tables were created using the Corps of Engineers Dredge Estimating Program, where it was assumed that mechanical dredging equipment would be used. Typical costs from conversations with dredging companies were incorporated into these tables as well as upland disposal costs from the New Bedford/Fairhaven DMMP (Massachusetts Office of Coastal Zone Management, 2002) screening process. Although both of these plans addressed site-specific dredging disposal options, they provided current costs associated with dredged material disposal. Typical costs from dredging companies supported the numbers presented in the reports.

RESULTS

The results of the analysis vary by disposal method. For near shore and open-water disposal by barge, costs range from a low of $11.61 for a travel distance of 10 miles to a high of $25.11 for a travel distance of 40 miles (Table 1). For near shore and open-water disposal by pipeline, the range is $10.26 per cubic yard at a distance of 10 miles to $27.00 per cubic yard at a distance of 40 miles (Table 2). Costs of disposal through pipeline increase beyond 20 miles because of the need for additional booster stations, staff, etc.

Table 1. Near Shore and Open-water Disposal (Barge)

Distance (miles)	Unit Cost ($/cy)[a]	Mob/Demob ($/cy)[b]	Total Cost ($/cy)[c]
10	$8.00 – 12.00	$0.60	$11.61 – 17.01
20	$10.00 – 14.00	$0.60	$14.31 – 19.71
30	$12.00 –16.00	$0.60	$17.01 – 22.41
40	$14.00 – 18.00	$0.60	$14.31 – 25.11

(a) Estimated unit cost of dredging and disposing based on national dredging companies.
(b) Mobilization and demobilization for dredging
(c) Final cost per cubic yard of dredged material, including mark up (x1.35)

Table 2. Near Shore and Open-water Disposal (Pipeline)

Distance (miles)	Unit Cost ($/cy)[a]	Mob/Demob ($/cy)[b]	Total Cost ($/cy)[c]
10	$7.00 - 9.00	$0.60	$10.26 -12.96
20	$9.00 - $11.00	$0.60	$12.96 – 15.66
30	$13.00 – 16.00	$0.60	$18.36 – 22.41
40	$18.00 – 20.00	$0.60	$25.11 – 27.00

(a) Estimated unit cost of dredging and disposing based on national dredging companies.
(b) Mobilization and demobilization for dredging
(c) Final cost per cubic yard of dredged material, including mark up (x1.35)

Upland disposal options were calculated based on the Providence River and Harbor Dredging Maintenance FEIS and the New Bedford/Fairhaven Harbor DMMP. Two alternatives were considered: creation of a new disposal site and existing sites that would accept dredged material such as a landfill. Table 3 summarizes the data from both plans. Costs to dredge and transport material to an upland site ranges from $43 to $200 per cubic yard. This large difference is due to the varying fees of individual landfills, which assumes the inclusion of management and monitoring of the disposal site.

The final disposal method analyzed was the Confined Disposal Facility (CDF). The Providence River and Harbor Dredging Maintenance FEIS calculated costs for dike construction within the Providence area and loading of dredged material. It is assumed that these cost represent the current typical costs associated with the CDF disposal method (Table 4). It is estimated that it would cost $15.50 per cubic yard of dredged material.

Table 3. Cost of dredging and upland disposal options

Upland Disposal						
	Unit Cost ($/cy)[a]	**Dewatering ($/cy)[b]**	**Hauling ($/cy)[c]**	**Dike F. Unit Cost ($/cy)[d]**	**Landfill Fee ($/cy)[e]**	**Total Cost ($/cy)[f]**
New site development (not including costs to obtain property)						
No liner	$8.50	$6.00	$5.00	$12.00		$42.53
Thin Liner	$8.50	$6.00	$5.00	$20.00		$53.33
Existing site A*	$8.50	$6.00	$5.50		$57.00	$103.95
Existing site B**		$20.00***	$17.00		$25.00	$62.00
Existing site C**		$20.00***	$17.00		$163.00	$200.00

* Providence River and Harbor Dredging Maintenance FEIS
** New Bedford/Fairhaven DMMP
*** Includes dewatering site preparation, operation and restoration
(a) Unit cost of dredging and disposal including double handling
(b) Dewatering unit cost consists of $1.50 soil handling, $1.50 soil offloading, and $3 temporary dike
(c) Unit cost to transport the disposal material from dewatering site to the upland facility by truck
(d) Upland dike facility cost
(e) Landfill fee for the disposal material
(f) Final unit cost per cubic yard of dredged material, including mark up (x1.35)

Table 4. Cost of dredging and use of a Combine Disposal Facility

For a Dike 10 feet in height and 49,300 cy quantity	**Dike cost ($mil)[a]**	**Hydroseed Cost ($mil)[b]**	**Dewatering Structures Cost ($mil)[c]**	**Subtotal (x1.35) ($mil)[d]**	**Dredge & Transfer Cost ($mil)[e]**	**Total Cost ($mil)[f]**	**Unit Cost ($/cy)[g]**
250,000 cy of dredged material	$0.60	$0.10	$0.10	$1.10	$2.80	$3.90	$15.50

(a) Cost of dike construction at $12 per cubic yard
(b) Hydroseeding and slope protection
(c) Cost of weir, piping and related structures
(d) Subtotal cost of columns 1, 2, and 3 for cost sharing including mark up (x 1.35)
(e) Cost of dredging from a CAD cell and loading to dewatering site including mark ups (x 1.35)
(f) Total direct construction cost
(g) The unit cost per cubic yard of the disposal material at a particular crest height

SUMMARY

Costs associated with the disposal of dredged material from the New Bedford/Fairhaven Harbor Dredged Material Management Plan (DMMP) Draft Environmental Impact Report and the Providence River and Harbor Maintenance Dredging FEIS were combined with typical costs from national dredging companies to determine the ZSF for the Rhode Island and southeastern Massachusetts region, specifically the open water limit. Both of the documents referenced are current and within the same geographic area, making them applicable for this analysis.

Results show that overall costs begin at $11.61 per cubic yard for open water disposal through pipeline within 10 miles to $200 per cubic yard for disposal in existing landfill facilities. Reasonable costs per cubic yard are assumed to range from $10 to $20, allowing for a diversity of options in identifying a potential disposal site for dredged material within the study area. This cost range restricts the open-water limit of the ZSF to a distance of about 20 miles from the 3-mile Territorial Limit of Rhode Island and southeastern Massachusetts. Facilities along the open water coastline would pay between $11 and $16 per cubic yard to dredge and dispose of dredged material in an open water or CDF disposal site. Facilities located in the upper parts of Narragansett Bay, for example, would pay between $14 and $25 per cubic yard. The upland limit to the ZSF cannot be determined based on a cost $10 to $20 per cubic yard of dredged material, since estimates are well above these assumed reasonable costs. Therefore, the limit was established by transport time, as discussed in the *Rhode Island Sound Long-Term Dredged Material Disposal Site Evaluation: Zone of Siting Feasibility* document.

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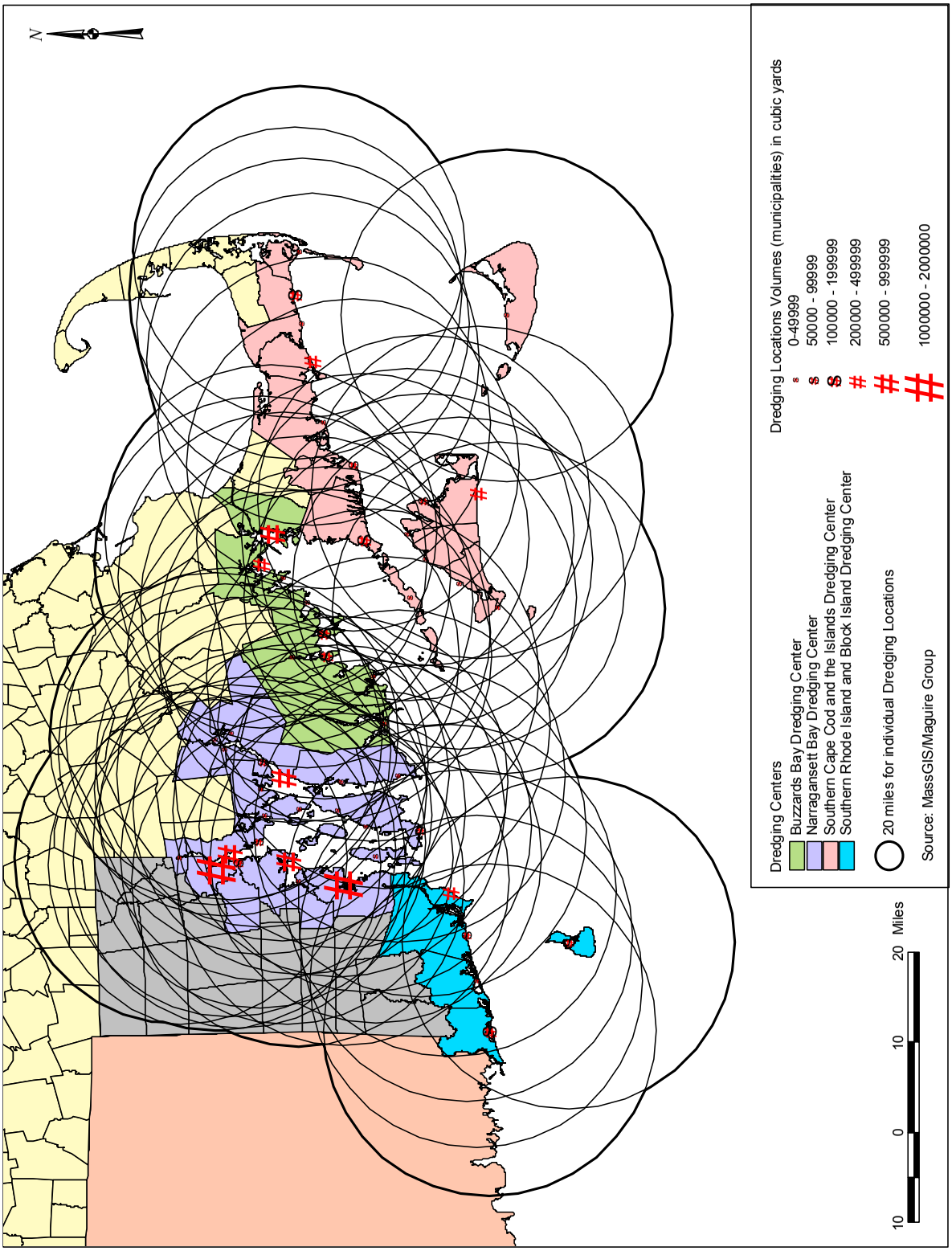
APPENDIX B

Map of 20-Miles Rings Around Dredging Locations (2002)



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