US ARMY CORPS
OF ENGINEERS
New England District

Contract No. DACW33-01-D-0004
Delivery Order No. 02
June 2003

Final Report

Task 10.4
ALTERNATIVE SITE SCREENING REPORT

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

FINAL

Alternative Site Screening Report

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

Contract Number DACW33-01-D-0004
Delivery Order No. 02

to

U.S. Army Corps of Engineers
North Atlantic Division
New England District
696 Virginia Road
Concord, MA 01742-2751

By:

Battelle
397 Washington Street
Duxbury, MA 02332
(781) 934-0571

June 25, 2003

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Acronyms

CI	Coastal Institute
Corps	U.S. Army Corps of Engineers
CPUE	catch per unit effort
CRMC	Coastal Resource Management Council
CZM	Coastal Zone Management
DEM	Department of Environmental Management
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ESRI	Environmental Systems Research Institute, Inc.
ft	foot
GIS	Geographic Information System
hr	hour
kg	kilogram
LIS	Long Island Sound
m^2	square meter
MA	Massachusetts
MCY	million cubic yards
MLLW	Mean Low Lower Water
mm	millimeter
MPRSA	Marine Protection Research and Sanctuaries Act
NEPA	National Environmental Policy Act
nmi	nautical mile
nmi^2	square nautical mile
NOAA	National Oceanic and Atmospheric Administration
NMFS	National Marine Fisheries Service
NOI	Notice of Intent
ODMDS	Ocean Dredged Material Disposal Site
RI	Rhode Island
RIR	Rhode Island Region
RIRPP	Rhode Island Resource Protection Project
Site 69B	Separation Zone Site
SPI	sediment profile imaging
URI	University of Rhode Island
USFWS	United States Fish and Wildlife Service
UXO	unexploded ordnance
WAVAD	ADvanced directional spectral WAVe model
ZSF	Zone of Siting Feasibility

1.0 INTRODUCTION

At the request of the Governor of Rhode Island, the United States Army Corps of Engineers (the Corps) New England District and United States Environmental Protection Agency (EPA) Region 1 are evaluating the feasibility of designating a long-term ocean dredged material disposal site for Rhode Island and southeastern Massachusetts, referred to herein as the Rhode Island Region (RIR), pursuant to the Marine Protection, Research, and Sanctuaries Act (MPRSA), 33 U.S.C. Section 1401 *et seq*. The potential site would be used for disposal of material dredged from harbors and navigation areas in Rhode Island and southeastern Massachusetts found to be suitable for ocean disposal under the MPRSA.

In accordance with EPA's Statement of Policy for Voluntary Preparation of National Environmental Policy Act documents for all ocean disposal site designations (Federal Register 62(229): 63334-63336, November 28, 1997), EPA will prepare an EIS for this project.
The EIS will evaluate the potential environmental impacts associated with designation of an ocean dredged material disposal site (ODMDS), as well as a no action alternative. As part of the site designation evaluation, EPA issued a Notice of Intent (NOI) (April 6, 2001), held formal scoping and public involvement activities (Petruny-Parker, *et al.*, 2003), defined the needs for dredging (Corps, 2002a), and defined the Zone of Siting Feasibility (ZSF) (Corps, 2002b). The ZSF is the reasonable and practical area within which a dredged material site could be located. The geographic boundaries of the ZSF were defined using guidelines prepared by EPA and the Corps (1986). The dredging needs and delineation of the ZSF was also coordinated with Federal and state cooperating agencies and the project's Working Group.

This report summarizes the process used to determine potential areas within the ZSF, which could be further considered as ocean disposal sites. This screening process involved review and evaluation of available biological, chemical, and physical data as well as considerations of other uses of the ocean within the ZSF. The following sections present the results of this process.

1.1 Authority

EPA has the authority to manage the disposal of dredged material in open water including the designation of ocean disposal sites under section 102(c) of the MPRSA. However, EPA's designation of an ocean disposal site does not authorize or result in the disposal of any particular material at any site. The use of any area designated by EPA for disposal of dredged material would only occur following the issuance of a permit by the Corps under Section 103 of the MPRSA. The dredged material disposal permitting process requires consideration of a range of disposal alternatives, including beneficial reuse and upland treatment and disposal. Designation only makes a site available for ocean disposal and is only one of a number of disposal options for proposed dredging projects.

1.2 Dredging Needs Study

A Dredging Needs Study was conducted to determine the current dredging needs and project volumes of dredged material in the Rhode Island and southeastern Massachusetts region over the next 20 years (Corps, 2002a). A questionnaire was sent to non-Federal, private and public navigation dependent facilities requesting an estimate of the quantities of material that they would likely dredge through 2021. Future dredging needs identified by the 178 returned questionnaires were combined with projections from proposed Federal navigation projects and supplemented with historic dredging data. Reviewing the historic dredging information allowed an identification of the material that has historically been used for beach renourishment, which was deducted from the working estimate. This analysis resulted in an estimate of the total dredged material for which disposal will be needed through 2021. The survey results indicated that between 2002 and 2021 the Rhode Island and southeastern Massachusetts region has the potential to generate almost nine million cubic yards (MCY) of dredged material that will require identification of a disposal location.

Based on the results of the dredging needs analysis, the study area was divided into four dredging centers or geographical areas that share a logical point of origin for dredged material. The identification of dredging centers was done to assist in identification of the Zone of Siting Feasibility (ZSF) since the location at which the largest volumes of dredged material are likely to originate will influence the ZSF. Transport distances are most likely to be centered on the dredging locations with the highest projected volume of dredged material. The dredging centers defined for the Rhode Island and southeastern Massachusetts region are: Southern Rhode Island and Block Island, Narragansett Bay, Buzzards Bay, and Southern Cape Cod and the Islands.

1.3 Zone of Siting Feasibility (ZSF) Study

The geographic boundaries of the ZSF were determined based on the results of the Dredging Needs Study (Corps, 2002a) along with evaluation of a series of selection criteria (Corps, 2002b). The selection criteria included political boundaries, navigation restrictions (such as safety issues, etc.), 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. Based on the results of the ZSF study, the northern boundary of the ZSF was set at the Territorial Limits of Rhode Island and Massachusetts (Figure 1). 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, since this area is currently being addressed under a separate EIS evaluating the designation of disposal sites in that region. The southern boundary is based on a travel distance of ~ 20 nautical miles (nmi) from the southern-most dredging location on Block Island. This distance was determined to be a reasonable transport distance considering costs, safety, practicality, and efficiency within an 8-hour workday. The eastern boundary of the ZSF extends south from the Rhode Island/Massachusetts boundary to a point where it intersects the three-mile Territorial Limit of Massachusetts west of the Naushan and Nashawena Islands. The eastern limit then follows the three-mile territorial sea limit to a point south of Noman's Land, and then extends south approximately ~ 20 nmi until it intersects the seaward boundary of the ZSF. The ZSF encompasses Rhode Island Sound, Block Island Sound, and the area of the continental shelf south to a distance ~ 30 nmi from the mouth of Narragansett Bay. The ZSF covers an area of 1100 nmi^2 and reflects the maximum distance offshore that is practical for transporting dredged material to a potential disposal site.

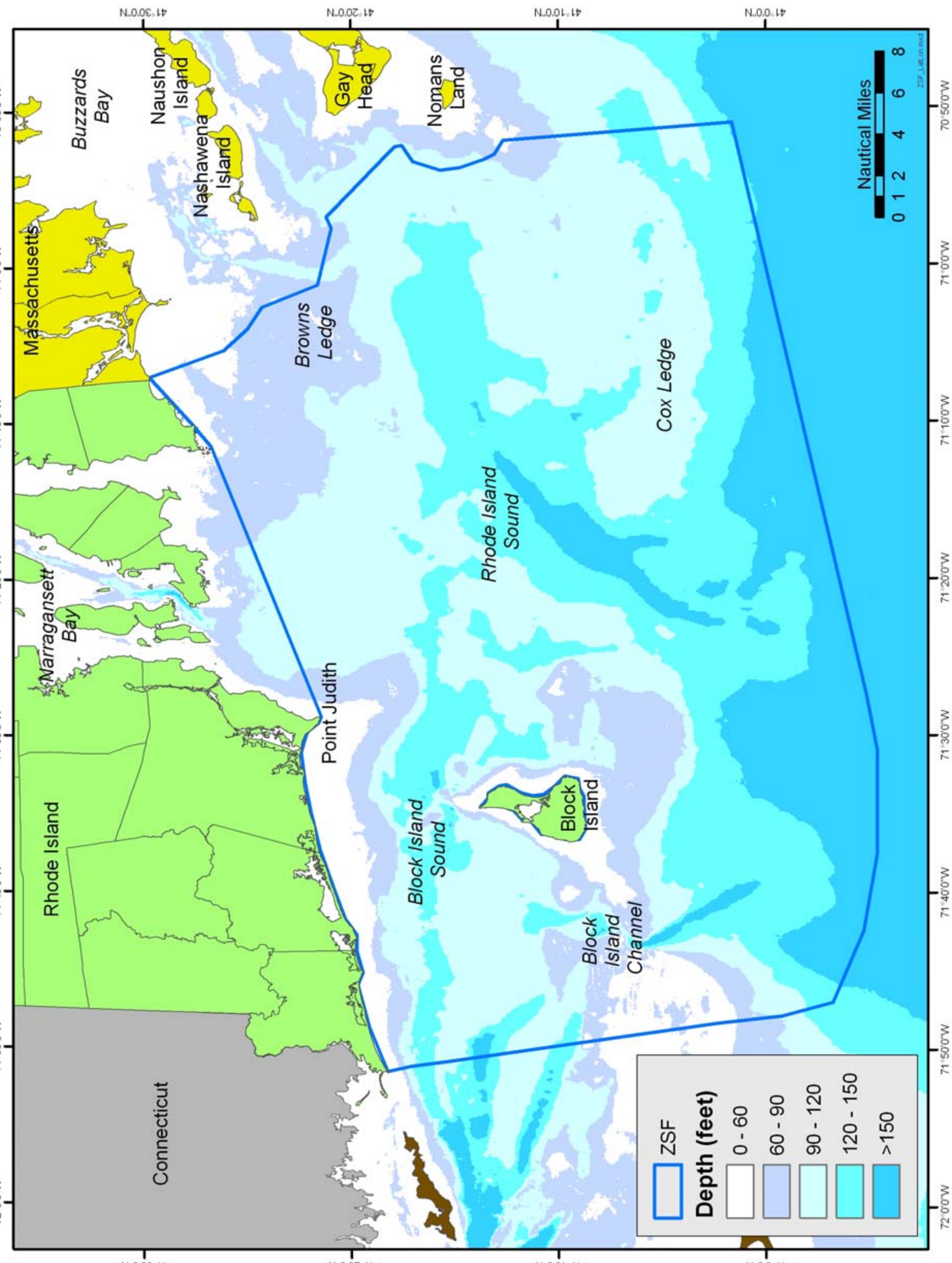


Figure 1. Zone of Siting Feasibility and Bathymetry for Rhode Island Region.

The following sections describe the data and steps used to screen out areas not acceptable for further consideration and those considered acceptable for evaluation in the EIS.

2.0 SITE SCREENING PROCESS

The MPRSA lists 5 general and 11 specific required criteria in the evaluation and designation of ocean disposal sites (40 CFR 228.5 and 40 CFR 228.6, respectively) (Table 1). The five general criteria are used in the selection and approval for continuing use of ocean disposal sites. The 11 specific criteria are used to ensure that the general criteria are met and may include a number of factors deemed important to the designation. EPA, in consultation with other Federal and state agencies, performed initial screening of areas within the ZSF using this criterion to identify areas within the ZSF where alternative disposal sites should not be located. Within the areas remaining after initial screening, alternative disposal sites will be delineated and site specific evaluations will be performed and documented in the EIS using criteria defined in the MPRSA.

A Working Group was established to supplement the criteria in MPRSA and to identify local evaluation factors that should also be considered in the screening process. The Coastal Institute (CI) at the University of Rhode Island (URI) served as a facilitators of the Working Group, which was made up of stakeholders, science and policy advisors from URI, and staff from the Corps, EPA, Rhode Island (RI) Coastal Resources Management Council (CRMC), RI Department of Environmental Management (DEM), and Massachusetts (MA) Coastal Zone Management (CZM). The Working Group was charged with developing a list of evaluation factors they considered important for identifying acceptable alternative sites and identified information and data needed to apply the evaluation criteria (Table 2). The list of Working Group factors were used to enhance the 5 general and 11 specific MPRSA criteria with the specific concerns and issues related to the RIR ZSF (Petruny-Parker, *et al*., 2003). The major issues identified by the Working Group included:

- Potential impacts to fisheries (commercial and recreational),
- Potential impacts to non-commercial species,
- Potential conflicts with recreational areas,
- Potential conflicts with commerce/military activities,
- Possible remedial use,
- Economic factors, and
- Hydrodynamic factors.

These evaluation factors and the site designation criteria were used by EPA and the Corps to identify a series of geospatial screening layers that addressed each of the Working Group's concerns (Table 2). To support the screening, EPA and the Corps developed three levels of quantitative values specific to each screening layer (Appendix A). These three levels were developed after relevant available data for each screening layer were examined and were used to quantitatively categorize areas that should be excluded from consideration (Level 1), areas that could be excluded or included (Level 2), and areas that could be included (Level 3). In addition, the individual layers, developed based on the ocean disposal site designation criteria and the

Table 1. MPRSA Criteria for the Evaluation and Designation of ODMDS (MPRSA 228.5 and 228.6).

MPRSA Section	MPRSA Regulation
228.5(a)	The dumping of materials into the ocean will be permitted only at sites or in areas selected to minimize the interference of disposal activities with other activities in the marine environment, particularly avoiding areas of existing fisheries or shellfisheries, and regions of heavy commercial or recreational navigation.
228.5(b)	Locations and boundaries of disposal sites will be so chosen that temporary perturbations in water quality or other environmental conditions during initial mixing caused by disposal operations anywhere within the site can be expected to be reduced to normal ambient seawater levels or to undetectable contaminant concentrations or effects before reaching any beach, shoreline, marine sanctuary, or known geographically limited fishery or shellfishery.
228.5(c)	If at any time during or after disposal site evaluation studies, it is determined that existing disposal sites presently approved on an interim basis for ocean dumping do not meet the criteria for site selection set forth in §§ 228.5 through 228.6, the use of such sites will be terminated as soon as suitable alternate disposal sites can be designated.
228.5(d)	The sizes of ocean disposal sites will be limited in order to localize for identification and control any immediate adverse impacts and permit the implementation of effective monitoring and surveillance programs to prevent adverse long-range impacts. The size, configuration, and location of any disposal site will be determined as a part of the disposal site evaluation or designation study.
228.5(e)	EPA will, wherever feasible, designate ocean dumping sites beyond the edge of the continental shelf and other such sites that have been historically used.
228.6(a)	In the selection of disposal sites, in addition to other necessary or appropriate factors determined by the Administrator, the following factors will be considered:
(1)	Geographical position, depth of water, bottom topography and distance from coast;
(2)	Location in relation to breeding, spawning, nursery, feeding, or passage areas of living resources in adult or juvenile phases;
(3)	Location in relation to beaches and other amenity areas;
(4)	Types and quantities of wastes proposed to be disposed of, and proposed methods of release, including methods of packing the waste, if any;
(5)	Feasibility of surveillance and monitoring;
(6)	Dispersal, horizontal transport and vertical mixing characteristics of the area, including prevailing current direction and velocity, if any;
(7)	Existence and effects of current and previous discharges and dumping in the area (including cumulative effects);
(8)	Interference with shipping, fishing, recreation, mineral extraction, desalination, fish and shellfish culture, areas of special scientific importance and other legitimate uses of the ocean;
(9)	The existing water quality and ecology of the site as determined by available data or by trend assessment or baseline surveys;
(10)	Potentiality for the development or recruitment of nuisance species in the disposal site;
(11)	Existence at or in close proximity to the site of any significant natural or cultural features of historical importance.

Table 2. Rhode Island Region Screening Layers and Associated MPRSA Criteria.

Screening Layer	MPRSA Criteria Section	CI Factor	Tier
ZSF	228.5(e)		1
Erosion Potential	228.6(a)(6)	X	1
Bathymetry	228.6(a)(1)		1
Anchorages	228.5(a); 228.6(a)(8)	X	1
Reserves/Science Area	228.5(b)	X	1
Public Beaches - RI/MA	228.5(b); 228.6(a)(3)	X	1
Refuges, Parks, Protected Areas	228.5(b); 228.6(a)(3)	X	1
Active Ordnance/Military Use	228.6(a)(8)	X	1
Active Utilities and Pipeline	228.6(a)(8)	X	1
Historic or Culturally Important Shipwrecks/ Cultural/Historical Sites	228.6(a)(11)		1
NMFS Total fish CPUE - 3 Seasons	228.6(a)(2); 228.5(a)	X	2
NMFS Top 10 Commercial Fish Species CPUE - 3 Seasons	228.5(a); 228.6(a)(2)	X	2
Battelle Finfish CPUE Data (Battelle, 2001/2002)	228.5(a); 228.6(a)(2)	X	2
Fisheries Areas (2002) Rollup	228.5(a); 228.6(a)(8)	X	2
Fishing areas from M&E Rpt Fig. 12	228.5(a); 228.6(a)(8)	X	2
Anecdotal Fisheries Areas from Fishermen (2003)	228.5(a); 228.6(a)(8)	X	2
NMFS Lobster CPUE - 3 Seasons	228.5(a); 228.6(a)(2)	X	2
Battelle Lobster CPUE Data (2001/2002)	228.5(a); 228.6(a)(2)	X	2
Lobster V-Notch Data	228.5(a); 228.6(a)(2)	X	2
Lobster Distribution Anecdotal from Fishermen (2002/2003)	228.5(a); 228.6(a)(2)	X	2
Ocean Quahog Distribution (Fall River EIS, 1976)	228.5(a); 228.6(a)(2)	X	2
Ocean Quahog Data (Fogarty, 1979)	228.5(a); 228.6(a)(2)	X	2
Quahog Data (Battelle, 1998/2002)	228.5(a); 228.6(a)(2)	X	2
Scallops	228.5(a); 228.6(a)(2)	X	2
Shipping Lanes	228.5(a); 228.6(a)(8)	X	2
Ferry Routes	228.5(a); 228.6(a)(8)	X	2
Lightering Areas	228.5(a); 228.6(a)(8)	X	2
Diving Areas	228.6(a)(8); 228.6(a)(11)	X	2
UXO	228.6(a)(12)	X	2
Distance from coast - Economics	228.6(a)(1)	X	2
Currents - Tidal Ellipses	228.5(b); 228.6(a)(3); 228.6(a)(6)	X	2
Sedimentary Environment (grain size distributions)	NA	X	2
Historic Disposal Sites	228.5(c); 228.6(a)(7)	X	2
One Nautical Mile Grid (from Top Left Corner of ZSF)	NA	NA	Screening aid

Working Group factors, were prioritized into two tiers to facilitate the screening process (Table 2). Tier 1 layers were exclusionary layers used to identify areas within the ZSF that were not acceptable for locating an ocean disposal site designated under the MPRSA (Tier 1 screening). Tier 2 layers were used to identify area(s) for further evaluation in the EIS.

Data from current and historical studies were assembled and mapped graphically as Geographic Information System (GIS) data layers using Environmental Systems Research Institute, Inc. (ESRI) ArcGIS Desktop software (i.e., Arcview) to address each screening criteria (Table 2). These screening maps were presented at an interagency meeting held at the Corps in Concord, MA on May 15, 2003. The interagency group included representatives from the Corps, EPA Region 1, National Marine Fisheries Service (NMFS), US Fish and Wildlife Service (USFWS), RI CRMC, and MA CZM. Battelle facilitated the interagency meeting and conducted the screening presentation. As a result of the interagency screening, two areas were identified within the ZSF as acceptable for locating dredged material disposal sites.

The data layers used to screen the ZSF and the results of the screening process are presented in the following sections. This information is presented as follows:

- Tier 1 data
- Tier 1 screening results
- Tier 2 data
- Tier 2 screening results
- Completed screening results
- Areas carried forward for further evaluation

2.1 Tier 1 Screening Approach and Results

Tier 1 screening defined areas within the ZSF that were not acceptable for locating an ocean disposal site designated under the MPRSA and refined the area to be considered for Tier 2 screening. The geographic boundaries of the ZSF previously excluded areas beyond the continental shelf and areas seaward of approximately 17 nmi south of Block Island, RI. In addition, areas of high erosion potential and of clearly conflicting uses were excluded from further consideration during the Tier 1 screening.

2.1.1 Areas of High Dispersion (Erosion) Potential

The potential erosion and transport of sediment is an important factor in assessing a suitable location for dredged material disposal. However, movement of bottom sediments is not uncommon on the continental shelf (Butman *et al.*, 1979). To characterize in detail the erosional/depositional processes at work in the ZSF, a modeling effort was undertaken. Waves and currents were modeled throughout the ZSF using wave measurements taken at the Buzzards Bay Tower by the National Data Buoy Center (1990 – 1992) and available wind hindcast data. The wind field over the ZSF was developed based on wind data generated by the National Center of Atmospheric Research (1990-1999). A directional wave model (also known as WAVAD [the ADvanced directional spectral WAVe model]) was then applied to characterize long-term wave climate over the ZSF.

To estimate the potential resuspension of sediments caused by modeled wave and current field, the bottom shear stress generated by the wave and current forces was determined. Shear stress is the frictional or "sliding" force that horizontal currents exert on the sea bed (Figure 2).

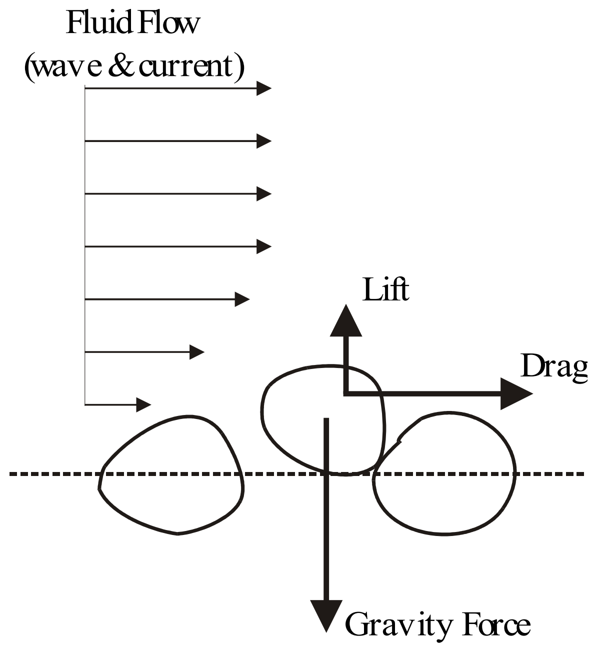


Figure 2. A Schematic Depicting Shear Stress on the Sea Bed.

Resuspension is estimated by comparing shear stress exerted by the waves and currents to the theoretical critical shear stress for the initiation of sediment motion. Bottom shear stress is a function of the current velocity, wave height, wave period, water depth, and bottom roughness. Critical shear stress was estimated from grain size.

A model of sediment transport was then applied to the ZSF for 1% frequency of occurrence wave conditions combined with the typical peak tidal currents for 1.0 millimeter (mm) grain size sediments. These wave conditions represent the waves expected during the strongest winter storm of a single year. These values were used to characterize the potential for erodability throughout the ZSF. The erodability parameter is defined as the ratio of the wave and current induced bottom shear stress to the critical threshold shear stress (Equation 1).

$$\text{Erodability Parameter} = \frac{\text{Bottom Shear Stress}}{\text{Critical Shear Stress}}$$

where:
Bottom Shear Stress = frictional or sliding force exerted by horizontal flow (waves and currents)
Critical Shear Stress = critical value of shear stress necessary to overcome gravity

Sediment erodability parameter values less than one indicate that wave and current energy are not sufficient to resuspend and transport non-cohesive bottom sediments for the given storm conditions and indicate areas that are likely to be depositional. Sediment erodability parameter values greater than one but less than three indicate that wave and current energy may occasionally be sufficient to mobilize non-cohesive bottom sediments and indicated areas of some sediment sorting and reworking. Sediment mobility parameter values greater than three are considered to indicate high wave and current energy environments and areas of frequent reworking and erosion. Figure 3 shows the model-predicted erodability parameter values within the ZSF.

The calculated erodability parameter was then compared to depth (Figure 4). The data predicted that sediments were not expected to be resuspended at depths below 170 feet (ft) (erodability = 1), but occasional erosion and frequent sediment sorting occurred at depths shallower than 105 ft (erodability >3). Depths above 105 ft corresponded to erodability parameter greater than three and were too erosional to be considered for an ocean disposal location.

The interagency group considered an option of limiting the depth that provided a 10 ft buffer between the erodability depth (105 ft) and the top of the mound or other options, such as limiting the height of the disposal mounds to no more than 105 ft below Mean Lower Low Water (MLLW). After discussion, it was agreed that a buffer zone between the erosional depth and the top of the disposal mound was not necessary. Estimates of potential mound height were developed using the estimates of dredging volumes (~8 MCY) over the next 20 years. The disposal material from the dredging needs study would result in a mound approximately 10 ft high over 1 nmi^2 with a 10% buffer between the mound and the site boundary. Therefore, a depth of 115 ft represents the erosional depth (105 ft) plus the theoretical height of the disposal mound (10 ft). As a result, depths of greater than 115 ft were determined as the minimum depth for locating a disposal site (Figure 5).

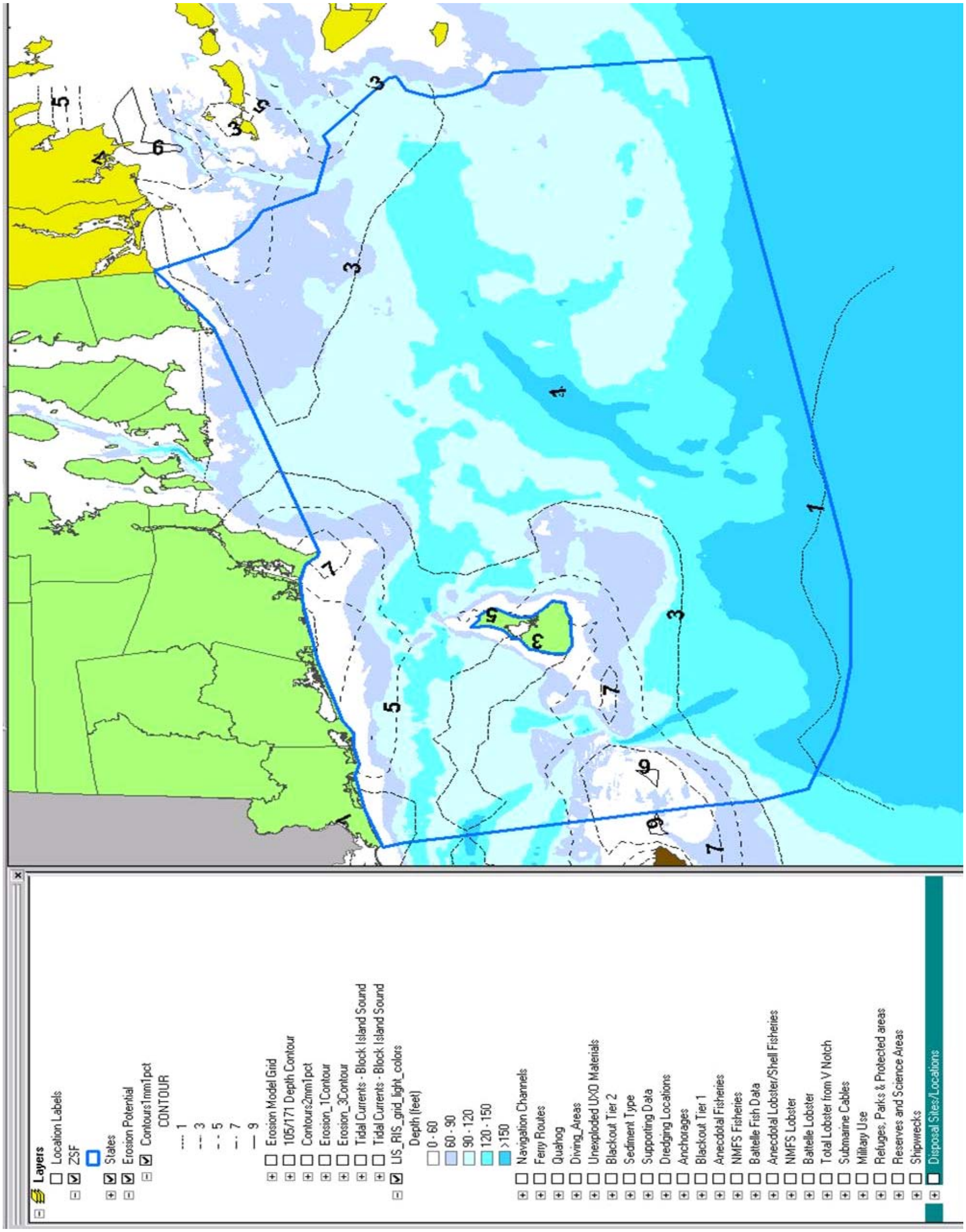


Figure 3. Predicted Sediment Erodability Parameter for 1.0 mm Grain Size for Typical Peak Tide and 1% Frequency of Occurrence Wave Conditions.

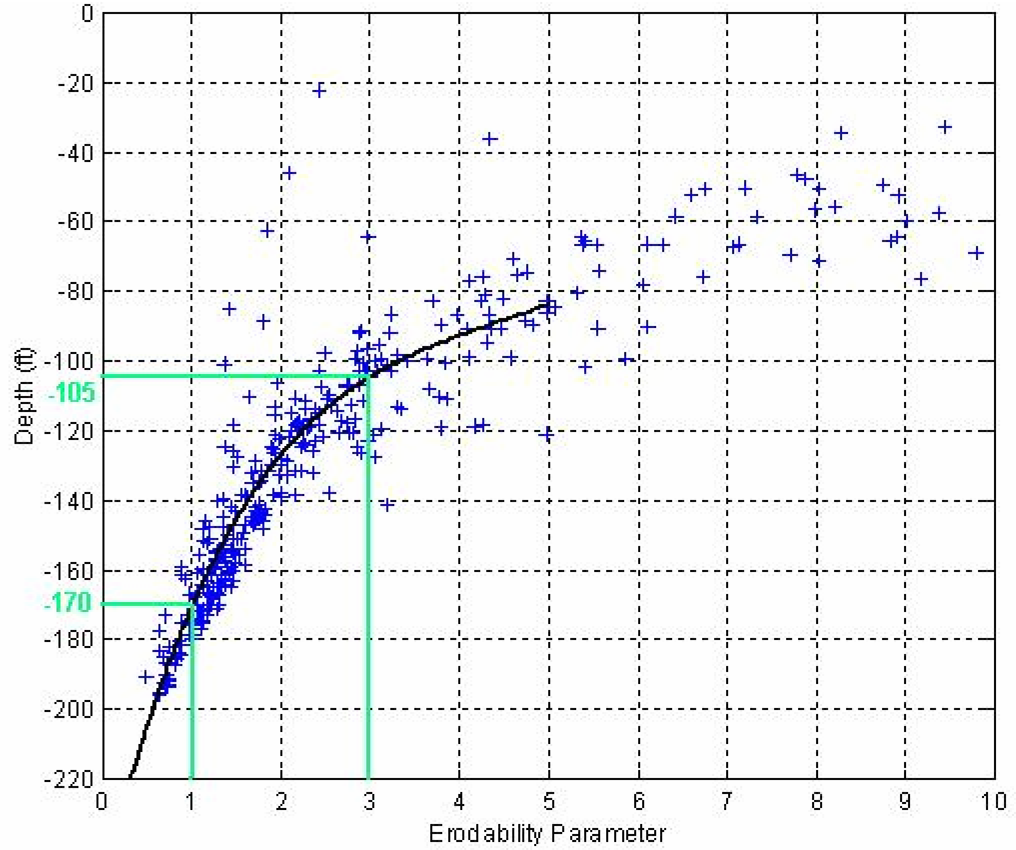


Figure 4. Predicted Relationship Between Depth and Sediment Erodability Parameter.

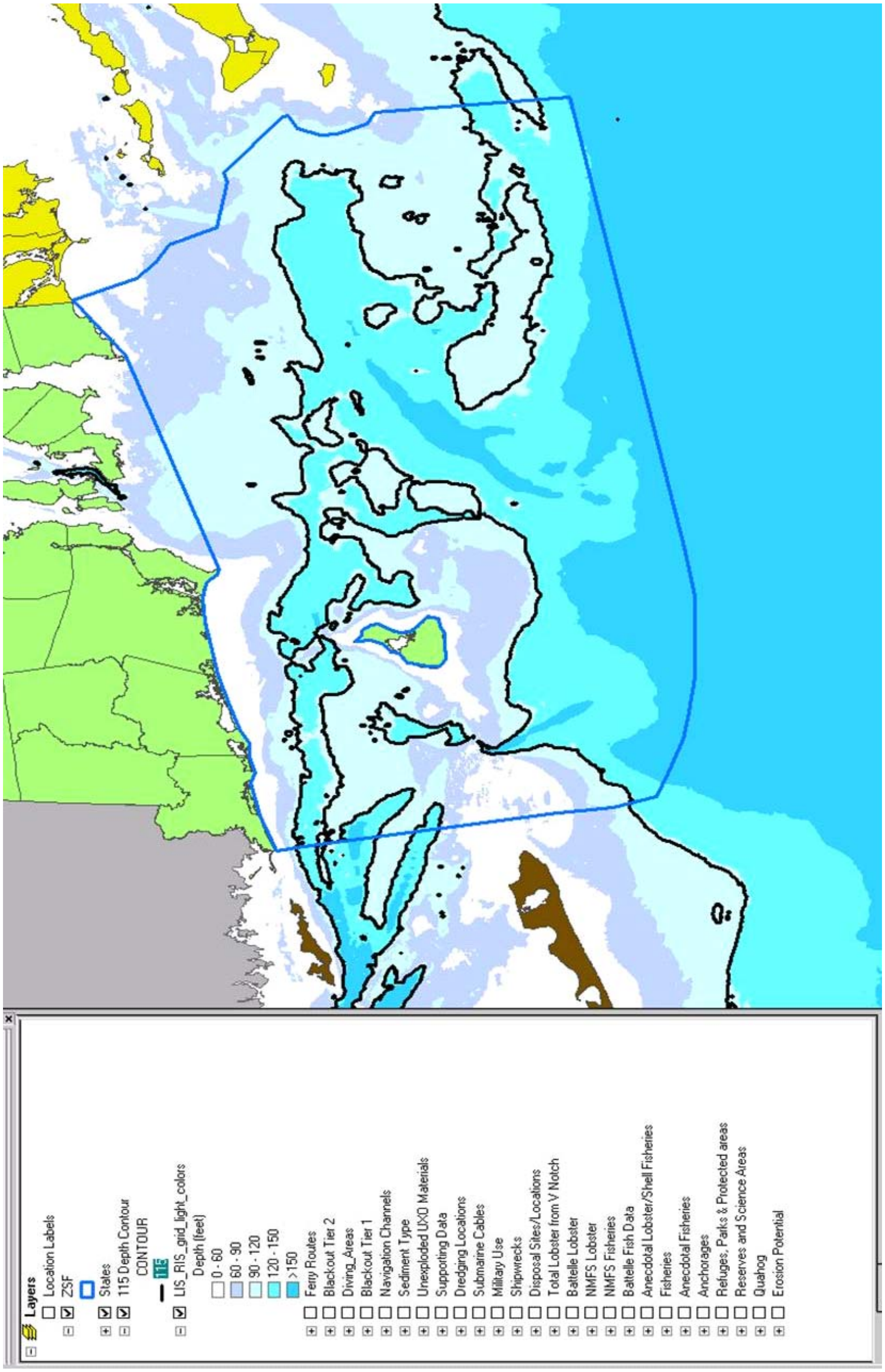


Figure 5. Depth Contour of 115 ft, the Minimum Depth for Locating a Disposal Site.

2.1.2 Areas of Conflicting Uses

The MPRSA criteria state that areas for ocean disposal of dredge material should be chosen to minimize the interference of disposal activities with other uses of the marine environment. Conflicting uses considered in Tier 1 screening included:

- Anchorages (MPRSA Criteria 228.5(a)),
- Reserves and science areas (MPRSA Criteria 228.5(b)),
- Beaches and amenities (MPRSA Criteria 228.5(b)),
- Conservation areas (sanctuaries, wildlife refuges, national seashores, parks, fish havens, artificial reefs) (MPRSA Criteria 228.5(b)),
- Active ordnance and military use (MPRSA Criteria 228.6 (a)(8)),
- Active Utilities (pipelines, cable areas, etc) (MPRSA Criteria 228.6 (a)(8)), and
- Historic or culturally important shipwrecks (MPRSA Criteria 228.6(a)(11)).

Anchorages are located off the coast of southeastern MA and off Montauk Point, New York (NY) in western Block Island Sound in areas well outside of the boundaries of the ZSF (Figure 6). A 0.25 nmi buffer was placed around each anchorage, and these areas were excluded from consideration in Tier 1 screening. The interagency group agreed that ODMDS alternatives would not include state or federal reserve areas, science areas, beaches, or other conservation areas (Figure 6). The interagency group also agreed that active ordnance and military use areas, and pipeline and cable areas would be avoided (Figure 7). In addition, shipwrecks, which provide habitat relief and recreational diving, and an additional 0.25 nmi buffer were excluded during screening (Figure 8).

2.1.3 Summary of Tier 1 Considerations

Once the areas of conflicting uses were determined, these areas were removed from further consideration (Figure 9). Depths less than 115 ft, the minimum depth for locating a disposal site based on the erosional depth and theoretical mound height, were then excluded during Tier 1 screening (Figure 10). While depth was used as the exclusionary layer for erosion, the erodability parameter utilized some additional physical parameters, such as wind and waves, to estimate sediment resuspension. The interagency group felt that those results should also be considered as an exclusionary layer. The areas with an erodability parameter of greater than three are shaded as gray (Figure 10). The areas of high sediment erodability in the northwest corner of the ZSF also coincide with areas of strong currents (Figure 11), which further supports the exclusion of this area from consideration as a location for a disposal site. The unshaded (clear) areas of the ZSF were considered in the Tier 2 evaluation.

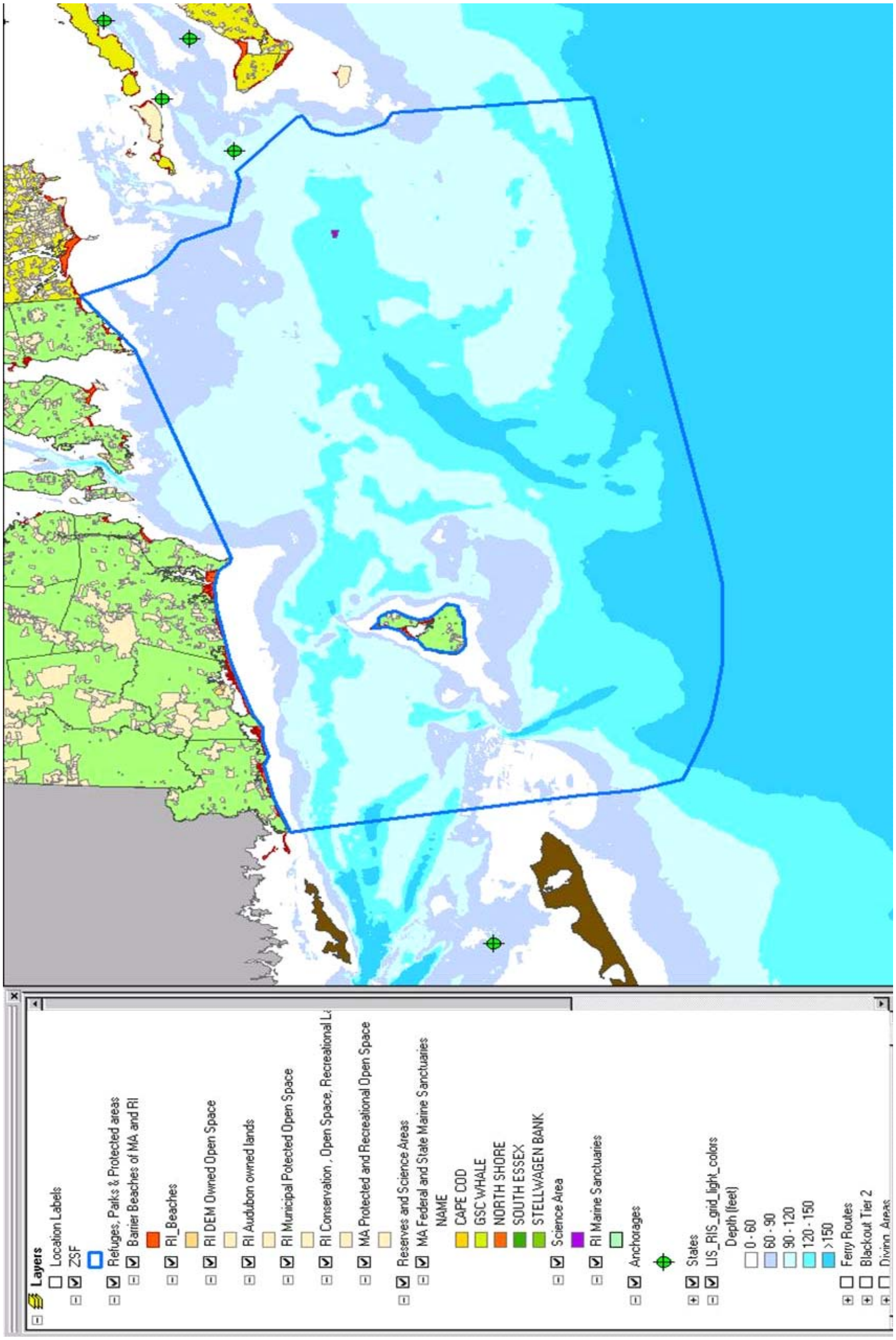
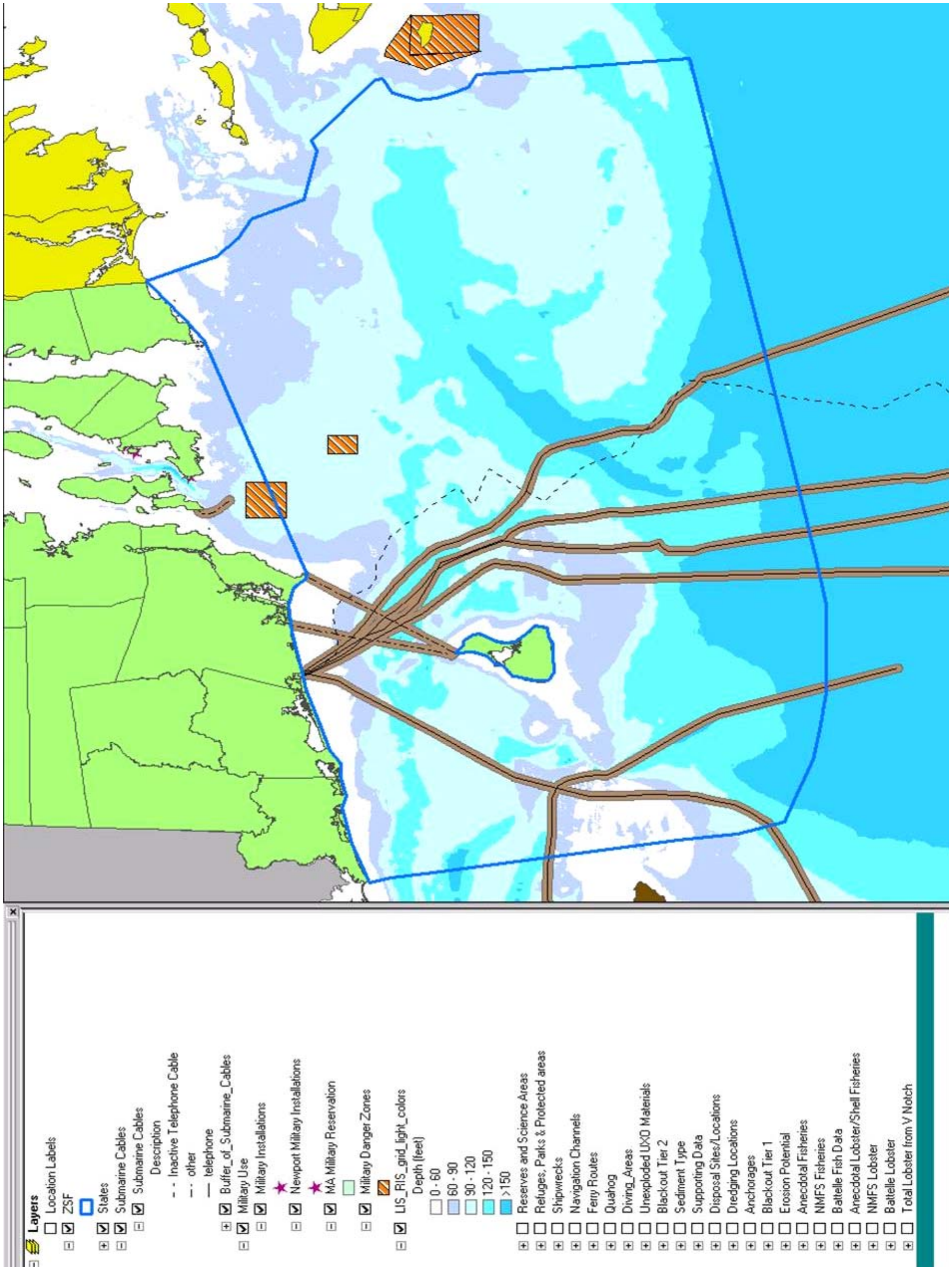


Figure 6. Anchorages, Reserve Areas, Science Areas, Beaches, or Other Conservation Areas.



Note: Brown area represents a 0.25 nmi buffer on either side of active cables.

Figure 7. Active Ordnance, Military Use, Pipeline, and Cable Areas.

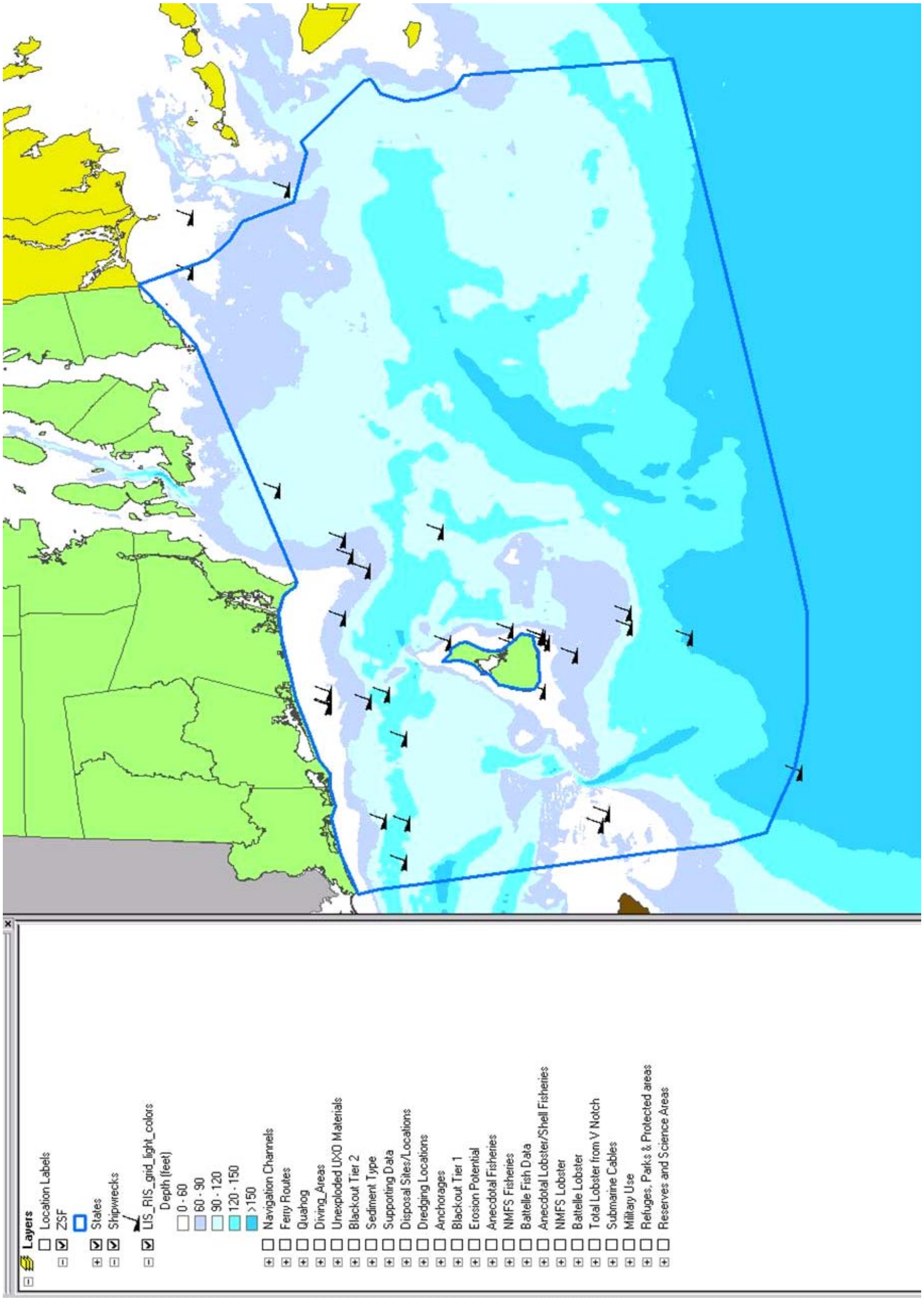


Figure 8. Shipwrecks within the ZSF.

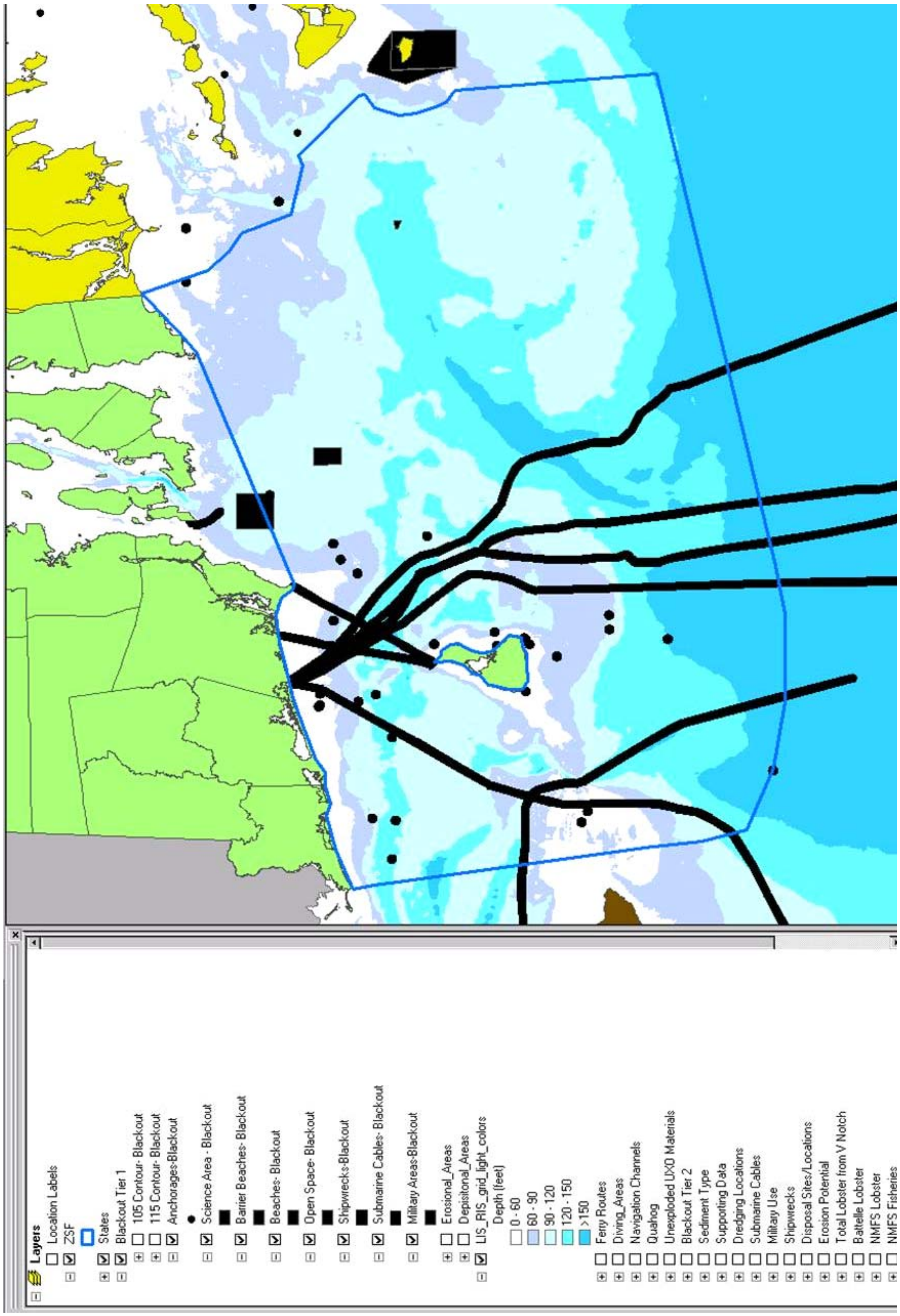


Figure 9. Conflicting Uses Areas Excluded During Tier 1 Screening.

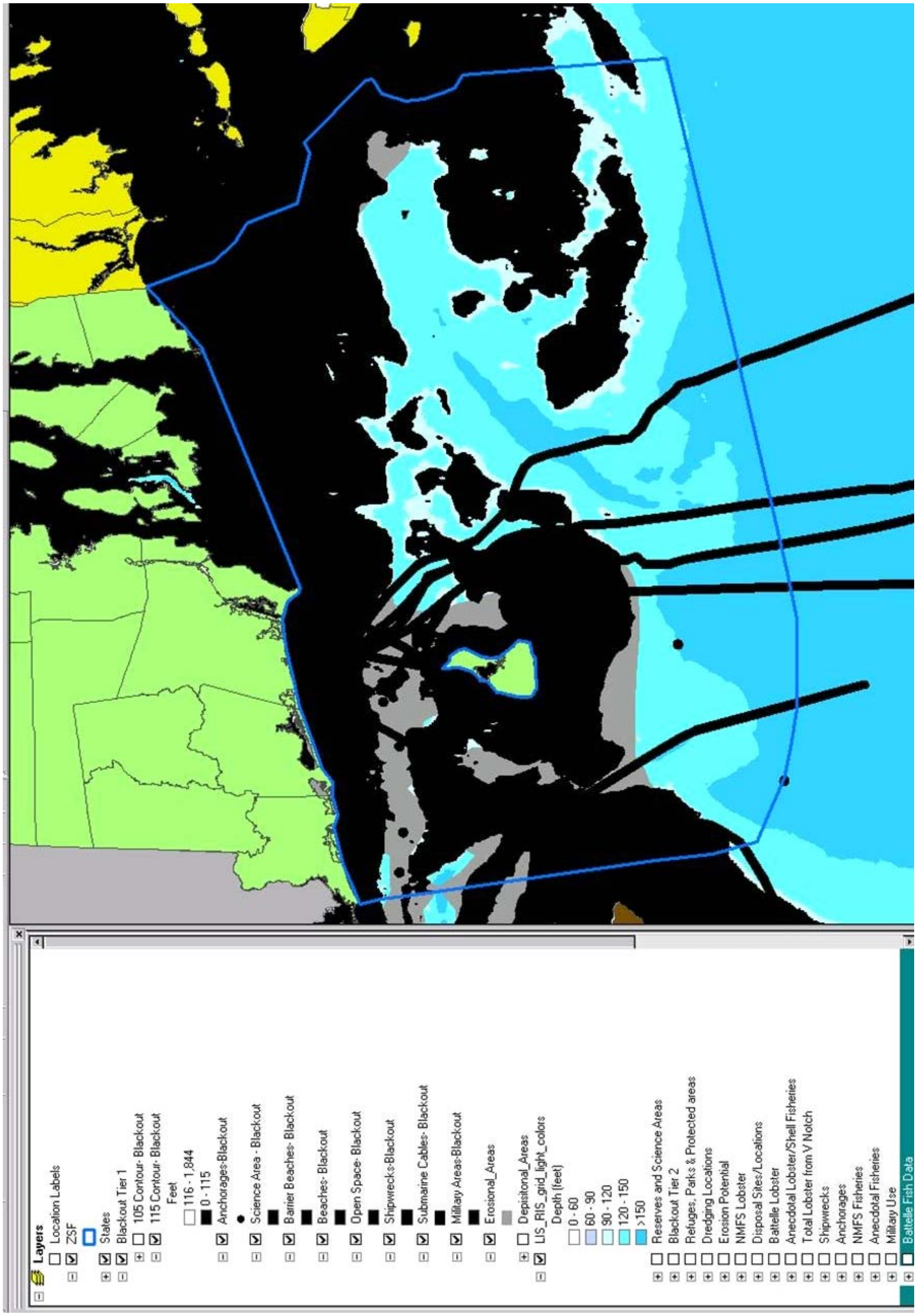


Figure 10. Tier 1 Screening Summary.

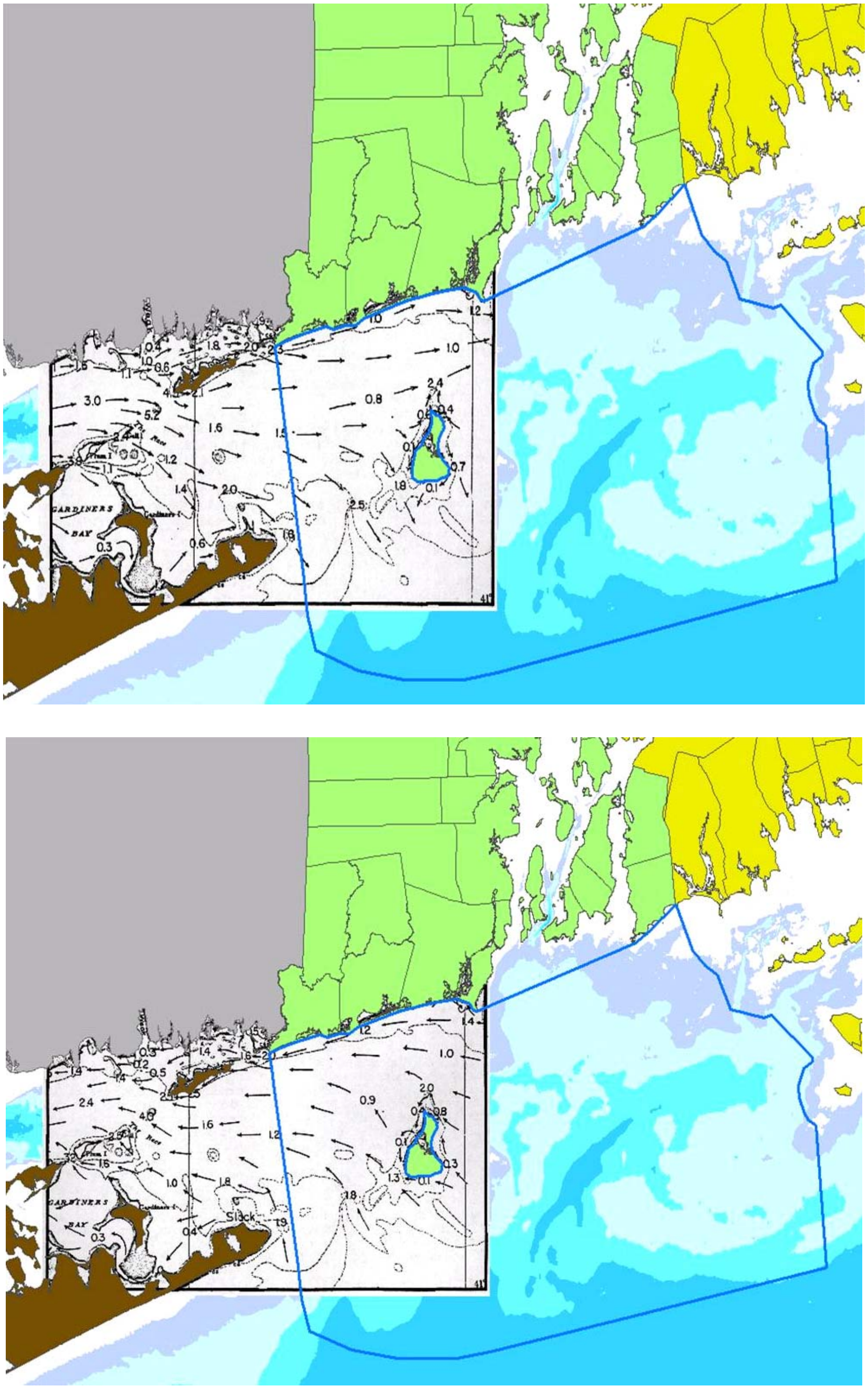


Figure 11. Ebb (top) and Flood (bottom) Currents in the Northwest Corner of the ZSF.

2.2 Tier 2 Screening Approach and Results

The objective of the Tier 2 screening was to further screen the area where sites would not likely be considered within the ZSF and, if possible, determine actual areas for further evaluation in the EIS. The three levels of quantitative screening values were used to further evaluate this area (Appendix A). The screening criteria considered in Tier 2 screening included:

- Fish and shellfish resources (finfish, lobster, and shellfish),
- Navigation,
- Diving areas,
- Unexploded ordnances (UXOs),
- Economics,
- Tidal ellipses,
- Grain size distributions, and
- Historic and current disposal sites.

2.2.1 Minimizing Impacts to Fish and Shellfish Resources

The Working Group identified the potential impacts to fisheries by the designation of a disposal site as a major concern. The screening criteria developed by the Corps and EPA excluded highly productive fish, lobster, and shellfish habitat and concentration zones from consideration to minimize significant impacts of an ODMDS to these resources.

Fish

Fishing areas within the ZSF were identified by various sources, including the Rhode Island Resource Protection Project (RIRPP), Rhode Island Marine Resource Uses GIS Data (URI and RI CRMC, 2003), Metcalf and Eddy (1987), and day fishermen. These areas were excluded from consideration during Tier 2 screening (Figure 12).

The total fish catch-per-unit-effort (CPUE) data (based on a 30 minute tow) collected by NMFS and the Corps was reviewed and mapped spatially to confirm significant fishing areas previously identified (Figure 13). The NMFS has conducted seasonal trawl surveys in the coastal waters off the U.S. since the late 1960s using a stratified random sampling design to identify tow locations. Since 1990, NMFS has collected data at 102 stations within or adjacent to the ZSF. The data used for this screening layer included spring and fall surveys from 1990 to 2002, and winter surveys from 1992 to 2002.

Trawl surveys were also conducted by the Corps at several locations within the ZSF in September 2001, June 2002, November 2002, and December 2002. The November and December 2002 fish trawl surveys were conducted to evaluate whether the deeper regions, surrounded by more shallow areas, tend to congregate fish as indicated by several commercial fishermen who fish within the ZSF. The methods used for Battelle surveys were slightly different from those conducted by NMFS, and results cannot be directly compared between

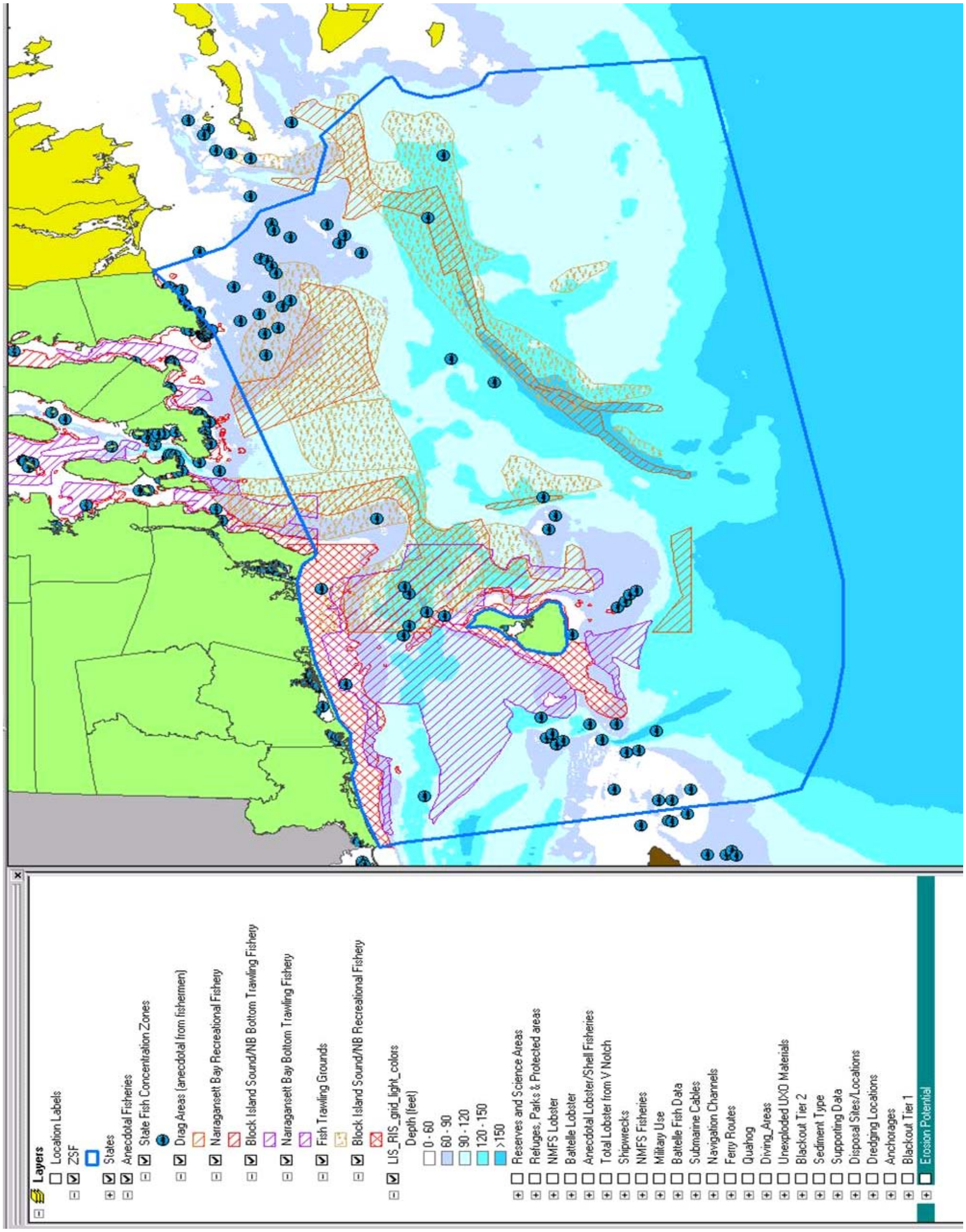
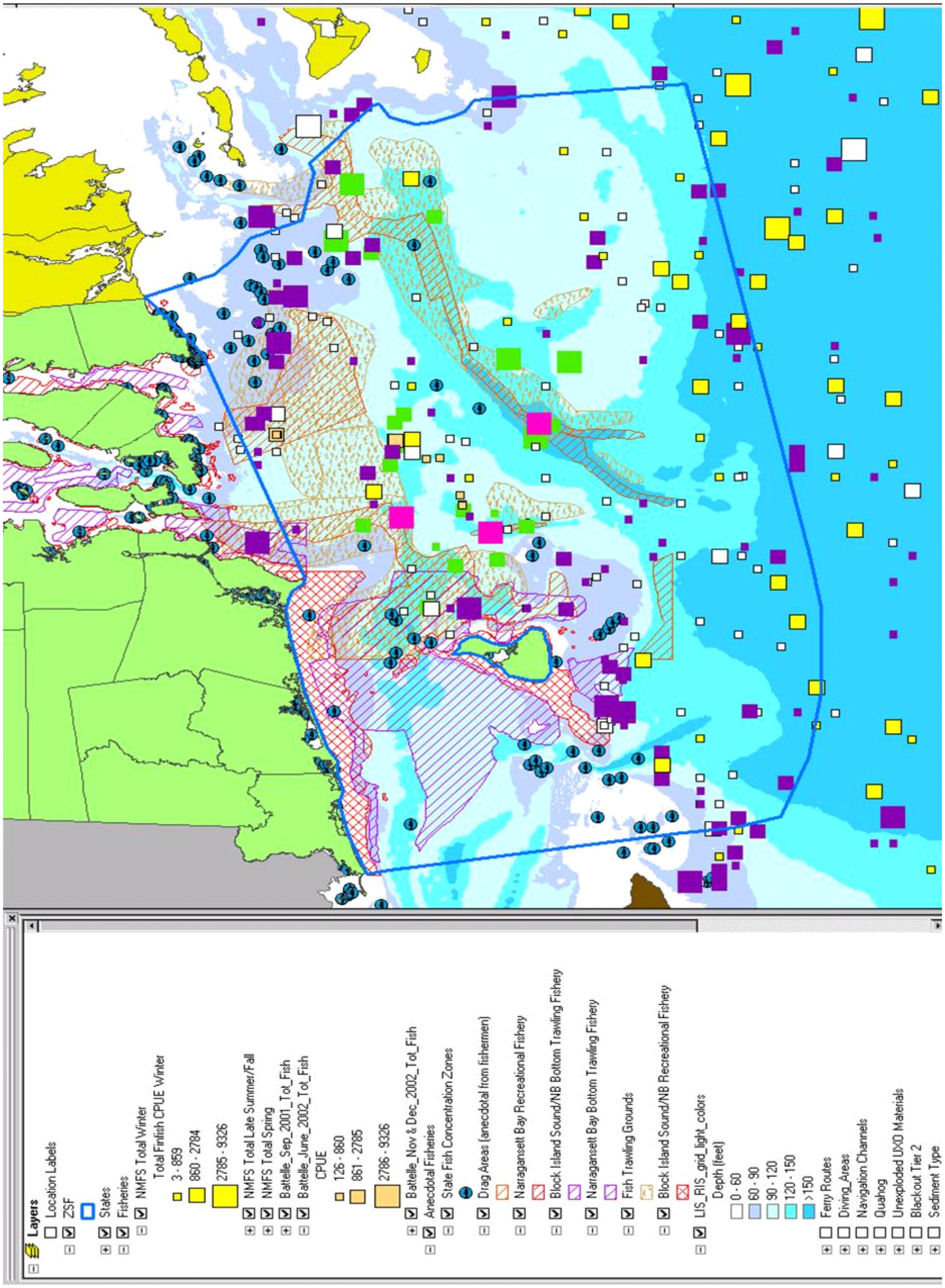


Figure 12. Anecdotal Fishing Areas in the ZSF Identified by Day Fishermen.



Note: white = NMFS Spring, purple = NMFS Late Summer/Fall, magenta = Battelle September 2001, green = Battelle November/December 2002.

Figure 13. Total Fish CPUE Data Collected by NMFS and the Corps with Anecdotal Fishing Areas.

programs. However, the results can discriminate differences in catch among the specific sites surveyed. The data and the method of applying it to the layers were discussed with the Federal and state cooperating agencies to solicit their support for the application to the layers.

All NMFS and Corps trawl data were categorized into three levels using a statistical formula that identified natural breakpoints in the data. These natural breakpoints (derived from the NMFS and Corps data) served to rank the finfish catch into three levels that indicated a particular location (at the time of sampling) was highly productive (CPUE $\geq$ 2,785), of medium productivity (CPUE $\geq$ 860 $\leq$ 2,784) or of low productivity (CPUE $\leq$ 860). Areas with high CPUE values generally coincided with areas identified as fish concentration zones or as fishing grounds by fishermen.

Lobster

Lobstering areas identified within the ZSF were delineated by lobstermen during interviews and at Working Group meetings (Figure 14). These areas were excluded from consideration during Tier 2 screening. The lobster CPUE data (based on a 30 minute trawl) collected by NMFS and the Corps were reviewed by the interagency group and were used to confirm lobstering areas identified by the lobstermen (Figure 15). Total lobster catches from the V-notch program were also used to understand areas where the most lobster catches were being reported.

As discussed in the Fish section, NMFS conducts research trawls within, and in close proximity to, the ZSF. These NMFS research trawl surveys also capture lobsters. CPUE data from the fall, winter, and spring surveys from 1990 through 2002 were used to calculate a CPUE for any given trawl location. The Corps also collected lobster in finfish trawls collected in September 2001, June 2002, November 2002, and December 2002.

All NMFS and Battelle trawl lobster data were categorized into three levels using a statistical formula that identified natural breakpoints in the data. These natural breakpoints served to rank the lobster catch into three levels that indicated a particular location (at the time of sampling) was highly productive (CPUE $\geq$ 114), of medium productivity (CPUE $\geq$ 31 $\leq$ 113) or of low productivity (CPUE $\leq$ 30).

The National Oceanic and Atmospheric Administration (NOAA) Restoration Center, in response to the North Cape oil spill in 1996, began the “V-notch” program. This program is designed to protect and restock lobster resources of the coast of Rhode Island. V-notching of legal sized berried female lobsters is done using a special tool that notches the telson (tail) of appropriate individuals. These lobsters are released back into the environment and cannot be harvested until the notch reaches a size of approximately 0.25 inches, following several molts. As part of this program, lobstermen voluntarily report the total number of lobster (v-notched and landed) caught offshore of RI. These data only indicate where the most lobster catches were reported. Since the program is voluntary, only data that is reported by lobstermen who participate in the program is collected. Data is also reported by grid areas, so it is not possible to distinguish the exact location within the grid where the lobster catches were made. Areas with the highest reported lobster catches from the V-notch program, however, did appear to coincide with areas of high lobster CPUE values (NMFS and Battelle) and anecdotal fishing areas.

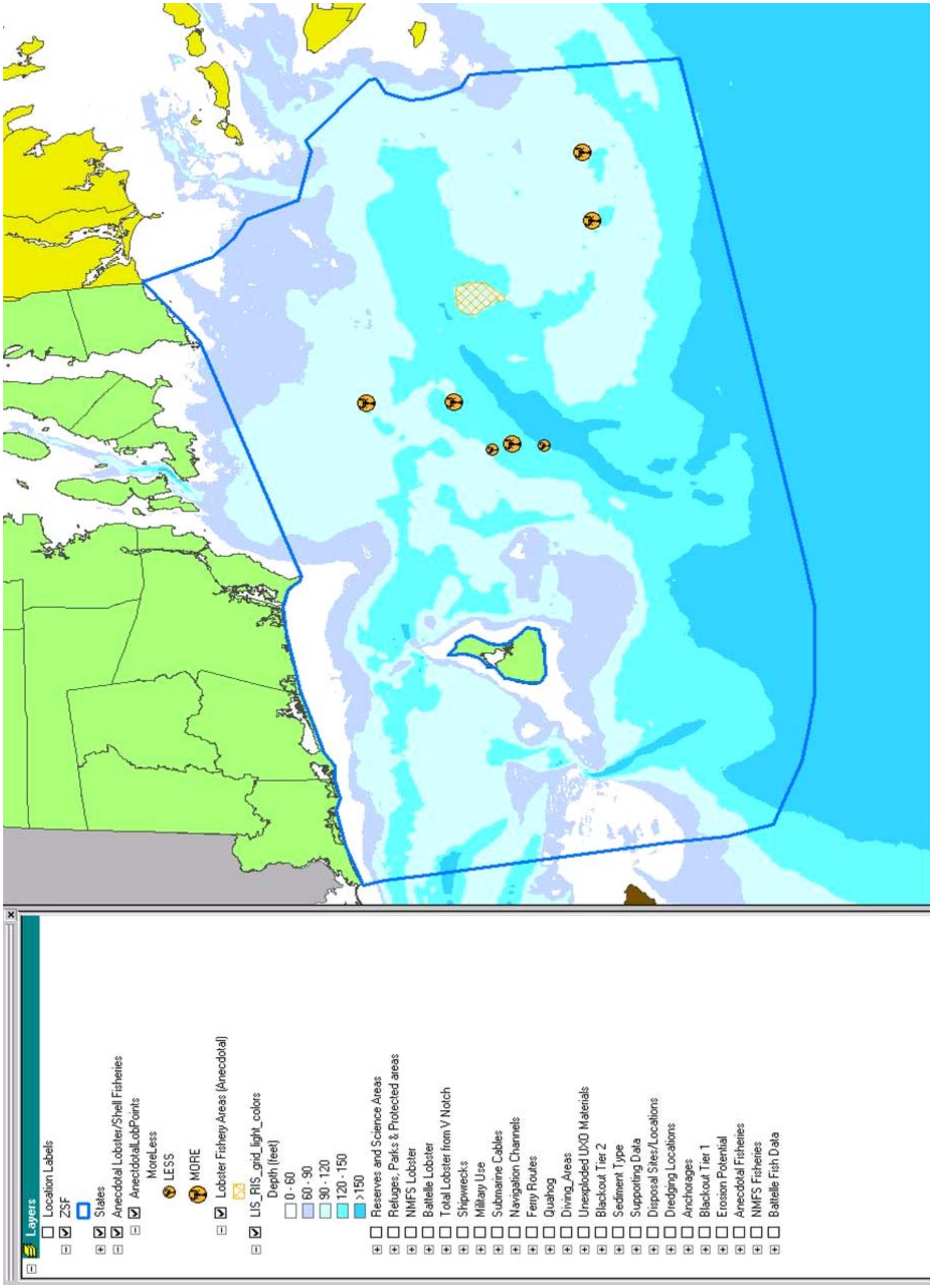
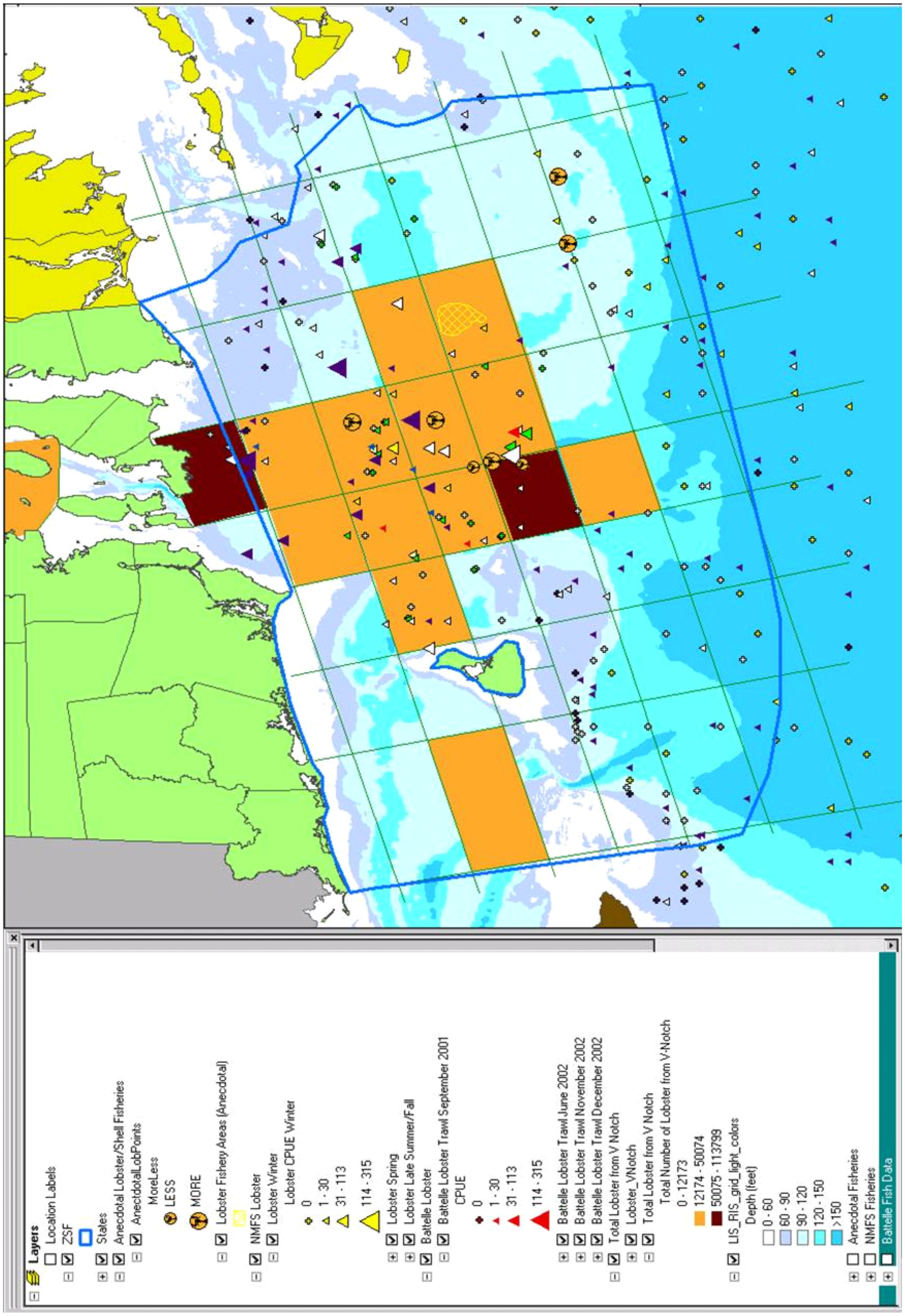


Figure 14. Anecdotal Lobstering Areas in the ZSF Identified by Lobstermen.



Note: white = NMFS Spring, purple = NMFS Late Summer/Fall, magenta = Battelle June 2002, green = Battelle November 2002, light green = December 2002.

Figure 15. Lobster CPUE from NMFS and the Corps with Anecdotal Information.

Shellfish

Shellfish habitats within the ZSF have been identified using several historical sources of information (Corps, 1976; Fogarty, 1979; Battelle, 1998), recent data collected by the Corps, and anecdotal information from local fishermen (Figure 16). The 1976 Fall River Harbor Improvement Dredging Project Draft EIS identified shellfish beds south of Narragansett Bay, northeast of Block Island, and west of Martha's Vineyard (Corps, 1976).

The distribution of ocean quahogs in Rhode Island Sound was studied in detail by Fogarty (1979, 1981), who used a hydraulic clam dredge to sample at 212 stations. Ocean quahogs occurred at 139 stations (66%) and were distributed in relatively large-scale aggregations within the study area. The areas of high densities ($\geq$1.01 kilogram [kg] per square meter [m^2]) occurred in the southeast quadrant of the ZSF, following a "line" running southwest of Gay Head (Figure 16). A second area of high densities occurred in the north central part of the ZSF, generally along a line from Block Island northeast to Nashawena Island. The other important information provided by the dredge data is that the clam distribution is very patchy and densities vary considerably over relatively small spatial scales (about the scale between tows, which appears to be as small as about one nmi). Pockets of high clam densities are closely flanked by pockets of low densities, or even areas without clams. Shellfish sampling conducted by Battelle in 1997 and by the Corps in 2002 confirmed that shellfish were still present in some of the shellfish beds identified in 1976.

The three levels of quantitative screening values were developed based on the station specific quahog density data (kg/m^2) provided by Fogarty (1979). The natural break method was used to derive the screening criteria values for ocean quahog by identifying breakpoints between classes of data using a statistical formula (Jenk's optimization). Jenk's method minimizes the sum of the variance within each of the classes. Natural Breaks finds groupings and patterns inherent in the data. The station specific data, however, could not be spatially mapped, due to missing coordinate information. Therefore, a contour map developed by Fogarty (1979) was digitized into ArcView, and the classification levels used by Fogarty to form the quahog distribution contours were used to categorize the productivity of the shellfish areas. Areas of very high ($\geq$1.01 kg/m^2), high (0.51 – 1.01 kg/m^2), and medium (0.21 – 0.51 kg/m^2) quahog productivity were excluded from consideration in Tier 2 screening, using a graded scale of shading (black, dark gray, and light gray).

2.2.2 Minimizing Impacts to Navigation

Interference with navigation was considered an important consideration for Tier 2 screening. Areas within active shipping lanes, ferry routes, and lightering areas were excluded from consideration (Figure 17). In addition, a 0.5 nmi buffer on shipping lanes and ferry routes was incorporated into this screening layer as a safety factor.

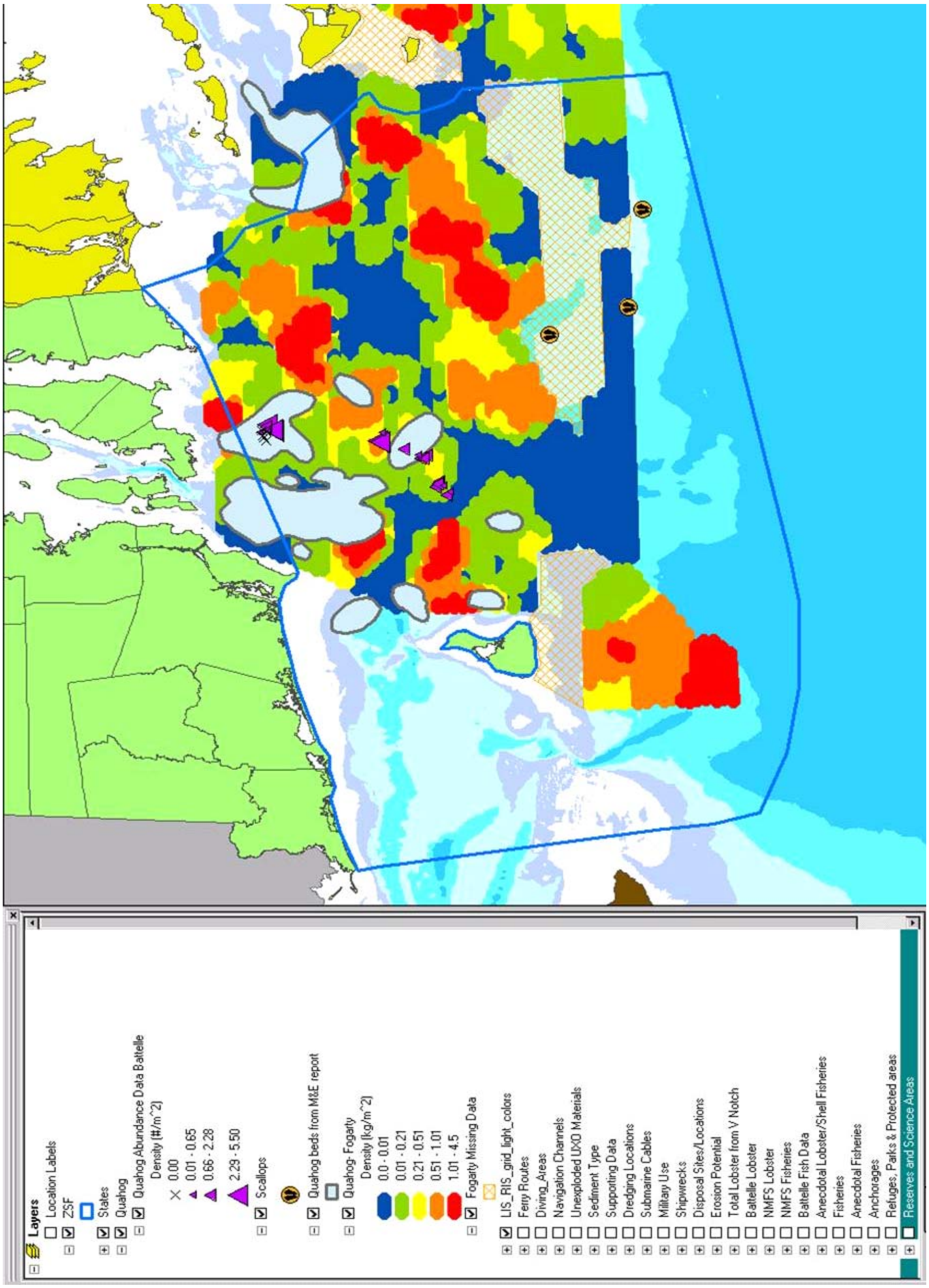


Figure 16. Shellfish Habitat within the ZSF.

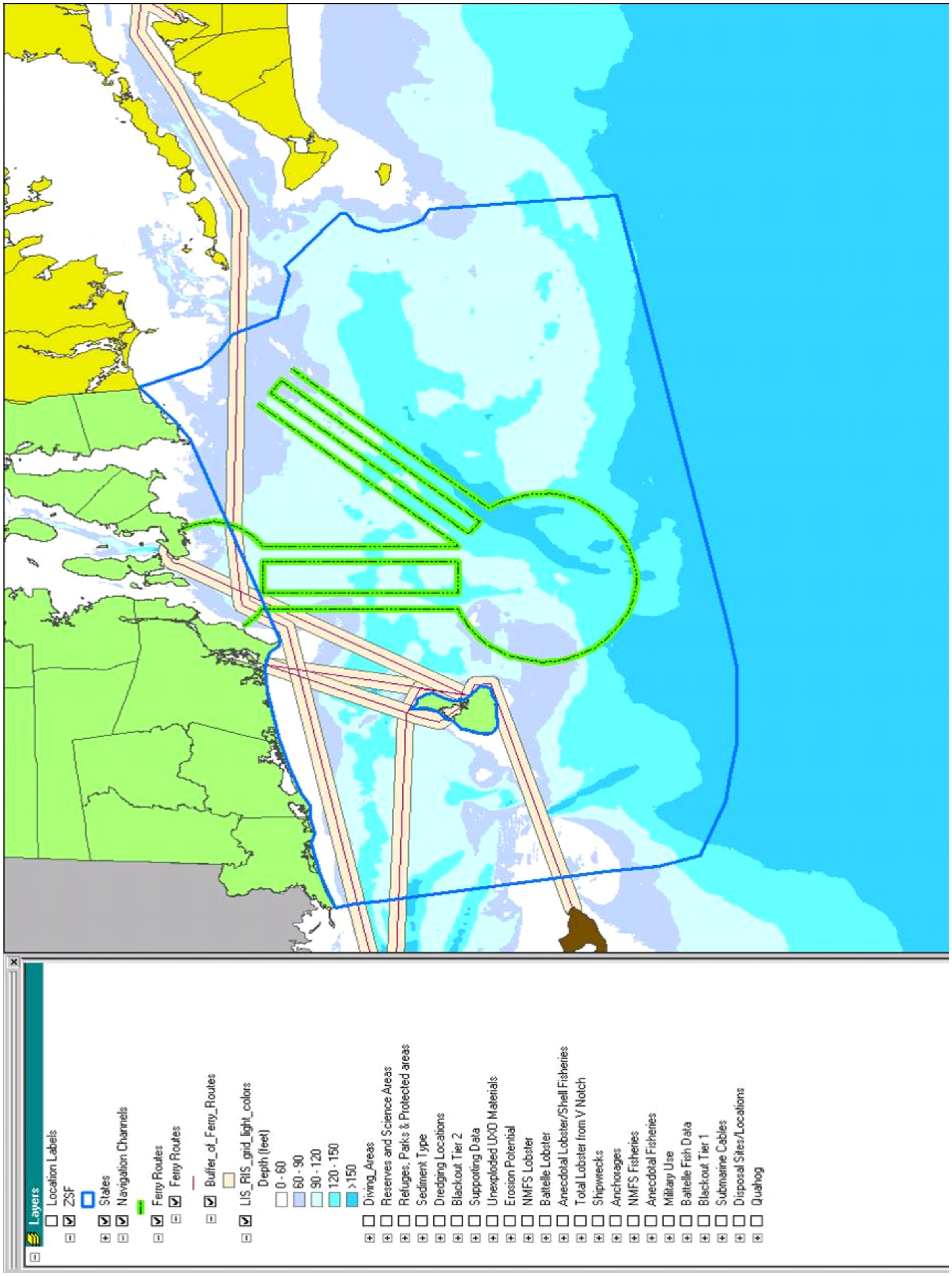


Figure 17. Navigational Uses of the ZSF (Shipping Lanes, Ferry Routes, and Lightering Areas).

2.2.3 Minimizing Impacts to Diving Areas

The Working Group was also concerned about the impact to recreational diving. Diving areas within the ZSF were identified from NOAA charts and diving club databases that are available on the internet. A 0.25 nmi buffer was added around locations known to have diving activity to minimize impacts to diving areas, and these areas were incorporated into a screening layer (Figure 18). Note that many of these diving locations coincide with shipwreck locations.

2.2.4 Other Considerations

Additional criteria considered during the Tier 2 screening included:

- Unexploded Ordnances (UXOs),
- Economics,
- Transport of water during typical tidal cycles,
- Grain size distributions, and
- Historic disposal sites.

Unexploded Ordnances (UXOs)

There are 11 identified locations of unexploded ordnances (UXO) in the ZSF. These include unexploded torpedoes, unexploded depth charges, and unexploded bombs (Figure 19). There is no evidence that these UXO's are going to be removed; some have been there since the 1940s. The interagency group agreed that for safety reasons, UXOs within the ZSF should be excluded during Tier 2 screening. For additional safety, a 0.25 nmi buffer was placed around each UXO.

Economics

A screening layer was developed to further refine the economically effective distance from the dredging centers to the disposal mound. The southern boundary of the ZSF was set at approximately 20 nmi from the dredging center on Block Island by considering all the potential dredging locations (Corps, 2002b). Further review of the information in the ZSF report identified that only the centers on Block Island and Gay Head caused the boundary to be located approximately 30 nmi offshore. Examination of the cost tables for typical barge operations (Table 4, Page 14 of Corps, 2002b) determined that a more appropriate economic distance from most harbors in Rhode Island and southeastern Massachusetts was approximately 20 nmi from the coast (Figure 20). This was found to be reasonable for the greatest haul distance in upper Narragansett Bay. Transfer distances of greater than 20 nmi off shore were considered less favorable from a cost perspective. After discussion, it was agreed that the area of the ZSF greater than 20 nmi from the coast would be removed from consideration.

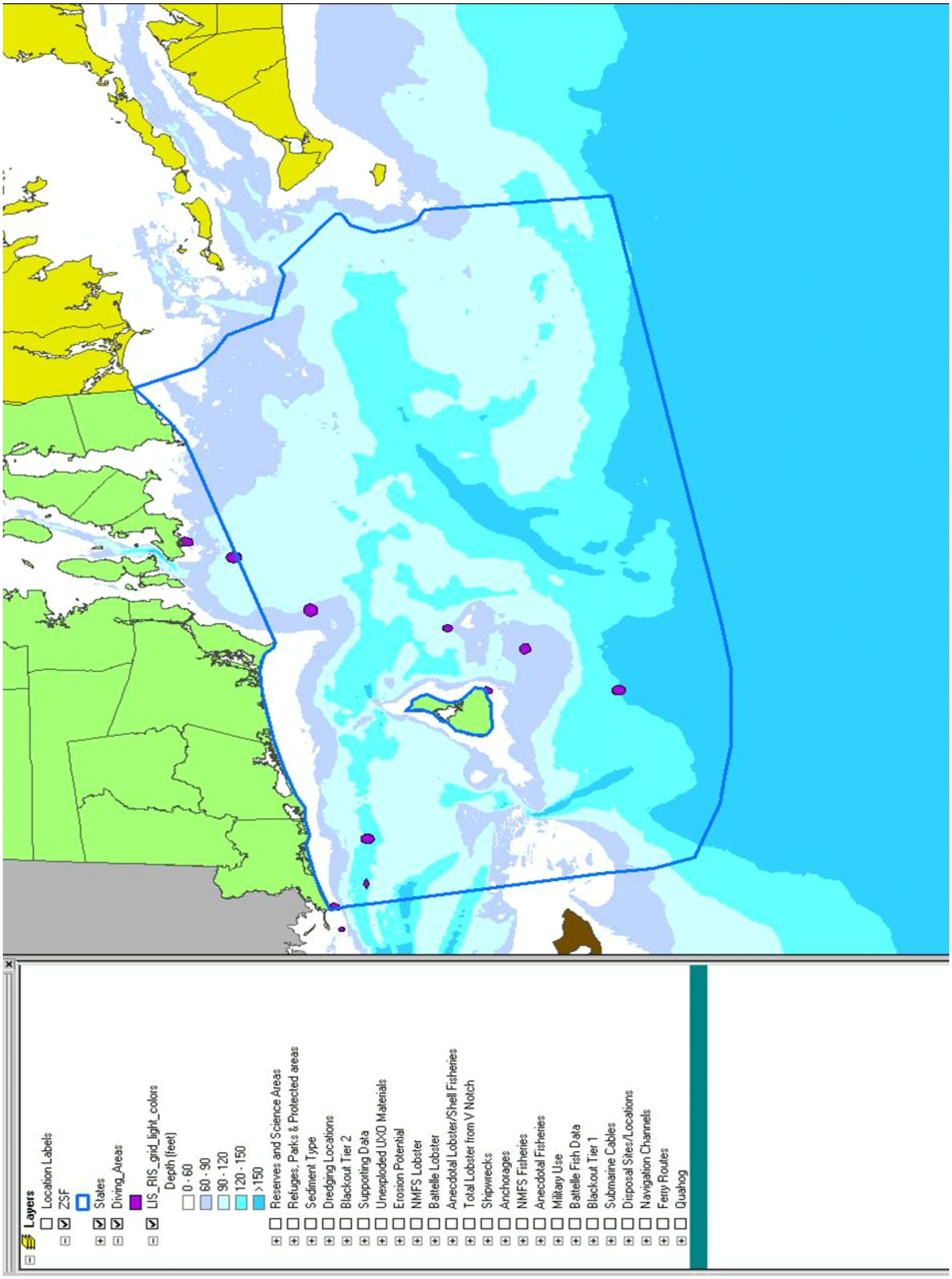


Figure 18. Diving Areas within the ZSF.

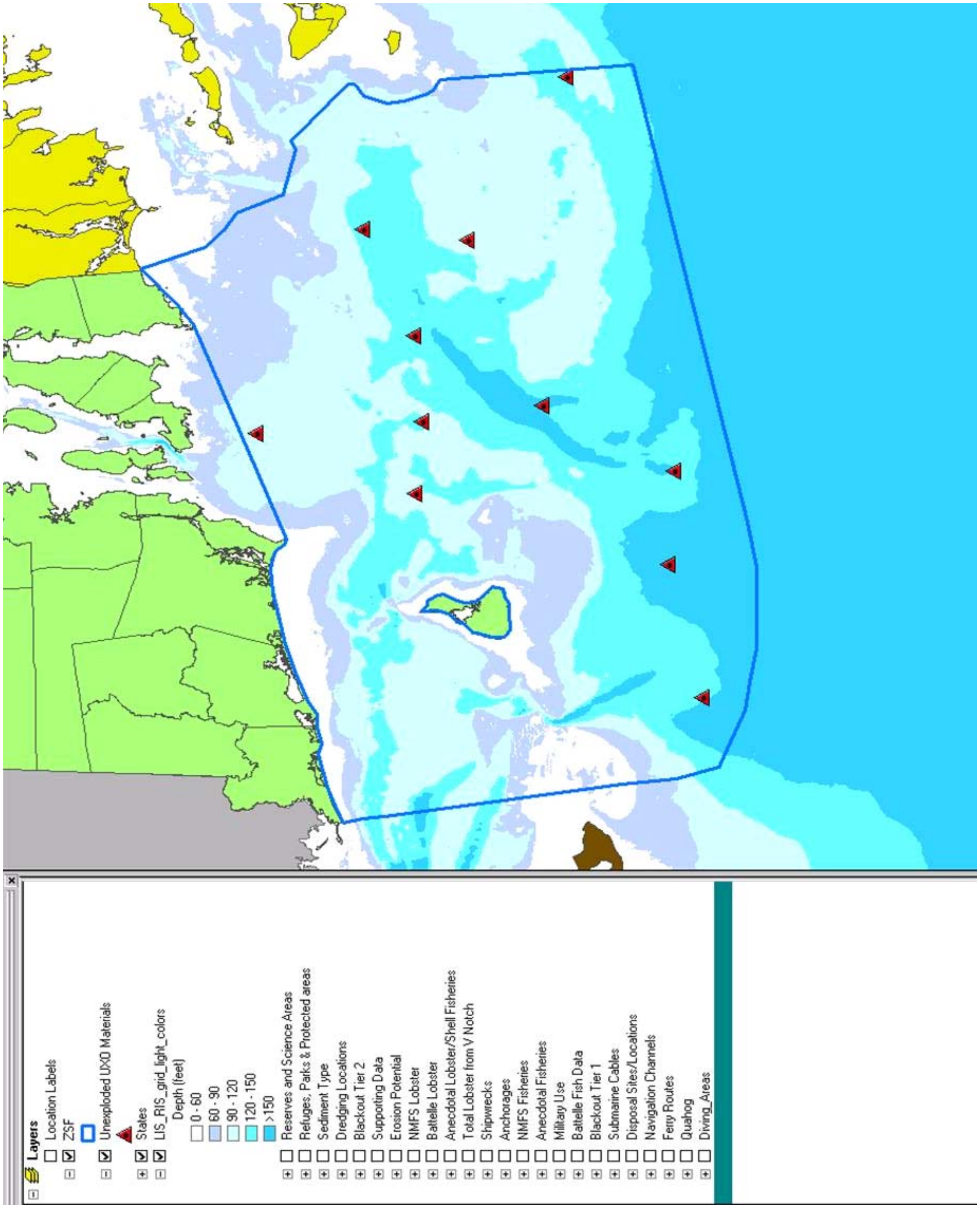


Figure 19. UXOs within the ZSF.

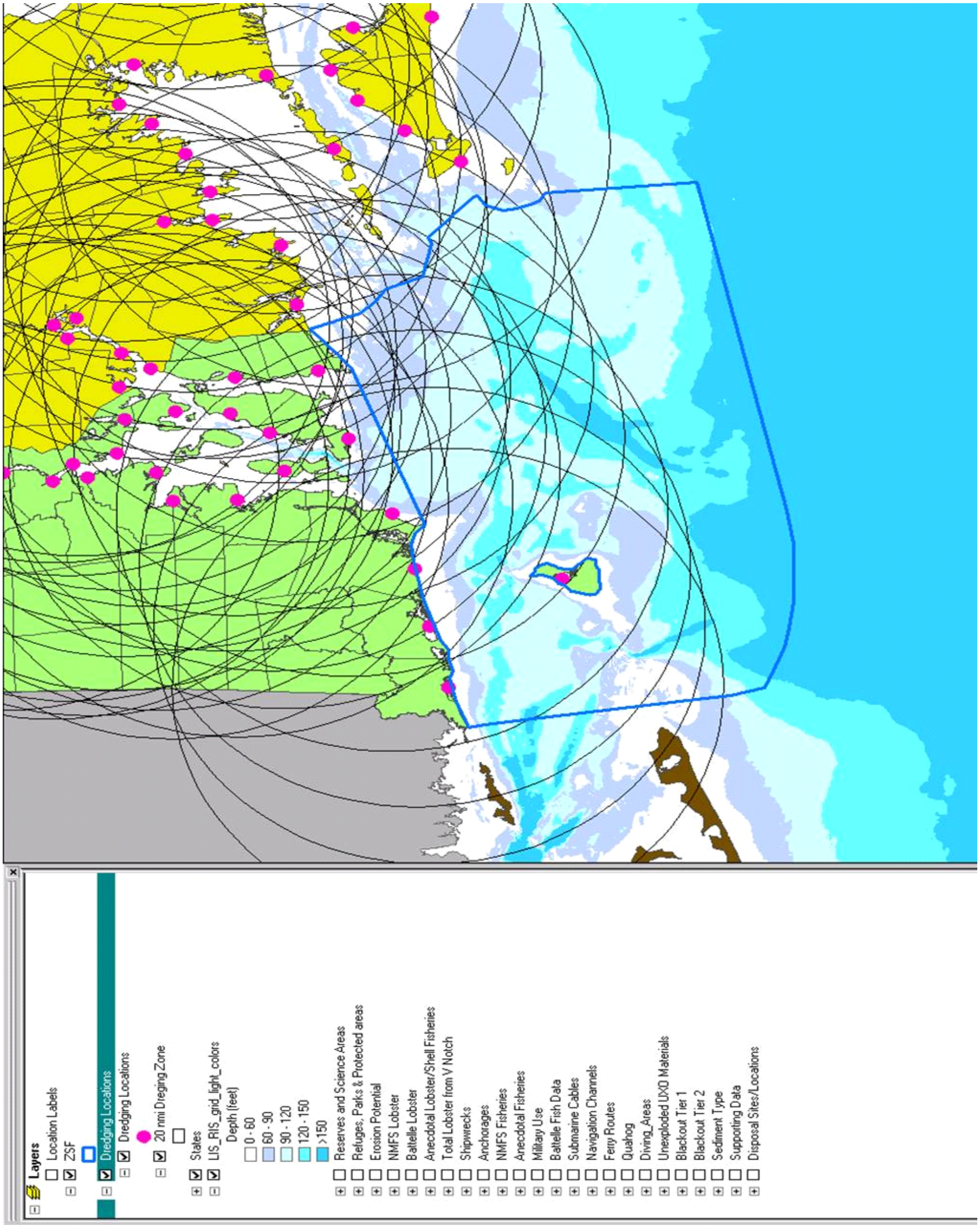


Figure 20. Concentric Circles with 20 nmi Radius from Dredging Centers in RI and MA.

Tidal Ellipses

Tidal currents are driven by the regular pattern of the rise and fall of the moon and as such change from flood to ebb and back to flood again every 12.42 hours (hr). In a narrow channel the flow is rectilinear, flooding and ebbing along a straight line, but in open water it is more elliptical or even circular. A tidal ellipse is drawn to represent the tidal current over the tidal cycle, such that the current flows in the direction of a vector that originates at the center of the ellipse and terminates on the perimeter. The vector moves around the ellipse every 12.42 hr. The direction and duration of the tidal currents within the ZSF were examined to understand the actual trajectory a packet of water might travel through the tidal cycle, thereby showing the extent of travel of the tidal driven flow. The tidal ellipses at the Separation Zone Site (Site 69B) show that the direction of the tides are from the northwest to southeast, and the movement of the surface waters are greater than the bottom waters (Figure 21). These tidal currents are expected to be similar throughout the central and eastern portions of the ZSF.

Grain Size Distributions

Historical studies have been conducted to determine the grain size distribution within the ZSF (McMaster, 1960; Knebel, *et al.*, 1982). Sampling conducted by the Corps in November and December 2002 was also used to understand the grain size of sediments in Rhode Island Sound. These data were used to establish whether areas remaining after screening are likely to be erosional (Figures 22 and 23). Sediment type was not a data layer used to include or exclude locations, due to the paucity of quantitative data.

Fogarty's studies (1979, 1981) correlated sediment grain size with distribution of ocean quahogs in Rhode Island Sound. The highest densities of ocean quahogs were found in sediments with high amounts of medium sand and shell fragments. Densities were lowest in high silt/clay or coarse sand-gravel sediment (Fogarty, 1981). This information was used to extrapolate grain size from the distribution and density of ocean quahogs in the ZSF (Figure 24). Some areas south of Block Island and west and southwest of Martha's Vineyard could not be sampled with the dredge, due to obstructions on the sea bed.

Historic Disposal Sites

There was agreement among members of the interagency group that preference should be given to historical disposal sites for siting alternative ODMDS in the RIR. Use of previously used disposal sites would avoid modifying the bottom type and habitat of additional areas of the ZSF. The historic disposal sites in the RIR are presented in Figure 25.

2.2.5 Summary of Tier 2 Considerations

Figure 26 shows the areas that were screened out as unacceptable for an ocean disposal site and those that remained for further evaluation if only Tier 2 screening information were used to identify candidate sites. Areas that were important fish and shellfish habitats, that were used for navigation and diving, that contained UXOs, and that were further than an economically effective distance from the dredging centers were all removed from consideration during Tier 2 screening.

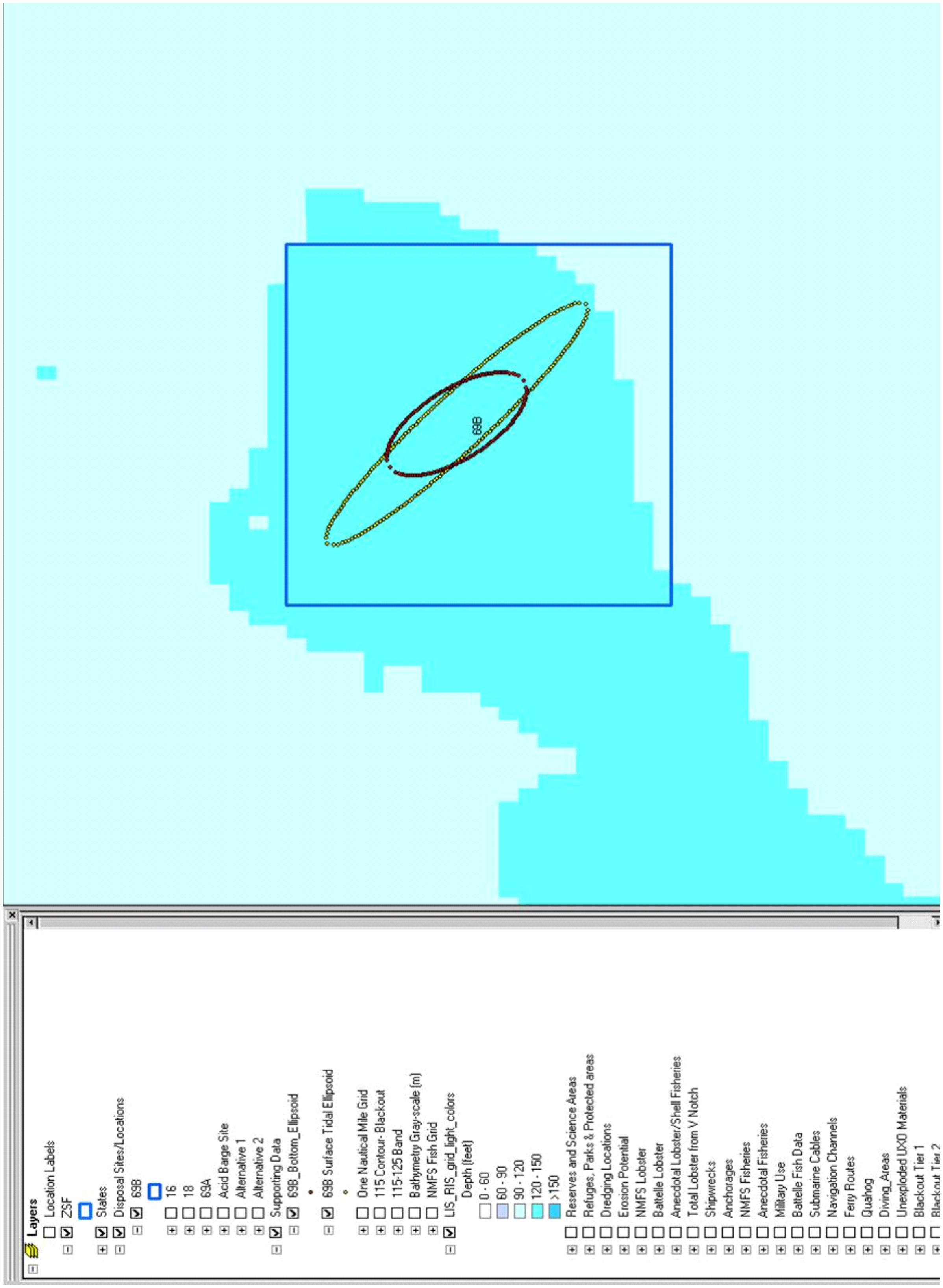


Figure 21. Tidal Ellipse at the Separation Zone Site (Site 69B).

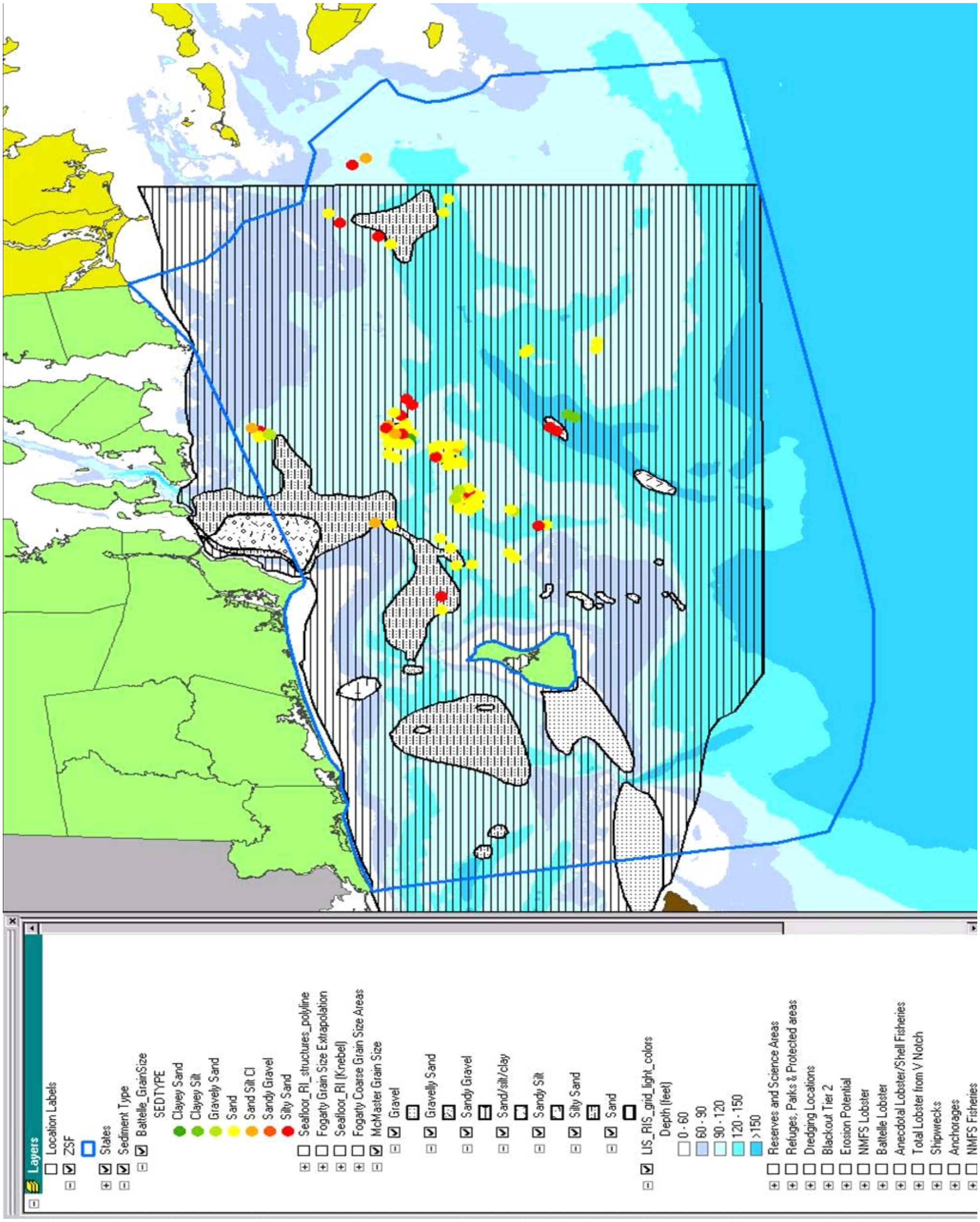


Figure 22. Grain Size Distribution within the ZSF by McMaster and Battelle.

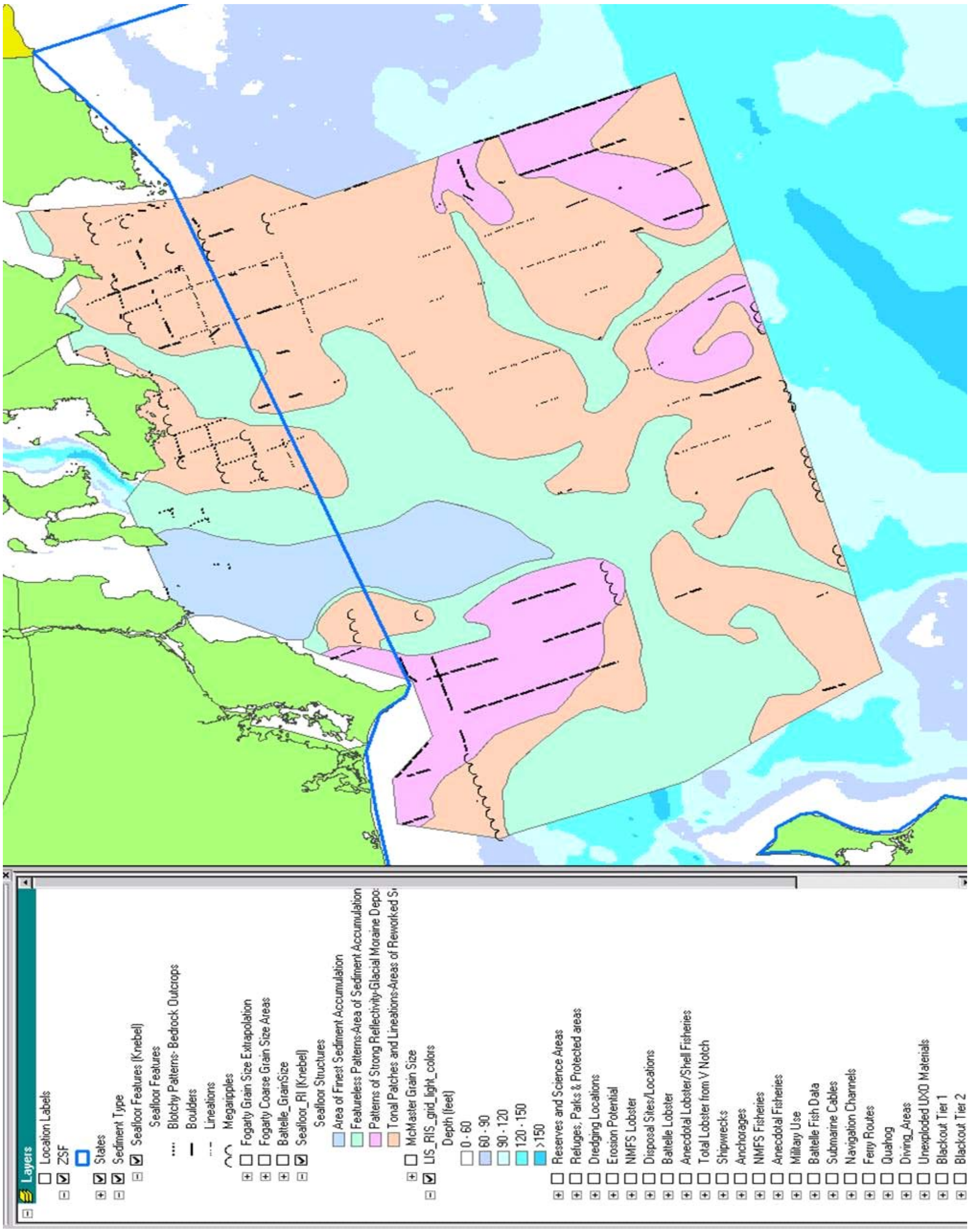


Figure 23. Grain Size Distribution by Knebel.

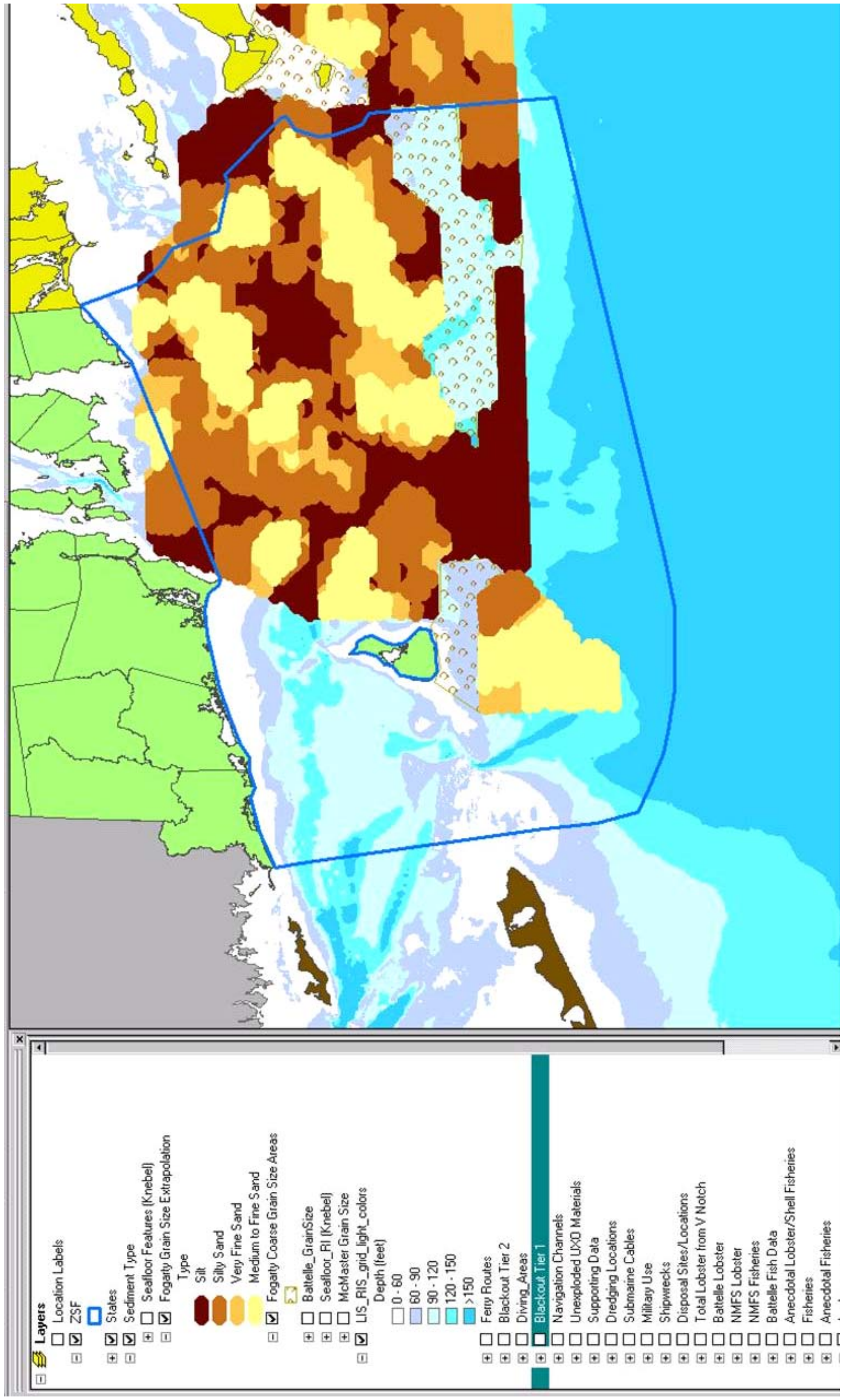


Figure 24. Grain Size Information Extrapolated from Ocean Quahog Distribution.

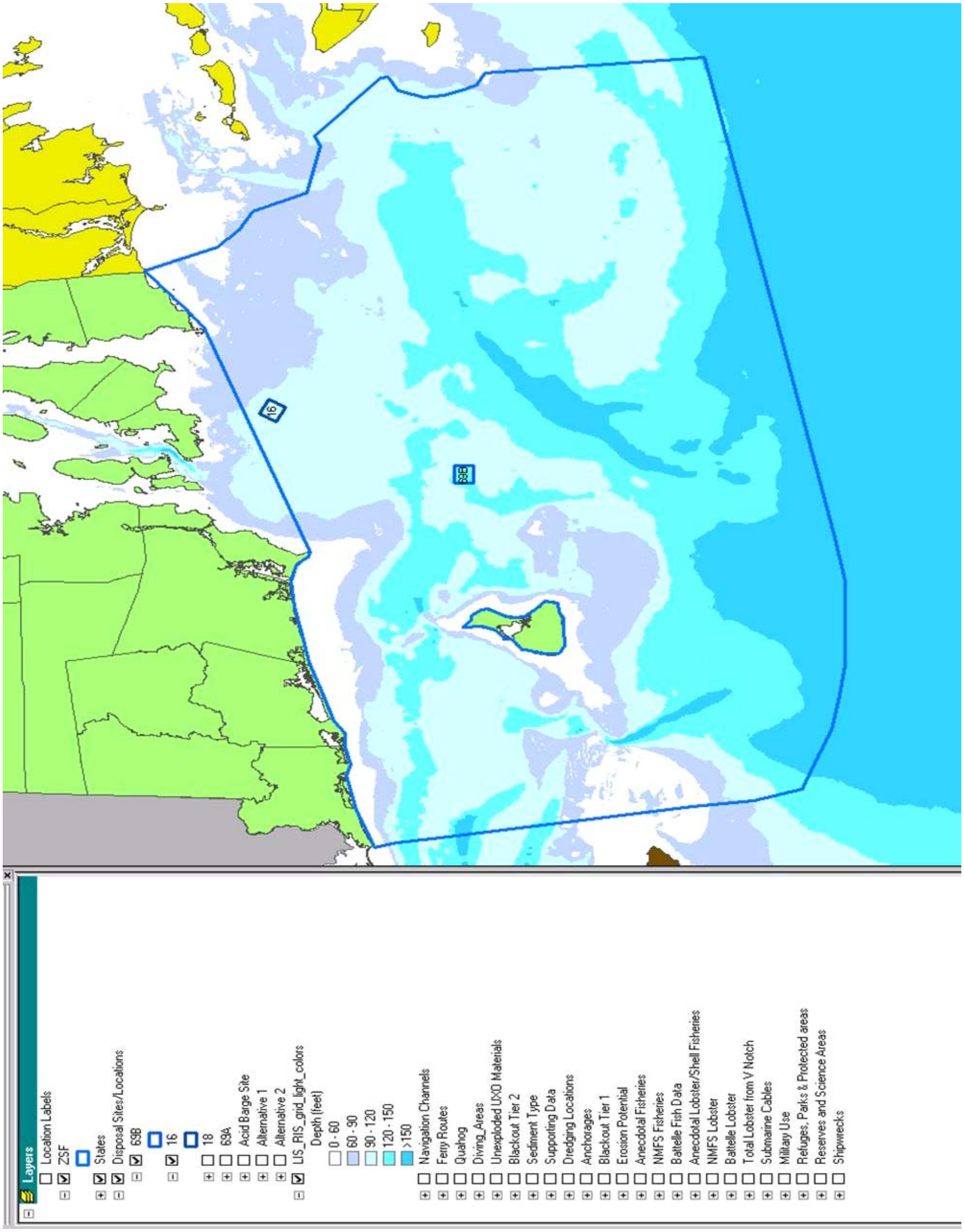


Figure 25. Historic and Current Disposal Sites within the ZSF.

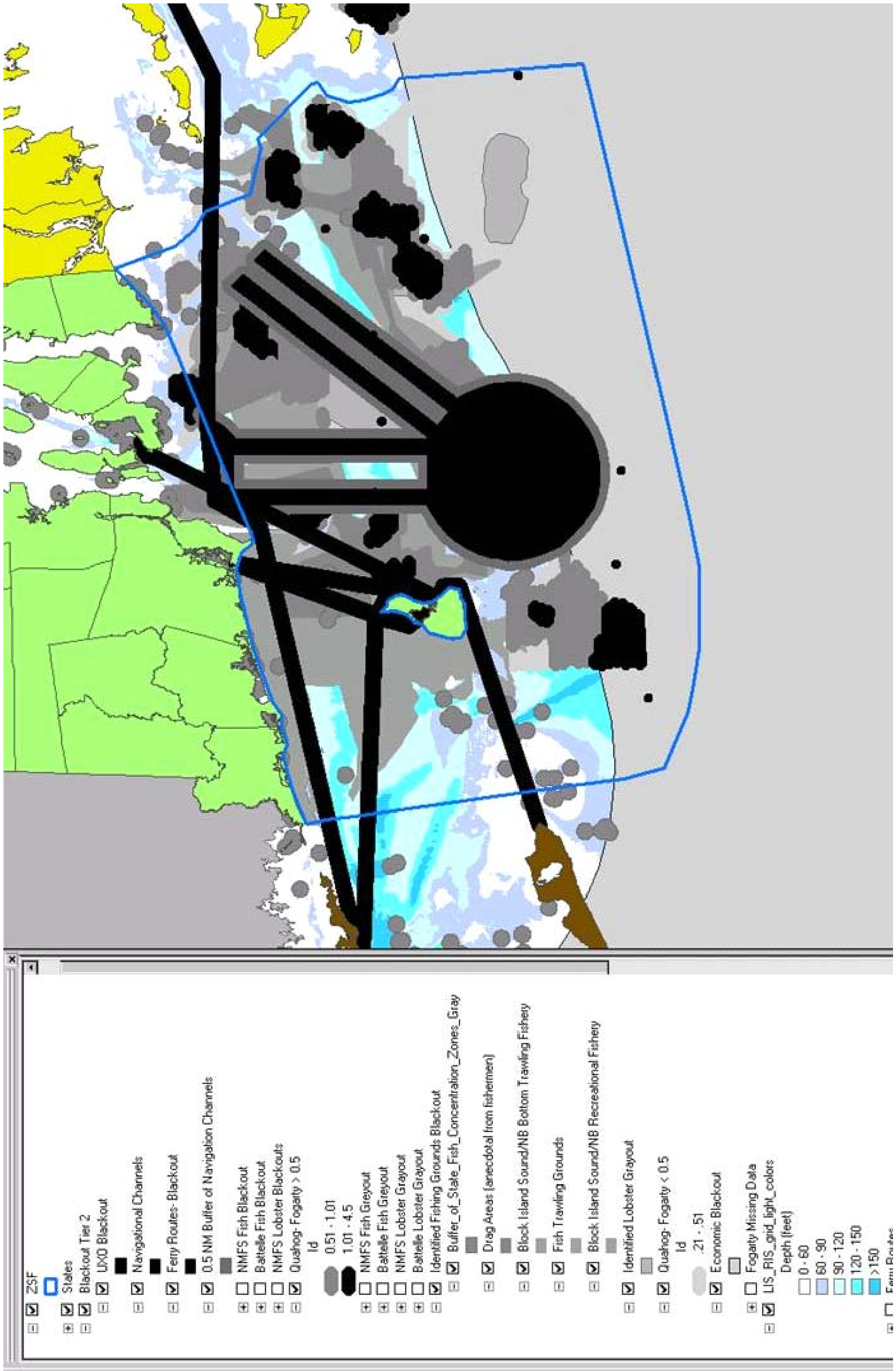


Figure 26. Tier 2 Screening Summary.

2.2.6 Completed Screening

The areas removed from further consideration by both the Tier 1 and Tier 2 screening are shown in Figure 27. Of the areas that remained after screening, the northwest corner of the ZSF was considered unacceptable for locating an ocean disposal site due to the high currents in that area and the desire to avoid dispersion of the dredged material once it is disposed. The area to the southwest of Block Island was also excluded from consideration based on information that the trough in that region is used as a migratory route for lobster, high currents, and other significant fisheries. The area to the southwest of Martha's Vineyard was also considered unacceptable due to its close proximity to highly productive shellfish beds.

Two areas were then recommended by the interagency group for further analysis and consideration in the EIS (Figure 28). The first area was located near Site 69B, which is being used for Providence River and Harbor Maintenance Dredging Project. The second area was located about 9 nmi to the east of Site 69B in 120 - 150 ft of water. Latitude and longitude information for these two areas is presented in Table 3. These areas were recommended for further evaluation and are the areas within which alternatives for evaluation in the EIS could be identified. Specific sites could not be determined due to lack of data in the eastern area (Area E). Moreover, the screening applied to these data indicated the western area (Area W) needs further survey work due to the overlap of the present Site 69B with the 0.5 nmi buffer area applied to the inbound navigation lane to Narragansett Bay. Thus, further survey work was determined as necessary in this area also. Once the data are available, the agencies will identify the specific footprints to evaluate as alternative sites in the EIS.

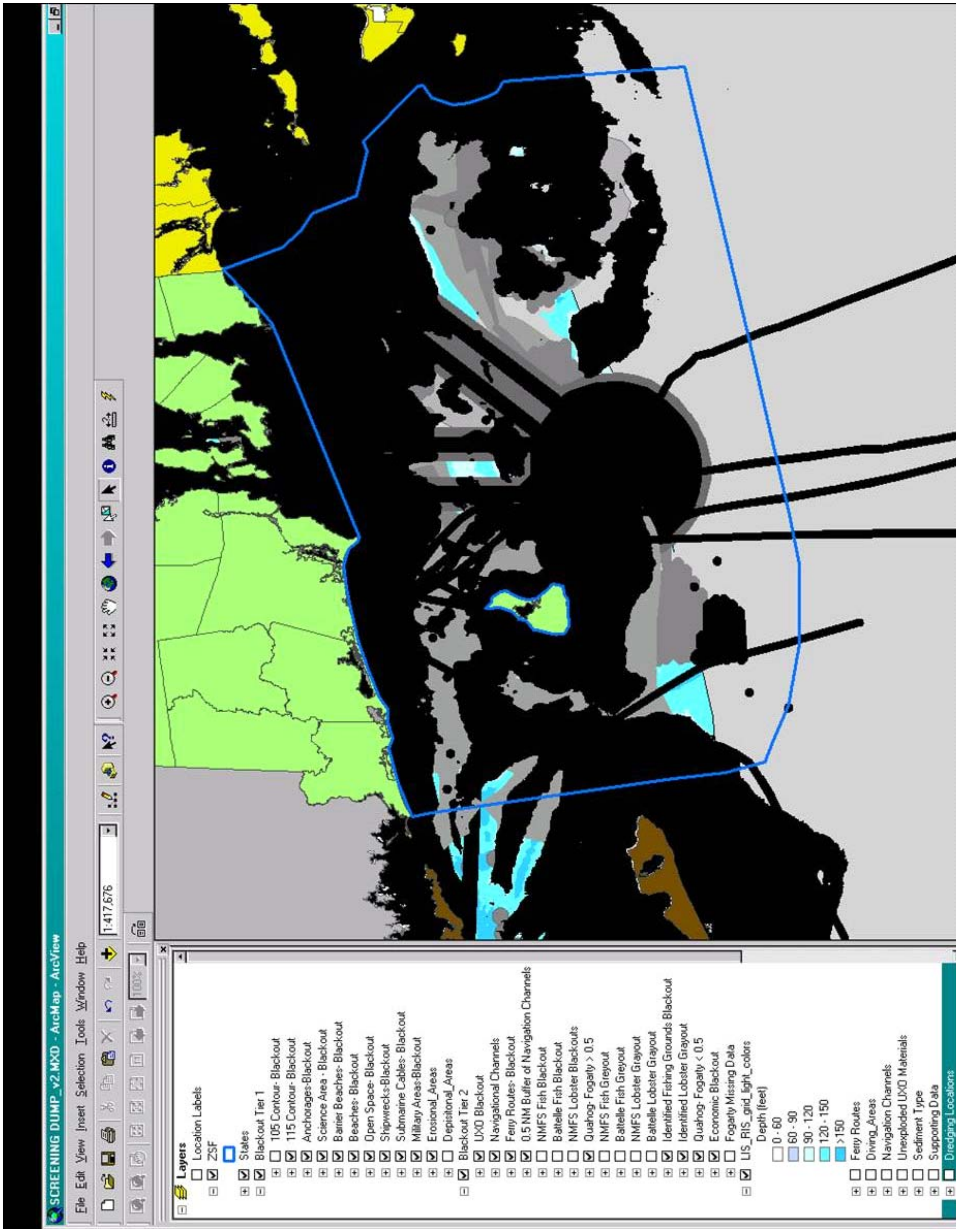


Figure 27. Tier 1 and Tier 2 Screening Results.

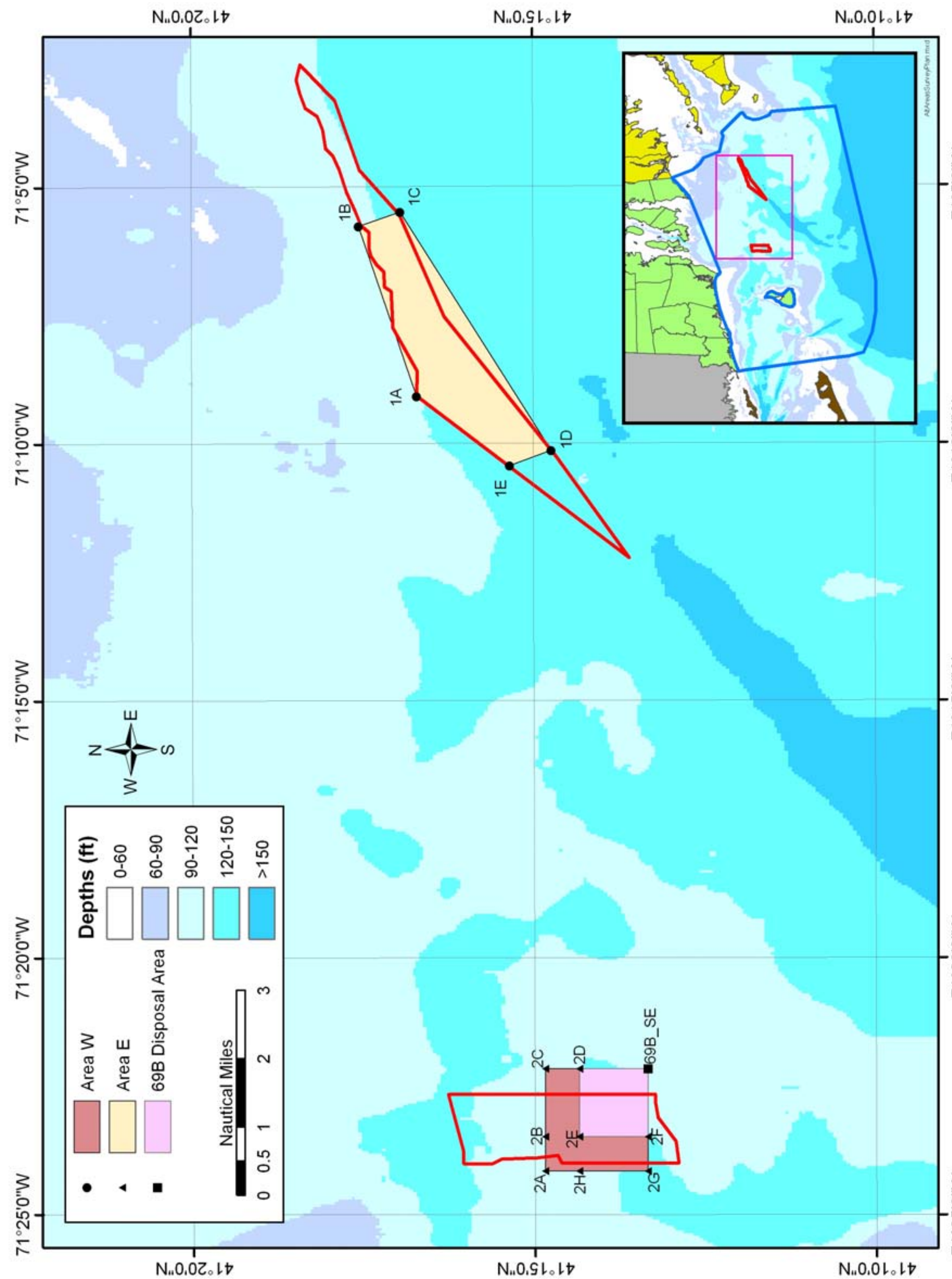


Figure 28. Recommended Areas (Areas E and W) Resulting from the Screening Process.

Table 3. Latitude and Longitude for Area E and Area W.

Point	Longitude (degree minutes)	Latitude (degree minutes)
1A	71° 9.082′	41° 16.714′
1B	71° 5.771′	41° 17.555′
1C	71° 5.492′	41° 16.945′
1D	71° 10.141′	41° 14.750′
1E	71° 10.433′	41° 15.359′
2A	71° 24.142′	41° 14.855′
2B	71° 23.480′	41° 14.855′
2C	71° 22.154′	41° 14.853′
2D	71° 22.155′	41° 14.353′
2E	71° 23.480′	41° 14.355′
2F	71° 23.482′	41° 13.354′
2G	71° 24.145′	41° 13.355′
2H	71° 24.143′	41° 14.355′
69B_SE	71° 22.157′	41° 13.353′

3.0 DATA GAPS

The interagency group discussed the data collection needs for Area E and Area W. Recent data collection efforts have been made by the Corps at Area W, but additional data will need to be collected west and north of Site 69B. No recent or historical data exist for Area E, and a complete data collection effort will need to be conducted. Data collection needs for the western portion of Area W and for the entire Area E include:

- Detailed bathymetry
- Side scan
- Magnetometer
- Current meter data, if data are not available from the WHOI buoy farm
- Sediment Profile Imaging (SPI)
- Sediment chemistry
    - Grain size/TOC
    - Selected metals and organics
- Benthic infauna
- Finfish and lobster trawls
- Unvented lobster pots
- Quahog trawls

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Appendix A

Quantitative Screening Values for RIR Screening Criteria (Levels 1, 2, and 3)

RHODE ISLAND REGION SCREENING CRITERIA (5/7/2003)

TIER 1	LEVEL 1 Area Exclusion	LEVEL 2	LEVEL 3
ZSF	Site is not within ZSF		
Depth of Site - Erosional Depth	Depth where sediment mobility is >3	Depth where sediment mobility is >1 and <3	Depth where sediment mobility is <1
Depth of Site	Site is < 105 feet deep	Site is > 105 feet and < 170 feet deep	Site is > 170 feet below deep
Scientific Research	Significant impact to scientific research	Insignificant impact to scientific research	No impact
Recreational Activities	Significant impact to recreational activities (fishing, diving, whale watching)	Insignificant impact to recreational activities (fishing, diving, whale watching)	No impact/or mitigatable through management
Proximity to Wildlife Refuge	Significant disturbance wildlife refuge (see list)	Insignificant disturbance wildlife refuge (see list)	No impact/or mitigatable through management
Protected Areas	Site is a protected area	Site near protected area	Site far from protected area
Proximity to Sensitive Areas	Significant WQ impact to beach, shoreline, marine sanctuary (see list)	Insignificant WQ impact to beach, shoreline, marine sanctuary (see list)	No impact/or mitigatable through management
T and E Species (None)	Significant impact to threatened or endangered species	Insignificant impact to threatened or endangered species	No impact/or mitigatable through management
Cultural and Historical	Significant impact to cultural and historical resources	Insignificant impact to cultural and historical resources	No impact
Military Zone		Site within active military zone	Site not within military zone
Active Utility Lines	Utility area impacted	Site located near (within ½ nm) active utility zone	Site distant (> ½ nm) from active utility zone

TIER 2	LEVEL 1	LEVEL 2	LEVEL 3
Finfish Habitat – Total CPUE	Area is a highly productive finfish habitat (≥ 2785 Catch Per Unit Effort [CPUE]*)	Site is a medium productive finfish habitat (≥ 860 CPUE and ≤ 2784 CPUE)	Site is a low productive finfish habitat (≤ 859 CPUE)
Finfish Habitat – Top 10 Commercial Species	Area is a highly productive finfish habitat (≥ 2245 CPUE)	Site is a medium productive finfish habitat (≥ 665 CPUE and ≤ 2244 CPUE)	Site is a low productive finfish habitat (≤ 664 CPUE)
Lobster Habitat	Area is a highly productive lobster habitat (≥ 114 CPUE)	Site is a medium productive lobster habitat (≥31 CPUE and ≤113 CPUE)	Site is a low productive lobster habitat (≤ 30 CPUE)

Shellfish Habitat (Ocean quahog)**	Area is a highly productive shellfish habitat ($\geq$ 2.28 kg/m^2)	Site is a medium productive shellfish habitat ($\geq$ 0.652 kg/m^{2}and $\leq$ 2.279 kg/m^2)	Site is a low productive shellfish habitat ($\leq$ 0.651 kg/m^2)
Fish Migratory Path	Area significantly interferes with fish migration	Insignificant interference with fish migration	Site does not interfere with fish migration
Benthic Habitat	Site is characterized mostly by climax Stage III species	Site is characterized mostly by intermediate Stage II species	Site is characterized mostly by pioneer Stage I species
Shipping Lanes	Within active shipping lane	Near (within ½ nautical mile [nmi]) active shipping lane	Far (> ½ nmi) from active shipping lane
Ferry Routes	Within ferry route	Near (within ½ nmi) ferry route	Far (> ½ nmi) from ferry route
Historic Disposal	Not exclusionary	Not exclusionary	Previously used disposal site

*CPUE = number of organisms/30 minute trawl
**Ocean quahog was the only shellfish species for which quantitative data were available.
N/A = Not applicable

TIER 3***	LEVEL 1	LEVEL 2	LEVEL 3
Recreational Racing		Within recreational racing route	Outside recreational racing route
Birds	Significant impact to migratory/sea birds	Insignificant impact to migratory/sea birds	No impact/or mitigatable through management
Marine Mammals	Significant impact to marine mammals	Insignificant impact to marine mammals	No impact/or mitigatable through management
Sea Turtles	Significant impact to sea turtles	Insignificant impact to sea turtles	No impact/or mitigatable through management
Nuisance Species	Creates significant development of nuisance species	Creates insignificant development of nuisance species	No impact
Site Dimensions	Site is too small for mixing zone or volume of material		
Beneficial Use/Habitat Creation			Site provides beneficial use of dredged material

***No GIS layers are associated with Tier 3 criteria. These criteria will be interpreted in the EIS.