4.6 Other Management Considerations

In addition to the management practices outlined in Section 4.1, other management considerations may be determined on a project by project basis through consultation with the NMFS and coordination with other state and Federal agencies. These may include the following:

- Use of marine mammal observers during disposal operations;
- Establishment of dredging windows;
- Compliance with Essential Fish Habitat (EFH) under the Magnuson Stevens Act and Endangered Species Act (ESA) concerns.

Any changes to special permit conditions will be discussed at the annual Agency planning meeting.

5.0 BASELINE ASSESSMENT

MPRSA 102(c)(3)(A) as amended by WRDA 92 requires that the SMMP include a summary of baseline conditions at the site. Much of the information provided in this section is based on surveys conducted in support of the site designation DEIS (EPA, 2003). This information will be updated as necessary based on any new information presented in EPA's Final EIS (FEIS). Baseline conditions are defined as the conditions existing at the time data to support the FEIS were developed. The section includes first a general characterization of the site followed by a description of past disposal at the site including information on the dredged material disposal mounds in the site.

5.1 Site Characterization

This section provides a summary of the physical, chemical, and biological environment at the site.

5.1.1 Site Location

The WLIS dredged material disposal site is located in Connecticut state waters approximately 2.7 nautical miles (5 kilometers) south of Long Neck Point, Darien, Connecticut. It is a square of approximately 1 square nautical mile (1.9 kilometers), centered on 41°00.0'N, 73°29.0'W (NAD 83) (see Figure 1). WLIS occupies an area of seafloor located in the western basin of Long Island Sound.

5.1.2 Reference Areas

The baseline assessment activities conducted at WLIS as part of the EIS study sampled an historic disposal mound, an active disposal mound within the site, a reference area outside of the disposal site, and two farfield stations outside of the disposal site. The Corps' DAMOS program has historically monitored the site and generally maintains reference areas outside the disposal site, three of which (S-REF, SW-REF, and SE-REF) will be adopted by this monitoring plan. The SE-REF area was added to replace 2000W due to the apparent

presence of relict dredged material at 2000W (SAIC 2002a). Several other reference areas (EAST, WLIS REF, 2000N, 3000E, and 2000S) have been abandoned in the past due to the presence of relict dredged material (Morris, 1998).

5.1.3 Physical Characteristics

The seafloor at WLIS is a gentle downward sloping plane from north to south and bisected by an axial depression that runs from east to west. Water depths range from 75 to 89 feet (23 and 27 meters) in the northwest and northeast corners, respectively, down to 98 feet (30 meters) along the southern boundary. The axial depression dips to 118-feet (36-meter) deep and occupies one quarter of the area of the site in the southern half. Distinct disposal mounds from past dredged material disposal activities are present throughout the site with peaks as high as 89 feet (27 meters) deep. Some mounds have been placed in the axial depression.

Natural sediments at WLIS consist primarily of fine silt and clays, as confirmed by the results of sampling conducted there in support of this DEIS (Table 1). The site is in an area of sediment accumulation, which is indicative of a generally low current regime. Bokuniewicz and Gordon (1980) estimated that the area in which WLIS is situated has accumulated 200 to 400 g/m2/yr of sediment during the last 8,000 years.

Table 1. Average Grain Size and TOC Content for Sediment Samples from WLIS[1]

Station Type	Average % fines	Average % TOC
WLIS[1]		
WLIS Active	52.5	1.5
WLIS Far Field	76.4	2.6
WLIS Historic	88.8	2.6
WLIS Reference	24.8	1.3

[1] Collected in February 2000 (USACE 2001a).

Throughout Long Island Sound tidal currents are dominant running east-southeast and west-northwest parallel to the long axis of the Sound. Average peak ebb and peak flood currents run 20 to 30 centimeters/second (0.7 to 1 feet/second) (depth-averaged), with the spring tides 20 to 40 percent stronger. Tidal ellipse parameters for surface, middle, near-bottom, and bottom currents measured in WLIS in the spring of 2001 are presented in Table 2 (USACE, 2001b). The dominant flow direction is nearly east-west and the narrow ellipses indicate that there was little flow normal to the dominant flow direction. Amplitude decreases with depth and near-bottom amplitude is less than 20 centimeters/second (0.7 feet/second). Seventy to ninety percent of the current variance during the 2-month spring deployment period was due to the tide with nearly 90 percent of the current variation in the x-direction because of tidal forcing at the bottom.

Table 2. Tidal Ellipse Parameters for Bottom, Near-bottom, Middle and Surface Currents Measured in WLIS, Spring 2001

Layer	Distance from Bottom (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Inclination (deg)	Phase (deg)	% Vx Tidal Variance	% Vy Tidal Variance
Surface	31.1	25.9	0.6	8.9	125.2	71.5	34.6
Middle	16.1	26.5	1.3	357.5	113.9	78.8	25.1
Near-Bottom	2.1	19.1	4.3	353.2	96.1	76.1	55.3
Bottom	~1.0	14.2	3.4	358.4	50.6	89.3	52.1

Source: USACE 2001b

While currents throughout Long Island Sound are continuously driven by the rise and fall of the tide, they are also intermittently driven by strong, steady wind events and by the density effect of freshwater inflows. The year-long current meter deployment reported by Fredriksson and Dragos (1996) revealed periodic strong near bottom flows to the west-southwest cause by the combining of the ebb tide with a west-southwestward flow associated with wind stress and to a lesser extent the density gradients. While near bottom peak ebb and flood tides run from 20 to 30 centimeters/second (0.7 to 1 feet/second), flows directed to the west-southwest run as high as 40 to 45 centimeters/second (1.3 to 1.5 feet/second) for 2 percent of the time and 35 to 40 centimeters/second (1.1 to 1.3 feet/second) for 5 percent of the time, with flows as high as 50 to 55 centimeters/second (1.6 to 1.8 feet/second) recorded on occasion. These results are consistent with the USACE (2001b) 2-month measurement from the spring of 2001 of 42 centimeters/second (1.4 feet/second) peak near-bottom current (2 meters [6.6 feet] above the bottom) and also with a month-long current meter deployment inside the boundaries of WLIS completed in January 1982 under the DAMOS program (Morton *et al.,* 1982). A current meter deployed in that study 1.5 meters (4.9 feet) above the bottom recorded a peak flood event of 45 centimeters/second (1.5 feet/second) associated with winds in excess of 30 knots (15.4 meters/second). Fredriksson and Dragos (1996) and Morton *et al.,* (1982) reported a net west-southwestward flow (long-term mean) of 1.5 to 5.5 centimeters/second (0.05 to 0.18 feet/second) indicative of the density driven estuarine circulation.

The wind fetch at WLIS is limited by the semi-enclosed nature of Long Island Sound which limits the wave heights that can be developed at the site by winds from directions other than the northeast (along the axis of the Sound). Considering that winter storms can produce powerful winds from the northeast (nor'easters), the potential effect of waves generated by them must be taken into account despite the otherwise limited fetch for the site. Few wave measurements are available at or near WLIS. The 2-month record of waves made in the spring of 2001 at a station within WLIS during a survey conducted in support of this DEIS (USACE 2001b) recorded 6.5-foot (2-meter) high waves (significant wave height) with 4 to 6 second periods associated with a 10 meter/second (19 knot) wind event (winds from the east). Near bottom peak orbital wave velocities measured at a 118-foot (36-meter) depth in the axial depression reached only 2 centimeters/second (0.07 feet/second). This survey, however, represents a short record of potential wave activity. Therefore a 12-year record of wind data from the Buzzards Bay Tower was analyzed for the period July 1985 to February 1994 and May 1997 to March 2001 to develop wind climatology for the region. Using these

data, wave height and period were determined for various wind conditions experienced in the Sound using a simple fetch and duration wave model. The results for WLIS are presented in Table 3.

Table 3. Wave Height and Period at WLIS for Storms of Various Return Periods Estimated from Wind Data

Return Period (years)	Wind Direction (Degrees from True North)									
	0˚		45˚		90˚		135˚		180˚	
	Wave Height (feet)[1]	Peak Wave Period (second)	Wave Height (feet)	Wave Period (second)	Wave Height (feet)	Wave Period (second)	Wave Height (feet)	Wave Period (second)	Wave Height (feet)	Wave Period (second)
1	4.64	4.17	7.19	5.27	8.39	5.72	6.68	5.09	3.17	3.50
2	5.06	4.34	7.86	5.50	9.25	6.01	7.33	5.33	3.45	3.65
5	5.61	4.56	8.73	5.80	10.35	6.36	8.17	5.62	3.82	3.83
10	6.03	4.71	9.38	6.01	11.17	6.62	8.80	5.83	4.11	3.96
20	6.45	4.86	10.03	6.21	11.97	6.87	9.42	6.04	4.40	4.09
50	7.02	5.06	10.87	6.47	13.02	7.18	10.24	6.30	4.78	4.25
100	7.45	5.20	11.50	6.66	13.79	7.40	10.85	6.49	5.07	4.37

Return Period (years)	Wind Direction (Degrees from True North)					
	225˚		270˚		315˚	
	Wave Height (feet)	Wave Period (second)	Wave Height (feet)	Wave Period (second)	Wave Height (feet)	Wave Period (second)
1	4.96	4.22	4.15	3.89	3.03	3.35
2	5.35	4.37	4.46	4.02	3.24	3.45
5	5.87	4.55	4.86	4.18	3.52	3.58
10	6.26	4.69	5.17	4.29	3.74	3.68
20	6.66	4.82	5.48	4.41	3.96	3.78
50	7.20	5.00	5.89	4.56	4.25	3.90
100	7.60	5.12	6.21	4.66	4.47	3.99

[1]Wave heights are reported as significant wave height which is the average of the one-third highest waves.

The prevailing direction of waves in the region follows the prevailing wind directions, from the north and northwest in fall and winter with occasional northeast events and from southwest in spring and summer. The data show a northeast storm with a return period of 2 years will generate waves of 9 feet (2.8 meters) with a 6 second period over WLIS. Storms with a return period of 10 years will generate 11-foot (3.4-meter) waves with a 6.6 second period over the site. The short period relative to wave height is indicative of locally-generated, fetch-limited waves. The waves reported in USACE (2001b) with a peak wave height of 6.5 feet (2 meters), represent storms that can be expected several times a year.

The oscillatory motions beneath steep waves do not penetrate as deeply as those beneath fully developed waves. For a representative average depth of 98 feet (30 meters)(the average depth of the WLIS including the axial depression), peak wave induced near-bottom orbital velocities calculated from linear wave theory for the 2 and 10 year storms would generate bottom orbital velocities of 10 and 20 centimeters/second (0.3 to 0.7 feet/second),

respectively. Velocities of this magnitude are not sufficient to cause significant erosion (Bokuniewicz and Gordon, 1980). Model estimates indicate that bottom orbital velocities of 35 centimeters/second (1.1 feet/second) are required to mobilize 1 millimeter (0.04 inches) of non-cohesive sediments.

5.1.4 Sediment Quality

To evaluate sediment quality, concentrations of metals and organic chemicals measured in sediments collected from the site were evaluated. In addition, the results of toxicity tests conducted using these sediments were considered.

At WLIS, the average concentrations of six metals (copper, mercury, nickel, and lead, silver and zinc) exceeded the Effects Range-Low (ER-L) at one or more of the station types (Table 4). The average mercury concentration in samples from the WLIS active station also slightly exceeded the Effects Range-Median (ER-M). Average concentrations of six metals exceeded the average background concentration for the depositional environments of Long Island Sound (silver, cadmium, copper, mercury, lead, and zinc). In general, average contaminant concentrations are highest in the farfield samples, followed by the active, historical and reference locations (Table 4).

Table 4. Summary of Metals Concentrations (mg/kg dry weight) in Sediment Samples from WLIS

Station	Silver	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc
ER-L[1]	1.0	1.2	81	34	0.15	20.9	46.7	150
ER-M[1]	3.7	9.6	370	270	0.71	51.6	218	410
Sound-wide Sediment Concentrations[2]								
LIS average	0.27	0.16	67.9	**39.1**	0.12	**24.8**	36.1	103
LIS depositional environment average	0.44	0.25	**93.3**	**59.5**	**0.18**	**32.2**	**47.7**	146
WLIS[3]								
WLIS Active	0.97	0.60	44.5	**63.5**	**0.79**	18.5	**49.4**	110
WLIS Far Field	**1.09**	0.62	68.8	**76.6**	**0.41**	**27.0**	**53.1**	**152**
WLIS Historic	0.90	0.31	68.6	**67.3**	**0.18**	**25.6**	44.6	139
WLIS Reference	0.36	0.20	27.2	**36.5**	0.13	12.9	24.1	118

Shaded values exceed the average background level for LIS depositional environments; Bold values exceed the ER-L; underlined values exceed the ER-M.
[1] Ecological effects values derived by Long *et al.* (1995)
[2] Mecray and Buchholtz ten Brink (2000)
[3] Collected in February 2000 (USACE 2001a)

Average concentrations of total low and high molecular weight PAHs and total PCBs at WLIS exceeded the ER-L at the active and farfield stations (Table 5); total DDT also exceeded the ER-L in the samples from the active station. Average concentrations of total PCBs and total DDT exceeded the ER-L in the samples from the historic stations. Average concentrations of most organic contaminants in the reference site samples were less than the ER-Ls (Table 5). It is important to note that the sediments from which the ER-L and ER-M were derived contained approximately 1 percent total organic carbon (TOC). The TOC of

sediments from Long Island Sound is typically higher than 1 percent which might reduce the bioavailability of many organic chemicals.

Table 5. Summary of Organic Chemical Concentrations (µg/kg dry weight) in Sediment Samples from WLIS

	Low Molecular Weight PAH	High Molecular Weight PAH	Total PAH	Total PCB	Total DDT	2,3,7,8-TCDD[1]
ER-L[2]	552	1700	4022	22.7	1.58	—
ER-M[2]	3160	9600	44792	180	46.1	—
Long Island Sound Average[3]	747	3470	2416	108	5.61	—
WLIS[4]						
WLIS Active	**1008**	**3283**	3865	**69**	**4.6**	0.0009
WLIS Far Field	**698**	**2000**	2414	**83**	1.1	0.0035
WLIS Historic	382	1016	1255	**43**	**1.8**	0.0016
WLIS Reference	158	542	630	9	1.1	0.00051

Shaded values exceed background levels; Bold values exceed the ER-L
[1] 2,3,7,8-TCDD is presented as a representative dioxin/furan
[2] Ecological effects values derived by Long *et al.*, 1995 using sediments containing 1 percent TOC
[3] NOAA NS&T Benthic Surveillance Program 1984-1991
(http://ccmaserver.nos.noaa.gov/NSandT/NSandTdata.html)
[4] Source: USACE 2001a

At WLIS, the mean percent survival ranged from 96 to 100 percent (Table 6). Amphipod survival in the test sediments was not significantly different from that in the reference site samples (the difference in survival between test sediments and the reference sediment did not exceed 20 percent). Therefore, sediments at the active, historic, and farfield stations at WLIS were not acutely toxic to *A. abdita*.

Table 6. Mean and Standard Deviation (sd) Survival in the 10-day Solid-Phase *Ampelisca abdita* Acute Toxicity Tests, at WLIS March 2000

Station IDs	Percent Survival		Survival Statistically Different from Reference? [1]	Absolute Difference from Reference (%)
	Mean	sd		
Sediment Toxicity Results for WLIS, March 2000				
WLIS				
Reference (STH)	98	3	NA	NA
EFH	96	2	No	–2
W5H	98	3	No	0
EBI	98	3	No	0
MDI	100	–	No	+2

[1] Site sediments were compared only to their site-specific reference sediment.
Source: USACE 2000a

5.1.5 Water Column Characteristics/Circulation

The salinity at WLIS is slightly less saline than the waters to the east of the site ranging from approximately 27 to 29 psu in the summer and 25 to 28 psu in the winter. Temperatures in the summer may range from 19 to 25 °C and be as low 2.5 °C or less in the winter. The water clarity in the summer months is slightly lower than the other areas of Long Island Sound. Hypoxia (dissolved oxygen less than 2 mg/L) in the bottom waters of the region that includes WLIS is well documented. Hypoxic conditions in the waters in and around WLIS develop earlier in the season, are more severe, and last longer than in the waters further east. The hypoxia at WLIS results from higher levels of nutrients (primarily nitrogen) that enter the waters of the western Long Island Sound relative to the central and eastern Long Island Sound basins and it smaller volume and restricted flow. The levels of contaminant chemical in the waters at WLIS and the surrounding region have not been measured but are expected to be similar to or slightly higher (due to the proximity to sources, its lower salinity, and smaller water volume) than the central and eastern regions of the Sound.

5.1.6 Biological Characteristics

This section summarizes the key biological communities at the WLIS site, including the benthic community, fish and shellfish, and endangered and threatened species.

Benthic Community

Benthic invertebrates sampled in July 2000 from an active mound ("I"), an historical disposal area (Eaton's Neck), a reference area (SOUTH), and two farfield stations 500 meters outside of the disposal site (E5H, W5H) showed similar benthic infaunal community within WLIS and the SOUTH reference site (see Figure 2 for sampling locations) (USACE, 2001c). The number of infaunal animals within each area in July 2000 was relatively high, with about 23,000 individuals per square meter within the disposal site and about 25,000 individuals per square meter occurring within the reference area (Table 7). The average numbers of species found in the disposal and reference site samples were 36 and 45, respectively. These sets of relatively high values were reflected in the moderately high Shannon-Wiener diversity (H′) values calculated for the WLIS samples (Table 7). Rarefaction analysis, which uses data from each sample to estimate the number of species expected for samples of various sizes (Sanders, 1968; Hurlbert 1971), of pooled WLIS samples showed that species diversity among the disposal site and reference stations was very similar. Rarefaction information for the reference station in July 2000 was slightly higher than that at the active disposal site station.

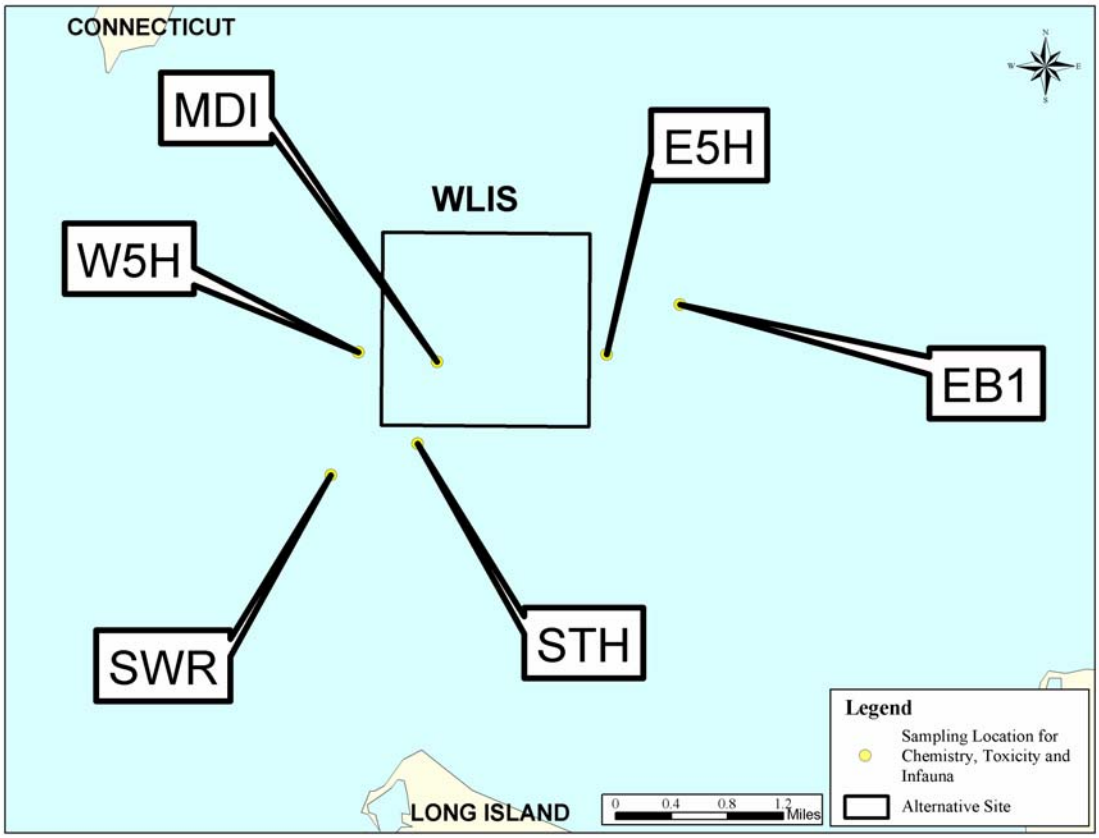

Figure 2. Sediment Sampling Locations Evaluated at WLIS During the EIS Process

Three deposit feeders, the small clams Nucula annulata and Macoma tenta and the polychaete worm Mediomastus ambiseta, were the most abundant infaunal organisms among the WLIS samples. Together they accounted for about 49 percent of the fauna identified from WLIS in July 2000. The density of *N. annulata* among all WLIS samples collected in July 2000 was about 10,800 individuals per square meter. Other numerically important species were the tube-dwelling polychaete worm Ampharete finmarchica and the surface deposit feeding worm Tharyx sp, which has not yet been described in the formal scientific literature; its taxonomic status is presently being studied.

The benthic communities evaluated using sediment profile camera images found range of sediment characteristics and generally advanced successional stages both within WLIS and at its reference stations (Table 7). The camera data indicted that the quality of the sediments and benthic community were generally good.

Table 7. Comparison of the Biological Characteristics of WLIS

	WLIS[1]	Reference[2]
Sediment Profile Imagery Features (July 1996)[3]		
Grain Size (phi)	>4	>4, 4–3
Prism Penetration (centimeters)	11–19	8–14
Dominant Processes	Biological/Physical	Biological/Physical
RPD Depth (centimeters)	0.4–4.9	1.6–2.7
Successional Stage	I, III	I, III
OSI	−1–10.5	3.5–9.0
Infaunal Community Features (February, July 2000)[4]		
Average Abundance (/sample)	910 (~23,000/m2)	1,002 (~25,000/m2)
Average Species (/sample)	36	45
Average Diversity (H′)	3.6	3.9
Average Evenness (J′)	0.7	0.7
Five Most Abundant Taxa[5]	*Nucula annulata* *Mediomastus ambiseta* *Ampharete finmarchica* *Macoma tenta* *Tharyx sp. 1B*	*Nucula annulata* *Ampharete finmarchica* *Mediomastus ambiseta* *Macoma tenta* *Tharyx sp. 1B*

[1] Four sediment profile imagery stations; range of values shown.
[2] Three sediment profile imagery stations; range of values shown.
[3] Source: SAIC, 1998
[4] Source: USACE 2002
[5] In order of decreasing abundance.

Commercial/Recreational Fish and Shellfish Resources

Long Island Sound, a semi-enclosed estuary, is an important economic resource for both commercial and recreational/sport fisherman. The region is occupied by more than 83 fish species; however, only a few of them are considered year-round residents (Gottschall *et al.,* 2000). Standard research tows for fish and shellfish conducted by the CTDEP Long Island Sound Trawl Survey between 1984 and 2000 document the average CPUE for the spring trawls in the area that includes WLIS was higher than in many other areas of the Sound (890) while the average fall CPUE (1,486) was lower. The seasonal average of the 1984 to 2000 surveys was 1,188. The species richness in the WLIS disposal analysis area was 12.46 in the fall and 12.25 in the spring. Species that recently (2000 data) dominate the area that WLIS is located include winter flounder, windowpane flounder, and scup during trawl survey. The fall 2000 trawl survey found the highest catch numbers associated with scup and weakfish. The fall and spring species composition found within the WLIS disposal analysis area is very comparable to that found in surrounding habitat areas (USACE, 2003). The data for WLIS are based on a limited number of trawls (15) conducted between 1984 and 2000. Eleven of these trawls were conducted in 2000.

The average 1984 to 2000 trawl lobster CPUE data in the areas in which WLIS is located was approximately 120 lobsters in the fall and about 115 in the spring. The decline in lobster

beginning in 2000 has lowered the abundance of lobster in the area. With respect to other commercial shellfish species, the average CPUE at WLIS in the fall was about 90 squid per tow but very low (nearly zero) was in the spring. Longfin squid are less abundant at WLIS than at the other areas of the Sound. Commercially harvested clam species were not found in benthic samples collected at the WLIS site in 2000 and there is no evidence of substantial populations.

Endangered/Threatened Species

This section provides a summary of known endangered, threatened, and "special concern" species within the Long Island Sound region. An endangered species is one whose overall survival in a particular region or locality is in jeopardy as a result of loss or change in habitat, overall exploitation by man, predation, adverse interspecies competition, or disease. Unless an endangered species receives protective assistance, extinction may occur. Threatened or rare species are those with populations that have become notably decreased because of the development of any number of limiting factors leading to a deterioration of the environment. A species may also be considered as a species of "special concern." These may be any native species for which a welfare concern or risk of endangerment has been documented within a state (NYSDEC 2003). Endangered and threatened species are protected under the Federal Endangered Species Act, 16 U.S.C. §§ 1531 *et seq.* and under state law while species listed as "special concern" are protected only by state law.

Endangered and Threatened Mammals. In general, whales and other marine mammals are not frequently observed in Long Island Sound, however, incidental sightings have resulted in the inclusion of several species on the endangered species list for Connecticut and New York (CTDEP, 2003; NYSDEC, 2003; USFWS, 2003). Table 8 lists the species on the Federal endangered and threatened whale species list for Connecticut and New York. Pursuant to Section 7 of the Endangered Species Act, EPA requested input from NMFS on the identification of Threatened and Endangered Species in Long Island Sound. Based on information received, marine mammals are not expected to spend significant portions of time within the western and central basins of Long Island Sound, therefore no additional information has been provided.

Table 8. Endangered Marine Mammals and Reptiles for Connecticut and New York

Species	Federal Status[1]	CT Status[2]	NY Status[3]
Humpback whale (*Megaptera novaeangliae*)	Endangered	Endangered	Endangered
Humpback whale (*Megaptera novaeangliae*)	Endangered	Endangered	Endangered
Fin whale (*Balaenoptera musculus*)	Endangered	Endangered	Endangered
Right whale (*Eubalaena glacialis*)	Endangered	Endangered	Endangered
Kemp's ridley sea turtle (*Lepidochelys kempii*)	Endangered	Endangered	Endangered
Loggerhead sea turtle (*Caretta caretta*)	Threatened	Threatened	Threatened
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered	Endangered	Endangered
Green sea turtle (*Chelonia mydas*)	Threatened	Threatened	Threatened
Hawksbill sea turtle (*Eretmochelys imbricata*)	Endangered	Endangered	Endangered

Source: [1]USFWS, 2003, [2]CTDEP, 2003; [3]NYSDEC, 2003;

Endangered and Threatened Reptiles. Sea turtles are the only endangered reptile species noted in the Long Island Sound area. Sea turtles are highly migratory and are often found throughout the world's oceans (NOAA, 1995). Pursuant to Section 7 of the Endangered Species Act, EPA requested input from NMFS, U.S. Fish and Wildlife Service (USFWS), CTDEP, and NYSDEC on the identification of Threatened and Endangered Species in Long Island Sound. Their assessment noted the five species of sea turtles as possibly being found in the waters of Long Island Sound.

Use of Long Island Sound by turtles appears related to the availability of prey, annual migration patterns, and age. The coastal waters of New York provide an important habitat for juvenile Kemp's ridley, green, and loggerhead turtles and adult-sized leatherbacks. Hawksbill turtles are only an incidental visitor to Long Island Sound, therefore Long Island Sound is not considered important habitat to the Hawksbill turtle.

Endangered and Threatened Fish. The shortnose sturgeon (*Acipenser brevirostrum*) is listed as an endangered species in both the state of Connecticut (CTDEP, 2003) and New York (NYDEC, 2003) and is managed by NMFS under the Endangered Species Act. Shortnose sturgeon occur in the lower Connecticut River from the Holyoke Pool to Long Island Sound. Shortnose sturgeon spawn in fresh water from the end of March to the first week of May (CTDEP, 2003). Populations of shortnose sturgeon in North America have declined due to overfishing, loss of habitat, limited access to spawning areas and water pollution. Unlike other anadromous species such as salmon and shad, shortnose sturgeon do not appear to make long-distance offshore migrations (NMFS, 2001a). It can be inferred that shortnose sturgeon utilizes portions of Long Island Sound since it is known to spawn in the Connecticut River. Shortnose sturgeon have not been observed in Long Island Sound during CTDEP trawls since 1984.

The Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) is listed as "threatened in inland waters" for the state of Connecticut (CTDEP, 2003). This designation means that the Atlantic sturgeon is not protected within the waters of Long Island Sound under the Connecticut's endangered species legislation, but a moratorium on harvesting the species in Long Island Sound has been enacted. In February 2003, a proposal was made to change the status of the Atlantic sturgeon to "endangered in all state waters" (personal communication Tom Savoy, Connecticut Marine Fisheries Division). This proposal is still under consideration at this time.

Atlantic sturgeon is an anadromous species that lives up to 60 years, reaching lengths up to 14 feet (4 meters) and weighing over 800 pounds (363 kilograms) (NMFS, 2001b). Long Island Sound may be an important feeding or resting area on-the-way to and from spawning areas in the Hudson River because all sizes of Atlantic sturgeon have been seen or captured in the Sound. Atlantic sturgeon were caught in all three basins of Long Island Sound but were mainly located in the vicinity of Falkner Island (Savoy and Pacileo, 2003).

Endangered and Threatened Birds. Table 9 lists the Federal and state endangered and threatened coastal and marine birds and bird species of special concern that have been recorded in Connecticut or New York and may occur within the Long Island Sound region. As shown in the table, none of these species is expected to occur at the alternative sites due to their foraging and breeding requirements.

Table 9. Federal and State Endangered and Threatened Birds, and Birds of Special Concern in the Long Island Sound Area

	Classification	Season	Federal Status	CT State Status	NY State Status	Use of offshore, open-water areas
Black tern (*Chlidonias niger*)	Colonial waterbird	Spring – early fall	--	--	Endangered	None
Common tern (*Sterna hirundo*)	Colonial waterbird	Spring – early fall	--	--	Threatened	Occasional
Least tern (*Sterna antillum*)	Colonial waterbird	Spring – summer	--	Threatened	Threatened	Occasional
Roseate tern (*Sterna dougallii*)	Colonial waterbird	Spring – early fall	Endangered	Endangered	Endangered	Occasional
Great egret (*Ardea albus*)	Colonial waterbird	Summer	--	Threatened	--	None
Black rail (*Laterallus jamaicensis*)	Marsh	Spring – fall	--	Endangered	Endangered	None
Common Loon (*Gavia immer*)	Pelagic	Winter	--	--	Special Concern	Occasional
Pied-Billed Grebe (*Podilymbus podiceps*)	Pelagic	Permanent	--	Endangered	Threatened	None
Bald eagle (*Haliaeetus leucocephalus*)	Raptor	Winter	Threatened	Threatened	Threatened	None
Northern harrier (*Circis cyaneus*)	Raptor	Resident	--	Endangered	Threatened	None
Osprey (*Pandion haliaetus*)	Raptor	Spring and early-late fall	--	--	Special concern	None
Peregrine falcon (*Falco peregrinus*)	Raptor	Early fall		Endangered	Endangered	None
Piping plover (*Charadrius melodus*)	Shore	Spring – early fall	Threatened	Threatened	Threatened	None
Willet (*Catoptrophorus semipalmatus*)	Shore	Spring – early fall	--	Special concern	--	None

Source: NYSDEC Endangered Species List (www.dec.state.ny.us/website/dfwmr/wildlife/endspec/etsclist.html) 12/31/2002; CTDEP Wildlife Division Endangered and Threatened Species Series (http://dep.state.ct.us/burnatr/wildlife/learn/esfact.htm) 12/31/2002; USFWS, 2003, Alsop, 2001

5.1.7 Bioaccumulation and Potential Risks

Based on data collected for NOAA's National Status and Trends Program, chemical contaminants in tissue from Long Island Sound are generally low and appear to be declining (Turgeon, *et al.,* 1989; O'Conner and Beliaeff, 1995). Concentrations of most chemicals tended to be highest in the western basin. In addition, chemical concentrations in fish, lobster, clam and worm tissue collected in support of this DEIS were also evaluated (see Figures 3 and 4 for sampling locations). These data were also low and showed little spatial variability across the areas evaluated.

As summarized in Tables 10 and 11, potential risks to human health and ecological receptors associated with exposure to sediments at the site are low. Tissue concentrations were well below Food and Drug Administration (FDA) limits for all chemicals. In addition, carcinogenic and non-carcinogenic risk estimates were within the acceptable risk range for all chemicals except PCBs. PCBs have previously been identified as a chemical of concern throughout Long Island Sound, as evidenced by the existence of a fish consumption advisory due to elevated PCB concentrations in fish tissue (Toal and Ginsberg, 1999). With the exception of copper, tissue concentrations were below ecological effect values, indicating that risks to ecological receptors are also low.

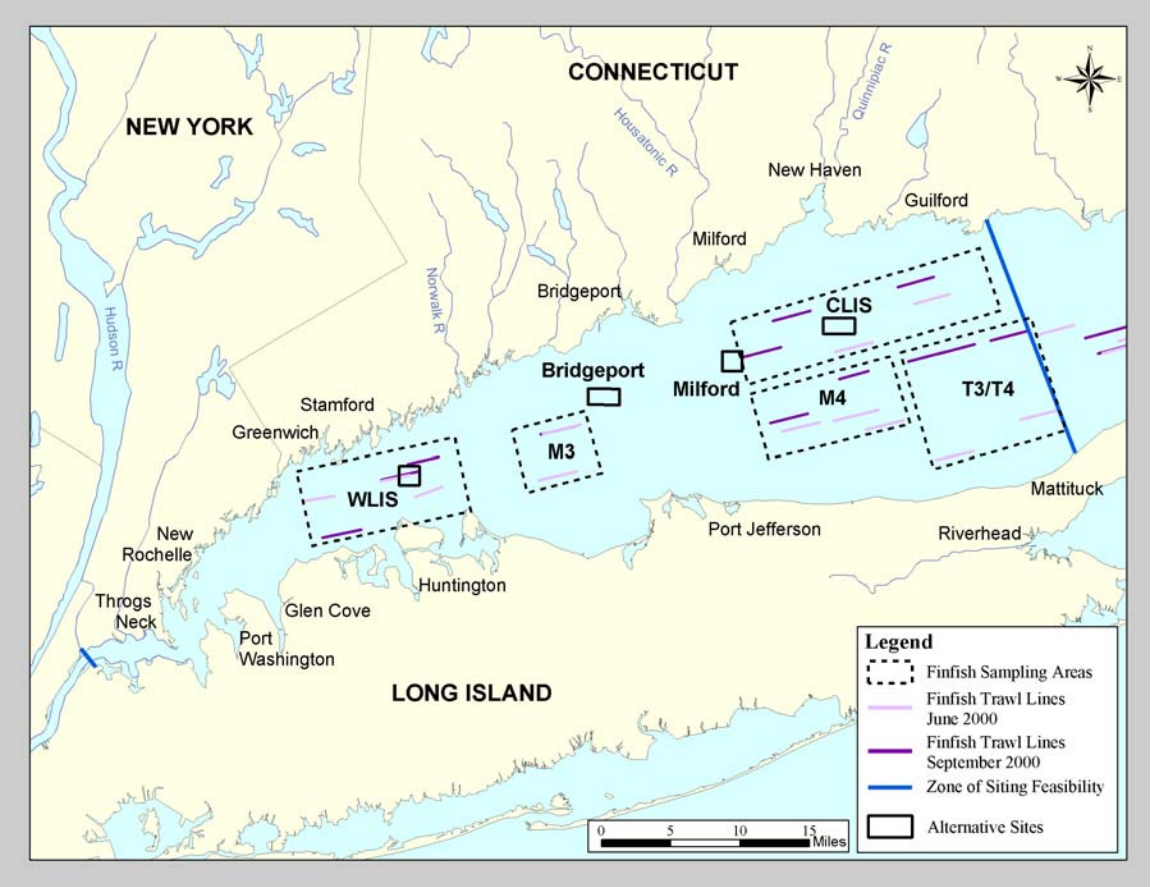

Figure 3. Finfish Sampling Locations, June and September, 2000
Source: USACE, 2000b

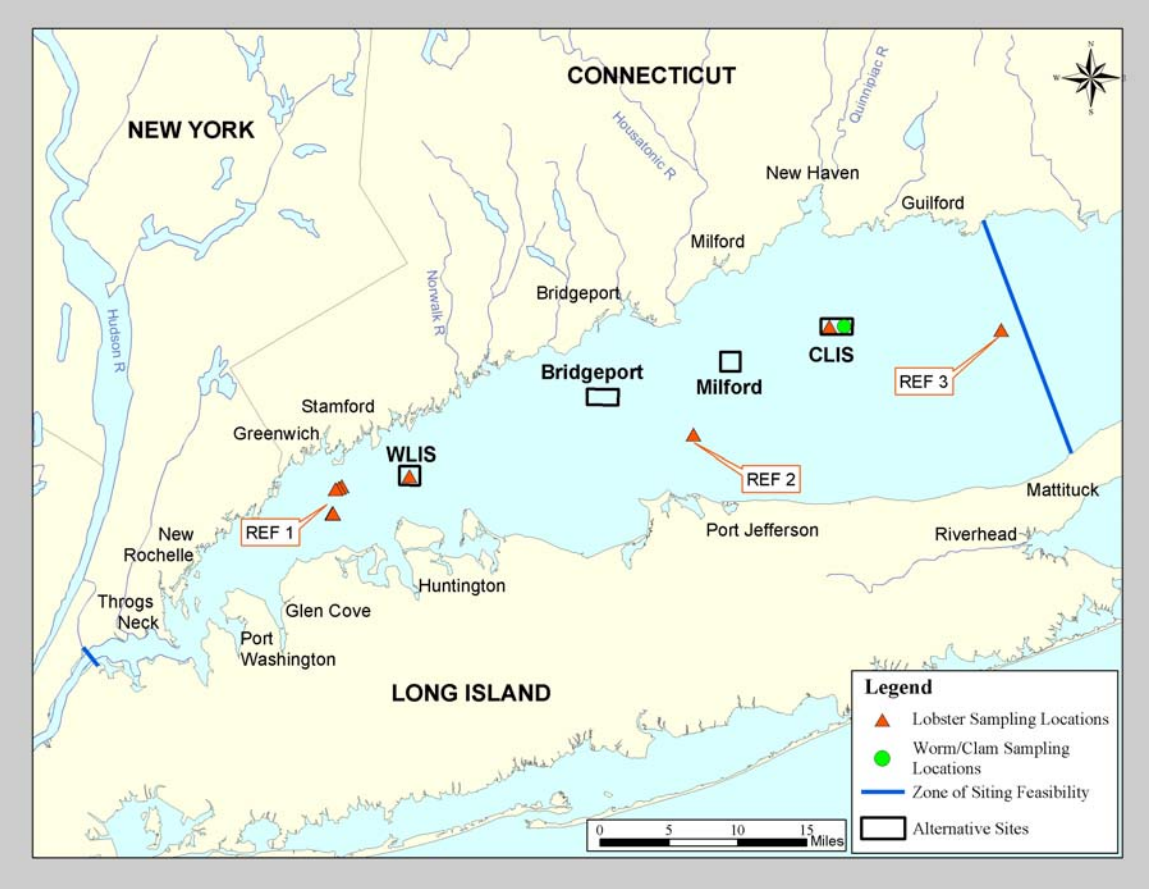

Figure 4. Benthic Tissue (Lobster, Clam, and Worm) Sampling Locations
Source: USACE, 2000b

Table 10. Comparison of Lobster and Finfish Edible Tissue Concentrations (wet weight) to Human Health Action Levels (*i.e.*, FDA Action Levels)[1]

Station	Species	Total PCB (µg/kg)	Total DDT (µg/kg)	Total Chlordane (µg/kg)[2]	Aldrin (µg/kg)	Dieldrin (µg/kg)	Heptachlor (µg/kg)	Heptachlor Epoxide (µg/kg)	Mercury (mg/kg)
FDA Human Health Action Levels		2000	5000	300	300	300	300	300	1
CLIS	Winter Flounder	82 – 108	6 – 9	1.19 - 1.25	0.02 U	0.75 – 1.04	0.02 U	0.02 U	0.01 - 0.02
	Scup	72 – 168	5 -12	0.5 – 0.7	0.02 U	0.34 – 3.9	0.02 U	0.02 U	0.06 – 0.07
	Bluefish	300	30	4	0.02 U	7	0.02 U	0.02 U	0.10
	Striped Bass	368	37.4	1.90	0.02 U	3.5	0.02 U	0.02 U	0.33
	Lobster	14 - 20	0.9 – 1.2	0.06 – 0.1	0.03 U	0.3 – 0.9	0.04 U	0.02 U	0.17 – 0.33
Strata M3	Winter Flounder	84 – 250	6 – 8	1.16 – 1.56	0.02 U	0.71 – 0.94	0.02 U	0.02 U	0.02 - 0.03
	Scup	80 – 250	5 – 20	0.5 – 1.0	0.02 U	0.39 - 5	0.02 U	0.02 U	0.08 - 0.09
	Bluefish	854	24	3.2	0.02 U	7.5	0.02 U	0.02 U	0.09
	Lobster	7.8 - 10	0.6 – 0.9	0.09 – 0.1	0.02 U	0.4 – 0.6	0.02 U	0.02 U	0.04 – 0.06
WLIS	Winter Flounder	60 – 68	5.2	1.13 – 1.56	0.02 U	0.77 - 0.89	0.02 U	0.02 U	0.02
	Scup	60 - 88	5 - 9	0.55 – 1.12	0.02 U	0.44 – 1.54	0.02 U	0.02 U	0.03 - 0.09
	Striped Bass	308	28.5	1.55	0.02 U	1.19	0.02 U	0.02 U	0.21
	Lobster	12 - 32	1.1 - 2	0.1 – 0.2	0.02 U	0.6 – 1.6	0.02 U	0.02 U	0.05 – 0.08
Strata M4 and Strata T3/T4	Winter Flounder	44 - 86	3 - 7	0.7 – 1.1	0.02 U	0.3 –1.0	0.02 U	0.02 U	0.01 – 0.03
	Scup	32 – 228	3 - 7	0.5 - 1	0.02 U	0.2 –5.1	0.02 U	0.02 U	0.03 - 0.07
	Lobster	18 - 32	1.1 – 2.1	0.09 – 0.17	0.02 U	0.4 – 0.6	0.02 U	0.02 U	0.04 – 0.06

Shaded cells indicate that maximum values are greater than the minimum CTDPH consumption restriction level (*i.e.*, 100 µg/kg for Total PCBs) (Toal and Ginsberg, 1999).

[1] Half the Detection limit reported for those analytes that were not detected.

[2] Total chlordane is the sum of cis Chlordane and trans-Nonachlor, as described in FDA (1989).

[3] Total PCBs defined as two times the sum of the congeners

U = Not detected

Table 11. Comparison of Benthic Tissue Concentrations to Ecological Effects Values[1]

Analyte	Ecological Effects Values[2]	Lobster				Clam		Worm	
		WLIS		CLIS		CLIS		CLIS	
		Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
PAHs (ug/kg wet)									
Anthracene	3750	0.08	0.12	0.06	0.07	1.16	1.36	1.44	2.36
Benzo(a)pyrene	8000	1.38	2.04	0.87	1.32	3.94	4.61	6.22	9.30
Total PAH	10000[3]	14.54	18.61	11.91	14.55	54.03	74.13	78.17	118.05
Total PCBs (ug/kg wet)									
Total PCB	4000[4]	15.7	32.72	16.3	19.82	28.36	35.54	66.22	83.2
Pesticides (ug/kg wet)									
Aldrin	299	0.02 U	0.02 U	0.02 U	0.02 U	0.06	0.13 U	0.06	0.07
Chlordanes	64	0.10	0.13	0.10	0.12	0.29	0.32	0.57	1.26
Total DDT	3000[5]	1.25	2.13	1.15	1.25	1.71	1.94	5.13	6.37
Dieldrin	4.37	1.10	1.62	0.89	2.40	0.15	0.27	0.38	0.60
Endosulfans	2.85	0.11 U	0.11 U	0.11 U	0.11 U	0.33 U	0.39 U	0.32 U	0.38 U
Metals (mg/kg wet wt)									
Arsenic	12.6	3.06	4.37	5.71	6.95	1.05	1.16	3.64	4.45
Cadmium	3	0.02	0.04	0.03	0.04	0.17	0.21	0.14	0.22
Chromium	11.8	0.04	0.04	0.04	0.04	0.40	0.54	0.16	0.20
Copper	9.6	**14.86**	**17.82**	**22.24**	**25.58**	2.60	3.25	2.99	4.25
Lead	11.9	0.06	0.24	0.01	0.02	0.78	1.05	0.53	0.72
Mercury	0.2[6]	0.06	0.08	0.08	0.10	0.01	0.01	0.01	0.01
Nickel	3.8	0.06	0.09	0.06	0.08	1.20	1.31	0.52	0.63
Silver	1.5	0.32	0.41	0.54	0.66	0.16	0.18	0.05	0.07
Zinc	1517	18.29	24.14	19.75	24.60	15.95	18.14	19.68	20.91

Bolded values indicate exceedence of the ecological effects values
[1] Half the detection limit reported for those analytes not detected.
[2] The ecological effects values represent tissue concentrations that are believed to be "safe" for aquatic organisms. They are derived from the final
chronic value of US EPA Water Quality Criteria (as suggested by Lee *et al.*, 1989) unless otherwise noted.
[3] Source: Widdows *et al.*, 1987
[4] Source: Hansen, 1974
[5] Source: Neufield and Pritchard, 1979
[6] Source: Friedmann *et al.*, 1996

5.2 Disposal Site History

The WLIS Dredged Material Disposal Site has received dredged materials since 1982. After completion of an EIS (USACE, 1982a, and 1982b), the site was established in 1982 as a regional disposal site to serve the needs of the western area of Long Island Sound. It is adjacent to three historic disposal sites (Eaton's Neck, South Norwalk, and Stamford, Figure 5) that collectively received over 17 million cubic yards of dredged material between 1954 and 1972 (personal communication, Dr. Thomas Fredette, USACE, September, 2002).

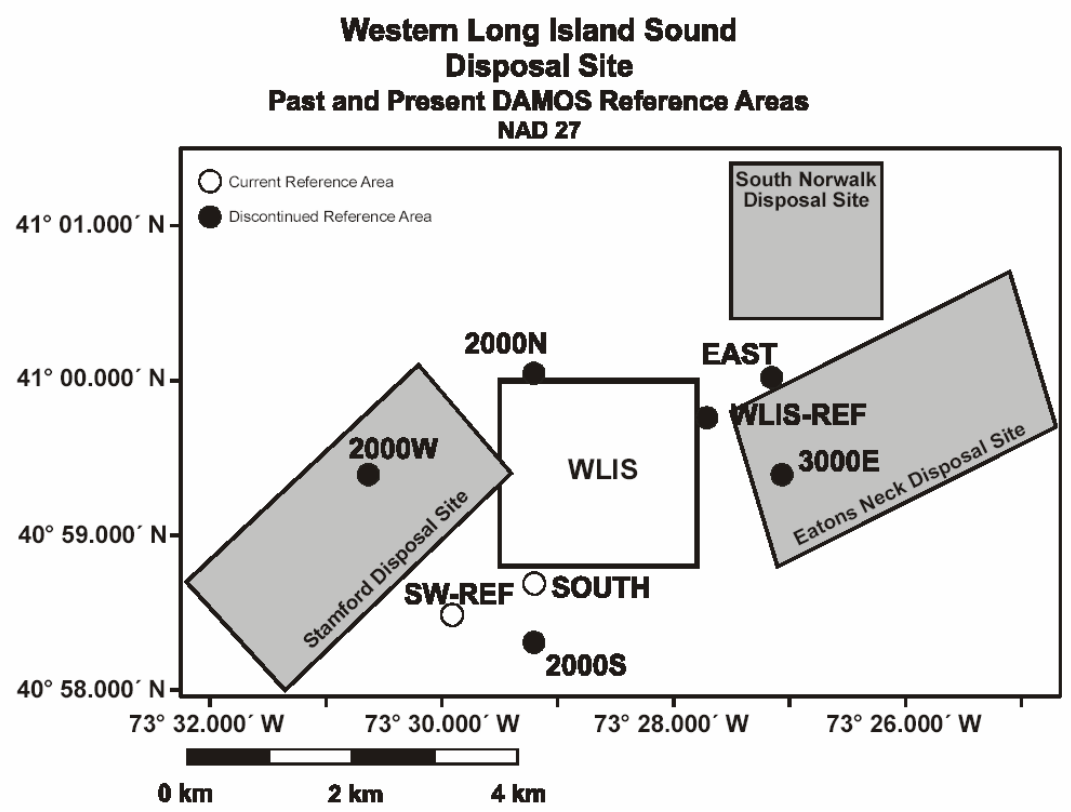

Figure 5. Location of Closed Disposal Sites and Discontinued Reference Areas Adjacent to WLIS Disposal Site

A summary of the source and volume of material placed at each of the disposal mounds since 1982, based on the disposal volume database maintained by the DAMOS program, is provided in Table 12.

This dredged material has been placed in 12 distinct disposal locations marked by taut-wire moored disposal buoys during the disposal season. Distinct low profile disposal mounds are detectable at each of these disposal locations (apart from WLIS-J with less than 14,000 cubic yards in 1997). The DAMOS program has identified each mound with a letter designation to support monitoring and tracking of disposal activity (Figures 6 and 7). Beginning in 1984, mounds were deliberately placed in rings to form a network of mounds to facilitate containment of larger projects in artificial berms (SAIC 2002a).

Table 12. Disposal Locations, Volumes, and DAMOS Mound Designations for WLIS Based on Estimated Barge Volumes

Year(s) Active	Mound	Project(s) Disposed	Approximate Volume Disposed (cubic yards)
1982-1983	A	Numerous	145,980
1984,1986-1988	B	Milford, Port Chester, Mianus, New Rochelle, Cos Cob	188,604
1985-1986	C	Mianus R., Norwalk Cove, Saugatuck	95,730
1989-1990	D	Mamaroneck, Stamford, Cos Cob, Wilson Cove	242,037
1990-1991	E	Rye, Oyster Bay, Kings Point	113,092
1991-1994	F	Cos Cob, Rye, Greenwich, E. Norwalk, Glen Cove	105,032
1994-1995	G	Norwalk Cove, Greenwich, Village Creek	68,670
1995-1996	H	Village Creek, Manhasset	20,012
1996-1997	I	Riverside, Manhasset, Norwalk	45,780
1997-1998	J	Oyster Bay, Manhasset Bay	13,995
1998-1999	K	Five Mile River, Rye	43,818
1999-2001	L	Greenwich Cove, Larchmont Harbor, Darien, Goodwives River	130,600

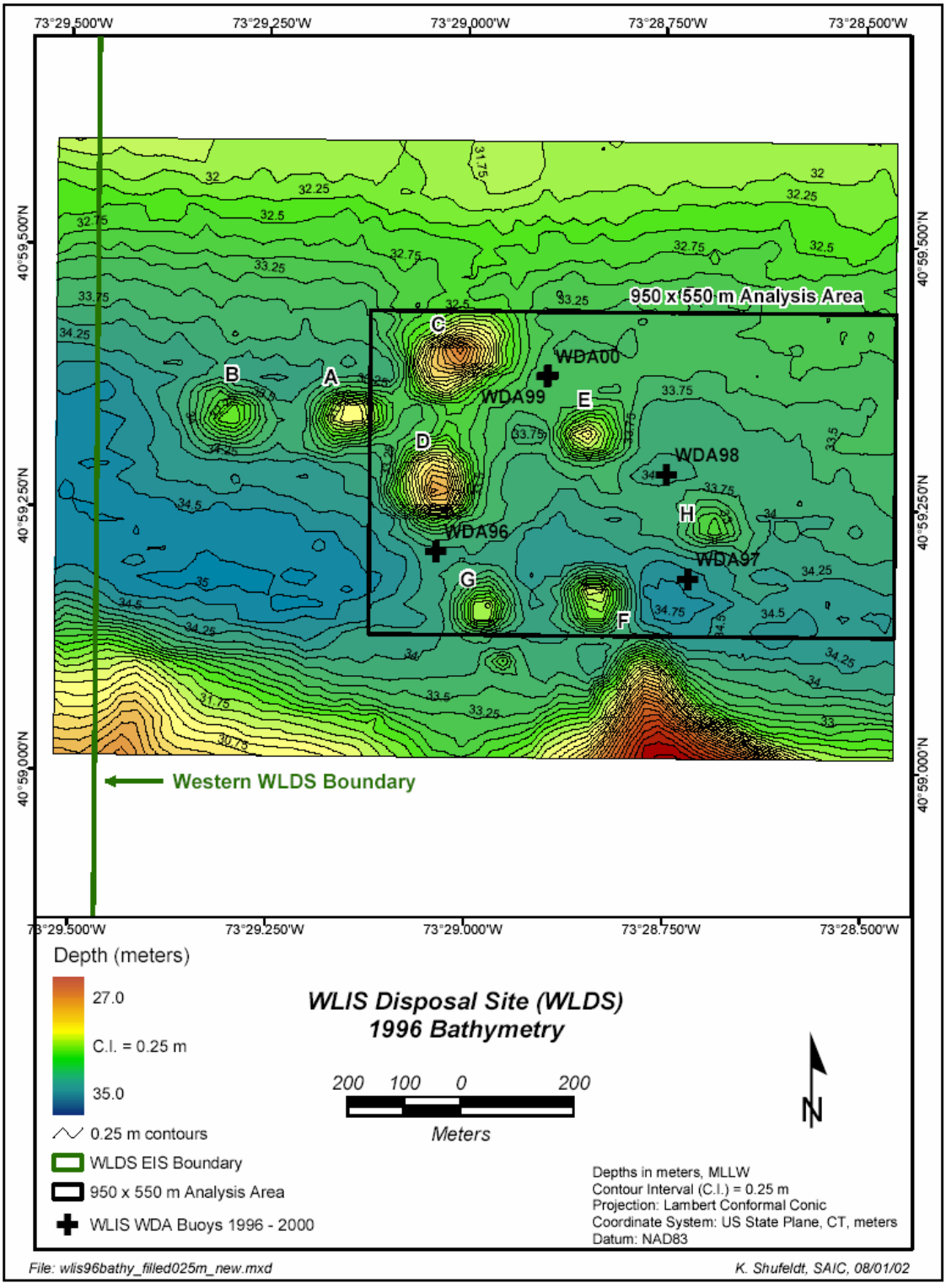

Figure 6. Location of Disposal Mounds and Disposal Buoy Locations within WLIS Based on DAMOS Disposal Logs and a Bathymetric Survey Conducted in 1996 (from SAIC 2002a)

(Note: Full boundaries of WLIS Alternative are not shown)

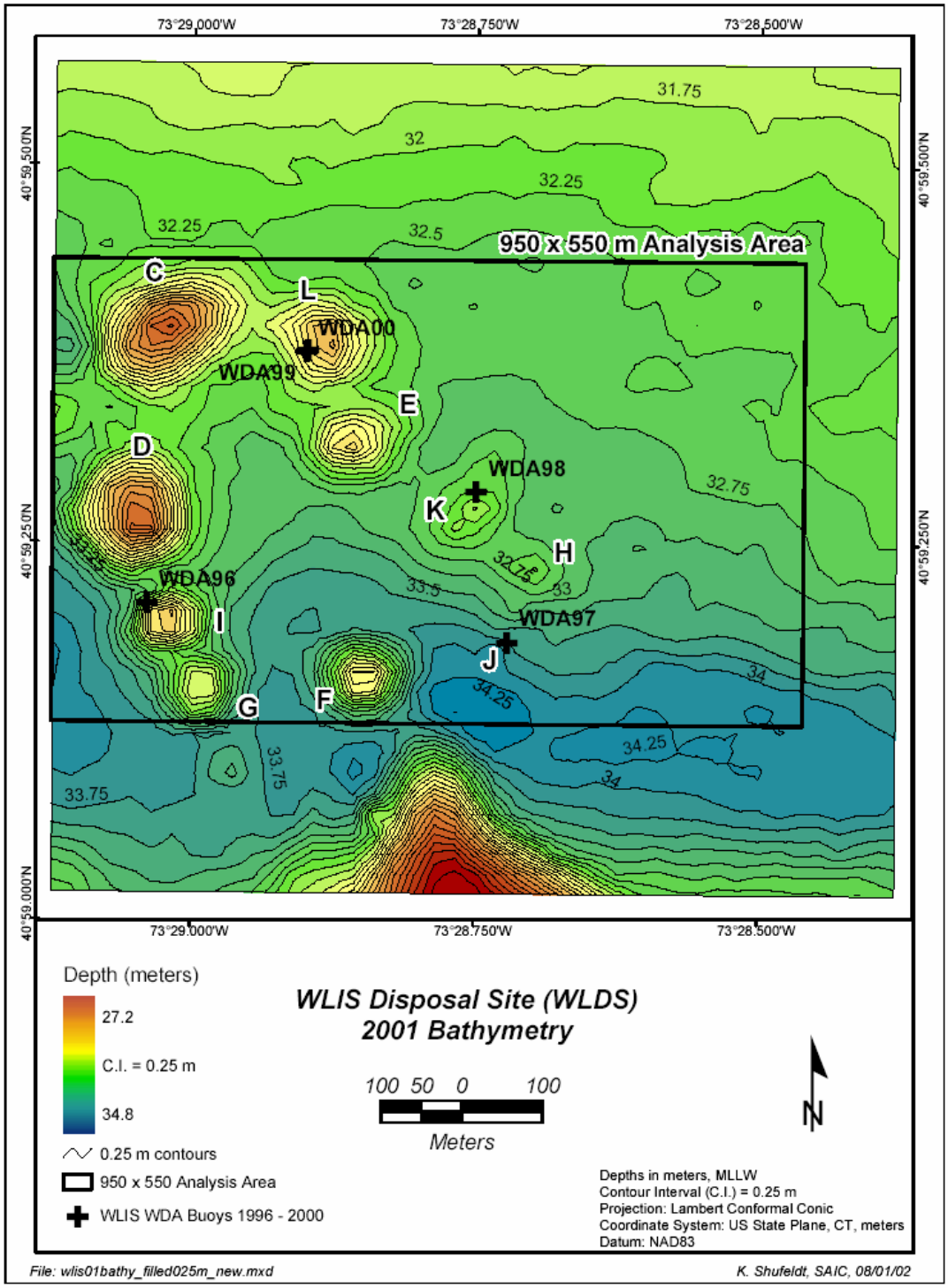

Figure 7. Location of Disposal Mounds and Disposal Buoy Locations within WLIS Based on DAMOS Disposal Logs and a Bathymetric Survey Conducted in 2001 (from SAIC 2002a)

(Note: Full boundaries of WLIS Alternative are not shown)

6.0 MONITORING PROGRAM

Dredged materials managed under both MPRSA and CWA will be disposed at WLIS. However, all monitoring of the site will be conducted under MPRSA requirements. Effective environmental monitoring programs draw on available knowledge and understanding to establish approaches and clearly define monitoring objectives that focus on the primary issues of concern. Historically, monitoring of disposal sites in New England has relied on the Corps DAMOS Program as the tool for data collection. The DAMOS program uses a tiered monitoring framework (Germano *et al.,* 1994). Thus, the monitoring program presented in this section incorporates many of the features of the DAMOS framework. The goal of the monitoring program for WLIS is to generate information that will:

- indicate whether disposal activities are occurring in compliance with permit and site restrictions;
- support evaluation of the short-term and long-term fate of materials based on MPRSA site impact evaluation criteria;
- support assessment of potential significant adverse environmental impact from dredged material disposal at WLIS.

To achieve this goal, data will be developed in two areas: 1) compliance with conditions in disposal permits and authorizations and 2) environmental monitoring of WLIS and nearby regions (as defined in Section 6.3). The latter information will be evaluated together with historic and ongoing dredged material testing data and other accessible and relevant databases (*e.g.,* Sediment Quality Information Database [SQUID], Dredged Material Spatial Management and Resolution Tool [DMSMART]). These data will be provided to the EPA, Corps, and states of Connecticut and New York at least one month prior to the annual agency planning meeting. The evaluation of impacts from disposal at the site will be accomplished through a comparison of the conditions at the disposal mound(s) to historical conditions (*e.g.,* changes in historic mound height and footprint) or to unimpacted nearby reference stations. The meeting participants will use this information and the monitoring data gathered in the previous year to assess the potential impact and plan monitoring surveys. EPA and the Corps will coordinate to implement the appropriate action (e.g., field surveys, additional investigations, or management actions [or subset of actions]) within the tiered Monitoring Program and to define appropriate actions to mitigate unacceptable situations.

This monitoring plan provides a general framework for the monitoring program and guides future sampling efforts at WLIS. Specific details about those efforts (*e.g.,* sampling design, statistical comparisons) will be developed in project-specific survey plans considered during the annual agency meeting. Similarly, the schedule for the monitoring surveys will be governed by the frequency of disposal at the site, results of previous monitoring surveys, and funding resources. The data gathered under this monitoring plan will be evaluated on an ongoing basis to determine whether modifications to the site usage or designation are warranted.

Section 6.1 describes the organization of the monitoring program and summarizes the measurement program, schedule, and results that would lead to implementing additional

studies. Sections 6.2 and 6.3 respectively, provide general information quality assurance requirements and a summary of the primary data collection tools.

6.1 Organization of Monitoring Program

The monitoring program is organized into two parts: compliance monitoring and environmental monitoring. Compliance information includes data relevant to the conditions in permits and authorizations and will be gathered separately from the environmental data.

The environmental monitoring program for WLIS is developed around four fundamental premises that establish the overall monitoring approach from a data acquisition perspective as well as the temporal and spatial scales of the measurement program:

- Testing information from projects previously authorized to use the site for dredged material disposal can provide key information about the expected quality of material that has been placed in the site;
- Lack of benthic infaunal community recovery on recently created mounds provides an early indication of potential significant adverse impact;
- Some aspects of the impact evaluation required under MPRSA Section 102(c)(3) can be accomplished using data from regional monitoring programs (*i.e.,* progressing water quality changes; fisheries impact);
- Measurement of certain conditions in the site can be performed at a lower frequency (*e.g.,* long term mound stability) or only in response to major environmental disturbances such as the passage of major storms.

The first premise requires that historic and ongoing dredged material testing results be available and reviewed to identify mounds where sediment quality might be reduced relative to other mounds and to track the quality of material in the future. The remaining premises require various types and scales of monitoring to ensure dredged material disposal at WLIS is not unduly impacting the marine environment. Thus, the monitoring program is further organized around five management focus areas that are derived from the six types of potential effects required for evaluation under MPRSA [40 CFR § 228.10(b)] as described in Section 2:

- **Management Focus 1: Movement of dredged material.** This focus combines the requirements under 40 CFR 228.10(b)(1) (Movement of materials into sanctuaries, or onto beaches or shorelines) and 40 CFR 228.10(b)(2) (Movement of materials towards productive fishery or shellfishery areas) into one focus;
- **Management Focus 2: Absence of pollutant-sensitive biota.** Addresses 40 CFR 228.10(b)(3) (Absence from the disposal site of pollutant-sensitive biota characteristic of the general area);
- **Management Focus 3: Changes in water quality.** Addresses 40 CFR 228.10(b)(4) (progressive, non-seasonal, changes in water quality or sediment composition at the disposal site when these changes are attributable to materials disposed of at the site);

- **Management Focus 4: Changes in composition or numbers of biota.** Addresses 40 CFR 228.10(b)(5) (Progressive, non-seasonal, changes in composition or numbers of pelagic, demersal, or benthic biota at or near the disposal site when these changes can be attributed to the effects of materials disposed at the site);
- **Management Focus 5: Accumulation of material constituents in biota.** Addresses 40 CFR 228.10(b)(6) (Accumulation of material constituents [including without limitation, human pathogens] in marine biota at or near the site [*i.e.,* bioaccumulation]).

A tiered approach, based on a series of null hypotheses[2], is used to monitor compliance and address concerns under each Management Focus. Tier 1 evaluates a series of hypotheses addressing "leading indicators" that provide early evidence of unacceptable environmental responses or conditions. Examples include documentation of whether recolonization is proceeding as expected or whether mounds are deposited as planned and that no post-deposition movement is occurring. Should the hypotheses under Tier 1 be falsified, the findings would be evaluated and decisions to conduct Tier 2 activities made. The specific condition that will initiate Tier 2 or Tier 3 monitoring will be decided between EPA and the Corps. Based on the type of event/action that has occurred, EPA and the Corps will work to implement the appropriate management practice with the Monitoring Program.

The measurement program under Tier 1 focuses on both individual dredged material and the overall site conditions. New mound construction will be evaluated within one to two years of completion and the entire site will be evaluated within successive five-year periods. While specific monitoring activities are defined under each Tier, the actual monitoring conducted in a given year must be consistent with budgetary constraints. Thus, prioritization of monitoring by organizational focus and findings of the monitoring program must be done annually during the Agency planning meeting.

Tiers 2 and 3 provide for progressively more detailed and focused studies to confirm or explain unexpected or potentially significant adverse conditions identified under Tier 1. For example, if Tier 1 monitoring under Management Focus 2, indicates that the benthic community was not recovering on recently deposited sediments, successive Tiers would enable examination of potential causes by incorporating additional investigation of sediment characteristics and quality. However, if the results from the Tier 1 data do not suggest impact, Tier 2 activities would not be invoked.

The following sections describe the monitoring approach that will be applied to each management focus. Each subsection provides the following:

- Intent of the data gathered under the focus area;
- Statement of relevant questions and hypotheses to be addressed within each tier;

[2] A null hypothesis, H_0, represents a theory that has been put forward, either because it is believed to be true or because it is to be used as a basis for argument, but has not been proved. The null hypothesis is often the reverse of what the experimenter actually believes.

- Summary of the measurement approach and tools to be used under each successive Tier.

Attachment A provides flow charts that summarize the tiered approach for each management focus as well as a table that summarizes each of the hypotheses and the leading indicators that would require action.

6.1.1 Compliance Monitoring

Compliance monitoring includes evaluation of information and data relevant to the conditions in permits and authorizations and will be gathered separately from the environmental data. The question that will be addressed is:

H_0 0-1: Disposal operations are not consistent with requirements of issued permits/authorizations.

This hypothesis will be evaluated by review of the disposal inspectors report and any variances identified will be discussed by the EPA and the Corps on a project-specific basis to determine the potential magnitude of effect and the appropriate action.

6.1.2 Management Focus 1: Movement of the Dredged Material

This management focus addresses two concerns relative to the disposal of dredged material at WLIS. The first is site management and compliance. The second is movement of the material after disposal. The questions that will be addressed include:

- Is the material deposited at the correct location?
- Are mounds constructed consistent with the site designation?
- Are mounds stable and dredged material retained within the disposal site?

The latter question directly address management concerns about material moving into sanctuaries, or onto beaches or shorelines and towards productive fishery or shellfishery areas.

Tier 1

The site designation specifies that WLIS is a non-dispersive site; therefore movement of materials out of the site is not expected. Loss of mound material could mean that the material is being lost inappropriately and may potentially impact areas outside of the site, if transported beyond the site's boundary. For the purpose of Tier 1, this question is addressed through two hypotheses.

H_0 1-1: Loss of dredged material from any mound deposited at WLIS is not greater than 1.5 feet (0.5 meter):

This hypothesis will be tested by determining the dimensions of disposal mounds created in a given dredging season and performing periodic monitoring of the mound using precision

bathymetry techniques (see Section 6.3). Baseline data for new or modified mounds will be collected within one year following disposal. Bathymetric surveys of mounds (historic and recently completed) will also be performed periodically. The bathymetry of the entire site will be fully documented every 2 to 4 years.

Information on mound size and height will be compared with previous data to determine if loss of material has occurred. If the height and volume of a mound changes by more than 1.5 feet (0.5 meters) within any five year interval, further study of the characteristic of the mound and surrounding area will be conducted under Tier 2.

H_0 1-2: Major storms (greater than 10 year return frequency) do not result in erosion and loss of material from disposal mounds at WLIS.

This hypothesis tests whether storms that produce waves greater than 11 meters height with a period of 7 seconds have eroded mounds. Previous studies and sediment erosion modeling conducted during the site designation process suggest that a storm having a ten year return probability may cause a small amount of erosion on the mounds that approach the mound height restrictions (14 meters [46 feet] below mean low water) and potentially transport material from deposited mounds. However, storms of greater magnitude may interact with recently deposited sediments or sediments that are below the limiting erosion depth and result in movement of material from the mounds.

This hypothesis will be tested by determining the dimensions of disposal mounds within 2 months following the passage of storms with a ten-year return frequency. Dimensions will be determined using precision bathymetry techniques (Section 6.3.1). The decision to conduct post-storm surveys will be made jointly by the site managers. If a mound changes in height by more than 1.0 feet (0.3 meters) from the previous survey, the site and surrounding area will be examined as defined under Tier 2.

Tier 2

Significant loss of material from the deposited mound may result in changes to sediment characteristics either within or beyond the site boundaries. Change in bathymetry and sediment characteristics immediately outside of the site would be indicative of potential unacceptable transport. Tier 2 investigates whether significant erosion of mound height determined under Tier 1 results in the relocation of material outside of the site boundaries.

H_0 1-3: Material lost from disposal mounds at WLIS does not change the (a) bathymetry or (b) sediment characteristics in areas adjacent to the site.

This hypothesis will be tested by determining changes in bathymetry and sediment characteristics within 1 kilometer (0.6 miles) beyond the site boundary. The survey design will take into account the expected direction of transport based on the predominant current direction and velocity (*e.g.,* it may not be necessary to survey the entire area within 1 kilometer [0.6 miles] of the site).

Precision bathymetry (Section 6.3.1) will be used to define substantive changes in bathymetry and topography (greater than 1 foot [30 centimeters]). Side-scan sonar, geotechnical, and sediment profile imagery may also be used to evaluate changes in sediment characteristics (see Section 6.3.2). The sediment profile imagery can be used to observe layers of material too thin to detect by precision bathymetric methods and can also be used to evaluate if the benthic community in the sediments has been disturbed or is under stress (as defined in Management Focus 2, Tier 2). Comparison of sediment profile imagery data from areas of concern to reference areas will be used to determine whether the transported material has a potential significant adverse biological effect.

Changes in bathymetry across the mound apex or apron of more than 1.0 feet (0.3 meters) or development of large areas of predominately muddy sediments not previously documented may be an indication of substantial transport of material from the site. If such changes are documented, Tier 3 characterization of sediment quality or further characterization of benthic communities may be required.

Tier 3

The premise of this Tier is that significant transport of material beyond the site boundary could affect the benthic productivity of the area. Therefore, characterization of sediment quality may be required.

H_0 1-4: Material transported beyond the WLIS boundaries does not result in significant degradation of sediment quality.

Sediment chemistry, toxicity, and benthic community structure will be measured at representative locations (determined through interagency coordination) from outside the deposited material and at WLIS references sites to test this hypothesis (see Section 6.3.4).

Chemical and toxicity testing and analysis will be conducted using methods required by the EPA/Corps Interim Regional Testing Manual (EPA/USACE, 1997) or subsequent approved documents. Benthic community sampling and analysis methods will the same as those conducted during site designation studies. Statistical comparisons and numbers of samples will be determined during project-specific survey planning.

Data from the area of concern will be compared statistically to data collected concurrently from the WLIS reference sites to determine if the quality of transported material is unacceptable. The decision of unacceptable conditions will be based on all three measures (*i.e.,* sediment quality, benthic community analysis, and toxicity).

6.1.3 Management Focus 2: Absence from the Disposal Site of Pollutant-Sensitive Biota Characteristic of the General Area

The premise underlying this management focus is that the infaunal community on disposal mounds recovers rapidly[3] after disposal ceases. Therefore, the absence of or slower-than-

[3] Rapidly in this context means up to three (or more) years depending on a variety of factors that influence recolonization in coastal waters.

expected recovery of the benthic infaunal community indicates a potential biological impact at the mound and by implication the ability of the site to support higher trophic levels. The long history of disposal site monitoring in New England has resulted in an excellent understanding of the rate at which benthic infauna recover from disturbances such as those caused by dredged material disposal as well as the types of communities that are expected to recolonize the mounds (SAIC 2002; Murray and Saffert, 1999; Morris, 1998; Charles and Tufts, 1997; Wiley *et al.,* 1996; Williams, 1995; Wiley, 1995; Wiley and Charles, 1995; SAIC, 1995; Wiley, 1994; Germano *et al.,* 1994; Germano *et al.,* 1993; SAIC, 1990; SAIC, 1988; SAIC, 1987; SAIC, 1988; SAIC, 1985; Morton *et al.,* 1984; Scott *et al.,* 1984; Scott *et al.,* 1983; Morton and Paquett, 1983; Arimoto and Feng, 1984; Morton *et al.,* 1982; Morton and Stewart, 1982; SAIC, 1982; Morton, 1980; Morton, 1980; SAIC 1980). Thus, the questions that the monitoring program addresses are directed at determining if benthic recovery is proceeding as expected and if pollutant sensitive organisms are growing on the mounds. For Tier 1, these questions include:

- Do opportunistic species return to the mound within a growing season?
- Are the infaunal assemblages consistent with similar nearby sediments or expected recovery stage?
- Are benthic communities and populations similar to surrounding sediments?

If these questions are answered in the affirmative, the biological community on the mounds is recovering as expected and significant adverse impact from the disposal operations is not demonstrated. If the questions are answered in the negative, investigation into potential causes is conducted under Tier 2.

Tier 1

This tier focuses on the biological recovery of the mound surface by sampling for specific, opportunistic, benthic infaunal species and the recolonization stage relative to nearby sediments.

H_0 2-1: The population density of opportunistic polychaetes on the disposal mound is not significantly less than that on the ambient seafloor outside the disposal site boundaries.

H_0 2-2: Stage 2 or 3 assemblages (deposit-feeding taxa) are not present on the disposal mound one year after cessation of disposal operations.

These hypotheses will be tested with sediment profile imaging on the disposal mounds created in a given dredging season and by periodic imaging of older mounds (see Section 6.3.2). This evaluation includes estimates of grain size classes, which is a key variable affecting the types of organisms observed in the images. The initial sediment profile imaging survey should be conducted within one to three years of mound completion. Evaluation of selected historic (inactive) mounds and imaging of the WLIS reference stations will be incorporated into this periodic survey of active mounds. Sampling of historic mounds can be sequenced across years depending on budgets and the conclusions of the previous data review at the annual agency coordination meeting. However, the entire site, including all historic mounds, should be sampled at least once in a given five-year period.

Significant adverse impact will be determined from comparison of the sediment profile imagery data on the active and historic mounds to that of the reference stations. If the comparison of the mound data to the reference areas finds no significant difference, the biological community on the mounds would be considered to be recovering as expected and significant adverse impact from the disposal operations not demonstrated. If there are significant differences in the sediment profile imagery data between the mounds and reference site and the grain size information from the images cannot explain the difference, further investigation into the potential causes of the difference is conducted under Tier 2.

Tier 2

This Tier is executed if differences in the benthic recolonization data on a dredged material mound cannot be explained by differences or changes in grain size. The hypotheses are designed to determine if the observations made under Tier 1 are localized (mound specific) or regional and to determine the affect of different sediment grain size distributions on the biological observations.

H_0 2-3: The absence of opportunistic species and Stage 2 or 3 assemblages is not confined to the disposal mounds.

H_0 2-4: Sediment grain-size distribution on the disposal mound is not significantly different from the ambient seafloor.

These hypotheses examine whether or not the differences observed in Tier 1 extend beyond the disposal mounds and whether the grain size distribution within and outside the site can explain the biological observations. If diminished recolonization (successional) stage data is widespread and substantial movement of material is not observed under Tier 1 or 2 of Management Focus 1 or if poor water quality conditions (*e.g.,* sustained low dissolved oxygen levels) are known to have occurred in the region (Management Focus 3), assignment of the dredged material disposal as the cause is questionable. However, if the differences are widespread and cannot be attributed to other factors, an investigation of cause would be initiated under Tier 3 of this Management focus.

These hypotheses will be tested with sediment profile imaging (see Section 6.3.2). The sediment profile image survey will be designed to sample representative conditions in the site and extend systematically to areas at least 1 kilometer (0.6 miles) beyond the site boundaries.

The full suite of information developed from the sediment profile images will be used to evaluate the similarity or differences of the areas sampled. This evaluation includes estimates of grain size classes, which is a key variable affecting the types of organisms observed in the images. The data will be used to address the above hypotheses.

If the results find the effect is widespread and that grain size distributions can not explain the biological observations, additional cause effect studies defined under Tier 3 may be conducted.

Tier 3

Tier 3 is conducted if the benthic recolonization data developed under Tier 2 indicate that potential impacts are widespread (*i.e.,* encompass areas within and beyond the site boundaries). This Tier attempts to determine if the Tier 2 findings are the result of contaminants in the sediments or sediment toxicity. Tier 3 studies will only be conducted after a review and concurrence by the agencies managing the site.

H_0 2-5: The benthic community composition and abundance is not equal that at reference sites.

H_0 2-6: The toxicity of sediment from the disposal site is not significantly greater than the reference sites.

Sampling and analysis of the sediments for benthic infaunal enumerations and community analysis will be conducted to determine whether pollution-sensitive taxa are present beyond the site, evaluate the status of the infaunal community, and compare the community to measures of sediment quality (see Section 6.3.2 and Section 6.3.4). Sediment chemistry and toxicity will be measured at representative locations from within the deposited material and at WLIS references sites (see Section 6.3.4).

Chemical and toxicity measures will be conducted as defined in the Interim Regional Testing Manual (EPA/USACE, 1997) or subsequent approved documents. Data from the area of concern will be compared statistically to data collected concurrently from the WLIS reference sites to determine if the quality of transported material is unacceptable. The number of stations to include in the testing will be determined at the annual meeting. The decision of unacceptable conditions will be based on all three measures.

6.1.4 Management Focus 3: Changes in Water Quality

The premise underlying this management focus is that water quality in the western basin of Long Island Sound is affected by many different sources and that dredged material placed at the site exerts a low oxygen demand on the water column. Moreover, dredged material plume studies indicate the cloud of particles resulting from dredged material disposal has a very short duration in the water column and turbidity levels reach ambient levels within minutes to hours. This fact, coupled with required testing that ensures residual material meets water quality criteria within an initial mixing period (within four hours within the site and always outside the site) before the material can be accepted at the site, minimizes any long-term, cumulative impact to the water column. Therefore, it is expected that significant short-term adverse effects are unlikely to result from the disposal operations and that long-term monitoring programs underway in the Sound provide the level of information necessary to determine if the dredged material disposal at WLIS is affecting the overall quality of water in the central basin of the Sound. Relevant questions for water quality include:

- Is water quality in WLIS different during disposal operations than in areas outside the site?
- Does dredged material disposal have a substantive impact of water quality measures such as dissolved oxygen?

As discussed under Management Focus 1 and 2, dredged material placed at WLIS must pass the requirements of the EPA/Corps Interim Regional Testing Manual (or subsequent approved manuals) for disposal at WLIS. Thus, short-term water quality impacts are not expected. Ample evidence exists, as documented in the DEIS (EPA, 2003), that dredged material disposal poses minimal potential to impact water quality in the short time scales that residual material remains in the water column. Thus, a measurement program to document whether short-term changes in water quality during disposal occur is not proposed under Tier 1.

Tier 1

Under this tier, it is assumed that water quality at WLIS is not degraded by disposal of dredged material. Moreover, it is assumed that regional monitoring programs can provide sufficient information to assess whether disposal of dredged material at WLIS contributes significantly to the changes in water quality of the western basin of the Sound. It is also assumed that the quality of the sediment placed at the site does not affect the marine environment as the sediments undergo testing for acceptance into the site. Thus, sediment quality issues are not tested under this Tier, but rather are evaluated under the tiered monitoring structure under Management Focus 2.

H_0 3-1: Spatial and temporal trends in water quality in waters near WLIS do not indicate WLIS as a source of change.

This hypothesis examines the trend in leading water quality indicators (*e.g.,* chlorophyll, dissolved oxygen, turbidity) in the vicinity of WLIS. These parameters are consistently measured at a series of locations near WLIS by the Long Island Sound Study Program. The data from this and other relevant programs will be obtained by the agencies managing WLIS and evaluated to determine whether or not there are spatial gradients in the measures near WLIS that can be attributed to the site and whether there are long term changes in water quality in the general vicinity of the site.

Consistent gradients pointing to WLIS as a potential source of poor water quality or long-term trends determined to show detrimental changes in water quality will trigger assessments under Tier 2 of this management focus.

Tier 2

Measurements under this Tier will be triggered if trends evaluated under Tier 1 suggest WLIS as a potential cause of poor water quality in the western basin of Long Island Sound.

H_0 3-2: Water quality at WLIS is not different than nearby areas.

This hypothesis will be tested through water quality surveys designed to evaluate short-term gradients in water quality during disposal operations. If significant sustained short-term changes are found, further evaluation of the relationship to dredged material disposal will be undertaken (Tier 3) after discussion by the managing agencies.

Tier 3

Specific hypotheses cannot be defined for this Tier at this time and will be developed through interagency coordination at such time the Tier is deemed necessary. However, they may include special studies that determine the sediment oxygen demand to evaluate the contribution of the site to spatial and temporal dissolved oxygen trends in the water column. Such studies would compare the sediment oxygen demand levels in sediments within and outside the site including the three WLIS reference locations. Special plume tracking studies may also be mounted to examine the specific effects of individual dredged material plumes on water quality during the disposal season.

6.1.5 Management Focus 4: Changes in Composition or Numbers of Pelagic, Demersal, or Benthic Biota at or Near the Disposal Site

This management focus addresses regional changes in species composition and abundance. Two areas of study are considered: finfish and macrobenthic organisms such as lobster. These organisms will be monitored in the vicinity of WLIS. As discussed in the DEIS (EPA, 2003), significant short-term adverse effects to these communities are unlikely to result from the disposal operations. Long-term impacts to fish and shellfish populations in Long Island Sound are also unlikely, but are more difficult to predict. However, these populations are regularly monitored by the State of Connecticut through their fish trawl surveys. These surveys are anticipated to provide sufficient data to develop information necessary to determine if the dredged material disposal at WLIS is affecting the fish and lobster populations in the western basin of the Sound. Relevant questions include:

- Is the composition of the pelagic and demersal fish community affected by disposal operations at the site?
- Is the composition of macro benthic biota affected by disposal operations at the site?

The DEIS identifies endangered species in general as a concern for dredge material disposal in Long Island Sound. However, the DEIS found that no significant impact would be expected to endangered species from disposal at WLIS.

Tier 1

H_0 4-1: Disposal of dredged material has no significant long-term impact on fish/shellfish populations or abundance.

This hypothesis will be addressed with data developed under the CTDEP fish trawl surveys. These data are collected on a yearly basis under a stratified random sampling design. Data from near the site will be compared with data obtained from other similar areas (depth,

sediment type, *etc*.) in the western basin of Long Island Sound to determine if there are significant spatial difference that could be related to dredged material disposal at WLIS.

H_0 4-2: Material and operations has no significant direct impact on threatened and endangered species.

The need to test this hypothesis during Tier 1 monitoring would be determined during the annual agency meeting. Methodologies may include the placement of marine mammal observers on tugs or hopper dredges. In addition, turbidity plumes may also be monitored during disposal operations at least once every five years.

Tier 2

If the data reviewed under Tier 1 suggest that dredged material disposal at WLIS is potentially having an adverse affect on the fish or shellfish populations or abundance, special studies to evaluate the distribution of these species in and near the site will be developed. These studies would address the distribution and composition of the fish and macrobenthic organism species within the site and in areas contiguous to the site boundaries. Control areas with similar habitat and depths to those found at WLIS would be identified and sampled to provide a control on the sample design. Specific study questions and sampling design will be developed and approved by the agencies managing WLIS before any study is conducted.

If studies under Tier 2 demonstrate a link between reduced fish or shellfish species and abundances and dredged material disposal at WLIS, additional studies to determine cause will be implemented under Tier 3.

Tier 3

Studies conducted under this tier may include evaluation of the availability of prey species in the site and surrounding areas and evaluation of bioaccumulation of chemicals in the fish and macro benthic species. Studies of prey species may include evaluation of the successional stage, infaunal community analysis (as described in Section 6.3) or bioaccumulation studies similar to those defined under Section 6.1.5 below. Specific study questions and sampling design will be developed and approved by the agencies managing WLIS before any study is conducted.

6.1.6 Management Focus 5: Accumulation of Material Constituents in Marine Biota at or Near the Site

The intent of this management focus is to evaluate whether significant potential for bioaccumulation results from disposal of dredged material at WLIS. The basic premise of this management focus is that testing of sediments for open water disposal eliminates material that pose an unacceptable risk to the marine environment from disposal at WLIS. Moreover, because bioaccumulation of contaminants is a phenomena, it may not result in the impairment or death of organisms in and of itself. However, because bioaccumulation may result in transfer and possible biomagnification of certain chemicals throughout the food chain, which may pose potential unacceptable risks to marine organisms and humans that are

not addressed through the evaluation of benthic community recovery, measurements for potential bioaccumulation are precautionary and prudent.

Such bioaccumulation data can serve two purposes. The first is to help understand whether transfer of chemicals from sediments to organisms could be contributing to a significant adverse biological response (*e.g.,* failure of a benthic infaunal community to thrive). The second is to estimate potential risks posed from bioaccumulation of contaminants at the site. The challenge in the monitoring program is how to best develop the information. Two questions are relevant under this Management Focus:

- Are risk levels from sediments placed at WLIS low?
- Does the bioaccumulation potential from the deposited sediments remain low after deposition?

There are several ways to address these questions. The first question is best addressed by continuing to test potential projects for potential risk (as currently practiced in the region) and by compiling test results into a readily available database. Addressing the second question involves periodically evaluating bioaccumulation potential for sediments at and near the disposal site. Methods for developing this information can range from estimating bioaccumulation potential using bioaccumulation models, to measuring the levels of contaminants in organisms collected from a site, to conducting controlled laboratory bioaccumulation studies with test organisms. These approaches are used in a tiered manner to address bioaccumulation concerns at WLIS.

If either of these questions is answered in the negative, significant adverse impact from the disposal operations may be present. Question 1 will be addressed through evaluation of the testing data submitted as part of the permit application and approval process. Question 2 is addressed under the Tiered approach below.

Tier 1

The premise of this Tier is that bioaccumulation potential at WLIS, and thus risk, does not increase after the sediments are deposited.

H0 5-1: Bioaccumulation potential of sediments collected from WLIS is not significantly greater than the baseline condition determined during site designation or at site reference stations.

This hypothesis will be tested by periodically collecting sediments from within WLIS and its reference areas and measuring the level of contaminants in the sediments. If statistically significant increases in sediment chemistry above baseline conditions are found theoretical bioaccumulation calculations will be performed. These may be performed in association with any sampling for sediment chemical analysis (*i.e.,* Tier 3 Management Focus 4). Such surveys should be designed to address other relevant management evaluations. If such sample collections are not performed within any five-year interval, a survey may be planned and conducted as a precautionary evaluation.

If the bioaccumulation modeling indicates a significant increase in potential bioaccumulation relative to baseline conditions or reference areas more specific studies that directly measure bioaccumulation may be conducted under Tier 2.

Tier 2

Direct evidence of bioaccumulation from sediments placed at WLIS may be obtained by comparing bioaccumulation in organisms collected from within and near (reference stations) the disposal site. The study may include collection of representative infaunal organisms from these locations and comparing the level of chemicals in their tissues or testing sediments under controlled laboratory conditions (*i.e.,* bioaccumulation bioassays) or both.

The specific study questions and sampling design will be developed and approved by the agencies managing WLIS before any study is conducted.

If significant increases in bioaccumulation are determined to exist in the sediments from the site, ecological and human health risk models may be run to examine the significance of the increase. If risks increase significantly studies described under Tier 3 would be implemented.

Tier 3

This Tier tests for transfer of bioaccumulated compounds at the site into higher trophic levels.

H_0 5-2: Bioaccumulation of material constituents in higher tropic levels that reside at or near the site does not result from disposal of dredged material at WLIS.

Proving the source of contaminants measured in higher trophic level species is a difficult and complex task. Therefore, careful experimental design is required to make a cause effect link to the sediments deposited in WLIS. The specific study design will be developed and approved by the agencies managing WLIS before any study is conducted.

6.2 Quality Assurance

An important part of any monitoring program is a quality assurance (QA) regime to ensure that the monitoring data are reliable. Quality assurance has been described consisting of two elements:

- Quality Control - activities taken to ensure that the data collected are of adequate quality given the study objectives and the specific hypothesis to be tested, and include standardized sample collection and processing protocols and technician training (National Research Council (NRC), 1990).
- Quality Assessment - activities implemented to quantify the effectiveness of the quality control procedures, and include repetitive measurements, interchange of technicians and equipment, use of independent methods to verify findings, exchange of samples among laboratories and use of standard reference materials, among others (NRC, 1990).

Relevant laboratories are required to submit Quality Assurance (QA) sheets with all analyses on a project-specific basis (see RIM, ITM and Green Book for further details).

6.3 Monitoring Technologies and Techniques

This section describes equipment and approaches typically used to evaluate dredged material disposal sites in the northeast United States. Use of consistent techniques increases comparability with future and historic data; however, monitoring methods used at WLIS are not limited to these technologies. New technology and approaches may be used as appropriate to the issues and questions that must be addressed. The applications of equipment and survey approach must be tailored to each individual monitoring situation, as warranted.

6.3.1 Mound Erosion

Loss of deposited dredged material (erosion) at the site will be investigated using bathymetry (SAIC, 1985). Typically this methodology applies a minimum area bounded by rectangular dimensions of approximately 800 meters to 1200 meters centered around a disposal buoy and aligned with the major axis of the tidal ellipse at the site will be surveyed. Side scan sonar and sediment profile imaging systems (Germano and Rhoads, 1982; 1994) may also be used and is useful for defining broad areas where grain size may have changed or identify thin layers of dredged material, respectively (Rhoades, 1994). Specific survey requirements and application of these measurement tools will be defined for each tier and situation investigated. Evidence of mound erosion will need to be evaluated carefully to distinguish between actual erosion and mound consolidation.

6.3.2 Biological Monitoring

Benthic recovery at disposal mounds will be measured by sediment profile imagery (Germano and Rhoads, 1982; 1994). Stations will center on the disposal buoy and sampled in a star pattern at 100 meter intervals (if more than one area is used in the year then these additional areas will be surveyed in a similar manner). In addition, stations in a cross pattern at 100 meter intervals at each of the three reference sites will be obtained. At each station three photos will be taken with the sediment profile imaging camera. Image analyses will provide the following information:

- Sediment grain size;
- Relative sediment water content;
- Sediment surface boundary roughness;
- Sea floor disturbance;
- Apparent Redox Potential Discontinuity (RPD);
- Depth of camera penetration;
- Sediment methane;
- Infaunal successional stage;
- Organism-Sediment Index (OSI).

6.3.3 Water Quality

The National Estuary Program's Long Island Sound Study (LISS) (http://www.epa.gov/region01/eco/lis/index.htm) routinely measures temperature, salinity, and dissolved oxygen using vertical hydrocasts. In addition, water samples will be collected via Niskin bottle and analyzed via Winkler titration at selected stations. Data collected near WLIS will be obtained from the LISS program and evaluated. Should site specific monitoring be required, methodologies comparable to the LISS program data collections will be used (http://www.epa.gov/region01/eco/lis/index.htm).

6.3.4 Sediment Quality

Grab samples of the sediments will be collected and analyzed for grain size, total organic carbon, and selected contaminants such as trace metals (*e.g.,* mercury, lead, zinc, arsenic, iron, cadmium, copper), total PCBs, total PAH, and pesticides (EPA/USACE, 1997). The number of stations and locations will be defined during survey planning and will be sufficient to enable characterization of within and among station variability. A minimum of two replicate samples should be obtained from each station sampled including each of the three WLIS reference stations.

Toxicity tests will be selected from those used to evaluate dredge material proposed for disposal at WLIS (EPA/USACE, 1997). The number of stations and locations will be defined during survey planning and will be sufficient to enable characterization of within and among station variability. A minimum of two replicate samples should be subjected to testing and include each of the three WLIS reference stations.

6.3.5 Living Resources

Data from the CTDEP Trawl Survey (http://www.dep.state.ct.us/burnatr/fishing/geninfo/fisherie.htm#Coastal%20Programs) will be obtained and analyzed to determine whether the diversity and abundance of recreational and commercial fish in the vicinity of WLIS area differs from other similar areas (depth, sediment type, etc) of the Long Island Sound.

A body burden analysis will also be conducted to determine the concentrations of persistent, bioaccumulatable chemicals such as trace metals (mercury, lead, iron, cadmium, copper) and total PCBs in benthic invertebrates. The methodologies used will be consistent with those recommended in the EPA and Corps Interim Regional Testing Manual (EPA/USACE, 1997). The specific species to be evaluated as well as the number of stations and locations will be defined during survey planning and will be sufficient to enable characterization of within and among station variability. A minimum of three replicate samples should be obtained from each station sampled including each of the three WLIS reference stations. Benthic infaunal organisms analyzed may include *Nephtys incisa* or other infaunal species representative of the site and its contiguous areas that have sufficient tissue mass to enable chemical analysis.

Sampling and chemical analysis of higher trophic levels will be at the discretion of the site managers and focus on determining bioaccumulation in species that can clearly document whether bioaccumulations from the deposited sediments may be determined.

6.3.6 Bioaccumulation Measurements

Measurement of bioaccumulation will include collection of representative benthic infaunal species within the site and at reference locations. At least two types of organisms (filter feeders and sediment feeders) will be obtained and genus level species aggregated into field replicates. Sufficient biomass to enable quantifications of bioaccumulatable compounds will be obtained from grab samples (or other appropriate sample collections device). Tissue will be prepared and analyzed using methods consistent with EPA/USACE (1997). The number of stations and locations will be defined during survey planning and will be sufficient to enable characterization of within and among station variability. Between three and five replicate samples should be obtained from each station sampled including each of the three WLIS reference stations.

Laboratory based bioaccumulation testing will follow the requirements outlined in EPA/USACE (1997).

7.0 ANTICIPATED SITE USE AND QUANTITY AND QUALITY OF MATERIAL TO BE DISPOSED

MPRSA 102(c)(3)(D) and (E) requires that the SMMP include consideration of the quantity of the material to be placed in the site, and the presence, nature, and bioavailability of the contaminants in the material as well as the anticipated use of the site over the long term. WLIS is designated to receive dredged material only. No other material may be placed in the site.

Projected dredging volumes for the western and central regions of Long Island Sound include a mix of large and small Federal navigation projects and many small private dredging projects (marinas, boatyards, and harbors, and a few large private projects), which is consistent with the pattern of dredging in Long Island Sound over the past 20 years. A total of 16 million cubic yards of material are anticipated to be dredged in western and Central Long Island Sound over the next 20 years. Of this volume approximately 1 million cubic yards is anticipated to be derived from improvement dredging. Approximately 13.9 million cubic yards of material is expected to be from Federal navigation projects with the rest of the volume coming from other facilities in Long Island Sound. Sediments projected for disposal are expected to come primarily from maintenance dredging projects, although expansion dredging may be required for deeper draft vessels or from increased commerce in Long Island Sound.

Historically one third of the dredged material volume comes from large projects (>500,000 cubic yards; 382,277 cubic meters), one third from medium sized projects (200,000 to 500,000 cubic yards; 152,911 to 382,277 cubic meters), and one third from small projects (<200,000 cubic yards; 152,911 cubic meters). The sediment properties are

expected to be variable although the predominant sediment type is likely be silty material (silts, organic silts, sandy silts, *etc.*). About 70 percent of the maintenance material volume can be characterized as silty material. Approximately, 10 percent the expansion material are expected to be sands and clays.

All projects using WLIS for disposal must be either permitted or authorized under MPRSA and the CWA (see Section 3.0). The quality of the material will be determined on a project specific basis under the testing requirements necessary to meet open-water disposal requirements of either CWA 404 or MPRSA 103. The quality of MPRSA material will be consistent with EPA's Ocean Dumping Regulations (40 CFR Part 227), as implemented under the EPA and Corps Interim Regional Testing Manual (EPA/USACE, 1997). Any updates to the Interim Regional Manual (EPA/USACE, 1997) will be in force when approved by the EPA and Corps.

A specific closure date for WLIS has not been assigned as of the date of this SMMP. The capacity of the site will be evaluated at least every three years.

8.0 REVIEW AND REVISION OF THIS PLAN

MPRSA 102 (c)(3)(F) requires that the SMMP include a schedule for review and revision of the SMMP, which shall not be reviewed and revised less frequently than 10 years after adoption of the plan, and every 10 years thereafter. The EPA, the Corps, and states have agreed to review this plan annually as part of the annual agency planning meeting agenda (Section 3.2). A formal review and revision of this SMMP will take place every 5 years beginning from the date of designation unless the frequency is modified during the annual agency planning meeting.

9.0 COORDINATION/OUTREACH

To ensure a disposal program that minimizes impacts to the marine environment, the following management practices will continue to be implemented at the WLIS as a matter of policy. First and foremost, all proposed dredging projects will be reviewed for suitability for ocean disposal by both the Corps and EPA.

An interagency dredged material management review group composed of representatives from EPA, Corps, NMFS, USFWS, and New York and Connecticut state representatives meets approximately every two months to discuss management and monitoring of New England dredged material disposal sites.

To assess compliance with applicable permit conditions and to track overall site usage, permittees will be required to provide written documentation of disposal activities to the Corps during disposal operations and after dredging is complete. Disposal permits and authorizations will include standardized requirements for this reporting to include the source of the dredged material, the amount of the material disposed, the rate of disposal, the date, time and LORAN-C coordinates (or differential GPS, if available) of disposal as well as the due-date for the documentation itself.

The Corps will provide EPA with summary information on each project at two stages of the dredging and disposal process. A Summary Information Sheet will be provided when dredging operations begin, and a Summary Report will be submitted when dredging operations have been completed.

The EPA and the Corps will continue to inform and involve the public regarding the monitoring program and results. For example, the DAMOS Program holds periodic symposia (typically every three years) to report results and seek comment on the program. In addition, DAMOS monitoring results are published in an ongoing series of technical reports that are mailed to interested people and organizations and also distributed at various public meetings. The Corps also has prepared and distributed several Information Bulletins and brochures. To better meet this need, a series of presentations on different aspects of the dredging and disposal process has been prepared. In addition, site related reports can be reviewed at both the Corps Technical Library and the EPA regional library:

U.S. EPA (New England)
Library
One Congress St., 11th Floor
Boston, MA
Hours: Monday-Friday 8:00-5:00

U.S.ACE
NAE Technical Library
696 Virginia Road
Concord, MA 01742
Hours: Monday-Friday 7:30-4:00

Any party interested in being added to the DAMOS mailing list should mail the appropriate information to the Corps at:

U.S. Army Corps of Engineers, New England Division
Regulatory Division
Marine Analysis Section
696 Virginia Road
Concord, MA 01742

10.0 FUNDING

The costs involved in site management and monitoring will be shared between EPA New England Region and the Corps NAE. This SMMP will be in place until modified or the site is de-designated and closed.

Those monitoring programs conducted under other Federal (*i.e.,* Long Island Sound Study) and state agencies (*i.e.,* CTDEP Trawl Survey) will depend solely on funds allocated to the programs by those agencies or other supporting agencies.

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Attachment A

Hypotheses Flowcharts and Summary Table

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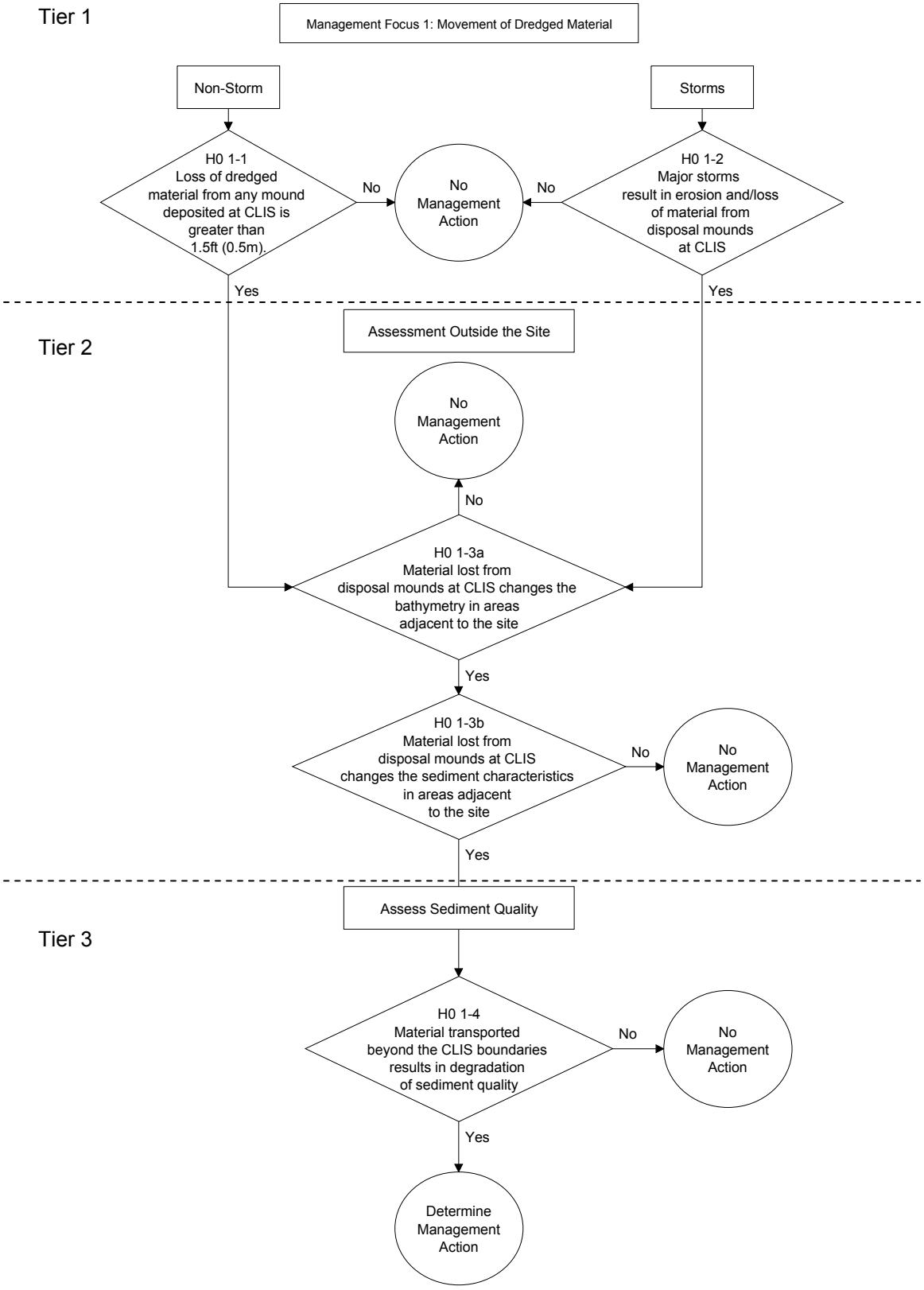
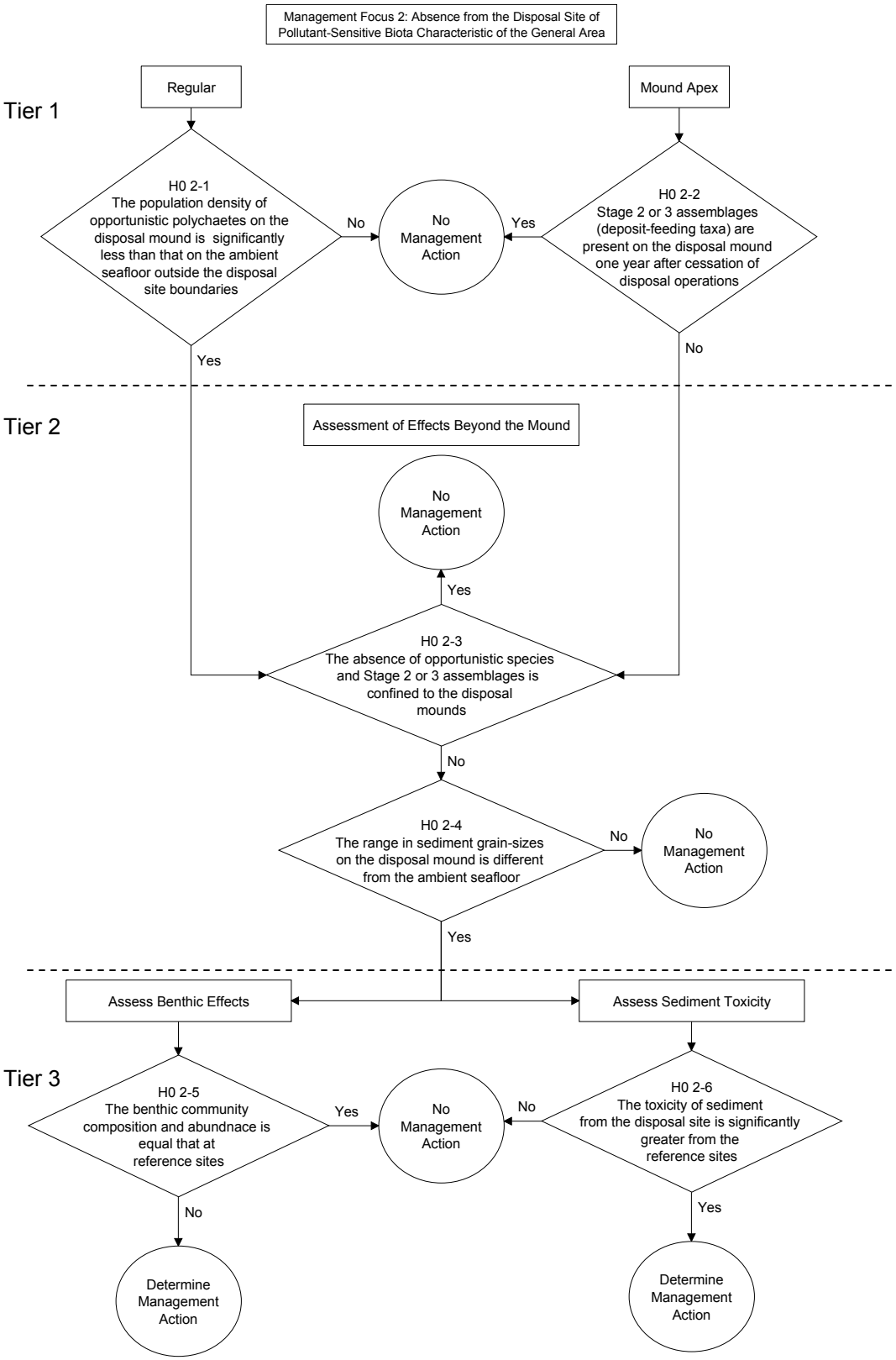
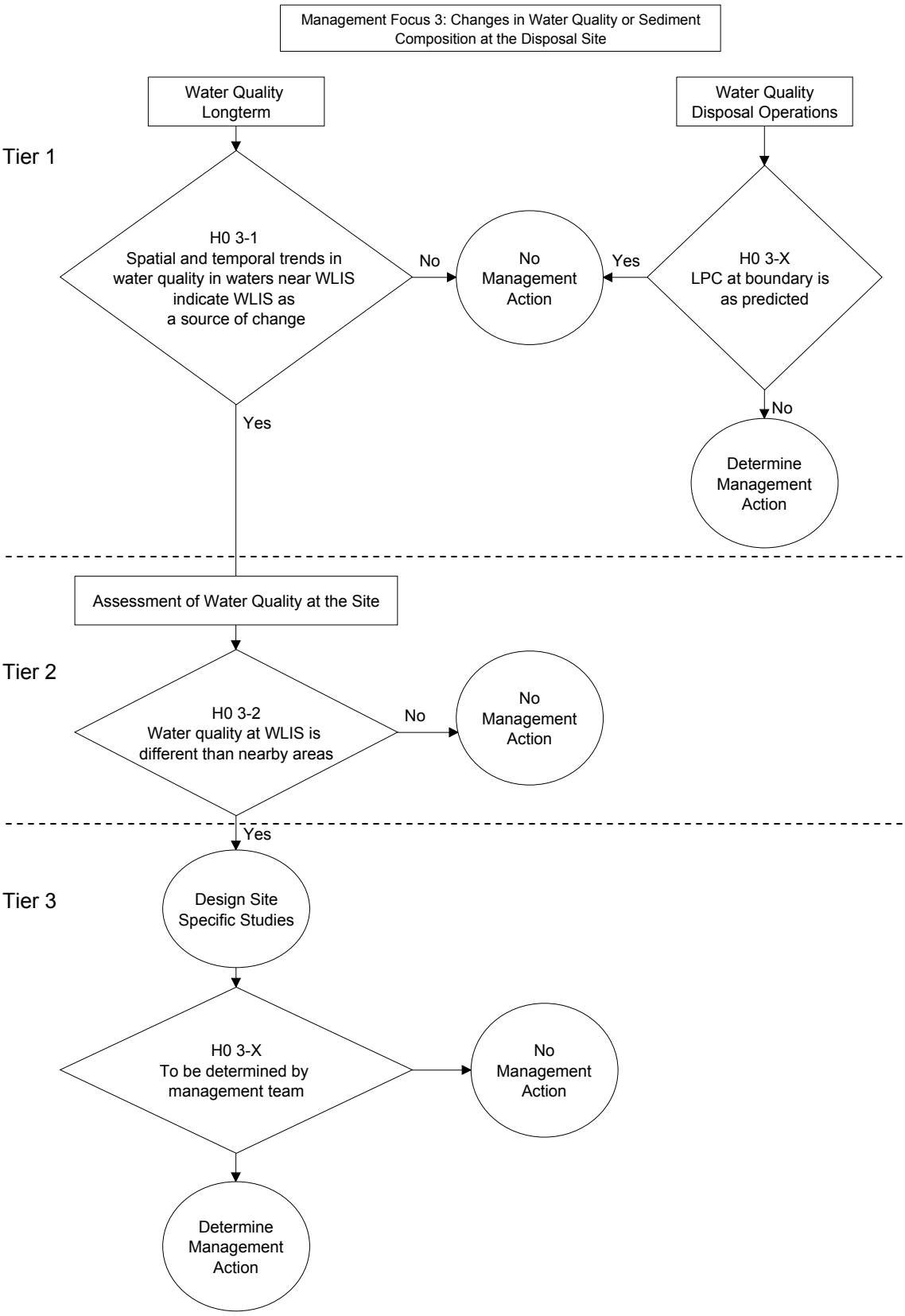
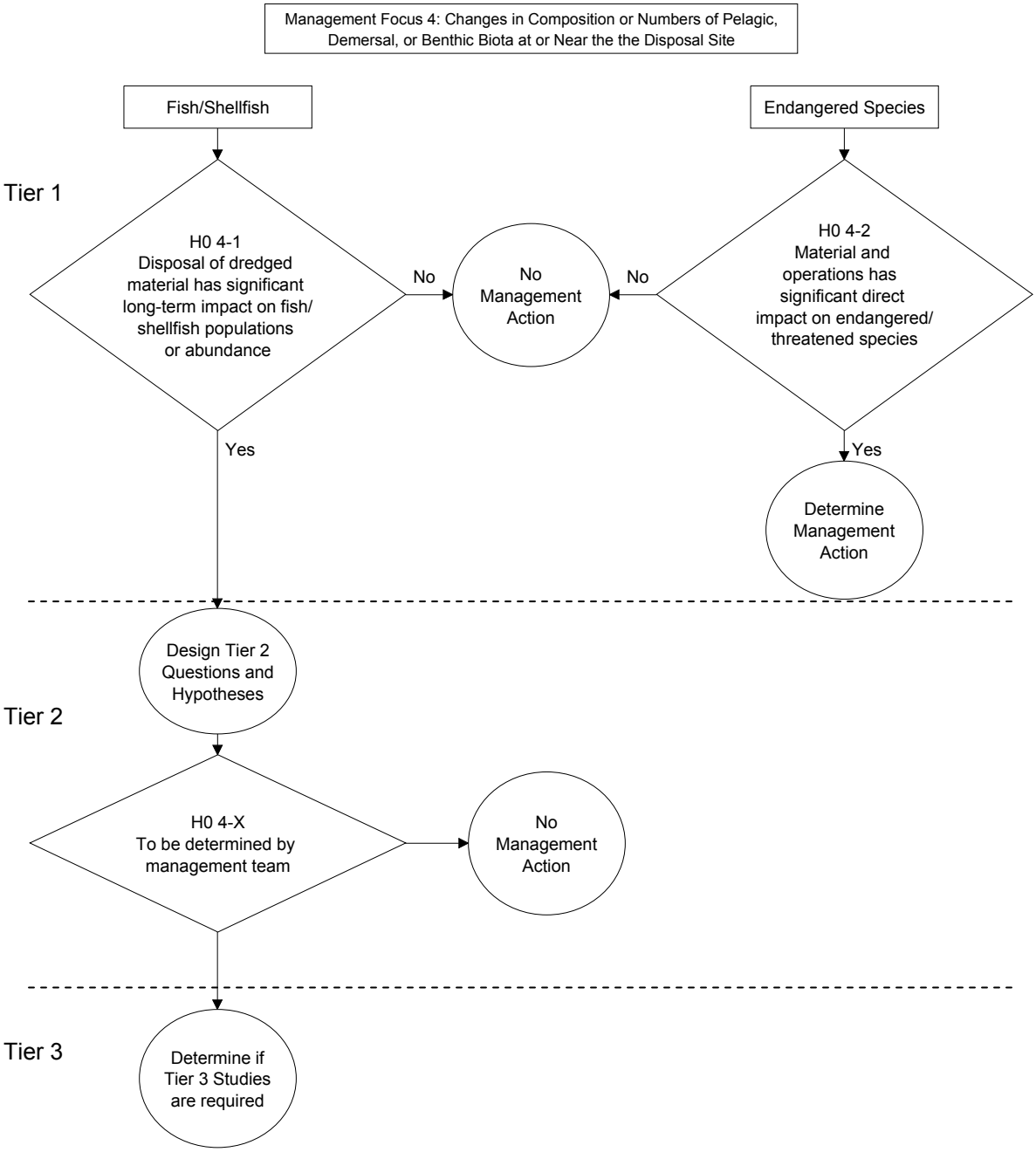

Tier 1
Management Focus 1: Movement of Dredged Material
Non-Storm
Storms
H0 1-1
Loss of dredged material from any mound deposited at CLIS is greater than 1.5ft (0.5m).
No
No Management Action
No
H0 1-2
Major storms result in erosion and/loss of material from disposal mounds at CLIS
Yes
Yes
Tier 2
Assessment Outside the Site
No Management Action
No
H0 1-3a
Material lost from disposal mounds at CLIS changes the bathymetry in areas adjacent to the site
Yes
H0 1-3b
Material lost from disposal mounds at CLIS changes the sediment characteristics in areas adjacent to the site
No
No Management Action
Yes
Tier 3
Assess Sediment Quality
H0 1-4
Material transported beyond the CLIS boundaries results in degradation of sediment quality
No
No Management Action
Yes
Determine Management Action


Management Focus 2: Absence from the Disposal Site of Pollutant-Sensitive Biota Characteristic of the General Area
Tier 1
Regular
Mound Apex
H0 2-1
The population density of opportunistic polychaetes on the disposal mound is significantly less than that on the ambient seafloor outside the disposal site boundaries
No
No Management Action
Yes
H0 2-2
Stage 2 or 3 assemblages (deposit-feeding taxa) are present on the disposal mound one year after cessation of disposal operations
Yes
No
Tier 2
Assessment of Effects Beyond the Mound
No Management Action
Yes
H0 2-3
The absence of opportunistic species and Stage 2 or 3 assemblages is confined to the disposal mounds
No
H0 2-4
The range in sediment grain-sizes on the disposal mound is different from the ambient seafloor
No
No Management Action
Yes
Assess Benthic Effects
Assess Sediment Toxicity
Tier 3
H0 2-5
The benthic community composition and abundnace is equal that at reference sites
Yes
No Management Action
No
H0 2-6
The toxicity of sediment from the disposal site is significantly greater from the reference sites
Yes
No
Determine Management Action
Determine Management Action


Management Focus 3: Changes in Water Quality or Sediment Composition at the Disposal Site
Water Quality Longterm
Water Quality Disposal Operations
Tier 1
H0 3-1
Spatial and temporal trends in water quality in waters near WLIS indicate WLIS as a source of change
No
No Management Action
Yes
H0 3-X
LPC at boundary is as predicted
No
Determine Management Action
Yes
Assessment of Water Quality at the Site
Tier 2
H0 3-2
Water quality at WLIS is different than nearby areas
No
No Management Action
Yes
Tier 3
Design Site Specific Studies
H0 3-X
To be determined by management team
No Management Action
Determine Management Action


Management Focus 4: Changes in Composition or Numbers of Pelagic, Demersal, or Benthic Biota at or Near the the Disposal Site
Fish/Shellfish
Endangered Species
Tier 1
H0 4-1
Disposal of dredged material has significant long-term impact on fish/ shellfish populations or abundance
No
No Management Action
No
H0 4-2
Material and operations has significant direct impact on endangered/ threatened species
Yes
Yes
Determine Management Action
Design Tier 2 Questions and Hypotheses
Tier 2
H0 4-X
To be determined by management team
No Management Action
Tier 3
Determine if Tier 3 Studies are required

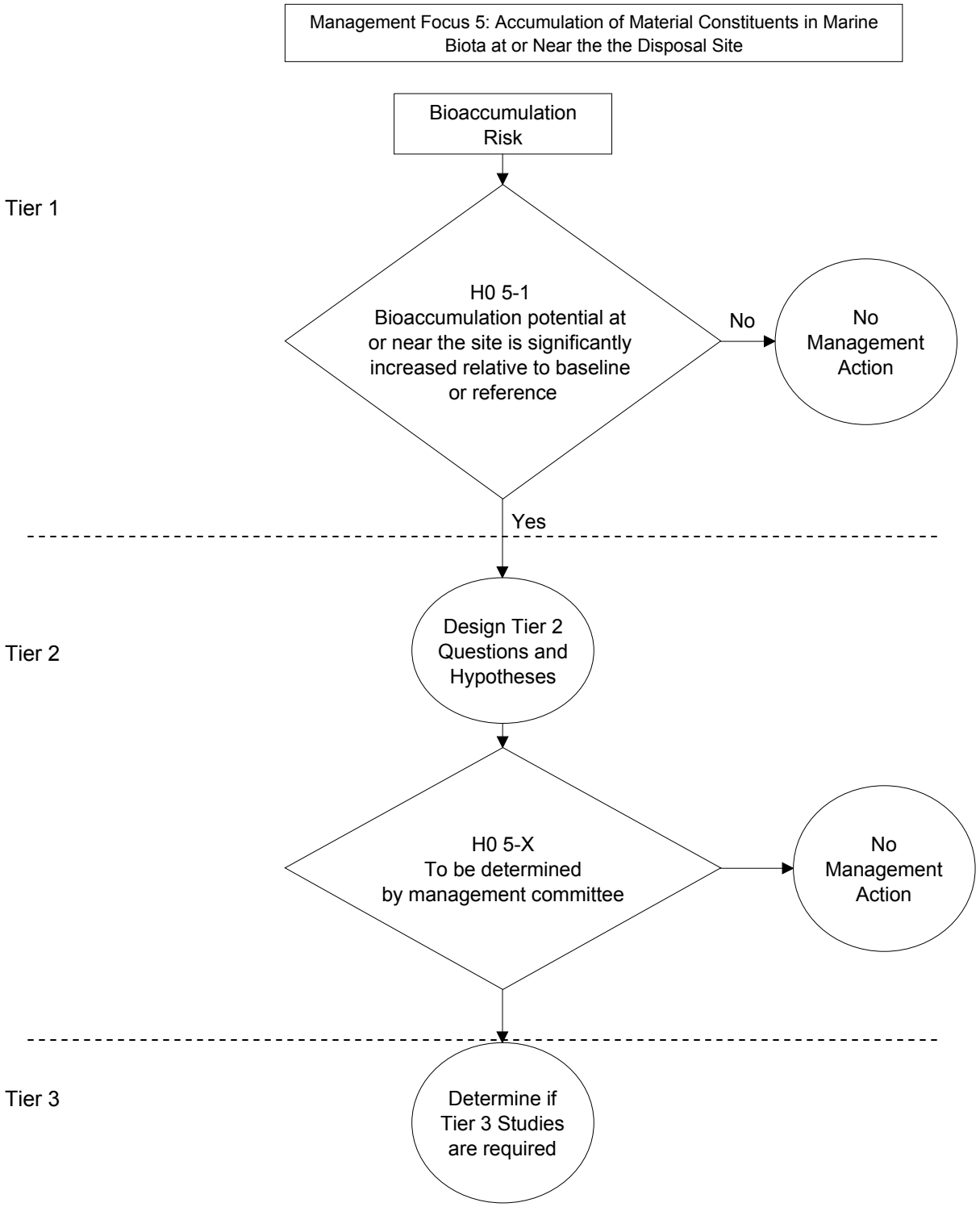

Management Focus 5: Accumulation of Material Constituents in Marine Biota at or Near the the Disposal Site
Bioaccumulation Risk
Tier 1
H0 5-1
Bioaccumulation potential at or near the site is significantly increased relative to baseline or reference
No
No Management Action
Yes
Tier 2
Design Tier 2 Questions and Hypotheses
H0 5-X
To be determined by management committee
No Management Action
Tier 3
Determine if Tier 3 Studies are required

Table A-1. Summary of Hypotheses and Leading Indicators for Each Management Focus

	Management Focus 1: Movement of the Dredged Material	Management Focus 2: Absence of Pollutant-Sensitive Biota	Management Focus 3: Changes in Water Quality	Management Focus 4: Changes in Composition or Numbers of Biota	Management Focus 5: Accumulation of Material Constituents in Biota
TIER 1					
Hypothesis 1	Baseline taken within 1 yr after disposal; entire site bathymetry at 3-4 yr intervals	SPI within 1-3 yrs of disposal and survey of historic mounds once every 5 yrs.	Annual water quality measured in site vicinity (LISS Monitoring program data)	Annual CTDEP trawl survey data	Sediment bioaccumulation potential estimated for sediments collected within site and ref. areas at least every 5 yrs
Condition(s) triggering Tier 2 monitoring:	Mound changes by > 1.0 ft w/in 5 yr interval	Significant differences between site and ref. areas	Consistent gradients in measures of long-term water quality changes in vicinity	Significant differences in community composition or abundance from baseline or contiguous areas is found	Significant increase in bioaccumulation potential relative to baseline conditions or reference areas
Hypothesis 2	Bathymetry taken ≤ 2 months after 10-yr storm	SPI w/in 1-3 yrs of disposal and survey of historic mounds once every 5 yrs.	N/A	N/A	N/A
Condition(s) triggering Tier 2 monitoring:	Mound changes by > 1.5 ft from last survey	Significant differences between site and ref. areas	N/A	N/A	N/A
TIER 2					
Hypothesis 3	Bathymetry and sediment char. survey w/in 1 km. of site boundary	SPI at site and ref. areas at least 1 km away; grain size analysis	Water quality measured at site and ref. areas	No hypothesis but studies may include measurement of species distribution at site and ref. areas	No hypothesis but studies will involve the collection of biota from site and ref. areas
Condition(s) triggering Tier 3 monitoring:	Apex or apron bathymetry changes are > 1.5 ft or large undocumented areas w/ muddy sed.	Widespread differences between site and ref. areas are not caused by other factors	Significant short-term WQ gradients are found	A link between reduced biota or diversity and dredged material at the site is found	Significant bioaccumulation is detected
Hypothesis 4	N/A	SPI at site and ref. areas at least 1 km away; grain size analysis	N/A	No hypothesis but studies may include species distribution at site and ref. areas	Further studies not yet determined

Table A-1. Summary of Hypotheses and Leading Indicators for Each Management Focus (continued)

	Management Focus 1: Movement of the Dredged Material	Management Focus 2: Absence of Pollutant-Sensitive Biota	Management Focus 3: Changes in Water Quality	Management Focus 4: Changes in Composition or Numbers of Biota	Management Focus 5: Accumulation of Material Constituents in Biota
TIER 2 (Cont'd)					
Condition(s) triggering Tier 3 monitoring:	N/A	Widespread differences between site and ref. areas are not caused by other factors	N/A	N/A	Further studies not yet determined
TIER 3					
Hypothesis 4	Sed. chem, toxicity, and benthic community measured at site and ref. areas	Sed. chem, toxicity, and benthic community measured at site and ref. areas	No hypothesis but studies may include evaluation of sediment oxygen demand	No hypothesis but studies may include prey evaluation, bioaccumulation, succession, etc.	Further studies not yet determined
Condition triggering Management Action	All three measures are deemed unacceptable	All three measures are deemed unacceptable	Low dissolved oxygen at site and ref. areas is linked to dredged material	A link between reduced biota or diversity and dredged material at the site is found	A cause-effect link between sediment and higher trophic levels is detected
Hypothesis 4	N/A	Sed. chem, toxicity, and benthic community measured at site and ref. areas	No hypothesis but studies may include evaluation of sediment oxygen demand	No hypothesis but studies may include prey evaluation, bioaccumulation, succession, etc.	Further studies not yet determined
Condition triggering Management Action	Significant movement of material outside of the site and significantly impaired benthic community	All three measures are deemed unacceptable	Low dissolved oxygen at site and ref. areas is linked to dredged material	A link between reduced biota or diversity and dredged material at the site is found	A cause-effect link between sediment and higher trophic levels is detected

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Attachment B

Scow Log Sample

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INSPECTOR'S DAILY REPORT OF DISPOSAL BY SCOW

NOTE: Dredged material volume stated below is approximate and shall not be used for measurement and/or payment.

Permittee _____ Disposal Area _____
Permit/Contract No. _____ Date _____
Project _____ Towboat _____
Dredging Contractor _____ Owner _____

Trip No.	Scow No.	Started From Place	Started From Time	Disposal Time	Returned To Place	Returned To Time	Round Trip Time	Round Trip Dist.	Lat/Long Coordinates* Specified	Lat/Long Coordinates* Actual	Dist./Dir. From Buoy

Trip No.	No. of Pockets Loaded	No. of Pockets Dumped	Reason Pocket Not Dumped	Disposal Depth	Speed	Weather	Sea Conditions/ Visibility	Approx. Volume (CY)	Scow Draft

Comments:

*Check the datum used ___NAD27 ___NAD83. Also note any factors that may affect reliability of navigation instrument and readouts.

Time On	Time Off	Hours On Duty
Total Hours On Duty		

Reviewed By: Permittee's Representative or, for Corps Projects, Corps' Resident Engineer or Field Inspector

To the District Engineer, U.S. Army Engineer District, New England, Concord, Massachusetts:

I certify that I informed the tug captain of the conditions of the U..S. Army Corps of Engineers permit or contract regarding the distance from the buoy and the speed of the scow during the release of the dredged material. I also informed the captain that failure to comply with these conditions would constitute a violation of the permit and would be reported to the Corps. I certify that this report is correct and that I am not an employee of the dredging or towing firm, or the permittee, nor have I been employed by any of them at any time during the past six months. The approximate volume of dredged material stated on this report is only an estimate. It was made either by me, the dredging or towing contractor, or the Corps of Engineers Resident Engineer of Field Inspector. I do not certify that it correctly states the volume of material dredged.

_____ _____
Signature of Disposal Inspector (Certification No.)

Print Name Here _____

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