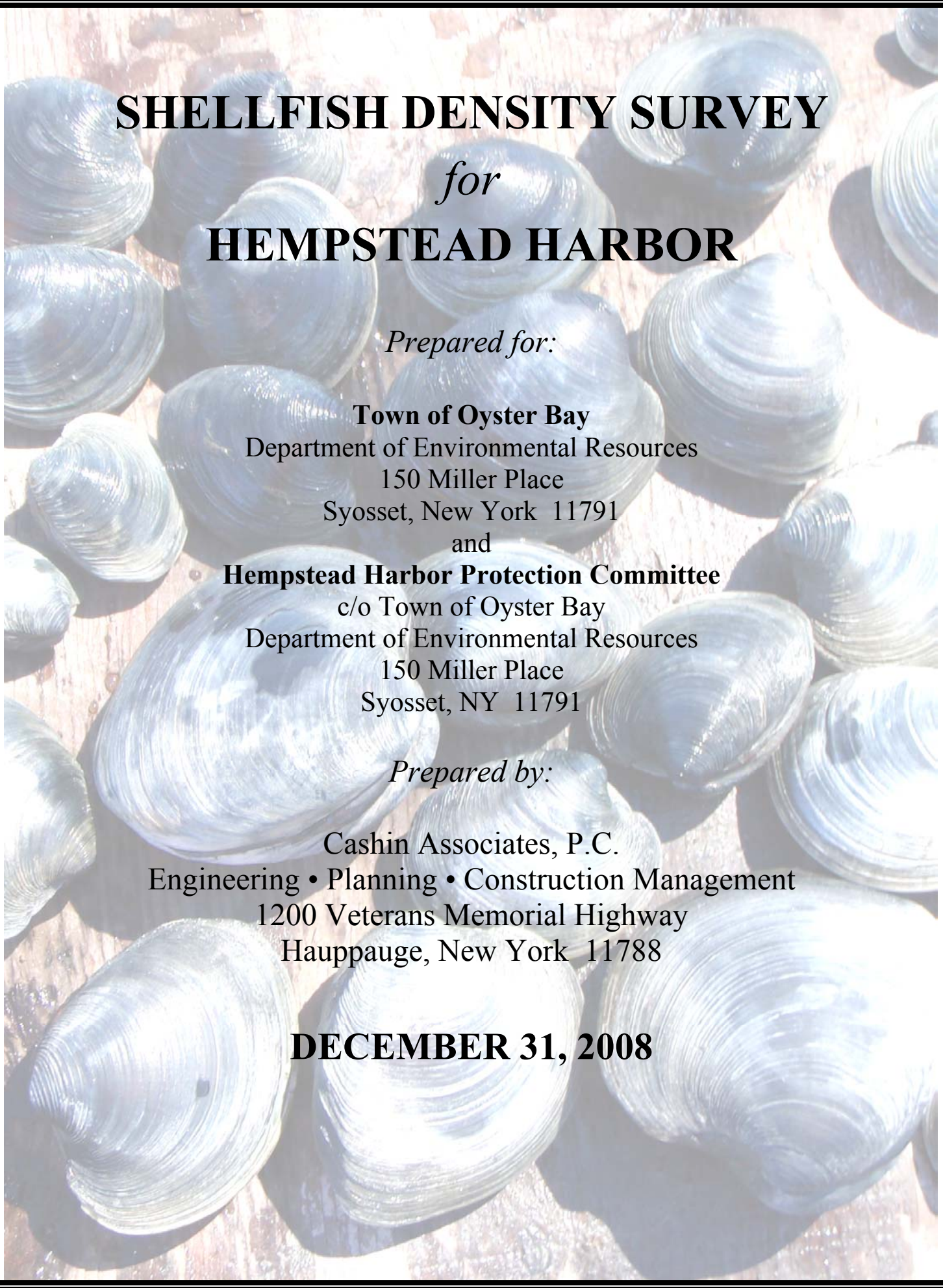

SHELLFISH DENSITY SURVEY

for

HEMPSTEAD HARBOR

Prepared for:

Town of Oyster Bay
Department of Environmental Resources
150 Miller Place
Syosset, New York 11791
and
Hempstead Harbor Protection Committee
c/o Town of Oyster Bay
Department of Environmental Resources
150 Miller Place
Syosset, NY 11791

Prepared by:

Cashin Associates, P.C.
Engineering • Planning • Construction Management
1200 Veterans Memorial Highway
Hauppauge, New York 11788

DECEMBER 31, 2008

TOWN OF OYSTER BAY

SHELLFISH DENSITY SURVEY

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DECEMBER 31, 2008

CA Job #7022.08

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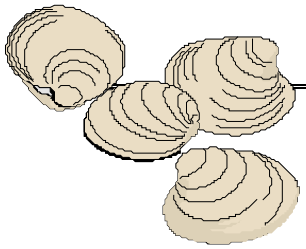


SECTION 1
STUDY OVERVIEW

1.1 Study Overview

This report presents the findings of a shellfish density survey performed by the Town of Oyster Bay and the Hempstead Harbor Protection Committee (HHPC) for Hempstead Harbor, Nassau County, NY during August 2008. The objective of the survey was to obtain data on the distribution and abundance of hard clams (*Mercenaria mercenaria*), and to provide information on other benthic species and substrate in the harbor. The harbor has not been certified and open for shellfishing for over 50 years because water quality standards have not been met. However, improvements in water quality brought about by stormwater abatement and other clean-up initiatives have raised the possibility that portions of the harbor can be open for shellfishing in the future. The Town and HHPC are committed to protecting and improving the water quality and ecologic conditions in the harbor. The present study was implemented to provide additional baseline data on the harbor and in particular the shellfish resource, to aid in management of the resource if and when it is open to shellfishing. Previous management activities have included the preparation of the Harbor Management Plan (HMP) for Hempstead Harbor (August 2004) and follow-up implementation of stormwater abatement and other water quality improvement actions.

1.2 Summary of Methodology

The field portion of the survey was performed in August 2008 on accessible underwater land in the harbor from the Roslyn Viaduct on the south to the open Long Island Sound along a line running from Prospect Point on the west to Dosoris Island on the east. The study area was identified at a HHPC meeting on July 15, 2008. Sampling was performed

with a barge mounted clamshell dredge, which obtained a sample of bottom sediments including shellfish, and deposited it on a grid for sorting and recovery of shellfish. The clams found at each station were measured for size, as were other shellfish, shellfish predators and macro-invertebrates obtained in each sample. A total of 122 grabs were taken at 61 different locations throughout the harbor. A detailed description of the methodology and sample locations is provided in Section 2 of this report.

The methodology utilized for this survey was the same as that used for previous shellfish surveys performed for the Town of Oyster Bay, including 1999 and 2007 surveys of the Oyster Bay Harbor/Cold Spring Harbor Complex, and a 2004 survey of South Oyster Bay. This study utilized the same methodology, identical culling racks, key scientific staff, and contractor/crew as the 1999 and 2007 Oyster Bay Harbor/Cold Spring Harbor Complex study. The clamshell dredge methodology has also been used by a number of other Long Island municipalities including the Towns of Huntington, Islip, and Brookhaven, and the Nature Conservancy.

Results of the field survey were complied and utilized to calculate clam density and distribution. Data on other benthic species and sediment type were also compiled. Grain size analysis was conducted for sediment samples collected at each station, based on methodology described by Folk (1980). Specific findings are presented in Section 3 of this report. The findings were used to develop recommendations for future management strategies, as discussed in Section 4 of this report.

During the shellfish survey, samples of clams were collected for the New York State Department of Environmental Conservation (NYSDEC) for laboratory testing of potential contaminant levels. As requested by NYSDEC, samples of clams were collected at two locations – an outer harbor area off Webb Institute (in vicinity of station 13) and a central harbor area off Glen Cove Creek (in vicinity of station 37), nearer to potential past and current sources of contamination. The samples were collected, packaged, and labeled per NYSDEC instructions, and delivered directly to NYSDEC representatives for subsequent transport to the laboratory. The specific locations for collection of the samples were based on the availability of sufficient natural stock to obtain the number of clams required for adequate sample size. The sample collection was performed on August 12 and August 20, 2008, and again on October 20, 2008 to obtain additional samples.

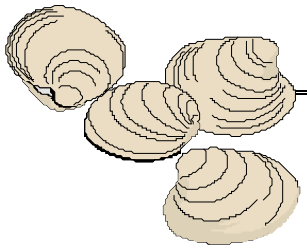
1.3 Background Information

There is limited existing information about the shellfish resources in Hempstead Harbor. The Coalition to Save Hempstead Harbor, Sea Cliff, NY, performed a hard clam survey in Hempstead Harbor in August 1998. The survey involved raking for clams at 14 stations extending from Mott Point to the innermost harbor area. The survey found clams at all but three stations. Clams were recorded in the seed, littleneck, cherrystone, and chowder seed size categories. The clams were observed to be in generally healthy condition with new shell growth on the outer shell edge. The sampling methodology did

not permit quantitative estimates of clam density. Other species noted during the survey included horseshoe crabs and oysters.

Cornell University Cooperative Extension and the HHPC provided information on the planting of clam and oyster seed in the harbor on October 9 or 10, 2007. An approximate map of the seeding area along the eastern shore north of the Glen Cove jetty was provided. Seeding included 1.5 million clam and oyster seed. Both *notata* variety and white clams in the 15 to 20 mm size category were planted. Additional seeding of clams in the 10 to 12 mm range and oysters in the 25 to 35 mm range was also performed. Seeding locations included the area north of the jetty as well as areas south of Bar Beach.

Although the harbor has been closed to clamming since the 1920s, harvesting of clams for transplant programs has been performed with mechanical dredges over the past 20 years under NYSDEC jurisdiction. Anecdotal reports indicate that harvestable populations of clams are present in the outer harbor. The present survey is being performed to provide quantitative data on the abundance of clams by means of standardized survey methodology throughout the harbor, within the limits of the budget and timeframe available for the study.



SECTION 2
FIELD METHODOLOGY

2.1 Field Methodology

The field survey was performed during August 2008 using a barge-mounted clamshell dredge which obtained an intact sample of the substrate, including all shellfish, shell, stones, and sedentary organisms. The field methodology used is a standard method of surveying clam density, and the procedures utilized in this study were comparable to those used in other clam surveys on Long Island, including: surveys of the Oyster Bay Harbor/Cold Spring Harbor complex by the Town of Oyster Bay in 1999 and 2007, a survey of the Greater Huntington and Northport Bay Complex performed by the Town of Huntington in 1998, on-going annual surveys performed by the Town of Brookhaven and The Nature Conservancy in the Great South Bay, and a survey of South Oyster Bay performed by the Town of Oyster Bay in 2004. The scientific crew, equipment, and crane operator utilized on this study were the same as that utilized for the 1999 and the 2007 Oyster Bay Harbor/Cold Spring Harbor surveys.

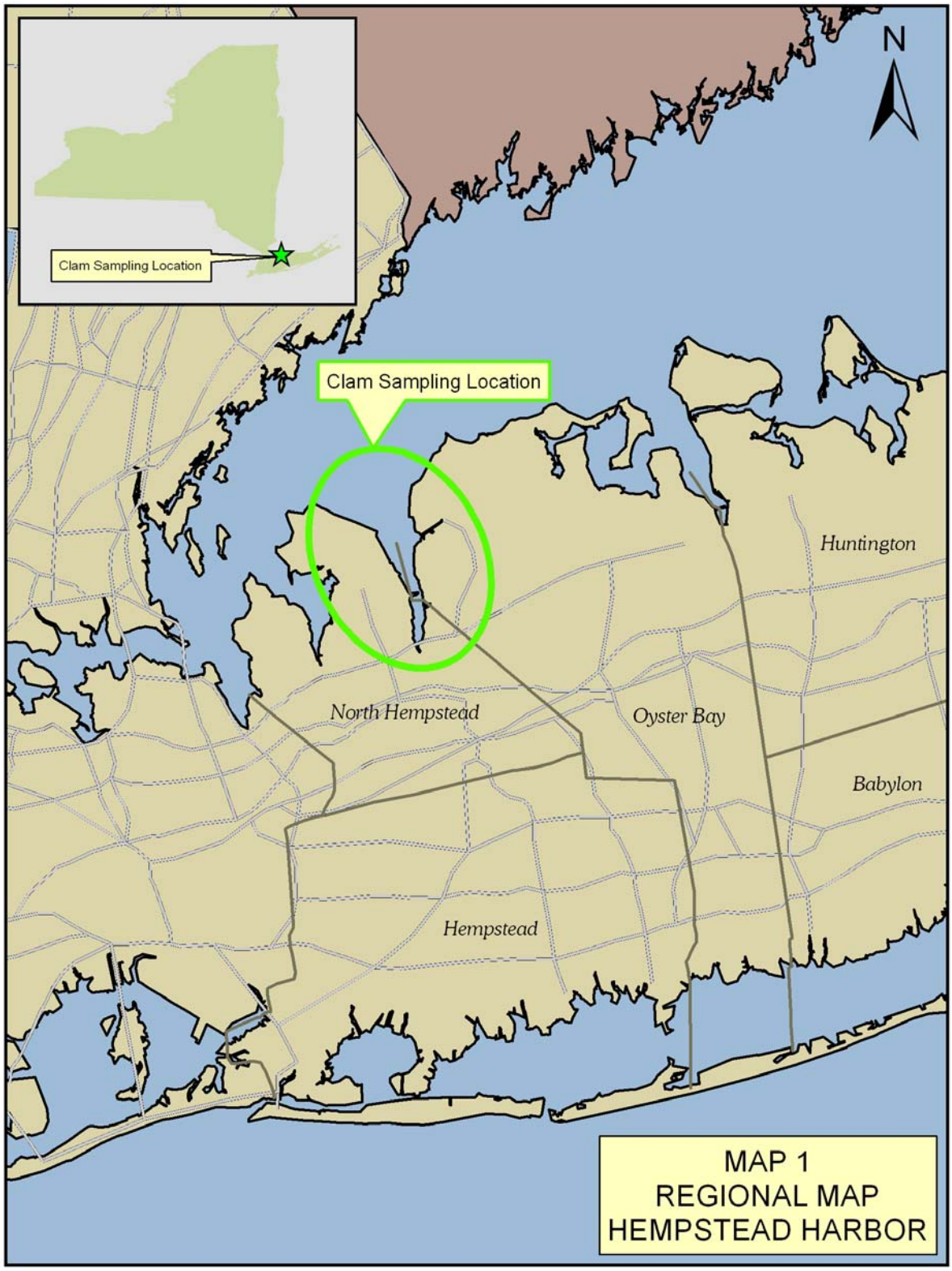
The advantage of the clamshell bucket sampling method is that it recovers a complete sample of the bottom including both small and large shellfish. The sample area and depth can be controlled, and it works well in both shallow and deep waters. The full range of sediment types in the bay can be adequately sampled, including muddy, sandy, and stony sediments. The clamshell bucket method is effective at recovering juvenile clams which is important in assessing the overall health of the resource.

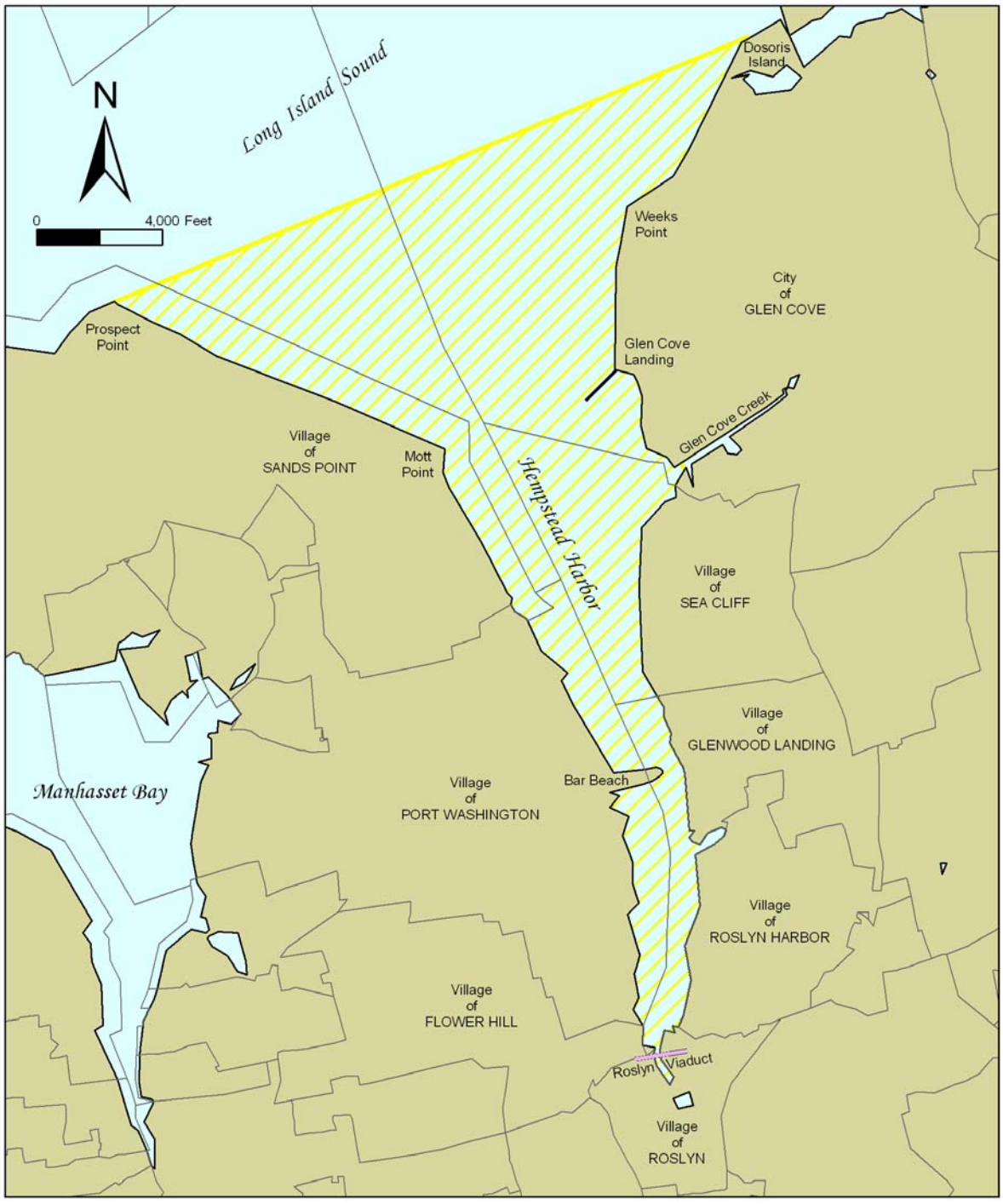
The survey was performed using a 100-foot by 30-foot barge as a work platform. It was moved by a small tug boat. A crane was situated on one end of the barge. An open area

on the other end served as the work site for personnel responsible for sorting and identifying the samples.

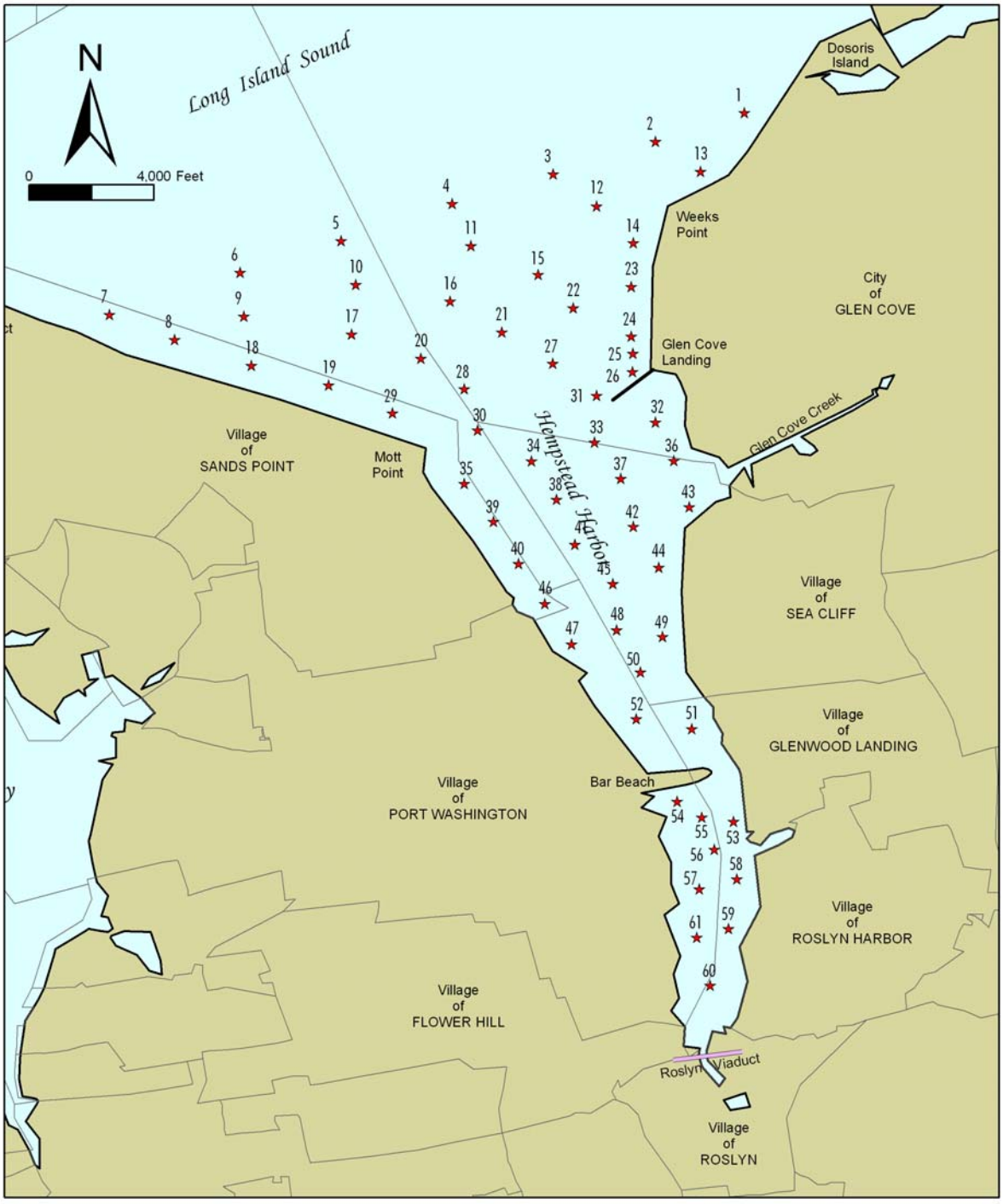
Once the barge was on-station, measurements of site characteristics were taken while the marine contractor prepared the crane to take a bottom sample. Water depth was determined using a calibrated drop line with a weight on the terminal end. Salinity was checked with a hand-held conductivity/salinity meter. Air and water temperatures were recorded. Position was taken with a Global Positioning System (GPS) from a fixed position on the barge enabling a horizontal accuracy of better than 10 feet.

A total of 122 samples were taken at 61 locations in the harbor. The regional location of the study area is shown in Map 1, and a study area location map is shown in Map 2. Sampling locations were selected so that there was coverage of all accessible areas of the harbor included in the study. In general, stations were distributed on a grid approximately 1,000 feet apart, as shown on Map 3. A listing of the stations, with position, and water depth, is given in Table 2-1. Coverage was provided for near-shore areas to a minimum depth of approximately four to six feet (low tide), which was the minimum operating depth for the barge. In addition to GPS, station locations were fixed by shoreline landmarks and range estimates, and by utilizing identifiable landmarks along the shoreline. Areas of the harbor that were not accessible during this study were: areas of less than 4 to 6 feet of depth during high tide; areas with submerged rocks and navigational hazards; boat mooring areas; areas near Bar Beach peninsula in the vicinity of the overhead electrical transmission lines; and areas within tributary creeks.


N
Clam Sampling Location
Clam Sampling Location
Huntington
North Hempstead
Oyster Bay
Babylon
Hempstead
MAP 1
REGIONAL MAP
HEMPSTEAD HARBOR



MAP 2
HARBOR STUDY AREA



MAP 3
CLAM SAMPLING LOCATIONS

TABLE 2-1
STATION LOCATIONS AND DEPTH

STATION NO.	LAT.	LONG.	DEPTH (ft.)
1	73.64763603	40.88634495	18
2	73.65541748	40.88383378	34
3	73.66437993	40.88100424	34
4	73.67324204	40.87839427	30
5	73.68294009	40.87514785	30
6	73.69179963	40.87235432	30
7	73.70324120	40.86867417	22
8	73.69754593	40.86648455	21
9	73.69146840	40.86851827	36
10	73.68167412	40.87131856	30
11	73.67158167	40.87471746	34
12	73.66059048	40.87816950	36
13	73.65147374	40.88121576	20
14	73.65735444	40.87495476	34
15	73.66569320	40.87217896	33
16	73.67340544	40.86985771	30
17	73.68204296	40.86695258	31
18	73.69079805	40.86421293	23
19	73.68403099	40.86249449	21
20	73.67596881	40.86482564	29
21	73.66889419	40.86715406	30
22	73.66263842	40.86925438	31
23	73.65756089	40.87112940	17
24	73.65753284	40.86678690	20
25	73.65742088	40.86526797	16
26	73.65742721	40.86368007	22
27	73.66441157	40.86440980	29
28	73.67215382	40.86216863	31
29	73.67845145	40.86004935	23

TABLE 2-1
STATION LOCATIONS AND DEPTH

STATION NO.	LAT.	LONG.	DEPTH (ft.)
30	73.67100493	40.85853200	32
31	73.66056716	40.86157085	21
32	73.65542958	40.85925248	15
33	73.66077990	40.85747102	21
34	73.66627985	40.85585589	29
35	73.67216290	40.85385603	11
36	73.65381776	40.85588424	13
37	73.65845617	40.85430596	18
38	73.66409384	40.85249614	21
39	73.66961713	40.85053541	18
40	73.66742828	40.84685102	20
41	73.66249789	40.84854296	20
42	73.65736830	40.85009782	19
43	73.65247866	40.85183190	15
44	73.65512359	40.84650612	18
45	73.65914697	40.84509121	18
46	73.66510192	40.84333314	17
47	73.66276855	40.83977870	4
48	73.65881636	40.84104483	17
49	73.65479946	40.84045864	9
50	73.65674090	40.83735517	13
51	73.65223548	40.83238343	7
52	73.65710012	40.83324180	12
53	73.64859314	40.82424656	3
54	73.65351966	40.82600066	9
55	73.65135546	40.82462968	6
56	73.65027965	40.82182178	9
57	73.65158309	40.81834789	10
58	73.64830720	40.81923315	12

TABLE 2-1
STATION LOCATIONS AND DEPTH

STATION NO.	LAT.	LONG.	DEPTH (ft.)
59	73.64903077	40.81485700	6
60	73.65064284	40.80988552	6
61	73.65181326	40.81411144	7

A sample of the bottom sediment was obtained with the clam shell bucket controlled by a crane (photograph of the sampling process and equipment are shown in photos 1 to 10 in the photo log, Attachment 1). It was lowered to the bottom in a fully opened position, then closed and raised, and the contents were dumped into a hopper above the clam culling equipment. A sample of bay bottom approximately one and one-half square meters in area was collected by the bucket. A small sediment sample was retained and a description of the sediment was noted.

Using a two-inch gas powered pump attached to a 1 ½ -inch hose and nozzle, the sample was washed through two racks to remove the sediment. The top of the cull rack consisted of metal bars with a spacing of approximately one inch. Sediment and smaller material dropped through to a ¼ inch galvanized screen. The top rack was removable to enable full washing and examination of the small material including juvenile shellfish.

The entire sediment-free sample was examined for the presence of hard clams and other shellfish, all of which were measured and recorded. Hard clams were measured length-wise (longest dimension from side to side) in millimeters. The presence of any *M. mercenaria notata*, which is a hard clam variant that has zig-zag brown markings, was noted. The *notata* variety (commonly referred to as red clams) is often utilized to produce seed stock by hatcheries.

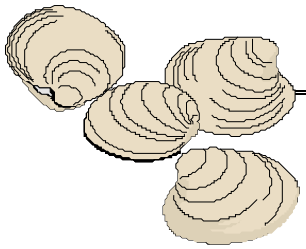
A second sample was taken at the same station following the described procedures. Two separate culling racks were utilized for the study. This permitted the collection of two

samples in relatively quick succession, so that the barge and equipment could be relocated to the next station while the samples were being processed. The use of two culling racks improved efficiency of the operation substantially by avoiding crew downtime during travel to the next station.

The survey was undertaken in accordance with a shellfish population survey permit issued by the NYSDEC. A copy of this permit and associated conditions is provided as Attachment 2. Permission was also obtained from the Town of North Hempstead for conducting the sampling program south of the Bar Beach Peninsula on underwater lands under the jurisdiction of the Town.

2.2 Data Analysis

Data from the field survey was entered into a computer and analyzed in terms of hard clam density for each grab sample. Size frequency distributions, indicating the number of clams in various size groups, were calculated to show the age distribution of the resource. The density measurements were extrapolated to calculate hard clam standing stock estimates for the total harbor. Findings are summarized in the various tables and figures provided in Section 3 of this report.



SECTION 3
GENERAL FINDINGS

3.1 General Findings

3.1.1 Hard Clam Density

The density data for clams obtained during the survey for the harbor, by size class and sub-area, is provided in Table 3-1. Table 3-2 contains a listing of clam density found at each station. Specific data on the number and sizes of clams found at each station is provided in the data table in Attachment 3.

Table 3-1
Mean Clam Density by Size Class

	Seeds	Little Necks	Cherry Stones	Chowder	Total
Harbor-Wide Mean Density	0.51	0.36	0.26	0.48	1.61

Table 3-2
Mean Clam Density at Each Station
Note: Density in clams/sqm

STATION NO.	CLAM DENSITY
1	2.3
2	0.0
3	0.3
4	0.0
5	0.0
6	0.0
7	0.7
8	0.0
9	0.3
10	0.0
11	0.0
12	0.0
13	29.3
14	0.0
15	0.3
16	0.0
17	0.0
18	0.7
19	3.7
20	0.0
21	0.3
22	0.3
23	4.3
24	9.7
25	1.0
26	2.3
27	0.0
28	0.0
29	0.7
30	0.0
31	0.0
32	0.0

STATION NO.	CLAM DENSITY
33	0.7
34	0.0
35	0.3
36	1.3
37	5.0
38	0.3
39	0.0
40	0.0
41	1.0
42	0.3
43	0.7
44	0.3
45	0.0
46	0.0
47	1.3
48	0.0
49	0.3
50	0.0
51	3.0
52	0.0
53	2.0
54	0.0
55	2.7
56	4.0
57	0.3
58	0.0
59	3.3
60	7.7
61	1.0

Hard clams were found at 34 of the 61 stations sampled. The mean density of clams for the entire area sampled was 1.6 clams per square meter (clams/sqm), with a maximum of 29.3 clams/sqm at station 13, which is in muddy sand sediments along the east shore of the harbor generally off Pratt Institute. Other stations with relatively high densities (over 5 clams/sqm) were: station 24 along the east shore of the harbor, north of the Glen Cove jetty (where a clam seeding program was conducted in 2007); stations 37 and 43 off Glen Cove Creek; and station 60 at the most southern area sampled in the inner harbor.

As is typical of populations of clams and other benthic organisms, clam populations were found to be very patchy, often with wide variation in clam abundance between adjacent stations and between samples taken at the same station.

A map indicating the general distribution and abundance of clams in the study area is shown in Map 4. Based on a comparison of clam densities found within the harbor, a density of 3 clams/sqm was considered high, and a density below 1 clam/sqm was considered low. In general, high density was found in muddy sands along the eastern shore of the outer harbor, in muddy sands along the eastern shore north of the Glen Cove jetty, isolated areas in rocky substrates along the outer harbor western shore, and the upper harbor south of Bar Beach peninsula, specifically the sandy intertidal areas and also the muddy up-harbor areas.

Overall, the most productive clam area appears to be in the outer harbor along the eastern portion, and in particular off Webb Institute (station 13). The highest density of clams

found in the study was in this area. Follow-up hand raking in vicinity of that station, performed for NYSDEC sample collection, indicated that clams are abundant in muddy sands from 15 feet to 20 feet deep (mean low water). Raking in the shallow areas (sandy substrates along the shore from 10 to 14 feet deep) indicated that clams were not abundant along the shore. The clams in vicinity of station 13 appear to have fast growing, attractive shells, and all size classes from seeds to chowders were well represented (photos 11 and 12). This area appears to have the greatest potential for harvesting, although the expansiveness of the beds and total standing stock may be somewhat limited.

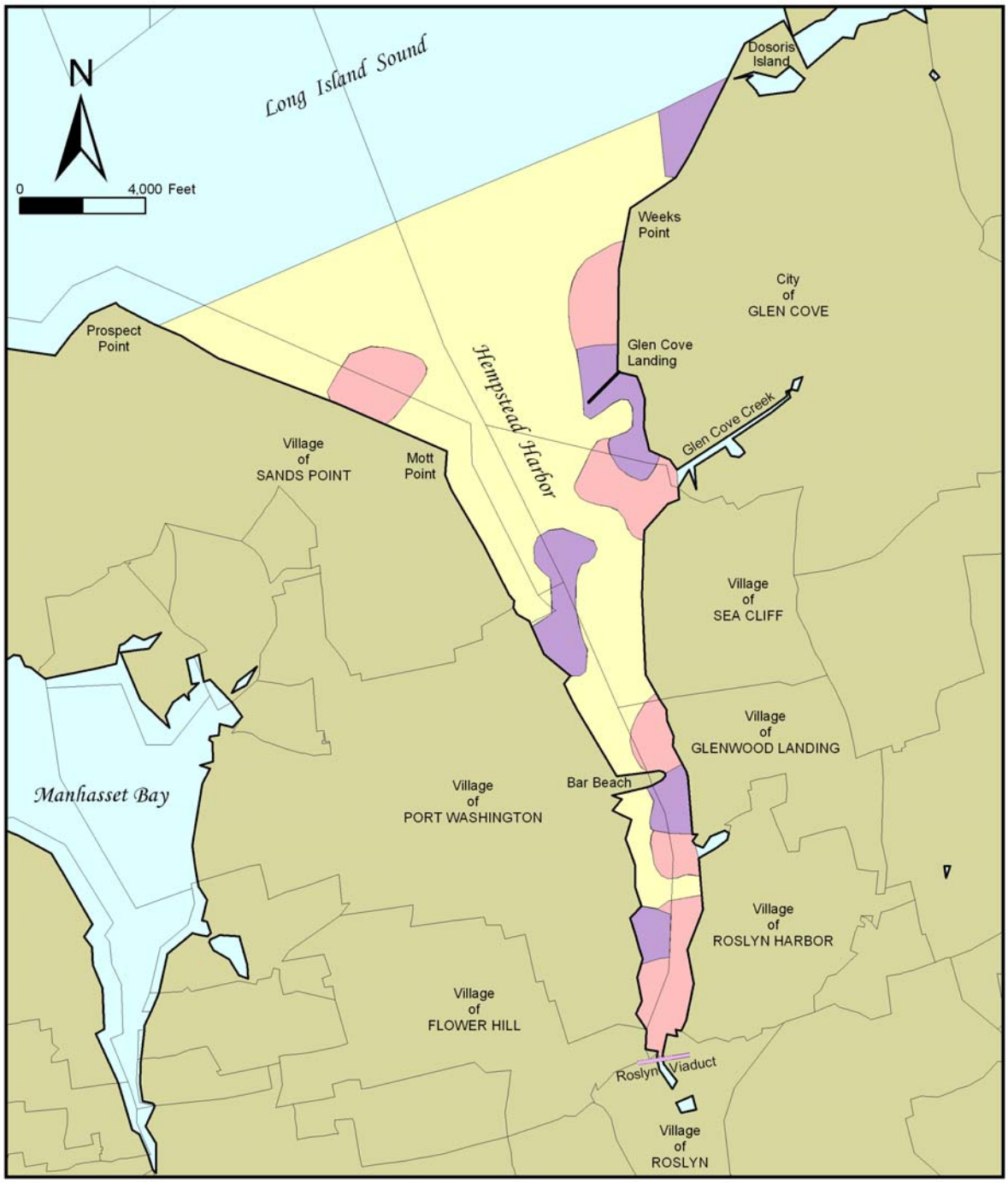
The area along the eastern shoreline just north of the Glen Cove jetty (stations 23, 24, 25, and 26) also showed high abundance, including a significant percentage of seed clams. These stations were placed generally in the area where prior seeding with juvenile clams was performed in 2007. A relatively high percentage of clams in the 10 to 20 mm length size were found at station 24 (photo 13). It should be noted that the area identified as the seed planting area appears to encompass the transition zone between muddy sand substrate and mud substrate. Sampling found sandy sediments on one side of the barge and muddy sediments on the other side of the barge at stations 25 and 26. Several dead seed clams in the 35 mm size range were found in the area with moonsnail drill holes. These clams had a distinctive growth ring break in the 10 to 15 mm size, indicating that they may have been planted seed clams. It is also interesting to note that numerous small dead clams were found in the sediment at station 22, which is located further off-shore from the seed planting area.

An area in the western shore of the harbor in stony/gravely sand substrate also had high abundance, but harvesting in this area could be inhibited by the presence of extensive cobble-size rocks (photo 14).

The central harbor area off Glen Cove Creek also had areas with significant clam populations (stations 37 and 43). The clams found were predominantly chowder sized in muddy sand substrate over 15 feet of depth (low water). Follow-up raking in this area as part of the NYSDEC sample collection confirmed an abundance of chowder size clams in muddy sand substrate.

The inner harbor area south of the Bar Beach peninsula (stations 55, 56, 59, and 60) also showed relatively high abundance. Clams were found in the intertidal sand flats and in the muddy sediments in moderate densities. The clams were generally larger size, cherrystones and chowders, with few seeds (photo 15).

Generally, central portions of the harbor, with depths over 25 feet, had low densities of clams, or no clams present. These areas had muddy sediment, characterized with very high percentage (over 90%) silt plus clay fractions. These areas also had low abundance of other species. Areas of the central mid-harbor, such as that off the gravel off-loading operations, also had low or no abundance of clams. Sediments in these areas consisted of high silt/clay muds, with areas of man-made debris (gravel, coal slag, and wood). Diversity and abundance of other species were generally low in this area as well.



Legend

- High Density (3.0 clams/sqm and above)
- Moderate Density (1.0 to 2.9 clams/sqm)
- Low Density (< 1.0 clams/sqm)

MAP 4
DISTRIBUTION AND ABUNDANCE OF CLAMS

3.1.2 Size Distribution

The average size of clams obtained at all stations was 58.1 mm shell length. A general size distribution of clams at all stations is shown in Figure 3-1. A size distribution broken down by commercial category (i.e. seed, littleneck, cherrystone, chowder) for the entire clam stock is provided in Figure 3-2. The size breakdown for the four categories of clams, based on standard shell length and thickness measurement, is as follows:

Size Class	Approx Shell Length
Seed	Less than 48 mm
Littleneck	48 mm to <70 mm
Cherrystone	70 mm to <80 mm
Chowder	Over 80 mm

Figure 3-1
Size Frequency Distribution – All Stations, Hempstead Harbor

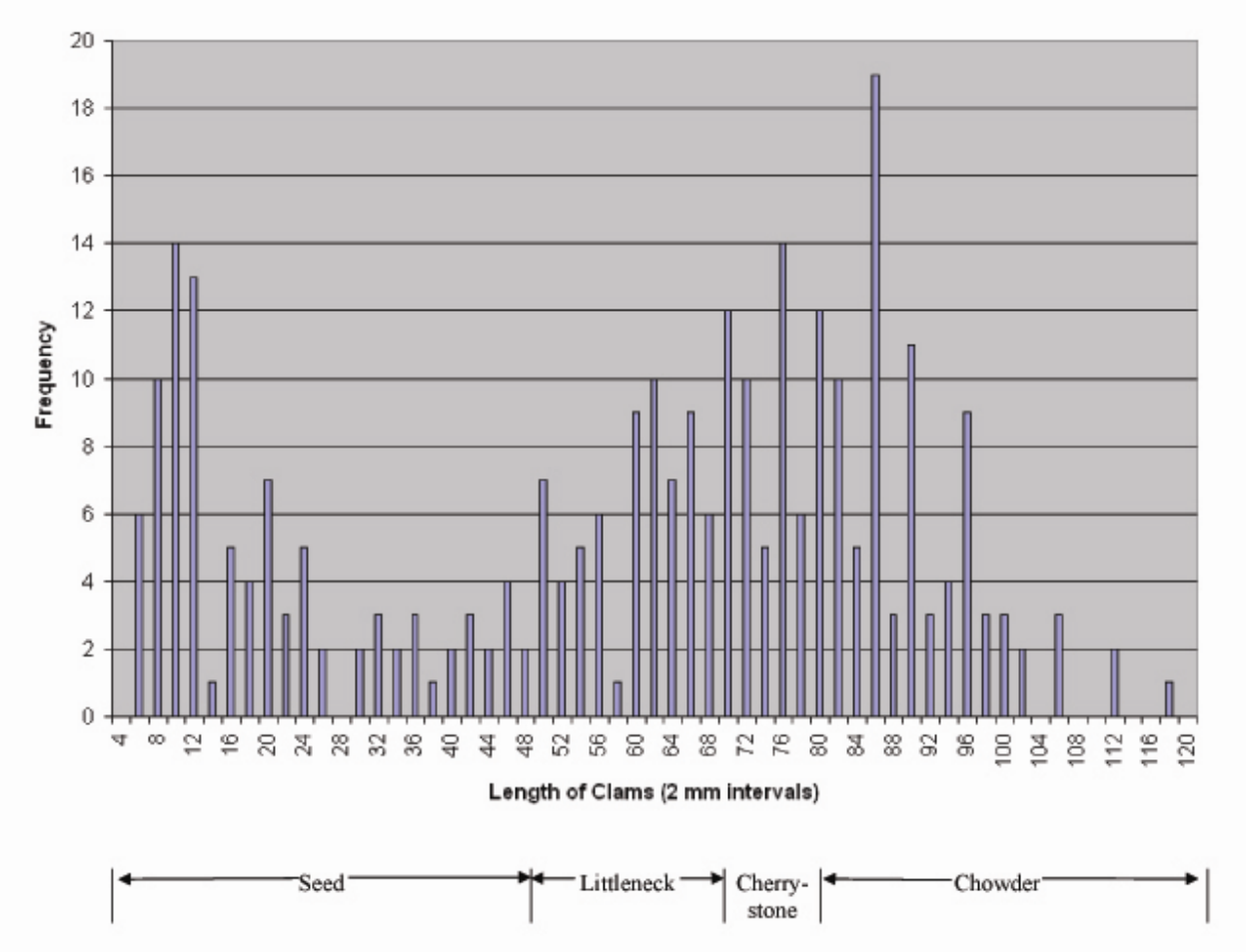
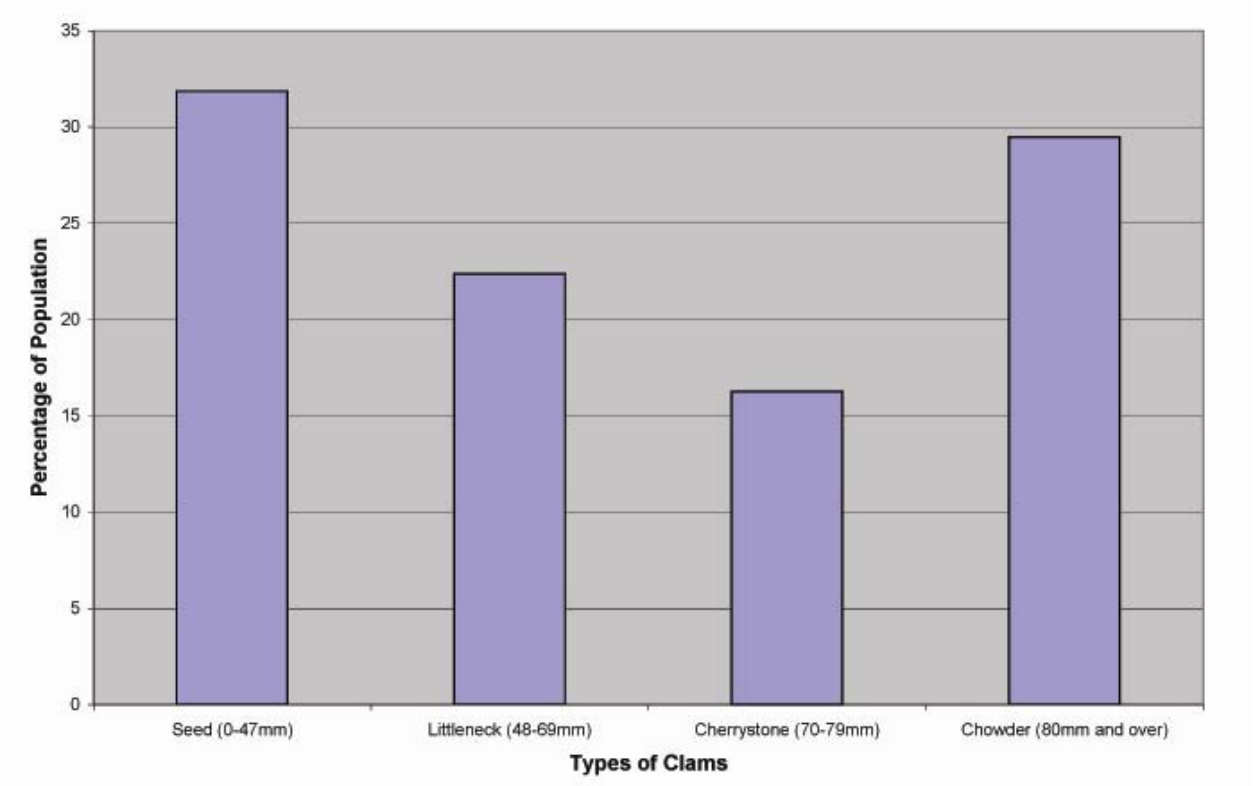


Figure 3-2
Size Frequency Distribution of Standing Stock – Harbor-Wide



The minimum size category for littlenecks, which is set by New York State Law, is one inch thickness, corresponding to approximately 48 mm in shell length. The other size categories are traditional size categories established over the past 40 years by the commercial market.

Clam populations in some areas of the harbor, such as those off Glen Cove Creek, were dominated by chowder size clams. These clams were large, many over 80 mm in shell length, with fat blunted shells, indicating that they were old, likely in excess of 20 years in age.

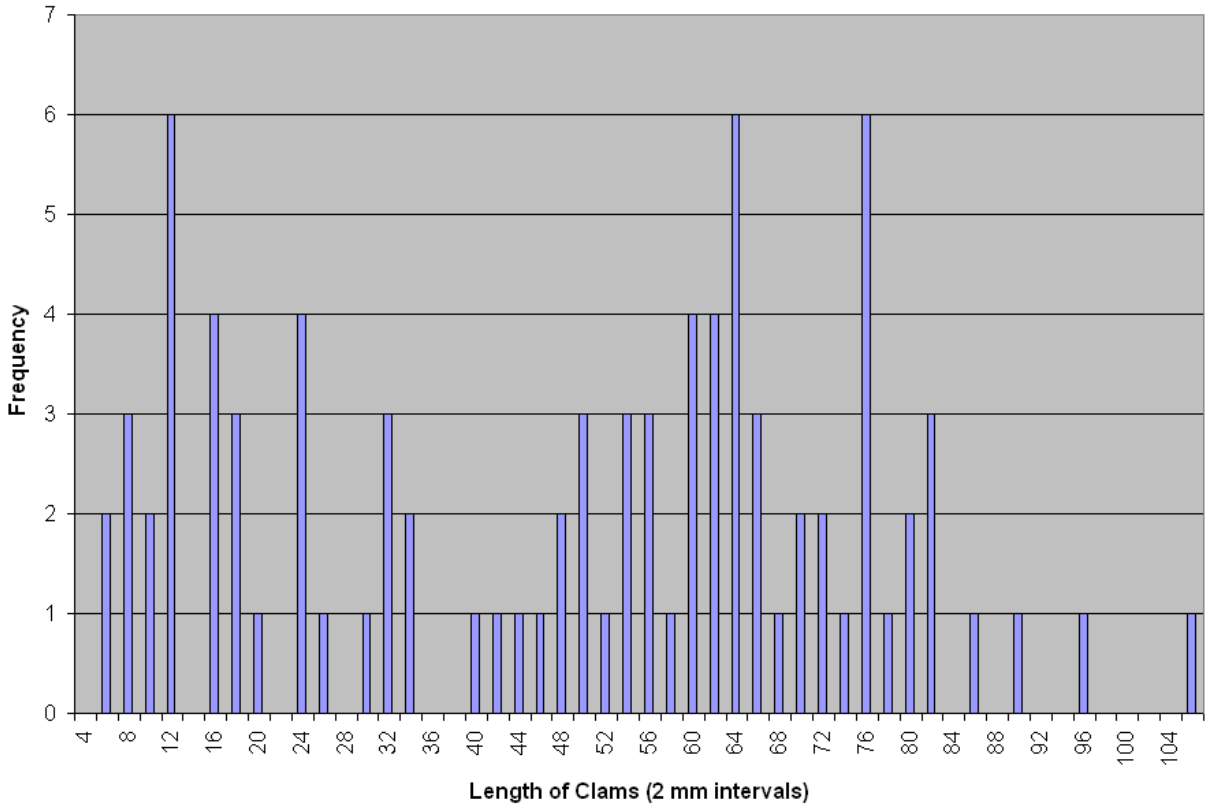
The clam population in the vicinity of station 13 was healthy in that the full range of size classes from seed to chowders were present. The size frequency distribution (Figure 3-3) indicates a significant portion of the population in the seed size category. The clam population in vicinity of stations 23 to 24 had a higher percentage of seeds than other areas of the harbor. This area was seeded in 2007 by Nassau County and the HHPC, but it could not be determined if the seed clams sampled were related to the seeding program. As mentioned previously, drilled clams were found in the 35 mm range that had pronounced growth breaks in the 10 to 15 mm size range, indicating that they could have been seeded clams.

Overall, approximately 54 percent of the population in the study area consisted of seeds and littlenecks, and approximately 46 consisted of cherrystones and chowders, as demonstrated in Figure 3-2. The relative abundance of large clams, especially chowders,

is indicative of a population that is not subject to harvesting pressure, as is the case with Hempstead Harbor because the entire area is closed to shellfishing. The relatively high abundance of seed clams at some locations, especially along the eastern side of the outer harbor, is a positive condition because it indicates that clam reproduction, setting, and seed survival are successful.

The low density of clams in the central harbor, and the large size of the clams that were found in those areas, indicate that clam setting and/or survival is poor, and that there is little natural clam productivity.

Figure 3-3
Size Frequency of Clams – Station 13, Hempstead Harbor



3.1.3 Summary of Mean Density and Size

The overall density of hard clams found in the harbor system indicates low abundancy population, compared to densities found in other water bodies considered to be productive clamming grounds. Clams were found at 56 percent of the stations sampled, indicating that the species is fairly widespread in the harbor. However, large areas of the harbor have low or no densities of clams, especially the muddy central portions of the outer harbor, and the central harbor area previously affected by prior industrial activities. The sediments in these areas consisted of black fine grain muds that may be unfavorable for the growth and/or survival of clams.

In some areas of the harbor the presence of high density populations with significant seed clam populations is a positive finding, indicating that the resource is in a healthy condition.

Many empty clam shells were found with evidence of predation by moonsnails (i.e., drilled holes in the shells). A relatively high abundance of moonsnails was observed overall in the harbor, as discussed further in Section 3.6.

3.2 Overall Standing Stock of Clams

The clam density measurement recorded for each station and the total area of the harbor included in the survey were used to calculate the standing stock of clams for the harbor. Results are presented in Table 3-3.

Table 3-3

Standing Stock of Clams (in millions of clams)

	Seeds	Little Necks	Cherry Stones	Chowder	Total
Total	8.54	6.00	4.36	7.91	26.81
Percent	31.9	22.4	16.3	29.5	100.00

In terms of sizes, the percentage breakdown of the total stock, as indicated in Table 3-3, is as follows: seeds – 32 percent; littlenecks – 22 percent; cherrystones – 16 percent; and chowders – 30 percent. The high percentage in the seed category indicates a favorable potential for good recruitment into the harvestable size categories over the near term, but seed abundance is limited to only several areas of the harbor.

3.3 Hard Clam *Notata* Variant

Mercenaria mercenaria notata is a hard clam variant that has zig-zag reddish brown markings on its exterior shell (photo 16). The variant is commonly used as hatchery stock because the shell patterns provide a natural marker for seed clams produced by the hatchery, and it is generally believed that they grow faster. The occurrence of *notata* was recorded in this study to provide information as the possible origin of clams in the harbor. Approximately 1.7 percent of the clams recorded during the survey were the *notata* variety. However, all *notata* specimens were in the seed size category, indicating that 5.3 percent of all seeds obtained during the study were of this variety. This appears to be somewhat greater than the percentage that would be expected from natural occurrence (estimated at less than 1 percent). The presence of the *notata* could be related to prior

seeding activities in the harbor that utilized the variant. Predated *notata* (by moonsnails) were also found at several locations.

A summary of the number of *notata* found by size category is given in Table 3-4.

Table 3-4

Hard Clam *Notata* Variant - Percent of Total Hard Clam Population by Size Class

	Seeds	Little Necks	Cherry Stones	Chowders	Total
***Notata* Variant**	5	0	0	0	5
Total Hard Clams	94	66	48	87	295
Percent of *Notatas* in Total Hard Clam Population	5.32	0.00	0.00	0.00	1.69
	3.13		0.00		

3.4 Comparison with Other Water Bodies

Available data from several other clam density surveys was reviewed for comparison with the Hempstead Harbor data. As discussed in Section 3.1.1, the overall clam density found in this study was 1.6 clams/sqm. The Town of Oyster Bay survey of the Oyster Bay Harbor/Cold Spring Harbor complex in 2007 found an overall density of 6.33 clams/sqm and a mean size of 58.1 mm (which incidentally is the same mean size found in Hempstead Harbor). The Town of Huntington conducted a clam density survey of Huntington and Northport Bay Complex in 1998 using methods similar to those used in this study. The study found an average density of 7.74 clams/sqm for the entire bay complex. The percent of the population consisting of seeds and littlenecks was approximately 85 percent, with the balance of 15 percent attributable to cherrystones and

chowders. At the time of the survey, Huntington and Northport Bays were considered very productive in terms of hard clam catches. A study of South Oyster Bay performed by the Town in 2004 found an overall clam density of 3.5 clams/sqm and a mean size of 81.8 mm.

A comprehensive clam density survey of the Great South Bay System performed in the 1980s when clam production in the bay was near its peak, found average densities in various sub-areas of the bay ranging from 3.3 clams/sqm to 7.8 clams/sqm in the most productive zones (U.S. Environmental Protection Agency, 1982). The overall average of all waters from South Oyster Bay to Moriches Bay was found to be 5.5 clams/sqm. Discussions with Town of Brookhaven Division of Environmental Control and The Nature Conservancy have indicated that clam densities in the Brookhaven portion of Great South Bay have undergone a general, consistent decline since the productive years of the 1970s and 1980s. Clam density in much of Great South Bay under jurisdiction of the Town of Brookhaven and The Nature Conservancy is well below 3 clams/sqm. The Nature Conservancy is working on a hard clam restoration program for the bay and has set a restoration goal of 6 clams/sqm (Lobue, 2007). Clam densities in the Towns of Islip and Babylon portions of Great South Bay have also experienced major declines, and the clam fishery is presently at minimal levels. Clam density in the Islip Town portion of Great South Bay declined from approximately 7 clams/sqm in 1978 to 1 clam/sqm in 2003 (Kraeuter, et. al., 2005).

Data from a clam density survey from Montauk Harbor found an overall clam density of 3.3 clams/sqm (Flagg and Greene, 1981). The population consisted of a slight majority of older clams with 51 percent consisting of cherrystones and chowders. At the time of the survey, Lake Montauk was not regarded as a highly productive clam harvesting area, and did not have sizeable seed clam populations.

Overall, the present data indicates that Hempstead Harbor has a clam population that is lower in abundance than that of other embayments with populations regarded as productive. However, certain areas of the harbor have densities comparable to those found in productive shellfish areas in other Long Island bays.

3.5 Shellfish Predators and Other Species

Although the present survey was directed primarily at hard clams, a record was kept of other species obtained in each sample, including known shellfish predators and other bivalves. A listing of other macro-invertebrate species, with relative abundance, is provided in Table 3-5.

Please note that species not large enough to be retained on the one quarter inch mesh of the sorting rack, soft bodied animals and mobile animals were not represented in the samples collected; therefore, micro-fauna, including small crustaceans (shrimp, isopods, etc.) and worms are not included in the inventory.

A total of 24 different species of benthic invertebrates was identified during the survey. The hard shell clam was found to be the most abundant in terms of the number of stations it was found at (34 stations). The second most abundant species (28 stations) was the northern dwarf tellin, a small bivalve generally less than an inch in length with no commercial value (photo 17). The tellin was found throughout the outer harbor area, and it was the one species found in the mud sediments of the central harbor. Another abundant bivalve was the duck clam, which is typically found at high densities in mud substrates (photo 18). Mud sediments typically have high concentrations of duck clam shells that accumulate from occasional highs in abundance of the species (photo 19). The duck clam is known to be an important food source for diving ducks and bottom feeding fish. Another widespread bivalve found was the razor clam (23 stations). Although the razor clam has commercial value, all specimens found in Hempstead Harbor were small, generally less than two inches in length.

In terms of density, the blue mussel was found at high concentrations, up to approximately 1,500 per sqm, at several locations. The sand flats south of Bar Beach peninsula had extensive populations of juvenile mussels (photo 20). Mussels were also abundant on rocky substrates along the western shore of the outer harbor (stations 8, 18 and 29). Most of the mussels sampled were small (10 to 20 mm in shell length) and few large mussels were found. Such thick patches of mussels are likely important as a food source for fish and birds, and may provide water quality benefits from filter feeding activity. Another small bivalve found at nine stations, was the Gould's pandora, which was found in both sand and mud (photo 21).

Table 3-5

All Species Found – Hempstead Harbor

Common Name	Scientific Name	No. of Stations Found At	Highest Number Found	Known Clam Predator
MOLLUSCS				
Bivalves				
Hard Clam	*Mercenaria mercenaria*	34	88	
Northern Dwarf Tellin	*Tellina agilis*	28	50	
Duck Clam	*Mulinia lateralis*	25	430	
Razor Clam	*Ensis directus*	23	53	
Blue Mussel	*Mytilus edulis*	12	1515	
Gould's Pandora	*Pandora gouldiana*	8	9	
Blood Arc	*Anadara ovalis*	3	6	
False Quahog	*Pitar morrhuana*	2	12	
Angel wing	*Cyrtopleura costata*	2	1	
Soft-Shelled Clam	*Mya arenaria*	1	1	
Gastropods				
Mud Dog Whelk	*Nassarius obsoletus*	27	148	
Atlantic Slipper Shell	*Crepidula fornicata*	17	325	
Atlantic Moonsnail	*Polinices duplicatus*	9	3	□
New England Dog Whelk	*Nassarius trivittatus*	4	18	
Smooth Oyster Drill	*Urosalpinx cinerea*	4	1	□
Eastern White Slipper Shell	*Crepidula plana*	2	8	
CRUSTACEANS				
Black-fingered Mud Crab	*Panopeus herbstii* and related species	17	15	□
Rock Crab	*Cancer irroratus*	8	7	□
Hermit Crab	*Pagurus arcuatus*	5	4	□
Mantis Shrimp	*Squilla empusa*	3	3	
Horseshoe Crab	*Limulus polyphemus*	4	2	□
Spider Crab	*Libinia emarginata*	1	1	□
Green Crab	*Carcinus maenas*	1	1	□
Pea Crab	*Pinnixa sp.*			
MISCELLANEOUS				
Common Starfish	*Asterias forbesii*	6	7	□

With regard to gastropods, the Atlantic slipper shell was the most common in terms of sheer densities. Slipper shells were common in substrates containing rocks, which provide attachment sites for the organism. High densities were found at station 58 off Mott's Cove (photo 22). Mud dog whelks, commonly referred to as mud snails, were also common, and were especially abundant on the flats south of the Bar Beach peninsula, and on muddy sand sediments off Glen Cove Creek and Bar Beach.

The Atlantic moonsnail, known to be a voracious predator of bivalves, was found at stations at densities up to three per station at station 55 (photos 23 and 24). Moonsnails were found in the upper harbor south of the Bar Beach peninsula, at four of the eight stations sampled in that area. This represents a very high abundance for the moonsnail, and the species appears to be a major predator of clams in the harbor. Clam shells with the distinctive drill hole from moonsnail predation were found throughout the harbor, including stations 25, 37, 51, and 60. Seed clams, including the *notata* variety, with moonsnail drill holes were observed at station 25 (photos 25 and 26).

The ratio of moonsnails to clams in the harbor was found to be 1 to 23; the comparable ratio for Oyster Bay Harbor/Cold Spring Harbor was 1 to 330, and for South Oyster Bay 1 to 440. The number of moonsnails relative to clams is extremely high in Hempstead Harbor.

The most common shellfish predator observed in the bay was the mud crab. The crab was found at 17 stations, at densities up to 50 per station, typically in substrates providing

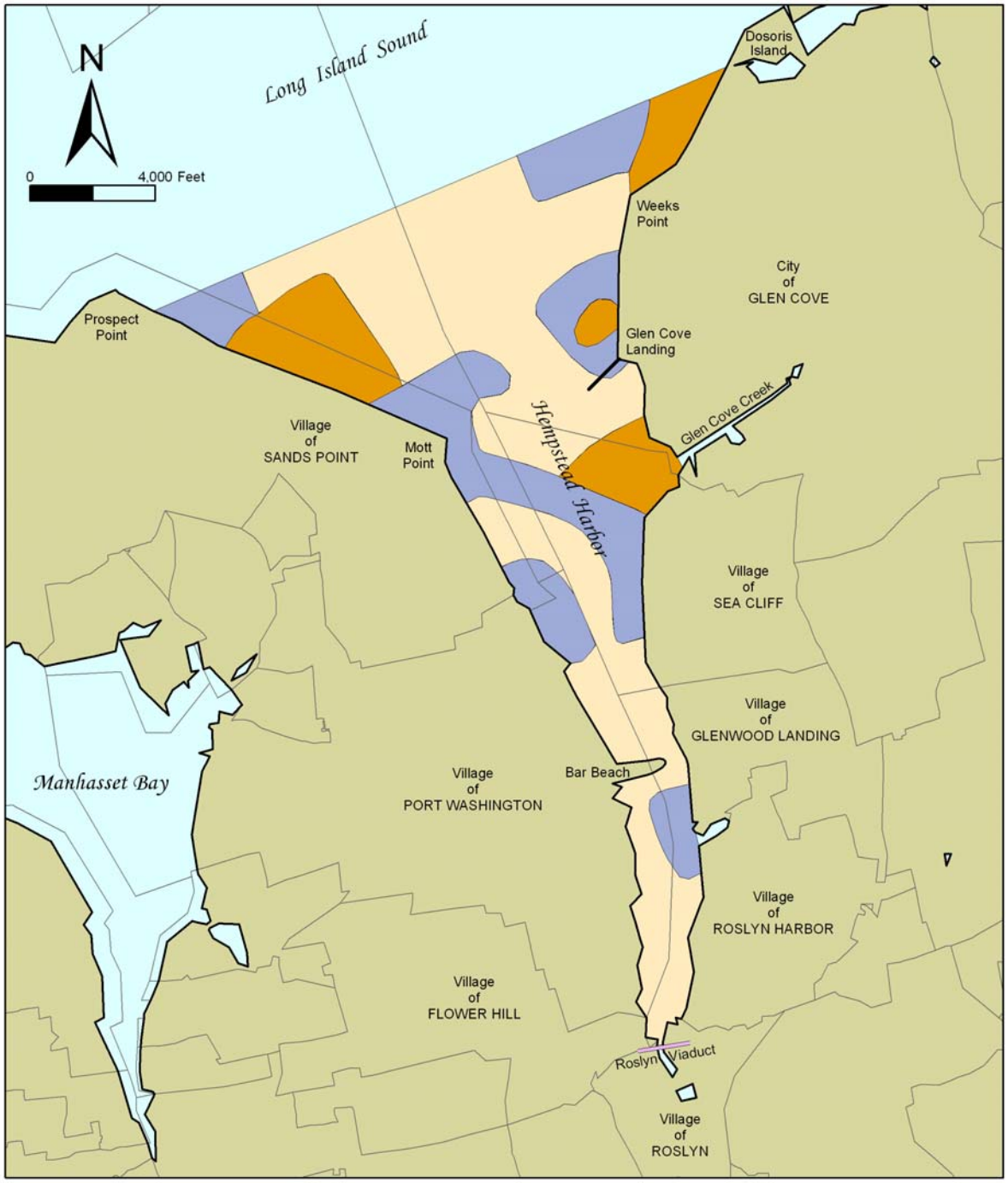
some type of cover for the crab (stone, shell). Because of their small size (generally less than 20 mm), mud crabs are predators of young seed clams only. Other crabs found in the study, also known shellfish predators, included the spider crab, rock crab, hermit crab, green crab, and horseshoe crab, although none were found at high densities.

Another shellfish predator found in the harbor was the common starfish. Starfish were found at six stations, at densities up to seven per station (station 43 at Glen Cove Creek). Starfish were found off Glen Cove Creek and in the upper harbor north of the Bar Beach peninsula. The starfish found at station 43 were very large, over 150 mm in diameter (photo 27). Starfish appear to represent a major shellfish predator in the harbor. They were found in much higher densities than in Oyster Bay Harbor/Cold Spring Harbor and South Oyster Bay.

Another shellfish predator observed included the oyster drill which was found at four stations at low density. One common predator not found in the harbor was the whelk (channeled and knobbed). This predator is present in many Long Island embayments, including Oyster Bay Harbor and Long Island Sound, and it is not clear why whelks were not found in Hempstead Harbor.

An overview of species diversity found in the summary is provided in Map 5. These categories of diversity were established: low – less than 3 species; moderate – 4 to 7 species; and high – 8 species or more. Areas of high diversity generally compounded with areas of high clam abundance. One exception was the inner harbor north of the

Roslyn Viaduct which had moderate clam abundance in mud sediments with low abundance of other species. The central harbor areas with mud sediments tended to have both low clam abundance and low diversity. The presence of gravel, stone, and rocks in the substrate appears to increase diversity by providing habitat and attachment sites for multiple species.


N
0
4,000 Feet
Long Island Sound
Dosoris Island
Weeks Point
City of GLEN COVE
Prospect Point
Glen Cove Landing
Glen Cove Creek
Village of SANDS POINT
Mott Point
Hempstead Harbor
Village of SEA CLIFF
Village of GLENWOOD LANDING
Manhasset Bay
Village of PORT WASHINGTON
Bar Beach
Village of ROSLYN HARBOR
Village of FLOWER HILL
Roslyn Viaduct
Village of ROSLYN
Number of Species Found
Low (0 to 3)
Moderate (4 to 7)
High (8 and above)
MAP 5
SPECIES DIVERSITY

3.6 Historic Species Abundance

The survey found evidence that several species of shellfish were historically abundant in the harbor. Although the present survey found the soft clam at one location, the species was widely distributed in both sand and mud substrate in the past. Large soft clam shells were found at 15 stations throughout the harbor (photo 28).

Shells of the Eastern oyster were found at seven stations, in the central harbor off Glen Cove Creek, in both muddy sand and mud. Shells from very large individuals, over 10 inches long, were found (photos 29 and 30).

The bay scallop was also apparently very abundant in the harbor in the past. Heavy concentrations of adult bay scallops shells were found at six stations in the central harbor off Glen Cove Creek (photos 31 and 32). Fragments of bay scallop shells were found in muddy sediments off Glen Cove Creek. Extensive shell deposits of blue mussels and ribbed mussels were also found in the harbor.

3.7 Sediment Type

Table 3-6 indicates the type of sediment with respect to grain size found at each station. Thirty-three of the stations had sediment classified as sand or gravel, while the balance of 28 had sediment classified as mud.

The central portions of the harbor contain mud sediments with a high percentage of fine grain materials (silt plus clay fractions). Some of the sediments were very high in silt

plus clay, over 90% and as high as 99%. The muds tended to be very fine grain material, black in color and sometimes devoid of shell material (photo 34). Some of the muds, especially those in the middle harbor off Glen Cove Creek, contained significant amounts of shell (photo 35). Sandy and gravelly sediments tended to be located along the shoreline, and in the shoals found in the upper harbor. Some sediments along the western shore consisted of gravel, stones, and cobbles (photo 36).

A review of clam density by sediment type as presented in Table 3-6 indicates that clams tended to be more abundant in sand/gravel sediments compared to mud. Twenty-seven percent of sand/gravel sediments did not have clams, while 64 percent of the mud sediments were devoid of clams. The mean density of clams at stations with sand/gravel sediments was 2.5 clams/sqm, which was approximately four times the mean density of clams at stations with mud sediments (0.6 clams/sqm). Stations with the highest clam densities (over 5 per sqm at stations 13, 24, 37, and 43) had sandy sediments with one exception, station 60 which had sandy mud. The mud offers a poor environment for the setting and/or survival of young clams. Furthermore, it is known that sediments with gravel can be favorable for clam survival because seed clams are provided more protection from predation.

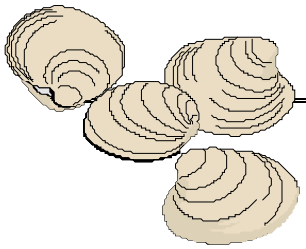
TABLE 3-6
SEDIMENT GRAIN SIZE AT EACH STATION

STATION NO.	GRAVEL (%)	SAND (%)	MUD (%)	GRAIN SIZE CLASSIFICATION	CLAM DENSITY
1	0.0	82.3	17.7	muddy sand	2.3
2	0.0	21.4	78.6	sandy mud	0.0
3	0.0	65.1	34.9	muddy sand	0.3
4	0.0	69.0	31.0	muddy sand	0.0
5	0.0	2.5	97.5	mud	0.0
6	0.0	0.1	99.9	mud	0.0
7	40.0	48.8	11.2	muddy sandy gravel	0.7
8	17.4	82.6	0.0	muddy sand	0.0
9	1.0	98.0	1.0	sand	0.3
10	0.0	1.5	98.5	mud	0.0
11	0.0	0.1	99.9	mud	0.0
12	5.4	60.5	34.1	gravelly muddy sand	0.0
13	6.1	79.3	14.6	gravelly muddy sand	29.3
14	2.4	92.6	5.0	sand	0.0
15	0.0	9.3	90.7	mud	0.3
16	0.0	0.1	99.9	mud	0.0
17	0.0	8.9	91.1	mud	0.0
18	26.8	53.8	19.4	gravelly mud	0.7
19	0.0	81.6	18.4	muddy sand	3.7
20	0.0	11.2	88.8	muddy sand	0.0
21	0.0	24.3	75.7	muddy sand	0.3
22	0.0	0.8	99.2	mud	0.3
23	0.1	57.1	42.8	muddy sand	4.3
24	0.2	99.6	0.2	sand	9.7
25	3.4	96.5	0.1	sand	1.0
26	0.0	59.0	41.0	muddy sand	2.3
27	0.0	6.5	93.5	mud	0.0
28	0.0	99.5	0.5	sand	0.0
29	0.0	95.5	4.5	sand	0.7
30	0.0	20.8	79.2	sandy mud	0.0
31	1.7	12.9	85.4	sandy mud	0.0
32	48.1	34.0	17.9	muddy sandy gravel	0.0
33	1.3	75.1	23.6	muddy sand	0.7
34	0.0	17.1	82.9	sandy mud	0.0
35	0.0	96.1	3.9	sand	0.3

TABLE 3-6
SEDIMENT GRAIN SIZE AT EACH STATION

STATION NO.	GRAVEL (%)	SAND (%)	MUD (%)	GRAIN SIZE CLASSIFICATION	CLAM DENSITY
36	0.0	99.5	0.5	sand	1.3
37	3.0	96.5	0.5	gravelly sand	5.0
38	0.4	38.8	60.8	sandy mud	0.3
39	0.0	9.2	90.8	mud	0.0
40	0.0	3.0	97.0	mud	0.0
41	25.3	39.6	35.1	gravelly muddy sand	1.0
42	3.8	95.7	0.5	gravelly sand	0.3
43	2.2	97.8	0.0	sand	0.7
44	3.4	95.6	1.0	sand	0.3
45	0.0	93.4	6.6	sand	0.0
46	19.8	38.0	42.2	gravelly mud	0.0
47	0.0	87.1	12.9	sandy mud	1.3
48	0.0	4.7	95.3	mud	0.0
49	0.0	14.9	85.1	sandy mud	0.3
50	0.0	11.5	88.5	sandy mud	0.0
51	4.4	92.5	3.1	gravelly sand	3.0
52	0.0	9.4	90.6	sandy mud	0.0
53	26.4	59.2	14.4	gravelly muddy sand	2.0
54	0.0	20.2	79.8	sandy mud	0.0
55	30.6	67.1	2.3	sandy gravel	2.7
56	41.7	57.4	0.9	sandy gravel	4.0
57	0.0	25.0	75.0	sandy mud	0.3
58	2.4	96.6	1.0	sand	0.0
59	0.0	16.5	83.5	sandy mud	3.3
60	0.0	16.5	83.5	sandy mud	7.7
61	0.0	1.0	99.0	mud	1.0

Note: Grain size classification according to Folk (1980)



SECTION 4
SUMMARY AND CONCLUSIONS

4.1 Summary and Conclusions

The general findings of the shellfish survey are described below:

1. Hard clams existing in the area of Hempstead Harbor included in this survey appear to be fairly abundant, based on the wide distribution of the species found during the survey. The overall density of clams is low compared to that recorded for other water bodies considered to be productive clam waters. Although overall density appears to be low, certain areas have clam densities that are high and healthy in terms of size distribution of the clams.

   The overall size distribution of clams indicates that all sizes of clams from seeds to chowders are well represented in the population. However, the overall size distribution is slanted by the relatively high abundance of seeds and littlenecks at a small number of stations. Large size clams predominate in many of the areas where clams are present.

2. Many areas of the harbor were found to be sparsely populated with hard clams. The central portions of the middle harbor and outer harbor had very low clam abundance. Survival and recruitment of clams in these areas appears to be poor, perhaps due to adverse environmental conditions associated with mud substrate.

3. Areas of the harbor with mud sediments tended to have low clam abundance. The mean density of clams in sandy sediments was approximately four times higher

than the density in mud areas. Mud substrates are present throughout the central portions of the harbor. Muds typical of the harbor had a very high percentage of fine grain material (silt plus clay), over 90 percent.

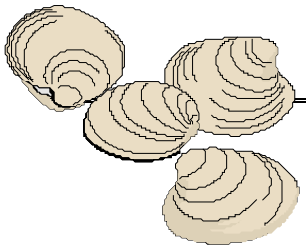
4. Areas of relatively high clam abundance were found in muddy sands along the eastern shore of the outer harbor near Dosoris Island; areas of rocky substrate along the western shore of the water harbor; areas off Glen Cove Creek; and areas of the upper harbor south of Bar Beach Peninsula. High clam abundance was found along the shoreline north of the Glen Cove jetty in the area where seeding was reportedly performed. Based on a site distribution that included significant seed and littleneck fractions, the most productive clam areas appear to be in muddy sand sediments along the eastern shore of the outer harbor.

5. In addition to hard clams, a total of 23 other species of benthic macro-invertebrates was found during the study. Other species found in abundance in certain areas included the dwarf tellin, duck clam, juvenile blue mussel, mud dog whelks, and slipper shells. Areas of high abundance of other species generally corresponded with areas of higher hard clam abundance. The mud areas devoid of clams also tended to be devoid of other species.

6. Several clam predators appear to be abundant in the bay. The Atlantic moonsnail, a voracious predator of adult clams, was present at densities much greater than other Long Island embayments. Dead shellfish, with the distinctive drill hole by

moonsnails, were present throughout the harbor. Seed clams of the *notata* variety were also found with moonsnail drill holes at some stations, indicating that planted seeds are subject to predation by the snail. Other predators found at high abundance at specific stations included the starfish and several species of crab. Predation may be a strong factor limiting clam abundance in many areas of the harbor.

7. The presence of remnant shells, sometimes at high densities, indicated that significant populations of adult oysters, soft clams, and bay scallops once inhabited the harbor.



SECTION 5
MANAGEMENT RECOMMENDATIONS

5.1 Management Recommendations

Based on the above findings regarding the viability of the hard clam resources, the following management recommendations are made:

1. Resumption of Harvesting – If water quality has improved sufficiently to allow re-certification of shellfish areas in the outer harbor, harvesting of clams may be permitted in the near future. It appears that there are clam resources of sufficient quality and density to provide for commercial and recreational harvesting. The areas may be limited, however, to the muddy sand zones between the shoreline and the mud of the central harbor, and the clam resource could be depleted by over-harvesting. Although the resource could be protected by imposing limits on harvesting through controls on the number of licenses or harvesting periods, the clams are in waters controlled by New York State and harbor specific controls cannot be implemented. Monitoring of catches would be helpful in tracking catch quantities and rates to provide information on the sustainability of the resource.

2. Shellfish Seeding – Placement of seed clams and oysters should be encouraged to help rejuvenate shellfish stocks in the harbor. Larger shellfish populations can help improve water quality by increasing biological filtering of the harbor water. Sites for seeding must be carefully selected based on sediment type, presence of shell material for cover, water depth, and other factors. It appears that the 2007 seed placement area north of the Glen Cove jetty was a good area, assuming that the seeds were placed on the sand substrate and not in the mud substrate. The transition line between sand and

mud that runs generally parallel to the shore appears to run through the area identified as the seeding area. Placement of seed should be done on the sand substrate side. Field marking of the seeded area and accurate documentation of the position by GPS will make it possible to monitor the fate of seeds stock placed in the harbor. Given the abundance of predators present in the bay, it is important that follow-up periodic monitoring of the seed stock be performed to measure the growth and mortality of the seeds. Possible clam seeding locations are indicated on Map 6.

3. Multiple Seeding Locations – Several areas should be considered for planting seed stocks, in order to improve chances of success and to provide data as to which areas are optimal for survival. Seeding in stony sediments along the eastern side of the bay, and other areas with muddy sand or sand sediment with gravel and shell content should be considered.

4. Size of Seed Stock – Consideration should be given to utilizing larger size clams for the seeding program. The protected grow-out of small hard clam seeds (as in aquaculture systems) enables them to reach a size that decreases their vulnerability to predators and improves their chances for survival. The field survey for this investigation revealed greater densities of clams in areas with substrate containing sand, shell, and gravel. This is evidence that predation is affecting clam survival, so survival could be improved by utilizing larger seed stock. However, larger seed stock is more costly and a smaller number of clams would be seeded for the same budget if

the seed size were increased. The use of grow-out facilities should be considered so that the amounts of larger size clams placed in the harbor can be increased.

5. Seed Data Collection – It would be useful to have data as to the fate of seed clams placed into the bay. Experiments could be established to monitor the growth and survival of seed clams. Such data would be useful in assessing factors affecting the abundance of clams in the bay, and in developing improvements to the seeding program.

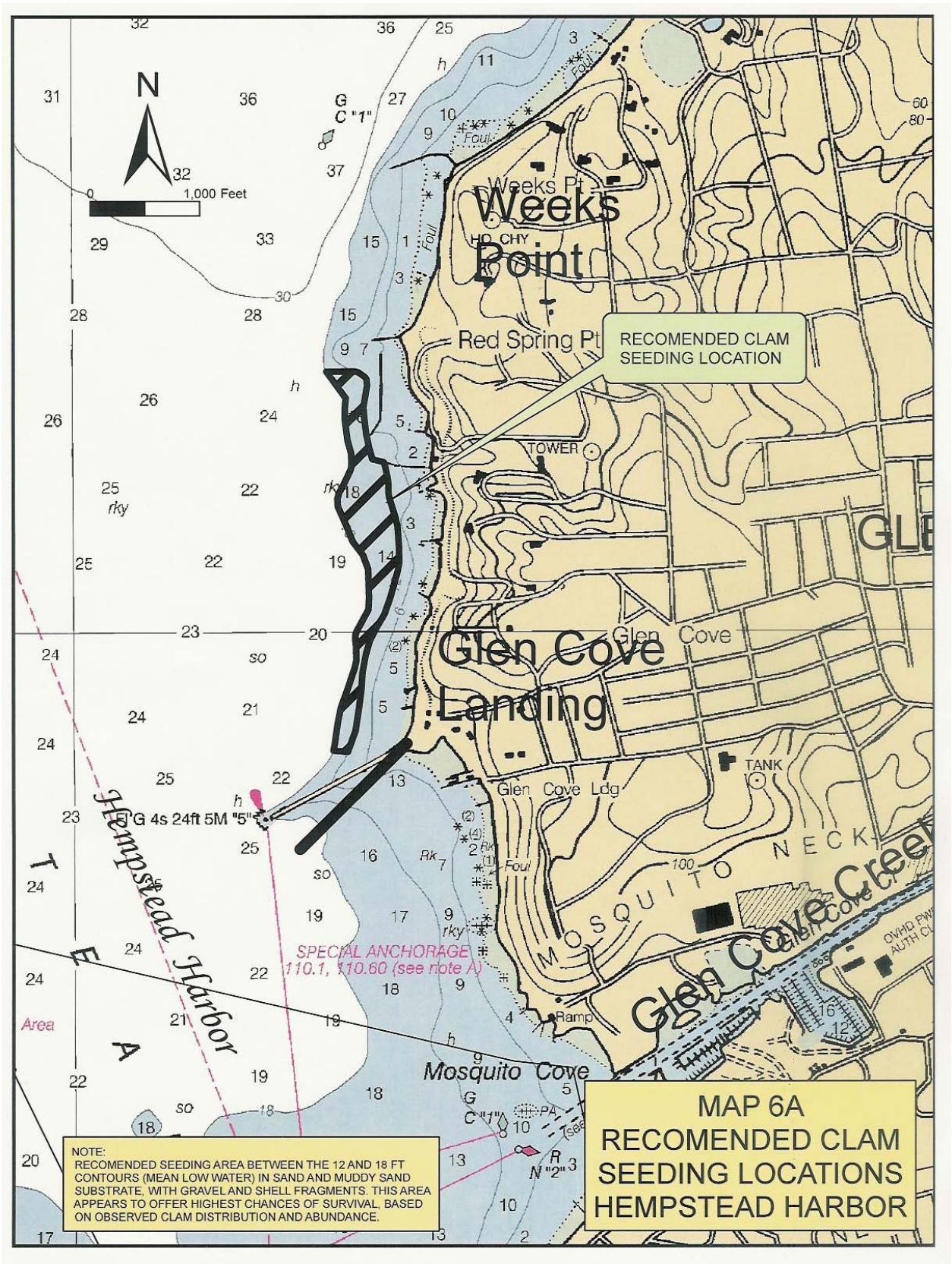
6. Chowder Transplants - Chowder transplant programs have traditionally been used on Long Island to provide for supplemental spawner stock. Even though a large proportion of clams in the harbor are cherrystone and chowder size, there does not appear to be extensive areas with dense populations of the large clams. Large clam populations in the harbor could be supplemented by purchasing large clams and planting them in the harbor in areas where they would survive. Dense populations of large clams can offer benefits of a local spawning stock that could benefit natural sets of seed clams in adjacent areas. The beds of large clams could also have water quality benefits because of their filtering capacity. An area suitable for a chowder transplant would be the area off Glen Cove Creek where chowders presently exist. A denser area of chowders would serve as a spawner sanctuary for the rest of the harbor and contribute to cleaning of waters emanating from the creek and nearby shoreline areas. Chowder clams would be less vulnerable to predation because of their large size.

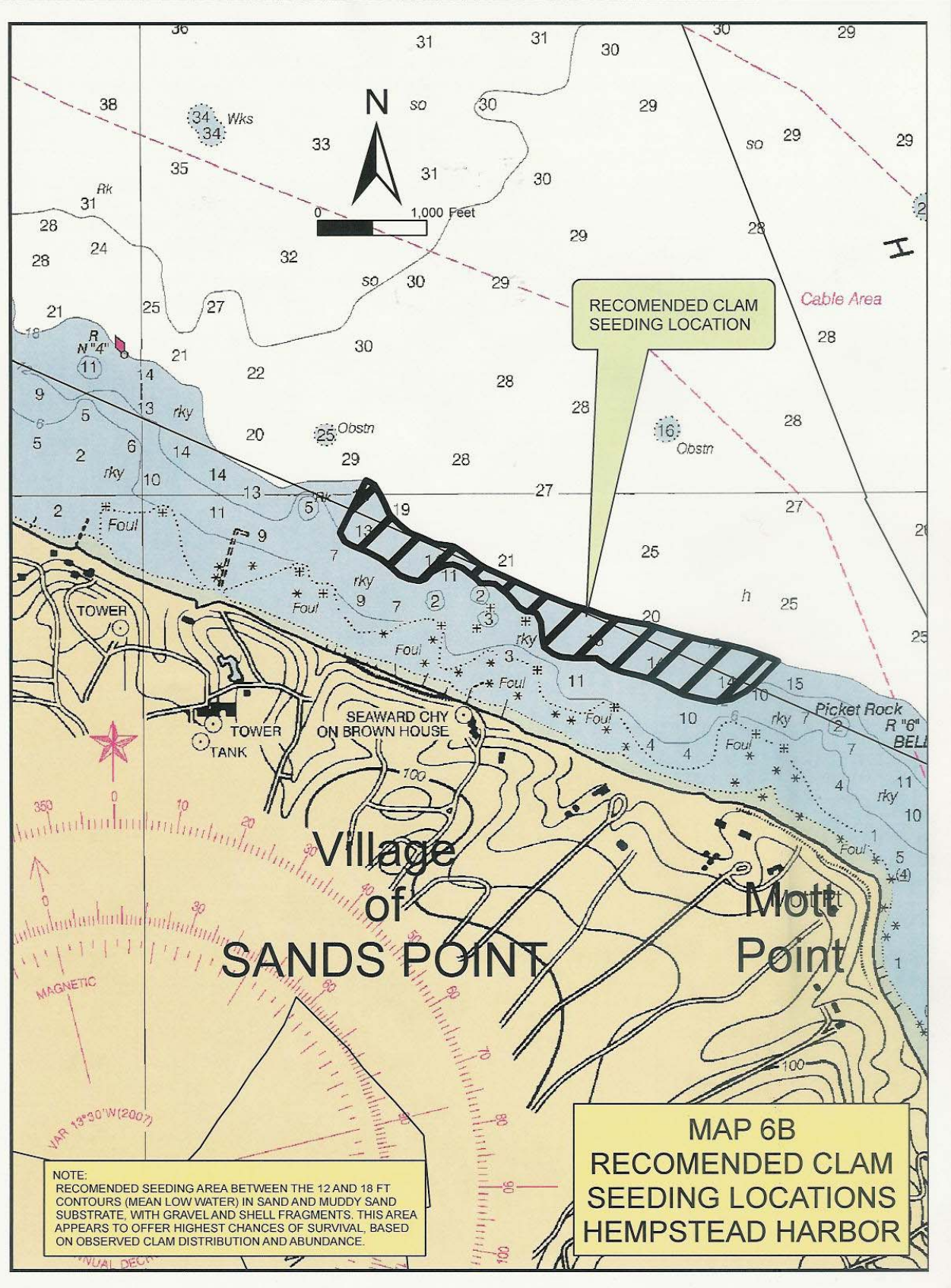
7. Shellfish Aquaculture – It is becoming more and more evident that wild stocks of fish and shellfish are being over-exploited and are unable to meet consumer demand. Aquaculture is being implemented in many areas of the country to provide alternative, renewable sources of seafood. As an example, the Oyster Bay Harbor Complex supports a valuable aquaculture operation that benefits the Town's public underwater lands by providing locally raised hatchery stock, by providing predator control, and by maintaining a stock on leased grounds that spawns and provides clam larvae for the rest of the harbor. Assuming that portions of the harbor become certified for shellfishing, consideration should be given to making an arrangement to allow for aquaculture on non-productive shellfish grounds in the harbor, even as a pilot project. Aquaculture projects may help to enhance the shellfish population and protect water quality in the harbor. It should be noted, however, that the underwater lands in the outer harbor are under the jurisdiction of New York State, and only NYSDEC would have jurisdiction to permit shellfish aquaculture.

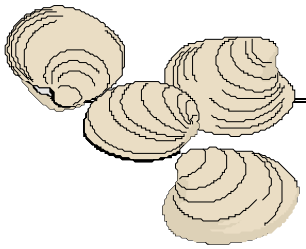
8. Water Quality Protection – The water quality of Hempstead Harbor has reportedly improved in recent years, to a level at which certain areas may be certified for shellfishing in the near future. Long-term degradation of water quality could have adverse effects in terms of the decertification of shellfish beds and impacts on the health and reproductive ability of shellfish populations. The efforts by the HHPC and participating municipalities in controlling stormwater runoff and other measures included in the harbor management program should be continued to help maintain the

water quality improvements that have been attained, and to improve water quality in isolated portions of the embayment still subject to degradation.

9. Follow-Up Shellfish Survey – If portions of the harbor are opened for shellfishing, a repeat of the shellfish survey would provide data on the changes in the shellfish population after harvesting begins. This data would be especially important to assess the size of the harvestable stock and to evaluate seed stock and recruitment. To provide resource data, shellfish survey could be repeated every two years in specific areas of interest, such as areas subject to harvesting and a control area not open to harvesting.


N
1,000 Feet
Weeks Pt
Weeks Point
Red Spring Pt
RECOMENDED CLAM SEEDING LOCATION
TOWER
Glen Cove
Glen Cove Landing
Glen Cove Ldg
TANK
MOSQUITO NECK
Glen Cove Creek
Hempstead Harbor
SPECIAL ANCHORAGE
110.1, 110.60 (see note A)
Mosquito Cove
Ramp
NOTE:
RECOMENDED SEEDING AREA BETWEEN THE 12 AND 18 FT CONTOURS (MEAN LOW WATER) IN SAND AND MUDDY SAND SUBSTRATE, WITH GRAVEL AND SHELL FRAGMENTS. THIS AREA APPEARS TO OFFER HIGHEST CHANCES OF SURVIVAL, BASED ON OBSERVED CLAM DISTRIBUTION AND ABUNDANCE.
MAP 6A
RECOMENDED CLAM SEEDING LOCATIONS
HEMPSTEAD HARBOR


N
0
1,000 Feet
RECOMENDED CLAM SEEDING LOCATION
Cable Area
Village of SANDS POINT
Mott Point
TOWER
TOWER TANK
SEAWARD CHY ON BROWN HOUSE
Picket Rock
Obstn
Foul
rky
MAGNETIC
VAR 13°30'W(2007)
NOTE:
RECOMENDED SEEDING AREA BETWEEN THE 12 AND 18 FT CONTOURS (MEAN LOW WATER) IN SAND AND MUDDY SAND SUBSTRATE, WITH GRAVEL AND SHELL FRAGMENTS. THIS AREA APPEARS TO OFFER HIGHEST CHANCES OF SURVIVAL, BASED ON OBSERVED CLAM DISTRIBUTION AND ABUNDANCE.
MAP 6B
RECOMENDED CLAM SEEDING LOCATIONS
HEMPSTEAD HARBOR



SECTION 6
REFERENCES

6.1 References

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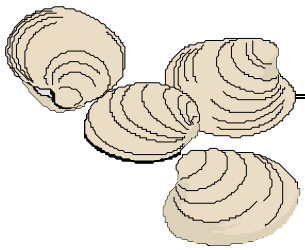
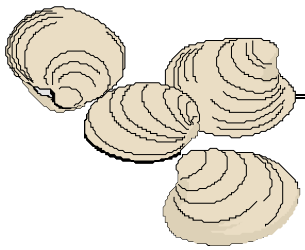


ATTACHMENTS



ATTACHMENT 1
PHOTO LOG

Photo1
Bucket used to collect samples.

Photo 2
Crane used to collect bucket samples.

Photo 3
Initial one inch cull rack in cull box

Photo 4
Bottom quarter inch cull rack in cull box.

Photo 5
Bucket dredge sample being hoisted to culling rack.

Photo 6
Samples being released into culling rake.

Photo 7
Wash down of sample on one-inch cull rack.

Photo 8
Clams and rocks retained on one inch cull rack.

Photo 9
Wash down of sample on one quarter inch cull mesh.

Photo 10
Materials left on ¼ inch cull mesh after wash down.

Photo 11
Clams from station 11. Note presence of all size classes including seeds, and *notata* variety.

Photo 12
Clams from station 11. Note presence of all size classes including seeds, and *notata* variety.

Photo 13
Seed clams from station 24.

Photo 14

Photo 15
Clams from station 60, inner harbor area.

Photo 16

Photo 17
Northern Dwarf Tellin found at station 44, where a total of 57 Tellins were found.

Photo 18
Duck Clams found at station 22, when a total of over 50 were found.

Photo 19
The sediment at station 4 had numerous Duck Clam shells.

Photo 20
Clumps of small Blue Mussels, 10 to 12 mm in length, were found attached to pebbles at station 55.

Photo 21
An example of a Gould's Pandora, a bi-valve found at station 1.

Photo 22
Numerous large crepidula were found at station 58 off Motts Cove.

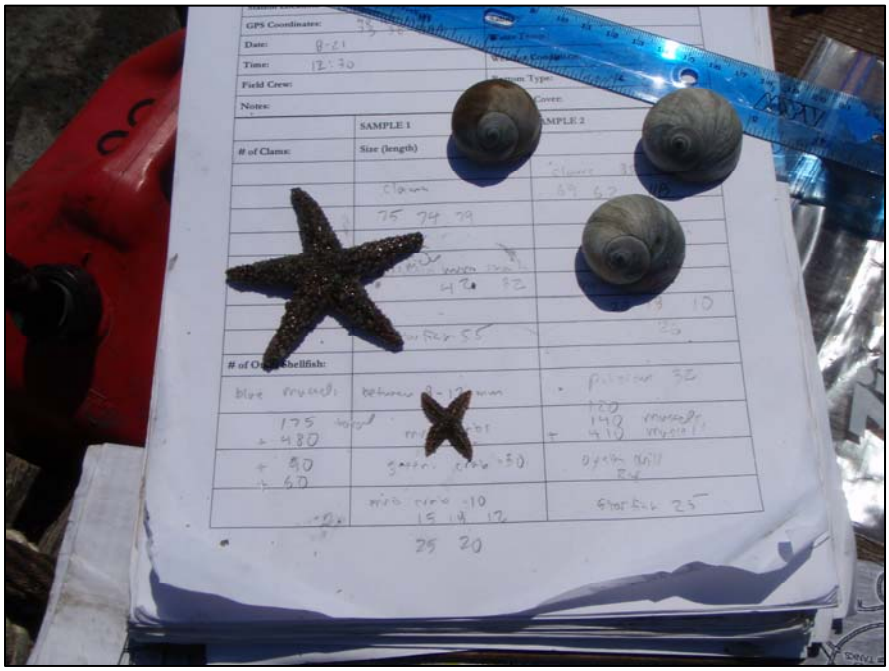


Photo 23
Moonsnails and starfish found at station 55.

Photo 24
Close-up view of the Atlantic Moonsnail.

Photo 25
Examples of Soft Shell Clams and Hard Clam with drill holes from Moonsnail predation, station 37.

Photo 26
Notata variety seed clam observed at station 25.

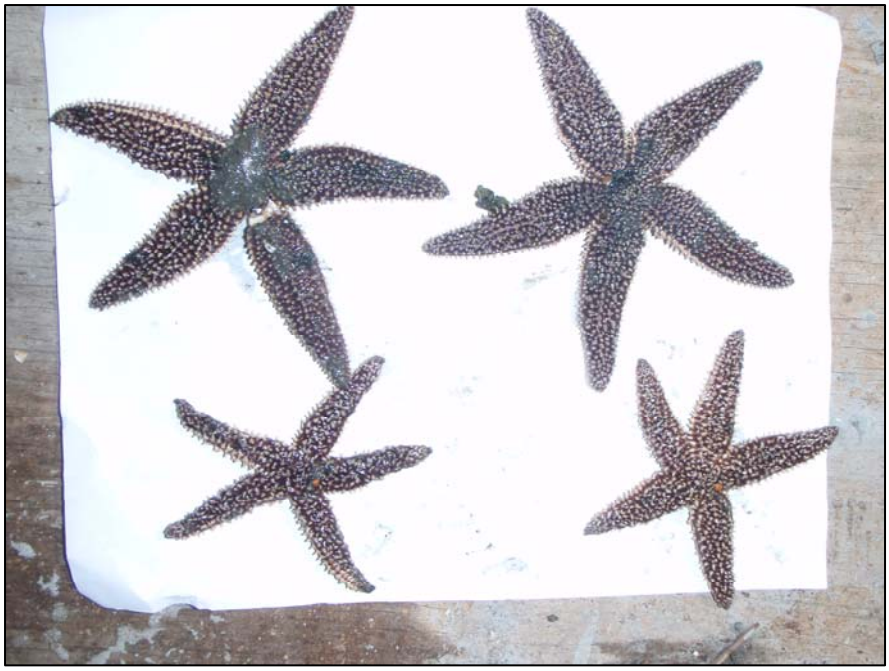


Photo 27
Large starfish found at station 43, off Glen Cove Creek.

Photo 28
Shells of Soft Shell Clam present in muddy sediments at station 12.

Photo 29
Oyster shells found in muddy sediments off Oyster Cove Creek.

Photo 30
Examples of the shells of larger oysters found off Glen Cove Creek.

Photo 31
Fragments of Bay Scallop shells found in mud sediments off Glen Cove Creek.

Photo 32
Close-up of Bay Scallop shells abundant in sediments off Glen Cove Creek.

Photo 33
Although not recorded as part of the study, sulfur sponge was fairly common in rocky areas of the outer harbor.

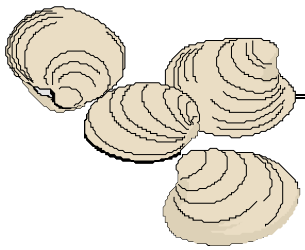
Photo 34
Fine grain muds typical of the central harbor, station 11.

Photo 35
Mud with significant amounts of shell, station 16.

Photo 36
Substrate consisting of sands, gravel, stones and cobles at station 19.

Photo 37
Clam samples collected from NYSDEC, station 13.

Photo 38
Samples collected from NYSDEC, station 37.



ATTACHMENT 2
NYSDEC SHELLFISH SURVEY PERMIT

New York State Department of Environmental Conservation
Division of Fish, Wildlife & Marine Resources
Shellfish Management Unit
205 North Belle Mead Road, Suite 1, East Setauket, New York 11733
Phone: (631) 444-0483 • **FAX:** (631) 444-0472
Website: www.dec.state.ny.us

Alexander B. Grannis
Commissioner

SHELLFISH POPULATION SURVEY PERMIT

PERMIT AMENDMENT

Permit No. 08-SP-4

Pursuant to the provisions of Sections 13-0319 and 13-0321 of the Environmental Conservation Law, Shellfish Population Survey Permit No. 08-SP-4, issued to Cashin Associates, P.C., 1200 Veterans Memorial Highway, Hauppauge, New York, to undertake a Shellfish Population Survey in the uncertified waters of Hempstead Harbor, is hereby amended as follows:

Condition No. 1:

The shellfish population surveying activities hereby permitted shall be amended to include the use a of hand rake working onboard a vessel controlled and operated by the Town of Oyster Bay's, Department of Environmental Resources.

Condition No. 4:

The shellfish harvesting and surveying activities hereby permitted shall be amended to include the collection of two shellfish samples in the area off Glen Cove Creek, Hempstead Harbor and off Dosoris Island, located west of Matinecock Point. The shellfish samples collected shall be provided to the New York State Department of Environmental Conservation's, Bureau of Marine Resources, for chemical analysis of shellfish tissue.

Condition No. 7:

The shellfish surveying and collection activities hereby permitted shall be amended to take place on one day, weather permitting, between the dates of October 9, 2008 and October 31, 2008.

All other conditions and provisions of Shellfish Population Survey Permit No. 08-SP-4 shall remain in full force and effect.

Debra A. Barnes
Biologist 2 Marine

DATED: October 8, 2008
cc: NYSDEC Law Enforcement, Marine Unit & Region 1
William Hastback, Shellfisheries
Eric Swenson, Town of Oyster Bay

Councilman Pollack offered the following resolution and moved its adoption, which resolution was declared adopted after a poll of the members of this Board:

RESOLUTION NO. 490 - 2008

A RESOLUTION AUTHORIZING THE EXECUTION OF AN ACCESS AGREEMENT WITH CASHIN ASSOCIATES, P.C. TO CONDUCT A SHELL FISH SURVEY ON BEHALF OF THE HEMPSTEAD HARBOR PROTECTION COMMITTEE.

WHEREAS, the Town of North Hempstead (the "Town") owns and maintains the bottom of Hempstead Harbor (the "Harbor Bottom") pursuant to the Dongan and Kiefft Patents; and

WHEREAS, the Hempstead Harbor Protection Committee (the "Committee"), of which the Town is a member and serves as business agent for, wishes to have Cashin Associates, P.C. of Hauppauge New York (the "Licensee"), conduct a shellfish survey (the "Licensed Use") along portions of the Harbor Bottom (the "Licensed Premises"); and

WHEREAS, the Town Board wishes to authorize and direct the Supervisor or the Deputy Supervisor, or their designees, to execute, on behalf of the Town as business agent for the Committee, an entry and access agreement with the Licensee for the undertaking of the Licensed Use at the Licensed Premises (the "Agreement").

NOW, THEREFORE, BE IT

RESOLVED that the Supervisor or Deputy Supervisor is hereby authorized and directed to execute, on behalf of the Town as business agent for the Committee, the Agreement, which will be filed in the Office of the Town Clerk, and to take such other action as may be necessary to effectuate the foregoing; and be it further

RESOLVED that the Office of the Town Attorney be and hereby is authorized

and directed to negotiate and supervise the execution of said Agreement.

Dated: Manhasset, New York

July 29, 2008

The vote on the foregoing resolution was recorded as follows:

Ayes: Councilman Dwyer, Councilman Ferrara, Councilman Pollack, Councilwoman Poons, Councilwoman Seeman, Councilman Troiano, Supervisor Kaiman

Nays: None

cc: Town Attorney Comptroller

STATE OF NEW YORK)
COUNTY OF NASSAU) ss.:
TOWN OF NORTH HEMPSTEAD)

I, LESLIE C. GROSS, TOWN CLERK of the TOWN OF NORTH HEMPSTEAD and custodian of the records of said Town, **DO HEREBY CERTIFY** that I have compared the annexed with the original **Resolution 490-2008** on file in my office, and that the same is a true copy thereof, and the whole of said original.

IN TESTIMONY WHEREOF,
I have hereunto signed my name
and affixed the official seal
of said TOWN, this 8th day of
August 2008

LESLIE C. GROSS,
TOWN CLERK

7022.08
File
3 copies
to GC

New York State Department of Environmental Conservation
Division of Fish, Wildlife & Marine Resources
Bureau of Marine Resources - Shellfisheries Section
205 North Belle Mead Road, Suite 1, East Setauket, New York 11733
Phone: (631) 444-0481 • **FAX:** (631) 444-0472
Website: www.dec.ny.gov • **Email:** wecarden@gw.dec.state.ny.us

Alexander B. Grannis
Commissioner

July 17, 2008

Cashin Associates, P. C.
Gregory T. Greene
1200 Veterans Memorial Highway
Hauppauge, NY 11788

RE: Shellfish Population Survey Permit 08-SP-4, Condition No. 2 updated

Greetings Mr. Greene,

Enclosed is Cashin Associates' updated Shellfish Population Survey Permit for survey activities to be undertaken during July and August, 2008. The updated permit only contains changes to the language of Condition No. 2. These changes reflect the additional information you provided in your recent email concerning the boundary limits of the survey in uncertified waters north of Bar Beach peninsula (i.e., to a line running between East Creek in the west and Dosoris Pond in the east) that are controlled by the State of New York. Furthermore, this condition of the permit now provides for the survey extending south of Bar Beach peninsula into uncertified waters controlled by the Town of North Hempstead. If you have any questions, or if I can be of any assistance, please do not hesitate to give me a call at (631) 444-0481.

Sincerely,

Wade Carden
Biologist 1 Marine

Enclosures
cc: Eric Swenson, Hempstead Harbor Protection Committee

New York State Department of Environmental Conservation
Division of Fish, Wildlife & Marine Resources
Shellfish Management Unit
205 North Belle Mead Road, Suite 1, East Setauket, New York 11733
Phone: (631) 444-0483 • **FAX:** (631) 444-0472
Website: www.dec.state.ny.us

Alexander B. Grannis
Commissioner

SHELLFISH POPULATION SURVEY PERMIT

Permit No. 08-SP-4

Pursuant to the provisions of Sections 13-0319 and 13-0321 of the Environmental Conservation Law, permission is hereby granted to Cashin Associates, P.C., 1200 Veterans Memorial Highway, Hauppauge, New York, to undertake a Shellfish Population Survey in the uncertified waters of Hempstead Harbor, under the following conditions:

1. All shellfish surveying activities shall be undertaken through the use of a clamshell bucket from a barge mounted crane, which is towed by a tug boat.

2. The surveying activities hereby permitted shall take place in the uncertified waters of Hempstead Harbor, including waters south of Bar Beach peninsula that are controlled by the Town of North Hempstead, and waters north of Bar Beach peninsula to a line extending from East Creek in the west to Dosoris Pond in the east, which are controlled by the State of New York.

3. All surveying activities undertaken pursuant hereto shall be carried out under the supervision of representatives of Cashin Associates, P.C. working in cooperation with the Hempstead Harbor Protection Committee.

4. All shellfish harvested pursuant hereto shall be immediately returned to the waters from which they are taken except for those shellfish retained for chemical analysis of shellfish tissue. Under no circumstances shall shellfish harvested in uncertified waters be returned to certified waters.

5. The Permittee shall notify the Department of Environmental Conservation's Division of Law Enforcement, (631) 444-0250, of the vessel to be used, and the date(s) of the subject survey activities at least twenty-four hours prior to the start of the survey.

6. A copy of the Shellfish Population Survey Permit must be maintained on board the involved vessel used by the Permittee to supervise the activities hereby permitted and made available to a Department representative upon request.

7. This permit is issued for activities hereby approved to take place over a two week period **between the dates of July 20, 2008 and August 20, 2008.**

8. The New York State Department of Environmental Conservation reserves the right to directly supervise the shellfish population survey activities hereby permitted. In addition to the notification requirements identified in Condition No. 5, the permittee shall notify the Department's Shellfish Management Unit at least twenty-four hours prior to the survey collection dates in order to arrange for Department representatives to be available for the survey as appropriate.

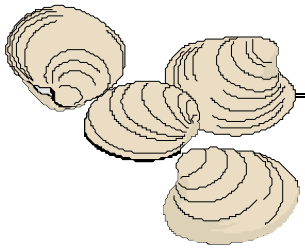
9. The Permittee shall provide the Department with a report of the shellfish population survey activities hereby permitted within 30 days following the completion of this survey. The report shall include, but is not limited to, information on the dates of the surveying activities, stations sampled, quantities and sizes of each species collected at each station during the survey, the results of the survey activities and any other important biological information collected during the survey.

This permit is issued subject to a reserved right of **SUMMARY SUSPENSION AND/OR REVOCATION** whenever such **SUSPENSION OR REVOCATION** is deemed prudent or necessary by the Department of Environmental Conservation in carrying out the purposes of the Environmental Conservation Law or the Rules and Regulations promulgated thereunder, whenever in the judgement of the Department the Permittee shall have violated any term or condition of the Permit or whenever the Permittee shall have violated any provision of the Environmental Conservation Law or the Rules and Regulations promulgated thereunder.

Wade Carden

Wade Carden
Biologist 1 Marine

DATED: July 10, 2008
cc: NYSDEC Law Enforcement, Region 1
William Hastback, Shellfisheries
Eric Swenson, Hempstead Harbor Protection Committee



ATTACHMENT 3
2008 DATA TABLES

TOWN OF OYSTER BAY
Hard Clam Survey
All Stations

STATION NUMBER	1		2		3		4		5		6		7		8		9		10		11		12		13			14		15		16		17		18		19		20		21		22		23		24		25		26		27		2
SAMPLE NUMBER	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1		2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1
LENGTH MEASUREMENTS (mm)	10	7				50							74					90							5	60	6				20					98	95	6	12			50		65		15	20	6	6	67		38					
	10	65											81												7	60	7											8	14							22	22	8	6	84		44					
	85																								10	60	7											86	65							25	35	9	7	92		46					
	106																								10	61	11											87	85							70	85	10	7			50					
	111																								11	61	11											90	90							85	94	10	8			52					
																									12	62	12												100							95	100	11	8			54					
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NUMBER OF CLAMS	5	2	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	70		18	0	0	0	1	0	0	0	0	1	1	5	6	0	0	1	0	1	0	7	6	13	16	3	0	7	0	0	0	0
AVERAGE SIZE PER SAMPLE (mm)	64.4	36				50							78					90							52.7		29.3				20					98	95	55	61			50		65		60	59	32	14.1	81		48					
AVERAGE SIZE PER STATION (mm)	56.3				50.0								77.5				90.0								47.9					20.0					96.5		58.5				50.0		65.0		59.5		22.0		81.0		48.4					
CLAM DENSITY PER SAMPLE (Clams/m^2)	3.3	46.7	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	46.7		12.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.7	0.7	3.3	4.0	0.0	0.0	0.7	0.0	0.7	0.0	4.7	4.0	8.7	10.7	2.0	0.0	4.7	0.0	0.0	0.0	0.0
CLAM DENSITY PER STATION (Clams/m^2)	2.3		0.0		0.3		0.0		0.0		0.0		0.7		0.0		0.3		0.0		0.0		0.0		29.3			0.0		0.3		0.0		0.0		0.7		3.7		0.0		0.3		0.3		4.3		9.7		1.0		2.3		0.0		0.

	TOTAL
TOTAL NUMBER OF CLAMS	295
AVERAGE NUMBER OF CLAMS PER SAMPLE	2.4
AVERAGE SIZE OF ALL CLAMS SAMPLED (mm)	58.1
AVERAGE DENSITY (Clams/m^2)	1.6

TOWN OF OYSTER BAY
Hard Clam Survey
All Stations

8	29		30		31		32		33		34		35		36		37		38		39		40		41		42		43		44		45		46		47		48		49		50		51		52		53		54		55		56		57		58		59		60		61	
2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
	93								85				90		92	20	30	36	71						81	83		85	10	12	92						95	95				80			35	62			19	74			74	62	56	78	75				59	40	53	45		72
	100								90						96	86	42	77								90			11	19							111	101							64	68			68	85			75	69	59	90					68	42	59	46		73
																	76	80											17	19															88	68				86			79	85	59						75	61	61	51		86
																	80	80											49	65															93	70				102				96	62							78	70	65	71		
																	85	81											60	71															94									118	70								80	66	71		
																	86	85											70	72																									72								98	69	75		
																		88											71	80																									79									70	76		
																		90											76	81																									82									70	77		
																		96											80	83																									85									78	79		
																													83	90																									86									81	81		
																														95																																		86	83		
																																																																			97		
0	2	0	0	0	0	0	0	0	2	0	0	0	1	0	2	2	6	9	1	0	0	0	0	0	1	2	0	1	10	11	1	0	0	0	0	0	2	2	0	0	0	1	0	0	4	5	0	0	2	4	0	0	3	5	10	2	1	0	0	0	4	6	11	12	0	3
	97								88				90		94	53	67	79	71						81	87		85	53	62	92						103	98				80			70	72			44	87			76	86	71	84	75				70	65	69	71		77
	96.5								87.5				90.0		73.5		74.1		71.0						84.7		85.0		57.8		92.0						100.5				80.0			71.3				72.3			82.3		73.2		75.0				67.1		70.0		77.0	
0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.7	0.0	1.3	1.3	4.0	6.0	0.7	0.0	0.0	0.0	0.0	0.0	0.7	1.3	0.0	0.7	6.7	7.3	0.7	0.0	0.0	0.0	0.0	0.0	1.3	1.3	0.0	0.0	0.0	0.7	0.0	0.0	2.7	3.3	0.0	0.0	1.3	2.7	0.0	0.0	2.0	3.3	6.7	1.3	0.7	0.0	0.0	0.0	2.7	4.0	7.3	8.0	0.0	2.0
.0	0.7		0.0		0.0		0.0		0.7		0.0		0.3		1.3		5.0		0.3		0.0		0.0		1.0		0.3		7.0		0.3		0.0		0.0		1.3		0.0		0.3		0.0		3.0		0.0		2.0		0.0		2.7		4.0		0.3		0.0		3.3		7.7		1.0	