DAMOS

DISPOSAL AREA MONITORING SYSTEM

Summary of Program Results
1981-1984

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Part A
Section I

contribution #46

Science Applications International Corporation

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I. CENTRAL LONG ISLAND SOUND DISPOSAL AREA - PREVIOUS SURVEYS

1.0 INTRODUCTION

The Central Long Island Sound (CLIS) disposal site (Fig. I-1-1) has been under study by the New England Division (NED) since 1974, when 1.2 million m^3 of dredged material were deposited at the 1974 New Haven mound and covered with a sand layer from outer New Haven Harbor. In 1979, the Stamford/New Haven capping project was accomplished using techniques developed as part of a regional disposal management plan, resulting in the deposition of two disposal mounds. At the north mound, 26,000m^3 of Stamford material was capped with 33,000m^3 of sand from the breakwater area of New Haven Harbor. The south mound consisted of 38,000m^3 of Stamford material that was capped with 72,000m^3 of silt from New Haven Harbor. Results of monitoring studies at these two sites have been detailed in the 1980 DAMOS Annual Report, Volumes I-III.

Beginning in 1981, the Norwalk site received 70,000m^3 of Class III material from Norwalk Harbor that was capped with 280,000m^3 of Class I material from outer Norwalk Harbor. The Mill-Quinnipiac River site has received 70,000m^3 of low density, high water content pulp mill waste and clay from the Mill River that was subsequently capped with 190,000m^3 of silty-clay from the Quinnipiac River.

This section summarizes the monitoring studies at the two cap sites in addition to describing the disposal operations and monitoring that has occurred at the two new disposal mounds. The location and the extent of the survey areas of each disposal site in the CLIS disposal area are shown in Figure I-1-2.

2.0 METHODS

2.1 Bathymetry

Precision replicate bathymetry was accomplished at each of the four disposal sites using navigation control that was provided by the SAIC Navigation and Data Acquisition System.

When conducting the surveys, range data from a Del Norte positioning system, with an accuracy of $\pm$1m, are input to a computer which then provides steering information to assist the helmsman in maintaining the ship's position relative to the survey grid. Since precision data are required for this work, surveys are only made on calm days so that steering errors are less than 5 meters on either side of a given transect. This navigational precision is necessary for comparing replicate surveys, since slight errors in position can cause large errors in depth over sloping bottoms.

Data acquisition is controlled by the sampling rate of the Del Norte Trisponder unit which is nominally one position

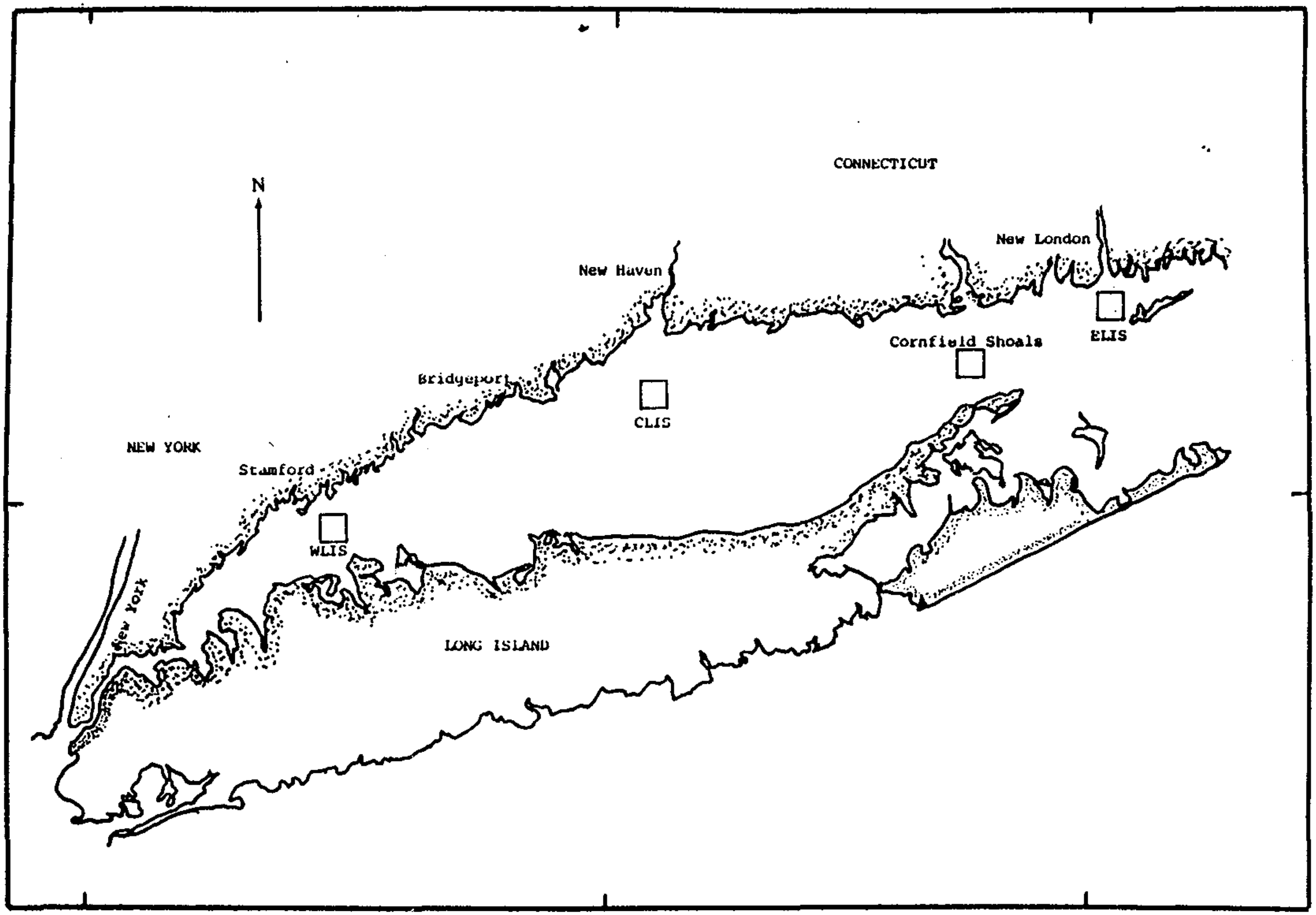


FIGURE I-1-1. Location of Central Long Island Sound Disposal Site

FIGURE I-1-2

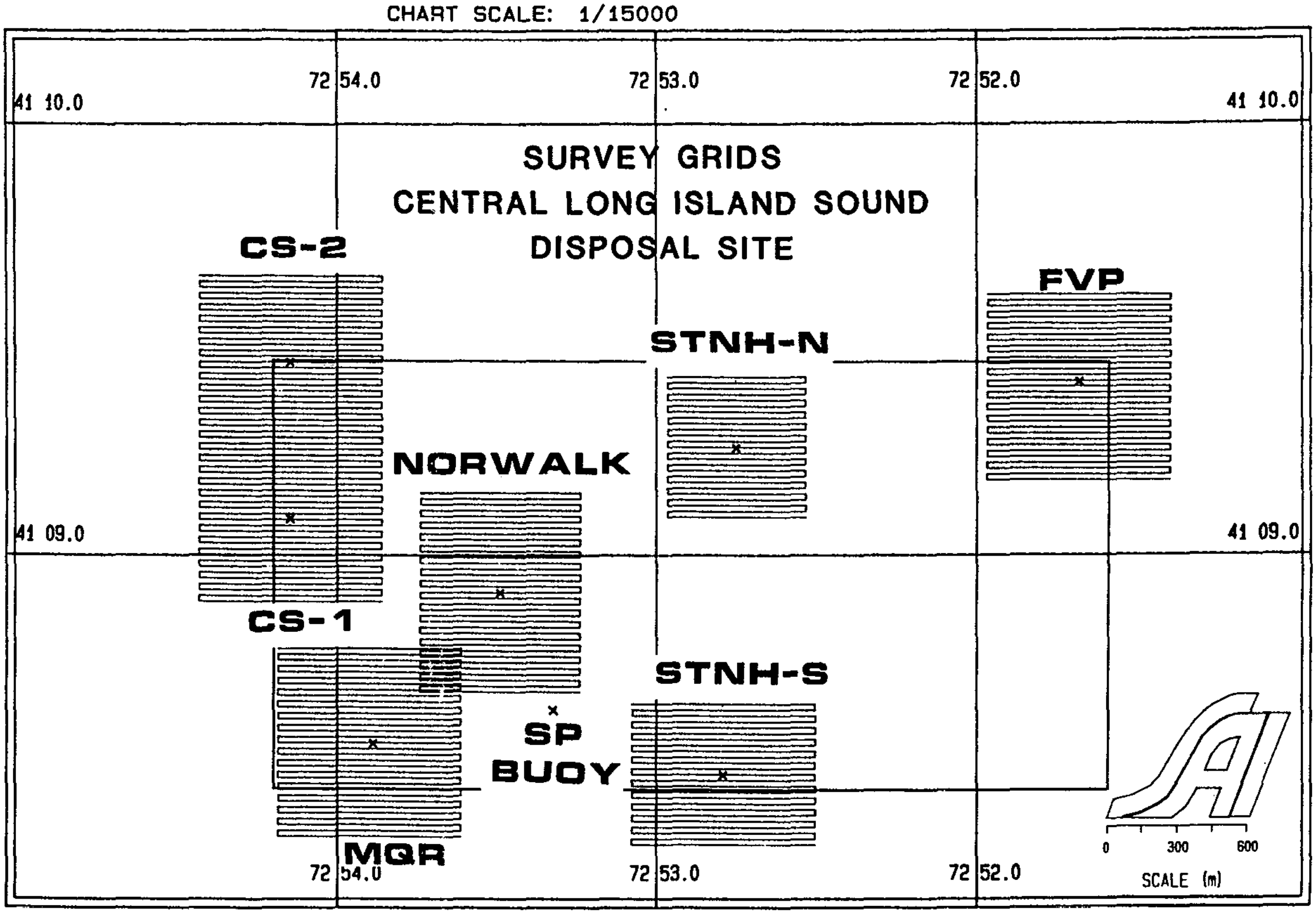


CHART SCALE: 1/15000
72 54.0
72 53.0
72 52.0
41 10.0
41 10.0
SURVEY GRIDS
CENTRAL LONG ISLAND SOUND
DISPOSAL SITE
CS-2
FVP
STNH-N
NORWALK
41 09.0
41 09.0
CS-1
STNH-S
SP
BUOY
MQR
72 54.0
72 53.0
72 52.0
0
300
600
SCALE (m)

measurement per second. Depth measurements are obtained from a Raytheon 719 fathometer with a digitizing unit and are recorded on magnetic disk with corresponding time and position information.

Analysis of bathymetric data is accomplished through the generation of depth sections along the transect lanes. Since each transect is reproducible with a positional accuracy of better than 5 meters, these sections provide a means of evaluating the precision of the survey technique, as well as small scale changes in topography. All depths on these sections are corrected for sound velocity, draft and tidal height. Assuming no significant change (i.e. deposition or erosion) in the depth of the ambient bottom at some distance from the mound, the precision of the depth measurements between successive surveys can be evaluated by comparing the depths at the extremities of the transect.

Following development of the vertical sections, the data are inserted into a grid pattern for further analysis. This grid pattern is established such that each grid block is centered on a transect lane, with a north-south length equal to the lane spacing (25m), and an east-west length equal to one half the lane spacing (12.5m). This convention is applied to all surveys, even though it is possible to establish a finer grid pattern by sampling more frequently along the transect direction. The finer grid pattern would, however, introduce a bias into the data since the resolution between lanes cannot be improved.

All depth measurements falling within the area of each grid block are averaged and a mean depth is assigned to each grid location. The matrix of depths is then used to develop a contour chart of the entire survey area.

Surveys at Norwalk (NOR), Stamford/New Haven North (STNH-N) and South (STNH-S), and Mill Quinnipiac River (MQR) were established by setting up survey lanes in an east-west direction. Each lane was spaced 25 meters from the adjacent lane and the survey area generally covered $800m^2$ (Fig. I-1-2).

2.2 Sediment Characteristics

Three replicate samples of surface sediments were taken at selected stations at each site. The samples were taken from a $0.1m^2$ surface area using a Smith MacIntyre grab sampler and were stored under ice for transport to the New England Division. Analysis at NED included trace metal concentrations, grain size and organic content.

2.3 Benthic Community Analysis

Three replicate samples were taken at each station using the Smith MacIntyre grab sampler. The sediment was sieved through a 0.1 mm mesh screen and the material retained on the sieve was preserved in 10% buffered formalin for later processing. In the laboratory, samples were soaked in rose-bengal stain for 24 hours to provide contrast between animals and detritus. Clean sandy or shelly samples were sorted in glass trays under bright lights and with contrasting backgrounds. If organic detritus was present, it was separated by elutriation and sorted under a dissecting microscope. Animals were identified under a dissecting microscope, counted, and preserved in alcohol. Sieve residue was labeled and archived.

Standard reference works and some unpublished studies in preparation for the NOAA series "Marine Flora and Fauna of the Northeastern United States" were used to identify the specimens. The reference collections of the New England Aquarium and the Marine Biological Laboratory (Woods Hole) were also examined.

In the existing DAMOS benthic data, there are several closely related species reported which could represent a single species with a form varying with age or location. In this study, the choice was made to 'lump' rather than 'split' the data in order to give a less ambiguous record. Some epibenthic species, with no possibility of responding to sediment pollution (e.g. loose colonial hydroids), and the planktonic species were eliminated.

Some graphs of single variable abundances at Central Long Island Sound sites are included in this report. These illustrate the single species approach that is believed to be most appropriate for Long Island Sound data.

2.4 REMOTS

On 25, 26 and 27 January 1983, a REMOTS survey was made of the entire CLIS site, including samples at Norwalk (NOR), Stamford-New Haven North (STNH-N), Stamford-New Haven South (STNH-S), and Mill-Quinnipiac (MQR) disposal sites, and the Central Long Island Sound Reference Site (CLIS-REF). The purpose of this survey was to map the benthic faunal successional stages, sediment grain-size patterns, small-scale boundary roughness, and the depth of the redox boundary within the sediments of the four disposal sites and to compare these parameters with those of the ambient seafloor as measured at the CLIS-REF site.

A north-south and east-west sampling transect was made at each disposal site. The intersection of the transects was centered on, or near, the depositional center of each mound. Stations were designated by their distance (in meters) and direction (N, S, E, or W) from the center of the cross-shaped transect pattern. The REMOTS camera was deployed at least three times at each station. The number of stations occupied at each site was as follows: Norwalk=9, STNH-N=9, STNH-S=11, MQR=13, CLIS-REF=3. From analysis of these data, it was clear that additional replicates were needed from the CLIS-REF station. Therefore, on 15 March 1983, an additional 12 camera drops were made at that site. These drops were made in a circular pattern around the station center, with the radius of the circle approximately 30 meters.

Measurements of boundary roughness, camera prism penetration depth, and the area of the positive redox in the sediment as seen in profile were taken from the REMOTS black and white negatives. These measurements were accomplished with the Measuronics LMS Image Analysis System. Negatives were used instead of positive prints in order to avoid changes in image density that can accompany printing a positive image. The image analysis system is capable of detecting 256 grey scale values while density slicing an image. Data on grain-size estimates, evidence of surface erosion, and faunal information were determined from 8x10 inch positive prints. At this magnification, the resulting print is 1.5 times real scale.

The range of grain-size (exclusive of shells and shell fragments) is estimated from the photographs by overlaying a grain-size comparator which is of the same scale. The comparator was prepared by photographing a series of Udden-Wentworth size classes through the profile camera (equal to or less than coarse silt, up to granule and larger sizes). Seven grain-size classes were developed on this comparator. The lower limit of optical resolution of the photographic system is about 62 microns, allowing recognition of grain sizes equal to, or greater than, coarse silt. The accuracy of this method has been documented by comparing the REMOTS estimates with grain-size statistics determined from laboratory sieve analysis.

The boundary roughness values represent the maximum topographic relief measured over the width of the optical window (12.75 cm).

If there is oxygen in the overlying water column, the near surface sediment will have a high reflectance value relative to anoxic sediment underlying it. This is because the oxidized surface sediment contains ferric hydroxide (an olive color when associated with organic particles), while the hydrogen sulphide sediments below this oxygenated layer are grey to black. Although the surface layer with the high reflectance value is referred to in this report as the "oxidized layer", sulphate reduction can take place in microanaerobic environments (interiors of fecal pellets or diatom frustules) within this ferric hydroxide zone. The boundary between light colored ferric hydroxide surface sediment and underlying grey to black sediment is called the redox potential discontinuity and is abbreviated as the RPD.

The area of the positive (aerobic) RPD is determined with the Measuronics LMS System by density-slicing its unique reflectance value. The oxidized layer can then be divided by 12.75 (the prism window width) to obtain a mean depth for the RPD. In the absence of a bioturbating fauna, the RPD depth is less than 0.5 cm thick in organic-rich muds. Pioneering stages have RPD depths generally less than 3 cm deep, while mature infaunal successional stages have RPD depths greater than 3 cm (Rhoads and Germano, 1982). A seasonal change in the RPD depth has been observed related to the temperature effect on bioturbation rates. The RPD depth is given special attention in this analysis as it is a sensitive indicator of infaunal succession, within station patchiness, and bioturbation activity.

A detailed discussion of how the stage of succession can be deduced from REMOTS images is given in Rhoads and Germano (1982) and Rhoads and Boyer (1982). However, these two papers deal with primary succession, i.e. faunal colonization of a new or recently disturbed sedimentary surface. This survey revealed a condition of secondary succession, i.e., the appearance of pioneering polychaetes on bottoms that are already populated by mature successional stages. This condition is transient and has been observed before. Pioneering species can make appearances at the surface of mature systems. In the data coding, these associations are described as III-I, i.e. a Stage III mature assemblage invaded by a Stage I polychaete assemblage.

A multi-parameter habitat index has been constructed to characterize habitat quality which is defined relative to two end-member standards. The lowest value is given to those bottoms which have low, or no dissolved oxygen in the overlying water, no apparent macrofaunal life, and methane gas present within the sediment (see Rhoads and Germano, 1982 for REMOTS criteria for these conditions). The habitat index for such a condition is minus 10. At the other end of the scale, an aerobic bottom with a deeply depressed RPD, evidence of a mature macrofaunal assemblage, and no apparent methane gas bubbles at depth will have a habitat index of plus 11. The habitat index is arrived at by summing the subset indices shown in Table I-2-1.

3.0 RESULTS

3.1 Norwalk

3.1.1 Bathymetry

Bathymetric surveys were conducted at the Norwalk disposal site in January, April and August 1981, and in January and December 1982. The April 1981 survey was a post-disposal survey, following the disposal of approximately 70,000m^3 of Norwalk Harbor material. The August 1981 was a post-capping survey.

Comparison of the January 1981 (Fig. I-3-1) and the April 1981 surveys (Fig. I-3-2) indicates that a significant amount of disposal took place between January and April 1981, mostly on the north side of the buoy. It is important to note that the minimum depth of the mound south of the buoy decreased to less than 16 meters indicating additional material was dumped in that area as well. North of the buoy, a second mound has developed from disposal of Class III material which reaches a minimum depth of slightly greater than 17 meters. A significant feature of this mound is the elongation of the deposit to the west, indicative of substantial dumping away from the disposal point.

TABLE I-2-1

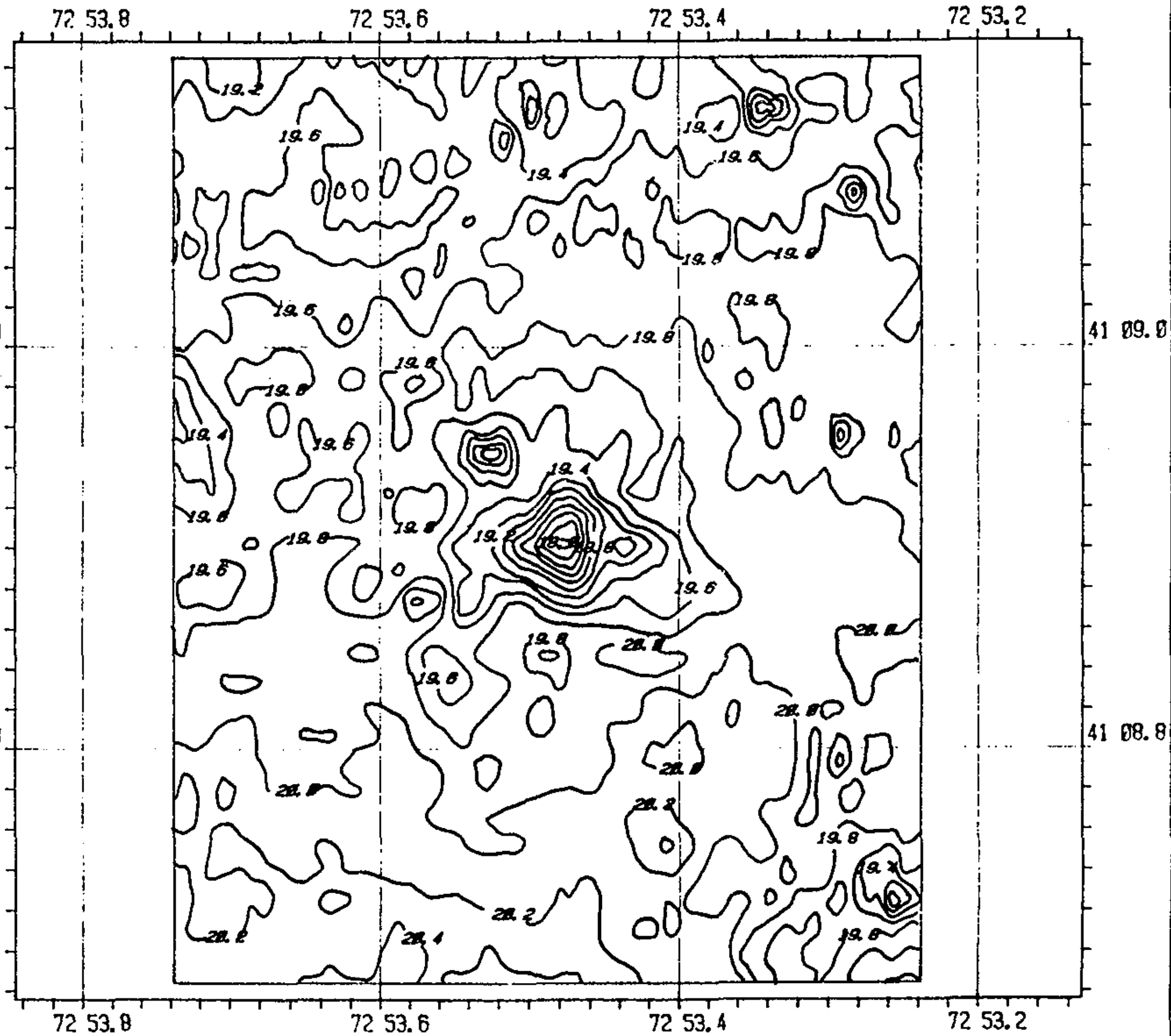
PLANIMETERED RPD AREA	INDEX VALUE
0-10 CM^2	1
10-1-20.0	2
20.1-30.0	3
30.1-40.0	4
40.1-50.0	5
50.1	6
CHEMICAL PARAMETERS	**INDEX VALUE**
Methane present	-2
No/low dissolved 0_2	-4
SUCCESSIONAL STAGE	**INDEX VALUE**
(Primary succession)	
Azoic	-4
Stage 1	1
Stage 1-2	2
Stage 2	3
Stage 2-3	4
Stage 3	5
SUCCESSIONAL STAGE	**INDEX VALUE**
(Secondary succession)	
Stage 1 on a Stage 3	5 I
Stage 2 on a Stage 3	5 II

HABITAT INDEX = Total of all subset indices

NORWALK SURVEY AREA

25 JANUARY 1981
CONTOUR INTERVAL .2m
DATUM: MLW
CHART SCALE 1/4000

FIGURE I-3-1



0 80 160
SCALE (m)

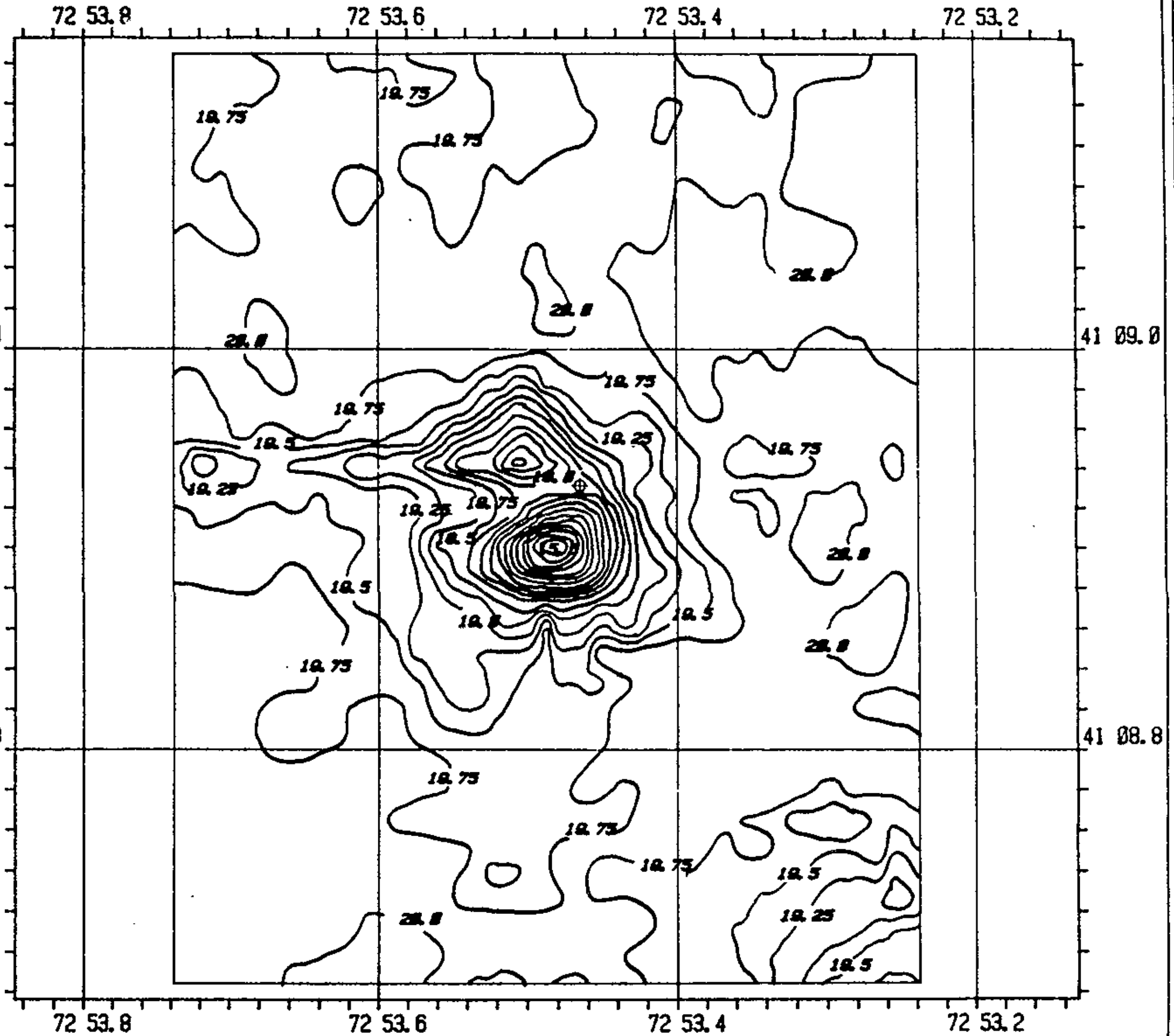
NORWALK SURVEY AREA

28 APRIL 1981

CONTOUR INTERVAL: .25 METERS
CHART SCALE: 1/4000
DATUM: MLW
SOUNDINGS IN METERS

⊕ DISPOSAL BUOY

FIGURE I-3-2



0 80 160
SCALE (m)

Figure I-3-3 is a contour chart of the 19 August survey, which indicates several significant points. Most important of these, the south mound has remained essentially stable since the previous survey with a minimum depth slightly deeper than 15 meters. The contour difference chart (Fig. I-3-4) indicates that disposal since April was much better controlled as the north mound had built up to a depth similar to the south mound, but no additional material was added to the west. If further dumping was conducted at this site, the disposal point should be changed to keep the minimum depth from becoming more shallow.

The January 1982 survey shown in Figure I-3-5 indicates an apparent loss of dredged material from the site during the August 1981 to January 1982 period. Comparison of the August 1981 survey with the January 1982 survey shows a loss of approximately one meter from the north mound and one meter from the south mound. The cause of this material loss is probably a combination of consolidation and compaction of the mound, along with a storm-induced movement of material due to the shallowness of the mounds. The December 1982 survey (Fig. I-3-6) indicates no change in the mound topography during 1982, and that after initial settling, the Norwalk mound is quite stable.

3.1.2 Sediment Chemistry

In August 1981 and January 1982, sediment samples were taken in north-south and east-west transects across the disposal mounds. Each station was sampled in triplicate. The station locations and results for lead, zinc, chromium and copper are shown in Tables I-3-1 and I-3-2. The August data shows the presence of dredged material at the 275N and 50N stations where concentrations for these metals were higher than at the center station. In the east-west direction, the center station had the highest metal levels. The same trends held true for the January 1982 data for the north-south transect, but there were elevated metal concentrations to the east. Since the stations sampled in January 1982 were not the same as those sampled in August 1981, the temporal significance of these data is unknown.

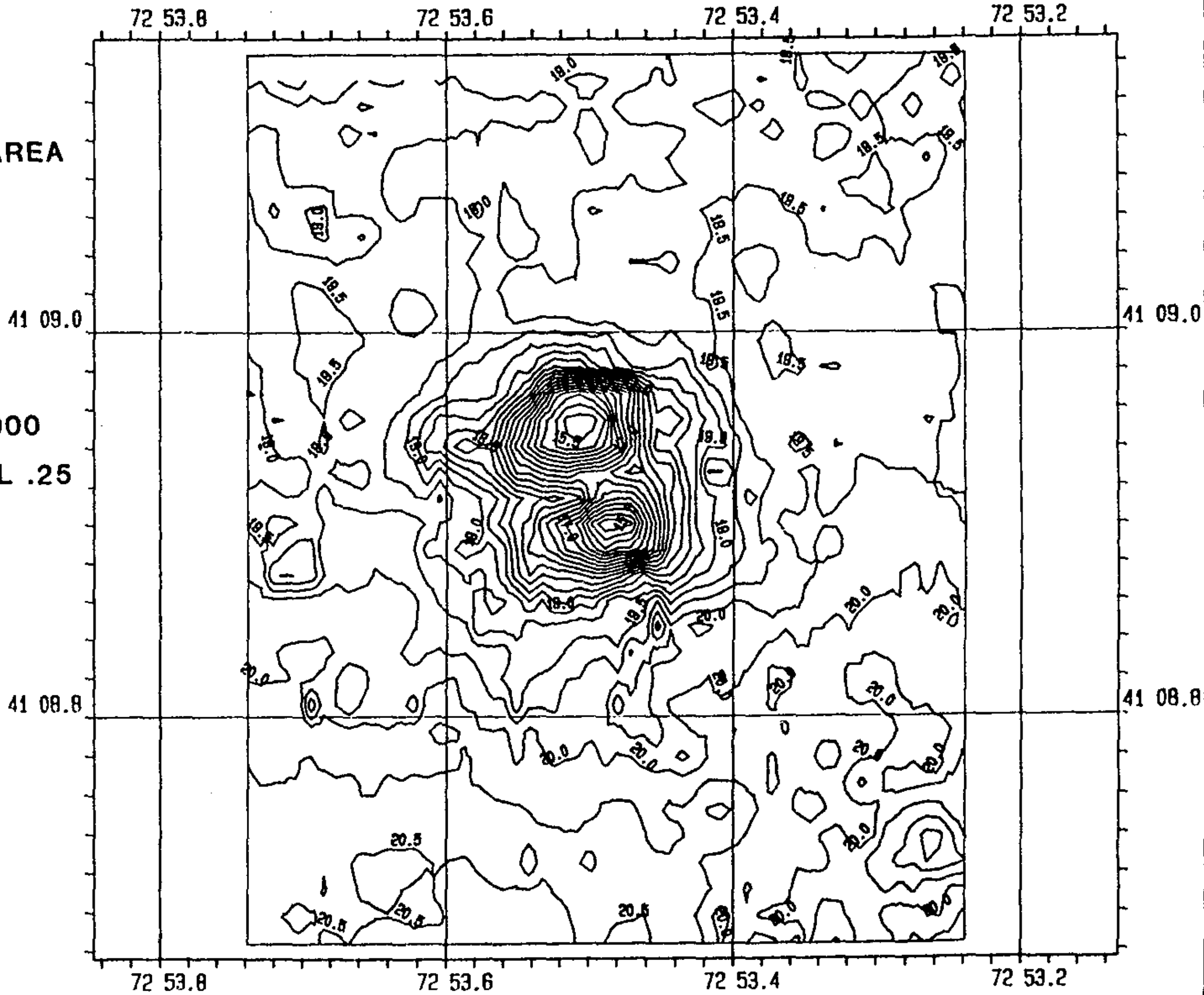
In August 1982, an east-west transect was sampled and in December 1982, sediment samples were taken at the center, the inner edge and the outer edge (Tables I-3-3 and I-3-4). There were elevated levels of lead at all stations in August 1982, as compared to the 1981 samples. However, by December 1982, these levels had decreased so that no difference between the center station and the outer edge station (450E) remained.

In August 1983, sediment samples were collected along the north-south and east-west transects for chemical analysis (Table I-3-5). The data indicate slightly elevated concentrations of lead and zinc at the center of the mound when compared to the 200N, 200S, 200E and 200W samples.

NORWALK SURVEY AREA

AUGUST 1981
CHART SCALE 1/4000
CONTOUR INTERVAL .25

FIGURE I-3-3



0 80 160
SCALE (m)

NORWALK DISPOSAL SITE

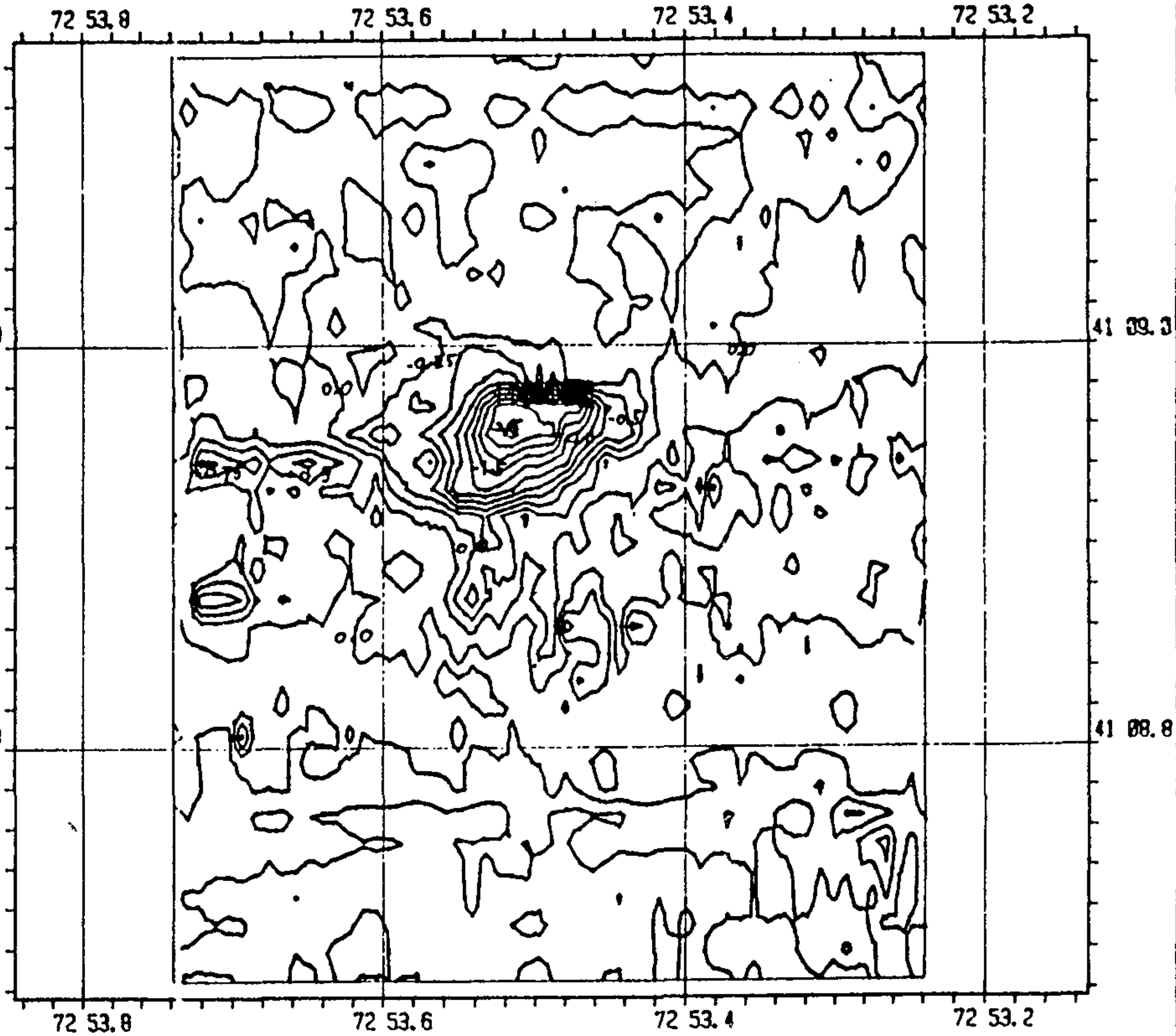
CONTOUR DIFFERENCE

AUGUST - APRIL, 1981

CONTOUR INTERVAL - .25m

CHART SCALE - 1/4000

FIGURE I-3-4



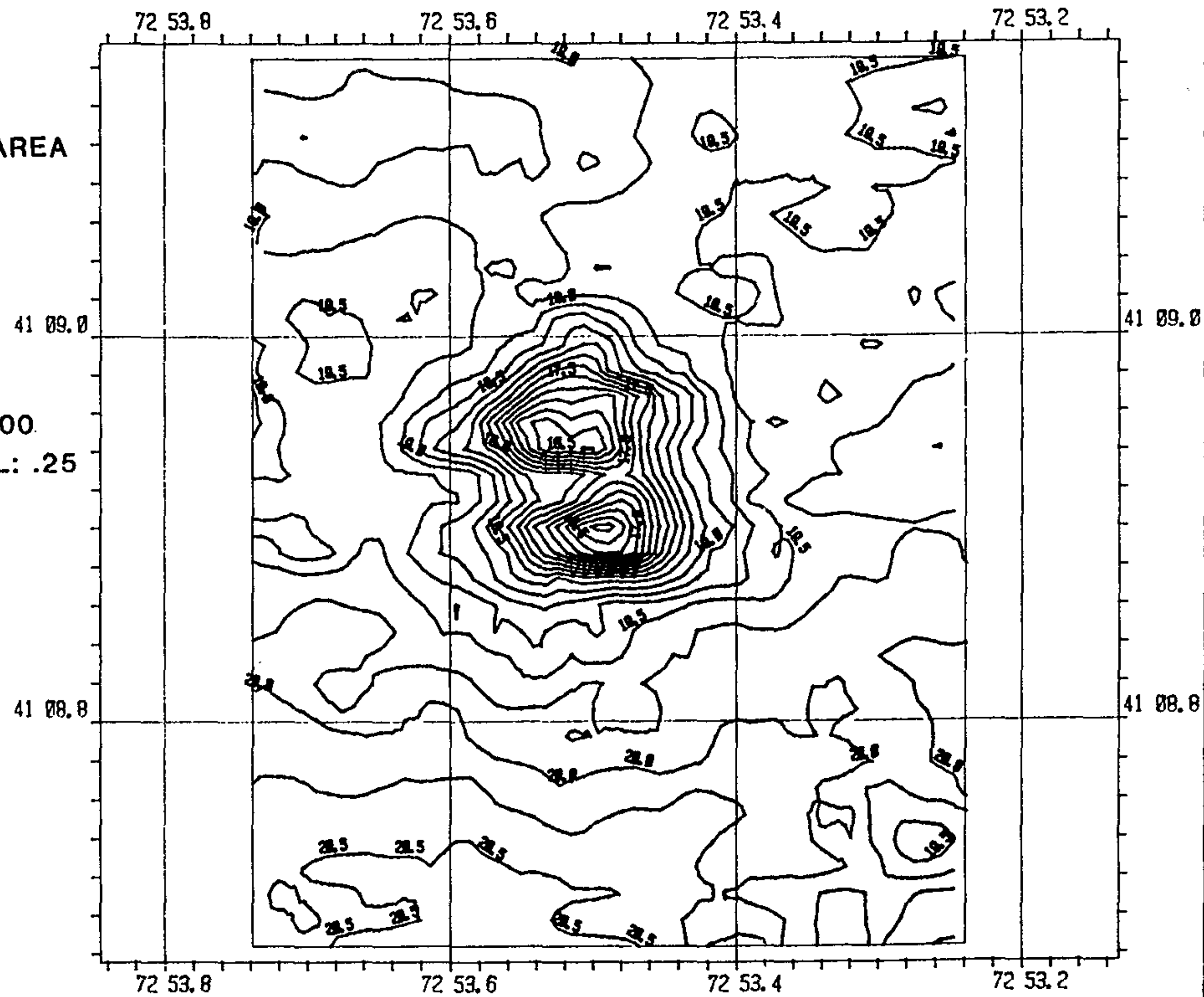
SCALE (m)

NORWALK SURVEY AREA

JANUARY 1982
CHART SCALE 1/4000
CONTOUR INTERVAL: .25

FIGURE I-3-5

0 80 160
SCALE (m)



NORWALK SURVEY AREA

11 DECEMBER 1982
CHART SCALE 1/4000
CONTOUR INTERVAL .2

FIGURE I-3-6

0 80 160
SCALE (m)

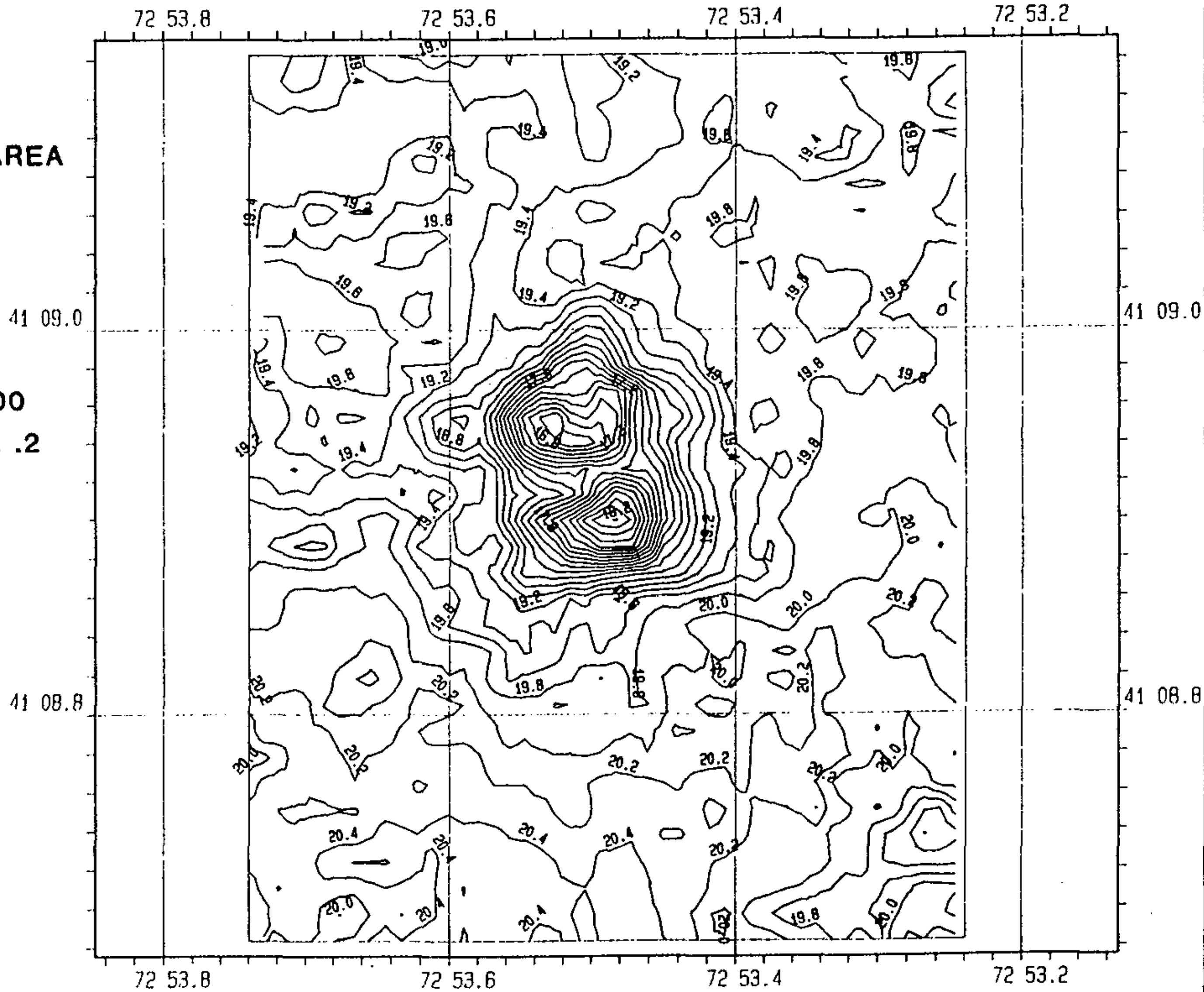


TABLE I-3-1.
Norwalk - North-South Transect
Chemical Analysis
August 1981

Location	% Vol Solids NED	Pb ppm	Zn ppm	Cr ppm	Cu ppm
400N-A	--	60	160	110	110
B	--	70	150	100	80
275N-A	--	140	280	140	280
A	--	100	220	120	150
B	--	110	180	110	130
B	--	260	490	140	260
C	--	350	620	200	930
C	--	80	190	150	150
50N-A	--	180	370	140	250
B	--	150	340	180	240
C	--	180	340	190	250
CTR-A	--	80	240	130	160
B	--	80	240	130	150
C	--	140	280	140	190
50S-A	--	80	240	130	150
B	--	120	230	140	170
C	--	210	390	230	320
450S-A	--	140	260	140	60
B	--	130	290	150	150
C	--	100	240	120	130
550S-A	--	180	400	170	240
REF-A	--	40	160	90	60
B	--	50	170	90	60
C	--	50	190	90	50

TABLE I-3-1 (Cont.)
Norwalk - East-West Transect
Chemical Analysis
August 1981

Location	% Vol Solids NED	Pb ppm	Zn ppm	Cr ppm	Cu ppm
450E-A	--	90	170	100	70
B	--	60	180	110	90
C	--	50	210	130	110
300E-A	--	90	170	90	80
B	--	130	210	120	110
C	--	110	190	100	110
CTR-A	--	80	240	130	160
B	--	80	240	130	150
C	--	140	280	140	190
300W-A	--	110	280	110	130
B	--	90	260	80	120
C	--	100	230	110	110
400W-A	--	170	270	140	190
B	--	50	130	100	80
C	--	50	170	100	80

TABLE I-3-2.
Norwalk
Chemical Analysis
North-South Transect
January 1982

Location	% Vol Solids NED	Pb ppm	Zn ppm	Cr ppm	Cu ppm
200N-A	6.67	*	44	*	10
B	5.69	121	357	108	229
C	7.88	305	677	121	682
100N-A	4.69	79	281	86	153
B	5.10	150	375	79	333
C	5.44	109	353	94	183
CTR-A	6.50	73	170	62	63
B	6.10	120	290	120	220
C	6.50	95	240	100	190
50S-A	6.57	144	465	112	252
B	6.14	50	240	59	104
C	4.81	102	269	81	159
100S-A	3.45	81	218	40	65
B	4.11	26	137	58	65
C	3.29	154	271	43	110
200S-A	2.51	113	183	36	57
REF-A	4.17	48	140	68	50
B	3.74	68	140	84	54
C	4.15	56	150	84	55

*Below minimum detection limit.

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TABLE I-3-2 (Cont.)
Norwalk
Chemical Analysis
West-East Transect
January 1982

Location	% Vol Solids NED	Pb ppm	Zn ppm	Cr ppm	Cu ppm
200W-A	4.22	53	191	74	108
B	4.67	44	171	65	84
C	5.45	103	319	117	201
100W-A	4.25	66	257	88	138
B	3.48	23	168	38	43
C	4.26	57	242	75	128
CTR-A	6.50	73	170	62	63
B	6.10	120	290	120	220
C	6.50	95	240	100	190
100E-A	6.41	126	468	146	279
B	--	131	456	113	240
C	5.83	148	577	189	257
200E-A	4.02	124	323	101	118
B	5.12	105	399	145	161
C	4.66	135	270	113	126
REF-A	4.17	48	140	68	50
B	3.74	68	140	84	54
C	4.15	56	150	84	55

TABLE I-3-3.
Norwalk
Chemical Analysis
August 1982

Location	% Vol Solids NED	Pb ppm	Zn ppm	Cr ppm	Cu ppm
450E-A	2.59	160	170	60	97
B	4.49	180	180	74	71
C	5.29	140	170	57	153
300E-A	5.13	240	220	42	79
B	3.66	120	250	54	67
C	6.19	160	310	120	220
CTR-A	4.60	180	290	78	170
B	4.53	130	180	52	120
C	4.06	180	230	71	170
150W-A	4.94	140	317	81	153
B	4.16	53	256	50	134
C	4.66	140	268	78	149
300W-A	4.12	56	176	64	97
B	4.00	36	168	61	81
C	3.73	43	225	47	65
REF-A	4.34	140	170	55	55
B	4.70	160	160	55	56
C	4.19	100	150	49	49

*Below minimum detection limit.

TABLE I-3-4.
Norwalk
Chemical Analysis
December 1982

Location	% Vol Solids NED	Pb ppm	Zn ppm	Cr ppm	Cu ppm
CTR-A	4.47	57	207	92	131
B	4.36	68	238	97	148
C	5.18	63	234	89	136
300E-A	5.29	64	219	82	106
B	4.43	71	242	91	124
C	4.29	63	220	80	104
450E-A	3.67	55	235	117	136
B	4.29	42	169	71	67
C	4.25	56	219	100	121

TABLE I-3-5.
Norwalk
Chemical Analysis
North-South Transect
August 1983

Location	% Vol Solids NED	Pb ppm	Zn ppm	Cr ppm	Cu ppm
200N-A	4.98	37	189	61	99
B	6.44	31	160	57	86
C	6.00	82	287	82	237
100N-A	7.12	53	217	61	114
B	7.14	138	325	97	188
C	--	44	193	59	91
CTR-A	5.45	115	348	80	175
B	6.01	108	337	97	205
C	5.25	53	207	67	107
50S-A	7.44	102	366	116	208
B	5.90	45	179	63	92
C	4.90	47	211	20	91
100S-A	6.86	115	351	130	212
B	5.38	72	235	79	111
C	5.32	55	208	79	104
200S-A	5.00	70	260	83	133
B	5.75	57	263	80	133
C	6.49	56	232	80	122
REF-A	4.98	56	177	54	54
B	4.50	45	201	58	61
C	4.38	52	175	51	52

TABLE I-3-5 (Cont.)
Norwalk
Chemical Analvsis
East-West Transect
August 1983

Location	% Vol Solids NED	Pb ppm	Zn ppm	Cr ppm	Cu ppm
200W-A	4.43	53	251	86	90
B	4.69	60	232	84	103
C	4.44	64	239	99	119
100W-A	5.19	63	268	84	106
B	6.60	119	223	91	116
C	--	49	175	61	82
CTR-A	5.45	115	348	80	175
B	6.01	108	337	97	205
C	5.25	53	207	67	107
100E-A	4.96	62	212	64	110
B	4.22	28	168	46	61
C	4.17	45	180	55	84
200E-A	4.09	44	220	52	77
B	3.75	45	221	68	93
C	4.21	68	293	96	151
REF-A	4.98	56	177	54	54
B	4.50	45	201	58	61
C	4.38	52	175	51	52

SAIC

3.1.3 Benthic Community

The benthic community at the Norwalk disposal site was sampled in April 1980, prior to disposal, and in January and August 1981, January and August 1982, and January 1983. The August 1981 samples have been processed after disposal, with three replicates from each of three stations, the center of the mound (CTR), the inner edge (IE) and the outer edge (OE). The data are presented in Table I-3-6.

The mean number of species at the CTR station in April 1980 (pre-disposal) was 11, ranging from 4 to 19. In the August 1981 samples, the mean was 8.7 and ranged from 4 to 15 (Fig. I-3-7a). The center samples have significantly lower numbers of individuals per replicate (Fig. I-3-7b) and, except for one replicate, fewer numbers of species.

The densities of the dominant species at the site are displayed in Figures I-3-8 to I-3-11. For all of the dominant species, densities are consistently lower at the center station. These data indicate that the mound has not been completely recolonized in the six weeks following the disposal of the cap material. The complete analysis of all collected samples would describe the rate of recolonization of the Norwalk mound.

3.1.4 REMOTS

In January 1983, REMOTS samples were taken at nine stations along the north-south and east west transects at the Norwalk disposal site. Three replicates were taken at each of the nine stations shown in Figure I-3-12a. A wide range of RPD depth values were found at this site, with values ranging from a low of 2.17 to a high of 6.36 (Fig. I-3-12b). Over 75% of the boundary roughness values are less than 0.8 cm (Fig. I-3-13), and 25 of the 27 station replicates show that most of the surveyed area consists of silt-clay, although two of four replicates at the Center Station show the presence of very fine sand mixed with mud. The major mode for grain size was $\leq 4\phi$ (Fig. I-3-13).

The lowest mean RPD depth values lie along the N-S transect and include stations CTR, 150S, 100N, and 300N. It is important to note that these same stations are occupied by either a Stage I assemblage or a mixture of I and III-I (Fig. I-3-14a). As a result, the habitat indices indicate that the most affected stations lie along the N-S transect (Fig. I-3-14) and that the CTR and 100N stations have comparable indices, followed by 300N and 150S. The balance of the stations are located on relatively undisturbed bottoms. Replicates 1 and 3 of station 400W probably represent a local (within station) disturbance. Within station variance at 150S is also great (Fig. I-3-15), with each replicate yielding a different habitat index (Fig. I-3-14b).

Recolonization of the sites has been partially successful. Although the CTR station is near the depositional center of the disposal site, the bottom has been successfully colonized by a Stage I polychaete assemblage (Fig. I-3-16).

TABLE I-3-6

Benthic Community, Norwalk, August 1981

	NRWK-NH-OE 8/21/81			NRWK-NH IE 8-21-81			NRWK-NH CTR 8-20-81		
	REP4	REP6	REP9	REP1	REP2	REP6	REP8	REP9	REP10
CNIDARIA	.	.	.	.	.	.	.	.	.
Edwardsia elegans	.	.	.	.	.	.	.	.	.
Haloclava producta	.	.	.	.	.	.	.	.	.
Corymorpha pendula	.	.	.	.	.	.	.	.	.
Ceriantheopsis americanus	1	3	2	6	5	2	.	.	.
PLATYHELMINTHES SPECIES	.	.	.	.	.	.	.	.	.
RHYNCHOCOELA	.	.	.	.	.	.	.	.	.
Cerebratulus spp.	.	.	.	1	0	0	1	0	0
Micrura sp.	.	.	.	.	.	.	.	.	.
Tubulanus pellucidus	.	.	.	0	1	0	.	.	.
Tetrastemmidae species	.	.	.	.	.	.	.	.	.
Rhynchocoel RB	.	.	.	.	.	.	.	.	.
Phoronida									
Phoronis muelleri	2	0	1	0	0	1	.	.	.
GASTROPODA	.	.	.	.	.	.	.	.	.
Crepidula plana	.	.	.	.	.	.	.	.	.
Lunitia heros	1	0	2	0	4	0	0	1	0
Polynices duplicatus	.	.	.	.	.	.	.	.	.
Mitrella lunata	0	0	1	.	.	.	.	.	.
Nassarius trivittatus	6	2	3	3	0	0	0	6	0
Aceton punctostriata	.	.	.	.	.	.	.	.	.
Retusa canaliculata	.	.	.	.	.	.	.	.	.
Cyclichna oryza	.	.	.	.	.	.	.	.	.
Turbonilla interrupta	.	.	.	.	.	.	.	.	.
Opisthobranchia	.	.	.	.	.	.	.	.	.
BIVALVIA	.	.	.	.	.	.	.	.	.
Nucula annulata	89	125	78	320	106	127	0	4	0
Yoldia limatula	1	7	2	3	3	0	.	.	.
Anadara transversa	.	.	.	.	.	.	.	.	.
Mercenaria mercenaria	.	.	.	0	1	0	1	0	0
Pitar morrhuana	15	42	13	9	9	9	.	.	.
Mulinia lateralis	5	6	1	27	26	1	9	0	1

TABLE I-3-6 (Cont.)

Benthic Community, Norwalk, August 1981

	NRWK-NH-OE 8/21/81			NRWK-NH IE 8-21-81			NRWK-NH CTR 8-20-81		
	REP4	REP6	REP9	REP1	REP2	REP6	REP8	REP9	REP10
Tellina versicolor	.	.	.	.	.	.	.	.	.
Macoma tenta	.	.	.	.	.	.	.	.	.
Ensis directus	.	.	.	.	.	.	.	.	.
Pandora gouldiana	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.
POLYCHAETA	.	.	.	.	.	.	.	.	.
Harmothoe sp.	.	.	.	.	.	.	1	0	0
Paranaitis speciosa	0	0	5	.	.	.	0	1	0
Phyllodoce arenia	.	.	.	.	.	.	0	3	0
Lepidonotus sublevis	.	.	.	.	.	.	.	.	.
Phloe minuta	.	.	.	.	.	.	.	.	.
Glycera dibranchiatus	.	.	.	0	0	1	.	.	.
Nephtys incisa	13	13	0	16	6	10	3	5	0
Nephtys picta	.	.	.	.	.	.	.	.	.
Syllis sp.	.	.	.	.	.	.	.	.	.
Sigambra tentaculata	5	0	0	3	3	1	.	.	.
Nereis sp.	.	.	.	.	.	.	0	1	0
Mediomastus ambiseta	.	.	.	.	.	.	0	0	16
Aricidea sp.	.	.	.	.	.	.	.	.	.
Clymenella torquata	.	.	.	.	.	.	.	.	.
Polydora caulleryi	2	0	0	.	.	.	.	.	.
Polydora socialis	.	.	.	.	.	.	.	.	.
Spiochaetopterus oculatus	.	.	.	.	.	.	.	.	.
Spiophanes bombyx	.	.	.	.	.	.	.	.	.
Streblospio benedicti	.	.	.	.	.	.	.	.	.
Paraonis gracilis	1	0	0	.	.	.	.	.	.
Sabellaria vulgaris	.	.	.	.	.	.	.	.	.
Pherusa affinis	0	1	0	3	0	0	0	1	0
Lumbrineris fagilis	.	.	.	.	.	.	.	.	.
Ninoe nigripes	.	.	.	.	.	.	.	.	.
Scoloplos sp.	.	.	.	.	.	.	.	.	.
Tharyx sp. A	.	.	.	.	.	.	.	.	.
Tharyx sp.	.	.	.	.	.	.	.	.	.
Owenia fusiformis	.	.	.	.	.	.	0	1	0
Pectinaria gouldii	86	165	38	54	51	17	9	7	5
Amphitrite ornata	.	.	.	.	.	.	.	.	.
Ampharete acutifrons	.	.	.	.	.	.	0	1	0

TABLE I-3-6 (Cont.)

Benthic Community, Norwalk, August 1981

	NRWK-NH-OE 8/21/81			NRWK-NH IE 8-21-81			NRWK-NH CTR 8-20-81		
	REP4	REP6	REP9	REP1	REP2	REP6	REP8	REP9	REP10
Ampharete oculata	1	0	0	.	.	.	.	.	.
Ampharete arctica	.	.	.	.	.	.	.	.	.
Melinna cristata	.	.	.	.	.	.	.	.	.
Polycirrus sp.	.	.	.	.	.	.	.	.	.
Loimia medusa	.	.	.	.	.	.	.	.	.
OLIGOCHAETA SPECIES	0	0	2	.	.	.	0	1	1
CIRRIPEDIA	.	.	.	.	.	.	.	.	.
Balanus balanoides	.	.	.	.	.	.	.	.	.
Balanus crenatus	.	.	.	.	.	.	.	.	.
CUMACEA	.	.	.	.	.	.	.	.	.
Oxyurostylis smithi	.	.	.	.	.	.	0	1	0
ISOPODA	.	.	.	.	.	.	.	.	.
Edotea montosa	.	.	.	.	.	.	.	.	.
AMPHIPODA	.	.	.	.	.	.	.	.	.
Ampelisca vadorum	0	1	0	.	1	.	2	2	0
Unciola irrorata	.	.	.	.	.	.	.	.	.
Leptocheirus pinguis	.	.	.	.	.	.	.	.	.
Jassa falcata	.	.	.	.	.	.	.	.	.
Caprella sp.	.	.	.	.	.	.	.	.	.
MYSIDACEA	.	.	.	.	.	.	.	.	.
Neomysis americana	.	.	.	.	.	.	.	.	.
DECAPODA	.	.	.	.	.	.	.	.	.
Crangon septemspinosa	.	.	.	.	1	.	.	.	.
Axius serratus	.	.	.	.	.	.	0	1	0
Pagurus longicarpus	.	.	.	1	.	.	.	.	.
Pagurus pollicaris	.	.	.	.	.	.	.	.	.
Ovalipes ocellatus	.	.	.	.	.	.	.	.	.
Rhithropanopeus harrisii	.	.	.	.	.	.	.	.	.
Pinnixa sayana?	.	.	.	.	.	.	.	.	.

TABLE I-3 6 (Cont.)

Benthic Community, Norwalk, August 1981

	NRWK-NH-UE 8/21/81			NRWK-NH IE 8-21-81			NRWK-NH CTR 8-20-81		
	REP4	REP6	REP9	REP1	REP2	REP6	REP8	REP9	REP10
ASTEROIDEA	.	.	.	.	.	.	.	.	.
Asterias forbesi	.	.	.	.	.	.	.	.	.
HEMICHORDATA	.	.	.	.	.	.	.	.	.
Saccoglossus kowalevskii	.	.	.	.	.	.	.	.	.
Number of Species	14	10	12	12	13	9	7	15	4
Number of individuals	228	365	148	446	217	169	26	36	23

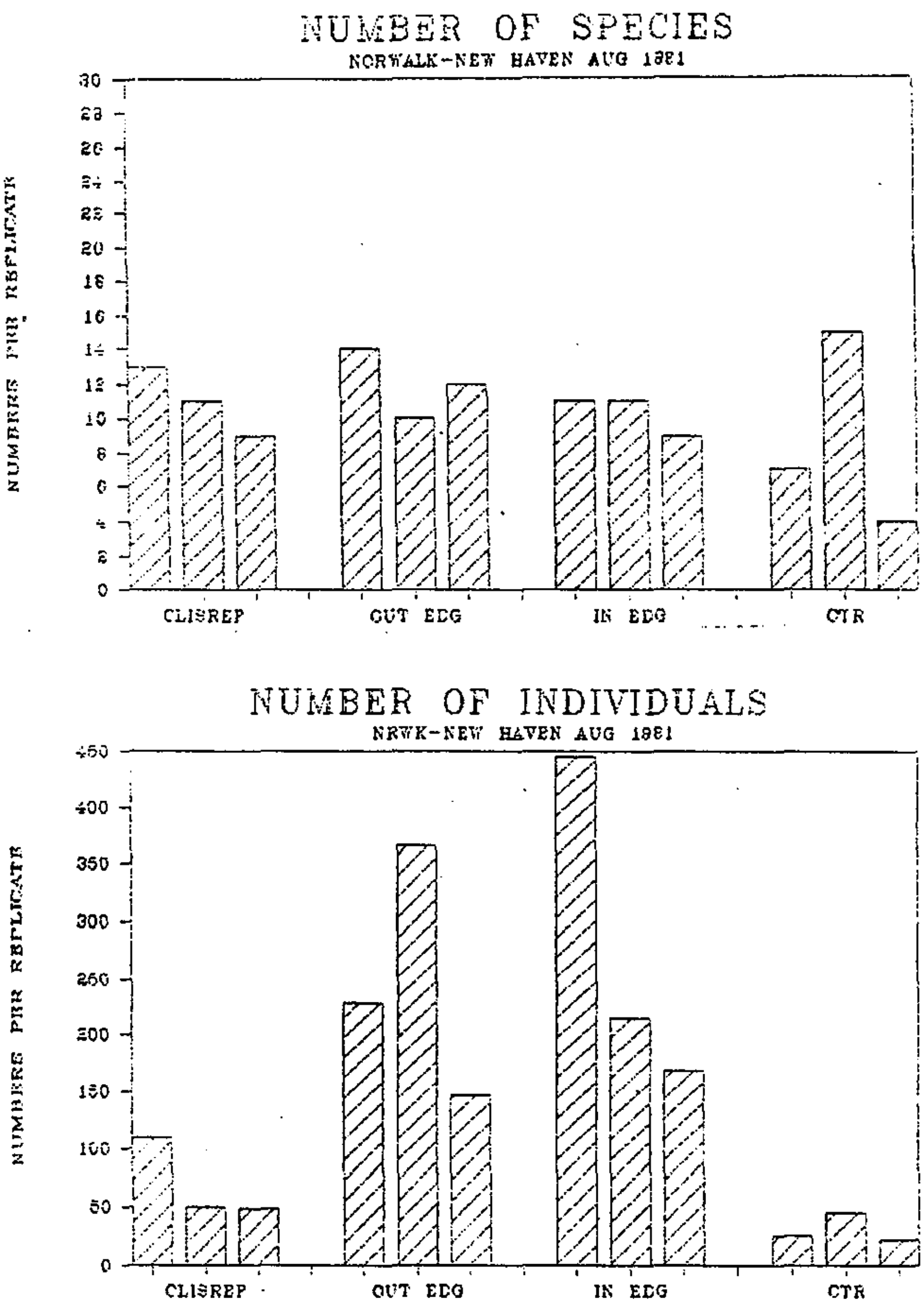
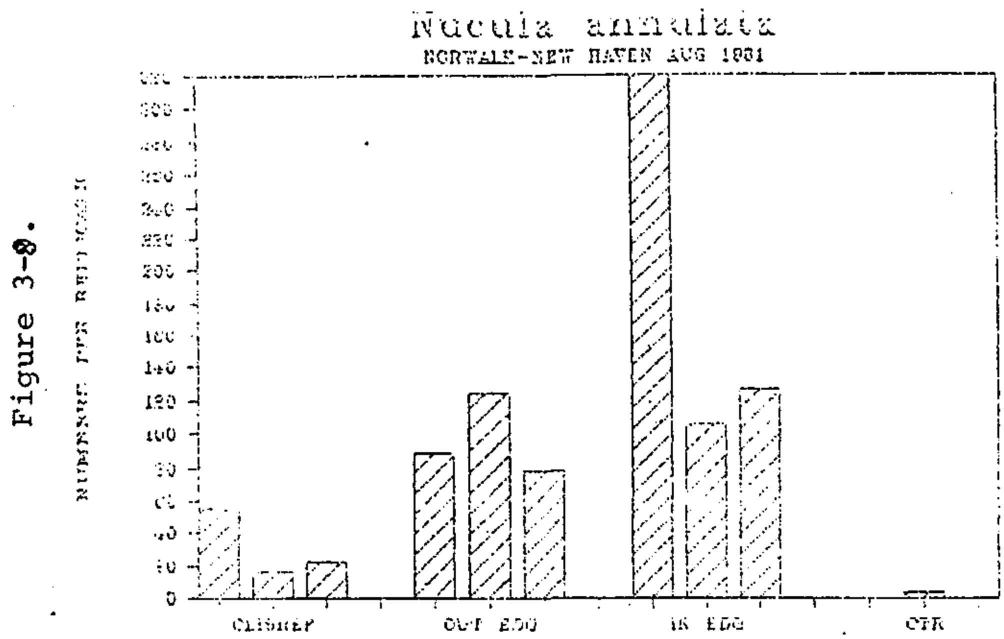


FIGURE I-3-7. Number of species and individuals at Norwalk, August 1981.



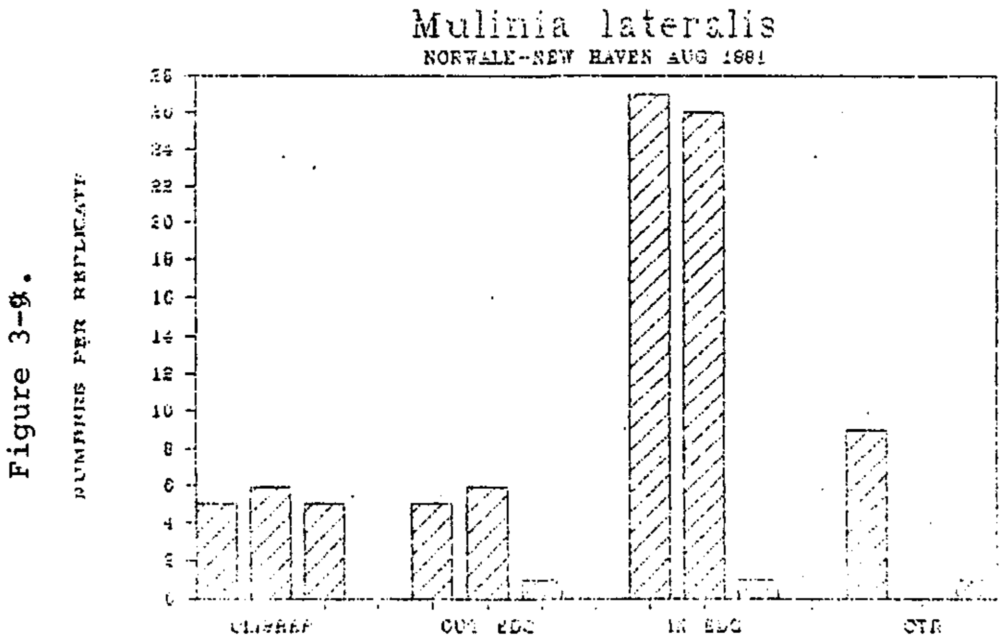


FIGURE I-3-8. Abundance of <u>Nucula annulata</u> at Norwalk, August 1981.

FIGURE I-3-9. Abundance of <u>Mulinia lateralis</u> at Norwalk, August 1981.

SAIC

Figure 3-10.

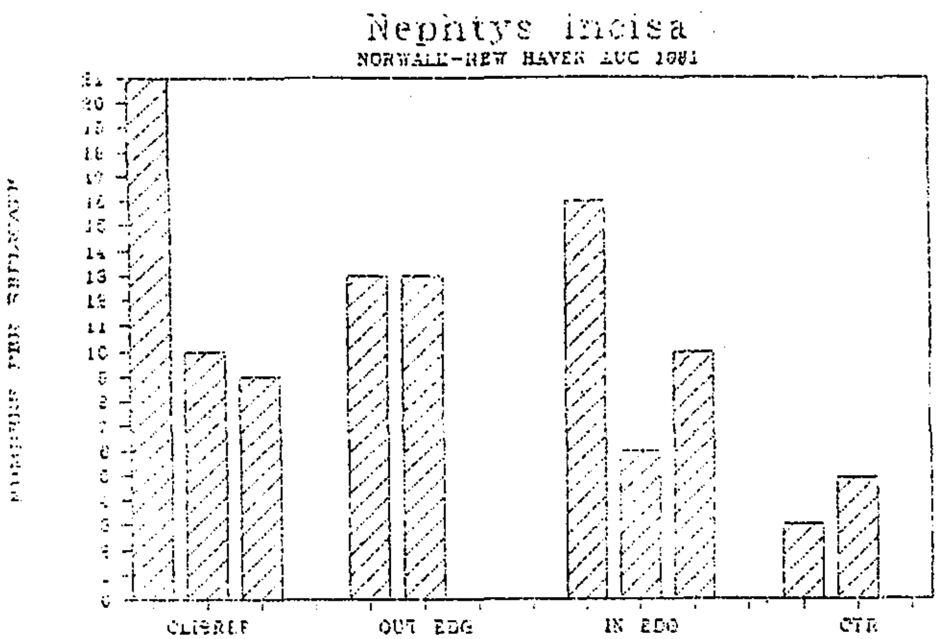


Figure 3-11.

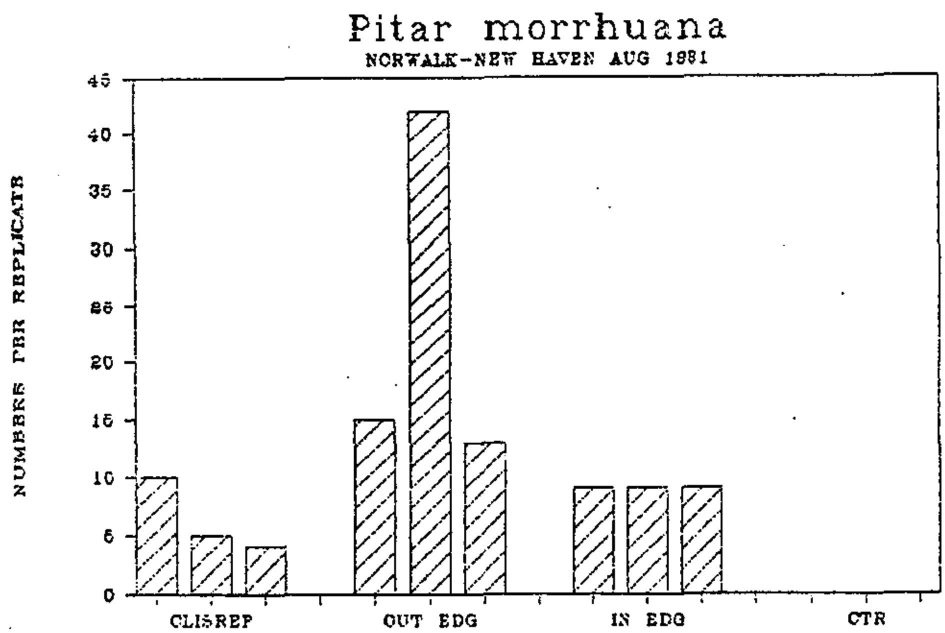


FIGURE I-3-10. Abundance of Nephtys incisa at Norwalk, August 1981.

FIGURE I-3-11. Abundance of Pitar morrhuana at Norwalk, August 1981.

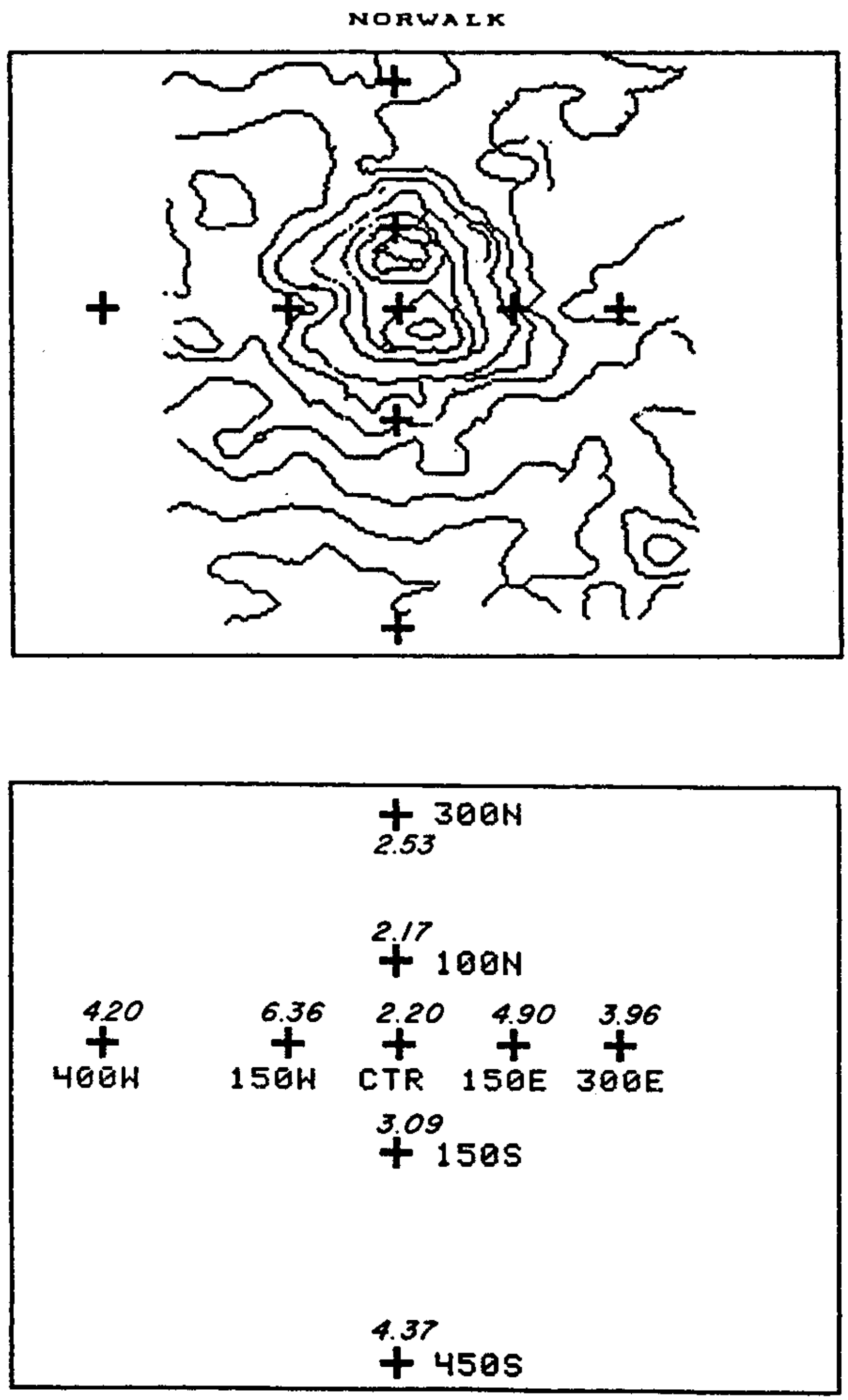


FIGURE I-3-12. Station locations and RPD depths at Norwalk, January 1983.

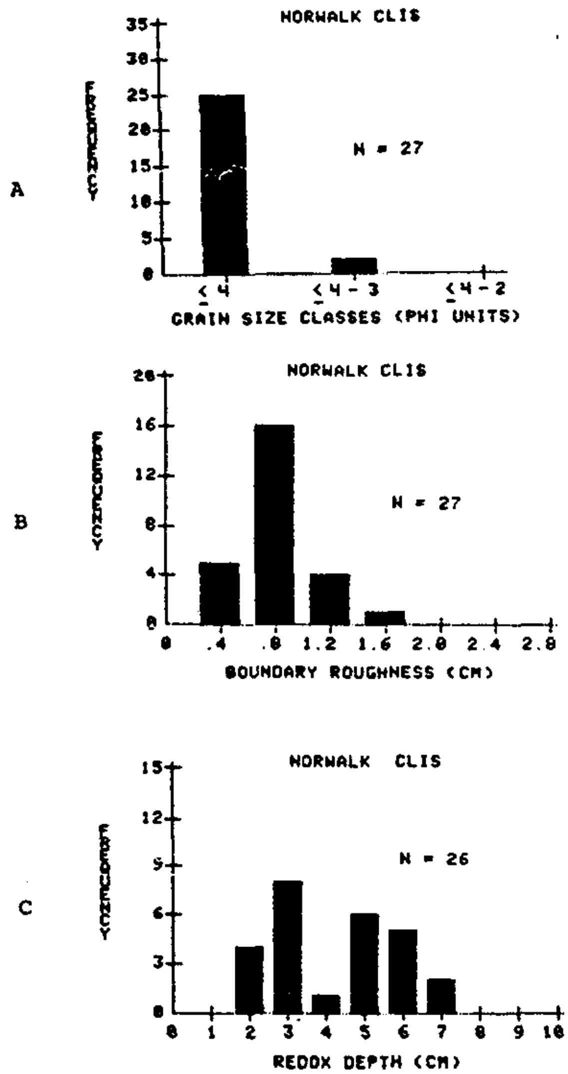
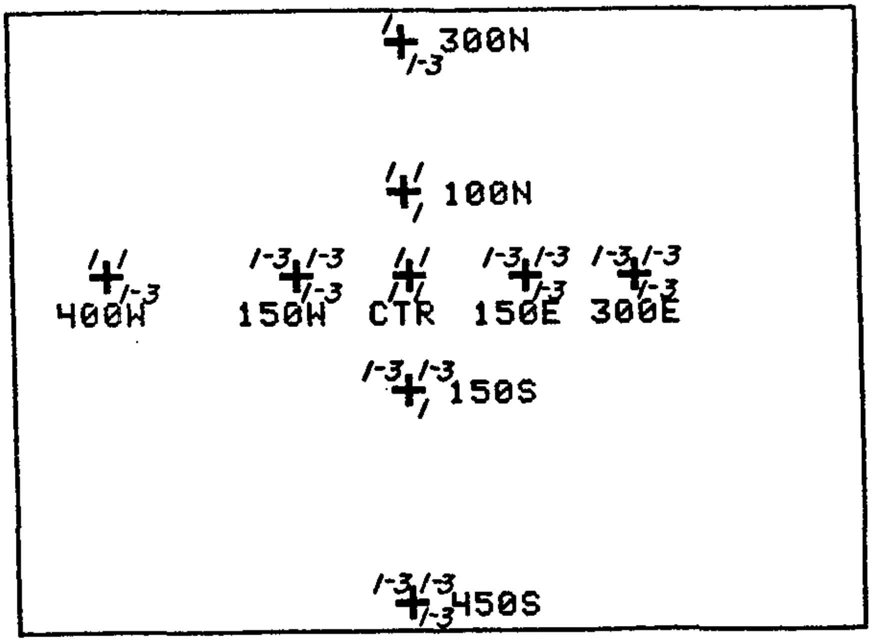
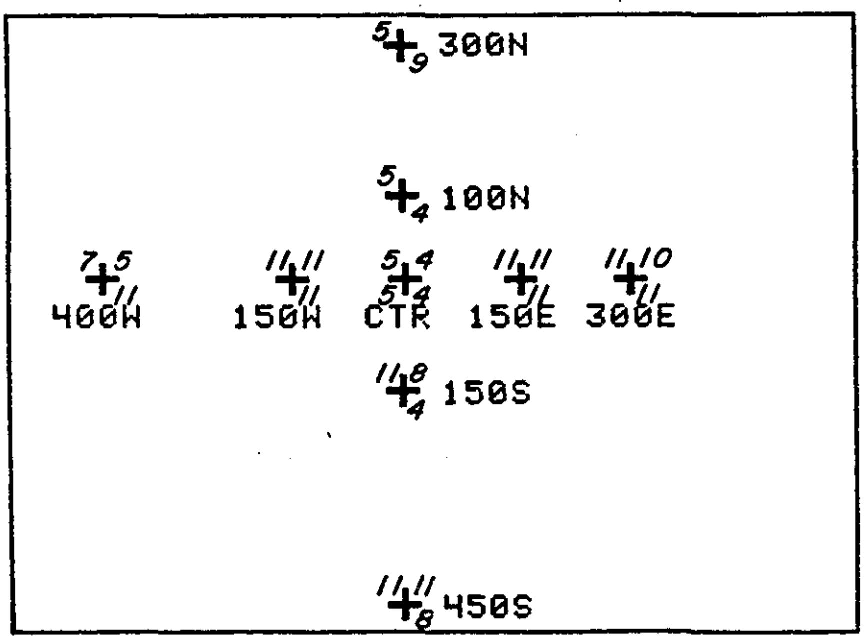


FIGURE I-3-13. Frequency distribution for grain size, boundary roughness, and redox depth at the Norwalk disposal site (CLIS), January 1983.



A



B

FIGURE I-3-14. Successional stages and habitat indices at Norwalk, January 1983.

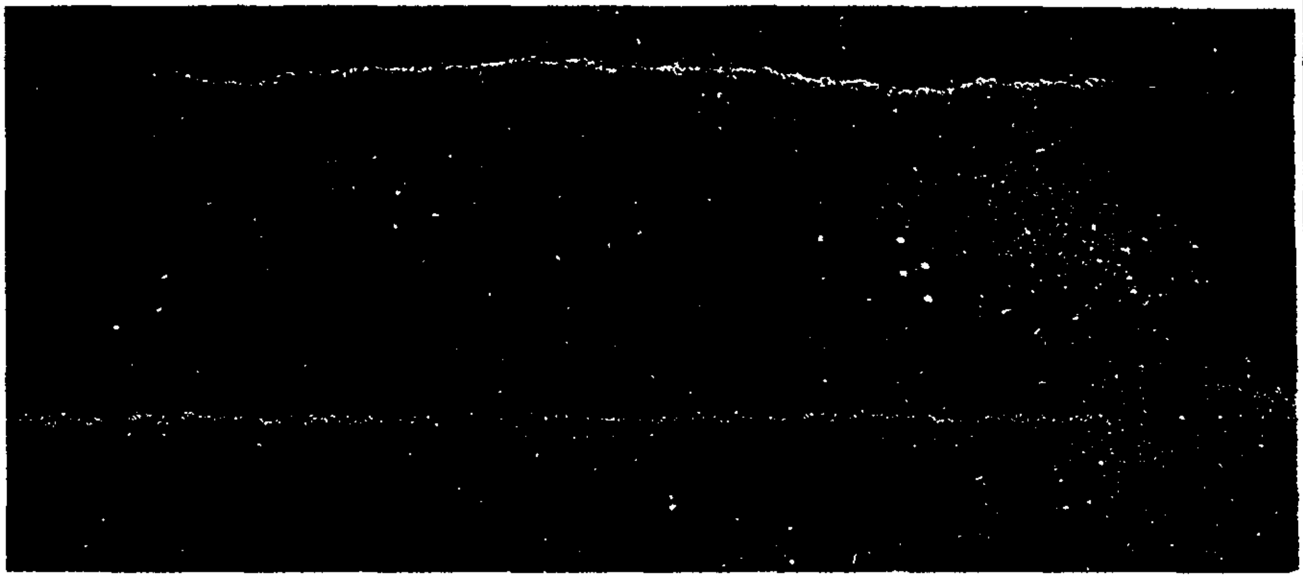


FIGURE I-3-15. Replicate 1.

FIGURE I-3-15. Replicate 2.

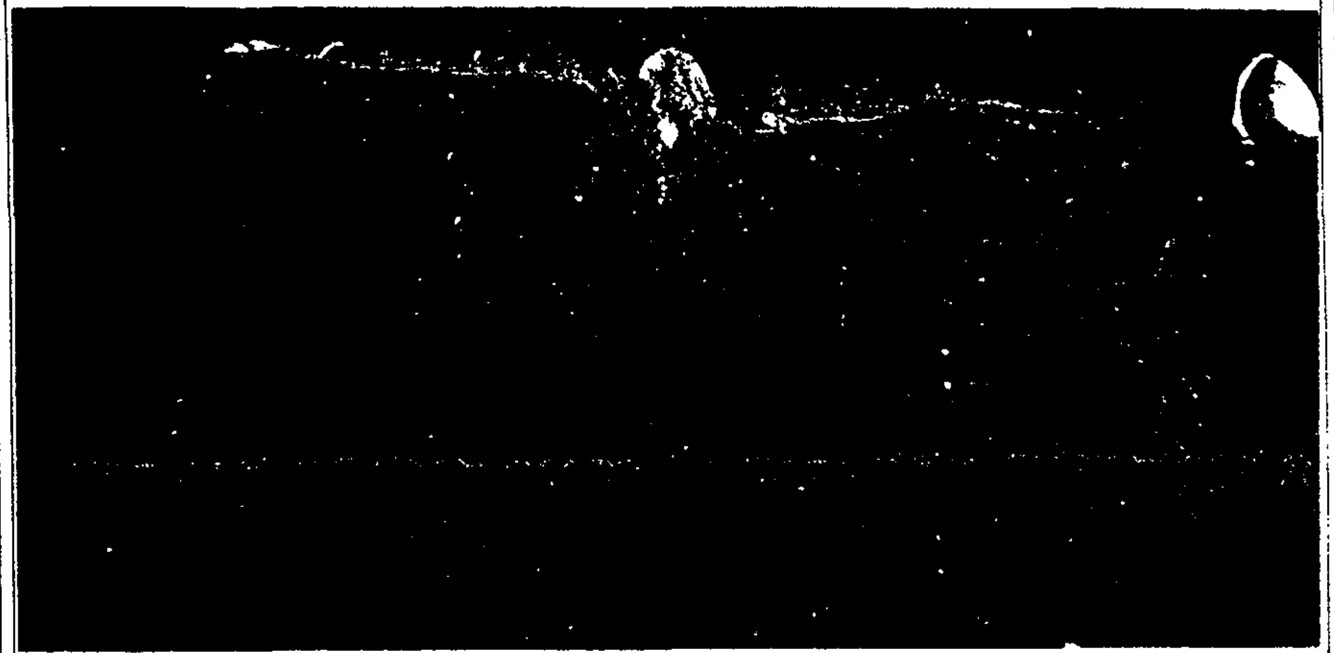


FIGURE I-3-15. Replicate 3.

FIGURE I-3-15. REMOTS replicates for station 150S at Norwalk, January 1983 showing variations in faunal patchiness.

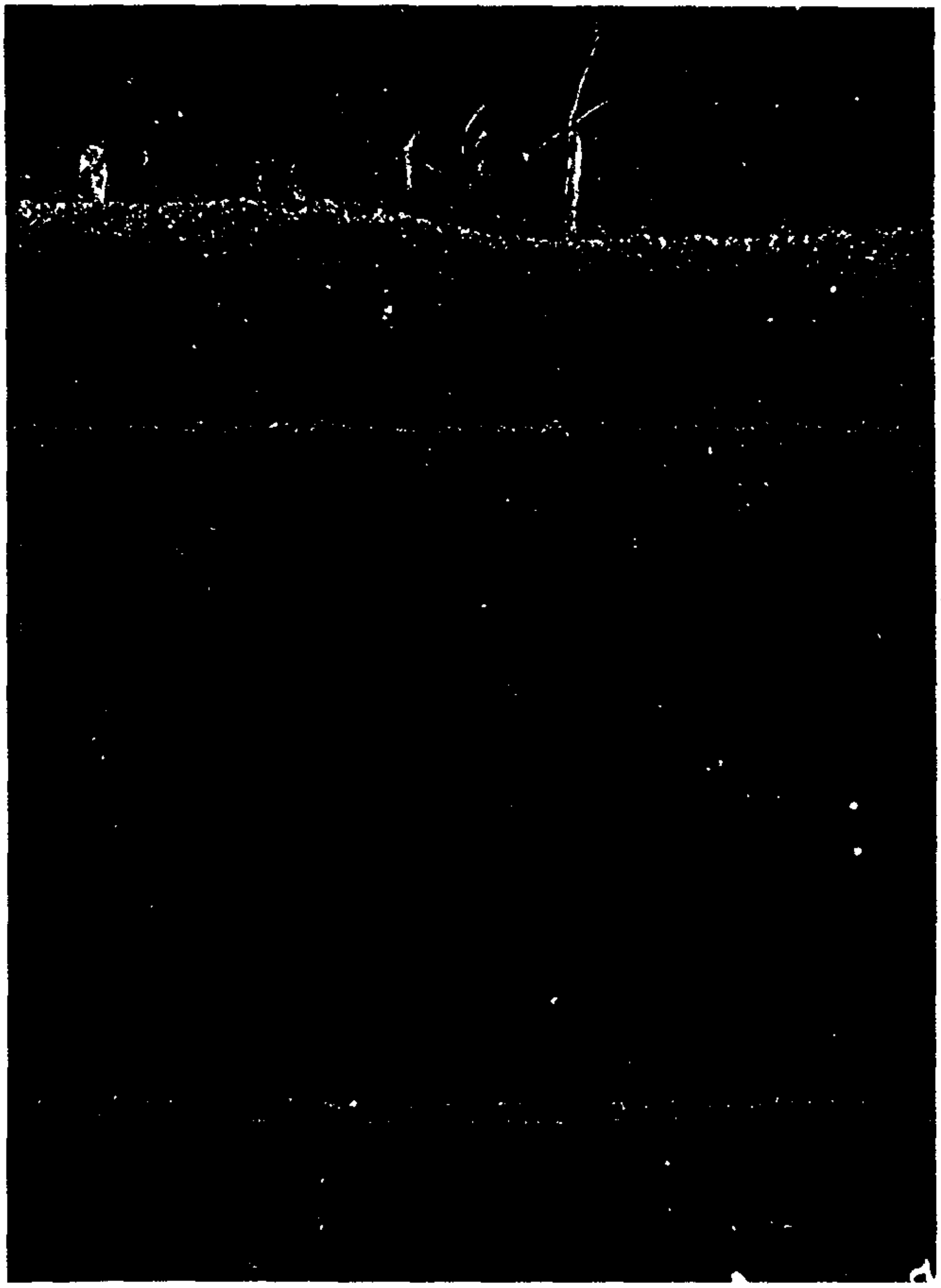


FIGURE I-3-16.   Norwalk, August 1981 station CTR.

Evidence for dumping at this station is a shallow RPD(1.6cm) with a Stage I polychaete assemblage.

However, the REMOTS data indicate that, although approximately 16 months have passed since disposal, the community has not yet returned to background conditions, especially on the north-south axis.

3.2 Stamford/New Haven North and South

As described in the introduction, these two disposal mounds (Fig. I-1-2) were the subject of a dredged material capping study in 1978-1979, the results of which were presented in the DAMOS 1980 Annual Report. In this study, relatively contaminated dredged material was capped with clean silty sediments at the south site and sandy sediments at the north site. Since completion of the capping study, a routine monitoring of these sites has been conducted over the past several years.

3.2.1 Bathymetry

The August 1979 bathymetric survey (Fig. I-3-17) at STNH-N was conducted after the sand cap was in place and disposal operations were completed. Additional surveys were conducted in November 1979 (Fig. I-3-18), and approximately one year later in September 1980 (Fig. I-3-19). Comparison of the August 1979 and September 1980 surveys shows that the minimum depth of the mound was 16.25m in August 1979 (approximately 2.75m thick), but slightly less than 17m (approximately 2m thick) in September 1980.

One possible explanation for the loss of material may be the passing of Hurricane David in early September 1979. However, some consolidation and compaction of the mound due to the emplacement of the sand cap in June 1979 may have continued to occur subsequent to the August 1979 survey. There appears to be a general smoothing of the contour lines over this period, indicating that the mound continued to adjust and settle, possibly through a combination of biological reworking and physical forces.

The bathymetric survey data for January 1981, and January, August and December 1982 are shown in Figures I-3-20, 21, 22, and 23, respectively. From September 1980 through this entire period, no further significant depth increase at the mound apex or change in the surrounding bottom was observed. In general, the configuration of the mound has remained the same from September 1980 through December 1982. Such stability enhances the credibility of the capping procedure, particularly for sandy cap material.

The bathymetric data for the STNH-S site for the same period of time are shown in Figures I-3-24 to I-3-30. The topography of the STNH-S mound changed drastically between August and November 1979 as a result of Hurricane David, which essentially flattened the top of the mound at a depth of approximately 18.5m. It is important to note that although this

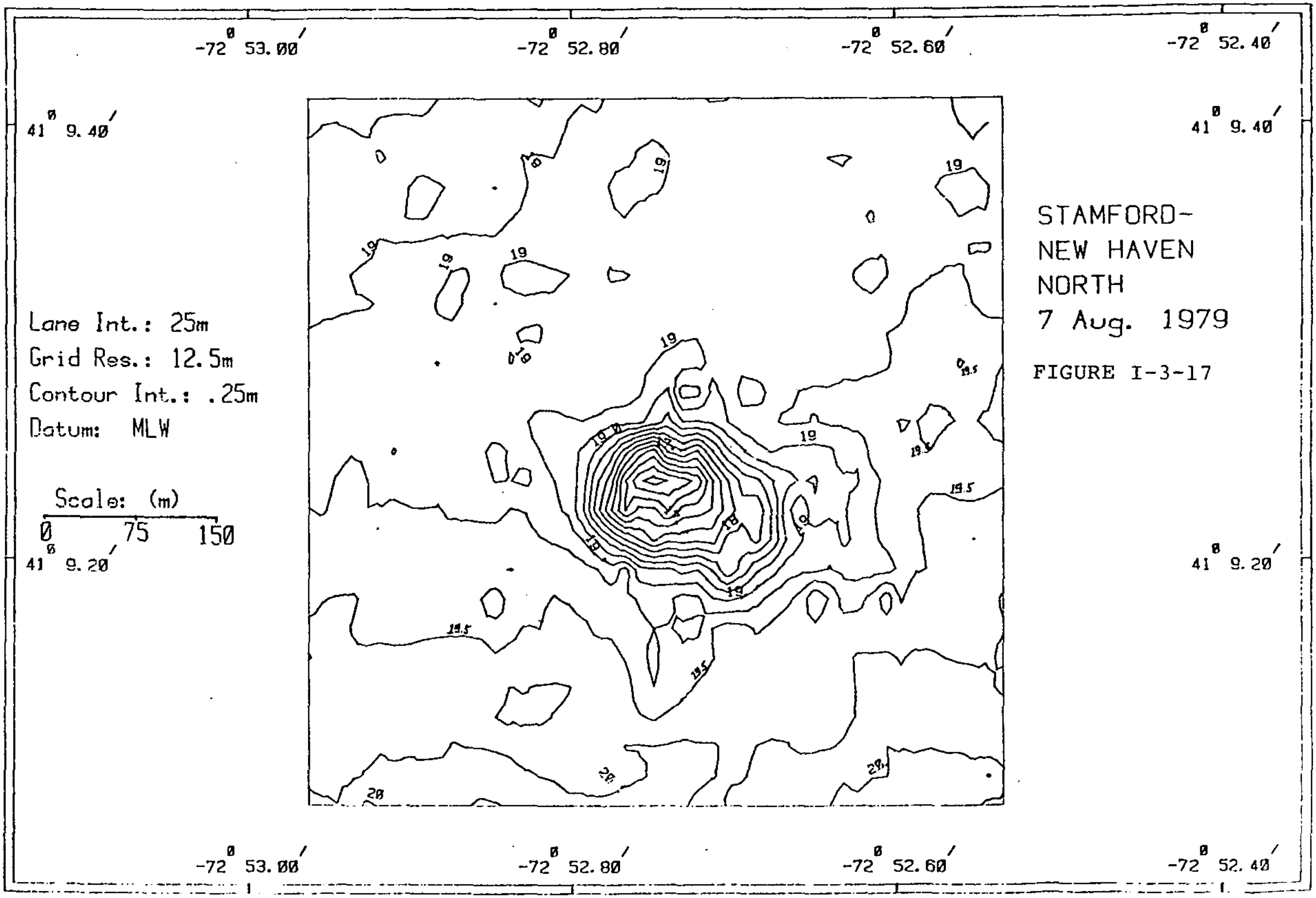
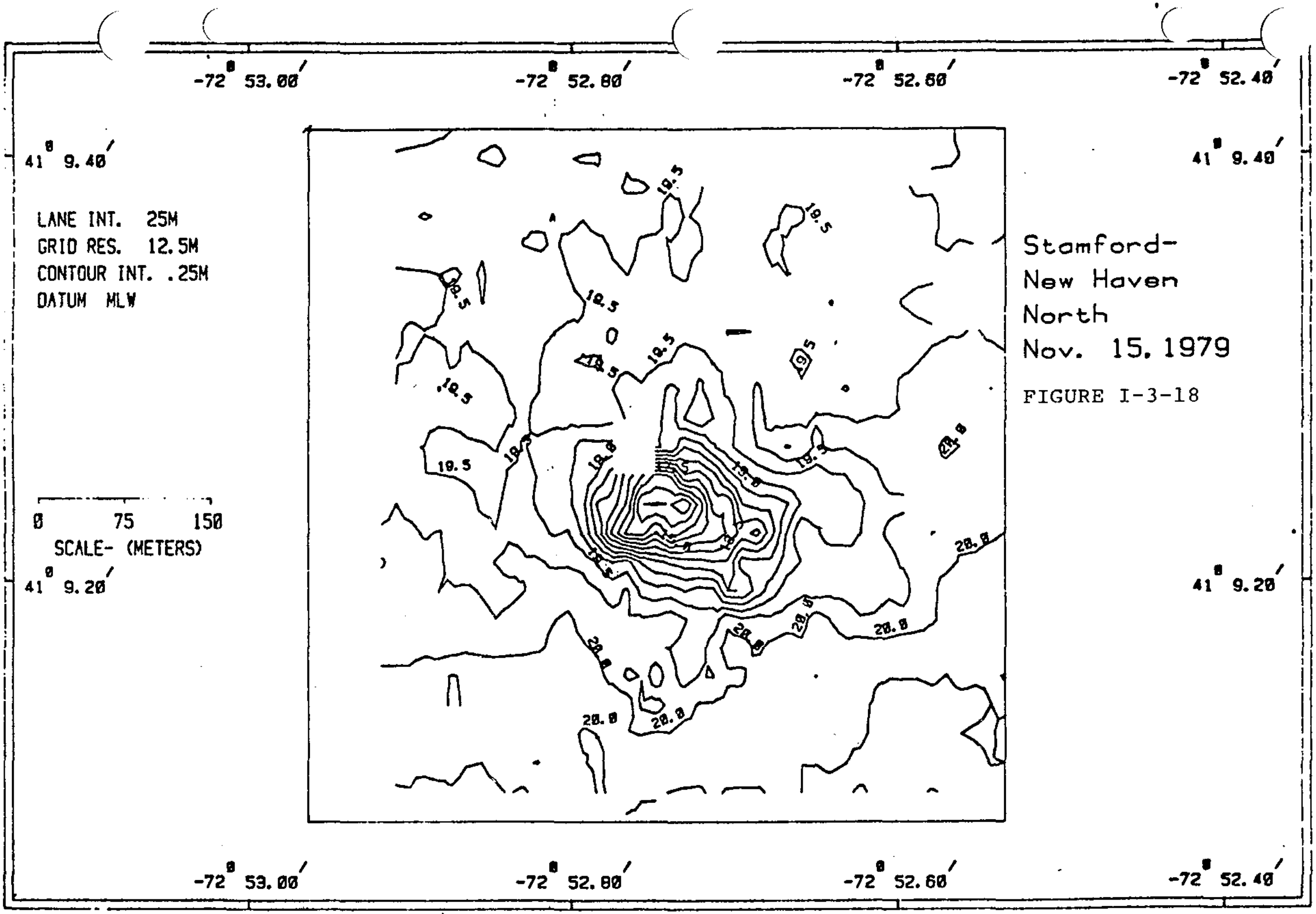

-72° 53.00'
-72° 52.80'
-72° 52.60'
-72° 52.40'
41° 9.40'
41° 9.20'
STAMFORD-
NEW HAVEN
NORTH
7 Aug. 1979
Lane Int.: 25m
Grid Res.: 12.5m
Contour Int.: .25m
Datum: MLW
Scale: (m)
0 75 150
19
19.5
20

FIGURE I-3-17



-72° 53.00'
-72° 52.80'
-72° 52.60'
-72° 52.40'
41° 9.40'
41° 9.20'
LANE INT. 25M
GRID RES. 12.5M
CONTOUR INT. .25M
DATUM MLW
0 75 150
SCALE- (METERS)
Stamford-
New Haven
North
Nov. 15, 1979
FIGURE I-3-18

FIGURE 5

STNH-N

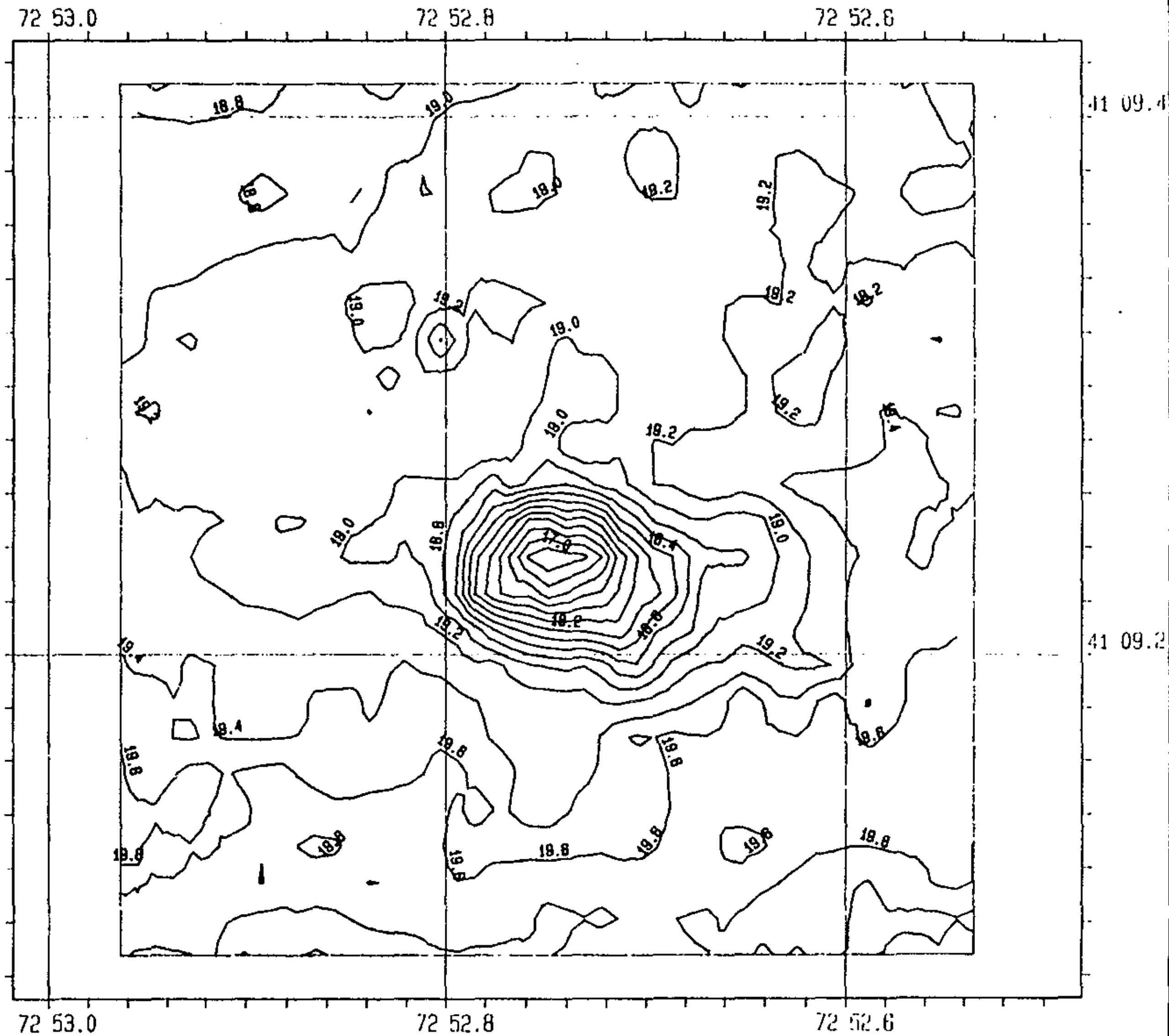
SEPTEMBER 1980

CHART SCALE 1/4000
CONTOUR INTERVAL .2m

FIGURE I-3-19

0 60 120

SCALE (m)



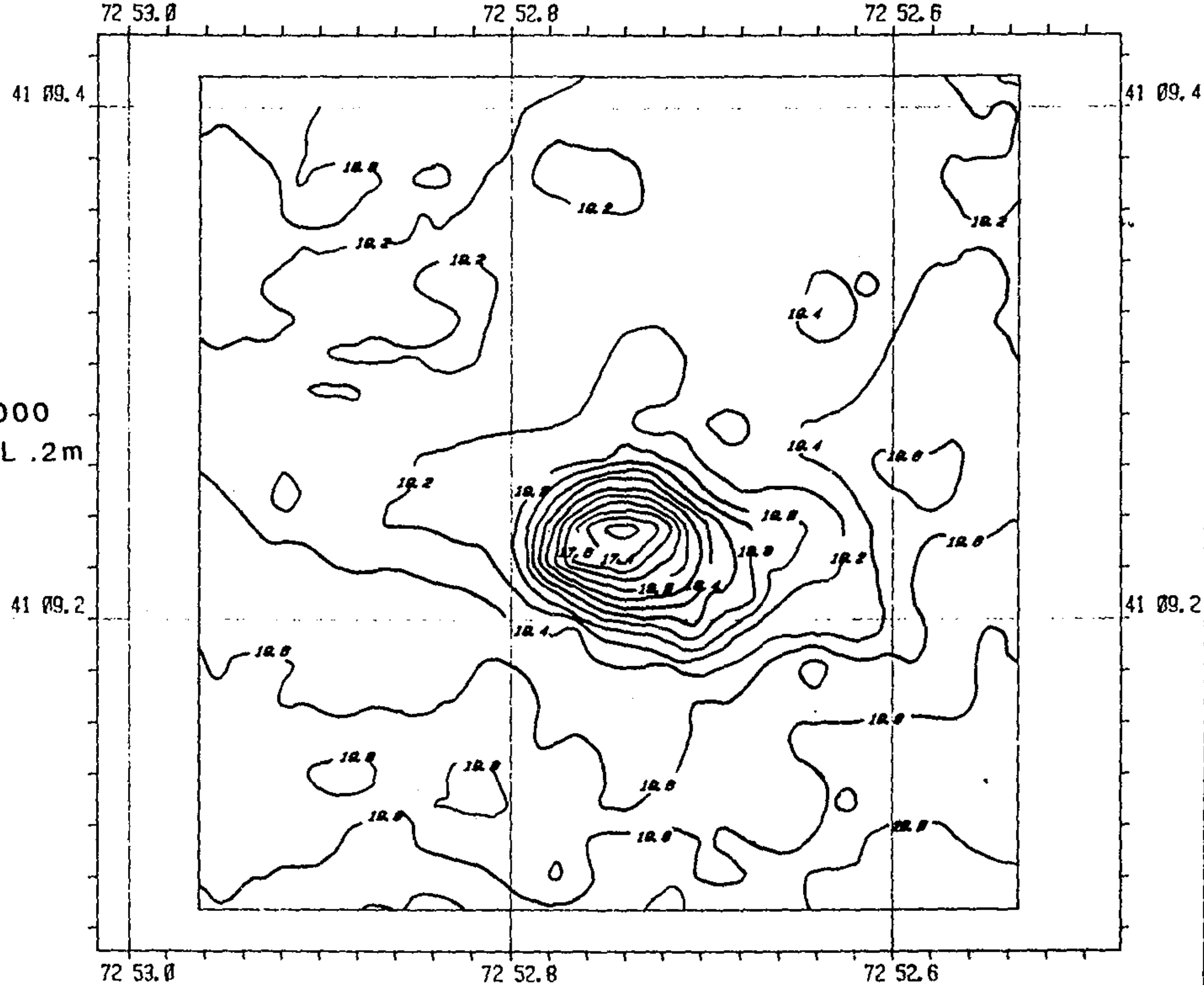
STNH-N

JANUARY 1981

CHART SCALE 1/4000
CONTOUR INTERVAL .2m

FIGURE I-3-20

0 60 120
SCALE (m)

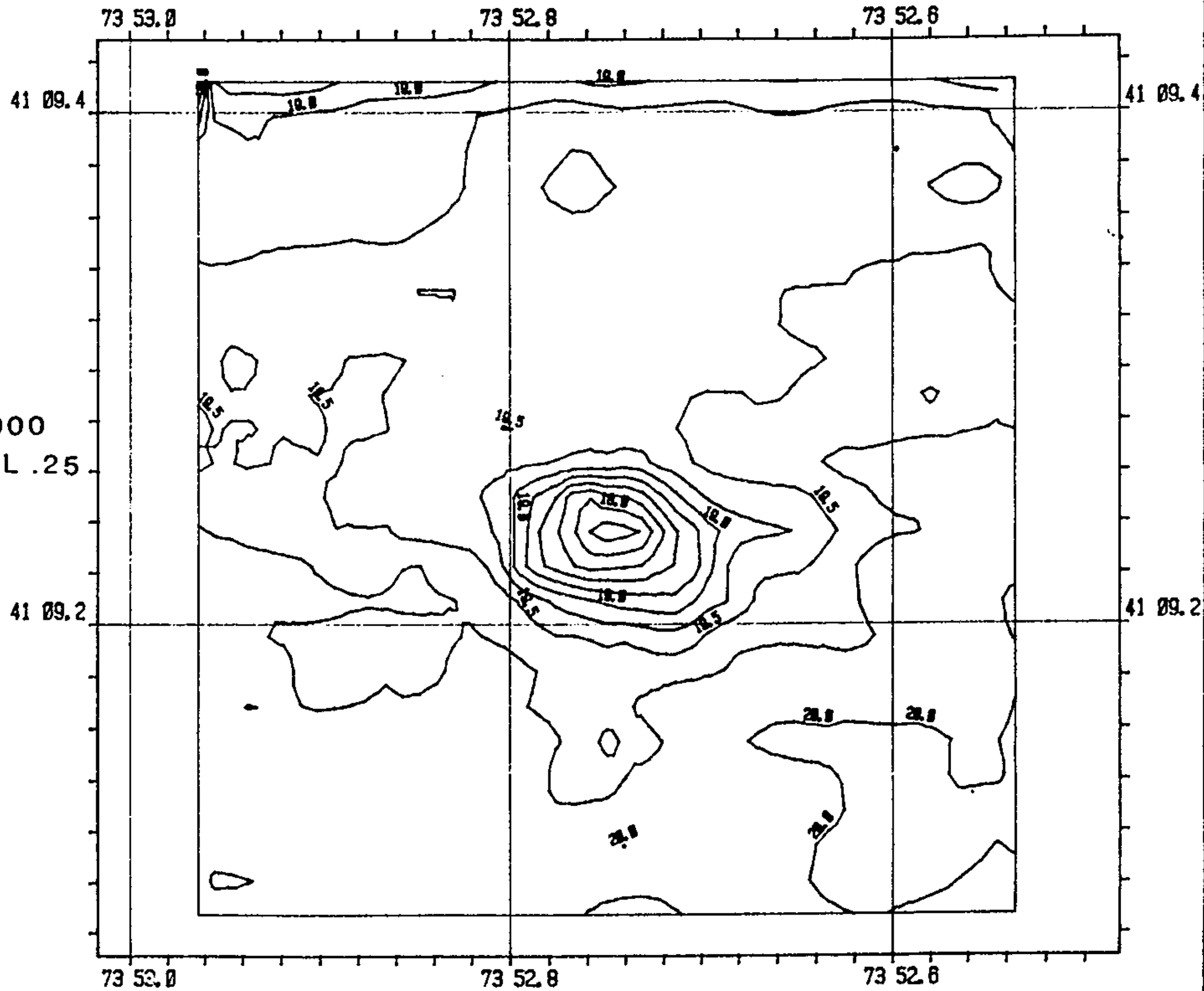


STNH-N

JANUARY 1982

CHART SCALE 1/4000
CONTOUR INTERVAL .25

FIGURE I-3-21



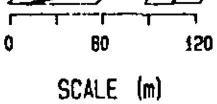
0 60 120
SCALE (m)

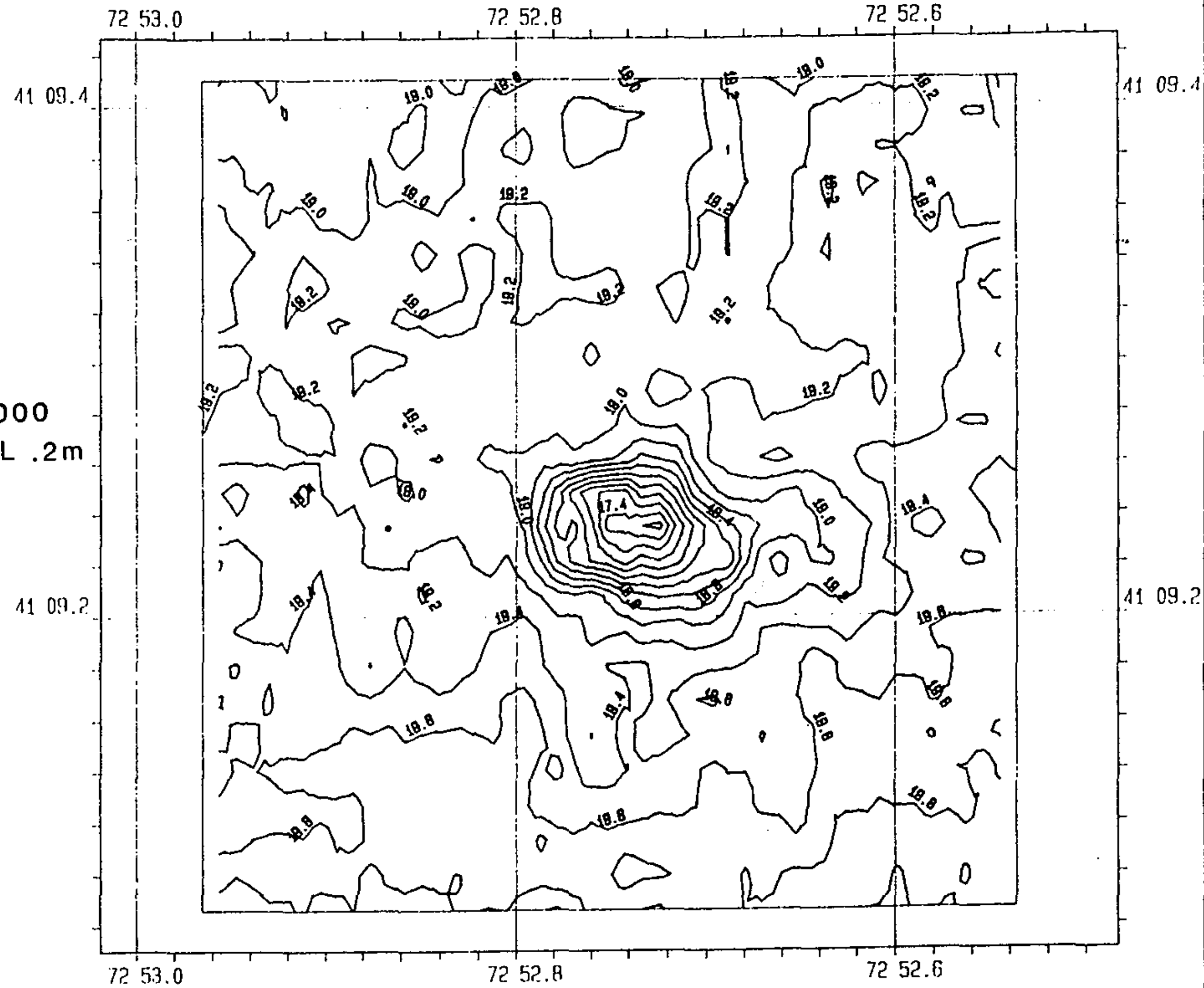
STNH-N

AUGUST 1982

CHART SCALE 1/4000
CONTOUR INTERVAL .2m

FIGURE I-3-22



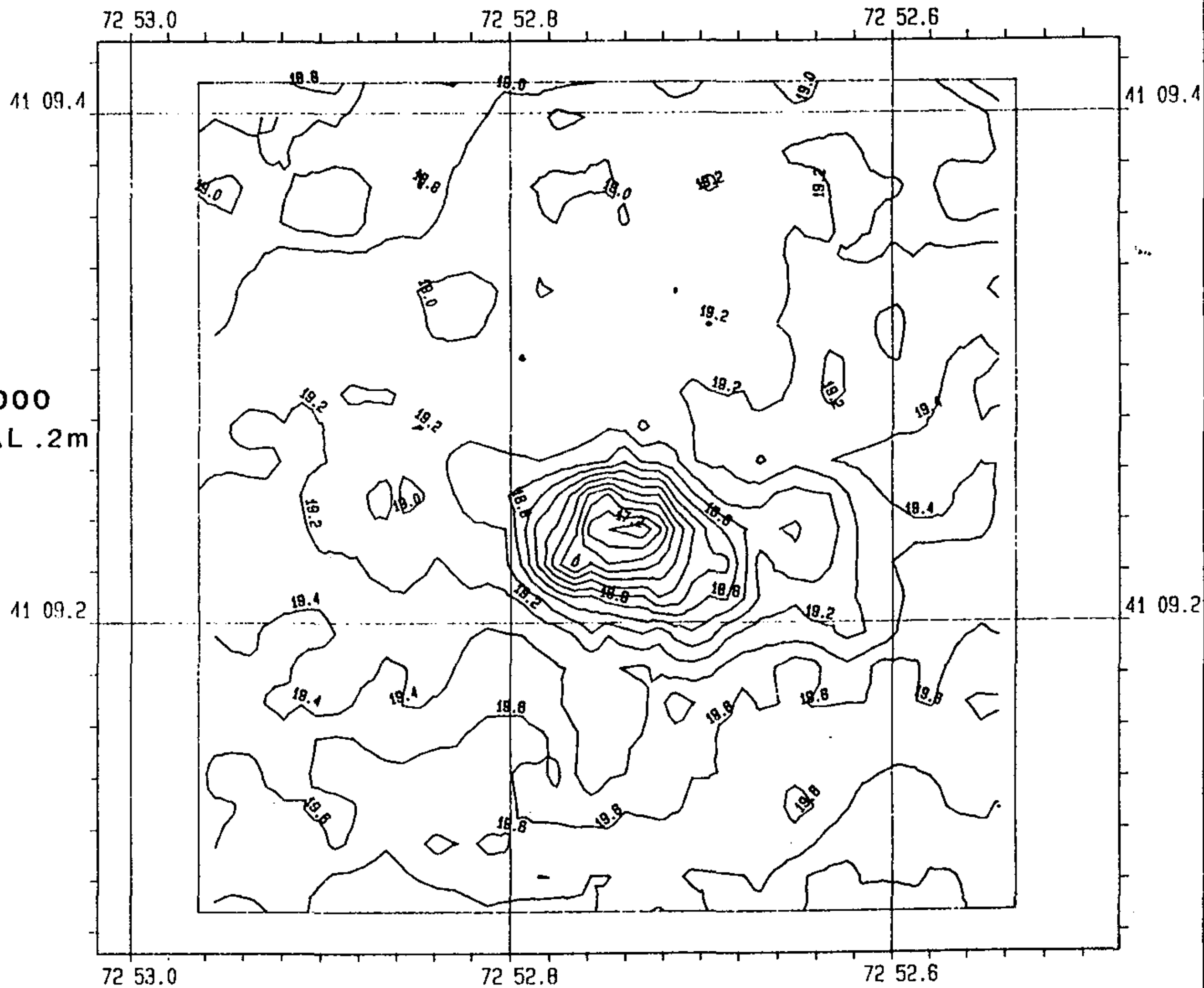


STNH-N

DECEMBER 1982

CHART SCALE 1/4000
CONTOUR INTERVAL .2m

FIGURE I-3-23



0 60 120
SCALE (m)

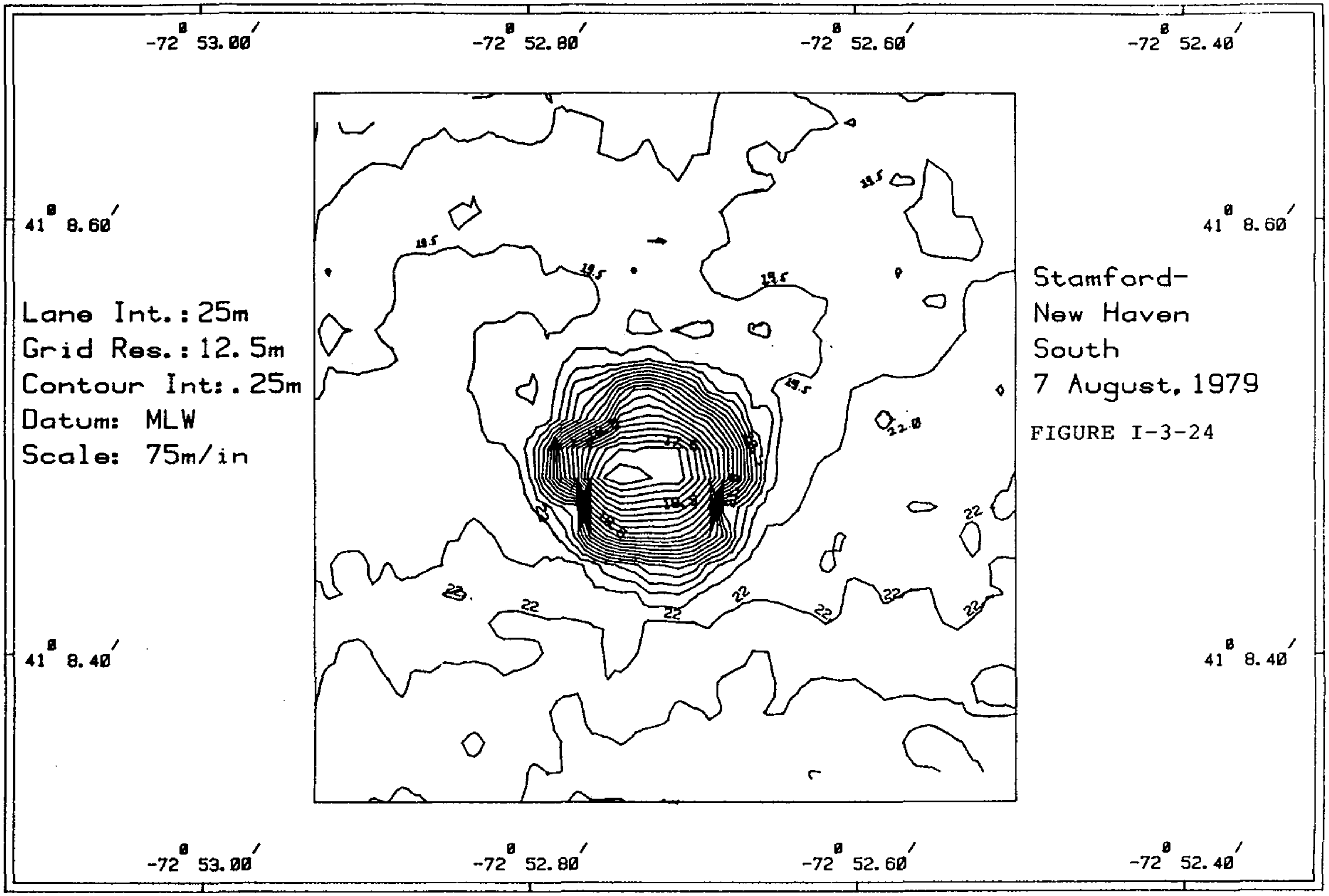

-72° 53.00′
-72° 52.80′
-72° 52.60′
-72° 52.40′
41° 8.60′
41° 8.40′
Lane Int.: 25m
Grid Res.: 12.5m
Contour Int: .25m
Datum: MLW
Scale: 75m/in
Stamford-
New Haven
South
7 August, 1979
19.5
22
22.0

FIGURE I-3-24

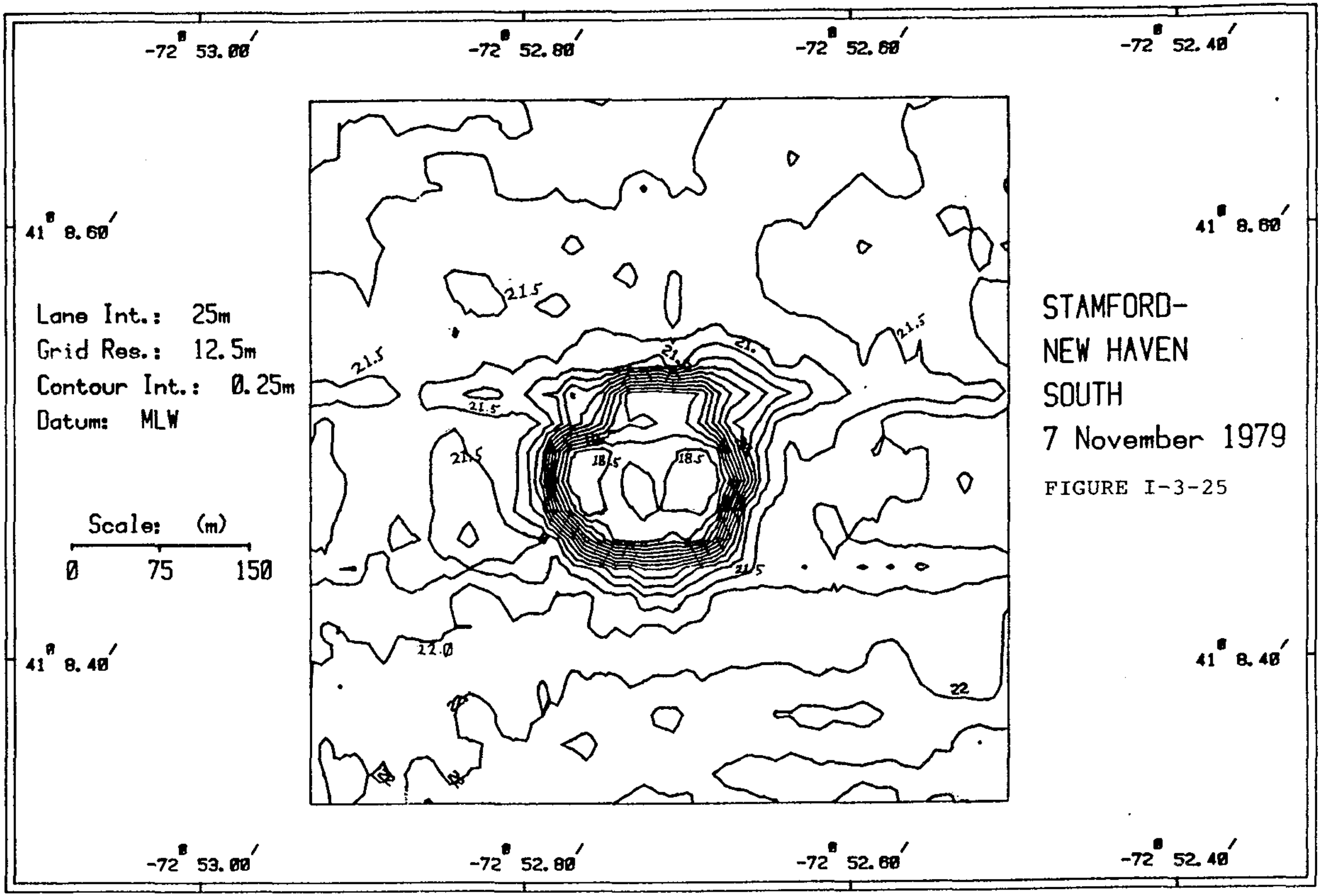

-72° 53.00′
-72° 52.80′
-72° 52.60′
-72° 52.40′
41° 8.60′
41° 8.40′
Lane Int.: 25m
Grid Res.: 12.5m
Contour Int.: 0.25m
Datum: MLW
Scale: (m)
0 75 150
21.5
18.5
22.0
22
STAMFORD-
NEW HAVEN
SOUTH
7 November 1979

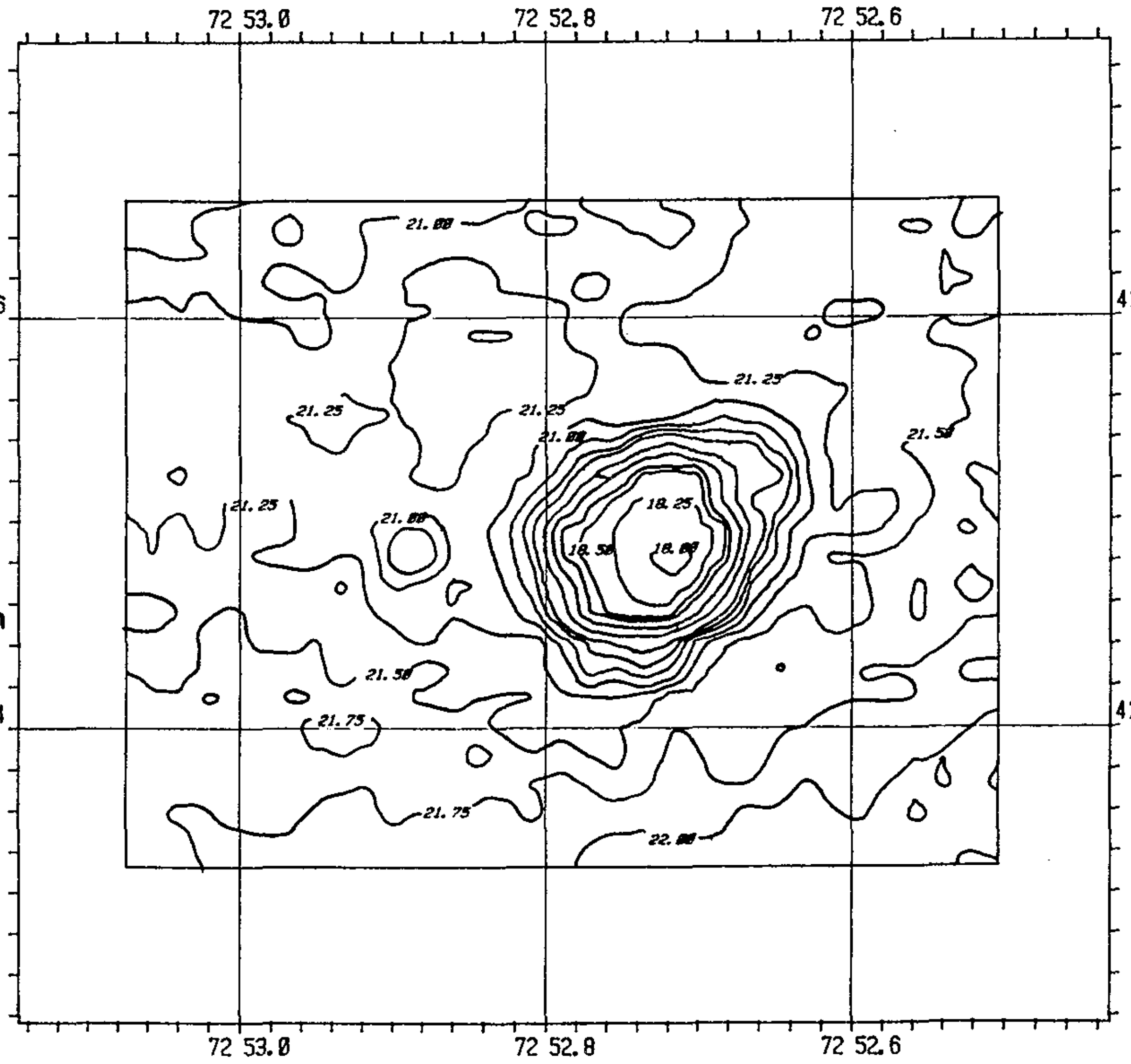
FIGURE I-3-25

STNH-S

SEPTEMBER 1980

CHART SCALE 1/4000
CONTOUR INTERVAL .2m

FIGURE I-3-26



0 80 100

SCALE (m)

STAMFORD NEW HAVEN SOUTH SURVEY AREA 8 SEPTEMBER 1980 CHART SCALE: 1/4000 CONTOUR INTERVAL: .25

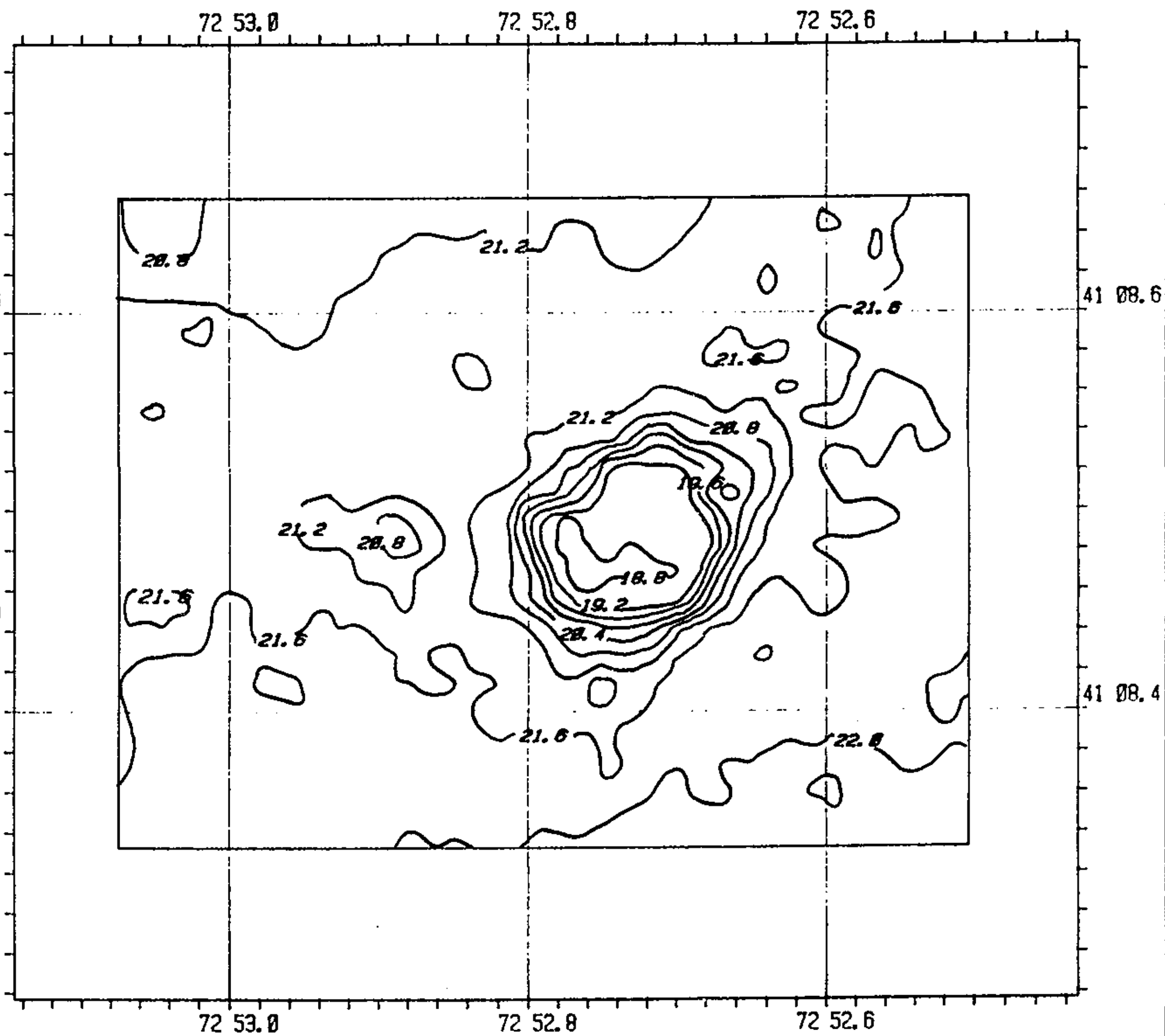
STNH-S

JANUARY 1981

FIGURE I-3-27

CHART SCALE 1/4000
CONTOUR INTERVAL .2m

0 50 100
SCALE (m)

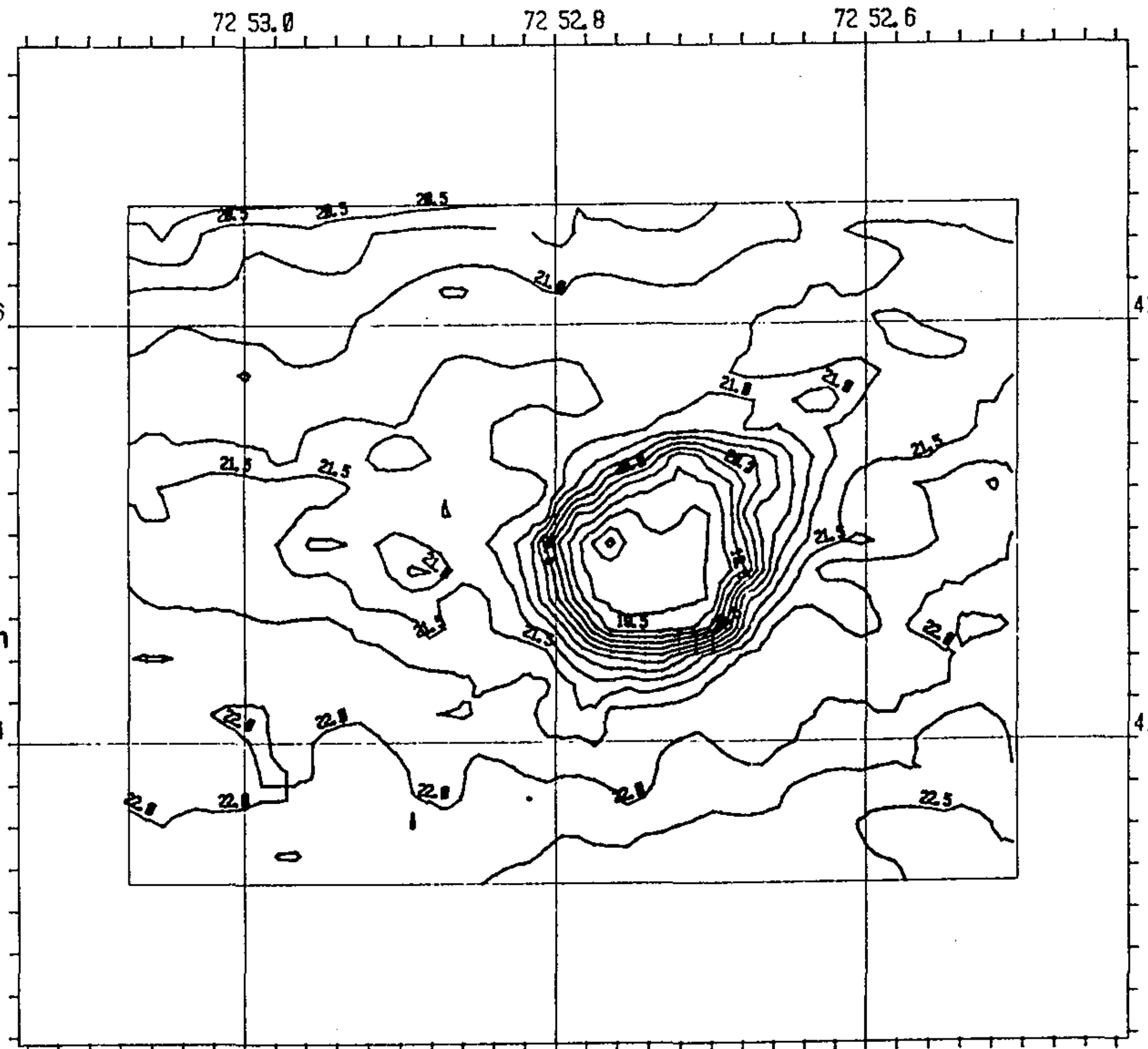


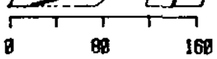
STNH-S

JANUARY 1982

FIGURE I-3-28

CHART SCALE 1/4000
CONTOUR INTERVAL .2m





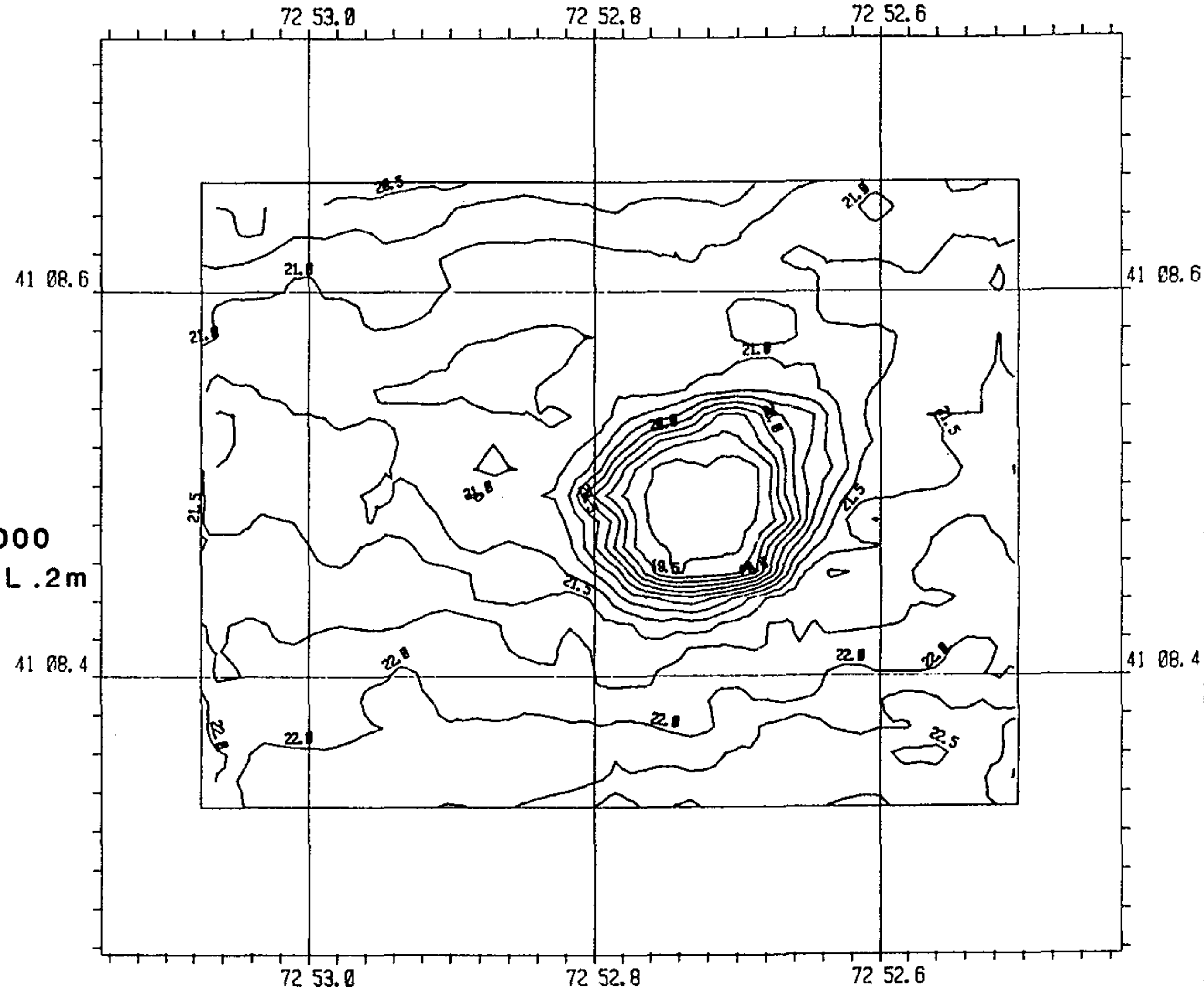
SCALE (m)

STNH-S

AUGUST 1982

CHART SCALE 1/4000
CONTOUR INTERVAL .2m

FIGURE I-3-29



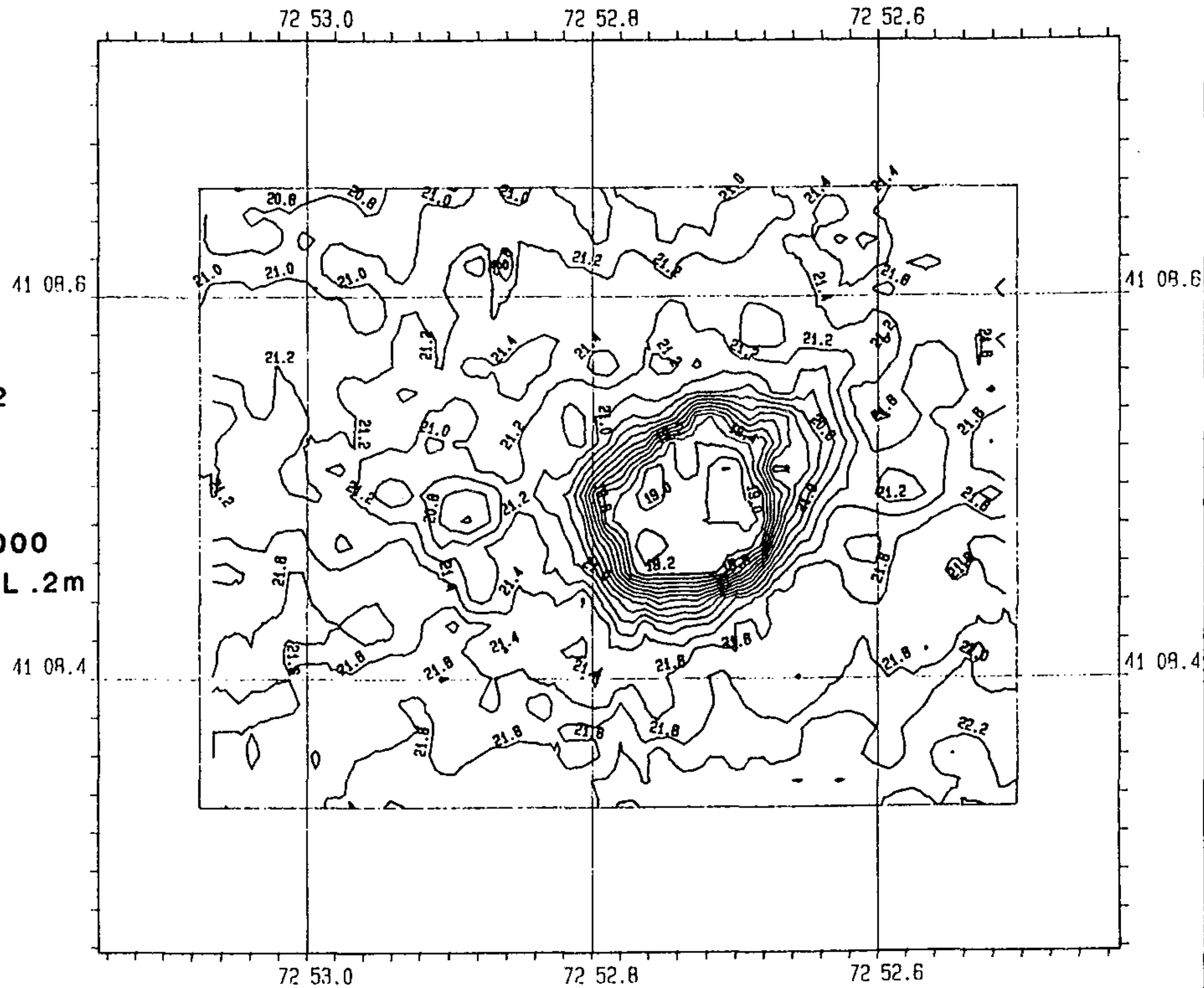
0 80 160
SCALE (m)

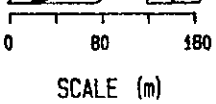
STNH-S

DECEMBER 1982

CHART SCALE 1/4000
CONTOUR INTERVAL .2m

FIGURE I-3-30





major change in topography occurred at the top of the mound, very little change occurred at the base or on the surrounding bottom. Such conditions indicate that once erosion and resuspension occur, the material is transported away from the site and cannot be detected in the vicinity of the mound. The addition of Stamford and New Haven material during November 1979 and March 1980 is evident in the September 1980 survey by the decrease in depth on the eastern side of the mound and the small mound west of the main feature. The topographic relief of the mound did not change significantly as a result of this disposal, remaining approximately 3.5 meters thick.

By January 1981, there was a decrease in elevation as the top of the mound adjusted to a flat plain at a depth of approximately 19.2 meters. From January 1981 through December 1982, this depth has been maintained and there has been no change in mound topography.

In summary, it appears that aside from initial changes in the mound elevations in 1980, both mounds have stabilized, and the mound configurations have not changed over the study period, showing the effectiveness of both the sand and silt caps.

3.2.2 Sediment Chemistry

Sediment samples were taken at both sites for chemical analysis in January, August and December 1982. The south site was sampled again in August 1983. An east-west and north-south sampling scheme was used on the January 1982 and August 1983 cruises to determine the long-term effectiveness of the capping operation (Tables I-3-7 to I-3-12).

A good indication of the presence of the sand cap is the level of volatile solids, with lower levels found in sand and higher levels in silt-clay. As shown in Tables I-3-7 and I-3-8, the sand cap is still present on the north site at 100N to 250S and 150W to 200E. Another indication of Stamford dredged materials are high copper (Cu) levels (DAMOS Annual Report, 1980) of 100 ppm or more. In January 1982, the 100S station at STNH-N had Cu concentrations consistently above 100 ppm. The August samples show elevated Cu levels at 300W. In December 1982, the volatile solids remain low at the center and 200E with low copper concentrations at the three stations sampled.

The results of the chemical analysis for the south mound are presented in Tables I-3-10 to I-3-13. Earlier surveys following the second Stamford Harbor dredged material disposal and capping in November 1979 indicated incomplete coverage of the Stamford sediments. Chemical analysis of the January 1982 samples showed high copper concentrations, indicative of Stamford dredged material, on a north-south transect from 100N to 250S. The east-west stations appeared to be closer to background levels. By August 1982, there were dramatic increases in copper concentrations from 100E to 150W (Table I-3-11), indicating the removal of capping material. Copper concentrations had decreased by December (Table I-3-12), but remained higher at the center

TABLE I-3-7.
Stamford/New Haven North
Chemical Analysis
North-South Transect
January 1982

Location	% Vol Solids NED	Pb ppm	Zn ppm	Cr ppm	Cu ppm
200N-A	3.02	38	152	44	52
B	3.54	60	308	73	85
C	2.75	22	164	39	42
100N-A	0.50	22	110	*	21
B	0.50	*	38	*	9
C	1.07	*	165	*	11
CTR-A	0.80	58	160	58	66
B	0.40	*	48	*	21
C	0.50	*	63	*	*
100S-A	4.02	38	246	93	104
B	2.09	81	266	82	153
C	3.69	44	365	97	107
250S-A	2.57	34	239	43	40
B	2.30	94	300	71	116
C	2.59	15	96	34	35
REF-A	4.17	48	140	68	50
B	3.74	68	140	84	54
C	4.15	56	150	84	55

*Below minimum detection limit.

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TABLE I-3-7 (Cont.)
Stamford/New Haven North
Chemical Analysis
West-East Transect
January 1982

Location	% Vol Solids NED	Pb ppm	Zn ppm	Cr ppm	Cu ppm
400W-A	3.98	49	198	70	79
B	3.70	62	291	73	93
C	3.76	42	315	73	83
150W-A	1.90	96	170	44	60
B	3.23	216	336	106	106
C	1.80	45	150	43	43
CTR-A	0.80	58	160	58	66
B	0.40	*	48	*	21
C	0.50	*	63	*	*
200E-A	-	-	-	-	-
B	1.30	45	170	29	48
C	1.70	24	75	26	32
400E-A	3.70	64	160	58	72
B	3.20	40	160	58	75
C	4.10	52	170	56	68
REF-A	4.17	48	140	68	50
B	3.74	68	140	84	54
C	4.15	56	150	84	55

TABLE I-3-8.
Stamford/New Haven North
Chemical Analysis
East-West Transect
August 1982

Location	% Vol Solids NED	Pb ppm	Zn ppm	Cr ppm	Cu ppm
400E-A	3.49	220	150	41	67
B	4.03	220	220	44	64
C	3.73	110	220	43	65
200E-A	1.72	*	170	*	39
B	1.56	*	100	14	30
C	1.56	93	150	*	21
CTR-A	0.53	180	73	*	11
B	0.50	*	64	*	*
C	0.76	110	75	*	15
150W-A	5.72	136	216	51	111
B	2.83	33	163	*	55
C	3.65	57	174	48	67
300W-A	2.59	*	175	*	64
B	4.35	65	224	77	131
C	3.74	54	197	67	140
REF-A	4.34	140	170	55	55
B	4.70	160	160	55	56
C	4.19	100	150	49	49

*Below minimum detection limit.

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TABLE I-3-9
Stamford/New Haven North
Chemical Analysis
December 1982

Location	% Vol Solids NED	Pb ppm	Zn ppm	Cr ppm	Cu ppm
CTR-A	0.78	*	46	*	12
B	0.60	*	46	*	9
C	0.71	*	60	*	6
200E-A	2.31	65	152	45	63
B	3.39	65	160	60	64
C	2.20	21	108	32	33
400E-A	4.75	52	194	56	64
B	4.62	48	179	55	62
C	4.67	47	186	66	64

TABLE I-3-10
Stamford/New Haven South
Chemical Analysis
North-South Transect
January 1982

Location	% Vol Solids NED	Pb ppm	Zn ppm	Cr ppm	Cu ppm
200N-A	3.05	41	229	57	72
B	2.27	15	177	35	36
C	2.09	29	182	*	42
100N-A	4.21	68	286	109	123
B	3.97	49	424	72	71
C	4.03	68	245	89	104
CTR-A	4.50	60	230	100	130
B	2.60	46	120	44	55
C	3.40	60	120	60	80
100S-A	4.81	162	220	*	62
B	5.88	39	243	64	71
C	6.71	41	165	54	60
250S-A	2.15	21	156	35	39
B	2.55	20	113	38	82
C	1.85	13	229	31	186
REF-A	4.17	48	140	68	50
B	3.74	68	140	84	54
C	4.15	56	150	84	55

*Below minimum detection limit.

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TABLE I-3-10 (Cont.)
Stamford/New Haven South
Chemical Analysis
West-East Transect
January 1982

Location	% Vol Solids NED	Pb ppm	Zn ppm	Cr ppm	Cu ppm
400W-A	3.29	38	210	64	71
B	3.70	33	195	62	69
C	3.61	30	238	66	64
250W-A	1.72	33	205	65	63
B	3.02	30	177	*	53
C	3.34	37	191	63	62
150W-A	2.45	*	183	*	33
B	3.00	31	128	40	45
C	2.61	39	147	63	67
CTR-A	4.50	60	230	100	130
B	2.60	46	120	44	55
C	3.40	60	120	60	80
100E-A	2.70	34	110	40	57
B	3.90	60	170	50	66
C	2.90	32	100	19	38
400E-A	3.30	51	160	60	74
B	4.70	60	170	67	72
C	5.00	69	180	64	66

*Below minimum detection limit.

TABLE I-3-11

Stamford/New Haven South
Chemical Analysis
East-West Transect
August 1982

Location	% Vol Solids NED	Pb ppm	Zn ppm	Cr ppm	Cu ppm
400E-A	3.58	*	100	32	30
B	4.32	*	220	51	60
C	2.21	*	102	33	43
100E-A	3.41	*	170	98	130
B	3.83	*	170	54	74
C	3.38	*	190	50	80
CTR-A	4.49	*	210	100	140
B	3.91	*	230	95	130
C	3.83	*	200	85	120
150W-A	3.28	79	207	102	124
B	3.44	43	160	61	58
C	5.53	67	237	111	131
250W-A	4.07	49	197	63	61
B	3.97	33	155	57	57
C	2.84	85	113	42	39
400W-A	3.70	84	163	54	61
B	3.35	75	134	50	54
C	3.75	101	154	55	60
REF-A	4.34	140	170	55	55
B	4.70	160	160	55	56
C	4.19	100	150	49	49

*Below minimum detection limit.

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TABLE I-3-12

Stamford/New Haven South
Chemical Analysis
December 1982

Location	% Vol Solids NED	Pb ppm	Zn ppm	Cr ppm	Cu ppm
CTR-A	3.63	53	195	96	87
B	3.32	54	202	84	92
C	2.95	31	169	88	76
100E-A	4.78	57	156	63	54
B	4.06	41	135	57	41
C	4.22	54	163	74	66
400E-A	3.57	31	129	56	58
B	4.37	43	152	62	51
C	3.75	40	134	50	44

TABLE I-3-13
Stamford-New Haven South
Chemical Analysis
North-South Transect
August 1983

Location	% Vol Solids NED	Pb ppm	Zn ppm	Cr ppm	Cu ppm
200N-A	3.73	42	185	56	75
B	3.86	*	203	46	67
C	4.44	43	198	76	129
100N-A	5.05	34	204	68	86
B	5.60	47	233	83	101
C	4.64	34	169	47	67
CTR-A	5.59	37	240	83	108
B	3.66	32	221	87	102
C	4.78	42	341	113	148
100S-A	2.57	28	126	48	59
B	2.43	*	147	45	59
C	3.03	*	136	35	57
250S-A	4.12	46	163	48	53
B	3.54	37	193	56	69
C	1.45	48	96	23	32
REF-A	4.98	56	177	54	54
B	4.50	45	201	58	61
C	4.38	52	175	51	52

*Below Detection Limit

TABLE I-3-13 (Cont.)
Stamford-New Haven South
Chemical Analysis
East-West Transect
August 1983

Location	% Vol Solids NED	Pb ppm	Zn ppm	Cr ppm	Cu ppm
400W-A	3.33	60	166	49	64
B	2.71	51	121	34	56
C	3.13	48	110	32	43
250W-A	4.90	54	176	55	68
B	4.90	37	230	62	64
C	4.28	42	154	55	53
150W-A	2.84	--	167	50	40
B	2.72	31	180	49	48
C	4.52	38	157	55	52
CTR-A	5.59	37	240	83	108
B	3.66	32	221	87	102
C	4.78	42	341	113	148
100E-A	4.47	32	162	51	48
B	4.46	34	171	57	55
C	3.70	*	144	51	44
400E-A	2.78	*	84	29	17
B	2.94	*	130	33	44
C	2.89	*	150	50	43
REF-A	4.98	56	177	54	54
B	4.50	45	201	58	61
C	4.38	52	175	51	52

*Below Detection Limit

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stations. These results reflect the deposition of background particulates over the mound. The results of the analyses of sediment collected in August 1983 show little significant change.

3.2.3 Benthic Community

Benthic samples were collected and analyzed from both mounds in January 1981 and February 1982. Three replicate samples were taken at the center, inner edge and outer edge from each site. The species counts for each sample are given in Tables I-3-14 and I-3-15 for STNH-N, and in Table I-3-16 for the CLIS reference station. Densities of Nucula, Pitar, Mulinia and Nephtys along with total numbers of species and individuals are graphically represented in Figures I-3-31 through I-3-36.

At the north site with the sand cap, the total numbers of species and individuals increased from 1981 to 1982 at the center and inner edge stations while there was a slight decrease in species and individuals at the outer edge station. Compared to samples taken at the same stations in September 1980 (DAMOS Contribution #24), the mean number of species had decreased dramatically from a range of 26-32 species to 10-18 species in January 1981 (Fig. I-3-31). The difference between the data for the two periods on the north mound is that the January 1981 community was a mixture of a mud fauna and sand fauna which had colonized the sand cap, whereas the sand fauna was less prevalent in the community during the following two years. Species numbers for the 1981 and 1982 sampling dates were similar to those found at the CLIS REF station (Fig. I-3-31). The increase in species number probably reflects the colonization process that occurs with time in the CLIS benthos. The bivalves, Nucula and Pitar, were essentially absent from the center station in both years, but were much more abundant at the inner and outer stations than at the Reference site (Figs. I-3-33 and I-3-34). Mulinia showed an increase at the center from 1981 to 1982, but decreased in abundance at the outer edge station in 1982 (Fig. I-3-35). Nephtys (Fig. I-3-36) was absent at the center station in both years. These species are dominant members of the CLIS benthos and their absence from the center station is not surprising, since the sand cap is quite thick here. The presence of these species at the inner and outer edge stations indicates a depletion and or a mixing of the sand cap with underlying material. In most cases, these animals are at least as abundant at these two stations as at the Reference site.

At the south site, which is capped with cohesive silty sediments, the same trends of an increase in numbers of species and individuals from 1981 to 1982 (Figs. I-3-37 and I-3-38) holds true. Species numbers remained lower than what was found in September 1980 (DAMOS Contribution #24). Nucula was essentially absent from the south site during both sampling periods, but was also absent from the Reference station in 1981 (Fig. I-3-39). Pitar and Mulinia both experienced declines in abundance during the second year (Figs. I-3-40 and I-3-41). In contrast to the north site, Nephtys was quite abundant at the center station in both years (Fig. I-3-42).

TABLE I-3-14

Benthic Community, Stamford/New Haven North, January 1981

	STNH-N OE 1-28-81			STNH N IE 1-28-81			STNH N CTR 1-28-81		
	REP3	REP5	REP6	REP2	REP6	REP9	REP1	REP4	REP3
CNIDARIA	.	.	.	.	.	.	.	.	.
Edwardsia elegans	0	0	1	0	1	0	.	.	.
Haloclava producta	.	.	.	0	1	0	.	.	.
Corymorpha pendula	.	.	.	.	.	.	.	.	.
Ceriantheopsis americanus	2	2	4	0	0	0	.	.	.
PLATYHELMINTHES SPECIES	.	.	.	.	.	.	.	.	.
RHYNCHOCOELA	.	.	.	.	.	.	.	.	.
Cerebratulus spp.	.	.	.	.	.	.	.	.	.
Micrura sp.	.	.	.	.	.	.	3	3	2
Tubulanus pellucidus	.	.	.	.	.	.	.	.	.
Tetrastemmidae species	.	.	.	.	.	.	.	.	.
Rhynchocoel RB	.	.	.	.	.	.	.	.	.
Phoronida									
Phoronis muelleri	.	.	.	.	.	.	2	0	0
GASTROPODA	.	.	.	.	.	.	.	.	.
Crepidula plana	.	.	.	.	.	.	.	.	.
Lunitia heros	.	.	.	0	1	0	.	.	.
Polynices duplicatus	.	.	.	.	.	.	0	1	0
Mitrella lunata	.	.	.	.	.	.	.	.	.
Nassarius trivittatus	.	.	.	.	.	.	22	9	12
Aceton punctostriata	0	1	0	.	.	.	.	.	.
Retusa canaliculata	3	1	1	3	6	1	.	.	.
Cyclichna oryza	.	.	.	.	.	.	.	.	.
Turbonilla interrupta	0	0	1	0	1	1	.	.	.
Opisthobranchia	.	.	.	.	.	.	.	.	.
BIVALVIA	.	.	.	.	.	.	.	.	.
Nucula annulata	3	87	51	96	111	44	.	.	.
Yoldia limatula	0	0	2	4	1	1	.	.	.
Anadara transversa	.	.	.	.	.	.	.	.	.
Mercenaria mercenaria	.	.	.	0	0	1	.	.	.
Pitar morrhuana	14	6	16	28	37	24	.	1	.
Mulinia lateralis	28	25	34	55	38	28	0	2	0

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TABLE I-3-14 (Cont.)

Benthic Community, Stamford/New Haven North, January 1981 — Page 2 of 4

	STNH-N OE 1-28-81			STNH N IE 1-28-81			STNH N CTR 1-28-81		
	REP3	REP5	REP6	REP2	REP6	REP9	REP1	REP4	REP3
Tellina versicolor	.	.	.	0	2	0	29	46	9
Macoma tenta	0	0	1	0	0	0	.	.	.
Ensis directus	.	.	.	.	.	.	1	4	3
Pandora gouldiana	0	0	1	1	0	4	.	.	.
	.	.	.	.	.	.	.	.	.
POLYCHAETA	.	.	.	.	.	.	.	.	.
Harmothoe sp.	.	.	.	.	.	.	.	.	.
Paranaitis speciosa	.	.	.	.	.	.	.	.	.
Phyllodoce arenia	.	.	.	.	.	.	1	3	0
Lepidonotus sublevis	.	.	.	.	.	.	.	.	.
Phloe minuta	.	.	.	.	.	.	.	.	.
Glycera dibranchiatus	.	.	.	.	.	.	.	1	.
Nephtys incisa	19	8	12	11	18	6	.	.	.
Nephtys picta	.	.	.	0	0	11	14	4	1
Syllis sp.	.	.	.	.	.	.	.	.	.
Sigambra tentaculata	.	.	.	.	.	.	.	.	.
Nereis sp.	.	.	.	.	.	.	.	.	.
Mediomastus ambiseta	0	0	2	.	.	.	.	.	.
Aricidea sp.	.	.	.	.	.	.	0	1	0
Clymenella torquata	.	.	.	.	.	.	.	.	.
Polydora caulleryi	.	.	.	.	.	.	.	.	.
Polydora socialis	.	.	.	.	.	.	2	0	0
Spiochaetopterus oculatus	.	.	.	.	.	.	.	.	.
Spiophanes bombyx	.	.	.	.	.	.	0	4	2
Streblospio benedicti	.	.	.	.	.	.	.	.	.
Paraonis gracilis	1	0	0	0	1	0	.	.	.
Sabellaria vulgaris	.	.	.	.	.	.	.	.	.
Pherusa affinis	.	.	.	.	.	.	.	.	.
Lumbrineris fagilis	.	.	.	.	.	.	0	1	0
Ninoe nigripes	.	.	.	.	.	.	.	.	.
Scoloplos sp.	.	.	.	.	.	.	.	.	.
Tharyx sp. A	.	.	.	.	.	.	.	.	.
Tharyx sp.	.	.	.	.	.	.	.	.	.
Owenia fusiformis	.	.	.	.	.	.	2	0	1
Pectinaria gouldii	.	.	.	1	0	0	0	0	1
Amphitrite ornata	.	.	.	.	.	.	.	.	.
Ampharete acutifrons	.	.	.	.	.	.	.	.	.

TABLE I-3-14 (Cont.)

Bnethic Community, Stamford/New Haven North, January 1981

	STNH-N OE 1-28-81			STNH N IE 1-28-81			STNH N CTR 1-28-81		
	REP3	REP5	REP6	REP2	REP6	REP7	REP1	REP4	REP3
Ampharete oculata	.	.	.	.	.	.	.	.	.
Ampharete arctica	.	.	.	.	.	.	4	1	0
Melinna cristata	.	.	.	.	.	.	.	.	.
Polycirrus sp.	.	.	.	.	.	.	2	2	0
Loimia medusa	.	.	.	0	0	1	.	.	.
OLIGOCHAETA SPECIES	.	.	.	0	1	0	.	.	.
CIRRIPEDIA	.	.	.	.	.	.	.	.	.
Balanus balanoides	.	.	.	.	.	.	.	.	.
Balanus crenatus	.	.	.	.	.	.	.	.	.
CUMACEA	.	.	.	.	.	.	.	.	.
Oxyurostylis smithi	.	.	.	.	.	.	.	.	.
ISOPODA	.	.	.	.	.	.	.	.	.
Edotea montosa	.	.	.	.	.	.	.	.	.
AMPHIPODA	.	.	.	.	.	.	.	.	.
Ampelisca vadorum	.	.	.	0	1	0	0	1	0
Unciola irrorata	.	.	.	.	.	.	.	.	.
Leptocheirus pinguis	.	.	.	.	.	.	0	1	0
Jassa falcata	.	.	.	.	.	.	.	.	.
Caprella sp.	.	.	.	.	.	.	.	.	.
MYSIDACEA	.	.	.	.	.	.	.	.	.
Neomysis americana	1	5	8	3	0	0	0	0	1
DECAPODA	.	.	.	.	.	.	.	.	.
Crangon septemspinosa	.	.	.	.	.	.	.	.	.
Axius serratus	.	.	.	.	.	.	.	.	.
Pagurus longicarpus	.	.	.	.	.	.	10	5	4
Pagurus pollicaris	.	.	.	.	.	.	.	.	.
Ovalipes ocellatus	.	.	.	.	.	.	.	.	.
Rhithropanopeus harrisii	.	.	.	.	.	.	.	.	.
Pinnixa sayana?	.	.	.	.	.	.	1	0	0

TABLE I-3-14 (Cont.)

Benthic Community, Stamford/New Haven North, January 1981

	STNH-N OE 1-28-81			STNH N IE 1-28-81			STNH N CTR 1-28-81		
	REP3	REP5	REP6	REP2	REP6	REP9	REP1	REP4	REP3
ASTEROIDEA	.	.	.	.	.	.	.	.	.
Asterias forbesi	.	.	.	.	.	.	.	.	.
HEMICHORDATA	.	.	.	.	.	.	.	.	.
Saccoglossus kowalevskii	.	.	.	0	0	1	.	.	.
Number of Species	8	8	13	9	14	12	13	18	10
Number of individuals	71	135	134	202	220	123	93	90	36

TABLE I-3-15

Benthic Community, Stamford/New Haven North, February 1982

	STNH-N OE 2-82			STNH-N IE 2-82			STNH-N-CTR 2-82		
	rep1	rep3	rep6	rep5	rep4	rep2	rep4	rep10	rep1
CNIDARIA	.	.	.	.	.	.	.	.	.
Edwardsia elegans	1	1	0	1	0	0	.	.	.
Haloclava producta	.	.	.	.	.	.	.	.	.
Corymorpha pendula	.	.	.	.	.	.	.	.	.
Ceriantheopsis americanus	3	4	2	2	1	0	.	.	.
PLATYHELMINTHES SPECIES	.	.	.	.	.	.	0	1	0
RHYNCHOCOELA	.	.	.	.	.	.	.	.	.
Cerebratulus spp.	.	.	.	0	0	1	.	.	.
Micrura sp.	.	.	.	.	.	.	20	6	8
Tubulanus pellucidus	.	.	.	.	.	.	.	.	.
Tetrastemmidae species	.	.	.	.	.	.	.	.	.
Rhynchocoel RB	.	.	.	.	.	.	2	0	0
Phoronida									
Phoronis muelleri	0	1	0	.	.	.	.	.	.
GASTROPODA	.	.	.	.	.	.	.	.	.
Crepidula plana	.	.	.	.	.	.	0	1	30
Lunitia heros	.	.	.	.	.	.	.	.	.
Polynices duplicatus	.	.	.	0	0	1	.	.	.
Mitrella lunata	.	.	.	.	.	.	.	.	.
Nassarius trivittatus	0	1	1	1	0	0	4	2	9
Aceton punctostriata	.	.	.	.	.	.	.	.	.
Retusa canaliculata	0	1	0	.	.	.	.	.	.
Cylichna oryza	0	1	0	4	3	1	1	0	0
Turbonilla interrupta	.	.	.	.	.	.	0	0	3
Opisthobranchia	.	.	.	.	.	.	0	1	1
BIVALVIA	.	.	.	.	.	.	.	.	.
Nucula annulata	0	55	12	84	66	90	.	.	.
Yoldia limatula	0	6	6	5	5	7	.	.	.
Anadara transversa	0	1	0	.	.	.	.	.	.
Mercenaria mercenaria	.	.	.	.	.	.	.	.	.
Pitar morrhuana	.	.	.	4	1	5	.	.	.
Mulinia lateralis	1	6	9	26	61	47	28	7	30

TABLE I-3-15 (Cont.)

Benthic Community, Stamford/New Haven North, February 1982

	STNH-N OE 2-82			STNH-N IE 2-82			STNH-N-CTR 2-82		
	rep1	rep3	rep6	rep5	rep4	rep2	rep4	rep10	rep1
Tellina versicolor	.	.	.	.	.	.	99	85	97
Macoma tenta	0	5	0	8	22	26	.	.	.
Ensis directus	.	.	.	.	.	.	1	4	1
Pandora gouldiana	.	.	.	1	2	1	1	2	1
	.	.	.	.	.	.	.	.	.
POLYCHAETA	.	.	.	.	.	.	.	.	.
Harmothoe sp.	.	.	.	.	.	.	.	.	.
Paranaitis speciosa	.	.	.	.	.	.	1	1	1
Phyllodoce arenia	.	.	.	.	.	.	2	7	4
Lepidonotus sublevis	.	.	.	.	.	.	.	.	1
Phloe minuta	.	.	.	.	.	.	.	.	1
Glycera dibranchiatus	.	.	.	.	.	.	2	3	2
Nephtys incisa	3	13	3	18	19	24	.	.	.
Nephtys picta	.	.	.	0	1	0	11	7	13
Syllis sp.	.	.	.	.	.	.	.	.	1
Sigambra tentaculata	.	.	.	.	.	.	.	.	.
Nereis sp.	.	.	.	.	.	.	.	.	.
Mediomastus ambiseta	.	.	.	.	.	.	.	.	.
Aricidea sp.	.	.	.	.	.	.	.	.	.
Clymenella torquata	.	.	.	.	.	.	2	2	1
Polydora caulleryi	.	.	.	.	.	.	.	.	.
Polydora socialis	.	.	.	3	0	0	0	1	3
Spiochaetopterus oculatus	.	.	.	.	.	.	.	.	.
Spiophanes bombyx	.	.	.	0	2	0	4	14	4
Streblospio benedicti	.	.	.	.	.	.	1	0	0
Paraonis gracilis	0	1	0	0	1	0	.	.	.
Sabellaria vulgaris	.	.	.	.	.	.	3	3	5
Pherusa affinis	0	2	0	1	0	0	1	2	1
Lumbrineris fagilis	.	.	.	.	.	.	.	.	.
Ninoe nigripes	.	.	.	.	.	.	.	.	.
Scoloplos sp.	.	.	.	.	.	.	1	0	0
Tharyx sp. A	.	.	.	.	.	.	1	0	0
Tharyx sp.	.	.	.	.	.	.	.	.	.
Owenia fusiformis	.	.	.	.	.	.	2	1	0
Pectinaria gouldii	0	2	0	15	17	28	2	1	1
Amphitrite ornata	.	.	.	.	.	.	.	.	.
Ampharete acutifrons	.	.	.	.	.	.	.	.	.

TABLE I-3-15 (Cont.)

Benthic Community, Stamford/New Haven North, February 1982

	STNH-N OE 2-82			STNH-N IE 2-82			STNH-N-CTR 2-82		
	rep1	rep3	rep6	rep5	rep4	rep2	rep4	rep10	rep1
Ampharete oculata	.	.	.	.	.	.			.
Ampharete arctica	0	2	0	.	.	.	2	3	7
Melinna cristata	.	.	.	.	.	.	.	.	.
Polycirrus sp.	.	.	.	.	.	.	2	2	3
Loimia medusa	.	.	.	.	.	.	.	.	.
OLIGOCHAETA SPECIES	.	.	.	.	.	.	.	.	.
CIRRIPEDIA	.	.	.	.	.	.	.	.	.
Balanus balanoides	.	.	.	.	.	.	.	.	.
Balanus crenatus	.	.	.	.	.	.	5	2	85
CUMACEA	.	.	.	.	.	.	.	.	.
Oxyurostylis smithi	.	.	.	.	.	.	.	.	.
ISOPODA	.	.	.	.	.	.	.	.	.
Edotea montosa	.	.	.	.	.	.	.	.	.
AMPHIPODA	.	.	.	.	.	.	.	.	.
Ampelisca vadorum	.	.	.	9	8	2	4	4	0
Unciola irrorata	.	.	.	.	.	.	10	12	5
Leptocheirus pinguis	.	.	.	.	.	.	0	0	1
Jassa falcata	0	1	0	.	.	.	.	.	.
Caprella sp.	.	.	.	.	.	.	0	1	0
MYSIDACEA	.	.	.	.	.	.	.	.	.
Neomysis americana	.	.	.	.	.	.	.	.	.
DECAPODA	.	.	.	.	.	.	.	.	.
Crangon septemspinosa	.	.	.	.	.	.	.	.	.
Axius serratus	.	.	.	.	.	.	.	.	.
Pagurus longicarpus	.	.	.	.	.	.	0	0	1
Pagurus pollicaris	.	.	.	.	.	.	0	0	1
Ovalipes ocellatus	.	.	.	.	.	.	1	1	0
Rhithropanopeus harrisii	.	.	.	.	.	.	.	.	.
Pinnixa sayana?	.	.	.	.	.	.	.	.	.

TABLE I-3-15 (Cont.)

Benthic Community, Stamford/New Haven North, February 1982 — Page 3 of 4

	STNH-N OE 2-82			STNH-N IE 2-82			STNH-N-CTR 2-82		
	rep1	rep3	rep6	rep5	rep4	rep2	rep4	rep10	rep1
ASTEROIDEA	.	.	.	.	.	.	.	.	.
Asterias forbesi	.	.	.	.	.	.	.	.	.
HEMICHORDATA	.	.	.	.	.	.	.	.	.
Saccoglossus kowalevskii	.	.	.	.	.	.	.	.	.
Number of Species	4	17	6	15	14	12	27	27	30
Number of individuals	8	103	33	182	209	233	215	176	322

TABLE I-3-16

Benthic Community, Central Long Island Sound Reference

	CLISREF1-26-81			CLISREF8-19-81			CLISREF 1/30/82		
	rep3	rep5	rep6	rep5	rep6	rep9	REP5	REP3	REP10
CNIDARIA	.	.	.	.	.	.	.	.	.
Edwardsia elegans	1	0	2	0	0	1	1	4	4
Haloclava producta	.	.	.	0	0	1	.	.	.
Corymorpha pendula	.	.	.	.	.	.	.	.	.
Ceriantheopsis americanus	2	1	5	5	5	5	6	3	3
PLATYHELMINTHES SPECIES	.	.	.	.	.	.	0	0	1
RHYNCHOCOELA	.	.	.	.	.	.	.	.	.
Cerebratulus spp.	.	.	.	1	0	0	.	.	.
Micrura sp.	.	.	.	.	.	.	.	.	.
Tubulanus pellucidus	.	.	.	2	0	0	.	.	.
Tetrastemmidae species	.	.	.	.	.	.	.	.	.
Rhynchocoel RB	.	.	.	.	.	.	.	.	.
Phoronida									
Phoronis muelleri	.	.	.	1	1	0	1	0	1
GASTROPODA	.	.	.	.	.	.	.	.	.
Crepidula plana	.	.	.	.	.	.	.	.	.
Lunitia heros	.	.	.	.	1	.	.	.	.
Polynices duplicatus	.	.	.	.	.	.	.	.	.
Mitrella lunata	.	.	.	.	.	.	.	.	.
Nassarius trivittatus	.	.	.	1	3	.	.	.	.
Aceton punctostriata	.	.	.	.	.	.	.	.	.
Retusa canaliculata	.	.	.	.	.	.	2	1	0
Cyclichna oryza	.	.	.	.	.	.	0	0	2
Turbonilla interrupta	.	.	.	.	.	.	.	.	.
Opisthobranchia	.	.	.	.	.	.	.	.	.
BIVALVIA	.	.	.	.	.	.	.	.	.
Nucula annulata	.	.	.	56	16	22	5	13	13
Yoldia limatula	0	0	8	4	2	1	0	3	3
Anadara transversa	.	.	.	.	.	.	.	.	.
Mercenaria mercenaria	.	.	.	.	.	.	.	.	.
Pitar morrhuana	1	4	8	10	5	4	0	2	11
Mulinia lateralis	7	2	21	5	6	5	8	19	36

TABLE I-3-16 (Cont.)

Benthic Community, Central Long Island Sound Reference

	CLISREF1-26-81			CLISREF8-19-81			CLISREF 1/30/82		
	rep3	rep5	rep6	rep5	rep6	rep9	REP5	REP3	REP10
Tellina versicolor	.	.	.	.	.	.	2	6	11
Macoma tenta	.	.	.	.	.	.	.	.	.
Ensis directus	.	.	.	.	.	.	.	.	.
Pandora gouldiana	.	.	.	.	.	.	0	1	1
	.	.	.	.	.	.	.	.	.
POLYCHAETA	.	.	.	.	.	.	.	.	.
Harmothoe sp.	.	.	.	.	.	.	.	.	.
Paranaitis speciosa	.	.	.	.	.	.	.	.	.
Phyllodoce arenia	.	.	.	.	.	.	.	.	.
Lepidonotus sublevis	.	.	.	.	.	.	.	.	.
Phloe minuta	.	.	.	.	.	.	.	.	.
Glycera dibranchiatus	.	.	.	.	.	.	.	.	.
Nephtys incisa	10	11	11	21	10	9	1	4	8
Nephtys picta	.	.	.	.	.	.	.	.	.
Syllis sp.	.	.	.	.	.	.	.	.	.
Sigambra tentaculata	.	.	.	1	0	0	.	.	.
Nereis sp.	.	.	.	.	.	.	.	.	.
Mediomastus ambiseta	.	.	.	.	.	.	.	.	.
Aricidea sp.	.	.	.	.	.	.	.	.	.
Clymenella torquata	.	.	.	.	.	.	.	.	.
Polydora caulleryi	.	.	.	.	.	.	.	.	.
Polydora socialis	.	.	.	.	.	.	.	.	.
Spiochaetopterus oculatus	.	.	.	.	.	.	.	.	.
Spiophanes bombyx	.	.	.	.	.	.	.	.	.
Streblospio benedicti	.	.	.	.	.	.	.	.	.
Paraonis gracilis	.	.	.	2	0	0	.	.	.
Sabellaria vulgaris	.	.	.	.	.	.	.	.	.
Pherusa affinis	.	.	.	0	1	0	0	0	2
Lumbrineris fagilis	.	.	.	.	.	.	.	.	.
Ninoe nigripes	.	.	.	.	.	.	0	0	1
Scoloplos sp.	.	.	.	.	.	.	.	.	.
Tharyx sp. A	.	.	.	.	.	.	.	.	.
Tharyx sp.	.	.	.	.	.	.	.	.	.
Owenia fusiformis	.	.	.	.	.	.	.	.	.
Pectinaria gouldii	.	.	.	.	.	.	0	1	1
Amphitrite ornata	.	.	.	.	.	.	.	.	.
Ampharete acutifrons	.	.	.	.	.	.	.	.	.

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TABLE I-3-16 (Cont.)

Benthic Community, Central Long Island Sound Reference

	CLISREF1-26-81			CLISREF8-19-81			CLISREF 1/30/82		
	rep3	rep5	rep6	rep5	rep6	rep9	REF5	REF3	REF10
Ampharete oculata	.	.	.	.	.	.	0	1	0
Ampharete arctica	.	.	.	.	.	.	.	.	.
Melinna cristata	.	.	.	1	1	0	.	.	.
Polycirrus sp.	.	.	.	.	.	.	.	.	.
Loimia medusa	.	.	.	.	.	.	.	.	.
OLIGOCHAETA SPECIES	.	.	.	.	.	.	.	.	.
CIRRIPEDIA	.	.	.	.	.	.	.	.	.
Balanus balanoides	.	.	.	.	.	.	0	0	1
Balanus crenatus	.	.	.	.	.	.	.	.	.
CUMACEA	.	.	.	.	.	.	.	.	.
Oxyurostylis smithi	.	.	.	.	.	.	.	.	.
ISOPODA	.	.	.	.	.	.	.	.	.
Edotea montosa	.	.	.	.	.	.	.	.	.
AMPHIPODA	.	.	.	.	.	.	.	.	.
Ampelisca vadorum	.	.	.	.	.	.	.	.	.
Unciola irrorata	.	.	.	.	.	.	.	.	.
Leptocheirus pinguis	.	.	.	.	.	.	.	.	.
Jassa falcata	.	.	.	.	.	.	.	.	.
Caprella sp.	.	.	.	.	.	.	.	.	.
MYSIDACEA	.	.	.	.	.	.	.	.	.
Neomysis americana	0	0	1	.	.	.	.	.	.
DECAPODA	.	.	.	.	.	.	.	.	.
Crangon septemspinosa	.	.	.	.	.	.	.	.	.
Axius serratus	.	.	.	.	.	.	.	.	.
Pagurus longicarpus	.	.	.	.	.	.	.	.	.
Pagurus pollicaris	.	.	.	.	.	.	.	.	.
Ovalipes ocellatus	.	.	.	.	.	.	.	.	.
Rhithropanopeus harrisii	.	.	.	.	.	.	.	.	.
Pinnixa sayana?	.	.	.	0	0	1	.	.	.

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TABLE I-3-16 (Cont.)

Benthic Community, Central Long Island Sound Reference

	CLISREF1-26-81			CLISREF8-19-81			CLISREF 1/30/82		
	rep3	rep5	rep6	rep5	rep6	rep9	REP5	REP3	REP10
ASTEROIDEA	.	.	.	.	.	.	.	.	.
Asterias forbesi	.	.	.	.	.	.	.	.	:
HEMICHORDATA	.	.	.	.	.	.	.	.	.
Saccoglossus kowalevskii	.	.	.	.	.	.	.	.	.
Number of Species	5	4	7	13	11	9	8	12	16
Number of individuals	21	18	56	110	51	49	26	58	99

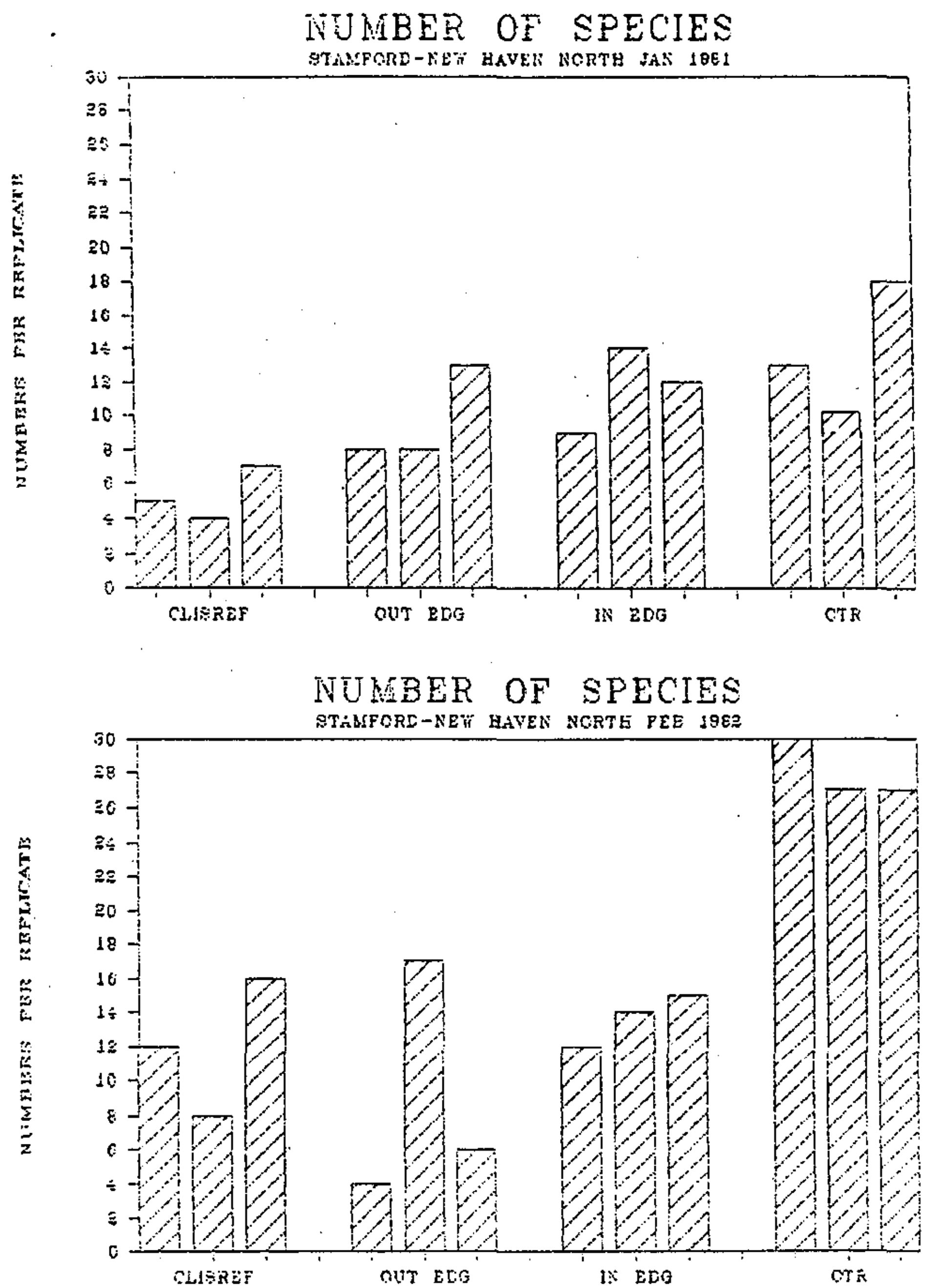
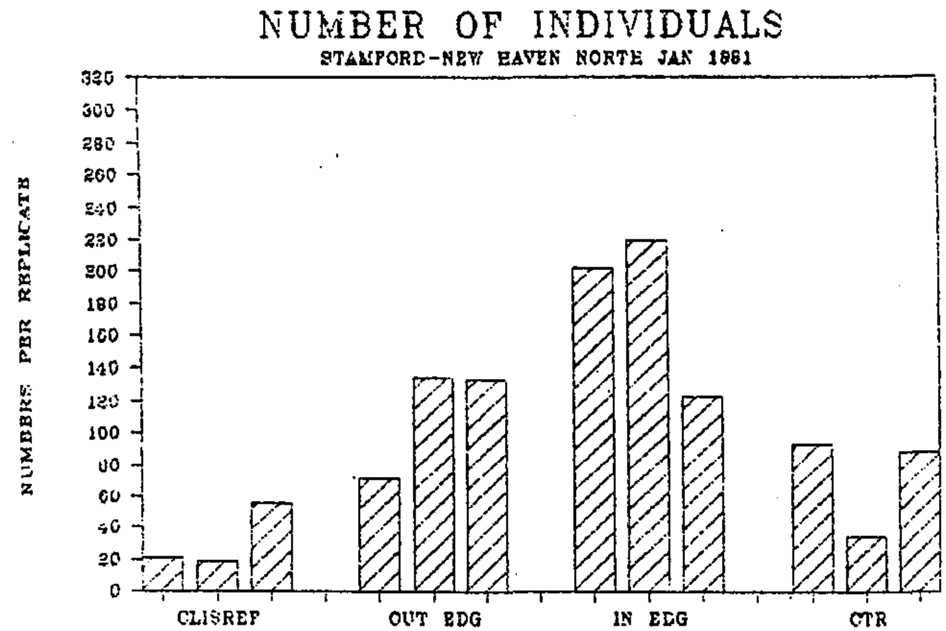


FIGURE I-3-31. Number of species at Stamford- New Haven North January 1981 and February 1982.



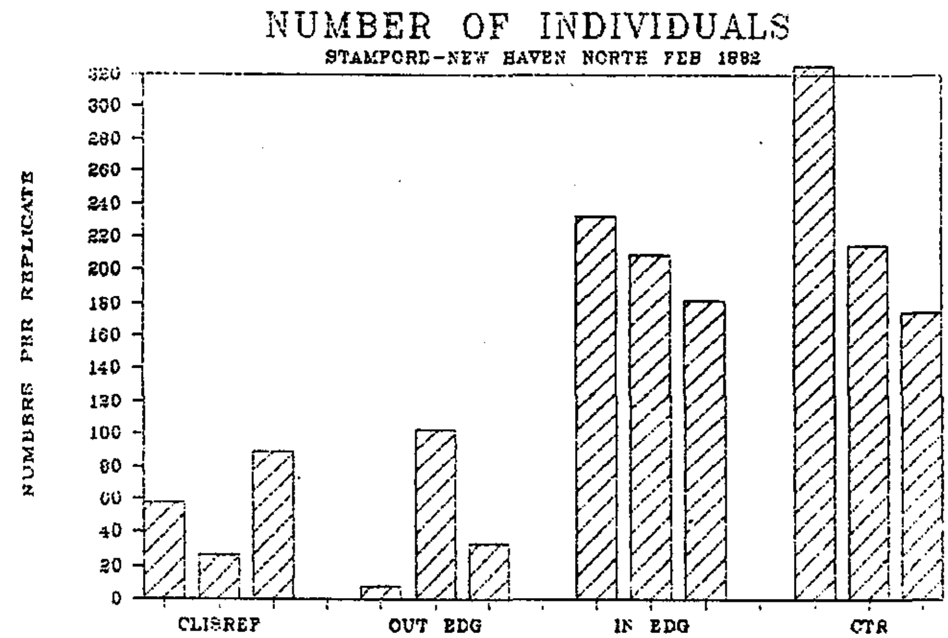


FIGURE I-3-32. Number of individuals at Stamford-New Haven North for January 1981 and February 1982.

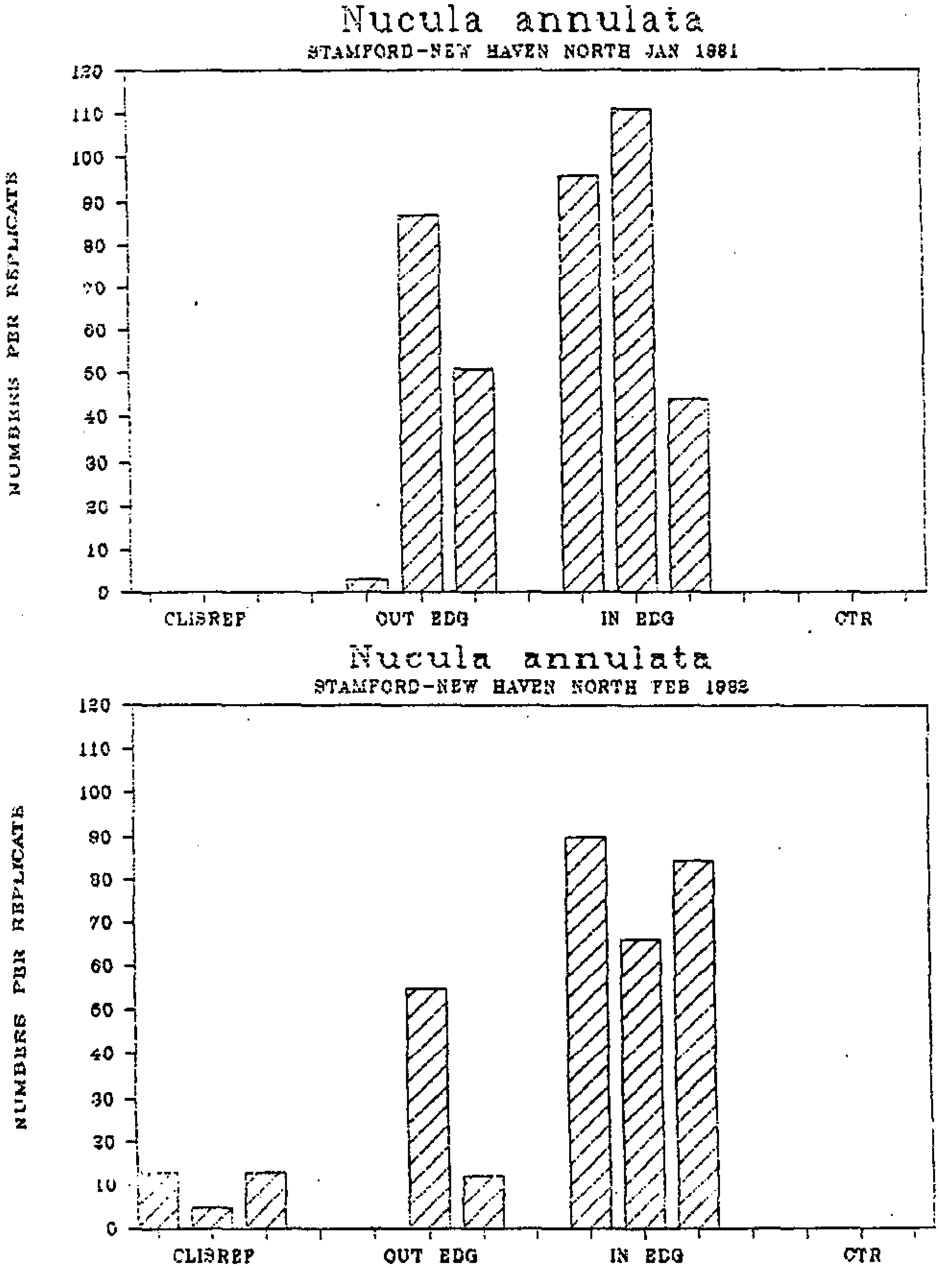


FIGURE I-3-33. Abundance of Nucula annulata at Stamford-New Haven North for January 1981 and February 1982.

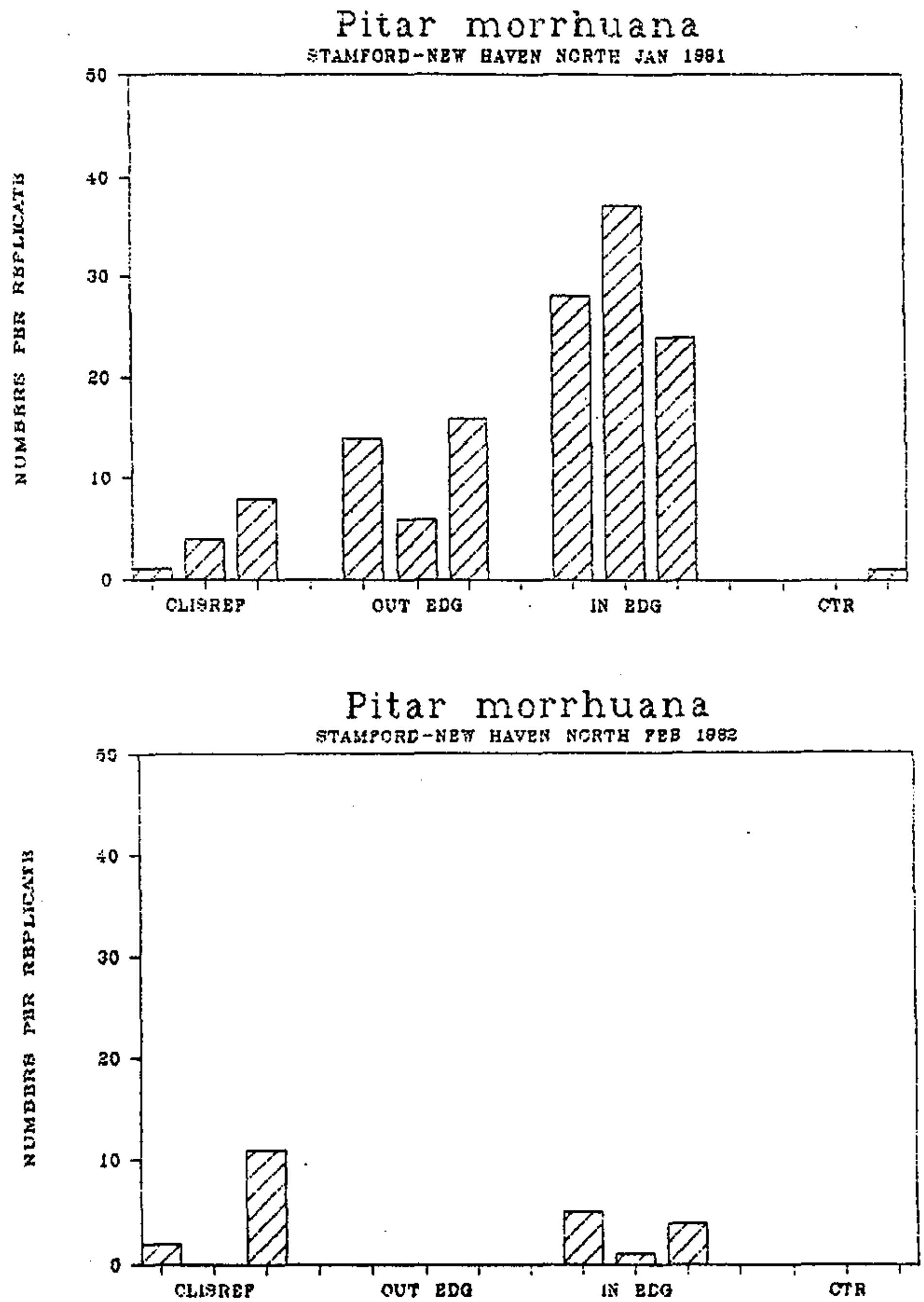


FIGURE I-3-34. Abundance of *Pitar morrhuana* at Stamford-New Haven North for January 1981 and February 1982.

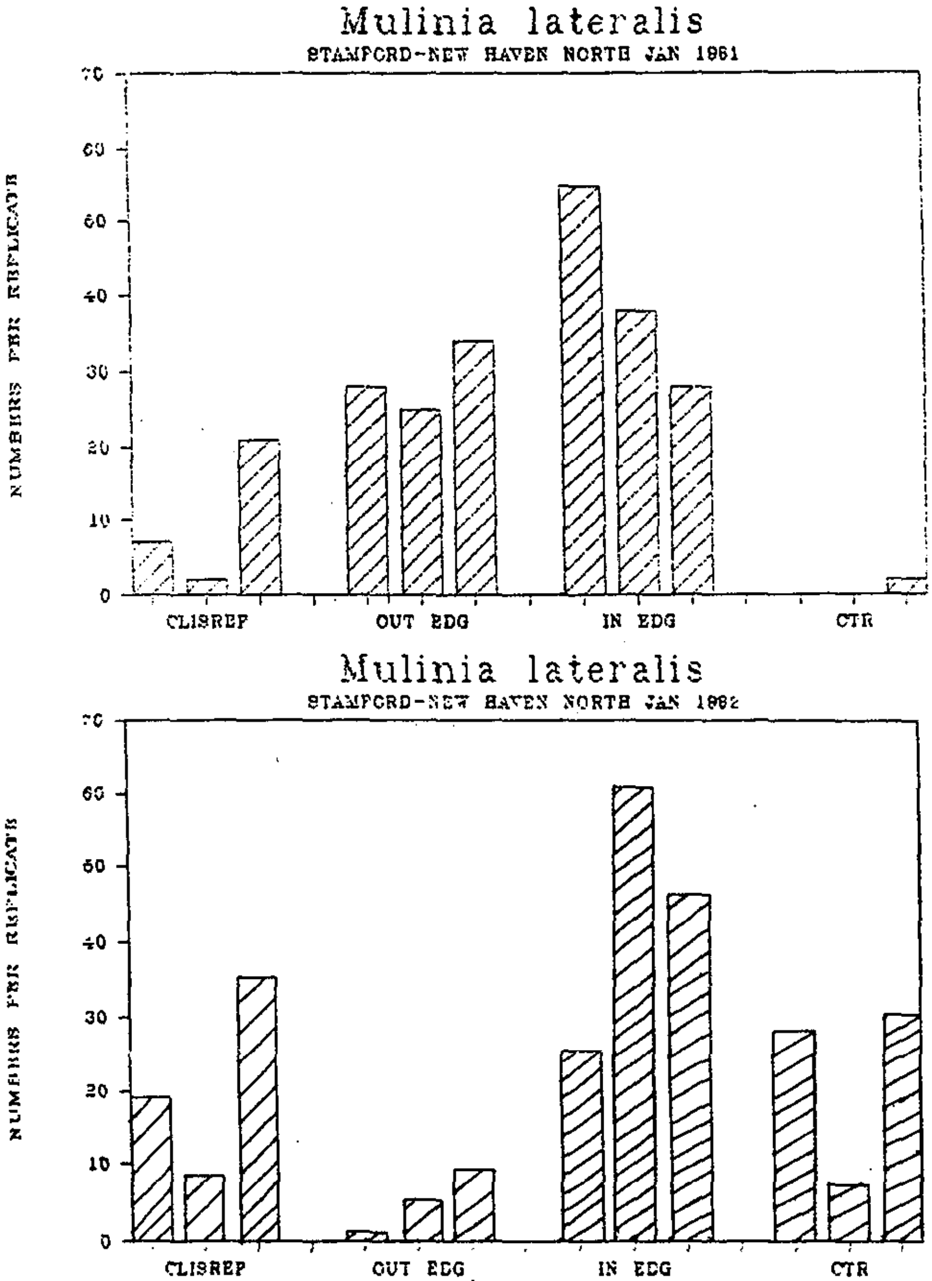


FIGURE I-3-35. Abundance of <u>Mulinia lateralis</u> at Stamford New Haven North for January 1981 and February 1982.

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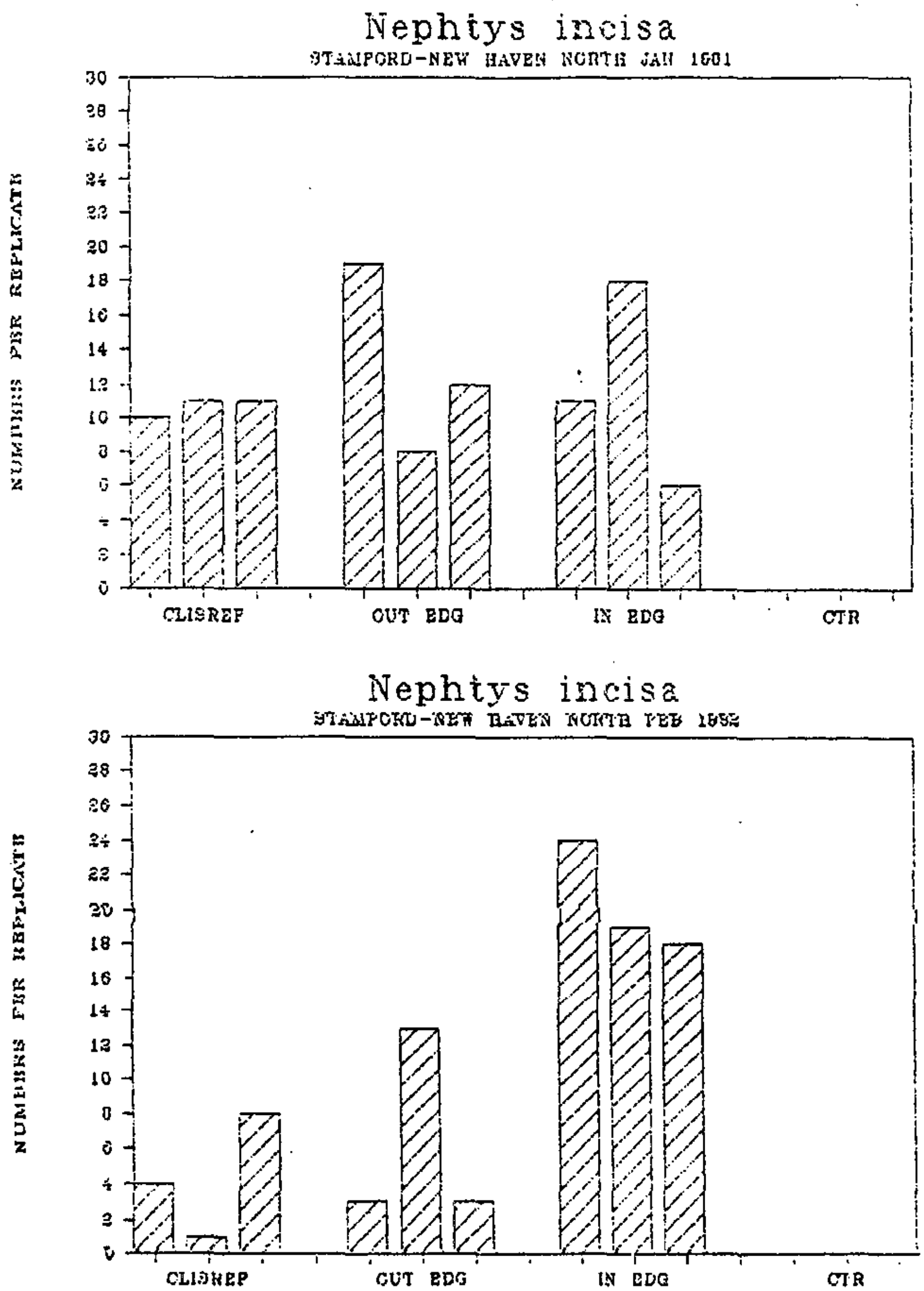


FIGURE I-3-36. Abundance of <u>Nepthys incisa</u> at Stamford-New Haven North for January 1981 and February 1982.

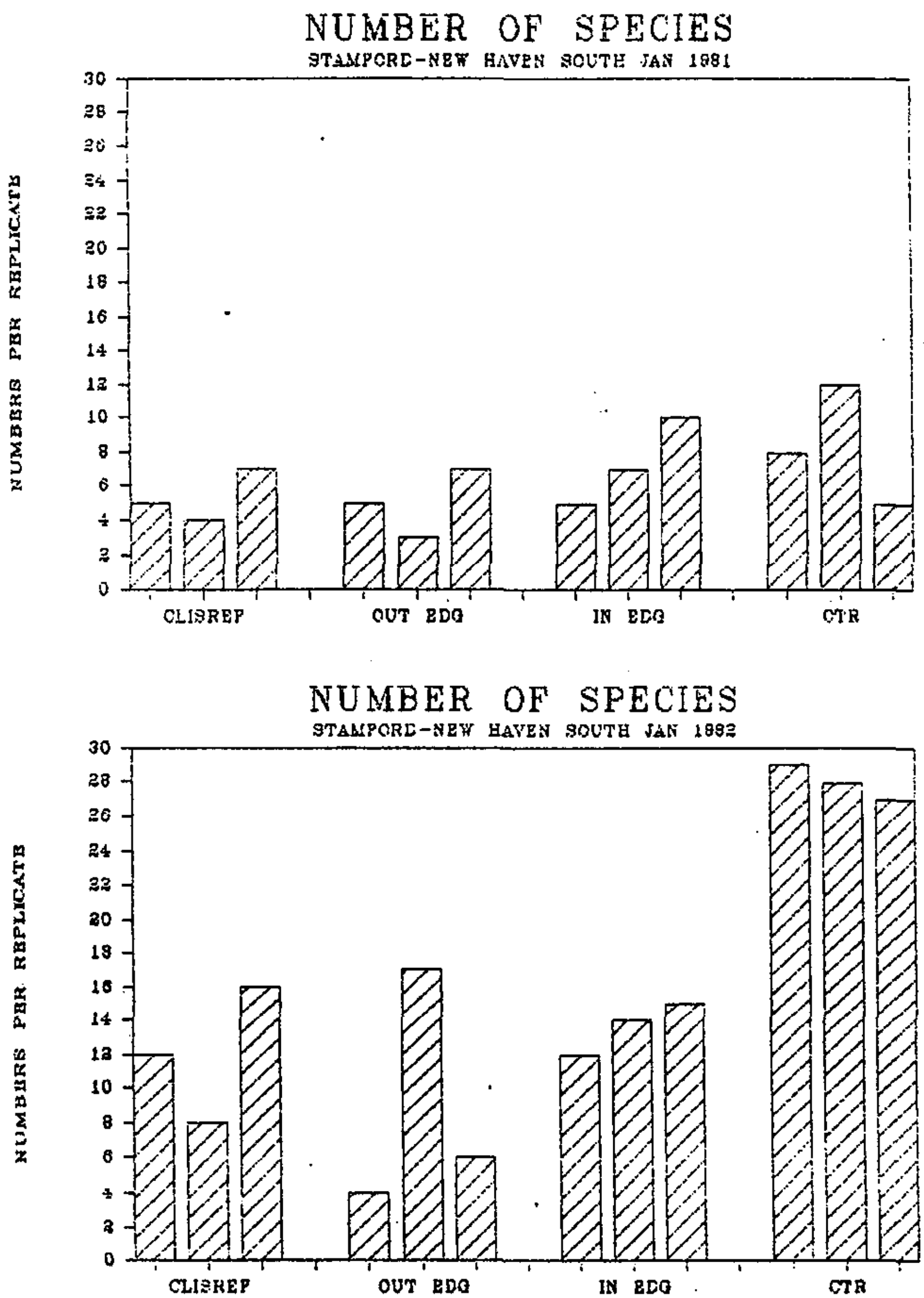
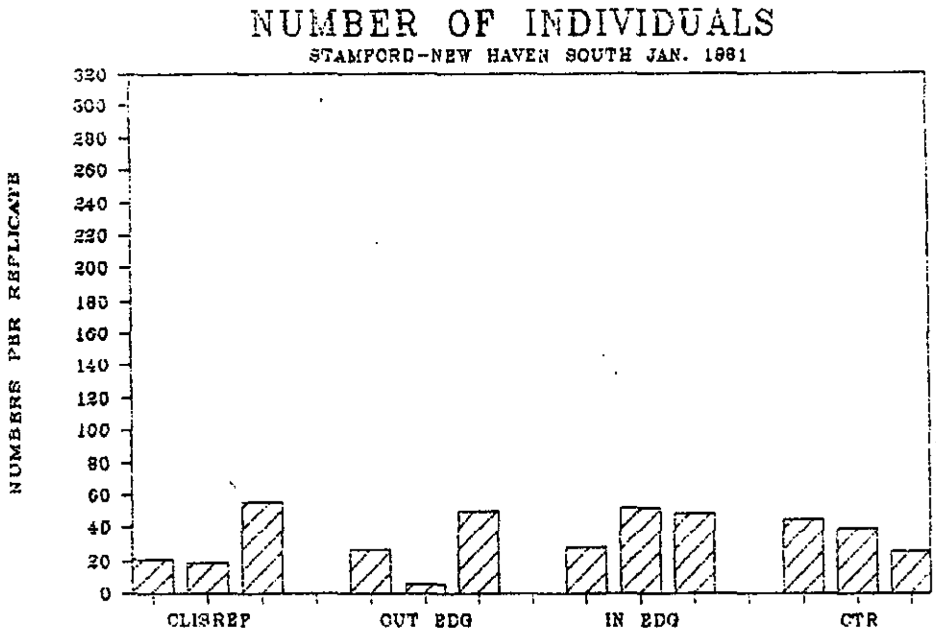


FIGURE I-3-37. Number of species at Stamford- New Haven South for January 1981 and February 1982.



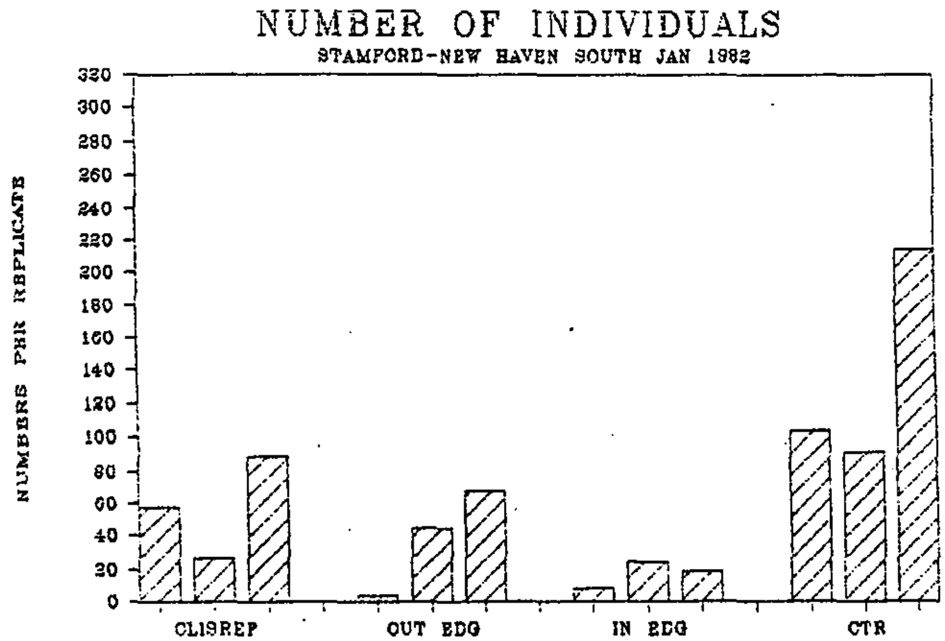


FIGURE I-3-38. Number of individuals at Stamford-New Haven South for January 1981 and February 1982.

SAIC

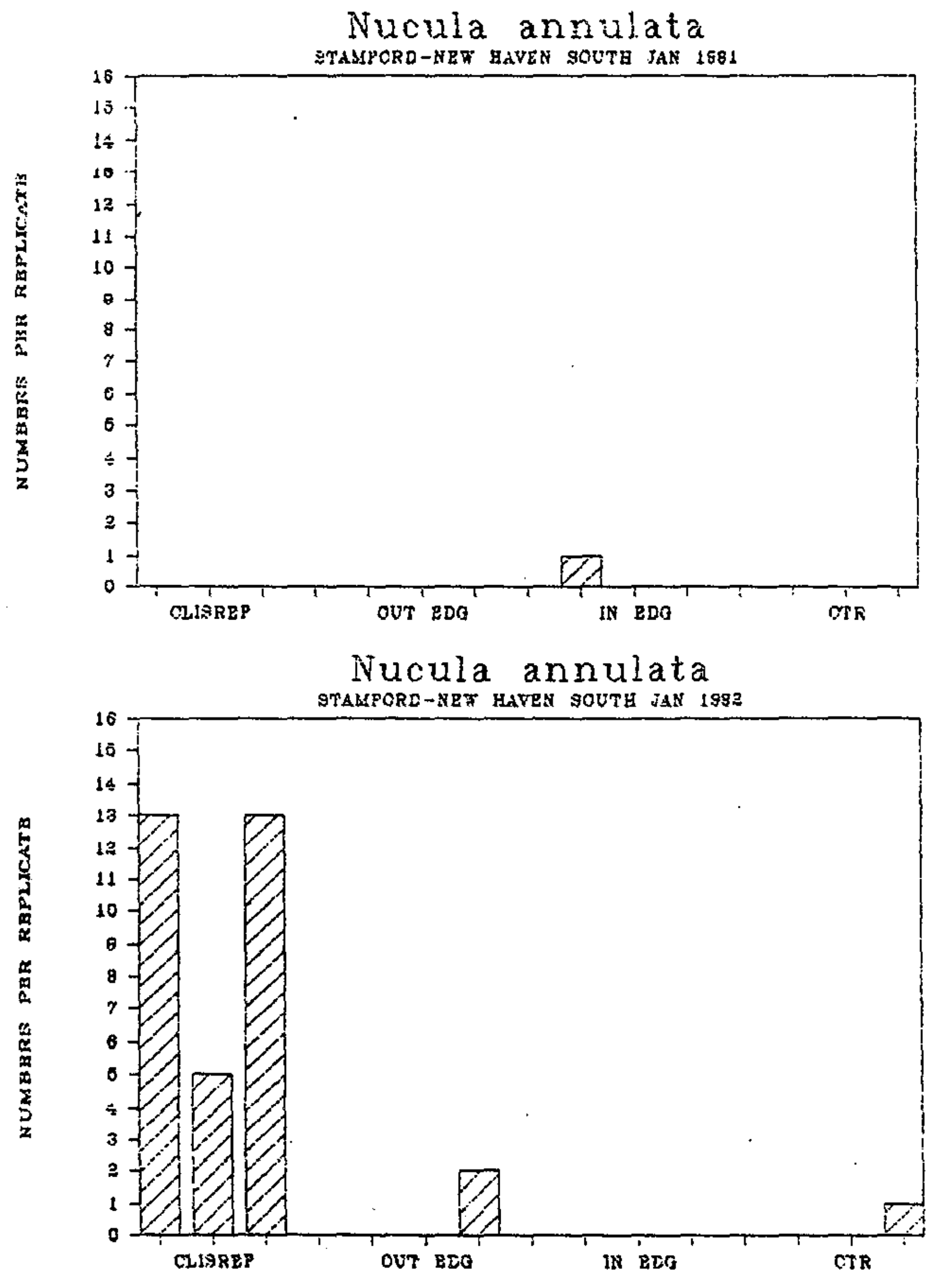


FIGURE I-3-39. Abundance of Nucula annulata at Stamford-New haven South for January 1981 and February 1982.

SAIC

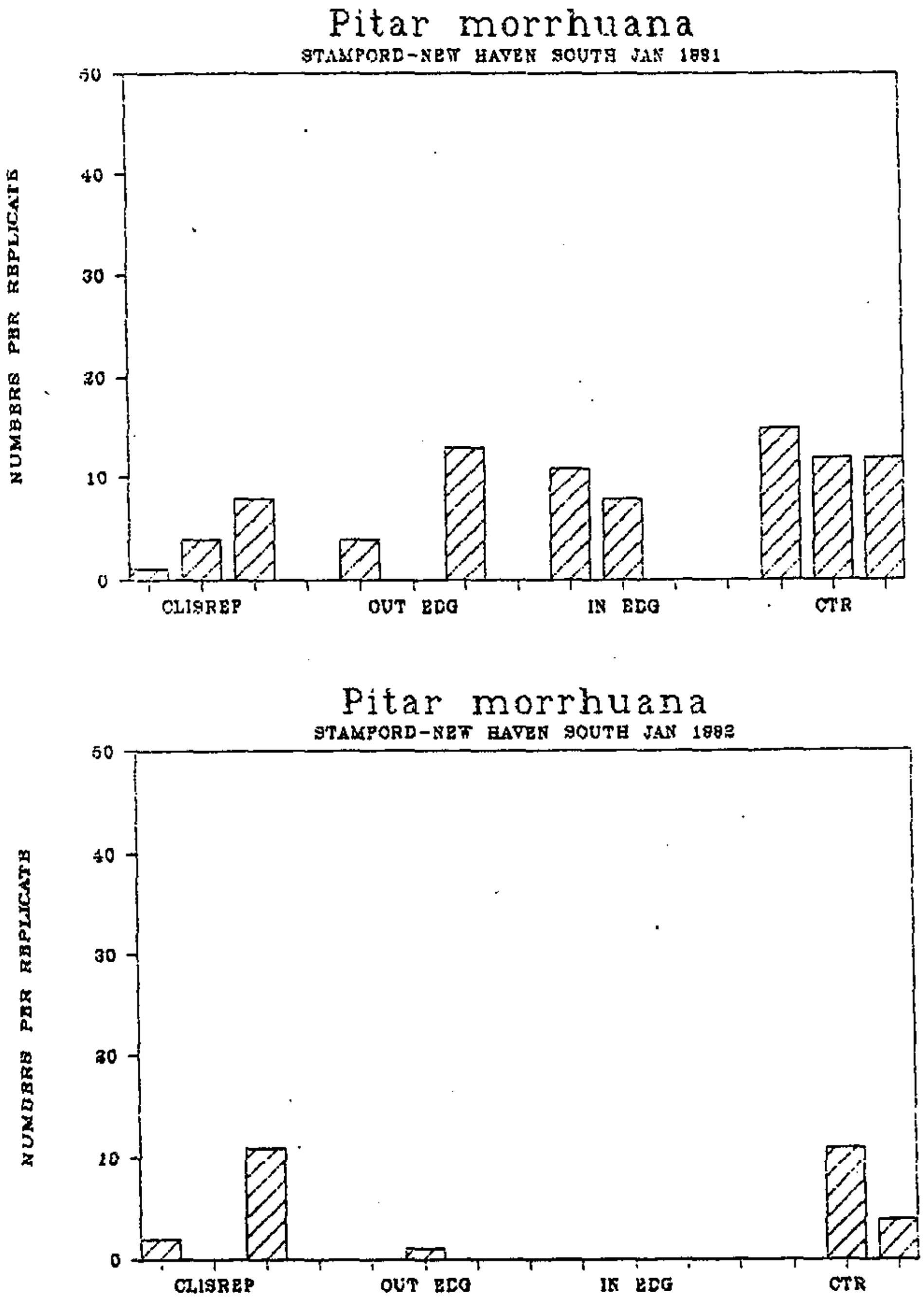


FIGURE I-3-40. Abundance of Pitar morrhuana at Stamford-New Haven South for January 1981 and February 1982.

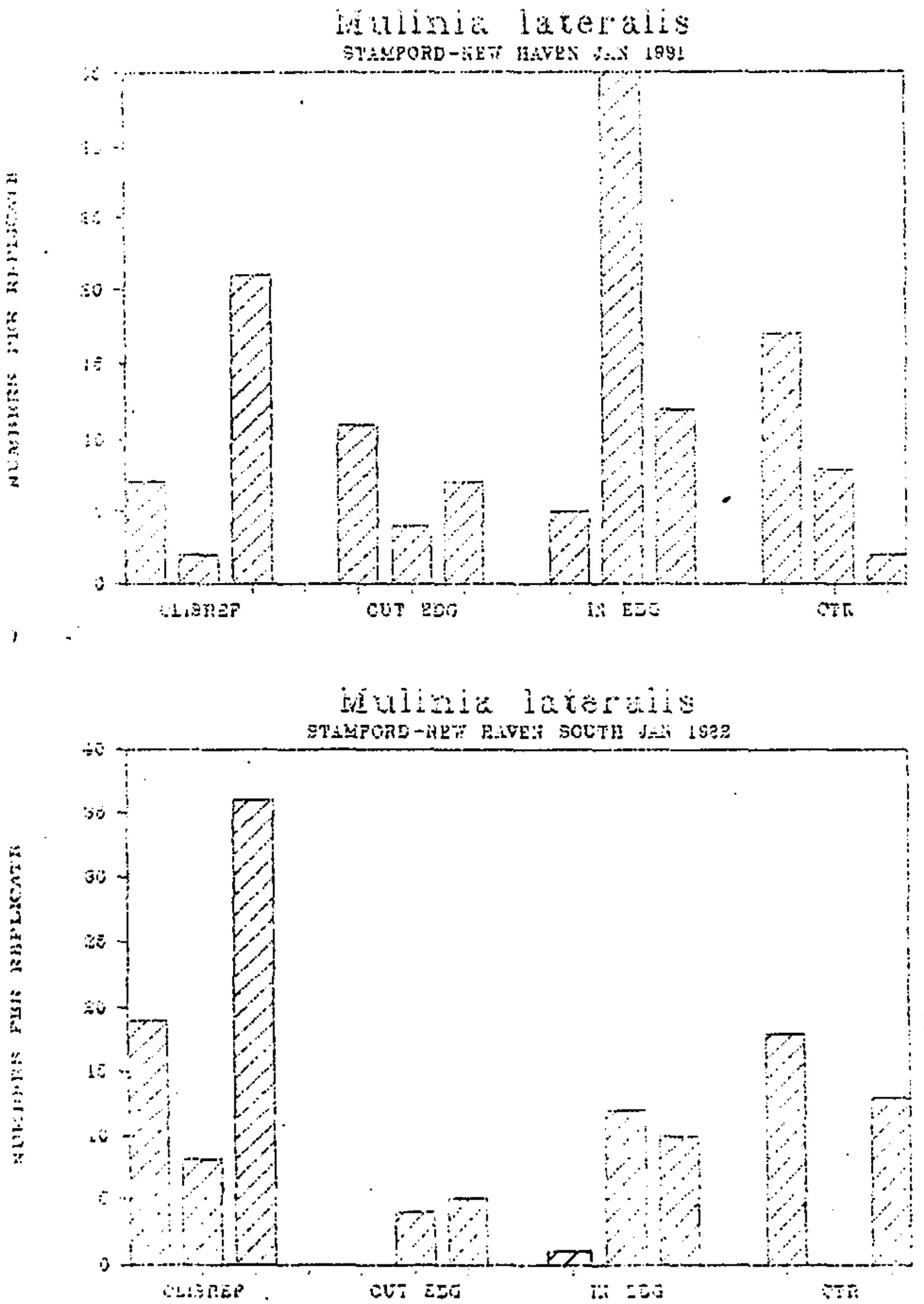


FIGURE I-3-41. Abundance of Mulinia lateralis at Stamford New Haven South for January 1981 and February 1982.

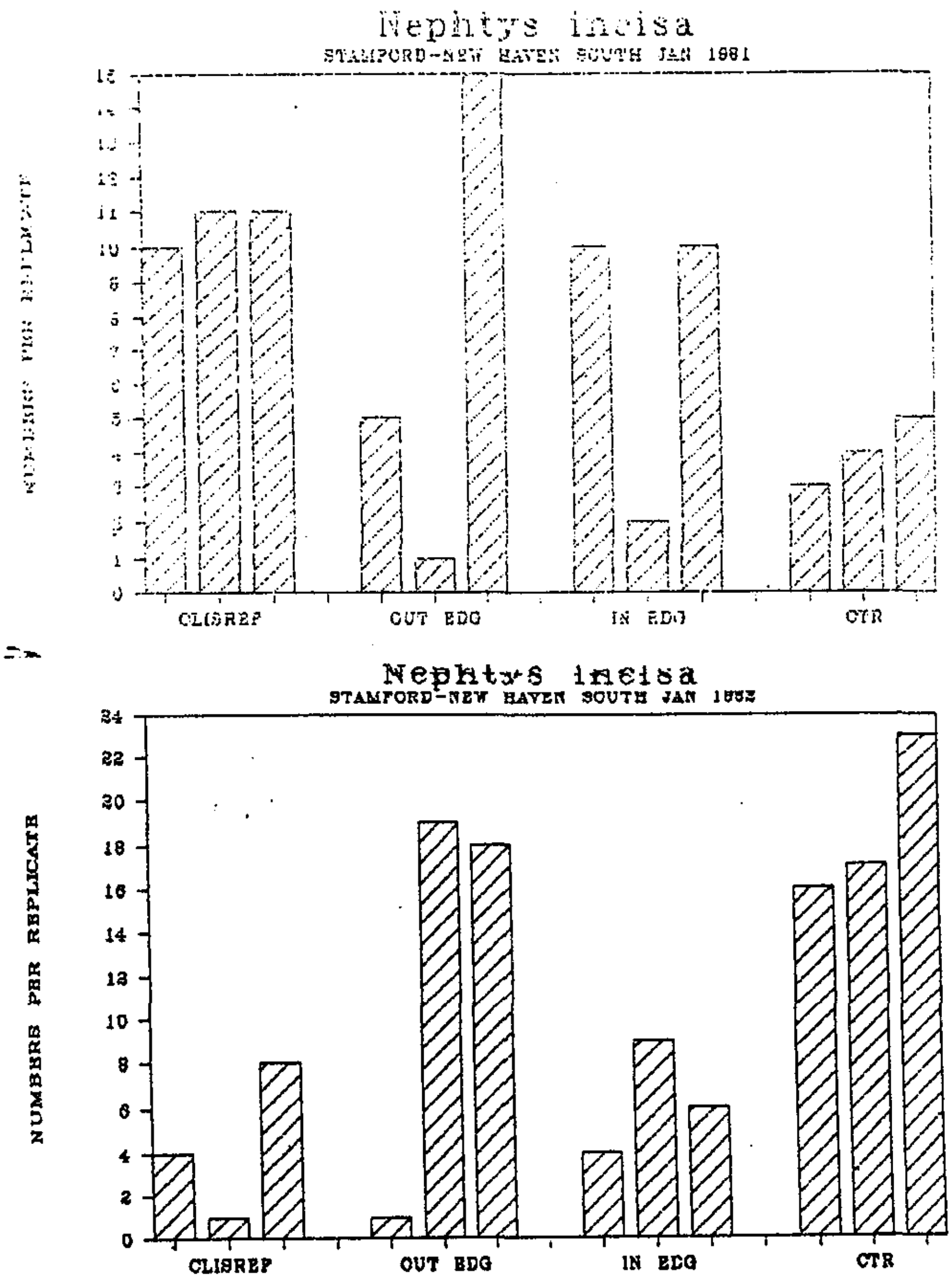


FIGURE I-3-42. Abundance of Nephtys incisa at Stamford-New Haven South for January 1981 and February 1982.

These data indicate that colonization is proceeding on both mounds as reflected in increased species numbers and individuals from 1981 to 1982. Differences in the composition of the community mainly result from the substrate differences in the capping material. In both cases, the center of the mound, where cap thickness is expected to be the greatest, had the greatest numbers of species.

3.2.4 REMOTS

A REMOTS survey was conducted at both sites in January 1983 to complement the previous benthic data. Twenty-six station replicates were taken at both mounds. At the north site, stations CTR, 100S, 100N and 250S are represented by poorly sorted muddy sands (4 ϕ to 3 ϕ) with an unidentified fraction of gravel and shell. The remaining stations consist of silt-clay muds (Fig. I-3-43). Penetration of the camera prism was poor at stations CTR, 100S, and 100N because of the abundance of shell and gravel.

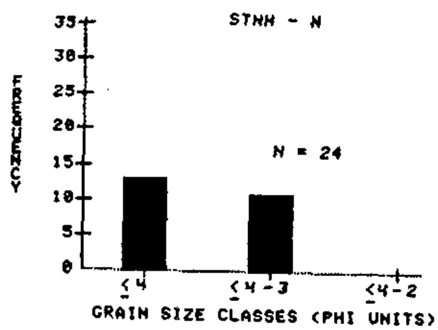
The range of RPD values and frequency distribution of boundary roughness values (exclusive of stations CTR, 100S, and 100N which are indeterminant because of poor camera penetration) are comparable to the CLIS-REF (Figs. I-3-44 to I-3-45).

The mean RPD depth could be determined in 6 of the 9 stations surveyed. All of these are located either on the margins of the disposal mound (150W, 200E, 300W, and 250S) or on the ambient seafloor (400E and 200N, Fig. I-3-46). The successional stage of CTR and 100S could not be determined because of the poor penetration depth of the camera. Two replicates of station 100N provided estimates of a Stage I assemblage (Fig. I-3-47). The habitat indices suggest that stations CTR, 100N, 100S, 200E, 150W, and 250S are affected by dredged material disposal. Stations clearly not affected are 200N and 400E. Replicate 3 of station 300W has a low habitat index of 3, but this appears to represent a small patch of the Stage I bivalve Mulinia lateralis (Fig. I-3-48), which is located in an otherwise undisturbed bottom (Fig. I-3-49).

At the south site, twenty-six station replicates show the predominant grain size to be 4 ϕ (Fig. I-3-43). Station 250S is a sandy mud as well as two replicates at station 250W. The frequency distribution of RPD depths has two modes. Most values fall between 4.1 and 5.0 cm. The range is greater than at the north site, however this mode coincides with the major mode of the CLIS-REF (Fig. I-3-45). A subordinate mode exists with 8 station replicates having low values between 2.1 and 3.0 cm. These low values are found at station CTR, 100S, and 200N (Fig. I-3-50). Boundary roughness values are comparable to the CLIS-REF (Fig. I-3-45).

The mapped distribution of successional stages and habitat indices show no clearly defined disturbance gradients

A



B

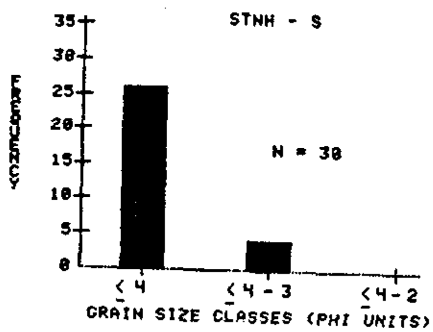


FIGURE I-3-43. Grain size classes at STNH-N and STNH-S for January, 1983.

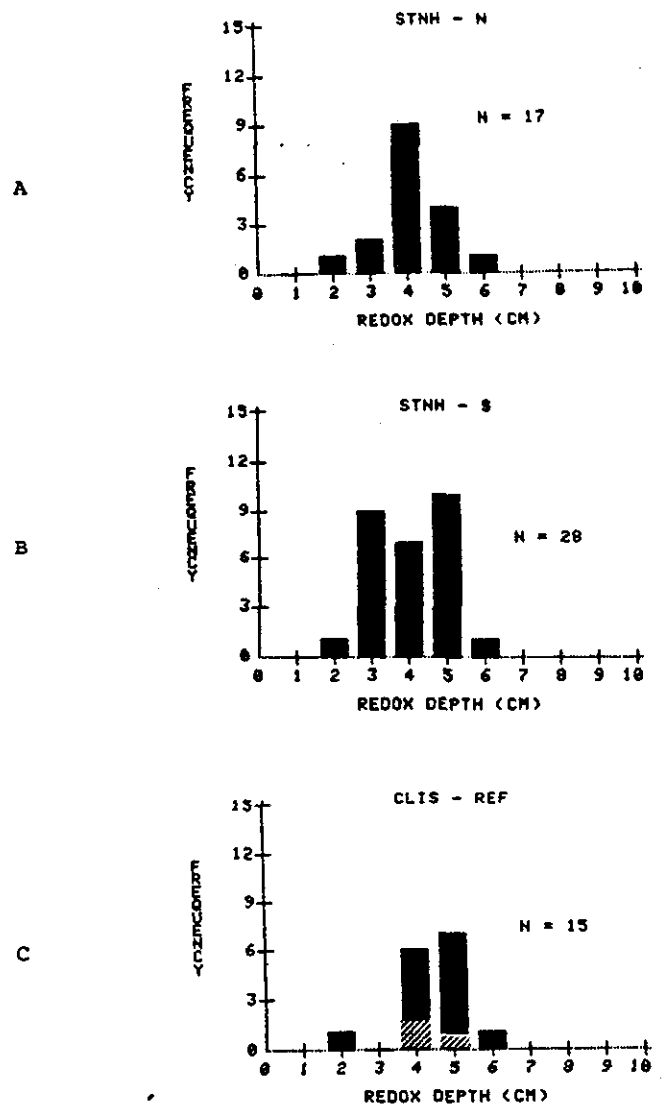
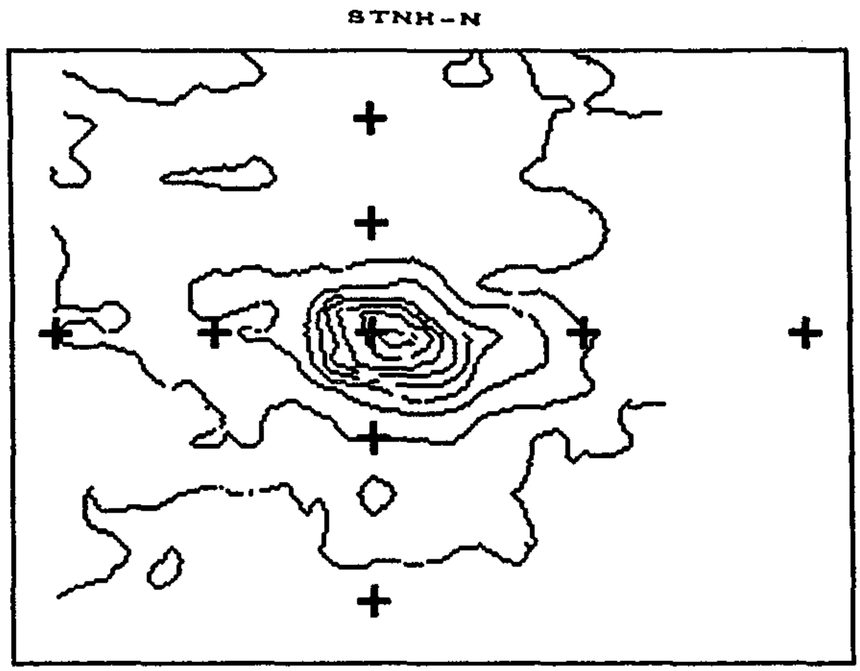
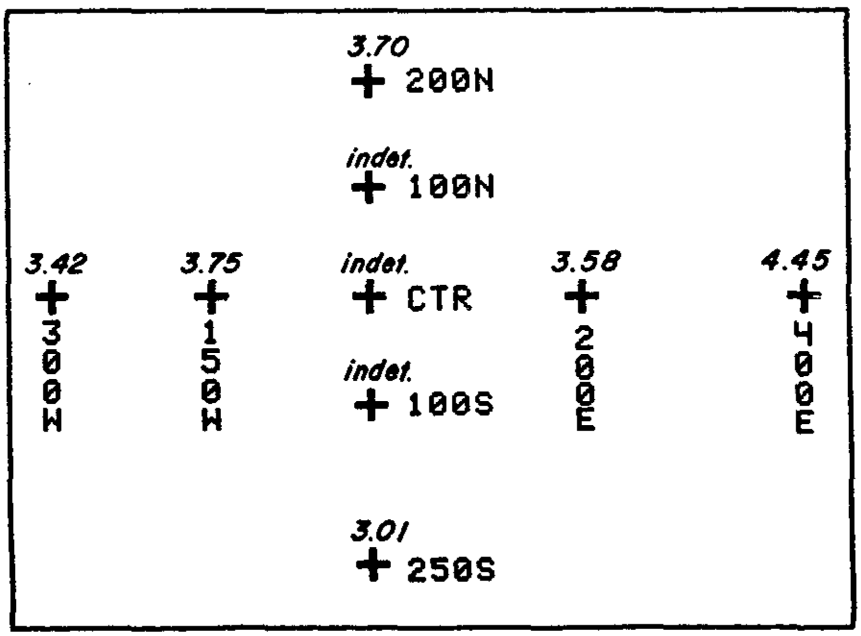


FIGURE I-3-44. Redox depths at STNH-N, STNH-S, and CLIS-REF. (January 1983)



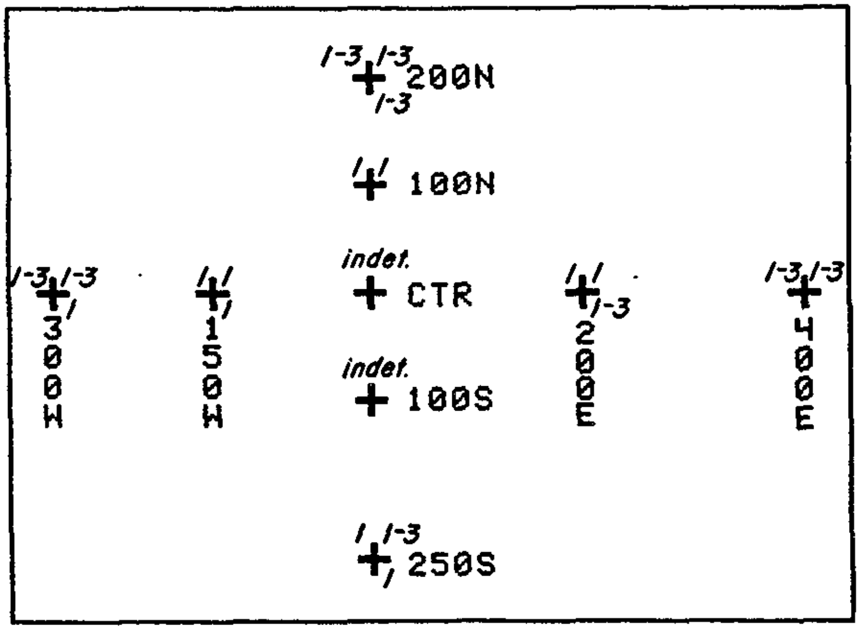
A



B

FIGURE I-3-46. Station locations and RPD depths at Stamford-New Haven North January 1983.

SAIC



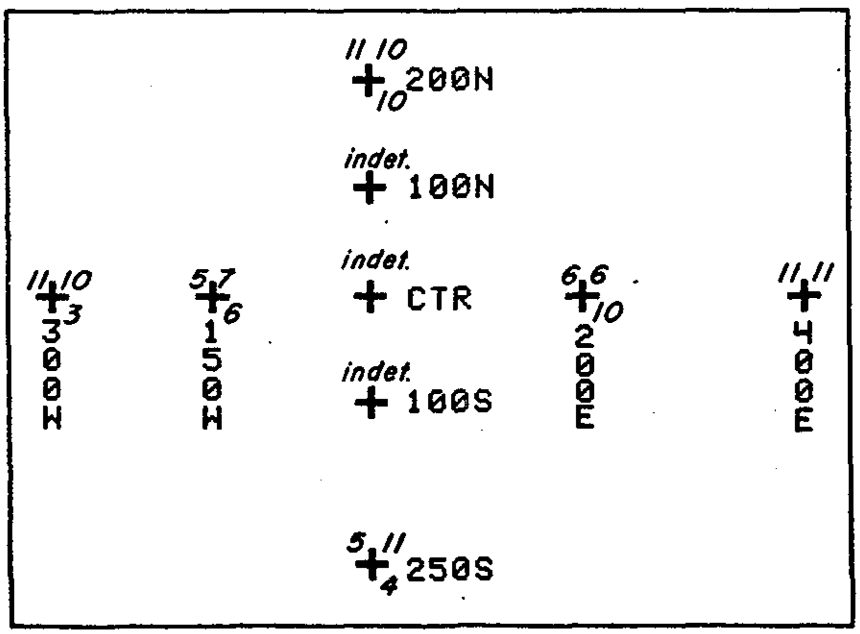


FIGURE I-3-47. Successional stages and habitat indices at Stamford-New Haven North, January 1983.

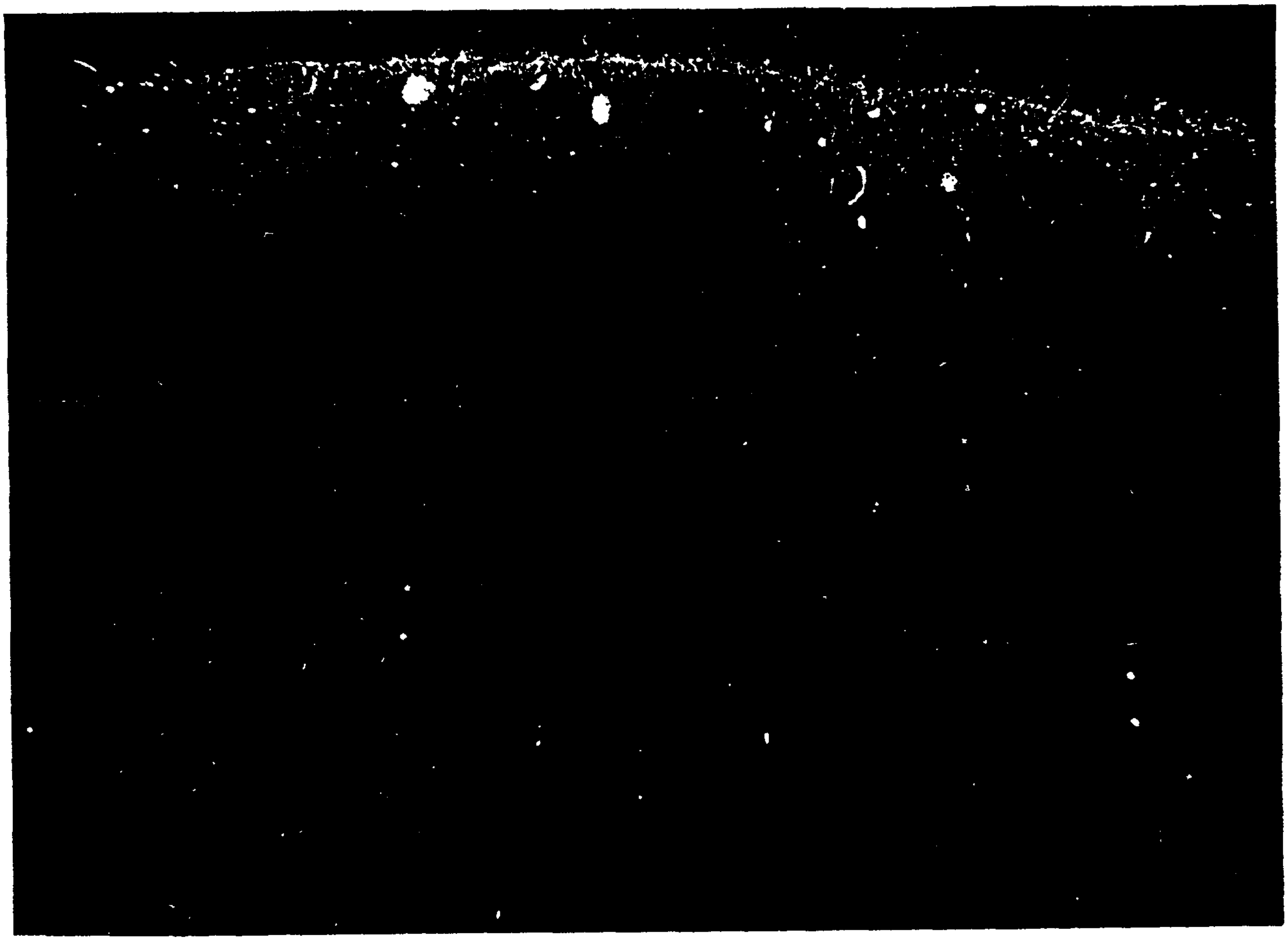


FIGURE I-3-48. STNH-N, station 300W. Scale = 1.5X

A local patch of the pioneering mactrid bivalve, Mulinia lateralis. The RPD is located at a depth of 1.4cm.

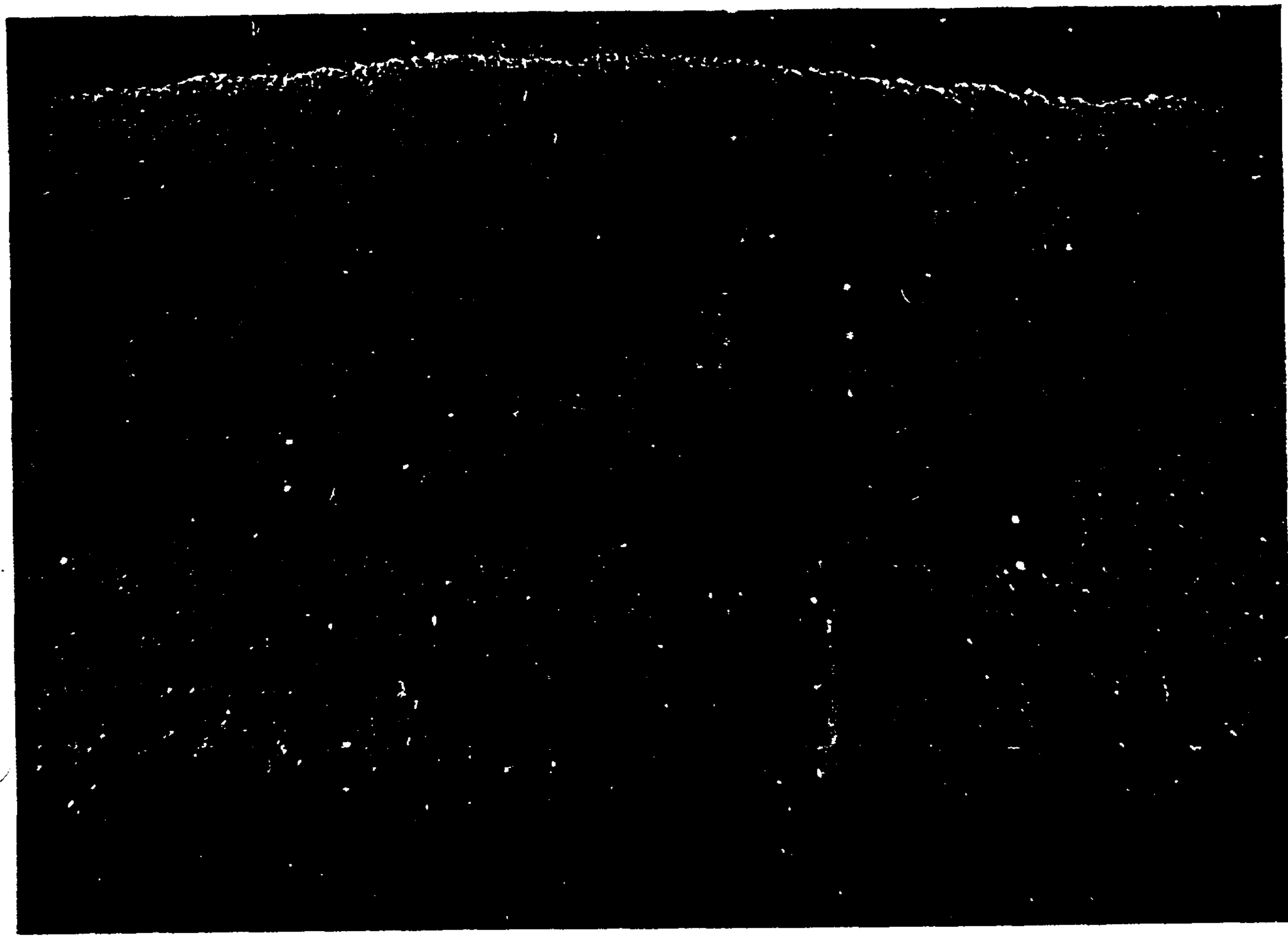


FIGURE I-3-49. STNH-N, station 300W. Scale = 1.5X

This replicate shows the presence of a well developed stage III-I assemblage. The RPD is located at a depth of 5cm. A Maldanid polychaete is shown by the arrow.

SAIC

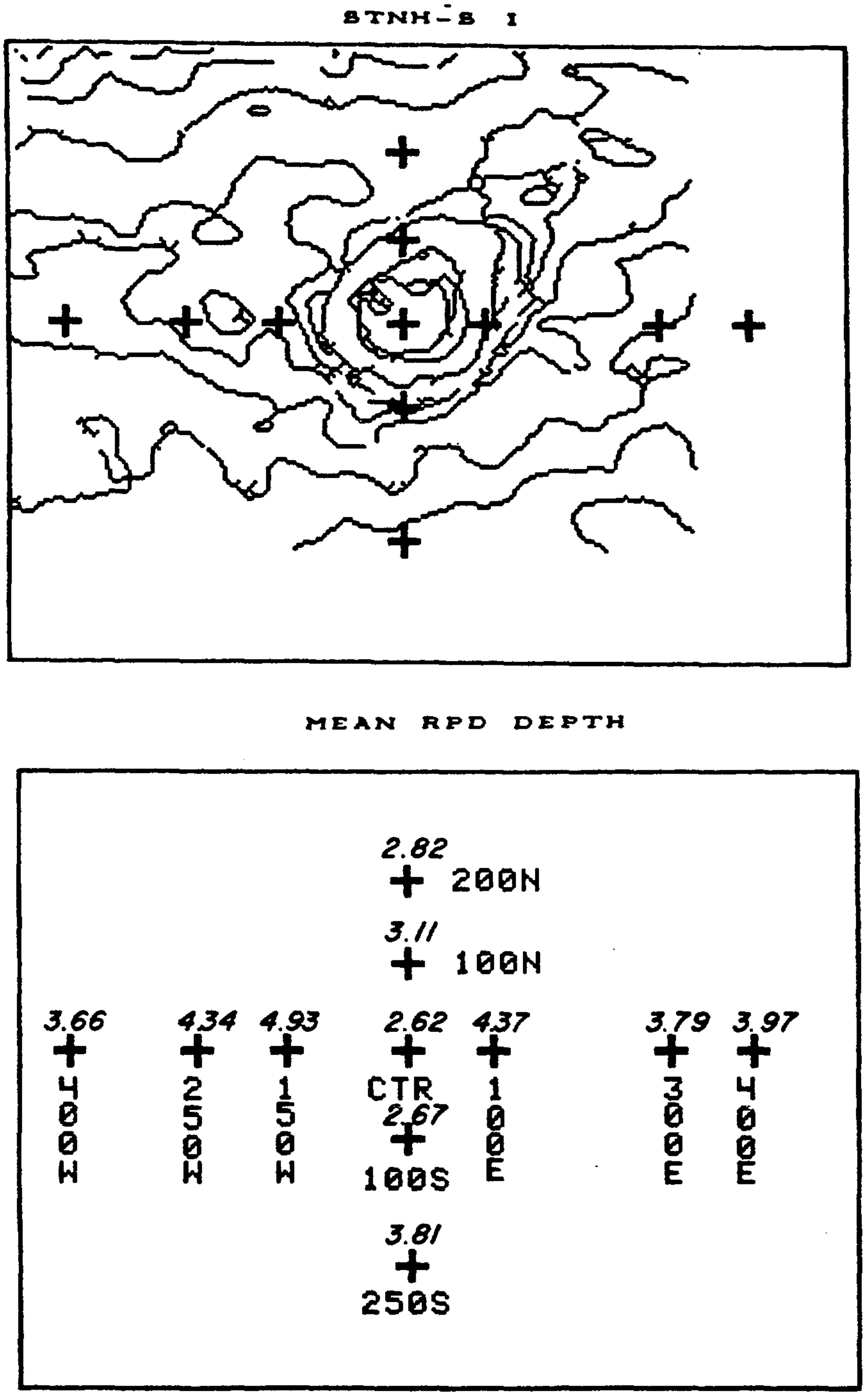


FIGURE I-3-50. Station locations and RPD depths at STNH-S, January 1983.

away from the mound apex (Fig. I-3-51). Rather, the surveyed area appears to be physically and biologically patchy. Stations 100E, 150W, and 250W are similar to the CLIS-REF.

Within station patchiness is high, with the three replicates of the stations yielding different RPD depths and variances (e.g. station 100N, Fig. I-3-52). Those stations most affected by the disposal activity lie along the N-S transect.

3.2.5 Diver Observations

Diver observations were made at the north and south sites in January 1982 and then again at the north disposal site in December 1982. In January 1982, four dives were conducted in 63 feet of water and 68 feet of water at the north and south sites, respectively. The dives were conducted to observe sediment surface conditions, survey species types and relative abundance and provide photo-documentation of conditions. Observations at each site are outlined in Tables I-3-17 and I-3-18.

The sediment surface was characterized as a sand/shell hash mixture with 1-2 cm of nepheloid layer. A heavy defecation layer was evident at the north site, while the more cohesive substrate at the south site had evidence of burrow excavation and an obvious 2-3 cm oxygenated surface layer. There was a distinct transition zone between the sand and the soft silt bottom on the north site, where there was intense Libinia and Cancer activity. Areas of shell hash were composed primarily of Gemma, Mulinia, and Crepidula. Only one mound feature, a .25m protrusion above the substrate, was sighted on the south site.

Considerable biological activity by motile epifauna was observed at the north and south transects. Numerous decapods, gastropods, and finfish were sighted both actively feeding and in overwintering condition. The South site had two large reproductive Corymorpha on the sediment surface, heavy hydroid fouling on the old subsurface buoy, and dense Metridium on the old mussel bags from the bioaccumulation experiment.

Table I-3-19 summarizes species observed and their relative abundances. Figure I-3-53 provides photodocumentation of conditions during the survey.

The December diving survey was conducted to assess long-term post disposal conditions at the Stamford/New Haven North disposal site. Two dives were conducted in 63 feet of water to observe sediment surface conditions, survey species types and relative abundances, and provide photodocumentation of conditions (Table I-3-20; Fig. I-3-54). Loran-C coordinates for the diver transect were from 44000.5/26543.7 to 44000.0/26542.6. For this survey, two biologist-divers were on 15 foot tethers to the video camera sled and executed an easterly transect with the support ship R/V UCONN under power.

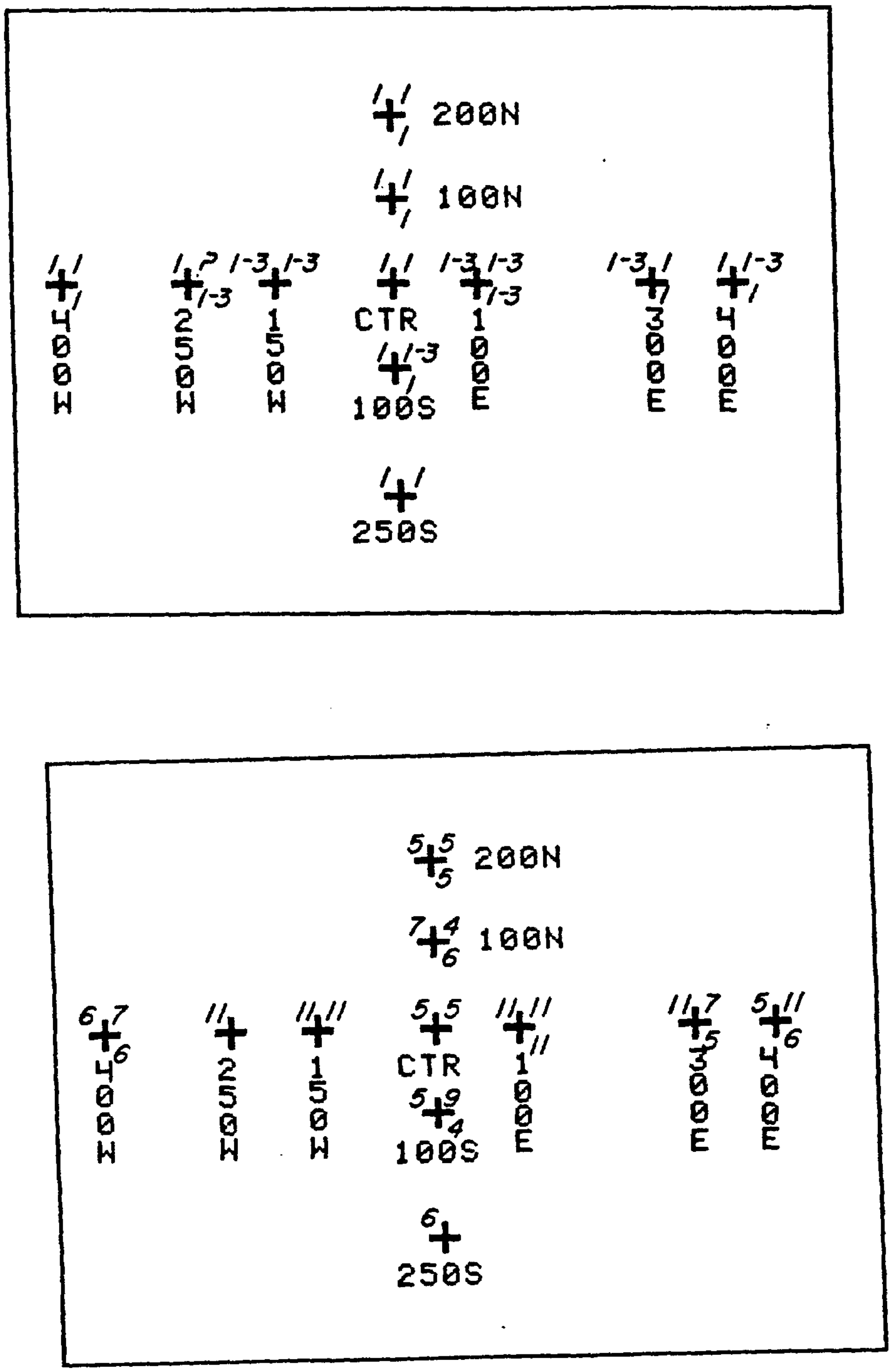


FIGURE I-3-51. Successional stages and habitat indices at STNH-S, January 1983.

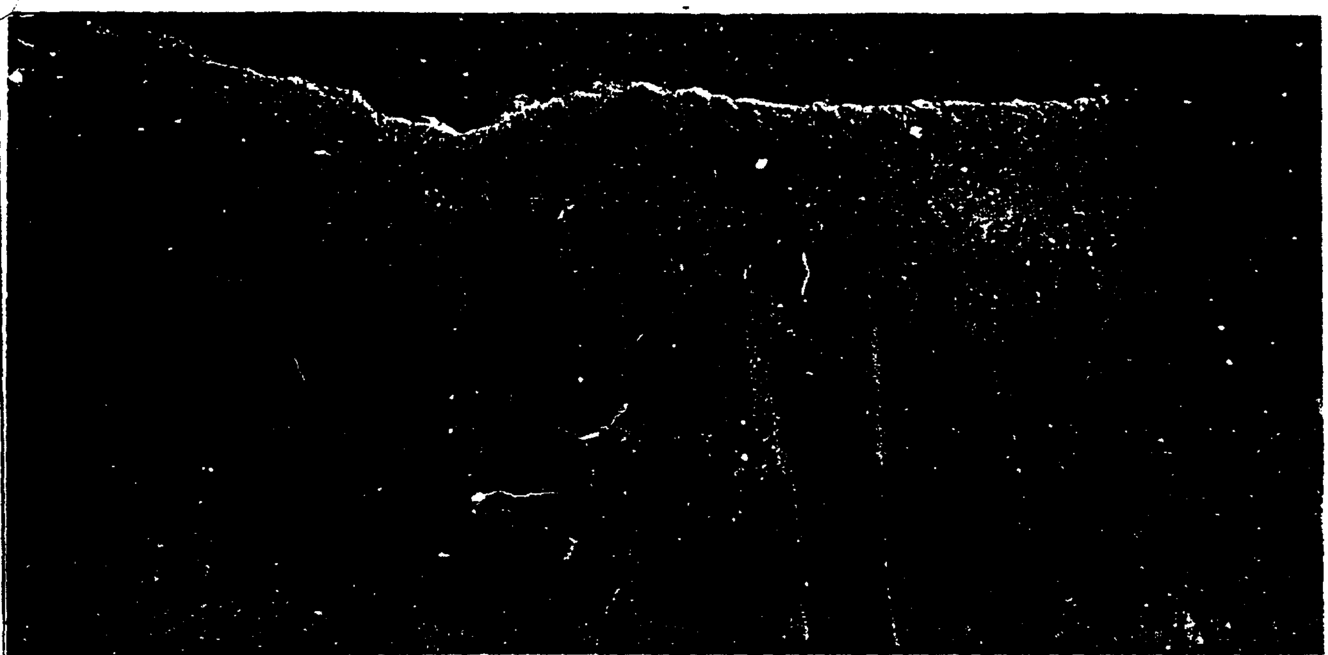


FIGURE I-3-52a. STNH-S, station 100N. Scale 1.0X
Replicate 1.

FIGURE I-3-52b. STNH-S, station 100N. Scale 1.0X

Replicate 2.

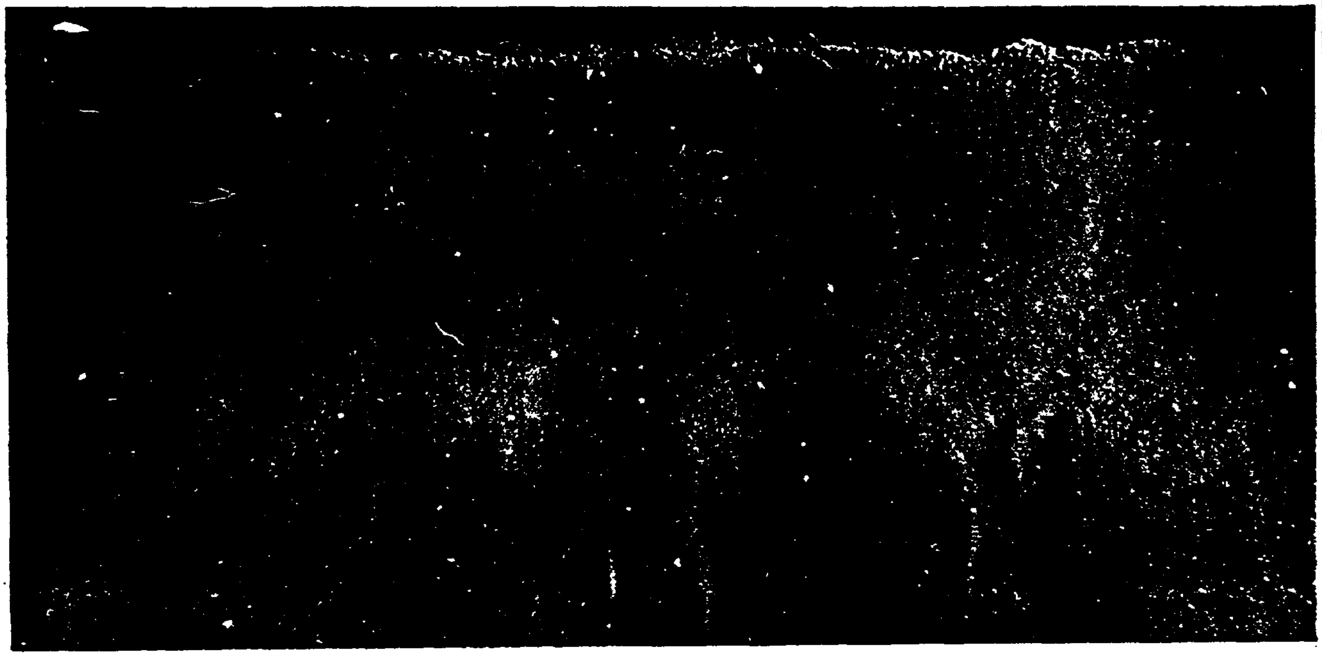


FIGURE I-3-52c. STNH-S, station 100N. Scale 1.0X

Replicate 3, RPD depth of 4.2cm. Each of the three replicates shows a different RPD depth related to faunal patchiness.

TABLE I-3-17

D.A.M.O.S. DIVER MONITORING LOG, STNH-N, January 1982

DATE: 29 Jan. '82 LOCATION: New Haven - North Site

DIVERS: L. STewart TIME: 1357-1415 DEPTH: 63' T^oC: -1^o VISIBILITY: 4'

DIVE (in/out Loran C): DISPOSAL or REFERENCE BUOY (L/C:
Bouy location - SW transect 75 m

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, nefflold layer, surface features (composition), shell hash (% cover), topography (slope/contour/apron), compaction, bioturbation, perimeter Loran C.

End flood ~ .25 kts to West; uniform suspended load in water column, course sand with shell surface (Anomia, Crepidula) predominant, course sand/shell intermixed with silt/fecal layer. At end of transect course a sand slope ~ 20^o interfaced with soft silt bottom. Libinia and Cancer burrow activity was extensive at the bottom type transition zone.

Attempt on SW transect to intercept old N site transect line was unsuccessful.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Libinia (5) overwinter burrowed to carapace depth.
Cancer irroratus (2) 1 eggshell.
Pagurus pollicaris (100+) - (4) .25 m^2 counts = 4, 9, 6 2
P. longicarpus (100+) concentrations .25 m diam. areas (20+) obvious sand substrate attraction.
Nassarius trivattatus mucal tracing evident at silt border.
Urophycis - (1) - hake
Scopthalmous aquosa - 1 (sediment veneer covered)
Busycon canniculatum burrowed 3/4 below sediment horizon.

II. DISCRETE SAMPLES OR METHODS:

_____ A. Epibenthic net (30 sec. traverse): on or off spoil, target species.

X (4) B. .25 m^2 quadrant count/photography.

_____ C. Penotrometer tests, elevation stake readings, sediment trap.

_____ D. Mussel deployment - bioaccumulation subsample.

_____ E. Sonic beacon placement or electrolyte change.

_____ F. Remote bathymetric camera photos.

_____ G. Video tape (location, time min. run, tape index)..

_____ H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)

TABLE I-3-18

D.A.M.O.S. DIVER MONITORING LOG, STNH-S,
January 1982

DATE: 29 Jan.'82 LOCATION: New Haven - S site

DIVERS L. Stewart TIME: 1130-1150 DEPTH: 68' T°C: -1° VISIBILITY: 5'

DIVE (in/out Loran C): At S buoy to N DISPOSAL or REFERENCE BUOY (L/C:
50 m transect

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, nefflold layer, surface features (composition), shell hash (% cover), topography (slope/contour/apron), compaction, bioturbation, perimeter Loran C.

Flood .5 kt to W, 3' surf chop from WNW, silt with small (Gemma, Mulinia) shell hash overlay, reduced (i.e. collect in depressions) nephloid layer (less deffication) 1-2 cm crest ripples, 4 areas of clay sed. mud burrow excavation, oxygenated 2-3 cm surface layer (sticky cohesive) 1 mound feature .25 m protrusion noted - rest flat leveled.
Located S site mussel platform.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

C. irraratus (15+) 10% in recent post molt condition.
Pectenaria agglutated tubes evident 10+
Merluccius bilinarus (whiting) 1 juv.
Corymorpha (2) large and mature with reprod. hydranth (on mound tops)
Nassarius trivittatus (few) 10-15
Old subsurf buoy heavily fouled-Hydroid)
Collected (4) old mussel bouys - dense epifauna Metridum, Balanus,
Tautogalabrus adopersus (3.0 cm) juv.

II. DISCRETE SAMPLES OR METHODS:

_____ A. Epibenthic net (30 sec. traverse): on or off spoil, target species.

_____ B. .25 m^2 quadrant count/photography.

_____ C. Penotrometer tests, elevation stake readings, sediment trap.

__X__ D. Mussel deployment - bioaccumulation subsample. 4 buoys retrived - platform located 50' S of subsurf buoy.

_____ E. Sonic beacon placement or electrolyte change.

__X__ F. Remote bathymetric camera photos. 4-5 film non-advance 20 exp.

_____ G. Video tape (location, time min. run, tape index).

_____ H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)

TABLE I-3-19

Table 1 - Summary of Species and Relative Abundances from Diver Visual Transect

Species	Relative Abundance
Porifera	
Poriferan	Present
Cnidaria	
Tubularia	Present
Bryozoa	
Bryozoan	Present
Gastropoda	
Nassarius trivittatus	4-5/.25 m^2 (sand cap) 1/.25 m^2 (ambient sediment)
Yoldia sp.	Present
Crustacea	
Pagurus longicarpus	100
Pagurus pollicaris	35
Homarus americanus	1
Pisces	
Raja erinacea	2
Pseudopleuronectes americanus	1
Urophycis sp.	1

FIGURE I-3-53.

Photodocumentation of Benthic Conditions at STNH-N, January 1982.

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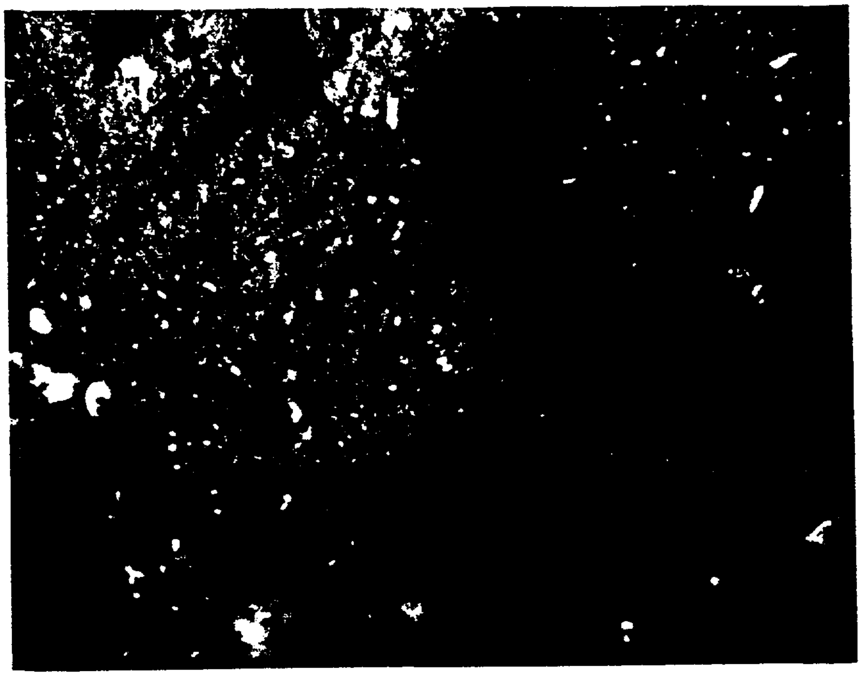


Plate a. Dense amphipod tubes and colonized hydrozoans on consolidated clump material.

Plate b. <u>Nassarius</u> <u>trivittatus</u> leaving tracks on soft silt surface.

Plate c. Cancer irroratus burrowed in overwintering posture up to carapace depth.

Plate d. Pagurus pollicaris occupying whelk shell.

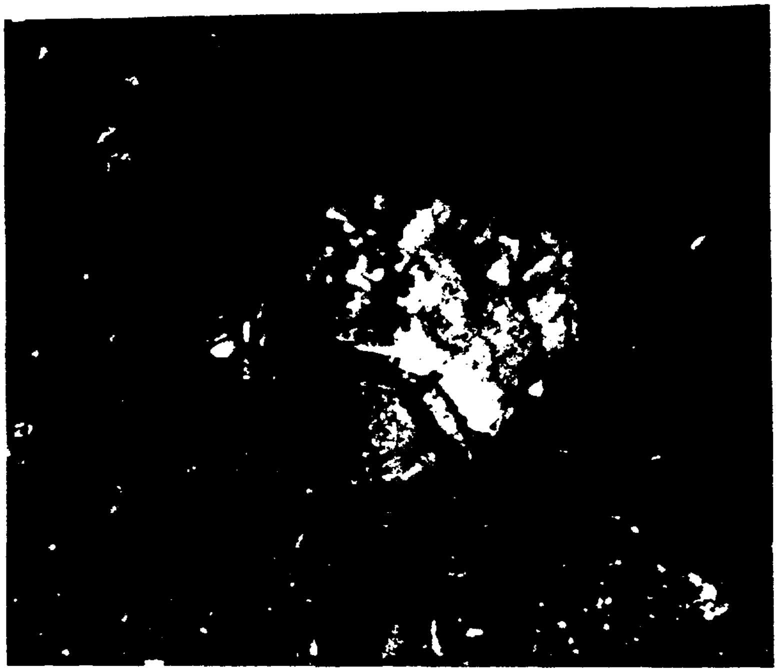


Plate e. Pagurus pollicaris burrowing into sediment surface.

Plate f. A partially buried Libinia emarginata in an over-wintering posture with amphipod tubes affixed to its dorsal carapace.

SAIC

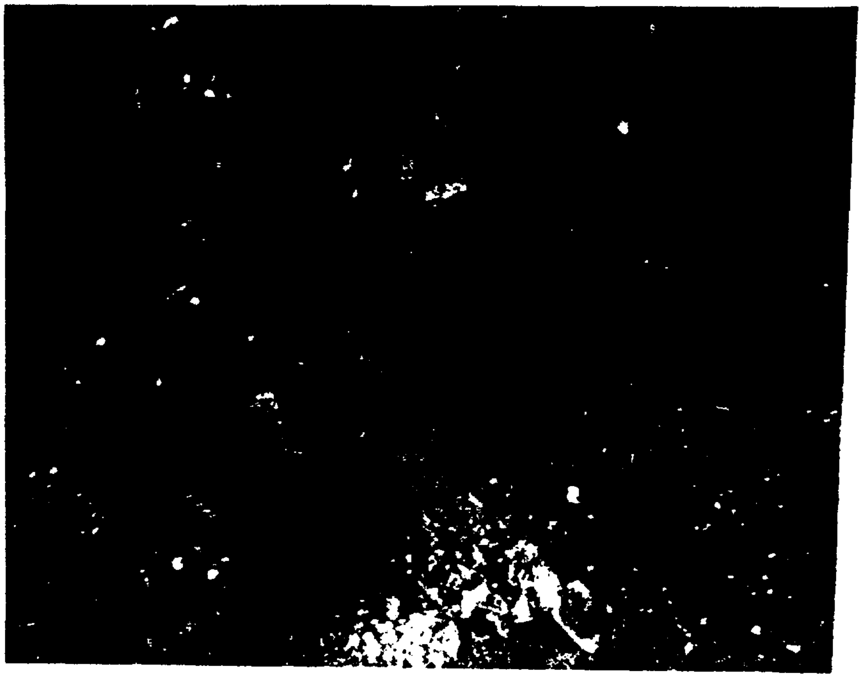


Plate g. A grubby sculpin, Myoxocephalus aneus, on surface of capping material.

TABLE I-3-20
D.A.M.O.S. DIVER MONITORING LOG, STNH-N,
December 1982

DATE: 10 Dec 82 LOCATION: CLIS - S/NH North 200 m E — Video sled excursion - R/V UCONN drift cast. Divers on 15' tether.

DIVERS: Stewart Auster TIME: 1139-1204 DEPTH: 63' T°C: 10°C VISIBILITY: 3'

DIVE (in/out Loran C): 44000.5/26543.7 44000.0/26542.6 DISPOSAL or REFERENCE BUOY (L/C: S/NH N Central Pt 44000.5/26543.7

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/apron), compaction, bioturbation, perimeter Loran C.

Tide half ebb, ~ .5 kt to east, nephloid layer thin (1-2 mm) mud silt pockets (10%) within exposed dense shell hash/sand surface at central point. Toward eastern flank larger silt filled depressions (2-5 m dia.) occurred. Extensive bioturbation. High polychaete worm activity indicated by high density of fecal casts. Cap had flat, featureless topography. Course of transect proceeded from sand cap to apron flanks to natural soft silt bottom (with associated changes in the faunal assemblage).

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

see attached page

II. DISCRETE SAMPLES OR METHODS:

____ A. Epibenthic net (30 sec. traverse): on or off spoil, target species.

X B. .25 m^2 quadrant count/photography. 1:3 Nikonos

____ C. Penotrometer tests, elevation stake readings, sediment trap.

____ D. Mussel deployment - bioaccumulation subsample.

____ E. Sonic beacon placement or electrolyte change.

____ F. Remote bathymetric camera photos.

____ G. Video tape (location, time min. run, tape index).

____ H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)

TABLE I-3-20 (Cont.)

I OBSERVATIONS

B. (BIOLOGICAL)

Raja erinacea - 2 (1 juv. ~10 cm; 1 adult ~30 cm)
Pseudopleuronectes americanus - 1
Urophycis sp. - 1 (10 cm)
Homarus americanus - 1
Pagurus longicarpus > 100
Pagurus pollicaris - 35
Nassarius trivittatus - on fine grain material 4-5/.25 m^2
- on sand/shell hash < 1/.25 m^2

Yoldia sp. - venting observed

Encrusting organisms on exposed hard substrates (i.e. shell hash) such as *Tubularia*, sponges, bryozoans.

FIGURE I-3-54.

Photodocumentation of Benthic Conditions at STNH-N, December 1982

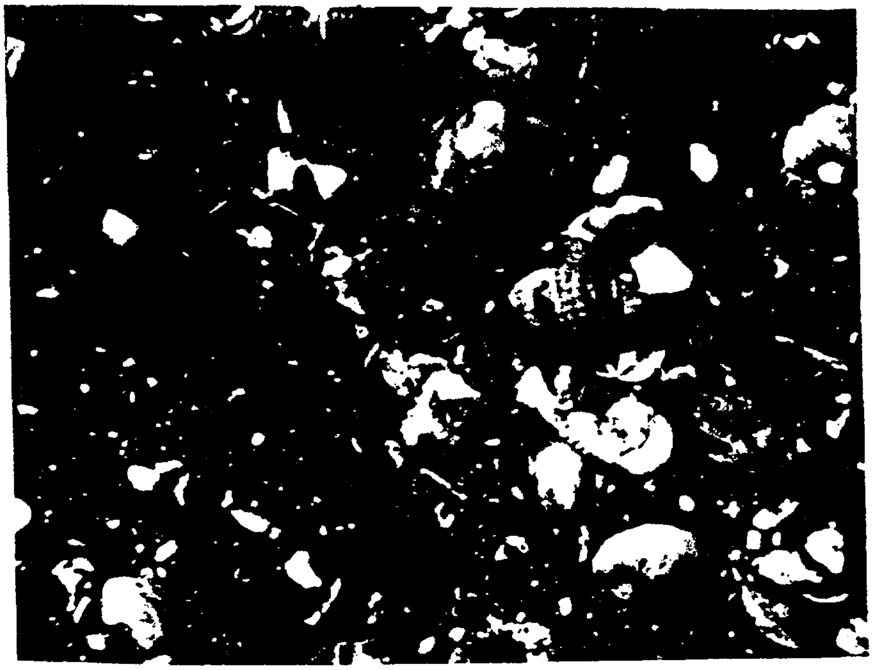


Plate a. Typical shell hash and compact sand material at the central part of the cap. Nassarius shell contains a Pagurus longicarpus.

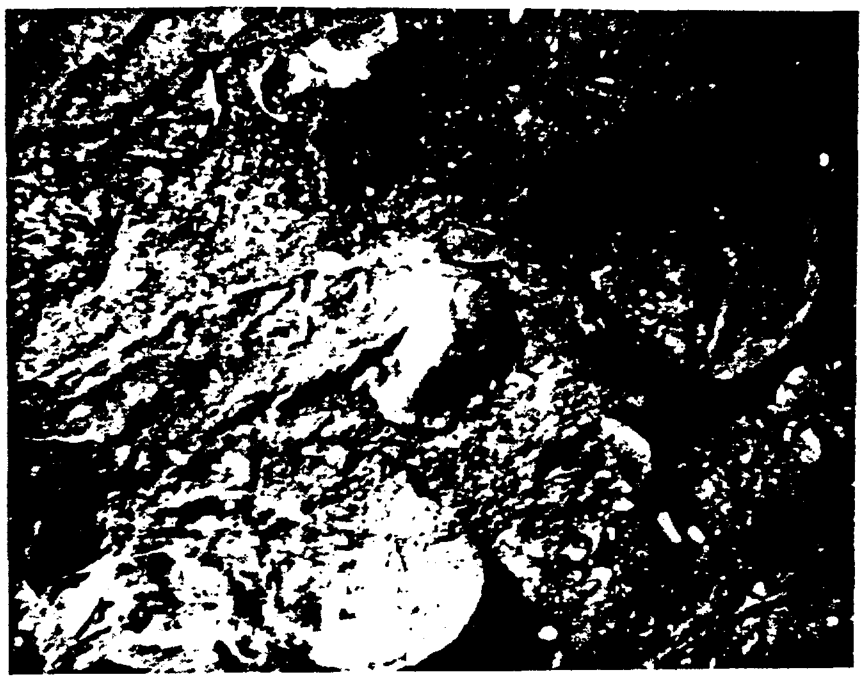


Plate b. Mussel shells filled with silt material in a depression on the cap.

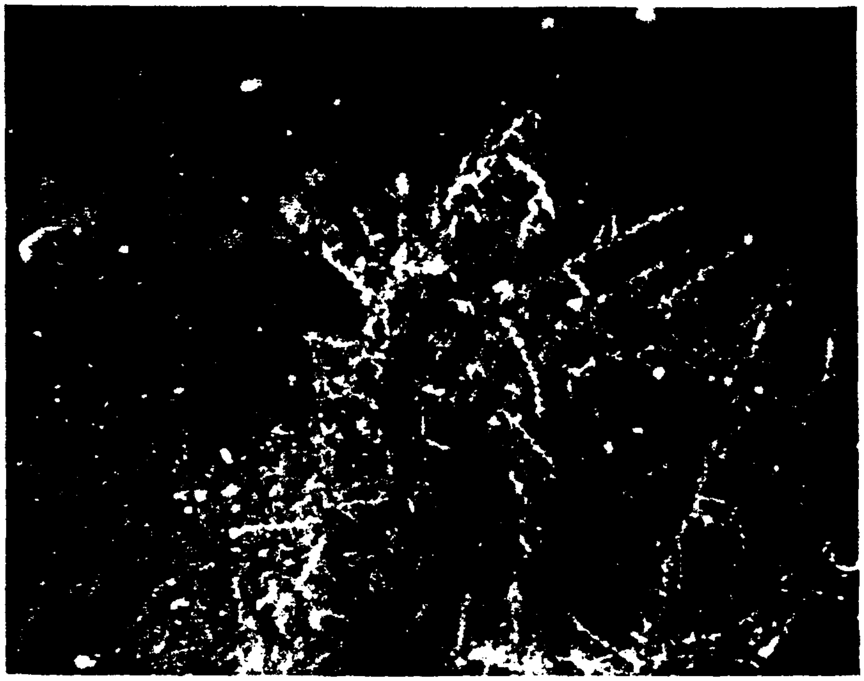


Plate c. Colonial hydroids which have attached to a hard substrate on the cap material.

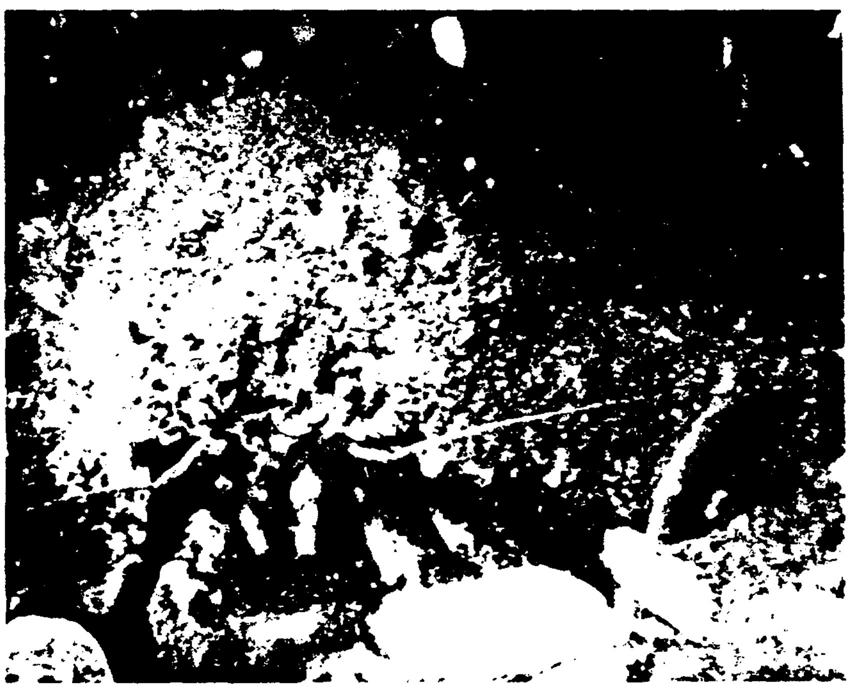


Plate d. Pagurus pollicaris is a large bioturbator of the cap material.

The course of the transect proceeded from the sand cap to the apron flanks to natural soft silt bottom. On the sand cap, a thin nepheloid layer (1-2 mm) was observed. Pockets of mud/silt substrate covered approximately 10% of the central cap area. The remaining central area was the normal compacted exposed shell hash/sand cap material. Toward the eastern flank, larger silt-filled depressions (2-5 m diameter) occurred. Off the flanks the ambient soft silt bottom was observed.

Change in faunal composition over the course of the transect was apparent, with higher diversity of megabenthic species on the sand cap and decreasing diversity to the ambient sediments.

3.3 Mill Quinnipiac River Disposal Site

During the spring of 1982, the Mill Quinnipiac River (MQR) site was designated for the disposal of Mill River sediments from New Haven to be followed with the disposal of capping material from the Quinnipiac River. In the spring of 1983, disposal at this site continued with the addition of Bridgeport and Black Rock Harbor sediments, which were relatively high in heavy metals and organic content. Subsequently, this material was capped with a large amount of sediment that was dredged from New Haven Harbor.

3.3.1 Bathymetry

Baseline conditions at MQR are shown in Figure I-3-55. The bottom was relatively flat, with a slight north to south increase in depth of approximately 1 to 1.5 meters. Sediment from the Mill River in New Haven was deposited at the MQR site (Fig. I-3-56), and capped with additional material from the Quinnipiac River. The mound created by the capping operation is readily apparent in Figure I-3-57 as an elliptically shaped elevation of approximately 1.5m. Replicate surveys of the site were conducted in August and December 1982. Figure I-3-58 shows the results of the December survey prior to the initiation of the Bridgeport and Black Rock Harbor projects. Very little change had occurred as shown in the contour difference plot for June and December 1982 (Fig. I-3-59). This indicates a stable containment situation.

Initial disposal at the MQR site in 1983 consisted of point disposal of a small quantity of sediment from Bridgeport and Black Rock Harbors, which was relatively high in heavy metals and organic content. This material was then capped by the large volume of sediment dredged from New Haven Harbor.

Based on the results of previous capping operations with New Haven material and, because of the large volume of sediment to be dredged, a Loran-C controlled navigation system was used to spread the capping sediment over a larger area rather than develop a steep-sided mound using point dumping procedures. This disposal control system (DAMOS Contribution #35) was programmed with ten different disposal points arranged

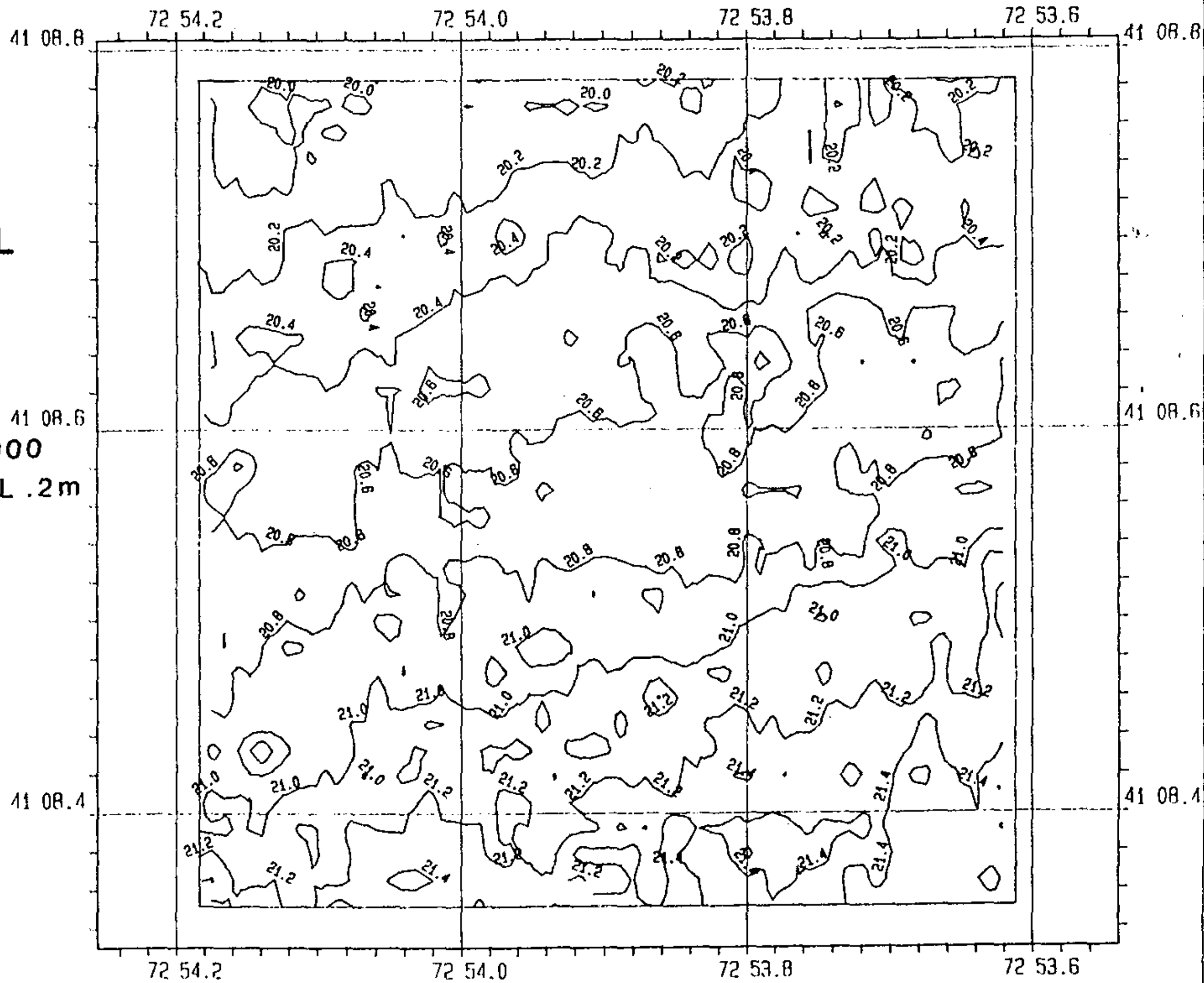
MQRDS PRE-DISPOSAL

MARCH 1982

CHART SCALE 1/4000
CONTOUR INTERVAL .2m

FIGURE I-3-55.

0 80 160
SCALE (m)



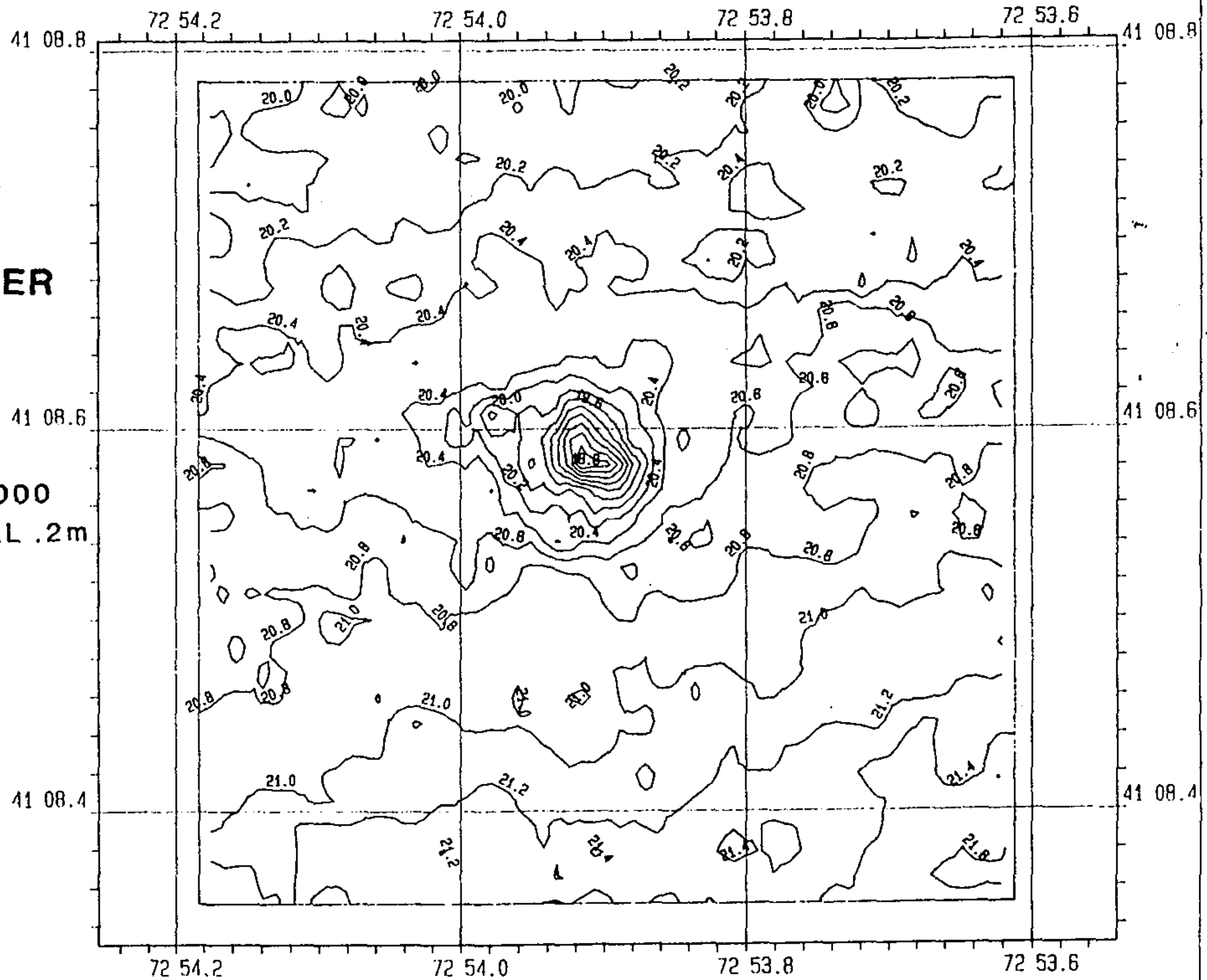
MQRDS
POST-MILL RIVER

APRIL 1982

CHART SCALE 1/4000
CONTOUR INTERVAL .2m

FIGURE I-3-56.

0 80 160
SCALE (m)



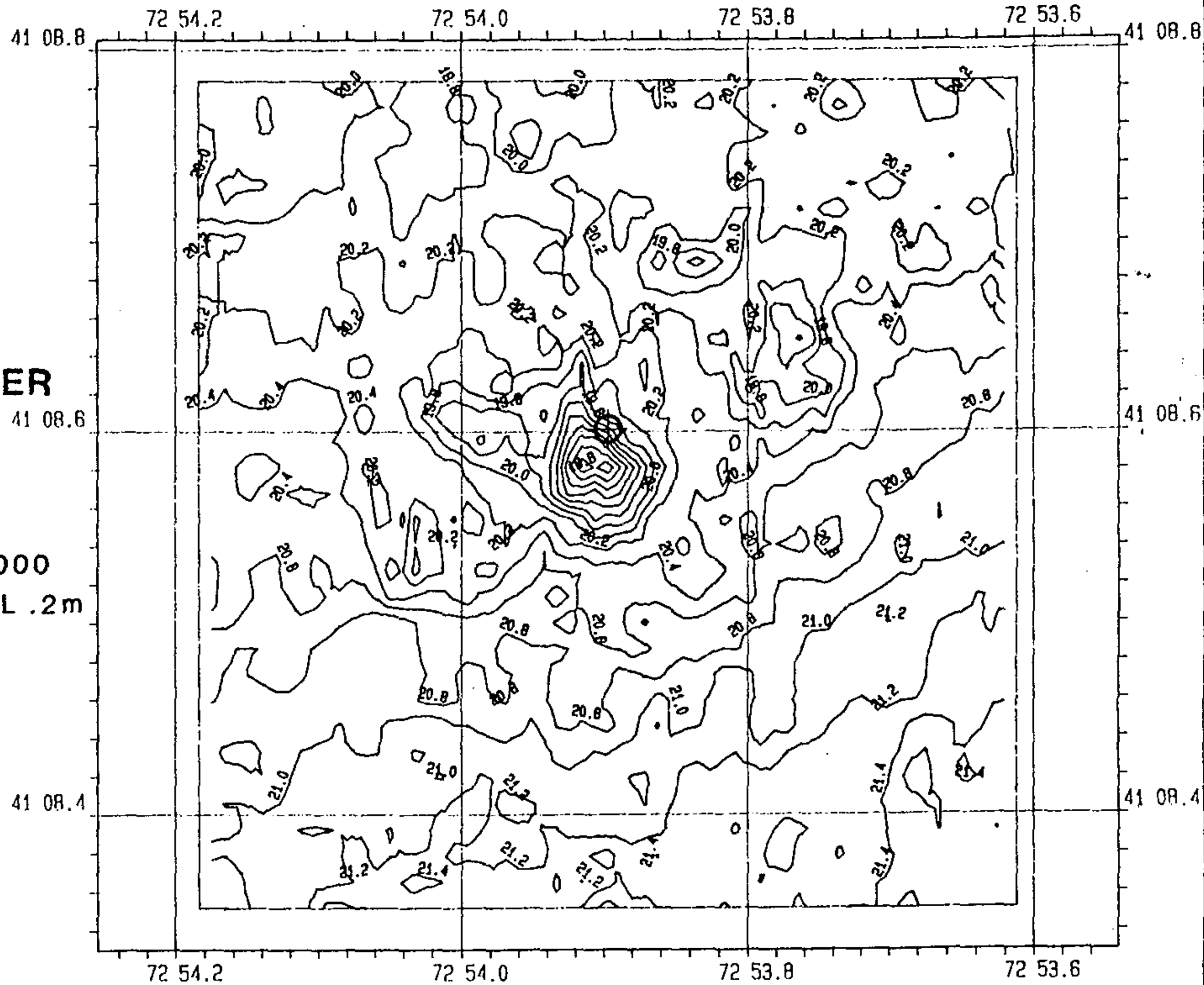
MQRDS

POST-
QUINNIPIAC RIVER

JUNE 1982

CHART SCALE 1/4000
CONTOUR INTERVAL .2m
FIGURE I-3-57.

0 80 160
SCALE (m)



MQRDS

DECEMBER 1982

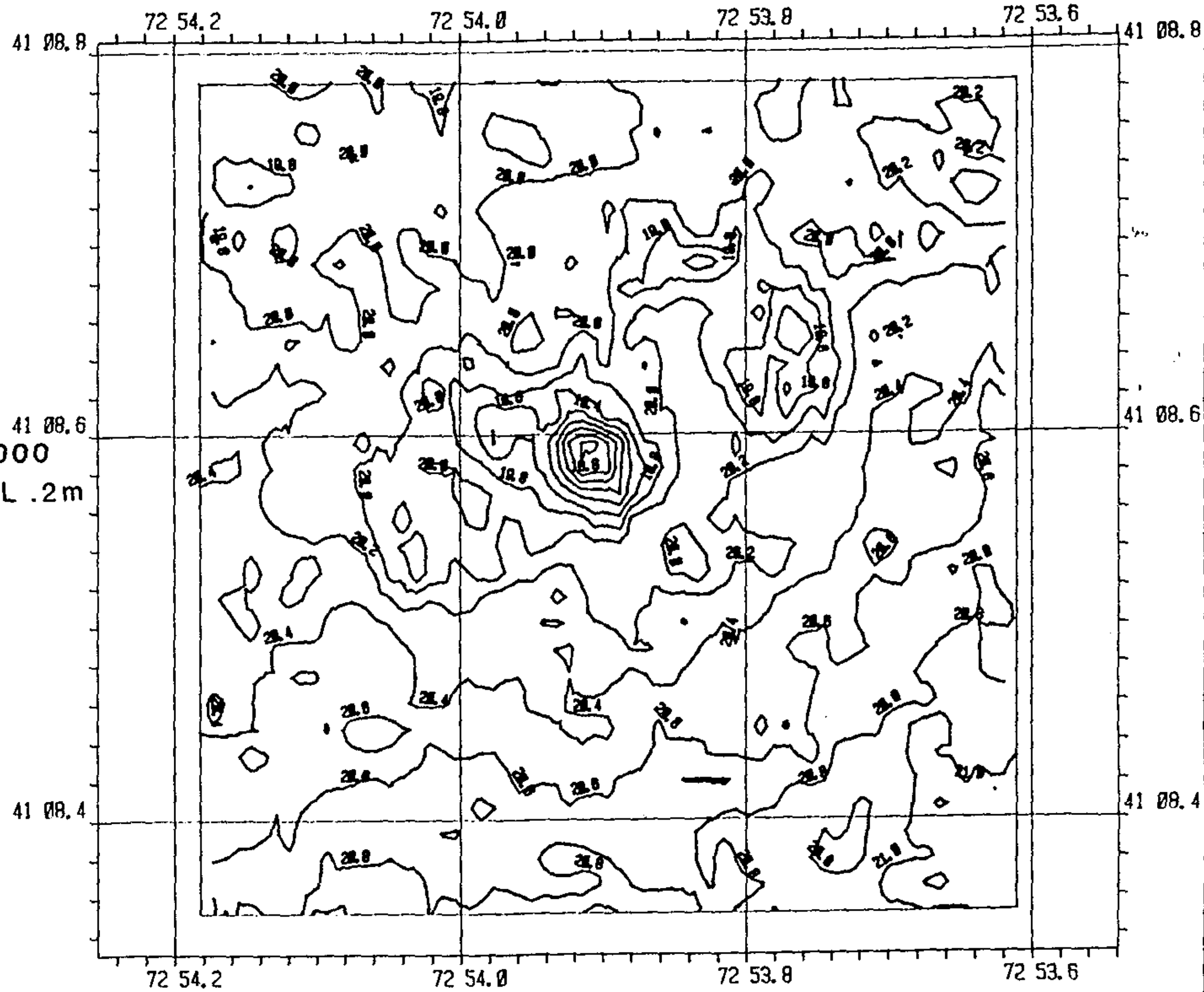
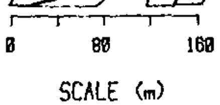


CHART SCALE 1/4000
CONTOUR INTERVAL .2m

FIGURE I-3-58.



MQRDS

CONTOUR DIFFERENCE

JUNE - DECEMBER 1982

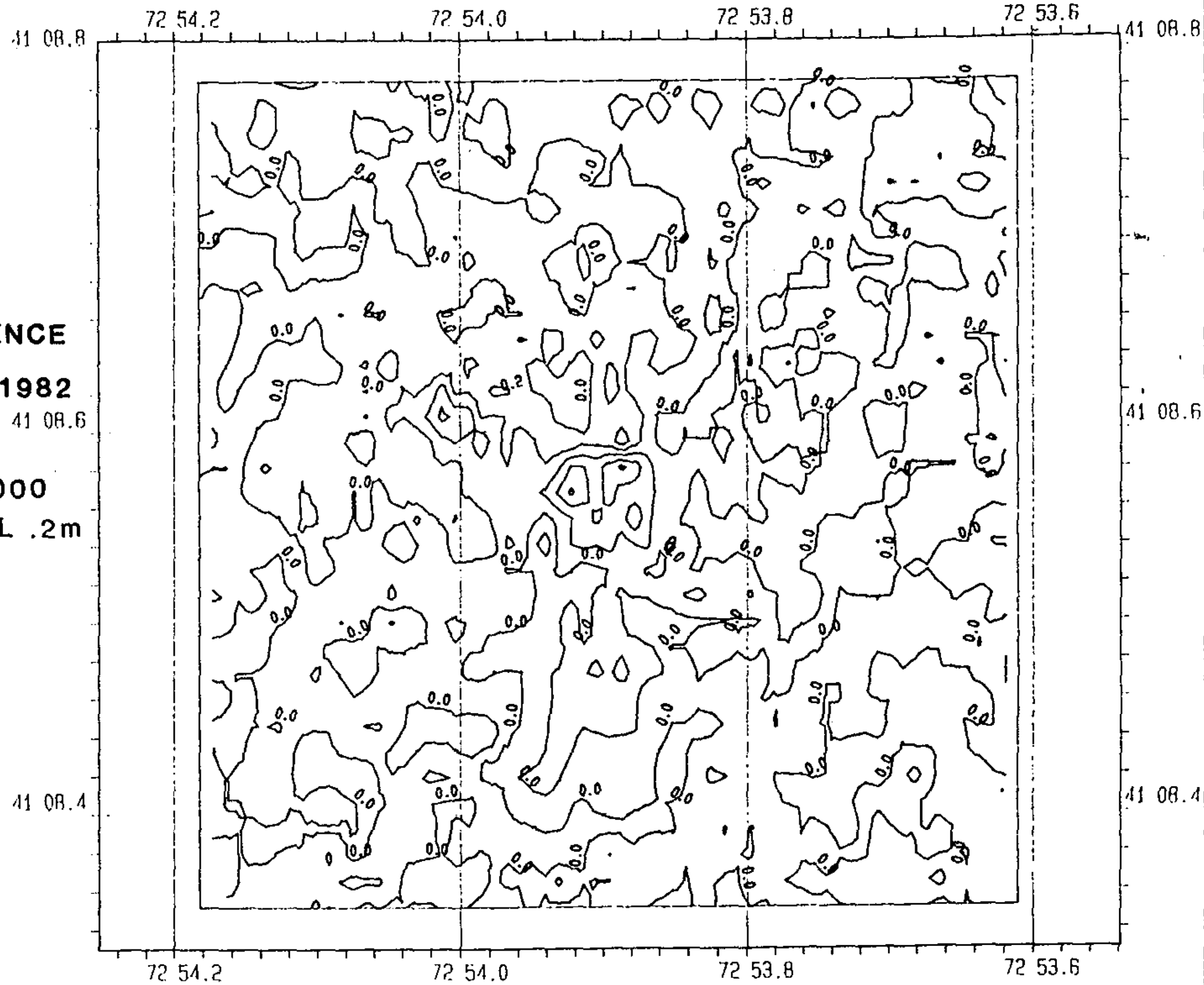
CHART SCALE 1/4000

CONTOUR INTERVAL .2m

FIGURE I-3-59.

0 80 160

SCALE (m)



concentrically at distances of 80 and 120 meters from the center of the site. By sequencing through these points, the dredged material was spread evenly over the bottom and a record of each disposal was obtained.

Although some problems were experienced due to loss of Loran-C signals during disposal at the "SP" buoy , the system was successful in distributing the dredged material over the designated area. Figure I-3-60 is a contour chart of an interim bathymetric survey conducted on 6 May 1983. At this time, approximately 70% of the dredging had been completed and the mound at the MQR site had expanded to a roughly circular configuration with a diameter of 400m and an average thickness of approximately two meters.

Following completion of the bathymetric survey, a series of grab samples were obtained on N-S and E-W transects across the mound. As in previous capping operations, the thickness of dredged material decreased rapidly beyond the flanks of the mound to a 1-2cm layer at distances of 400m from the center of the site. Traces of material were present, however, at distances up to 1000 meters, particularly on the west transect.

Disposal of New Haven material at the MQR site took place entirely under Loran-C control. Figure I-3-61 shows the results of the post-capping survey conducted in June 1983. The capping material at the MQR site produced a well defined, circular mound approximately 450 meters in diameter. The contour difference chart (Fig. I-3-62) indicated a cap 2-3 meters thick.

In summary, the disposal of New Haven material at the MQR site was accomplished efficiently and effectively so that a large volume of material was disposed of in a relatively small area. A uniform cover was provided without creating a steep-sloped conical mound, which would have been more susceptible to wave action and, consequently, less stable as a cap. Based on this survey, controlled distribution of disposal points appeared to be an effective method for placement of capping material.

3.3.2 Sediment Chemistry

Samples were taken for chemical analysis during the baseline survey in March 1982, after Mill River sediments had been disposed of in April 1982, and again after the Quinnipiac River capping sediments were deposited. Subsequent samples were taken in December 1982, before the Bridgeport and Black Rock Harbor sediments were deposited, and in June 1983, after deposition of the capping material.

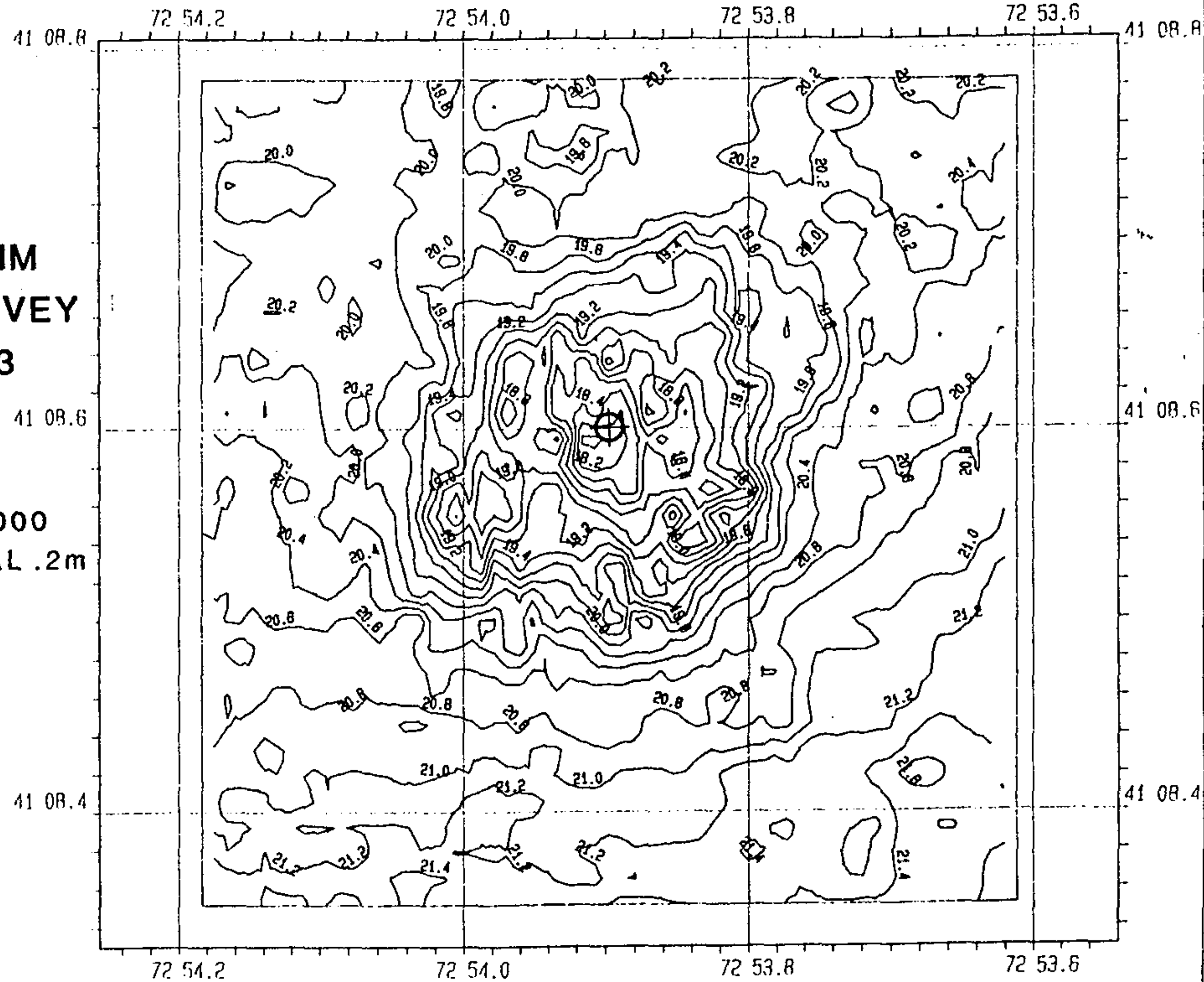
Baseline pre-disposal chemical analyses are presented in Table I-3-21. Comparison of these data with those taken following the disposal of Mill River sediments in April 1982 shows elevated levels of lead, chromium and copper from 100N to 100S and from 200W to 100E (Table I-3-22). There were very high levels of volatile solids at the center station. After disposal

CLIS

MQR INTERIM DISPOSAL SURVEY MAY 1983

CHART SCALE 1/4000
CONTOUR INTERVAL .2m

FIGURE I-3-60.



0 80 160
SCALE (m)

MQRDS

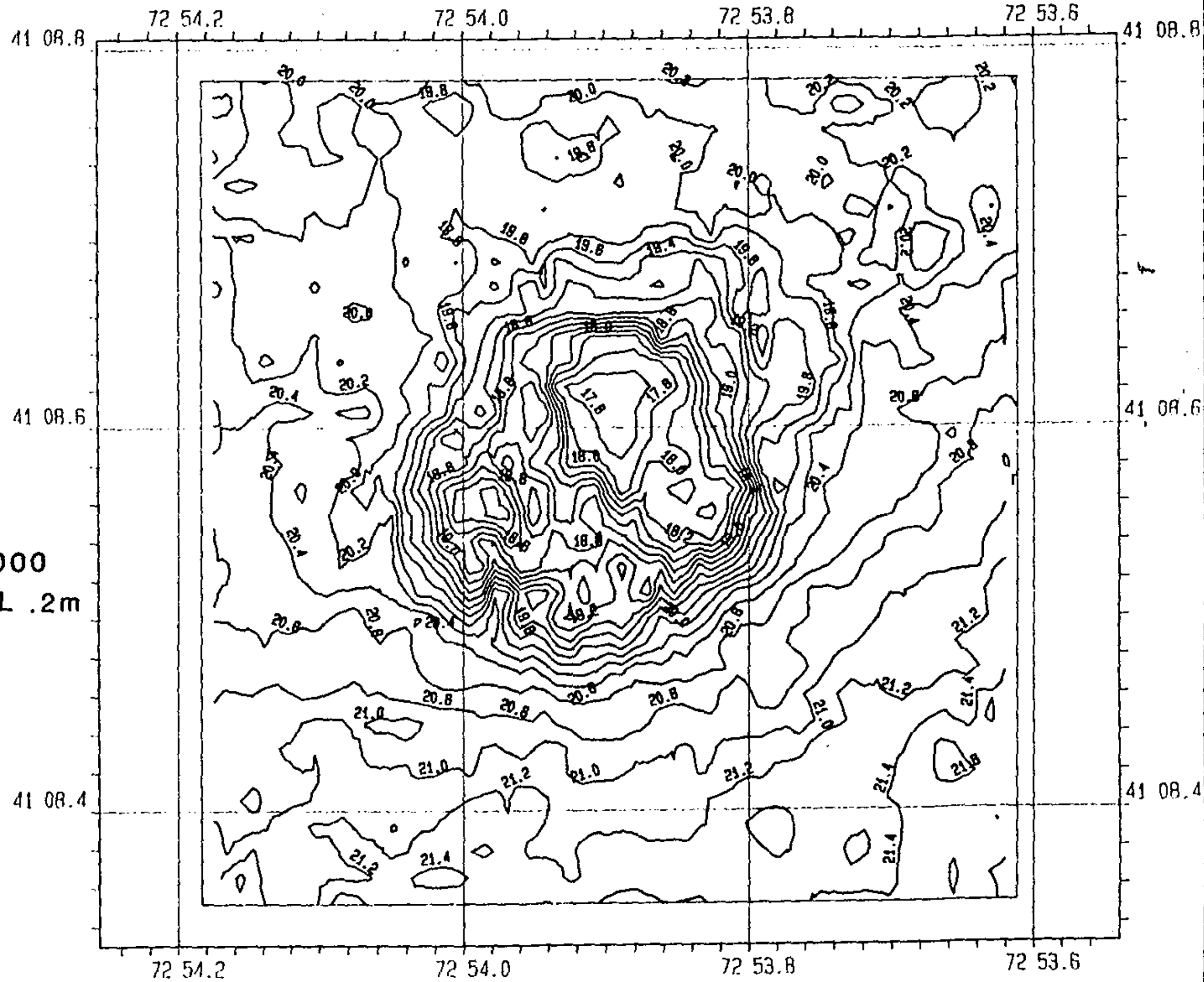
POST-NEW HAVEN CAPPING

JUNE 1983

CHART SCALE 1/4000

CONTOUR INTERVAL .2m

FIGURE I-3-61.



0 80 160

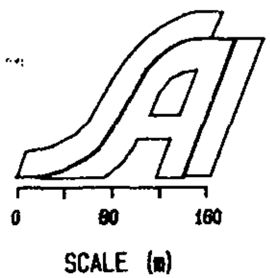
SCALE (m)

MQRDS

CONTOUR DIFFERENCE
DECEMBER 1982 -
JUNE 1983

CHART SCALE 1/4000
CONTOUR INTERVAL .2m

FIGURE I-3-62.



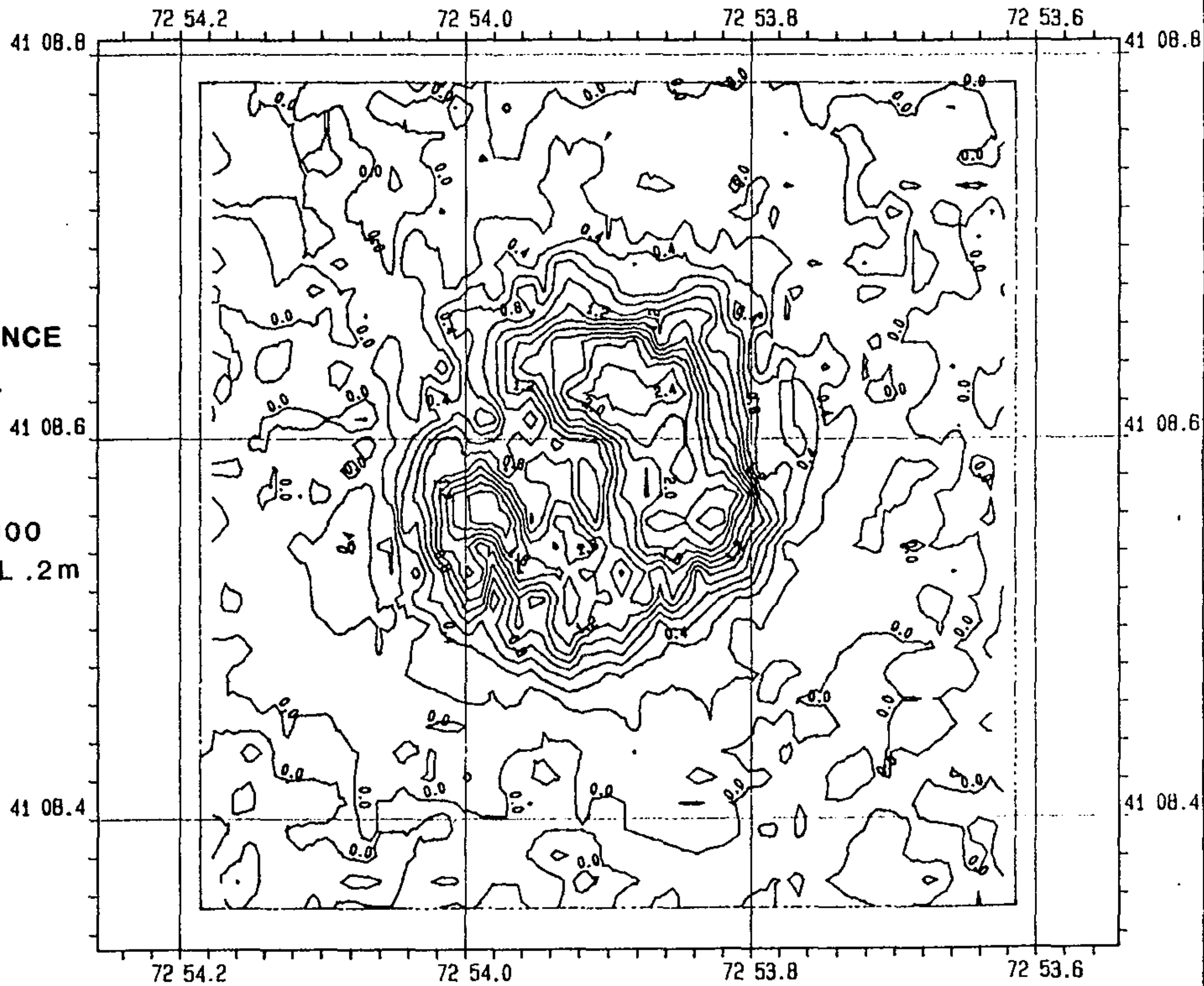


TABLE I-3-21

MILL-QUINNIPIAC RIVER
Chemical Analysis
Baseline
March 1982

Location	% Vol Solids NED	Pb ppm	Cr ppm	Cn ppm
400N	2.6	84	61	61
200N	4.1	93	78	85
CTR- A	4.0	150	173	285
CTR- B	4.0	81	77	77
CTR- C	4.2	76	76	86
200S	3.6	98	79	80
400S	3.9	101	84	81
W/E				
400W	4.1	93	77	74
200W	4.0	101	79	81
200E	3.9	84	81	80
400E	4.2	87	76	84

TABLE I-3-22

MILL-QUINNIPIAC RIVER
Chemical Analysis
North/South Transect
April 1982

Location	% Vol Solids NED	Pb ppm	Cr ppm	Cn ppm
200N-A	4.0	66	48	61
B	3.9	58	54	63
C	4.2	61	58	59
100N-A	9.1	136	104	227
B	11.5	191	145	559
C	3.6	24	35	31
CTR- A	21.8	501	147	1400
B	24.5	442	142	1920
C	11.7	108	48	402
100S-A	5.9	122	89	215
B	10.3	205	133	861
C	9.5	181	225	525
150S-A	5.5	76	60	66
B	4.6	66	60	72
C	4.2	75	86	86

SAIC

TABLE I-3-22 (Cont.)

MILL-QUINNIPIAC RIVER
Chemical Analysis
West/East Transect
April 1982

Location	% Vol Solids NED	Pb ppm	Cr ppm	Cn ppm
250W-A	4.8	73	63	83
B	5.1	78	69	93
C	4.8	73	66	85
200W-A	5.4	95	80	141
B	5.4	77	65	102
C	4.8	72	68	155
CTR- A	21.8	501	147	1400
B	24.5	442	142	1920
C	11.7	108	48	402
100E-A	5.4	86	71	132
B	6.8	114	90	186
C	7.1	112	91	201
300E-A	3.2	56	54	67
B	3.5	49	50	59
C	4.7	61	62	84

of Quinnipiac River dredged material, the June 1982 samples showed volatile solids concentrations had dropped, but Pb and Cr concentrations remained above background at the center of the mound (Table I-3-23).

Sediment samples collected in December 1982 contained high copper concentrations at all three stations (Table I-3-24). Following the disposal of Bridgeport and Black Rock Harbor sediments and the New Haven capping material, metal concentrations were high at all stations (Table I-3-25). Copper concentrations were high at the 400E and 800W stations.

3.3.3 REMOTS

A REMOTS survey was conducted at the MQR site in January 1983, before disposal of Bridgeport and Black Rock Harbor sediments. Replicate photographs were taken at the stations shown in Figure I-3-63.

The major grain-size mode is silt-clay ($\leq 4\phi$). Only station CTR, replicate 1, shows a grain-size range which encompasses 4ϕ to 2ϕ (Fig. I-3-64). The frequency distribution of RPD depth classes appears to bimodal with a major mode at 3.1 to 4.0 cm and a subordinate mode at 5.1 to 6.0 cm (Fig. I-3-64). The major mode is interpreted to represent disturbed sites, while the subordinate mode represents relatively undisturbed sites.

The frequency distribution of boundary roughness values encompasses the range of values measured at the CLIS-REF station (Fig. I-3-65). The mean RPD depth is shallowest at the dump site center and at station 300E (Fig. I-3-63). One replicate at the dump site center shows the presence of a "chaotic" fabric consisting of a heterogeneous mixture of mud clasts and pockets of sand below the sediment surface , while another replicate is uniformly silt-clay (Fig. I-3-66). There was some surficial erosion at Station 300E, with a shell lag of <u>Aequipecten irradiens.</u> Feeding pockets at depth suggested that a Stage III infauna is present in addition to Stage I polychaetes (Fig. I-3-67a).

Based on the mapped distributions of RPD depths, successional stages, and resulting habitat indices, stations CTR, 100E, and 300E appear to be located in areas that are affected by dumping (Fig. I-3-67). Replicates 2 and 3 of station 100W also appear to be stressed, while replicate 1 is a well developed Stage III-I (Fig. I-3-68). Stations 300W and 500W have relatively low RPD values, Stage I assemblages, and intermediate habitat indices (Fig. I-3-67b). These two stations may be located on dumped material or, alternatively, reflect an ambient disturbance which is unrelated to dumping activity.

3.3.4 Diver Observations

Diver observations were made at the MQR site in March 1982 to describe baseline conditions and then during the interim disposal stage in April 1982, and in the post-disposal stage in

TABLE I-3-23

MILL-QUINNIPIAC RIVER
Chemical Analysis
North/South Transect
June 1982

Location	% Vol Solids NED	Pb ppm	Zn ppm	Cr ppm
400N-A	3.7	77	149	72
B	3.7	73	190	70
C	3.6	65	270	64
200N-A	5.0	133	286	94
B	3.7	118	199	76
C	3.0	69	145	50
CTR- A	8.7	151	357	100
B	13.1	109	575	204
C	8.7	87	522	169
300S-A	2.5	114	240	120
B	4.7	99	309	89
C	4.2	168	534	163
350S-A	4.0	84	179	81
B	3.9	67	162	50
C	4.1	76	187	90

TABLE I-3-23 (Cont.)

MILL-QUINNIPIAC RIVER
Chemical Analysis
West/East Transect
June 1982

Location	% Vol Solids NED	Pb ppm	Zn ppm	Cr ppm
500W-A	5.4	84	295	110
B	4.5	66	320	78
C	5.1	91	258	121
300W-A	2.6	<30	93	21
B	4.9	124	400	156
C	5.2	121	310	131
CTR- A	8.7	151	357	100
B	13.1	109	575	204
C	8.7	87	522	169
300E-A	4.6	84	356	106
B	4.3	97	245	104
C	5.0	125	376	141
400E-A	3.6	110	311	135
B	5.0	126	328	140
C	3.8	89	216	107

SAIC

TABLE I-3-24

Mill Quinnipiac River
Chemical Analysis
December 1982

Location	% Vol Solids NED	Pb ppm	Zn ppm	Cr ppm	Cu ppm
CTR-A	5.61	98	296	116	178
B	4.93	82	314	118	210
C	8.15	84	340	130	230
300E-A	3.48	23	200	76	124
B	4.41	85	241	91	163
C	4.03	39	166	60	95
400E-A	4.37	56	212	86	144
B	5.99	64	242	96	165
C	4.66	32	154	54	118

SAIC

TABLE I-3-25

Mill Quinnipiac River
Chemical Analysis
North-South Transect
June 1983

Location	% Vol Solids NED	Pb ppm	Zn ppm	Cr ppm	Cu ppm
400N-A	5.32	77	317	114	173
B	6.24	64	351	128	186
C	5.59	79	486	123	196
300N-A	7.62	50	349	141	177
B	6.04	62	366	141	179
C	5.98	83	526	138	194
CTR-A	5.92	90	488	142	225
B	6.37	105	582	159	235
C	6.71	112	615	181	268
300S-A	5.71	108	364	142	214
B	6.19	84	437	122	183
C	6.25	103	592	138	210
400S-A	5.13	65	377	86	132
B	5.79	46	407	101	149
C	4.95	49	242	63	35

TABLE I-3-25 (Cont.)

Mill Quinnipiac River
Chemical Analysis
West-East Transect
June 1983

Location	% Vol Solids NED	Pb ppm	Zn ppm	Cr ppm	Cu ppm
800W-A	5.89	39	306	79	127
B	6.07	66	480	115	190
C	4.38	70	309	98	138
400W-A	6.35	81	362	125	185
B	5.93	100	429	150	239
C	5.84	92	421	165	262
CTR-A	5.92	90	488	142	225
B	6.37	105	582	159	235
C	6.71	112	615	181	268
400E-A	4.19	78	426	151	261
B	5.11	75	470	125	219
C	4.80	77	370	157	267
800E-A	4.43	26	246	58	90
B	4.38	74	339	91	153
C	3.01		174	35	52

SAIC

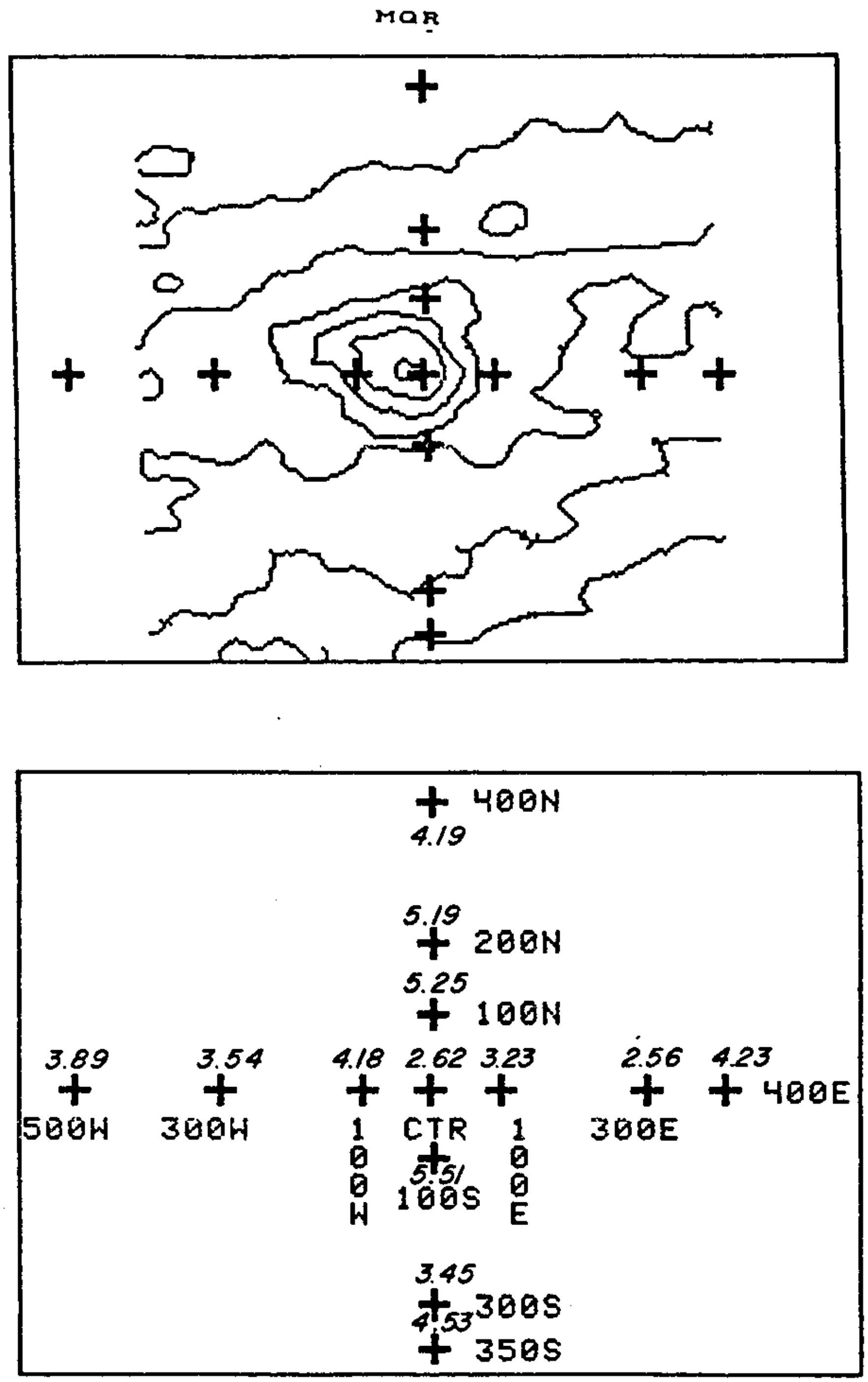


FIGURE I-3-63. Station locations and RPD depths at MQRDS, January 1983.

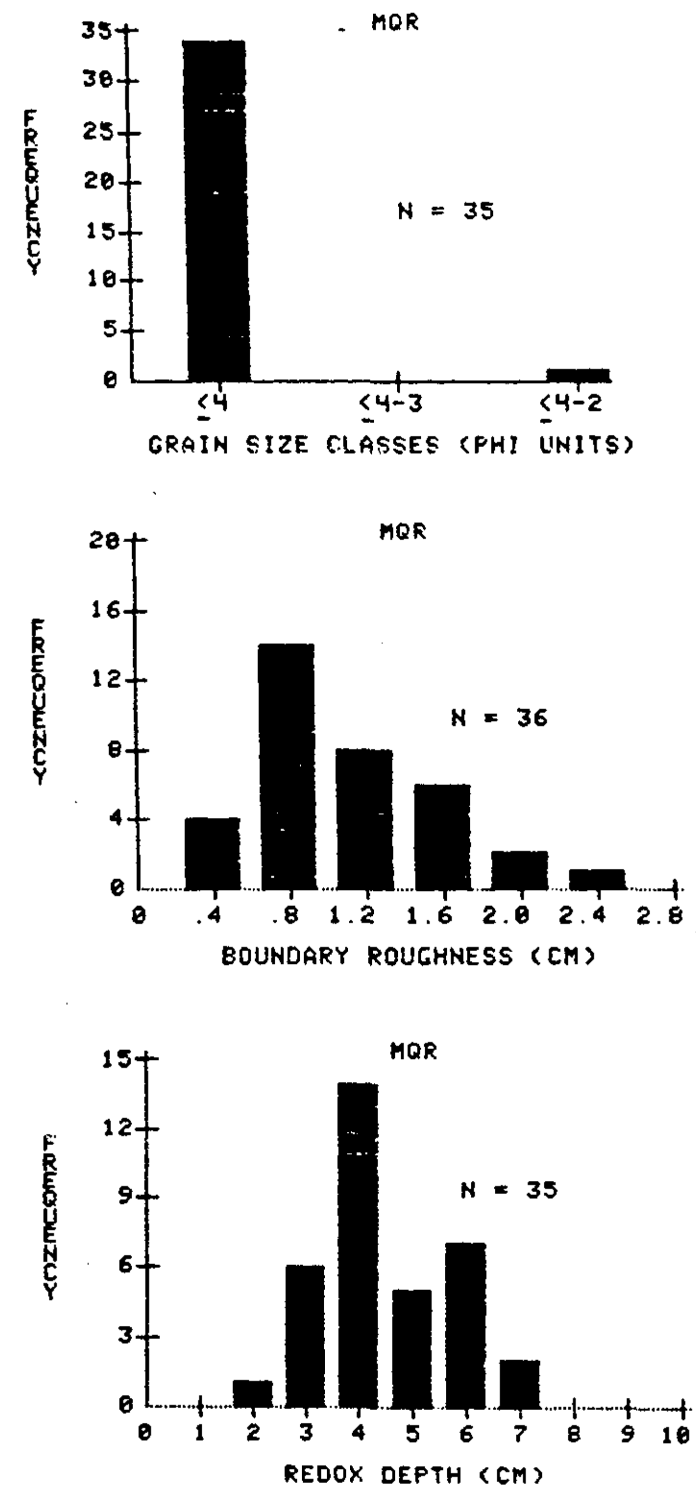
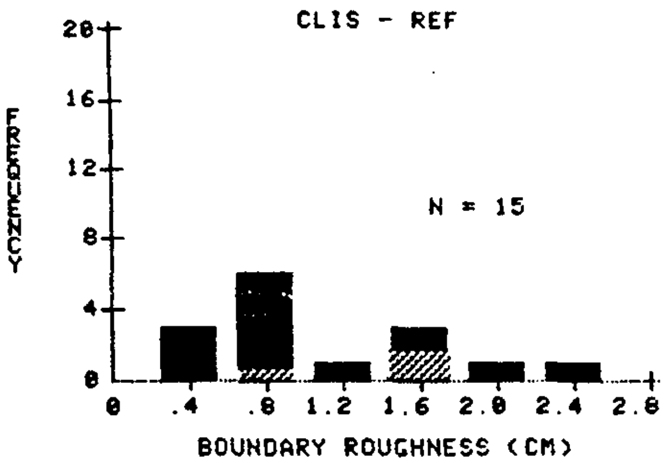


FIGURE I-3-64. Frequency distribution of grain size, boundary roughness, and redox depth for Mill-Quinnipiac River disposal site, January 1983.



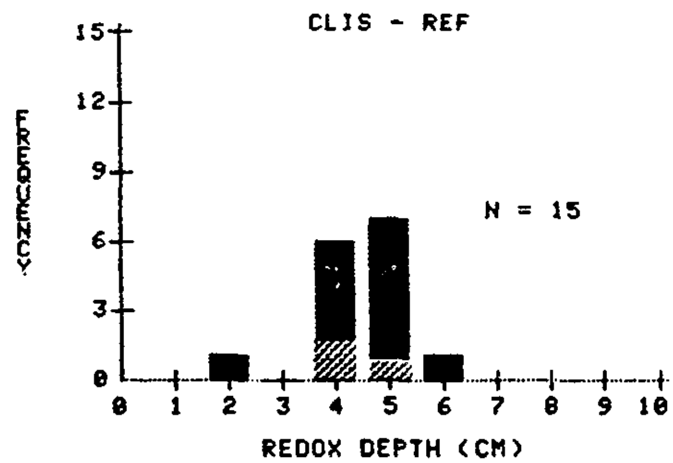


FIGURE I-3-65a & b. Frequency distributions of the mean RPD depth and boundry roughness for CLIS-REF. Stippled bars represent January 1983 data; black bars represent March data.

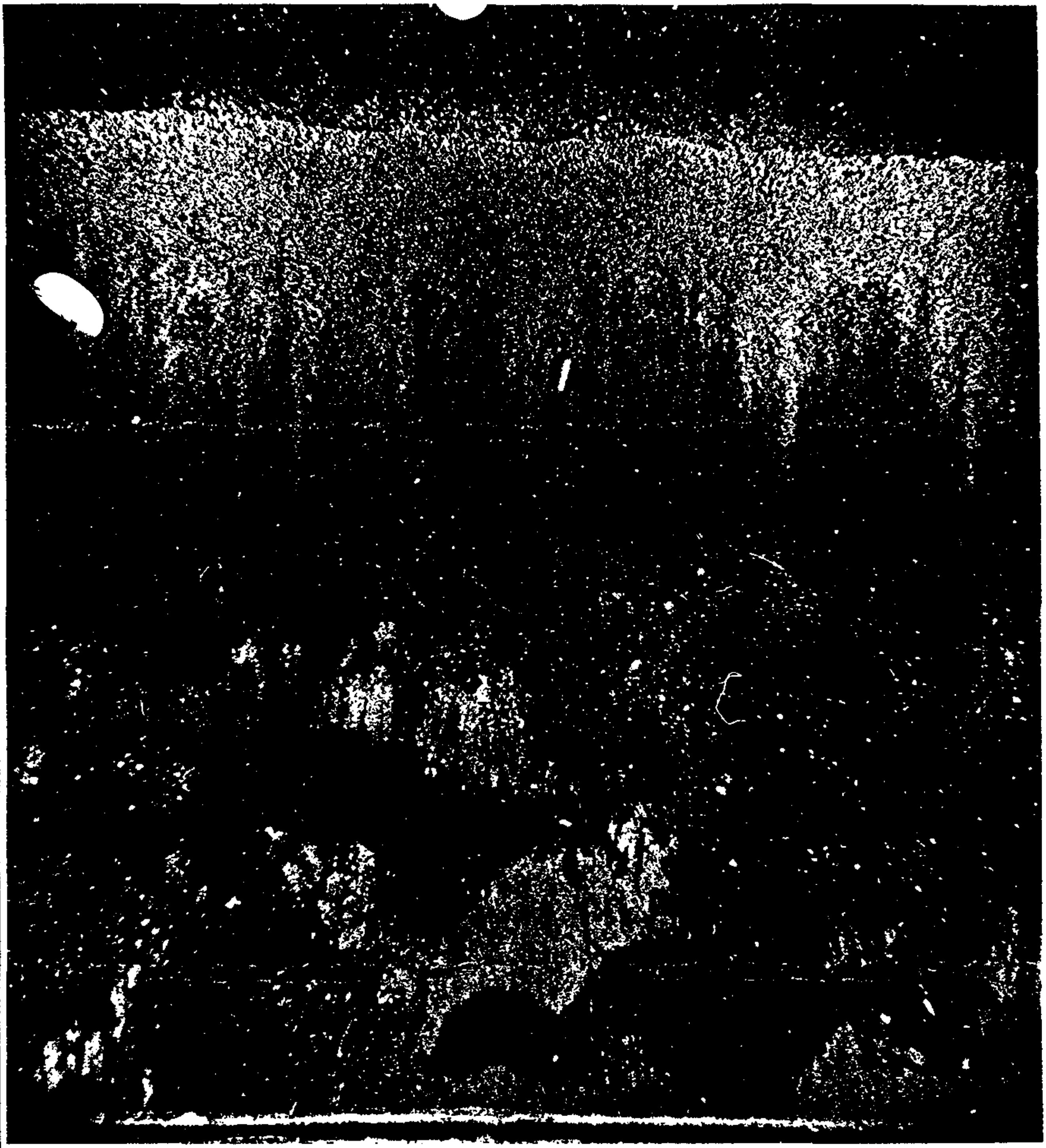


Figure I-3-66a. MQR, station CTR, Scale = 1.0X.
A "chaotic" fabric, typical of heterogeneous dredged material, can be seen at depth. This texturally mixed material is capped over with a silt-clay mud. The RPD is located at 2.1cm.

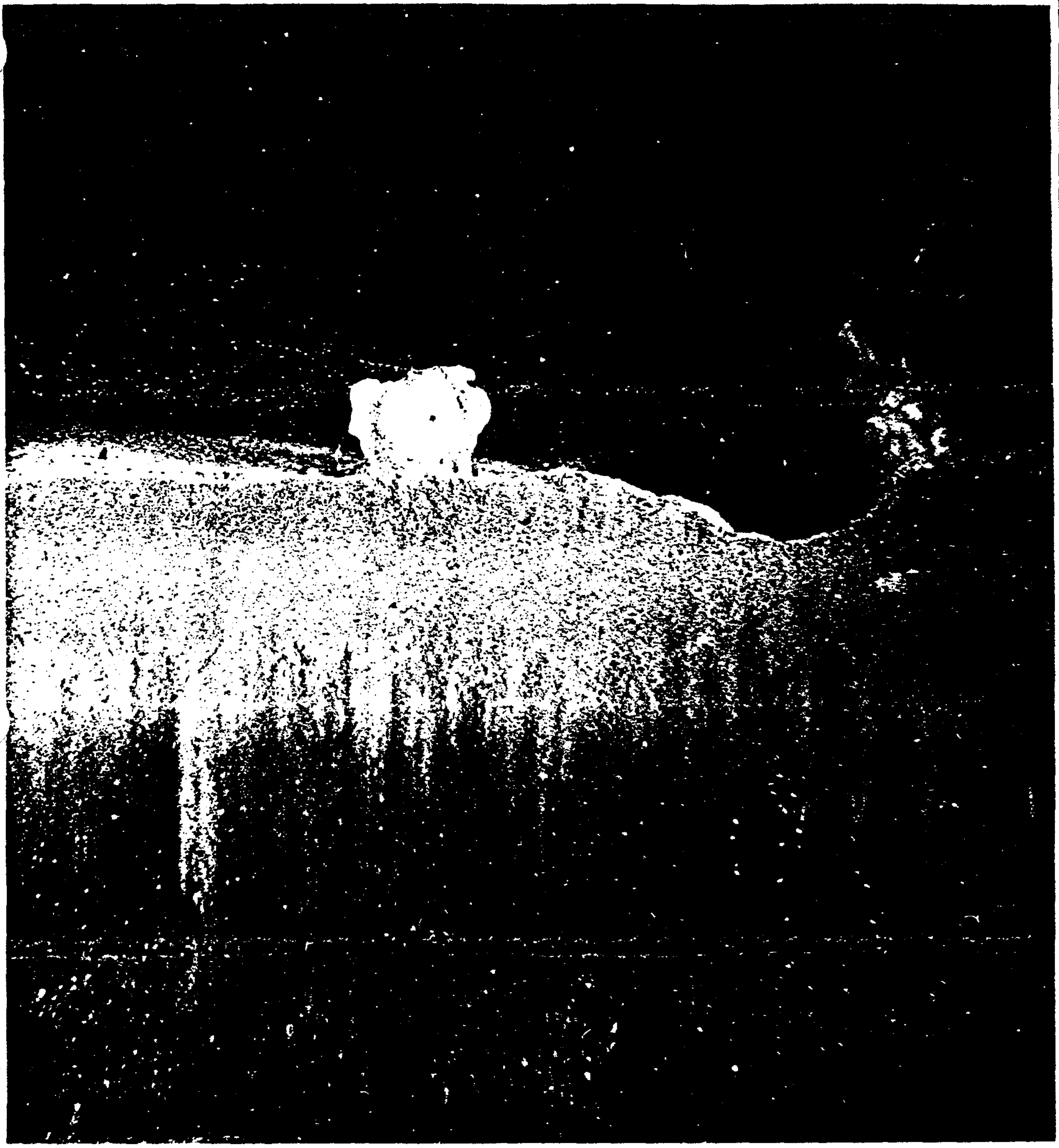
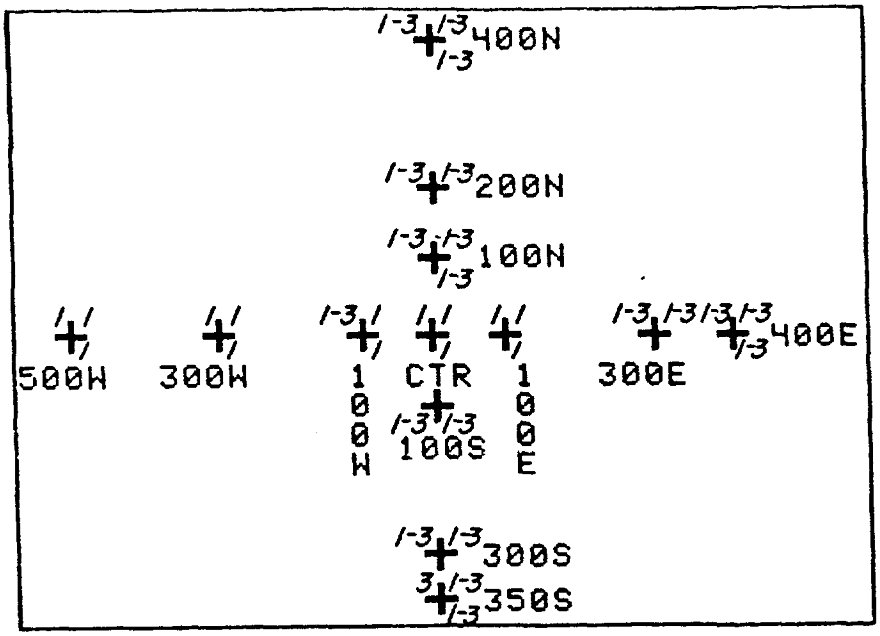


Figure I-3-66b. MQR, station CTR. Scale = 1.0X
A decapod carapace (Ovalipes Ocellatus) is observed at the sediment surface. Boundry relief to the right is either related to current scour around the tube of Diopatra cuprea, located at the right-hand edge of the photo, or associated with a large burrow opening.

SAIC



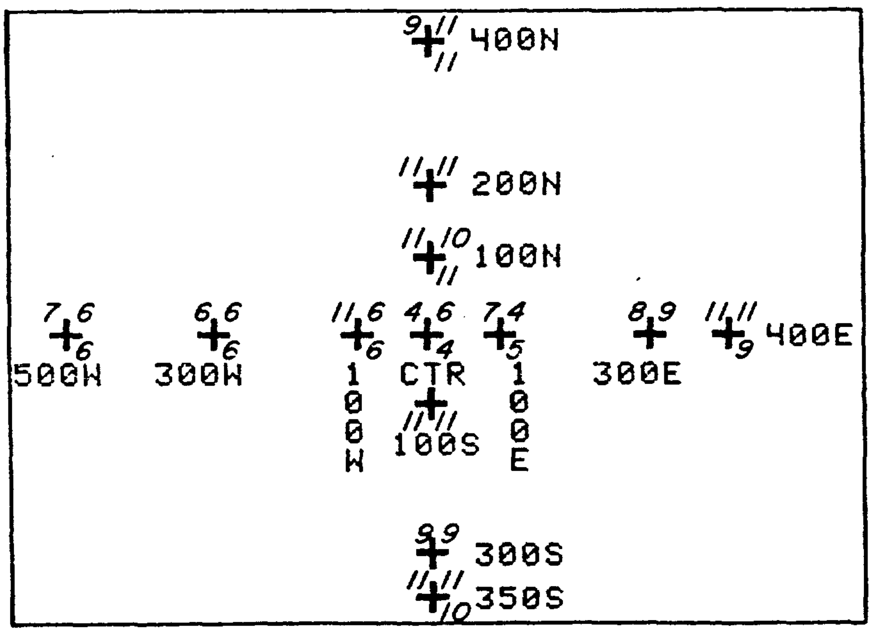


FIGURE I-3-67. Successional stages and habitat indices at MQRDS, January 1983.

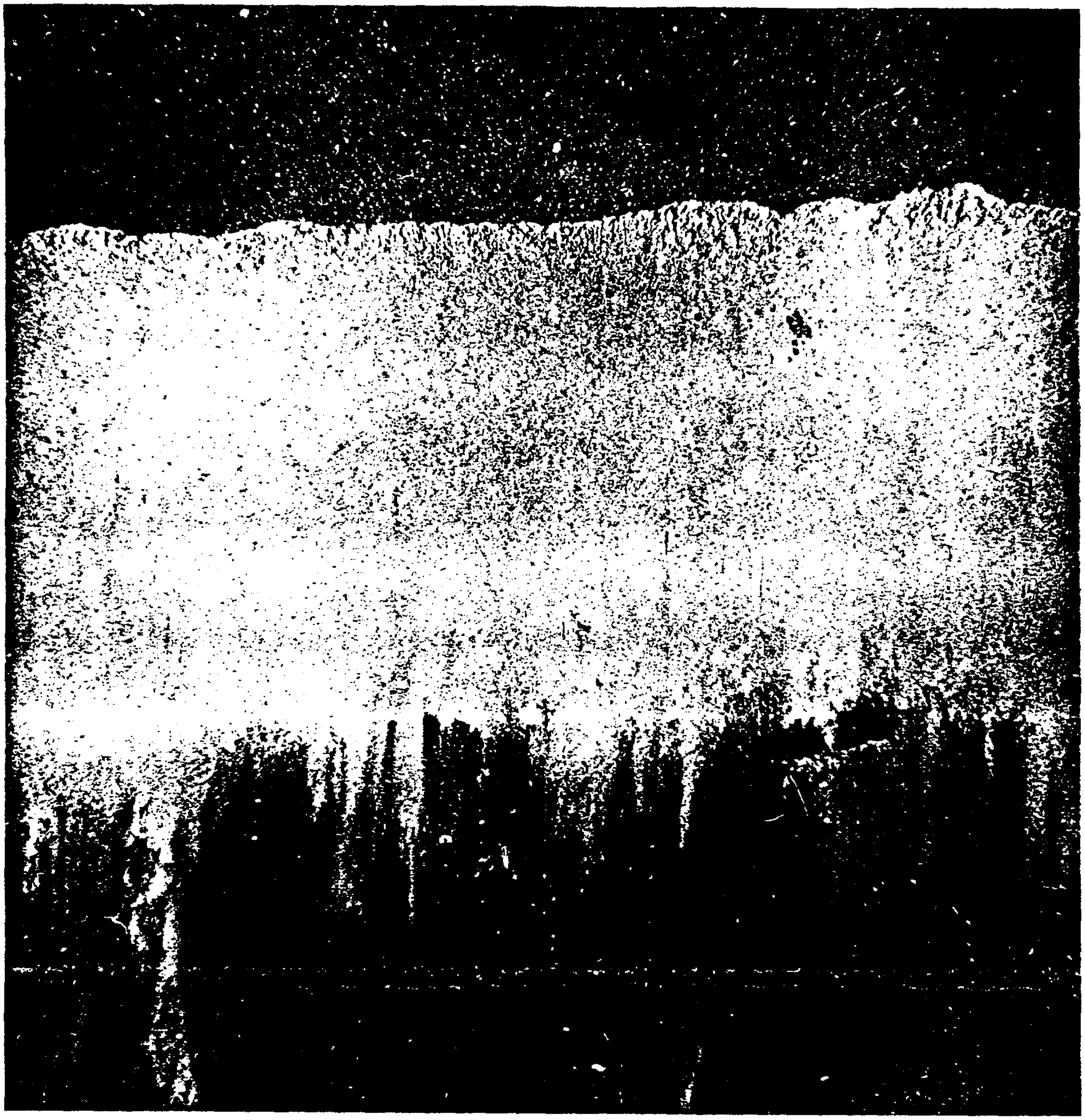


Figure I-3-68. MQR, station 100W. Scale = 1.5X
A stage III showing a well developed feeding void at depth, The RPD = 5.2cm.

June and September 1982. On 23 March 1982, two dives were conducted in 75 feet of water in order to observe sediment surface conditions, survey species types and relative abundances, and provide photodocumentation of conditions. Loran-C coordinates for the diver transect were from 26552.4/43997.2 to 26552.2/43996.7. Details of the dives are shown in Table I-3-26.

The sediment surface was flat and relatively featureless. It consisted of soft unconsolidated material with a 0.5 cm floculant surface veneer in boundary layer semi-suspension. The surface veneer moved with the tidal flux. Less than 10% of the surface sediment had incorporated shell hash material. Surface shell hash is attributed to actively feeding Asterias forbessi on Mulinia lateralis. Two vertical mud burrows (approximately 10 cm diameter) were observed and only one abandoned mud lobster burrow was noted over the transect area. Bioturbation in the area from surface tracking and self-burial is attributed to Cancer irroratus, Usosalpinx and Nassarius trivattatus.

Table I-3-27 summarizs species observed and their relative abundances. Figure I-3-69 provides documentation of conditions during the survey. Three video transects were completed in a SW to NE direction for 10 minutes each. Data derived from analysis of the tape will be presented in a future report.

On 21 April 1982, four dives were conducted to observe sediment surface conditions, survey species type and relative abundance and provide photodocumentation of conditions. Loran-C coordinates for the transect were from 15050.0/43995.0 to 15046.0 and 15047.2/43995.2. The DAMOS dive log is shown in Table I-3-28.

Physical sediment characteristics included a 1-4 cm brown/yellow unconsolidated, oxygenated nepheloid layer showing some tidal movement. Black/brown clay clumps, 15 cm - 30 cm in diameter were observed protruding through the layer. Approximately 2 cm diameter sponge rubber balls were observed on the dredged material surface and are evidence of industrial upland debris. An apron area of 5 to 10 m width was observed overlying natural sediments.

Tracks from Cancer irroratus and Asterias forbessi and mucoid gastropod trails were observed on the dredged material surface. Mysids were very dense in the near bottom waters (200 x/.25 m^2 bottom x .5 m into water column). Corymorpha pendula was observed at the SW mound perimeter area. Individuals and clusters were buried to full 5 cm or partial 2-4 cm stalk height by the nepheloid layer. Patches of Yoldia sp. valves as well as predation on Yoldia by Pagurus logicarpus was observed.

Table I-3-29 summarizes species observed and their relative abundances. Figure I-3-70 documents conditions at the site.

TABLE I-3-26

D.A.M.O.S. DIVER MONITORING LOG, CLIS-REF,
March 1982

DATE: 23 March 1982 LOCATION: CLIS (SW) corner - Mill, Quinnipiac R. Disposal Site (baseline) SW Transect 80 m

DIVERS: Stewart, DeGoursey TIME: 1000-1030 DEPTH: 75' T°C: 2°C VISIBILITY: 6'

DIVE (in/out Loran C): DISPOSAL or REFERENCE BUOY (L/C:

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/apron), compaction, bioturbation, perimeter Loran C.

Soft uncolidated bottom, flat throughout transect. The usual .5 cm floculant sediment surface veneer, in boundary layer semi suspension state moved with tidal flux. 10% shell noted incorporated in surface sediment. Due to Gemma or Mulinia valves; produced by feeding activity of Asterias forbesi. Two verticle mud burrows (~10) with only one abandoned mud lobster burrow over transect course. Bioturbation attributed to tracks and self-burial activity of C. irroratus, mucal trails of Urosalypinx, Nassarius.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Scophthalmous aquosus (1) 1.5 cm
Asterias forbessi (100+) active feeding on Gemma and/or Mulinia scattered valves on surface.
Corymorpha (.5 cm - 4 cm max.) .25 m. counts taken.
Crangon (2)
Cancer irroratus (20+)
Urosalypinx (40+) Nassarius (50+)
Verticle burrows (~10)
Squilla (abdomen) collected in depression. on natural bottom at dive survey conclusion.

II. DISCRETE SAMPLES OR METHODS:

_X_ A. Epibenthic net (30 sec. traverse): on or off spoil, target species.

_X_ B. .25 m² quadrant count/photography. (3) - 22,16, 28 .25 counts polype range .5- 4 cm heights.

___ C. Penotrometer tests, elevation stake readings, sediment trap.

___ D. Mussel deployment - bioaccumulation subsample.

___ E. Sonic beacon placement or electrolyte change.

___ F. Remote bathymetric camera photos.

_X_ G. Video tape (location, time min. run, tape index). (3) SW NE drifts final over Norwalk pile gave best ima

_X_ H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)
Abdomen of Squilla - moult cast

TABLE I-3-27

SUMMARY OF SPECIES AND RELATIVE ABUNDANCES
March 1982

Species	Relative Abundance
Cnidaric	
Corymorpha pendula	22, 16, 28/.25 m^2
Gastropoda	
Nassarius trivittatus	50+
Urosalpinx	40+
Crustacea	
Cancer irroratus	20+
Crangon septemspinosa	2
Squilla empusa	- molted abdomen in depression (10 vertical burrows observed)
Echinodermata	
Asterias forbessi	100 +
Pisces	
Scophthalmus aquosus	1 (15 cm TL)

Figure I-3-69.

Photodocumentation of Benthic Conditions at MQRDS, March 1982.

Plate a. Leaf debris as an example allochthonous input on an eroded clay clump of substrate material.

Plate b. Vertical profile of substrate, showing flocculent material over consolidated clays.

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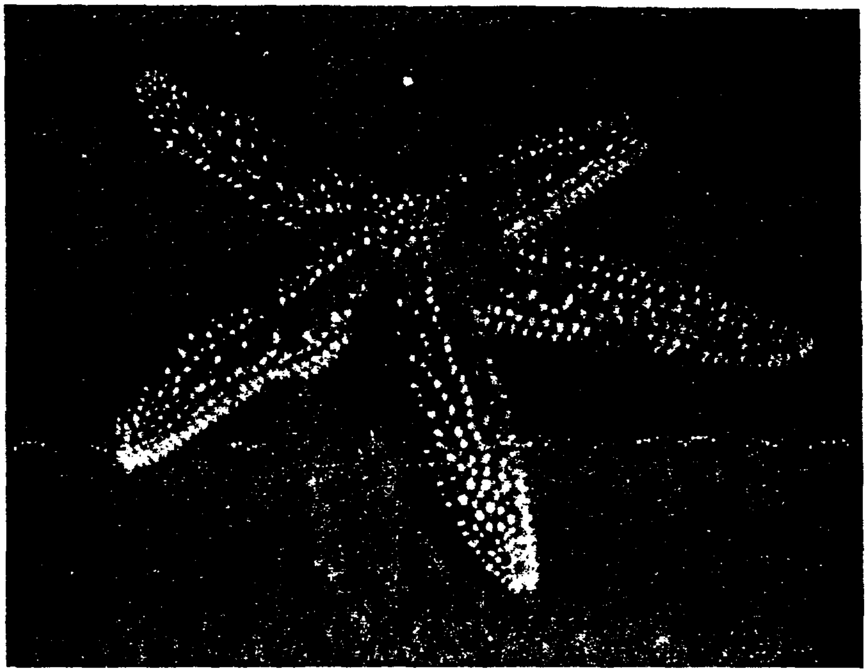

Plate c. Asterias forbesi as evidence of high sedimentation of flocculent material.

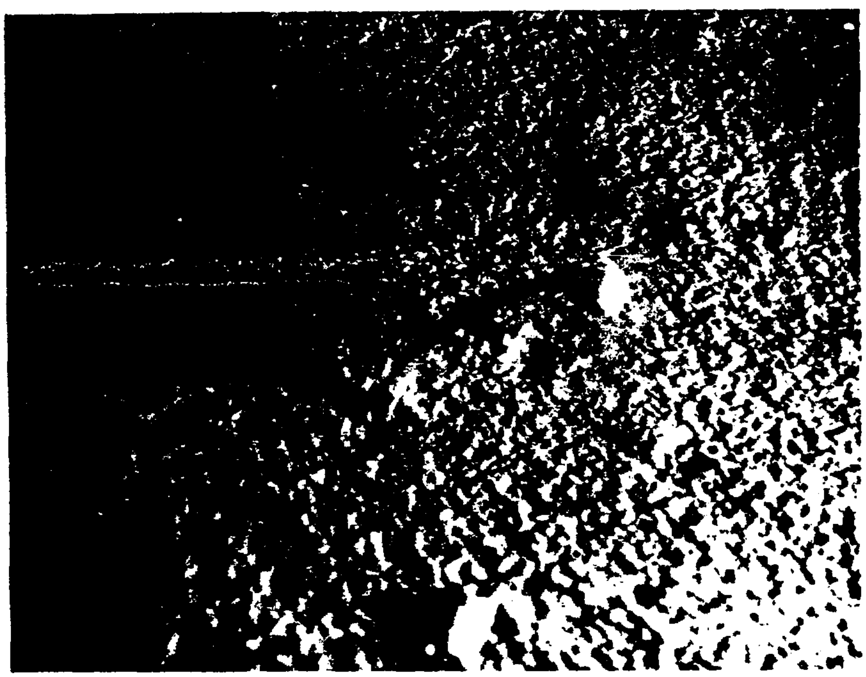

Plate d. Corymorpha pendula growing out of flocculent substrate.

SAIC

Plate e. Cancer irroratus burrowing into substrate by action of its hind walking legs.

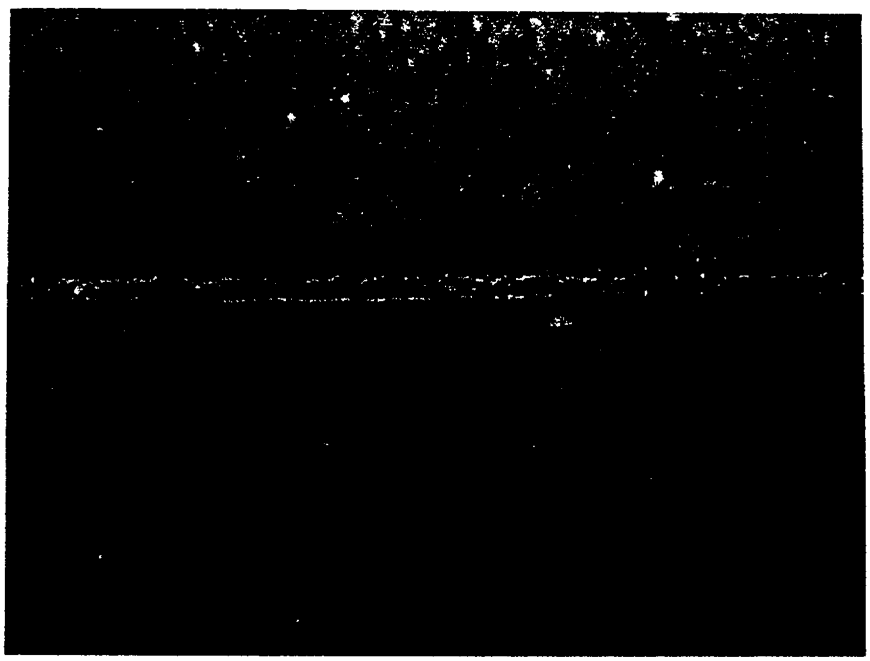

Plate f. Scopthalmous aquosus on substrate.

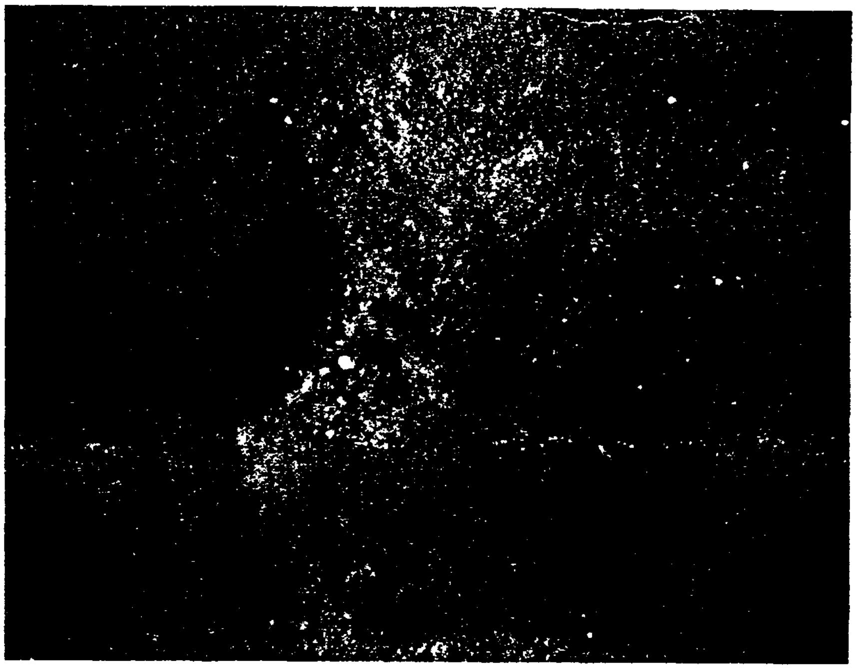

Plate g. A two entranced burrow constructed out of the consolidated substrate, possibly formed by a lobster, Homarus americanus.

Plate h. Moult cast from abdomen of Squilla empusa in flocculent sediment.

Plate i. *Cancer irroratus* and *Asterias forbesi* on the substrate. Note high rate of sedimentation from material on the dorsal surface of *Asterias*.

SAIC

TABLE I-3-28

D.A.M.O.S. DIVER MONITORING LOG, MQR
April 1982

DATE: 21 April '82 LOCATION: CLIS - Mill-Quinnipiac River - Interim

DIVERS: Stewart DeGoursey TIME: DEPTH: $T^{o}C$: VISIBILITY: 3 feet

DIVE (in/out Loran C):
In 15050.0/43995.0
Out 15046.0/44006.0

DISPOSAL or REFERENCE BUOY (L/C:
MQR - 15050.9/43997.0
SP 12047.1/43996.4

I. OBSERVATIONS:

A. **BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.**

Unconsolidated layer 12" - 6" clay/black/brown clumps protruding.
1-4 cm brown/yellow oxygenated nephloid layer (tidal movement) overlay.
Sponge rubber balls (2 cm dia.) upland debris.
Apron 5-10 m drift overlay.

B. **(BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).**

Mucoid tracks, Asterias paths, Cancer irroratus tracks.
Dense mysids (200+ per .25 m^2 sed. surf. to .5 m off bottom).

On spoil - Cancer irroratus - 3
Psuedopleuronectes - 1
Asterias - 12
Mysids - 1000++
Nassarius - 50
Cyanea - dense in water column (2-3 cm dia.)

At border - P. longicarpus - 3
Urophycis - 1
Corymorpha - individual and clusters buried to full 5 cm or partial (2-4 cm) stalk height by floc. layer (particulate mud).
Veritical burrow - 1-2 cm dia.
Patches Yoldia valves.

II. DISCRETE SAMPLES OR METHODS:

_____ A. **Epibenthic net (30 sec. traverse): on or off spoil, target species.**

__X__ B. **.25 m^2 quadrant count/photography.**

_____ C. **Penotrometer tests, elevation stake readings, sediment trap.**

_____ D. **Mussel deployment - bioaccumulation subsample.**

_____ E. **Sonic beacon placement or electrolyte change.**

_____ F. **Remote bathymetric camera photos.**

_____ G. **Video tape (location, time min. run, tape index).**

_____ H. **Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)**

TABLE I-3-29

SUMMARY OF SPECIES AND RELATIVE ABUNDANCES, MQR
April 1982

Species	Relative Abundance
On spoil	
Gastropods	
Nassarius trivittatus	50
Crustacea	
Cancer irroratus	3
Mysidacea	1000 ++ (200+/.25 m^2 aerial sediment surface x .5 m height)
Echinodermata	
Asterias forbessi	12
Pisces	
Pseudopleuronectes americanus	1
At border	
Corymorpha pendula	
Bivalves	
Toldia sp.	
Crustacea	
Pagurus longicarpus	3
Pisces	
Urophycis sp.	1

FIGURE I-3-70.

Photodocumentation of Benthic Conditions at MQRDS, April 1982.

Plate a. Sediment accumulation on the dorsal surface of Asterias forbesi. Sediment is coarse granular sand grain inpregnated pulp material.

Plate b. Allochthonous input fouling on Asterias forbesi. Corymorpha pendula is on the sediment surface, indicating a disposasl material border region.

SAIC

Plate c. Surface textured features on the area of a fracturing clay clump. Fracturing indicates active dredge disposal in this area.

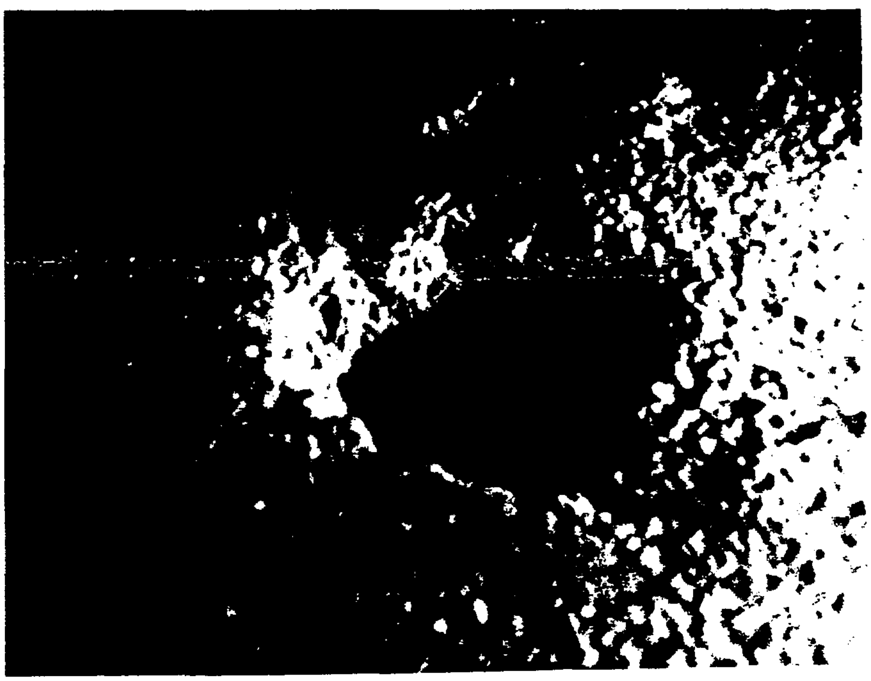

Plate d. Conical 2 cm diameter burrow is evidence of recolonization of disposal material apron by large burrowing animal.

Plate e. Partial burial of *Corymorpha pendula* is indication of dredged material dispersal limits in the apron area.

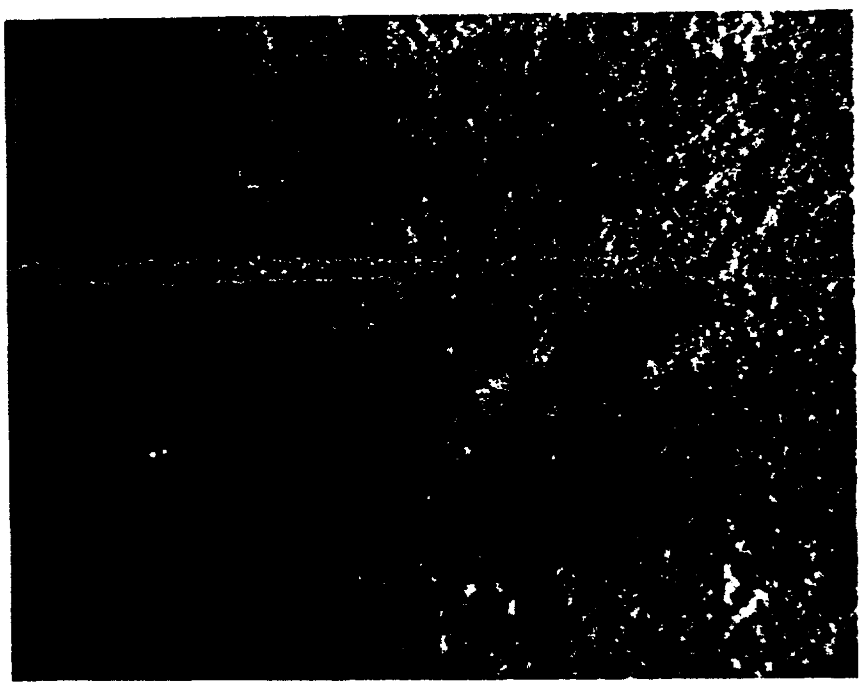

Plate f. Dredged material around the stalk of *Corymorpha pendula* has adhesive properties, probably due to its high organic content.

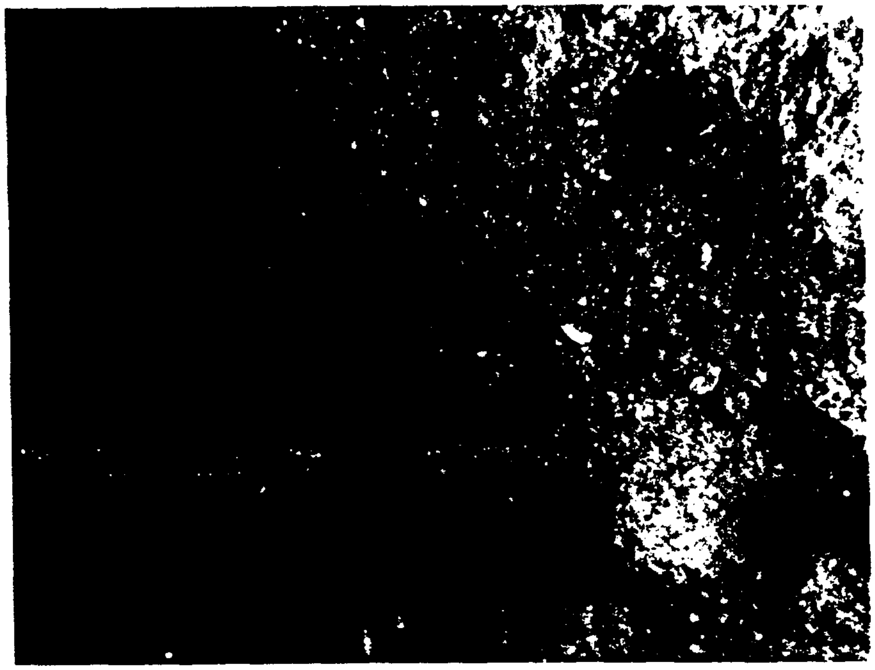

Plate g. Leaf debris is an example of allochthonous inputs to the area by the disposal operation.

Plate h. Winter flounder, *Pseudopleuronectes americanus* was observed on dredged material in the apron area.

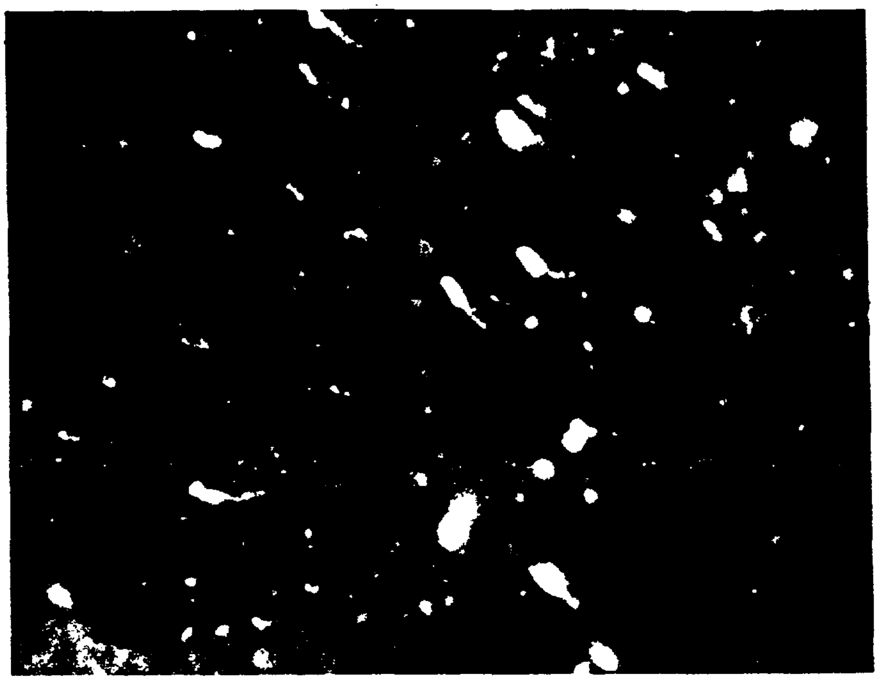

Plate i. Mysid shrimp swarms probably Neomysis americanus, were present in the disposal area.

Plate J. Juvenile hake, Urophycis sp. were observed in areas of irregular topography on the dredged material pile.

SAIC

Plate k. *Cancer irroratus* is a common species in the area and generally is an immediate colonizer of new dredged material.

A barge dump was observed from the R/V Shock (URI) on 21 April at 1640 hours. Evidence of high volatile oil and grease content was apparent by a 200 m slick generated by the disposal operation. Foam rubber balls were also observed on the surface. Mortality of Cyanea at the surface was evident. This is the worst surface evidence of impact noted to date.

A diver survey was conducted on 4 June 1982 to assess conditions at the Mill-Quinnipiac River disposal site after disposal operations were completed. Two dives were made in 70 feet of water to observe sediment surface conditions, survey species type and relative abundance, and provide photodocumentation of conditions. Loran-C coordinates for the diver transect were from 26552.5/43996.9 to 26552.7/43996.4. The DAMOS dive log describes bottom conditions in Table I-3-30.

General sediment surface conditions were characterized by a very thin nepheloid, less than 1 mm in thickness. A brown oxidized layer approximately 1 cm in thickness overlaying a soft black silt/mud layer. Incorporated throughout the top 20 cm of dredged material was granular, gravel-shell sediment. The abundant unconsolidated material observed on the 21 April survey was not seen throughout the course of this transect. Occasional small (10-20 cm) and large (1-1.5 m) clay clumps were observed, as well as organic clusters of Phragmites stalks.

Considerable biological activity by motile epifauna was observed over the entire transect. Abundant decapod tracks, mucoid tracings and fin ray imprints were noted over the entire surface throughout the transect. Several Cancer irroratus excavations in progress were observed at clay mound bases. No Corymorpha or Cerianthus was observed. Other than surficial sediment movement and decapod burrowing, bioturbation from fish was the greatest influence on the dredged material surface.

Table I-3-31 summarizes species observed and their relative abundance. Figure I-3-71 documents conditions on the mound surface. An epibenthic sample was taken for later anlysis. Presentation of epibenthic sampling data will appear in a later report.

An additional post-disposal survey was made in September 1982 to assess long-term recolonization and sediment conditions. Two dives were conducted in 62 feet of water to observe sediment surface conditions, survey species type and relative abundance, and provide photodocumentation of conditions. Loran-C coordinates for the diver transect were from 43996.8/26552.4 to 43996.9/26552.3 (DAMOS diver log Table I-3-32).

Sediment surface conditions consisted of typical soft cohesive dredged material, a flat and featureless interface with few small eroded clay clumps. Decomposing organic debris (i.e. Spartina sp.) was still present. Shell debris (Mya and Crassostrea) covered less than 5% of the surface area.

TABLE I-3-30

D.A.M.O.S. DIVER MONITORING LOG, MQR
June 1982

DATE: 4 June 1982 **LOCATION:** CLIS-MQR Post Disposal (transect)

DIVERS: Stewart DeGoursey **TIME:** 1010 **DEPTH:** 70' **T°C:** **VISIBILITY:** 4 ft.

DIVE (in/out Loran C):
15050.9)
43996.9) 100 m SSE Transect

DISPOSAL or REFERENCE BUOY (L/C:
MQR - DC buoy removed yesterday from 15050.9
43997.0

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, nefflold layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

Begin eff 0 kt. water column uniform low turbidity on bottom, very thin nephaloid layer (1 mm), brown oxidized sediment surface - 1 cm thick overlay soft black silt/mud layer; 10-15 cm beneath and/or incorporated throughout top 20 cm was granular gravel - shell sediment. Floculant unconsolidated material observed in April 21 dive not seen throughout course of transect. Occasional small (10-20 cm) and large (1 - 1.5 m) clay clumps noted. Organic peat, Phragmites stalks, cluster observed.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Cancer irroratus (10+)
Nassarius trivittatus (200+) aggregations (interlaced mucal tracking)
Mysids (2-5) per each 10 cm square observation patch.
Crangon (2)
Urophycis (1)
Scophthalmus aquosus (3) small 10-20 cm
Prionotus carolinus (1) large
Asterias (30+)
Busycon canniculatum (1) large)

Considerable decapod tracks, mucal tracings fin ray imprints were noted over entire spo[illegible] surface throughout transect. Several C. irroratus excavations (in process) were observed at clay mound bases.

II. DISCRETE SAMPLES OR METHODS:

_X_ **A. Epibenthic net (30 sec. traverse): on or off spoil, target species.**

___ **B. .25 m² quadrant count/photography.** at end transect-sediment strata.

___ **C. Penotrometer tests, elevation stake readings, sediment trap.**

___ **D. Mussel deployment - bioaccumulation subsample.**

___ **E. Sonic beacon placement or electrolyte change.**

___ **F. Remote bathymetric camera photos.**

___ **G. Video tape (location, time min. run, tape index).**

___ **H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)**

TABLE I-3-31

SUMMARY OF SPECIES AND RELATIVE ABUNDANCES, MQR
June 1982

Species	Relative Abundance
Gastropods	
Nassarius trivittatus	200 + (in aggregations)
Busycon canniliculatum	
Crustacea	
Mysidacea	2-5/10 cm^2 observations patchy
Crangon septemspinosus	2
Cancer irroratus	10 +
Echinodermete	
Asterias forbesi	30 +
Pisces	
Urophycis chuss	1
Scophthalmus aquosus	3 (juv. 10-20 cm TL)
Prionotus carolinus	1 (adult)

FIGURE I-3-71.

Photodocumentation of Benthic Conditions at MQRDS, June 1982.

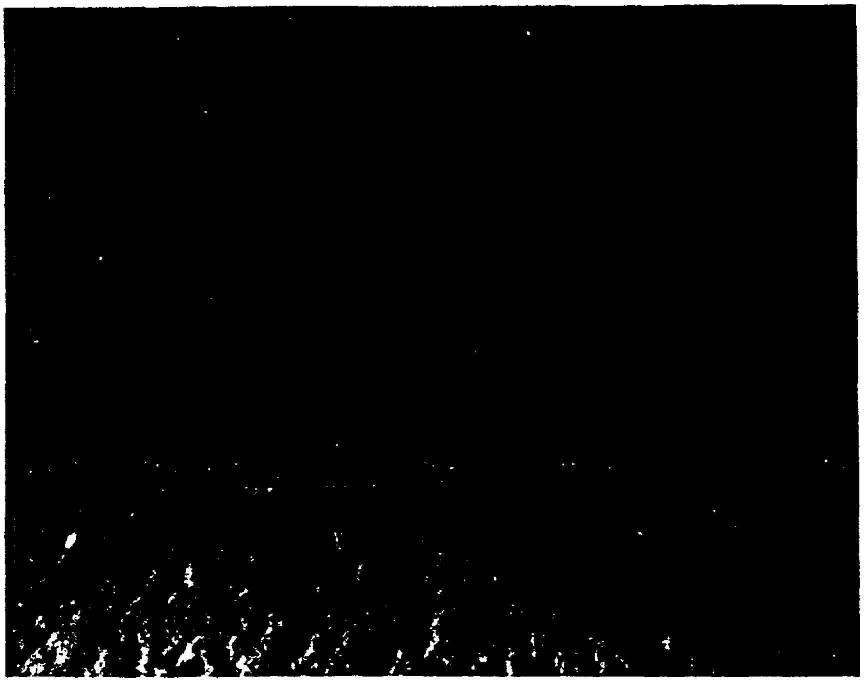

Plate a. Sediment surface marked with crab tracks.

Plate b. An intact clay clump. Note rounded, eroded surfaces and sediment accumulation along the base.

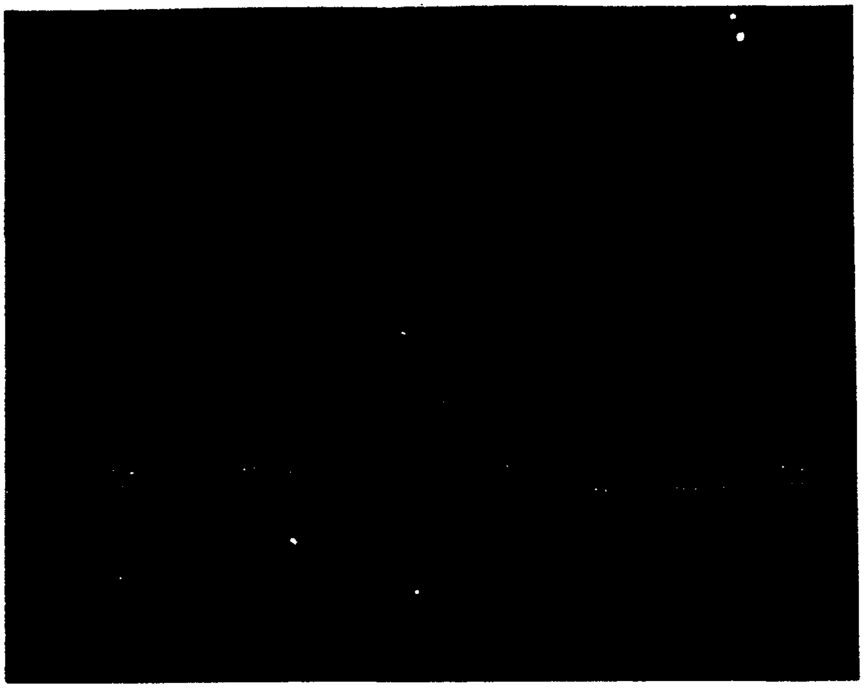

Plate c. Organic peat clump with protruding Phragmites stalks.

Plate d. Close-up of peat clump surface. Protruding plant fragments are visible.

SAIC

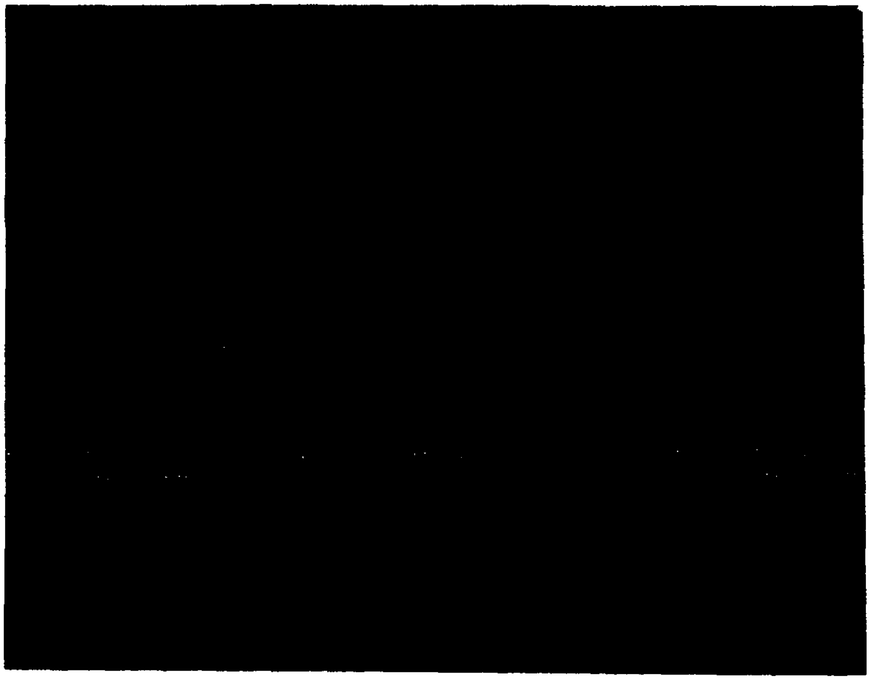

Plate e. *Cancer irroratus* burrowed to the depth of the carapace margin.

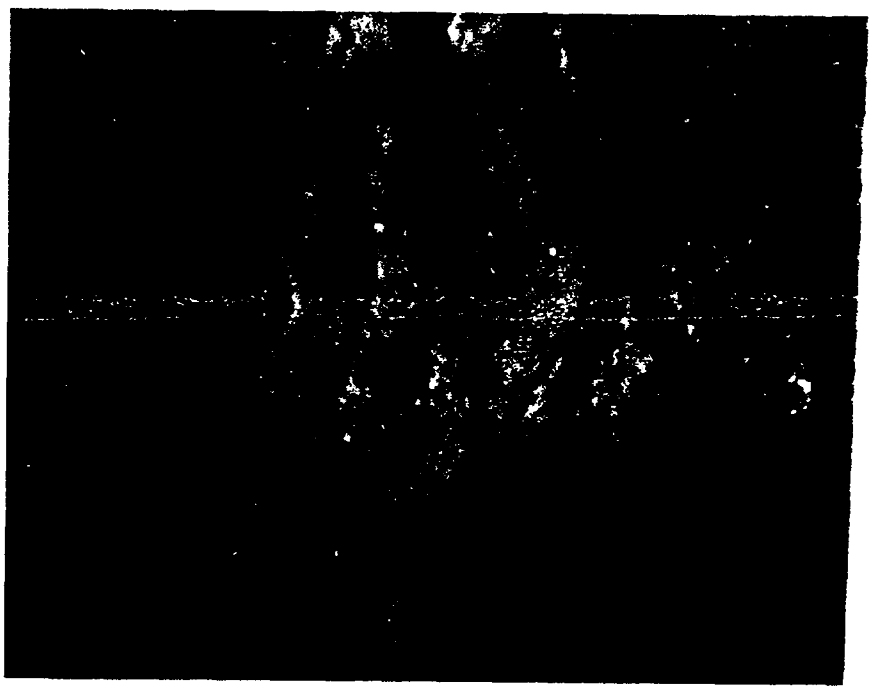

Plate f. Dense aggregate of *Nassarius trivittatus*. The surficial sediments are cohesive and snail tracks remain distinct.

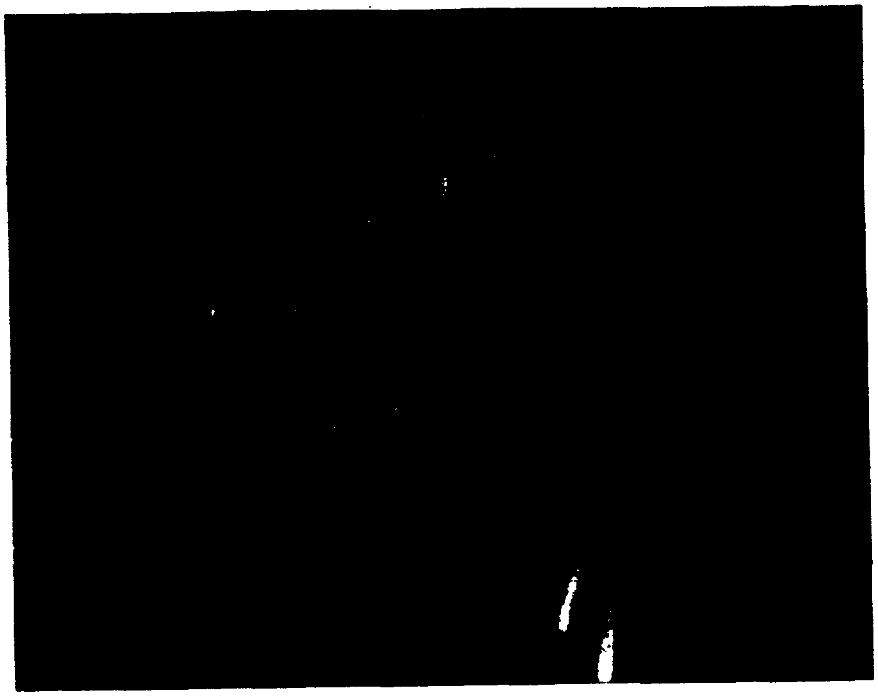

Plate g. An adult *Prionotus carolinus* was observed on the mound during this post-disposal survey.

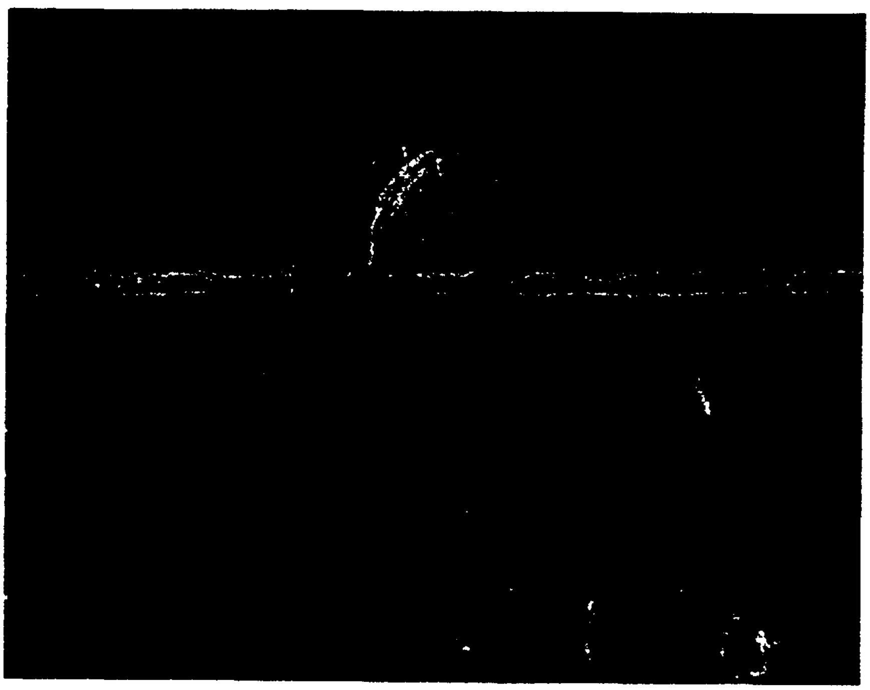

Plate h. Debris remaining on the dredged material surface included wood and valves of *Crassostrea virginica*.

SAIC

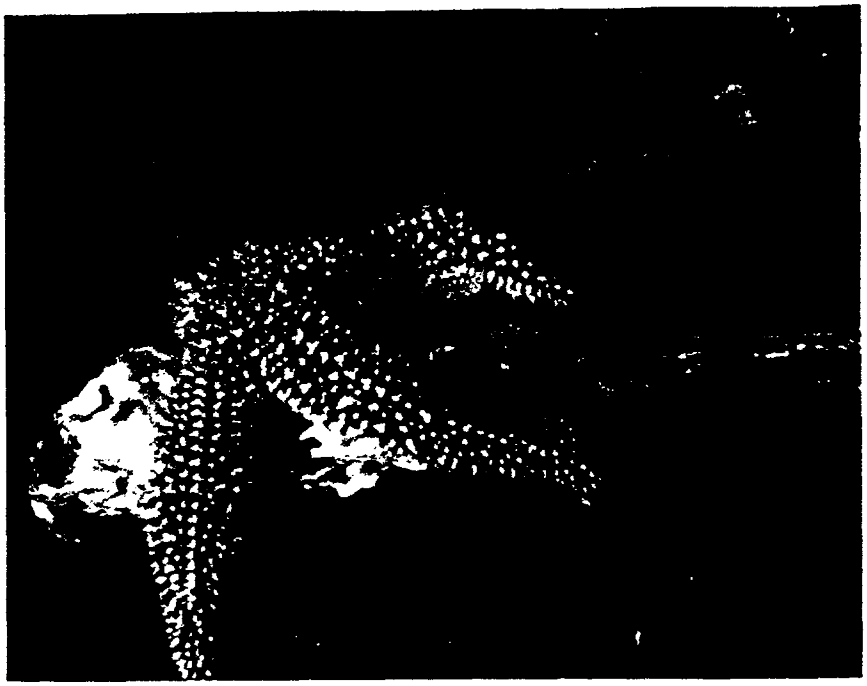

Plate i. *Asterias forbesi* preying upon *Crassostrea virginica* which was transported to the disposal site.

TABLE I-3-32
D.A.M.O.S. DIVER MONITORING LOG, MQR
September 1982

DATE: 9/3/82 **LOCATION:** Central Long Island Sound - Mill-Quinnipiac River

DIVERS: P.Auster **TIME:** 1055-1122 **DEPTH:** 62 **T°C:** **VISIBILITY:** 2 ft.

DIVE (in/out Loran C): **DISPOSAL or REFERENCE BUOY (L/C:**
43996.8/26552.4 Out 43996.9/26552.3

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, nefflold layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

Soft cohesive spoil material. Decomposing organic debris (mostly flora). Flat surface, few small clumps observed over traverse. Mya and Crassostrea shell debris (less than 5% cover).

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Mysids - abundant
Ovalipes - (.5 - 2.0 cm carapce width) 3-5/.25 m^2
Pagurus longicarpus 100
Hippoglossus oblongus - 4 (all less than 12 cm TL)
Scophthalmus aquosus - 3 (juveniles)
Prionotus evolans - 1 - feeding on mysids
Loligo - 3 - attracted to dive lights

II. DISCRETE SAMPLES OR METHODS:

__1__ **A. Epibenthic net (30 sec. traverse): on or off spoil, target species.**

__X__ **B. .25 m^2 quadrant count/photography.** 1.3

_____ **C. Penotrometer tests, elevation stake readings, sediment trap.**

_____ **D. Mussel deployment - bioaccumulation subsample.**

_____ **E. Sonic beacon placement or electrolyte change.**

_____ **F. Remote bathymetric camera photos.**

_____ **G. Video tape (location, time min. run, tape index).**

_____ **H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)**

D.A.M.O.S. DIVER MONITORING LOG, CLIS
September 1982

DATE: 9/3/82 **LOCATION:** Central Long Island Sound Site - Off Spoil NE Corner

DIVERS: P. Auster **TIME:** 1319-1325 **DEPTH:** 62 **T°C:** **VISIBILITY:** 2 ft.

DIVE (in/out Loran C): **DISPOSAL or REFERENCE BUOY (L/C:**
In/Out 44000.1/26536.5

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

Flat, featureless - Cohesive mud.
No shell hash on surface but debris did appear in epibenthic sample.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Cerianthiopsis americana 3-5/.25 m^2
Pagurus longicarpus 80
Cancer irroratus - 5
Asterias forbessi - 1
Mysids - abundant
Ovalipes - 10

II. DISCRETE SAMPLES OR METHODS:

_____ A. Epibenthic net (30 sec. traverse): on or off spoil, target species.

_____ B. .25 m^2 quadrant count/photography.

_____ C. Penotrometer tests, elevation stake readings, sediment trap.

_____ D. Mussel deployment - bioaccumulation subsample.

_____ E. Sonic beacon placement or electrolyte change.

_____ F. Remote bathymetric camera photos.

_____ G. Video tape (location, time min. run, tape index).

_____ H. Opportunistic collection (i.e. natural mussel bed, *Corymorpha Axius*.)

The area supports a large stock of juvenile species common in the region of Long Island Sound. All animals were active and bioturbating the surficial sediments. Table I-3-33 lists the species observed and their relative abundances. Figure I-3-72 provides examples of photodocumentation obtained during the dive and demonstrates conditions observed. A diver-operated epibenthic net was used to sample organisms at the nepheloid layer. Analysis of the sample will be reported later.

Long term post-disposal conditions at the Mill-Quinnipiac River disposal site were assessed in December 1982. Two dives were conducted in 67 feet of water to observe sediment surface conditions, survey species type and abundance, and provide photodocumentation of conditions. Loran-C coordinates for the transect were from 43996.9/26552.4 to 43997.9/26554.7. For this survey, two biologist-divers were on 15 foot tethers to the video camera sled and performed a west-northwest transect with the support ship R/V UCONN under power (DAMOS dive log, Table I-3-34).

The dredged material consisted of a soft silt bottom similar to ambient sediments but with a thin fibrous, flocculent material nepheloid layer. This fibrous material has been characteristic of the Mill-Quinnipiac River dredged material and atypical of other dredged material sources at the CLIS site. Occasional sightings of 1-2 m diameter shell hash patches were made. These patches are probably the result of disintegrated dredged clump material with the shell fragments remaining. Shell cover was approximately 50% in these patches and less than 1% in other areas surveyed.

The decapod assemblage was active on the dredged material exhibiting typical bioturbational behavior (i.e. burrowing and sifting sediment material through mandibles). A typical large dish depression excavated by a large Homarus americanus was observed. Hake, Urophycis sp., were observed on the site and congregated around debris in shallow excavated depressions.

Table I-3-35 summarizes species observed and their relative abundances over the transect. Figure I-3-73 documents conditions observed at the site.

TABLE I-3-33

SUMMARY OF SPECIES AND RELATIVE ABUNDANCES, MQR
September 1982

Species	Relative Abundance
Gastropoda	
Loligo pealei	3 (approx. 3 cm total length - attracted to diving light).
Crustacea	
Ovalipes ocellatus	3-5/.25 m^2 (.5 - 2.0 cm CW)
Mysidacea	abundant 40/.25 m^2
Pagurus longicarpus	100
Pisces	
Hippoglossus oblongus	4 (all less than 12 cm TL)
Scophthalmus aquosus	3 (juveniles)
Prionotus evaolans	1

Figure I-3-72.

Photodocumentation of Benthic Conditions at MQRDS, September 1982.

Plate a. A juvenile sea robin, <u>Prionotus evolans</u>, foraging for mysids on sediment surface.

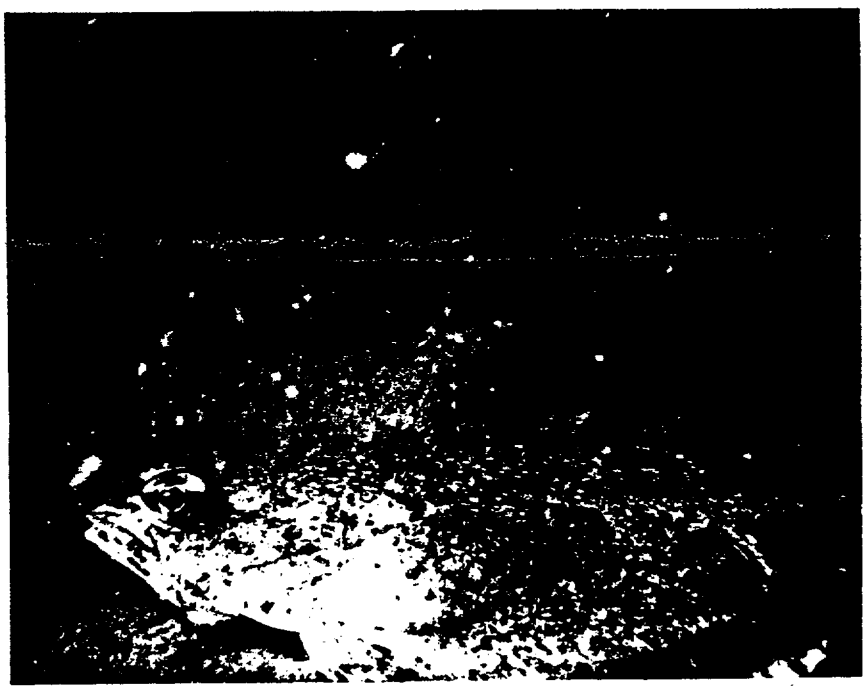

Plate b. <u>Hippoglossus oblongus</u> observed fanning the sediment surface.

Plate c. A juvenile Scophthalmus aquosus on the disposal mound. Note fin tracks on the sediment to the left of the animal.

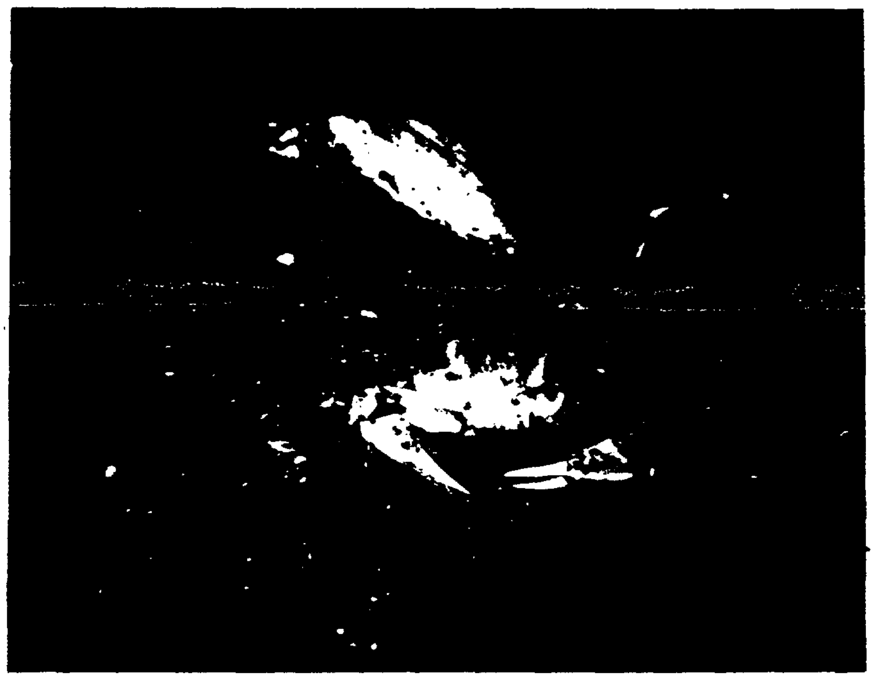

Plate d. Ovalipes ocellatus juveniles were abundant during this survey. Burrowing behavior was a major bioturbating mechanism during this period.

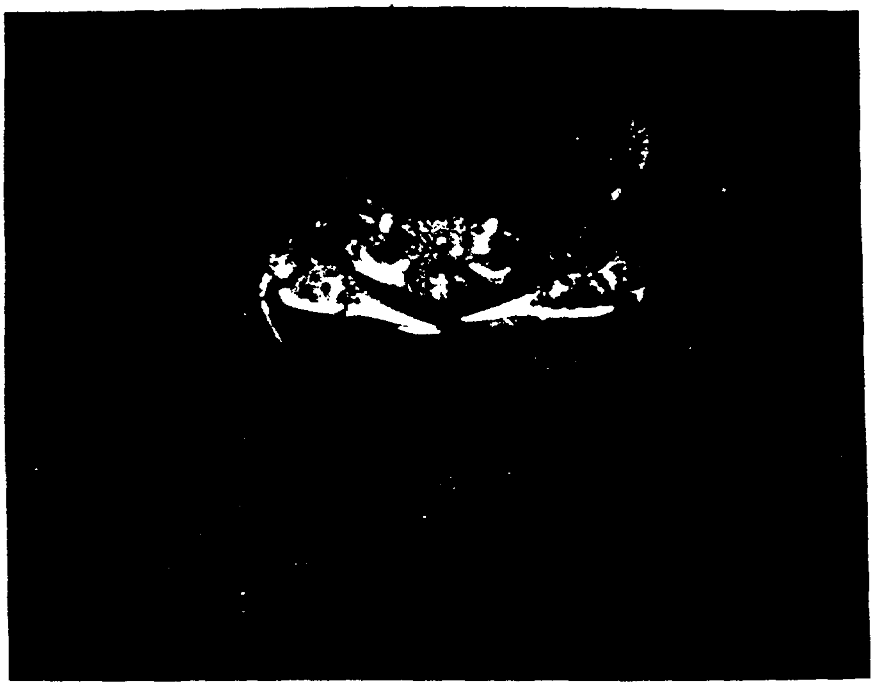

Plate e. A juvenile *Ovalipes ocellatus* in aflight posture with swimming legs erect.

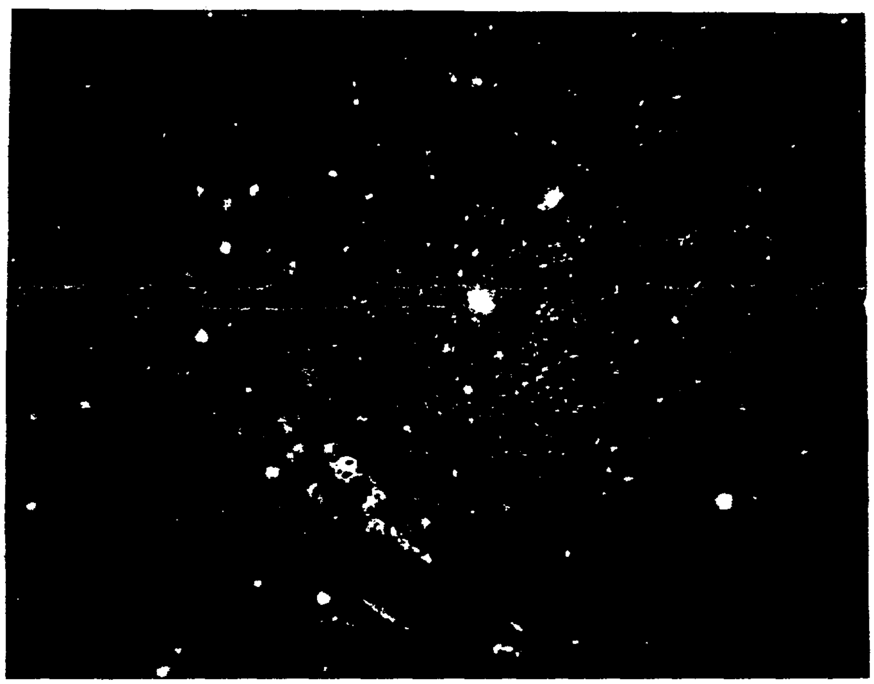

Plate f. Juvenile squid, *Loligo pealei*, were present in the water column over the disposal mound.

TABLE I-3-34

D.A.M.O.S. DIVER MONITORING LOG, MQR
December 1982

DATE: 10 Dec 82 **LOCATION:** CLIS-MQR Divers on Video Sled with 15' tethers.
400 m to WNW R/V UCONN under power.

DIVERS: Stewart
Auster **TIME:** 1227-1243 **DEPTH:** 67' **T°C:** **VISIBILITY:**

DIVE (in/out Loran C): **DISPOSAL or REFERENCE BUOY (L/C:**

43996.9/26552.4 to 43997.9/26554.7

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

Soft mud silt bottom similar to natural bottom, with occasional sighting of 1-2 m diameter shell hash patches (probable result of disintegrated dredge clump with remaining shell fragments). Fifty percent cover in patches, otherwise 99% shell free, thin nephloid layer type bottom. Dish depression excavated by large Homarus (3) debris (piling, plant, 50 gal drum) sightings.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Libinia emarginata - 5
Cancer borealis - 2
Cancer irroratus - 6
Pagurus pollicaris - 10
Pagurus longicarpus - $>$100
Homarus americanus - 1 (in dish depression)
Nassarius trivittatus - 50

Urophycis sp. - 4 ($>$ 200 mm TL)
Urophycis sp. - 3 (small $<$150 mm TL) around shell debris)
Pseudopleuronectes americanus - 3
Raja erinacea - 2
Tautogolabrus adspersus - 1 large
Corymorpha pendula - in a discrete patch of approx. 5m^2 at 3-4/.25m^2

II. DISCRETE SAMPLES OR METHODS:

_____ **A. Epibenthic net (30 sec. traverse): on or off spoil, target species.**

__X__ **B. .25 m^2 quadrant count/photography.** 1:3 Nikonos

_____ **C. Penotrometer tests, elevation stake readings, sediment trap.**

_____ **D. Mussel deployment - bioaccumulation subsample.**

_____ **E. Sonic beacon placement or electrolyte change.**

_____ **F. Remote bathymetric camera photos.**

_____ **G. Video tape (location, time min. run, tape index).**

_____ **H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)**

TABLE I-3-35

SUMMARY OF SPECIES AND RELATIVE ABUNDANCES, MQR
December 1982

Species	Relative Abundance
Cnidaria	
Corymorpha pendula	3-4/.25m^2 (in discrete patch of approximately 5m^2)
Gastropoda	
Nassarius trivittatus	50
Crustacea	
Libinia emarginata	5
Cancer borealis	2
Cancer irroratus	6
Pagurus pollicaris	10
Pagurus longicarpus	100
Homarus americanus	1
Pisces	
Urophycis sp. (> 200 mm TL)	4
Urophycis sp. (< 150 mm TL)	3
Pseudopleuronectes americanus	3
Tautogolabrus adspersus	1
Raja erinacea	2

Figure I-3-73.

Photodocumentation of Benthic Conditions at MQRDS, December 1982.

Plate a. A small hake, Urophycis sp., in depression along debris accumulated on the disposal site.

Plate b. Shell hash patch on the surface of dredged material. These patches were 1 to 2 m in diameter and are probably the result of disintegrated dredge clump material.

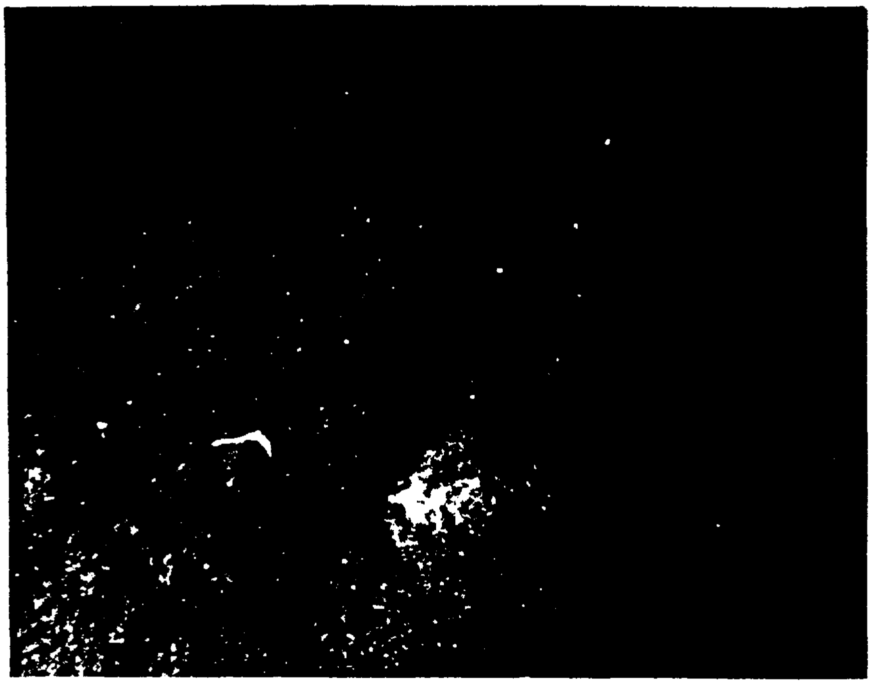

Plate c. Example of surficial fibrous flocculent material. The distribution of this material over the sediment surface is non-uniform.

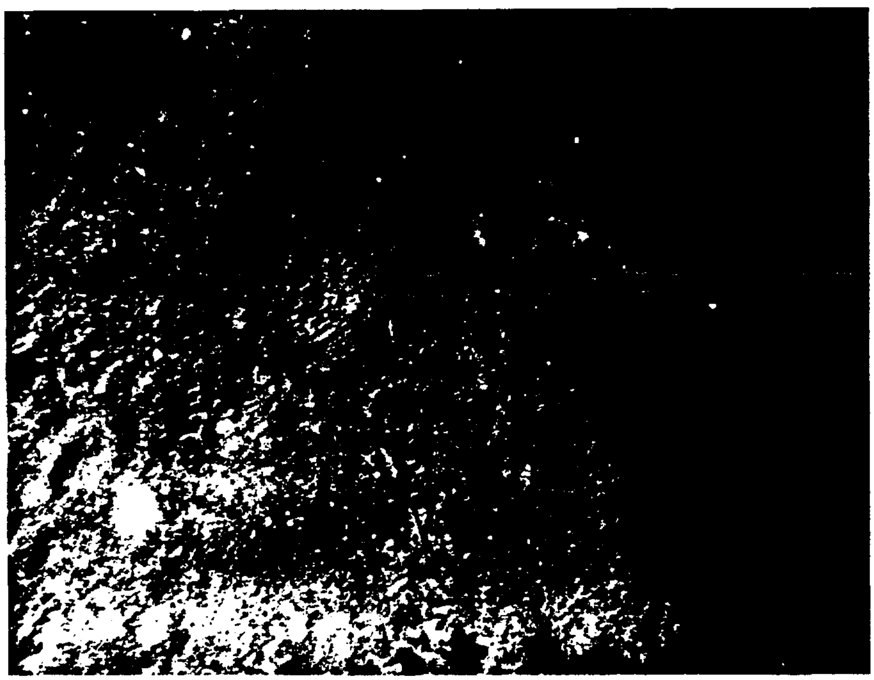

Plate d. Example of surficial fibrous flocculent material. The distribution of this material over the sediment surface is non-uniform.

SAIC