FIELD VERIFICATION PROGRAM

MONITORING CRUISE ON 19 MARCH 1985

CONTRIBUTION #47

July 29, 1985

Contract #DACW33-83-D-0004

SAIC Report #SAIC-85/7515&C47

Submitted to:

New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254

Submitted by:

Joseph D. Germano
Jeffrey H. Parker
Science Applications International Corporation
Ocean Science & Technology Division
Admiral's Gate
221 Third Street
Newport, RI 02840
(401) 847-4210

TABLE OF CONTENTS

LIST OF FIGURES

1.0 INTRODUCTION

Through the Disposal Area Monitoring System program (DAMOS), the New England Division of the Corps of Engineers has been supporting a joint EPA-COE project at the CLIS disposal site since March 1982. A description of the Field Verification Program (FVP), the baseline surveys and subsequent disposal site selection have been presented in DAMOS Contributions #23 and #46. The proposed FVP site at the northeast corner of the CLIS open water disposal area ($41^{o}9.39'N$, $72^{o}51.75'W$) was characterized by a flat, gently sloping topography with the typical Central Long Island Sound mud bottom. The disposal site was considered to be very homogenous and typical of natural sediments in the region. These conclusions were reached based on sediment chemistry, diver observations and the REMOTS interface camera. Suspended sediment measurements indicated that the potential impact on the FVP site of other proposed disposal operations in the southwest corner of the CLIS disposal area would be negligible.

The most recent cruise was conducted on 19 March 1985 at the FVP site. During this period, a precision bathymetric survey was performed to detect change to mound volume and REMOTS sediment interface photographs were taken to characterize the sediment and benthos. Sediment samples were also collected and taken to the EPA laboratory at Narragansett for chemical and physical analysis, as well as characterization of the benthic community.

2.0 BATHYMETRY

The survey grid (Fig. 2-1) (established in April 1983) consists of 33 transects, 800 meters long oriented in an east-west direction and spaced 25 meters apart. When conducting the surveys, navigation control was provided by the SAIC Navigation and Data Acquisition System. All navigation control for surveys and REMOTS photography was provided by the SAIC Navigation and Data Acquisition System, a computerized control unit interfaced to a Del Norte 540 microwave positioning system. The SAIC system provides real time video displays of ship position relative to designated lanes or locations which substantially enhance the capability of the ship's helmsman to steer survey lanes within $\pm$5 meters and to obtain replicate sediment samples within $\pm$10 meters. This precision in ship control is an essential requirement for this program since the disposal mounds are quite small and spatial variability in measured parameters is relatively large. Using calibration techniques established under the DAMOS program, recorded position accuracies within the CLIS disposal site are $\pm$1-2 meters.

Figures 2-2 is the bathymetric contour chart for the present survey. Examination of the depth at the center of the dredged material mound reveals that no significant changes have occurred. The bathymetric surveys conducted in 1984 depicted a stable mound configuration with no significant changes occurring.

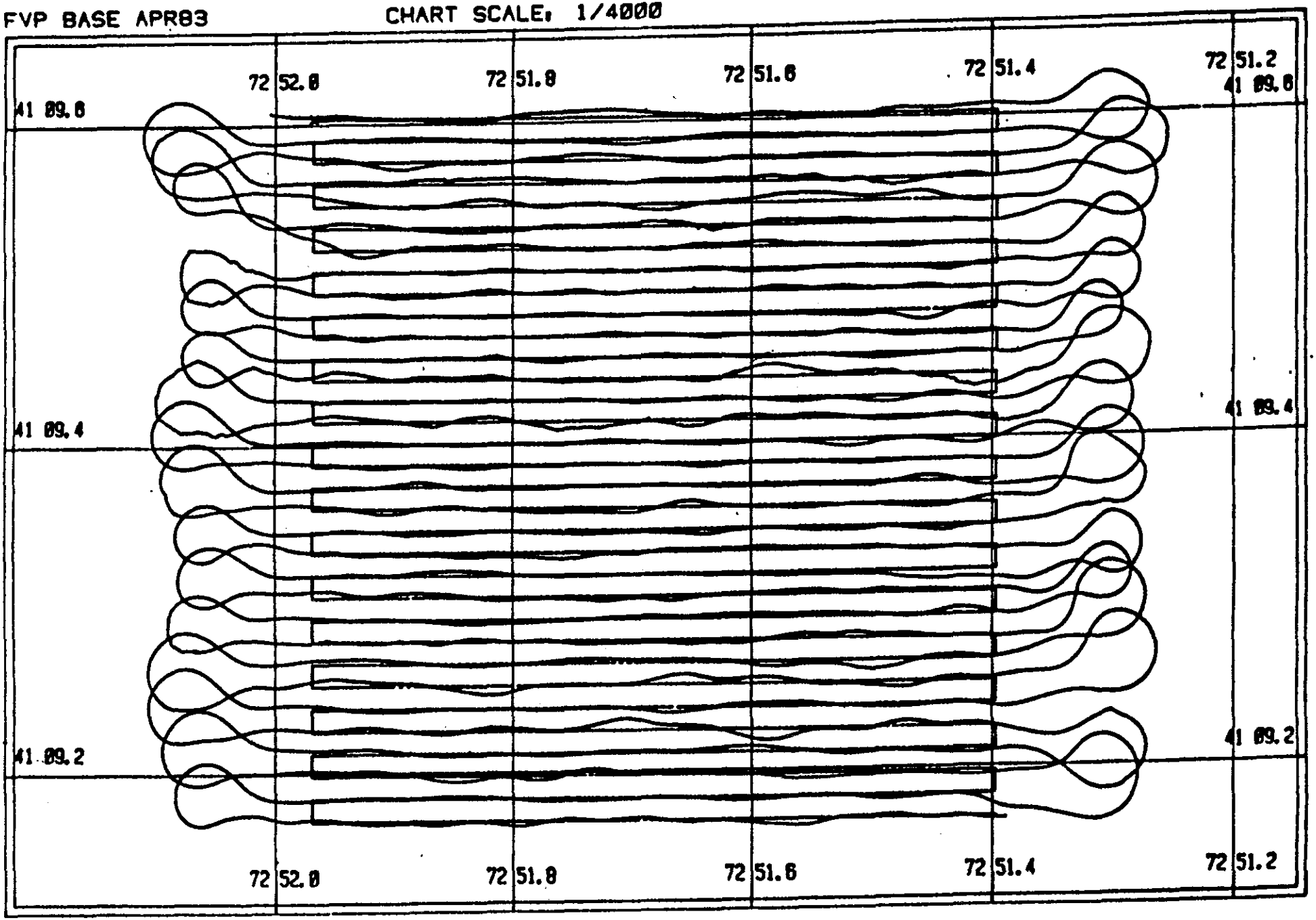


Figure 2-1. Ship's Track, FVP Base, April 1983.

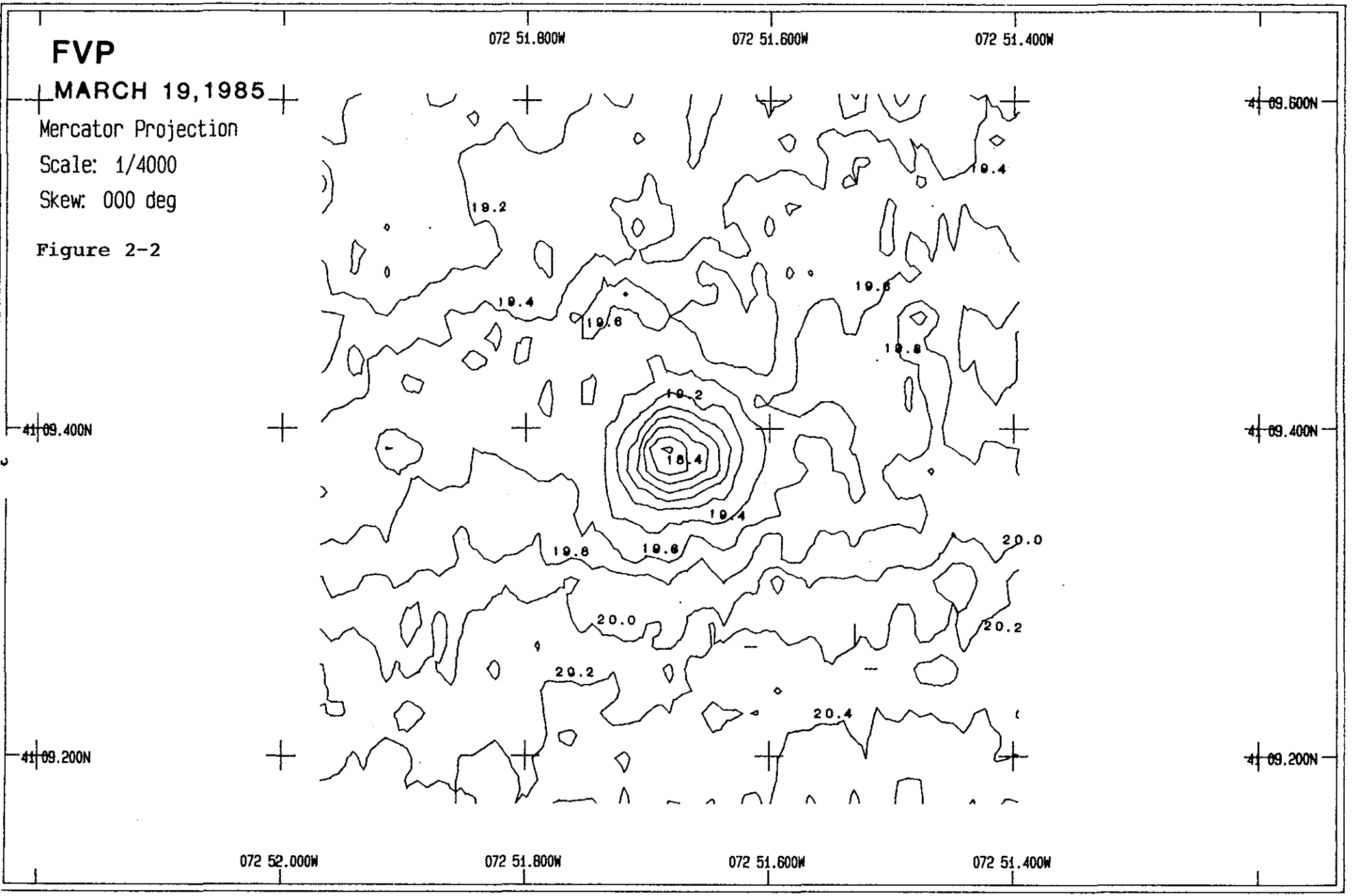

FVP
MARCH 19,1985
Mercator Projection
Scale: 1/4000
Skew: 000 deg
072 51.800W
072 51.600W
072 51.400W
41 09.600N
41 09.400N
41 09.200N
072 52.000W
19.2
19.4
19.6
19.8
20.0
20.2
20.4

Figure 2-2

3.0 REMOTS

The purpose of this March 1985 FVP REMOTS survey is to monitor potential change in the sedimentary characteristics of the dredged material mound, to document the process of successional recovery at the FVP disposal site, and to monitor changes in the ambient fauna and sediments adjacent to the site. This survey was conducted approximately 22 months after the disposal operation.

3.1 Methods

On 22 March, 21 stations were occupied at or adjacent to the FVP site. These stations correspond to the standard locations which have been monitored since the June 1984 FVP REMOTS survey. The twelve central stations are considered to be on the main dredged material mound or flanks based on REMOTS and bathymetric surveys conducted immediately after the FVP disposal operation (Fig. 3-1). The surrounding nine stations are classified as edge and ambient stations. Three REMOTS images were scheduled to be taken at all stations. Only two images, however, were obtained at stations 200N and 500E, and only one image was obtained at 250N. Fifteen REMOTS images were taken at the CLIS-REFERENCE site compared to twenty-one images in the December 1984 survey.

Methods of image interpretation are described in earlier FVP reports to SAIC and are not repeated here.

3.2 Results

The distribution and thickness (cm) of observable dredged material at the FVP site is shown in Figure 3-1. This distribution is comparable to that observed in previous REMOTS surveys.

All stations show an apparent grain-size major mode of > 4 phi (silt-clay), with minor fractions of 3 and 2 phi (very fine to fine sand). A layer of fine sand (3-2 phi) overlying silt-clay continues to be observed at station CTR. This feature has been observed since the January 1984 REMOTS survey; it appears to represent a lag deposit resulting from current washing of the mound apex.

The frequency distributions of boundary roughness values for the dredged material mound stations, the edge and ambient stations, and the CLIS-REF site are shown in Figure 3-2. The distributions are similar for all three areas, with the major mode for small-scale topographic relief being 0.4 cm. Boundary roughness values have not changed since the December 1984 survey.

A layer of floccular material was observed at the

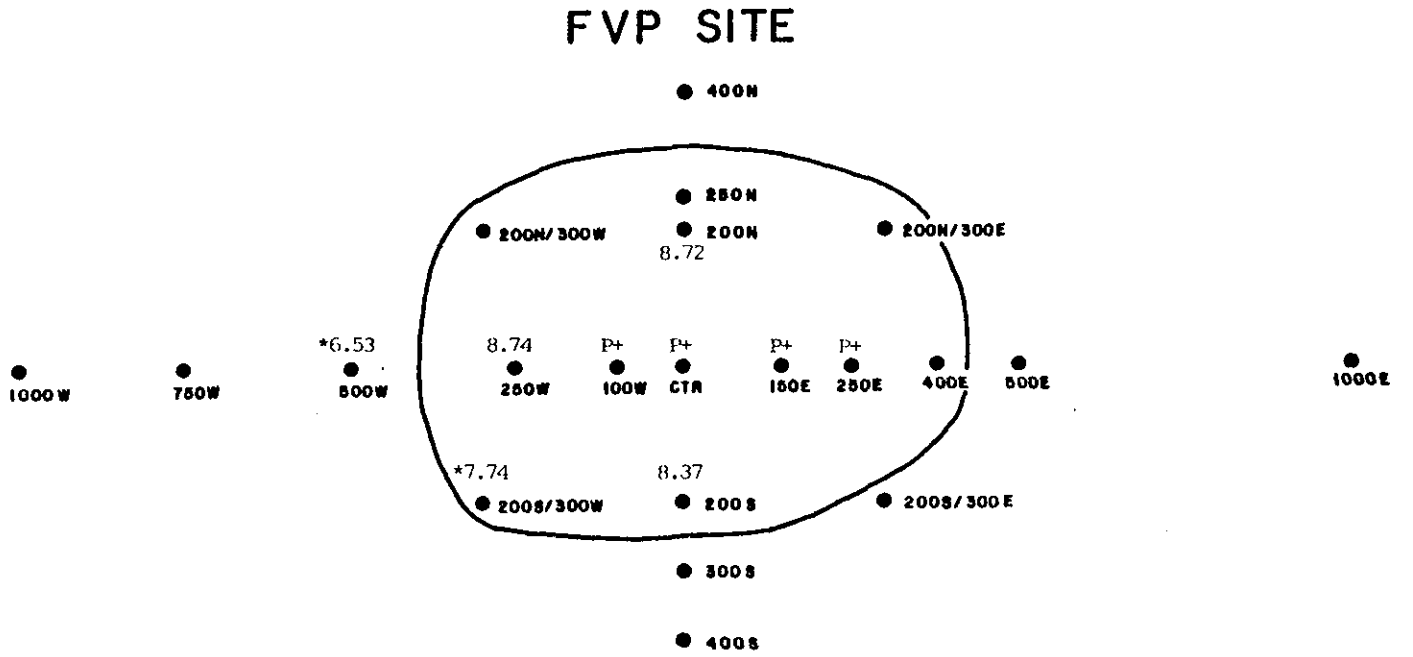
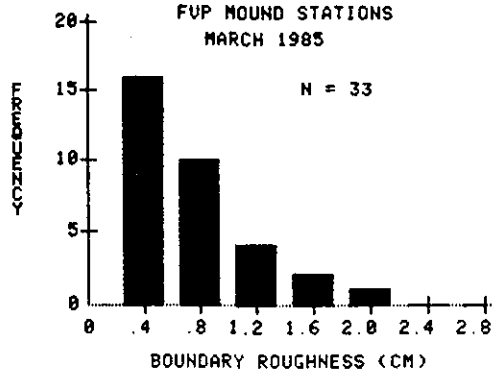
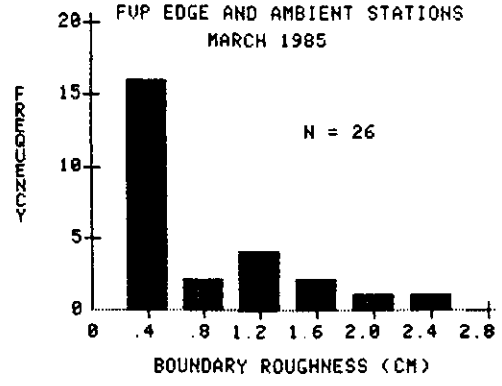


Figure 3-1. The apparent distribution and thickness (cm) of dredged material averaged by station at the FVP site in March 1985. The solid line encloses the twelve stations considered to be on the main dredged material mound or flanks as defined by REMOTS and bathymetric surveys conducted immediately after the disposal operation.

P+ = Dredged material thicker than REMOTS window penetration.

* = Dredged material not observed in all replicates from that station.





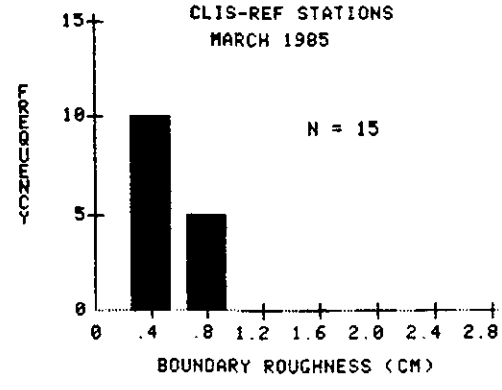


Figure 3-2. The frequency distributions of boundary roughness values for dredged material mound stations, edge and ambient stations, and the CLIS-REF site.

sediment-water interface in 86% of the images taken during this survey. The layer ranges from 0.24 to 1.42 cm thick, with a mean thickness over the site of 0.61 cm. In some replicates, the material is clearly distinct from the underlying sediment, while in others it is incorporated into the bottom (photos, Fig. 3-3). The distribution of this floccular material is mapped in Figure 3-4; no obvious gradient is discernible across the site.

The source of the floccular material is probably the bloom of plankton that typically occurs in Long Island Sound in late February or early March (Conover, 1956). The temporal window for observation of this phenomenon appears to be very narrow; past surveys conducted at this time of year have never recorded a floccular layer at the sediment-water interface. The annual input of organic carbon into the sediments of Long Island Sound from phytoplankton detritus is estimated at 63 g/m^2 (Riley, 1956). The large deposition of organic material observed during this survey must represent a significant portion of that input. This floccular material is very easily resuspended and probably the source of the near-bottom turbidity levels reported by divers.

Figure 3-5 shows the average depth of the apparent RPD for each station. Station CTR, which was the only station to show an RPD shallower than 3.00 cm in December, had an average RPD of 3.33 cm in this survey. The average RPD value for mound stations is 4.88 cm; this is not significantly different from the average value of 4.33 cm for edge and ambient stations ($p = .0757$, Mann-Whitney U-test). CLIS-REF RPD depths are also not significantly different than those on the mound ($p = .6810$, Mann-Whitney U-test).

Figure 3-6 shows the frequency distributions of mean RPD depths for mound stations, edge and ambient stations and the CLIS-REF area. Mound stations and CLIS-REF have a distribution centered around 5.0 cm, while the distribution for edge and ambient stations is centered around 4.0 cm. Mound RPD's have not significantly changed since the December 1984 survey ($p = .6466$, Mann-Whitney U-test). RPD's at the edge and ambient stations have become significantly shallower since December ($p = .005$, Mann-Whitney U-test), while at CLIS-REF they have become significantly deeper than the anomalously shallow RPD's found there in December 1984 ($p = .006$, Mann-Whitney U-test).

The mapped distribution of successional stages is shown in Figure 3-7. Of the mound stations, 27% exhibit Stage III seres; this compares with 77% percent of the edge and ambient stations and 87% of the CLIS-REF replicates. A series of chi-square tests show that the difference in number of Stage III seres between mound stations and both edge and ambient and CLIS-REF stations is significant ($p < .001$), while the discrepancy between edge and ambient stations and the CLIS-REF area is not significant ($p = .4548$). In December, 63% of the mound stations, 77% of the edge and ambient stations, and 81% of the CLIS-REF replicates were recorded as exhibiting Stage III seres. Since that survey, the apparent abundance of Stage III

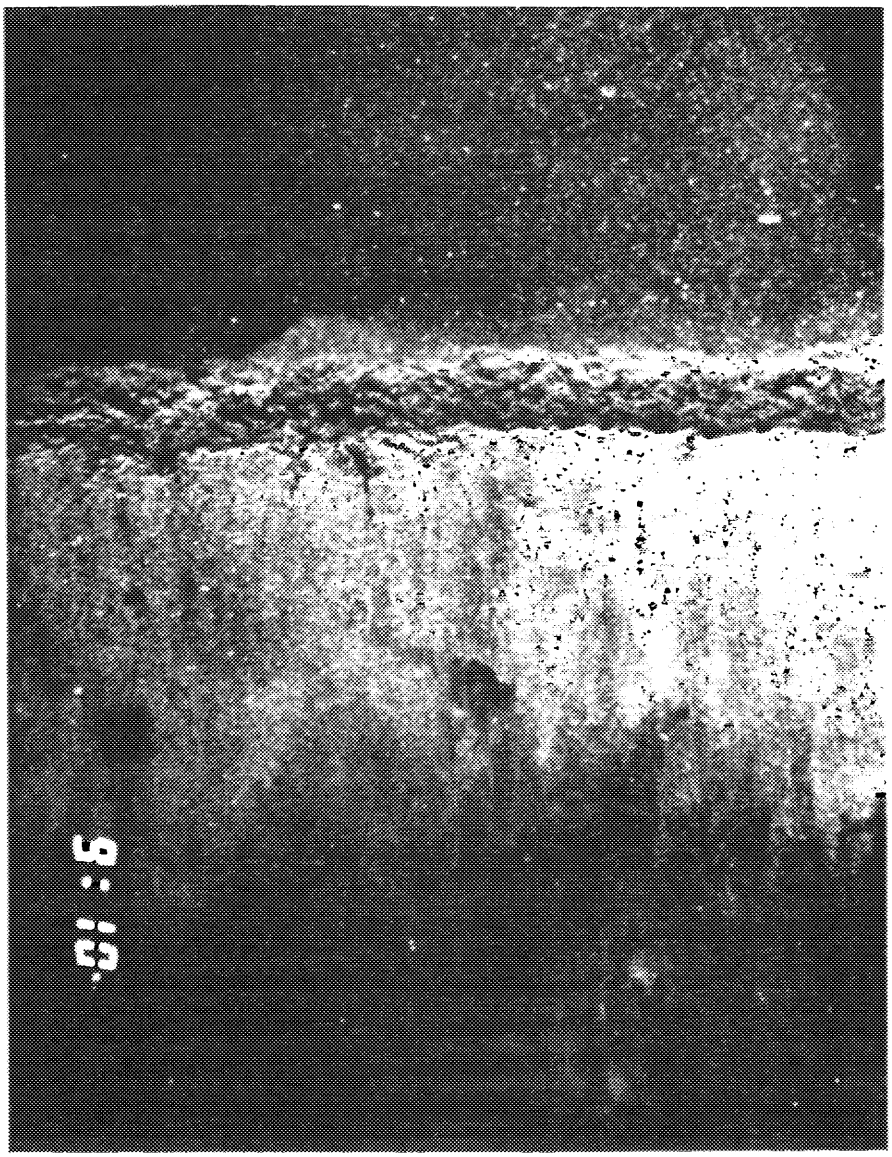


Figure 3-3a. REMOTS image from station 400N showing a layer of floccular material (phytoplankton detritus) at the sediment-water interface. The material is clearly distinct from the old interface.

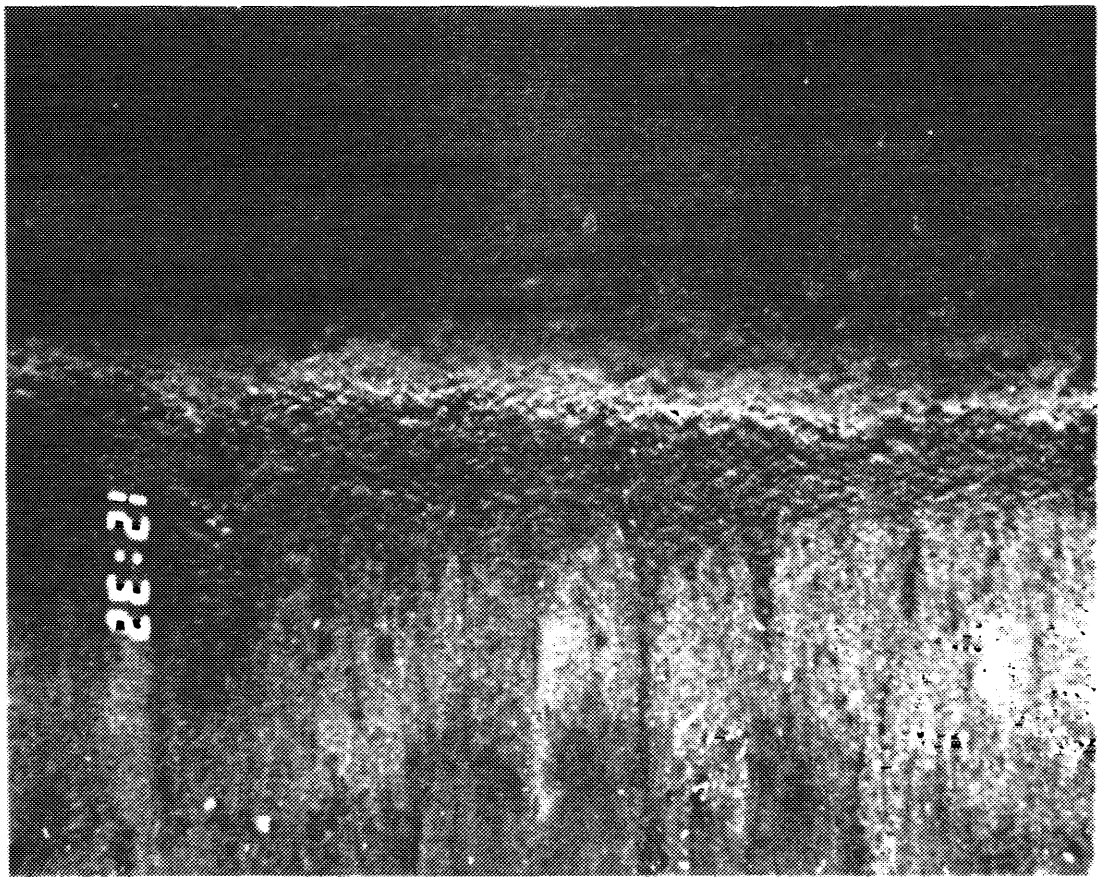


Figure 3-3b. REMOTS images from station 200N/300W showing a layer of floccular material (phytoplankton detritus) at the sediment-water interface. The material is incorporated with the underlying sediment due to bioturbation by the infauna.

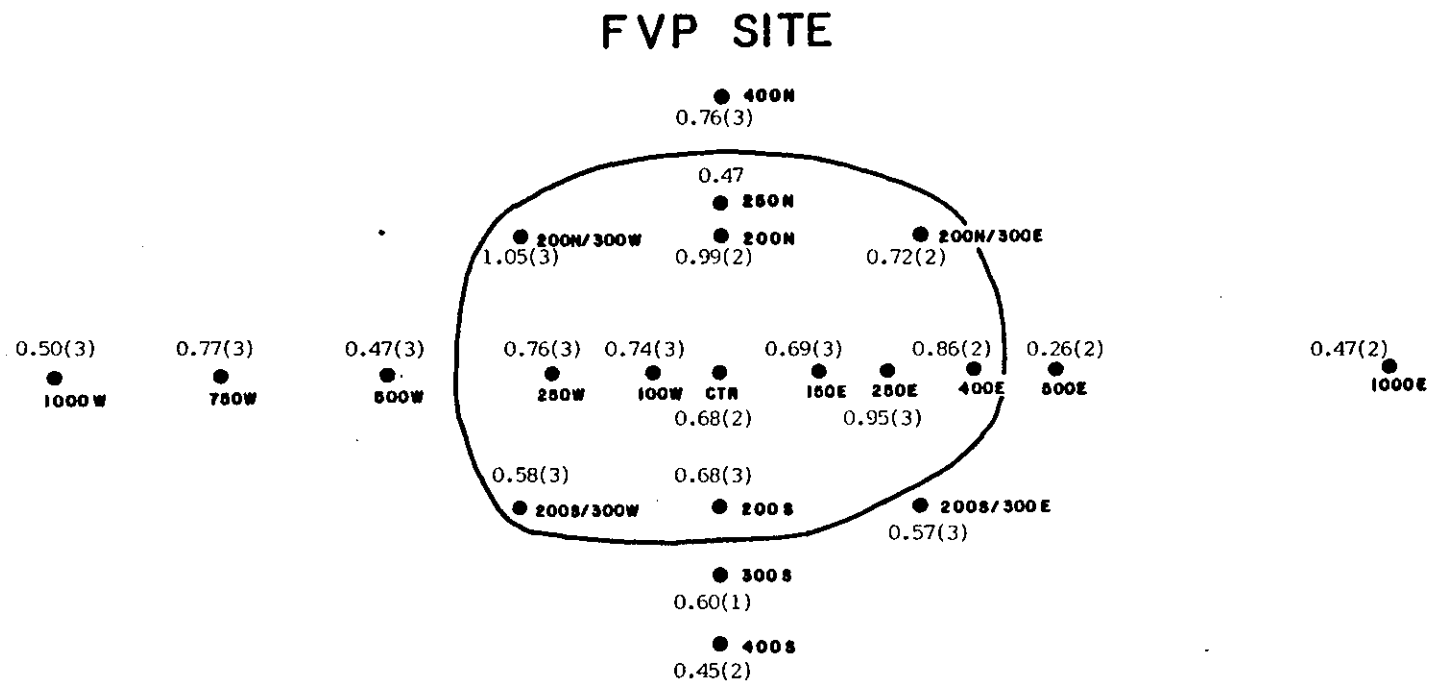


Figure 3-4. The apparent distribution and thickness (cm) of floccular material, averaged by station, deposited at the FVP site in March, 1984. This material is believed to be derived from the February plankton bloom.

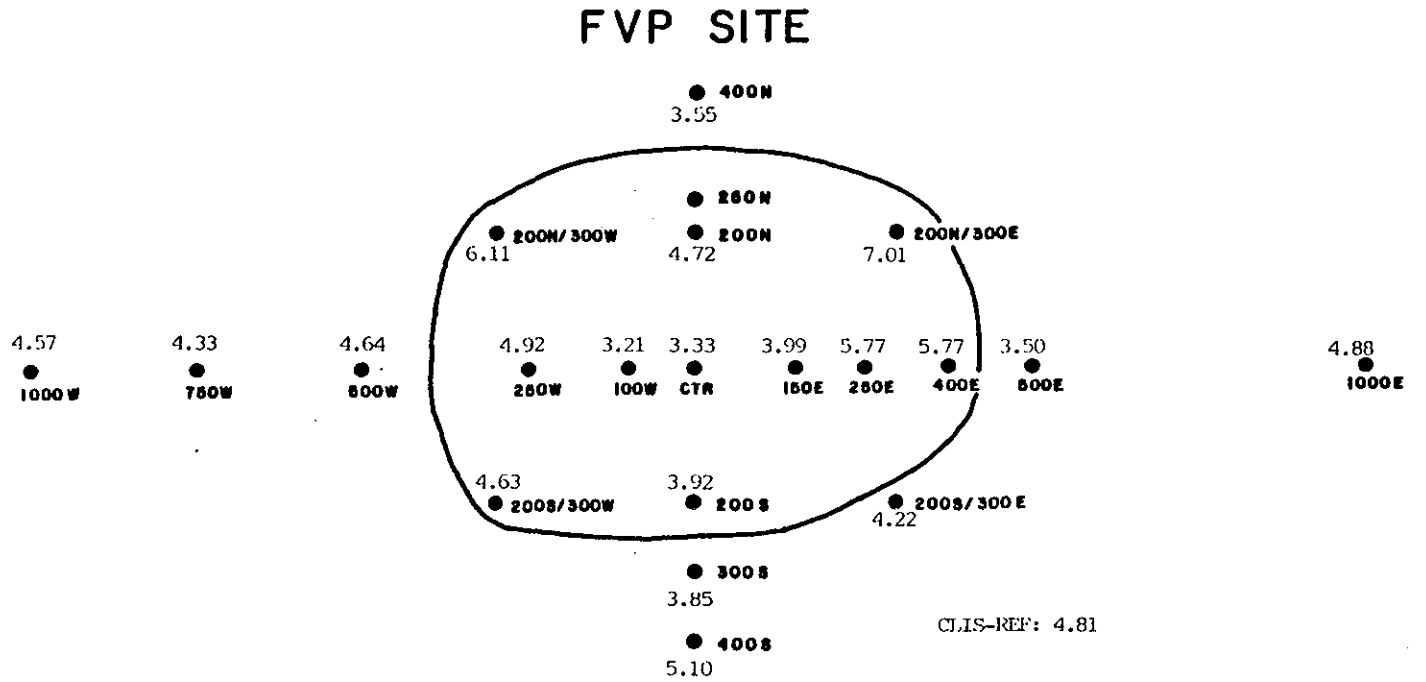
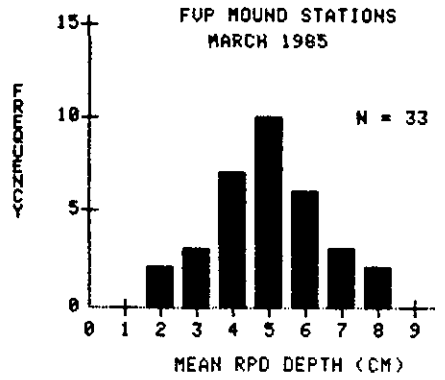
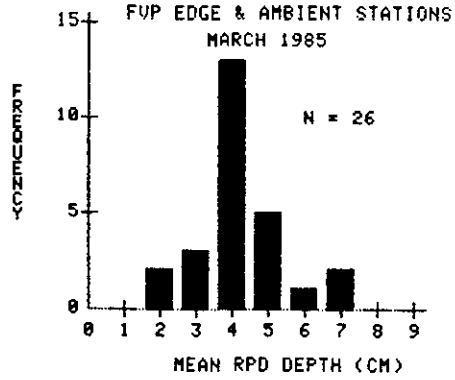


Figure 3-5. The mapped average RPD values at each station.





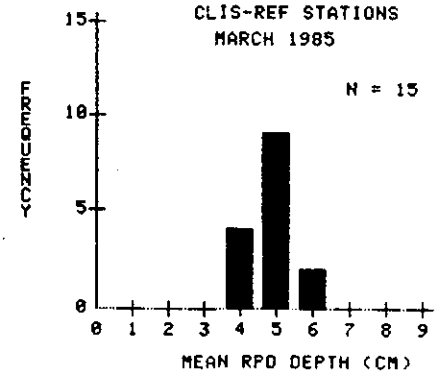


Figure 3-6. The frequency distributions of mean RPD depths for mound, edge and ambient, and CLIS-REF stations.

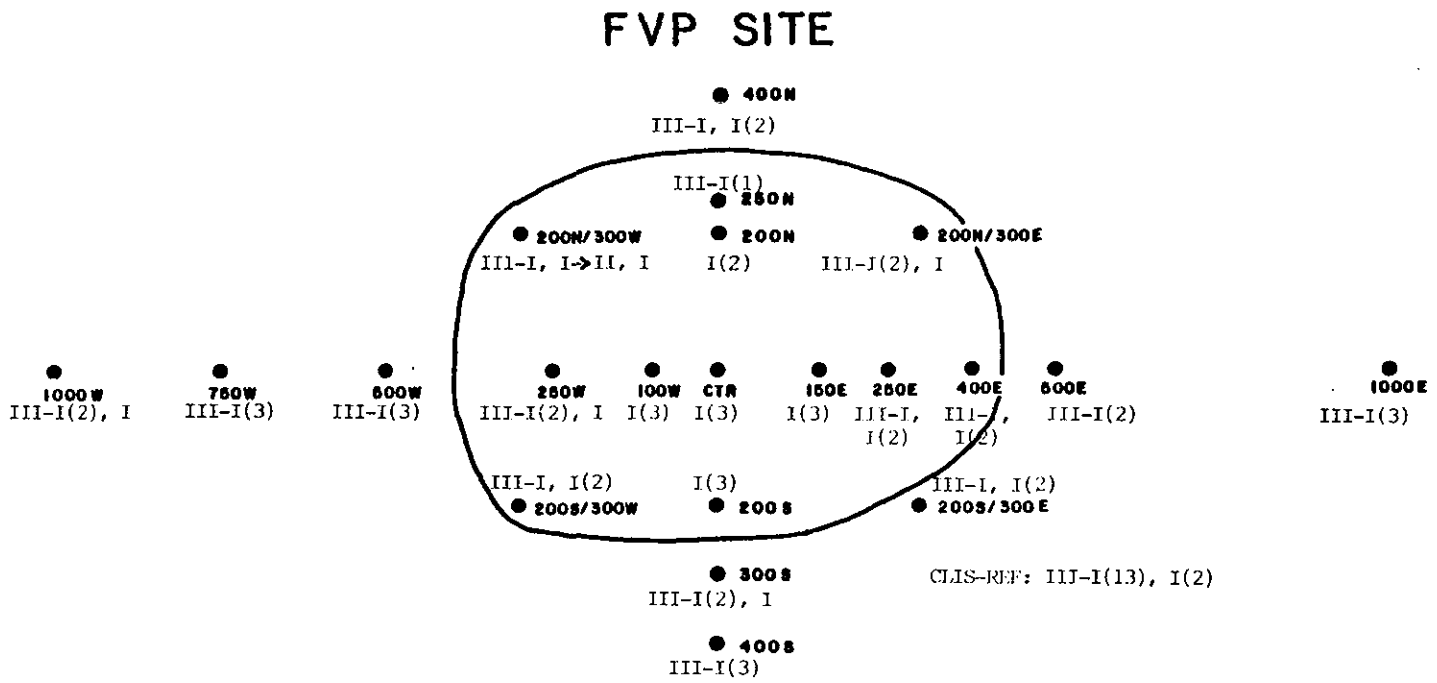


Figure 3-7. The mapped distribution of infaunal successional stages at the FVP site.

fauna has decreased significantly on the mound ($p = .0117$, chi-square test), and has not significantly changed through the rest of the FVP site ($p > .3$, chi-square test).

It has been pointed out in previous FVP reports that the presence of feeding voids at depth is an important criterion for identifying Stage III fauna. As infaunal feeding rates decrease with decreasing water temperatures in winter, feeding voids can collapse, giving the impression that no head-down feeders are present. The most accurate characterization of Stage III faunal abundances is therefore achieved during the warmer months. Collapsed voids were visible in the sediment in December; because a collapsed void is indicative of recent head down feeding activity, REMOTS images with such features were given a Stage III designation. As winter progresses, it becomes increasingly difficult to discern collapsed voids: in the present survey such relict voids are rarely seen.

In December, the abundance of Stage III fauna on the main disposal area was for the first time comparable to their abundance on the surrounding seafloor. In the March survey, the abundance of Stage III fauna is once again significantly lower on the mound than on the surrounding seafloor. More active voids are seen at edge and ambient stations than on the mound, whereas in December approximately the same number of replicates from each area showed the presence of open voids (42% for edge and ambient; 41% for mound). The reason for the present discrepancy in the number of Stage III seres on and off the mound is unclear. It may reflect a delay in the resumption of macrofaunal activity on the mound versus the adjacent seafloor. Future REMOTS surveys should help to resolve this issue.

The mapped distribution of REMOTS benthic indices is shown in Figure 3-8. Benthic indices on the mound are significantly lower than those for the rest of the FVP site ($p < .01$, Mann-Whitney U-test), reflecting the smaller number of stage III seres seen on the mound.

Figure 3-9 shows the frequency distributions of benthic index values for the three areas surveyed. The major modal benthic index value for CLIS-REF and edge and ambient stations is 11. The index values for these regions have not changed significantly since December ($p > .05$, Mann-Whitney U-test). Mound stations show a bimodal distribution of benthic index values, with a major mode at 7 and a minor mode at 11. The index values for this area have decreased significantly since December ($p = .0158$, Mann-Whitney U-test), reflecting the decrease in numbers of Stage III fauna observed on the mound.

3.3 Summary and Conclusions

This REMOTS survey was done 22 months after disposal of Black Rock Harbor dredged materials at the FVP site. The areal distribution of dredged material is comparable to that described in earlier FVP reports. Sediment grain-size also remains

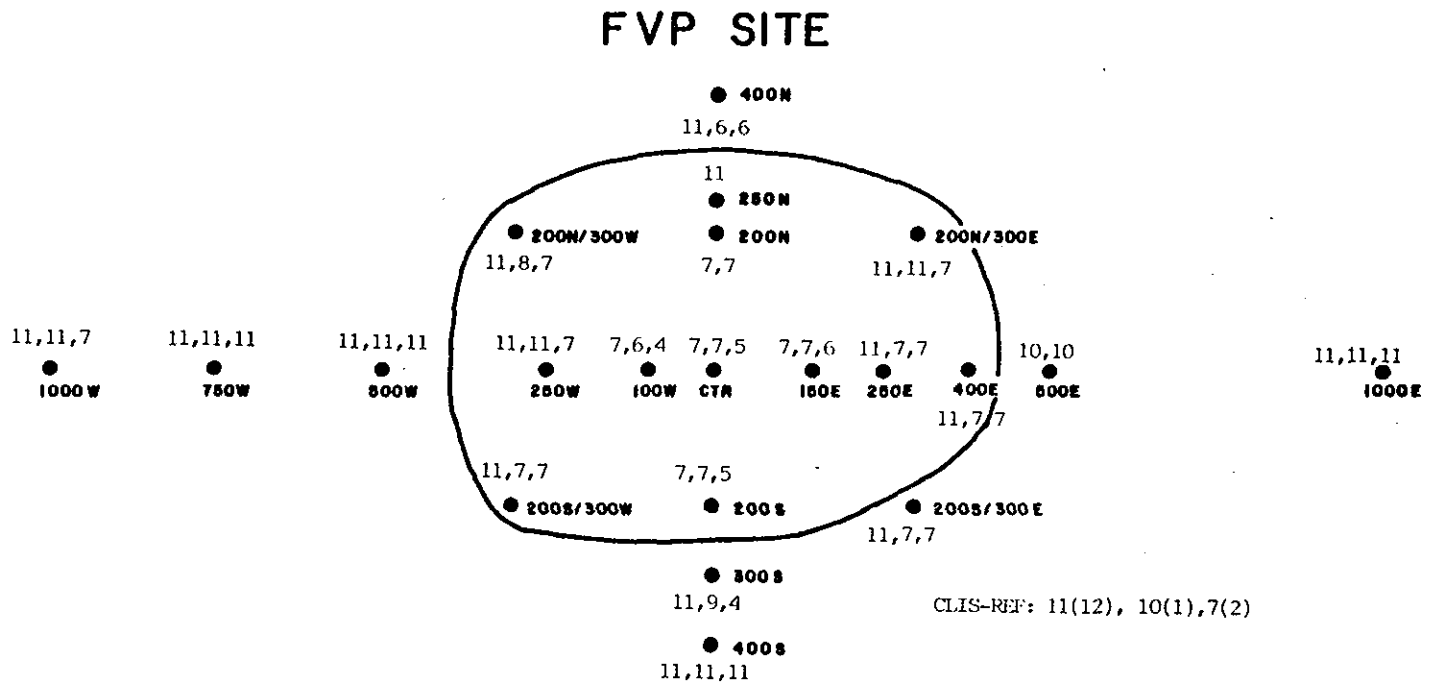
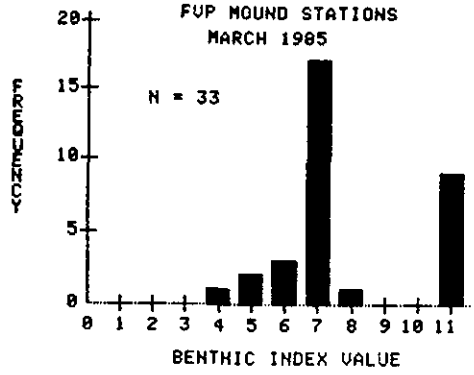
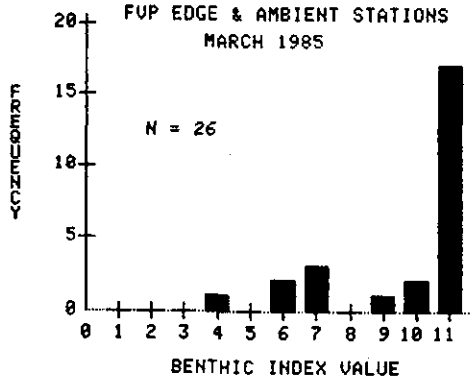


Figure 3-8. The mapped distribution of benthic indices for all replicates in the March survey.





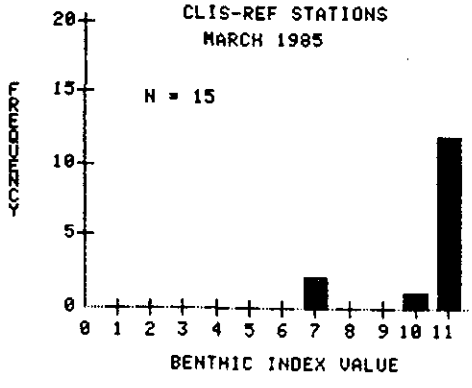


Figure 3-9. Benthic index frequency distributions for the on-mound, edge and ambient, and CLIS-REF stations.

unchanged, with the major mode being > 4 phi (silt). A lag deposit of fine sand is observed at station CTR; the fine sediment fraction at the surface apparently has been removed by current washing and sorting.

Small-scale surface boundary roughness is uniform throughout the survey site (mound stations, edge and ambient stations, and CLIS-REF). Surface boundary roughness has remained constant since the beginning of 1984.

In this survey, for the first time, large quantities of plankton bloom-derived floccular material are seen at the sediment-water interface. The material is distributed over the entire site, and represents a high input of organic carbon into the sediment.

The apparent depth of the RPD (depth to which bioturbation and diffusion supply oxygenated seawater to pore waters) at the mound is similar to the RPD depth at the edge and ambient stations. The mean RPD values at the edge and ambient stations have become significantly shallower since the December, 1984 survey, while values at the mound have remained the same. The major modal RPD depth at CLIS-REF increased from an anomalously low 2.0 cm in December to 5.0 cm in March.

Stage III seres are significantly more abundant at edge and ambient stations (77% of the replicates) than on the mound (27% of the replicates). This represents a change from December, 1984, when the abundance of Stage III seres recorded on the main disposal area was for the first time comparable to the abundance recorded on the surrounding seafloor.

The REMOTS benthic indices at the on-mound stations are lower than those at edge and ambient stations, reflecting the smaller number of Stage III seres observed on the mound. Index values for edge and ambient stations and for CLIS-REF have not changed since December 1984; depressed benthic indices at mound stations relative to the December survey result from the fewer Stage III fauna seen in that region.

4.0 REFERENCES

Conover, S.M. 1956. Oceanography of Long Island Sound, 1952-1954. IV. Phytoplankton. Bull. Bingham Oceanogr. Coll. 15:62-112.

Riley, G.A. 1956. Oceanography of Long Island Sound, 1952-1954. IX. Production and utilization of organic matter. Bull. Bingham Oceanogr. Coll. 15:324-344.