Monitoring Cruise at the Portland Disposal Site
January 1989

Disposal Area Monitoring System DAMOS

Contribution 78
September 1990

US Army Corps of Engineers
New England Division

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	September 1990	Final Report

4. TITLE AND SUBTITLE
Monitoring Cruise at the Portland Disposal Site
January 1989

5. FUNDING NUMBERS

6. AUTHOR(S)

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Science Applications International Corporation
221 Third Street
Newport, RI 02840

8. PERFORMING ORGANIZATION REPORT NUMBER

SAIC-89/7560 & C80

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U.S. Army Corps of Engineers - New England Division
424 Trapelo Road
Waltham, MA 02254-9149

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

DAMOS Contribution No. 78

11. SUPPLEMENTARY NOTES

Available from DAMOS Program Manager, Regulatory Division
USACOE-NED, 424 Trapelo Road, Waltham, MA 02254-9149

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

Field operations were conducted between January 23rd and 30th 1989. The objective of this survey was to determine acoustically the portion of the disposal mound greater than 30 cm thick and delineate with REMOTS® the extent and thickness of dredged material not detectable with bathymetry. In addition REMOTS® photography was used to observe the status of benthic colonization on and near the mound.

Though the REMOTS® was more sensitive than bathymetry in detecting the presence of dredged material, it is important to note that REMOTS® may also have underestimated the extent of disposed material. Of 43 stations sampled, 9 had either hard or irregular bottom characteristics that made it impossible to obtain sediment-profile photographs. Dredged material which might have been deposited among the rocks was therefore not detected.

The majority of the stations sampled had evidence of significant recolonization of the disposed material with head-down, deposit feeding taxa. The presence of Stage III organisms at 92% (43 of 47) of the disposal site stations sampled indicates a very healthy, functioning benthic community which is similar to nearby reference stations. Because of the relatively low volume and wide dispersal of material disposed over a long period of time, indigenous fauna apparently have been able to recolonize most of the affected area within the site.

14. SUBJECT TERMS
Portland disposal site
dredged material
sediments
REMOTS
sediment profile photography
bathymetry

15. NUMBER OF PAGES
26

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified			

TABLE OF CONTENTS

LIST OF FIGURES

1.0 INTRODUCTION

The Portland Disposal Site is located in Bigelow Bight approximately 7.1 nautical miles east of Cape Elizabeth, Maine (Figure 1-1). It is a one nautical mile square with sides running true north-south and east-west, centered at 43° 4.1' N, 70° 02.0' W. The center area has a maximum depth of 60 meters; it is surrounded by hard rock ridges which shoal up to 48 meters.

Dredged material disposal began at the Portland site in 1979. Initial disposal occurred at a taut-wire moored buoy located at 43° 34.11' N, 70° 01.91' W. This buoy was the location for specific disposal operations until its removal in 1984. For the last five years, disposal has taken place at a conventionally moored buoy presently located 350 meters north of the taut-wire buoy location (Figure 2-1).

Previous monitoring at the Portland Disposal Site under the DAMOS program has included bathymetric and sidescan surveys, sediment and benthic sampling, and direct observation in a manned submersible; the last DAMOS monitoring survey took place five years ago in May 1984 (SAIC, 1984). Since that time, an estimated total of 46,000 m^3 of dredged material has been deposited.

Field operations were conducted between January 23rd and 30th 1989. The objective of this survey was to determine acoustically the portion of the mound greater than 30 cm thick and delineate with REMOTS® the extent and thickness of dredged material not detectable with bathymetry. In addition REMOTS® photography was used to observe the status of benthic colonization on and near the disposal mound.

2.0 METHODS

2.1 Navigation and Bathymetry

Navigational control was provided by the SAIC Integrated Navigation and Data Acquisition System (INDAS). A comprehensive description of this system is available in DAMOS Contribution #48 (SAIC, 1985). Microwave trisponders were positioned in Maine at the Cape Elizabeth Light and Portland Head Light shore stations (SAIC, 1985). These shore stations were the same ones used during the 1984 survey, to ensure accurate comparisons.

Depth measurements were calculated and digitized by an Odom Echotrac® model DF3200 survey fathometer using a 200 kHz transducer. An Applied Microsystems® CTD was used at the start of the survey to determine the speed of sound; this value was later used to calibrate recorded depths during bathymetric analysis. A detailed description of this procedure is provided in DAMOS Contribution #48 (SAIC, 1985).

The original survey grid of 900 m x 900 m used in the 1984 survey was enlarged to 900 m x 1100 m to encompass potential dredged material north of the present buoy location (Figure 2-1). Forty-five lanes were surveyed, oriented east and west with 25 m lane spacing, overlaying the 1984 survey track and continuing an additional 200 m north. The survey grid covered the positions of both the 1984 and present buoy locations.

Analysis of the bathymetric data was conducted immediately after completion of the survey to determine the extent of deposited dredged material and to finalize the REMOTS® sediment profile sampling grid. All depth values were converted to Mean Low Water after compensating for vessel draft and tidal fluctuations that occurred while surveying. During this procedure, position and depth data were checked to identify and eliminate any outlying values before producing an accurate contour plot.

2.2 REMOTS® Sediment Profile Photography

The 1989 survey marks the first time REMOTS® photography was used at the Portland Disposal Site. The sediment profile camera was used to complement the bathymetric data and identify areas with thin layers (1-20 cm thick) of dredged material. REMOTS® also was used to monitor the status of benthic colonization at and adjacent to the disposal mounds. An in-depth description of REMOTS® operation, analysis, and interpretive rational is found in DAMOS Contribution #60 (SAIC, 1989).

The REMOTS® survey grid was centered at the present disposal buoy. A cross-shaped sampling pattern was established with stations at 50 m, 100 m, 150 m, 200 m, 300 m, 400 m, and 500 m north, east, south, and west from the center, with additional stations in each quadrant at 100 m, 200 m, and 300 m, northeast, southeast, southwest, and northwest of center. After identification of the old disposal mound with bathymetry, two additional stations at 250 m and 350 m south were added (Figure 2-2). At each of the 43 stations, an attempt was made to acquire three replicate sediment-profile photographs.

In addition to the disposal site, three reference stations were occupied. One (REF-84) was an existing reference station located southeast of the disposal site in about 90 m of water at coordinates 43° 32.802' N, 70° 00.193' W. The other two reference stations (S-REF and E-REF) were established after analysis of bathymetry and sediment grab samples showed these locations to have water depth and sediment texture similar to the disposal site (Figure 2-2). Station S-REF was located south of the disposal site in 60 m of water at coordinates 43° 33.346' N and 70° 01.753' W; station E-REF was east of the disposal site in 70 m of water at coordinates 43° 34.429' N and 69° 59.732' W. One photograph was

taken at each of thirteen stations in a cross-shaped grid at each reference area.

3.0 RESULTS

3.1 Bathymetry

The bathymetric survey identified the existing mound at the former taut-wire buoy location, and a mound-like structure at the current disposal buoy location (Figure 3-1). Previous bathymetric surveys conducted in 1979, 1980, and 1984 had ended with their northern boundary at the current disposal point; however, they all have shown shallower depths in this area. Depth difference calculations revealed no change in bottom topography at the former taut wire buoy location and no visible differences from the 1984 survey elsewhere in the disposal area (Figure 3-2).

3.2 REMOTS® Sediment-Profile Photography

It was impossible to obtain REMOTS® photographs at several stations because they had such irregular, hard bottom which prevented camera prism penetration (Figure 3-3). The REMOTS® camera is activated when the prism is lowered below the base frame; any bottom projections (such as rocks) that come up though the frame and block prism travel will prevent the camera from firing. At other stations, three to five camera lowerings produced one or more photographs, but they did not show sediment penetration, again indicating hard or irregular bottom.

Recently deposited dredged material covered a circular area centered at the present buoy location and having a diameter of roughly 500 - 600 meters (Figures 3-4 and 3-5). Relict dredged material was evident beyond this area to the east, south, and west (Figure 3-6). Relict dredged material with overlying "fresh" material was visible at several stations scattered throughout the mound. Only a few stations at the outer edges of the REMOTS® sampling grid had no dredged material (Figure 3-7).

Silt-clay (4 phi) was the most prevalent sediment grain size at the disposal site and at all three reference stations. Stations 150, 200, 250, and 300 south all had very fine sand to silt clay (4 - 3 phi) as the major mode. These stations bracket and extend slightly north of the 1984 disposal buoy area. Similar material was found at the center and north of the present disposal point (Figure 3-8). Sand over mud, and sand/mud/sand stratigraphy existed at many stations scattered across the REMOTS® grid, with gravel visible at four stations (150W, 150N, 300N, and 100S).

There was no discernable difference in the frequency distributions of boundary roughness values at the disposal site and the reference stations (Figure 3-9).

Mean apparent Redox Potential Discontinuity (RPD) depths range from zero to 4.3 cm at the disposal site stations where dredged material was present with the average at 1.5 cm (Figure 3-10). Stations with relatively low RPD values (< 2.25 cm) occurred around the center of the disposal area (Figure 3-11). In contrast, the reference stations had significantly greater RPD depths.

Infaunal successional seres present at the disposal site included Stage I, Stage I on III, and Stage III (Figure 3-12). All stations except 50m south and east had at least one replicate photograph with Stage III organisms. Even though there were Stage I taxa present at two of the reference areas (REF 84 and E-REF) Stage III taxa also dominated the areas outside the disposal site.

The Organism-Sediment Index (OSI) values for the disposal stations were significantly lower than the values for the reference sites, mean = 7.1 vs. 9.8 (Figure 3-13). This difference was due primarily to the deeper RPD values at the reference areas. Four stations clustered at the center of the disposal site had relatively low mean OSI values (<+6), presumably representing the area most recently disturbed by disposal operations (Figure 3-14).

4.0 DISCUSSION

The main objectives of the survey were to determine the areal extent of dredged material and assess the benthic recolonization of the disposed material. Dredged material ("relict" and "fresh") was identified at 83% (25/30) of the REMOTS® stations, covering a circular area with a diameter of approximately 700m.

The use of REMOTS® photography proved more valuable than bathymetry in identifying the presence of the dredged material. There are several likely explanations for the differential success of the two methods at the Portland site. Based on scow logs, the volume of disposed material since 1984 was relatively small (estimated 46,000 cubic meters). Furthermore, a conventionally moored buoy with a wide watch circle was used to mark the disposal point. Therefore, this small volume of material likely was dispersed over a large area resulting in layers that are too thin to be detected acoustically. A quick check of Loran-C scow positions revealed that disposal occurred as far as 150 m from the current disposal buoy. The majority of these disposal events occurred north and east of the buoy in an area not covered in the 1984 bathymetric survey, preventing depth difference calculations from being performed for the entire area covered with material. Scow logs also revealed that the Coast Guard-maintained disposal buoy was replaced once (possibly twice) since the last survey. If

the buoy was not replaced in exactly the same location, this too would add to the possible increase in the size of the disposal "footprint". Finally, the presence of dredged material is not easily detected with a fathometer at this particular site. The irregular topography surrounded by sharply rising sides makes comparisons with previous surveys difficult and less reliable than at other disposal sites where the regional topography is smoother.

Though the REMOTS® was more sensitive than bathymetry in detecting the presence of dredged material, it is important to note that REMOTS® may also have underestimated the extent of disposed material. As previously indicated, 9 of 43 stations sampled had either hard or irregular bottom characteristics that made it impossible to obtain sediment-profile photographs. Dredged material which might have been deposited among the rocks was therefore not detected.

The majority of the stations sampled had evidence of significant recolonization of the disposed material with head-down, deposit feeding taxa. The presence of Stage III organisms at 92% (43 of 47) of the disposal site stations sampled indicates a very healthy, functioning benthic community which is similar to nearby reference stations. Because of the relatively low volume and wide dispersal of material disposed over a long period of time, indigenous fauna apparently have been able to recolonize most of the affected area within the site.

5.0 REFERENCES

SAIC. 1984. Disposal Area Monitoring System (DAMOS) Annual Report, 1984. DAMOS Contribution #46 (SAIC Report # SAIC-84/7521&C46). US Army Corps of Engineers, New England Division, Waltham, MA.

SAIC. 1985. Standard Operating Procedure Manual for DAMOS Monitoring Activities. DAMOS Contribution #48 (SAIC Report # SAIC-85/7516&C48). US Army Corps of Engineers, New England Division, Waltham, MA.

SAIC. 1989. Seasonal Monitoring Cruise at the New London Disposal Site, July 1986. DAMOS Contribution #60 (SAIC Report # SAIC-86/7540&C60). US Army Corps of Engineers, New England Division, Waltham, MA.

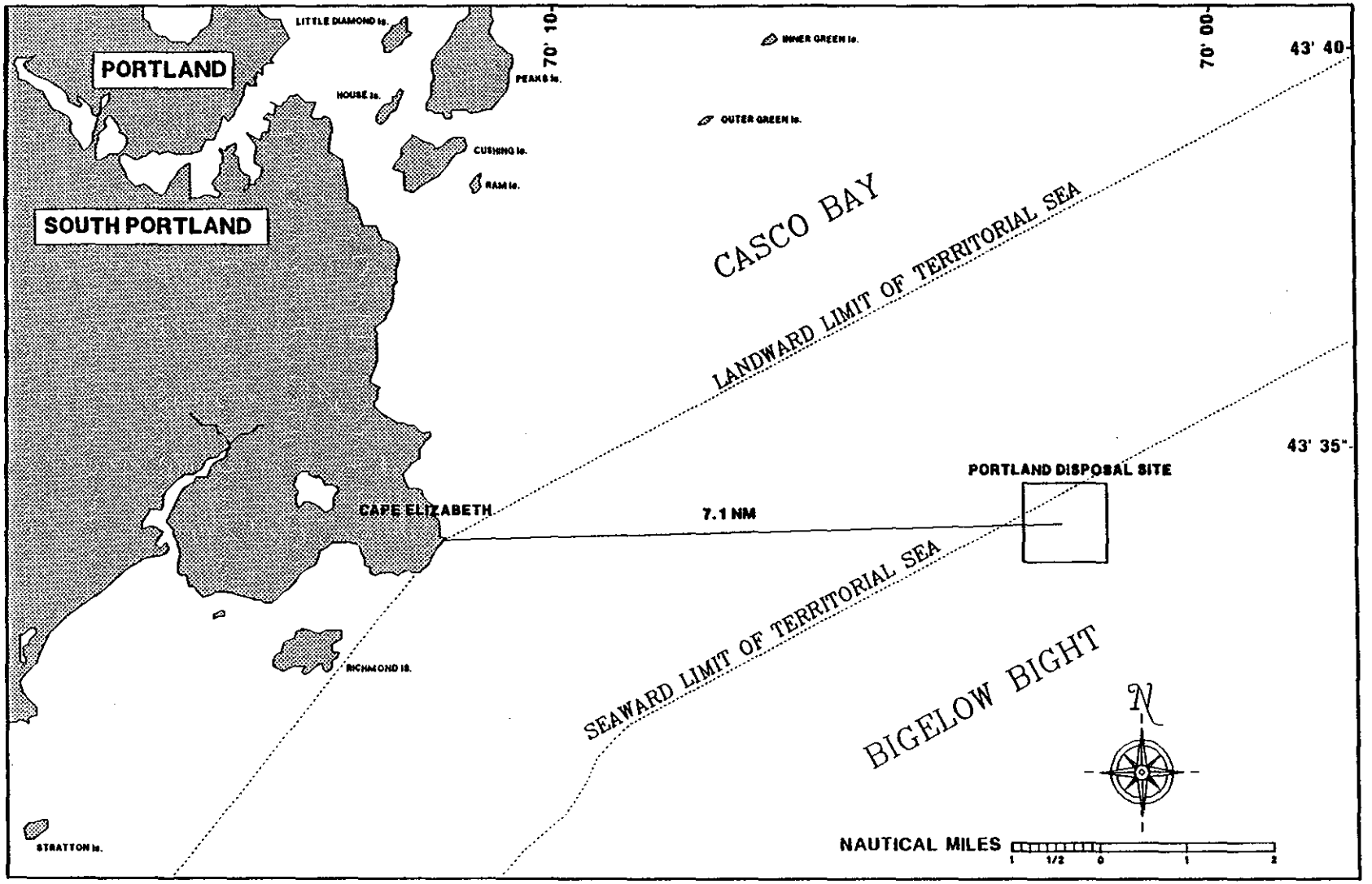


Figure 1-1. General location chart of the Portland Disposal Site.

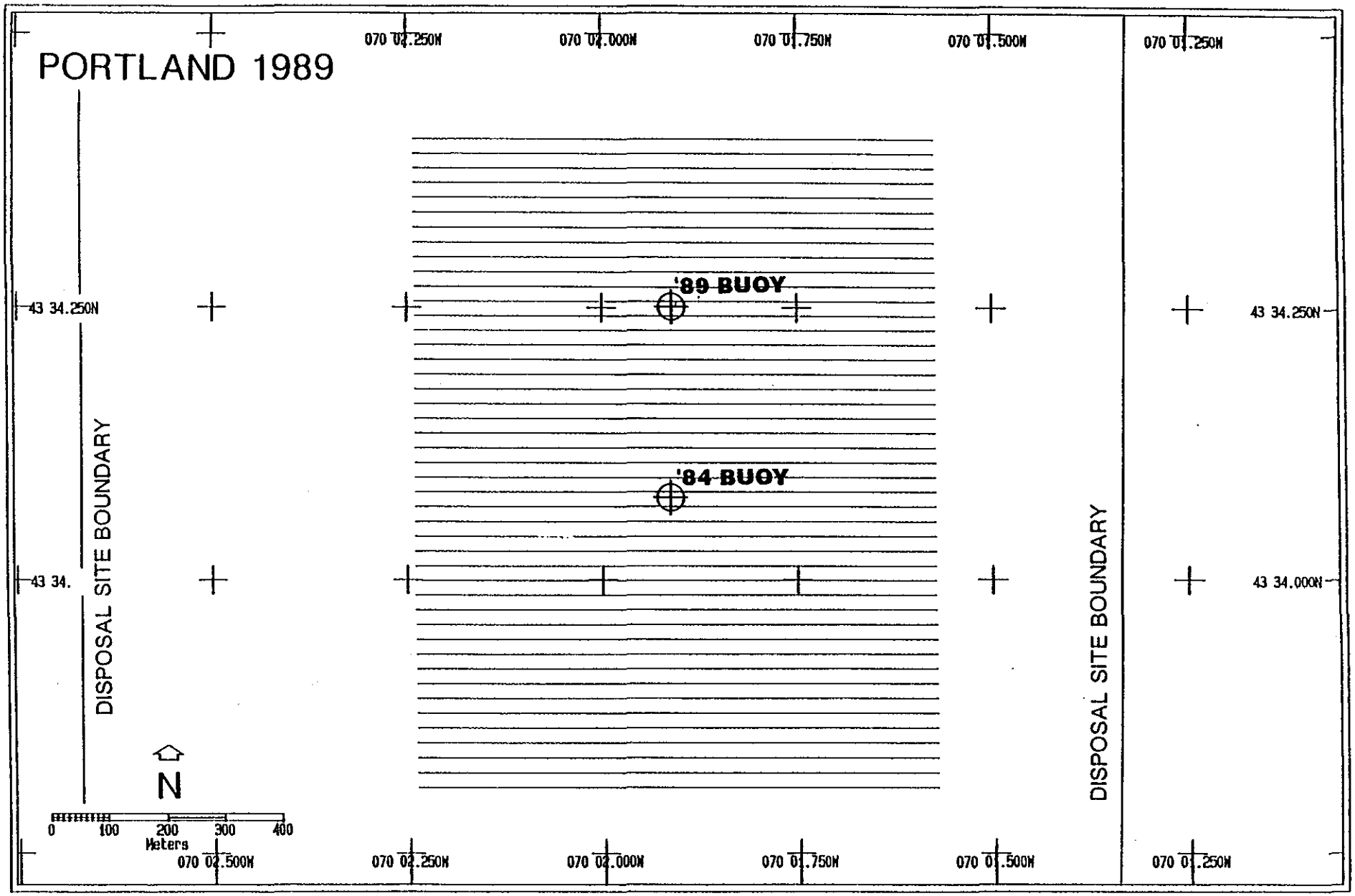


Figure 2-1. Bathymetric survey lanes at Portland, January 1989.

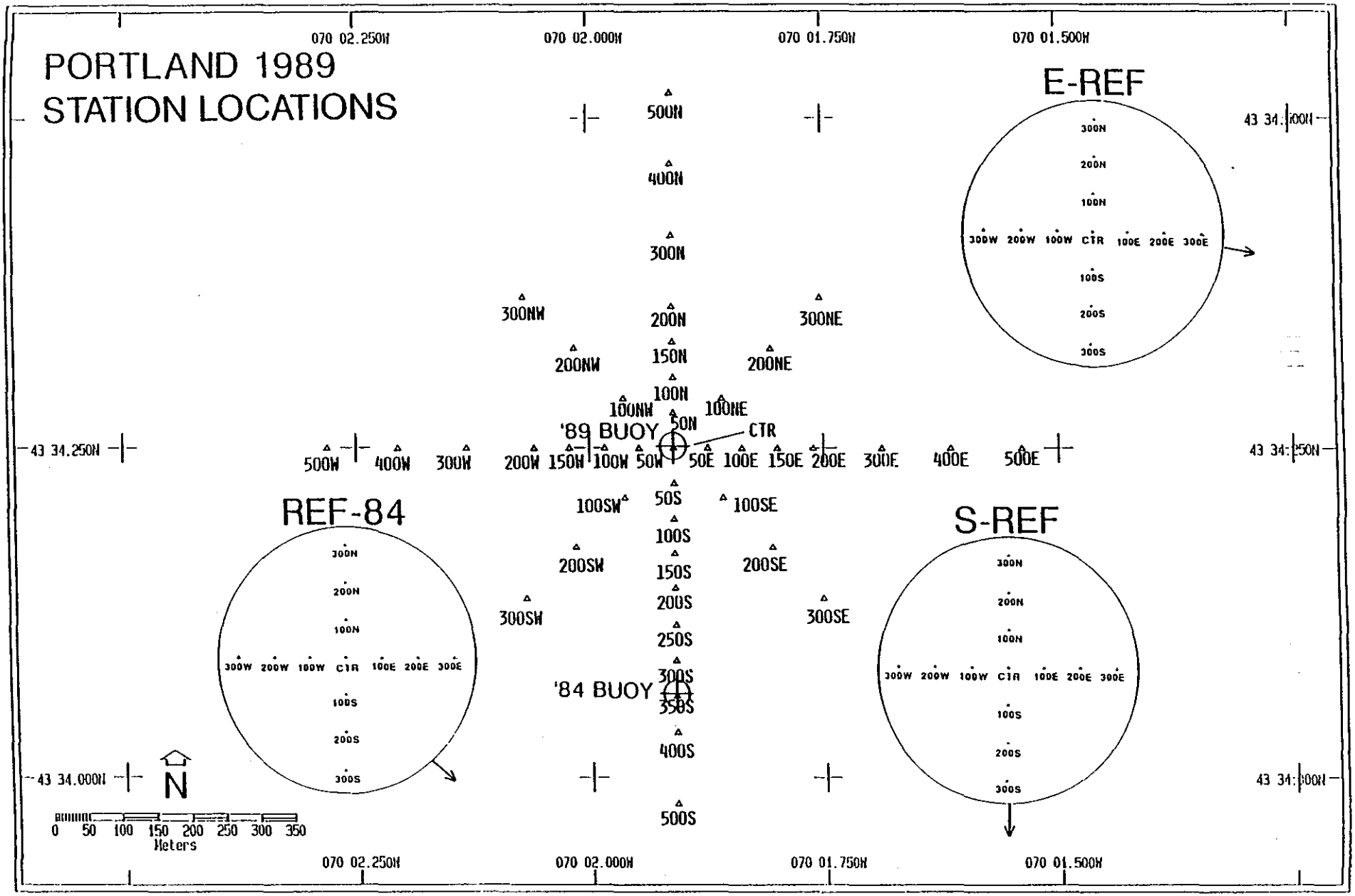


Figure 2-2. Locations and designations of REMOTS® stations occupied at Portland, January 1989.

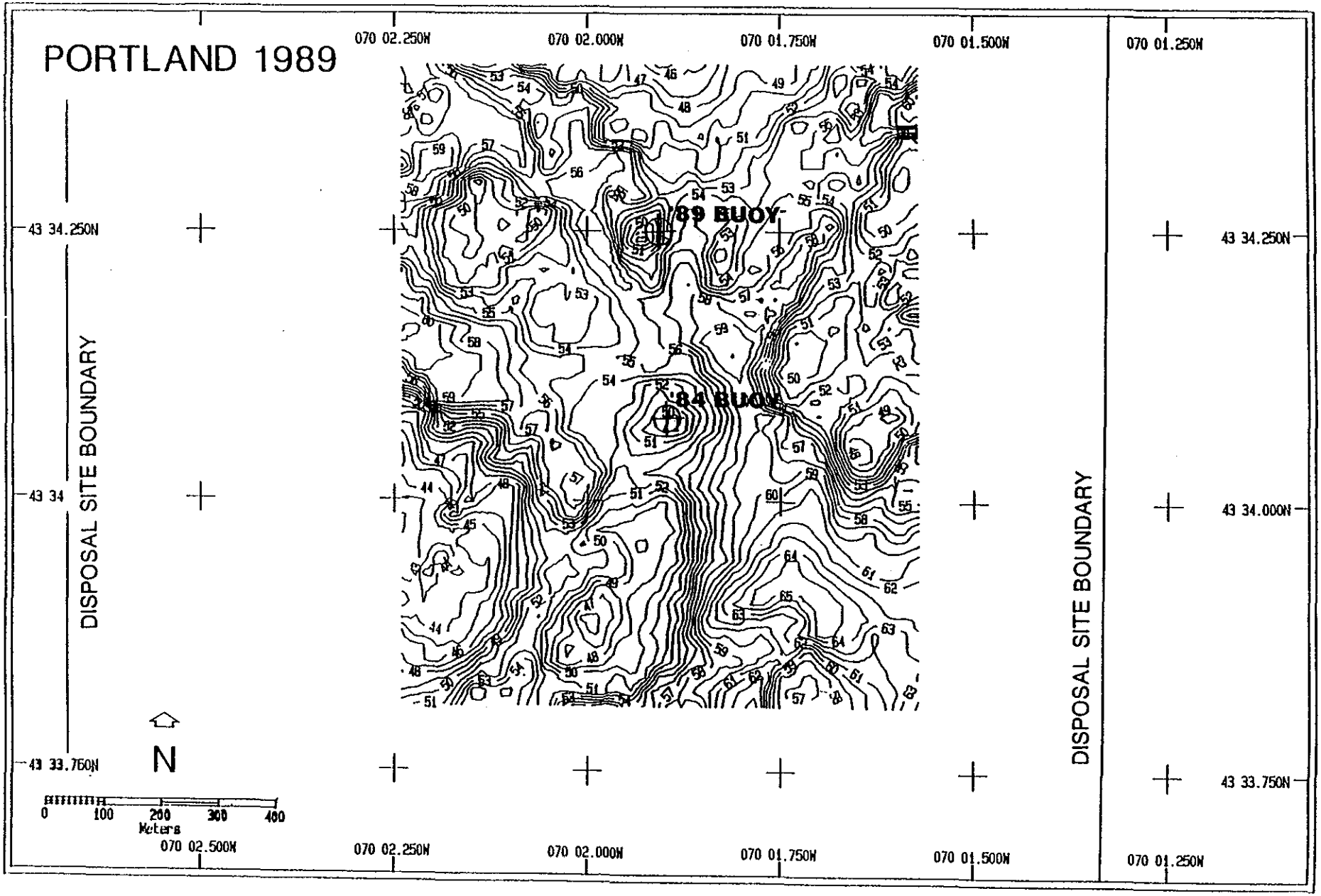


Figure 3-1. Contoured bathymetric chart of Portland Disposal Site, January 1989.

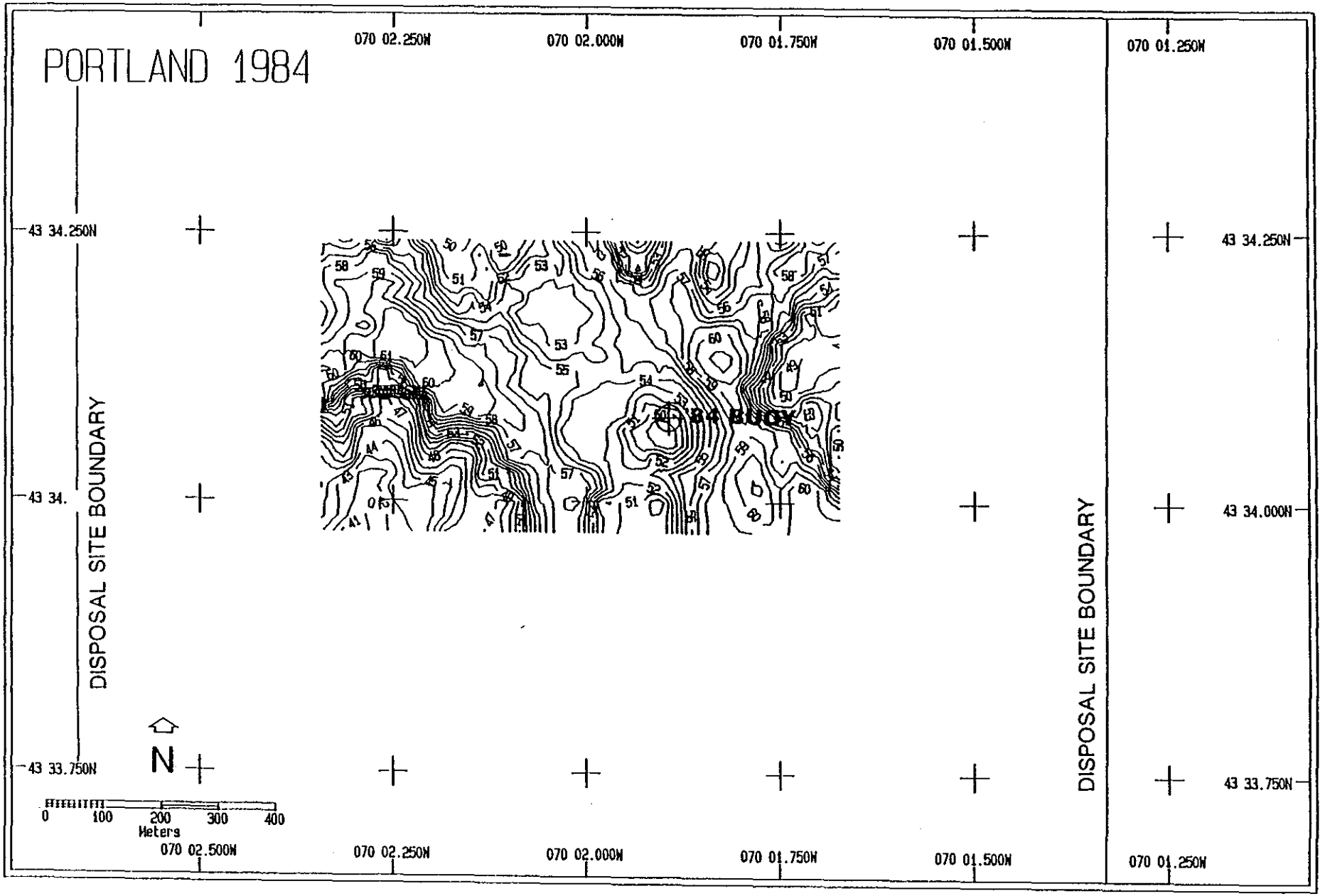


Figure 3-2. Contoured bathymetric chart of Portland Disposal Site, May 1984.

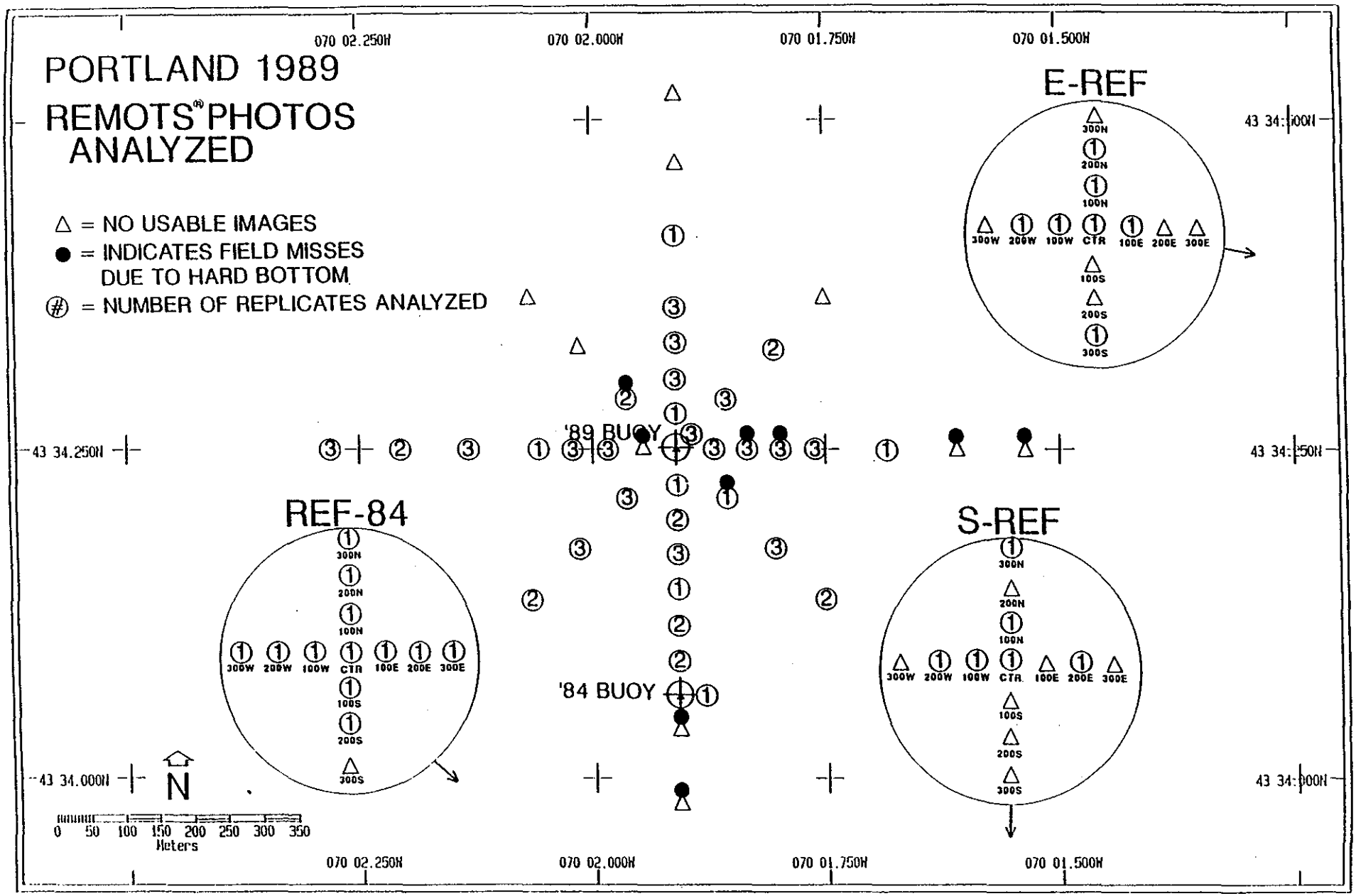


Figure 3-3. Location and number of usable REMOTS® photographs obtained at the Portland site.

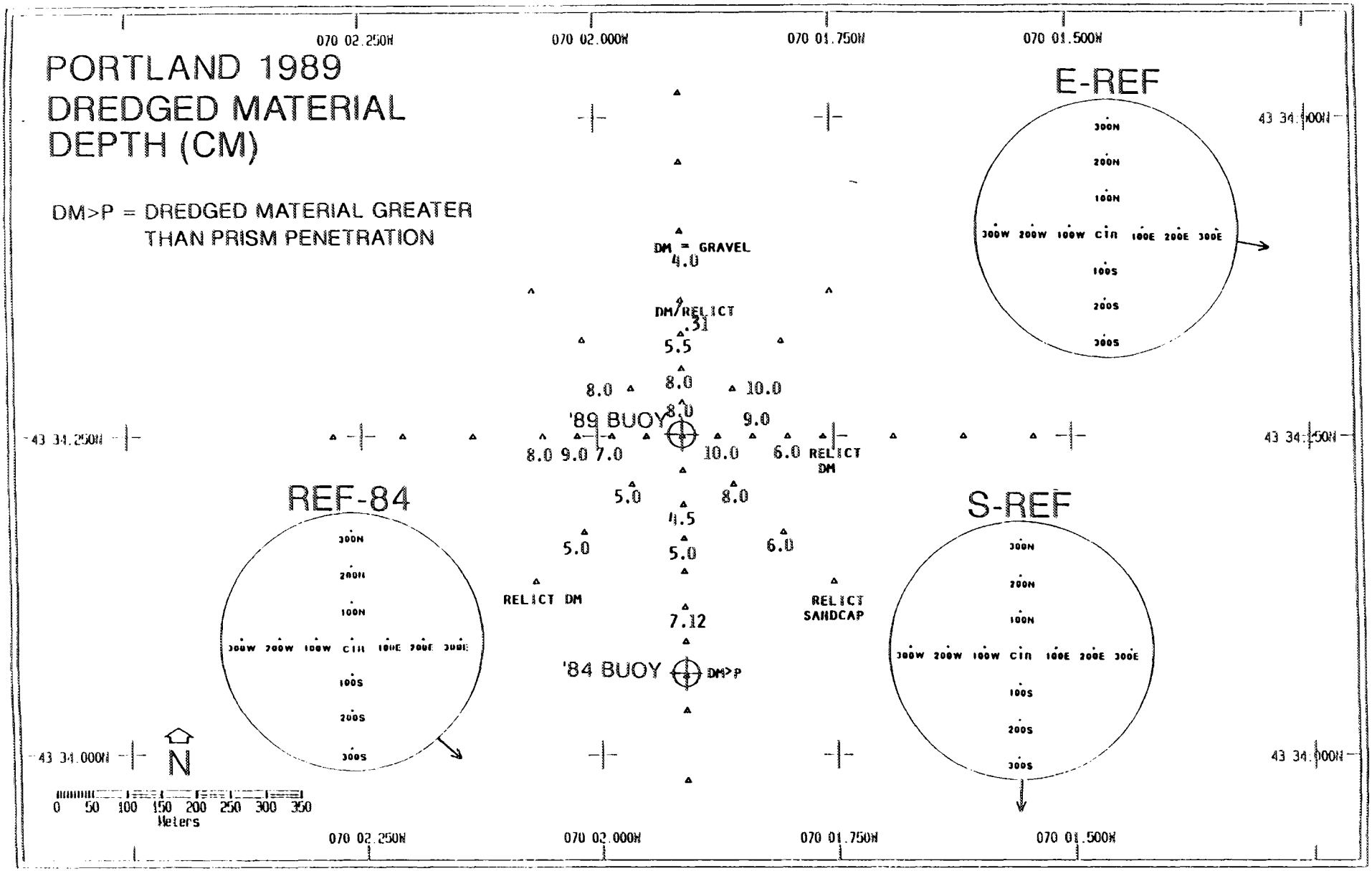


Figure 3-4. Distribution and thickness of dredged material layers at Portland Disposal Site, January 1989.

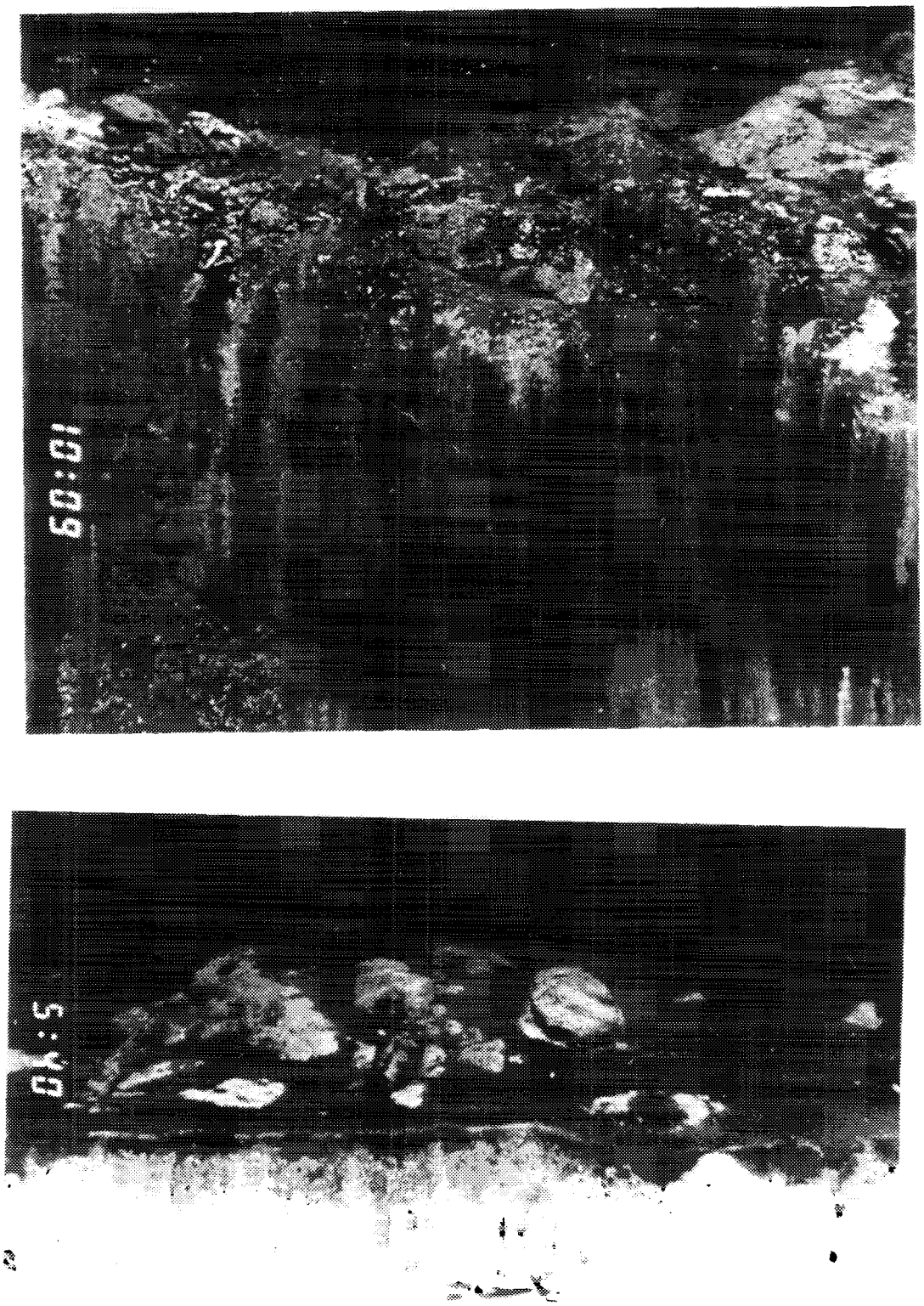
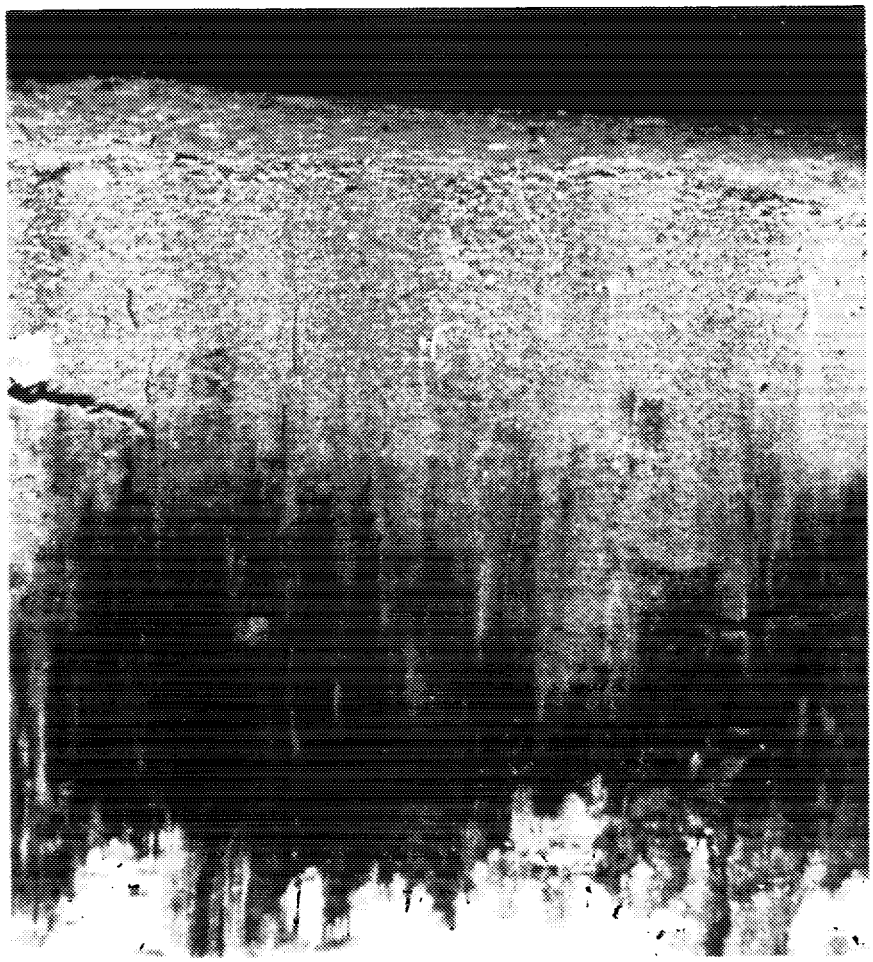
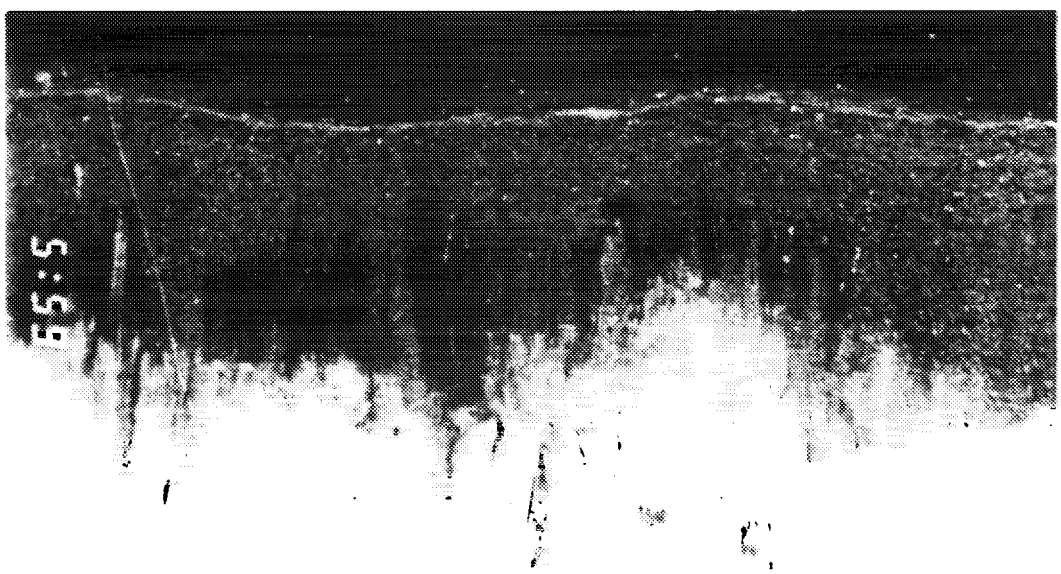


Figure 3-5. Two REMOTS® photos showing recently deposited dredged material at Portland Disposal Site (A = station 100N; B =station 300SE). Note the fine sand deposited on overconsolidated clay.



A



B

Figure 3-6. Two REMOTS® photos illustrating relict (photo A from station 200SW) and recently deposited (photo B from station 100SW) dredged material at the Portland Disposal Site.

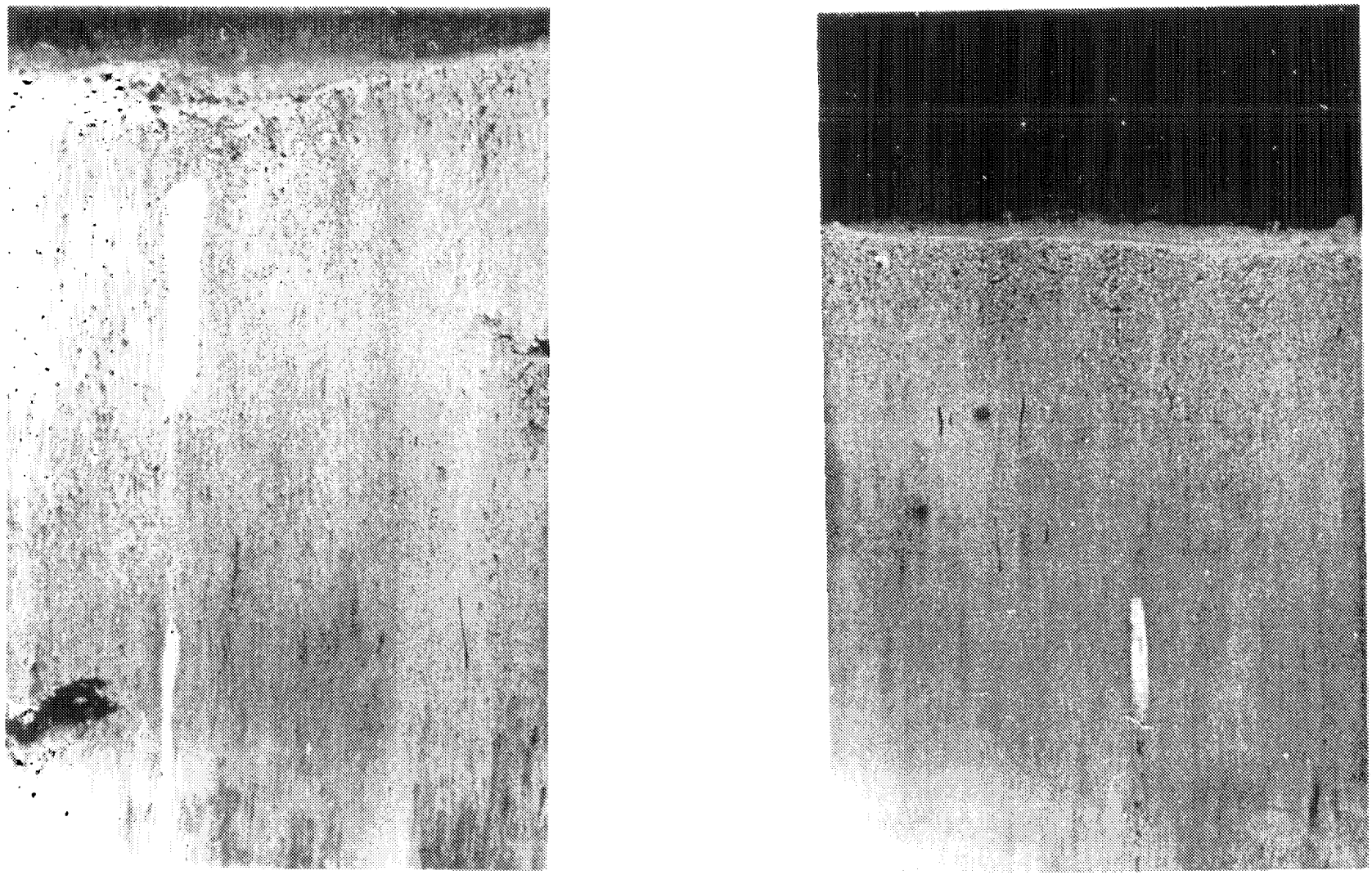


Figure 3-7. Two REMOTS® photos illustrating ambient sediment at Portland Disposal Site. Photo A is from station 300E photo B is from reference station E-REF 100W.

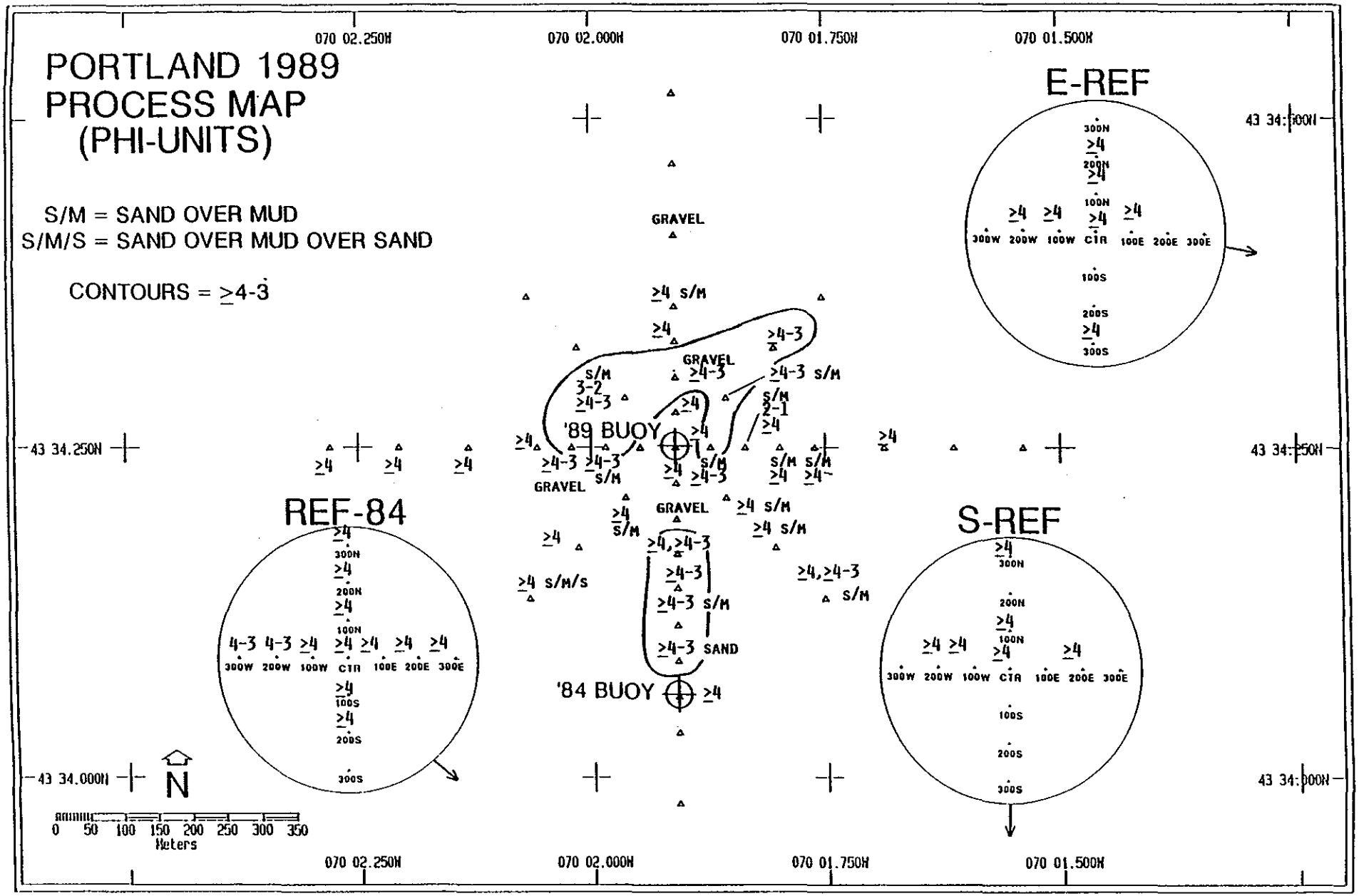


Figure 3-8. Distribution of sediment types at Portland Disposal Site and reference sites, January 1989.

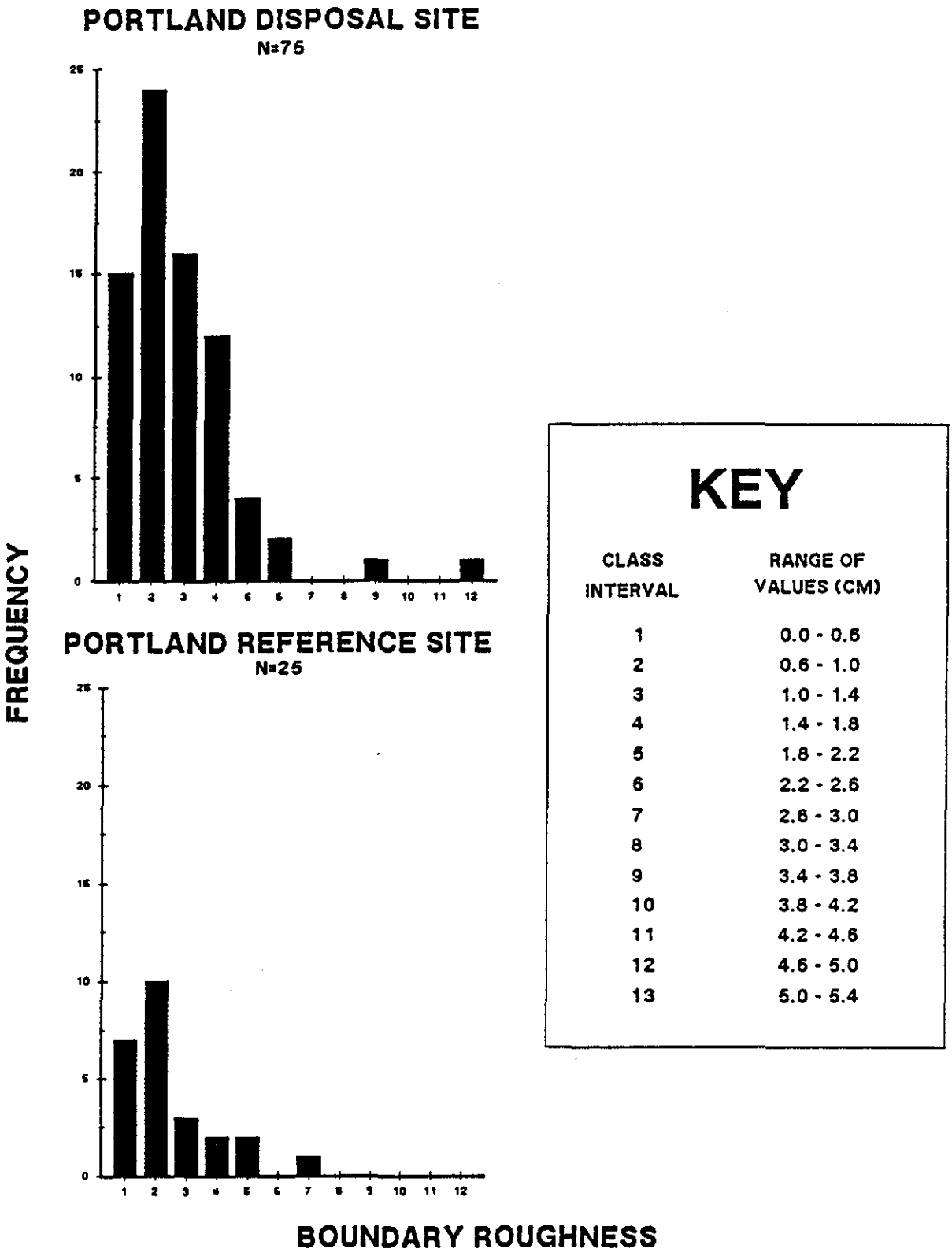


Figure 3-9. Boundary roughness frequency distributions at Portland Disposal Site and reference stations.

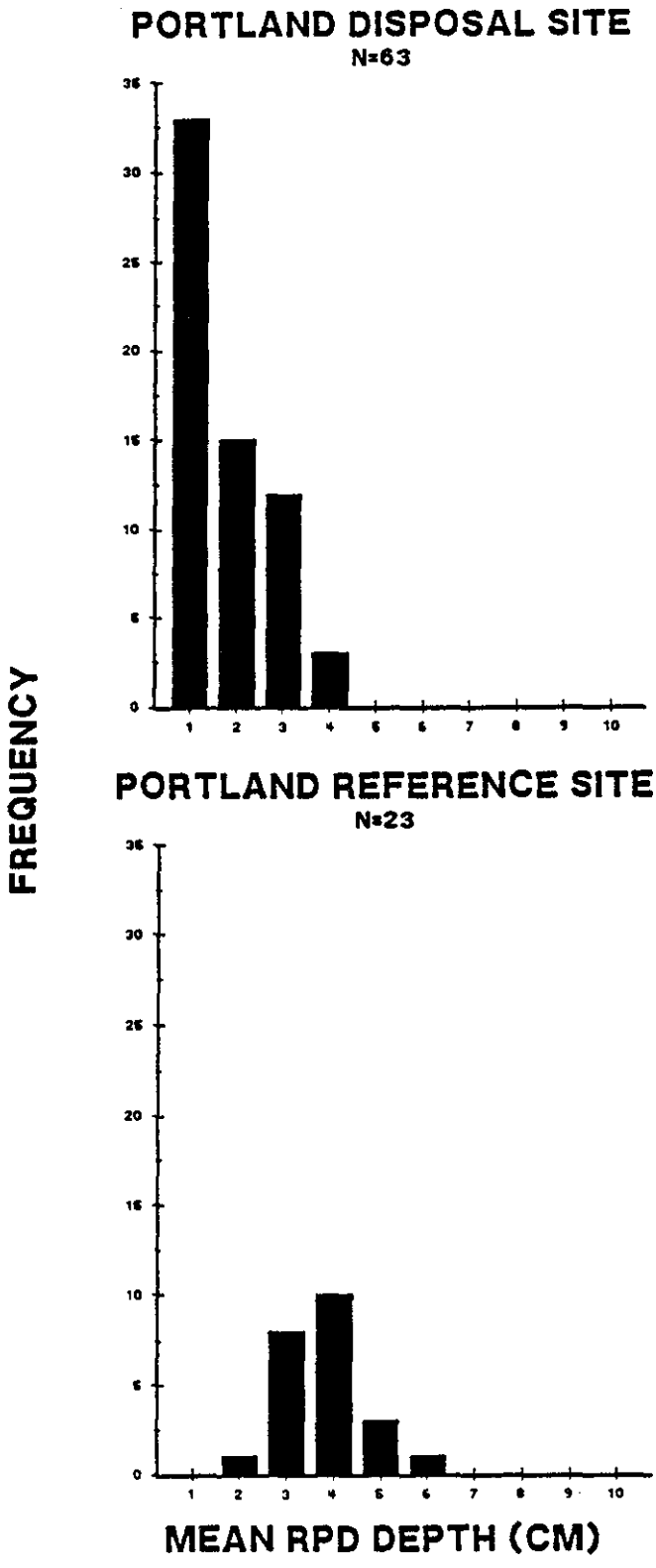


Figure 3-10. Frequency distributions for apparent RPD depths at Portland Disposal Site and reference stations.

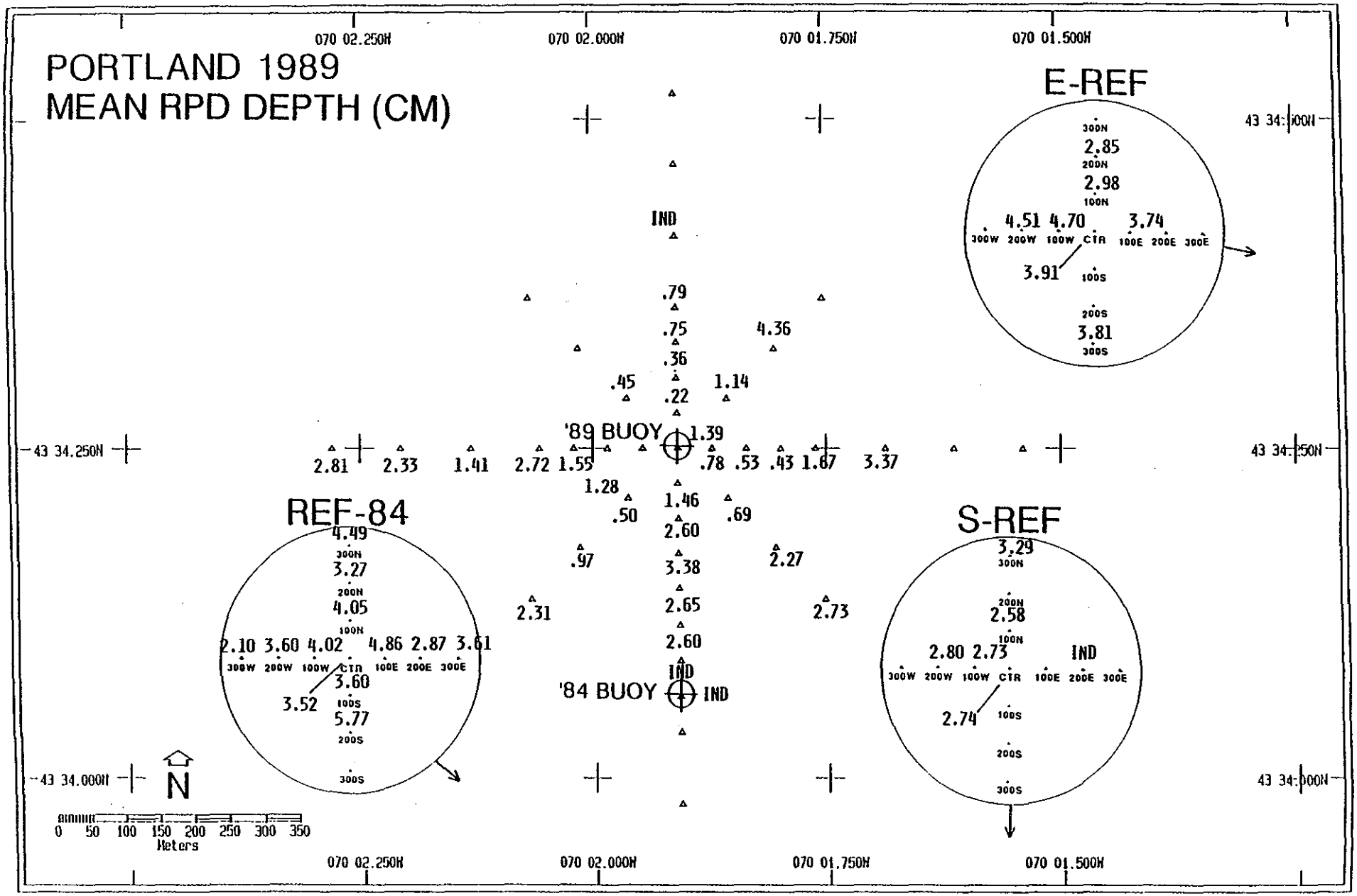


Figure 3-11. Mapped distribution of mean apparent RPD depths at Portland Disposal Site and reference sites, January 1989.

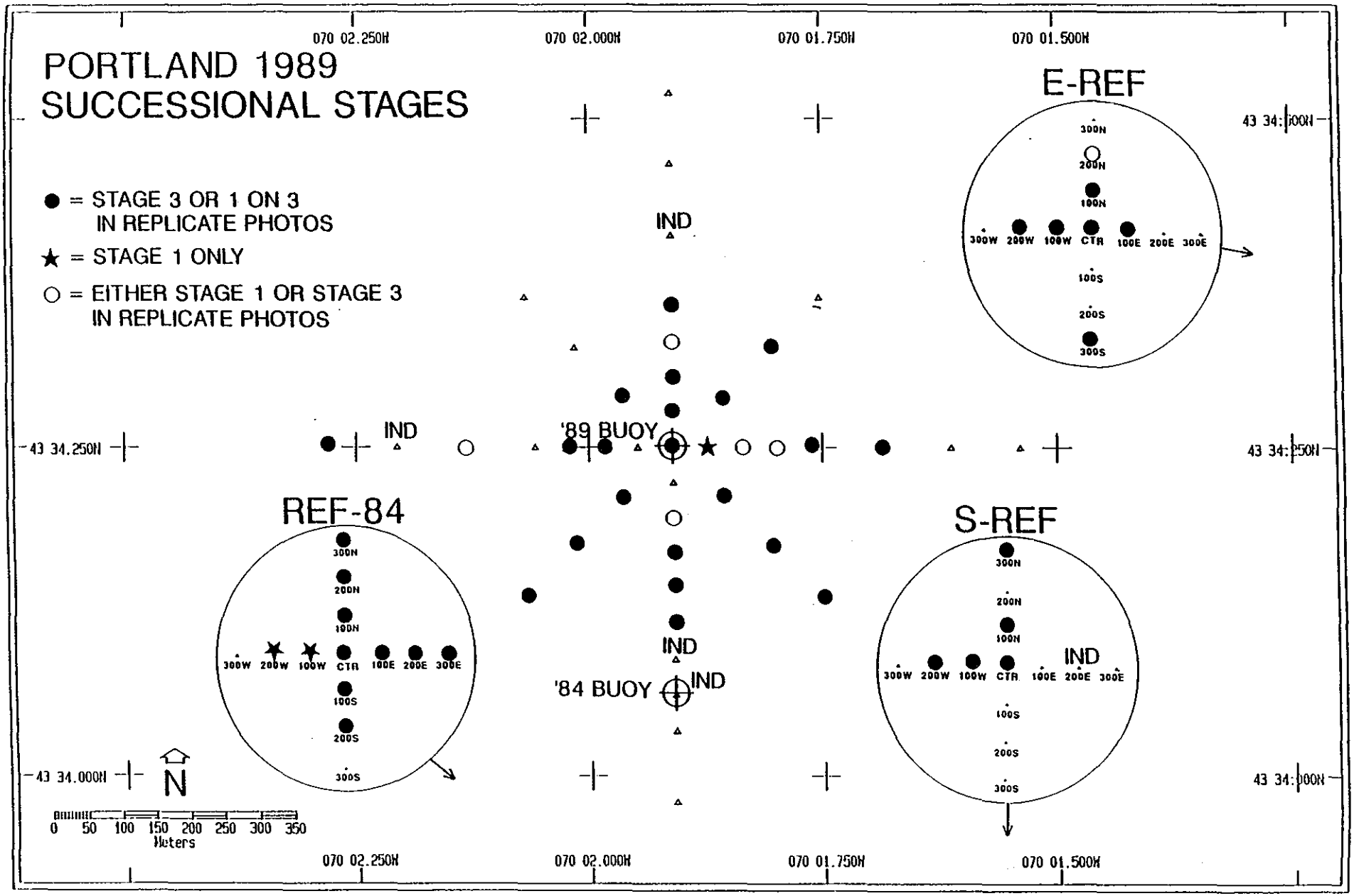


Figure 3-12. Infaunal successional seres present at Portland Disposal Site and reference sites, January 1989.

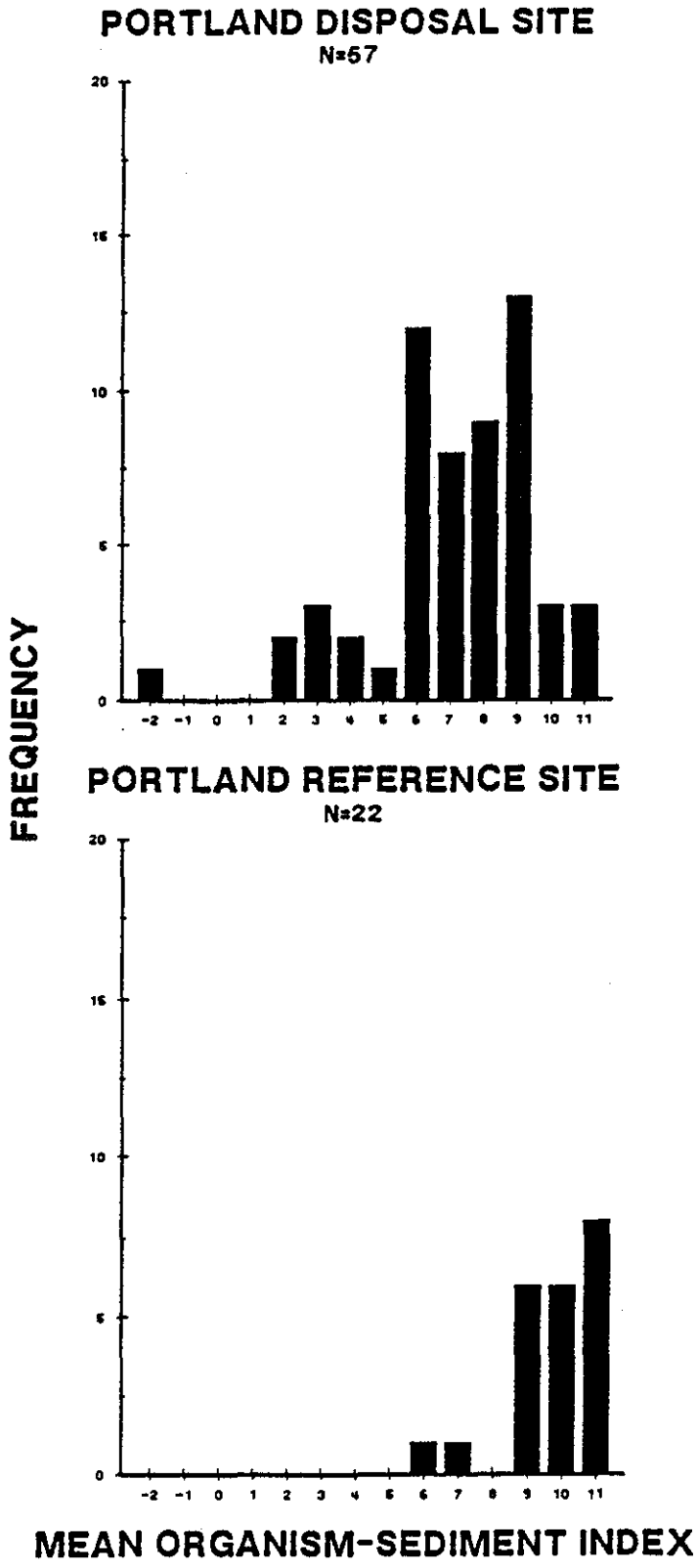


Figure 3-13. Frequency distributions of Organism-Sediment Index values at Portland Disposal Site and reference stations.

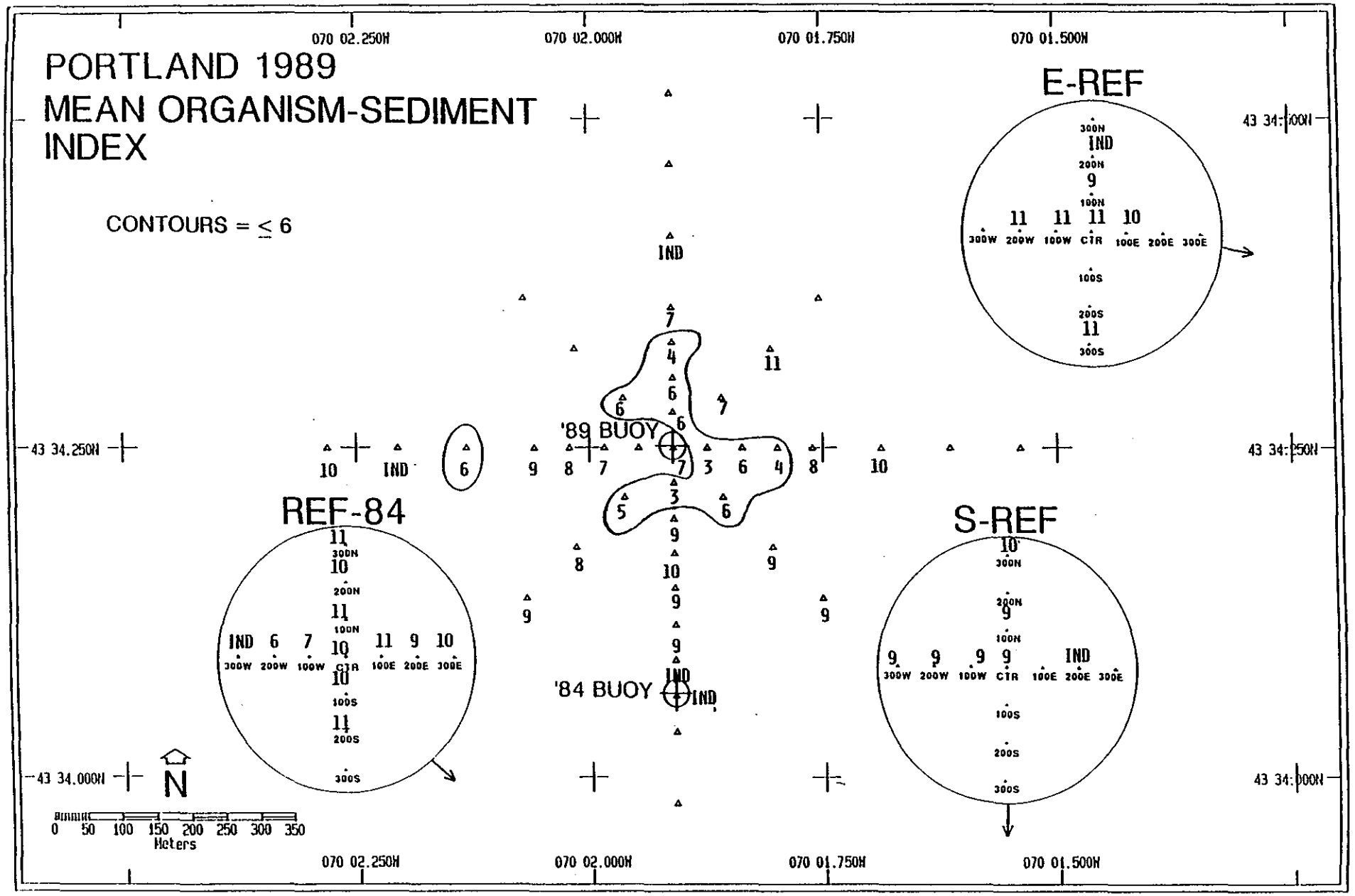


Figure 3-14. Mapped distribution of mean Organism-Sediment Index values at Portland Disposal Site and reference sites, January 1989.