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Formerly GA-4

NEW [redacted] STATE DEPARTMENT OF ENVIRONMENTAL CONSE[redacted]ON

TRANSMITTAL SLIP

TO
Rum Pergadia · Region 3 NYSDEC - New Paltz

FROM
Scott Bedabaugh: Central Office

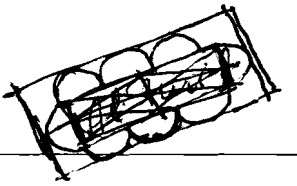
DATE
4/28/88

RE:
Marathon Battery Company Site, ID # 340006

Please find attached one copy of Final Work Plan for the DESIGN of Area I - Marathon Battery. Also please find attached one copy of sampling results from adjacent areas to the Marathon plant building. If you have any questions, call me at (518) 457-1708

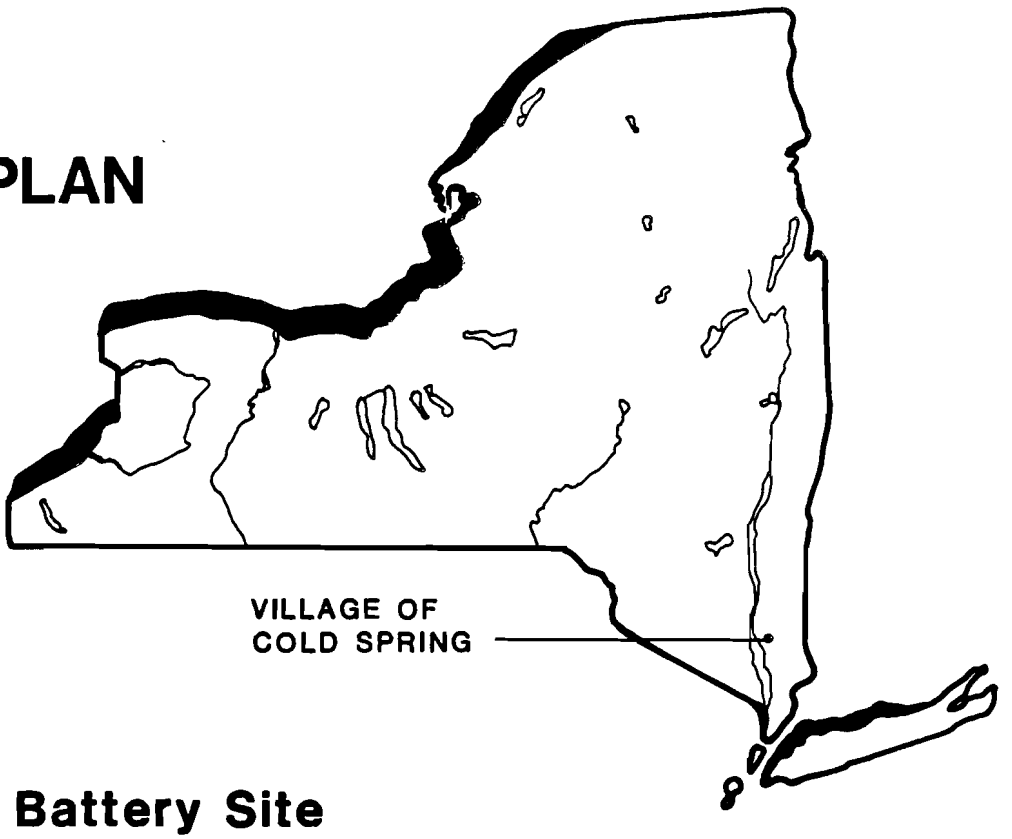
FOR ACTION AS INDICATED:

- ☐ Please Handle
- ☐ Prepare Reply
- ☐ Prepare Reply for _____ Signature
- ☒ Information
- ☐ Approval
- ☐ Prepare final/draft in _____ Copies
- ☐ Comments
- ☐ Signature
- ☒ File
- ☐ Return to me
- ☐ _____
- ☐ _____



WORK PLAN

FINAL



For

Marathon Battery Site
Superfund Remedial Action Design
Cold Spring, New York

August 1988
Project: 0285-24-2

MALCOLM PIRNIE

ENVIRONMENTAL ENGINEERS, SCIENTISTS & PLANNERS

US ARMY CORPS OF ENGINEERS
KANSAS CITY DISTRICT
CONTRACT NO. DACW41-88-C-0039

REMEDIAL ACTION DESIGN
FOR
MARATHON BATTERY SITE

COLD SPRING, NEW YORK

WORK PLAN

AUGUST 1988

NOTES: (1) This work plan is based upon the Engineering Services section of Malcolm Pirnie's contract with the Corps of Army Engineers, Contract No. DACW41-88-C-0039, pages 4-9.

(2) The numbering system for the various tasks corresponds to that used in the contract.

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White Plains, NY 10602

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MARATHON BATTERY REMEDIAL ACTION DESIGN WORK PLAN

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SECTION 1

Introduction

Background

The US Army Corps of Engineers (COE) awarded Contract No. DACW41 - 88 - C - 0039 to Malcolm Pirnie, Inc., on March 23, 1988. The work involves Superfund Remedial Action Design for the Marathon Battery Company Site in Cold Spring, New York. This document provides a work plan for the technical and health and safety aspects of performing field investigations, pilot tests and design activities. This document is required as a Predesign submittal under Task 2, Plans and Management, of the Contract.

The work will necessarily conform with the Selected Remedy specified by the US EPA Regional Administrator in a Record of Decision of 1986. The Record of Decision describes the selected remedy, as follows:

- "Pilot plant treatability study to determine an effective treatment scheme for fixating the contaminated sediments.
- Hydraulic dredging of the contaminated sediments from East Foundry Cove Marsh with cadmium concentrations greater than 100 milligrams/kilogram.
- Thickening of the dredged sediments.
- Treatment of thickener supernatant and discharge to the dredge cell.
- Chemical fixation of the thickened sediments.
- Truck transport of the fixated sediments to a local sanitary landfill.
- Restoration of East Foundry Cove Marsh by addition of clean fill, clay with a high affinity for cadmium, and revegetation.
- Diversion of the Kemble Avenue and New York State Department of Transportation storm sewers into East Foundry Cove and Foundry Brook, respectively.
- Long-term monitoring of Constitution Marsh sediments and biota.
- Bioassay sampling in East Foundry Cove to better characterize the link between the levels of cadmium in the sediments and bioaccumulation in

aquatic fauna."

The recommended project concept, as depicted in the Feasibility Study by EBASCO Services, Inc., is shown in Figure 1.

Objectives

The purpose of the work to be performed by Malcolm Pirnie, Inc., is to:

Perform supplemental field studies necessary to provide input to final design of dikes, storm sewer diversions, dredging, treatment of wastes, transport of wastes, restoration of the marsh, maintenance, and long-term monitoring.

Perform pilot testing of solidification/stabilization treatment to establish performance standards for treatment design parameters.

Develop designs and specifications for the remedial action.

Scope of Work

The Remedial Design Activities required under the Contract Scope of Work are summarized herein. The work includes site investigations to further define the extent of contamination and provide input to design, including:

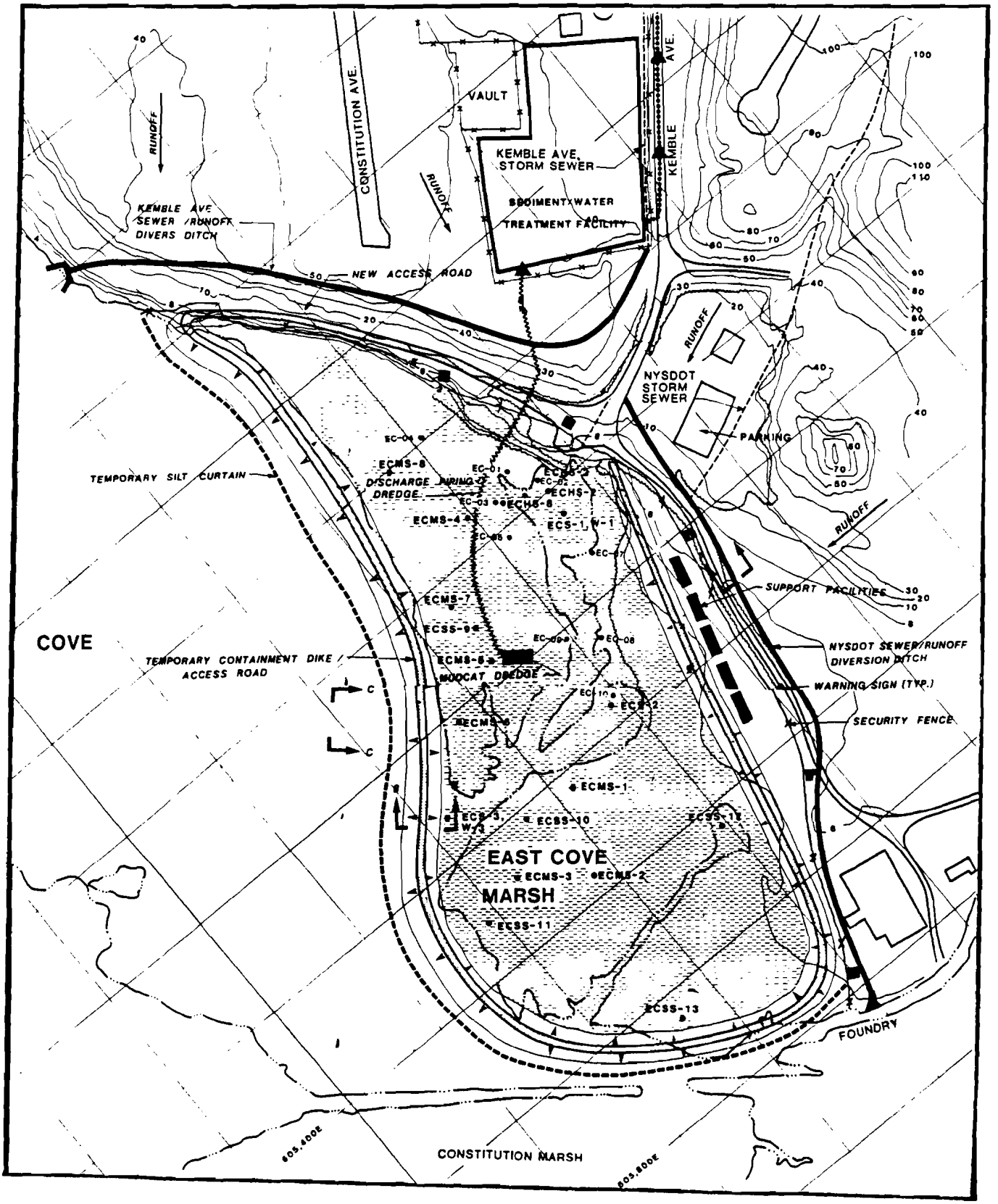
- contour maps of East Foundry Cove Marsh;
- sampling and analysis of water, sediment and vegetation samples from the Marsh;
- soil sampling in the vicinity of the proposed containment dikes; and
- investigation of storm drainage conditions.

The work also includes testing of sedimentation, thickening and fixation treatment of simulated dredged sediment. The wastes produced by treatment testing will be assessed to determine disposal requirements.

These efforts lead into the main focus of the work which is development of designs, plans, specifications and cost estimates for the remedial action. There will be phased submittals of results at the 35%, 65%, and 95% design stages. Review conferences will be held between the COE and Malcolm Pirnie following submittals at each design stage.

FIGURE 1

MARATHON BATTERY
RECOMMENDED PROJECT CONCEPT FOR REMEDIAL DESIGN



Source: Remedial Investigation Report on the Marathon Battery Site, Ebasco.

The final output of the work will be:

- reports on the site investigations and treatment tests;
- designs, plans and technical specifications for civil works to meet 100% final design standards;
- detailed performance specifications for treatment facilities; and
- Code "C" cost estimates.

SECTION 2

Site Description

General Description

The Marathon Battery Company site is located in the village of Cold Spring, within Putnam County, New York. The site includes a former nickel-cadmium battery manufacturing plant, plant grounds, and a series of river backwater areas known as Foundary Cove and Constitution Marsh. Figure 2 shows the site location. Figure 3 provides topographic and land use configurations of the area around the site. Figure 4 provides a schematic layout of the site.

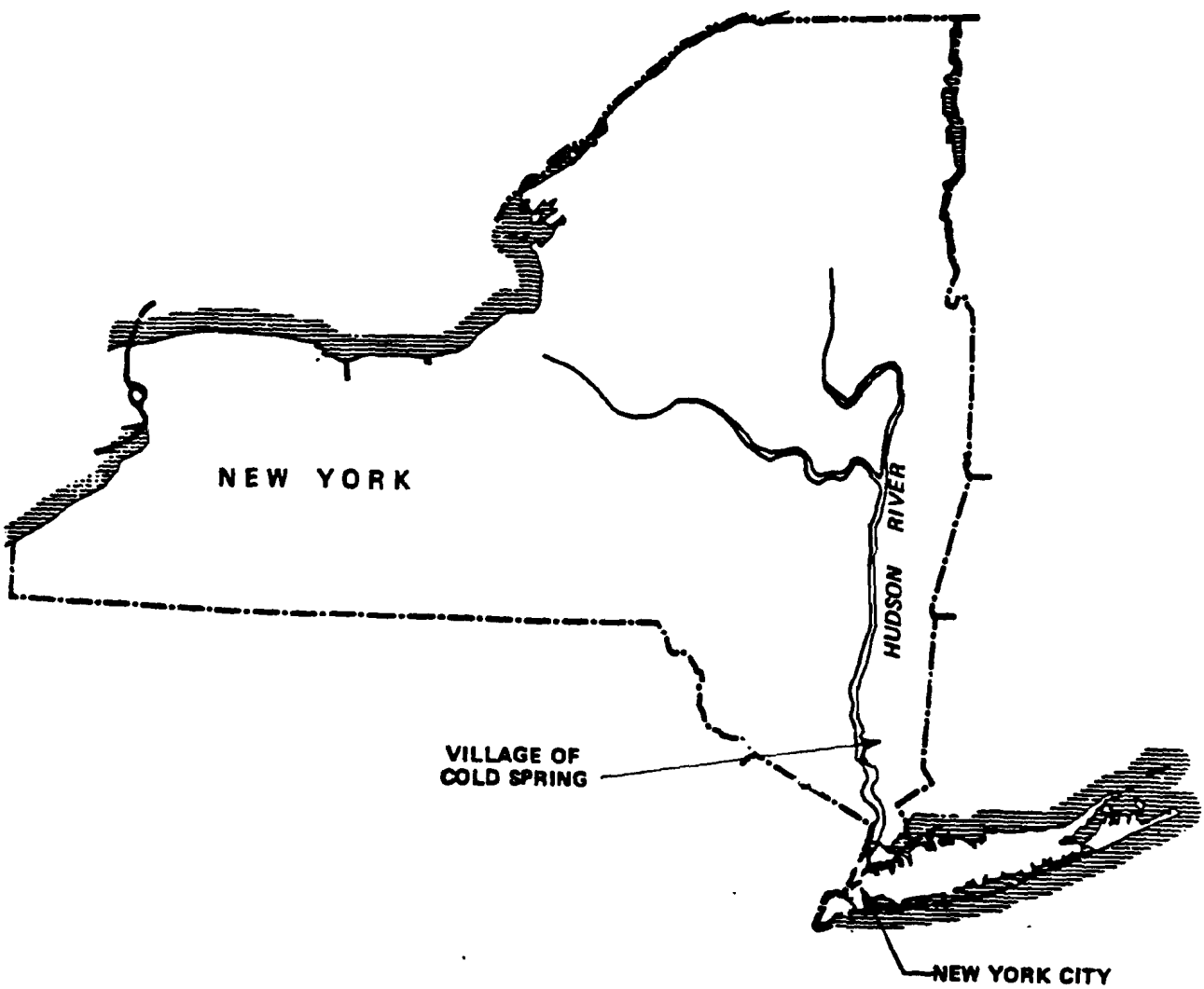
Site History

The US Army Corps of Engineers (COE) constructed a battery manufacturing facility at the site in 1952. Operation of the plant was contracted out to Sonotone Corporation in 1953. By 1955, the contract for operation was amended to permit Sonotone to also produce commercial batteries at the plant. In 1962, the property and all of its facilities were sold to Sonotone. The property was in turn sold in 1969 to Business Fund, Inc., which changed its name to Marathon Battery Company.

Battery production operations continued until 1979. In 1980, the property was sold to Merchandise Dynamics, Inc., which used the buildings for warehouse space to store books.

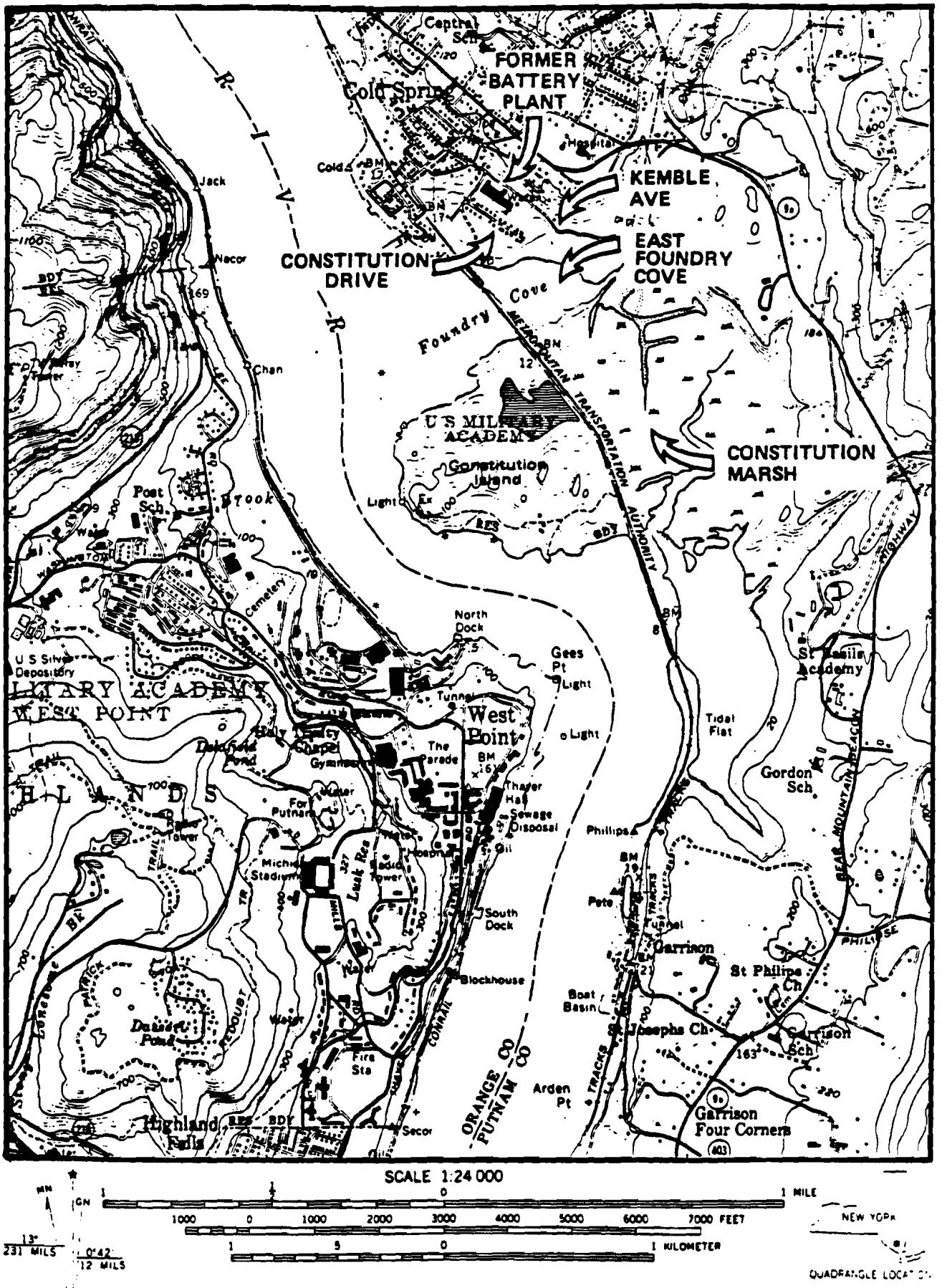
The contamination on site is derived from process wastewater which, until about 1965, was frequently by-passed into East Foundry Cove Marsh whenever the lift station into the Cold Spring municipal sewer system was shut down or overloaded. In about 1965, the Village of Cold Spring ordered Sonotone Corporation to disconnect its discharge into the municipal sewer system. In the immediate term, Sonotone discharged the entire plant wastewater flow into the storm sewer discharging into East Foundry Cove Marsh for a period of

FIGURE 2
MARATHON BATTERY SITE
REGIONAL MAP



Source: Remedial Investigation Report on the Marathon Battery site, Ebasco.

FIGURE 3
MARATHON BATTERY SITE
SITE LOCATION MAP

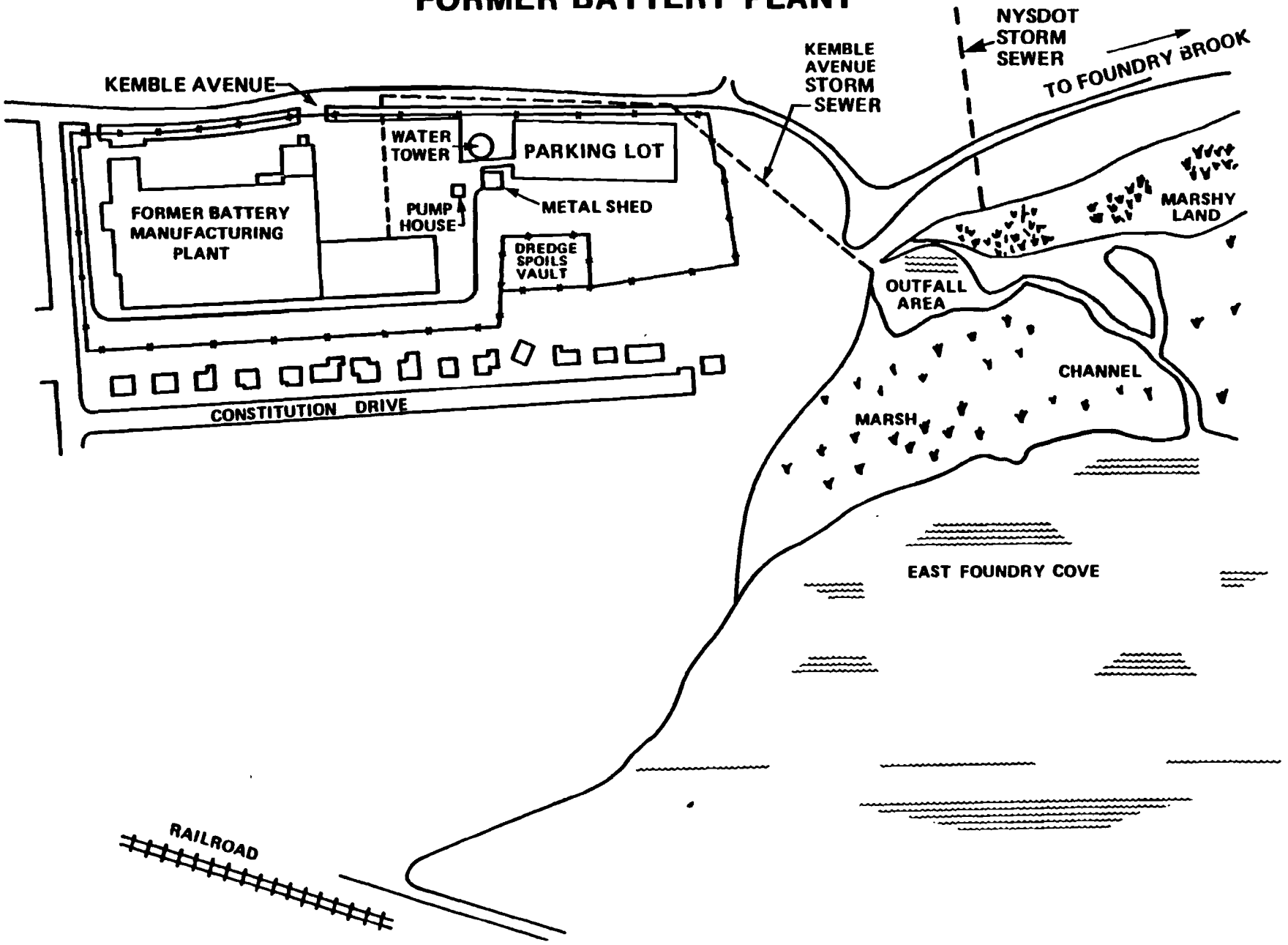


SOURCE: USGS WEST POINT QUADRANGLE

Source: Remedial Investigation Report on the Marathon Battery site, Fi

FIGURE 4

FORMER BATTERY PLANT



Source: Remedial Investigation Report on the Marathon Battery site, Ebasco.

time. Sonotone implemented an on-site treatment system. However, the treatment system failed to operate properly and the wastewater regularly failed to meet state discharge requirements. An estimated 50,000 kilograms of cadmium were reportedly discharged to the Cove over the life of the plant.

In 1972 and 1973, the Cove was dredged to remove about 4,000 cubic meters of contaminated marsh sediments. The dredged material was dewatered and then placed in a clay-lined underground vault on site. The vault was sealed with asphalt and fenced, and still exists on site.

In 1981, the site was placed on the National Priorities List because of the contamination still present within the Cove. Beginning in 1983, remedial investigations and remedial feasibility studies were performed. These studies were completed in 1986 and a Record of Decision was developed by the US EPA on the selected remedial action.

Proposals to do remedial action design were requested and evaluated by the COE in 1987. The resulting contract was awarded to Malcolm Pirnie, Inc., in March 1988. This work plan describes the planned remedial action design activities to be conducted between June 1988 and April 1989.

Previous Investigations

Between August 1983 and August 1985, ACRES International performed remedial investigation and feasibility studies on the site, under contract with the New York State Department of Environmental Conservation. From then until August 1986, EBASCO Services, Inc., was engaged by the COE to perform supplementary remedial investigation and feasibility studies. Previous site investigations have included:

- sediment characterization to define the spatial distribution of contaminant metals (i.e., nickel, cadmium and cobalt) and define other relevant parameters (i.e., total organic carbon, pH, total solids);
- characterization of aquatic biota and vegetation;
- assessment of influence of wetlands on water quality and shoreline

erosion;

- assessment of ecological effects of contamination (i.e., risk assessment from contamination within the food chain); and
- bench scale studies of dewatering, resuspension during dredging, and remedial treatment techniques.

Site Conditions

The Village of Cold Spring has a population of about 2,300 residents. It is located on the Hudson River within a scenic area of rugged terrain. More than 60% of the land in Putnam Country is forested and hundreds of acres have been set aside for conservation.

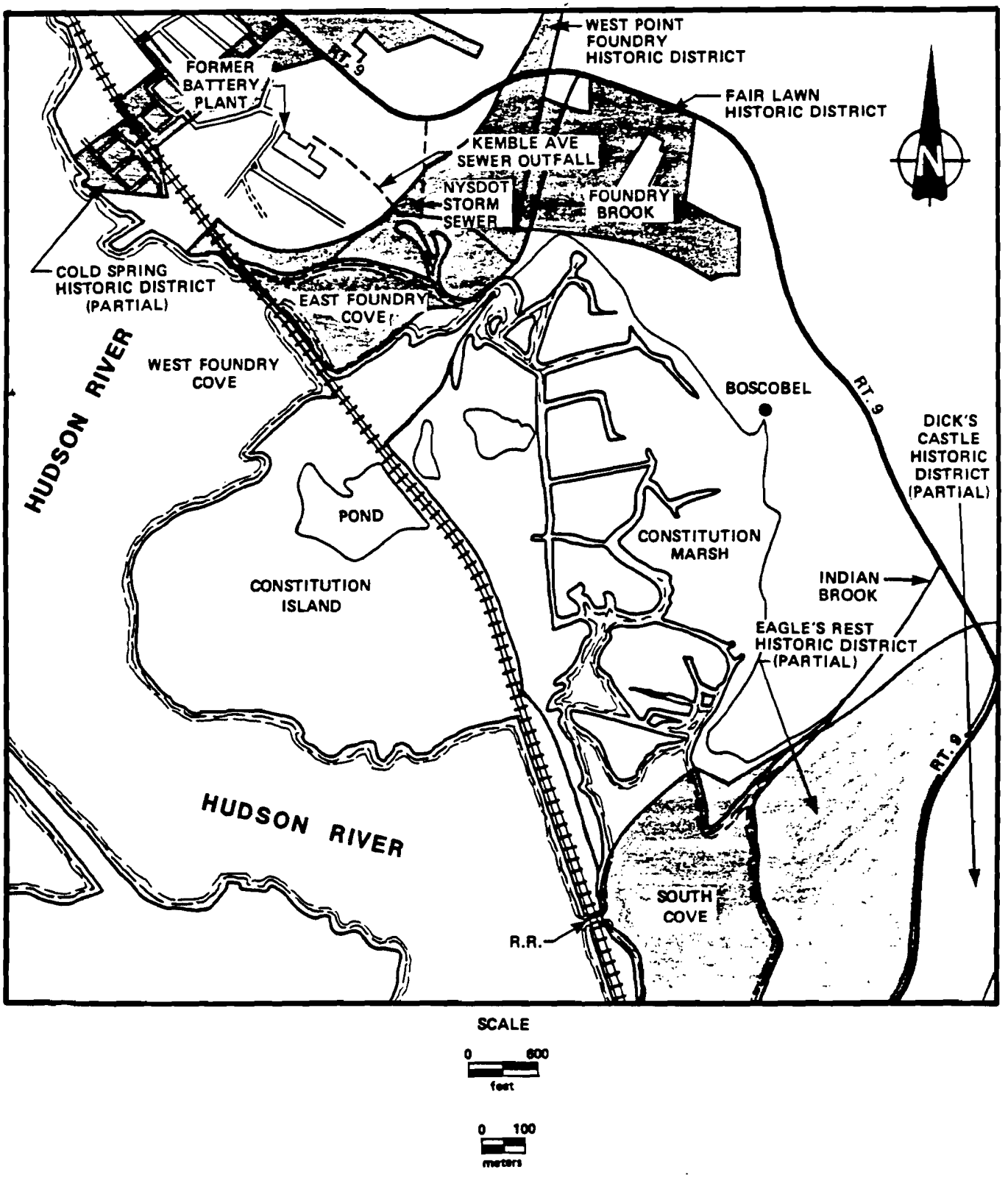
Constitution Marsh is a wildlife sanctuary managed by the National Audubon Society. It encompasses 270 acres dominated by cattail. East Foundry Cove Marsh, the marsh to be dredged and restored, is also dominated by cattail. The two marshes are shown on Figure 5.

The Marathon Battery Company site includes several cultural and historic resources of significance, particularly a foundry, established in 1837. The National Register Sites and Historic Districts on-site and within the surrounding area are shown on Figure 6.

The contaminants of concern at the site are sediment-bound cadmium, nickel, lead and cobalt within the East Foundry Cove Marsh. The amount of cadmium estimated to be bound within the Marsh sediments is between five and ten metric tons. Concentrations of contaminant metals within the bottom sediments of the Marsh were generally in the high hundreds of mg/kg range (EBASCO Services, Inc., 1986).

FIGURE 5

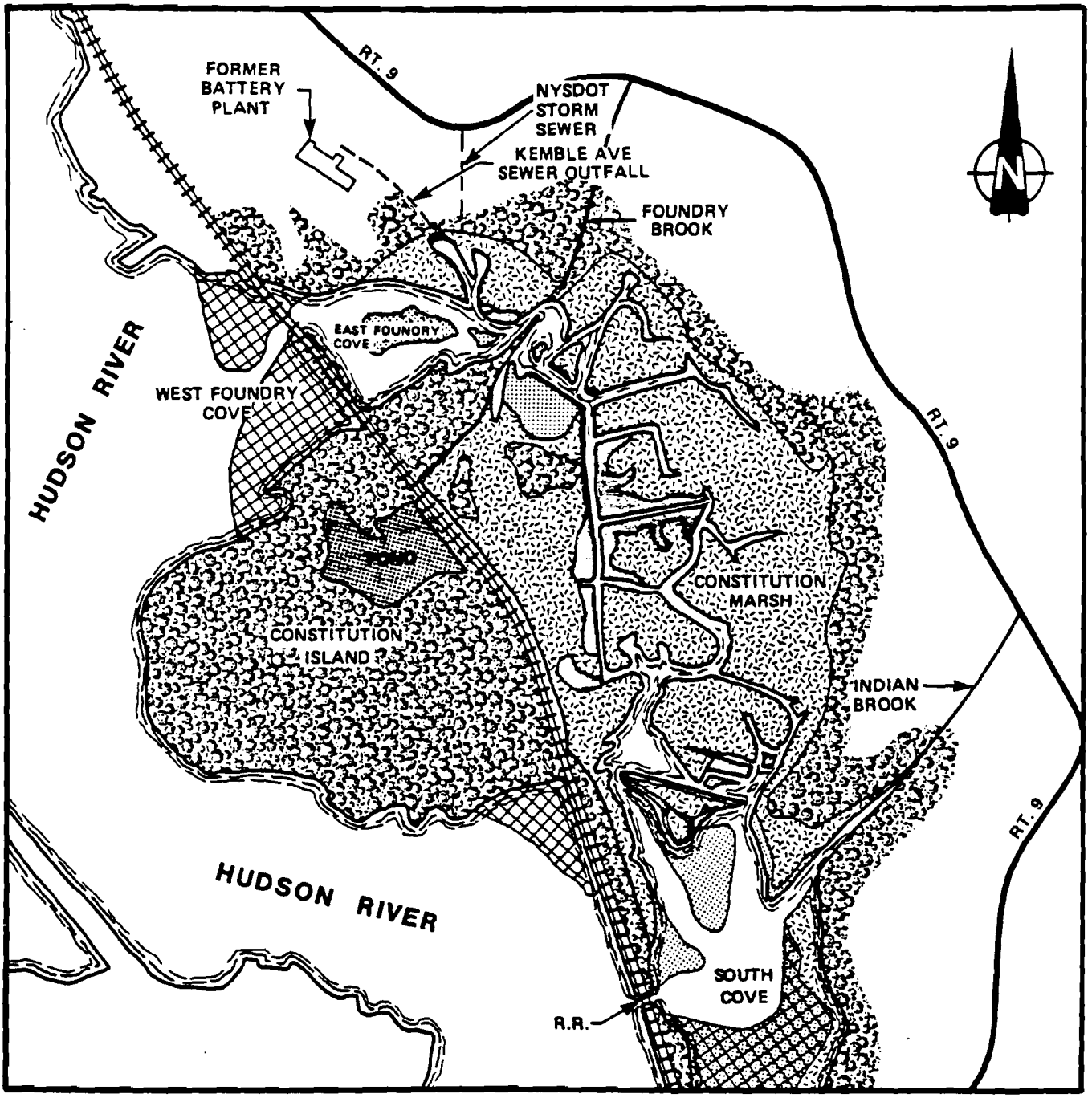
NATIONAL REGISTER SITES AND NATIONAL REGISTER HISTORIC DISTRICTS



Source: Remedial Investigation Report on the Marathon Battery site, Ebasco.

FIGURE 6

MAJOR VEGETATION PATTERNS



NOTE: ARROW ARUM OCCURRED ALONG THE BANKS OF THE CONSTITUTION MARSH CHANNEL & THE EAST COVE OUTFALL CHANNEL.

Source: Remedial Investigation Report on the Marathon Battery site, Fl[illegible] 10

SECTION 3

Site Mobilization Plan

General

The Marathon Battery East Foundry Cove Marsh remedial design project site will be prepared for access and use for purposes of the field investigations and testing activities. To properly mobilize, the following facilities will be needed:

- Keys to the gate locks for access into the existing plant site's fenced area.
- Field office trailer and portable sanitation facilities.
- Provision of a water supply for drinking and decontamination by tanker truck or water hook-up, whichever is most feasible.
- Decontamination area for decontaminating personnel and equipment.
- Space for parking for four vehicles, the field office trailer, and a water tank truck.
- Electrical connection.
- Secure storage for field equipment.
- Access for the sediment excavation equipment to work at East Cove Foundry Marsh.
- Storage area to hold contaminated materials generated during field investigations and testing.
- Drums and/or tanks for holding contaminated materials.
- A paved and roofed open area under which on-site laboratory equipment, chemicals, etc., will be stored.

Agency assistance will be required in obtaining the necessary easements or other rights of access to the cove and plant site. In addition, Agency assistance is requested in establishing contact with the site owner or other responsible party so that such questions may be answered, such as whether or

not water may be obtained from the factory yard hydrants for operating the pilot plant. The pilot treatability and fixation testing should be accomplished within the fenced area of the plant site. The parking lot on the easterly end of the site would be suitable for this purpose, but is partially covered with debris including sheet metal ducts, fans, concrete blocks, drummed waste and other material. This debris must be moved if the area is to be used for the pilot plant, and EPA may require that the debris be tested for contamination and disposal of waste.

Documentation

All field activities will be recorded in a field notebook.

SECTION 4

Technical Approach for Remedial Design Activities

This work plan covers the technical, health and safety and quality assurance planning requirements for the remedial action design effort to be conducted by Malcolm Pirnie, Inc. The Task Numbers used herein are consistent with those described in the Contract between the US Army Corps of Engineers and Malcolm Pirnie. Figure 7 provides a schedule of the Tasks and subtasks, as specified within the Contract.

Efforts performed under Tasks 1 and 2 under the Contract, namely for Tasks concerning Initial Pre-Design Activities and Plans and Management, are not described in this work plan. The work plan focuses on Tasks 3 to 6, namely Optional 35% Design, Optional 65% Design, Optional 95% Design and Optional 100% Design.

Task 3 - Optional 35% Design

1 Conduct Site Investigations

a Provide Contour Maps of the East Foundry Cove Marsh.

Planned Approach: 1987 aerial photographic mapping will be utilized to produce a topographic map of the area at a scale of 1 inch equals 50 feet with a one-foot contour interval. The mapping will be referenced to the New York State plan coordinate system and to the USGS data. The mapping will cover essentially the same area as that shown as Plate No. 4-2 of the Supplemental RI/FS Report by Ebasco Services but will extend to the northwest boundary of the former battery plant site.

Originally the mapping was planned to cover only the area of the containment dike and estimated area to be dredged. However, it has been expanded to the north and east to provide more detail for the NYSDOT and

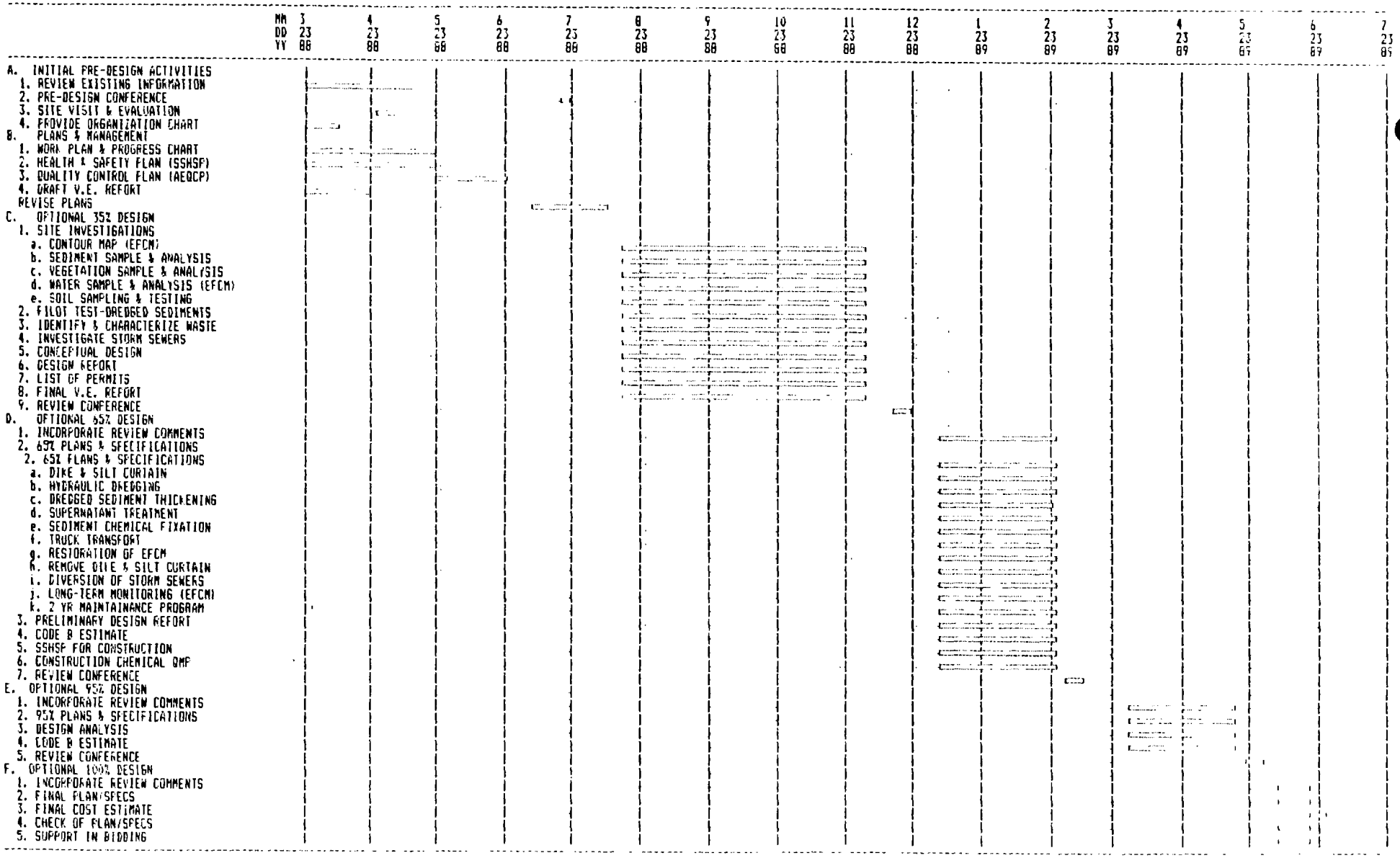
PROJECT SCHEDULE

U.S. ARMY CORPS OF ENGINEERS
700 FEDERAL BUILDING
KANSAS CITY, MO 64106-0659

MARATHON BATTERY

Project Mgr:SANDRA COINTREAU

run time : 11:53:58 ## 06-08-1986



Kemble Avenue storm sewer drainage diversion, to the northwest to provide more detail for the design of alternative access routes, and to the west to provide more detail for the design of an alternative containment dike layout (pending outcome of the sediment sample analysis showing the outer edge of the area to be dredged). A total area of approximately 62 acres will be mapped rather than the 30 acres originally estimated.

The base mapping will be prepared by a subcontractor, Badey and Watson Surveying and Engineering, P.C., of Cold Spring, New York. This subcontractor will also conduct the necessary horizontal and vertical control survey.

In as much as photogrametric mapping will not provide contours of the areas under water in the East Cove surrounding the marsh, and because cove bottom contours will effect the design of the containment berms or dikes, a limited amount of topographic survey work will be conducted around the periphery of the marsh by field crews working from a boat or in boots at low tide. The data obtained in this manner will be added to the topography obtained from photogrametric techniques.

Schedule: The subcontractor will be directed to proceed with photogrametric mapping immediately upon receipt of authorization for this task from the Corps. The field survey of underwater areas surrounding the marsh will be conducted once the results of additional sediment samples are obtained and the limits of the area to be dredged are defined and agreed upon.

b Sampling and Analyzing Additional Sediment Samples

Objective: The objective of the proposed sediment sampling program is to accurately define the volume of contaminated material to be removed and treated in the Remedial Action. The program design allows spatial definition and calculation of volumes required to meet statistical confidence levels for removal of materials which exceed contaminant action criteria.

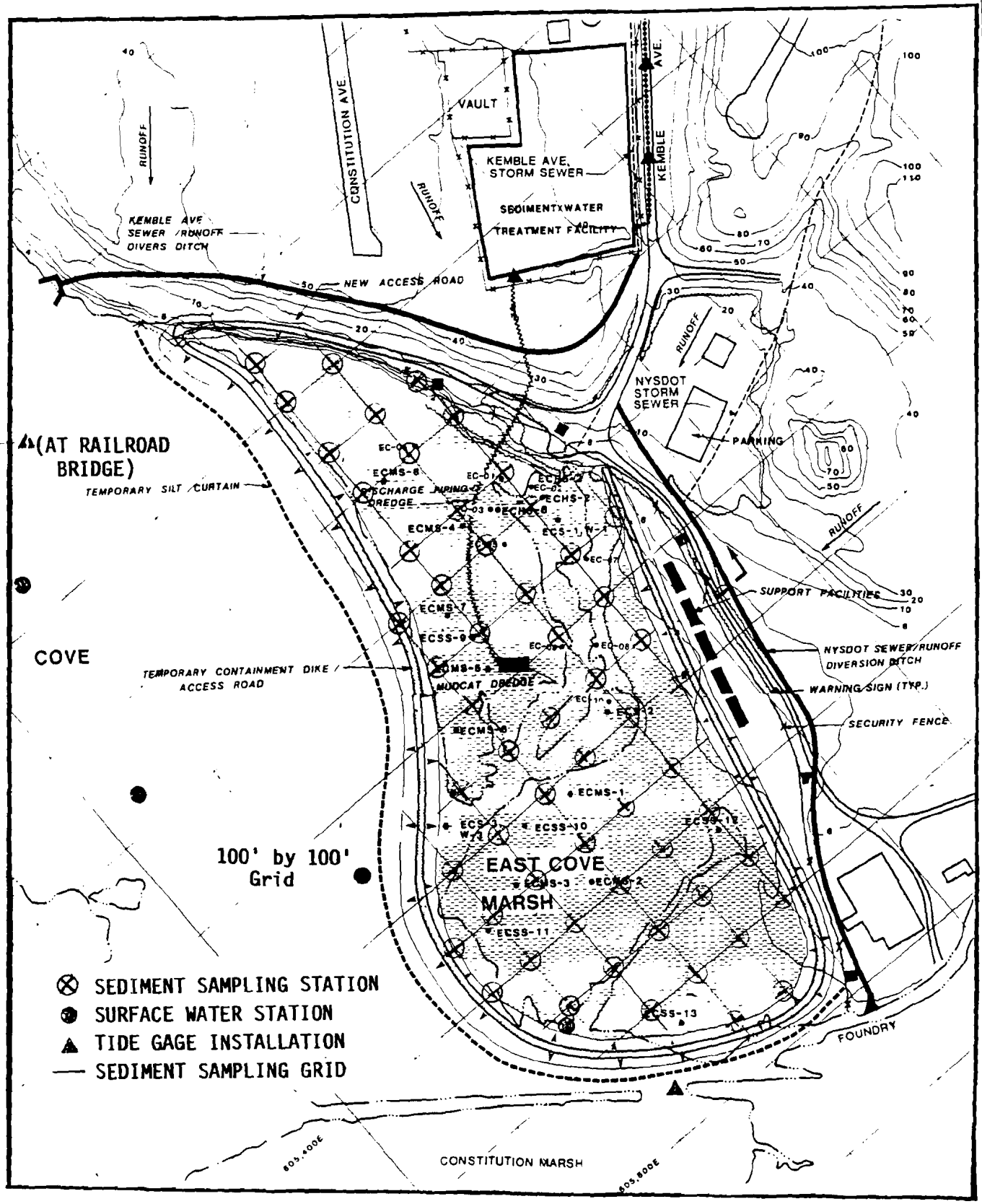
Methodology: Prior sampling of the East Foundary Cove marsh by ACRES International, Inc. and Ebasco, Inc. appear to have used a "biased" design which is appropriate if the target population is clearly defined, homogeneous and sufficiently assessable to eliminate sample selection bias as a problem. It is apparent from the data presented in the RI reports that sediment Cadmium levels in the East Foundary Cove marsh did not meet these conditions and the required assumptions were not verified.

The biased sampling approach is unacceptable for characterizing the spatial distribution of contaminants, the manner in which the data was used in the RI report. The method of choice for estimating trends or patterns is a "systematic" design. A systematic sampling design will be used for the sediment sampling. The East Cove Foundry marsh will be surveyed to establish a 100 foot square grid as shown in Figure 8.

Grid nodes will be marked with 10 foot long survey stakes, driven 4 feet into the sediments. Sediment samples will be collected at each sampleable grid node using a Wildco gravity core sampler with teflon liners. If penetration by the gravity corer is precluded by vegetation, an OSI vibracore sampler with a cutting head will be used.

FIGURE 8

EAST FOUNDRY COVE
FIELD INVESTIGATIONS



Source: Remedial Investigation Report on Marathon Battery Site, Ebasco

Figure shows Remedial Action Concept Recommended by Ebasco

NOT TO SCALE

Decontamination Procedure: Prior to sampling the equipment will be precleaned using the procedure proposed by the USEPA in Methods for Chemical Analysis of Water and Wastes and by the Office of Research and Development proposed analytical procedures for priority pollutant analysis (EPA,1980). The procedure includes:

- Wash all coring tubes, containers, caps, Teflon sheeting and aluminum foil with nonphosphate laboratory grade detergent and tap water;
- Triple rinse with tap water;
- Rinse with 1:1 nitric acid (reagent grade);
- Rinse with deionized-distilled water;
- Rinse with 1:1 hydrochloric acid (reagent grade);
- Triple rinse with deionized-distilled water;
- Rinse with acetone followed by a final rinse with pesticide grade hexane;
- Rinse with deionized/distilled water (analyte free); and
- Dry in a contaminant free area and wrap in aluminum foil(shiny side out).

The nitric acid-hydrochloric acid washes are designed to remove trace metals; the acetone-hexane washes are designed to remove organic impurities. However, to maintain the evidentiary quality of the data the full cleaning procedure will be followed.

Sample Collection: The core samples will be collected to a depth of three feet. Following collection of the sample, the coring tubes will be capped on both ends using Teflon stoppers. Overlying water will be retained in the tube.

Each core sample will be photographed, described and assigned a unique identification number. Information to be recorded in the field notebook

will include: the time of sample collection, location, approximate depth, stratigraphy and climatological and observed conditions which might impact the chemistry of the sample. The amount of compaction of the core will also be estimated based on the adhered material in the core liner and noted. Compaction of core samples of is frequently 2:1 or more. Estimation of compaction is necessary to sub-sample the correct depth intervals.

Sample Processing: A core sample from each station will be stored in coolers in an upright position and maintained at 4 degrees centigrade for transport to the laboratory for chemical analyses. A duplicate core sample from each station, a second core taken as close as possible to the first location while avoiding the influence of disturbance from collection of the first core, will be frozen and archived for engineering analysis. Accepted chain of custody procedures will be followed.

The laboratory will prepare sub-samples at 0-6 inches, 6-12 inches and 12-18 inches depth. The subsamples will be analyzed for cadmium, lead, nickel and cobalt following homogenization in stainless steel bowls. The portion of the core from 18-36 inches in depth will be archived for analysis if the 12-18 inch subsample shows a cadmium concentration higher than the Record of Decision action level of 100 mg/kg.

Quality Assurance: On each day of sampling a rinsate blank shall be prepared and submitted for analysis for the same parameters. Trip blanks and field blanks will not be required. Data received from the laboratory will be subjected to Quality Assurance review as described in the attached procedure.

Data Analysis: The chemical data will be analyzed using a geostatistical technique called kriging. Geostatistics has emerged as a valuable tool in hazardous waste investigations, as it permits accurate graphic displays of data not possible with most other methods of statistical analysis. Kriging can be used to develop isopleths of soil contaminant

concentrations, identify areas requiring additional sampling and establish confidence limits for contaminant boundaries.

Use of kriging generally requires the use of a systematic sampling design such as the gridded design proposed. The systematic design is generally the method of choice for estimating trends or patterns of contamination over space.

Kriging is based on the theory of regionalized variables, which assumes that contaminant concentrations are spatially correlated and follow a normal or log normal distribution. Wind dispersion of contaminants from a point source or water dispersion from point sources or contaminated soils, the transport mechanism at the Marathon site, frequently result in contaminant distributions that follow these spatial correlations and probability distribution requirements.

Data are evaluated for spatial correlation using a semi-variogram model. The semi-variogram portrays the variance between data pairs as a function of the distance between sample locations. Once a semi-variogram model has been selected, the data are used to estimate and map contaminant distributions by a process known as kriging. The software proposed for the analysis of the East Foundry Cove is a package developed by GEDA Systems Inc. of Boulder Colorado. A complete description is provided as Appendix A.

The model provides graphic output of the data analysis including "best estimate" isopleths and error maps. The level of confidence of the isopleth mapping can be set at 1, 2 or 3 standard deviations corresponding to confidence levels of 66, 95 and 99 percent confidence levels, respectively. The error map plots the error associated with the best estimate isopleths as standard deviations. Any area identified where the error is greater than acceptable, that is a standard error larger than that associated with the selected confidence level(1 standard deviation for a 99 percent confidence level) would be resampled to lessen the

error. The software also has the capability to calculate required removal volumes for specified action levels.

Reporting: A task report will be prepared which will graphically present the the isopleth maps for 66 percent, 95 percent and 99 percent confidence levels for removal of sediments with cadmium levels of 100 mg/kg or greater, the action level defined in the Record of Decision. The report will also include an evaluation of data quality and a tabulation of data. The report will also note and provide justification for changes in field procedures.

c Sampling and Analyzing Vegetation

Objective: The purpose of the proposed vegetation sampling is twofold. Data will be collected on the types and distribution of vegetation in the East Foundry Cove Marsh for use in restoration of the marsh. Data will also be collected on the levels of heavy metals in the plants to provide a pre-remediation database.

Methodology: In order to evaluate the success of restoration procedures, baseline data will be collected on contaminant levels in the marsh vegetation, species composition, production and plant densities. Data on these parameters has been used by the U.S. Army Engineer Waterways Experimentation Station (WES) in their evaluation of created wetlands in Florida, Louisianna and New York.

Because of the spatial trends in wetland vegetation related to substrate elevation and chemistry, and the trends in sediment contaminant levels discussed earlier, a systematic sampling design will be employed for collection of these data. From each of the grid nodes established for the sediment sampling a single location will be established using random x-y coordinates (x corresponding to north, y to east). At the resulting location a one square meter quadrat will be established. Each plant within the quadrat will be identified and located on a map of the quadrat

to establish current densities and species distribution. All vegetation will be cut off at ground level and weighed to characterize production.

Sub-samples of vegetation, roots and leaves/stems will be prepared by manual separation and removal of sediment by distilled water rinse for laboratory analyses and stored in polyethylene bags. Each sample will be photographed, described and assigned a unique identification number. Information to be recorded in the field notebook will include: the time of sample collection, location and observed conditions which might impact the chemistry of the sample.

Equipment decontamination procedures are the same as those described for surface water sampling. Duplicates will be submitted for 10 percent of the samples. The samples will be analyzed for cadmium, nickel, cobalt and lead.

Reporting: A task report will be prepared which will include mapping of vegetation types, densities and production. The mapping will be of sufficient detail to allow design of the planting program for marsh restoration. The report will also present the plant tissue heavy metal data, sampling methodologies and locations to allow comparability of data collected in the long term monitoring program.

d Sampling and Analyzing Additional Water Samples

Objective: The objective of the proposed sampling of the East Foundry Cove is to provide a pre-remediation database for the transport of heavy metal contamination in surface waters and to determine the relative contribution of contamination of the East Foundry Cove and Constitution marsh.

Methodology: Surface water sampling will be conducted during a dry weather event and storm water event. Samples will be collected at seven stations hourly over a twelve-hour tidal cycle during each survey for a

total of 84 environmental samples each survey. Sampling locations will include the connections of the East Foundry Cove with the Constitution Marsh and the West Foundry Cove, and five locations within the East Foundry Cove as shown on Figure 8.

The samples will be collected with a Teflon lined, 1.25-liter Nansen bottle. The Nansen bottle was chosen tor the limited potential for contamination of metal samples. Although there is some chance of contaminant introduction by the neoprene gaskets in the head and valve assemblies, both are removable allowing thorough cleaning. The limitation of the Nansen bottle is that because it must turn end over end to operate the valves, it is not suitable for collection of samples near the bottom. If sampling near the benthos is required a modified Van Dorn sampler will be used.

Prior to sampling field measurements will be collected for temperature, salinity, dissolved oxygen (STDO) and pH to determine if temperature or salinity stratification is present. If no stratification is present, a single sample will be collected at mid-depth. If stratification is present, discrete samples of the water layers above and below the thermocline or halocline will be collected.

Each sample will be photographed, described and assigned a unique identification number. Information to be recorded in the field notebook will include: the time of sample collection, location, approximate depth of water, STDO data, tide stage, stratigraphy and observed conditions which might impact the chemistry of the sample.

Tide Stage Control: During the sampling events tidal stage will be monitored continuously using a OSI TD-2 tide gage. This instrument operates based on pressure differentials of the water static head and atmospheric pressure. The instrument automatically compensates for temperature effects on water density. Correction for salinity is done manually. In addition three tide staffs will be installed at the

locations shown on Figure 8.

The tide staffs will be constructed of square aluminum tubing or porcelain coated steel. The staffs will be driven a minimum of five feet into the sediments and attached to permanent structures, such as bridge abutments if possible. The staffs will be marked in 1-inch intervals. Each staff will be surveyed and tied into a USGS benchmark to allow conversion of readings to the the Mean Sea Level (MSL) datum. Readings will be taken a minimum of once an hour during the surveys.

Decontamination Procedure: The following decontamination procedure is recommended by the USEPA for collection of trace metal samples:

- Wash with non-phosphate laboratory grade detergent and tap water;
- Rinse with 1:1 nitric acid (reagent grade);
- Rinse with tap water;
- Rinse with 1:1 hydrochloric acid (reagent grade);
- Rinse with tap water;
- Triple rinse with distilled-deionized water.

The listed procedure will be used to clean all sampling gear, accessories and sample containers prior to sampling and between samples. Nylon line used on the Nansen sampler will be changed between each location.

Sample Containers: Samples will be stored in 1-liter polyethylene or high quality borosilicate glass bottles with polypropylene caps. Teflon lid liners will be used.

Sample Preservation: Nitric acid will be added to the samples to adjust the pH to below 2, maintaining the metals in solution. At the time of analysis the sample container will be rinsed with 1:1 Nitric acid to recover metals adsorbed to the bottle. The rinse will be added to the sample. The samples will be analyzed for cadmium, nickel, lead and cobalt.

Quality Assurance: During each survey day, a minimum of one trip and rinsate blank will be prepared and submitted for analysis. In addition, a minimum of 10 percent of the samples will be collected in duplicate.

Data Analysis: Tidal stage data will be corrected for salinity if required and the readings corrected to the MSL data. Duplicate and blank sample data will be reviewed to assess matrix variability. Temporal or tidal variability and spatial variability will be characterized for use in designing the long term monitoring program and to develop a preliminary mass balance transport model for the East Foundry Cove.

Reporting: A task report will be prepared which will describe the sampling procedures used and recommended modifications in sufficient detail to be incorporated into the long term monitoring program specifications. The report will also include the analytical results, a quality assurance review of the data and the results of the data analysis.

e Soil Sampling and Testing for Design of Containment Dikes.

Planned Approach: Mueser Rutledge Consulting Engineers, acting under subcontract to Malcolm Pirnie, Inc., will prepare informal bid documents and request competitive bids from soil boring contractors for the installation of a minimum of eight soil borings along the proposed dike alignment and five borings in the proposed treatment plant area to determine foundation conditions. Full-time field inspection of the boring work, laboratory analysis of the samples, analyses of dike settlement and stability, and analysis of on-shore treatment facility foundation requirements will also be provided by Mueser Rutledge. A report summarizing the field data, test results, analyses and recommendations will be prepared at the completion of this task.

Methodology: Upon definition of the area to be dredged and establishment of the alignment of the dike, boring locations will be staked in the

field and ground elevations at the boring determined. A minimum of five borings will be made on the cove side of the marsh and three borings on the land side along the dike alignment. Floating drilling equipment will be utilized in the cove area. The boring locations in the treatment plant area will be determined when a preliminary layout of the plant has been prepared.

The soil borings will be made using conventional drilling equipment. If two drill rigs are used, a hollow steam auger may be employed in the treatment plant area. However, in the marsh and cove, 4-inch casing will be used with augers on a rotary bit to reduce the potential for contamination of the underlying strata. If required to prevent material from flowing into the open end of the casing, drillers mud may be used.

It is anticipated that at least one Shelby tube sample will be taken at each boring in the soft silt and clay sediments in the marsh and cove. Split spoon samples will be taken at the treatment plant site. Samples will be taken at five foot intervals and changes in strata.

Undisturbed samples will be taken of the soft, compressible marsh and cove bottom sediments using Shelby tubes. The underlying, dense sand and till layers will be sampled using split spoon samplers. Sampling will proceed to a minimum depth of five feet into the dense, underlying material or to rock, whichever is encountered first. No rock coring will be done. All borings will be backfilled with grout or a bentonite sand mixture to permanently seal the hole.

Each soil boring will be logged as it is drilled. The boring logs will include the following information, at a minimum:

- The project name and location.
- The boring number or letter designation and date drilled.
- The surface elevation of the ground or depth of water at the boring.
- The type of boring rig.

- The type of sampler.
- The diameter of any casing used.
- Whether any drilling mud was used.
- A description of the sample.
- Blow counts for each spoon sample.
- The pressure reading for each Shelby tube pushed.
- A description of the sample.
- The name of the contractor, the crew members and the inspector.
- The depth at which water was encountered, if applicable.

All drilling rigs and accompanying apparatus will be decontaminated by steam cleaning prior to their removal off-site.

Laboratory tests for unconfined compression and triaxial shear strength will be conducted to determine the bearing capacity of the underlying soils in the diked area. At least two consolidation tests and two shear tests will be conducted in the salt marsh sediments that will support the dike.

2 Pilot Plant Treatability Study

Objectives: The objective of the proposed pilot treatability study is to provide information for the conceptual and detailed design of the full scale treatment plant. The treatment scheme to be designed by this project is planned to include the following:

- Thickening of Dredged Sediments
- Treatment of Thickener Supernatant
- Chemical Fixation of the Sediments

Methodology: A systematic three phase program will be initiated to determine the critical design information that will be used for design of

the full scale treatment facility. Each phase will be described in detail below. The three phases of the testing program include the following:

- Jar Testing
- Long Tube Settling Testing
- Pilot Plant Testing

Jar Testing: Jar testing of the sediments will be performed in the Malcolm Pirnie Laboratory. The main objective of this phase is a preliminary determination of settleability of the sediments and the need for polymer addition.

The jar tests will be performed using one liter glass graduated cylinders and a standard stir rack. Duplicate core samples collected during the sediment sampling of East Foundry Cove Marsh will be used during jar testing phase. A mix of several core samples will provide a semi-representative sampling of the Cove. Approximately 0.30 gallons of sediment sample are required for this phase of testing.

The sediment sample mix will be diluted to concentrations of 100, 150, 200, 250 and 300 g/l. These are COE-WES recommended concentrations for settling tests involving hydraulic dredging (EM110-2-5027).

Sediment samples will be rapidly stirred for a 5 minute period to allow for a complete mix. Once a complete mix is obtained a sample will be taken for TSS prior to the stirring unit being shut down. After the sample is taken, the solid-liquid interface will be allowed to settle. Studies performed by Ebasco Services for the FS/RI report indicate that almost complete settling occurs during the first 60 minutes. Therefore, if measurable settling is rapidly occurring during this initial 60 minute period, the solid-liquid interface will be measured every 5 minutes.

After a review of COE documents, reference sources and COE-WES experience, the required settling time for this type of dredged material

would seem to be more in the 24 to 96 hour range. For this reason, the jar tests will be allowed to settle for the full 96 hour period. During the this time period the solid-liquid interface height will be measured every hour.

Samples from the clear-water and settled sediments will be taken at time = 1 hr. and every hour after that as needed, for total suspended solids (TSS). Based on the obtained settling curve and solids information, the preliminary area requirements for settling will be determined using the following equation (Metcalf and Eddy, 1972):

$$A = \frac{Q * tu}{Ho}$$

Where A = Area required for sludge thickening, sq.ft
Q = Flow rate into the tank, cfs
Ho = Initial height if interface in column, ft
tu = Time to reach desired underflow concentration, sec.

Time, tu, can be determined by the Talmadge and Fitch Method (Metcalf and Eddy, 1972). In this method a desired underflow concentration is selected and the depth required to meet this concentration is calculated by the following equation:

$$Hu = \frac{Co * Ho}{Cu}$$

Where Hu = Depth at desired underflow concentration.
Co = Initial solids concentration.
Ho = Initial height of interface column.
Cu = Desired underflow concentration.

By obtaining Hu and the settling curves for the sediments, time (tu) can be determined by the point of intersection of the horizontal line defined by Hu and the tangent of the settling curve at the critical concentration point.

Depending on the results obtained above, polymer addition or other conditioning may be required. Based on the work performed by Ebasco

Services, it is currently anticipated that polymer will be required in the treatment of the thickener supernatant only and not for the entire slurry. Based on this assumption, polymer addition test will tested on the "clear-water" portion of the sample only.

After the initial settling of the material has taken place, a sample of the "clear-water" will be removed. Prior to polymer testing, the sample will be tested for TSS, Cd, Ni, Co and Pb. Several polymers types and brands will be tested during this phase. The two best polymers will be re-tested to obtain the optimum dose requirements. Once the best resulting polymer is obtained, a sample of the sludge and liquid will be taken to determine the TSS, Cd, Ni, Co and Pb levels.

In the event of off-gassing from the sediments (i.e., methane, hydrogen sulfide or volatile organics) all jar testing will be be performed under a hood with the ventilation fan on at all times. As an extra precaution, the work area will also be monitored with a Photo Ionization Detector (PID) and an Organic Vapor Analyzer (OVA).

All sludge produced as a result of jar testing will be placed in 1 gallon pail and returned to the site for future disposal.

Long-Tube Settling Tests: Following jar testing, six long-tube settling tests will be performed in the Malcolm Pirnie Laboratory. The main objective during this phase is to better define the settleability of the sediments on a larger more representative and proven scale. This information will be used for the design and implementation of the on-site pilot plant.

Based on work performed by Ebasco Services in the Remedial Investigation Report, it was determined that the sedimentation behavior of the fine grained dredged material found in East Foundry Cove is governed by zone settling only. Test data obtained during this phase will provided the

detailed design information required to determine area for thickening, area requirements for clarification and clarifier overflow rates. The area requirements for thickening will be calculated as noted above in the jar testing section. The area requirements for clarification can be calculated by performing a solids flux analysis (Metcalf and Eddy, 1972). The areas for thickening and clarification will also be calculated by methods recommended in COE manuals EM-1110-2-5027, D-88-1 and D-88-2.

The required clarifier area and overflow rate will be designed so that the clarified overflow being returned to East Foundry Cove Marsh will meet the required to Federal and State discharge permit limits.

The long-tube settler used in this phase will be constructed in accordance with COE manual EM-1110-2-5027. The unit will consist of a eight inch diameter clear PVC column, with side extraction valves. A provision to bubble air from the bottom to keep the slurry mixed during column filling will be provided.

At concentrations over 50 g/l, column height has been found to have a significant effect on settling velocities. Because of this, the settling tests will be performed at a slurry height equal to the expected side water depth (SWD) of the anticipated full scale unit, 8 feet. Sample ports will be located at 6 inch intervals for the first three feet and every foot after that.

Slurry preparation and addition:

Sediment samples taken from the cove during previous field sampling will be used during this phase. The samples will be mixed in a 55 gallon drum and maintained in suspension by an electric mixer. Slurry concentrations of 10, 15, 20, 25 and 30 percent by weight will be used. This range of concentrations represents the possible variations obtained during the dredging of the marsh. Sediment samples will be mixed with water from East Foundry Cove to obtain the desired concentration.

Settling and sampling:

To prevent settling of the sediments during addition, an air bubbler has been added. Only the minimum amount of air required, if any, to maintain the material in suspension during filling will be used. Once the column is full, the air bubbler will be turned off and a 50 ml sample will be taken immediately from each of the sampling ports to determine the baseline TSS concentration. As the liquid/sludge interface falls, the interface will be measured as noted above in the jar testing section. A 50 ml sample for TSS will be taken from the sample ports above the sludge interface every hour or as required for the total length of the test. Each long tube settling test will run for the full 96 hour period.

During the test period, samples of the "clear-water" will be analyzed for TSS, Co, Ni, Cd and Pb. At the end of the test period a sample from sludge will be taken and analyzed for TSS, Co, Ni, Cd and Pb. All samples will be analyzed in accordance with the below procedures.

Approximately 5 gallons of sediment sample will be required for this phase. A portion of the thickened sediment sludge produced during this phase of work will be sent to the participating fixation vendors for in-house preliminary bench-scale work. The remaining settled sediments will be drummed and stored on-site for future disposal.

During the Long-Tube settler phase of this project, air in the work area will be monitored with a Photo Ionization Detector (PID) and an Organic Vapor Analyzer (OVA) to monitor for off-gassing of possible volatile organics during mixing and air bubbling of the sediment samples.

Pilot Plant Testing: Based on the data obtained during the above jar tests and long tube settling tests, an on-site pilot plant will be

designed and constructed to demonstrate the proposed RI/FS treatability scheme. The pilot plant will be operated on a continuous flow mode for a predetermined period to obtain sufficient laboratory data to confirm thickener area, clarifier overflow rate, pumping rates, fixation of the sediments and polymer addition rates (if required) for the complete full scale system.

For protection and security reasons, the pilot plant will be located within the fenced area of the Marathon Battery Company. For ease of operation, leveling and layout of the pilot plant, the system should be located on the level paved area.

The pilot plant is currently anticipated to be in the field for period of one month. During this time, the pilot plant components will be assembled and tested for a short periods of time. Once the initial start-up is completed, the pilot plant will operate for an eight-hour steady-state period. During this period samples will be taken to demonstrate the performance of the proposed treatability scheme. Based on the Supplemental RI/FS report by Ebasco Services, it is anticipated that the pilot system to be tested will consist of the following:

2	-	1,000 gallon Equalization Tanks
1	-	5 ft. Diameter Thickener
2	-	Thickener Sludge Pumps
1	-	5 ft. Diameter Clarifier
2	-	Clarifier sludge Pumps
Ast.	-	Other Apparatus
1	-	Clarified Overflow Holding Area
1	-	Thickened/Clarified Sediment Holding Area
4	-	Fixation Vendors

The above pilot plant configuration is based on the work completed by Ebasco Services and will be confirmed prior to construction once the data from jar and long tube testing is completed. Ebasco apparently based

much of their analysis on the assumption that dredged material would be about 20% solid by volume. However, it is more typical for dredged material to be nearer to 20% solids by weight. The COE-WES recommends 14% solid by weight, and 150 g/l, as representative of dredged material. If the data/results indicate that the currently proposed system is not practically viable, the pilot plant will be modified to reflect the up-to-date information.

With the current pilot plant schematic, we anticipate to operate the pilot plant as follows:

A) Approximately 15 yards of material will be excavated from a representative area of the marsh by either a backhoe or clamshell. Marsh sediments will be placed in a 20 yard clean dumpster and trucked from the excavation area. The dumpster will be placed on a lined area at the pilot plant area and any leakage collected for treatment.

   If at any point in the excavation operation, an apparent historic object is uncovered, the operation will be stopped and moved to the next representative area. The COE and EPA designated agency will be called to tell them of the possible historic find.

   Samples of the dredged material will then be taken out of the dumpster and moisture content will be determined in an on-site portable oven. Once this known, the correct dilution with marsh water to approximately 150 g/l can be obtained.

B) The marsh sediment will be mixed with marsh water in equalization tanks.

C) The marsh sediment slurry will then be pumped to the thickener for initial solids settling.

D) Thickener supernatant will be pumped to a clarifier for clarification of the liquid. Any required conditioning will be pumped into the line at this time.

E) Clarified overflow will be sent to a holding lagoon pending results on metals concentrations.

F) Underflow from both the thickener and clarifier will be pumped into a holding area prior to fixation.

During the operation of the pilot plant the following parameters will be monitored for process control and performance testing:

Water Temperature

Water pH

Slurry Mix tank pump rate

Thickener overflow rates

Thickener underflow rate

Clarifier overflow rates

Clarifier underflow rate

Chemical addition rates (if required)

The following samples, locations and analysis will be taken during the steady state operation:

Location	Analysis
Slurry Mix Tank	TSS, Cd, Ni, Co, Pb
Thickener Overflow	TSS, Cd, Ni, Co, Pb
Thickener Underflow	TSS, Cd, Ni, Co, Pb
Clarifier Overflow	TSS, Cd, Ni, Co, Pb
Clarifier Underflow	TSS, Cd, Ni, Co, Pb
Overflow Holding Lagoon	TSS, Cd, Ni, Co, Pb
Sediments for Fixation	Cd, Ni, Co, Pb, EP Tox.Test
Fixated Sediments	EP Toxicity Test

Site Requirements:

The following will be required on the Marathon Battery Co. site for pilot plant testing:

- Water - A tap water source will be needed for chemical make-up, general housekeeping needs and decontamination of the equipment.

- Power - A power supply will have to be brought over to the pilot plant area. A power supply capable of supplying 120 - 480 V. may be needed depending on the equipment supplied. lighting will also, be required on the site.

- Containment Areas - Currently three containment areas will be required on site during pilot testing.

  (1) Sediment Slurry Tanks: Two 1000 gallon tanks will be provided to maintain a constant flow of slurry to the pilot plant. Sediment from the dumpster will be either weighed or measured

in a known volumetric vessel prior to dilution with marsh water. Dilution water will be pumped up from the marsh as required. Plastic will be layered down around the tank area to catch any spills that may occur during transferring of the material. An electric mixer will be provided to keep the sediments in suspension.

(2) Clarified Overflow Holding Area: All clarified overflow produced during pilot testing, will be stored prior to being returned to the marsh. Samples from the lagoon will be taken prior to discharge back to the Marsh. If the clarified overflow does not meet the issued State and Federal discharge permits it will be treated with Bentonite. The lagoon water will be mixed with bentonite and the suspended solids allowed to settle for a 24 hour period, or longer as needed. After this period the water will be tested again.

The holding area will be a lined lagoon capable of holding 15,000 gallons. Positive displacement pumps will transfer the overflow back to the Marsh once the water has meet Federal and State discharge permits limits.

(3) Fixated Sediments: The sludges produced from thickening and clarification of the sediments will pumped to a separate 20 cubic yard dumpster. The sediments will be held in dumpster until the fixation treat-off. Any un-fixated sediments will be drummed and held on site for future treatment.

- Security - The pilot plant and immediate pilot plant area will be secured to prevent unauthorized people from obtaining entry onto the site.

- Covered Area - A sheltered area will be required to hold on-site lab equipment, chemicals, electrical items, etc.

During the pilot plant testing phase of work, air in the work area will be monitored with a Photo Ionization Detector and an Organic Vapor Analyzer for determination of possible off-gassing of volatile organics. A combination combustible gas meter will also be used to monitor for methane and H_2S gas that may be released from the excavated sediments.

Analytical Methods and Requirements: All analytical determinations noted will be completed in accordance with Environmental Protection Agency/ Corps of Engineers Technical Report No. EPA/CE-81-1 Procedures for Handling and Chemical Analysis of Sediment and Water Samples., May 1981, and other regulatory procedures.

Sample collection location will be as noted above. Each sample will be numbered, labeled and logged into the field notebook. Pre-cleaned sample bottles will be used as required. The proposed pre-cleaning procedure is shown under Sediment Sampling of the Work Plan.

All samples taken in the field will be stored at ambient temperature for transportation to the analytical laboratory. If the samples can not be processed by the lab in the required time period the samples will be preserved in accordance with Environmental Protection Agency/Corps of Engineers Technical Report No. EPA/CE-81-1.

Quality Assurance will consist of duplicate samples. Duplicates will be collected for a minimum of 10 percent of the samples. All data received from the laboratory will be subjected to a Quality Assurance Review.

Output: The following output regarding pilot testing will be provided as noted below for each item:

- Draft report of the results, conclusions and recommendations obtained during jar testing, long-tube testing and pilot plant testing of the excavated sediments.
- Preliminary cost estimates.

Schedule: The following schedule is currently foreseen for pilot testing of the dredged sediments:

Item	Time Required
Obtain Sediment Samples	1 week
Preliminary Jar Testing (6)	1 week
Long Tube Settling Tests (6)	2 weeks
Design Pilot Plant	2 weeks
Equipment Delivery	4 weeks
Site Work/Set-up	3 weeks
Pilot Plant Testing	3 weeks

3 Identification and Characterization of Waste

Objectives: The objectives of the identification and characterization phase of this study is to demonstrate that the chosen chemical fixation process will encapsulate the heavy metals contained in the settled sludge and provide a non-hazardous material. If the fixated material is capable of passing the EP Toxicity test it will then be suitable for disposal at a sanitary landfill.

Methodology: Not to limit the fixation process to any one manufacturer and to try and locate the lowest cost yet still effective means of fixation the following fixation test procedure was developed.

All vendors interested in participating in this project will receive a small sample (approx., 1 gallon) of settled sediments to perform in-house bench scale work. Once the bench scale results have been obtained from the participating vendors and evaluated, the four best resulting Vendors will be invited to participate in the on-site treatability study. Each vendor will have approximately 0.5 cubic yard of settled sludge available for fixation. Five 1/4 bag cement mixers will be used (one for each Vendor) to mix the fixation chemicals and sludge. Malcolm Pirnie will try one or more non-proprietary mixes based on its experience and the published literature.

Once each vendors mix is ready to be placed in the mold, nine samples will be taken from each mixer. The molds for the remaining mixer contents will be constructed of plywood. Each mold will be of sufficient size to hold the entire remaining contents of the mixer. The samples will be allowed to cure for the manufacturers required period. This can range from 12 hours to 3 days, depending on temperature and manufacturer. After the vendors' recommended cure times are reached, 1 set of samples will be run for an EP Toxicity test. The second sample from each vendors mixer will be allowed to cure for a period of 4 weeks. After this period a second set of samples will be tested for EP Toxicity.

Decontamination procedures for the fixed sediment samples will be as outlined under Sediment Sampling of the Work Plan.

The fixed samples will be collected as noted above for each vendor. Samples will be taken in a standard ASTM C-109/86 mold. Each sample will then be assigned an ID number, labeled and logged into the field notebook. The information logged will included the time of collection, location, approximate depth any other observed conditions.

Samples of the fixed sediments will be stored at ambient temperature for transportation to the laboratory for analysis. The laboratory will perform one (1) EP-Toxicity test for metals only on each sample delivered during this period. Since it is anticipated that the fixated material will pass the EP Toxicity Test and qualify to be sent to a sanitary landfill, the need to perform any physical integrity testing is not required.

Quality Assurance will consist of duplicate samples. Duplicates will be collected for a minimum of 10 percent of the samples. All data received from the laboratory will be subjected to a Quality Assurance Review as described in the attached procedures.

Reporting: The following output regarding Identification and Characterization of the Waste will be provided:

- o Draft report of the results, conclusions and recommendations obtained during the identification and characterization of the waste.

4 Investigate Condition of Storm Sewers

Objective: The Kimble Avenue and the NYSDOT Storm Sewers discharge in the North West corner of the East Cove Marsh. The RI/FS had identified the diversion of the Kimble Avenue sewer to the East Cove and the NYSDOT sewer to the Foundry Brook. The objective of this task is to review

these concepts and develop preliminary design of these diversions.

Methodology: The watershed area contributary to these sewers will be delineated on a USGS quadrangle map. Based on these watershed characteristics, and rainfall conditions, expected peak flow rates will be developed for these storm sewers.

The NYSDOT and the Village of Cold Springs will be contacted to obtain relevant information regarding these sewers. These would include, "as-built" drawings, design flow rates, design frequency of storm, etc.

A field survey will be conducted to ascertain the accuracy of the "as-built" drawings and to investigate the existing conditions of the sewers. Where accessible, the sewers will be visually checked (without entry into manholes) for sediment accumulation.

The peak flow rates developed will be compared to the capacity of the existing sewers and the larger of the two considered for design.

A preliminary layout of the proposed diversion channels will be made. Based on tidal stages in the cove and the existing topography, preliminary shape and size of the channel cross-section will be developed.

Additional Considerations: The methodology outlined above considers a permanent diversion of the storm sewers based on the recommendations of the RI/FS. However, the revegetation and restoration of the marsh might require fresh water input and the permanent diversion of these structures would prevent these waters from reaching the marsh. Therefore, it might be desirable to divert these sewers only temporarily during the dredging operations period.

If only temporary diversions are envisioned, the design criteria might be less stringent than a permanent structure would require.

Output: The output of this task will be:

1. Development of design flows of each of the storm sewers.

2. A preliminary layout of the diversion ditches of the Kimble Avenue and the NYSDOT storm sewers.

3. Typical cross-sections of the proposed channel.

5 Provide Concept Design, General Plans and Layout for Treatment and Cleanup of the Site.

Planned Approach: Conceptual design plans will include the following:

1 A general site plan showing existing conditions and the locations of soil borings, sediment samples, water and vegetation sampling points. The topographic mapping prepared for this project will be utilized for this purpose.

2 A general site plan showing the locations of proposed dikes, storm drain diversions, treatment units, electric power supply, process water supply, roads, parking areas, security fences, etc.

3 The proposed process train for treatment of sediments and dredge return water including a preliminary site layout showing the locations of major structures and pipe line routes.

4 Schematic flow diagrams through the water and sediment fixation treatment processes.

5 A hydraulic profile through the water treatment process.

6 Typical sections through roads, dikes and drainage ditches.

7 The approximate limits of any easements or fee takings required to complete the work.

The conceptual plans will be prepared in accordance with the "A-E Guidelines for Corps of Engineers, Kansas City District Drawings" and will be bound separately from the Concept Design Report under task 2(a)6 below.

Schedule: The preparation of general site plans will begin as soon as the topographic mapping is obtained. The locations of dikes surrounding the marsh will be determined upon definition of the area to be dredged. Preparation of treatment plant schematic drawings will begin as results become available from the pilot plant work. The conceptual design plans will be completed and submitted with the report on the 35% design effort

at the end of this phase of the work.

6 Prepare a Report to Include Results of the 35% Design Tasks.

Planned Approach: The report on the 35% design tasks will consist of a series of task reports as follows:

- A task report on task 2(a)1 b, "Sediment Sampling."
- A task report on task 2(a)1 c, "Vegetation Sampling."
- A task report on task 2(a)1 d, "Water Quality Sampling."
- A task report on task 2(a)1 e, "Soil Sampling and Testing."
- A task report on task 2(a)2, "Pilot Plant Treatability Study.
- A task report on task 2(a)3, "Identification and Characterization of Waste."
- A task report on task 2(a)4, "Investigation of Conditions of Storm Sewers."

In addition, the report will:

- describe any specific problems identified during the 35% design phase which may effect the overall project;
- provide a preliminary cost estimate for the remediation work.

Schedule: The report on the 35% design effort will be prepared in sections as individual work tasks are completed and will be submitted, together with the conceptual design drawings, at the end of this phase of the work which is scheduled in the contract to take three and one-half months.

7 List of Permits

A list of the permits required for implementation of construction and the relevant agencies involved in each permit application and approval process will be prepared.

8 Final Value Engineering Report

A list of ideas for value engineering study has been submitted to the COE for review and consideration. For those value engineering ideas which the COE requests to be evaluated, a special team of engineers and scientists from within Malcolm Pirnie, but separate from those involved in this remedial design project, will be formed. Their report on the potential for value engineering cost savings will be prepared for submittal with the 35% design reports.

9 Review Conference

Within two to four weeks of submittal of all documents prepared under Task 3, Optional 35% Design, Malcolm Pirnie staff will attend a review conference with the COE to be held at the Malcolm Pirnie headquarters offices in White Plains, New York.

Task 4 - Optional 65% Preliminary Design

1 Incorporate Review Comments

Incorporate comments from the 35% design review conference into the preparation of preliminary design plans and specifications.

2 Prepare 65% Plans and Specifications

The work under Task 4, "Optional 65% Preliminary Design", encompasses the preparation of preliminary construction plans and specifications for all aspects of the project including site work such as diversion of storm drainage; construction of roads, dikes and silt curtains; dredging work including sections showing dredge cuts in the area to be remediated; treatment works for the water treatment and sediment fixation; truck transport of the treated sediments to a local approved sanitary landfill; and restoration work including wetland restoration such that contours, currents and vegetation return to comparable natural conditions as the original baseline conditions.

The work involves preparing preliminary construction plans and specifications in accordance with Corps standards. Prepare drawings which comply with "Architect Engineer Guidelines for Corps of Engineers, Kansas City District Drawings." Specifications shall be prepared using "COE Standard Guide Specifications" and in accordance with "Instructions for Preparation of Bidding Documents for Construction Contracts."

Planned Approach: Prepare drawings containing all necessary plans, sections and details which define the materials and methods of construction for all appurtenant work. Drawings will be accompanied by technical specifications necessary to describe and install all materials and perform all work required for completion of the project. Plans and specifications will detail the following tasks.

- Construction of perimeter containment dike and silt curtain.
- Diversion of surface drainage and storm sewers.
- Dredging, excavating or other removal method compatible with the transport of sediments contaminated with cadmium concentrations greater than 100 mg/kg to the treatment facility.
- Performance requirements for sedimentation and thickening of the dredged material, clarification of the supernatant, and fixation of the sediment.
- Transport of the treated sediment to an approved landfill.
- Restoration of the East Foundry Cove Marsh
- Removal of all dikes, silt curtain or other temporary structures installed for the purpose of dredging and marsh restoration.
- Long-term monitoring of the East Foundry Cove Marsh and surrounding aquatic environs.
- Two-year maintenance program.

Specifications will include:

Clearing and Grubbing
Vegetation Harvesting
Excavation and Backfill
Earthwork (Roads and Dike Installation)
Piping and Valves

Pipe Installation
Performance Requirements and Process Flow Train for Settling, Thickening and Solidification
Site Restoration
Geotextiles
Geomembranes (if required)
Dredging
Concrete
Manholes

Drawings will include:

Site Utilities
Dike Locations
Stormwater Structures
Limits of Dredging
Pipe Installation
Treatment Process Flow Diagram
Site Security
Truck Routing
Road Construction
Dike Construction Details
Manholes

In addition to the 65% Plans and Specifications submittal, a final report on pilot plant testing will be prepared. Also, a final report on the identification and characterization of the waste will be prepared.

3 Prepare Preliminary Design Analysis Report.

Planned Approach: The report will define the parameters and assumptions used in developing the design of each major component of the project, specifically as they relate to the:

- location and method of construction for containment dikes and silt curtain;
- selected method and proposed sequence of operation for dredging;
- the transport, removal and reuse or disposal of materials of construction used for containment dikes and/or the silt curtain;
- rerouting and conveyance of storm drainage from existing or proposed runoff control systems; and
- performance requirements for the sedimentation, thickening and

fixation treatment process facility.

Schedule: The preparation of the 65% Preliminary Construction Plans and Specifications will begin after the 35% Design Review Conference under Task 3 has occurred and upon authorization to proceed with the Task 4 phase of work. The plans and specifications, preliminary design analysis reports, Code "B" cost estimates, site security plan, health and safety plan, and chemical quality management plan will be submitted at the completion of this phase of the project, which is scheduled within the contract to take one and one-half months. The preliminary design review conference will be held after initial review of the submittals by the COE, within two to four weeks of submittals.

Task 5 - Optional 95% Advance Final Design

General: Upon completion of the preliminary design review conference at Malcolm Pirnie's White Plains headquarter offices the end of Task 4, and upon authorization to proceed, the 95% advance final design documents will be prepared.

Planned Approach: The 95% advance final design documents will include complete construction drawings and typed technical specifications for civil works and equipment for facilities except the treatment system, design analysis documentation, typed performance specifications for the treatment system, site security plan, health and safety plan, chemical quality management plan, and detailed construction Code "C" cost estimate.

Each item will be bound separately. Review comments received from the 65% preliminary design review conference will be incorporated in these documents.

Schedule: The 95% advance final design documents will be submitted within one and one-half months of the authorization to proceed.

Task 6 - Optional 100% Final Design

General: Upon completion of the advance final review conference at the COE in Kansas City, and after authorization to proceed, any revisions required in the 95% advance final design documents will be made.

Planned Approach: Final plans, civil works construction specifications and equipment procurement specifications will be prepared to a level of detail adequate for bidding purposes, together with a final estimate for bidding, for all civil works and equipment except the fixation treatment facilities. For the treatment facilities, final performance specifications will be prepared.

Upon distribution of the final plans and specifications, a "Plans-in-Hands" check of drawings and specifications against existing conditions will be made at the site.

During the advertisement period, addenda will be prepared as required to respond to comments or questions from bidders and Malcolm Pirnie staff will attend the prebid conference.

Schedule: The final plans and specifications will be prepared within two weeks after authorization to proceed. The "Plans-in-Hands" check of drawings and specifications will occur within seven days thereafter, and the final estimate will be submitted. Support of the government during the advertisement period will be scheduled in accordance with the advertisement for bids.

SECTION 5

Organization and Management

The organization of the project is shown on Figure 9. Robert Schroeder of the U.S. Army COE is the Project Officer, in charge of providing technical direction and monitoring the technical performance of Malcolm Pirnie, Inc.

From Malcolm Pirnie, Inc., John Henningson, Vice President in charge of Environmental Sciences and Related Hazardous Waste Programs, is the Officer providing overall project direction. Richard Brownell, Vice President in charge of Industrial and Related Hazardous Waste Programs, is the Officer providing technical review. Harry Minter, Senior Manager specializing in construction design, will assist Mr. Brownell in providing technical review.

The Project Manager from Malcolm Pirnie, Inc., is Sandra Cointreau, Manager specializing in hazardous waste remediation projects. The Task Managers are John Mulligan, Senior Manager specializing in civil works design; Robert Kerble, Manager specializing in field investigations for remediation and aquatic biology; Joseph Lauria, Senior Manager specializing in process design; and Hagop Shahabian, Manager specializing in hydrology and storm drainage. Richard Califano, Manager specializing in toxicology, health and safety, and John Taylor, Manager specializing in quality assurance and contraol, will report directly to the President of Malcolm Pirnie, Inc., on issues related to their monitoring of these aspects of the project. On-site health and safety and on-site quality assurance will be the responsibility of Anthony Russo and John Logigian, respectively.

Malcolm Pirnie, Inc., has a matrix organizational structure. Project personnel are drawn from throughout the company irrespective of group or locational assignment. The project personnel are selected on the basis of appropriate skills, experience and availability. For purposes of this project, tasks and subtasks will be assigned to Task Managers. Personnel working on specific tasks will report on a day-to-day basis to their respective Task Managers.

Task Managers, in turn, will work under the day-to-day direction of the Project Manager.

Resumes for all project personnel have been provided to the COE. All project personnel who will be involved in field investigations and site work have received the required forty hours of certified health and safety training and, as appropriate, the eight hours of annual refresher training.

APPENDIX A

LITERATURE DESCRIBING COMPUTER PROGRAM

USED FOR ENVIRONMENTAL ANALYSIS

ENVIRONMENTAL SOFTWARE

PRODUCT OVERVIEW AND TECHNICAL BRIEF

GEDA Systems, Inc.
Information for Confident Decisions

GEO ENVIRONMENTAL DATA ANALYSIS

THE INSITE™ SYSTEM

THE INSITE SYSTEM is a set of powerful problem solving tools for the environmental professional. This sophisticated, integrated software system is designed to statistically estimate the extent and quantity of a specified parameter at a site. The INSITE System utilizes the most advanced geostatistical techniques available to provide statistically valid estimates.

The INSITE System is the tool to use if you need to:

- Determine a parameter's extent and quantity,
- plan optimal sampling strategies,
- maximize sampling costs and information return, or
- produce statistically valid maps.

The INSITE System has successfully analyzed both single and multiple point sources, as well as contamination fronts, soil, groundwater, soil gas and 2 and 3 dimensional problems. The INSITE System's advanced techniques maximize the spatial information contained in your data set to produce the most precise estimates possible. The results are displayed as either contour maps or block diagrams. These visual representations are extremely useful in identifying trends or evaluating remediation scenarios.

Geostatistical estimation methods are sound, objective and repeatable. Geostatistics is the only estimation technique which produces a confidence map illustrating the degree of confidence in which the parameter estimate can be viewed. The project manager or site investigation team can determine the sites minimum acceptable confidence level. The INSITE System can be used to determine the number of samples required to achieve a specified level of confidence. This is invaluable when addressing data adequacy or when planning your monitoring requirements.

The INSITE System is an essential project management tool which is applicable at all stages of an investigation. One is able to minimize sampling costs and maximize information results. Planning optimal sampling strategies becomes a scientific process rather than an educated guessing game. The visual representations, precise estimates and confidence maps provide the project manager with the accurate estimates needed for future budgeting, planning and project scheduling. The INSITE System is designed to meet all the geostatistical needs of the environmental professional.

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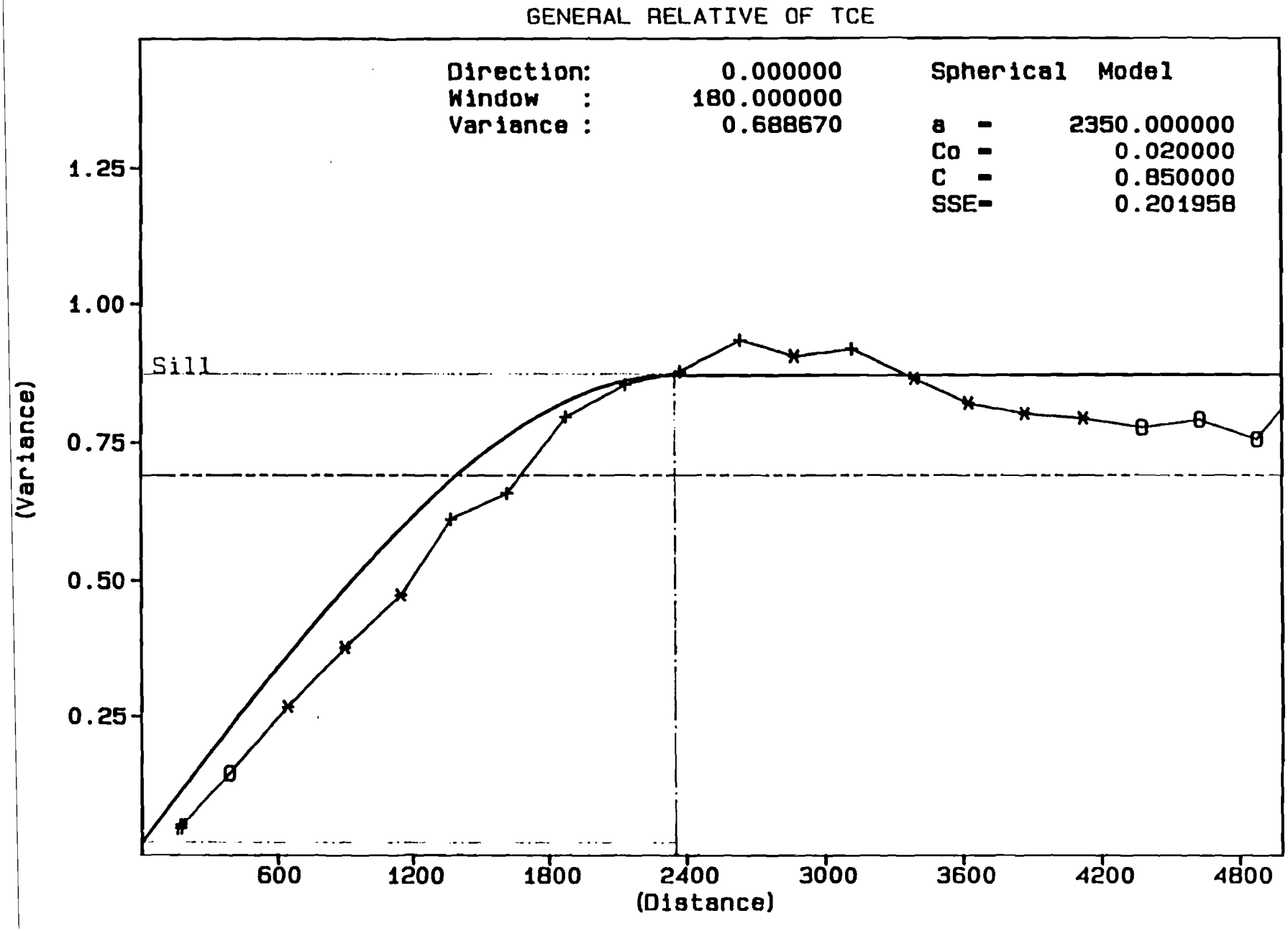
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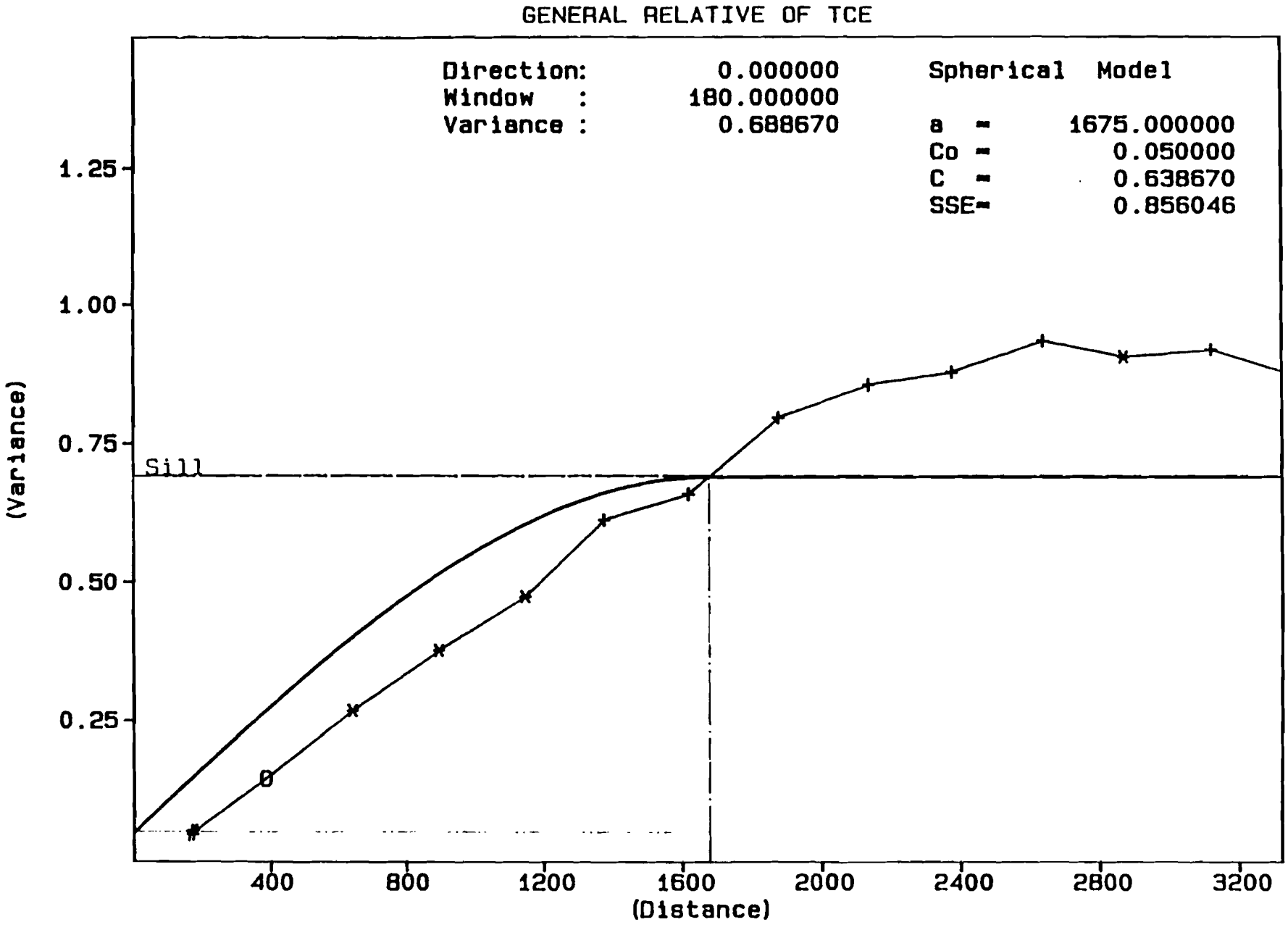
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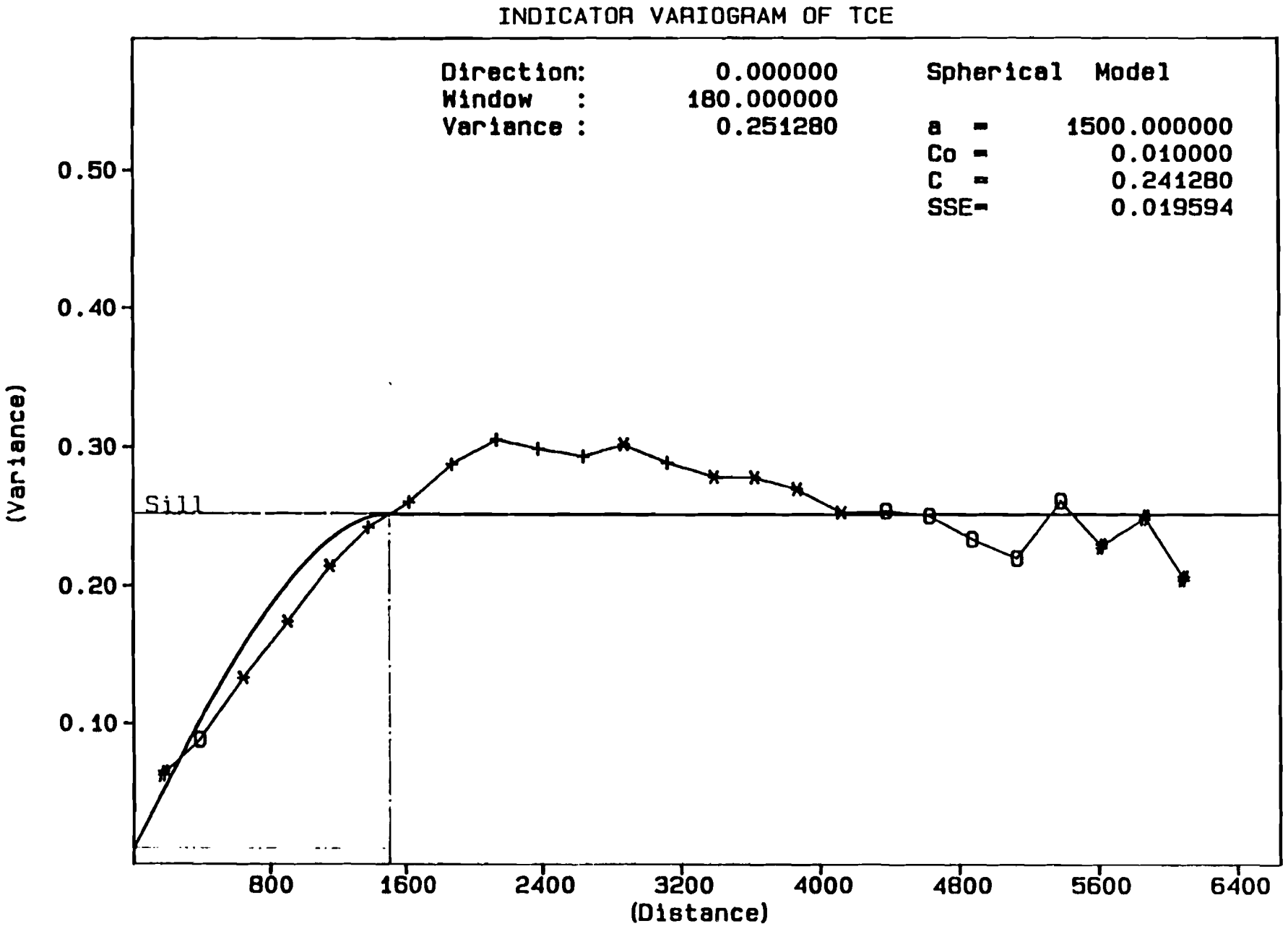
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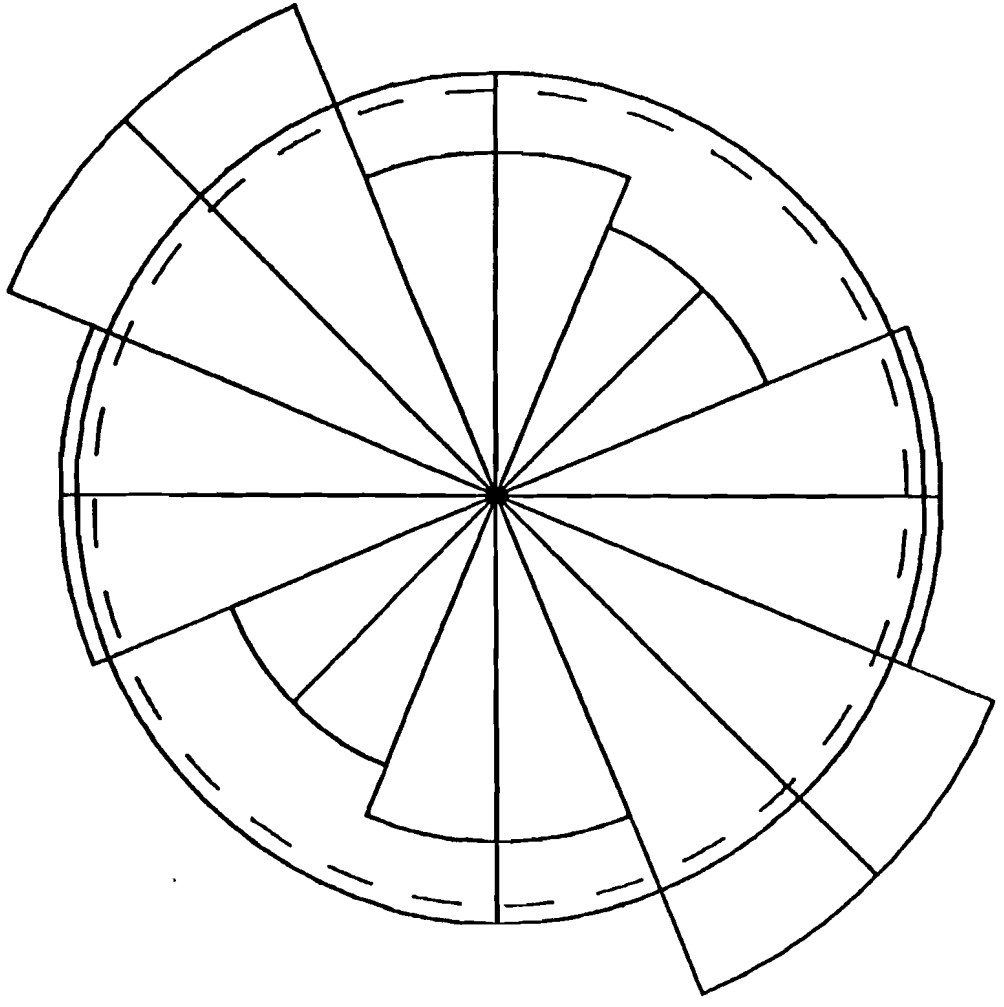
5	2100	135	45



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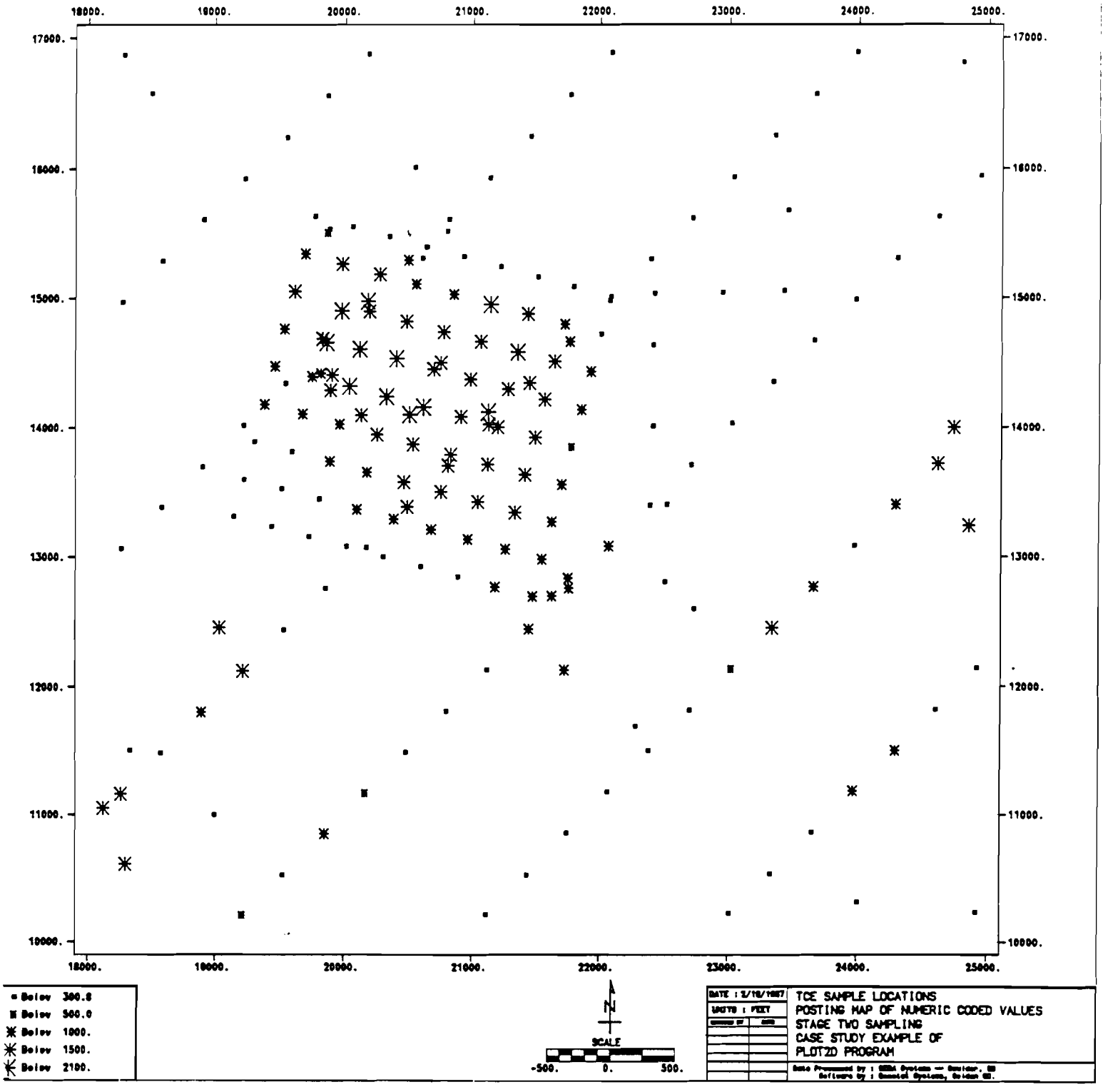
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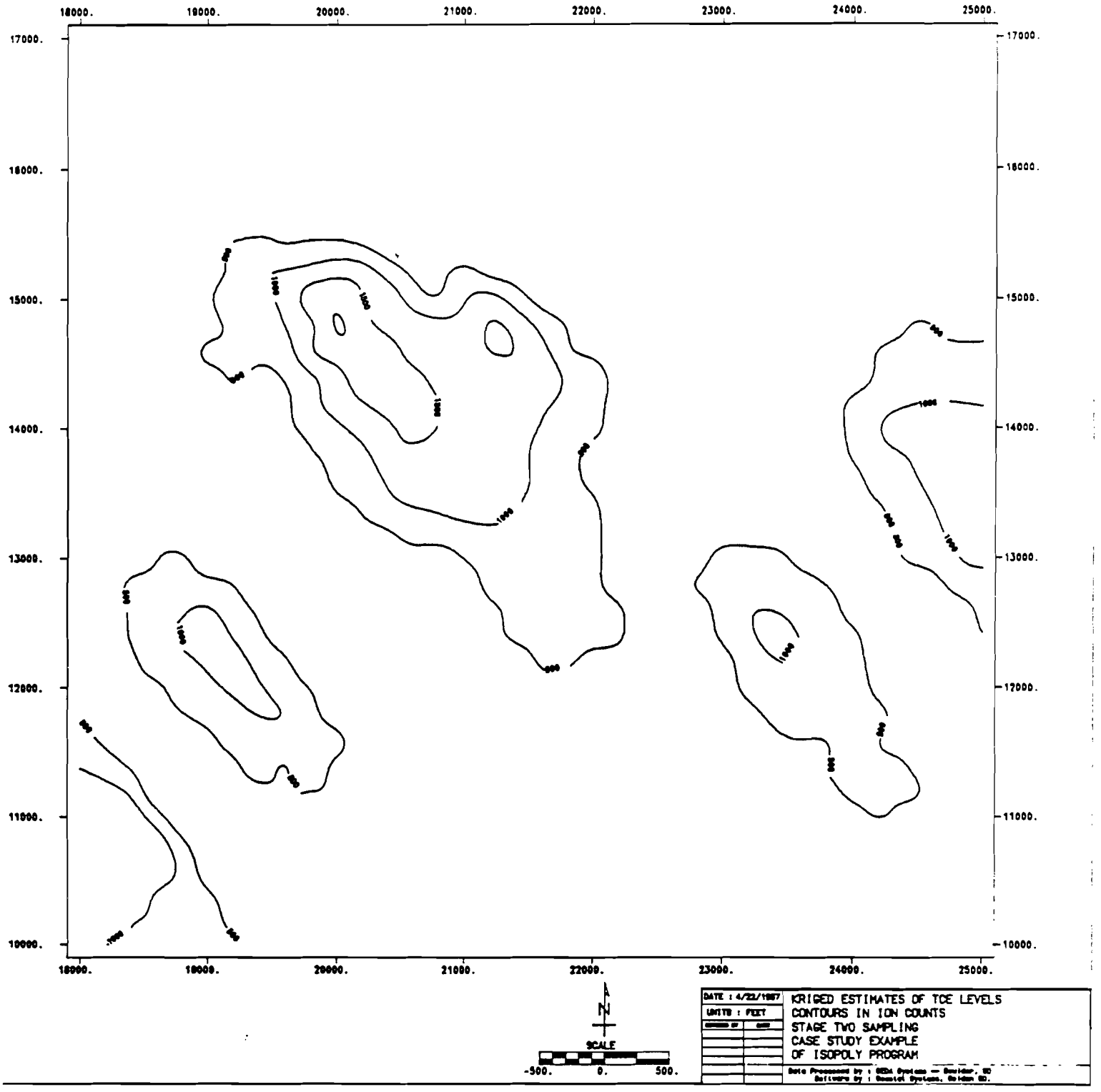
CASE STUDY EXAMPLE OF
PLOT2D PROGRAM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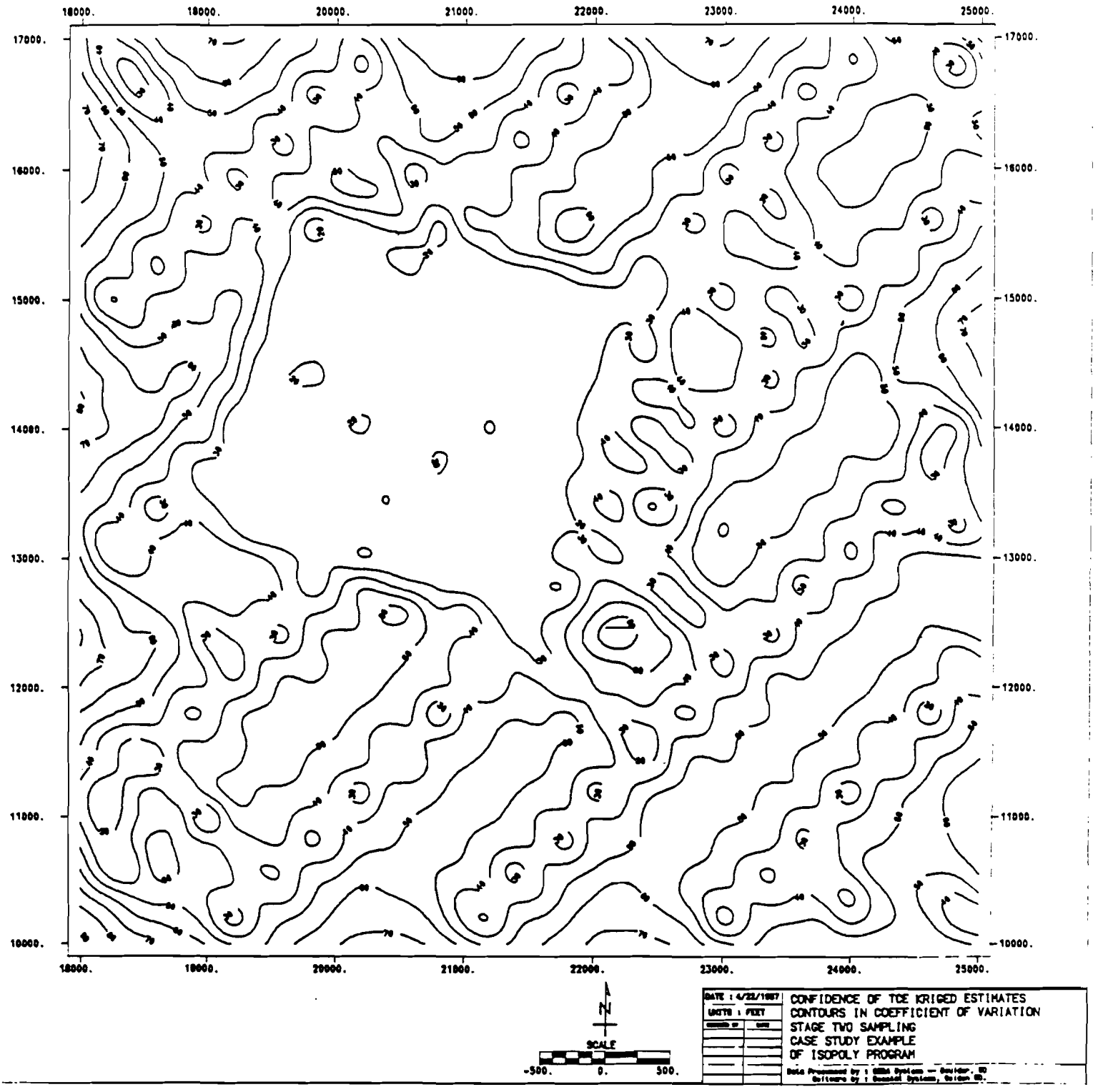
CASE STUDY EXAMPLE
OF ISOPOLY PROGRAM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CONFIDENCE OF TCE KRIGED ESTIMATES
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STAGE TWO SAMPLING
CASE STUDY EXAMPLE
OF ISOPOLY PROGRAM

GEO ENVIRONMENTAL DATA ANALYSIS

THE INSITE™ SYSTEM

A TECHNICAL BRIEF

The INSITE System is a sophisticated, integrated software system designed to give the most precise estimate possible of the extent and quantity of contamination. Using advanced geostatistical techniques, the system is invaluable for determining optimum sampling geometries, assessing contamination fronts, and mapping the results of your investigations. The problem solving power of The INSITE System can be applied anywhere and anytime a spatial relationship exists between samples. INSITE is a planning and management tool as well as an assessment and monitoring tool.

The complete INSITE System consists of an integrated set of menu-driven computer programs. Each module is supported by an extensive on-line help system. The system is designed to combine the professional's knowledge and expertise with advanced computer estimation and mapping techniques to produce valid and objective evaluations. The following is a technical description of each program and their corresponding function.

PRELIMINARY DATA ANALYSIS

HISTO HISTO calculates histograms of up to 20 variables. Relative and cumulative histograms can be computed in both real and logarithmic space. Output includes missing value indicator, lower/upper limitation for sample variables, mean and standard deviation. The results are represented by histograms of composited geologic or concentration values and computes the statistics of their distributions. The program also plots both the relative and cumulative frequency curves of one or two variables. Options include data log transformation, three parameter log transformation, missing value indicator, lower/upper limitation for sample variables and affine correction for block distributions. In addition to the histogram, the HISTO output includes the statistics of the graph: mean, variance, median, minimum value and standard deviation.

DCLUST DCLUST de-clusters data to prevent results from being biased in areas of high sampling density. This is accomplished by taking either averages of samples in cells of a 3D grid or randomly picking one sample in each cell. The analyst can select the cell size and block to calculate and obtain the statistics of the results. DCLUST will display the input data including, complete logarithmic transformations of variables and print the mean and standard deviation.

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CORREL CORREL computes the correlation coefficient between a paired data set or between two variables in the same data set. The correlation coefficient determines the degree of confidence with which an analyst can predict the corresponding value in a pair given one value. CORREL produces scatter diagrams showing the correlation between the pairs.

SECT SECT plots the profile of drill holes as projected on a given section plane. There are five ways to select the drill holes to be plotted and four ways to represent the assay intervals along the drill holes. The program imposes no limit on the orientation and location of the section plane. Two variables in a numeric, character or histogram format can be plotted along the hole. When the data produces maps that cannot be drawn in a single run of the plotter, SECT automatically splits the map into sections which can be assembled. Areas of high drilling density can be masked to prevent over plotting of the data.

POLYGN POLYGN computes and plots polygons of influence around sample locations. There are three ways to limit the lateral extent of the polygons: a user-defined window, property limits, or maximum distance of influence around the sample location. The program imposes no limit on the amount of data that can be processed.

COMPOS COMPOS composites vertically irregular drill hole data to give each sample its proper weight in estimation. The program enables the user to produce composites in three modes: by a constant length starting at the surface; by a constant level; or by a lithology type or rock code. Output reporting includes two files: a composite file of 3D coordinates and composite value, and a composited drill hole file. COMPOS options include the treatment of gaps, density variation, recovery, weight, units, flag length, lithology type or rock code, and number of values.

GEOSTATISTICS

VARIO3 In geologic studies, samples taken closely together tend to have values that are more similar than samples taken farther apart. A variogram is a way of quantifying and illustrating this spatial relationship. VARIO3 computes variograms - directional graphs that show how sample values vary as the distance between samples increases. In a single pass, VARIO3 computes absolute, general relative, local relative, logarithmic, and indicator variograms in two or three dimensions. The analyst can define the computation parameters and calculate the variography of up to 25 variables in five directions during a single run. The results can be illustrated on a printer, graphics screen, or plotter.

VMODEL This is a highly interactive display program designed for the accurate and consistent modeling of variograms. Using the output of the VARIO3 program, the user selects direction, type, and the parameters of the proposed theoretical model. VMODEL draws the proposed theoretical over the experimental curve on the screen. Spherical, linear, exponential, gaussian, and hole effect models may be chosen. Experimental points are displayed with coded symbols to indicate the number of pairs used in each calculation. VMODEL can also model using only user defined points. The modeled variograms and the an "anisotropy rose" of the variance structure can be illustrated on a printer, graphics screen, or plotter.

KRIGE3 Kriging is a geostatistical technique that produces the optimal estimation of unsampled points or blocks from known sample values. In statistical terms optimal means that the estimated values are produced with the smallest possible error and without systematic bias. KRIGE3 utilizes a user-specified variogram model to estimate two or three dimensional areas. It produces a regular grid of estimated values, a grid of estimated values and a grid of the standard error of estimation by either regular, lognormal or indicator kriging methods. The program will krige blocks or points positioned by real coordinates. Several built-in variogram models may be specified by the analyst. These include spherical, linear, exponential, gaussian or lognormal models with zonal or geometric anisotropies.

SPACE The Sample Placement and Confidence Evaluation (SPACE) program performs specialized kriging functions. These include the kriging of non-rectangular areas and the application of geostatistical estimation techniques and cost benefit analysis to optimize additional sampling at a site. The primary use of the SPACE program is to evaluate sample placement and the degree of confidence associated with kriging estimates within a defined area.

KRIJAC KRIJAC allows the professional to objectively compare different variogram models. The analyst can then select the one that produces the smallest nonbiased estimate errors during the kriging process. KRIJAC computes these estimation errors by kriging a data point with the surrounding data points in the test area. The analyst controls the location and extent of the test area, the size of the kriging matrix, and the type of variogram model used in the validation process.

KRIREC KRIREC computes contaminant block values on a 3D regular grid using either multi-gausian or disjunctive kriging. These two kriging methods allow the perspective of intra-block grade distribution in the estimation. KRIREC computes histograms and variograms for selected units. These units can be sample points, blocks or the entire contaminant body. All the features of KRIGE3 are available including optimization of neighbor samples, 3D search ellipsoid in any orientation, processing of a partial grid and full definition of the variogram model. KRIREC output includes both a numerical print file and a block plot showing each block, location, number of samples to estimate and the tonnage and concentration of each block.

SPATIAL CONSTRAINTS

LIMIT3 LIMIT3 limits the extent of estimation by creating a user-defined data envelope. Only values that are within the area or volume of interest are utilized in the estimation programs; increasing accuracy and precision. The program will define the limits of a block when the user specifies the cut-off values. LIMIT3 applies those values directly to the concentration of the composites. Plotting level or section maps with the estimated limits of a given envelope is a program capability.

GENL3D GENL3D imposes user-specified boundaries within a 2D/3D block model. The limits are polygonal lines with any number of vertices. The limits can be defined as a geologic or property type; a level or section; or a series of equally spaced levels or section planes of the block model. Each polygon is identified with a level or section index and a type index such as rock code. GENL3D generates a L3D file corresponding to any type in the input limit file and can show which blocks of a 3D grid are of a given type. In addition to producing L3D files for other programs, GENL3D has a plotting option to produce maps of the digitized vertices in each level or section plane. Printer output includes information about each section or level and the 3D totals of the sections or levels: the total number of blocks of the selected type, half perimeters of all groups of blocks along x and y axis, the surface area of all the blocks, the volume of all the blocks, and the tonnage of all the blocks.

SCREEN SCREEN uses a block limit file to select either sample composites or blocks within specified geologic or property limits. The program can be used to limit data before variogram computation or to select data before or after kriging.

DIGIT DIGIT reads point coordinates from a digitizer and allows on-screen editing of the point file created. For each set of X-Y coordinates, the program will accept one or two additional values. The Z values may be entered as constants for digitizing a contour map or as unique variables that change at each data point. DIGIT can display the point file on the graphic screen as individual points, as the vertices of a traverse, or as coordinates (X,Y,Z). The program can also calculate the area and perimeter of a traverse and record it in a separate file for use in later calculations. DIGIT currently interfaces with Houston Instruments, CalComp, SAC Sonic, Sumagraphics, Numonics and Digipad digitizers.

VOLUMETRICS

GRIDDER The volumetrics suite of programs will take the costly guesswork out of manual cut and fill estimation. GRIDDER imposes a grid or mesh over the data sets for the current topography of an excavation area. The program calculates an inverse distance to a power estimation of both data sets, providing the calculation base for VOLUME. The grid produces cells of a user-specified size, which can be altered to produce results of a given accuracy. Three dimensional views and contour maps can be produced with MAP3D and ISOPOLY.

VOLUME This program compares the two gridded files produced by GRIDDER and calculates the difference between them in three dimensions. The output can be reported in bank cubic yards or cut/fill in linear feet. The results can be plotted in block map format. An output file for a dot matrix printer is also generated, showing land features, cross sections and haul distances.

LIMNEW LIMNEW generates screening grids to efficiently limit the extent of the calculation. The program enables the analyst to calculate cut and fill for just one area of site. This flexibility allows the analyst to experiment with different topographic models or different stages of a project.

MANAGEMENT AND REPORTING

TOXICAD TOXICAD is a highly interactive site management tool. Using the block model produced by the KRIGE3 program, TOXICAD allows the manager to investigate various what-if scenarios for a project. User defined search criteria may be specified and the blocks meeting the criteria will be highlighted on the screen. New variables that are related to the kriged estimates or the error of estimation may be formulated, calculated and highlighted for each block in the site model. TOXICAD may also be used to evaluate the area that will be above a specific threshold at different levles of confidence. Reports, detailing the blocks that meet the search criteria, can be produced. In addition, the investigator has the ability to restrict the search and report function to specific geographic subareas within the project model. These subareas may correspond to property boundaries or other areas of special concern. Plot files showing the selected blocks can also be produced.

REPORT REPORT produces concentration/precision reports using either standard reporting technique or the log normal shortcut method. Using a block file from either KRIGE3 or SCREEN, the program prints a summary of estimated contamination for each cut-off interval, specified level, and contaminated volume. Using a L3D envelope from LIMIT3 or GENL3D, the user can target a portion of the block model for reporting. REPORT also permits the analyst to process flag indicators kriged in each block.

VARCUT Using the affine correction method, VARCUT calculates the histograms of contamination levels of contaminated blocks from sample data. These block histograms are interpolated from the composite data by the variance correction factor. The blocks considered in VARCUT are the selection units used to compute contaminated volumes above a specified threshold level. The program's output can be displayed for a given lithology type, the values above a given threshold value and for the entire contaminant block. The output also includes the variance correction factor, mean contaminant concentration, standard deviation, and number of samples.

DISPLAY PROGRAMS

ISOPOLY ISOPOLY is a flexible, high quality contouring program that accurately maps the results of geostatistical estimation techniques. Working with any rectangular or square grid of data, ISOPOLY will contour the estimates for each grid point. Map size is not restricted by plotter width as the program automatically splits oversize maps into bands which can be assembled. Options give the user control over axis graduation, map scaling, legend plotting and high density contour feathering. The user is also able to impose contour blanking in areas of scarce sampling.

MAP3D Three dimensional perspective views are very informative tools for illustrating the structure of various surfaces or phenomena. MAP3D uses the kriged output file of KRIGE3 to draw 3D mesh views of contamination gradients on a plotter. Options include vertical exaggeration and viewer position. MAP3D is useful for illustrating contaminant geometry.

PLOT2D PLOT2D draws sample or drill hole locations on the plotter. The user can plot a label and/or the numeric value with the location of any variable. User-specified options include map scale, axis graduation and drill hole projection. The analyst can also control the final product by screening out samples by either location coordinates or sample values. Like ISOPOLY, map size is not restricted by plotter width since oversize maps can be automatically split into sections.

BLKPLT BLKPLT is used to produce plotter and printer maps of blocks and their corresponding estimated values. The programs generate maps of kriged blocks of any size at any specified scale. Up to ten different values or variables may be displayed inside the blocks, with the format options left to the user's requirements. Input/Output format selections are available to suit most presentation needs.

COMPUTER AIDED DESIGN

IN2CAD IN2CAD is a conversion program which formats any Toxipac plot file to one compatible with AutoDesk's AutoCad system. This conversion allows the user to combine the analytical powers of INSITE with the advantages of a mature CAD system.

SIMULATION

TGAUSS TGAUSS completes the first step in a simulation study: analysis of the sample data histogram and normalization of the model. The model relates the histogram of the sample data to the histogram of standard gaussian data. This function, an expansion of Hermite polynomials, allows the option of disjunctive kriging. TGAUSS output includes: statistical analysis; definition of the normalized function; analysis of function fit; file of normalized and sample data; and a simulation, using the model, of the sample data from gaussian deviates. The variograms of the normalized sample data are analyzed with VARIO3.

SIM3 Using a given variogram, SIM3 produces simulated values of gaussian deviates either on a fixed grid or at specific points. The variogram used can be any combination of nugget effect, spherical, exponential, or gaussian models. Two or three dimensional anisotropies, both geometric and zonal, can be accommodated. The program will provide a statistical analysis of the sample point distribution at both sample and grid points. SIM3 will also produce a printer map of the simulated grid points.

SIM3C SIM3C performs a conditionalization of the random normal deviates produced by SIM3. This conditionalization process transforms the original normalized values to grid values that closely resemble the original sample values. The new values are interpolated from the sample values by kriging. Three different sets of values are used in this process: normalized real data at sample points (TGAUSS); simulated values at sample points (SIM3); and simulated values at grid points (SIM3). The conditionalization may be restricted to a specific area of the grid. The analyst defines the variogram function and the kriging ellipsoid search zone parameters. As with SIM3, the program provides a statistical analysis of the distribution of the sample points at both sample and grid points. SIM3C will also produce a printer map of the simulated grid points.

ITGAUSS ITGAUSS transforms the SIM3 or SIM3C model back into the original histogram distribution. The model is defined by the expansion of a transformation function with Hermite polynomials. This expansion is derived by TGAUSS using experimental data distributed according to the required model. Statistics, variograms, maps, and a sorted list of the transformed values can be produced by ITGAUSS.

UTILITY PROGRAMS

ROTATE In three dimensional space, ROTATE will rotate and/or translate coordinates. The program permits the analyst to look at directions oblique to a plane of coordinates. It will also help the analyst to compare different coordinate systems by changing them to a common coordinate system.

PREPLT This program allows on-screen preview of a plot file. PREPLOT displays a Geostat plot file on a graphics screen, permitting the analyst to examine a plot before hardcopy plotting on a plotter.

PENPLT PENPLT is a plotter driver that translates a Geostat plot file. The program currently interfaces with Houston Instruments or Ioline DM/PL, Hewlett-Packard HP-GL, and Calcomp 907 formats.

SHUFFLE If a block model has been split for a more accurate geologic estimation, SHUFFLE will integrate the parts into one model.

NIBBLE NIBBLE splits a large data file into several smaller files. This application is useful for editing a file and for transporting data between computers.

3DCOOR 3DCOOR is used interactively with a bore hole data base to calculate the 3D coordinates of points along a bore hole. The location can be calculated for any point down the hole or at regular distances. The original drill hole data base can be modified or appended at any time. 3DCOOR can be useful for ongoing drilling projects in which drill hole data is continually updated. Output can also aid in mapping drill hole traces in both the plan and cross section.

System Requirements: **The INSITE System** is designed to run on IBM PC/XT/AT or a 100% compatible machine with DOS 2.0 or higher. The recommended configuration is 640K RAM, a 10MB or larger fixed disk drive, 8087 or 80287 math co-processor, serial and parallel ports. Peripherals can include a dot matrix printer, graphics monitor, plotter, and digitizer.

The programs used in **The INSITE System** was developed by Geostat Systems International, Inc. of Golden, Colorado to meet the needs of the environmental professional. INSITE has been proven successful as an accurate estimation, budgeting and planning tool. The INSITE System is available from GEDA Systems of Boulder, Colorado.

GEO ENVIRONMENTAL DATA ANALYSIS

THE INSITE™ SYSTEM

ENVIRONMENTAL SOFTWARE PRICE LIST

PRELIMINARY DATA ANALYSIS

HISTO	Histograms	$ 800.00
DCLUST	Sample declustering	$ 700.00
CORREL	Correlation statistics	$ 700.00
SECT	Drill hole crossections	$ 2850.00
POLYGN	Polygon generation and display	$ 1500.00
COMPOS	Drill hole data compositing	$ 1500.00

GEOSTATISTICS

VARIO3	3D variogram computation	$ 1900.00
VMODEL	Interactive variogram modelling	$ 750.00
KRIGE3	3D kriging of blocks or grids	$ 3000.00
SPACE	Sample placement and confidence evaluation	$ 2500.00
KRIVAR	Interactive grid optimization	$ 1000.00
KRIJAC	Variogram validation	$ 1500.00
KRIREC	Multigaussian/disjunctive estimation	$ 2500.00

SPATIAL CONSTRAINTS

LIMIT3	Area/volume limiting capabilities	$ 1000.00
GENL3D	L3D limiting files by digitizing	$ 1000.00
SCREEN	3D sample/block screening	$ 1000.00
DIGIT	Digitizer interface (Calcomp, Houston Inst. Summagraphics, Numonics)	$ 500.00

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1221 Pearl Street, Boulder, CO 80302 (303) 447-9925

MANAGEMENT AND REPORTING

REPORT	3D block model reports	$ 1250.00
VARCUT	Grade distribution of blocks	$ 1000.00
TOXICAD	Interactive site management	$ 2500.00

DISPLAY PROGRAMS

ISOPOLY	Contouring 2D/3D gridded data	$ 2500.00
MAP3D	Mesh diagram of 2D gridded data	$ 2000.00
PLOT2D	Posting maps	$ 1250.00
BLKPLT	Slice maps of 3D block model	$ 1250.00

COMPUTER AIDED DESIGN

IN2CAD	Converts plot files to ACAD	$ 700.00

SIMULATION

TGAUSS	Normalization of sample data	$ 1350.00
SIM3	3D stochastic simulation	$ 2000.00
SIM3C	3D conditioning of simulated data	$ 1500.00
ITGAUSS	Denormalization of simulated data	$ 750.00

VOLUMETRICS

GRIDDER	Inverse Distance Gridding	$3500.00
VOLUME	Grid File Comparison	included
LIMNEW	Limiting Screen Grids	included

UTILITY PROGRAMS

ROTATE	3D rotation of coordinate grids	$ 500.00
PREPLT	Interface to graphics screen	$ 250.00
PENPLT	Interface to plotters	$ 250.00
DIGIT	Interface to digitizers	$ 500.00

All prices subject to change without notice. The above prices are effective as of October 1987.

CONDITIONS OF SALE

Individual programs include one copy of the user's manual, one diskette with the program in executable form, a menu to enter controls and the data files to reproduce the test run shown in the manual.

Graphic output programs require the use of PENPLT and/or PREPLT interface programs.

Package discounts of 15% apply to any combination of programs whose total price is greater than $10000.00.

Training and installation is included on any order greater than $5000.00. One day of on-site training is provide for orders over $5000.00. Three days are included in orders of $10,000.00 or more and five days for $25,000.00. The client is responsible for all expenses incurred during training including travel and lodging.

Multiple copy discount rates apply if ordered within six months: 25% off for the second copy, 50% off for the third and subsequent copies ordered within six months of the original order. If required, additional training will be billed at the standard consulting rates.

Special licenses are available including site, corporate, and source licenses. A site license for up to five CPU's at a single location may be obtained for 2.5 times the list price, with 1.5 times regular training and installation. A corporate license for up to five sites may be obtained for three times the list price, additional sites at 10% list each. Corporate license training includes 5 sites.