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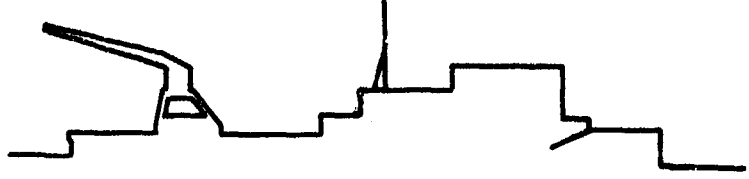
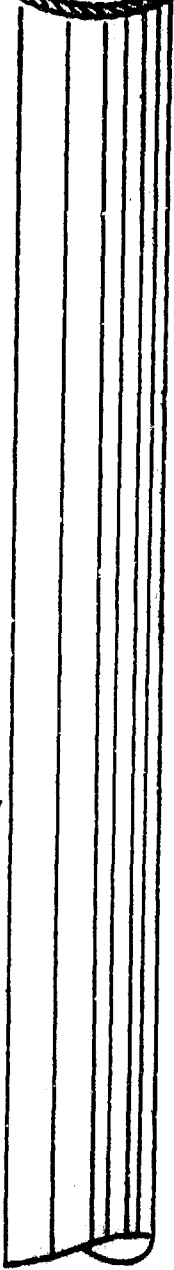
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Ocean Engineering

CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON NAVY YARD
WASHINGTON, DC 20374

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Tracor Marine



FINAL REPORT
AUTEC
BATHYMETRIC SURVEY
SITES 1 AND 2

Submitted to:
NAVAL FACILITIES
ENGINEERING COMMAND

By
TRACOR MARINE, INC.
24 August 1983

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As a follow-on to precision bathymetric surveys conducted at AUTEC Sites 1, 2 and 7 during May-July 1983, Tracor Marine conducted additional deep and shallow water surveys at Sites 1 and 2 during August 1983. Using the LCM 75 as a survey platform, the survey equipment consisted of a Krupp-Atlas- (Con't)

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Elektronik DESO-20 Fathometer System, and EDO Western Deep Water Bathymetric System, a DECCA Model 540 Trisponder Navigation System and an Autocarta II Data Acquisition System with a remote Left/Right Display Unit and 20 inch DP-3 Plotter.

The survey work at Site 1 on August 7 consisted of running 20 survey lines about a point situated approximately one-half nautical mile north of the seabuoy. The August 8 operations at Site 2 included running six survey lines approximately one-half nautical mile south of seabuoy. In addition, eight of the 20 survey lines at Site 1 were rerun. Using Sites 1, 2, 3 and High Cay proved adequate for navigation purposed. Preliminary data processing was completed for all survey lines on August 8 with demobilization on August 9. Numerous problems occurred with the fathometer systems which resulted in a delay of approximately one day on August 6. For the survey at Site 1 on August 7, the winds were typically ten knots from the southeast with waves running two to three feet. On August 8, nearly flat calm sea conditions prevailed. The purpose of this document is to present technical information on the procedures used by Tracor Marine to conduct the survey and to reduce the data. Developed 1:1 scale vertical profiles of sounding runs at Sites 1 and 2 are included in this report.

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FINAL REPORT
AUTEC BATHYMETRIC SURVEY
ANDROS ISLAND, BAHAMAS
SITES 1 AND 2

Submitted to:

Naval Facilities Engineering Command
Building 200
Washington Navy Yard
Washington, DC 20374


Contract Number
N00600-81-D-5270

Tracor Marine, Inc.
Job Number 723511

24 August 1983



Approved:


Edward Clausner
Vice President

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TABLE OF CONTENTS

<u>SECTION</u>		<u>PAGE</u>
1.0	Summary	1-1
2.0	Event Log	2-1
3.0	Navigation	3-1
4.0	Soundings	4-1
5.0	Data Processing and Deliverables	5-1

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1.0 SUMMARY

As a follow-on to precision bathymetric surveys conducted at AUTECH Sites 1, 2 and 7 during May-July 1983, Tracor Marine conducted additional deep and shallow water surveys at Sites 1 and 2 during August 1983. Using the LCM 75 as a survey platform, the survey equipment consisted of a Krupp-Atlas-Elektronik DESO-20 Fathometer System, an EDO Western Deep Water Bathymetric System, a DECCA Model 540 Trisponder Navigation System and an Autocarta II Data Acquisition System with a remote Left/Right Display Unit and 20 inch DP-3 Plotter.

The Tracor Marine Survey Team consisted of Dr. Lanny Yeske, Project Manager, Mr. Ira Kaplan of Krupp-Atlas-Elektronik, Mr. Dallis Copeland, Acoustic Technician, and Mr. Stan Copeland, Navigation Technician. Navy representatives included Mr. Phil DeNolfo, NUSC-New London, and Mr. Ernie Joyal, NUSC-West Palm Beach.

The survey work ^{was run} at Site 1 on August 7 consisted of running 20 survey lines about a point situated approximately one-half nautical mile north of the seabuoy. ^{At} Site 2 ^{on August 8} ~~included running~~ ^{weren't run} six survey lines approximately one-half nautical mile south of the seabuoy. ^{Eight} ~~In addition,~~ eight of the 20 survey lines at Site 1 were rerun. Using Sites 1, 2, 3 and High Cay proved adequate for navigation purposes. ~~Preliminary data processing was completed for all survey lines on August 8 with demobilization on August 9.~~ Numerous problems occurred with the fathometer systems which ^{caused a 1-day} ~~resulted in a delay of approximately one day on August 6.~~ For the survey ^{at} Site 1 on August 7, the winds were typically ten knots from the southeast with waves running two to three feet. On August 8, nearly flat calm sea

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conditions prevailed. ~~The purpose of this document is to present technical information on the procedures used by Tracor Marine to conduct the survey and to reduce the data.~~ Developed 1:1 scale vertical profiles of sounding runs at Sites 1 and 2 are included, in this report. *(Keywords:)*

1473
In addition to this report, the original bathymetric analog records from each echosounder, survey vessel track sheets for each area surveyed, and developed sounding sheets at 1:1,080 scale for each area surveyed, have been given directly to Mr. Ernie Joyal of NUSC-West Palm Beach.

In accordance with NUSC discussions, the original magnetic data tapes and data acquisition records collected during this survey have been retained by Tracor Marine and are available for further data reduction/refinement as desired.

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2.0

EVENT LOG

6 August 1983

Personnel and equipment arrive AUTECH at 0830. Installed Trisponder remote transmitter/receiver and directional antennas at Sites 1, 2, 3 and High Cay. Completed loading of equipment on LCM 75. Equipment tested satisfactorily at dockside. 1300 underway for survey operations. Encountered difficulties with DESO-20 echosounder in obtaining depths greater than 100 meters. At 1530 ordered replacement EDO echosounder system from Tracor Marine Headquarters. Replacement unit arrived AUTECH at 1940. Repairs accomplished to DESO-20 to permit sounding operations to 800 meter depths.

7 August 1983

LCM underway at 0800 for Site 1 operations using both DESO-20 and EDO fathometer systems. 1930 completed operations with 20 lines surveyed.

8 August 1983

Underway 0700 for Site 2 operations. 1400 completed operations at Site 2 with 6 lines surveyed. Continued data processing. At 1700 returned to Site 1 and resurveyed lines 13 through 20. Again, experienced digitizer difficulty with DESO-20 echosounder at Site 1.

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9 August 1983 Vessel demobilization. Tracor Marine personnel and equipment return to West Palm Beach at 1700. Final report preparation continues.

15 August 1983 Discussions on final report and deliverables with NUSC in Fort Lauderdale.

24 August 1983 Final report and analysis forwarded to NAVFACENCOM with copies to NUSC-New London and West Palm Beach.



3.0 NAVIGATION

The Tracor Marine supplied Decca Model 540 Trisponder System and Autocarta II Data Acquisition System with helmsman's Left/Right Indicator were used to position the LCM during survey operations. As shown in Figure 1, for the survey at Site 1, Trisponder antennas were located at Sites 1, 2 and High Cay. For the survey at Site 2, antennas were installed at Sites 1, 2, 3 and High Cay. Geographic positions, antenna heights and Universal Transverse Mercator coordinates for the shore NAVAIDS sites are given in Table 1. The ship's Trisponder antenna was located within one meter of the DESO-20 transducer position.

According to the manufacturer, the accuracy of the Model 540 Trisponder System is typically ± 1 meter. Because precise geodetic coordinates for High Cay were not available, the antenna location was determined using the Trisponder itself and is also subject to an error of ± 1 meter. Similarly, the Trisponder antenna was located approximately 2 meters from the alleged reference point on the Site 2 radar tower. In the unlikely event of all errors being additive, the maximum position error for Site 1 operations is ± 4 meters and ± 3 meters for Site 2 operations. If desired, High Cay could be surveyed and corrections applied to the Site 2 antenna location to reduce the overall error to ± 1 meter.

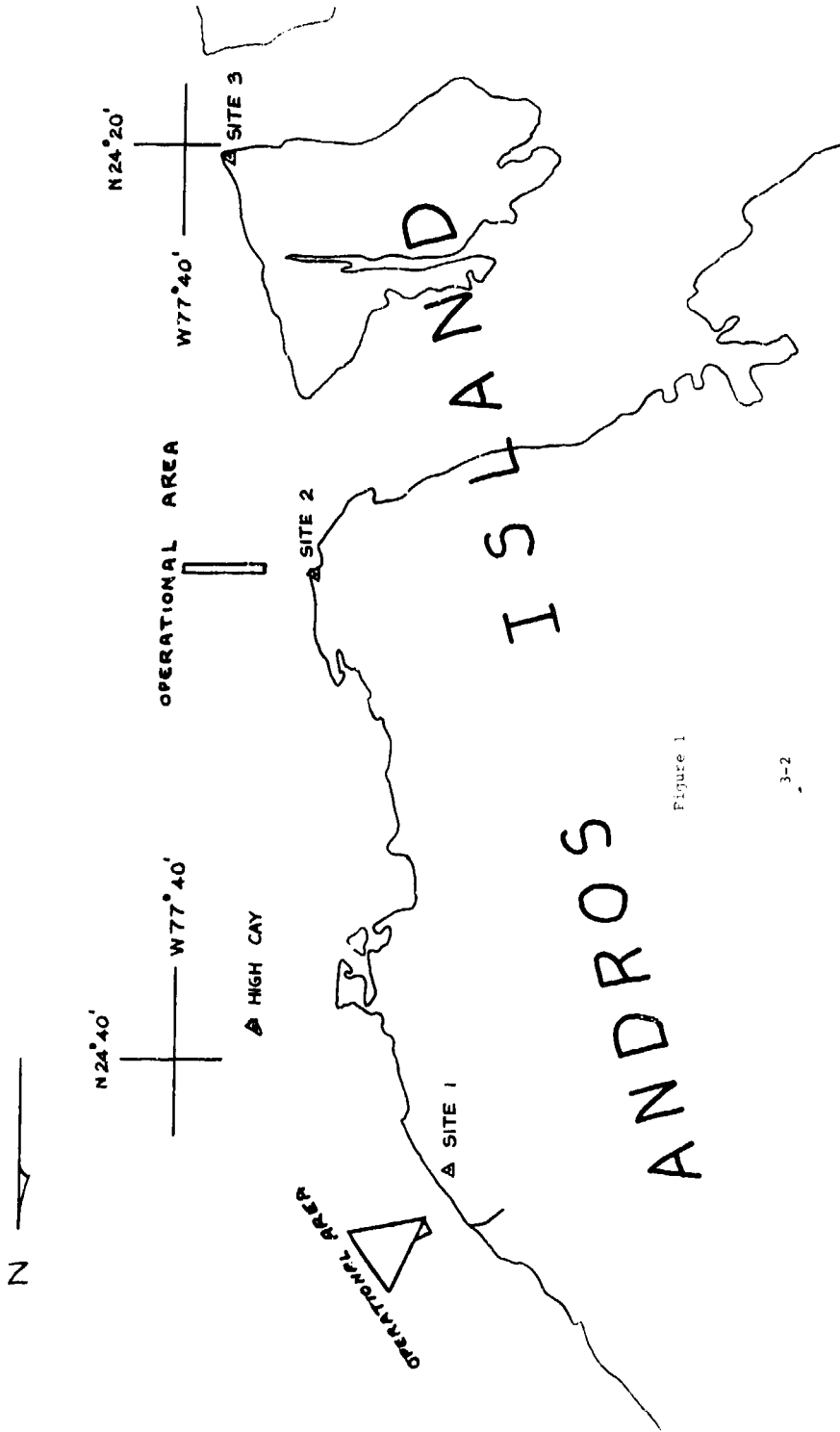


Figure 1

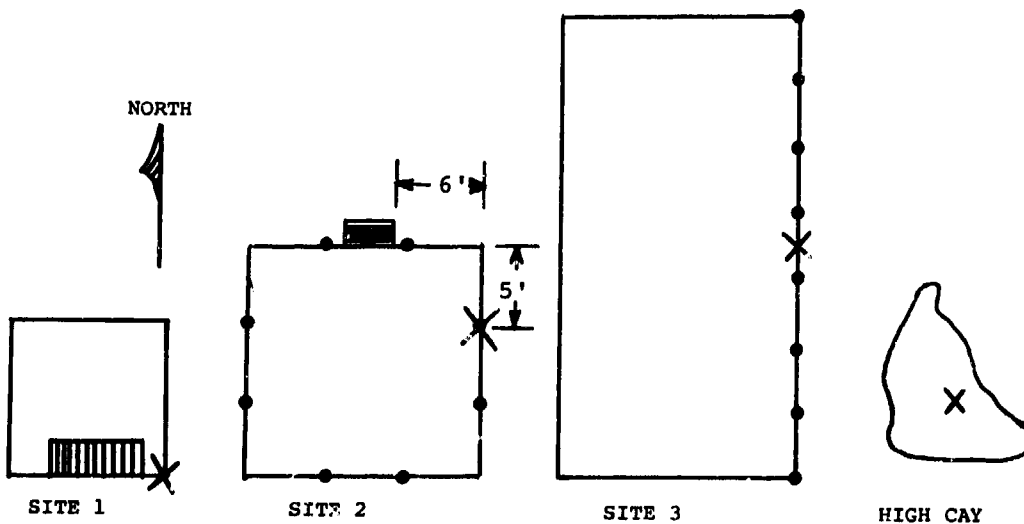
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TABLE 1

AUTEC ANTENNA LOCATIONS

Site 1	N24 ^o 42' 20.97"	N 2,735,041.749
	W77 ^o 45' 54.89"	E 220,223.007
	HT = 90' = 27.4 m	
Site 2	N24 ^o 29' 53.97"	N 2,711,958.265
	W77 ^o 43' 10.55"	E 224,389.325
	HT = 66.3' = 20.2 m	
Site 3	N24 ^o 20' 17.0743"	N 2,694,131.454
	W77 ^o 40' 59.9682"	E 227,723.084
	HT = 60' = 18.3 m	
High Cay	N24 ^o 38' 53.33"	N 2,728,511.14
	W77 ^o 41' 45.56"	E 227,107.91
	HT = 35' = 10.7 m	



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4.0 SOUNDINGS

Soundings were taken with a Krupp-Atlas Elektronik DESO-20 Bathymetric System, supplied by Tracor Marine. A Raytheon Model 719C Fathometer System was also provided as a backup for the DESO-20 and provided analog information but was not digitized. Soundings were taken using both the 33 KHZ 18° beam and 210 KHZ 9° narrow beam transducers with the sounding information digitized for subsequent plotting. The transducer was mounted over the side of the LCM at a fixed depth of 1.5 meters which is incorporated in the soundings on the smooth sheets. According to the manufacturer, the precision of the DESO-20 using 33 KHZ is .12% of the depth plus 9.5 cm, whereas for 210 KHZ the precision is .12% of the depth plus 1.5 cm.

Tidal corrections, ranging from 0 to 2 feet, were available but were not applied to the data in order to provide deliverables upon completion of the survey. If desired, these corrections could be applied at a later date.

At both Sites 1 and 2, it was feasible to compare soundings at principal line and crossline intersections and total agreement in soundings was observed. The DESO-20 soundings were also verified by checks at the seabuoy and comparisons with the EDO Western system. In addition, various soundings in excess of 700 meters were plotted on Naval Oceanographic Office Chart 10001 (Submarine Topography of AUTEK FORACS Range) where close agreement between Tracor Marine and NAVOCEANO soundings was achieved.

On August 7 and most of August 8, the DESO-20 performed well in depths of 850 meters. However, on steep bottom slopes and late on August 8, the digitizer could not accurately track the bottom.



5.0 DATA PROCESSING AND DELIVERABLES

Soundings and track sheets are UTM projections using the Clark 1866 Spheroid North American Datum of 1927. While vessel track sheets are plotted at various scales, all sounding sheets are plotted at a scale of 1:1,080. All trackline and sounding sheets are computer generated using the Autocarta II and DP-3 20 inch plotter. Obvious sounding errors are noted on the sounding sheets.

As a result of discussions with NUSC on 8 August 1983, 1:1 scale vertical profiles of the various sounding lines are provided in this section. These profiles are also computer generated; however, obviously erroneous soundings have been edited from the computer plots. Figure 2 shows the general orientation of the 20 survey lines run at Site 1. The vertical profiles for lines 1 through 12 are provided in Figures 3 through 14. Because of the large off-track distances of the vessel on line 3, this profile was hand drawn with soundings interpolated along the prescribed track. The reference point for these profiles is L $24^{\circ} 43' 47''$ N $\lambda 77^{\circ} 45' 37''$ W or UTM 220,779.389 X 2,737,679.446 Y.

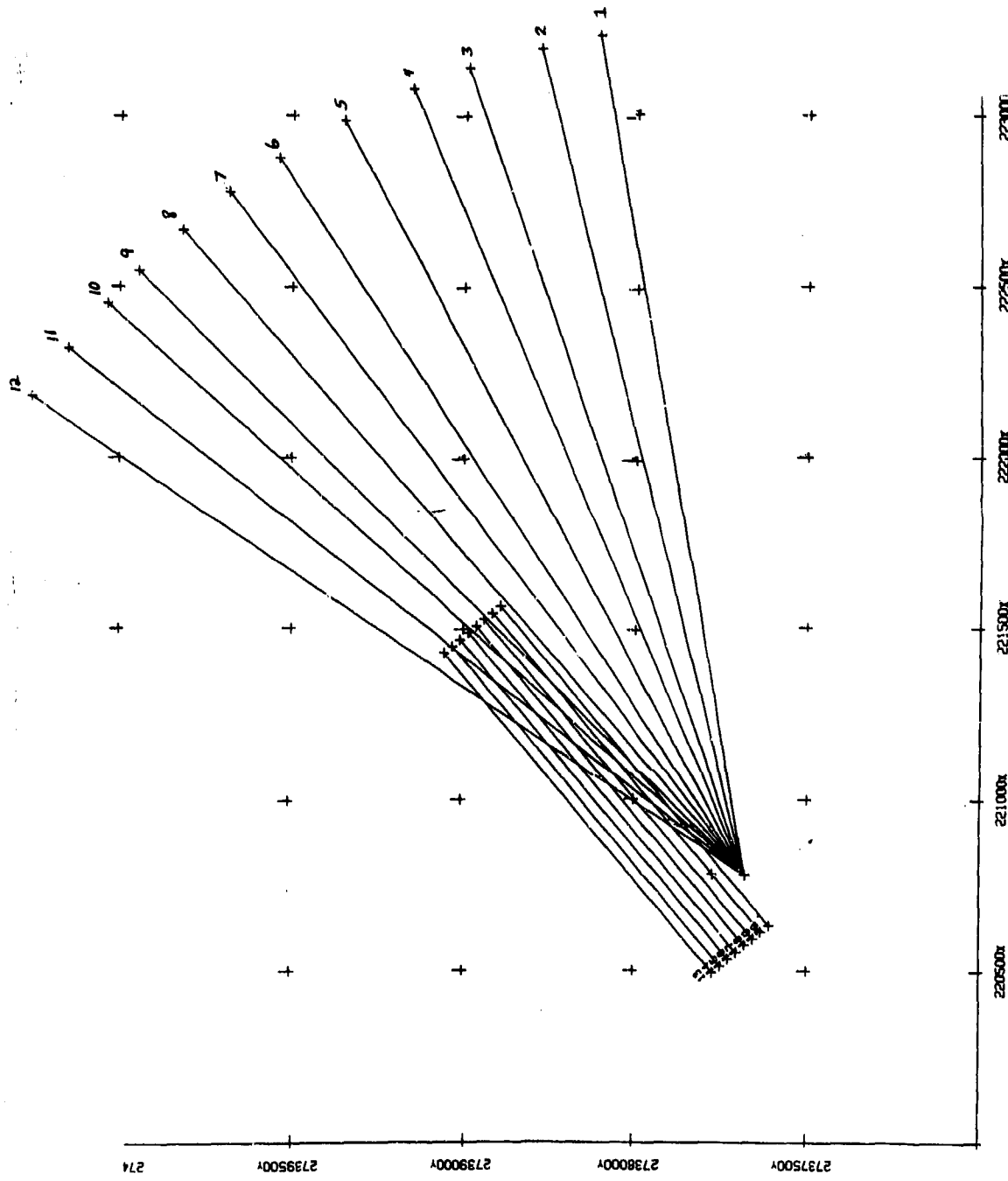
The soundings along lines 13 to 20 do not lend themselves to vertical profiles. Accordingly, Figure 15 shows depth contours in the region based upon both the 7 and 8 August 1983 data. The reference for these contours is a line oriented 320° T/ 140° T passing through a point located at L $24^{\circ} 43' 49.04''$ N $\lambda 77^{\circ} 45' 50.54''$ W or UTM 220,400 X 2,737,750 Y.

At Site 2, all six tracklines are referenced to a line oriented 353° T/ 173° T passing through a point located at L $24^{\circ} 29' 25.32''$ N $\lambda 77^{\circ} 41' 55.74''$ W or UTM 226,479 X 2,711,035 as shown in Figure 16. The vertical profiles for five of these lines are

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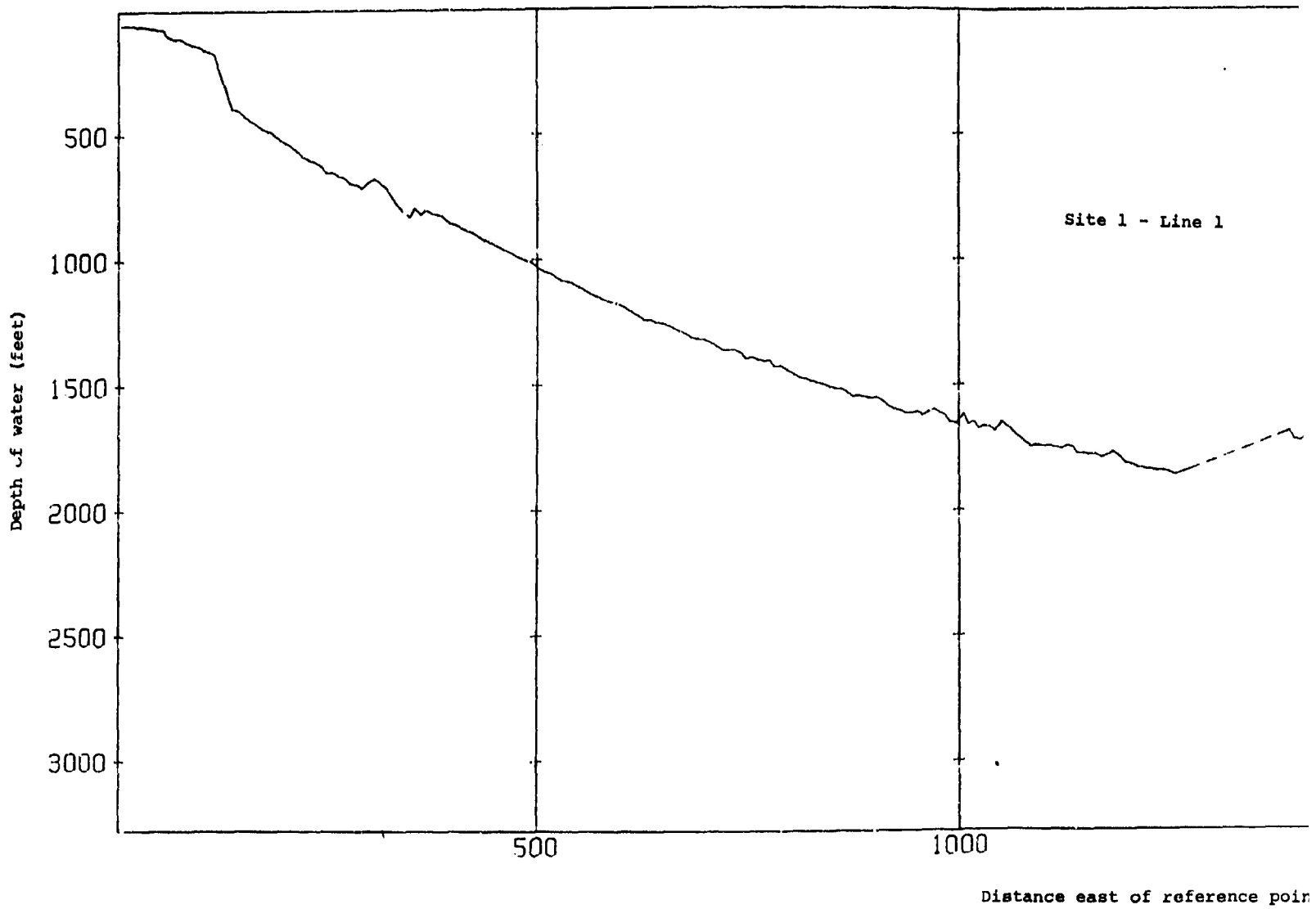


provided in Figures 17 through 21. The nature of the data along line 2 did not lend itself to vertical profiling.



ORIENTATION OF SURVEY LINES AT SITE ONE

Figure 2



1

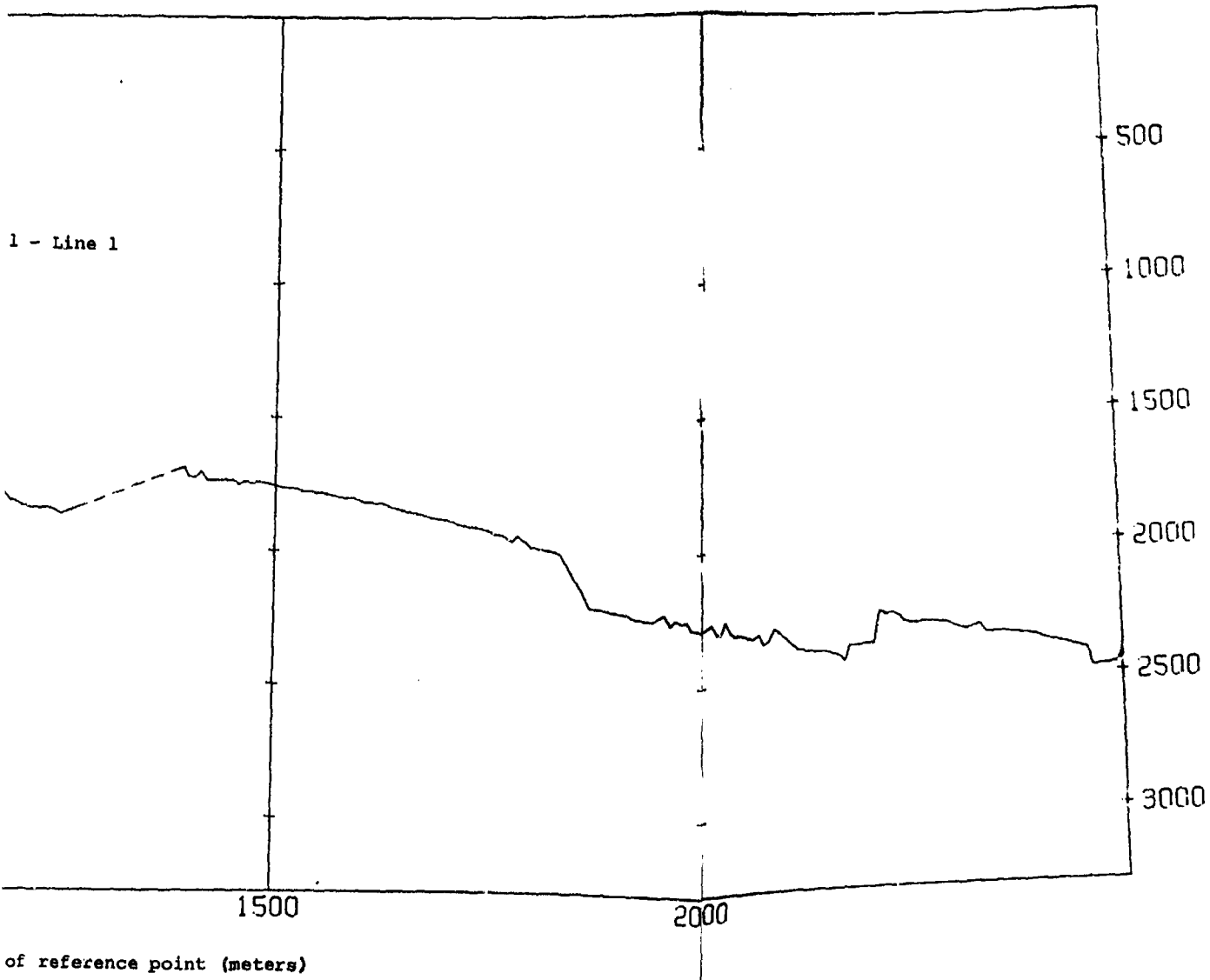


Figure 3

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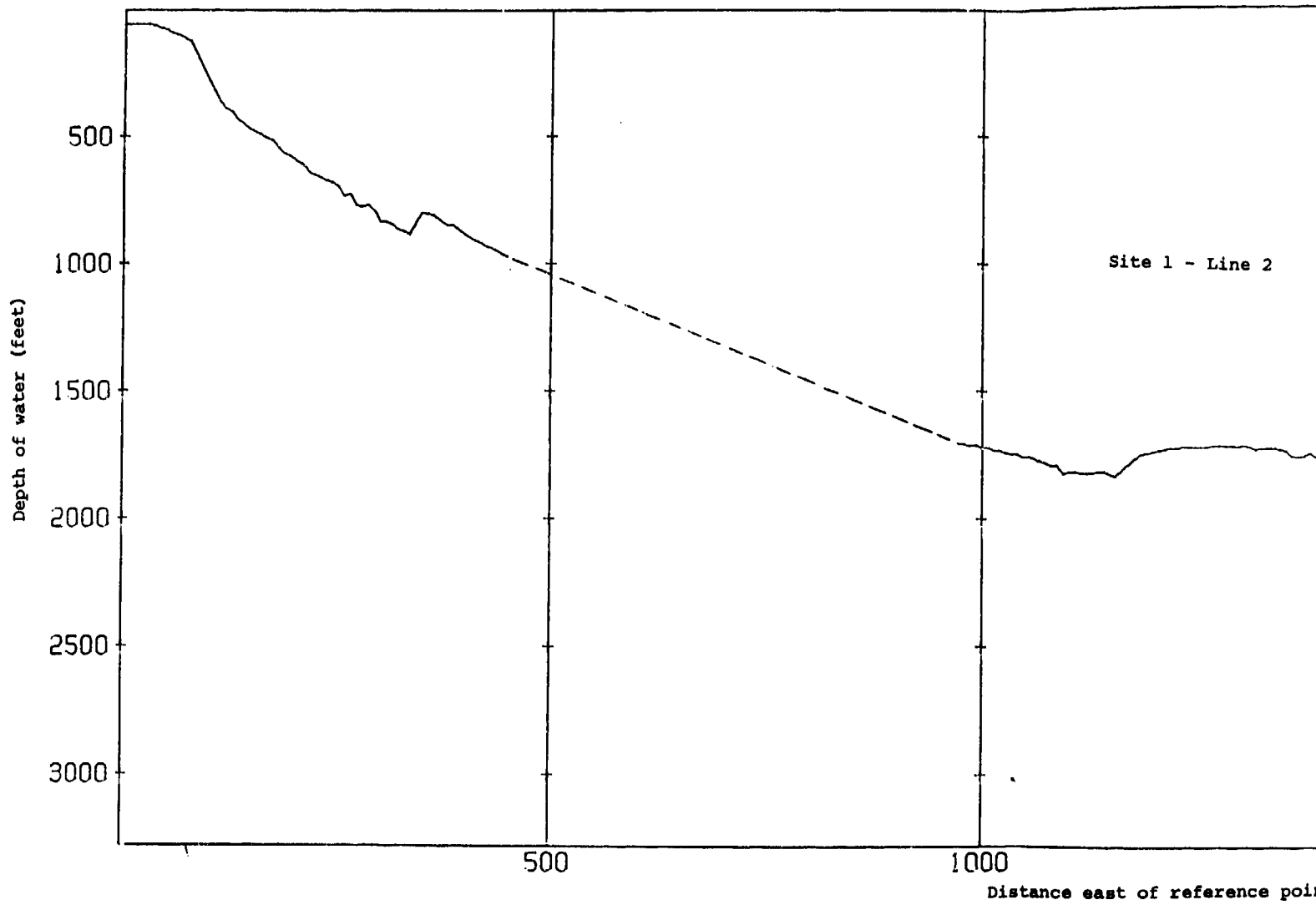


Figure 4

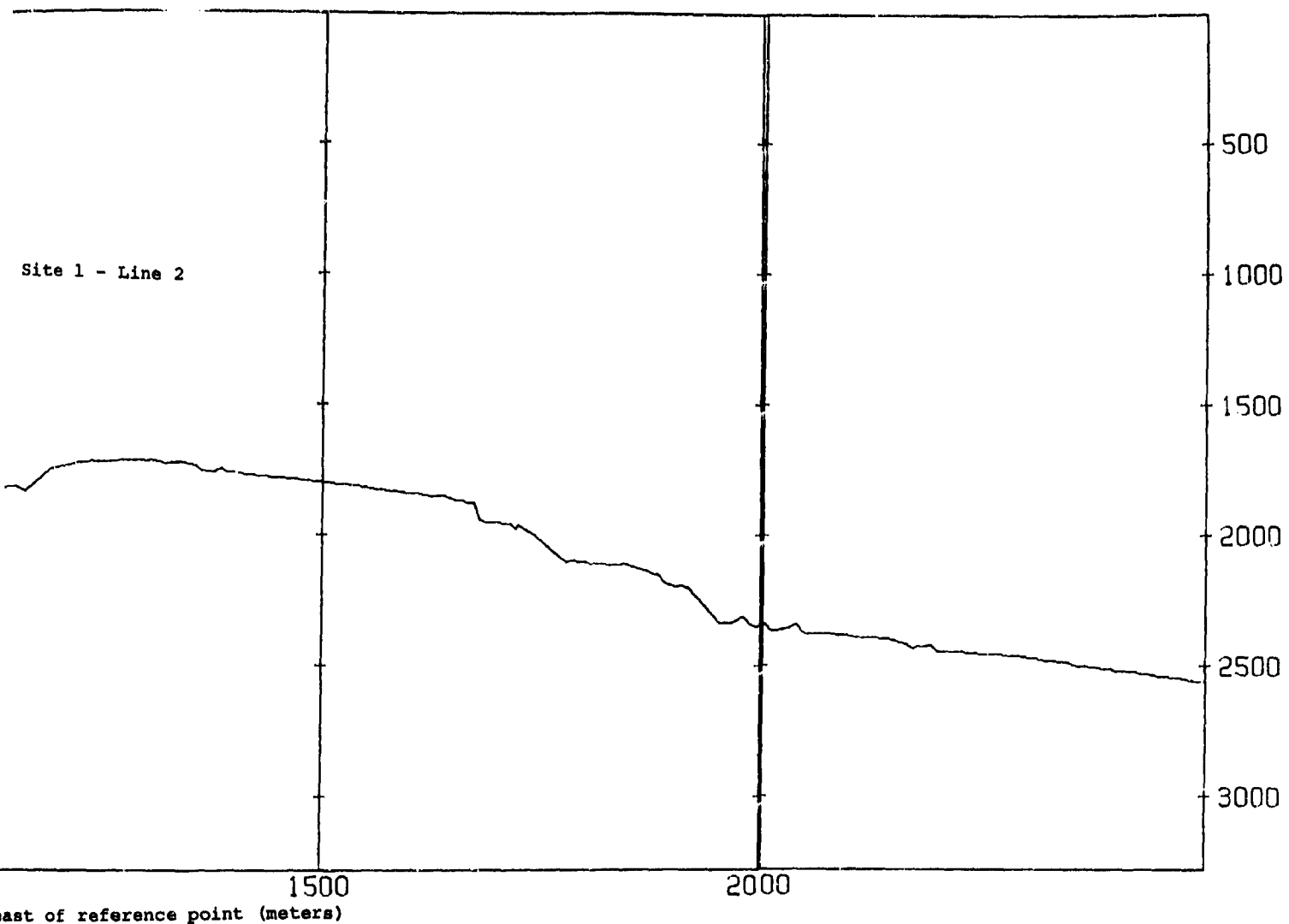
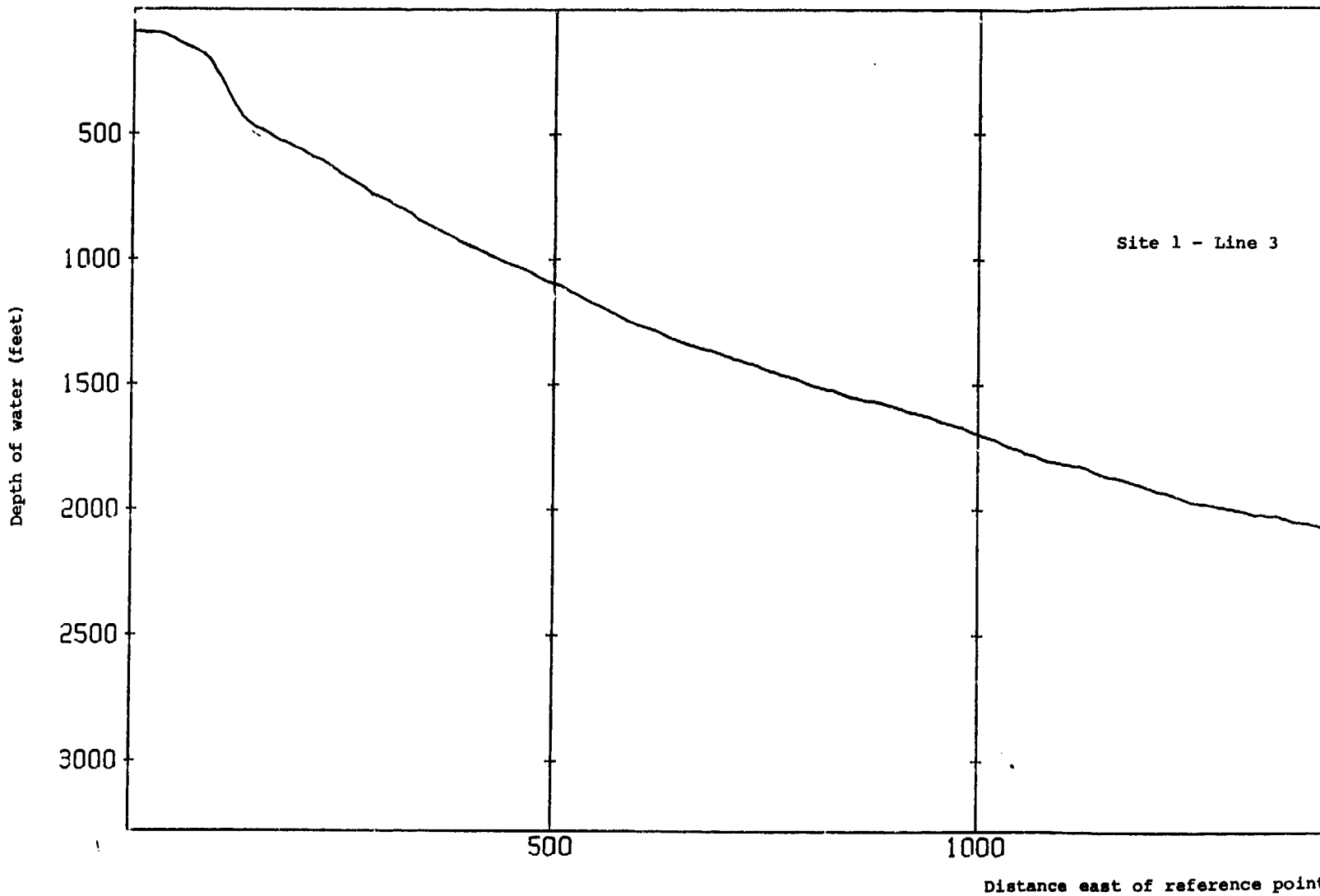


Figure 4

2



Site 1 - Line 3

Distance east of reference point

Figure 5

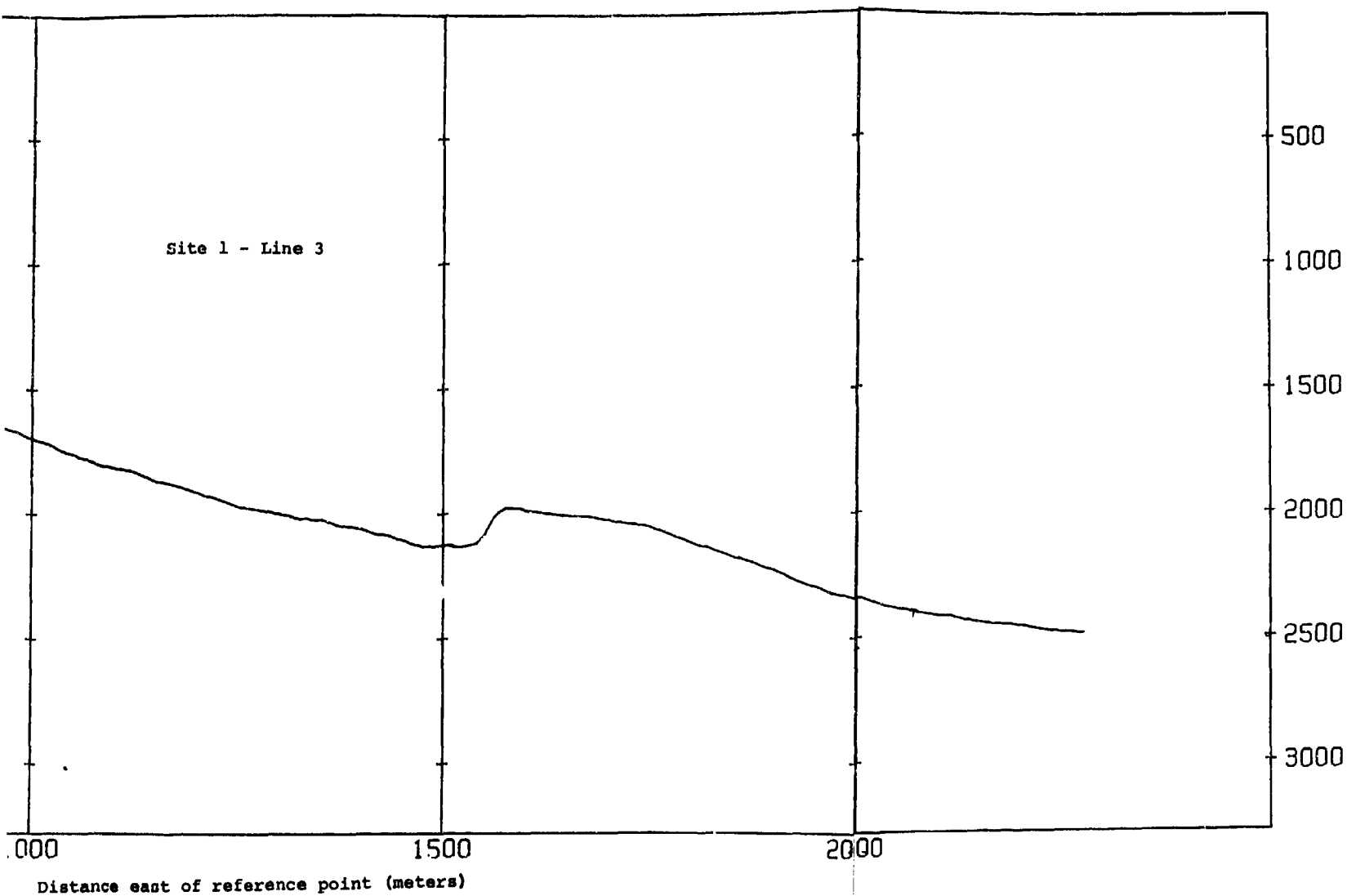


Figure 5

2

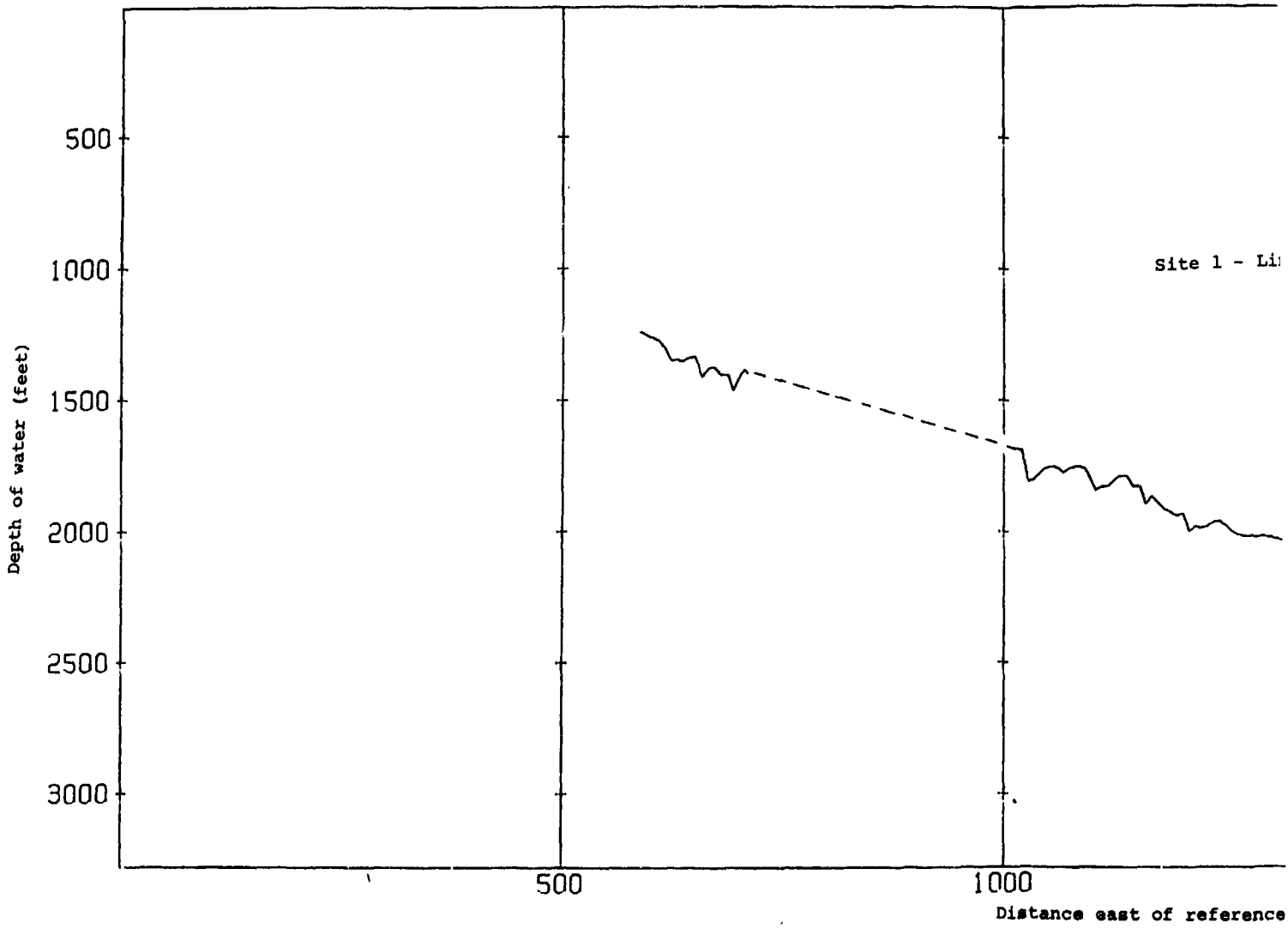


Figure 6

Site 1 - Line 4

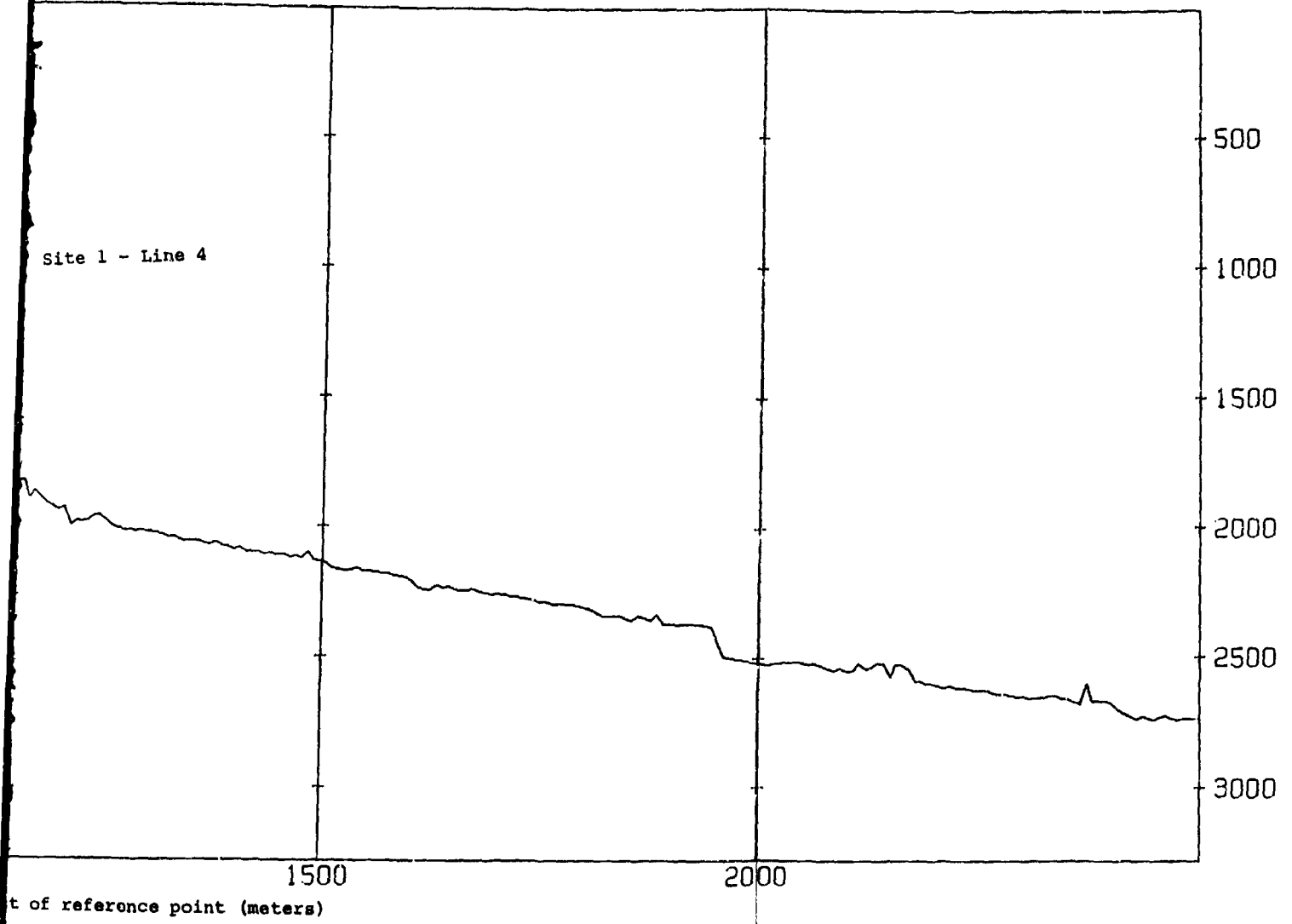


Figure 6

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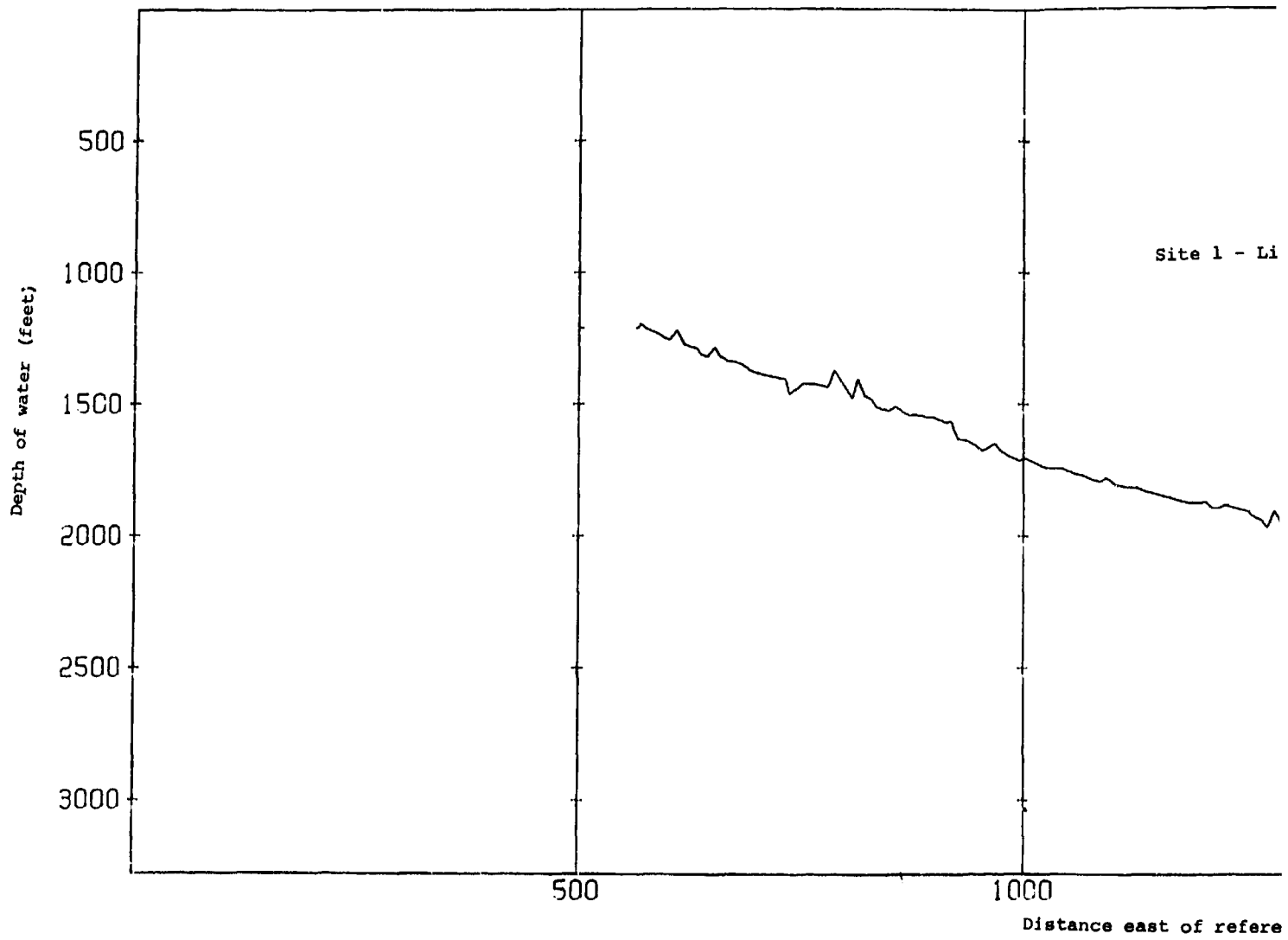
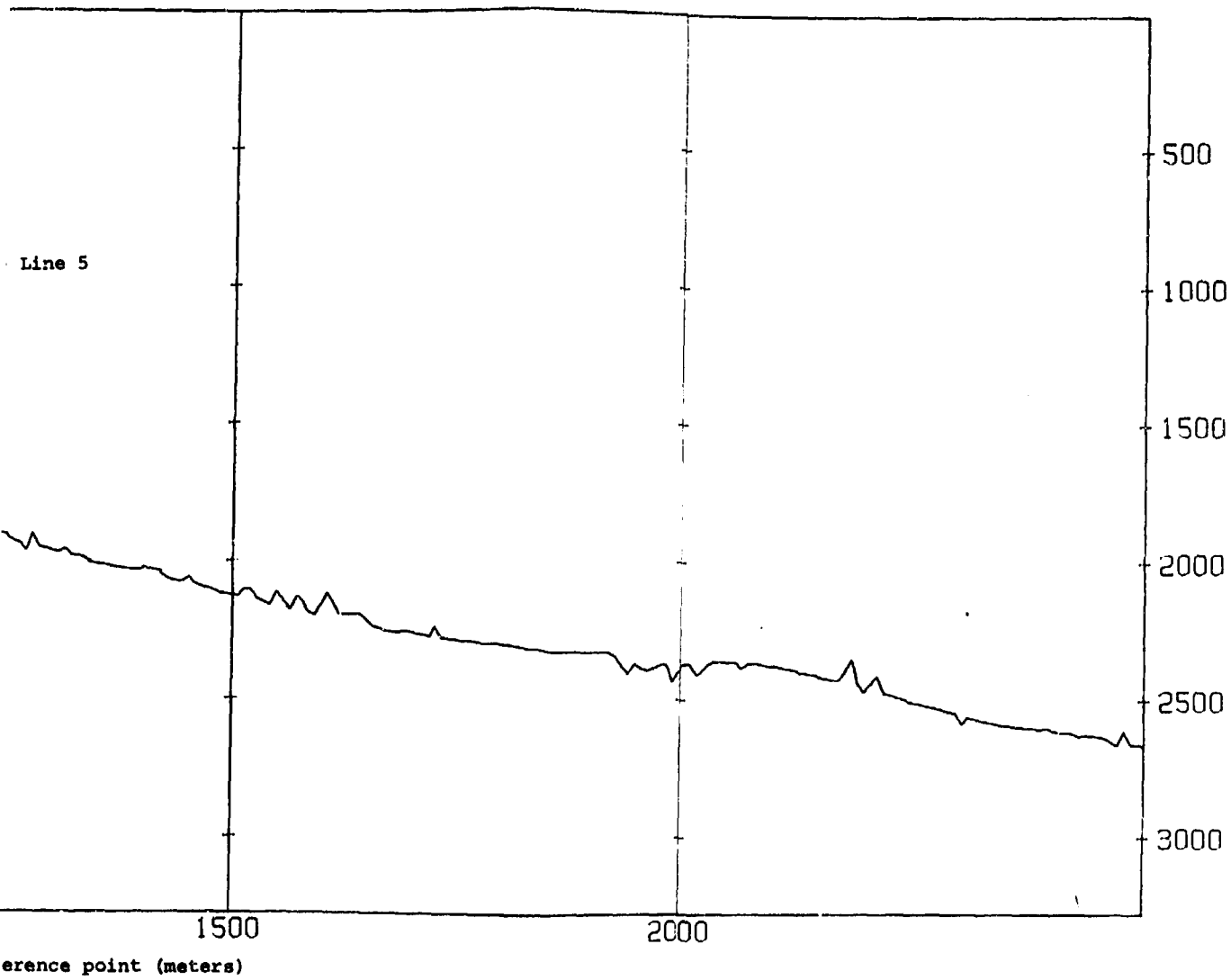


Figure 7



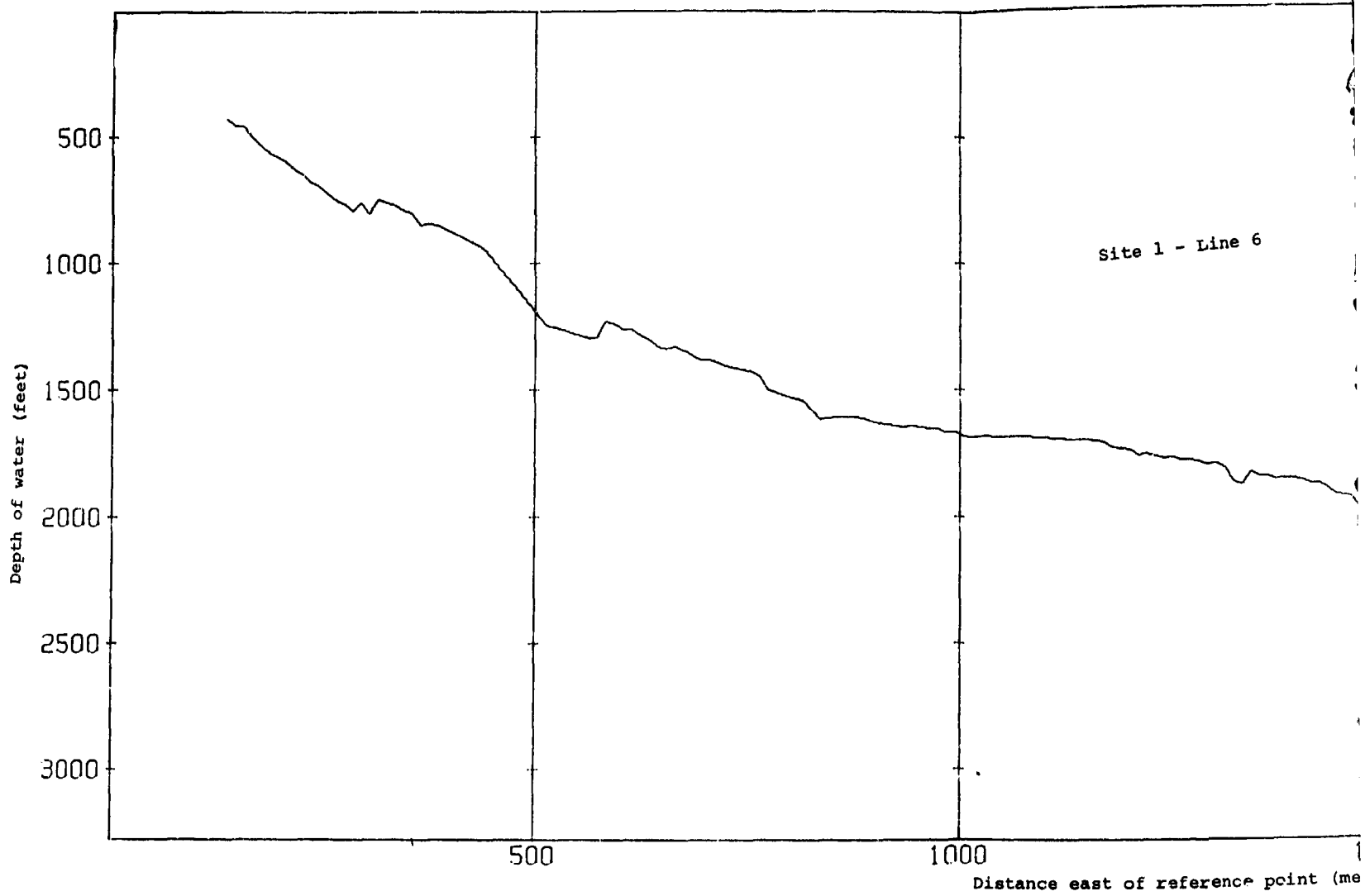


Figure 8

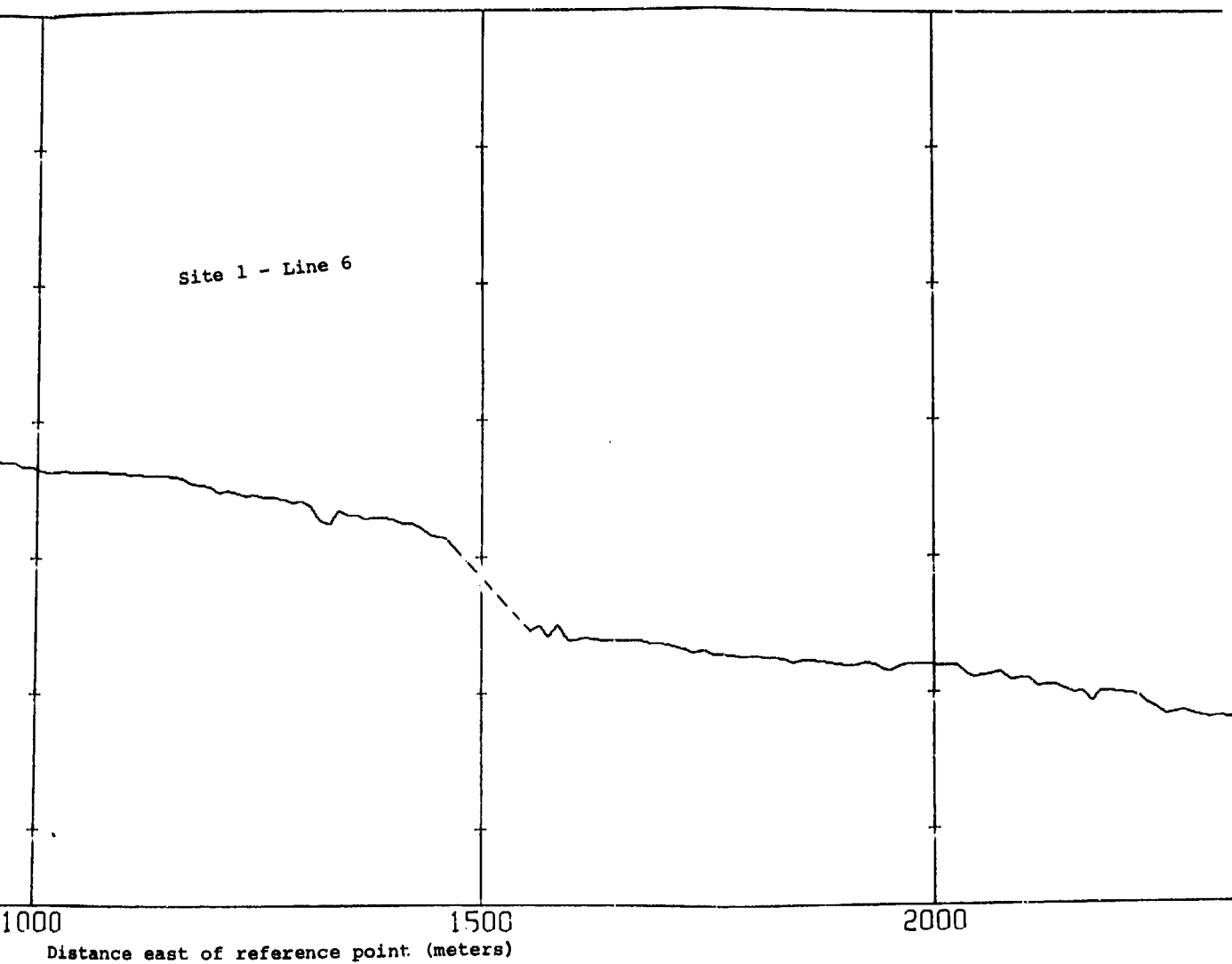
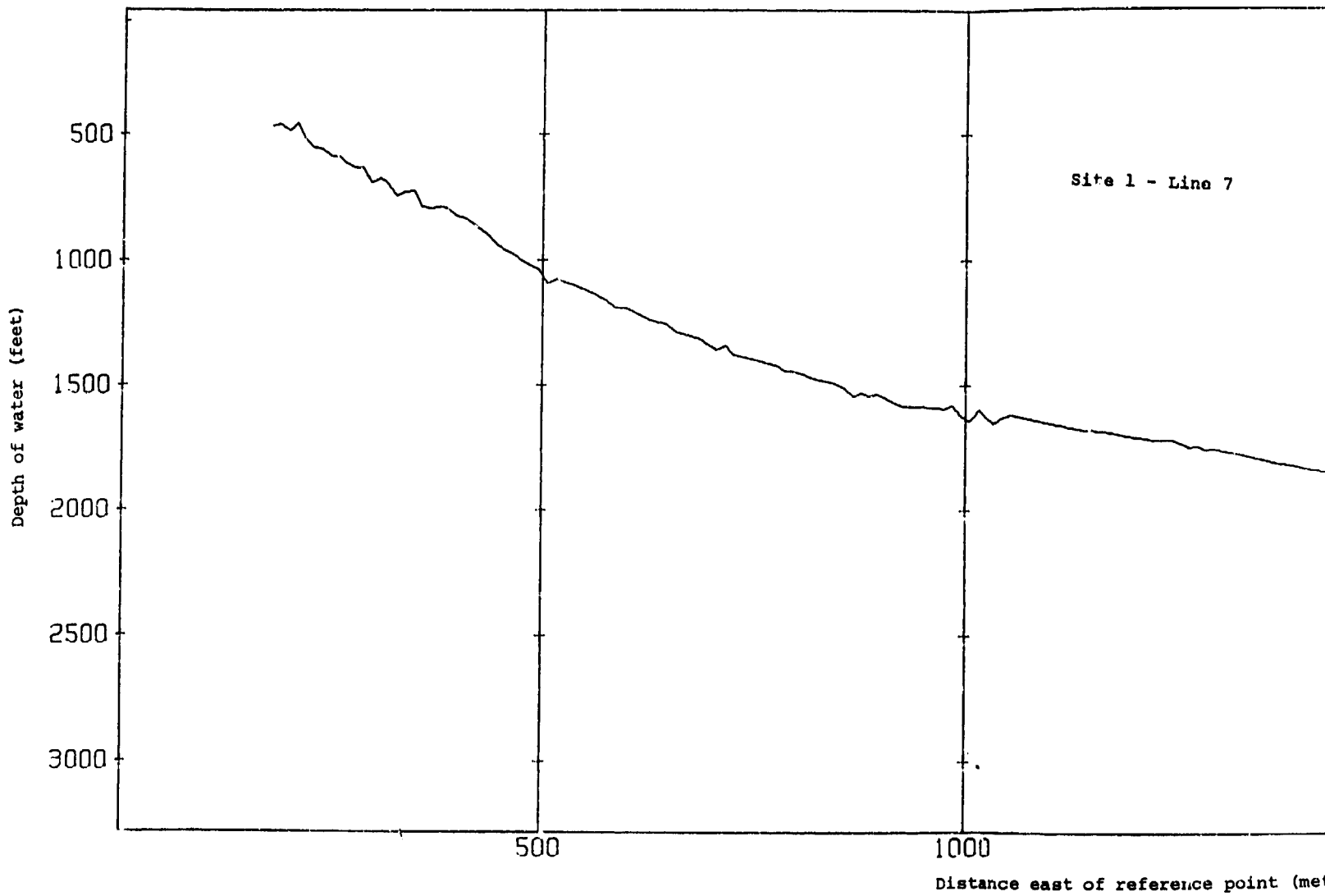


Figure 8



Site 1 - Line 7

Figure 9

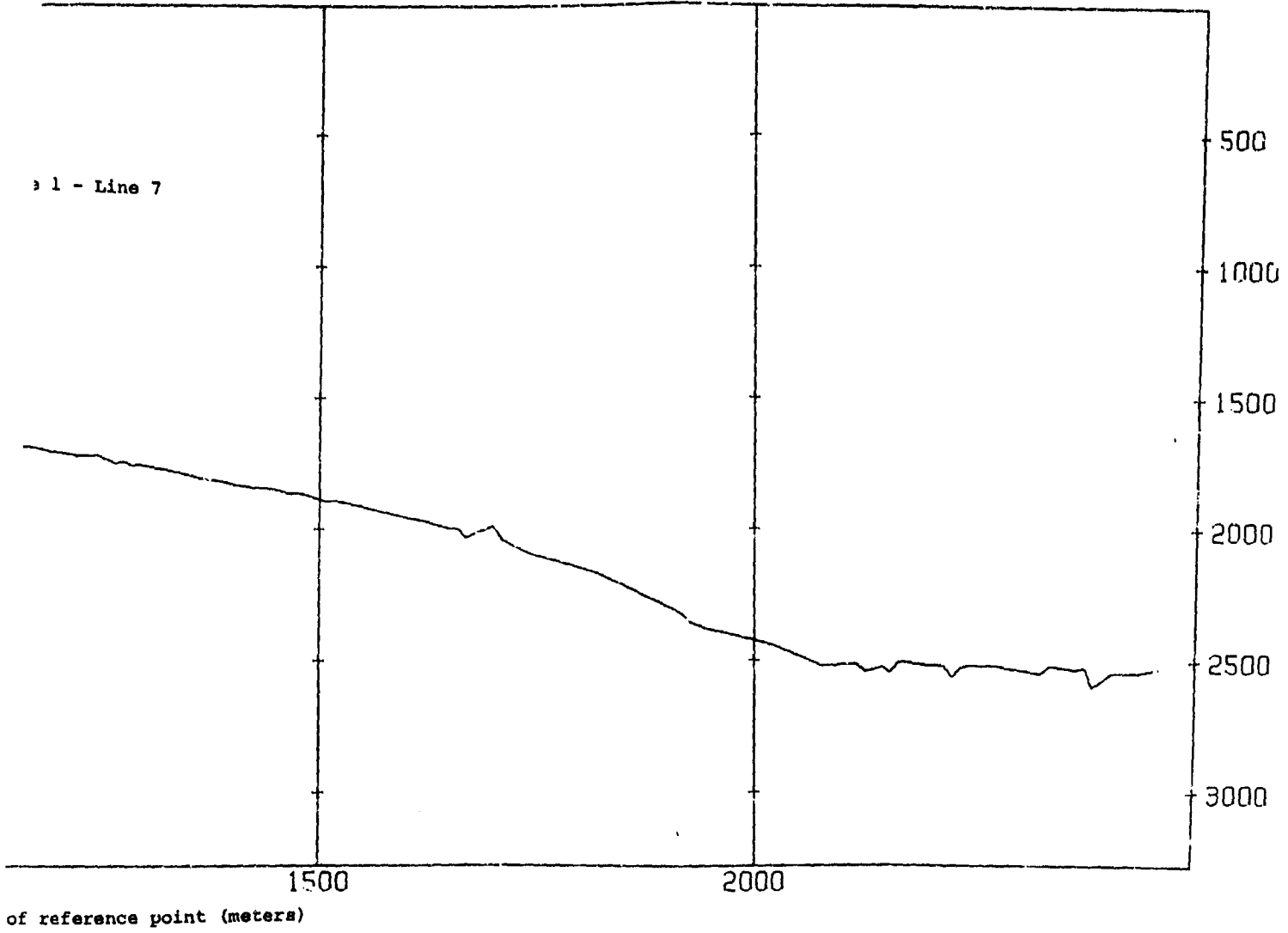


Figure 9

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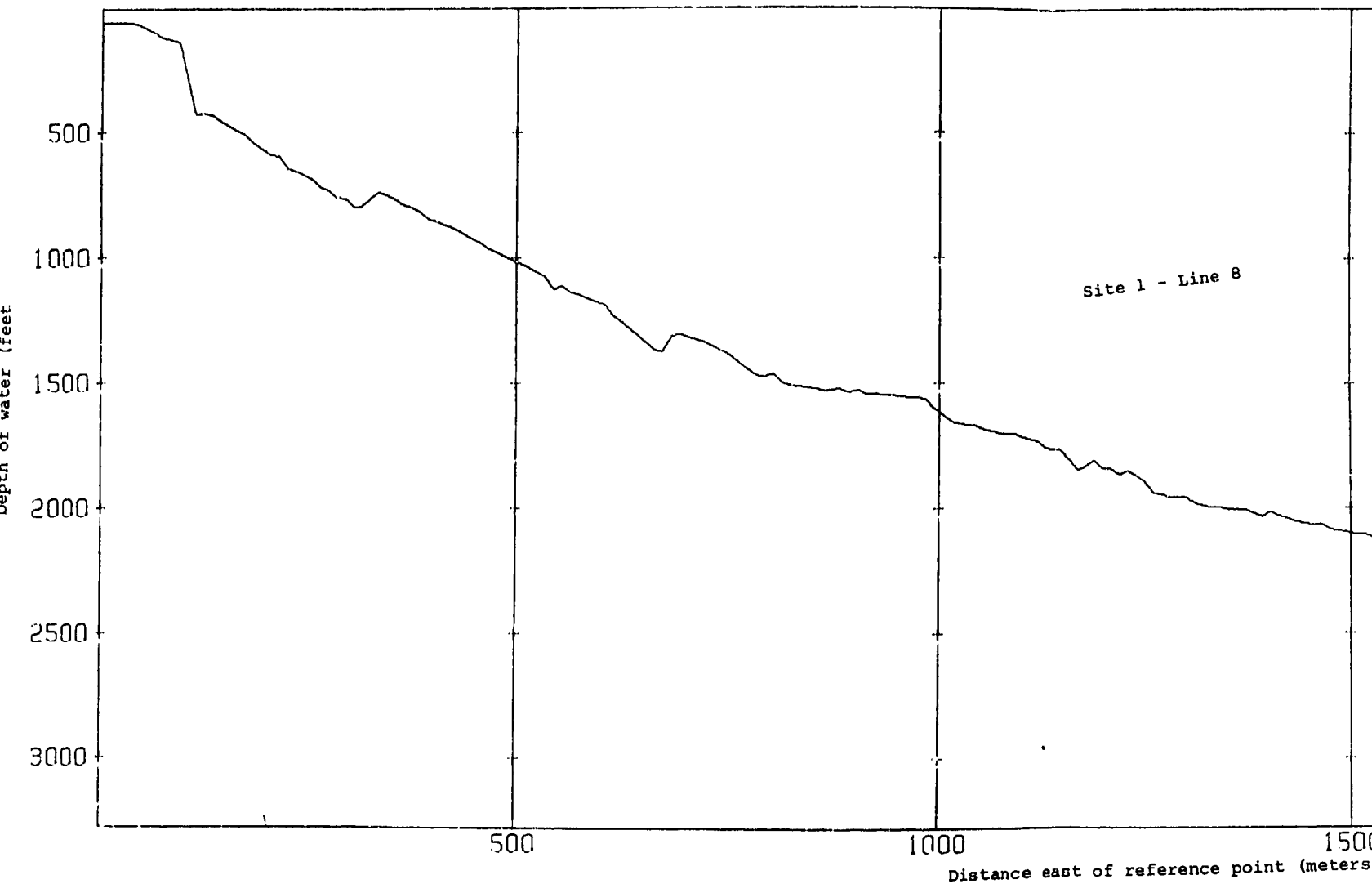


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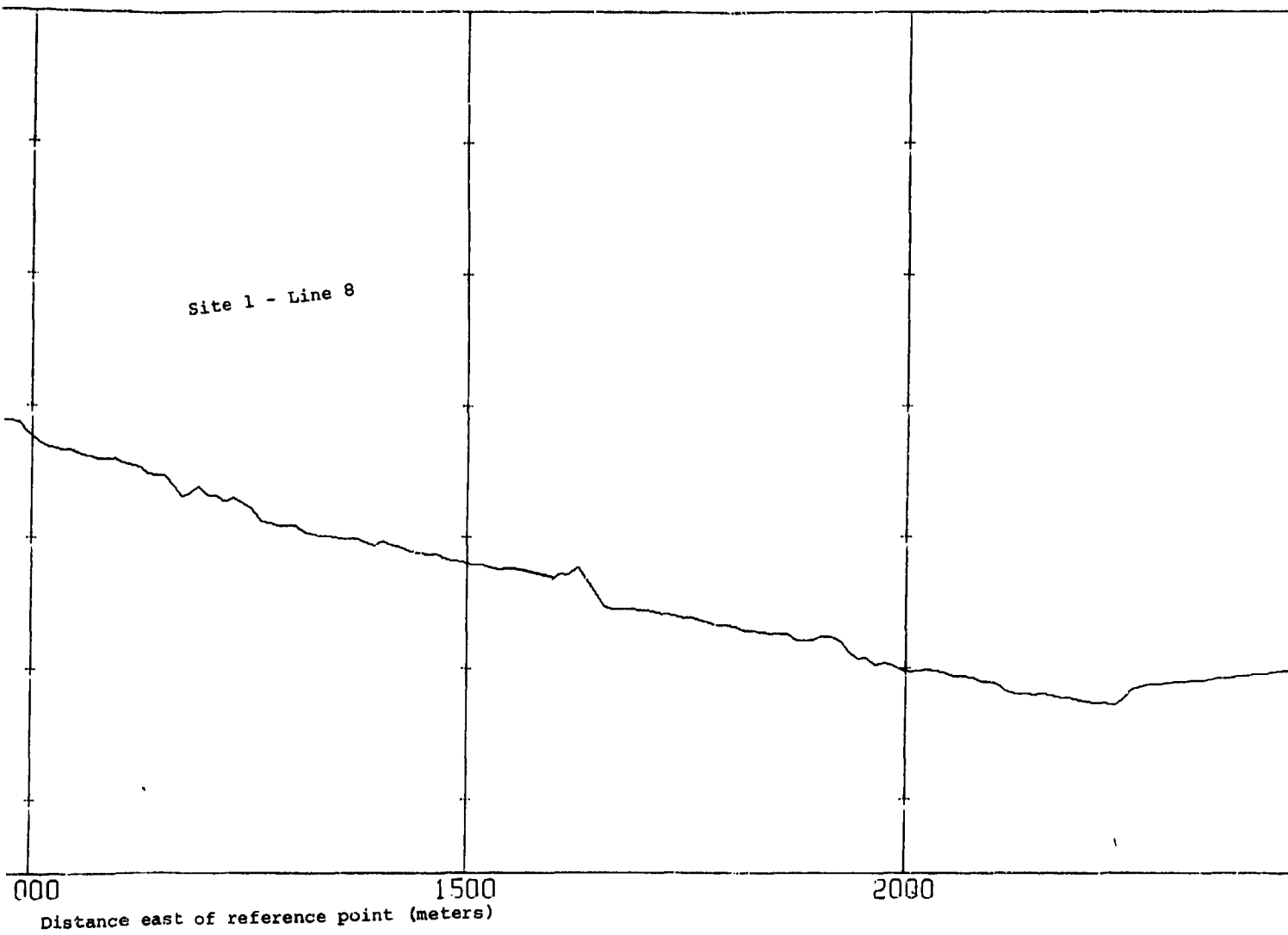
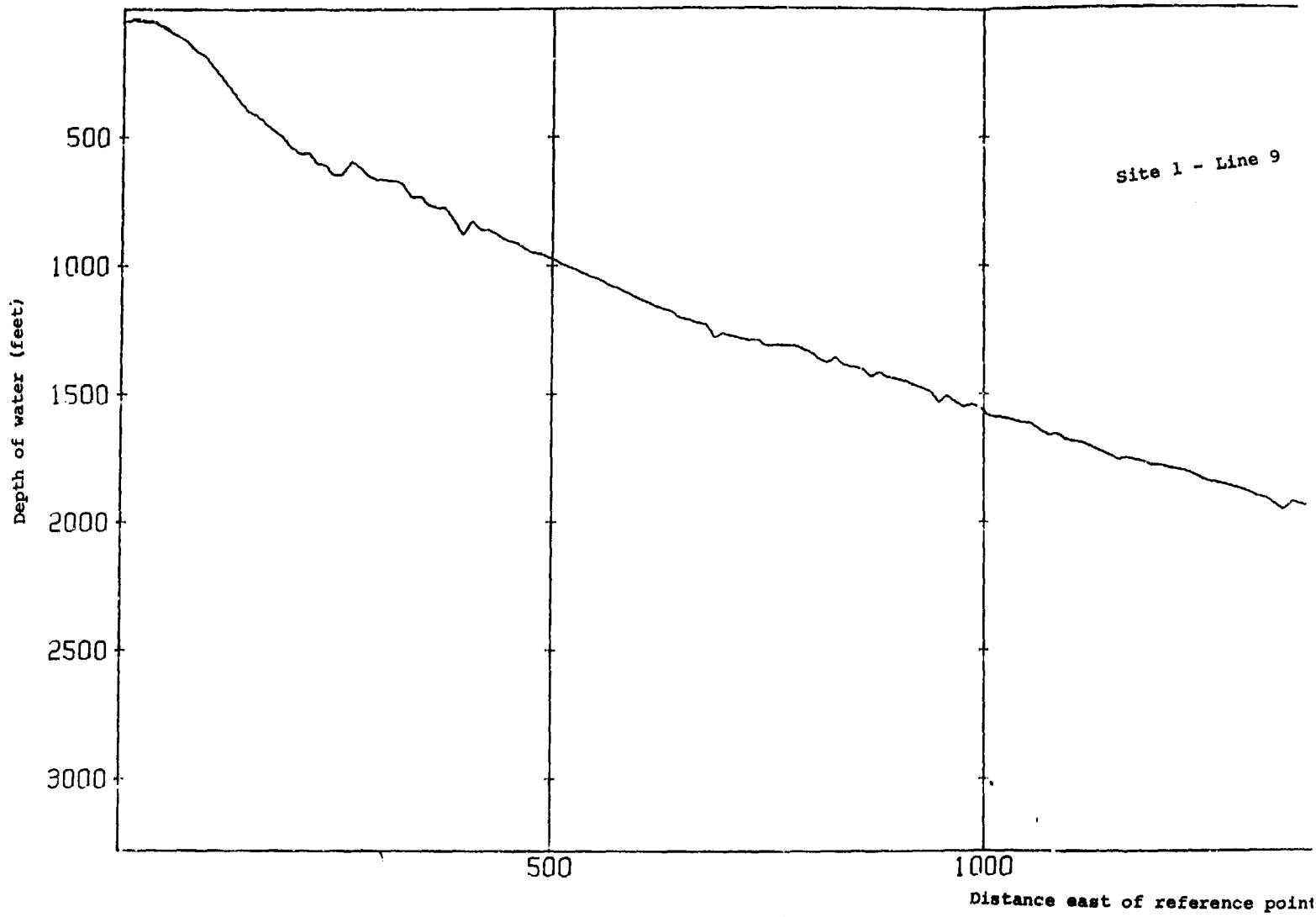


Figure 10



Site 1 - Line 9

Figure 11

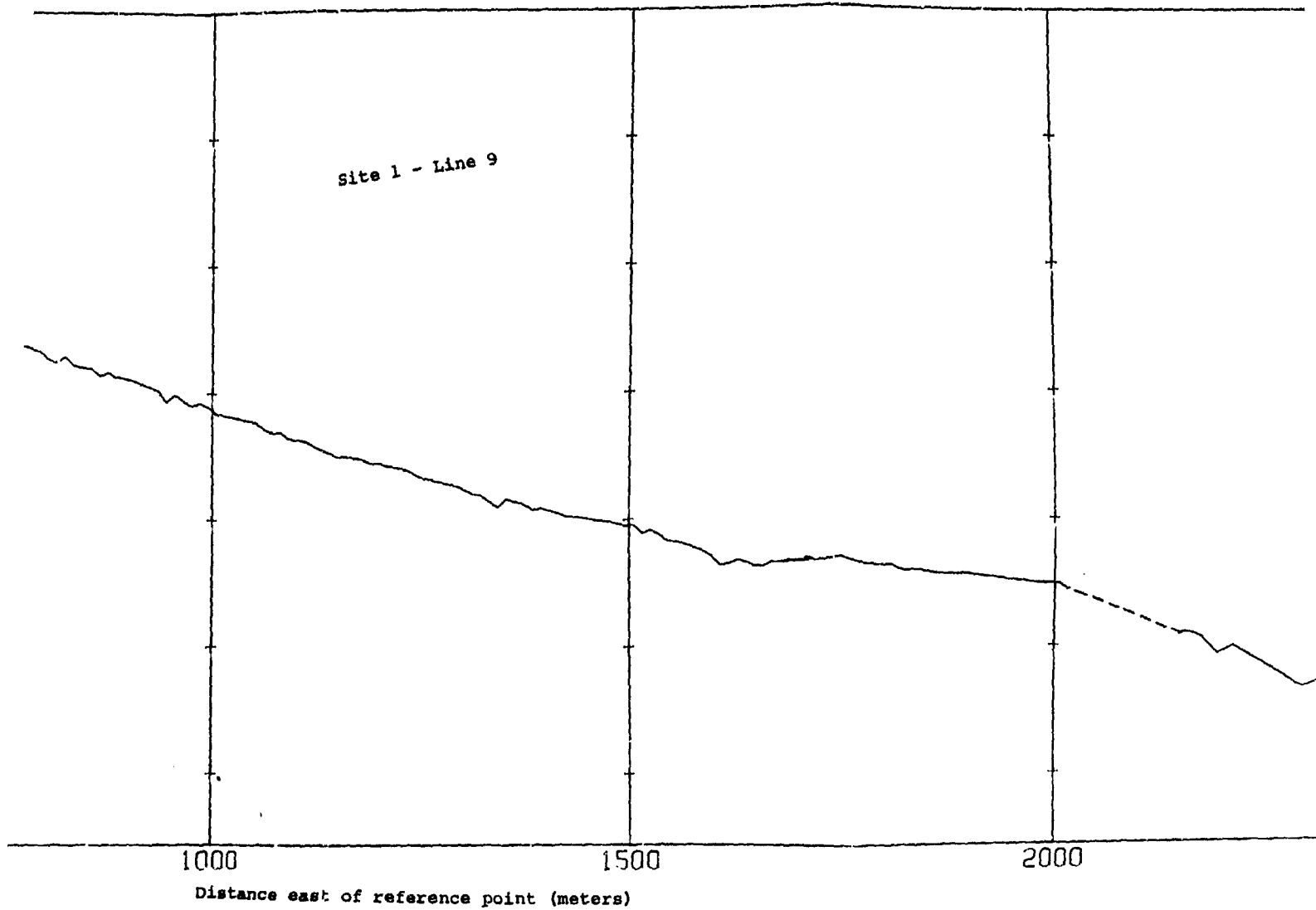


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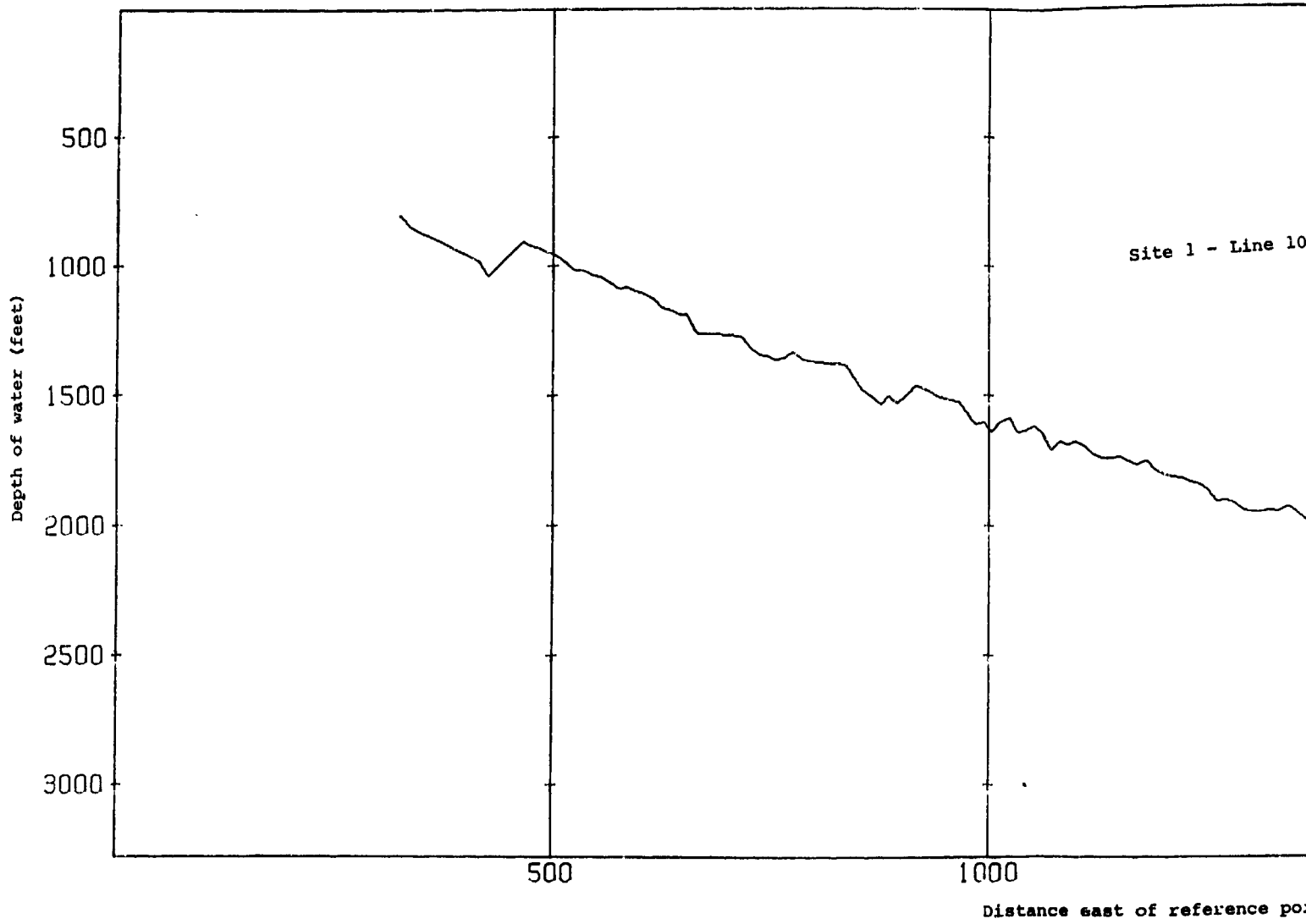


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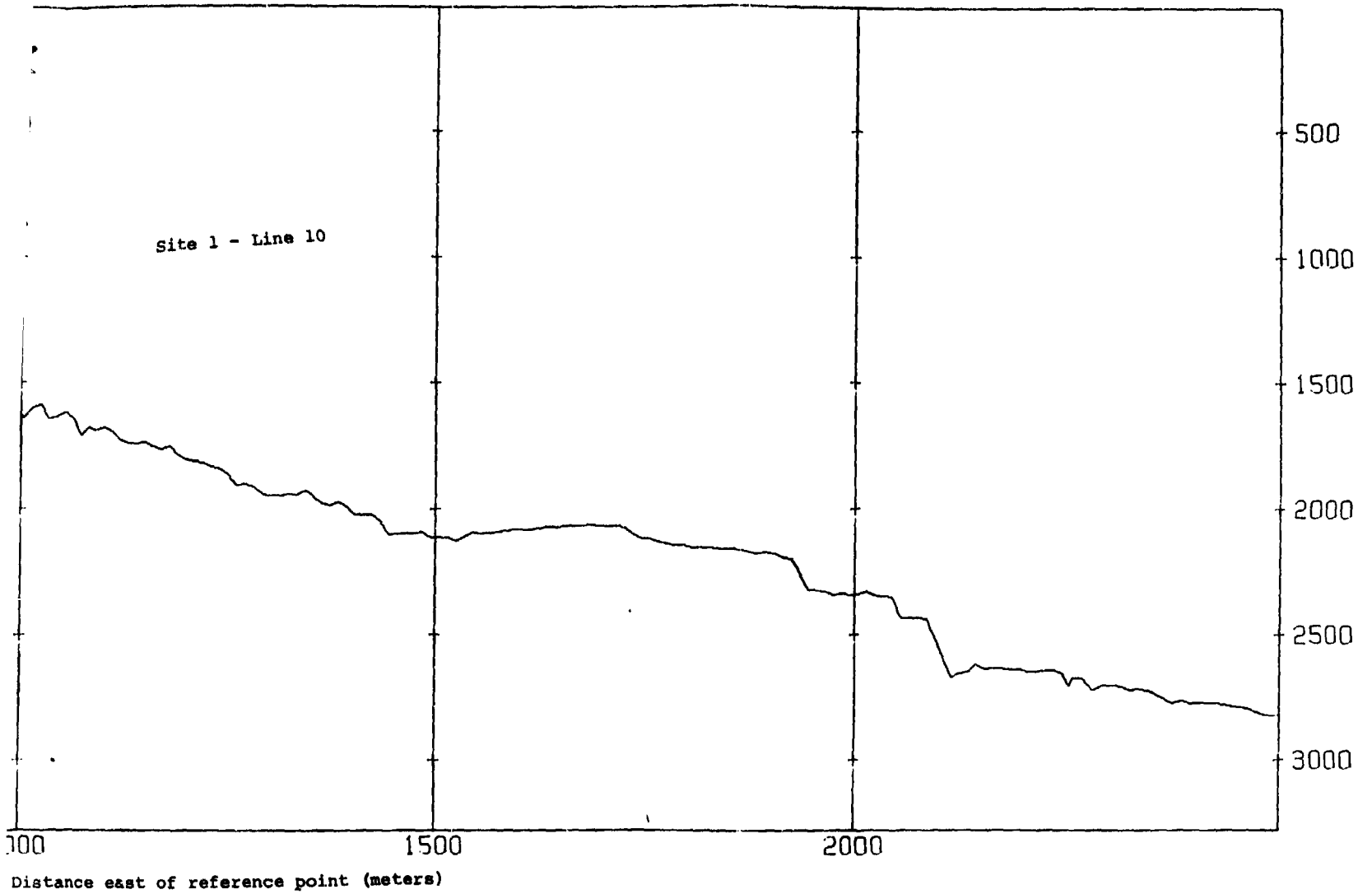


Figure 12

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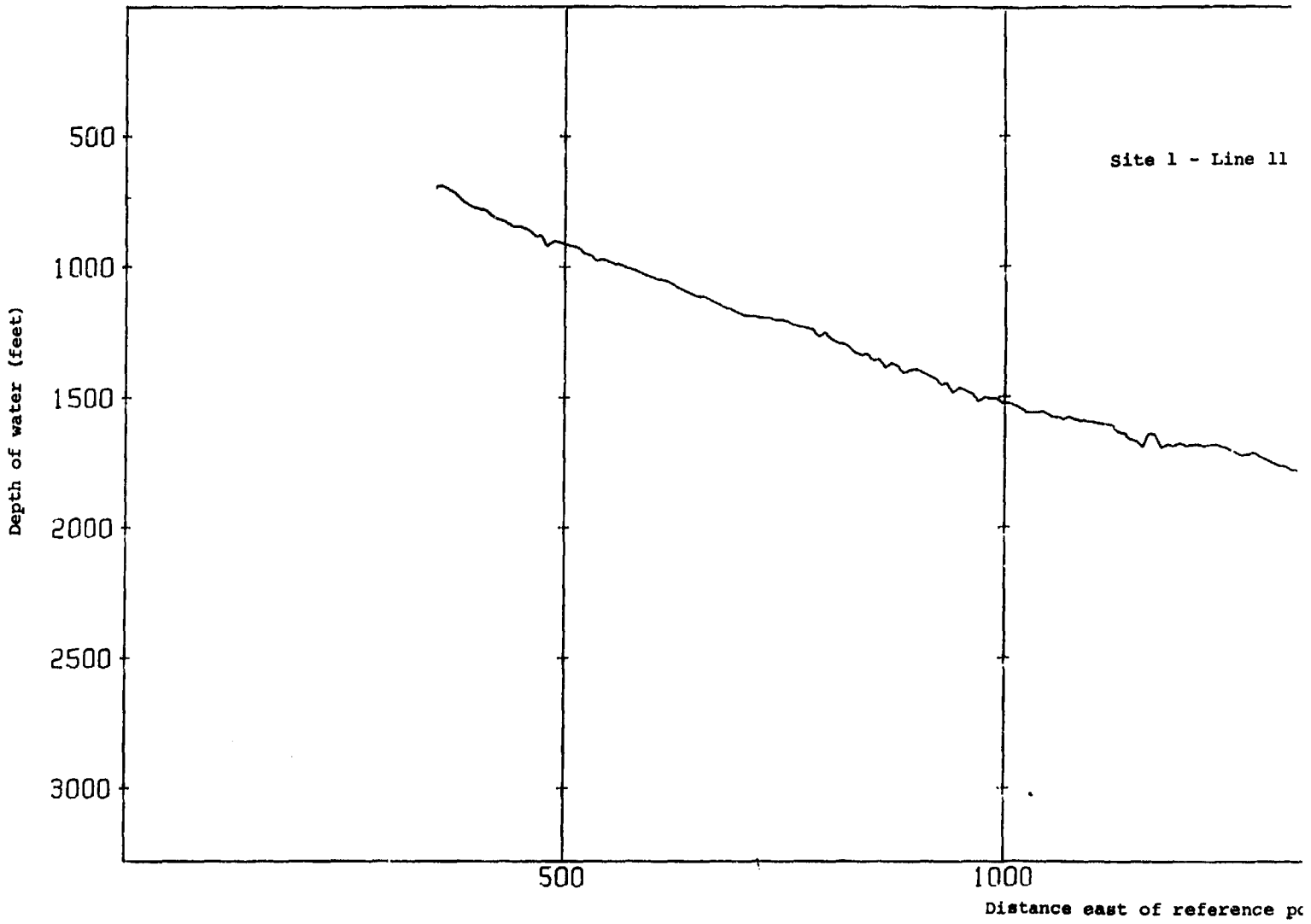


Figure 13

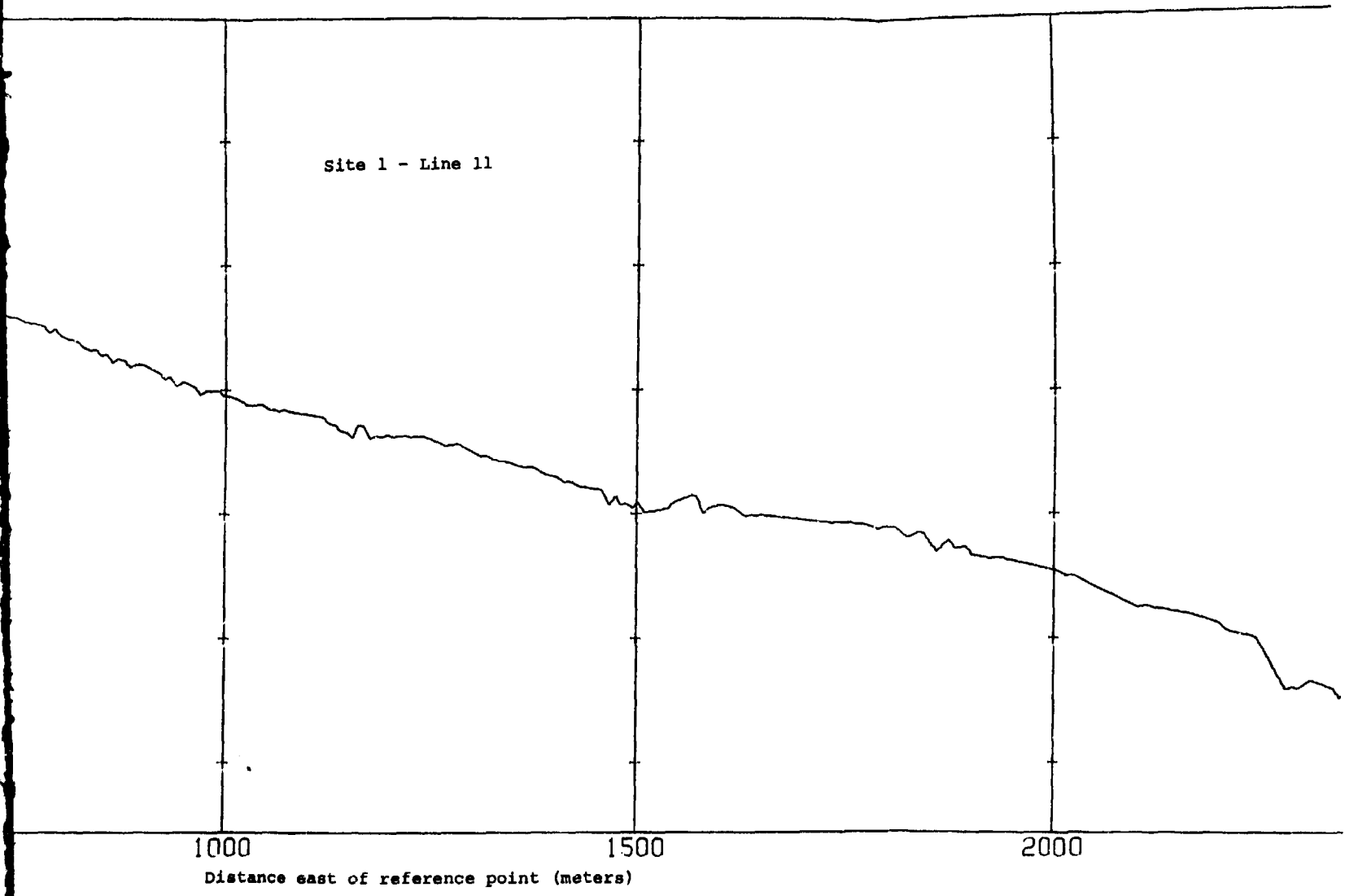
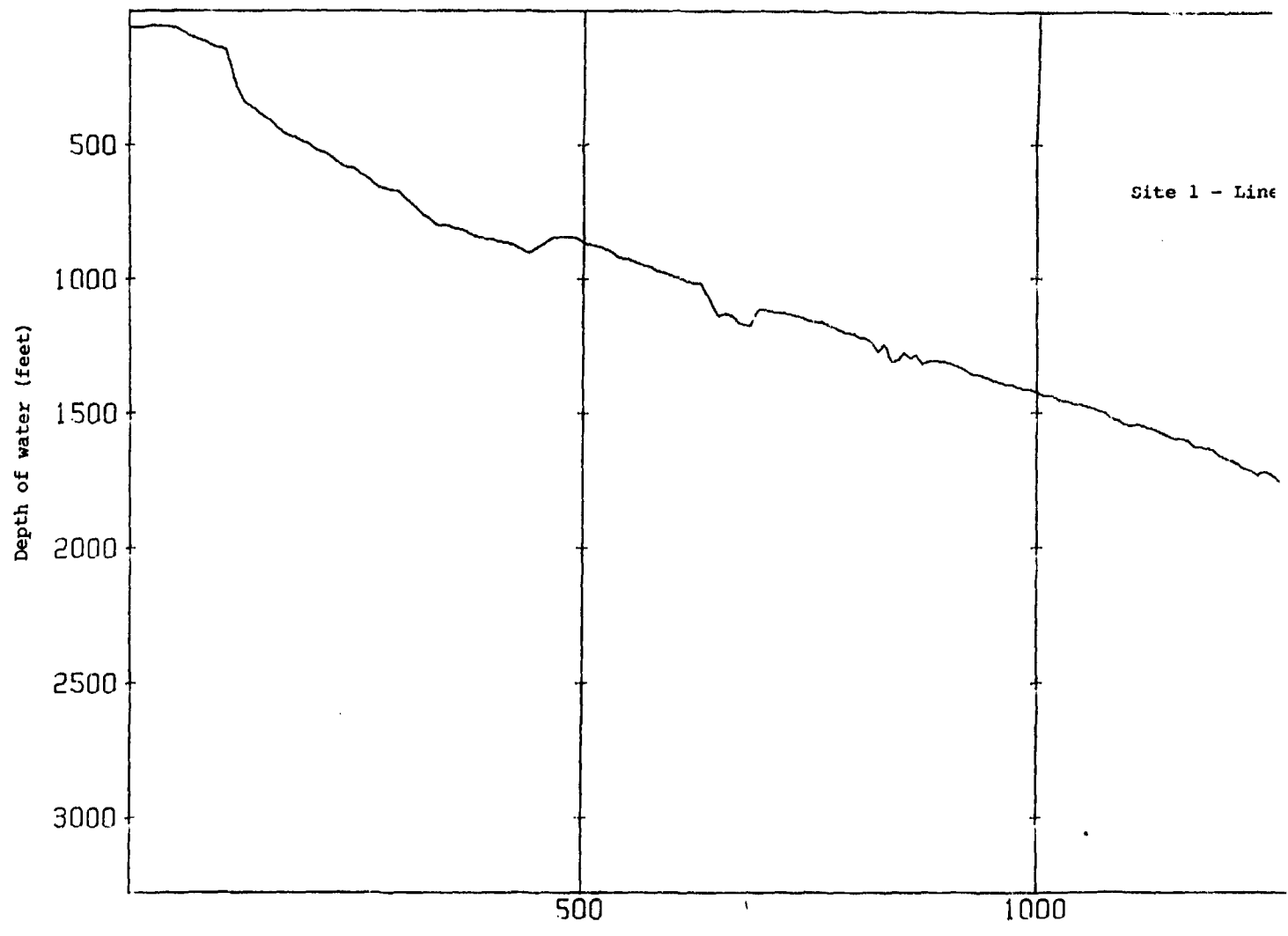


Figure 13

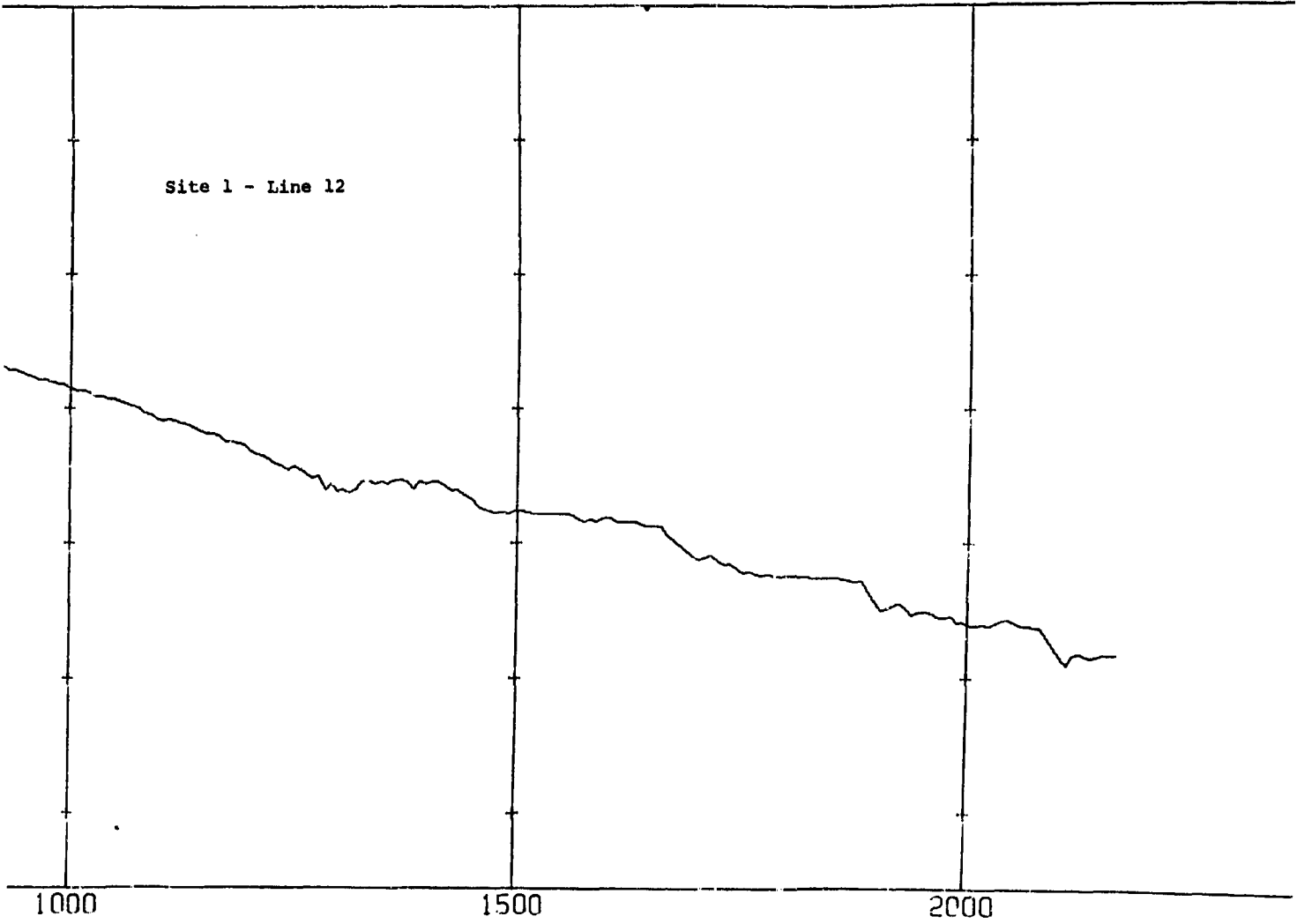
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Distance east of referenc

Figure

Site 1 - Line 12

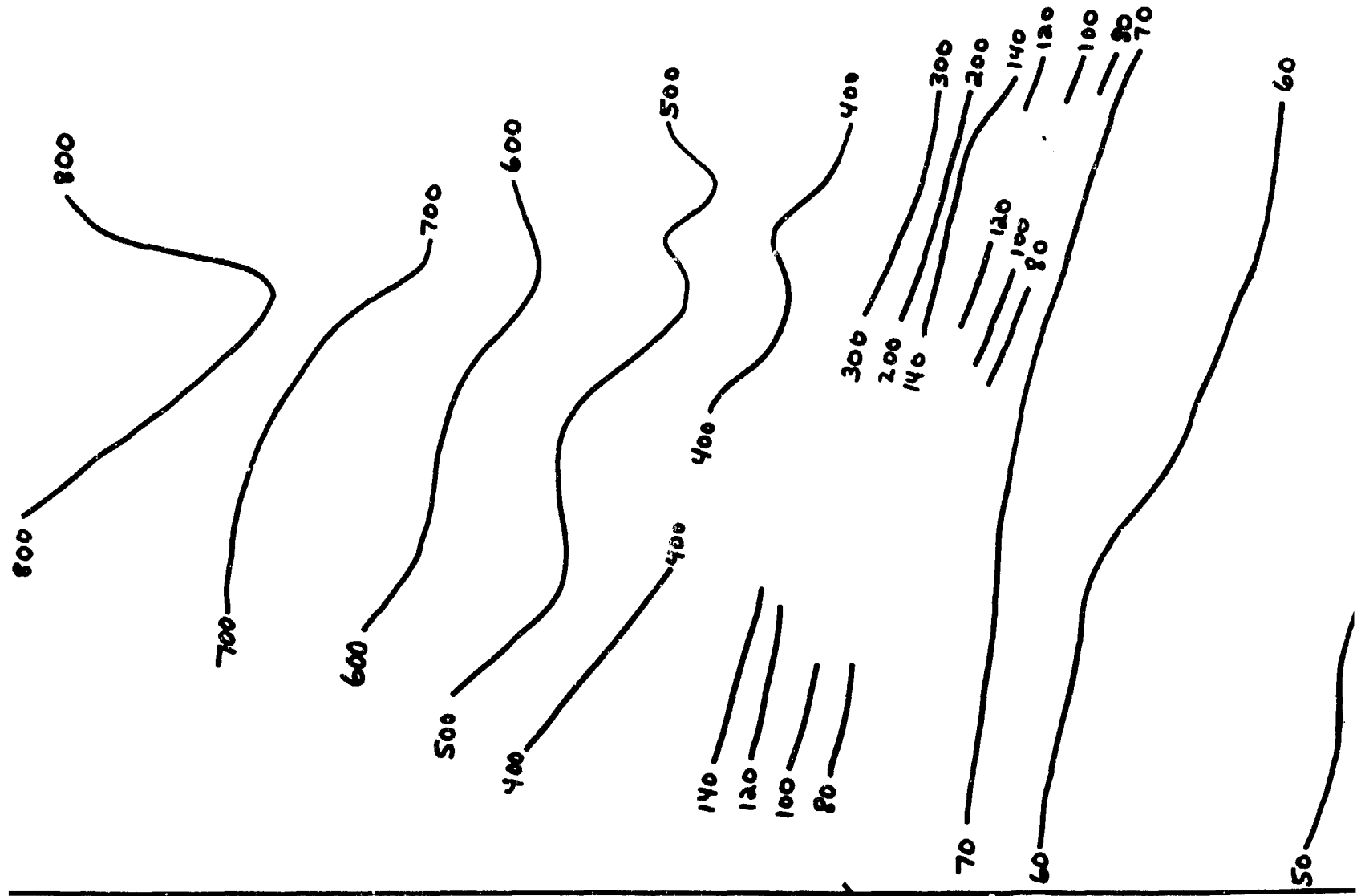


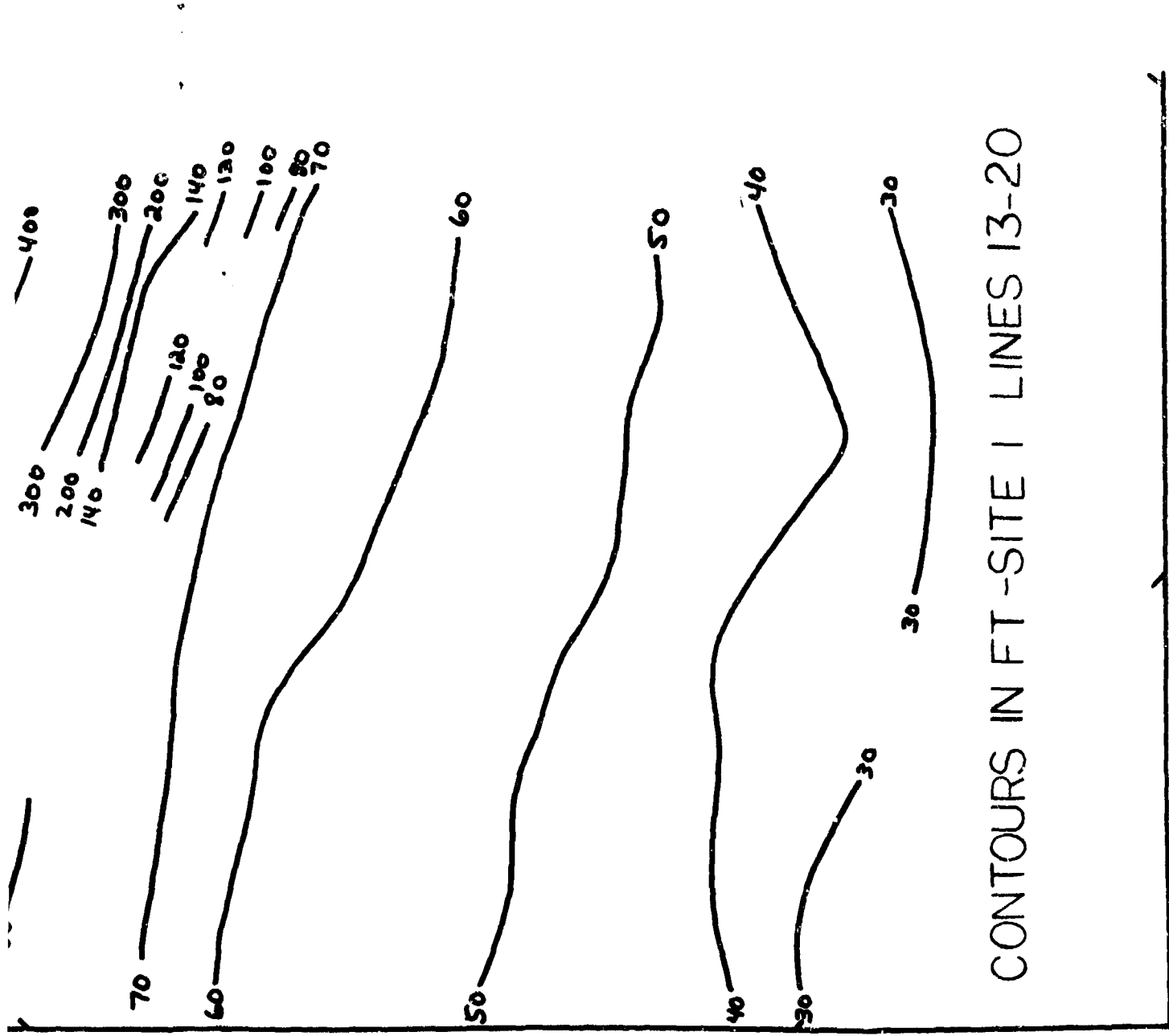
Distance east of reference point (meters)

Figure 14

2

2738000Y





CONTOURS IN FT - SITE 1 LINES 13-20

2738000

220500x

REF: 220400

REF: 2737750

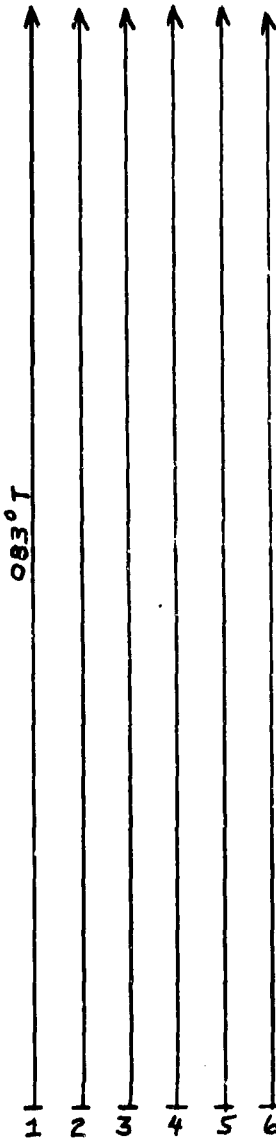
220500x

Figure 15

2737500y

227000x

ORIENTATION OF SURVEY
LINES AT SITE TWO



2711000y

X REF: 226350

Y REF: 2711400

Figure 16

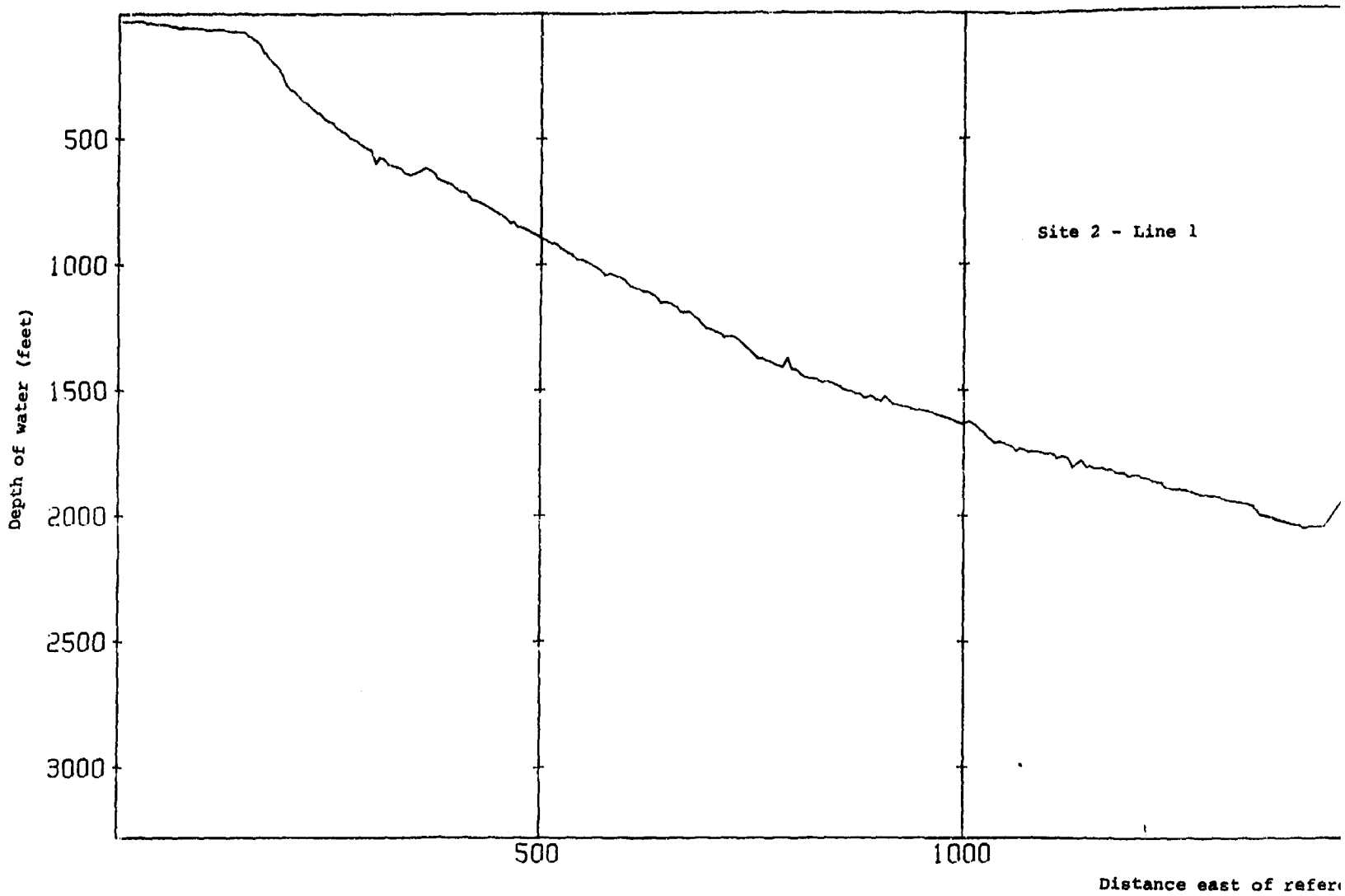
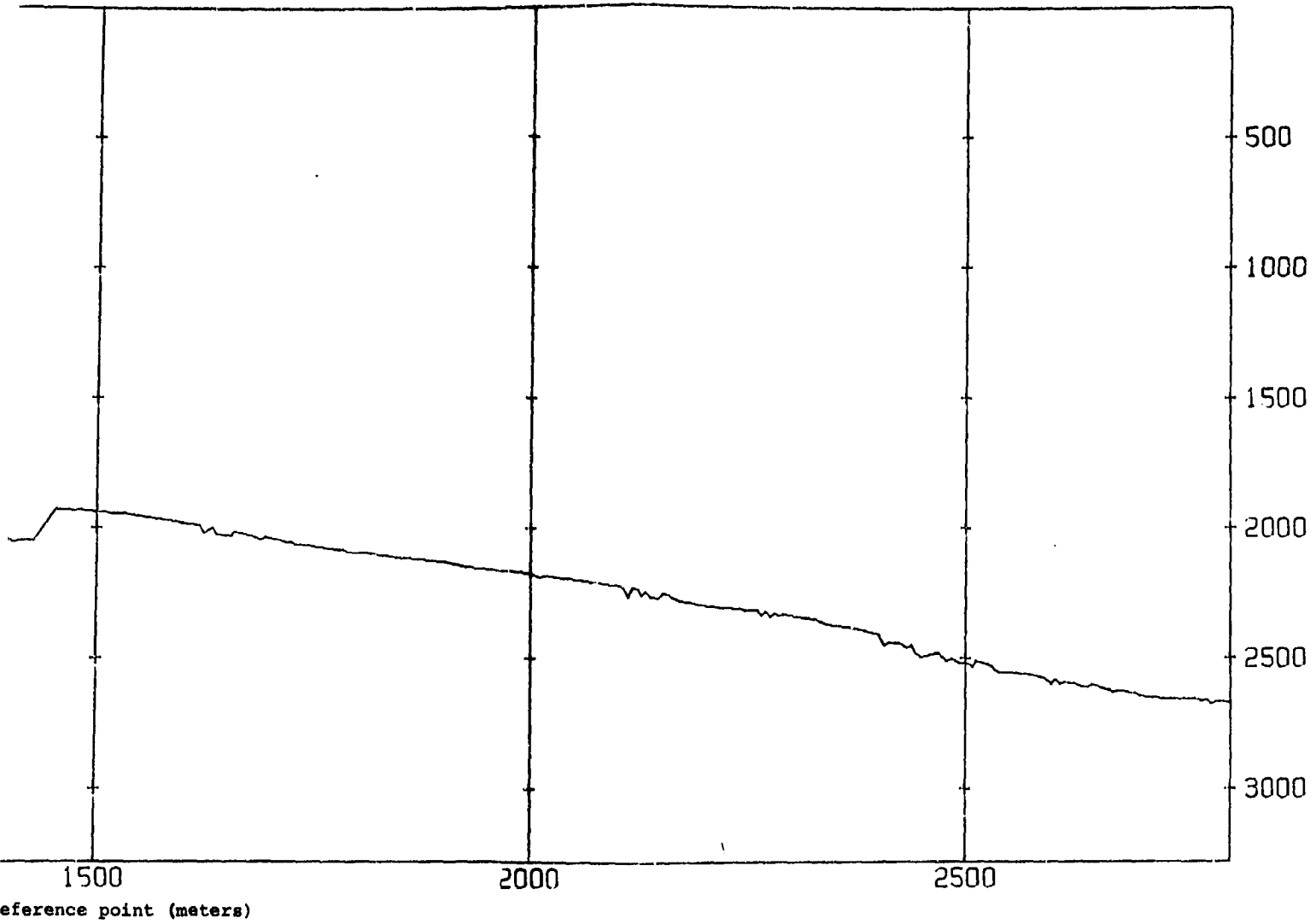
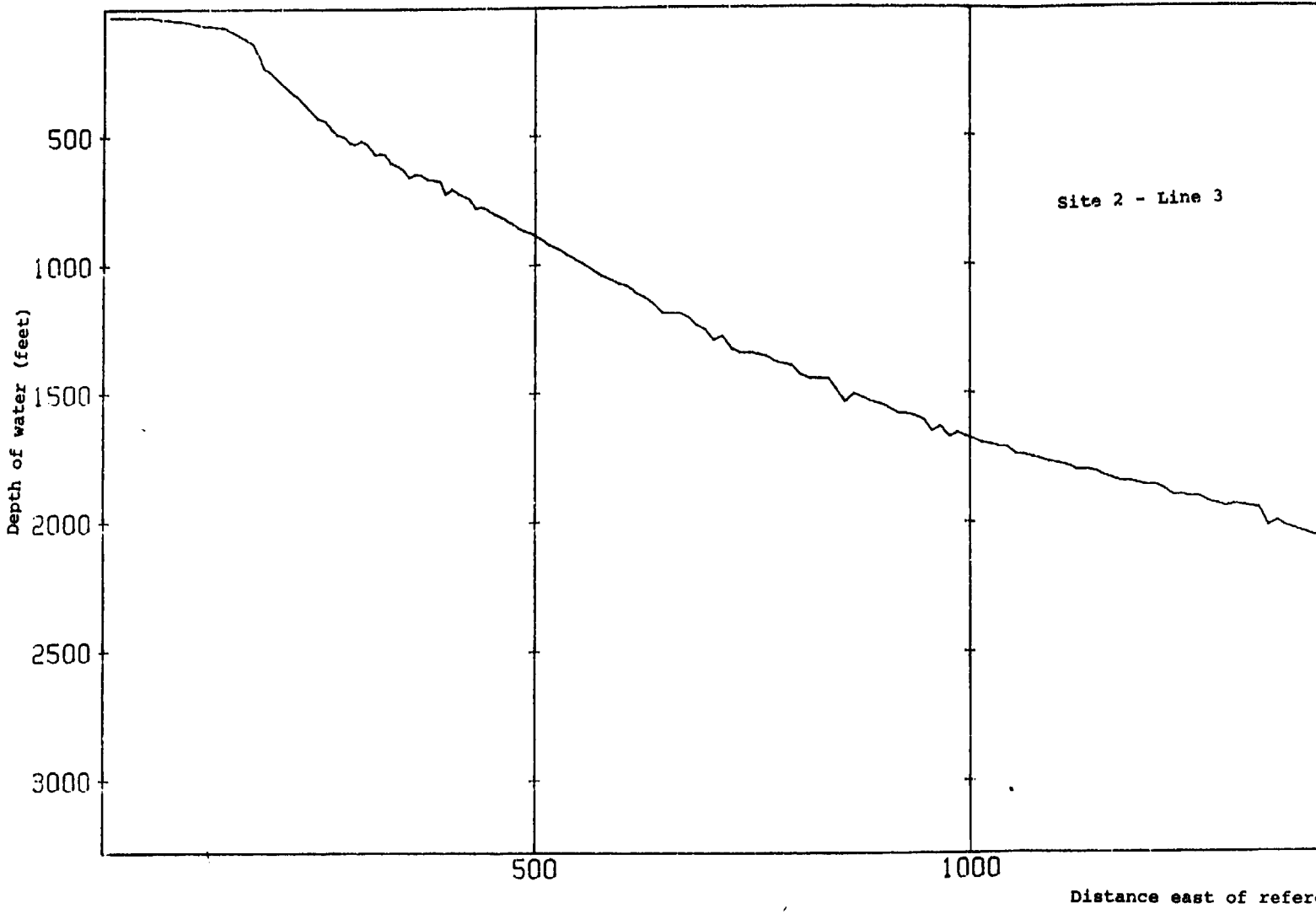


Figure 1



re 17

2



Distance east of refer

Figur

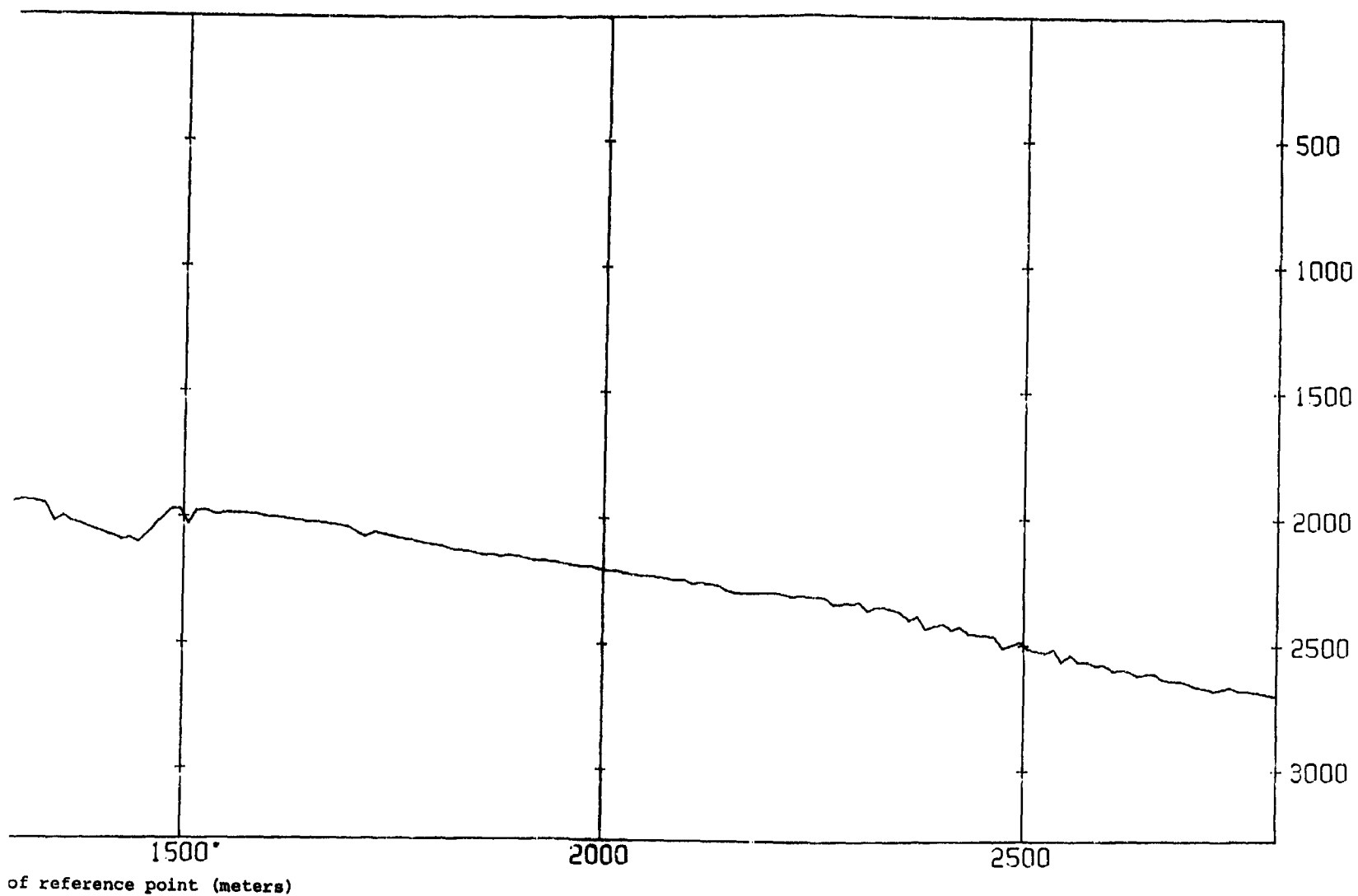
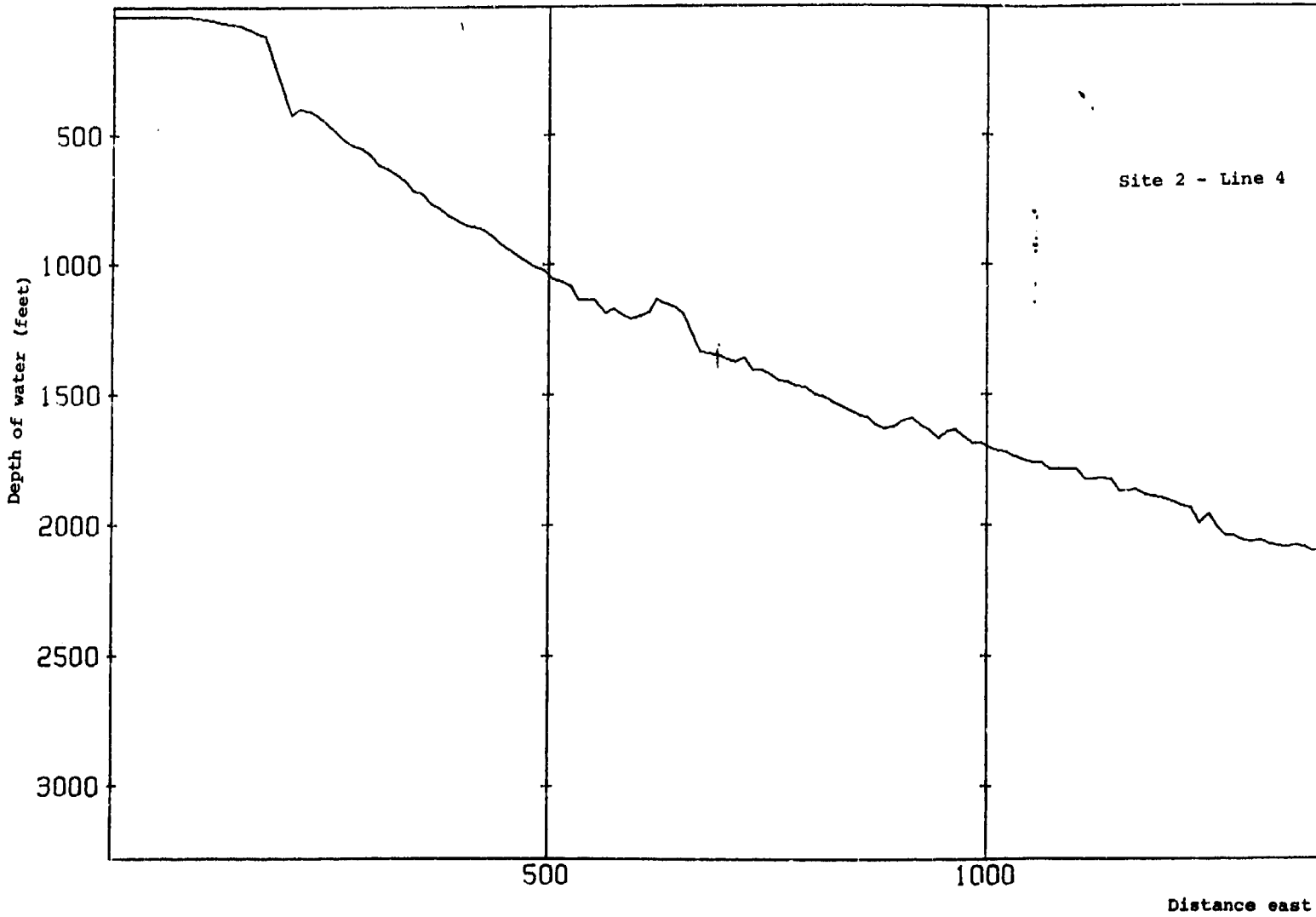


Figure 18

2



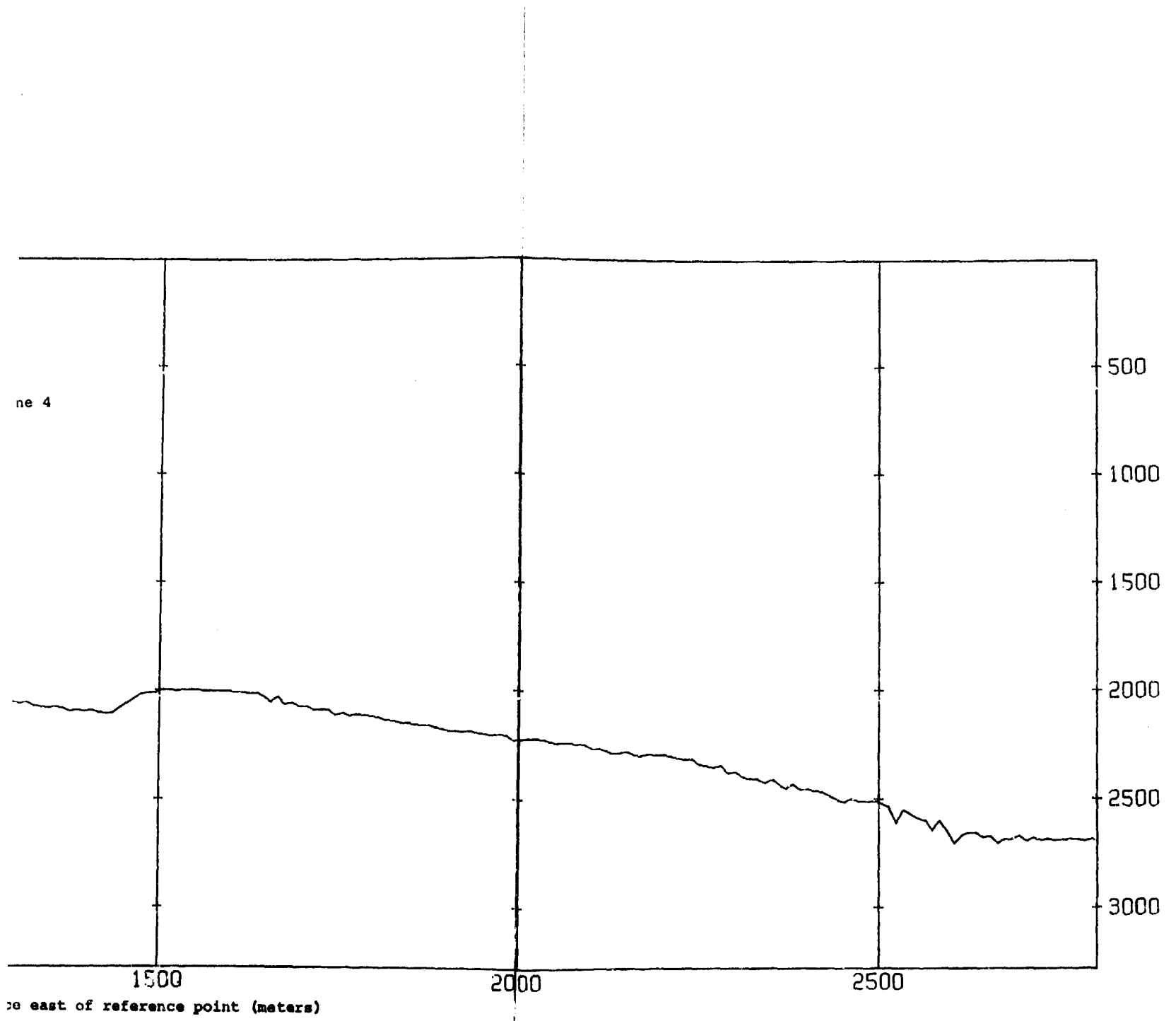
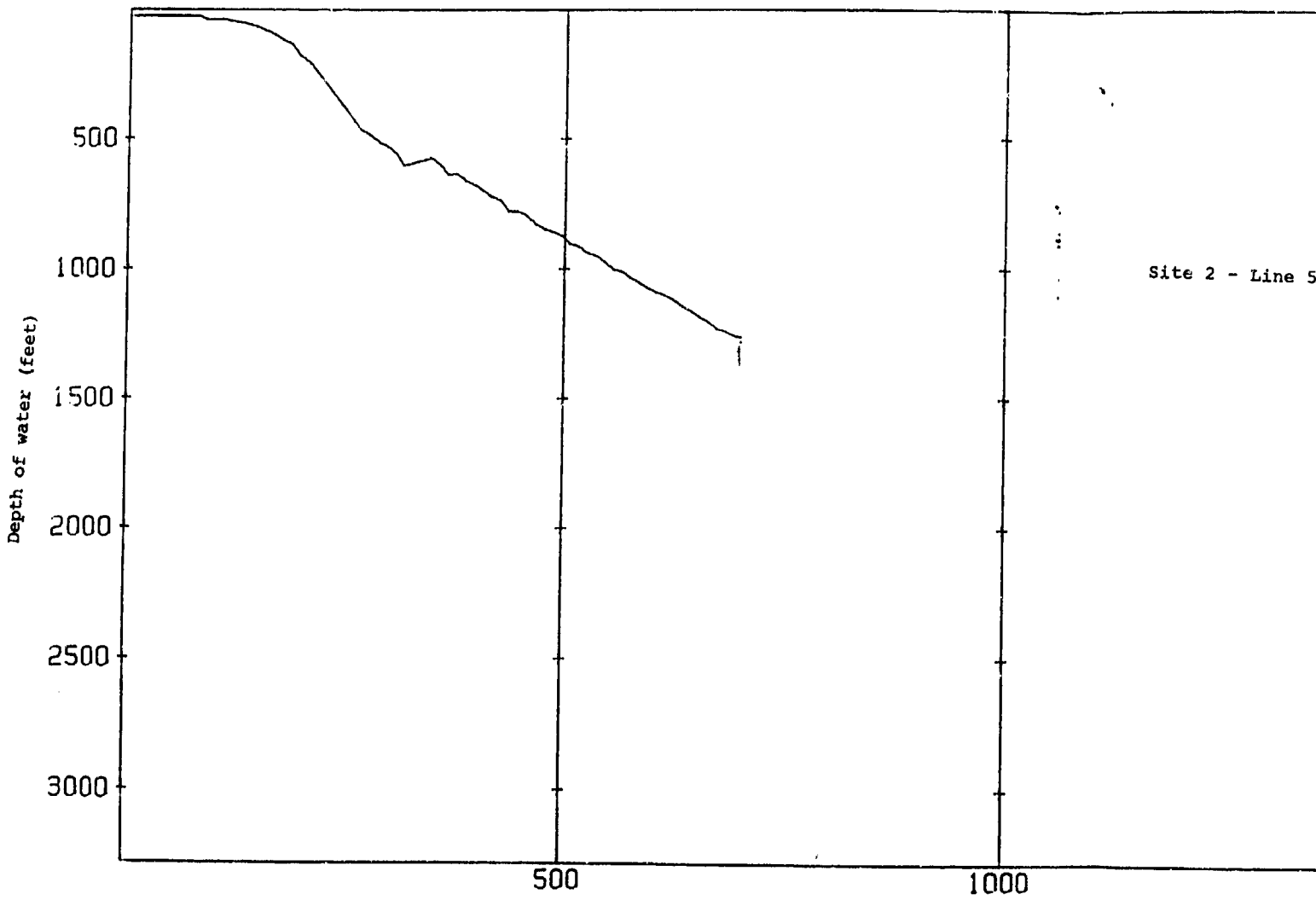


Figure 19

2



Site 2 - Line 5

Distance east of

Fig

1

Site 2 - Line 5

1000

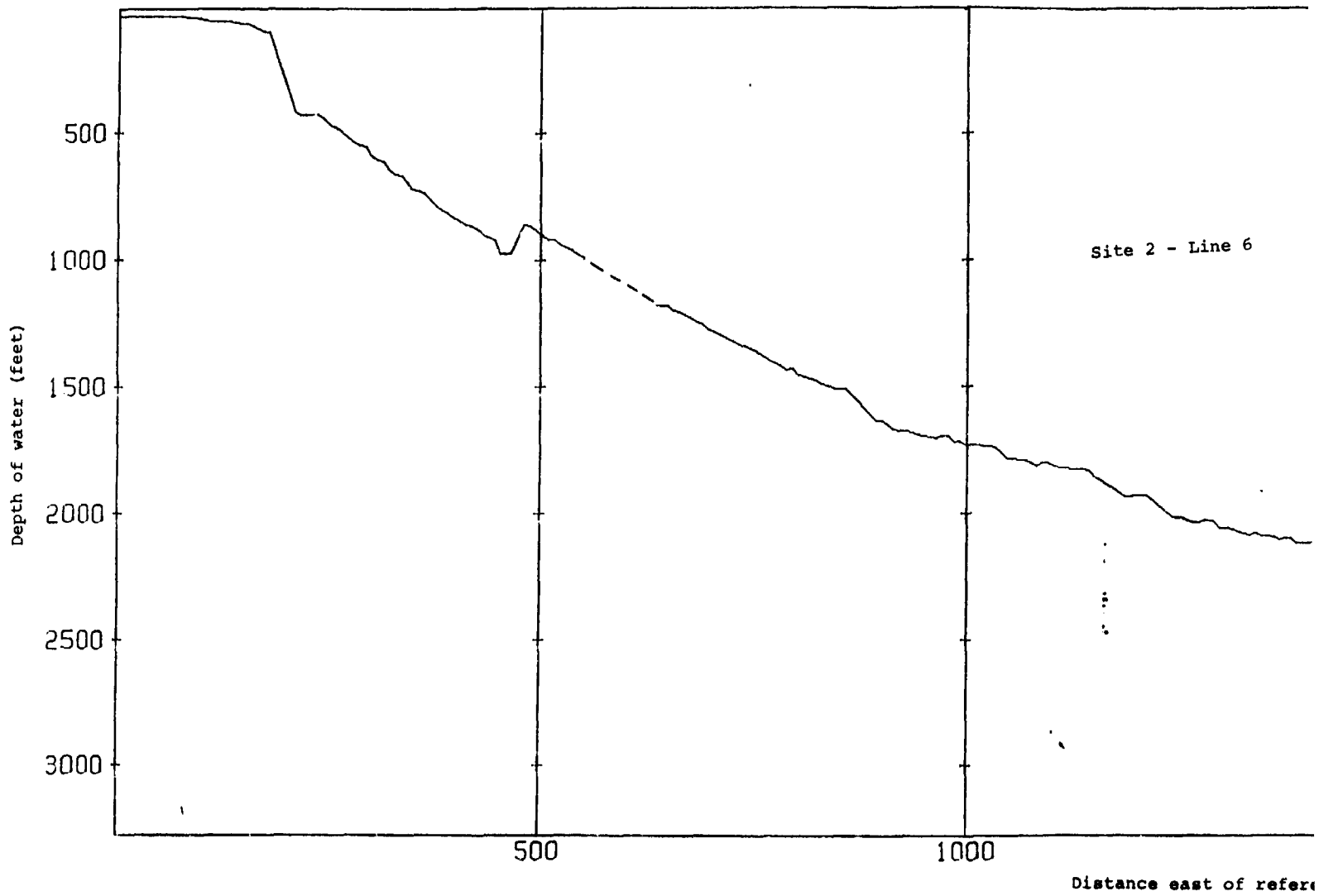
1500

2000

Distance east of reference point (meters)

Figure 20

2



Distance east of refer

Figur

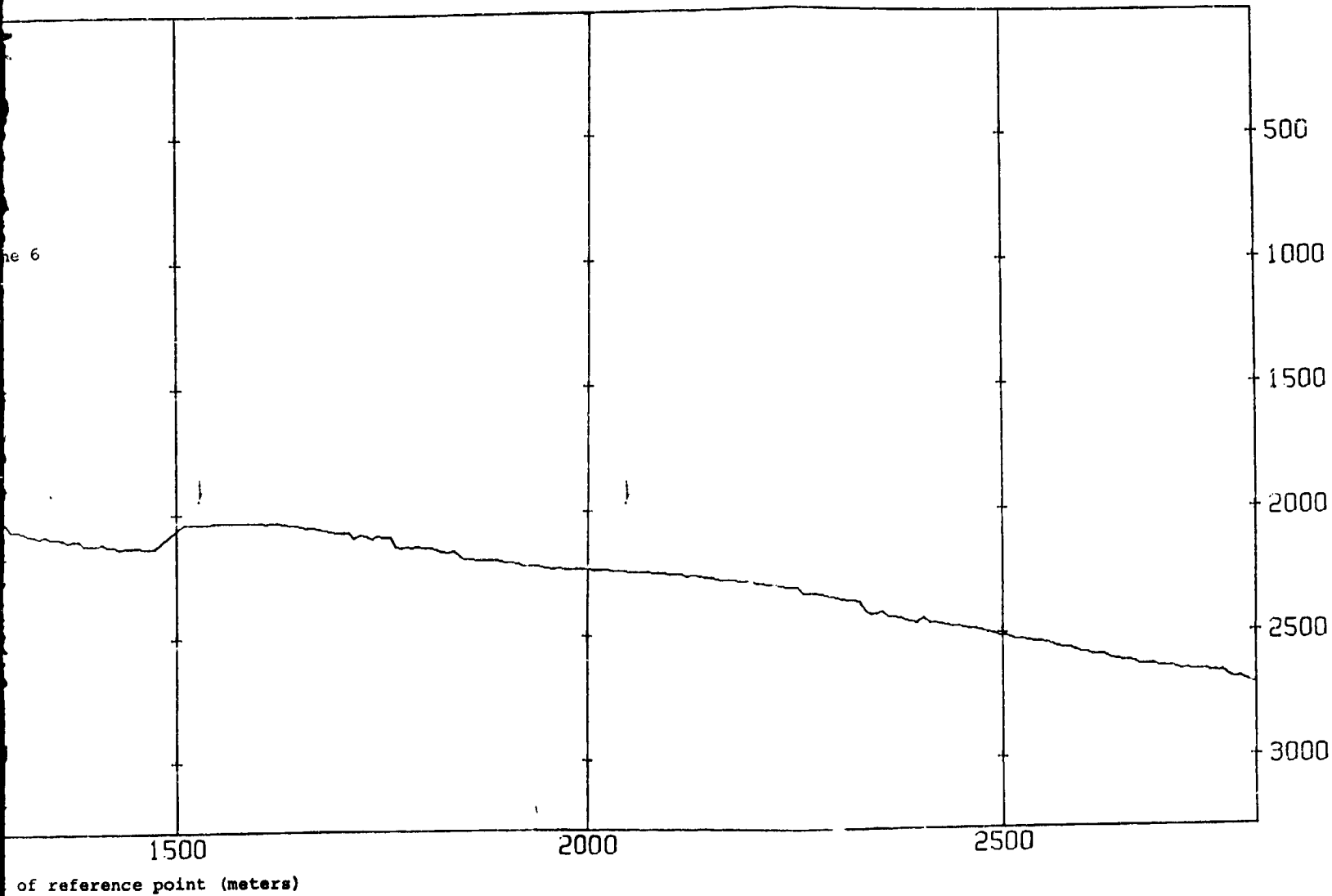


Figure 21