ODOR

AIR SAMPLING of ODOR (CO, H2S AND LEL)

Sampling Event	Date	Time	CO ppm	H2S ppm	LEL %
S-1 - San Mateo Landfill, Inlet of leachate treatment pond					
Morning	Oct. 18, 1998	6:15 AM	< 1	< 1	< 1
Daytime	Oct. 17, 1998	12:20 PM	1	< 1	1 %
Evening	Oct. 17, 1998	7:30 PM	2	< 1	< 1
Night time	Oct. 17, 1998	11:00 PM	< 1	< 1	< 1
S-5 - Residential Area, north of site					
Morning	Oct. 18, 1998	6:20 AM	< 1	< 1	< 1
Daytime	Oct. 17, 1998	12:25 PM	< 1	< 1	< 1
Evening	Oct. 17, 1998	7:35 PM	< 1	< 1	< 1
Night time	Oct. 17, 1998	11:10 PM	< 1	< 1	< 1

Note: % LEL is percent of the lower explosive limit. In the absence of odor measurement procedure, H2S and methane which are the common source of odor in a landfill are measured. Methane has a lower explosive limit of 5% by volume or 50,000 ppm (Material Safety Data Sheet). Therefore, the 1% reading represents methane concentration (assuming that all combustible gases that is detected is methane) of approximately 500 ppm.

Instrument used:

Quest Envirotrack IV Gas Monitor

NOISE/VIBRATION

VIBRATION AND NOISE TESTS IN SAN MATEO LANDFILL

29-31 October, 1998

Introduction

Measurements of ground vibration and acoustic noise were conducted in the vicinity of the Waste Disposal Sanitary Landfill Area in San Mateo, Rizal to estimate their level and characteristics.

Survey and Data Analysis

Ground vibration and noise measurements were conducted over a period of 24 hours in each site to determine maximum levels of ground vibration and acoustic noise. The survey was conducted from 30-31 October, 1998 on four sites proximal to the San Mateo Landfill (Figure 1).

In the San Mateo Landfill, the observation sites are the same sites where vibration measurements were previously conducted. Point S-1 is located several meters from the main road and is near the leaching ponds proximal to the compaction and dumping site. Points S-6 and S-11 lie along the main road, one (S-6) a few kilometers before the Landfill site near Sipinit Elementary School and the other (S-11) leading to the entrance/exit of the Garbage Landfill Area.

Station Code	Location	Test Conducted
S-1	Leaching pond	Vibration and Acoustic Tests
S-5	Residential Area	Vibration and Acoustic Tests
S-6	Sapinit Elementary School	Vibration and Acoustic Tests
S-11	Entrance/Exit	Vibration, Acoustic Tests and Traffic Count

For each of the four observation points, vertical seismometers with natural period of 1.0 Hz were deployed. These were connected to a digital recorder (EDR-1000). Recording parameters were mostly set to similar settings. A series of eight-minute measurements were simultaneously recorded on all points every hour of the observation period.

Recorded data were analyzed using EDRSEL program to view EDR-1000 data and to determine maximum velocity values. Selected waveforms representing records of noise and vehicular activity were reformatted for spectral analysis using DaDISP. Most of the large ground movements recorded by the network is dominated by vehicular activity. Hourly count was carried out at the three different areas and vehicles were classified according to their estimated weights, e.g., trucks are considered heavy while jeepneys and cars classified as light vehicles.

Results and Discussion

Temporal Variation of Ground Vibration Level

On measurement sites located along the main road (S-5, S-6 & S-11), the maximum amplitude levels of recorded vehicular activity follow a sinusoidal trend (Figures 2, 3, 4, 5, 6 and 7). In S-5 & S-11, this trend continues until midnight and appears to start again in the morning (Figure 2 and 4). While the actual amplitude levels of vehicular activity may not follow the same trend as the traffic counts histogram done on S-11, amplitude levels of background noise appear to fairly correlate with it. However, an envelope of the maximum amplitudes of vehicular record (Figures 5, 6 and 7) appears to agree with the vehicular count (Figure 8). In S-1, maximum ground vibration due to vehicular activity does not temporally follow traffic count histogram and may indicate other sources such as dumping and compaction activities in the landfill area (Figure 9).

Spectral Variation of Ground Shaking Level

Spectral content of records at each site was determined during periods of heavy vehicular and light activity. During both periods, Point S-11 shows a predominant peak at 5 Hz, either representing a site-specific predominant frequency or a marker frequency for a distal source of vibration. However, spectra of vehicular activity show a seemingly harmonic polymodal predominant peaks at approximately 8, 13 and 20 Hz. Similar cases can be seen in other recording stations near the landfill (see spectra appendices).

Acoustic Level

Acoustic measurements (in dB) were randomly conducted in the three areas. In the landfill area, Point S-1 has relatively lower acoustic values than the other three sites (Figure 17).

CONCLUSION

Recent measurements of ground vibration generally show higher amplitude levels at the same sites than in the survey made in February 1998. Frequency content also changed showing predominance of lower frequencies than before. This shift may be an effect of the smoother concrete road constructed in the sites. Rough roads tend to produce higher frequency content than smoother roads.

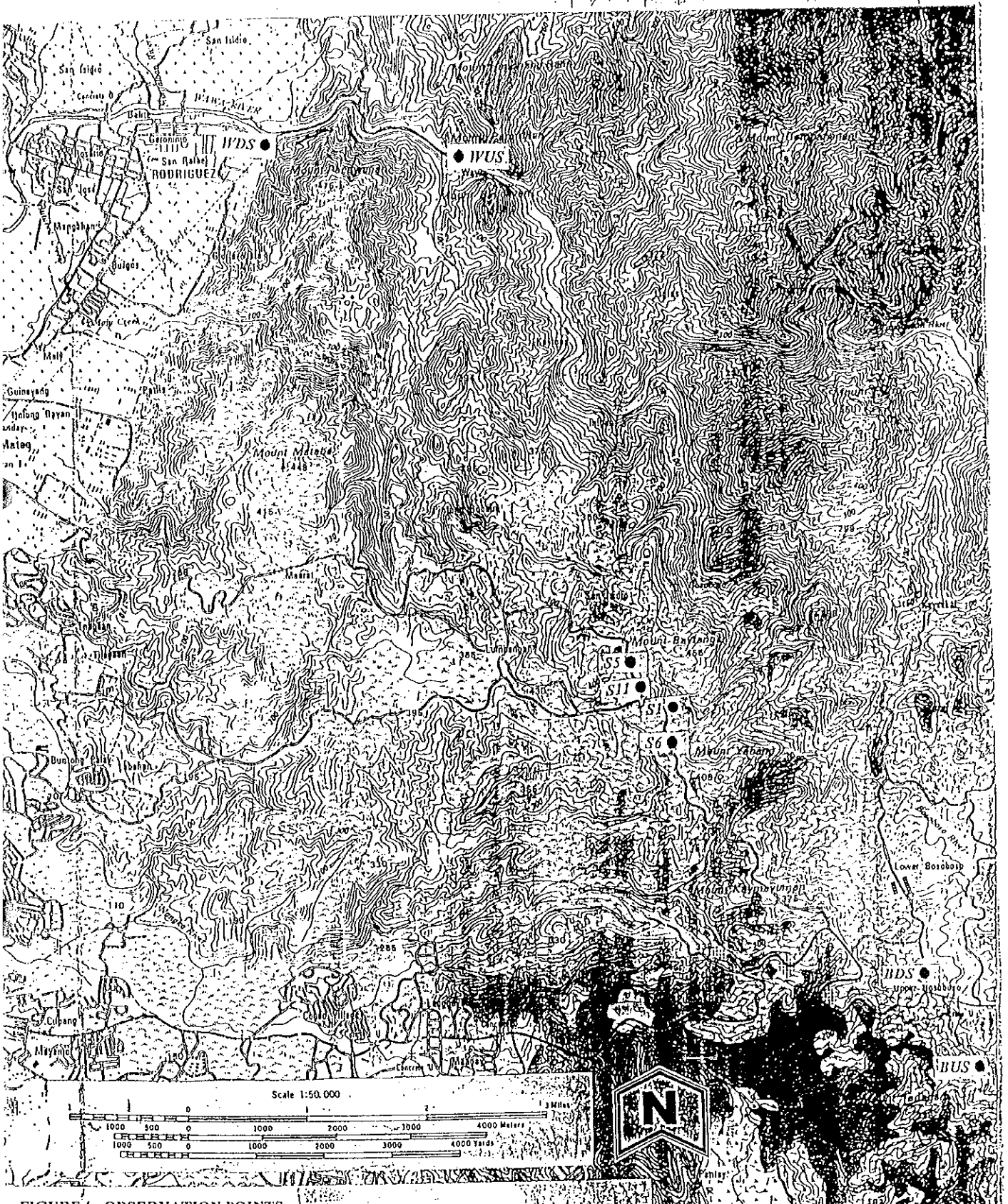


FIGURE 1. OBSERVATION POINTS

S6, Sapinit Elem. School	Vibration Test; and Random Acoustic Noise Test
S5, Residential Area	Vibration Test; and Random Acoustic Noise Test
S1, Leaching Pond	Vibration Test; and Random Acoustic Noise Test
S11, Entrance/Exit	Vibration Test; Random Acoustic Noise Test; and Traffic Count
WUS, Wawa Upstream	Vibration Test; and Random Acoustic Noise Test
WDS, Wawa Downstream	Vibration Test; Hourly Acoustic Noise Test; and Traffic Count
BUS, Boso-Boso Upstream	Vibration Test; and Random Acoustic Noise Test
BDS, Boso-Boso Downstream	Vibration Test; Random Acoustic Noise Test; and Traffic Count

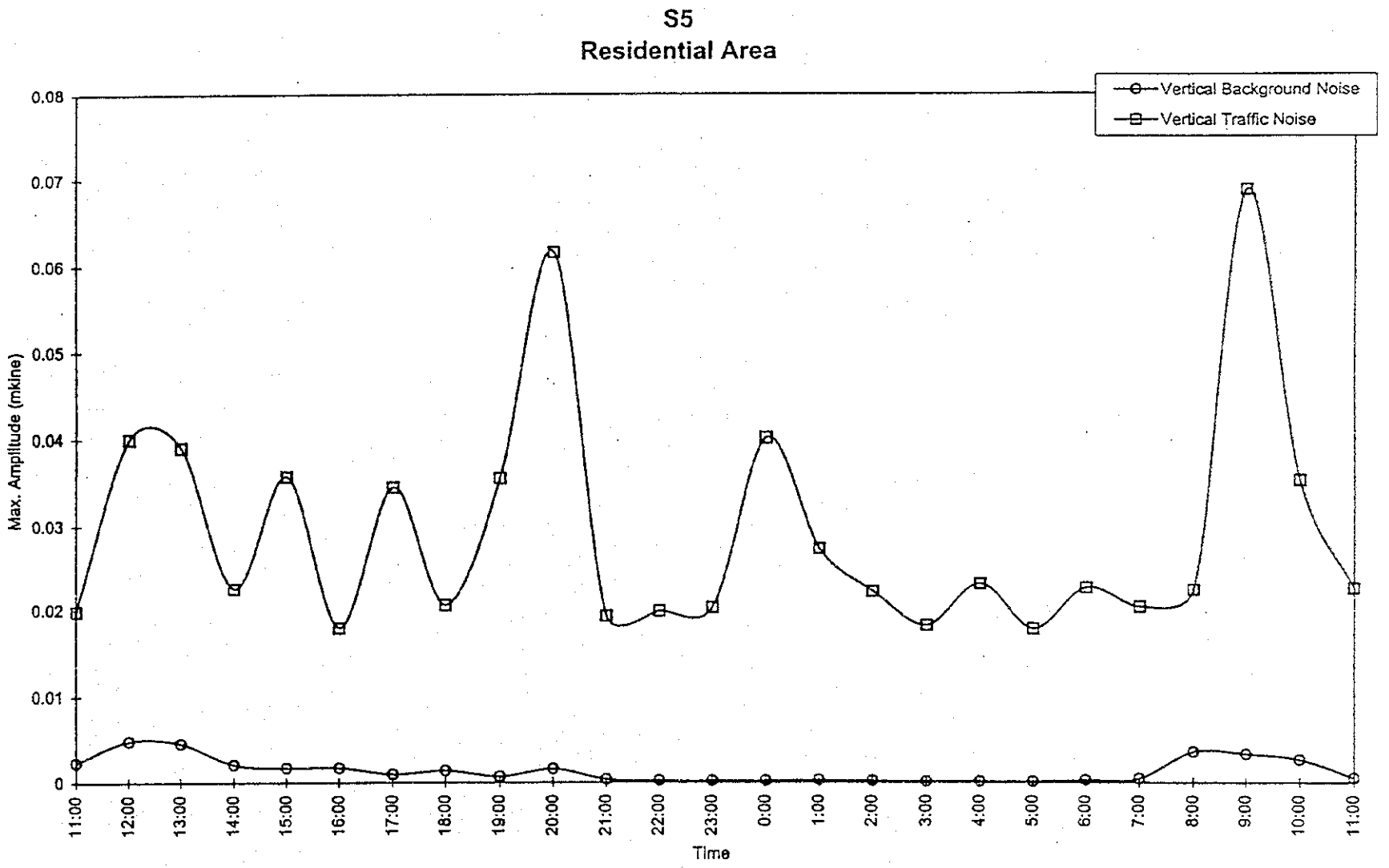

S5
Residential Area
Vertical Background Noise
Vertical Traffic Noise
Max. Amplitude (mkine)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
Time

FIGURE 2

S5 (40db) Vertical
Residential

Time	Vertical Background Noise	Traffic Noise		
11:00	0.00231	0.01983	0.231	1.983
12:00	0.00484	0.03996	0.484	3.996
13:00	0.00454	0.03901	0.454	3.901
14:00	0.00206	0.02244	0.206	2.244
15:00	0.00167	0.03564	0.167	3.564
16:00	0.00167	0.01786	0.167	1.786
17:00	0.00094	0.0344	0.094	3.440
18:00	0.00137	0.02051	0.137	2.051
19:00	0.00068	0.03546	0.068	3.546
20:00	0.00158	0.06159	0.158	6.159
21:00	0.00034	0.01923	0.034	1.923
22:00	0.00021	0.01978	0.021	1.978
23:00	0.00021	0.02022	0.021	2.022
0:00	0.00021	0.04	0.021	4.000
1:00	0.00026	0.02724	0.026	2.724
2:00	0.00021	0.0221	0.021	2.210
3:00	0.00013	0.01816	0.013	1.816
4:00	0.00013	0.023	0.013	2.300
5:00	0.00013	0.01778	0.013	1.778
6:00	0.0003	0.02253	0.030	2.253
7:00	0.00047	0.0203	0.047	2.030
8:00	0.00356	0.02227	0.356	2.227
9:00	0.0033	0.06874	0.330	6.874
10:00	0.00265	0.03512	0.265	3.512
11:00	0.00051	0.02244	0.051	2.244

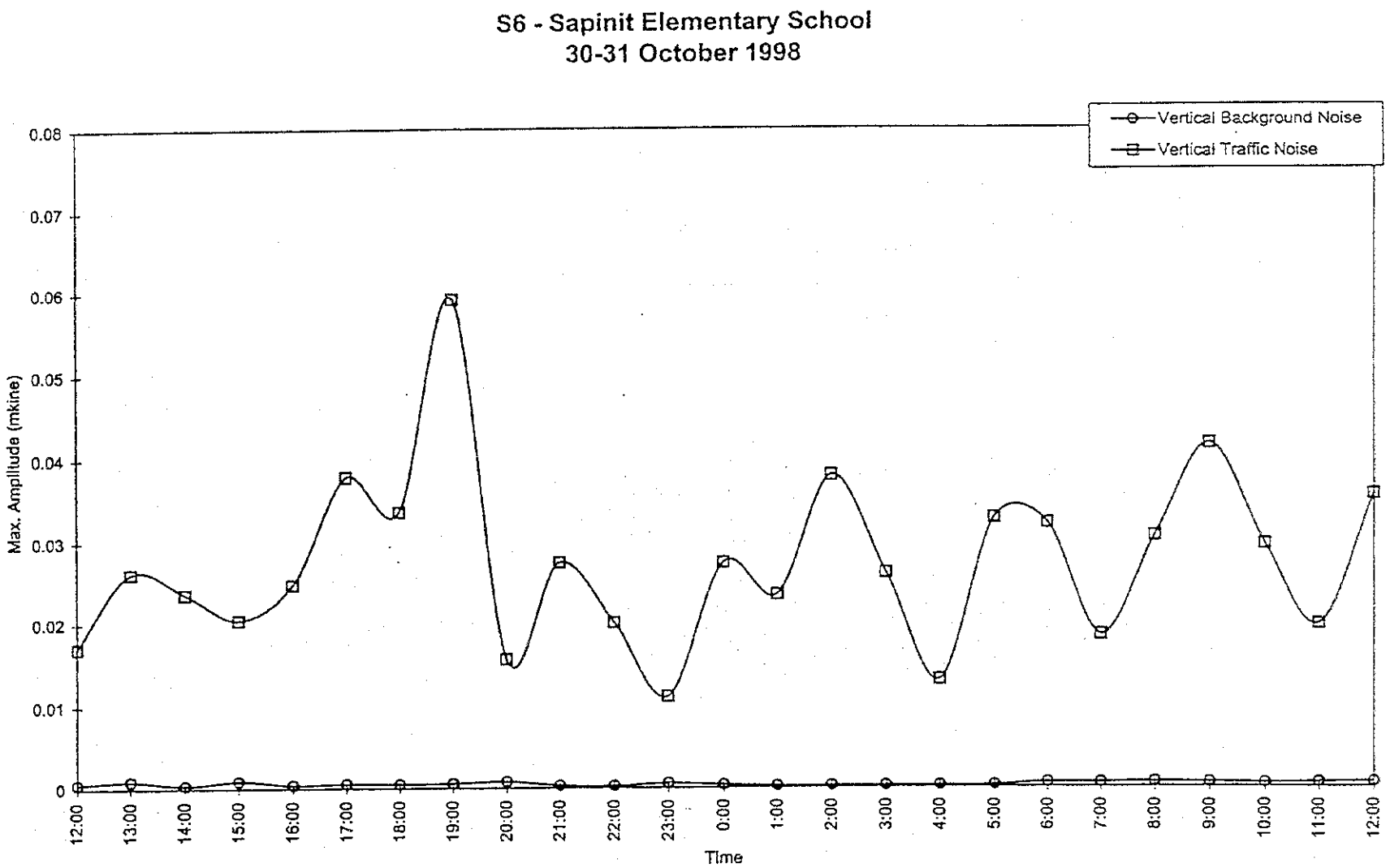

S6 - Sapinit Elementary School
30-31 October 1998
Vertical Background Noise
Vertical Traffic Noise
Max. Amplitude (mkine)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
Time

FIGURE 3

S6 (40db) Vertical
Sapinit Elementary School

Time	Vertical Background Noise	Traffic Noise		
12:00	0.00056	0.01713	0.056	1.713
13:00	0.0009	0.02621	0.090	2.621
14:00	0.00034	0.0236	0.034	2.360
15:00	0.0009	0.02043	0.090	2.043
16:00	0.00039	0.02476	0.039	2.476
17:00	0.00056	0.03786	0.056	3.786
18:00	0.00047	0.03362	0.047	3.362
19:00	0.00056	0.05915	0.056	5.915
20:00	0.00081	0.01572	0.081	1.572
21:00	0.00026	0.02741	0.026	2.741
22:00	0.00021	0.02	0.021	2.000
23:00	0.00056	0.0112	0.056	1.120
0:00	0.00034	0.02737	0.034	2.737
1:00	0.00017	0.02339	0.017	2.339
2:00	0.00017	0.03786	0.017	3.786
3:00	0.00017	0.02604	0.017	2.604
4:00	0.00017	0.01315	0.017	1.315
5:00	0.00021	0.03272	0.021	3.272
6:00	0.00056	0.03208	0.056	3.208
7:00	0.00051	0.01842	0.051	1.842
8:00	0.0006	0.0305	0.060	3.050
9:00	0.00056	0.04142	0.056	4.142
10:00	0.00043	0.02947	0.043	2.947
11:00	0.00051	0.0197	0.051	1.970
12:00	0.0006	0.03546	0.060	3.546

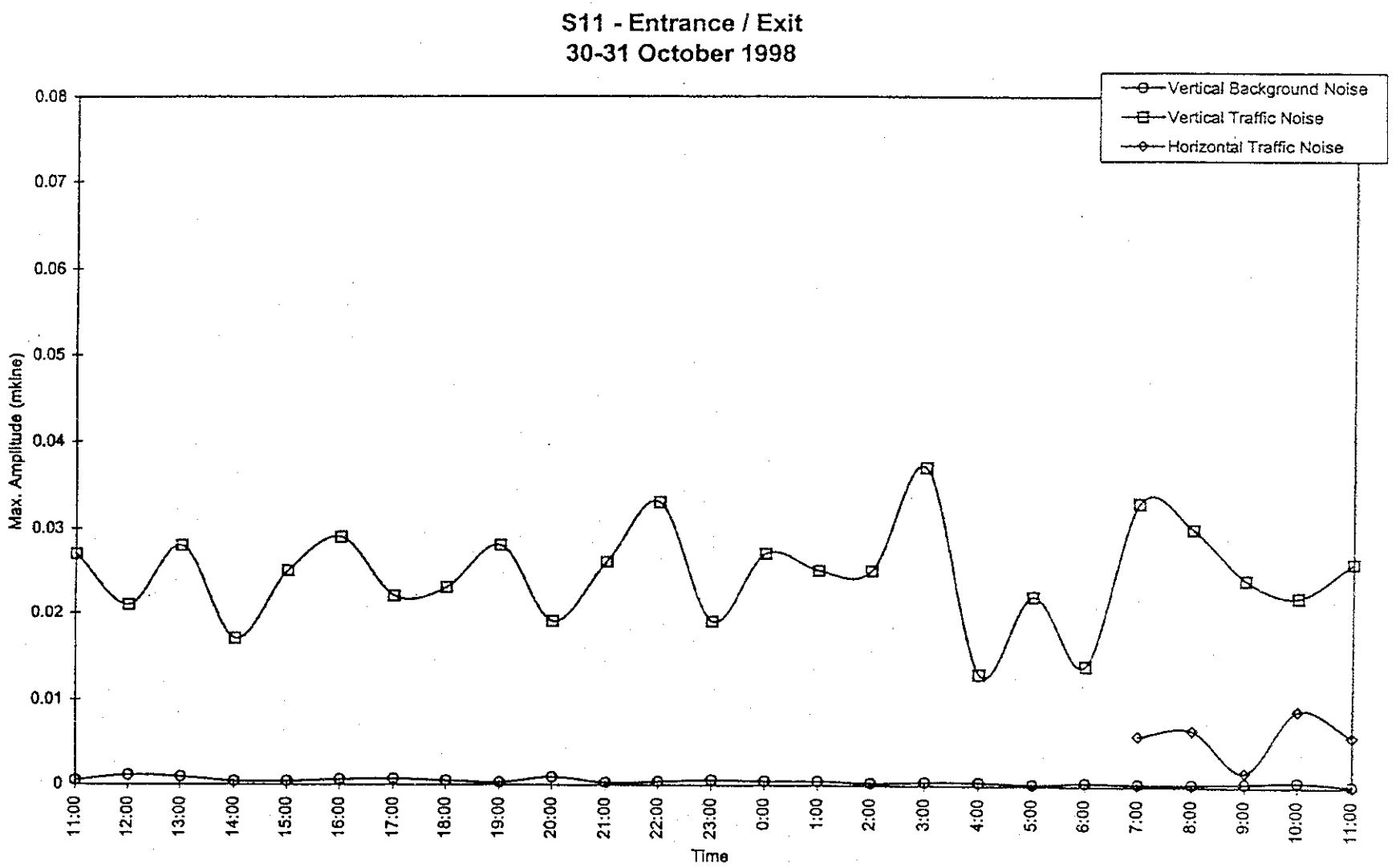

S11 - Entrance / Exit
30-31 October 1998
Vertical Background Noise
Vertical Traffic Noise
Horizontal Traffic Noise
Max. Amplitude (mkine)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
Time

FIGURE 4

S11 (40db) Vertical
Entrance/Exit

Time	Vertical Background Noise	Traffic Noise	Horizontal Traffic Noise			
11:00	0.0005	0.027		0.050	2.700	
12:00	0.0011	0.021		0.110	2.100	
13:00	0.0009	0.028		0.090	2.800	
14:00	0.0004	0.017		0.040	1.700	
15:00	0.0004	0.025		0.040	2.500	
16:00	0.0006	0.029		0.060	2.900	
17:00	0.0007	0.022		0.070	2.200	
18:00	0.0005	0.023		0.050	2.300	
19:00	0.0003	0.028		0.030	2.800	
20:00	0.0009	0.019		0.090	1.900	
21:00	0.0003	0.026		0.030	2.600	
22:00	0.0004	0.033		0.040	3.300	
23:00	0.0006	0.019		0.060	1.900	
0:00	0.0005	0.027		0.050	2.700	
1:00	0.0005	0.025		0.050	2.500	
2:00	0.0003	0.025		0.030	2.500	
3:00	0.0004	0.037		0.040	3.700	
4:00	0.0004	0.013		0.040	1.300	
5:00	0.0002	0.022		0.020	2.200	
6:00	0.0004	0.014		0.040	1.400	
7:00	0.0003	0.033	0.006	0.030	3.300	0.600
8:00	0.0003	0.03	0.0067	0.030	3.000	0.670
9:00	0.0004	0.024	0.0017	0.040	2.400	0.170
10:00	0.0006	0.022	0.009	0.060	2.200	0.900
11:00	0.0002	0.026	0.006	0.020	2.600	0.600

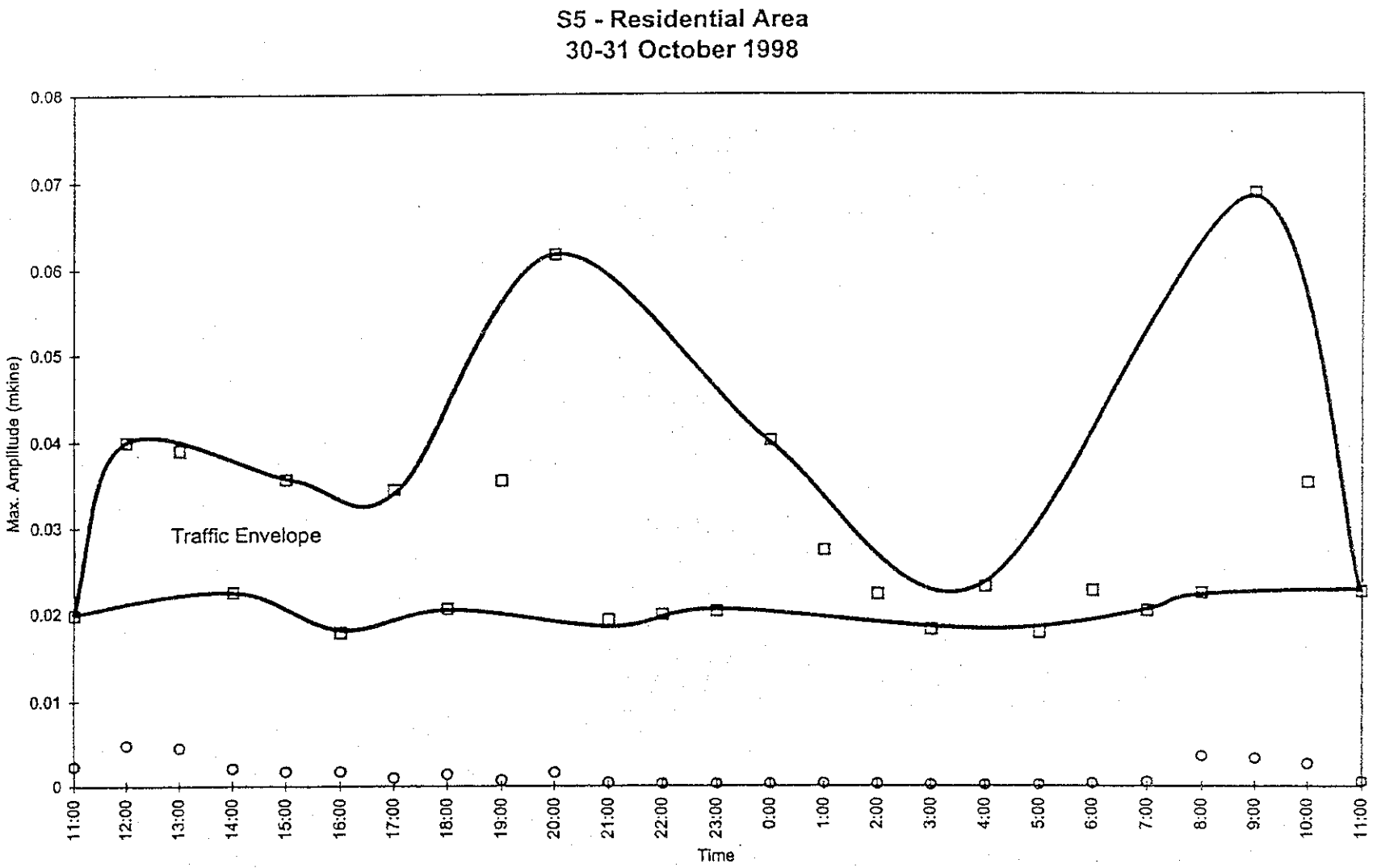

S5 - Residential Area
30-31 October 1998
Max. Amplitude (mkine)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Traffic Envelope
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
Time

FIGURE 5

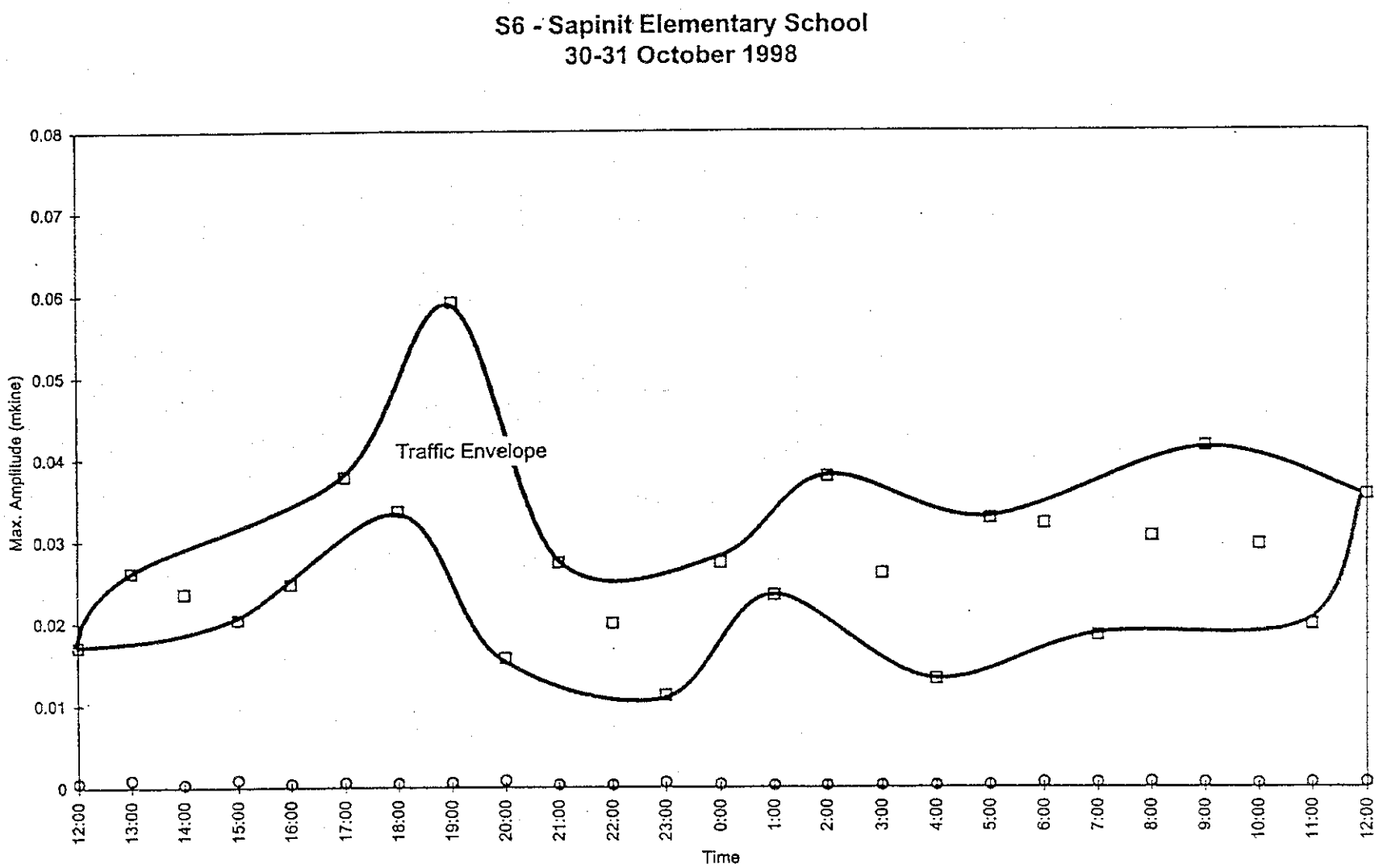

S6 - Sapinit Elementary School
30-31 October 1998
Traffic Envelope
Max. Amplitude (mkine)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
Time

FIGURE 6

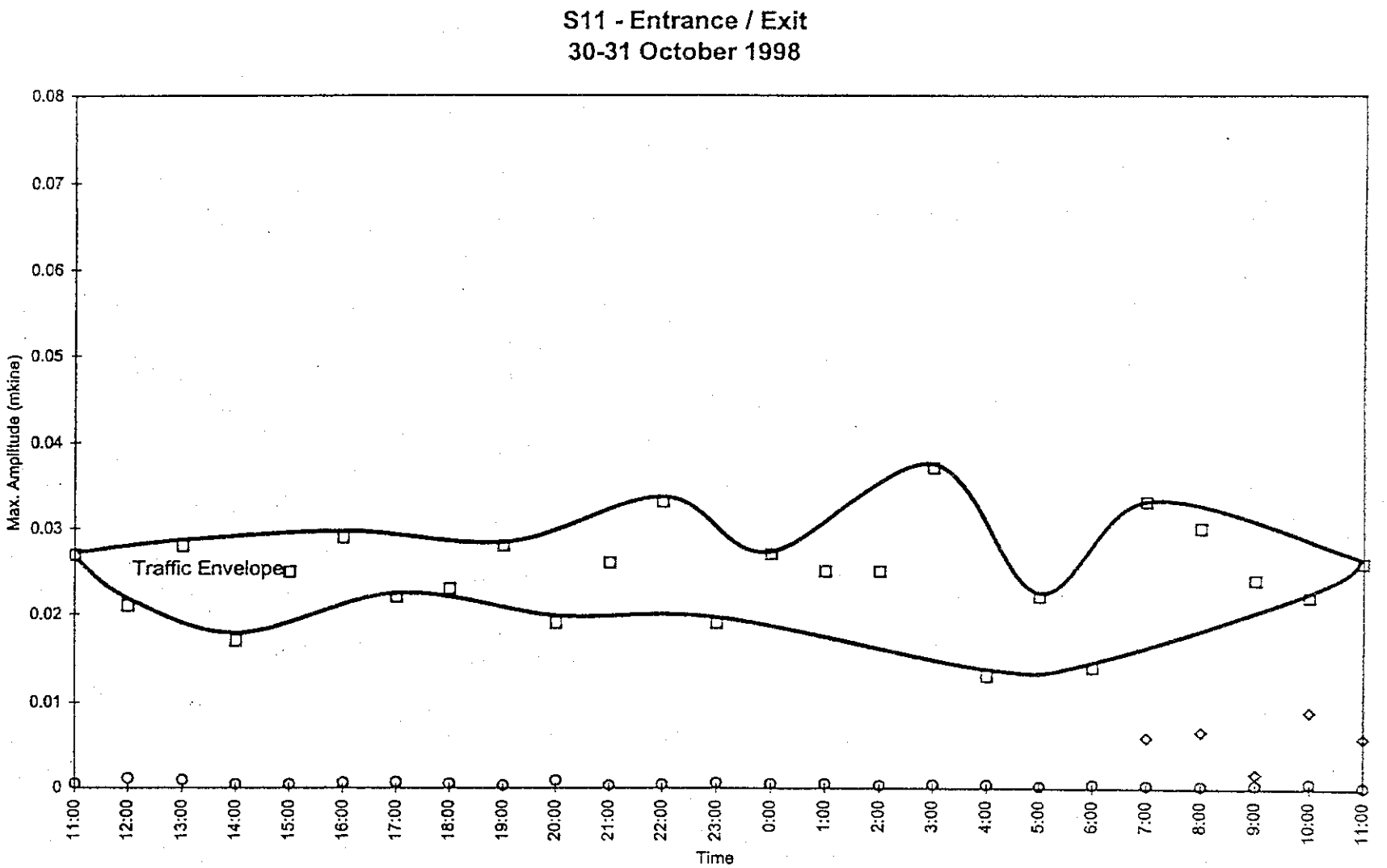

S11 - Entrance / Exit
30-31 October 1998
Max. Amplitude (mkine)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Traffic Envelope
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
Time

FIGURE 7

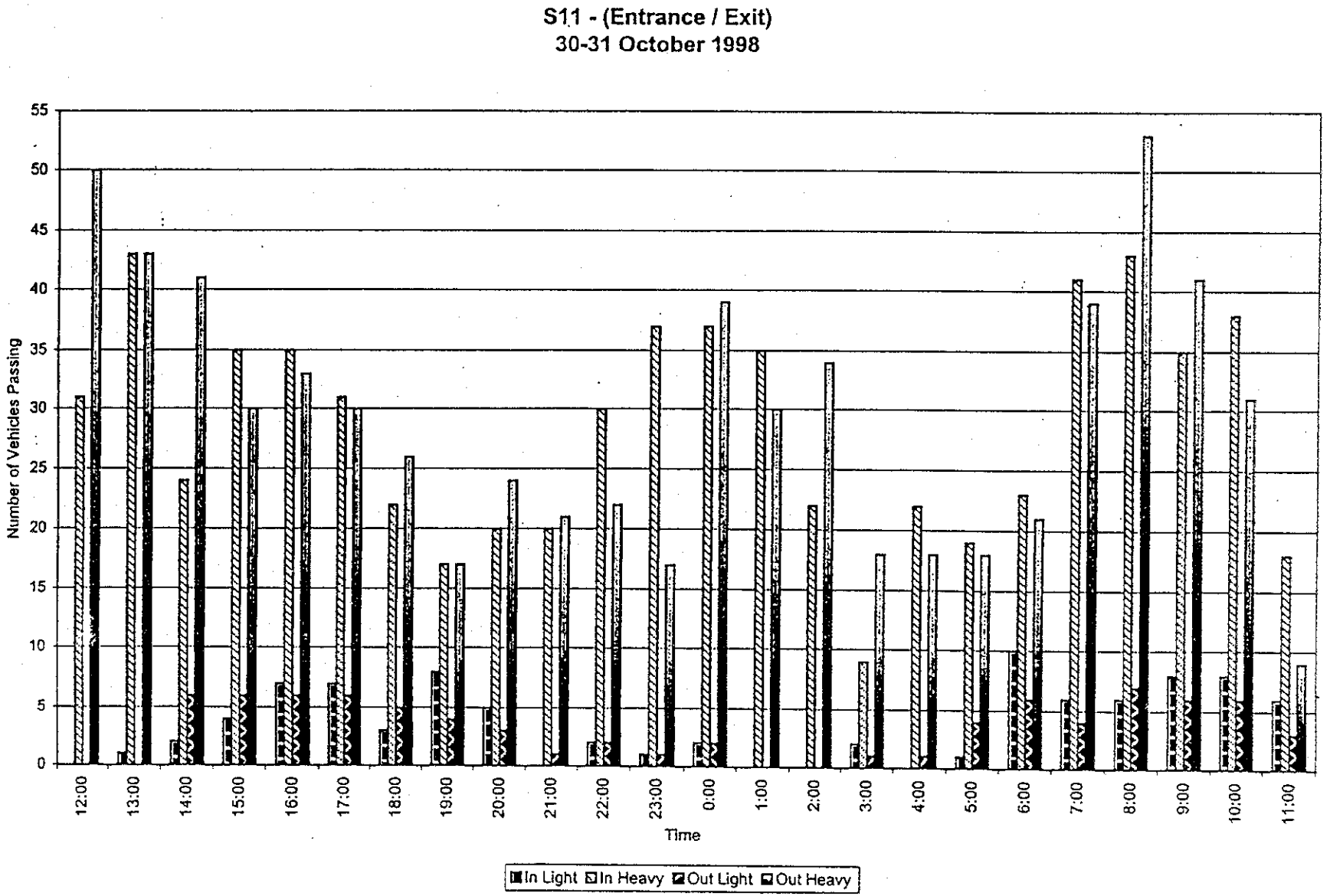

S11 - (Entrance / Exit)
30-31 October 1998
Number of Vehicles Passing
0
5
10
15
20
25
30
35
40
45
50
55
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
Time
In Light
In Heavy
Out Light
Out Heavy

FIGURE 8

S11 (Entrance / Exit)
30-31 October 1998

Day	Time	In Light	Heavy	Out Light	Heavy
30 Oct.	12:00		31		50
	13:00	1	43		43
	14:00	2	24	6	41
	15:00	4	35	6	30
	16:00	7	35	6	33
	17:00	7	31	6	30
	18:00	3	22	5	26
	19:00	8	17	4	17
	20:00	5	20	3	24
	21:00		20	1	21
	22:00	2	30	2	22
	23:00	1	37	1	17
31 Oct.	0:00	2	37	2	39
	1:00		35		30
	2:00		22		34
	3:00	2	9	1	18
	4:00		22	1	18
	5:00	1	19	4	18
	6:00	10	23	6	21
	7:00	6	41	4	39
	8:00	6	43	7	53
	9:00	8	35	6	41
	10:00	8	38	6	31
	11:00	6	18	3	9

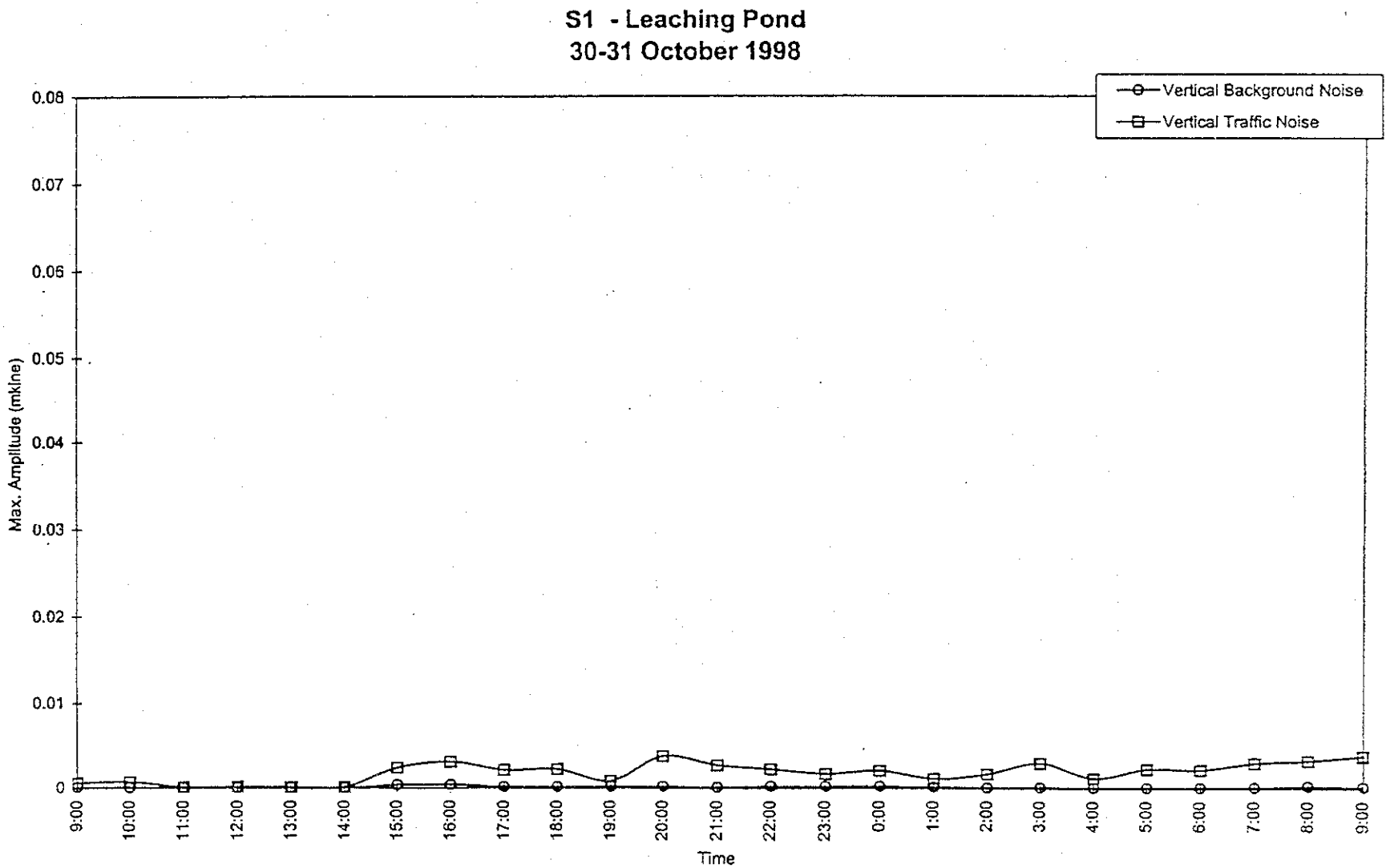
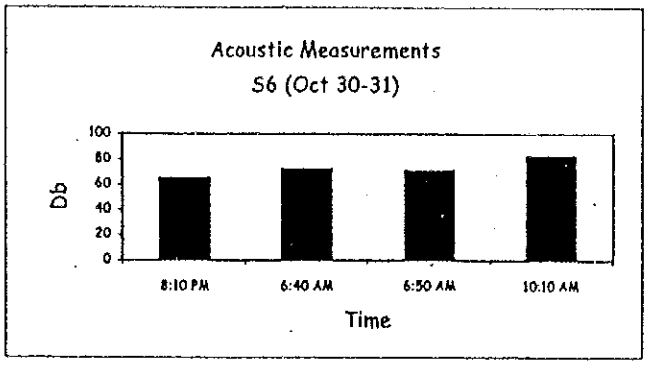
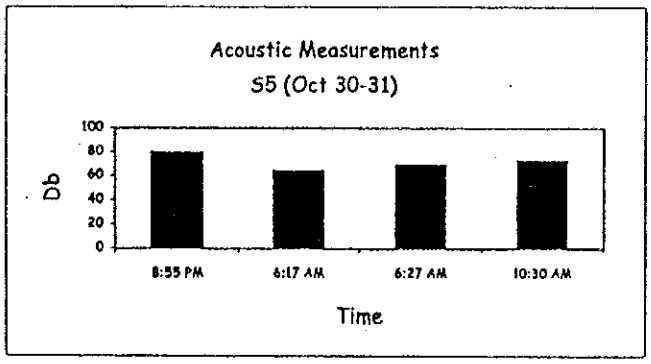

S1 - Leaching Pond
30-31 October 1998
Vertical Background Noise
Vertical Traffic Noise
Max. Amplitude (mkine)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
Time

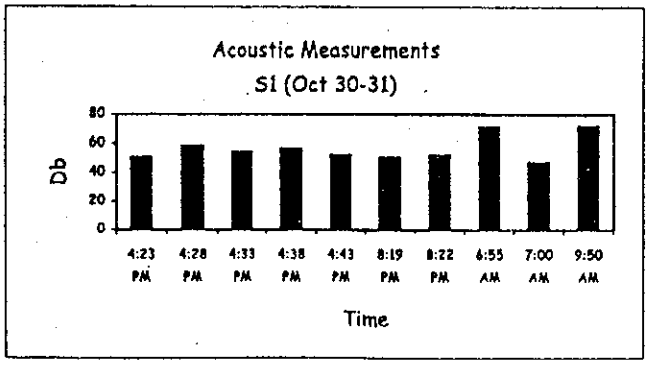
FIGURE 9

S1 (60db) Vertical
Leaching Pond

Time	Vertical Background Noise	Traffic Noise		
9:00	0.000055	0.000582	0.055	0.582
10:00	0.000021	0.000728	0.021	0.728
11:00	0.00003	0.00011	0.030	0.110
12:00	0.00003	0.00017	0.030	0.170
13:00	0.00004	0.00012	0.040	0.120
14:00	0.00003	0.00012	0.030	0.120
15:00	0.000381	0.002428	0.381	2.428
16:00	0.000368	0.003109	0.368	3.109
17:00	0.000167	0.002154	0.167	2.154
18:00	0.000179	0.002252	0.179	2.252
19:00	0.000179	0.000852	0.179	0.852
20:00	0.00019	0.0038	0.190	3.800
21:00	0.00011	0.00272	0.110	2.720
22:00	0.000218	0.00227	0.218	2.270
23:00	0.000192	0.001738	0.192	1.738
0:00	0.000235	0.002103	0.235	2.103
1:00	0.000162	0.001146	0.162	1.146
2:00	0.0001	0.0017	0.100	1.700
3:00	0.00012	0.003	0.120	3.000
4:00	0.00009	0.0012	0.090	1.200
5:00	0.00008	0.0023	0.080	2.300
6:00	0.00012	0.0022	0.120	2.200
7:00	0.00011	0.003	0.110	3.000
8:00	0.000261	0.003285	0.261	3.285
9:00	0.000205	0.003812	0.205	3.812







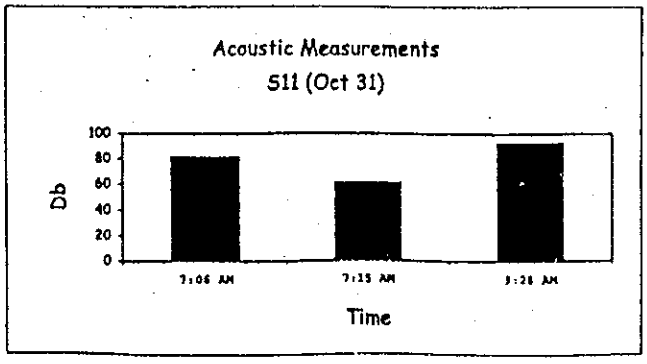
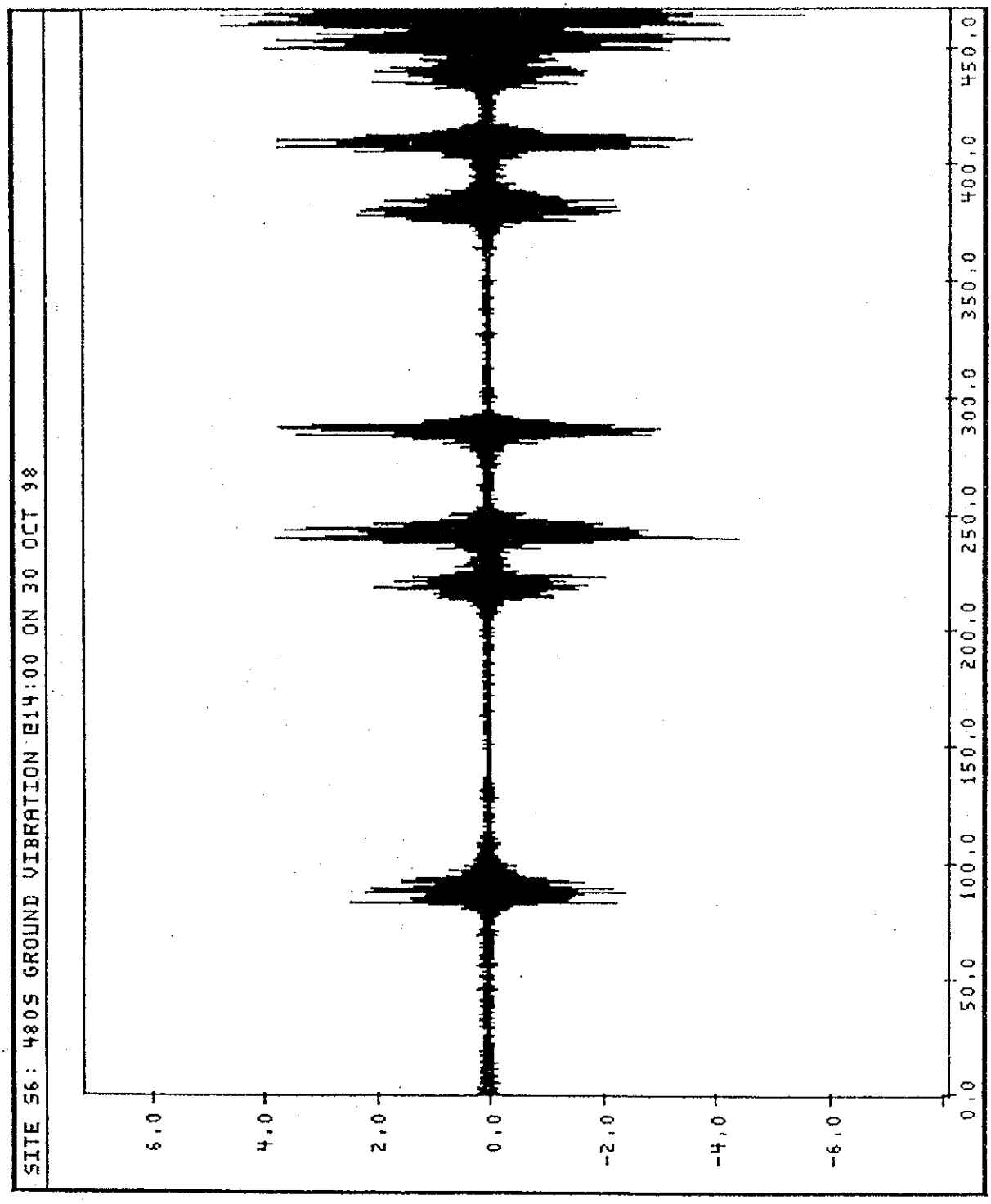
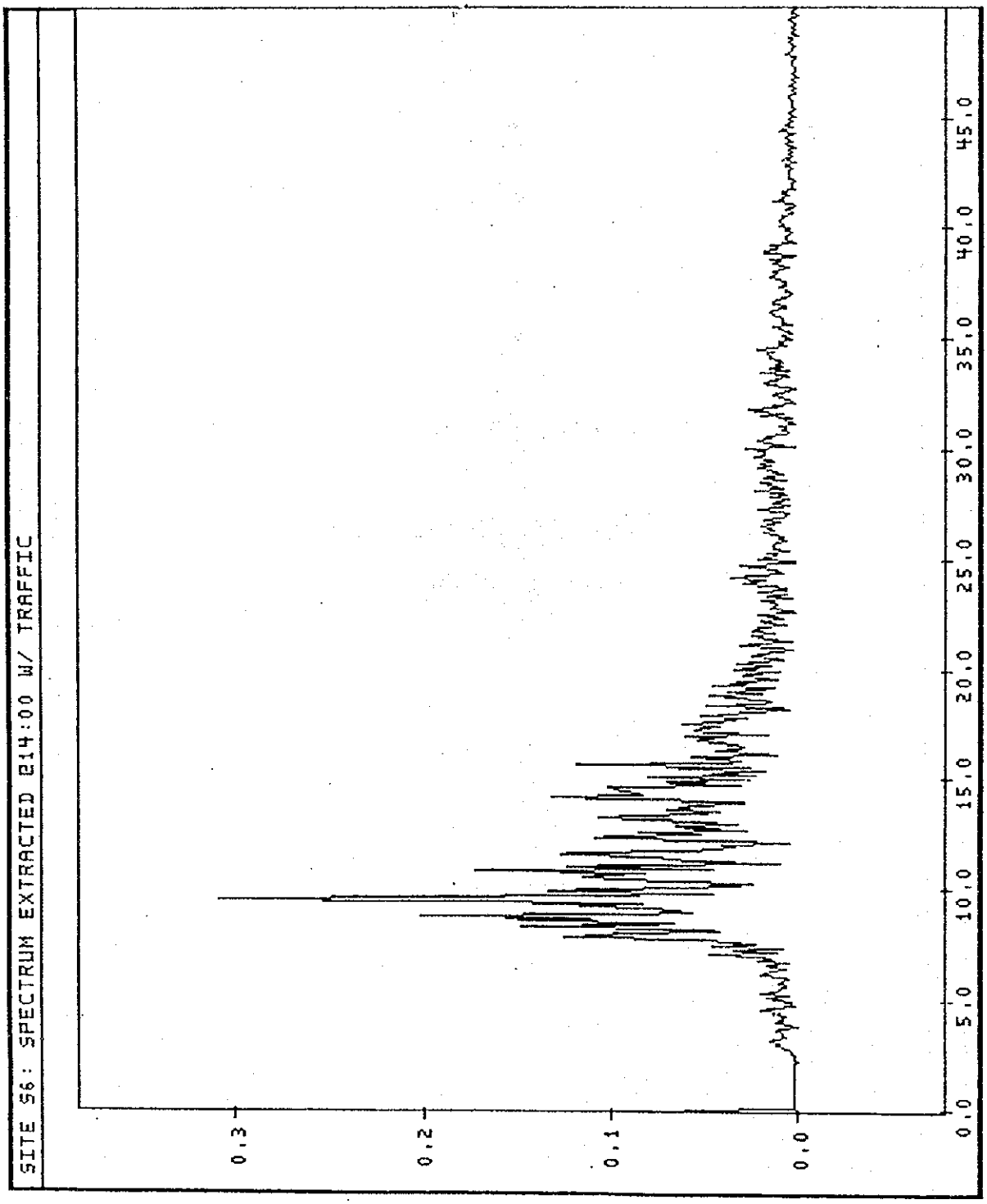
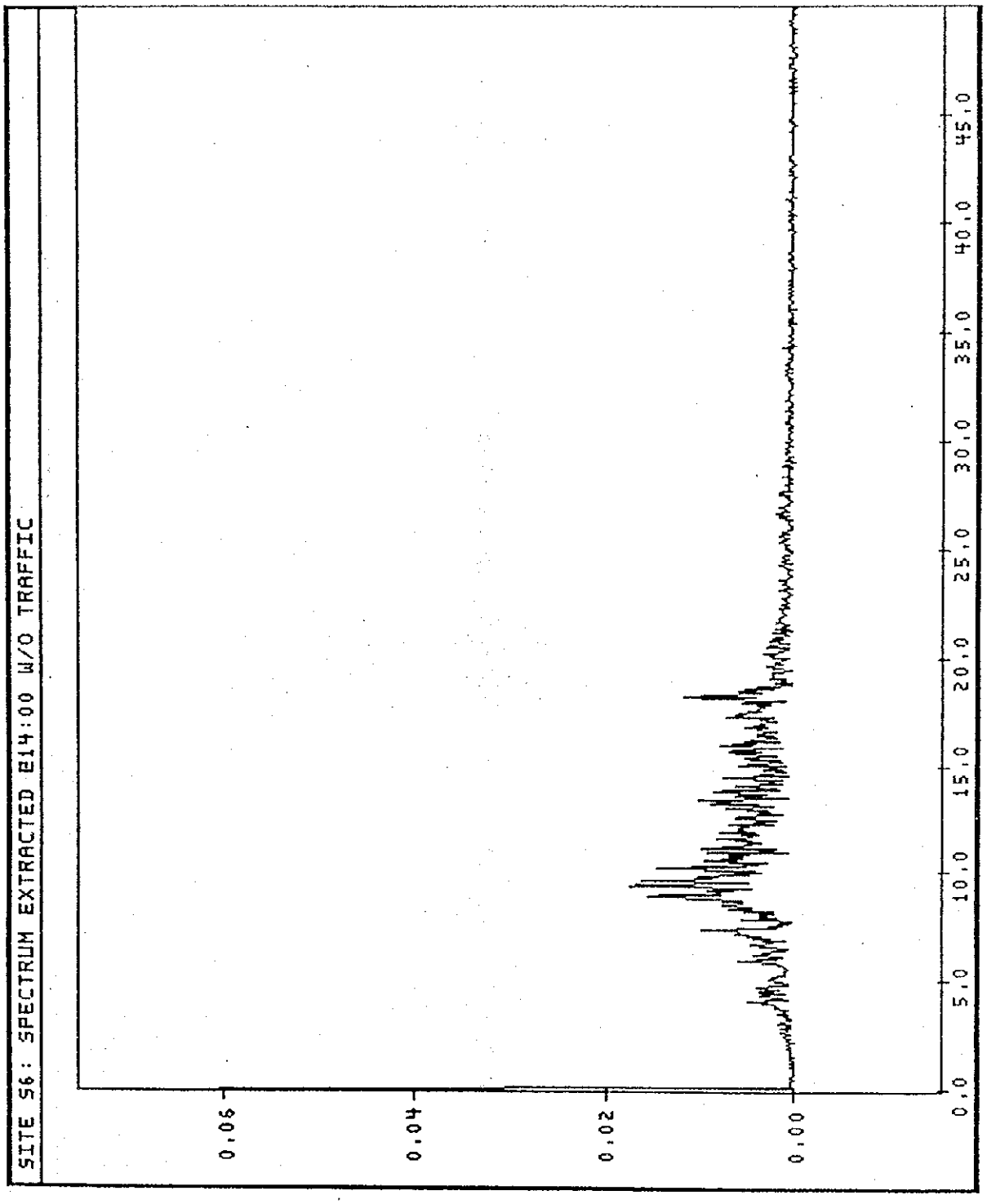


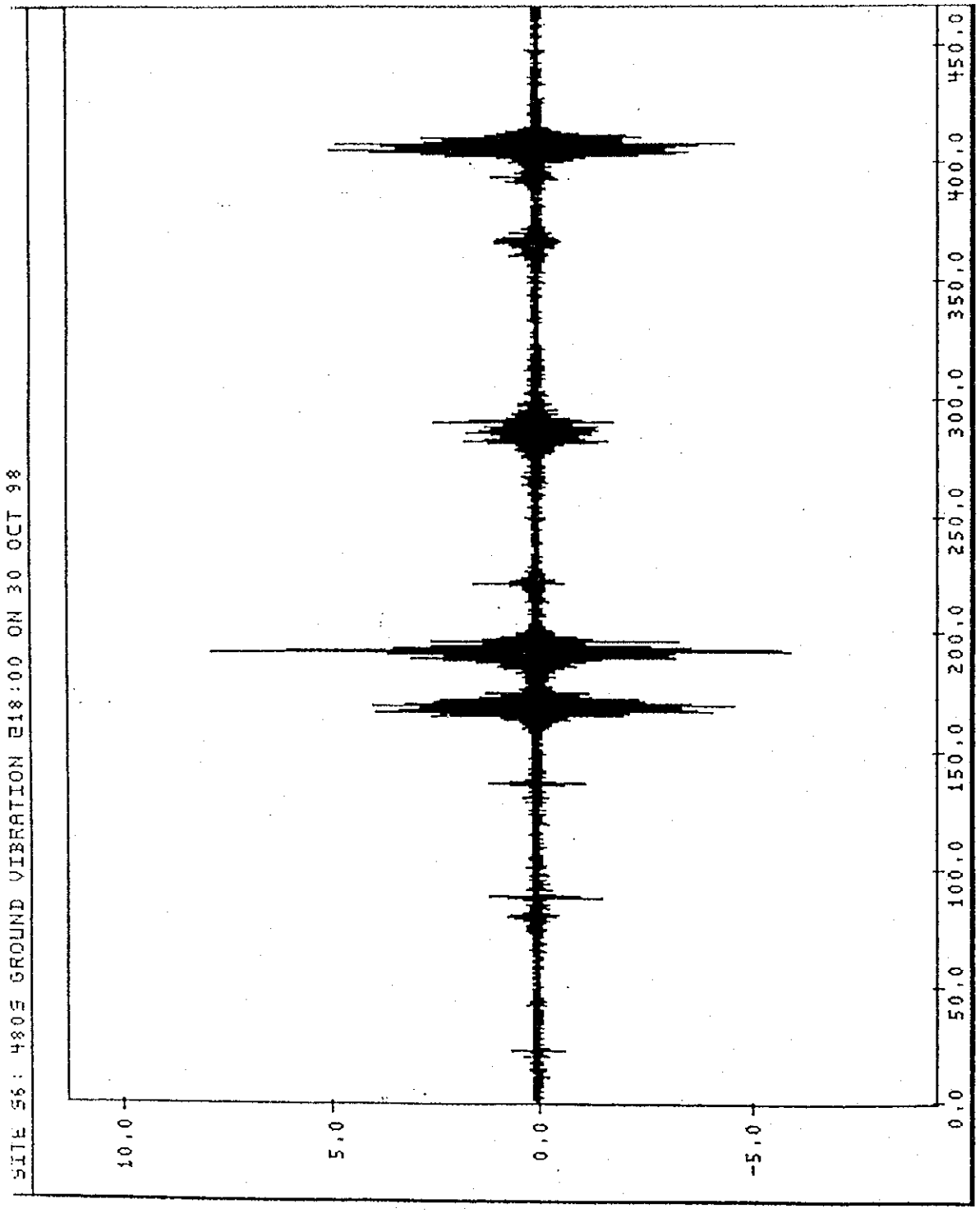
FIGURE 17. ACOUSTIC NOISE LEVEL AT POINTS ON TOP LANDFILL PROPER

Appendix

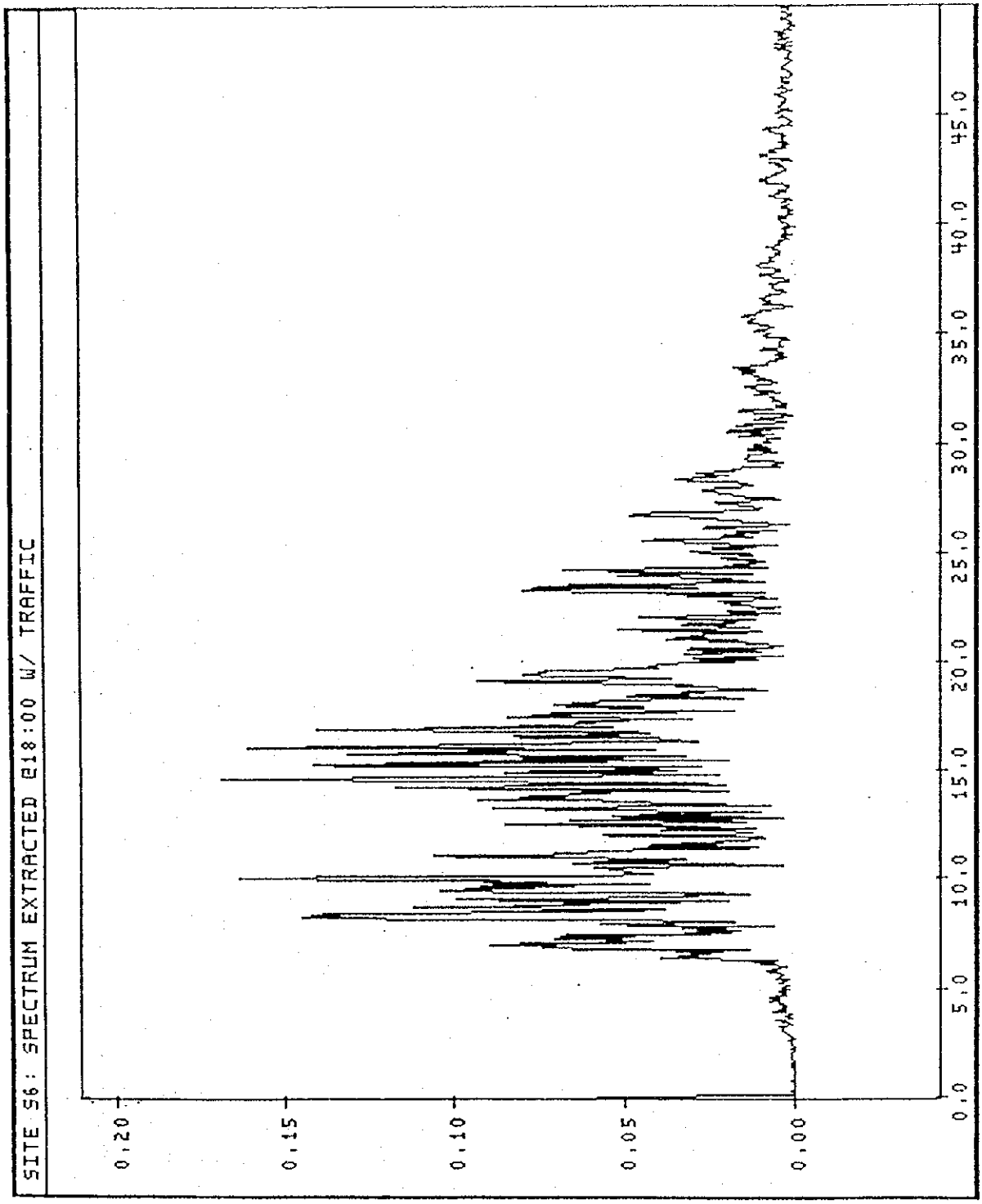

SITE S6: 480S GROUND VIBRATION @14:00 ON 30 OCT 98
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0

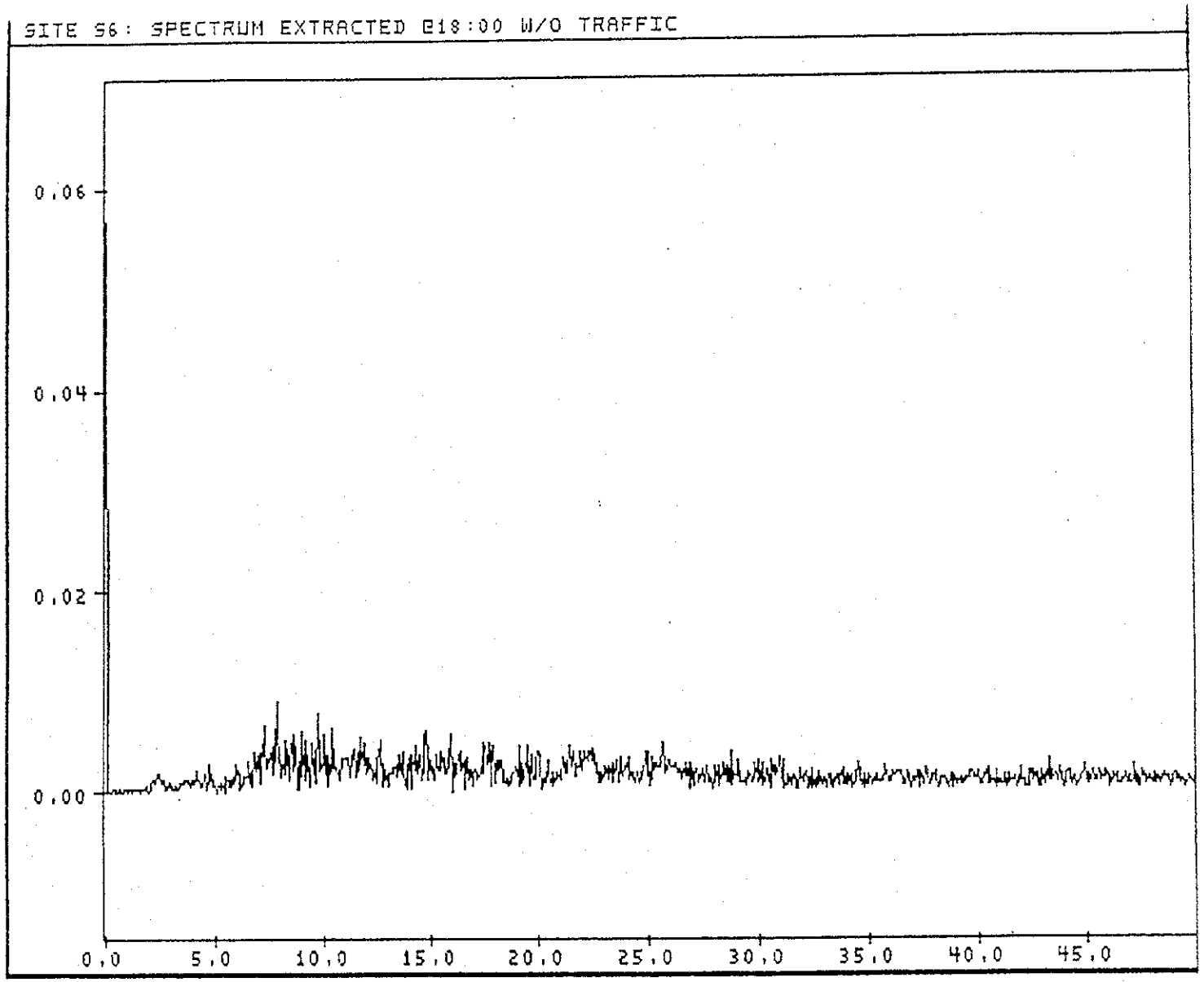

SITE S6: SPECTRUM EXTRACTED @14:00 W/ TRAFFIC
0.3
0.2
0.1
0.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0


SITE S6: SPECTRUM EXTRACTED @14:00 W/O TRAFFIC
0.06
0.04
0.02
0.00
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

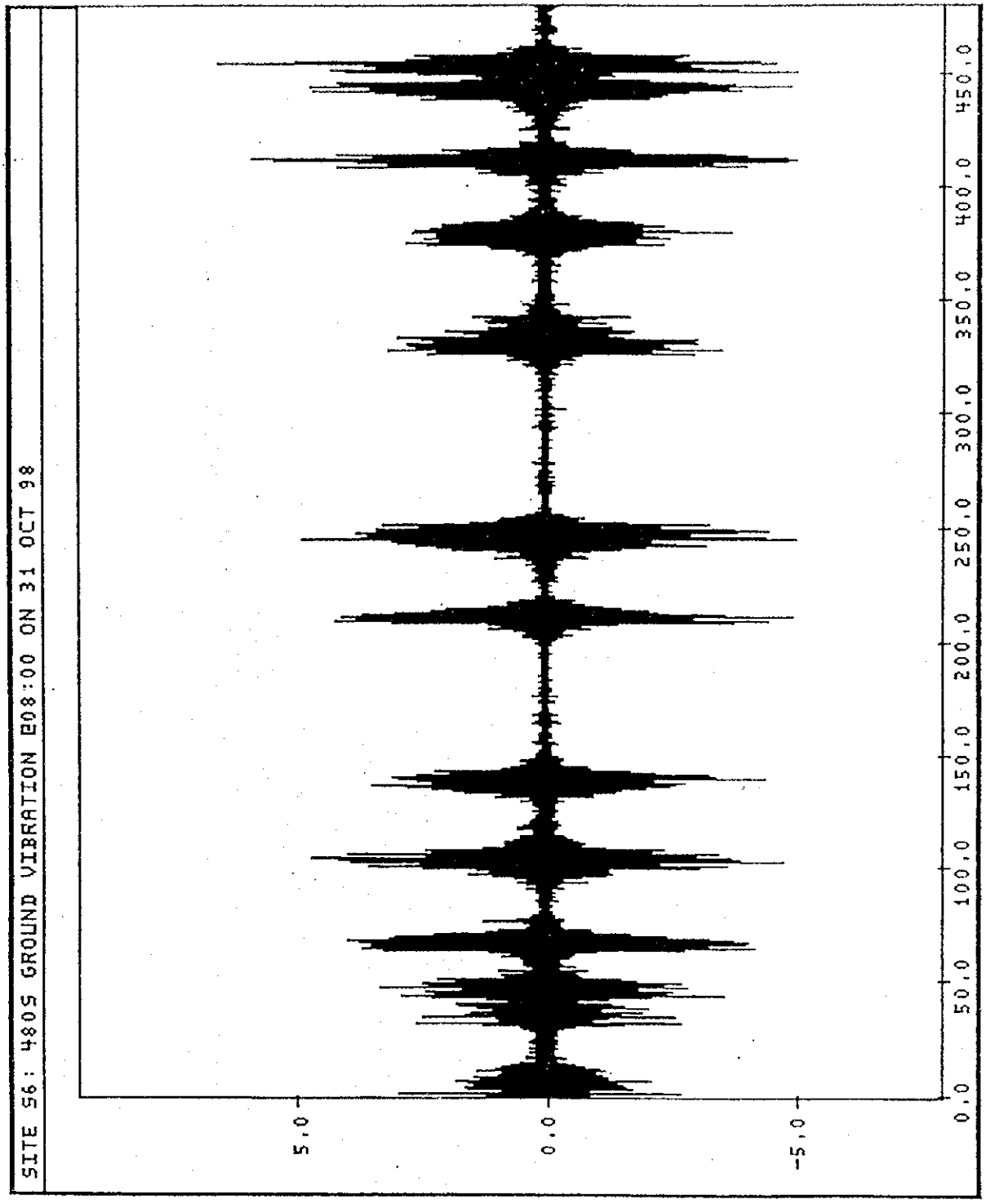

SITE 56: 4805 GROUND VIBRATION @18:00 ON 30 OCT 98
10.0
5.0
0.0
-5.0
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0

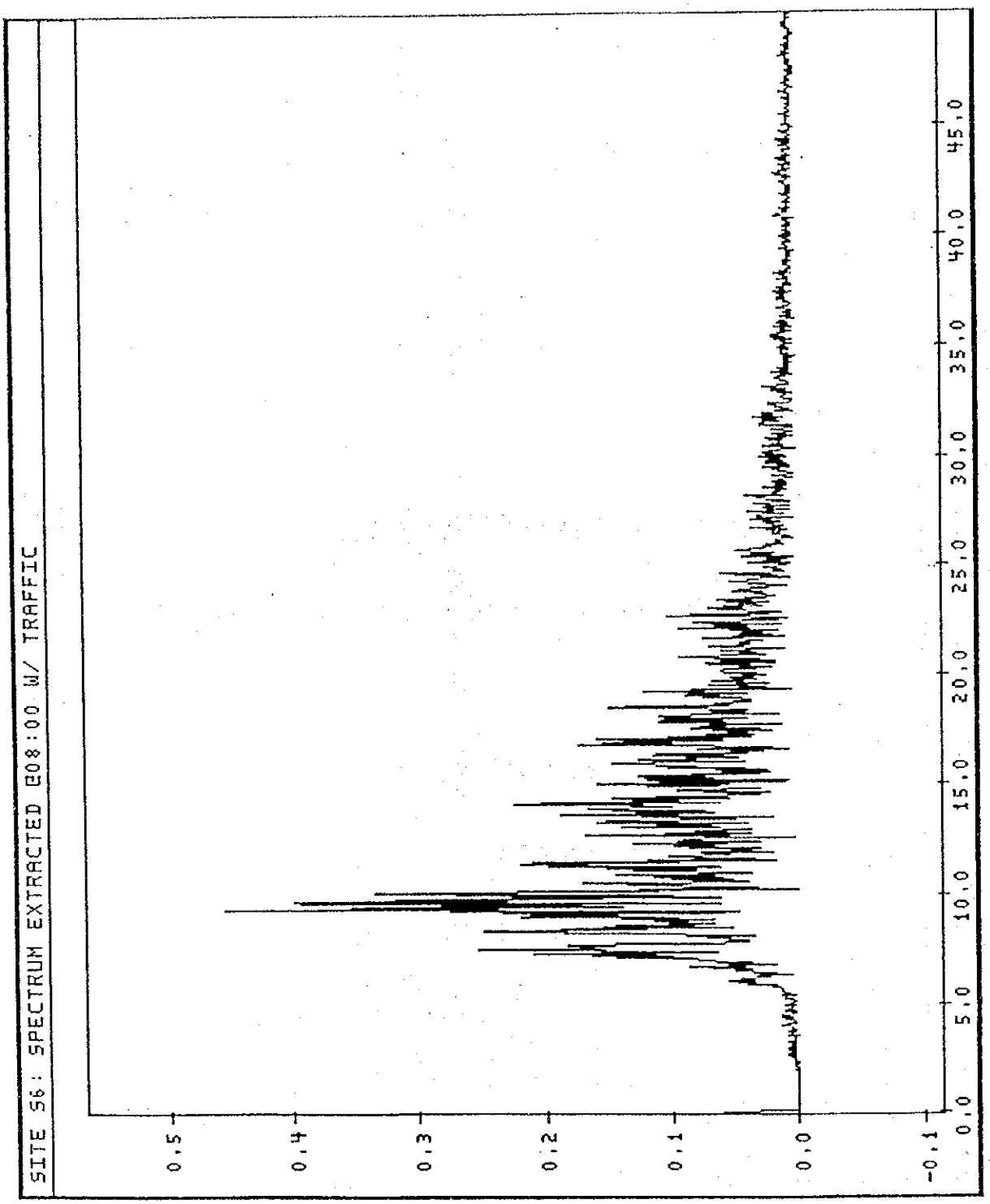
C#C-,

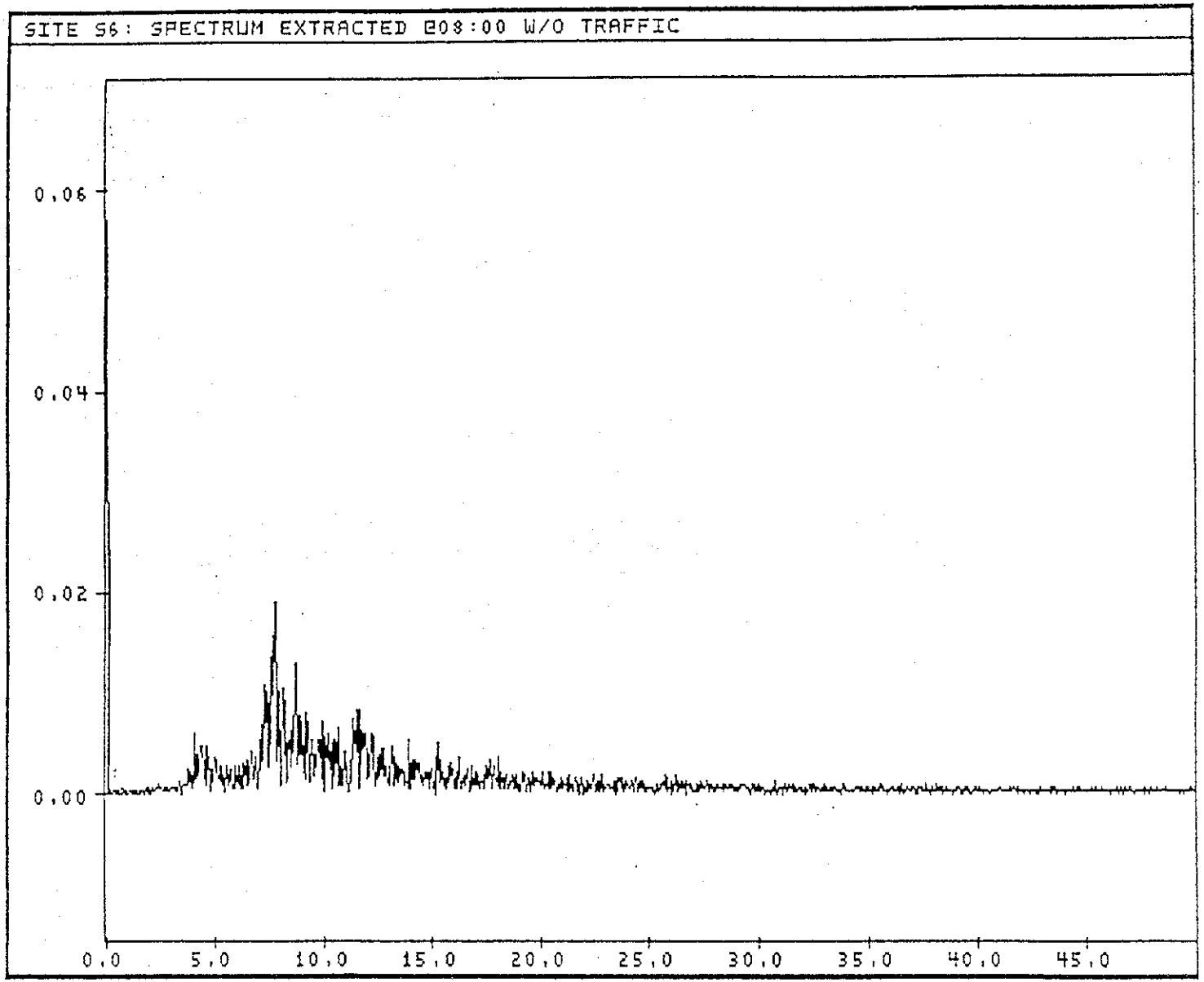

SITE S6: SPECTRUM EXTRACTED @18:00 W/ TRAFFIC
0.20
0.15
0.10
0.05
0.00
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0


SITE S6: SPECTRUM EXTRACTED @18:00 W/O TRAFFIC
0.06
0.04
0.02
0.00
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

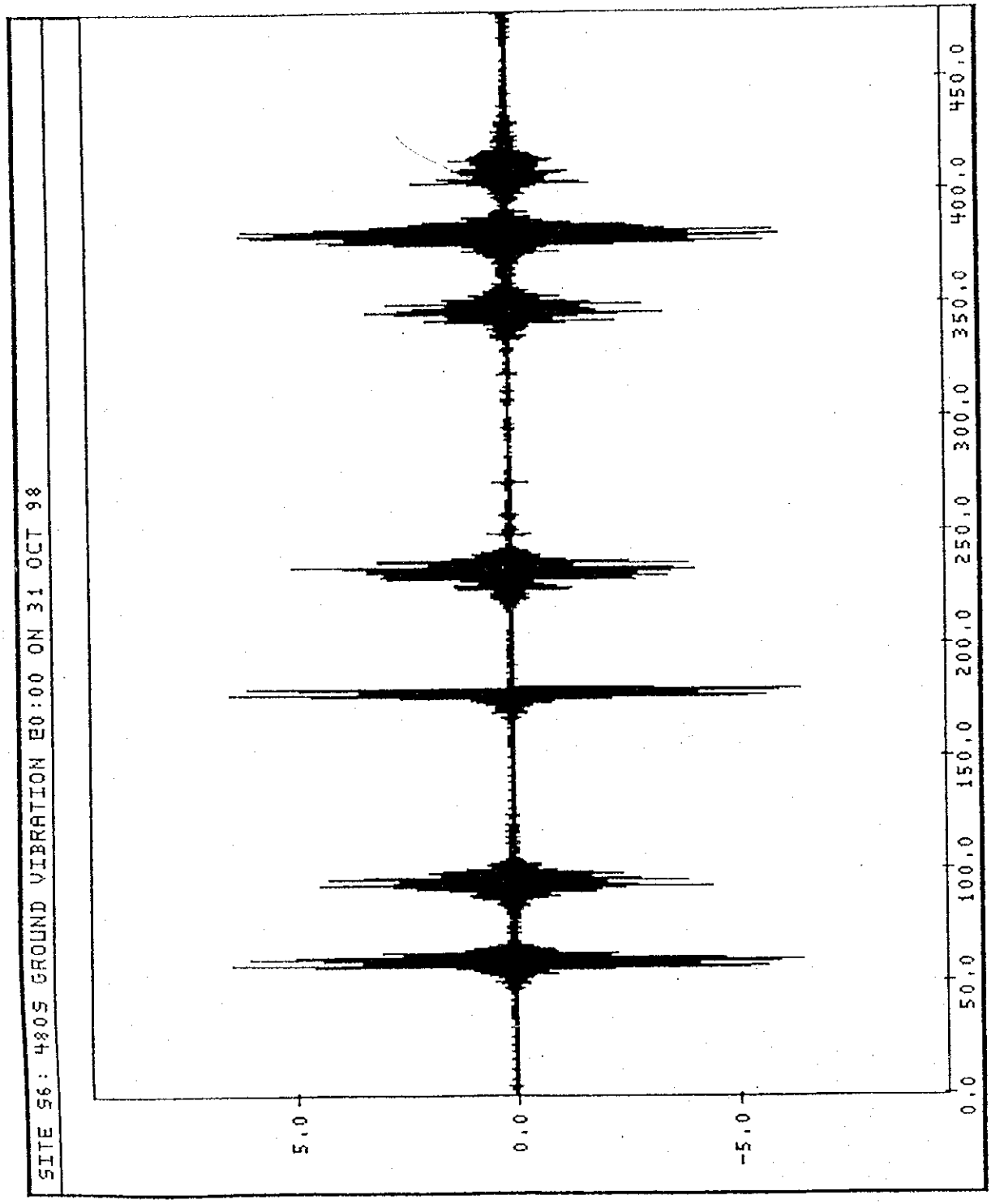
&15E

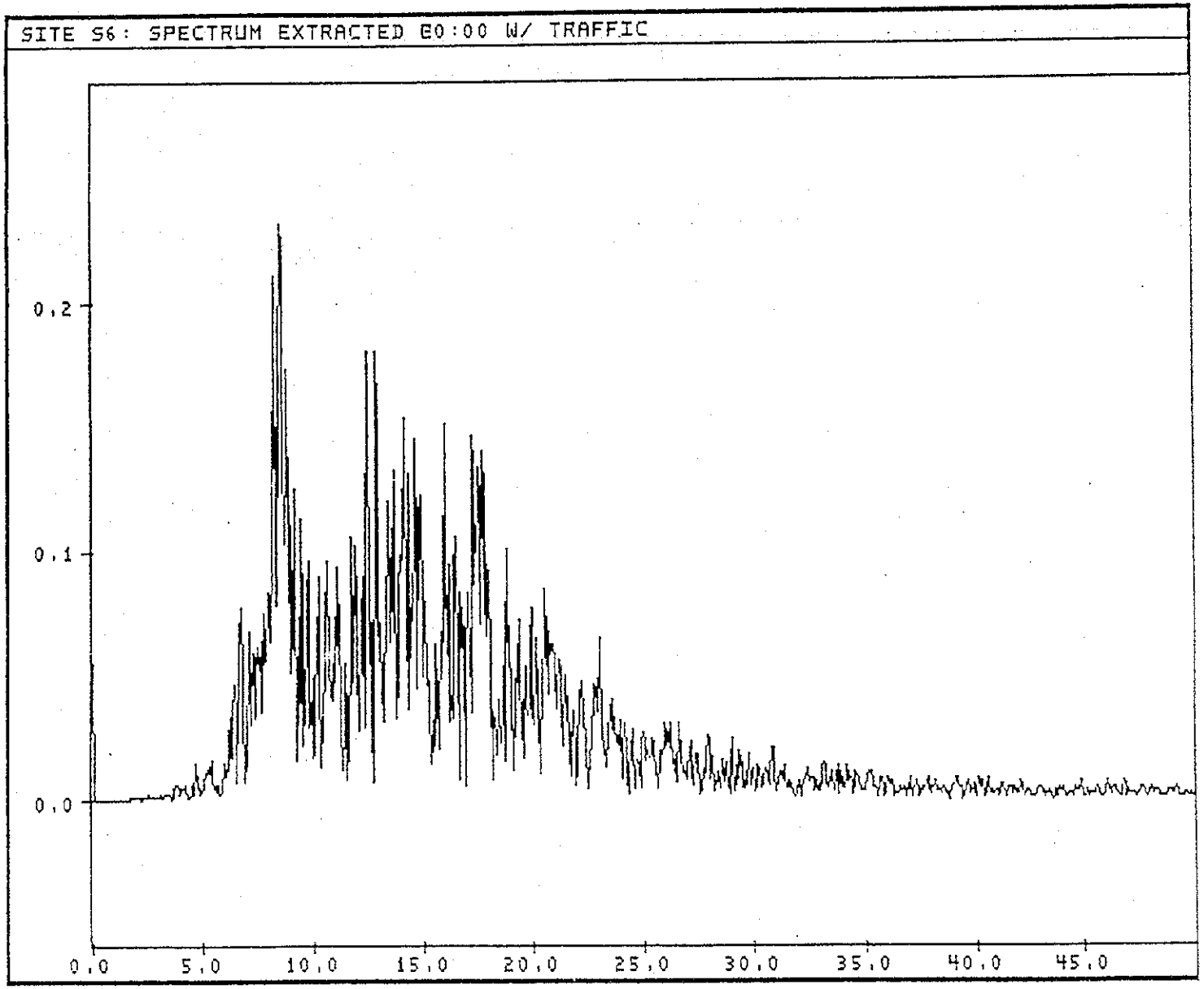

SITE 56: 480S GROUND VIBRATION @08:00 ON 31 OCT 98
5.0
0.0
-5.0
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0


SITE S6: SPECTRUM EXTRACTED @08:00 W/ TRAFFIC
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

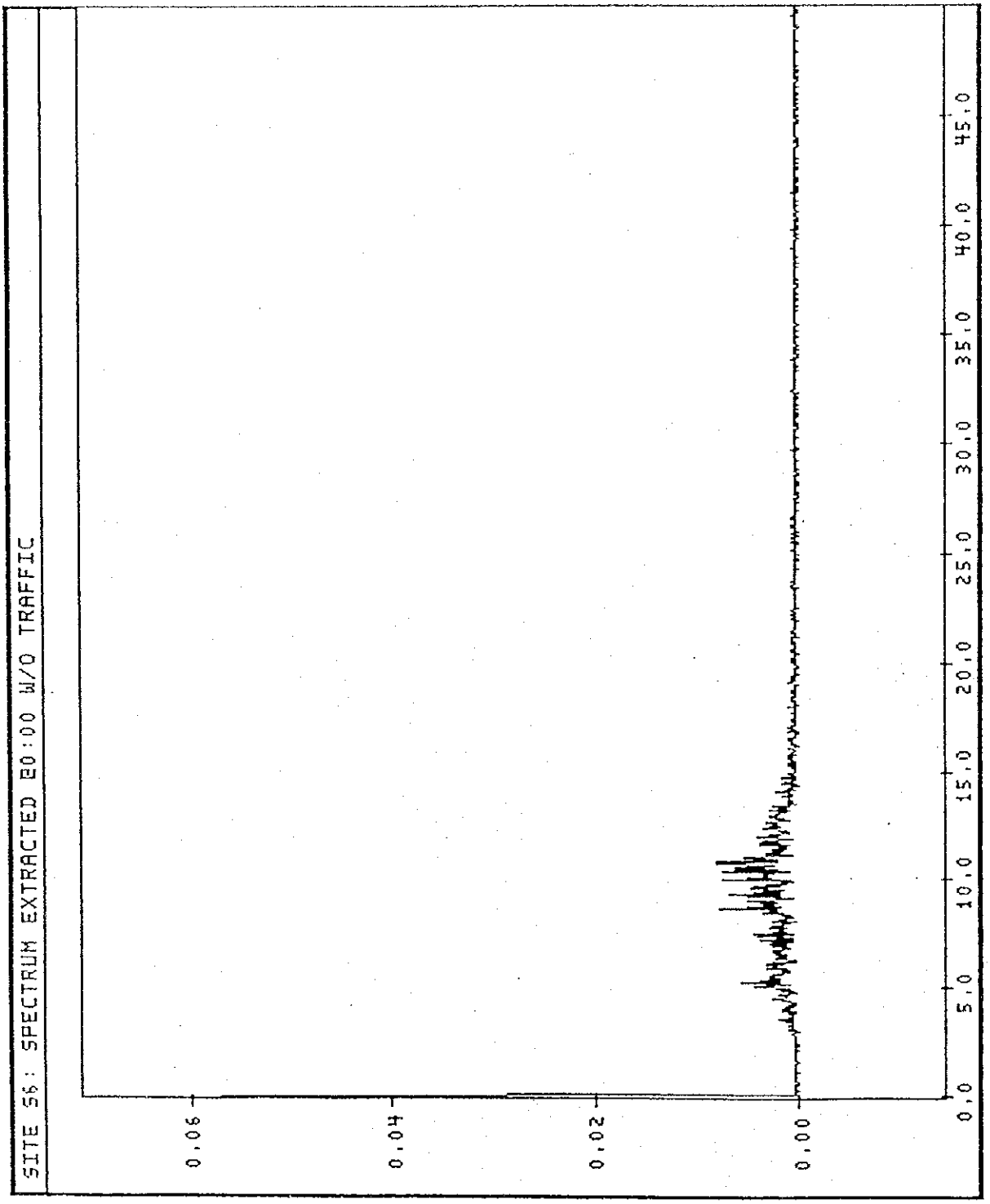

SITE S6: SPECTRUM EXTRACTED @08:00 W/O TRAFFIC
0.06
0.04
0.02
0.00
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

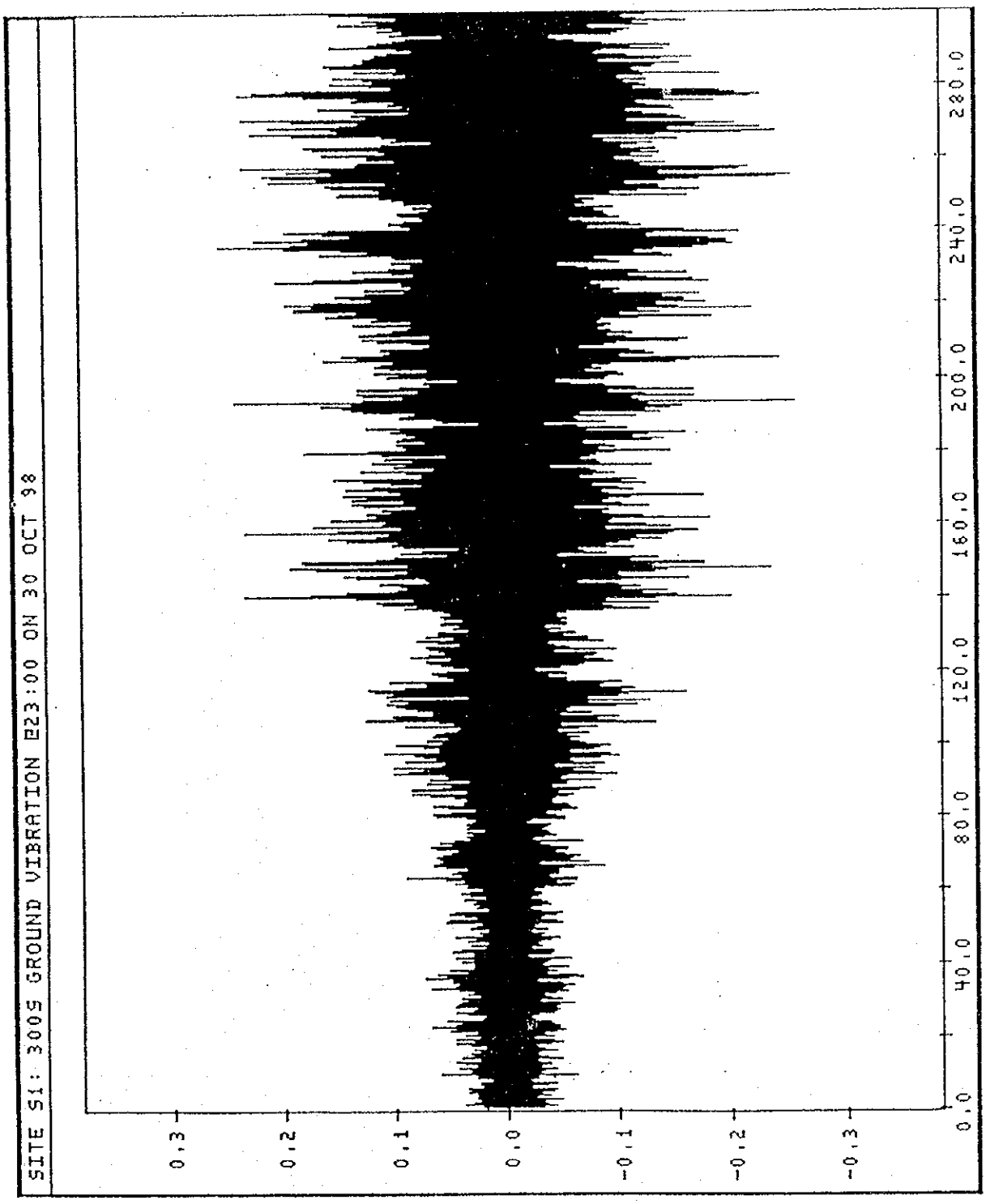
E51&

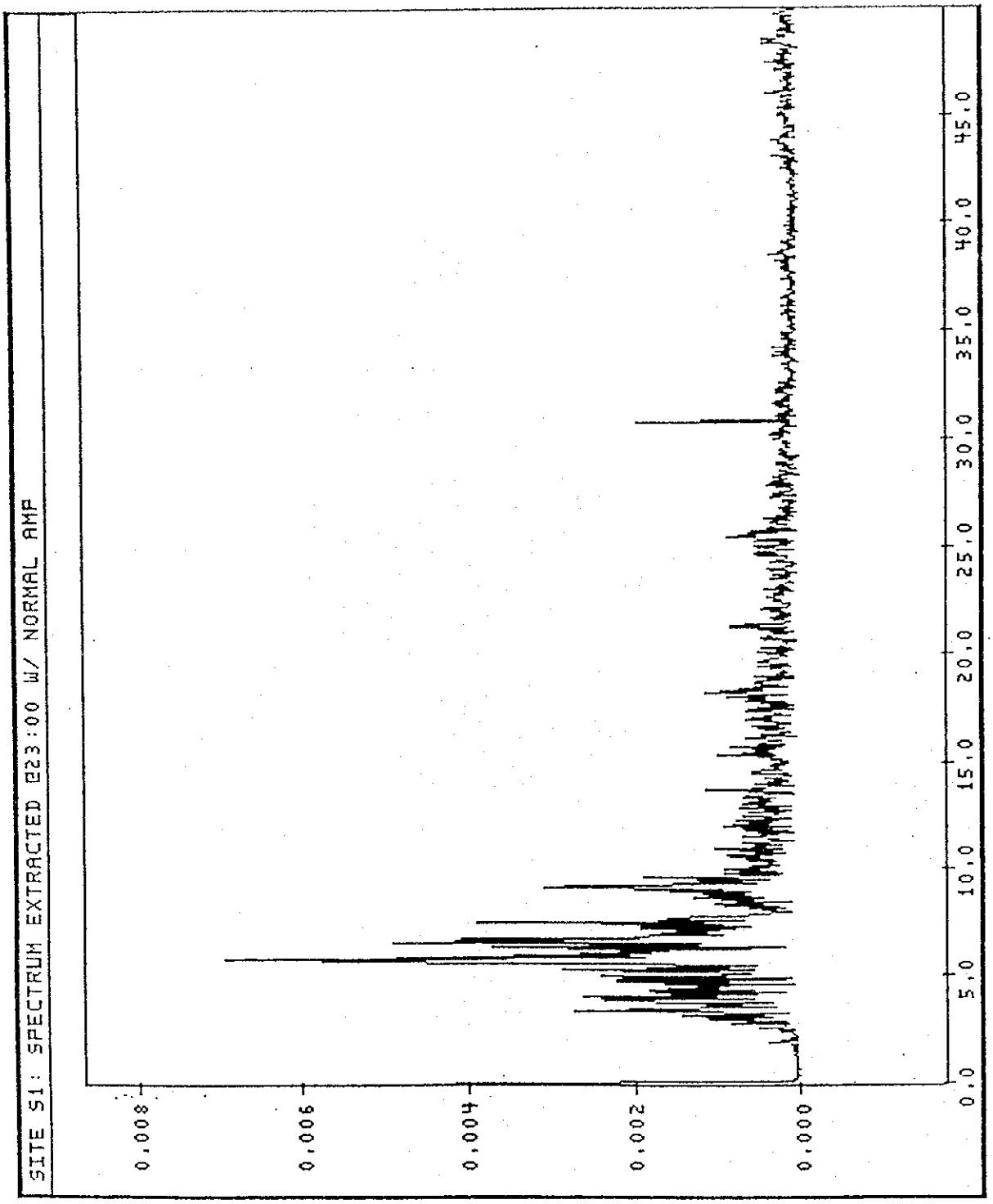

SITE S6: 4805 GROUND VIBRATION 20:00 ON 31 OCT 98
5.0
0.0
-5.0
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0

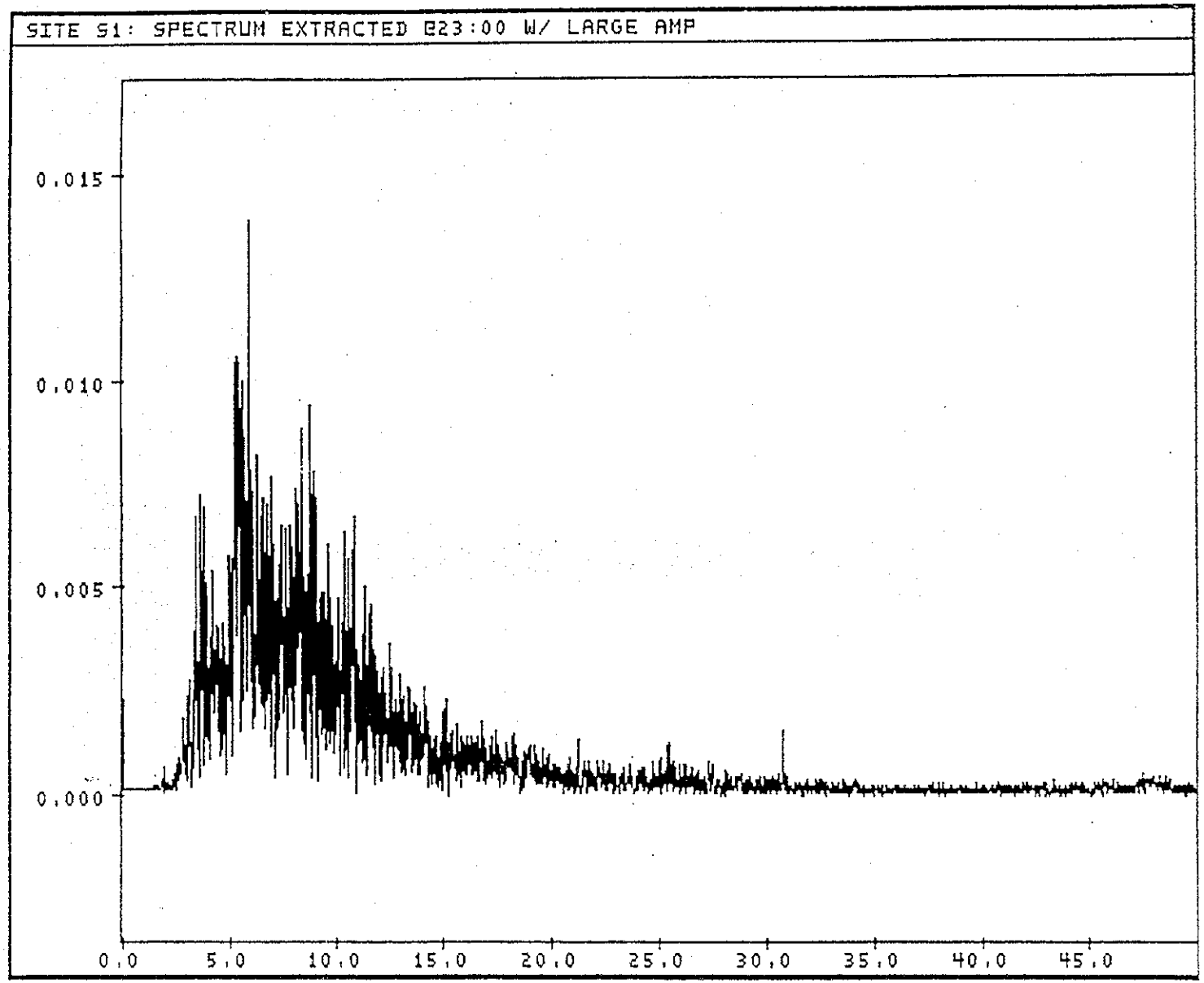


45X@PJL COMMENT HPLJ6PEN SOEPD04 Driver
@PJL COMMENT 1.20.0.0
@PJL SET P

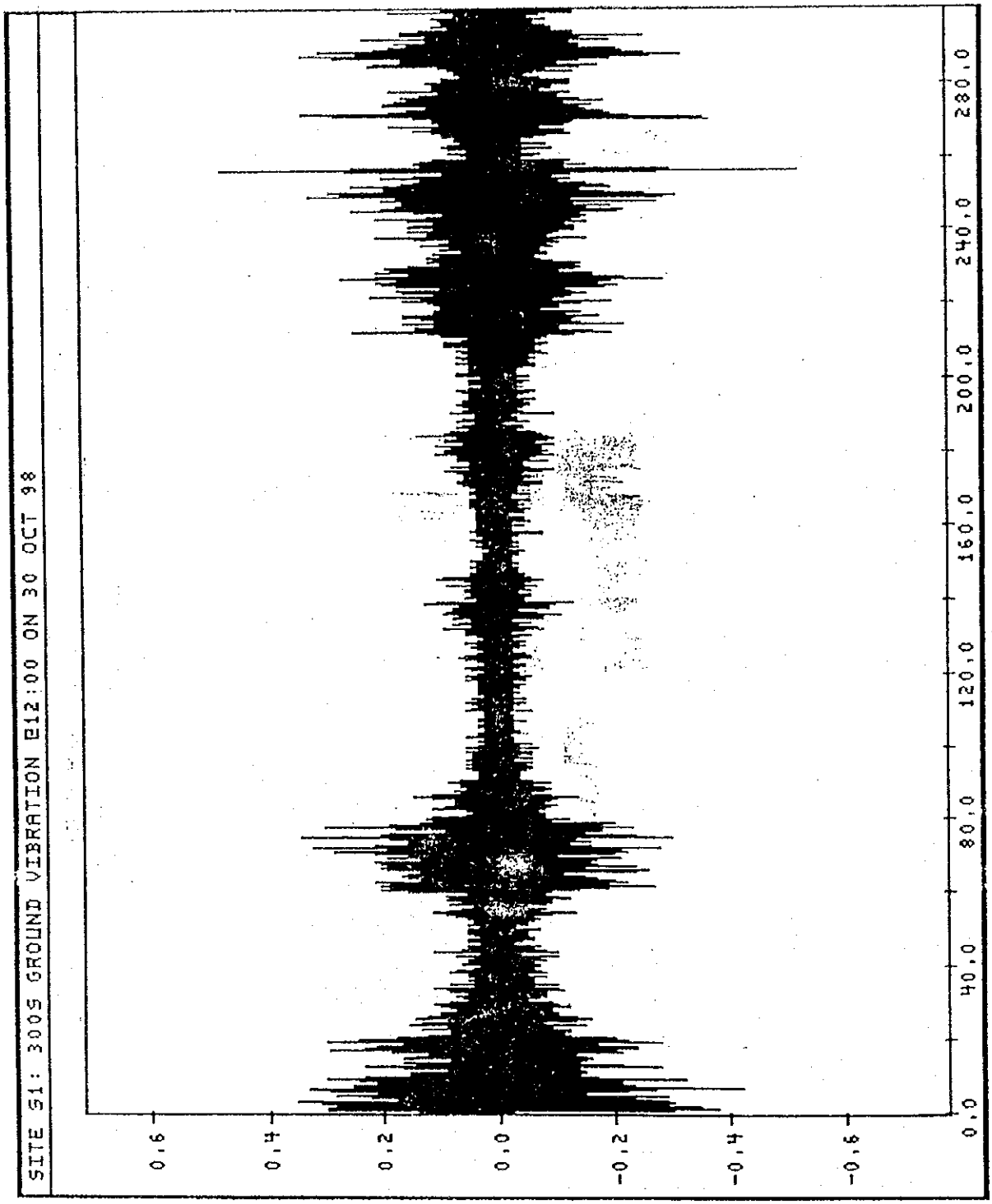

SITE 56: SPECTRUM EXTRACTED 20:00 W/O TRAFFIC
0.06
0.04
0.02
0.00
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

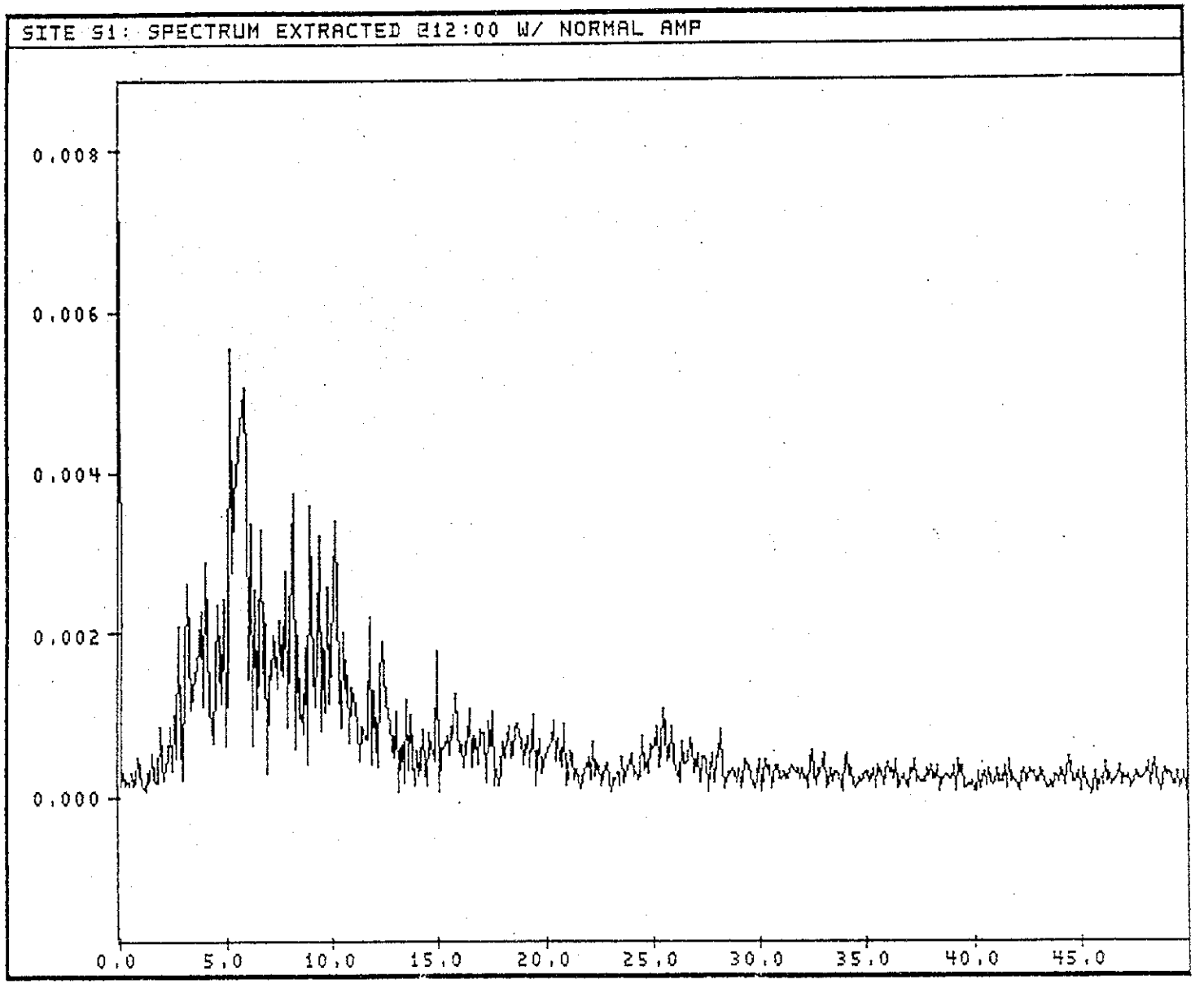

SITE S1: 3005 GROUND VIBRATION @23:00 ON 30 OCT 98
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
0.0
40.0
80.0
120.0
160.0
200.0
240.0
280.0

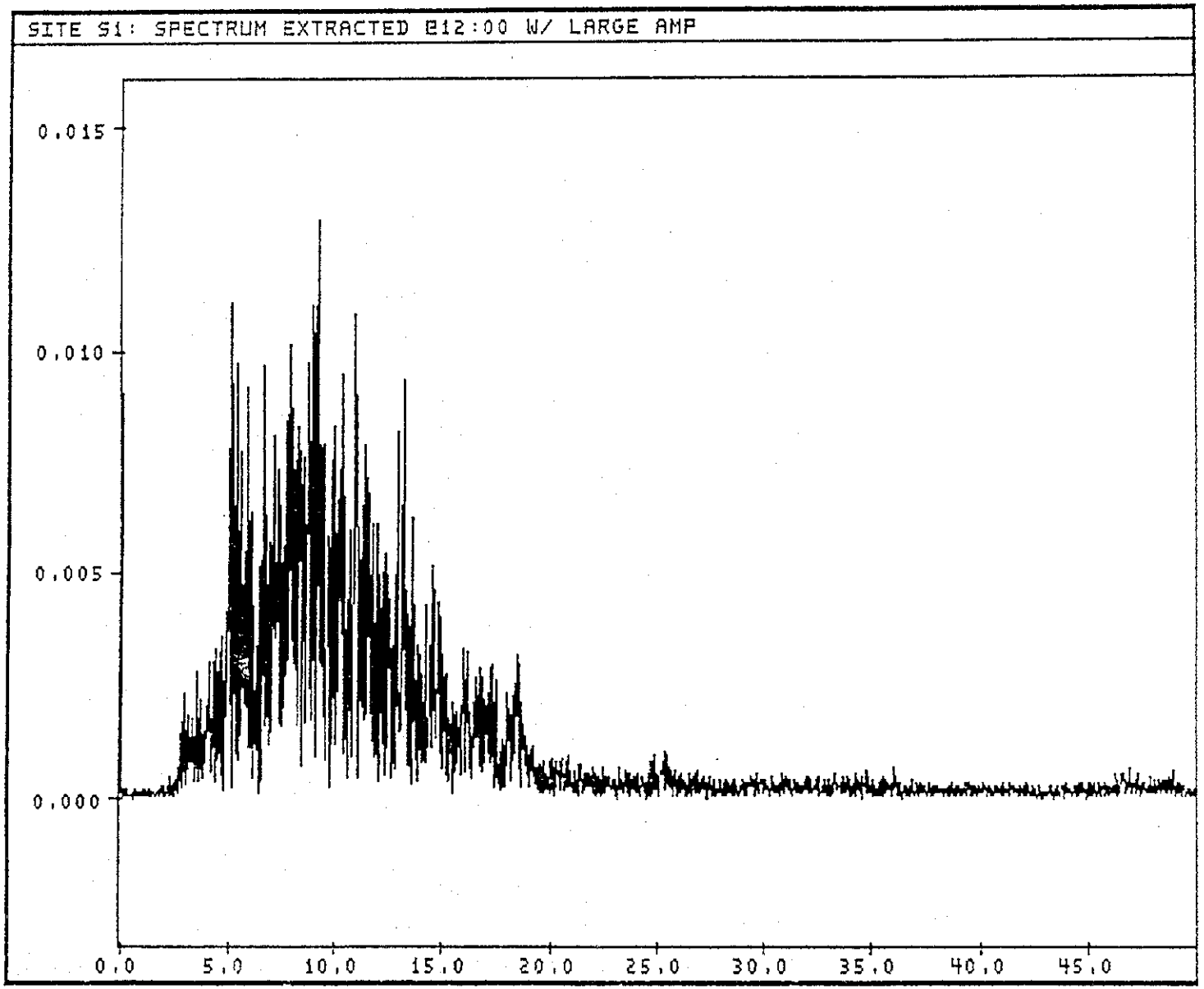

SITE S1: SPECTRUM EXTRACTED @23:00 W/ NORMAL AMP
0.008
0.006
0.004
0.002
0.000
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

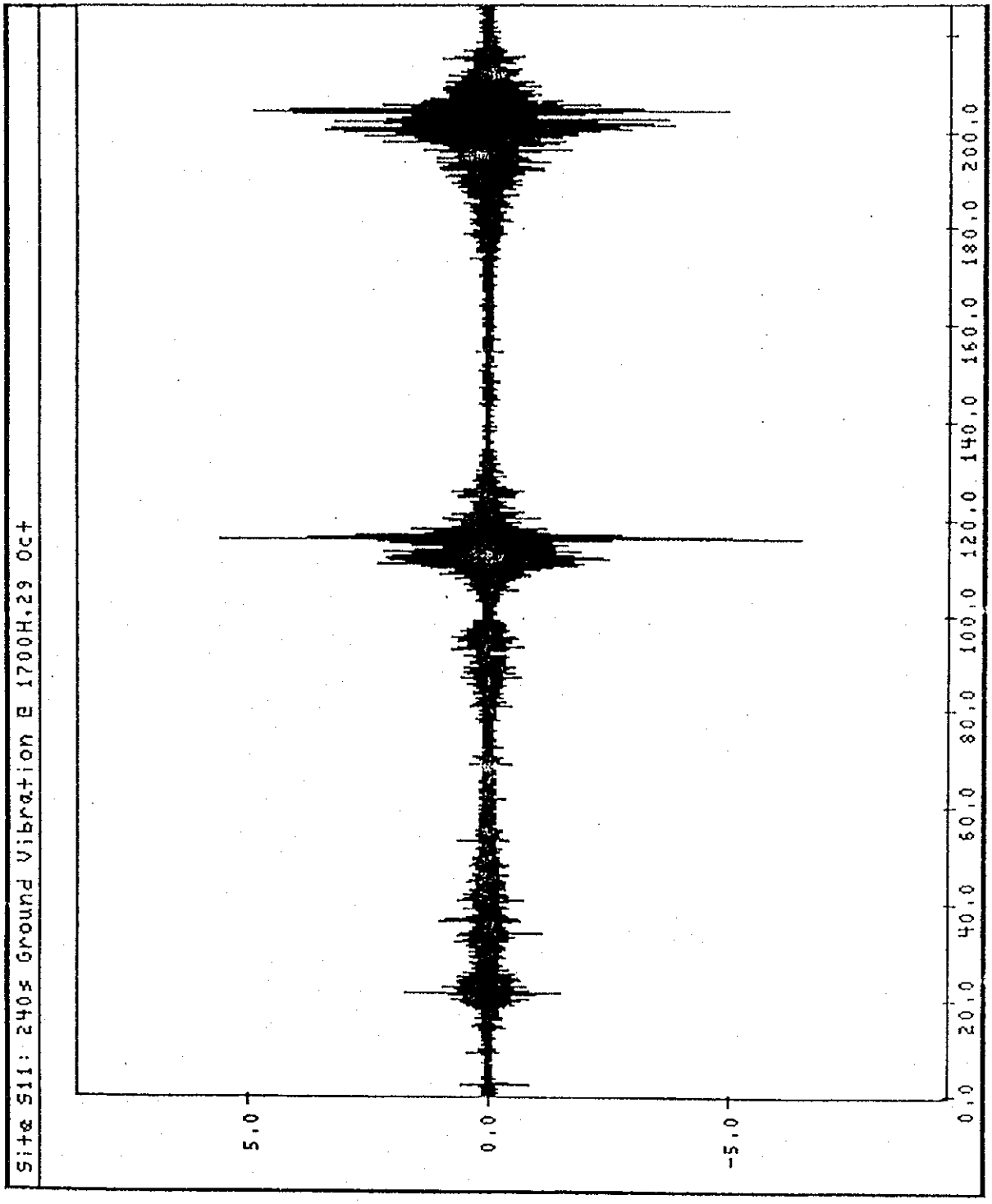

SITE S1: SPECTRUM EXTRACTED @23:00 W/ LARGE AMP
0.015
0.010
0.005
0.000
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

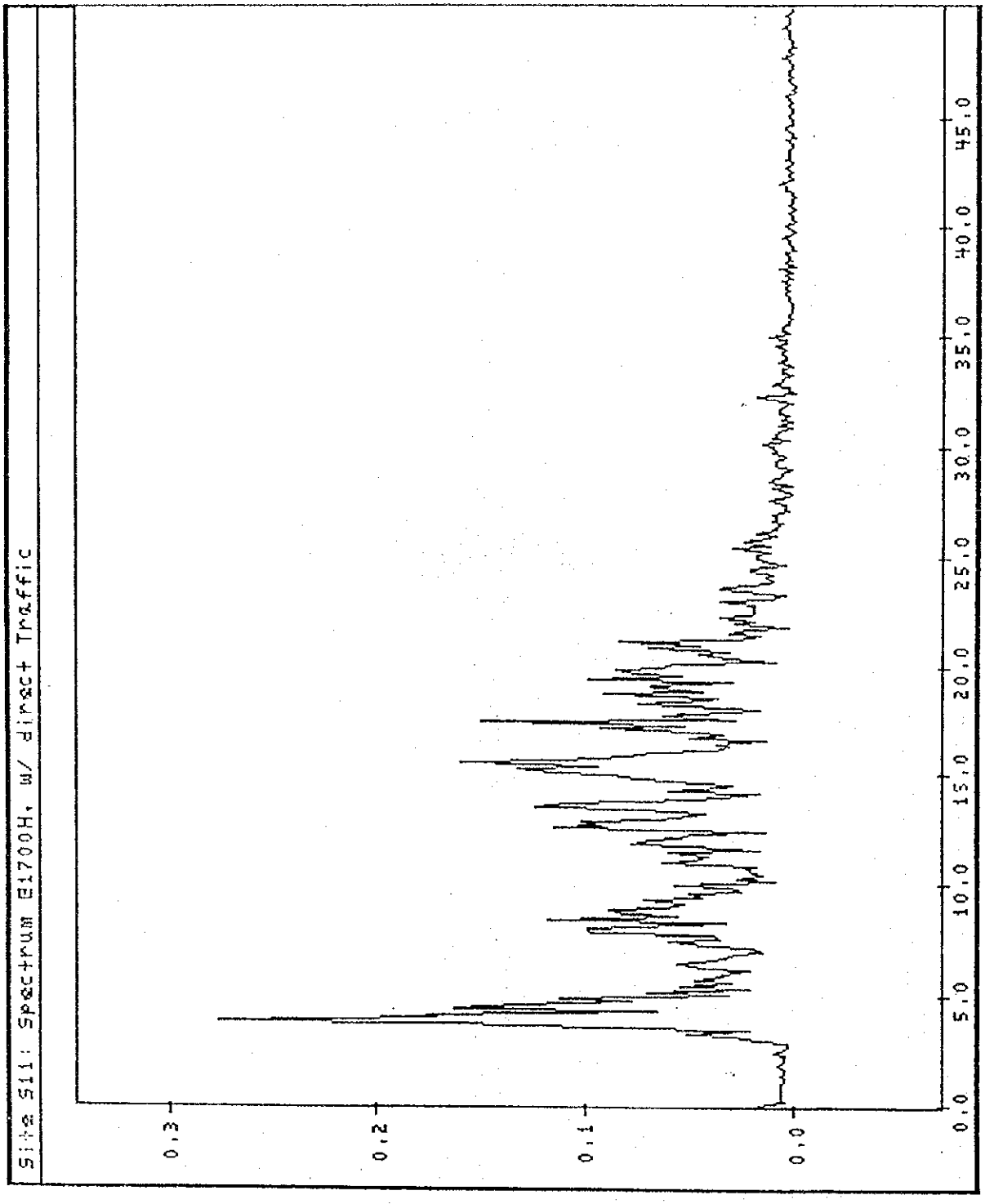
&15E

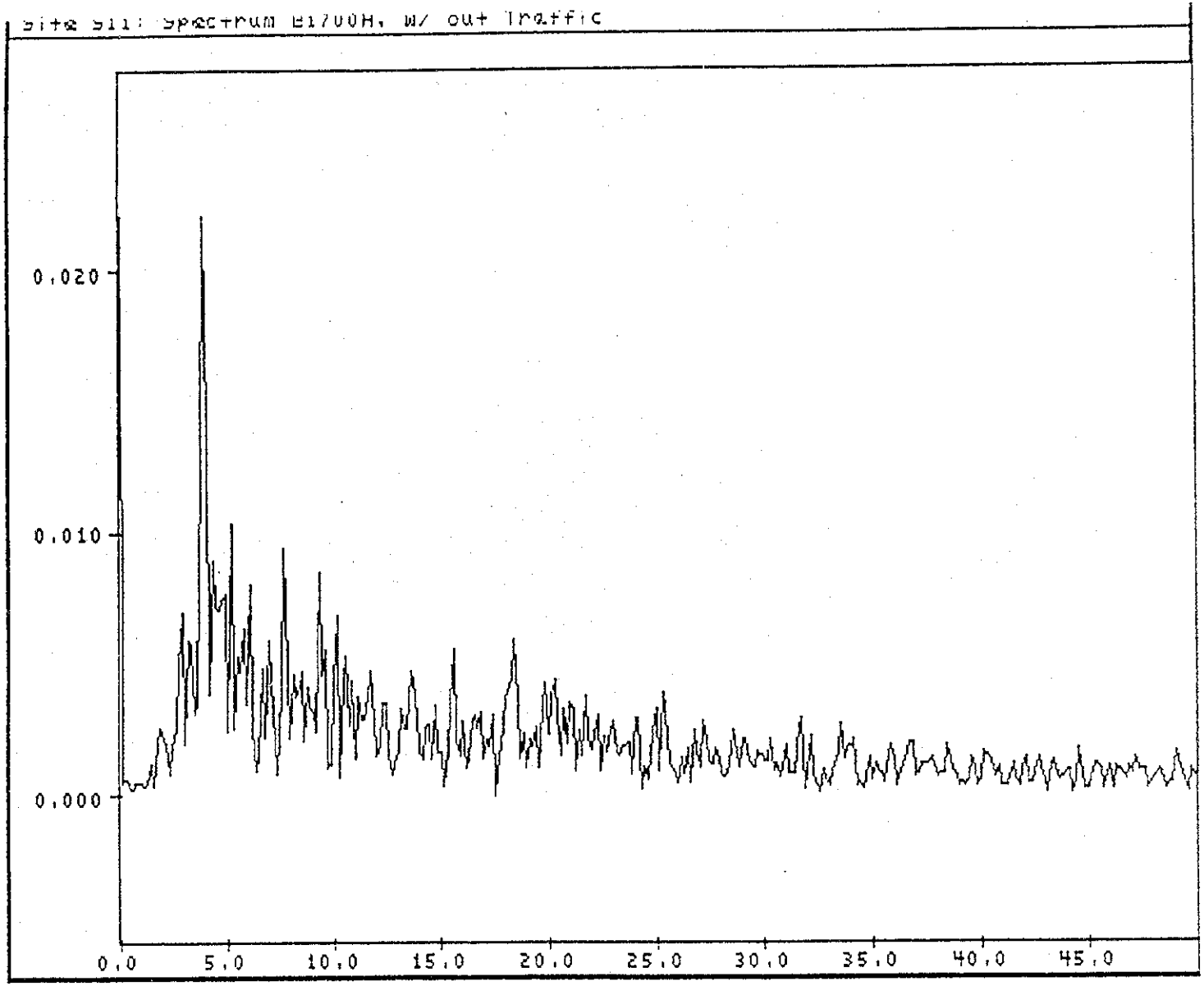

SITE S1: 300S GROUND VIBRATION @12:00 ON 30 OCT 98
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
0.0
40.0
80.0
120.0
160.0
200.0
240.0
280.0


SITE S1: SPECTRUM EXTRACTED @12:00 W/ NORMAL AMP
0.008
0.006
0.004
0.002
0.000
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

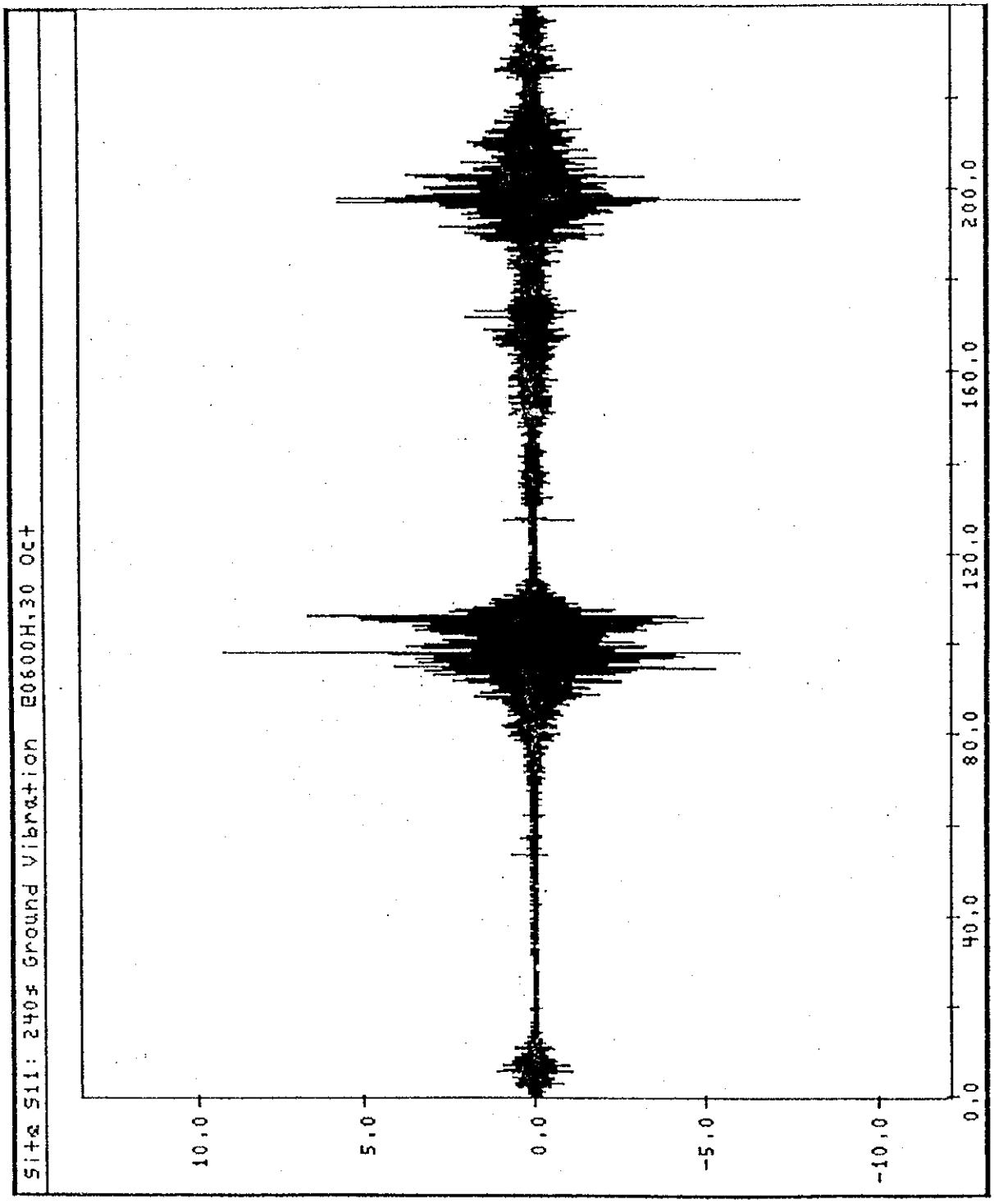

SITE S1: SPECTRUM EXTRACTED @12:00 W/ LARGE AMP
0.015
0.010
0.005
0.000
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

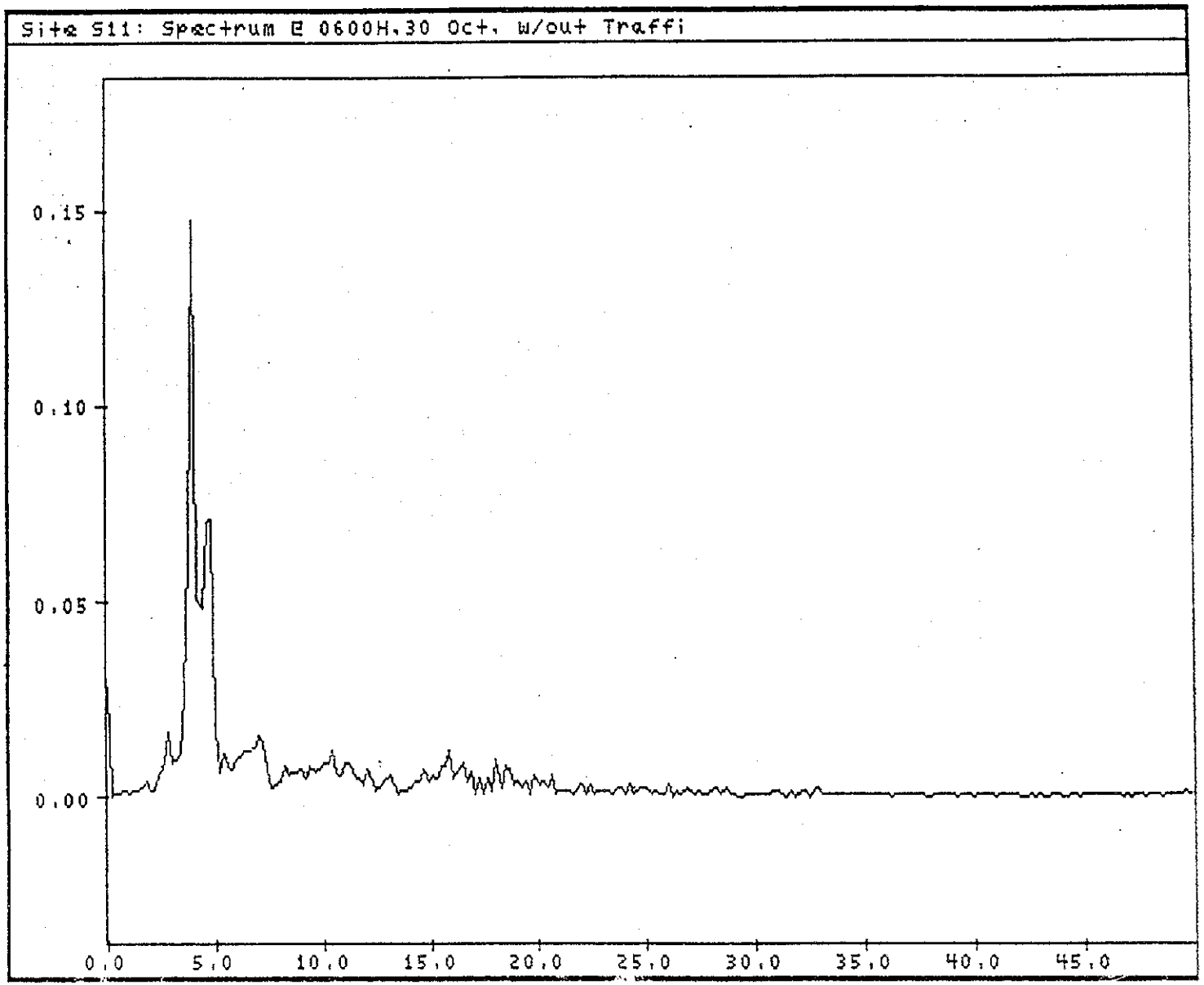

Site S11: 240s Ground Vibration @ 1700H,29 Oct
5.0
0.0
-5.0
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0

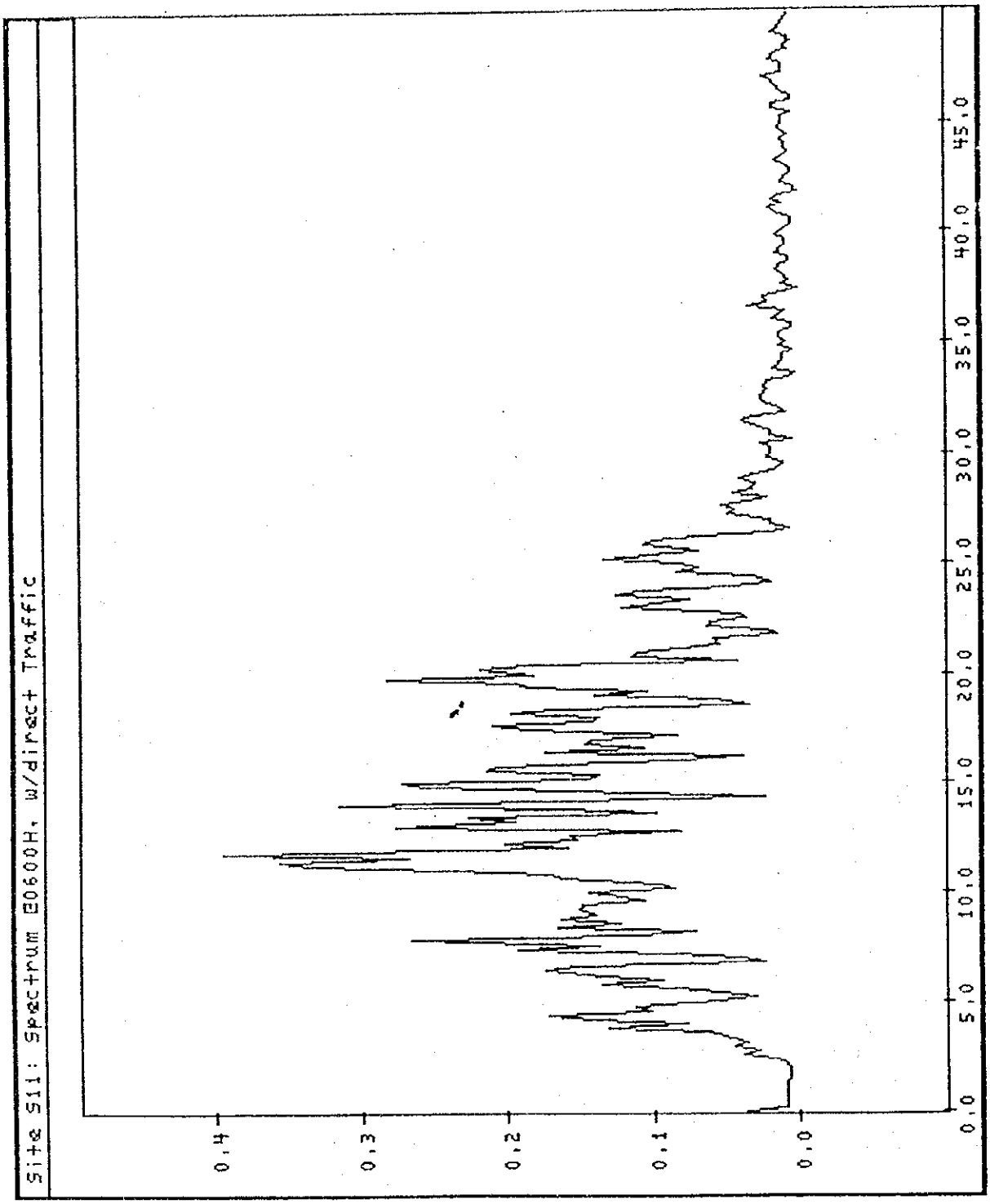

Sika 511: Spectrum B1700H, w/ direct Traffic
0.3
0.2
0.1
0.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

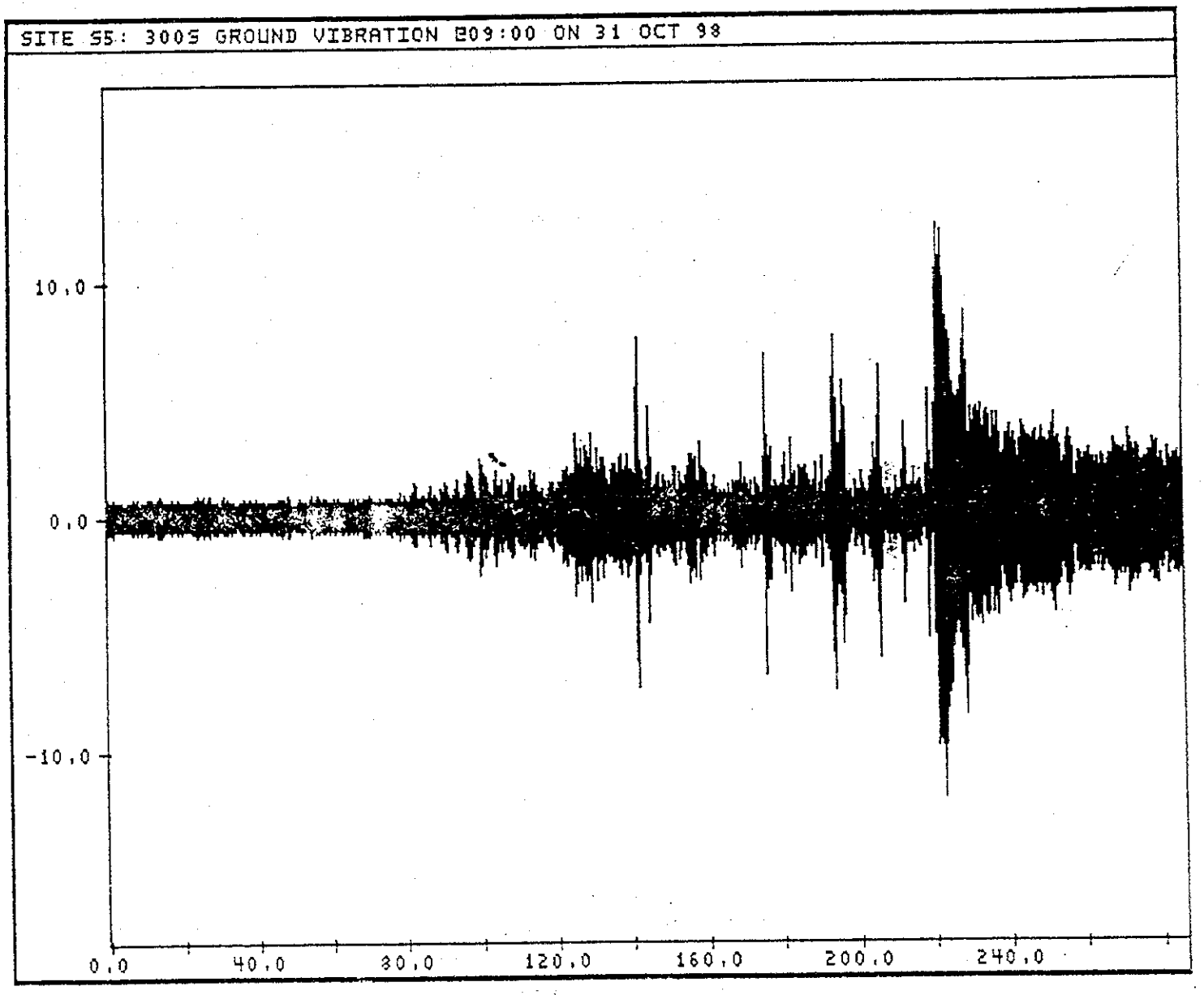

Site 511: Spectrum B1700H, W/ out Traffic
0.020
0.010
0.000
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

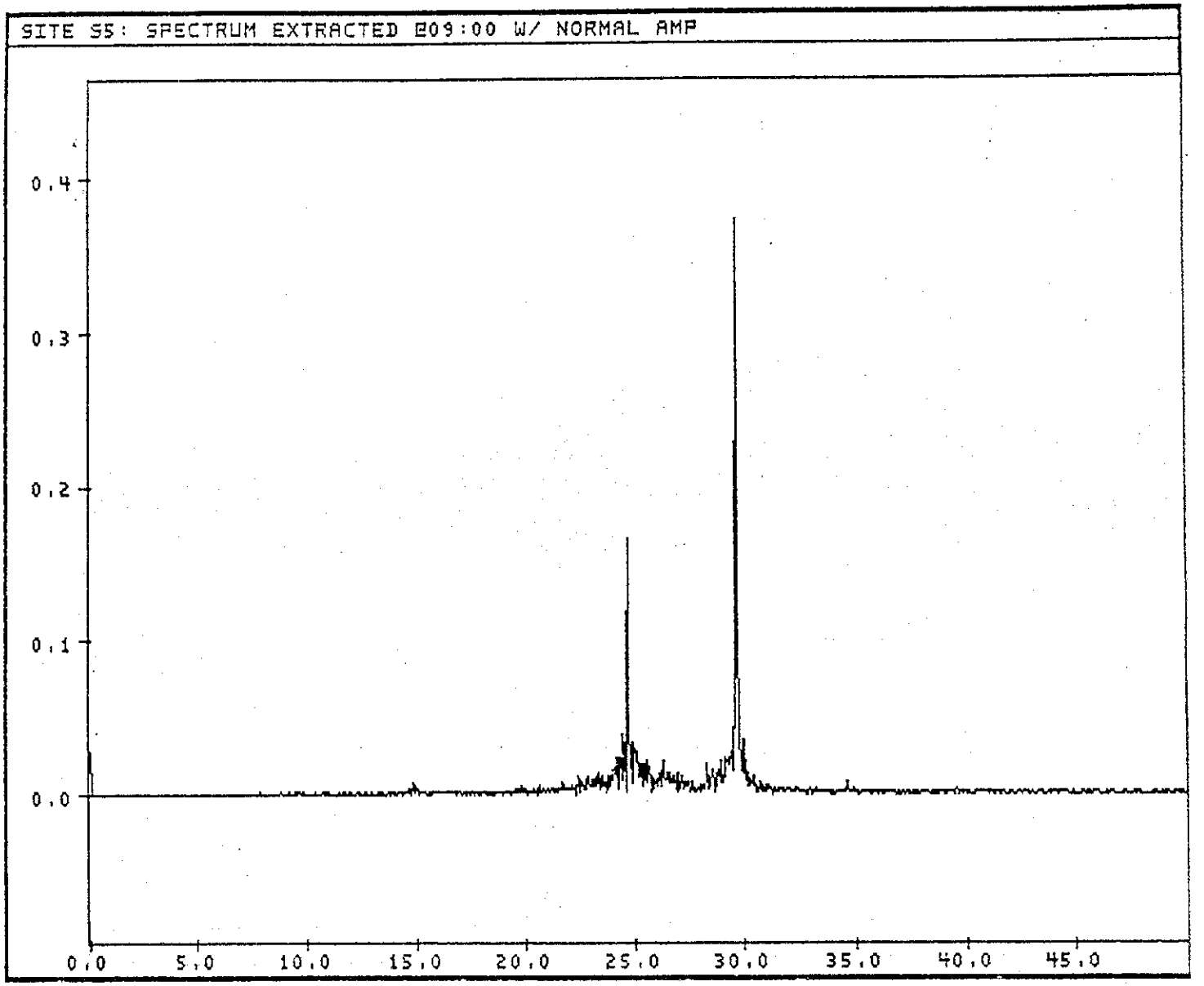
E15E


Site S11: 240s Ground Vibration 20600H,30 Oct
10.0
5.0
0.0
-5.0
-10.0
0.0
40.0
80.0
120.0
160.0
200.0

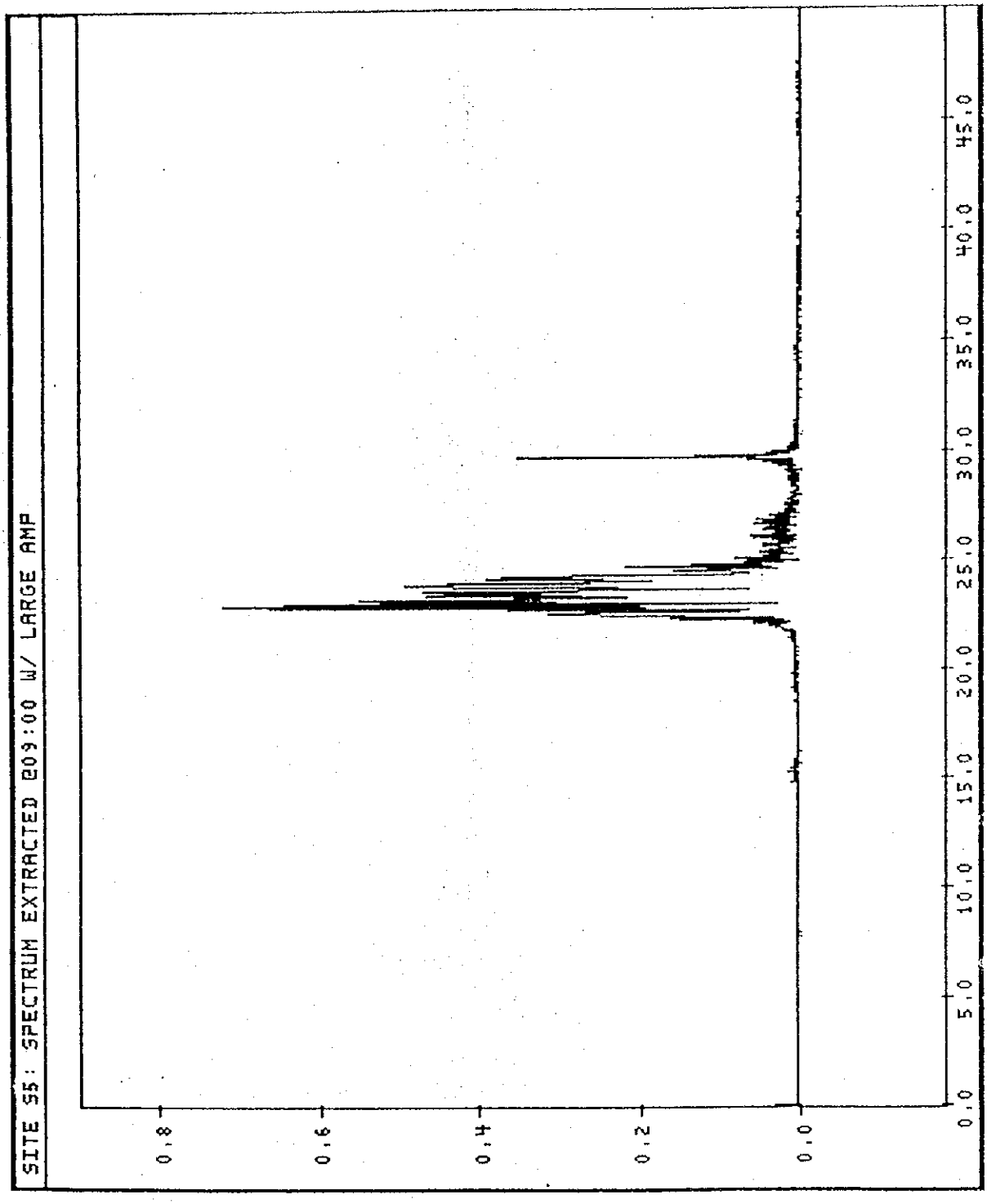

Site S11: Spectrum E 0600H,30 Oct, w/out Traffi
0.15
0.10
0.05
0.00
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

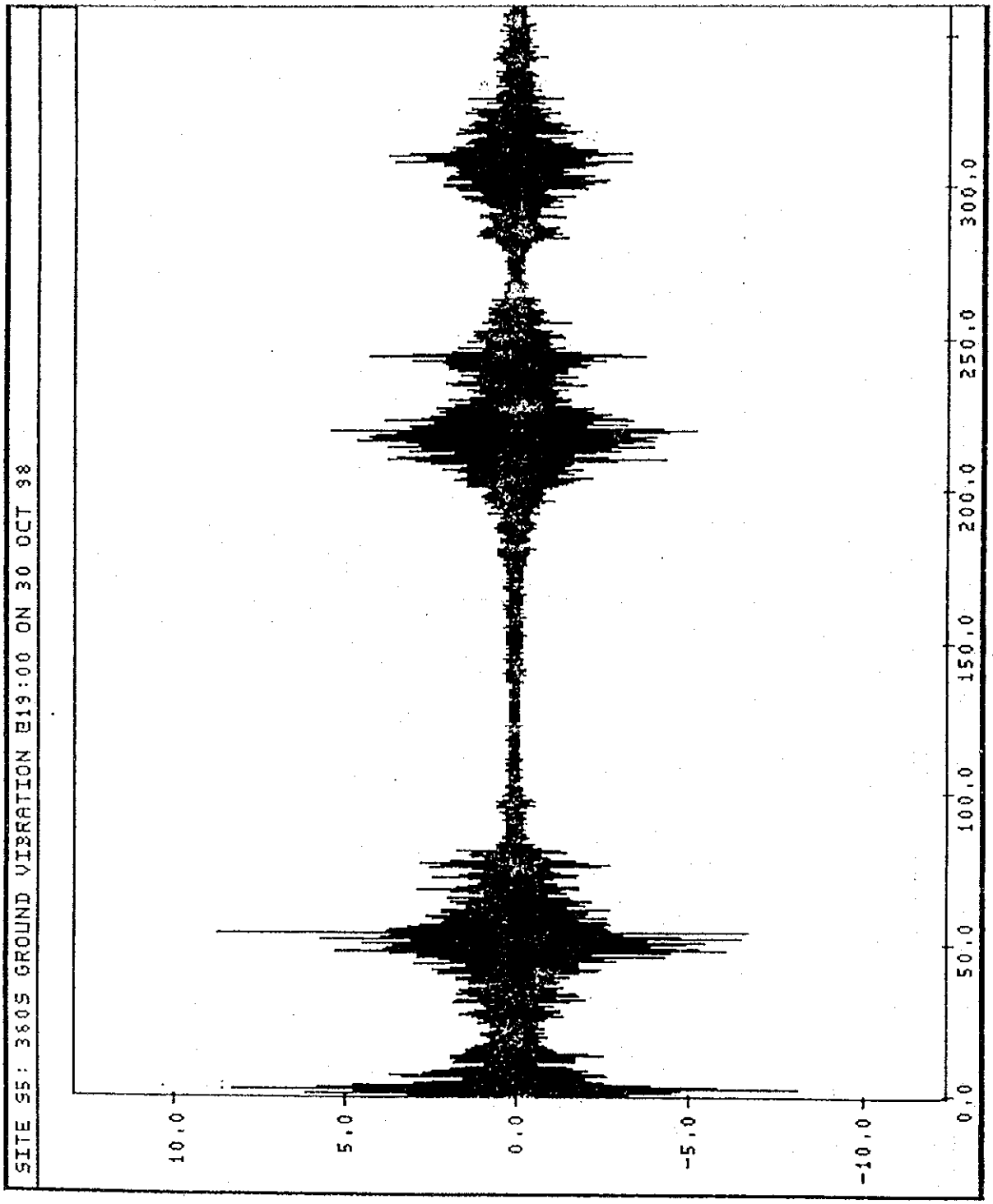

Site S11: Spectrum E0600H, w/direct Traffic
0.4
0.3
0.2
0.1
0.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

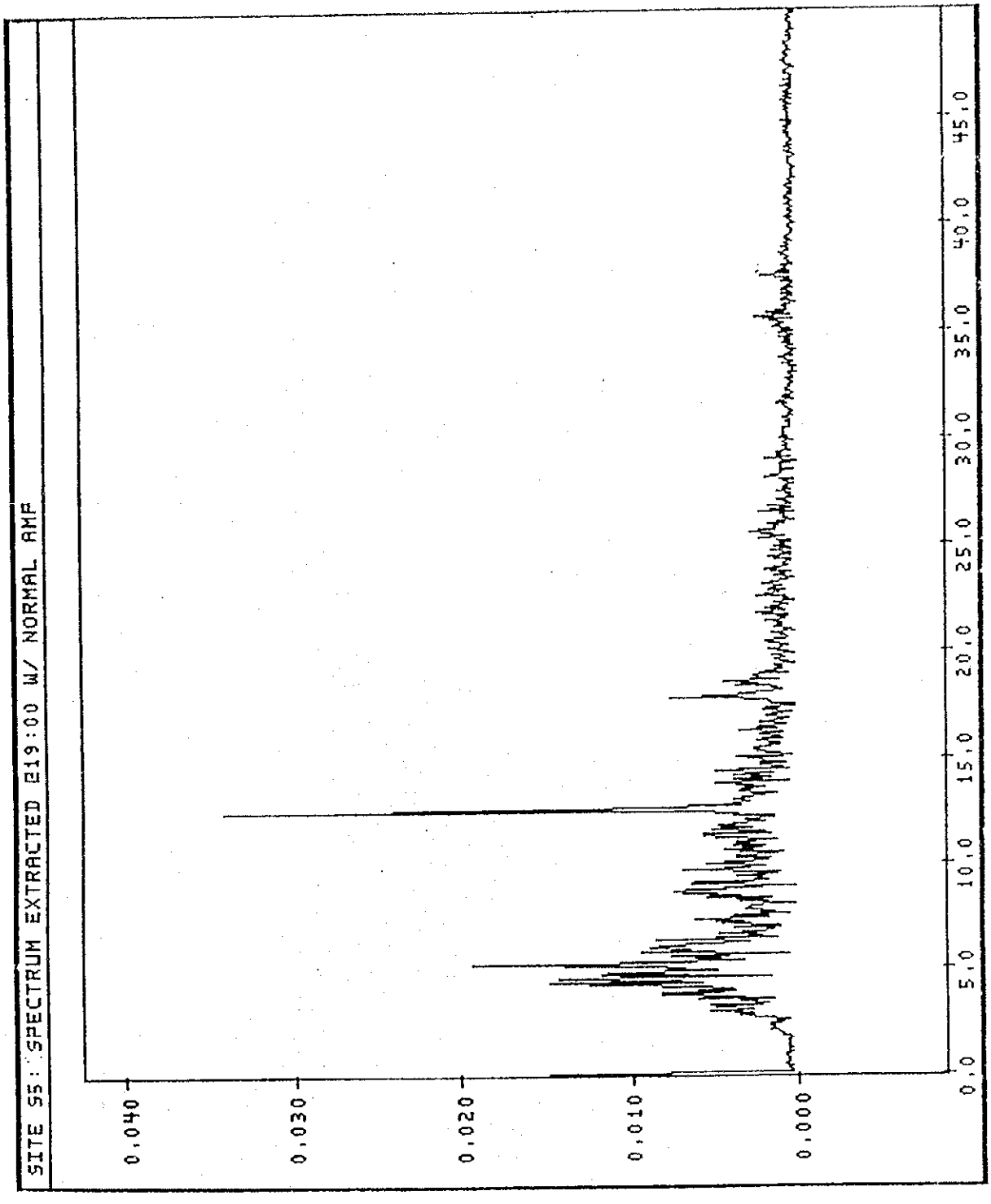

SITE S5: 300S GROUND VIBRATION @09:00 ON 31 OCT 98
10.0
0.0
-10.0
0.0
40.0
80.0
120.0
160.0
200.0
240.0

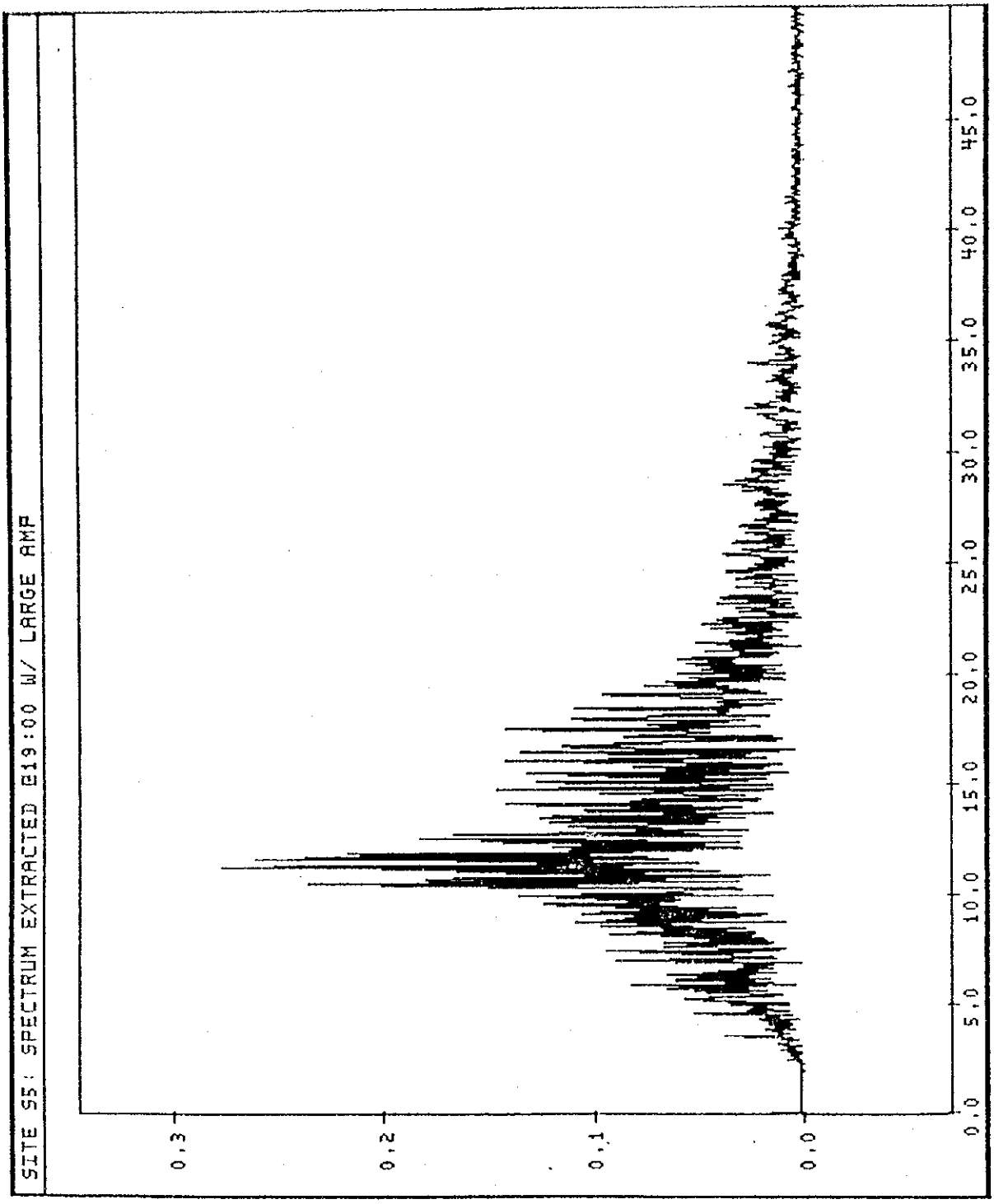

SITE S5: SPECTRUM EXTRACTED @09:00 W/ NORMAL AMP
0.4
0.3
0.2
0.1
0.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

E515


SITE S5: SPECTRUM EXTRACTED @09:00 W/ LARGE AMP
0.8
0.6
0.4
0.2
0.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0


SITE S5: 360S GROUND VIBRATION @19:00 ON 30 OCT 98
10.0
5.0
0.0
-5.0
-10.0
0.0
50.0
100.0
150.0
200.0
250.0
300.0


SITE 95: SPECTRUM EXTRACTED 219:00 W/ NORMAL AMP
0.040
0.030
0.020
0.010
0.000
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0


SITE S5: SPECTRUM EXTRACTED @19:00 W/ LARGE AMP
0.3
0.2
0.1
0.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

CLIMATE

H O U R L Y D A T A

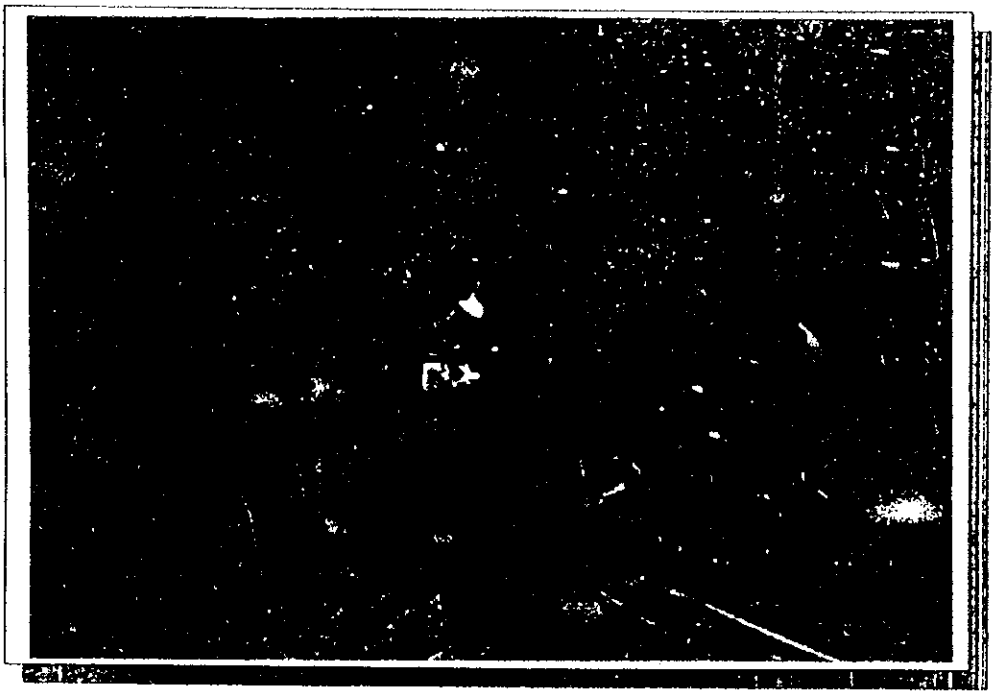
17/10	T	U	U9	VT	RG
01h00	30.6	68.0	0h00	2	154
02h00	31.4	61.5	0h00	4	218
03h00	32.4	59.5	0h00	5	258
04h00	33.4	54.0	0h00	5	270
05h00	31.7	57.0	0h00	6	166
06h00	31.5	61.0	0h00	3	86
07h00	32.8	59.5	0h00	4	176
08h00	31.2	63.0	0h00	4	100
09h00	29.9	70.0	0h00	3	46
10h00	28.8	76.5	0h00	3	6
11h00	28.7	79.0	0h00	2	0
12h00	28.4	81.0	0h00	1	0
13h00	28.2	82.5	0h00	1	0
14h00	22.9	87.5	0h00	4	0
15h00	23.3	90.5	0h18	0	0
16h00	23.4	91.5	1h00	0	0
17h00	23.5	91.5	1h00	0	0
18h00	23.8	92.0	1h00	0	0
19h00	24.0	92.0	1h00	0	0
20h00	23.8	92.5	1h00	0	0
21h00	23.7	93.0	1h00	0	0
22h00	23.9	93.5	1h00	0	0
23h00	25.7	93.5	1h00	0	20
24h00	28.2	76.0	0h36	0	62

18/10	T	U	U9	VT	RG
01h00	30.5	69.0	0h00	0	108
02h00	30.4	70.0	0h00	0	118
03h00	32.6	55.0	0h00	0	200
04h00	31.1	66.0	0h00	2	164
05h00	31.6	64.5	0h00	3	144
06h00	23.9	91.5	0h12	3	12
07h00	26.1	91.5	1h00	2	34
08h00	26.8	86.0	0h12	0	46
09h00	26.7	88.0	0h00	0	22
10h00	26.1	91.5	0h36	0	4
11h00	25.9	92.0	1h00	0	0
12h00	25.6	92.0	1h00	0	0
13h00	25.3	92.5	1h00	0	0
14h00	25.0	93.0	1h00	0	0
15h00	25.0	93.5	1h00	0	0
16h00	24.9	93.5	1h00	0	0
17h00	24.6	92.5	1h00	0	0
18h00	24.4	93.0	1h00	0	0
19h00	24.1	93.5	1h00	0	0
20h00	23.5	93.5	1h00	0	0
21h00	23.3	93.5	1h00	0	0
22h00	23.3	94.0	1h00	0	0
23h00	25.3	93.5	1h00	0	18
24h00	28.6	77.0	0h36	0	64

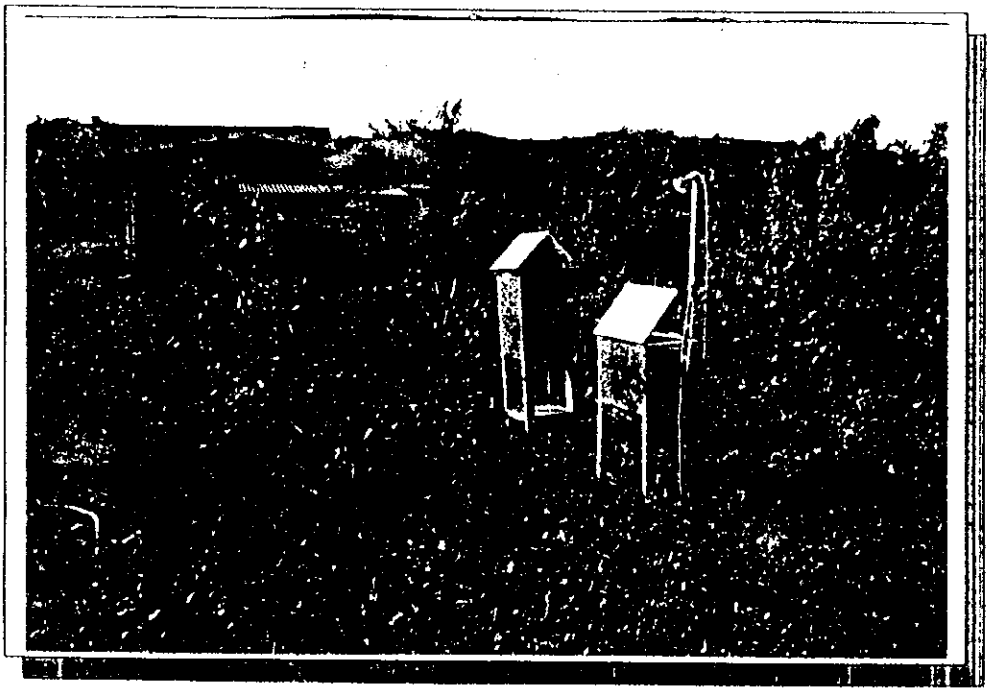
19/10	T	U	U9	VT	RG
01h00	29.8	69.0	0h00	0	110
02h00	32.3	58.0	0h00	0	200
03h00	31.3	63.0	0h00	0	178
04h00	31.0	66.0	0h00	0	106
05h00	30.4	68.5	0h00	1	88
06h00	30.7	67.5	0h00	1	72
07h00	31.4	63.0	0h00	3	80
08h00	30.3	65.5	0h00	2	80
09h00	29.4	72.0	0h00	1	18
10h00	28.0	79.5	0h00	0	4
11h00	26.8	86.5	0h00	0	0
12h00	27.2	79.0	0h00	0	0
13h00	26.5	82.0	0h00	0	0
14h00	25.9	82.5	0h00	1	0
15h00	25.0	92.0	0h36	0	0
16h00	25.1	89.5	0h48	0	0
17h00	24.7	92.0	0h48	0	0
18h00	24.5	93.0	1h00	0	0
19h00	24.6	93.5	1h00	0	0
20h00	24.4	93.5	1h00	0	0
21h00	24.4	93.5	1h00	0	0
22h00	24.2	94.0	1h00	0	[illegible]
23h00	25.1	93.5	1h00	0	
24h00	27.2	92.5	1h00	0	3

20/10	T	U	RR	VT	RG
01h00	27.7	78.0	0h06	1	70
02h00	29.0	74.5	0h00	0	74
03h00	28.7	69.0	0h00	1	94
04h00	28.9	75.5	0h00	4	52
05h00	28.6	72.5	0h00	2	72
06h00	31.2	61.0	0h00	3	148
07h00	29.3	66.0	0h00	5	64
08h00	29.3	66.0	0h00	4	72
09h00	28.2	72.0	0h00	4	14
10h00	27.2	75.0	0h00	2	4
11h00	26.9	77.5	0h00	0	0
12h00	24.9	90.5	0h06	1	0
13h00	25.0	92.5	1h00	0	0
14h00	25.0	93.0	1h00	0	0
15h00	24.9	93.0	1h00	0	0
16h00	24.9	92.5	1h00	0	0
17h00	24.7	93.0	1h00	0	0
18h00	24.8	93.0	1h00	1	0
19h00	24.7	93.5	1h00	0	0
20h00	24.6	93.5	1h00	0	0
21h00	24.4	93.5	1h00	0	0
22h00	24.3	94.0	1h00	0	0
23h00	25.1	93.5	1h00	0	12
24h00	27.7	80.0	0h48	0	58

PICTURES



Water sampling done at sta. S-7, upstream of Boso-Boso River.



Air sampling made at sta. S-12, beside Pintong Bocaue Elementary School.

23.2 Environmental Survey for New Parcel B Sanitary Landfill and Access Road Project

23.2.1 Survey for Wet Season

ENVIRONMENTAL SURVEY II (WET SEASON)
FOR
NEW PARCEL B SANITARY LANDFILL AND ACCESS ROAD PROJECT
OF
THE STUDY ON SOLID WASTE MANAGEMENT
FOR METRO MANILA IN THE REPUBLIC OF THE PHILIPPINES

A OBJECTIVE

The objective of the survey is to obtain information on the existing condition of the environment around the proposed New Parcel B Sanitary Landfill Site and Access Road Alignment, which will be used as basic data to forecast and evaluate the environmental impacts caused by the project.

B SAMPLING POINTS AND SCHEDULE

TABLE 1 shows the sampling stations at San Mateo Sanitary Landfill Site. The exact sampling points shown in FIGURE 1 were indicated by the Environmental Engineer of the JICA Study Team, and descriptions of which are shown also in TABLE 1. Method of sampling followed the Philippine standards.

The wet season sampling was conducted on October 13 to 31, 1998 for Noise and Vibration, Water Quality, and Air Quality and Odor.

C ITEMS FOR ANALYSIS

TABLE 1 also shows the items for analysis, sampling stations and sampling time.

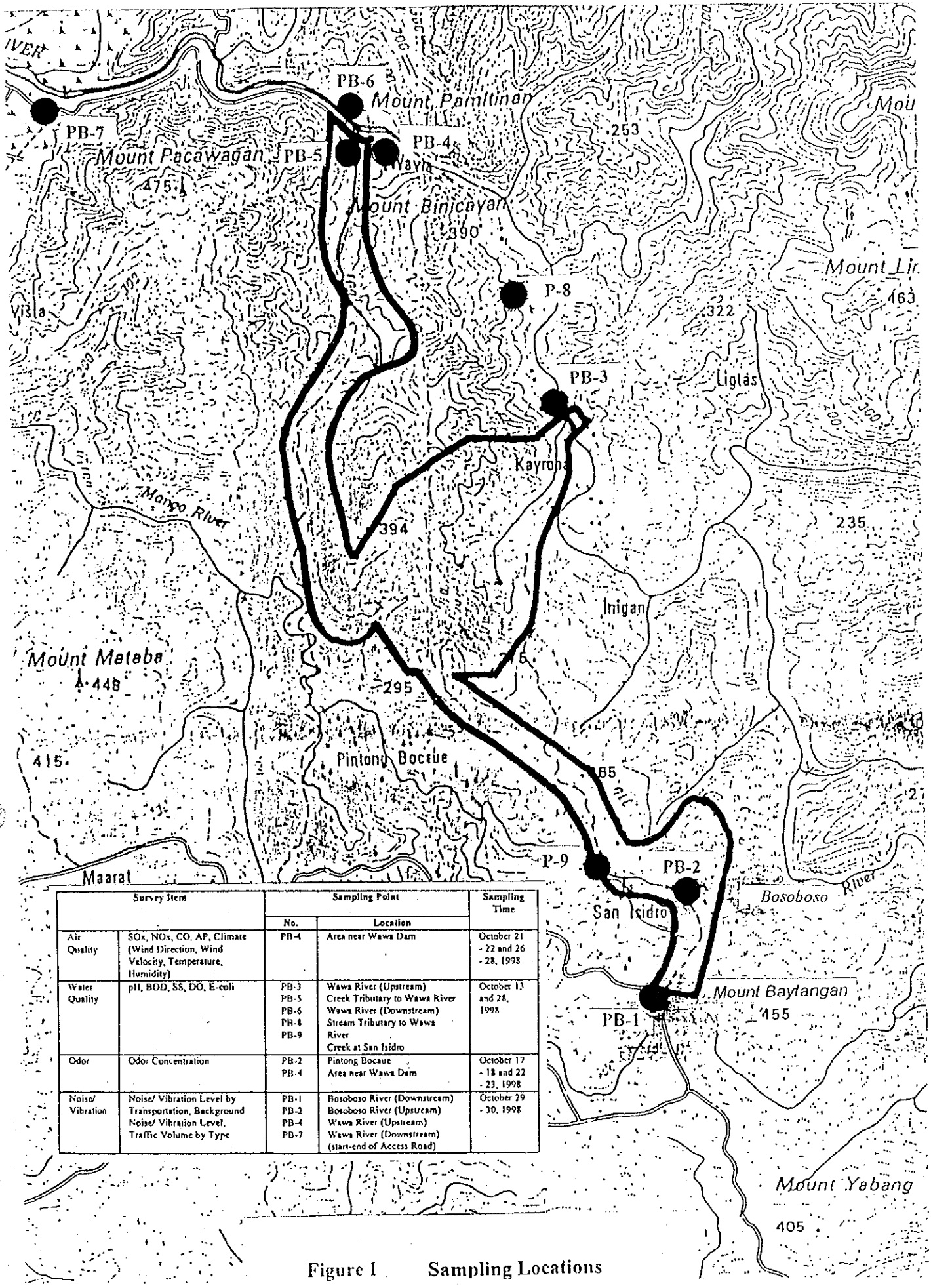
D RESULTS OF ANALYSIS

The methods of analysis and results of the laboratory tests are shown and discussed in following sections.

Table 1 Survey Item, Sampling Point and Sampling Time

Survey Item		Sampling Point		Sampling Time
		No.	Location	
Air Quality	SOx, NOx, CO, AP, Climate (Wind Direction, Wind Velocity, Temperature, Humidity)	PB-4	Area near Wawa Dam	October 21 - 22 and 26 - 28, 1998
Water Quality	pH, BOD, SS, DO, E-coli	PB-3 PB-5 PB-6 PB-8 PB-9	Wawa River (Upstream) Creek Tributary to Wawa River Wawa River (Downstream) Stream Tributary to Wawa River Creek at San Isidro	October 13 and 28. 1998
Odor	Odor Concentration	PB-2 PB-4	Pintong Bocaue Area near Wawa Dam	October 17 - 18 and 22 - 23, 1998
Noise/ Vibration	Noise/ Vibration Level by Transportation, Background Noise/ Vibration Level, Traffic Volume by Type	PB-1 PB-2 PB-4 PB-7	Bosoboso River (Downstream) Bosoboso River (Upstream) Wawa River (Upstream) Wawa River (Downstream) (start-end of Access Road)	October 29 - 30, 1998

Sampling Locations of Environmental Survey at New Parcel B Sanitary Landfill and Access Road Project



Survey Item		Sampling Point		Sampling Time
		No.	Location	
Air Quality	SOx, NOx, CO, AP, Climate (Wind Direction, Wind Velocity, Temperature, Humidity)	PB-4	Area near Wawa Dam	October 21 - 22 and 26 - 28, 1998
Water Quality	pH, BOD, SS, DO, E-coli	PB-3 PB-5 PB-6 PB-8 PB-9	Wawa River (Upstream) Creek Tributary to Wawa River Wawa River (Downstream) Stream Tributary to Wawa River Creek at San Isidro	October 13 and 28, 1998
Odor	Odor Concentration	PB-2 PB-4	Pintong Bocaue Area near Wawa Dam	October 17 - 18 and 22 - 23, 1998
Noise/ Vibration	Noise/ Vibration Level by Transportation, Background Noise/ Vibration Level, Traffic Volume by Type	PB-1 PB-2 PB-4 PB-7	Bosoboso River (Downstream) Bosoboso River (Upstream) Wawa River (Upstream) Wawa River (Downstream) (start-end of Access Road)	October 29 - 30, 1998

Figure 1 Sampling Locations

AIR QUALITY

AIR SAMPLING of TSP, SO2 AND NO2

Sampling Event	Date & Time	TSP ug/Ncm	SO2 ug/Ncm	NO2 ug/Ncm
PB-4 - Area near Wawa Dam				
Day 1	Oct. 21 - 22, 1998 (11:30 am to 11:30 am)	23.38	<4	3.71
Day 2	Oct. 26 - 27, 1998 (3:30 pm to 3:30 pm)	64.87	<4	7.69
Day 3	Oct. 27 - 28, 1998 (3:45 pm to 3:45 pm)	43.60	<4	1.92

Note: Ncm - Normal Cubic Meter (at temp = 25°C, p=1 atm)

Sampling & Analytical Procedure

TSP	Graseby high volume sampler	Gravimetric analysis
SO2	Graseby gas bubbler sampler	Pararosaniline method
NO2	Graseby gas bubbler sampler	Greiss saltzman method

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E-mail: omli@mlsa.lrf.ph.net

TEEM, INCORPORATED

DATE October 28, 1998
CLIENT REF. NO.
R.A. NO. 14552
CERT. NO. 98-1443
INVOICE NO. 13085
SHEET NO. 1 OF 1 PAGES

CERTIFICATE OF ANALYSIS

Sample Source : Montalban Rizal
Date Received : October 23, 1998
Date Analyzed : October 23 - 27, 1998

	SMF - 01
TSP, ug/ncm	23.38
SO2, ug/ncm	<4
NO2, ug/ncm	3.71

* * * * * NOTHING FOLLOWS * * * * *

ANALYTICAL METHOD/REMARKS:
The test results pertain only to the samples submitted and tested.
TOTAL SAMPLES 1 TOTAL ANALYSIS 3
N.D. = Element is not detected by the method employed.

CERTIFIED BY:

for LORNA G. SY
Manager, Analytical Services

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AMERICAN SOCIETY FOR TESTING MATERIALS

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TEEM, INCORPORATED

DATE	November 04, 1998
CLIENT REF. NO.	
R.A. NO.	14595
CERT. NO.	98 – 1472
INVOICE NO.	13119
SHEET NO. 1 OF 1 PAGES	

CERTIFICATE OF ANALYSIS

Date Sampled : October 26, 1998
Sample Source : MONTALBAN RIZAL
Date received : October 29, 1998
Date Analyzed : October 30 – November 03, 1998

	SMF # 02	SMF # 03
TSP, ug/ncm	64.87	43.60
SO_2, ug/ncm	<4	<4
NO_2, ug/ncm	7.69	1.92

***** NOTHING FOLLOWS *****

ANALYTICAL METHOD/REMARKS:
The test results pertain only to the samples submitted and tested.

TOTAL SAMPLES 2 TOTAL ANALYSIS 6

N.D. = Element is not detected by the method employed.

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WATER QUALITY

WATER SAMPLING

Station No.	Location	Date/Time	Ta	Tw	DO	pH	BOD	SS	E-coli
PB-6	Wawa River Downstream	Oct.13, ' 98/ 12:30 pm	25	26	7.3	7.7	10	25	neg.
PB-5	Creek Tributary to Wawa River	Oct.13, ' 98/ 4:30 pm	25	26	7.6	7.6	10	115	neg.
PB-3	Wawa River Upstream	Oct.13, ' 98/ 3:15 pm	25	26	6.7	7.7	12	9	neg.
PB-9	Creek at San Isidro	Oct.13, ' 98/ 3:30 pm	25	26	2.7	7.6	129	200	neg.
PB-8	Stream Tributary to Wawa River	Oct.28, ' 98/ 12:30 pm	35	30	5.5	6.7	1	14	neg.

Legend:		
	Ta - ambient air temperature	°C
	Tw - ambient water temperature	°C
	DO - dissolved oxygen	mg/l
	pH - pH scale	pH unit
	BOD - biochemical oxygen demand	mg/l
	SS - suspended solids	mg/l
	E-coli - E-coli bacteria	MPN/100 ml

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TEEM, INCORPORATED

DATE	October 23, 1998
CLIENT REF. NO.	
R.A. NO.	14521
CERT. NO.	98 – 1424
INVOICE NO.	13066
SHEET NO. 2 OF 3 PAGES	

CERTIFICATE OF ANALYSIS

	W – 1	W – 2	METHOD
pH	7.7	7.6	Electrometric Method
BOD, mg / L	10	10	(5 – Day BOD Test) Modified Winkler
TSS, mg / L	25	115	Gravimetric (dried at 103°C)
E. Coli	Negative	Negative	

***** OVER *****

The test results pertain only to the samples submitted & tested.

ANALYTICAL METHOD/REMARKS:
Ref. Std. Methods for
Water & Wastewater, 19th Ed.

TOTAL SAMPLES 7 TOTAL ANALYSIS 35

N.D. = Element is not detected by the method employed.

CERTIFIED BY:

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TEEM, INCORPORATED

DATE October 23, 1998
CLIENT REF. NO.
R.A. NO. 14521
CERT. NO. 98 – 1424
INVOICE NO. 13066
SHEET NO. 3 OF 3 PAGES

CERTIFICATE OF ANALYSIS

	W – 3	W – 4	METHOD
pH	7.7	7.6	Electrometric Method
BOD, mg / L	12	129	(5 – Day BOD Test) Modified Winkler
TSS, mg / L	9	200	Gravimetric (dried at 103^{0}C)
E. Coli	Negative	Negative	

***** NOTHING FOLLOWS *****

The test results pertain only to the samples submitted & tested.

ANALYTICAL METHOD/REMARKS:
Ref. Std. Methods for Water & Wastewater, 19th Ed.

TOTAL SAMPLES 7 TOTAL ANALYSIS 35

N.D. = Element is not detected by the method employed.

CERTIFIED BY:

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TEEM, INCORPORATED

DATE	November 04, 1998
CLIENT REF. NO.	
R.A. NO.	14595
CERT. NO.	98 – 1472
INVOICE NO.	13119
SHEET NO. 1 OF 1 PAGES	

CERTIFICATE OF ANALYSIS

Date Sampled : October 26, 1998
Sample Source : MONTALBAN, RIZAL
Date Received: October 29, 1998
Date Analyzed: October 30 – November 03, 1998

	SPRING WATER	METHOD
pH	6.7	Glass Electrode Method
BOD, mg / L	1	(5 – Day BOD Test) Modified Winkler
TSS, mg / L	14	Gravimetric (dried at 103°C)
E. Coli	Negative	

***** NOTHING FOLLOWS *****

The test results pertain only to the sample submitted & tested.

ANALYTICAL METHOD/REMARKS:
Ref. Std. Methods for
Water & Wastewater, 19th Ed.

TOTAL SAMPLES 1 TOTAL ANALYSIS 4

N.D. = Element is not detected by the method employed.

CERTIFIED BY:

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ODOR

AIR SAMPLING of ODOR (CO, H2S AND LEL)

Sampling Event	Date	Time	CO ppm	H2S ppm	LEL %
PB-2 - Pintong Bocaue					
Morning	Oct. 18, 1998	6:00 AM	< 1	< 1	< 1
Daytime	Oct. 17, 1998	12:00 PM	< 1	< 1	< 1
Evening	Oct. 17, 1998	7:15 PM	< 1	< 1	< 1
Night time	Oct. 17, 1998	10:45 PM	< 1	< 1	< 1
PB-4 - Area near Wawa Dam					
Morning	Oct. 23, 1998	5:00 AM	< 1	< 1	< 1
Daytime	Oct. 22, 1998	12:00 noon	< 1	< 1	< 1
Evening	Oct. 22, 1998	7:00 PM	< 1	< 1	< 1
Night time	Oct. 22, 1998	11:00 PM	< 1	< 1	< 1

Note: % LEL is percent of the lower explosive limit. In the absence of odor measurement procedure, H2S and methane which are the common source of odor in a landfill are measured. Methane has a lower explosive limit of 5% by volume or 50,000 ppm (Material Safety Data Sheet). Therefore, the 1% reading represents methane concentration (assuming that all combustible gases that is detected is methane) of approximately 500 ppm.

Instrument used:

Quest Envirotrack IV Gas Monitor

NOISE/VIBRATION

VIBRATION AND NOISE TESTS IN NEW PARCEL B LANDFILL

29-30 October, 1998

Introduction

Measurements of ground vibration and acoustic noise were conducted at the terminals of the proposed Access Road for the New Parcel B Sanitary Landfill Project to estimate their level and characteristics.

Survey and Data Analysis

Ground vibration and noise measurements were conducted over a period of 24 hours in each site to determine maximum levels of ground vibration and acoustic noise. The survey was conducted from 29-30 October, 1998 on four sites proximal to Wawa River and Boso-boso River, which are respectively located 6 kilometers northwest and 4 kilometers southeast of the San Mateo Landfill (Figure 1).

The station at the two distal areas are accordingly named upstream (WUS or PB-4 & BUS or PB-2) or downstream (WDS or PB-7 & BDS or PB-1) depending on their location to a nearby river system.

Station Code	Location	Test Conducted
PB-4	WUS - Wawa River (Upstream)	Vibration and Acoustic Tests
PB-7	WDS - Wawa River (Downstream)	Vibration, Acoustic Tests and Traffic Count
PB-2	BUS - Boso-boso River (Upstream)	Vibration and Acoustic Tests
PB-1	BDS - Boso-boso River (Downstream)	Vibration, Acoustic Tests and Traffic Count

For each of the eight observation points, vertical seismometers with natural period of 1.0 Hz were deployed. These were connected to a digital recorder (EDR-1000). Recording parameters were mostly set to similar settings. A series of eight-minute measurements were simultaneously recorded on all points every hour of the observation period.

Recorded data were analyzed using EDRSEL program to view EDR-1000 data and to determine maximum velocity values. Selected waveforms representing records of noise and vehicular activity were reformatted for spectral analysis using DaDISP. Most of the large ground movements recorded by the network is dominated by vehicular activity. Hourly count was carried out at the three different areas and vehicles were classified according to their estimated weights, e.g., trucks are considered heavy while jeepneys and cars classified as light vehicles.

Results and Discussion

Temporal Variation of Ground Vibration Level

Vehicular counts in Boso-boso show low activity during nighttime and resumes during daytime (Figure 10). This trend can be seen in measurements of maximum amplitudes of ground vibration in both the upstream and downstream recording sites in Boso-boso (Figures 11 and 12).

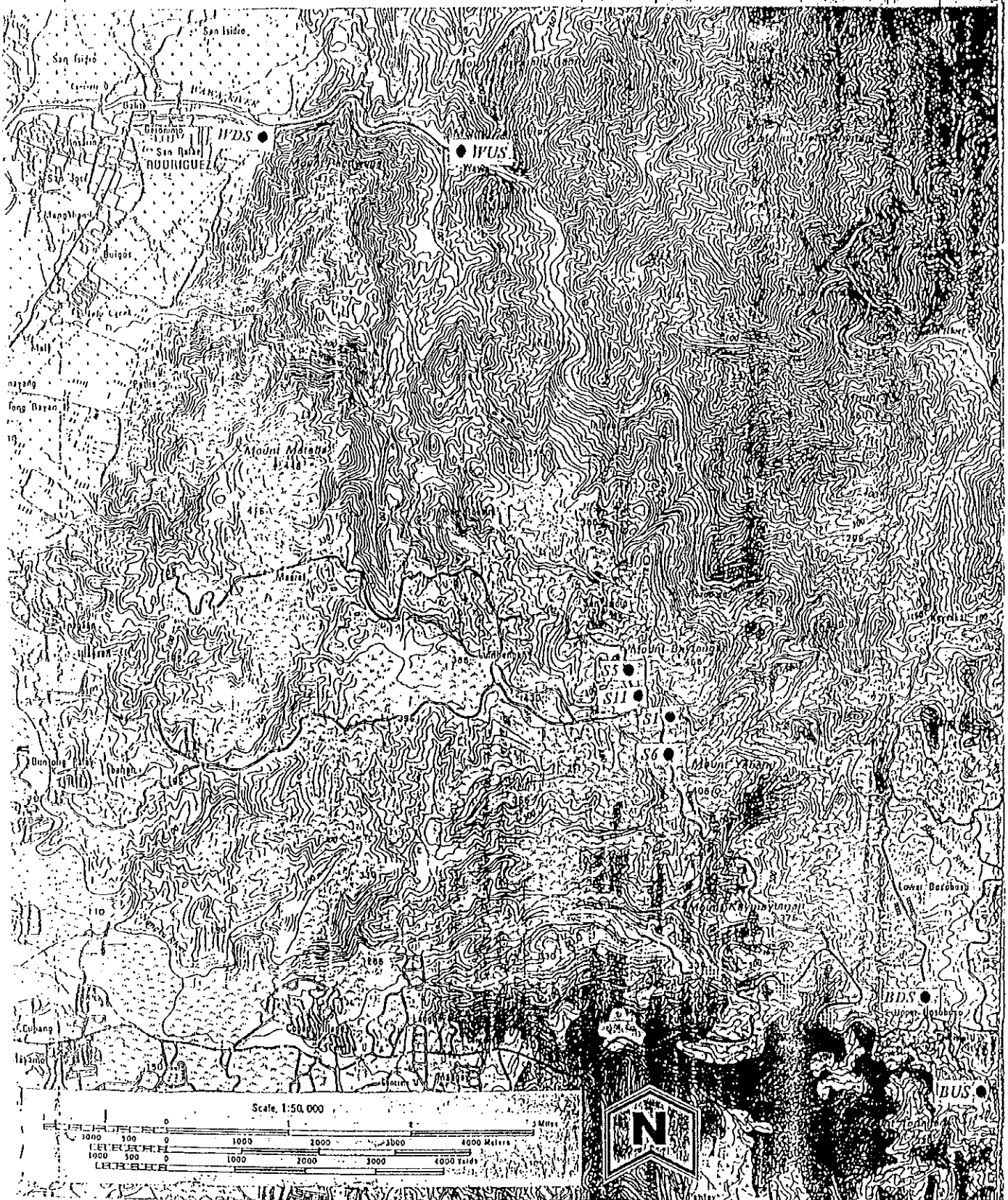
The number of passing vehicles in Wawa does not change at nighttime as more heavy vehicles begin to dominate the histogram until late midnight. This is then followed by the same trend in Boso-boso. While records of maximum amplitudes of ground vibration at WDS or PB-7 (Figure 13) follow the number of passing vehicle (Figure 14), this is not readily observable at point WUS or PB-4 (Figure 15). However, enveloped peaks of maximum ground vibration show a steady increase of amplitudes that follow the trend for heavy vehicles for WDS or PB-7 (Figure 16).

Spectral Variation of Ground Shaking Level

At Point WUS or PB-4, it appears that there is no distinct predominant frequency for very quiet periods and a peak at 25 Hz for records of high amplitudes. At Point WDS or PB-7, a predominant peak of 5 Hz appears on both periods with polymodal peaks at 8, 13 and 23 Hz. A predominant at peak at 5 Hz is visible of 15 Hz at point BUS or PB-2, while at Point BDS or PB-1, peaks at 3 and 8 Hz are visible for records of background noise and 8 & 15 Hz for records of vehicular activity.

Acoustic Level

Acoustic measurements (in dB) were randomly conducted in the area. Acoustic measurements in Boso-boso areas show that the values of upstream sites are lower than that of downstream sites (Figure 18) and Wawa has relatively higher values than Boso-boso (Figure 19).



URE 1. OBSERVATION POINTS

Sapinit Elem. School	Vibration Test; and Random Acoustic Noise Test
Residential Area	Vibration Test; and Random Acoustic Noise Test
Leaching Pond	Vibration Test; and Random Acoustic Noise Test
Entrance/Exit	Vibration Test; Random Acoustic Noise Test; and Traffic Count
S, Wawa Upstream	Vibration Test; and Random Acoustic Noise Test
S, Wawa Downstream	Vibration Test; Hourly Acoustic Noise Test; and Traffic Count
, Bosb-Boso Upstream	Vibration Test; and Random Acoustic Noise Test
, Bosb-Boso Downstream	Vibration Test; Random Acoustic Noise Test; and Traffic Count

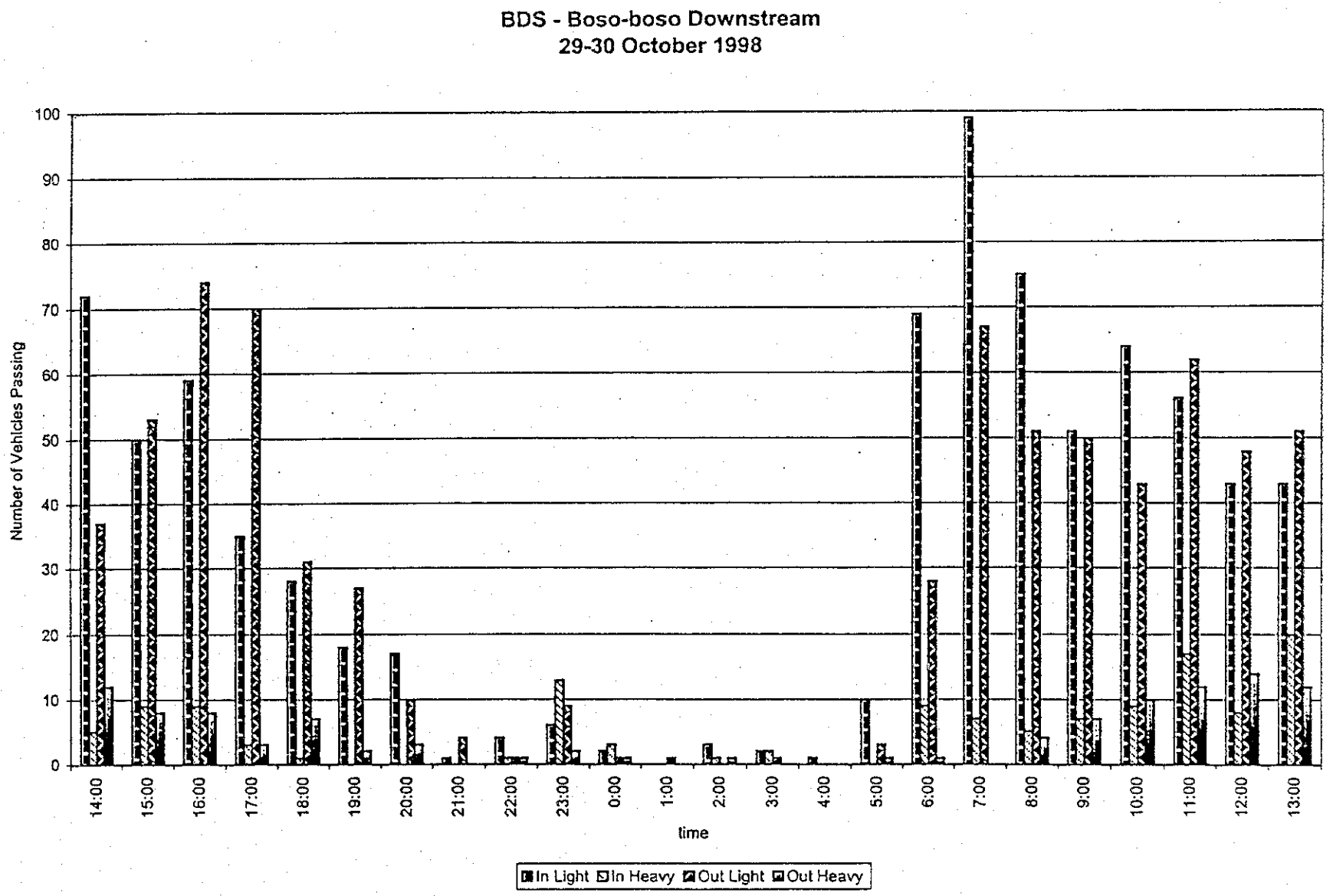

BDS - Boso-boso Downstream
29-30 October 1998
Number of Vehicles Passing
0
10
20
30
40
50
60
70
80
90
100
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
time
In Light
In Heavy
Out Light
Out Heavy

FIGURE 10

BDS - Boso-boso
29-30 October 1998

Day	Time	In Light	Heavy	Out Light	Heavy
29 Oct.	14:00	72	5	37	12
	15:00	50	9	53	8
	16:00	59	9	74	8
	17:00	35	3	70	3
	18:00	28	1	31	7
	19:00	18	0	27	2
	20:00	17	0	10	3
	21:00	1	0	4	0
	22:00	4	1	1	1
	23:00	6	13	9	2
	0:00	2	3	1	1
	1:00	0	0	1	0
30 Oct.	2:00	3	1	0	1
	3:00	2	2	1	0
	4:00	1	0	0	0
	5:00	10	0	3	1
	6:00	69	9	28	1
	7:00	99	7	67	0
	8:00	75	5	51	4
	9:00	51	7	50	7
	10:00	64	9	43	10
	11:00	56	17	62	12
	12:00	43	8	48	14
	13:00	43	20	51	12

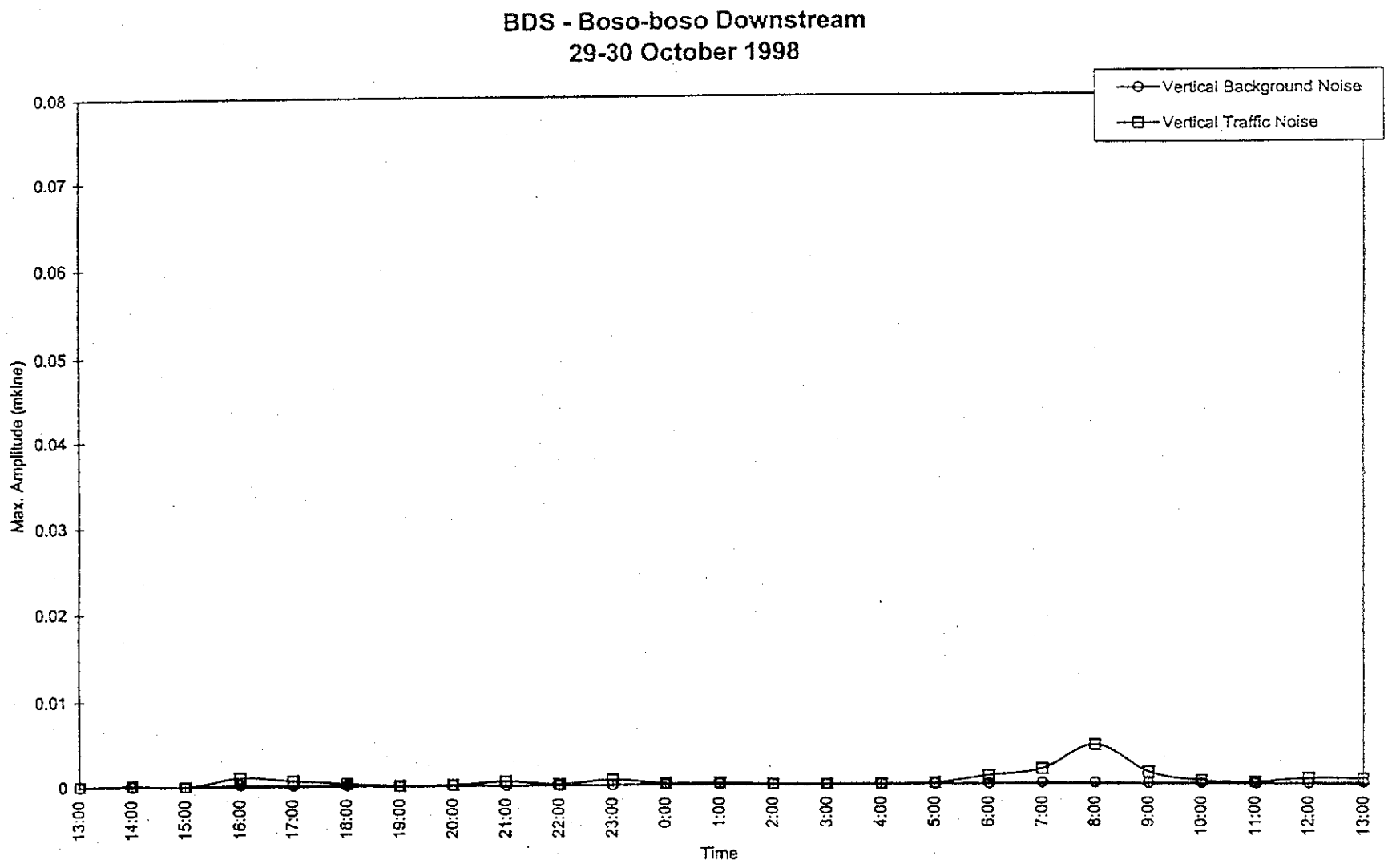

BDS - Boso-boso Downstream
29-30 October 1998
Vertical Background Noise
Vertical Traffic Noise
Max. Amplitude (mkline)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
Time

FIGURE 11

BDS (40db) Vertical
Boso-boso Downstream

Time	Vertical Background Noise	Traffic Noise		
13:00	0	0.000008	0	0.0008
14:00	0.00004	0.00021	0.004	0.021
15:00	0	0.00004	0	0.004
16:00	0.00021	0.00107	0.021	0.107
17:00	0.00013	0.00068	0.013	0.068
18:00	0.00008	0.00036	0.008	0.036
19:00	0	0.00008	0	0.008
20:00	0.00008	0.00017	0.008	0.017
21:00	0.00004	0.00051	0.004	0.051
22:00	0.000038	0.000188	0.038	0.188
23:00	0.000043	0.000672	0.043	0.672
0:00	0.000111	0.00024	0.111	0.24
1:00	0.000098	0.000257	0.098	0.257
2:00	0.00006	0.000107	0.06	0.107
3:00	0.000025	0.000051	0.025	0.051
4:00	0.000043	0.000098	0.043	0.098
5:00	0.000064	0.000201	0.064	0.201
6:00	0.000098	0.001007	0.098	1.007
7:00	0.000137	0.001778	0.137	1.778
8:00	0.000175	0.0046	0.175	4.6
9:00	0.000111	0.001418	0.111	1.418
10:00	0.000081	0.000445	0.081	0.445
11:00	0.000064	0.000274	0.064	0.274
12:00	0.000073	0.000676	0.073	0.676
13:00	0.000175	0.000634	0.175	0.634

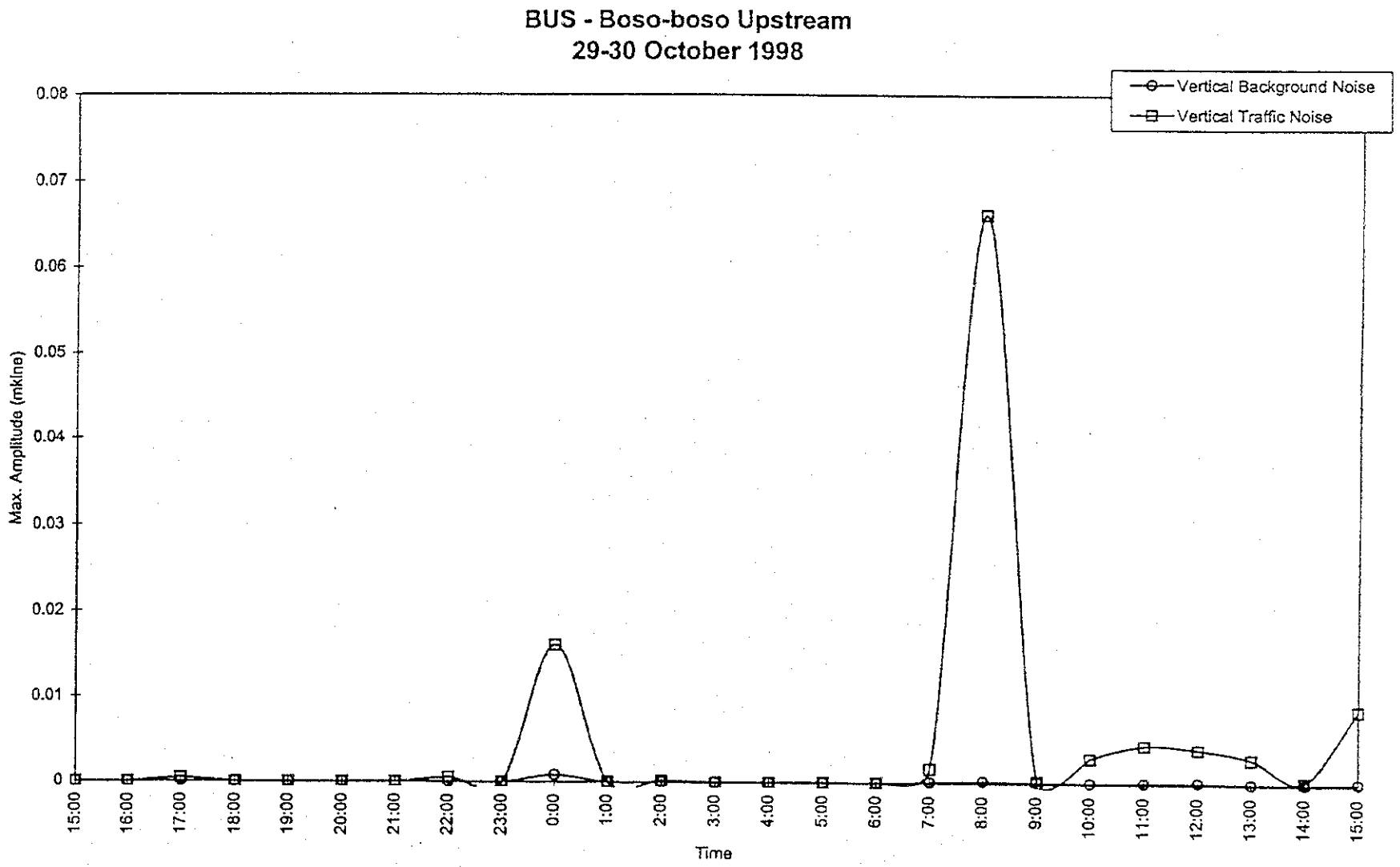

BUS - Boso-boso Upstream
29-30 October 1998
Vertical Background Noise
Vertical Traffic Noise
Max. Amplitude (mkline)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
Time

FIGURE 12

BUS (40db) Vertical
Boso-boso Upstream

Time	Vertical Background Noise	Traffic Noise		
15:00	0	0.000034	0	0.0034
16:00	0.00004	0.00004	0.004	0.004
17:00	0.00004	0.00043	0.004	0.043
18:00	0	0.00004	0	0.004
19:00	0	0.00004	0	0.004
20:00	0	0.00004	0	0.004
21:00	0	0.00004	0	0.004
22:00	0.00004	0.00051	0.004	0.051
23:00	0	0.00004	0	0.004
0:00	0.0008	0.01602	0.08	1.602
1:00	0	0.00008	0	0.008
2:00	0	0.00021	0	0.021
3:00	0	0.00004	0	0.004
4:00	0	0.00004	0	0.004
5:00	0	0.00008	0	0.008
6:00	0	0.00008	0	0.008
7:00	0.00013	0.00171	0.013	0.171
8:00	0.00026	0.06613	0.026	6.613
9:00	0.00013	0.00034	0.013	0.034
10:00	0.00008	0.00296	0.008	0.296
11:00	0.00013	0.00454	0.013	0.454
12:00	0.000193	0.00409	0.193	4.09
13:00	0.000086	0.002924	0.086	2.924
14:00	0.00006	0.000334	0.06	0.334
15:00	0.000231	0.008772	0.231	8.772

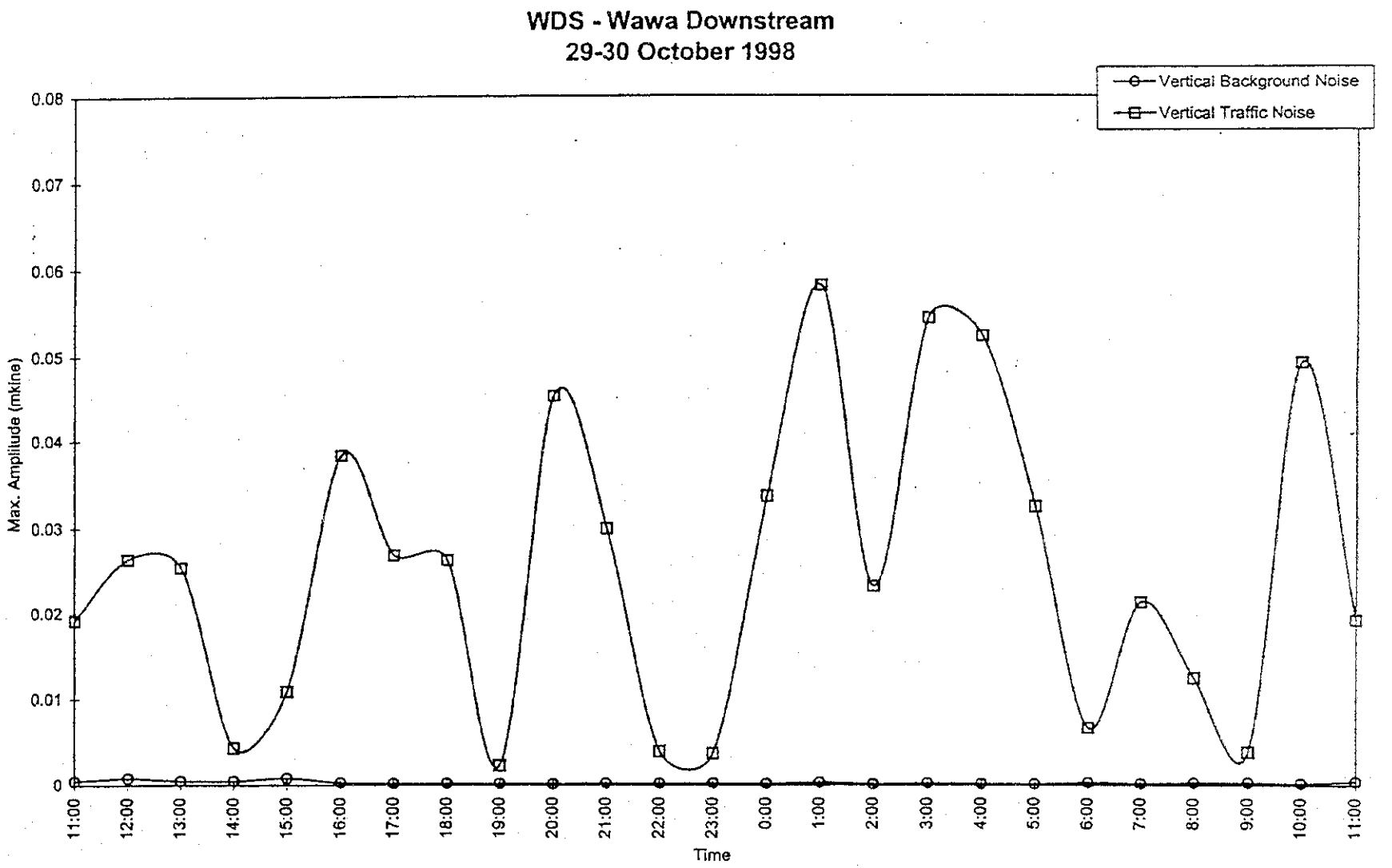

WDS - Wawa Downstream
29-30 October 1998
Vertical Background Noise
Vertical Traffic Noise
Max. Amplitude (mkine)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
Time

FIGURE 13

WR (40db) Vertical
Wawa River Downstream

Time	Vertical Background Noise	Traffic Noise		
11:00	0.00043	0.01915	0.043	1.915
12:00	0.00077	0.02643	0.077	2.643
13:00	0.00047	0.02544	0.047	2.544
14:00	0.00047	0.00432	0.047	0.432
15:00	0.00077	0.01088	0.077	1.088
16:00	0.00026	0.03833	0.026	3.833
17:00	0.00017	0.02688	0.017	2.688
18:00	0.00017	0.0263	0.017	2.630
19:00	0.00017	0.00231	0.017	0.231
20:00	0.00013	0.04527	0.013	4.527
21:00	0.00021	0.02994	0.021	2.994
22:00	0.00017	0.0039	0.017	0.390
23:00	0.00021	0.00368	0.021	0.368
0:00	0.00017	0.03345	0.017	3.345
1:00	0.0003	0.05804	0.030	5.804
2:00	0.00013	0.02313	0.013	2.313
3:00	0.00021	0.05427	0.021	5.427
4:00	0.00013	0.05217	0.013	5.217
5:00	0.00013	0.03225	0.013	3.225
6:00	0.0003	0.00668	0.030	0.668
7:00	0.00017	0.02124	0.017	2.124
8:00	0.0003	0.01246	0.030	1.246
9:00	0.0003	0.00385	0.030	0.385
10:00	0.00021	0.049	0.021	4.900
11:00	0.00043	0.01915	0.043	1.915

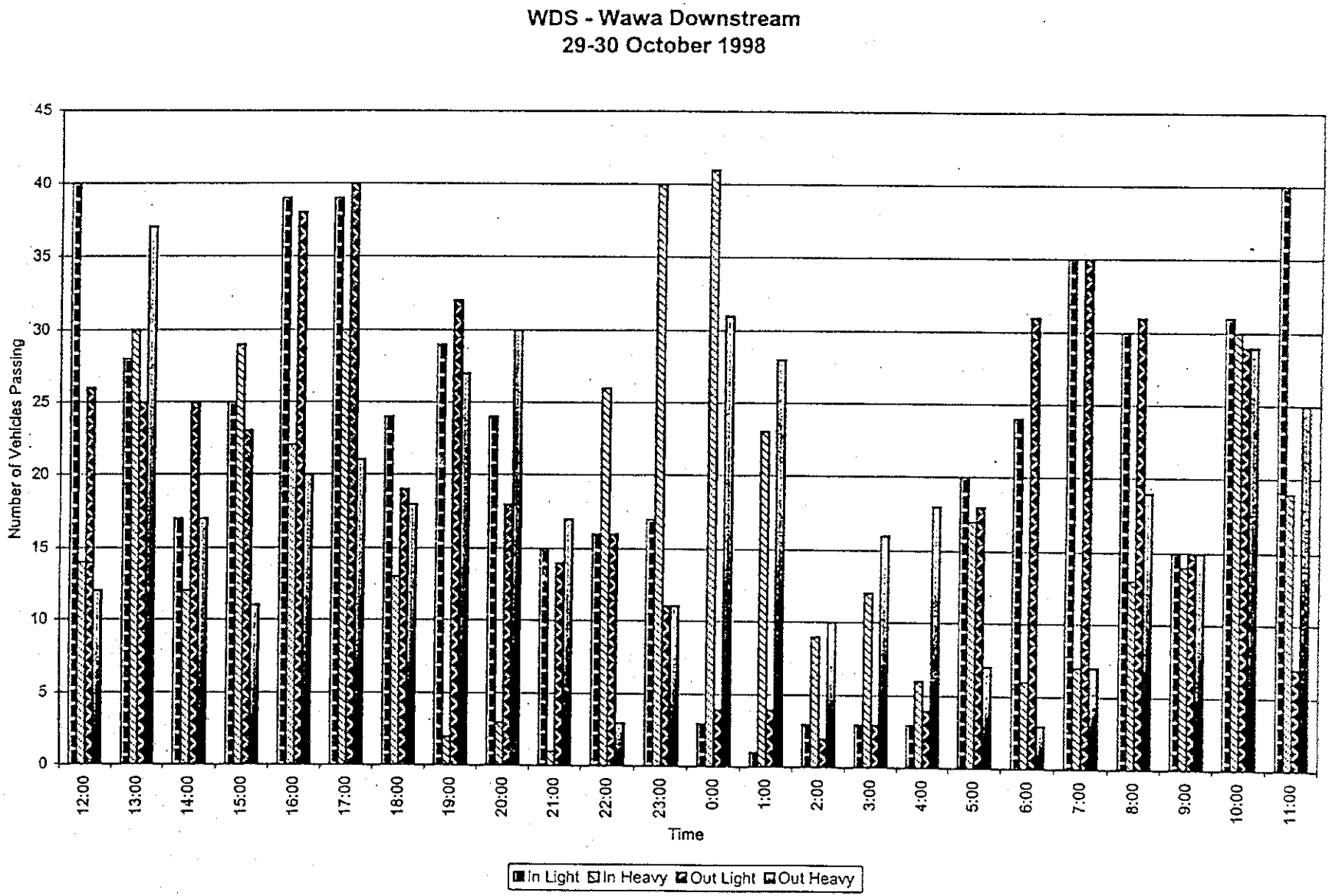

WDS - Wawa Downstream
29-30 October 1998
Number of Vehicles Passing
0
5
10
15
20
25
30
35
40
45
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
Time
In Light
In Heavy
Out Light
Out Heavy

FIGURE 14

WUS - Wawa River
29-30 October

Day	Time	In Light	Heavy	Out Light	Heavy
30 Oct.	12:00	40	14	26	12
	13:00	28	30	25	37
	14:00	17	12	25	17
	15:00	25	29	23	11
	16:00	39	22	38	20
	17:00	39	30	40	21
	18:00	24	13	19	18
	19:00	29	2	32	27
	20:00	24	3	18	30
	21:00	15	1	14	17
	22:00	16	26	16	3
	23:00	17	40	11	11
31 Oct.	0:00	3	41	4	31
	1:00	1	23	4	28
	2:00	3	9	2	10
	3:00	3	12	3	16
	4:00	3	6	4	18
	5:00	20	17	18	7
	6:00	24	6	31	3
	7:00	35	7	35	7
	8:00	30	13	31	19
	9:00	15	14	15	15
	10:00	31	30	29	29
	11:00	40	19	7	25

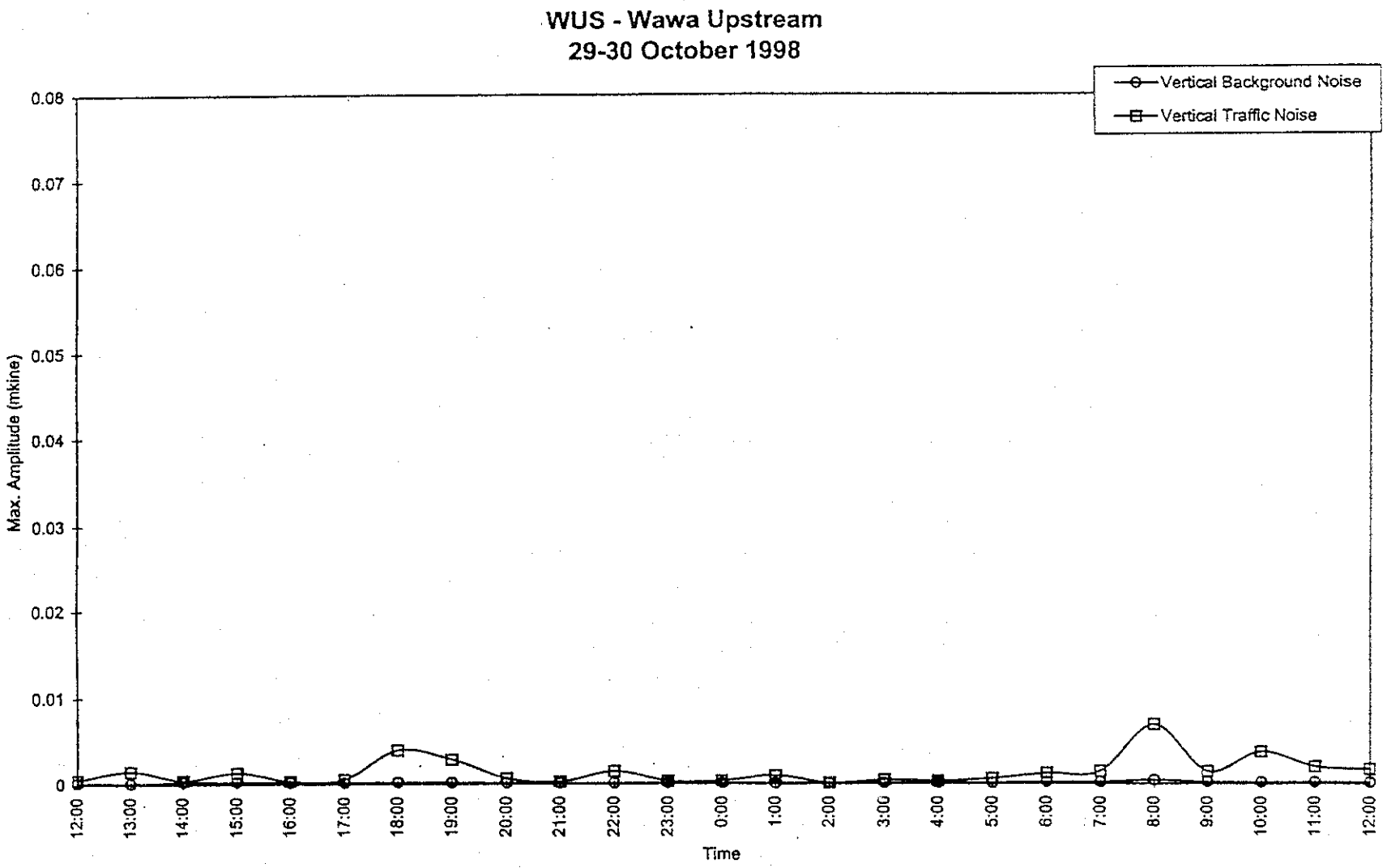

WUS - Wawa Upstream
29-30 October 1998
Vertical Background Noise
Vertical Traffic Noise
Max. Amplitude (mkine)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
Time

FIGURE 15

WR (40db) Vertical
Wawa River Upstream

Time	Vertical Background Noise	Traffic Noise		
12:00	0.00017	0.00051	0.017	0.051
13:00	0.00013	0.00154	0.013	0.154
14:00	0.00026	0.00051	0.026	0.051
15:00	0.0003	0.00137	0.030	0.137
16:00	0.00021	0.00038	0.021	0.038
17:00	0.00017	0.00056	0.017	0.056
18:00	0.00021	0.00403	0.021	0.403
19:00	0.00017	0.00291	0.017	0.291
20:00	0.00013	0.00068	0.013	0.068
21:00	0.00009	0.00029	0.009	0.029
22:00	0.00009	0.0015	0.009	0.150
23:00	0.00009	0.00034	0.009	0.034
0:00	0.00009	0.00039	0.009	0.039
1:00	0.00009	0.00099	0.009	0.099
2:00	0.00009	0.00013	0.009	0.013
3:00	0.00009	0.00047	0.009	0.047
4:00	0.00009	0.00034	0.009	0.034
5:00	0.00009	0.0006	0.009	0.060
6:00	0.00021	0.00124	0.021	0.124
7:00	0.00021	0.0015	0.021	0.150
8:00	0.00042	0.00694	0.042	0.694
9:00	0.00021	0.00146	0.021	0.146
10:00	0.00017	0.00381	0.017	0.381
11:00	0.00017	0.00201	0.017	0.201
12:00	0.00017	0.00171	0.017	0.171

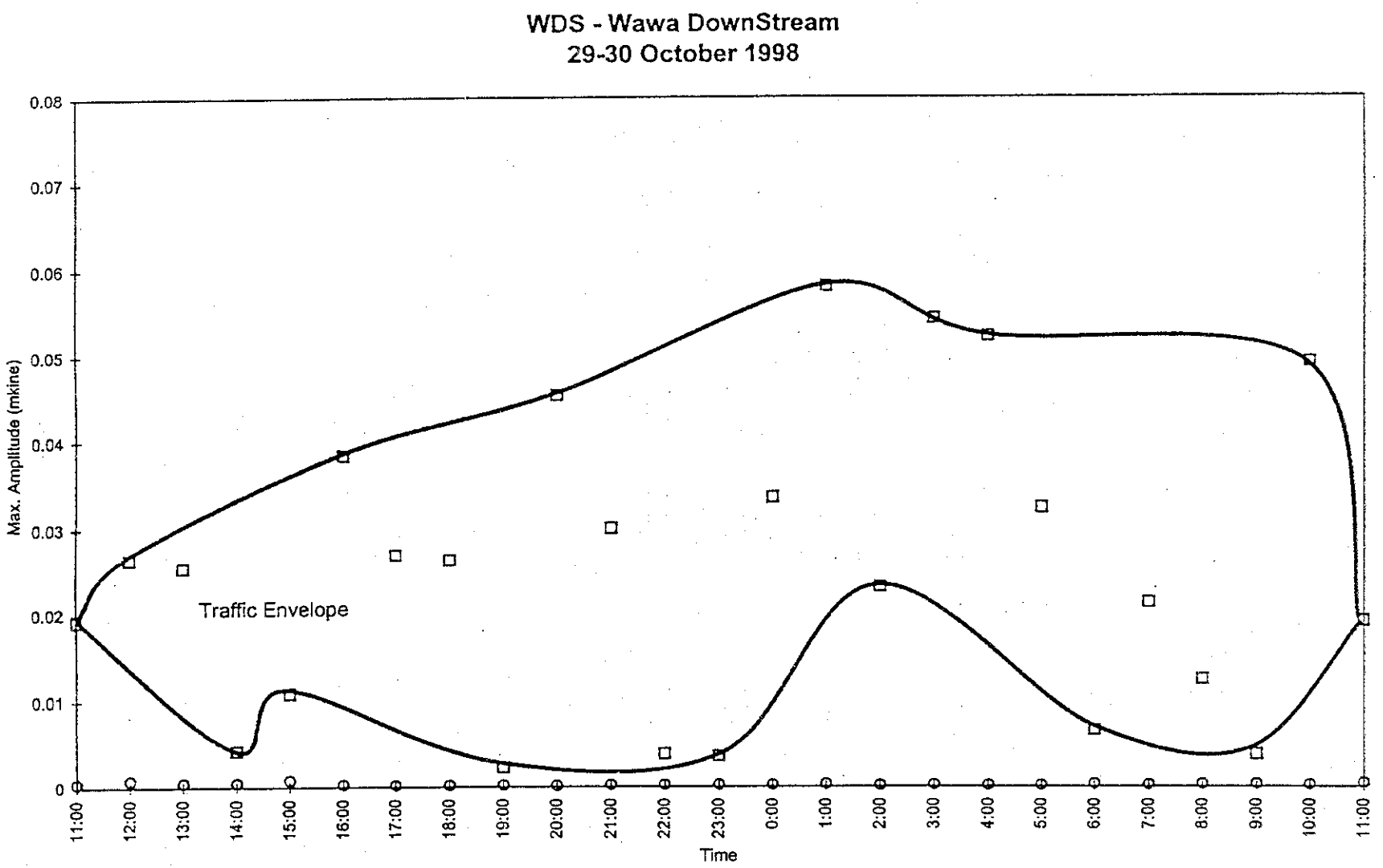
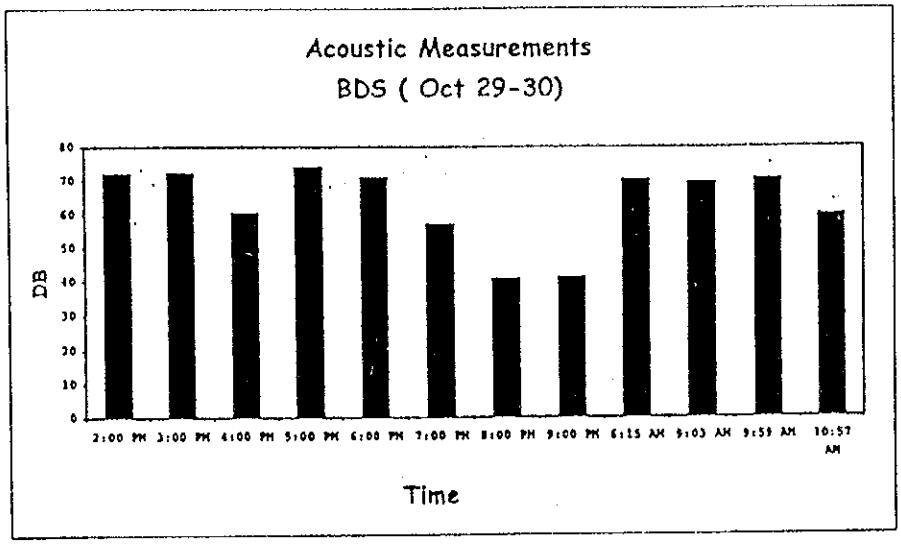

WDS - Wawa DownStream
29-30 October 1998
Max. Amplitude (mkine)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Traffic Envelope
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
Time

FIGURE 16



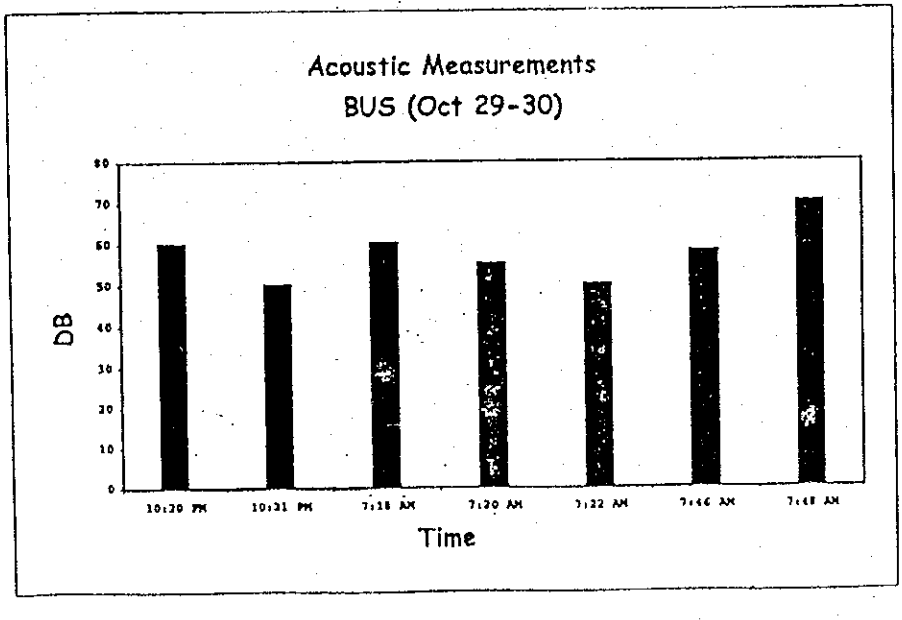


FIGURE 18. ACOUSTIC NOISE LEVEL ALONG BOSO-BOSO RIVER (UPSTREAM AND DOWNSTREAM)

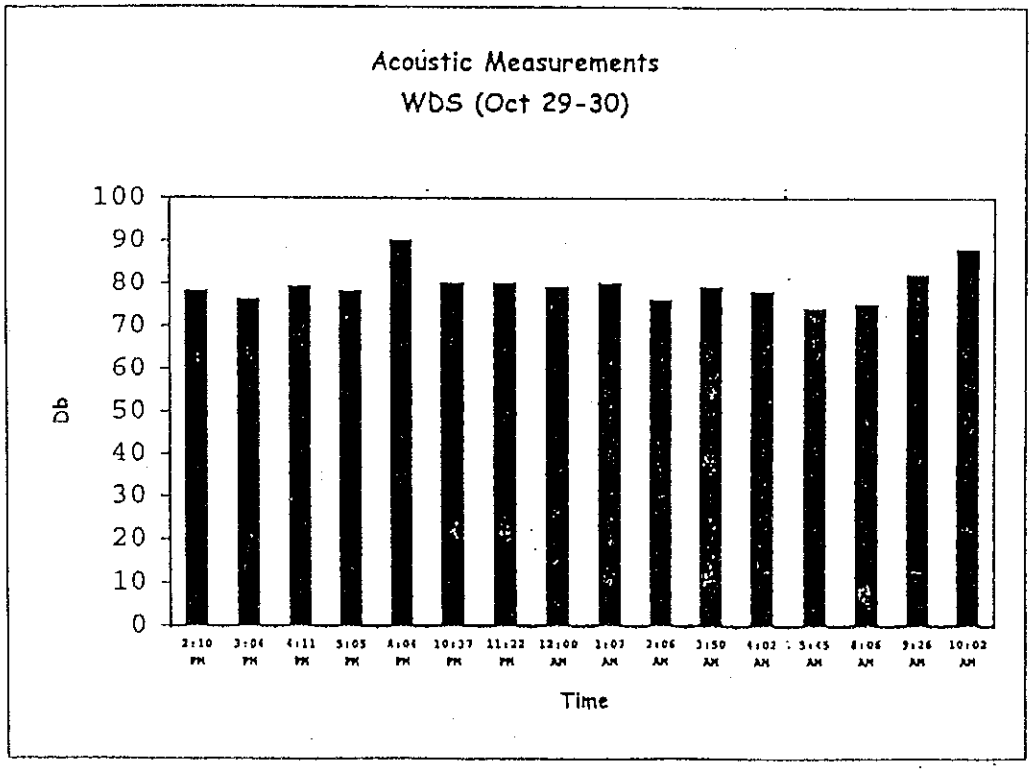
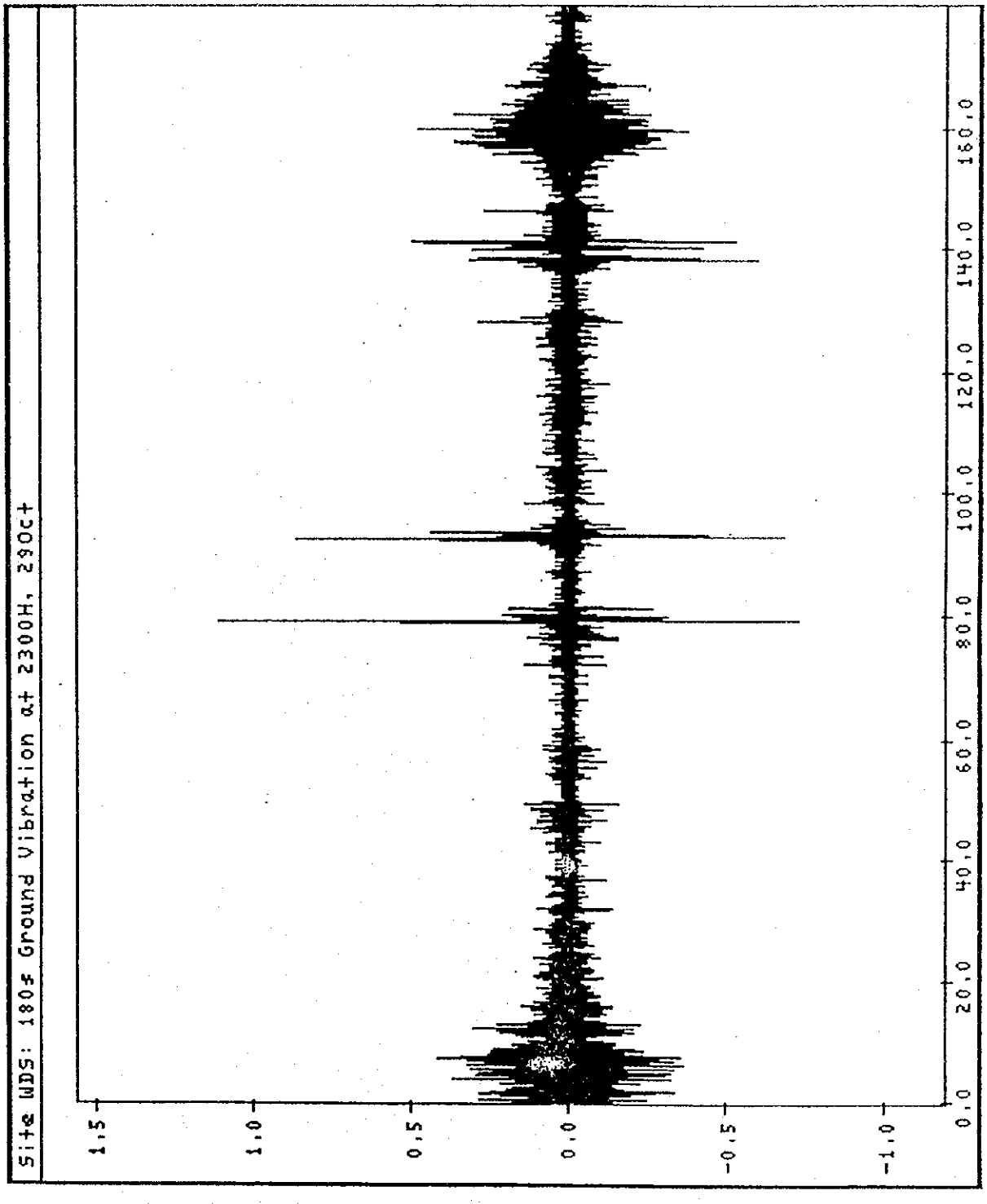
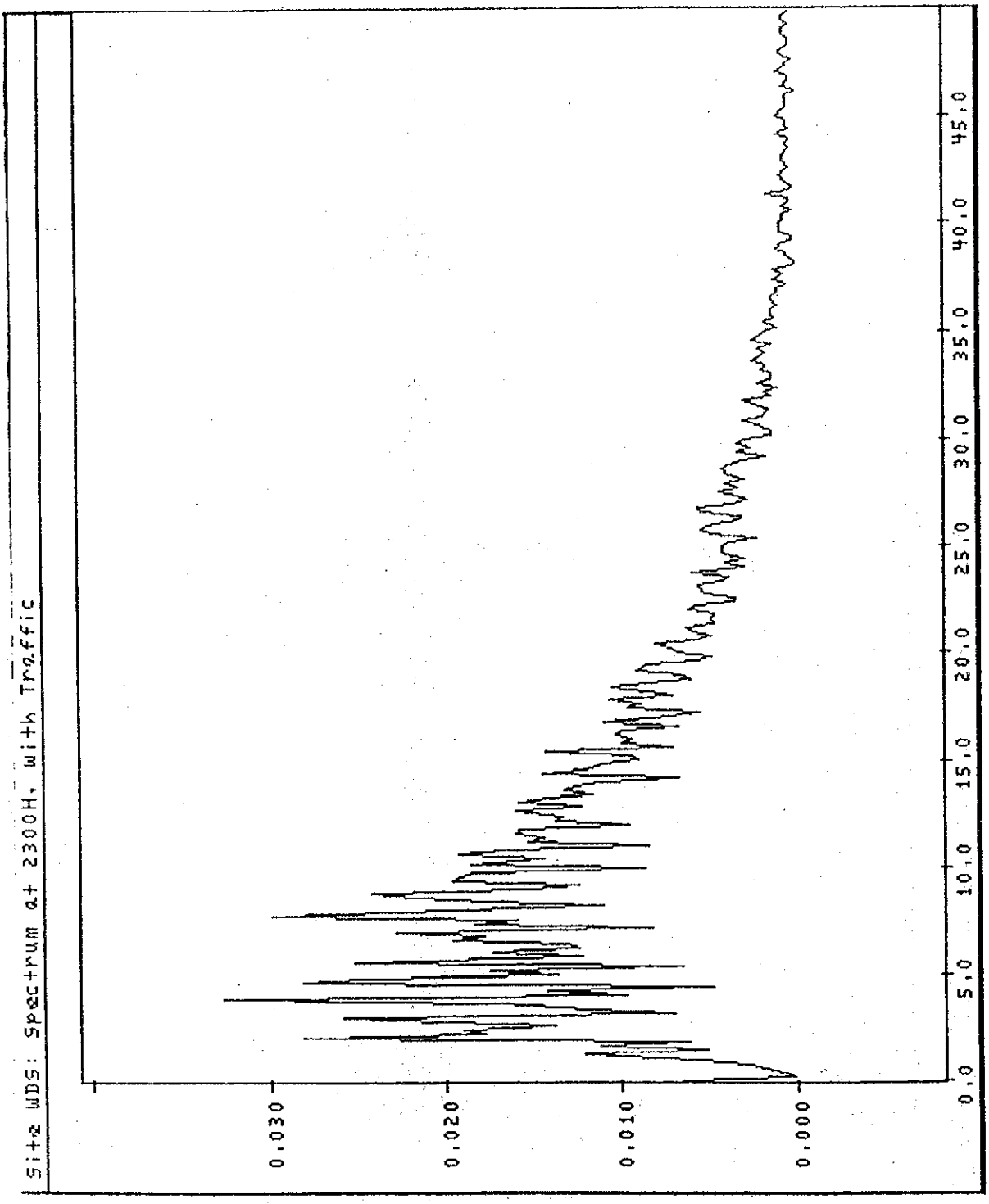
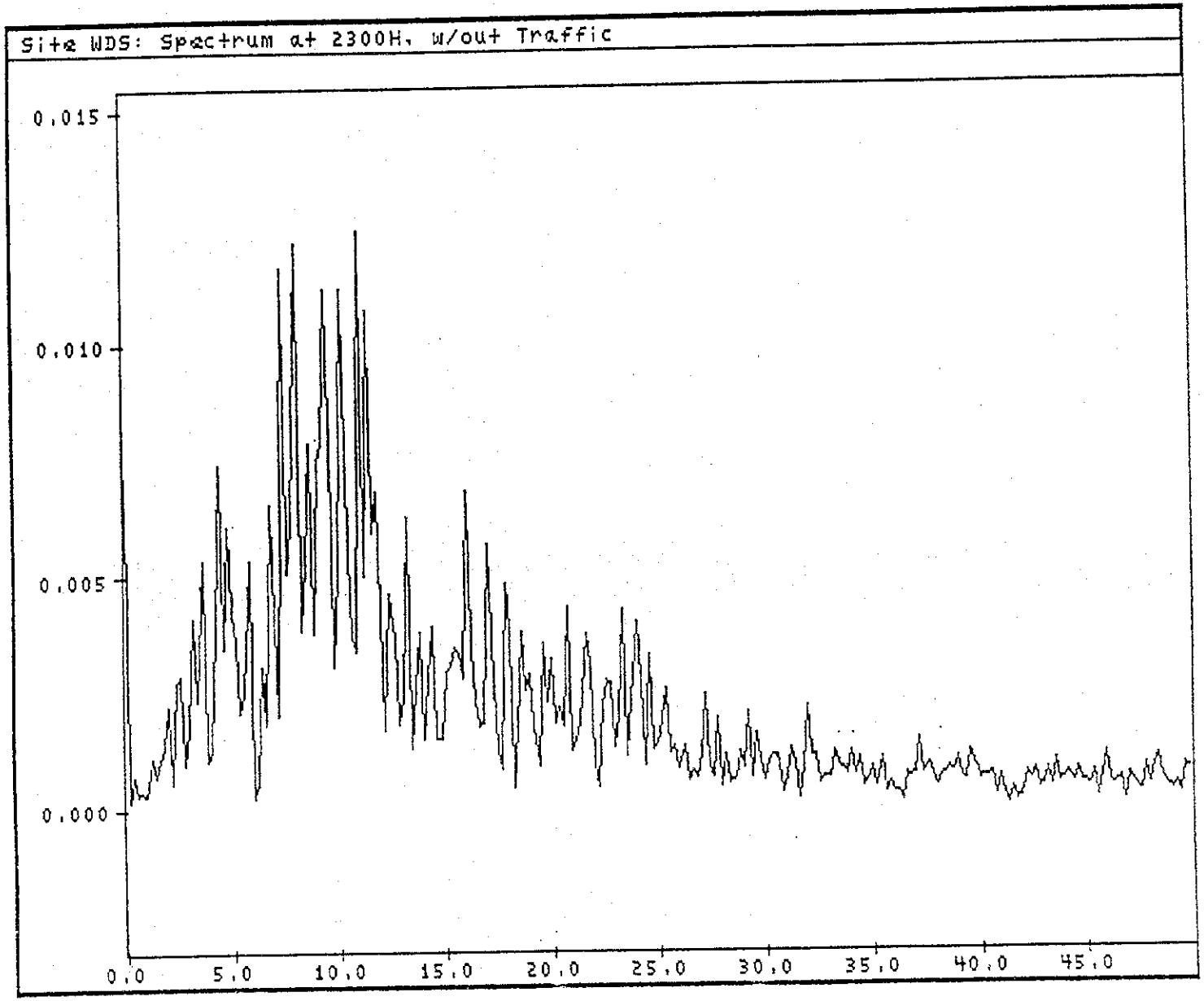


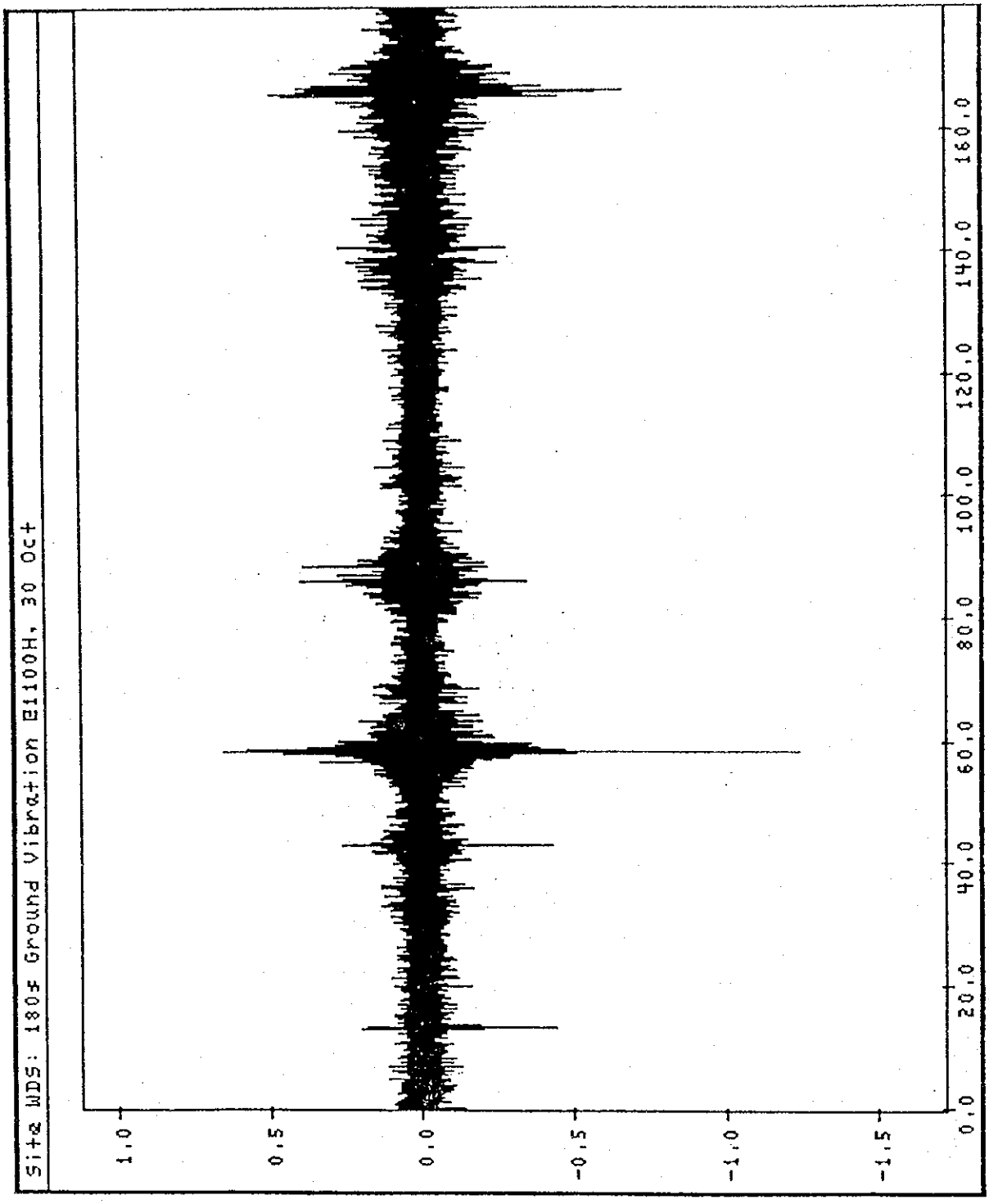
FIGURE 19. ACOUSTIC NOISE LEVEL ALONG WAWA RIVER (DOWNSTREAM AND UPSTREAM)

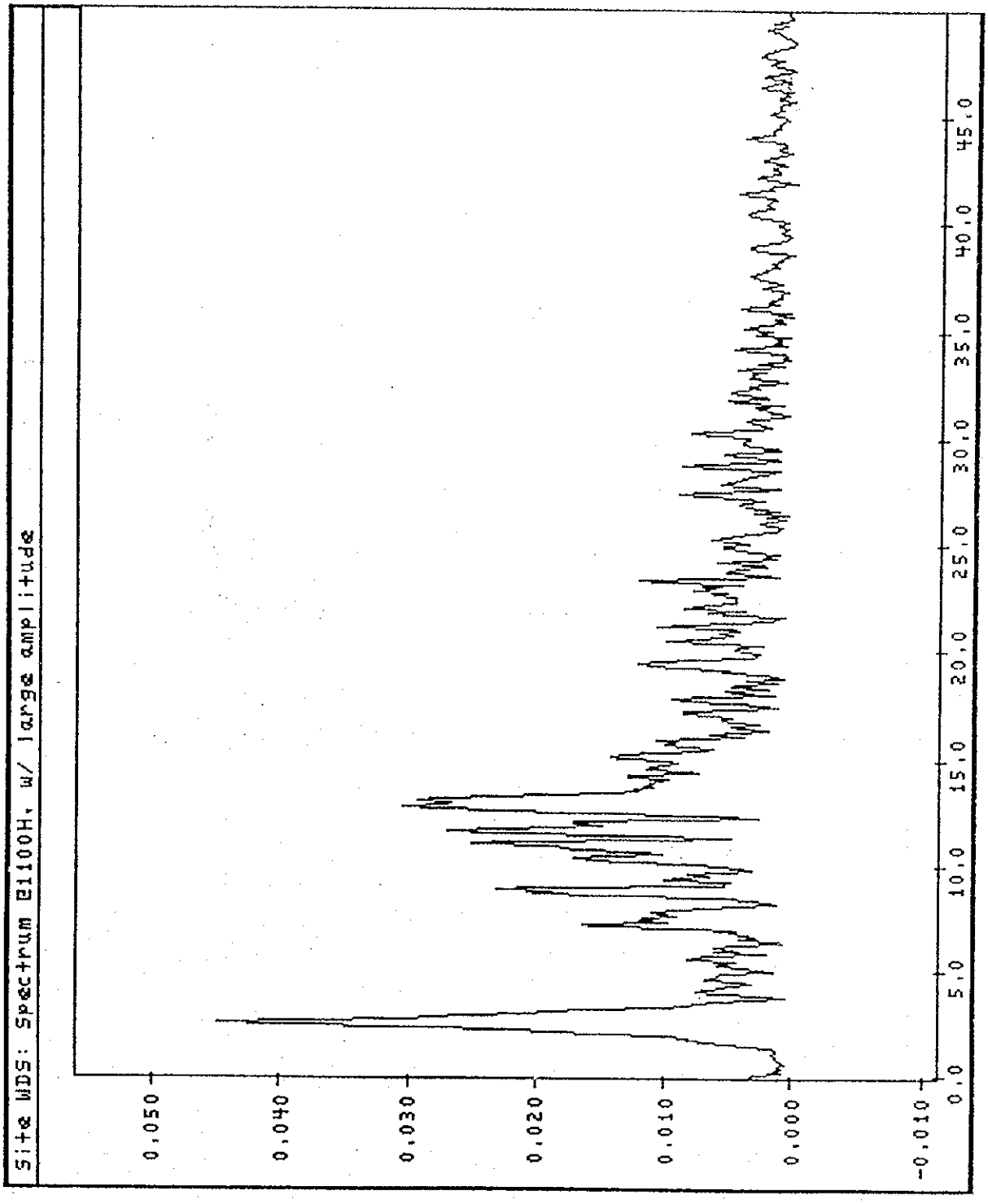
Appendix

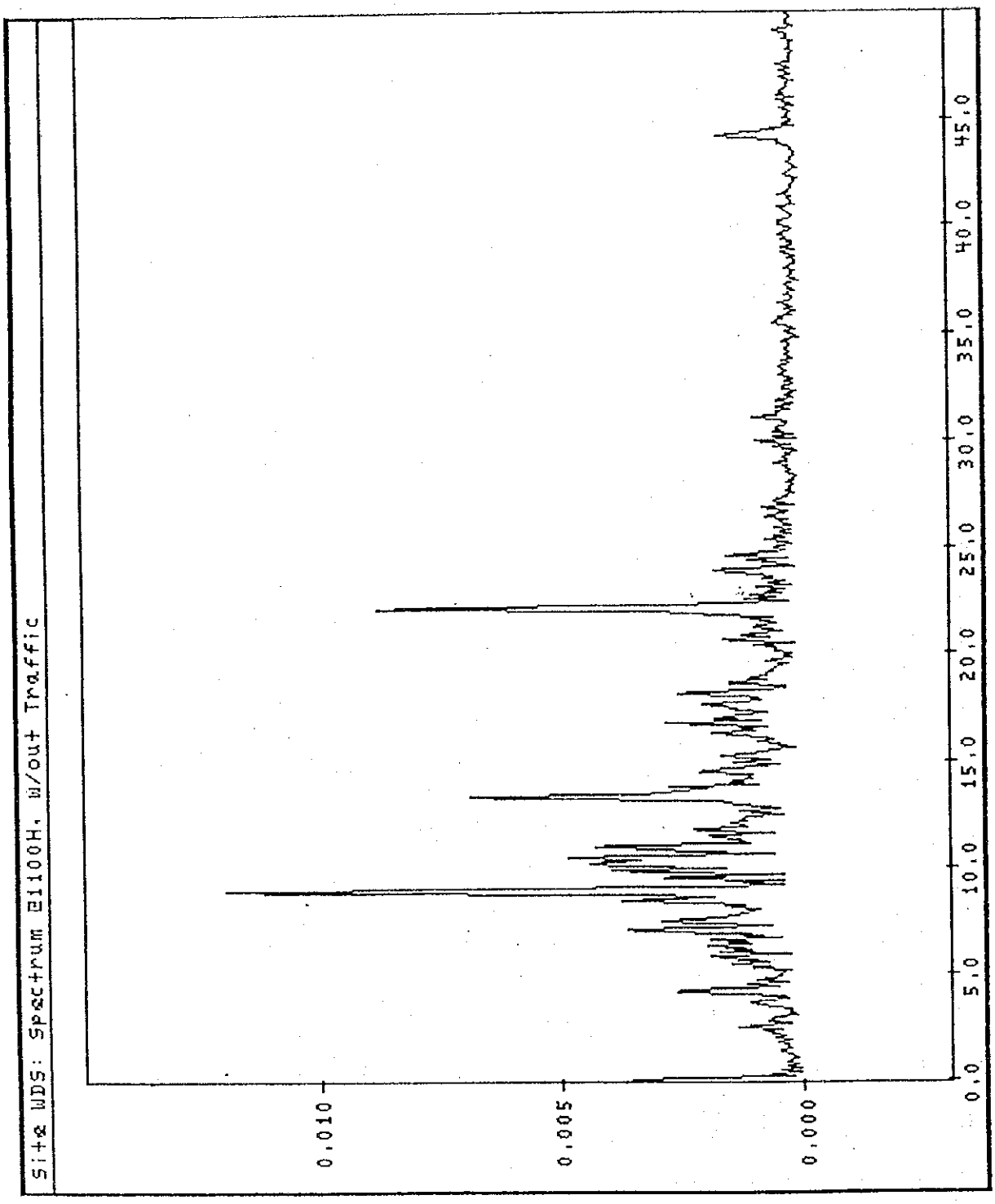

Site WDS: 180s Ground Vibration at 2300H, 29Oct
1.5
1.0
0.5
0.0
-0.5
-1.0
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0

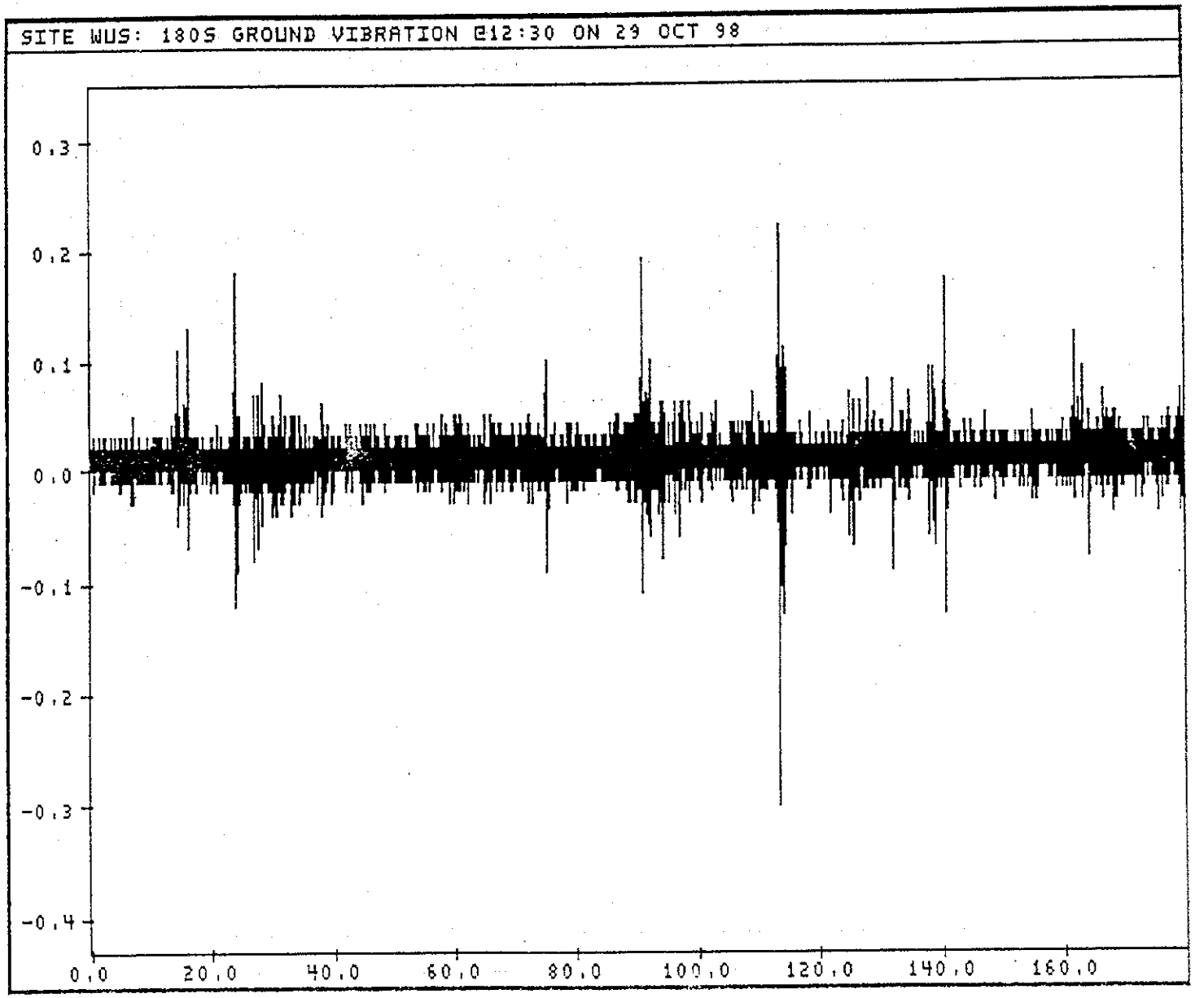

Site WDS: Spectrum at 2300H, with Traffic
0.030
0.020
0.010
0.000
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

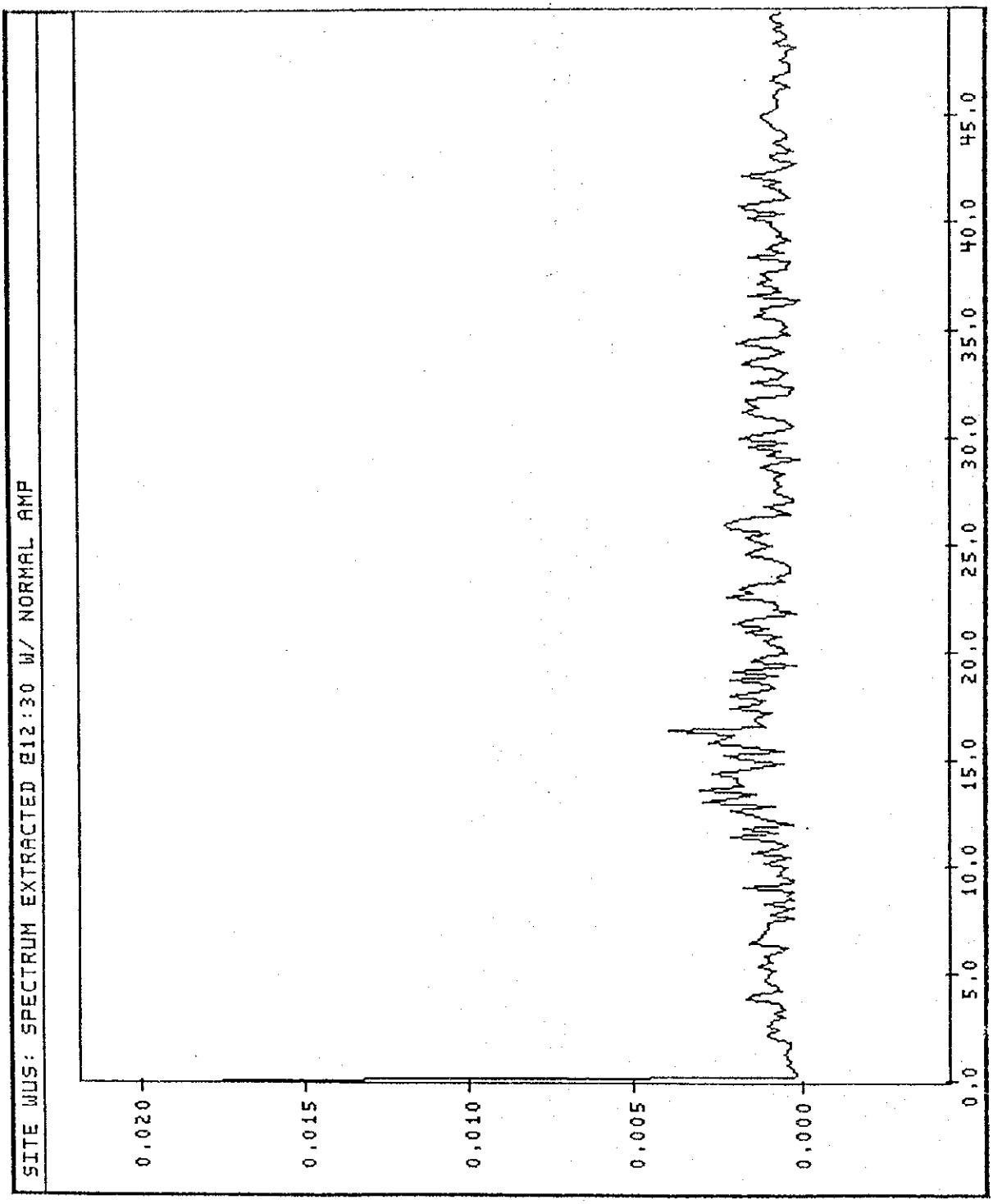

Site WDS: Spectrum at 2300H, w/out Traffic
0.015
0.010
0.005
0.000
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

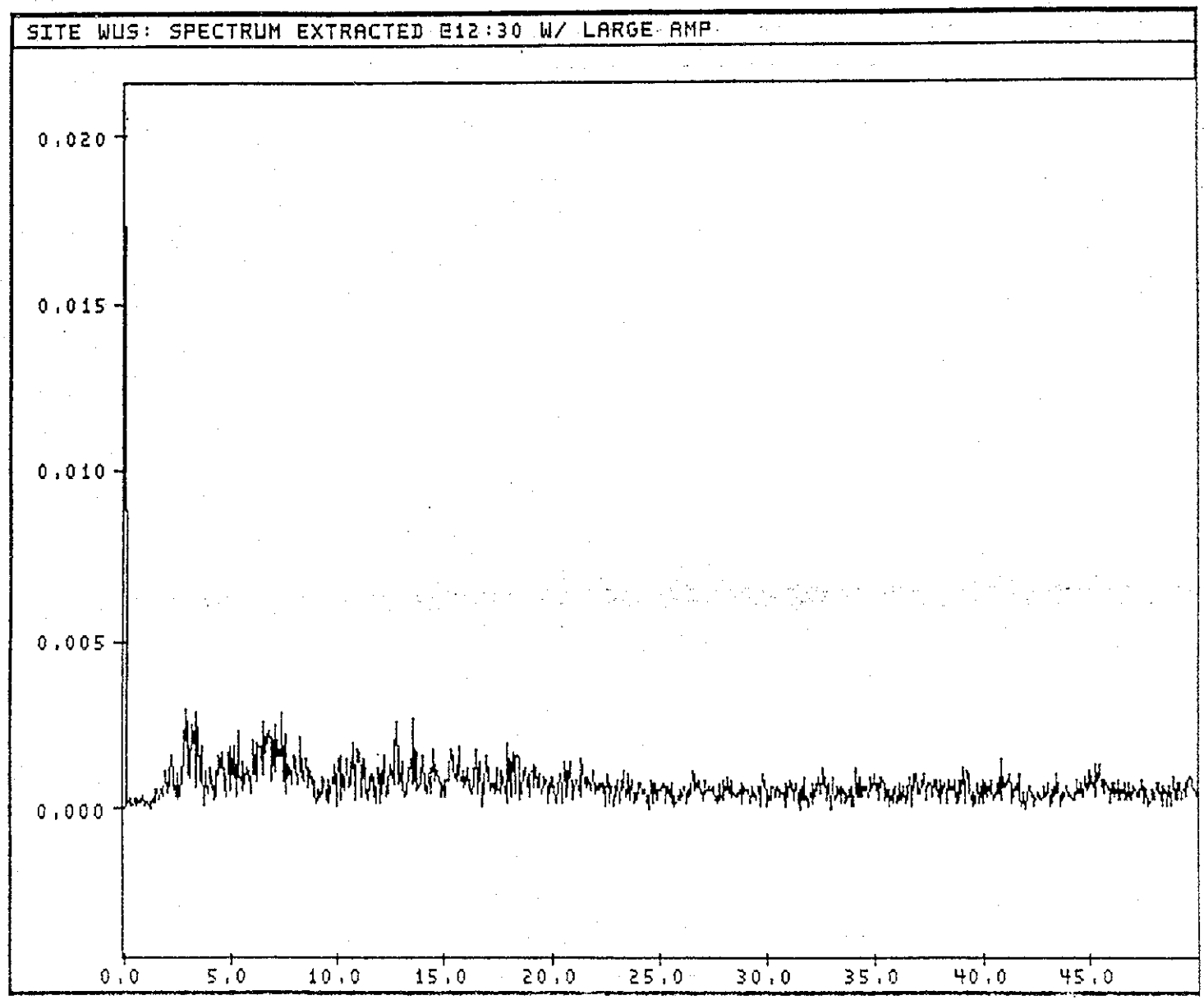

Site WDS: 180s Ground Vibration B1100H, 30 Oct
1.0
0.5
0.0
-0.5
-1.0
-1.5
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0

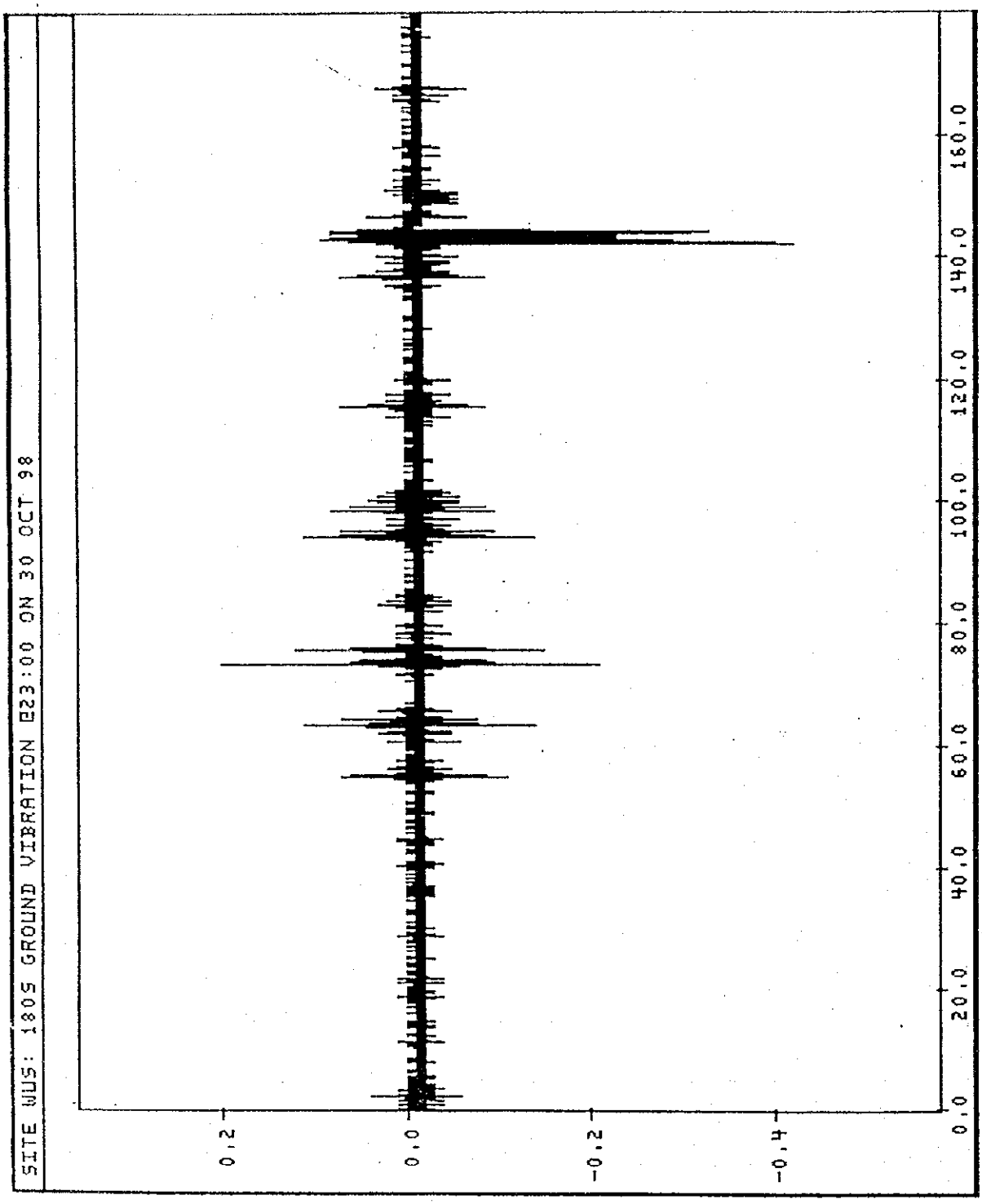

Site WDS: Spectrum E1100H, w/ large amplitude
0.050
0.040
0.030
0.020
0.010
0.000
-0.010
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

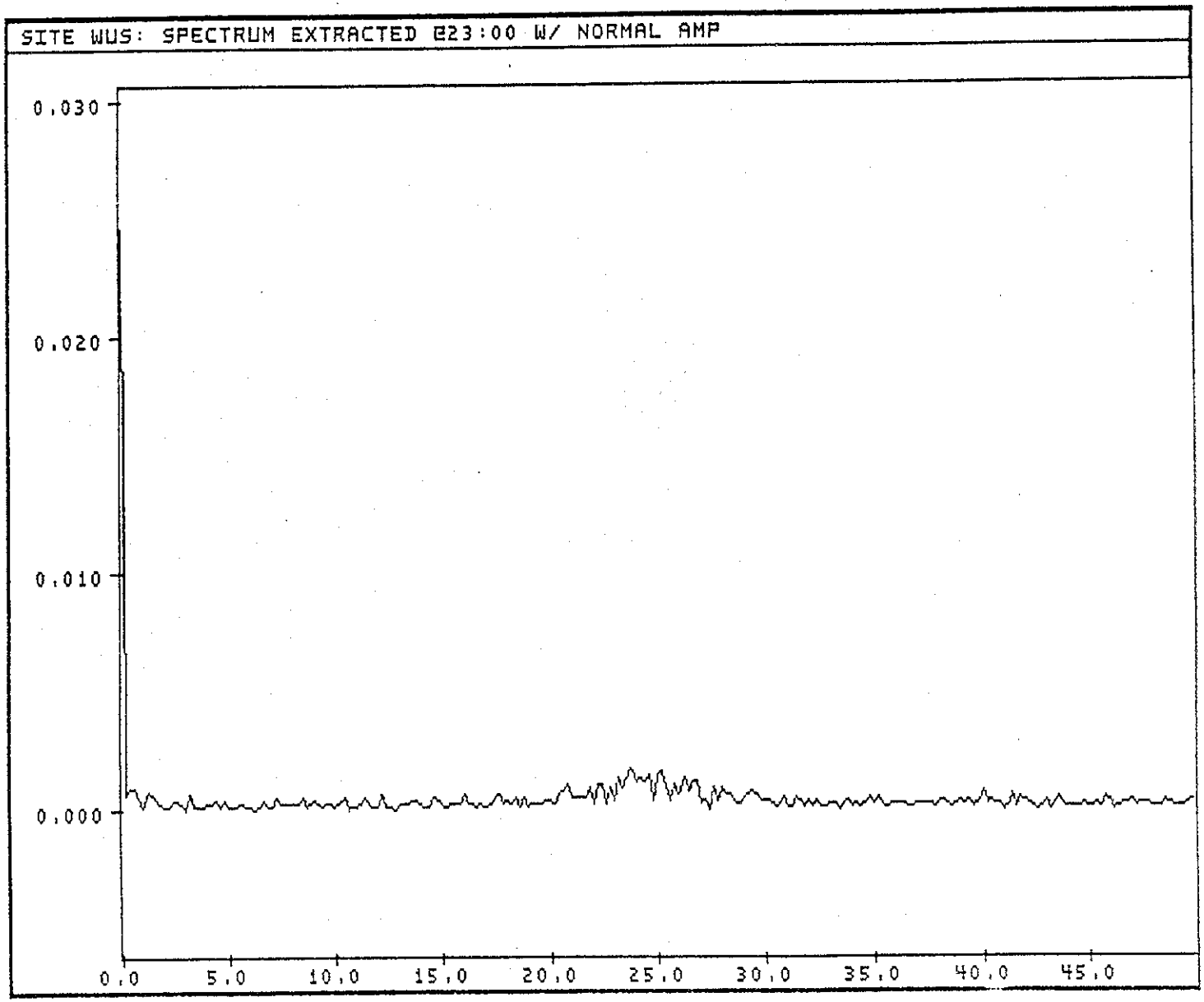

Si+α WDS: Spectrum E1100H, w/out Traffic
0.010
0.005
0.000
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

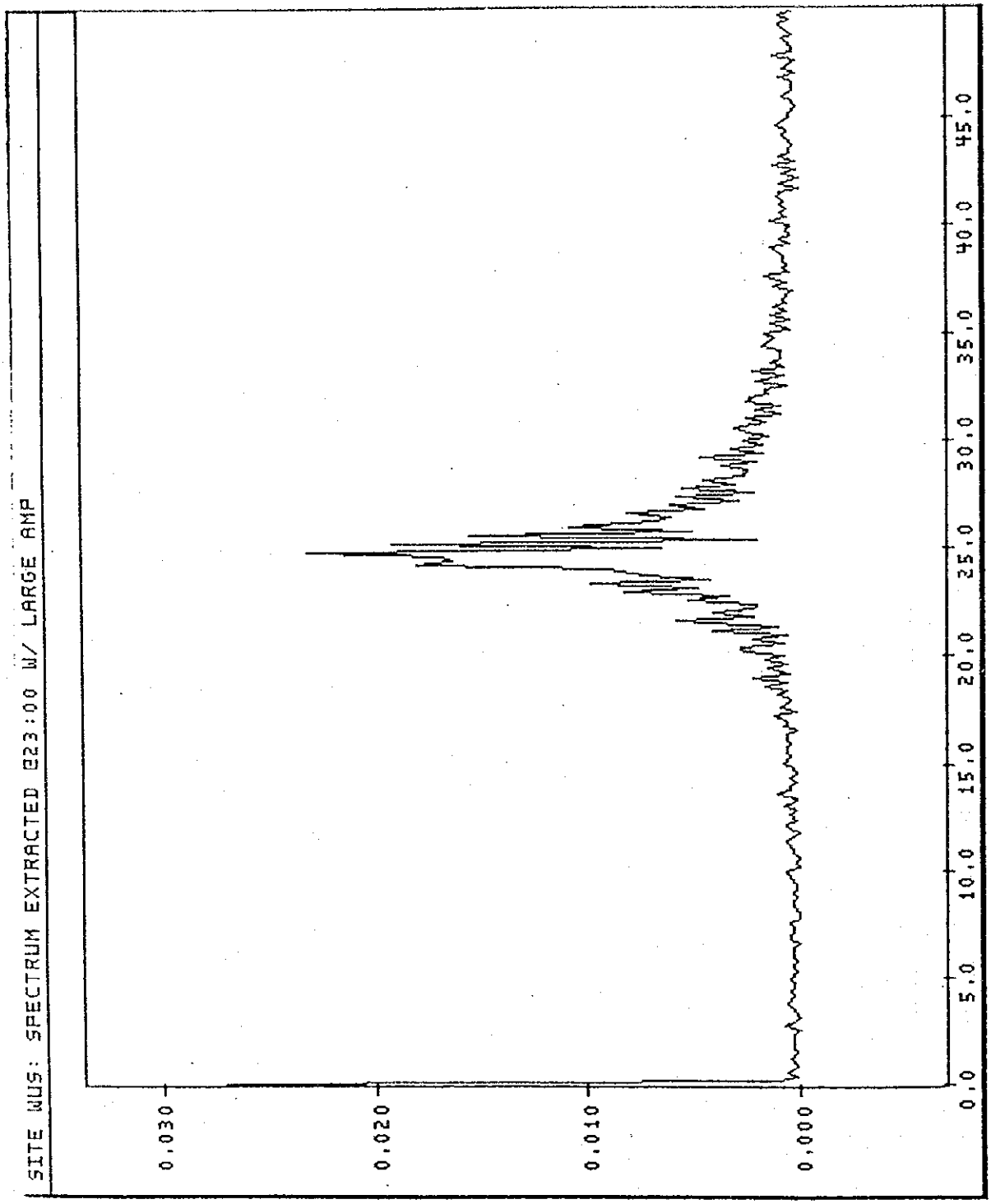

SITE WUS: 180S GROUND VIBRATION @12:30 ON 29 OCT 98
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0

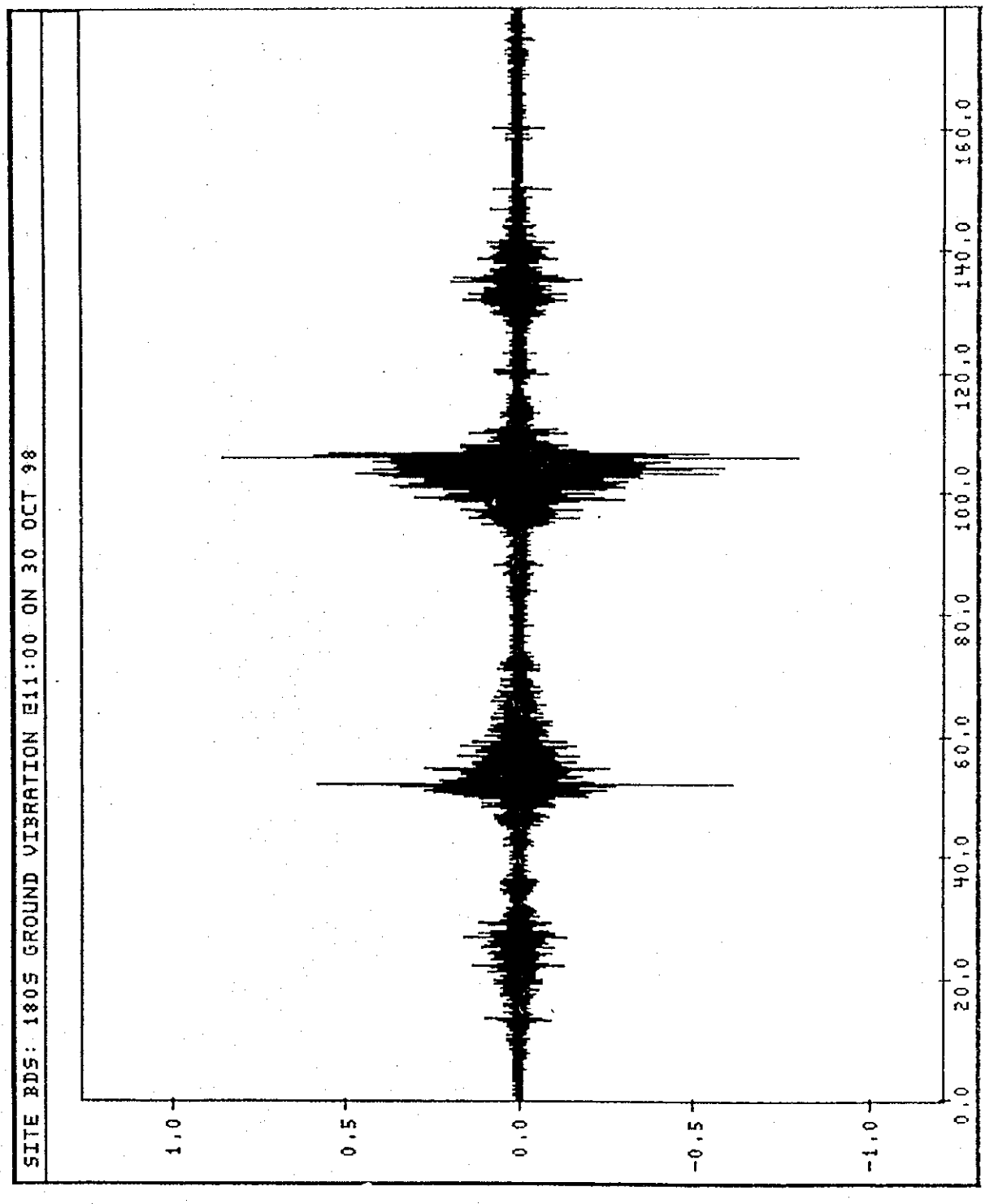

SITE WUS: SPECTRUM EXTRACTED @12:30 W/ NORMAL AMP
0.020
0.015
0.010
0.005
0.000
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

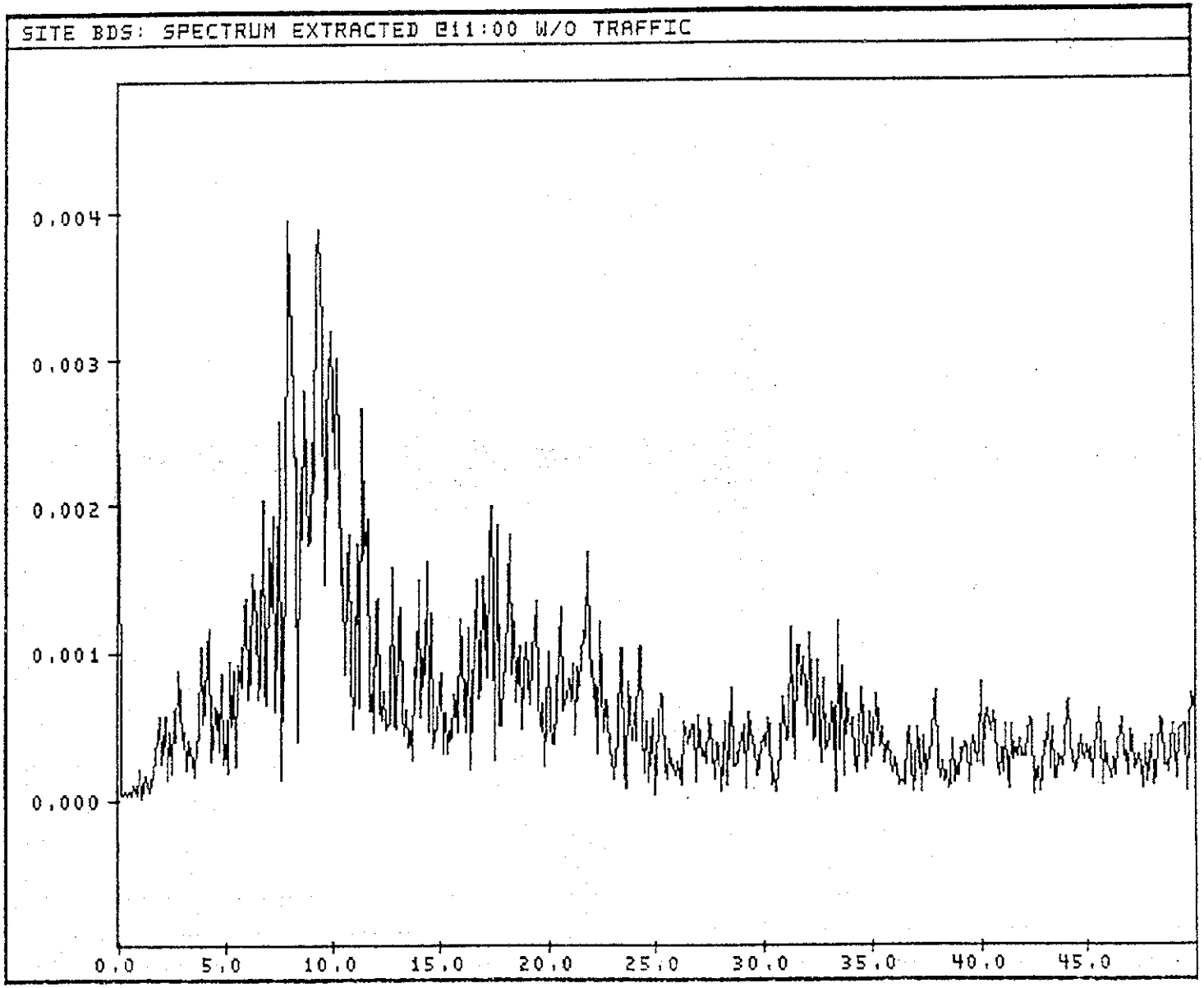

SITE WUS: SPECTRUM EXTRACTED @12:30 W/ LARGE AMP
0.020
0.015
0.010
0.005
0.000
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

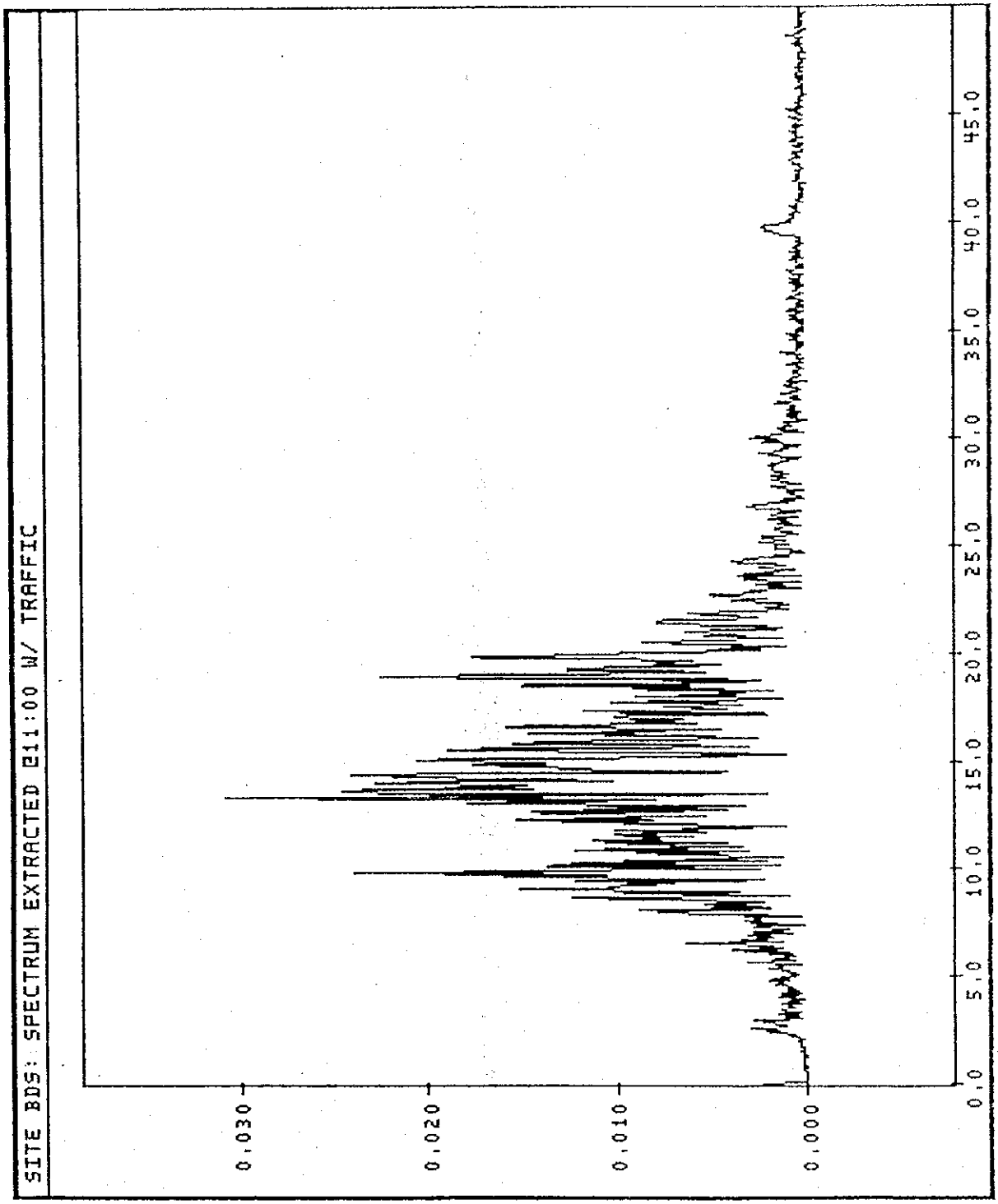

SITE WUS: 1805 GROUND VIBRATION @23:00 ON 30 OCT 98
0.2
0.0
-0.2
-0.4
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0

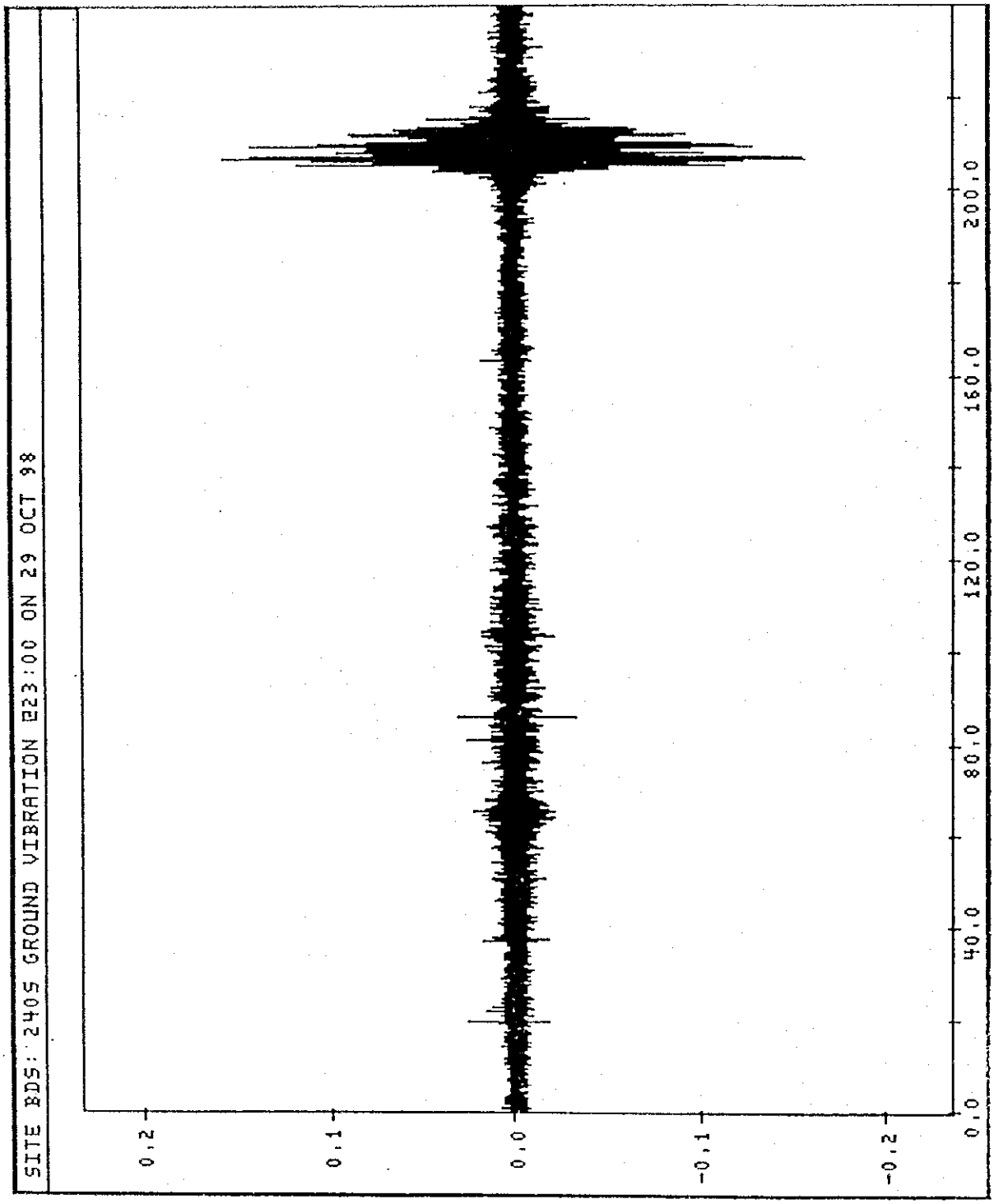

SITE WUS: SPECTRUM EXTRACTED @23:00 W/ NORMAL AMP
0.030
0.020
0.010
0.000
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

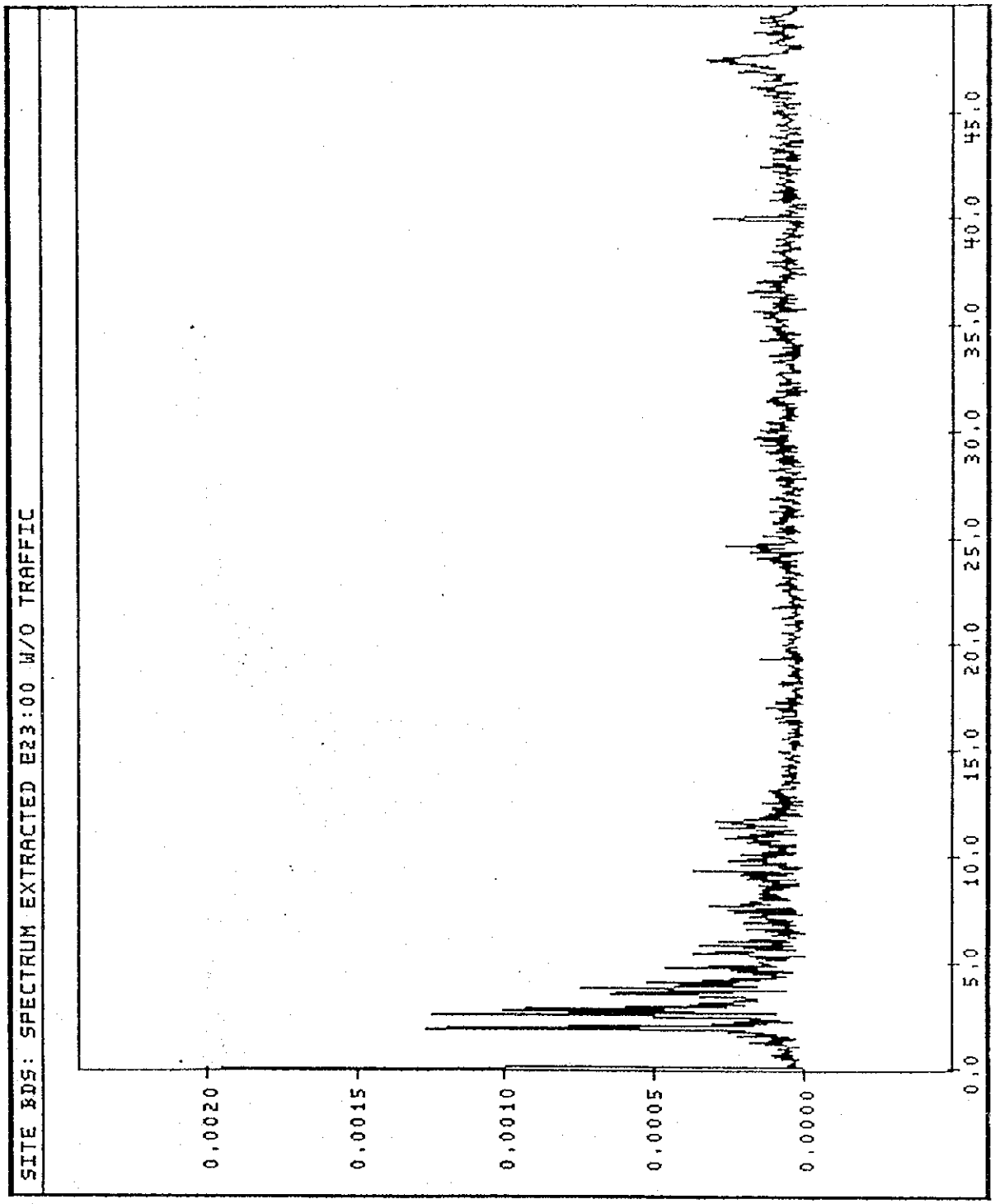

SITE WUS: SPECTRUM EXTRACTED 023:00 W/ LARGE AMP
0.030
0.020
0.010
0.000
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

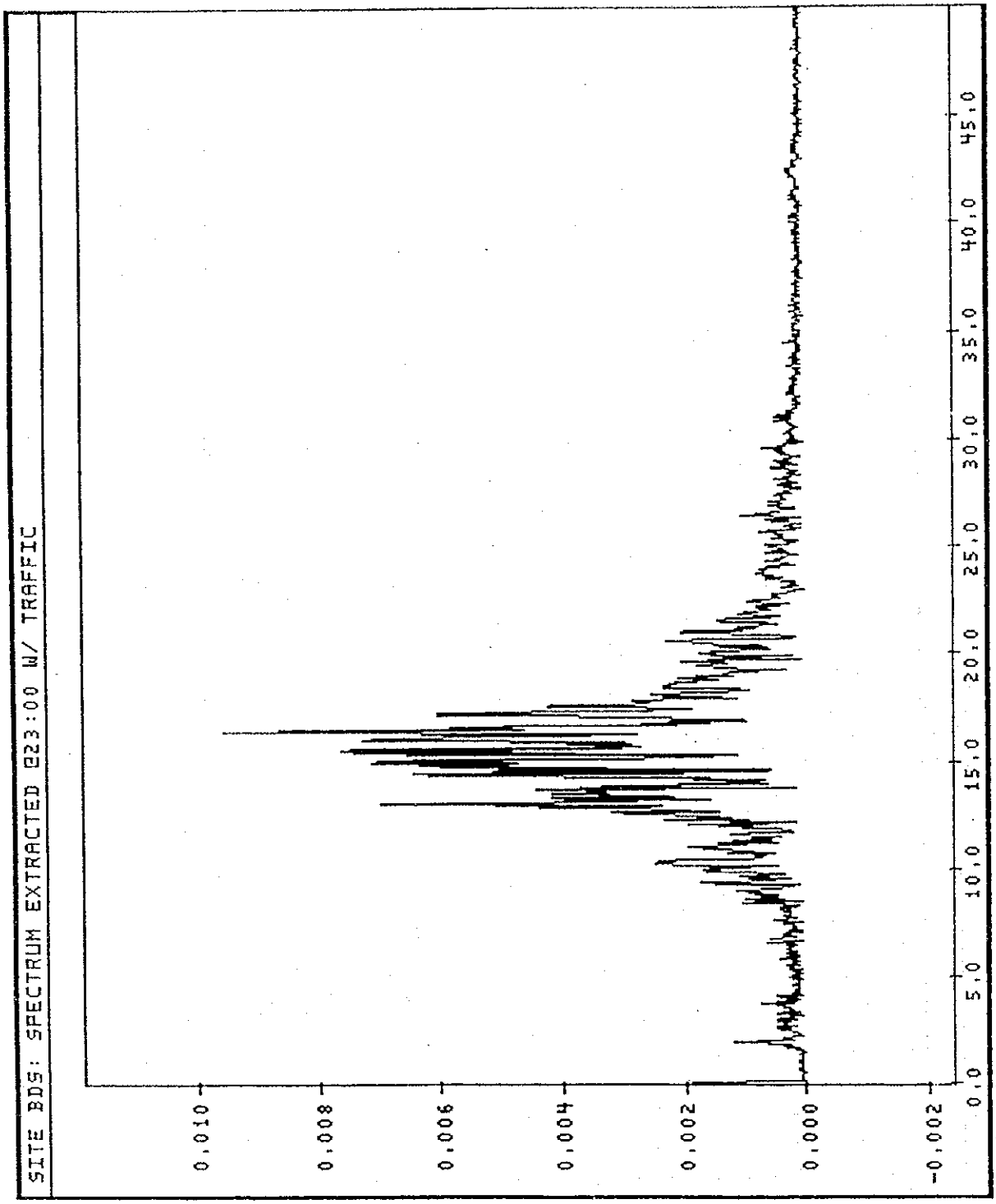

SITE BDS: 180S GROUND VIBRATION @11:00 ON 30 OCT 98
1.0
0.5
0.0
-0.5
-1.0
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0

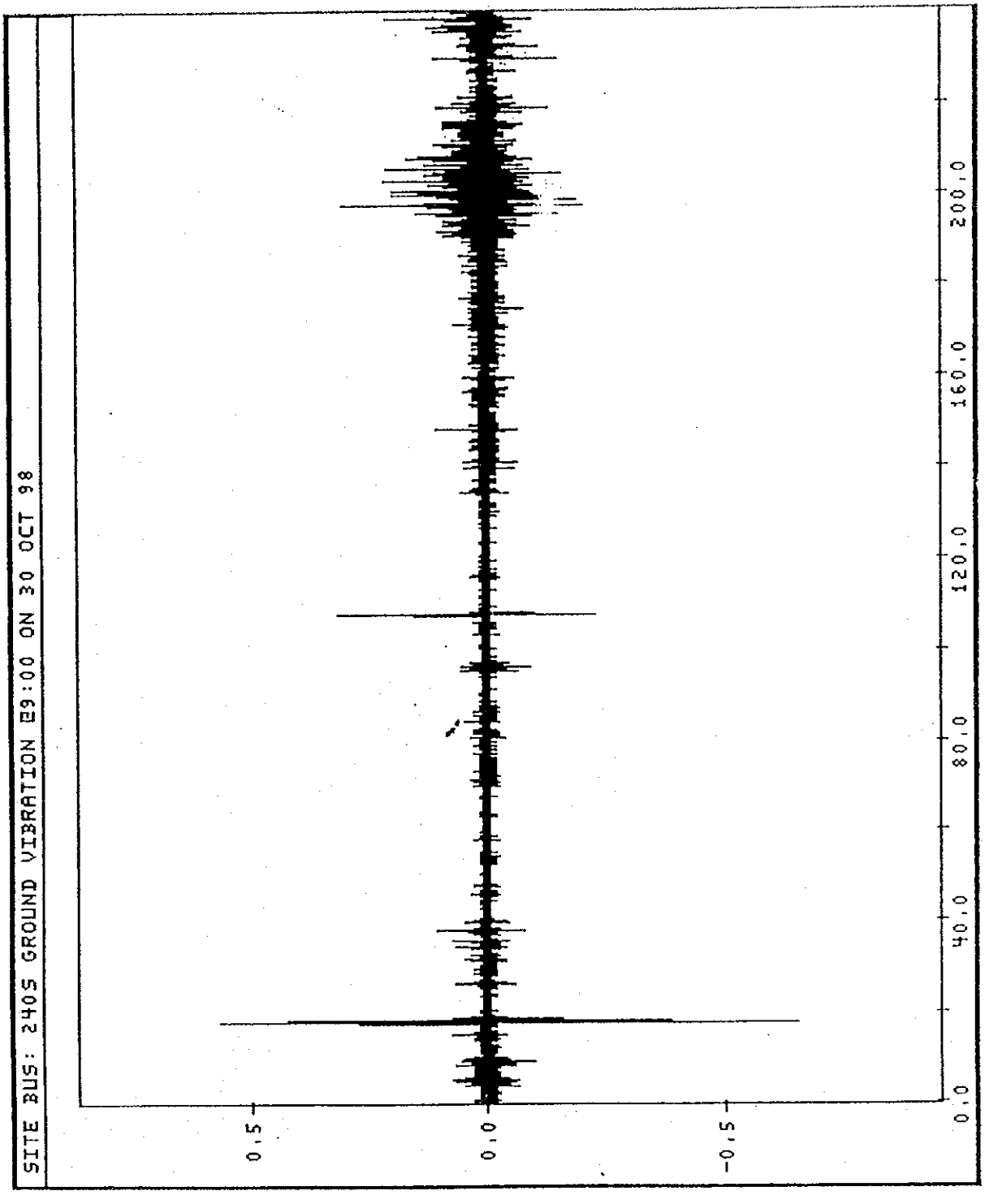

SITE BDS: SPECTRUM EXTRACTED @11:00 W/O TRAFFIC
0.004
0.003
0.002
0.001
0.000
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

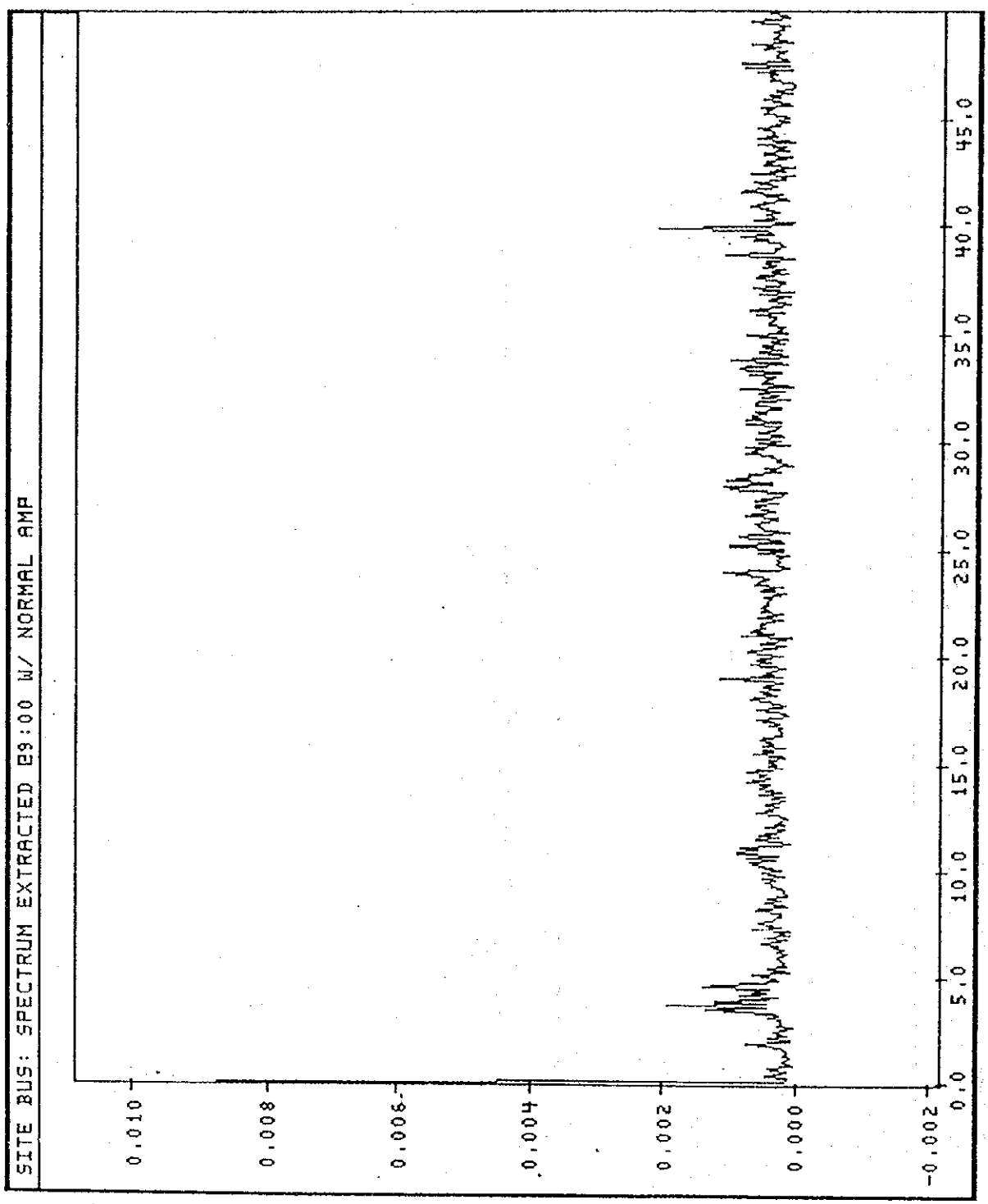

SITE BDS: SPECTRUM EXTRACTED @11:00 W/ TRAFFIC
0.030
0.020
0.010
0.000
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0

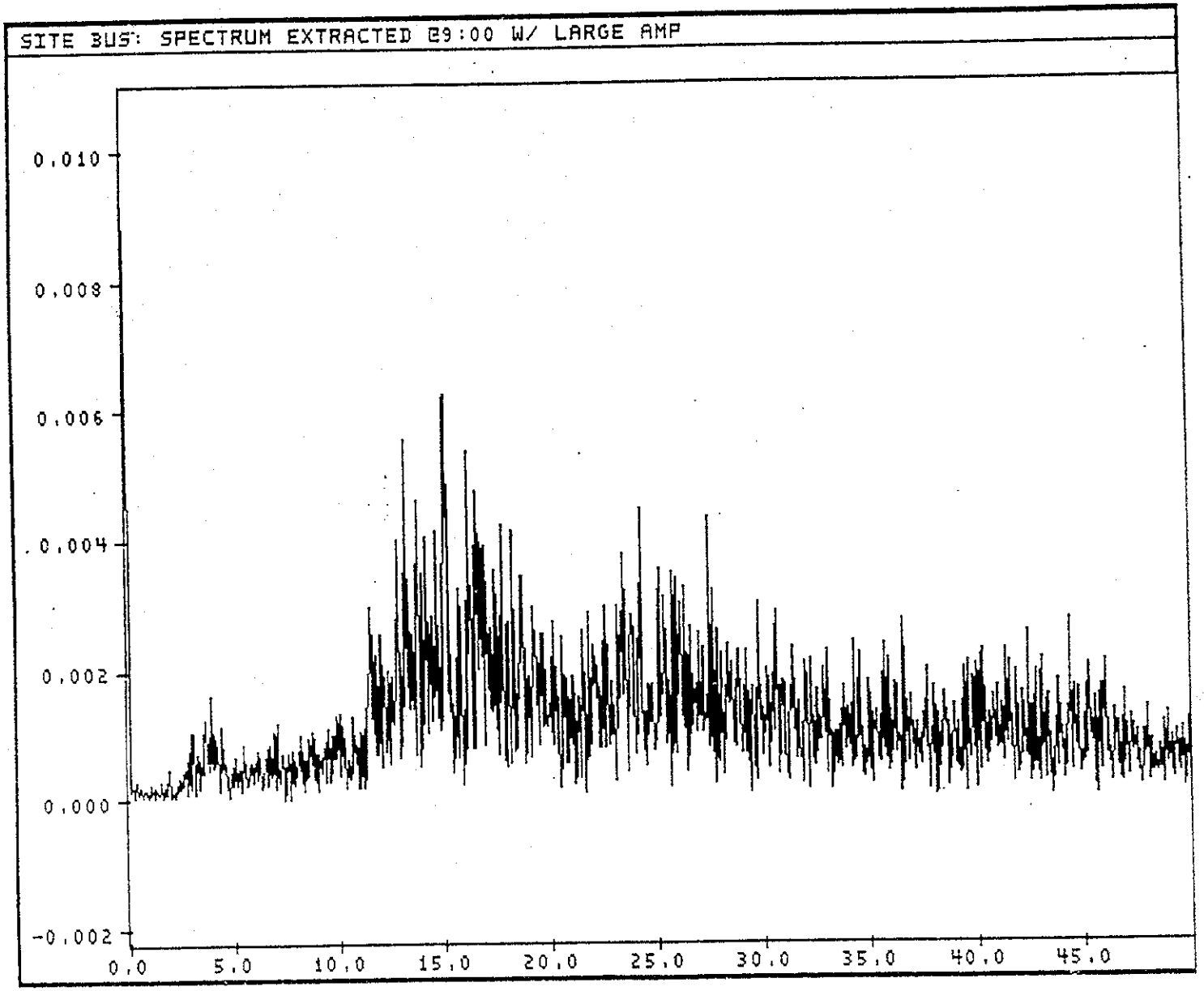

SITE BDS: 2405 GROUND VIBRATION 23:00 ON 29 OCT 98
0.2
0.1
0.0
-0.1
-0.2
0.0
40.0
80.0
120.0
160.0
200.0


SITE BDS: SPECTRUM EXTRACTED E23:00 W/O TRAFFIC
0.0020
0.0015
0.0010
0.0005
0.0000
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0


SITE BDS: SPECTRUM EXTRACTED 023:00 W/ TRAFFIC
0.010
0.008
0.006
0.004
0.002
0.000
-0.002
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0


SITE BUS: 240S GROUND VIBRATION E9:00 ON 30 OCT 98
0.5
0.0
-0.5
0.0
40.0
80.0
120.0
160.0
200.0


SITE BUS: SPECTRUM EXTRACTED 09:00 W/ NORMAL AMP
0.010
0.008
0.006
0.004
0.002
0.000
-0.002
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0


SITE BUS: SPECTRUM EXTRACTED @9:00 W/ LARGE AMP
0.010
0.008
0.006
0.004
0.002
0.000
-0.002
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0