N00236.001375
ALAMEDA POINT
SSIC NO. 5090.3

Cal/EPA

Department of
Toxic Substances
Control

700 Heinz Avenue
Suite 200
Berkeley, CA
94710-2737

February 10, 1997

Pete Wilson
Governor

James M. Strock
Secretary for
Environmental
Protection

Commander
Engineering Field Activity, West
Naval Facilities Engineering Command
Attn: Camille Garibaldi
900 Commodore Drive
San Bruno, California 94066-2402

Dear Ms. Garibaldi:

BACKGROUND CONCENTRATIONS FROM SITES IN THE SAN FRANCISCO BAY AREA FOR COMPARISONS AT NAVAL AIR STATION, ALAMEDA

The California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) has compiled background data from various sites within the greater San Francisco Bay Area for comparison to ambient inorganic data at NAS Alameda. The sites include: Roberts Landing in San Leandro; Pacific States Steel in Union City; Northern Santa Clara County; the Presidio in San Francisco; Hercules Properties in Hercules, Interstate 880 corridor in Oakland, and the East Bay Hills. This data should assist the DTSC, Regional Water Quality Control Board, United States Environmental Protection Agency, and the Navy in determining if ambient inorganic concentrations at NAS Alameda are elevated above the San Francisco Bay Area background.

We have enclosed supporting documentation and data from each of these sites. The background numbers for Hercules Properties, Roberts Landing and Pacific States Steel were established by collecting background samples at or near the sites. The East Bay Hill numbers were developed for Lawrence Berkeley National Laboratory (LBNL). Five geologic formations were sampled to establish the background metal concentrations at LBNL. Northern Santa Clara County background numbers were compiled by Christina Scott using data from several investigations in that area. Remedial investigation data is presented for the Interstate 880 corridor. All inorganic data, except for arsenic and lead, were below EPA Regional IX residential Preliminary Remediation Goals. The arsenic background concentration (19 parts per million) was supported by Caltrans in a study of I-880 site data and data from other sites in the bay area. Data from three geologic source materials was collected at the Presidio of San Francisco. High

Printed on Recycled Paper

concentrations of chromium and nickel are associated with the serpentinite and are not typical of soils in the bay area.

The data from these seven sources are presented on the enclosed tables entitled, "Background Comparisons for Sites in the San Francisco Bay Area." All average concentrations presented in the tables represent the arithmetic mean.

We hope this data is useful in establishing inorganic background for NAS Alameda. If you have any questions regarding this letter, please call me at (510) 540-3809.

Sincerely,

Thomas P. Lanphar
Project Manager
Base Closure Branch

Enclosure

cc. Ms. Lynn Suer
Regional Water Quality Control Board
2101 Webster Street, Suite 500
Oakland, California 94612

Mr. Steve Edde
Base Environmental Coordinator
Alameda Naval Air Station
Building 1, Code 52
Alameda, California 94501

Mr. James Ricks
U.S. Environmental Protection Agency
Region IX
75 Hawthorne Street
San Francisco, California 94105

Enclosures for letter
to Camille Garibaldi, February 10, 1997

1. Background Comparisons for Sites in the San Francisco Bay Area.

2. Second Revised Draft Final Remedial Investigation Report, Presidio Main Installation, Presidio of San Francisco, Appendix A, Summary Statistics and Box-and-Whisker Plots for Background Soil Samples.

3. Letter: Inorganic Arsenic Background Concentration at the Cypress Freeway, Oakland.

4. Background Metal Concentrations in Soils in Northern Santa Clara County, California, Christina M. Scott, 1995

5. Hercules Properties, Off-Site Background of Metal Concentrations, Table 4-4, March 12, 1991 Remedial Investigation Report.

6. Protocol for Determining Background concentrations of Metals in Soil at Lawrence Berkeley National Laboratory (LBNL), August 1995.

7. Site Wide Remedial Investigation Pacific States Steel Corporation Union City, California; Background Soil Samples

8. Background data, Roberts Landing Development Site, San Leandro, California

Background Comparisons for Sites in the San Francisco Bay Area

	Presidio SF Beach-Dunne			Presidio SF, Colma Formation			Presidio SF, Serpentinite		
Constituent	Minimum	Maximum	Average	Mimimum	Maximum	Average	Minimum	Maximum	Average
Antimony (Sb)	9.8	20.7	nd 12.	20.7	20.7	nd 2	9.8	20.7	nd 1
Arsenic (AS)	1.25	5.43	2.46	1.25	5	1.97	0.125	2.49	0.997
Barium (Ba)	8.12	22.8	14	26.9	121	63.9	1.65	92.3	32.9
Beryllium (Be)	0.134	0.7	0.261	0.248	0.681	0.33	0.05	5	nd 1.
Cadmium (Cd	0.258	0.6	nd 0.43	0.258	0.4	nd 0.3	0.258	400	nd 14.
Chromium (Cr	17.9	81.1	46.3	51.8	943	184	674	1290	914
Hex. Chr. (Cr	na	na	na	na	na	na	na	na	na
Cobalt (Co)	3.99	8.47	6.51	10.9	17	13	59.8	140	101
Copper (Cu)	4.6	57.3	20.5	10.4	80.8	27.3	5.08	64.6	32.5
Lead (Pb)	1.59	11.8	3.64	3.04	5.82	4.39	1.82	4.48	3.51
Mercury (Hg)	0.014	0.03	nd 0.0	0.014	0.09	nd 0.0	0.014	0.03	0.026
Nickle (Ni)	15	30.1	22.3	34.6	97.5	65.6	1120	3960	2570
Selenium (Se)	0.125	0.225	nd 0.2	0.208	0.832	0.341	0.125	0.225	nd 0.19
Silver (Si)	0.25	0.402	nd 0.2	0.25	0.261	nd 0.25	0.25	1067	0.581
Thallium (Tl)	0.081	17.2	nd 4.	0.081	7.35	nd 1.1	0.081	17.2	4.14
Vanadium (Vn	15.7	85.4	38.7	37.2	64.9	51.2	11.8	40.2	29.9
Zinc (Zn)	16.2	40.3	25.5	29.1	64.8	42.9	6.64	95.2	38.9

Background Comparisons for Sites in the San Francisco Bay Area

	San Leandro, Roberts Landing			Union City, Pacific States Steel			Northern Santa Clara County		
Constituent	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average
Antimony (Sb)	nd	nd	nd	nd (5.0)	nd (5.0)	2.5	nd	22	nc
Arsenic (AS)	1.8	5.9	3.58	6.92	20.2	10.6	nd	20	2.86
Barium (Ba)	15.4	499	124.97	173	313	234	na	na	na
Beryllium (Be)	0.28	0.52	0.38	nd (.5)	0.81	0.53	nd	3.2	0.88
Cadmium (Cd	0.25	0.25	0.25	nd (.5)	2.04	0.97	nd	14	nc
Chromium (Cr	24.8	43	33.36	41	112	72.6	nd	170	51.28
Hex. Chr. (Cr	na	na	na	na	na	na	na	na	na
Cobalt (Co)	5.1	15.8	8.82	8.74	12.6	10.3	na	na	na
Copper (Cu)	11.8	68	22.65	28.2	70.9	40.9	4.6	67	35.63
Lead (Pb)	3.3	10.4	7.35	10.7	166	71.9	nd	54	11.43
Mercury (Hg)	nd	nd	nd	nd (.1)	0.36	0.12	nd	1.3	nc
Nickle (Ni)	2.93	43.6	22.47	32.4	79.3	50.2	6	145	73.53
Selenium (Se)	0.25	0.25	0.25	nd (.5)	nd (.5)	0.25	nd	4	nc
Silver (Ag)	nd	nd	nd	nd (.5)	nd (.5)	0.25	na	na	na
Thallium (Tl)	0.5	0.5	0.5	nd (5.0)	nd (5.0)	0.25	nd	3.8	nc
Vanadium (Vn	18.2	39.5	27.75	40	51.1	46.5	na	na	na
Zinc (Zn)	9.28	61.3	39.89	89.3	592	298.5	7.8	120	65.27

na - not analyzed; nd - not detected with detection limit in brackets if available; nc - not calculated
Average is arithmetic mean. Calculated using 1/2 detection limit unless otherwise noted.

Background Comparisons for Sites in the San Francisco Bay Area

	Hercules, Hercules Properties			Oakland, I-880 Corridor			East Bay Hills, LBNL		
Constituent	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	95% UCL
Antimony (Sb)	na	na	na	nd (1.6)	5.7	1.8	5.2	7.1	5.5
Arsenic (AS)	3.9	16	8.3	nd (.3)	19.0 (24.6)	3.5	9.3	31	19.1
Barium (Ba)	na	na	na	42.9	368	83.9	154.1	411	323.6
Beryllium (Be)	na	na	na	nd (.2)	0.2	0.1	0.8	1.1	1
Cadmium (Cd	nd	4.3	1	nd (.5)	5.2	0.6	1.5	3.3	2.7
Chromium (Cr	0.2	18	10	nd(.6)	161	28.4	59	142.2	99.6
Hex. Chr. (Cr	na	na	na	nd (.05)	nd	nd	na	na	na
Cobalt (Co)	na	na	na	2.1	10.2	5.7	20.6	25.2	22.2
Copper (Cu)	5.2	61	22	5.3	291	56.1	40.9	99.7	69.4
Lead (Pb)	nd	220	32.4	1.2	(12000)	134.3	8.9	21.5	16.1
Mercury (Hg)	0.04	0.52	0.14		0.18	0.3	0.3	0.6	0.4
Nickle (Ni)	6.4	26	16	nd(1.6)	122	27.2	69.7	144.3	119.8
Selenium (Se)	na	na	na	nd(.16)	nd	0.1	4.8	7	5.6
Silver (Si)	na	na	na	nd(.2)	0.8	0.3	1.5	2.2	1.8
Thallium (Tl)	na	na	na	nd(.18)	0.23	0.1	8.7	42.5	27.1
Vanadium (Vn	na	na	na	16.5	350	31.5	36.2	90.1	74.3
Zinc (Zn)	14	300	65	7.9	1490	92.8	84.7	135.9	106.1
	Average is arithmetic mean. Calculated using 1/2 detection limit for non detects			Data collected for investigation, not for establishing background. Maximum Lead concentration is not background. Arsenic background determined to be 19ppm.			East bay hills include 5 geologic source areas. Minimum and maximum represent min and max 95% UCL for all sorce areas.		

Second Revised Draft Final
Remedial Investigation Report
Presidio Main Installation
Presidio of San Francisco

VOLUME IV
APPENDICES A-F

Contract No. DAAA15-90-D-0018
Task Order 0002, Data Item A009
November 1995

Prepared by:
DAMES & MOORE

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland 21010-5401

TABLE OF CONTENTS
VOLUME IV

PAGE

Introduction 1

Appendix A Background/PSF Water Supply A-1

Soil Borings A-2
Source Water Sampling Sheets A-25
LAMC and LAIR Data A-32
Summary Statistics and Box-and-Whisker Plots for Background Soil Samples A-43
Distributional Testing Output and Cumulative Probability Plots A-71
Beach / Dune Deposits A-73
Colma Formation A-147
Serpentinite A-221
Fill A-295

Appendix B Nike Facility B-1

Soil Borings B-2
Well Information B-43
Surface Water Sampling B-73

Appendix C Crissy Field Study Area C-1

C.1 Building 633 Soil Borings C-2
C.2 Building 637 . . . . . C-13
Soil Borings C-14
JMM Soil Borings C-20
Well Information C-27
JMM Well Information C-51
C.3 Building 638 Soil Borings C-95
C.4 Building 640 Soil Borings C-97
C.5 Building 642 Soil Borings C-102
C.6 Building 643 Soil Borings C-107
C.7 Landfill 7 . . . . . C-116
Sediment Samples C-117
Test Pits C-123
Soil Borings C-129
Discrete Groundwater Sample Sheets C-196
Well Information C-214
C.8 Crissy Field Lift Station C-303
Soil Borings C-304
Discrete Groundwater Sample Sheets C-309

Appendix D Building 900s Series Study Area D-1

D.1 Building 920 Soil Borings D-3
D.2 Building 924 and 931 Soil Borings D-5

Appendix A
Summary Statistics and Box-and-Whisker Plots for Background Soil Samples

Table A-4-1 Summary Statistics for Beach-Dune Background Metals

Analyte	Number of Samples	Frequency of Detection[a] (%)	Min	Max	Mean	Standard Deviation	Shapiro-Wilks (sig.)	LN Mean	LN Std. Dev	Shapiro-Wilks (sig.)	Distribution	95th Percentile[c]	Units
Aluminum	14	100	3030	7660	5160	1350	0.5933	8.516	0.269	0.6411	normal	7380	mg/kg
Antimony	4	0	9.8	20.7	12.5	5.43	b	2.469	0.373	b	—	—	mg/kg
Arsenic	14	71.4	1.25	5.43	2.46	1.29	0.0468	0.781	0.497	0.2469	log	4.95	mg/kg
Barium	14	100	8.12	22.8	14	4.21	0.0941	2.601	0.283	0.5856	log	21.5	mg/kg
Beryllium	14	85.7	0.134	0.7	0.261	0.177	<0.01	-1.481	0.481	<0.01	np	0.552	mg/kg
Cadmium	14	0	0.258	0.6	0.433	0.098	<0.01	-0.861	0.223	<0.01	—	—	mg/kg
Calcium	14	100	1750	7020	4100	1630	0.5913	8.240	0.426	0.6040	normal	6780	mg/kg
Chromium	14	100	17.9	81.1	46.3	20	0.7200	3.736	0.477	0.6049	normal	79.2	mg/kg
Cobalt	14	100	3.99	8.47	6.51	1.36	0.4255	1.851	0.223	0.2743	normal	8.75	mg/kg
Copper	14	100	4.6	57.3	20.5	15.9	0.0458	2.736	0.812	0.5589	log	58.7	mg/kg
Cyanide	14	0	0.125	0.46	0.149	0.09	<0.01	-1.986	0.348	<0.01	—	—	mg/kg
Iron	14	100	6030	27000	13700	6140	0.3850	9.432	0.446	0.9212	normal	23800	mg/kg
Lead	14	85.7	1.59	11.8	3.64	2.52	<0.01	1.155	0.495	0.1227	log	7.17	mg/kg
Magnesium	14	100	1520	4040	2590	804	0.3093	7.816	0.303	0.7240	normal	3910	mg/kg
Manganese	14	100	915	248	164	46.1	0.8012	5.061	0.297	0.5751	normal	240	mg/kg
Mercury	14	0	0.014	0.03	0.027	0.004	<0.01	-3.615	0.211	<0.01	—	—	mg/kg
Nickel	14	100	15	30.1	22.3	4.15	0.6494	3.089	0.197	0.3086	normal	29.1	mg/kg
Potassium	14	100	137	684	391	128	0.4423	5.912	0.369	0.0800	normal	602	mg/kg
Selenium	14	0	0.125	0.225	0.206	0.024	<0.01	-1.590	0.144	<0.01	—	—	mg/kg
Silver	10	0	0.25	0.402	0.297	0.073	<0.01	-1.240	0.226	<0.01	—	—	mg/kg
Sodium	14	100	48.3	190	116	41.9	0.5742	4.691	0.392	0.4477	normal	185	mg/kg
Thallium	14	0	0.081	17.2	4.26	7.25	<0.01	-1.044	2.420	<0.01	—	—	mg/kg
Vanadium	14	100	15.7	85.4	38.7	21.1	0.1977	3.519	0.545	0.4936	normal	73.4	mg/kg
Zinc	14	100	16.2	40.3	25.5	7.08	0.5088	3.203	0.273	0.8384	normal	37.1	mg/kg

Summary statistics calculated with 1/2 IDL for non-detects.

a. Frequency of detection is calculated from all accepted valid data except equipment rinsates.

b. Not enough samples available to perform test.

c. The normal distribution equation was used for nonparametric distributions.

"—" Not applicable because greater than 20% of data were non-detects.

Table A-4-2 Summary Statistics for Colma Background Metals

Analyte	Number of Samples	Frequency of Detection[a] (%)	Min	Max	Mean	Standard Deviation	Shapiro-Wilks (sig.)	LN Mean	LN Std. Dev	Shapiro-Wilks (sig.)	Distribution	95th Percentile[c]	Units
Aluminum	8	100	8910	25900	13500	5640	0.307	9.446	0.357	0.2641	log	22800	mg/kg
Antimony	2	0	20.7	20.7	20.7	0	b	3.028	0	b	—	—	mg/kg
Arsenic	8	25	1.25	5	1.97	1.41	<0.01	0.517	0.555	<0.01	np	4.29	mg/kg
Barium	8	100	26.9	121	63.9	33.8	0.3782	4.036	0.529	0.7765	normal	120	mg/kg
Beryllium	8	75	0.248	0.681	0.33	0.152	<0.01	-1.175	0.362	<0.01	np	0.58	mg/kg
Cadmium	8	0	0.258	0.4	0.364	0.066	<0.01	-1.026	0.204	<0.01	—	—	mg/kg
Calcium	8	100	1790	3680	3030	617	0.1522	7.995	0.236	0.0401	normal	4040	mg/kg
Chromium	8	100	51.8	943	184	307	<0.01	4.626	0.921	<0.01	np	689	mg/kg
Cobalt	8	100	10.9	17	13	1.91	0.2352	2.553	0.139	0.4328	normal	16.1	mg/kg
Copper	8	100	10.4	80.8	27.3	23.7	<0.01	3.070	0.676	0.2824	log	65.5	mg/kg
Cyanide	8	0	0.125	0.46	0.209	0.155	<0.01	-1.754	0.155	<0.01	—	—	mg/kg
Iron	8	100	14700	31200	21300	6510	0.2147	9.927	0.297	0.3181	normal	32000	mg/kg
Lead	8	100	3.04	5.82	4.39	1.02	0.6873	1.456	0.235	0.7486	normal	6.07	mg/kg
Magnesium	8	100	3470	4230	3940	287	0.2046	8.276	0.075	0.1492	normal	4410	mg/kg
Manganese	8	100	227	390	270	54.4	0.0341	5.585	0.182	0.0907	log (np)	359	mg/kg
Mercury	8	0	0.014	0.09	0.035	0.023	<0.01	-3.476	0.512	<0.01	—	—	mg/kg
Nickel	8	100	34.6	97.5	65.6	22.6	0.8007	4.126	0.376	0.5417	np	103	mg/kg
Potassium	8	100	320	726	432	132	0.0315	6.033	0.267	0.1989	log	647	mg/kg
Selenium	8	25	0.208	0.832	0.341	0.222	<0.01	-1.217	0.53	<0.01	np	0.706	mg/kg
Silver	8	0	0.25	0.261	0.253	0.005	<0.01	-1.376	0.019	<0.01	—	—	mg/kg
Sodium	8	100	123	340	239	75.8	0.7235	5.424	0.353	0.4768	normal	364	mg/kg
Thallium	7	0	0.081	7.35	1.12	2.75	<0.01	-1.869	1.704	<0.01	—	—	mg/kg
Vanadium	8	100	37.2	64.9	51.2	11	0.2689	3.915	0.217	0.2940	normal	69.3	mg/kg
Zinc	8	100	29.1	64.8	42.9	13.9	0.2433	3.716	0.311	0.4013	normal	65.8	mg/kg

Summary statistics calculated with 1/2 IDL for non-detects.

a. Frequency of detection is calculated from all accepted valid data except equipment rinsates.
b. Not enough samples available to test.
c. The normal distribution equation was used for nonparametric distributions.
"—" Not applicable because greater than 20% of data were non-detects.

Table A-4-3 Summary Statistics for Serp Background Metals

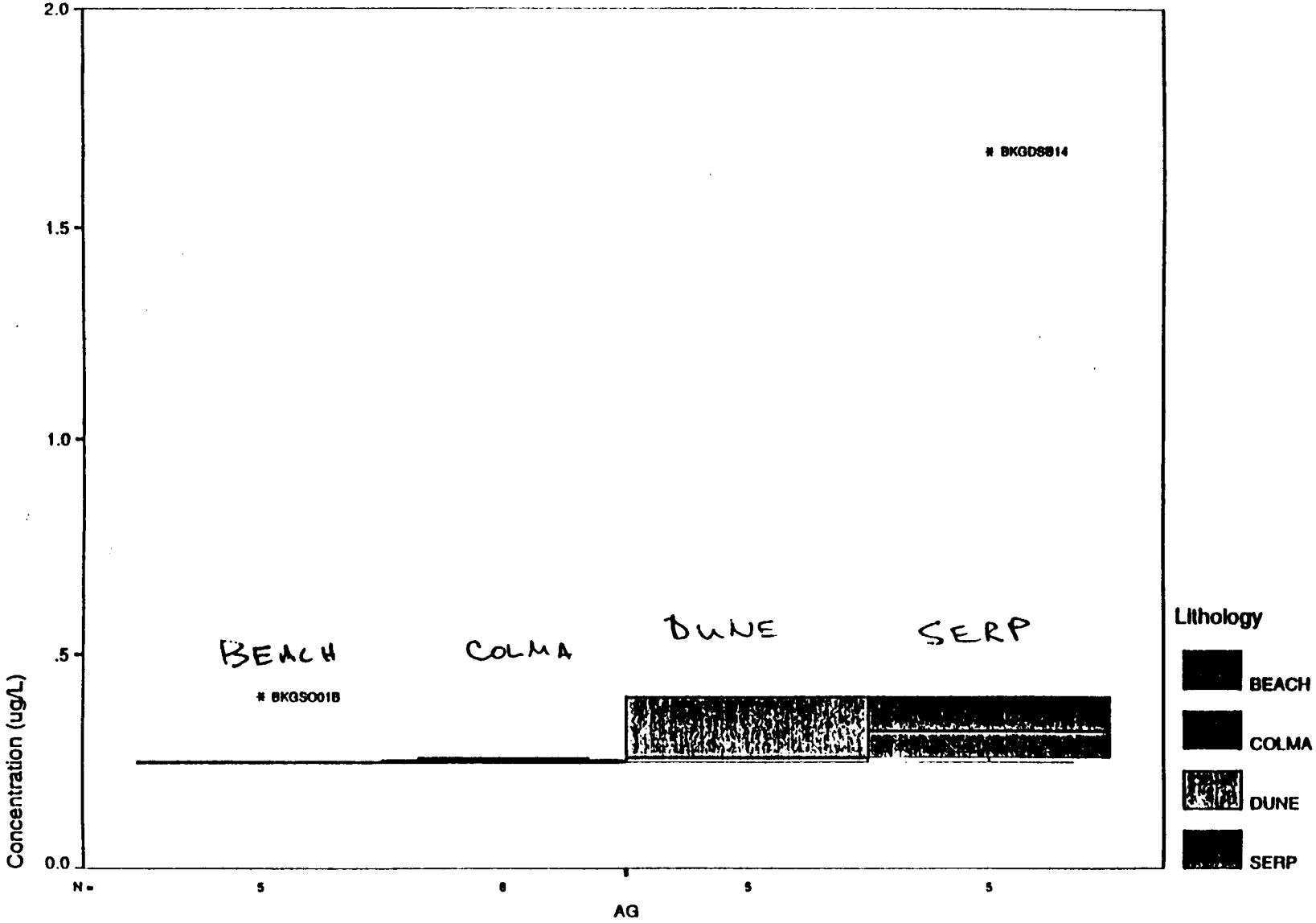
Analyte	Number of Samples	Frequency of Detection[a] (%)	Min	Max	Mean	Standard Deviation	Shapiro-Wilks (sig.)	LN Mean	LN Std. Dev	Shapiro-Wilks (sig.)	Distribution	95th Percentile[c]	Units
Aluminum	6	100	2540	8660	5190	2470	0.3489	8.459	0.482	0.4773	normal	9250	mg/kg
Antimony	2	0	9.8	20.7	15.2	7.67	b	2.655	0.527	b	—	—	mg/kg
Arsenic	6	66.7	0.125	2.49	0.997	0.876	0.3843	-0.417	1.094	0.7261	normal	2.44	mg/kg
Barium	6	83.3	1.65	92.3	32.9	36.3	0.1278	2.770	1.498	0.6942	normal	92.6	mg/kg
Beryllium	6	0	0.05	5	1.84	2.46	<0.01	-0.567	1.845	0.3361	—	—	mg/kg
Cadmium	6	0	0.258	400	14.2	20	<0.01	0.997	2.286	0.1010	—	—	mg/kg
Calcium	6	100	368	9200	2280	3420	<0.01	7.058	1.157	0.3923	log	7800	mg/kg
Chromium	6	100	674	1290	914	226	0.5671	6.794	0.237	0.8338	normal	1290	mg/kg
Cobalt	6	100	59.8	140	101	33.2	0.4156	4.565	0.345	0.4558	normal	156	mg/kg
Copper	6	100	5.08	64.6	32.5	24.1	0.3931	3.151	0.986	0.4249	normal	72.1	mg/kg
Cyanide	6	0	0.125	0.46	0.181	0.137	<0.01	-1.862	0.532	<0.01	—	—	mg/kg
Iron	6	100	36000	80700	59600	15800	0.8074	10.964	0.283	0.6311	normal	85600	mg/kg
Lead	4	75	1.82	4.48	3.51	1.17	b	1.200	0.408	b	—	—	mg/kg
Magnesium	6	100	15300	270000	140000	86300	>0.99	11.558	1.013	0.1578	normal	282000	mg/kg
Manganese	6	100	505	2090	899	596	<0.01	6.671	0.513	0.0900	np	1880	mg/kg
Mercury	6	25	0.014	0.03	0.026	0.006	<0.01	-3.681	0.313	<0.01	np	0.0359	mg/kg
Nickel	6	100	1120	3960	2570	1070	0.6011	7.769	0.462	0.6064	np	4330	mg/kg
Potassium	6	16.7	25	2500	576	963	<0.01	5.192	1.699	0.6560	—	—	mg/kg
Selenium	6	0	0.125	0.225	0.197	0.036	<0.01	-1.642	0.216	<0.01	—	—	mg/kg
Silver	5	20	0.25	1.67	0.581	0.613	<0.01	-0.852	0.787	0.0547	np	1.59	mg/kg
Sodium	6	83.3	19.4	450	208	174	0.3850	4.904	1.170	0.4960	normal	494	mg/kg
Thallium	6	0	0.081	17.2	4.14	7.01	<0.01	-0.869	2.561	<0.01	—	—	mg/kg
Vanadium	6	100	11.8	40.2	29.5	10.1	0.4463	3.317	0.444	0.0815	normal	46.1	mg/kg
Zinc	6	100	6.64	95.2	38.9	32.1	0.4052	3.338	0.937	0.9032	normal	91.7	mg/kg

Summary statistics calculated with 1/2 IDL for non-detects.

a. Frequency of detection is calculated from all accepted valid data except equipment rinsates.
b. Not enough samples available to test.
c. The normal distribution equation was used for nonparametric distributions.
"—" Not applicable because greater than 20% of data were non-detects.

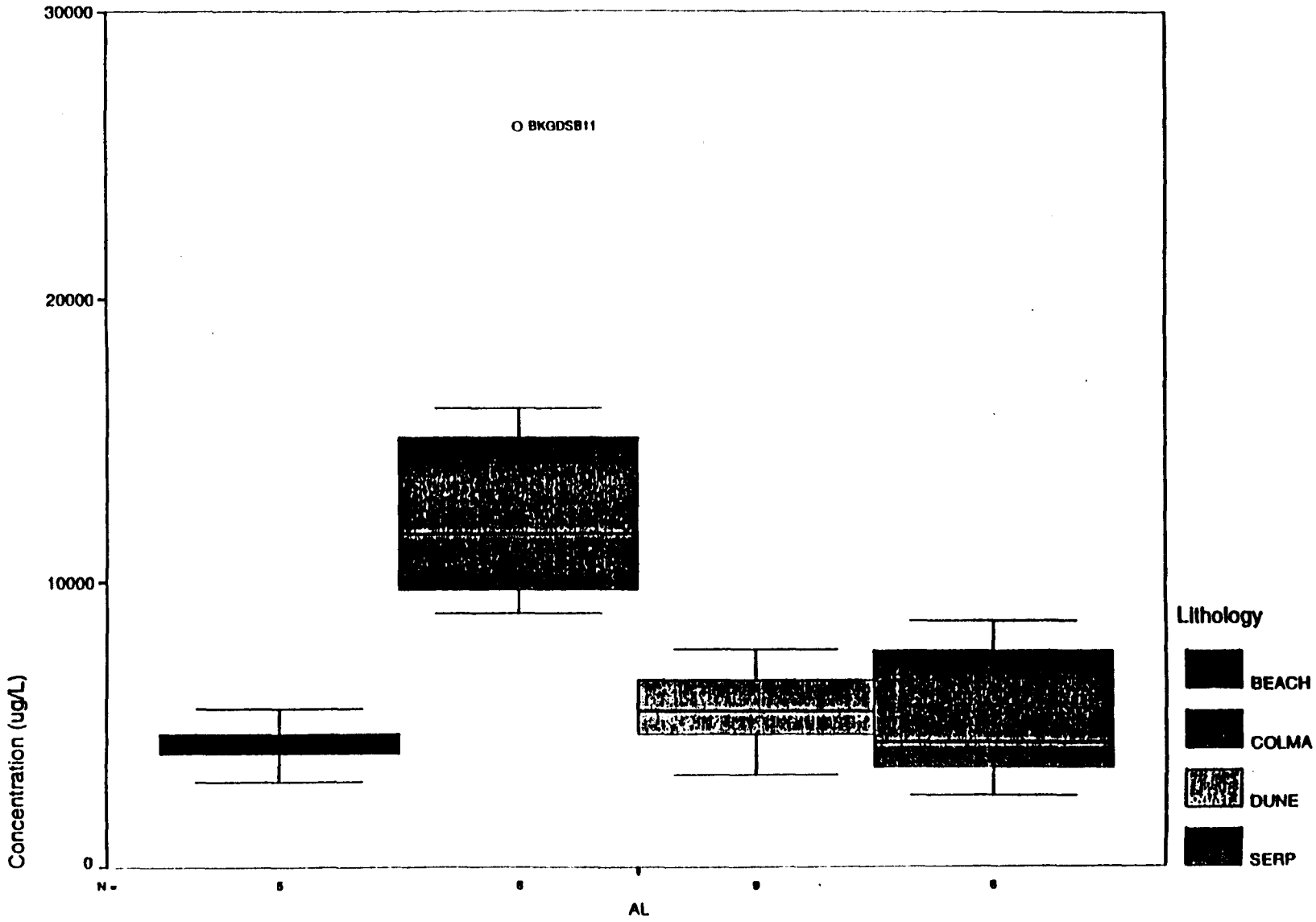
Presidio Background Soils

Silver



Presidio Background Soils

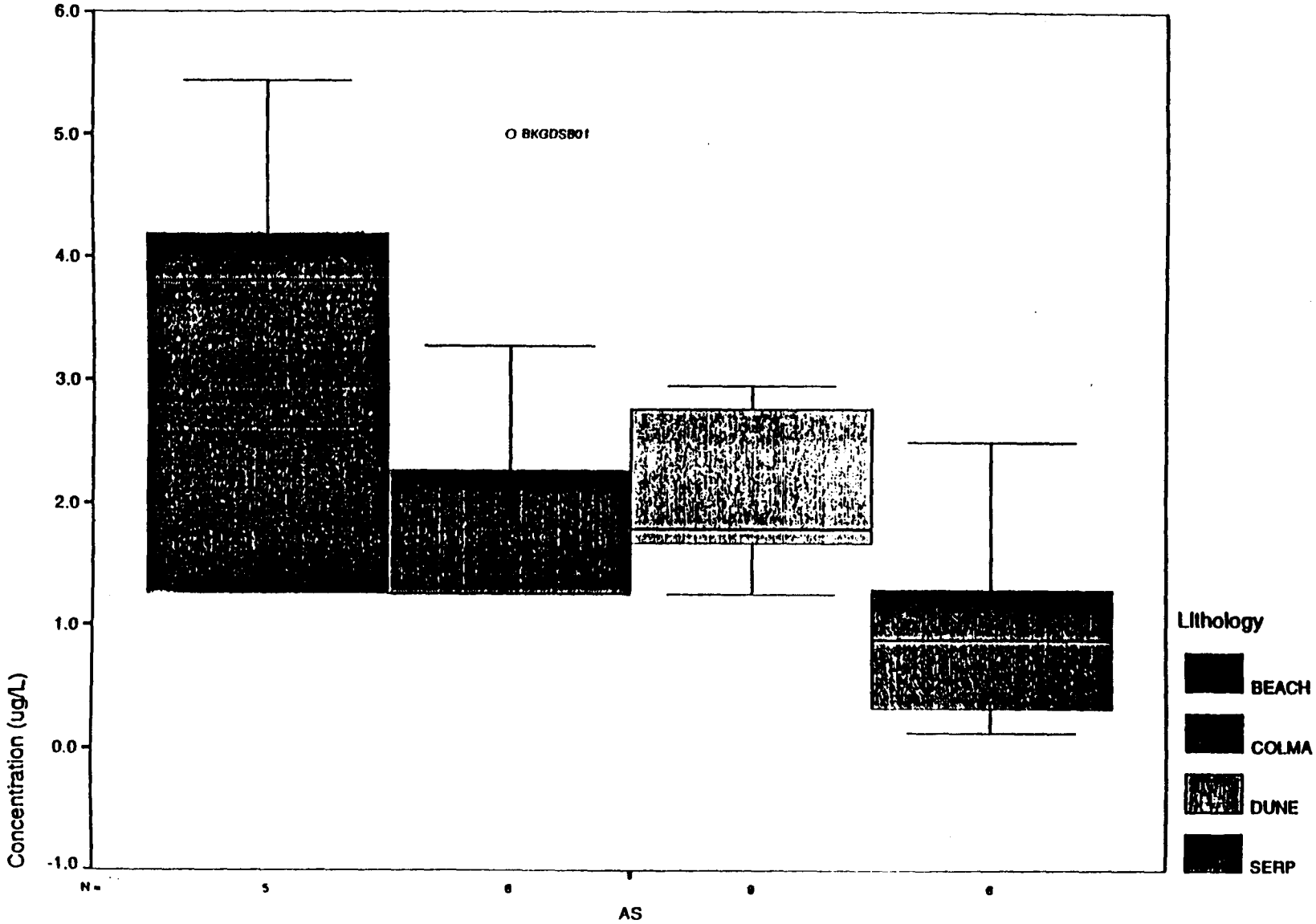
Aluminum



A-48

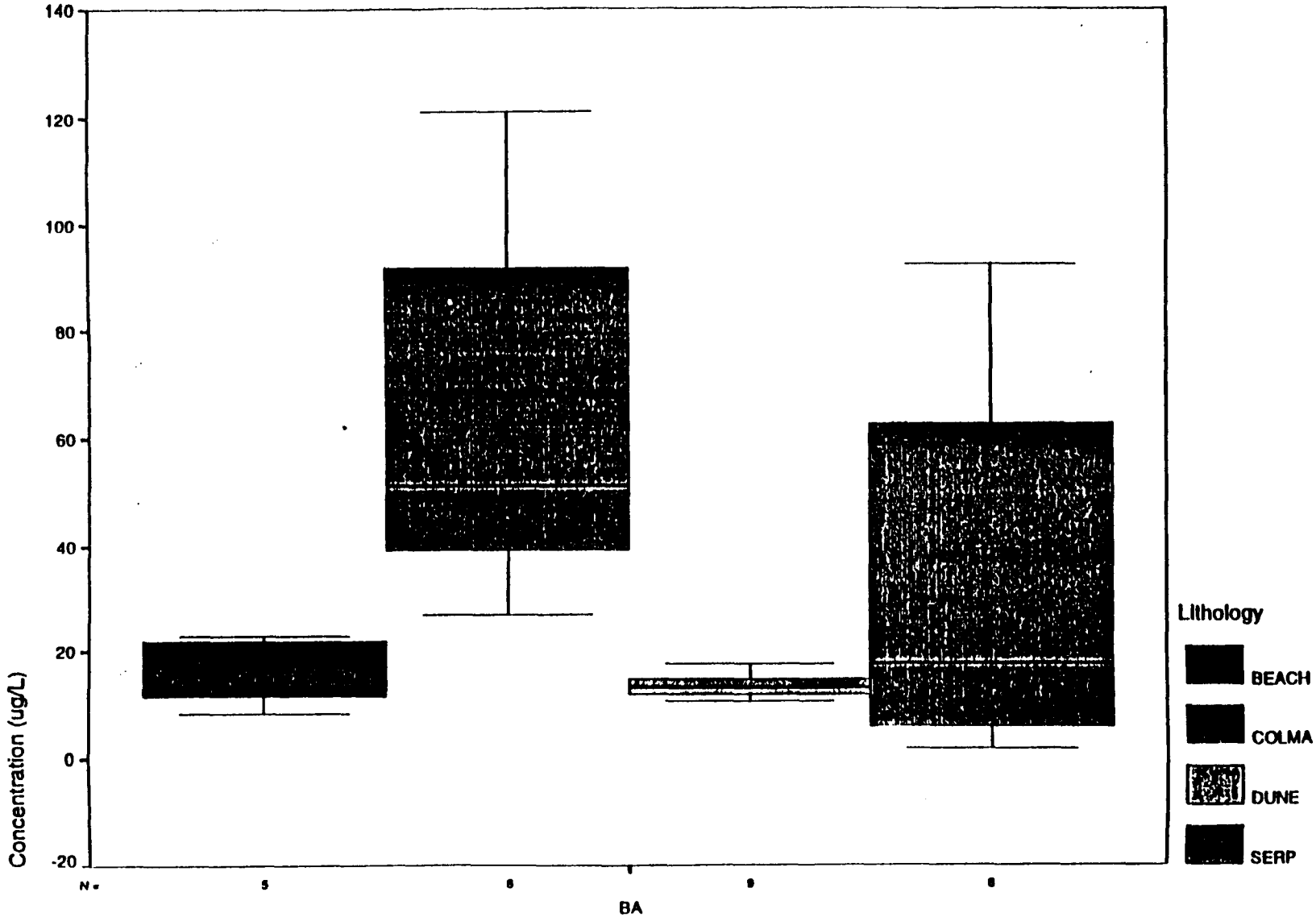
Presidio Background Soils

Arsenic



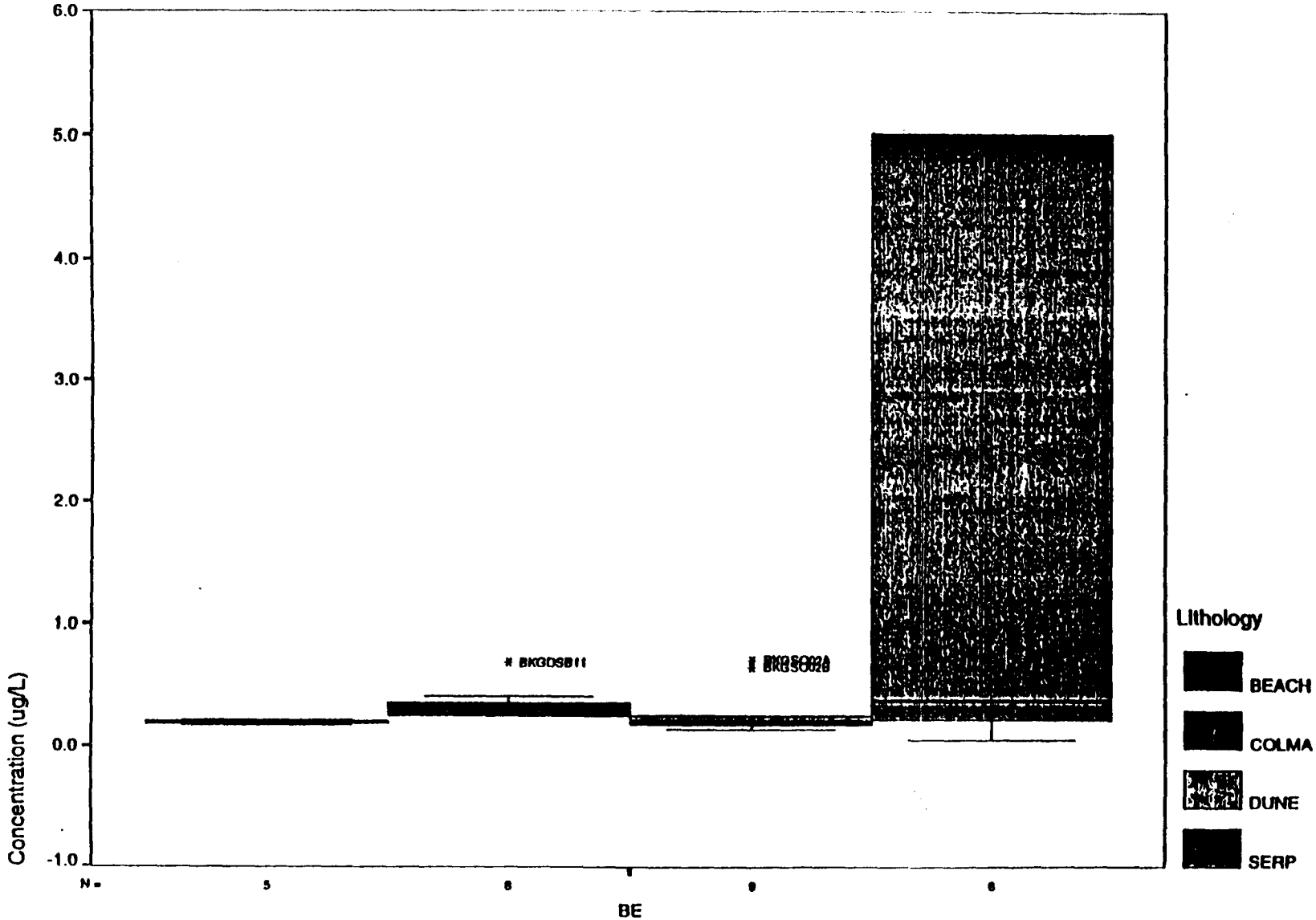
Presidio Background Soils

Barium



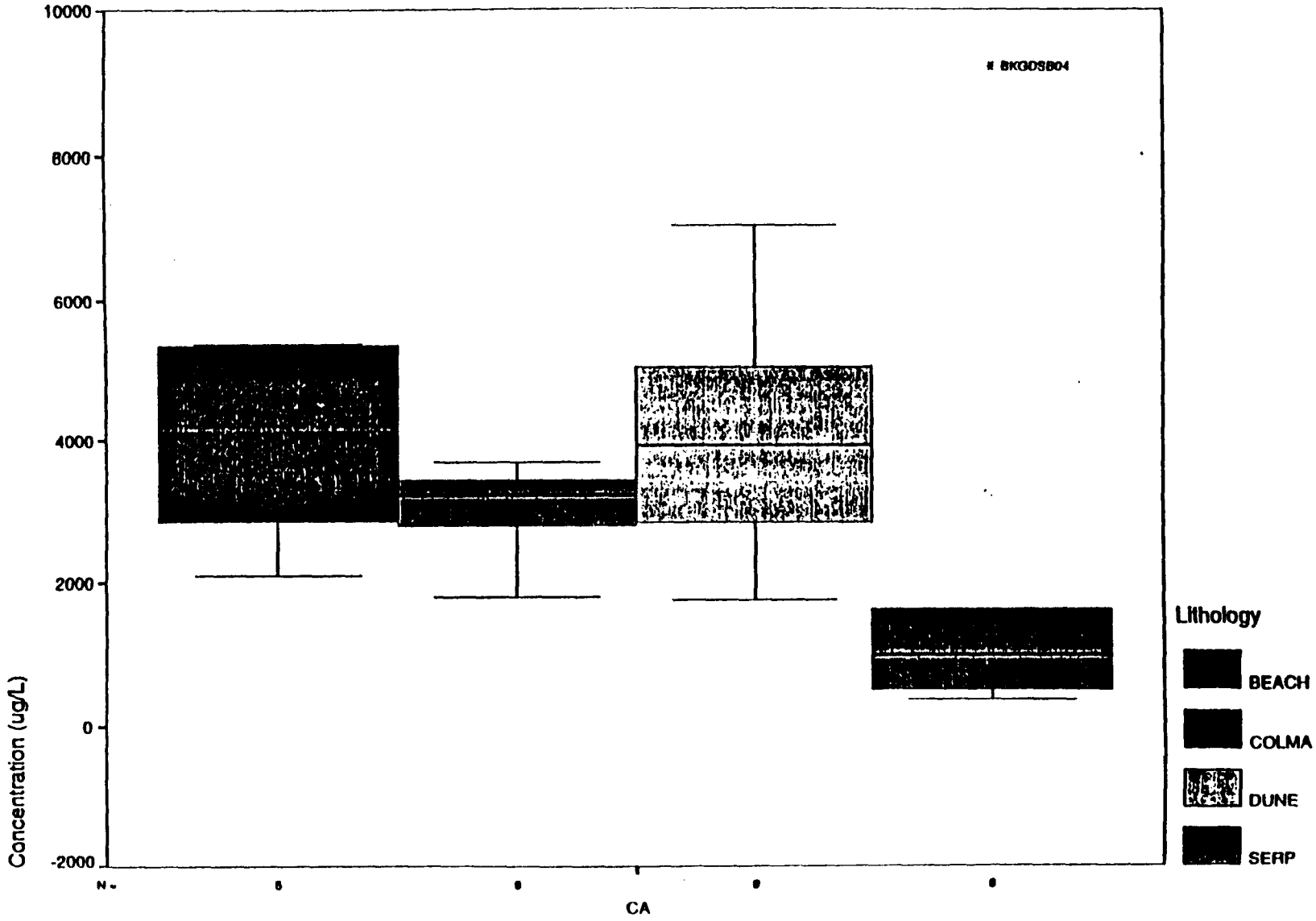
Presidio Background Soils

Beryllium



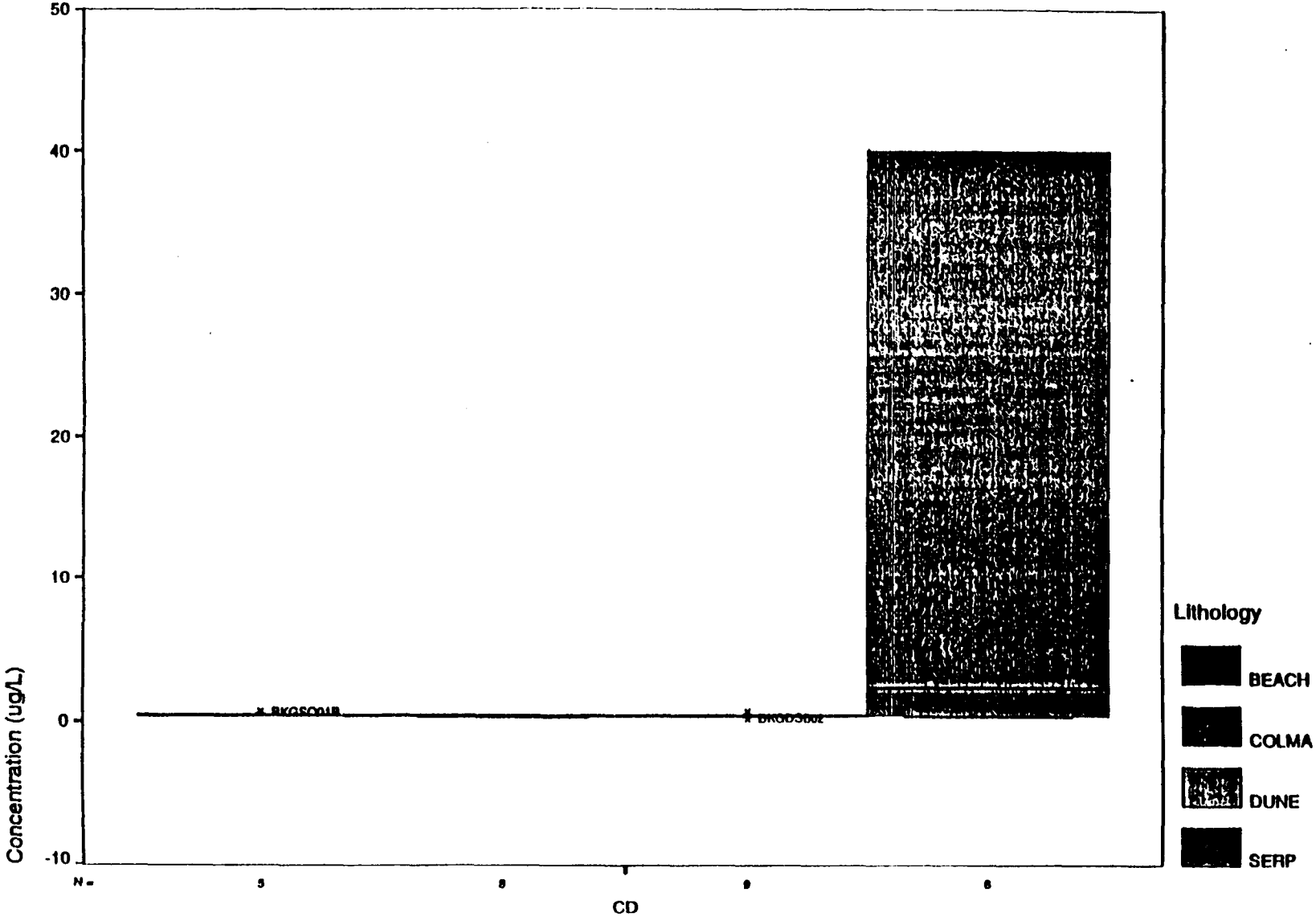
Presidio Background Soils

Calcium



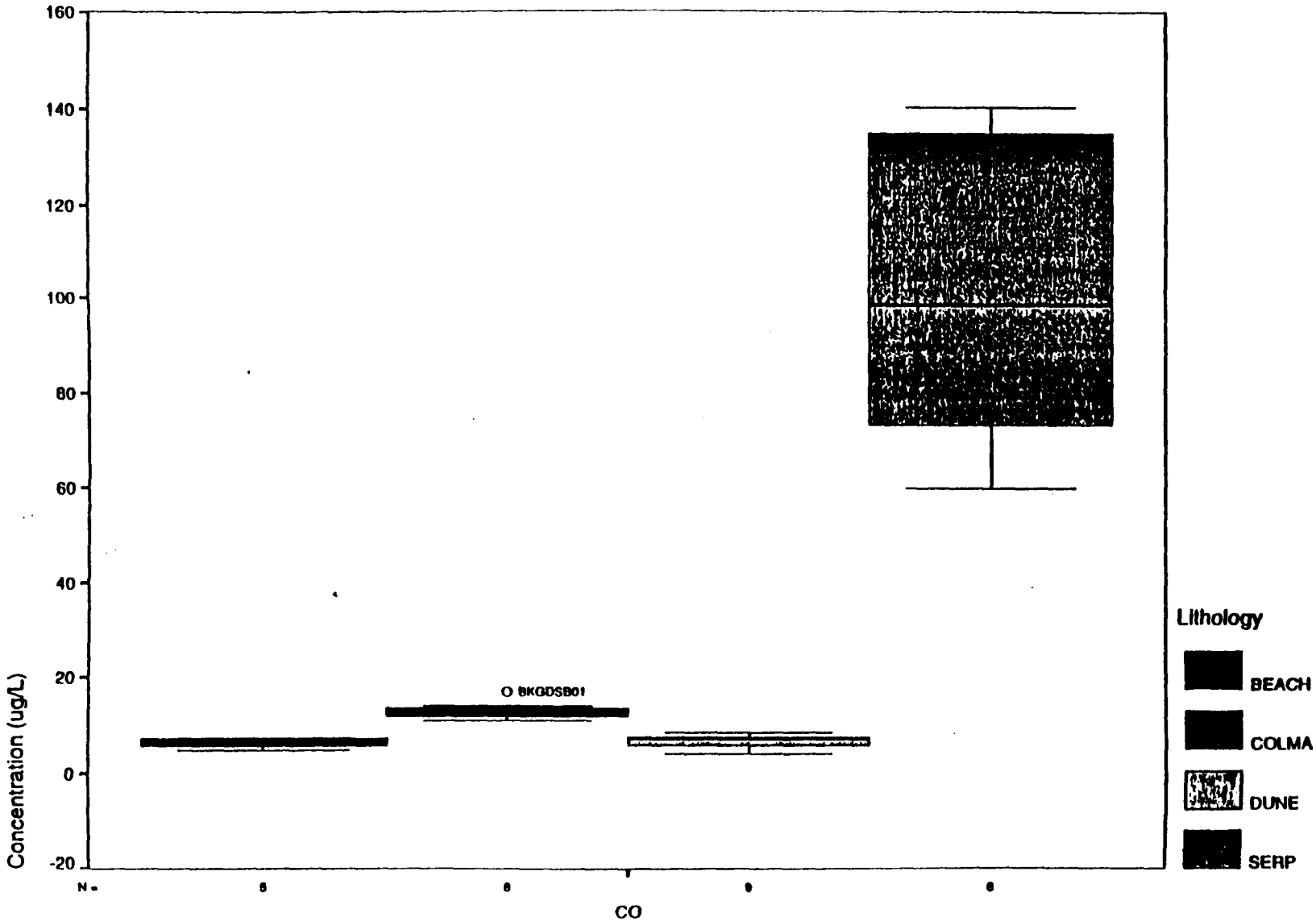
Presidio Background Soils

Cadmium



Presidio Background Soils

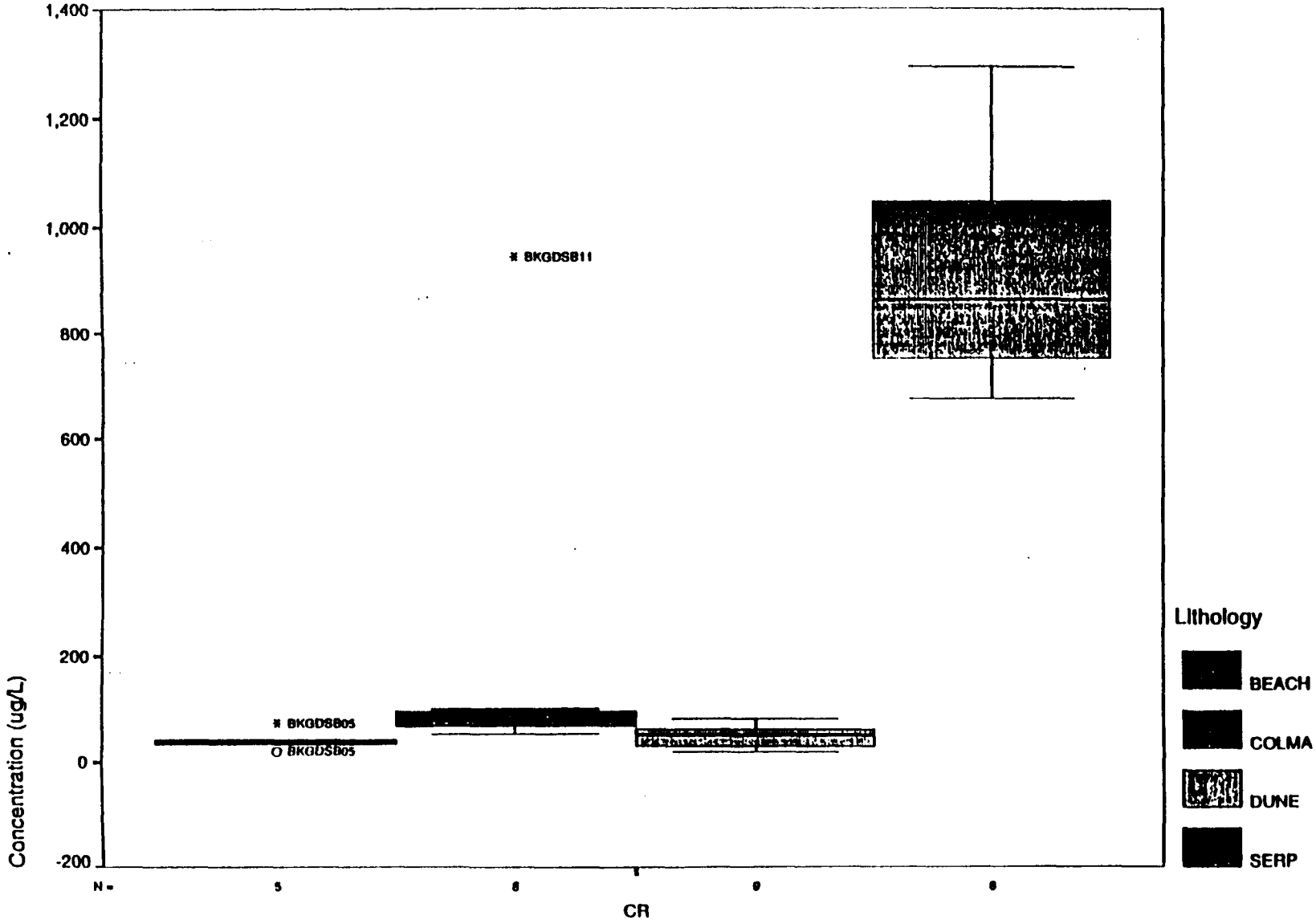
Cobalt



A-54

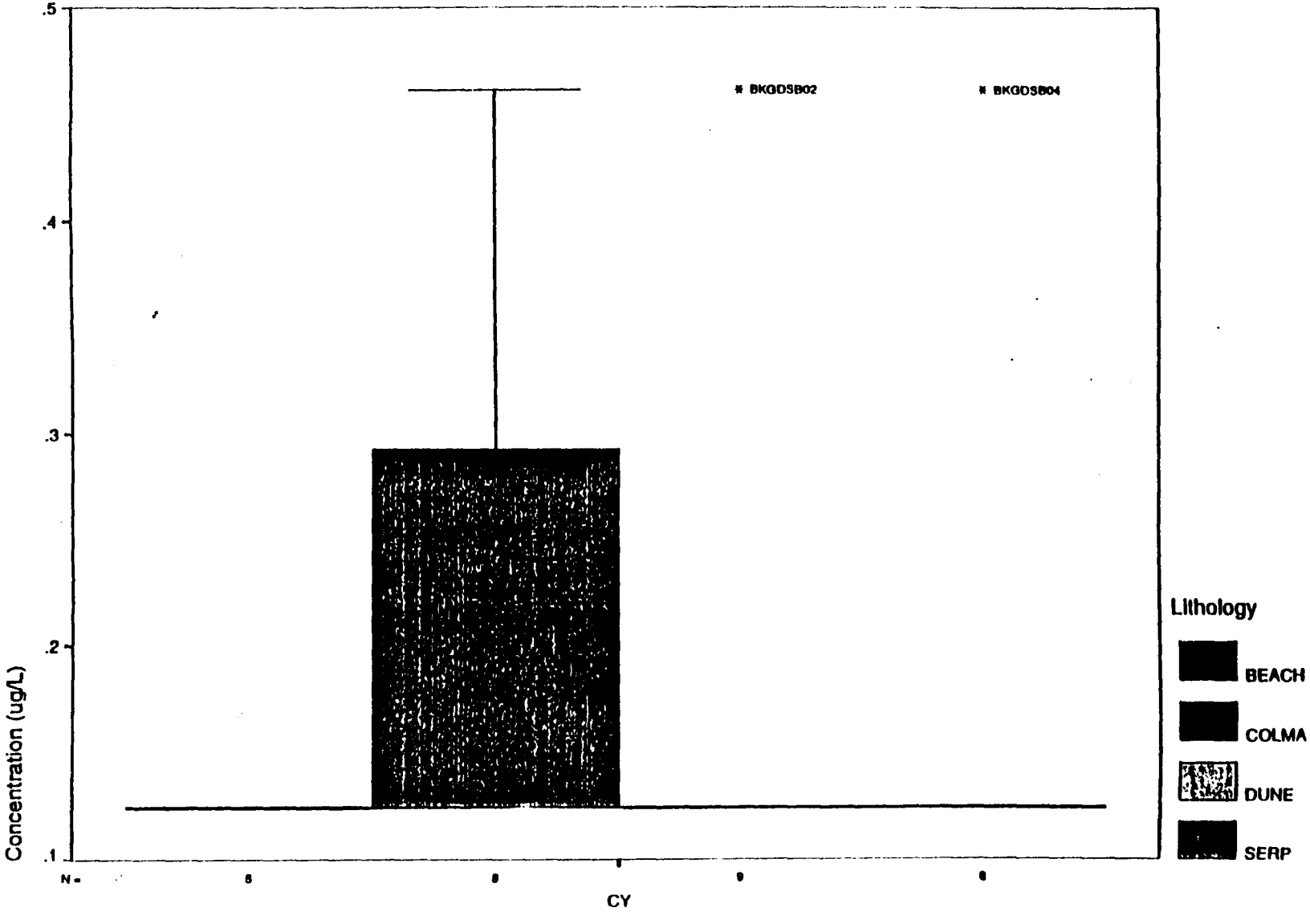
Presidio Background Soils

Chromium



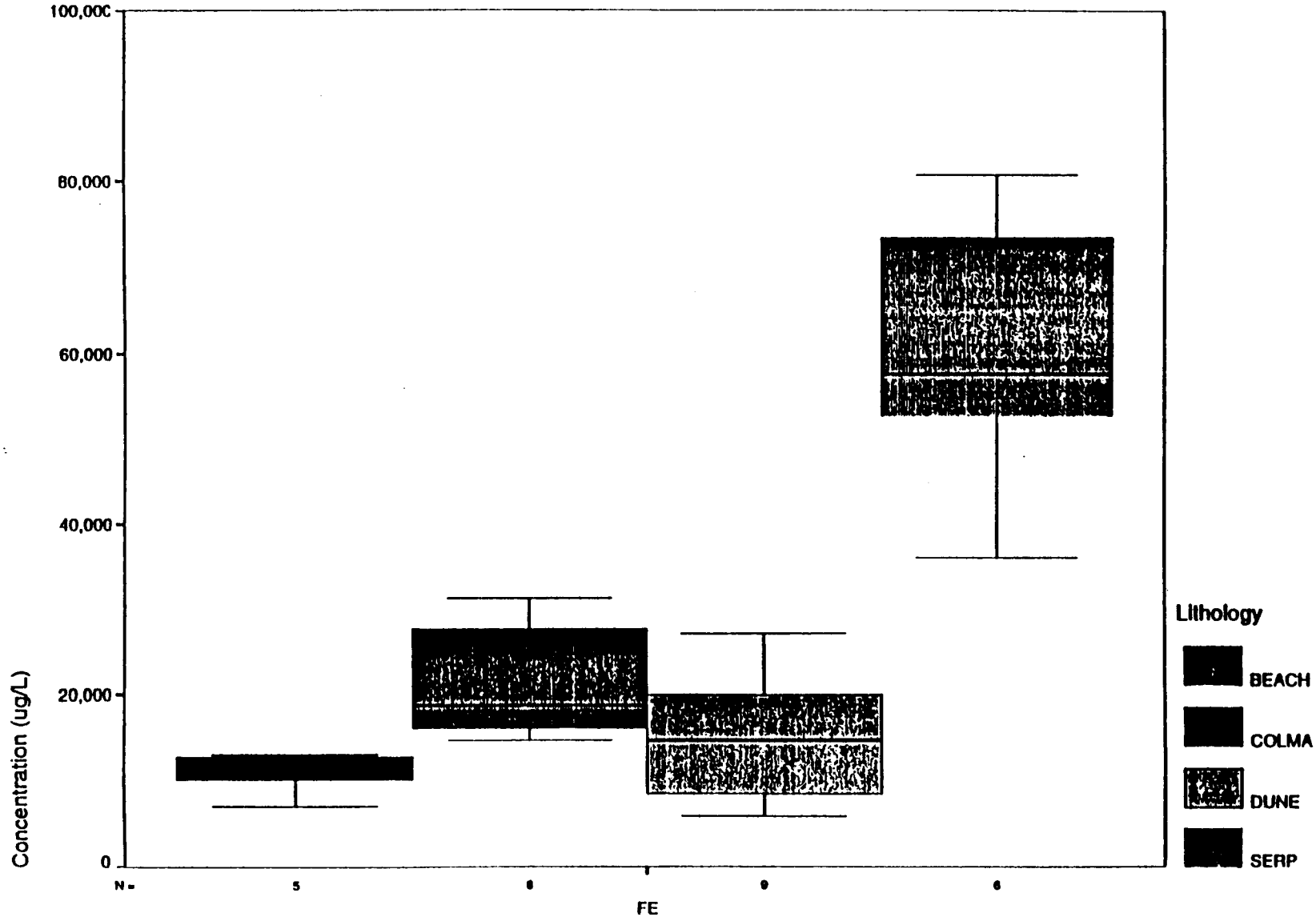
Presidio Background Soils

Cyanide



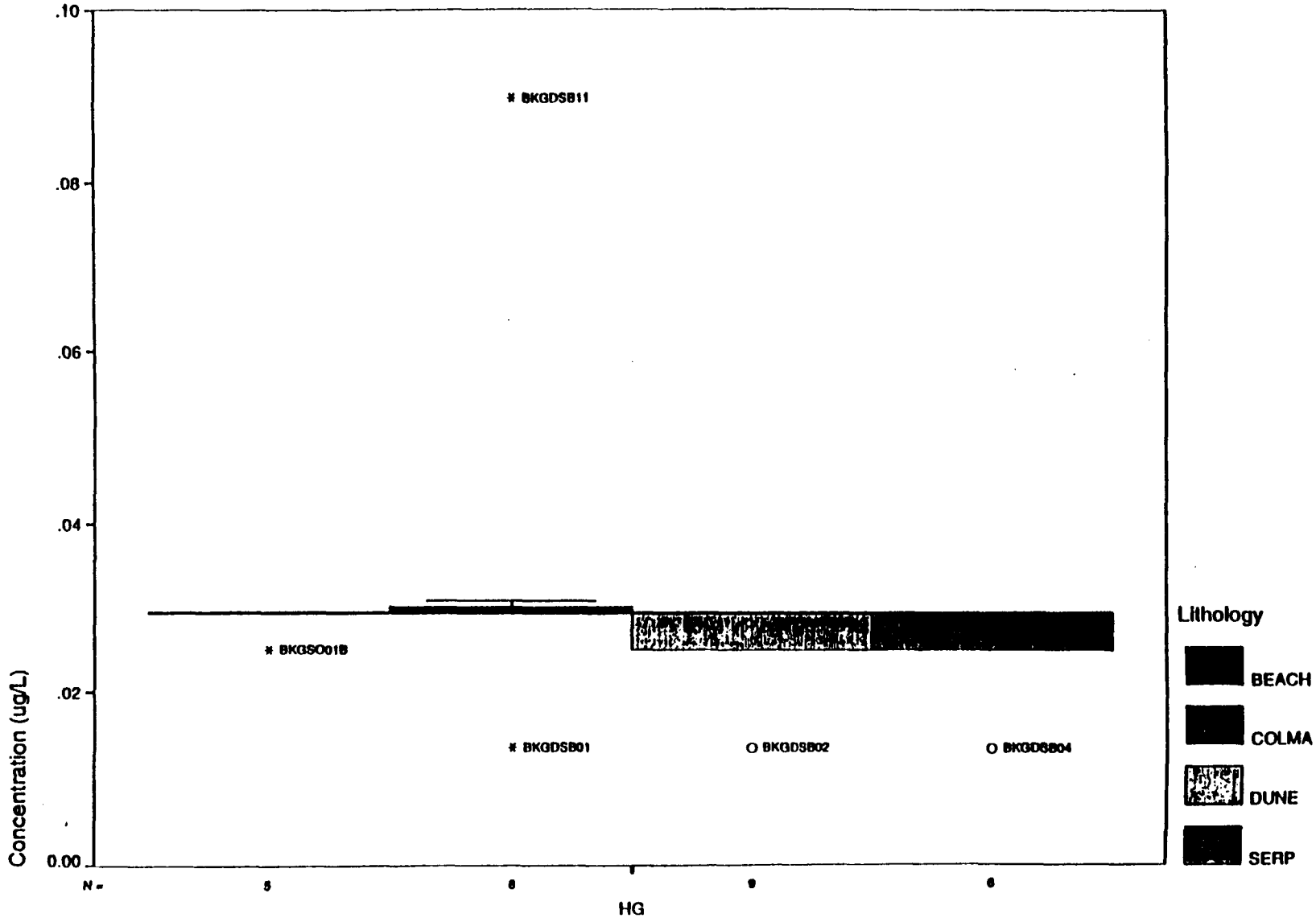
Presidio Background Soils

Iron



Presidio Background Soils

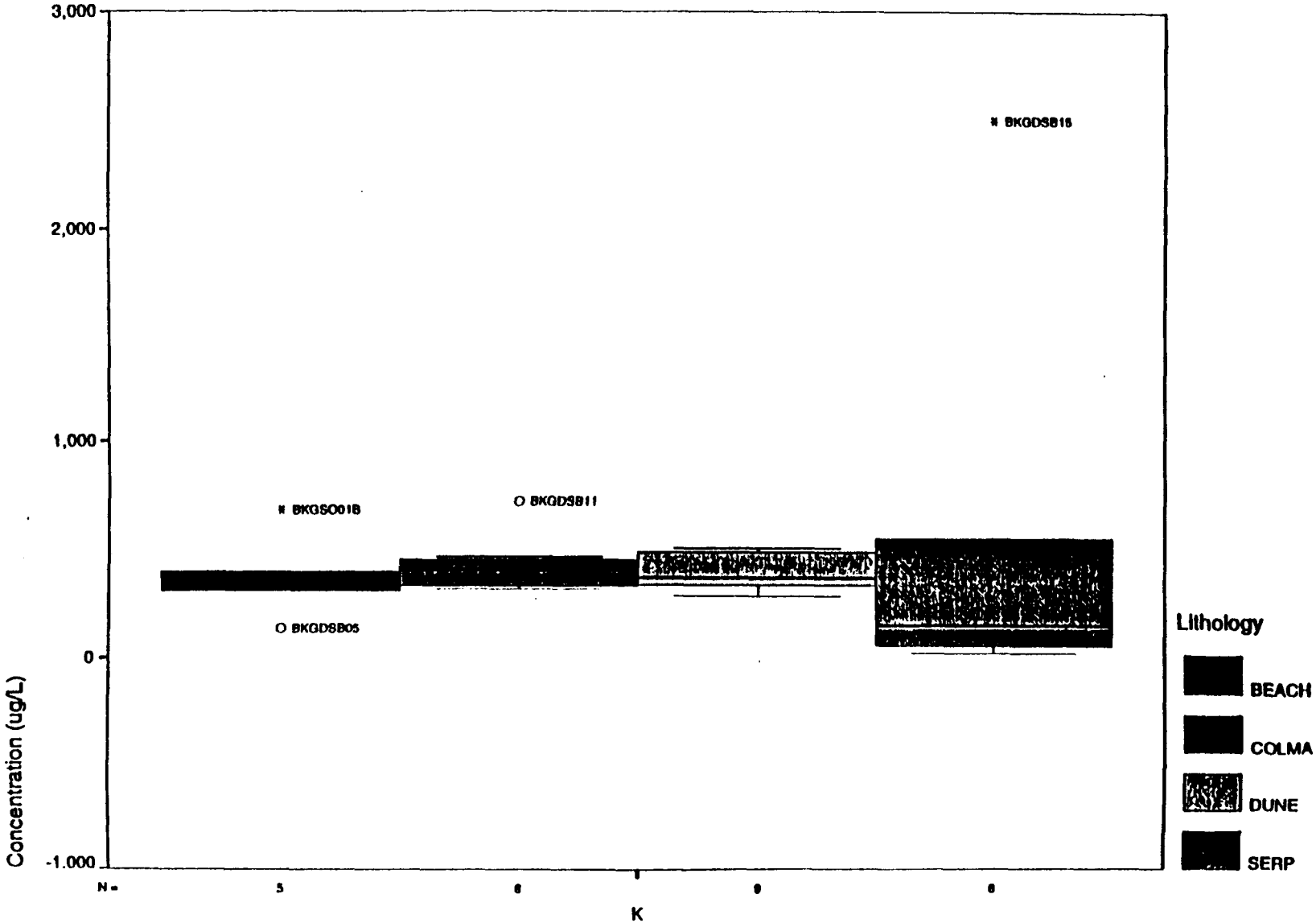
Mercury



A-58

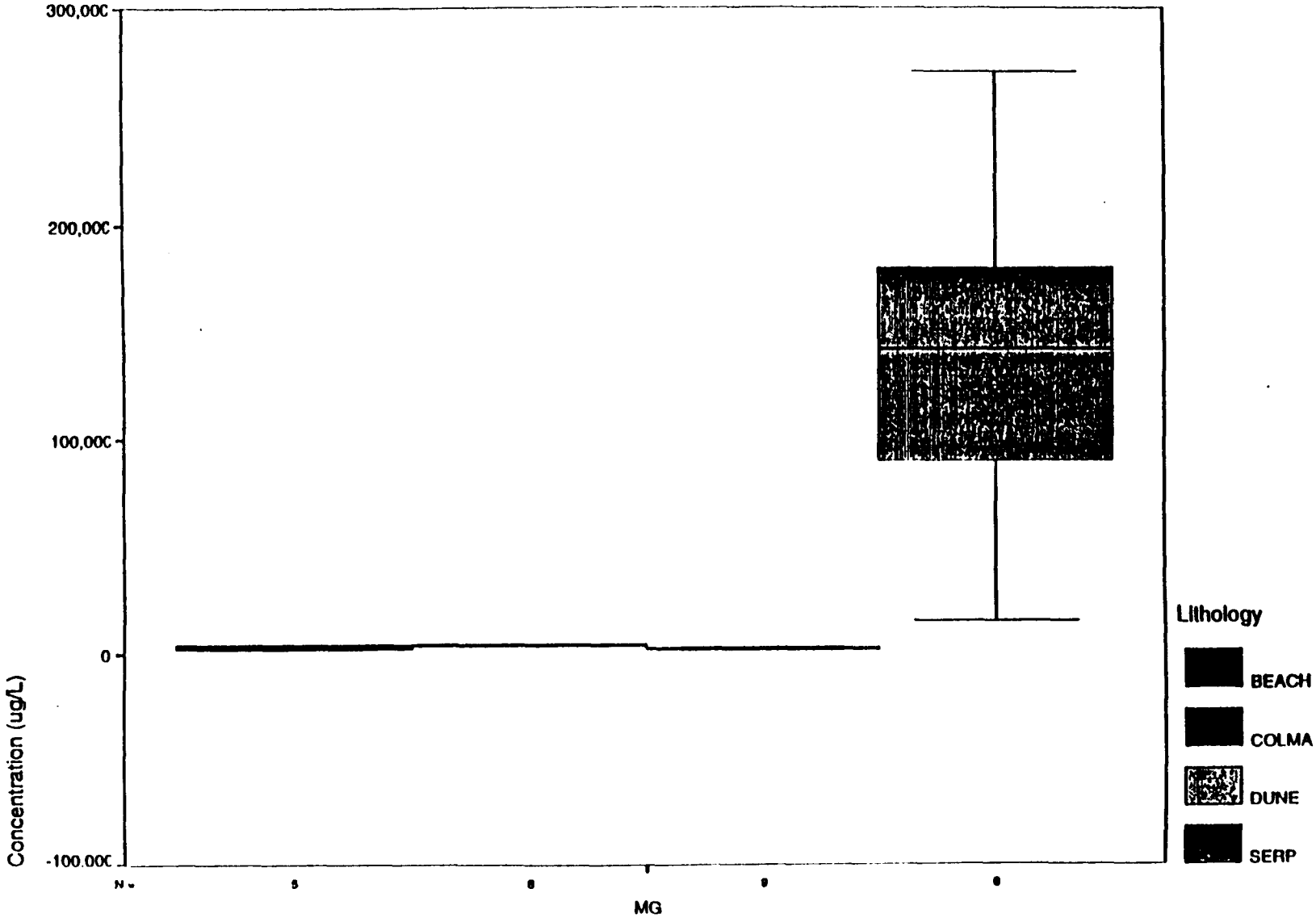
Presidio Background Soils

Potassium



Presidio Background Soils

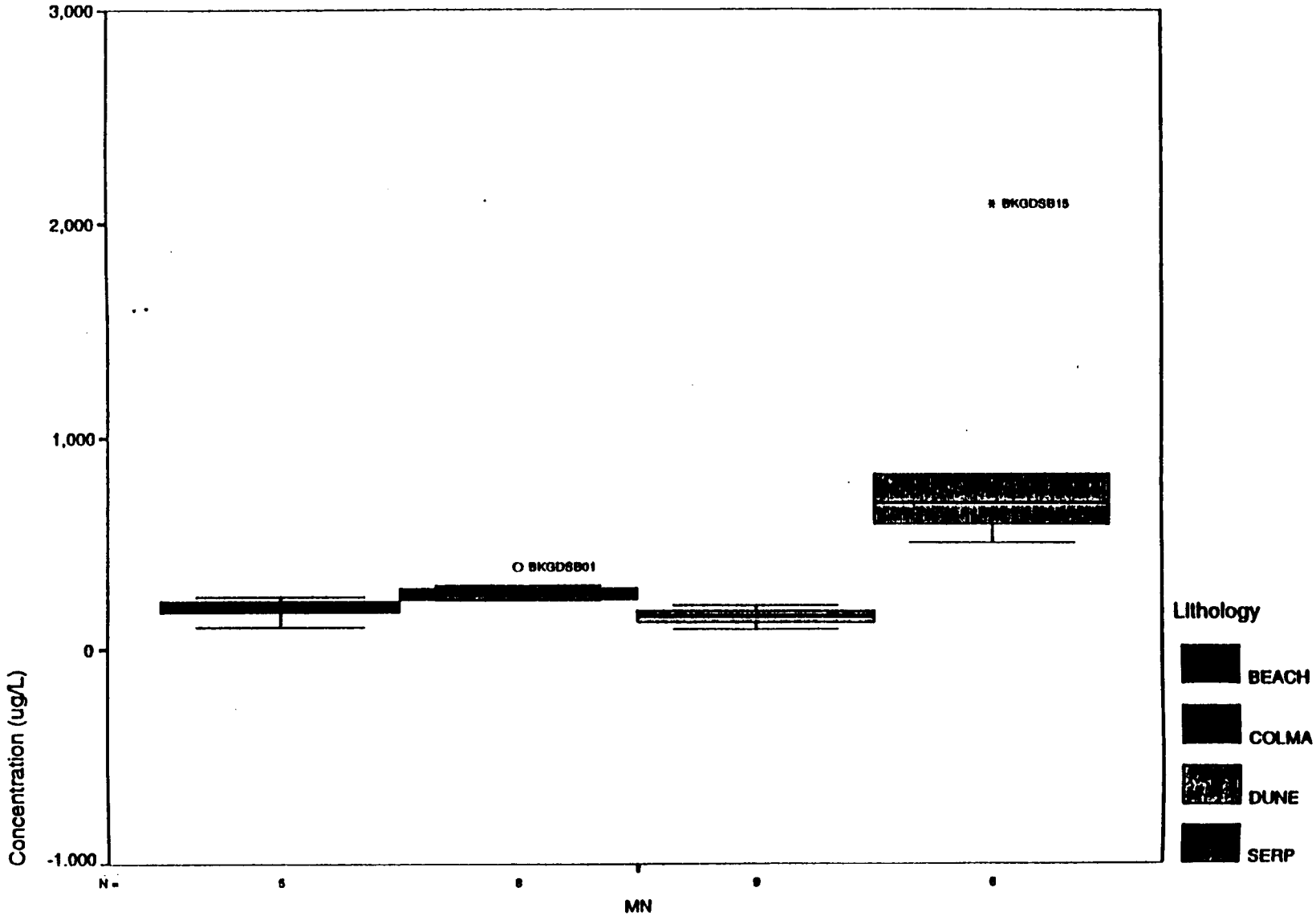
Magnesium



A-60

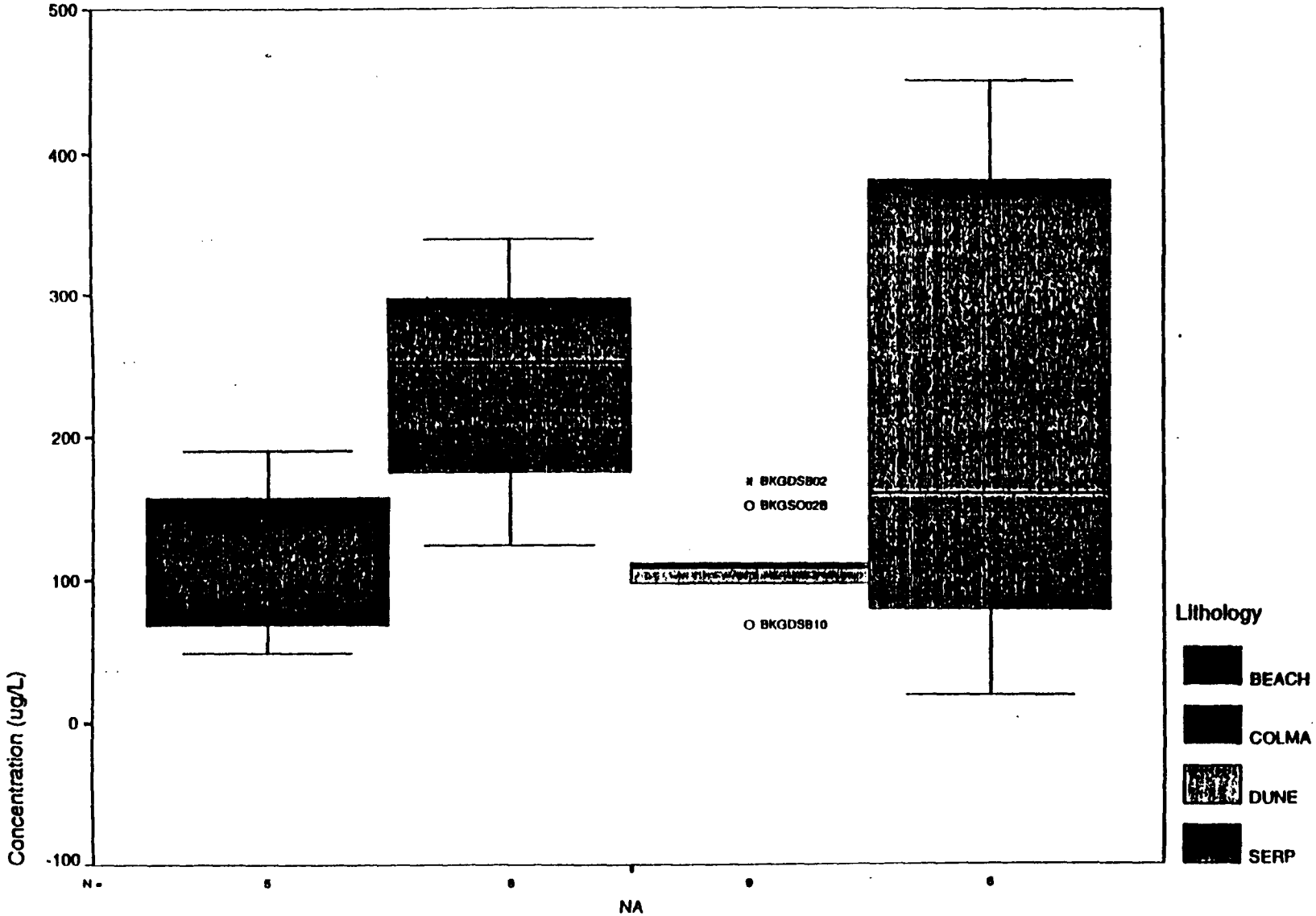
Presidio Background Soils

Manganese



Presidio Background Soils

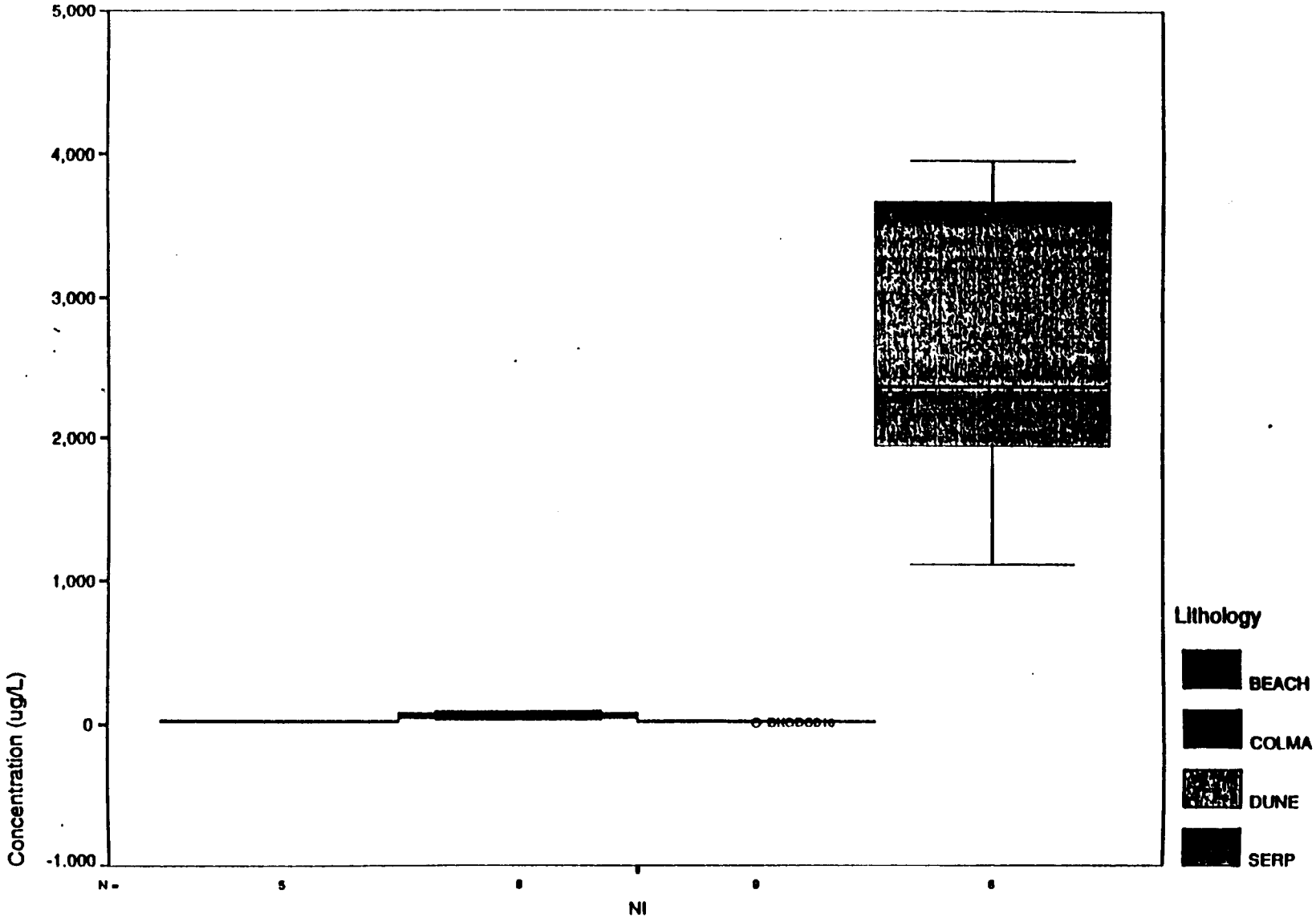
Sodium



A-62

Presidio Background Soils

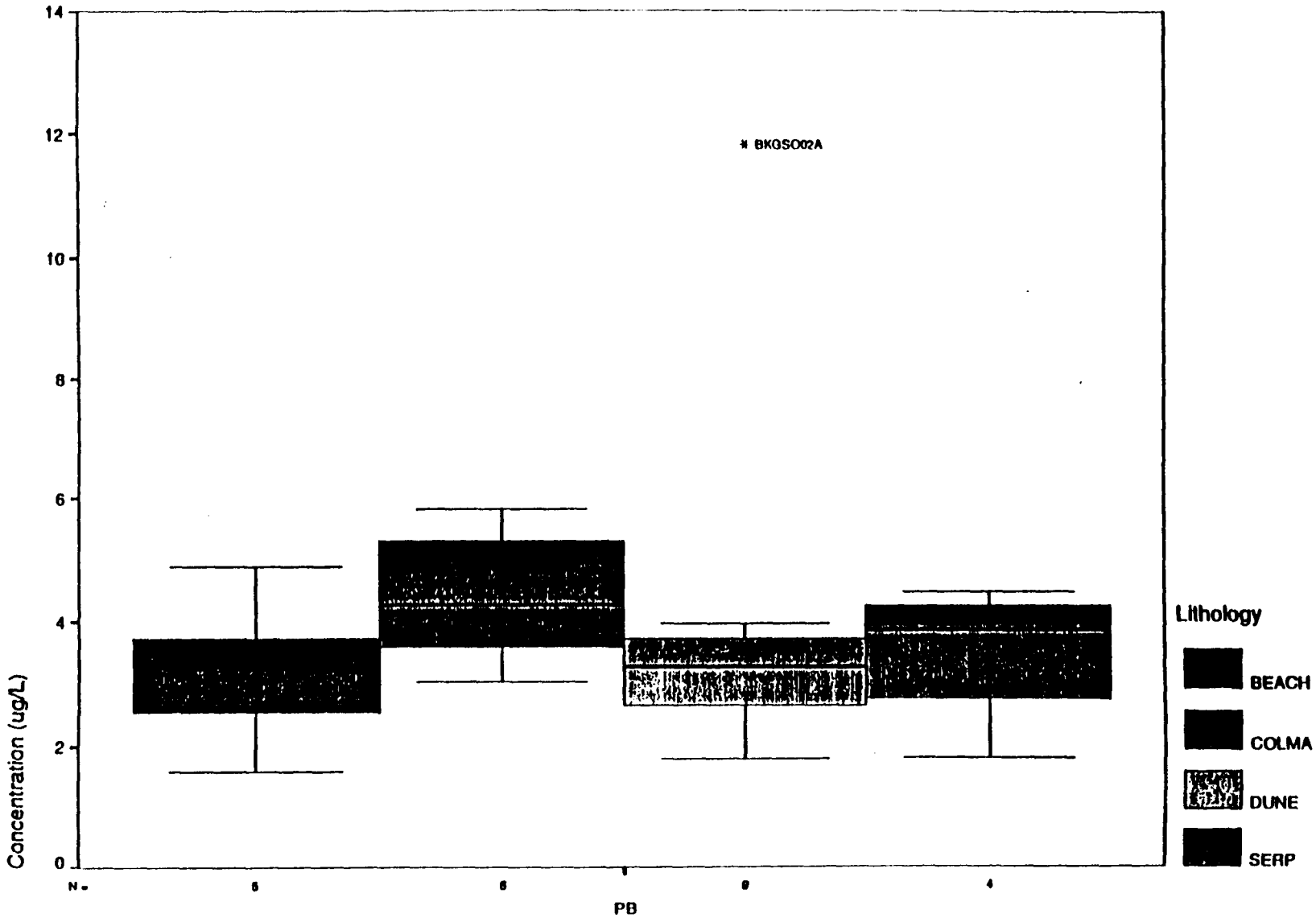
Nickel



A-63

Presidio Background Soils

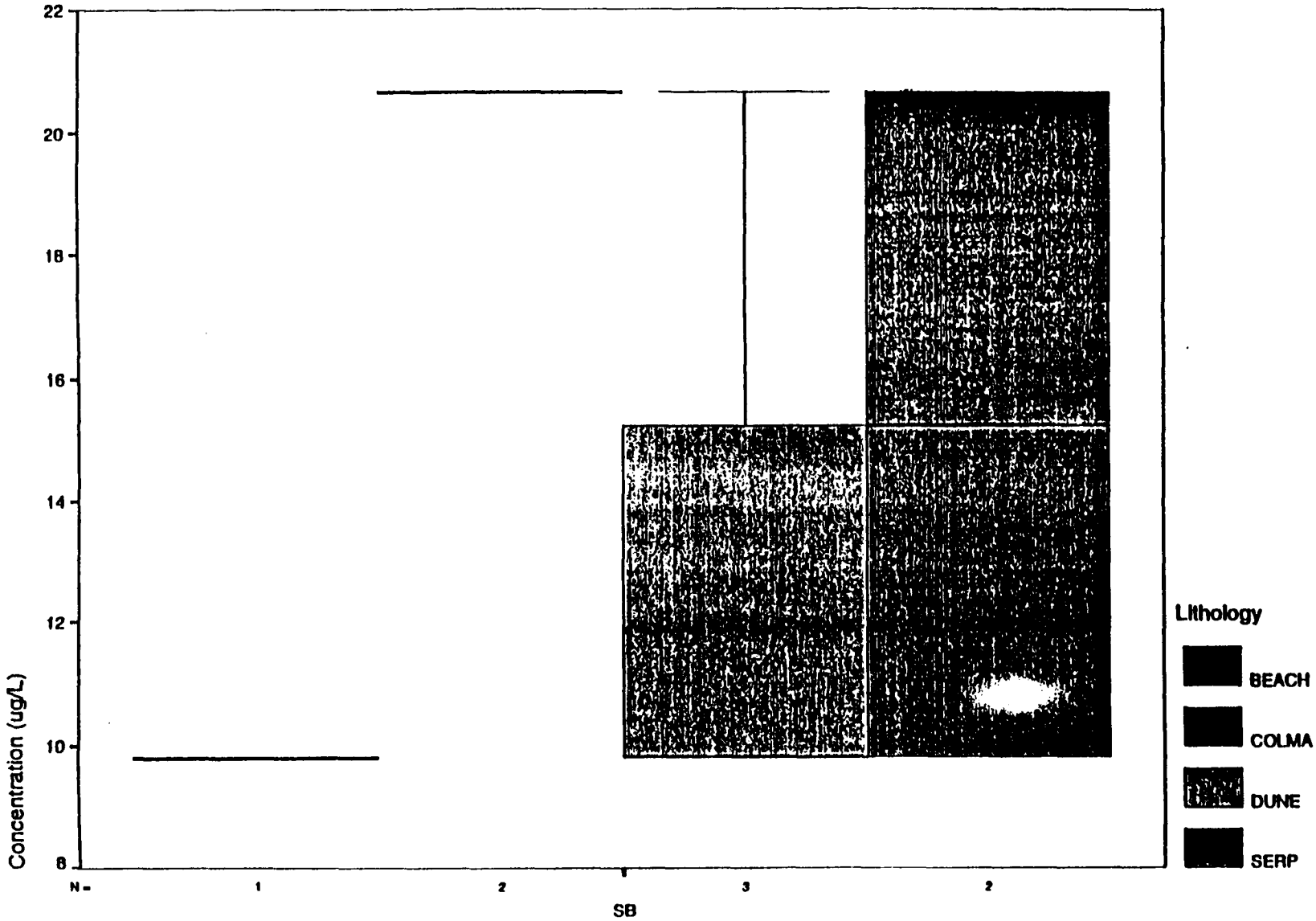
Lead



A-64

Presidio Background Soils

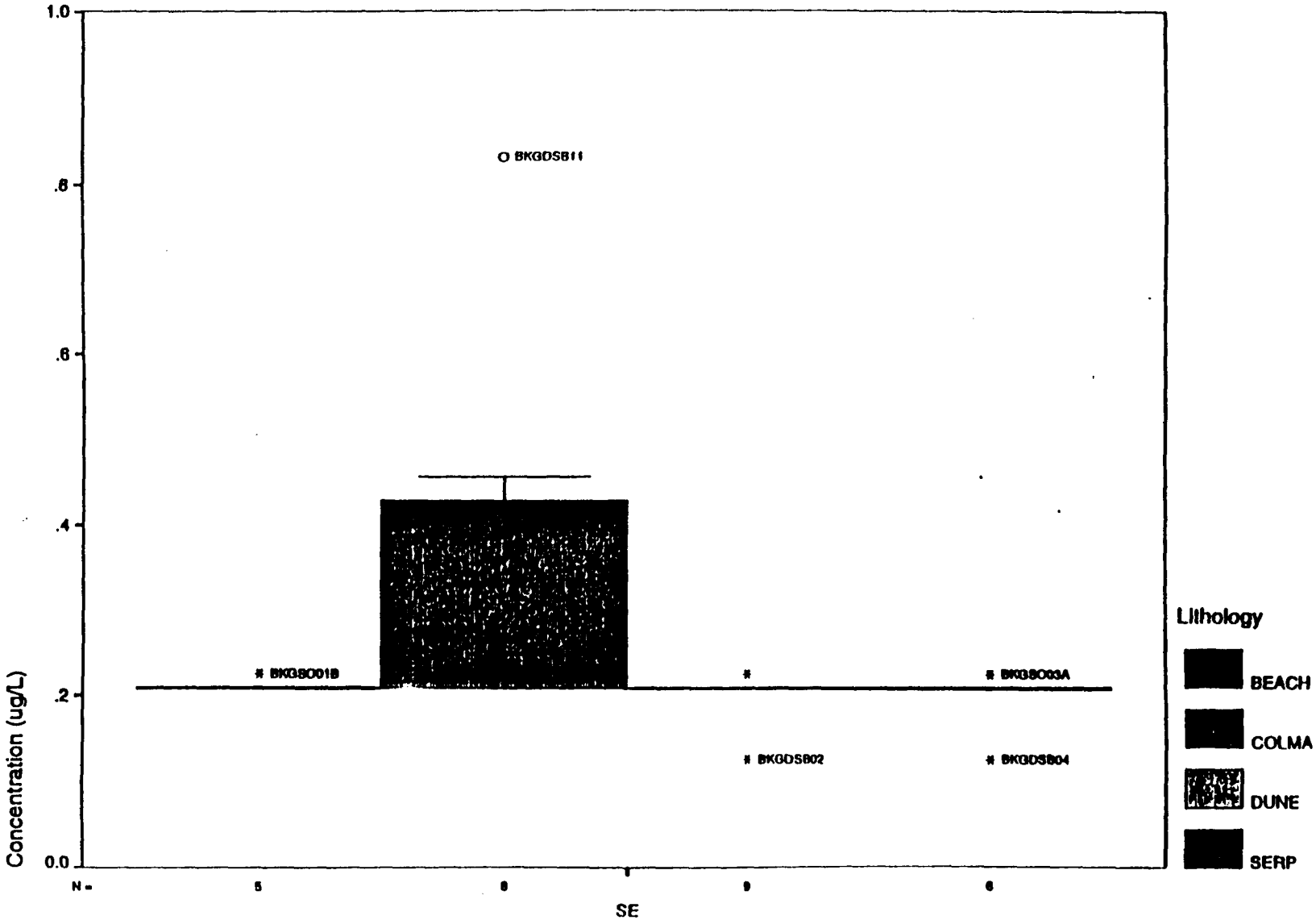
Antimony



A-65

Presidio Background Soils

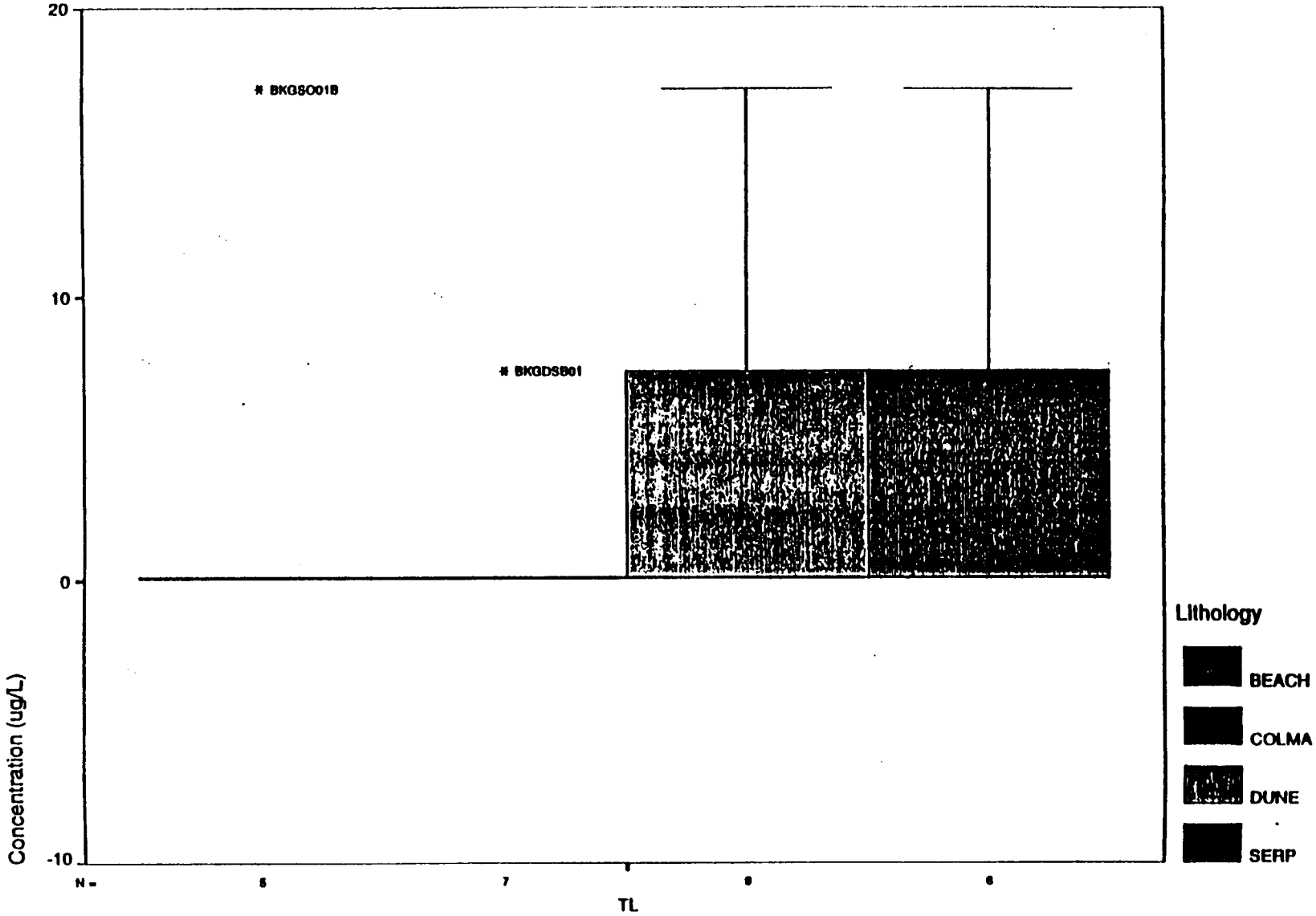
Selenium



A-66

Presidio Background Soils

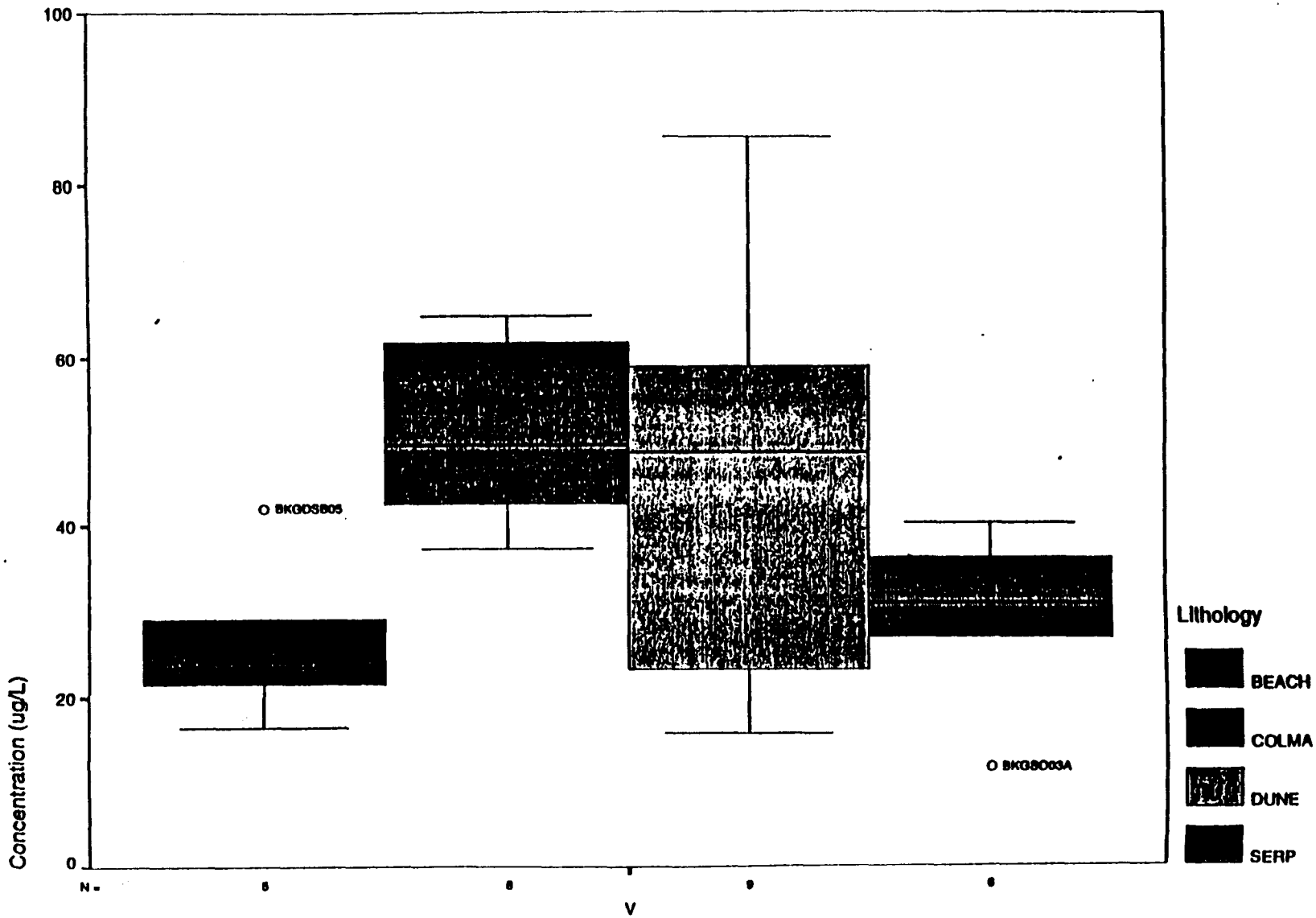
Thallium



A-67

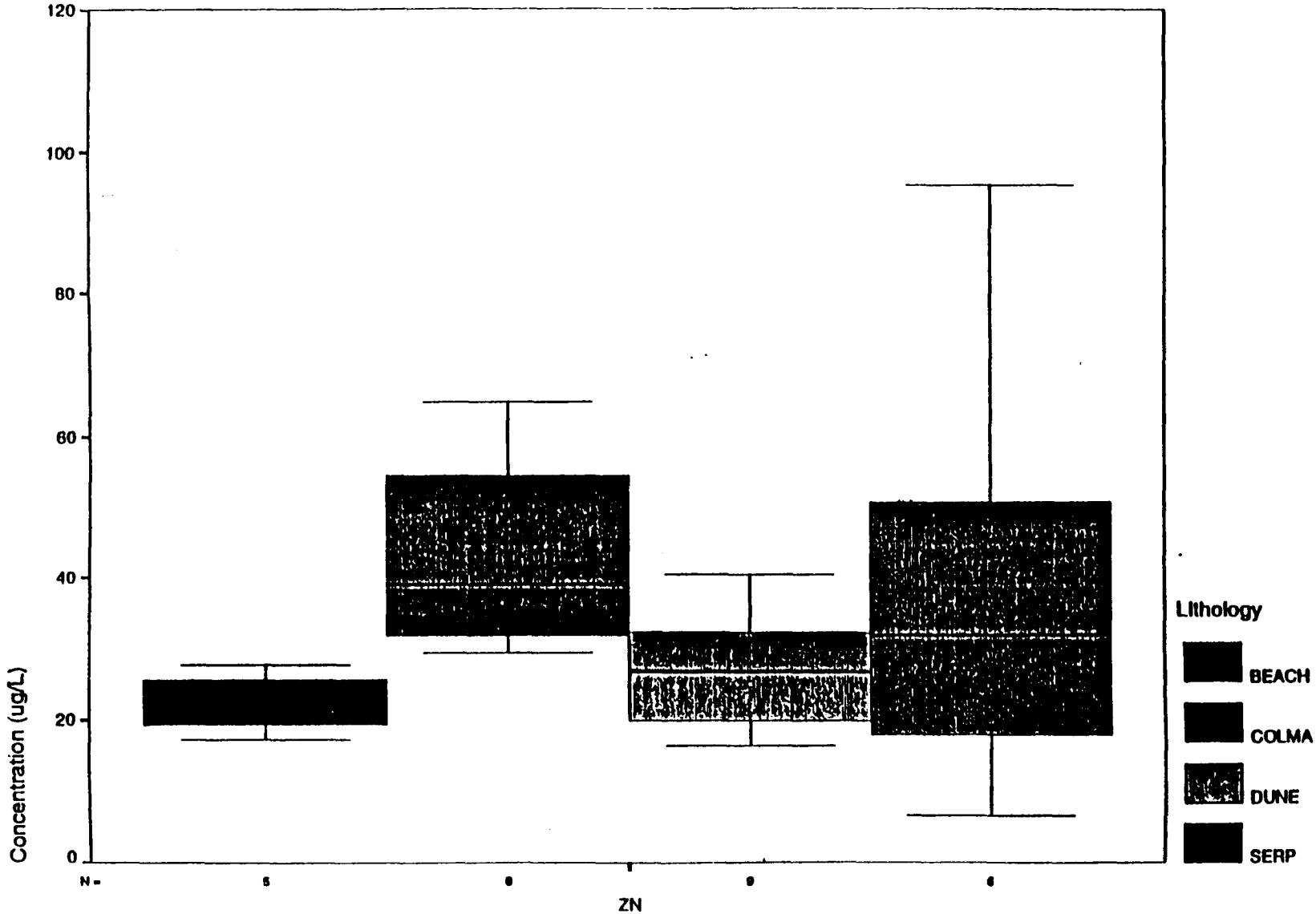
Presidio Background Soils

Vanadium



Presidio Background Soils

Zinc



PAGE INTENTIONALLY LEFT BLANK

DEPARTMENT OF TOXIC SUBSTANCES CONTROL
REGION 2
700 HEINZ AVE., SUITE 200
BERKELEY, CA 94710-2737
(510) 540-3724

COPY

January 3, 1996

Mr. Ace Forsen, Chief
Project Development/Benicia-Martinez Bridge
Caltrans
P.O. Box 23660
Oakland, California 94623-0660

Dear Mr. Forsen:

INORGANIC ARSENIC BACKGROUND CONCENTRATION AT THE CYPRESS FREEWAY, OAKLAND

The Department of Toxic Substances Control (DTSC) received a study prepared by Caltrans staff requesting that DTSC consider 19.0 parts per million (ppm) as the site background concentration for inorganic arsenic at the Cypress Freeway. The request is based on research conducted by Caltrans that includes the following: the new freeway is constructed on fill material that originated in the East Bay hills, including the Leona Quarry and another quarry near Lake Temesescal; the Leona Rhyolite (known to contain minor amounts of arsenic) is the predominant formation in the East Bay hills; the average maximum concentration of inorganic arsenic from eight site specific studies conducted in the East and South Bay Area is 19.5 ppm; and the average background concentration of inorganic arsenic in the Berkeley hills is 19.1 ppm. Based on staff evaluation of the above information, DTSC concurs with Caltrans' request to apply 19.0 ppm as the naturally occurring background level for inorganic arsenic within the construction limits of the Cypress Freeway Corridor and related contracts. Soils containing levels of inorganic arsenic greater than 19.0 ppm will be remediated and disposed at an appropriate off-site facility.

If you have any questions regarding this letter, please contact Lynn Nakashima at (510) 540-3839.

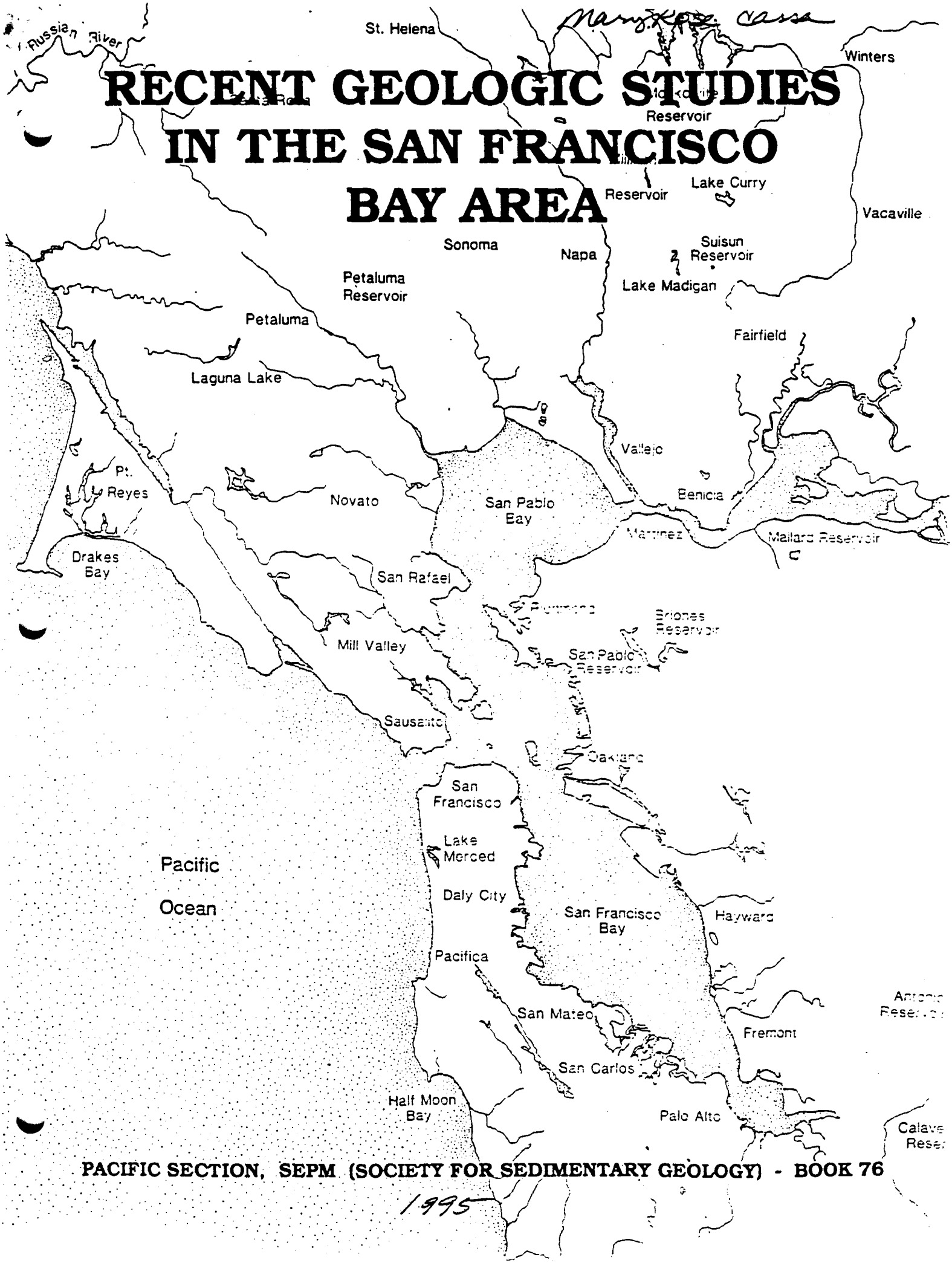
Sincerely,

Barbara J. Cook

Barbara J. Cook, P.E., Chief
Site Mitigation Branch

cc: See next page

RECENT GEOLOGIC STUDIES IN THE SAN FRANCISCO BAY AREA



PACIFIC SECTION, SEPM (SOCIETY FOR SEDIMENTARY GEOLOGY) - BOOK 76

1995

BACKGROUND METAL CONCENTRATIONS IN SOILS IN NORTHERN SANTA CLARA COUNTY, CALIFORNIA

Christina M. Scott
Lockheed Missiles & Space Company, Inc.
1111 Lockheed Way
Sunnyvale, CA 94089

ABSTRACT

Soil analytical data were evaluated to determine the natural background levels or baseline concentrations of selected metals in an area of northern Santa Clara County, California. The metals of interest are those designated by the U.S. Environmental Protection Agency as priority pollutants: silver, arsenic, beryllium, cadmium, chromium, copper, mercury, nickel, lead, antimony, selenium, thallium and zinc. These metals are naturally occurring in soil and their presence makes it difficult to evaluate potential contamination. The soil data used in this study were obtained from pre-existing environmental investigation reports. Results from over 150 samples were entered into a database. The average, standard deviation and range of concentrations for each metal were calculated, except in cases where the metal was not present above the laboratory analytical detection limit in at least fifty percent of the samples.

The ranges of background metal concentrations (in milligrams per kilogram) were found to be as follows: arsenic 0.2 to 5.5; beryllium 0.3 to 1.4; chromium 30.5 to 72; copper 23.8 to 47.5; nickel 46.4 to 101; lead 6.8 to 16.1; and zinc 47.7 to 82.8.

The background metal concentrations in the study area were at the low range of metals concentrations reported by the U.S. Geological Survey in a nation-wide study.

INTRODUCTION

Increasing environmental awareness and regulations have prompted many property owners to conduct soil investigations to determine if contamination is present beneath their facilities. Unlike many contaminants, metals occur naturally in the environment. Because of their natural occurrence and the need to understand concentrations that represent contamination, this research examined analytical results from environmental investigations to develop a database of the naturally occurring background levels of selected metals in soils. The metals examined are those designated by the U.S. Environmental Protection Agency (EPA) as priority pollutants.

Natural variations in the composition of soils are significant based on data compiled by the U.S. Geological Survey (USGS) from sites across the country (Shacklette and Boerngen, 1984). In order to minimize observation of the inherent natural differences in soil composition, the subject research was restricted to a limited area in northern Santa Clara County, California within a two-mile radius of the intersection of California State Highways 101 and 237 in Mountain View and Sunnyvale (Fig. 1).

This area contains light industrial and research facilities, many of which are in aerospace and computer technologies. Prior to development, the land use was primarily small farms and orchards. The area is well-suited to agriculture due to its flat to gently sloping topography and Mediterranean climate (U.S. Soil Conservation Service (SCS), 1968).

METHODOLOGY

The laboratory analytical data used for this research were derived from environmental investigation reports prepared by several independent researchers. These reports were prepared for private firms under the guidelines of government regulatory agencies. The information is considered public, but has never been published.

Metals data contained within these reports were tabulated and an arithmetic mean calculated for each metal, except in cases where it was not present above the laboratory's analytical detection limit. One standard deviation on either side of the mean is defined as the range of background concentrations for this research. This range encompasses 68 percent of the reported values.

GEOLOGIC SETTING

The orogenic development of the Santa Clara Valley is a major factor in the chemical composition of

in Sanginés, E.M., Andersen, D.W., and Buising, A.B., eds., 1995, Recent Geologic Studies in the San Francisco Bay Area: Pacific section S.E.P.M., Vol. 76, p. 217-224.

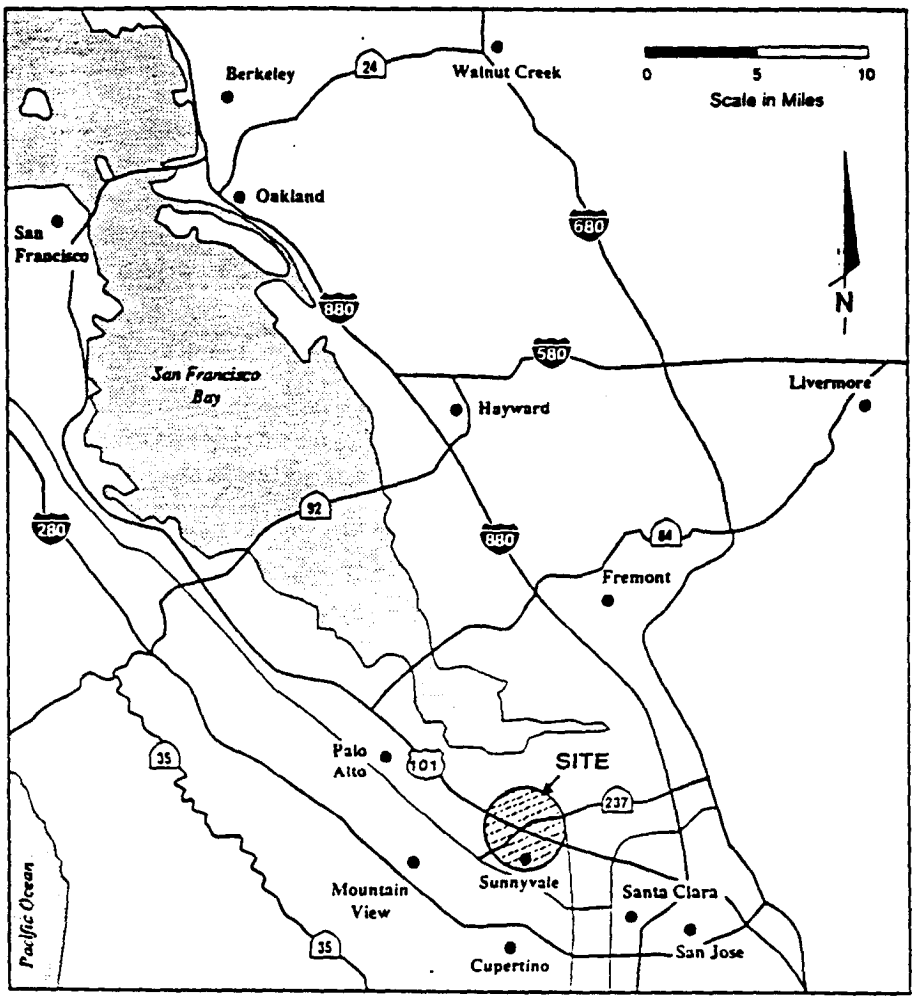


Figure 1. Area location map.

its soils. The geology of the basin and its physical characteristics are presented here in order to establish a basis for understanding the background data.

San Francisco Bay is the dominant physiographic feature of the Central Coast Region of California. The southern end of the bay lies within the Santa Clara Valley, a northwest-southeast trending basin that extends about 30 miles from south San Jose to San Mateo. The valley is bounded on the northeast by the Diablo Range, including Mount Hamilton, and on the southwest by the Santa Cruz Mountains. Alluvial fans of debris eroded from these mountain ranges formed along the edges of the valley (Helley and others, 1979). These gently sloping fans merge with the San Jose Plains and the marshes and wetlands adjaçent to San Francisco Bay.

Regional Stratigraphy

The oldest rocks of the northern California Coast Range sediments are the highly deformed, muddy sandstones and shales of the Franciscan Complex (Jennings and Burnett, 1961). These sediments were deformed and brecciated when they were scraped off the sea floor in the subduction zone. There are also submarine basalt flows incorporated into the Franciscan Complex (Dibblee, 1966).

The Coast Ranges contain serpentine, which is associated with, but separate from, the Franciscan rocks. It is extremely fractured and shows evidence of intrusion into existing rocks. Mercury and manganese have been mined from serpentine rocks in the Coast Ranges (Oakeshott, 1966).

Tertiary deposits topping the Coast Range are fossil-bearing marine sandstones and shales, with some basalt flows and sills. Southwest of the San Andreas fault in northern Santa Clara County, the Lambert Shale and the Vaqueros Sandstone of Oligo-Miocene age predominate (Dibblee, 1966).

Ringing the western edge of the Santa Clara Valley proper is the Quaternary Santa Clara Formation. These non-marine sedimentary rocks vary from lake

bed deposits to cobble conglomerates. In the vicinity of Stevens Creek Dam, the Santa Clara Formation has been measured at over 2,000 feet thick (Dibblee, 1966).

The alluvial fans emanating from the Santa Cruz Mountains and the Diablo Range have formed extensive valley fills. This Quaternary alluvium consists of unconsolidated stream bed gravels, sands, and silts. The valley floor is made up of recent flood plain deposits interfingering with marine muds near San Francisco Bay.

Site Stratigraphy

The surficial deposits in the project area have been mapped as recent alluvium (Helley and others, 1979). They range from fine-grained to coarse-grained unconsolidated alluvial fan deposits and are less than 5,000 years old. The soil units in this area have been mapped as Sunnyvale silty clay (SCS, 1968). The uppermost 50 to 100 feet of sediment contain lenticular and discontinuous layers. Deposits grade laterally and vertically from gravels and sands, which were formed by stream channels and levees, to medium-grained sands and silts in the flood plains between the ancestral Stevens Creek and San Francisquito and Calabasas Creeks. These deposits grade into and interfinger with fine-grained deposits of organic-rich silts and clays that originated in the lowland marshes and bay margins. These individual units of gravel, sand, silt, and clay range from a few inches to a few feet in thickness and may change laterally over only tens of feet (McLaren, 1987).

The deeper alluvium is comprised of unconsolidated clays, silts, and sands that are similar to the overlying recent alluvium. These Pleistocene deposits are slightly more consolidated than the shallow sediments (Helley and others, 1979) due to their age and thickness, which is approximately 150 to 200 feet in the study area. The Pleistocene sediments overlie the more coarse-grained Santa Clara Formation.

BACKGROUND

Determinations of Soil Background

When conducting environmental investigations, it is often desirable to determine if the soil contains a compound at a level above the naturally occurring background. For synthetic chemicals and petroleum hydrocarbons, the background concentration level of soil is assumed to be zero or below the analytical detection limit. In the case of most metals, there is a wide variability in the background level. Other researchers have investigated this subject in different manners, as described below.

The USGS conducted a study to investigate the concentration levels of 46 elements in soils from sites across the U.S. (Shacklette and Boerngen, 1984). Over 1,300 samples were collected by many USGS personnel at approximately equal spacings of 50 miles, usually near a highway, during other field programs or trips and were selected in unaltered natural soil material whenever possible. These samples were analyzed in a laboratory to determine the concentration of each of the 46 elements selected and the results were tabulated and plotted on maps. The study found the elements have a wide variety in the detected concentration ranges as well as in geographic distribution as noted in map view.

Other researchers have identified specific source areas to explain the background levels of selected metals. A study in the Salinas Valley of Central California (Majmundar, 1980) correlated the heavy metal content of stream sediment with the geology of the area to determine which bedrock units were sources of the anomalously high metal values. The study found that five (mercury, arsenic, cadmium, copper and zinc) of the six metals tested for could be correlated to Middle Miocene marine rocks as their source. High concentrations of cadmium were associated with phosphate beds of the Monterey and Pancho Rico Formations. Only lead seemed to be randomly distributed.

A similar study in western Fresno County, California analyzed 43 elements in soil samples to identify associations between element occurrences and source materials (Tidball and others, 1989). Five associations were identified and traced to their source rocks. One of these, containing dominant elements of nickel, magnesium, chromium, cobalt, manganese, and iron, was found to be derived from serpentine rocks located in the Diablo Range. This association was even more pronounced in finer-textured soils.

At Moffett Federal Airfield (formerly Moffett Field Naval Air Station), Mountain View, California, extensive environmental sampling was performed to characterize soil and groundwater contamination. An environmental investigation report (HAZWRAP, 1990) presented typical ranges for metal concentration levels in soil at Moffett. These ranges were determined by using one standard deviation above and below the lowest mean of four sets of data representing different

subsurface elevations.

THIS STUDY

Data Evaluation

Analytical results for up to 158 soil samples were selected for inclusion in this study based on a search of the California Regional Water Quality Control Board (RWQCB) document files and interviews with regulators, property owners, and environmental consultants. The number of samples included in this study varied between 104 and 158, because not all of the samples were analyzed for all thirteen priority pollutant metals. The samples used were collected from 25 locations (Fig. 2). Several of the sites are located close together and are not indicated separately on the map. Sample depths range from 6 inches to 65 feet below ground surface.

Samples were carefully evaluated before inclusion in the database. The land use histories of many sites were researched to exclude any samples that may have been contaminated with metals. In a few studies, a separate sample had been collected in an area of the site thought to be representative of the natural background.

Table 1 presents analytical data for the soil samples evaluated. The levels of the thirteen priority pollutant metals are expressed as milligrams of a metal per kilogram of soil (mg/kg). This is commonly referred to as parts per million (ppm). The average, or arithmetic mean, of each detected metal is shown in the top row of Table 1. The standard deviation of each detected metal is shown in the second row. The range, which appears in the next row, is the mean, plus and minus one standard deviation. The minimum and maximum values reported for each metal are shown. If the sample results include a non-detected value, the minimum is shown as "<DL", less than detection limit. The number of samples that contained detectable levels versus the total number of samples is provided in the next row. For example, in the silver column 18/129 indicates that silver was detected in 18 of the 129 samples analyzed for silver. Finally, the U.S.

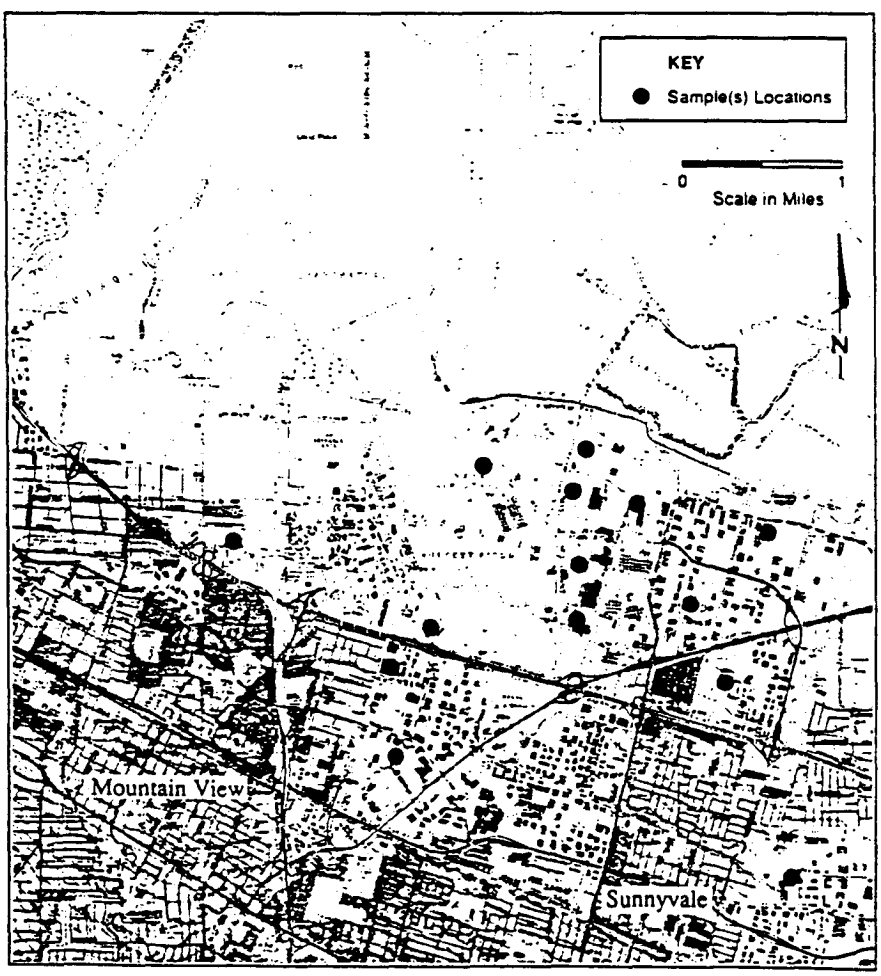


Figure 2. Sample location map (U.S.G.S. Mountain View, 7.5 minute quadrangle, 1961).

TABLE 1. Summation of statistical data for soil samples

	average	standard deviation	range	minimum value	maximum value	>DL/ total	US average
Ag	NC	NC	NC	<DL	4.8	18/129	NC
As	2.86	2.61	0.2-5.5	<DL	20	95/108	7.2
Be	0.88	0.55	0.3-1.4	<DL	3.2	94/158	0.92
Cd	NC	NC	NC	<DL	14	51/158	NC
Cr	51.28	20.77	30.5-72.0	<DL	170	51/158	NC
Cu	35.63	11.85	23.8-47.5	4.6	67	136/136	25
Hg	NC	NC	NC	<DL	1.3	29/127	0.09
Ni	73.53	27.15	46.4-101	6	145	136/136	19
Pb	11.43	4.66	6.8-16.1	<DL	54	135/158	19
Sb	NC	NC	NC	<DL	22	50/104	0.66
Se	NC	NC	NC	<DL	4	16/108	0.39
Tl	NC	NC	NC	<DL	3.8	42/108	NC
Zn	65.27	17.55	47.7-82.8	7.8	120	136/136	60

NOTES: All units are mg/kg.
average = arithmetic means of samples with detectable concentrations.
NC = Not Calculated
range = average ± one standard deviation
<DL = less than detection level
>DL/total = ratio of number of samples above detection level to total number analyzed
US average = Shacklette and Boerngen (1984) averages for United States soils

average concentration of each metal, as reported in Shacklette and Boerngen (1984), is included in the final row.

The Treatment of Non-detectable Concentrations

In this study, non-detected samples were omitted from the statistical calculations of the means. Only values greater than the analytical detection limit were summed to find the average value. Other environmental researchers sometimes substitute the analytical detection limit or a fraction thereof into the calculation of the mean. No standard method has been established.

Disregarding sample results below the analytical detection limit introduces a bias in the calculation of the average. It can become significant. The bias introduced into the mean by omitting the non-detected samples is the primary reason that the statistics of average, standard deviation and range are not presented for silver, cadmium, mercury, antimony, selenium, and thallium. These six metals had concentrations that were below the detection limits in more than half of the analyses. For the other metals, which had fewer values below the detection limits, this bias is considered insignificant.

Factors Affecting the Data

Metal concentrations in soil at a specific site are influenced by several factors to varying degrees. These factors include sample collection and analysis methods, natural soil variations, and man-caused impacts to the soil. All these factors contribute to the wide range of concentrations found in the data, thus the natural background levels are presented as ranges.

Another important factor affecting the concentrations of metals in soil is the composition of the parent or source material of the soil. Samples selected for this research were drawn from soils deposited by Stevens Creek. Stevens Creek drains the Monte Bello Ridge and Black Mountain areas of the Santa Cruz Mountains into the Santa Clara Valley. These source areas are composed of Franciscan sandstones and greenstones. Stevens Creek has eroded through them into the rift valley of the San

Andreas fault. In the rift valley, Stevens Creek traverses over marine sandstones and shales of Oligocene-Miocene age along with diabase, serpentine and Franciscan shale (Dibblee, 1966).

Trace elements (which include the priority pollutant metals) are more abundant in fine-grained sediments than in coarse-grained sediments (Dong and others, 1984). In igneous rocks, higher concentrations of trace elements are found in mafic or ferro-magnesian minerals due to ionic substitution (Krauskopf, 1967). Therefore, the more mafic the source material, the higher the trace element composition of the sediment.

RESULTS

Silver

Silver was detected, at a maximum concentration of 4.8 mg/kg, in only 18 of the 129 samples analyzed for this metal. Because of its very low concentration, silver content was determined too seldom to provide a statistically representative mean concentration. A nation-wide study completed by the USGS (Shacklette and Boerngen, 1984) reached the same conclusion. Dragun (1988) lists the typical range for silver in native soil to be 0.1 to 5.0 ppm.

Arsenic

Arsenic was detected in 95 of the 108 samples analyzed for this metal. The average arsenic concentration calculated is 2.86 mg/kg. The range, plus and minus one standard deviation of the mean, of naturally occurring arsenic is 0.2 to 5.5 mg/kg. Shacklette and Boerngen (1984) reported a range of arsenic content from less than 0.1 to 97 ppm, with an average of 7.2 ppm. Dragun (1988) described the typical range of arsenic as being from 1.0 to 40 ppm.

This research found that the range of arsenic in the study area is within, albeit at the low end, of these nation-wide ranges. The average is significantly lower than those reported by other researchers.

Beryllium

Of the 158 samples analyzed for this metal, beryllium was detected in 94. The average concentration is 0.88 mg/kg, and the concentration range is 0.3 to 1.4 mg/kg. This range of background concentrations is within the low end of the ranges given by Shacklette and Boerngen (1984) of less than 1 to 15 ppm and by Dragun (1988) of 0.1 to 40 ppm. Average beryllium contents measured during this research match the results of Shacklette and Boerngen (1984).

Cadmium

Cadmium was found in only 51 of the 158 samples analyzed, at a maximum concentration of 14 mg/kg. Because the majority of samples did not contain detectable cadmium, an average and standard deviation are not shown for this metal. The levels of cadmium detected in the eastern third of the study area appear to be higher than those in the other areas. Dragun (1988) reported that cadmium concentrations in native soil vary from 0.01 to 7.0 ppm. This element was identified too infrequently in a USGS study (Shacklette and Boerngen, 1984) for a mean concentration to be calculated, although these researchers did report that a sample collected in the Santa Clara Valley had a concentration of 10 ppm of cadmium.

Chromium

The average value of chromium is 51.28 mg/kg, and the range is from 30.5 to 72.0 mg/kg. This range of chromium concentrations is within the commonly referenced USGS study's wide spread of between 1 and 2,000 ppm. The arithmetic mean of the USGS data, 54 ppm, and this study's data are very close (Shacklette and Boerngen, 1984).

Copper

The arithmetic mean of copper is 35.63 mg/kg and the range is 23.8 to 47.5 mg/kg. The USGS report (Shacklette and Boerngen, 1984) calculated an average value for copper that was 10 ppm lower, although their range in copper content was wider than that found here, from less than 1 to 700 ppm. The copper level of 35.63 mg/kg calculated in this study is high, even when compared to other California surface sediments. The Salinas Valley was found to contain an average of 5 ppm of copper in the alluvium, 20 ppm in the stream sediments, and up to 32 ppm in Miocene marine bedrock formations. The only samples that contained average levels of copper higher than those found in this research were from phosphatic beds in the Miocene and Pliocene rocks (Majmundar, 1980).

Mercury

Mercury was found above the analytical detection

limit in only 29 of the 127 samples. The detection limits for mercury, which are frequently lower than for other metals, ranged from 0.02 to 0.5 mg/kg. The maximum concentration of mercury in these samples was 1.3 mg/kg. An average, standard deviation, and range of mercury in soil for the study area was not determined, because of the small number of samples in which this metal was detected. Other researchers have reported mercury content in soils to be from less than 0.01 to 0.08 ppm (Dragun, 1988) and to 4.6 ppm (Shacklette and Boerngen, 1984).

Nickel

All of the 136 samples tested for nickel contained measurable quantities of this metal. The average and standard deviation of the samples are 73.53 mg/kg and 27.15 mg/kg, respectively. The range of background levels is from 46.4 to 100.7 mg/kg. Nickel's average concentration level is significantly above the 19 ppm average reported by the USGS, but the range is within the lower ranges of background levels published by both the USGS (less than 5 to 700 ppm) and Dragun (5 to 1,000 ppm).

Lead

Lead was detected at an average concentration of 11.43 mg/kg. With a standard deviation of 4.66 mg/kg, the background range is 6.8 to 16.1 mg/kg. On a national scale, the lead content of soils was found to range from less than 10 up to 700 ppm (Shacklette and Boerngen, 1984) and from 2 to 200 ppm by Dragun (1988). The average lead content of the soils in this study is less than the national average of 19 ppm presented by the USGS researchers (Shacklette and Boerngen, 1984).

Antimony

Antimony was detected in 50 of the 104 samples, at a maximum concentration of 22 mg/kg. Because slightly less than half of the samples contained detectable concentrations, the average value of 3.53 mg/kg may not be a representative background concentration. The background level ranges presented by Shacklette and Boerngen (1984) are less than 1 to 8.8 ppm and Dragun (1988) are 0.6 to 10 ppm.

Selenium

Selenium was detected in only 16 of the 108 samples tested for this metal. The detection limit ranged from 0.2 to 4 mg/kg. The natural background level of selenium in the study area cannot be determined based on this limited information. Selenium has been found to be present only at very low concentrations in other studies. The USGS testing reports a range of selenium from less than 0.1 to 4.3 ppm (Shacklette and Boerngen, 1984), while Dragun (1988) reports an even lower range of 0.1 to 2 ppm.

Thallium

Thallium was found in measurable quantities in 42 of 108 samples. The analytical detection limits ranged from 0.2 to 5 mg/kg. The highest value of thallium detected in these samples was 3.8 mg/kg. Because of the high percentage of samples with non-detectable concentrations, an average and range of background concentrations of thallium were not calculated in this study. None of the other studies referenced in this report presented a background level for thallium in soil. The concentration of thallium in the Earth's crust has been described as 0.45 ppm, in basalt as 0.1 ppm, and in shale as 1 ppm by Krauskopf (1967).

Zinc

The average zinc concentration detected is 65.27 mg/kg. The range, encompassing two standard deviations, is 47.7 to 82.8 mg/kg. Although the range of zinc concentrations reported in the USGS study (Shacklette and Boerngen, 1984) is much wider, from less than 5 to 2,900 ppm, the arithmetic means of both data sets are very close, 60 and 65.27 ppm.

SUMMARY AND CONCLUSIONS

Laboratory analytical data from soil samples not impacted by metal contamination were collected in areas of northern Santa Clara County and were compiled to determine the natural range of background concentrations of EPA priority pollutant metals. Establishing background, or baseline, concentrations is important for differentiating naturally occurring metal concentrations from potentially contaminated soils. Background levels are best expressed as ranges of concentrations, not as specific values, to reflect the natural variations in soil composition. This research defined the range as being one standard deviation below and above the mean.

This research compiled metals results for 158 soil samples collected during previous investigations. The average and range of concentrations, respectively, that were calculated (in mg/kg) in this study were as follows:

arsenic 2.86 and 0.2 to 5.5,
beryllium 0.88 and 0.3 to 1.4,
chromium 51.28 and 30.2 to 72,
copper 35.63 and 23.8 to 47.5,
nickel 73.53 and 46.4 to 101,
lead 11.43 and 6.8 to 16.1, and
zinc 65.27 and 47.7 to 82.8.

The concentrations of silver, cadmium, mercury, antimony, selenium, and thallium in the soils were found to be below the analytical detection limits in the majority of the samples and their averages and ranges were therefore not calculated.

Natural variations in the metal concentrations of soils can be significant and are a function of the texture, composition and origin of the soils. The surface sediments in the lowlands areas near San Francisco Bay in northern Santa Clara County, California are mapped as recent fine-grained alluvium (Helley and others, 1979) derived from the Santa Cruz Mountains. The results of this research were compared to a USGS study (Shacklette and Boerngen, 1984) of analytical data for over 1,300 surface soil samples from across the United States and work performed by Dragun (1988). Comparisons with other studies revealed that northern Santa Clara Valley soils have metal concentrations within the ranges found by the other researchers. However, the average concentrations of the local soils were significantly higher for copper and nickel, and lower for arsenic and lead than in the nation-wide studies.

REFERENCES CITED

Dibblee, T.W., Jr., 1966, Geology of the Palo Alto quadrangle, Santa Clara and San Mateo Counties: California, California Division of Mines and Geology, map sheet 8, 1:62,500.

Dong, A., Chesters, G. and Simsiman, G.V., 1984, Metal composition of soil, sediments, and urban dust and dirt samples from the Menomonee River watershed, Wisconsin, U.S.A.: Water, Air and Soil Pollution, v. 22, p. 257-275.

Dragun, J., 1988, The soil chemistry of hazardous materials: Hazardous Materials Control Research Institute, Silver Springs, Maryland.

HAZWRAP Support Contractor Office, 1990, Phase I characterization report (draft), Naval Air Station, Moffett Field, California: Martin Marietta Energy Systems, Oak Ridge, Tennessee.

Helley, E.J., Lajoie, K.R., Spangle, W.E. and Blair, M., 1979, Flatland deposits of the San Francisco Bay region, California - their geology and engineering properties, and their importance to comprehensive planning: U.S. Geological Survey Professional Paper 943, p. 45-50.

Jennings, C.W. and Burnett, J.L., 1961, San Francisco sheet, Geologic map of California: California Division of Mines and Geology, 1:250,000.

Krauskopf, K.B., 1967, Introduction to geochemistry: New York, McGraw-Hill, 721 p.

Majmundar, H.H., 1980, Distribution of heavy elements hazardous to health, Salinas Valley region, California: California Division of Mines and Geology, Sjpecial Report 138, 57 p.

McLaren Environmental Engineering, 1987, Groundwater characterization phase I results and phase II work plan, Lockheed Missiles and Space Company plant one site, Sunnyvale, California: McLaren Environmental Engineering, Rancho Cordova, California.

Oakeshott, G.B., 1966, San Andreas fault in the Coast Ranges province, in E.H. Bailey, ed., Geology of Northern California, Bulletin 190: California Division of Mines and Geology, p. 357-374.

Shacklette, H.T. and Boerngen, J.T., 1984, Element concentrations in soils and other surficial materials of the coterminous United States: U.S. Geological Survey Professional Paper 1270, p. 4-7.

Tidball, R.R., Severson, R.C., Gent, C.A. and Riddle, G.O., 1989, Element associations in soils of the San Joaquin Valley of California, in L.W. Jacobs, ed., Selenium in agriculture and the environment, Soil Sci. Soc. of Amer. special publication no. 23: Soil Sci. Soc. of Amer., p. 179-193.

U.S. Geological Survey, 1961, Mountain View quadrangle California, 7.5 minute series topographic map: California Division of Mines and Geology, 1:24,000.

U.S. Soil Conservation Service, 1968, Soils of Santa Clara County: U.S. Government Printing Office, p.14-287.

3/12/91 RI Report
Hercules Properties, Lig. Site

TABLE 4-4

OFF-SITE BACKGROUND OF METAL CONCENTRATIONS[a]
(ppm)

METALS	OFF-SITE BACKGROUND[a]			PREVIOUS BACKGROUND[b]			WESTERN U.S. (FROM U.S. E.P.A.)		DHS TTLC
	MINIMUM	MAXIMUM	MEAN[c]	MINIMUM	MAXIMUM	MEAN[c]	COMMON RANGE	AVERAGE	
Arsenic	3.9[c]	16[c]	8.3[c]	2.8	5.1	<4.1	1-50	5	500
Cadmium	ND	4.3	1	<0.1	0.8	<0.9	0.1 - 0.7	0.6	100
Chromium	0.2	18	10	10	29	16.4	1 - 1,000	100	2500
Copper	5.2	61	22	4	13	7.2	2 - 100	30	2500
Lead	ND	220	32.4	15	130	61	20 - 100	10	1000
Mercury	0.04	0.52	0.14	ND	0.12	<0.11	0.01 - 0.3	0.03	20
Nickel	6.4	26	16	18[d]	18[d]	18[d]	5 - 500	40	2000
Zinc	14	300	65	18	100	67.2	10 - 300	50	5000
pH	5.5	8.2	NP	NA	NA	NA	NP	NP	NE

ND= Not detected
NA= Not available
NE= TTLC not established
NP= Not applicable

[a] Analyzed by EPA Method 6000/7000 Series.
[b] Based on 23 samples.
[c] The arithmetic mean was calculated by using 1/2 of the detection limit value wherever a non-detection was reported.
[d] Based on 11 samples from EnviroSearch site survey.
[e] Based on 8 samples.
[f] Based on 2 samples.

0212AMD5

Protocol for Determining Background Concentrations of Metals in Soil at Lawrence Berkeley National Laboratory (LBNL)

A Joint Effort of
Environment, Health and Safety Division and
Earth Sciences Division
Lawrence Berkeley National Laboratory
University of California
Berkeley, CA 94720

August 1995

This work was done at the Lawrence Berkeley National Laboratory, which is operated by the University of California for the U. S. Department of Energy under contract DE-AC03-76SF00098.

Lawrence Berkeley National Laboratory
UNIVERSITY OF CALIFORNIA

ENVIRONMENTAL RESTORATION PROGRAM

Protocol for Determining Background Concentrations of Metals in Soil at Lawrence Berkeley National Laboratory (LBNL)

August 1995

Protocol for Determining Background Concentrations of Metals in Soil at Lawrence Berkeley National Laboratory (LBNL)

Background concentrations for metals in soil at LBNL were determined in accordance with procedures described in "Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities" Interim Final Guidance, United States Environmental Protection Agency (EPA), February 1989 (PB89-151047). The background concentration was defined as the 95% upper confidence limit (UCL). A tolerance coefficient of 95%, as recommended in the EPA guidance document, was used to determine the 95% UCL, which was used to define the background levels. This means that one has a confidence level of 95% that the 95% UCL will contain at least 95% of the distribution of observations from the background data.

The upper confidence limit for background data that follows a normal distribution can be calculated by the formula:

$$UCL = X_{av} + K\sigma$$

where:

UCL	=	the upper confidence (tolerance) limit
X_{av}	=	the arithmetic mean
σ	=	the standard deviation
K	=	the one sided normal tolerance factor

Background concentrations were determined from the 95% upper confidence limit for the following California Code of Regulations (CCR) Title 22, California Assessment Manual (CAM) 17 metals:

1. antimony (Sb)
2. arsenic (As)
3. barium (Ba)
4. beryllium (Be)
5. cadmium (Cd)
6. chromium (Cr)
7. cobalt (Co)
8. copper (Cu)
9. lead (Pb)
10. mercury (Hg)
11. molybdenum (Mo)
12. nickel (Ni)
13. selenium (Se)
14. silver (Ag)
15. thallium (Tl)
16. vanadium (Vn)
17. zinc (Zn)

Site background concentrations were determined from the data set of 498 soil samples from the borings for construction of 71 monitoring wells. Samples from two monitoring wells, MW7-94-3 and MW77-92-10, which were installed in areas of potential metals contamination were excluded from the data set. In addition, the data set was reviewed for extreme outliers and those values were also excluded from the data set. The data used for the calculation of background concentrations are included in Table 1. The arithmetic mean (X_{av}) and standard deviation (σ) were calculated by assigning a value of the detection limit for all analytes with non-detectable concentrations. The one-sided normal tolerance factor (K) for the 95% UCL was obtained from Table 5, Appendix B of the EPA guidance document. This tolerance factor (K) is dependent on the number of the samples in the data set. Values of X_{av}, σ, and K used to calculate background concentrations are listed in Table 2.

The same data set was also used to calculate background concentrations (95% UCL) of metals for individual geologic units at LBNL, in order to assess if there is a geological dependent variation in background metals concentrations. Background concentrations were determined for the following geologic units:

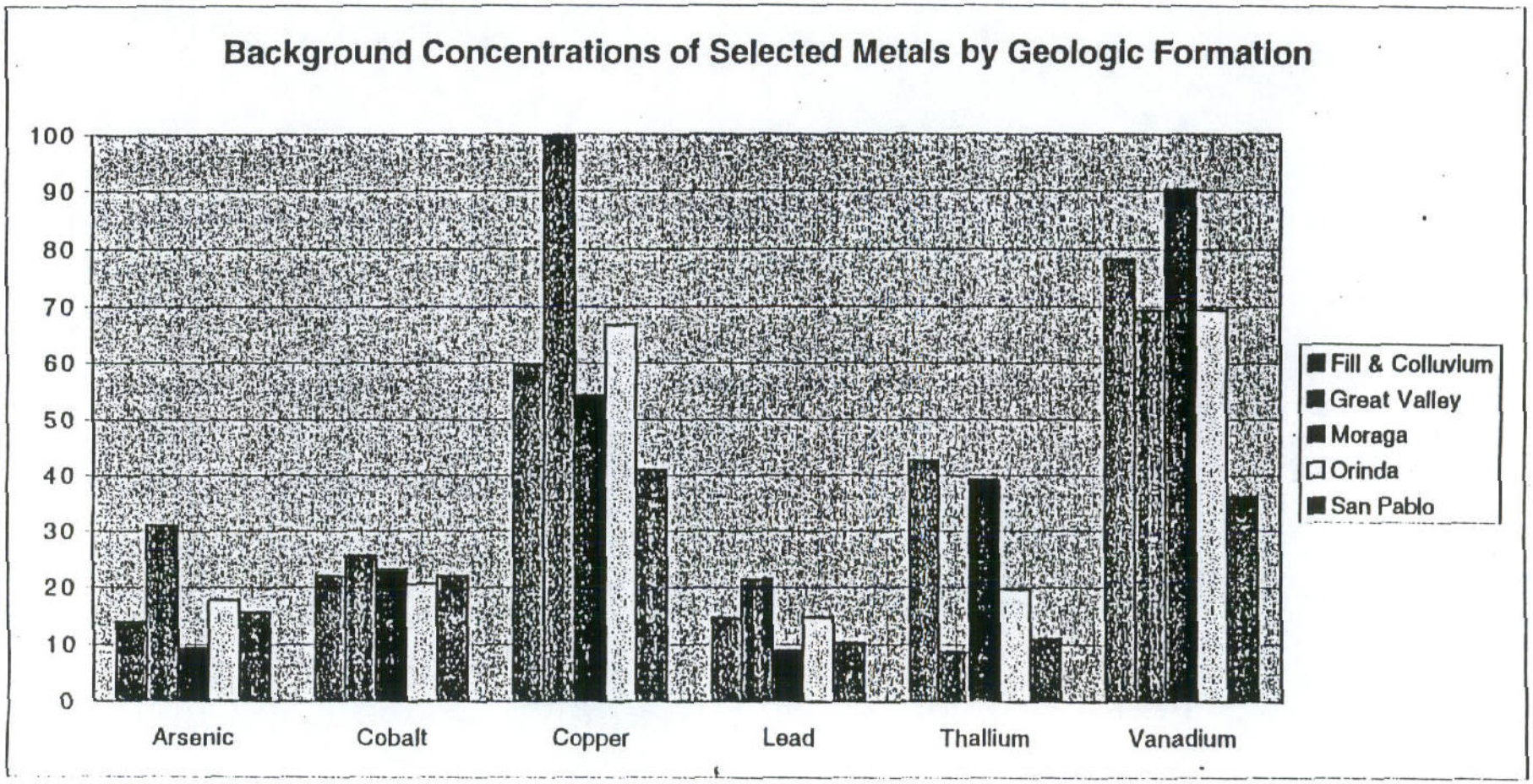
- Colluvium/Fill
- Moraga Formation
- Orinda Formation
- San Pablo Group
- Great Valley Group

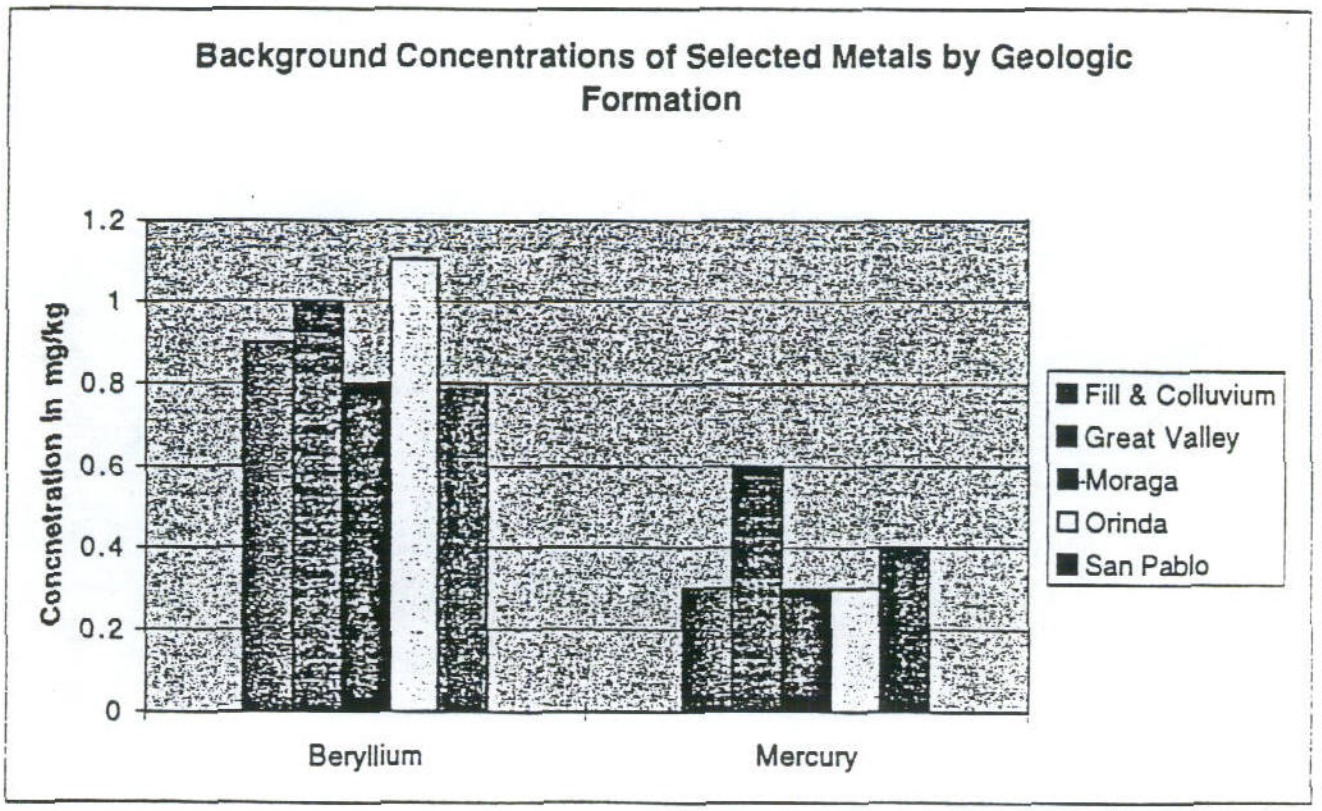
The calculated site background metals concentrations and the background concentrations for individual geologic units are listed in Table 3. The background concentrations for the geologic units are also presented graphically on chart 1 (arsenic, cobalt, copper, lead, thallium, and vanadium), chart 2 (beryllium and mercury), chart 3 (cadmium, antimony, selenium, silver, and molybdenum), and chart 4 (nickel, chromium, zinc, and barium). Since the background concentrations are generally similar for the different geologic units and since the specific formation corresponding to the sample location is not always known, overall site background levels will generally be utilized for requesting No Further Investigation (NFI) status for LBNL's Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs). Background metals concentrations for specific geologic units with background concentrations significantly greater than site background may also be used in some cases to request NFI status, including:

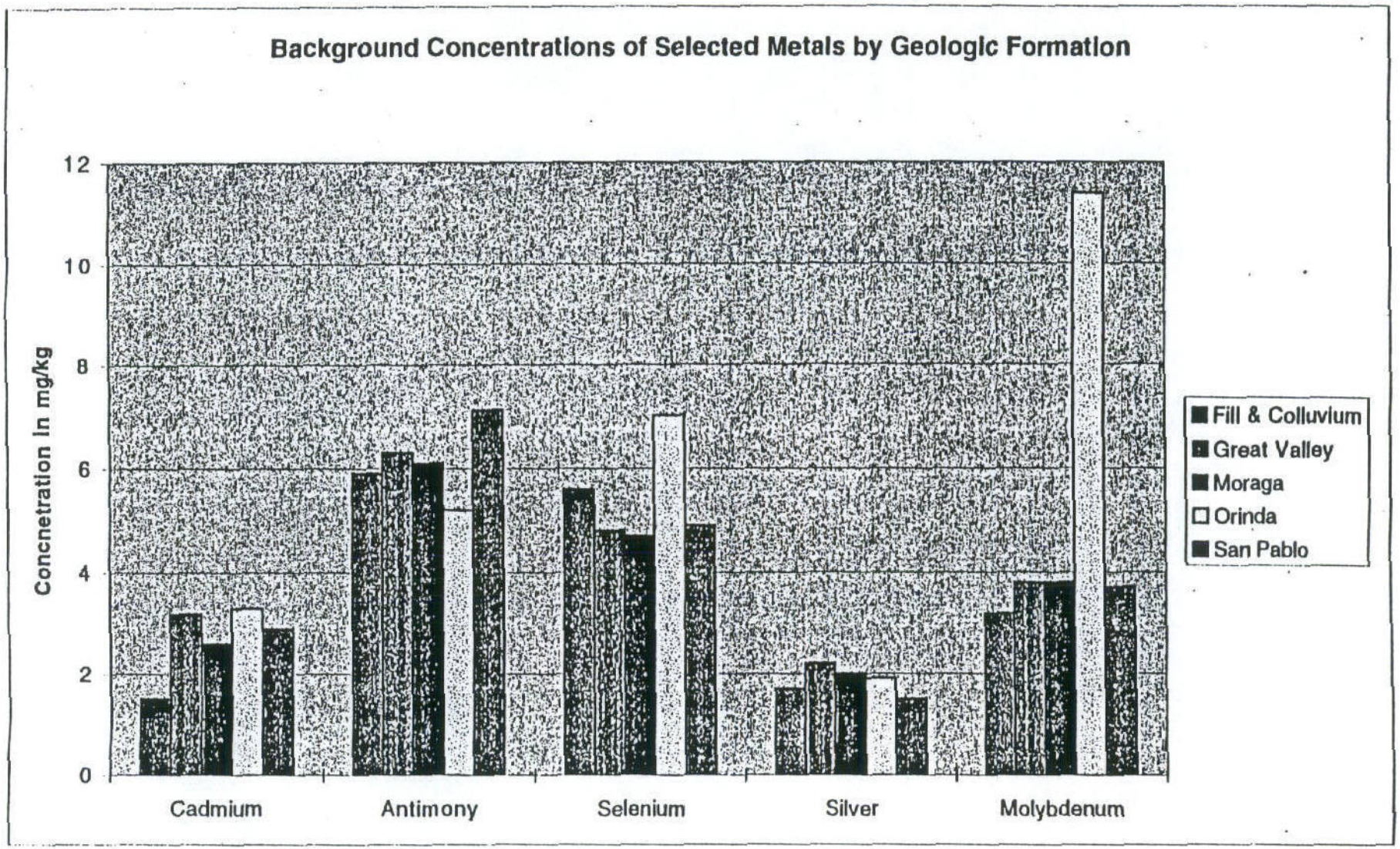
- Arsenic in Great Valley Group rocks
- Thallium in fill/colluvium and Moraga Formation rocks
- Molybdenum and selenium in Orinda Formation rocks
- Copper in Great Valley Group rocks

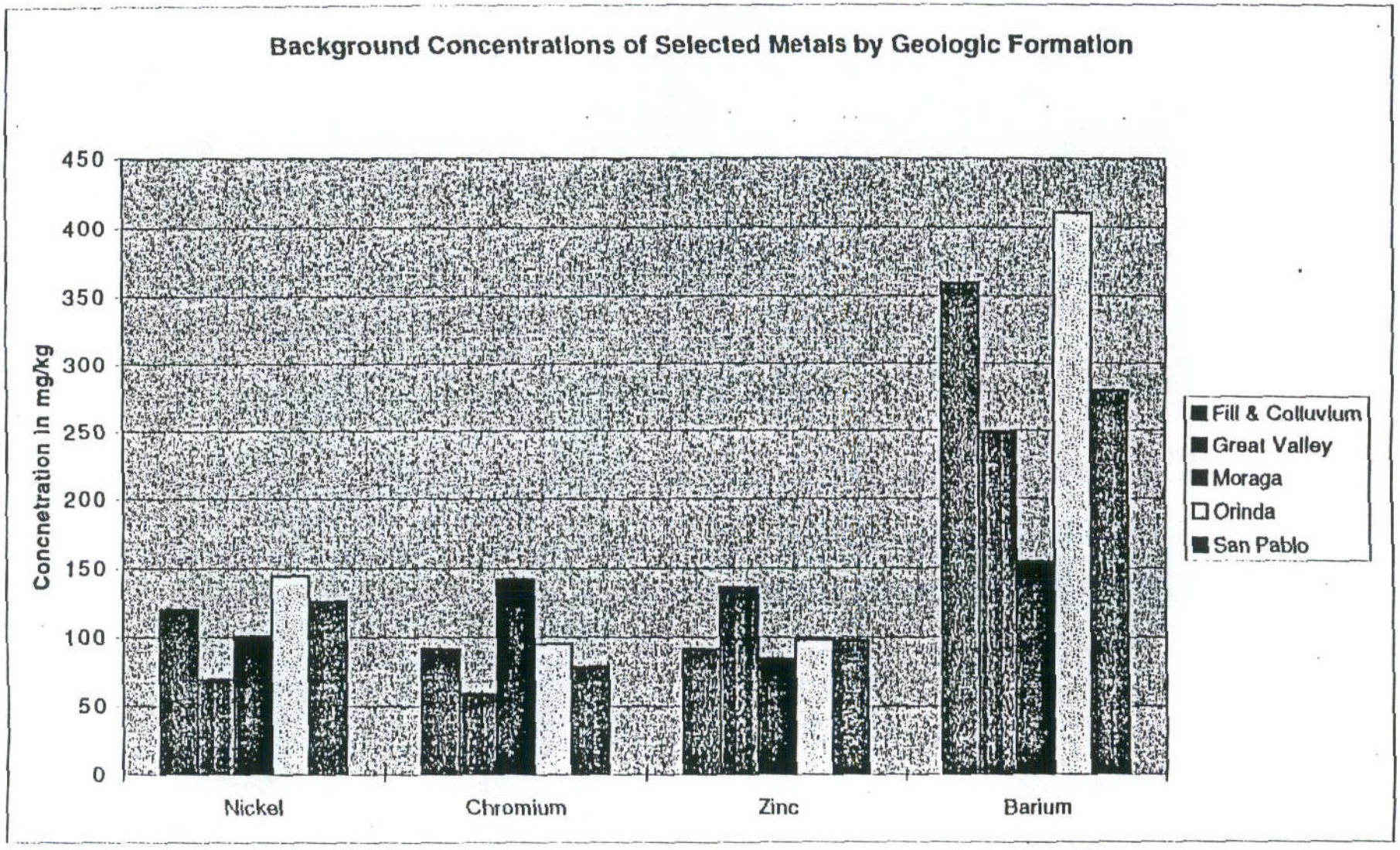
LIST OF FIGURES

		Page
Figure 1.	Background Concentrations of Selected Metals by Geologic Formation Chart 1: Arsenic, Cobalt, Copper, Lead, Thallium, Vanadium	4
Figure 2.	Background Concentrations of Selected Metals by Geologic Formation Chart 2: Beryllium, Mercury	5
Figure 3.	Background Concentrations of Selected Metals by Geologic Formation Chart 3: Cadmium, Antimony, Selenium, Silver, Molybdenum	6
Figure 4.	Background Concentrations of Selected Metals by Geologic Formation Chart Chart 4: Nickel, Chromium, Zinc, Barium	7


Background Concentrations of Selected Metals by Geologic Formation
100
90
80
70
60
50
40
30
20
10
0
Arsenic
Cobalt
Copper
Lead
Thallium
Vanadium
Fill & Colluvium
Great Valley
Moraga
Orinda
San Pablo


Background Concentrations of Selected Metals by Geologic Formation
Concnetration in mg/kg
1.2
1
0.8
0.6
0.4
0.2
0
Beryllium
Mercury
Fill & Colluvium
Great Valley
Moraga
Orinda
San Pablo


Background Concentrations of Selected Metals by Geologic Formation
Concnetration In mg/kg
0
2
4
6
8
10
12
Cadmium
Antimony
Selenium
Silver
Molybdenum
Fill & Colluvium
Great Valley
Moraga
Orinda
San Pablo


Background Concentrations of Selected Metals by Geologic Formation
Concnetration in mg/kg
450
400
350
300
250
200
150
100
50
0
Nickel
Chromium
Zinc
Barium
Fill & Colluvium
Great Valley
Moraga
Orinda
San Pablo

LIST OF TABLES

Page

Table 1. Metals concentrations in soils used to calculate background (in mg/kg) 9

Table 2. Parameters used to determine upper 95% confidence limit for background soil metals data (concentrations in mg/kg) 16

Table 3. Background concentrations of metals (concentrations in mg/kg) 17

TABLE 1
Metals Concentrations in soils used to calculate background (in mg/kg)

Location	Sample ID	Geol. Unit	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	Vn	Zn
MW51-92-2	BS51-92-2-5	f/c	2	9	93	0.6	0.4	71	18	20	10	0.2	0.6	49	2	0.2	3	61	54
	BS51-92-2-15	gv	2	9	330	0.8	0.2	89	14	33	12	0.2	0.6	110	2	0.2	3	44	67
MW88-92-4	BS88-92-4-5.5	f/c	2	13	130	0.6	0.2	23	8.8	13	11	0.2	1.1	18	2	0.2	3	42	45
	BS88-92-4-15.5	gv	2	13	210	0.7	0.7	25	15	15	10	0.2	0.7	46	2	0.2	4	59	57
	BS88-92-4-25.5	gv	2	13	38	0.2	0.2	6	2.4	4	5	0.2	0.6	9	2	0.2	3	15	15
	BS88-92-4-34.5	gv	2	17	56	0.7	0.5	41	9.5	47	13	0.2	0.9	33	3	0.2	3	42	82
	BS88-92-4-58	gv	2	14	24	0.3	0.3	7	4.2	43	8	0.2	0.7	6	2	0.3	3	22	52
MW37-92-5	BS37-92-5-6	o	2	12	88	0.5	0.2	68	25	34	23	0.2	0.6	62	2	0.2	3	65	96
	BS37-92-5-16	o	2	22	230	1.1	0.2	110	14	28	15	0.2	0.6	93	2	0.2	9	72	84
	BS37-92-5-36	o	2	18	1300	1.2	0.3	30	11	31	15	0.2	0.6	32	2	0.3	3	59	69
	BS37-92-5-65	o	2	17	93	1.1	0.3	38	15	21	13	0.2	0.6	36	2	0.2	3	62	88
	BS37-92-5-74	o	2	12	110	1.6	0.3	51	18	35	25	0.2	2.5	56	4	0.3	3	69	110
	BS37-92-5-81	gv	2	12	72	0.9	0.6	35	14	50	15	0.2	1.5	36	2	0.2	4	48	98
	BS37-92-5-88	gv	2	6	110	0.7	0.4	36	15	48	14	0.2	1	41	2	0.2	6	45	92
	BS37-92-5-97	gv	2	9	290	1	0.4	47	16	51	20	0.2	0.7	47	3	0.2	4	69	96
MW37-92-6	BS37-92-6-5.5	o	2	3	120	0.8	0.3	38	12	37	14	0.2	0.6	40	2	0.2	6	43	74
	BS37-92-6-16	o	2	6	280	0.8	0.2	40	14	36	16	0.2	1	59	3	0.2	10	39	82
	BS37-92-6-26	o	2	4	260	0.8	0.3	32	16	35	18	0.2	0.6	44	2	0.2	4	43	85
	BS37-92-6-35	gv	2	3	280	0.8	0.2	34	35	250	31	0.2	0.6	64	2	0.2	3	59	130
MW70-92-7	BS70-92-7-5.5	gv	2	17	180	0.9	0.5	56	18	53	17	0.2	0.6	57	2	0.2	3	56	110
	BS70-92-7-10.5	gv	2	16	59	1	0.5	45	12	39	16	0.2	0.6	37	2	0.2	3	53	96
	BS70-92-7-15.5	gv	2	19	51	0.8	0.3	47	13	34	15	0.2	0.6	45	2	0.2	3	57	81
	BS70-92-7-21	gv	2	10	37	0.4	0.2	27	7.8	21	8	0.2	0.6	25	3	0.2	3	33	48
MW58-92-8	BS58-92-8-5.5	m	2	2	97	0.3	0.3	52	15	21	4	0.2	0.6	21	2	0.2	3	22	45
	BS58-92-8-11	o	2	28	840	1.1	0.8	18	4.8	14	5	0.2	11	38	3	1	3	28	27
	BS58-92-8-16	o	2	8	330	0.8	1	51	23	35	13	0.2	0.6	79	6	0.5	3	36	75
	BS58-92-8-21	o	2	13	190	0.8	0.5	97	15	25	14	0.2	0.7	110	3	0.2	6	52	87
	BS58-92-8-30.8	o	2	5	270	0.8	0.3	33	15	24	12	0.2	0.6	51	3	0.2	3	35	75
MW46-92-9	BS46-92-9-5.5	f/c	2	7	100	0.9	0.2	73	23	28	11	0.2	0.6	72	2	0.4	3	85	49
	BS46-92-9-11	o	2	7	110	0.6	0.3	92	13	24	7	0.2	0.6	98	2	0.2	7	60	43
	BS46-92-9-15.5	o	2	5	110	0.7	0.3	43	10	26	9	0.2	0.6	59	2	0.2	4	45	50
	BS46-92-9-20.5	o	2	8	120	0.7	0.2	53	10	33	12	0.2	0.6	58	2	0.5	6	43	57
	BS46-92-9-30	o	2	11	200	2.7	0.2	61	12	29	11	0.2	0.6	65	2	0.6	5	50	58
	BS46-92-9-40.5	o	2	3	280	0.9	0.2	83	16	34	12	0.2	0.8	80	2	0.2	7	78	64
	BS46-92-9-50	o	2	11	230	0.9	0.2	99	16	21	14	0.2	0.6	100	2	0.6	8	67	80
	BS46-92-9-80	o	2	8	270	0.8	0.3	97	16	27	12	0.3	1.3	110	2	0.5	4	59	61
MW26-92-11	BS26-92-11-4	m	2	11	91	0.8	0.3	67	17	15	9	0.2	0.6	54	2	5.2	3	64	56
	BS26-92-11-9	o	2	7	170	0.8	0.2	59	19	20	6	0.2	0.6	40	2	0.2	3	60	36
	BS26-92-11-20.5	o	2	10	100	0.5	0.2	100	20	32	7	0.2	0.6	190	2	0.2	4	50	53
	BS26-92-11-30.2	o	2	11	94	0.6	0.2	77	16	35	8	0.2	0.6	130	2	0.2	8	50	57
MW61-92-12	BS61-92-12-10.5	f/c	2	4	370	0.8	0.3	34	12	43	13	0.2	0.6	41	2	0.2	5	33	74
	BS61-92-12-20.3	o	2	4	120	0.7	0.4	28	5.6	13	9	0.2	0.6	21	2	0.2	3	26	36
	BS61-92-12-30.3	o	2	6	240	0.5	0.2	19	7.1	21	11	0.2	0.9	36	2	0.2	11	18	48
	BS61-92-12-40.5	o	2	4	210	0.5	0.2	31	5.1	3	7	0.2	0.6	29	2	0.3	5	22	34
	BS61-92-12-60	o	2	3	170	0.4	0.2	43	4.6	4	6	0.2	0.6	26	2	0.2	3	25	40
	BS61-92-12-71	o	2	5	34	0.4	1.7	28	5.6	7	6	0.2	0.6	26	2	0.9	3	22	29
	BS61-92-12-85	o	2	7	230	0.6	0.2	30	6.6	200	9	0.2	0.7	28	2	0.3	3	25	130
MW74-92-13	BS74-92-13-6	f/c	1.5	0.25	45	0.1	1.2	12	3.2	7.5	4.5	0.12	0.28	45	0.5	0.25	2	7.8	26
	BS74-92-13-16	f/c	1	0.25	39	0.23	1.4	11	3.5	11	3.5	0.1	0.25	16	0.5	0.25	2	5.4	24
	BS74-92-13-25.5	sp	1	0.25	38	0.08	3.3	11	3.7	21	4.3	0.39	0.25	25	0.5	0.25	2	9	29
	BS74-92-13-33	sp	1	0.25	49	0.26	1.4	12	3.6	17	3.9	0.4	0.26	21	0.63	0.25	2	5.5	24
	BS74-92-13-40	sp	1	0.25	1.7	0.06	0.69	4.1	1.7	6.6	2.3	0.07	0.38	6.2	0.5	0.5	2	3.3	17
MW83-92-14	BS83-92-14-6	f/c	2	3	69	0.4	0.5	21	10	18	7	0.2	0.6	56	2	0.2	4	28	55
	BS83-92-14-11	f/c	2	1	87	0.4	0.2	16	9	13	8	0.2	0.6	51	2	0.2	3	8	42
	BS83-92-14-16	sp	2	3	250	0.4	0.5	27	9.7	20	8	0.2	0.8	56	3	0.2	8	13	75
	BS83-92-14-20	sp	2	4	59	0.3	0.5	22	7.1	7	4	0.2	0.6	51	3	0.2	5	11	32
	BS83-92-14-30.5	sp	2	7	210	0.6	0.3	34	23	30	9	0.2	0.6	120	3	0.2	5	8	84
	BS83-92-14-40.5	sp	2	14	100	0.3	0.2	9	4.6	3	6	0.2	0.6	21	3	0.2	10	7	19
	BS83-92-14-50	sp	2	4	120	0.4	0.3	14	5.4	16	7	0.2	1.2	33	2	0.2	3	8	47
	BS83-92-14-57	sp	2	3	92	0.3	0.3	10	4.5	6	6	0.2	0.6	34	3	0.2	3	6	41
MW46A-92-15	BS46A-92-15-6	f/c	1.5	9.9	62	0.1	0.05	41	12	16	5.5	0.09	0.25	34	2.7	0.25	2	37	39
	BS46A-92-15-16	f/c	1.3	7.6	87	0.12	0.05	49	12	21	3.9	0.05	1.3	40	1.2	0.25	2	46	44
	BS46A-92-15-26	f/c	1	6.6	41	0.08	0.05	20	9.5	21	2	0.05	0.25	12	1.2	0.25	2	42	63
	BS46A-92-15-36	o	1.1	12	56	0.08	0.05	51	13	65	5.7	0.11	0.25	63	0.5	0.25	2	42	78
MW7-92-16	BS7-92-16-5.5	f/c	1	9.7	130	0.23	0.13	41	14	107	6.8	0.07	0.25	46	9.1	0.25	2	42	47
	BS7-92-16-21	f/c	1.3	21	130	0.28	0.08	56	17	16	6.1	0.05	0.25	41	8.2	0.25	2	62	38
	BS7-92-16-30.8	m	1	2.7	51	0.12	0.05	57	13	33	2.2	0.05	0.25	21	0.5	0.25	2	39	66
	BS7-92-16-40.5	m	1	0.25	26	0.06	0.05	17	6.5	29	0.91	0.05	0.25	8.1	0.5	0.25	2	17	34
	BS7-92-16-50.2	m	1	1.1	28	0.29	0.05	34	10	33	1.8	0.05	0.25	13	0.5	0.25	2	46	65
MW6-92-17	BS6-92-17-6	m	1	6.3	69	0.22	0.21	75	16	31	5.5	0.05	0.25	120	0.5	0.25	2	46	49
	BS6-92-17-15.5	m	1	3.4	50	0.12	0.17	120	17	20	2.4	0.05	0.25	190	0.5	0.25	2	31	37

TABLE 1
Metals Concentrations in soils used to calculate background (in mg/kg)

Location	Sample ID	Geol. Unit	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	Vn	Zn
MW6-92-17	BS6-92-17-25.5	m	1	2.8	31	0.27	0.3	23	7.1	20	2.8	0.05	0.25	71	1.5	0.25	2	32	32
	BS6-92-17-30	o	1	7.8	40	0.26	0.29	109	17	32	4.1	0.29	0.25	180	0.5	0.25	2	40	46
	BS6-92-17-40.5	o	1	4	56	0.19	0.21	54	11	31	3.4	0.09	0.25	73	0.5	0.25	2	29	48
MW37-92-18	BS37-92-18-6	o	1.3	13	150	0.24	0.05	27	11	23	9.5	0.1	0.25	37	0.5	0.25	2	34	75
	BS37-92-18-16	o	1	3.7	80	0.05	0.05	22	4.3	5.1	4.5	0.08	0.25	23	0.5	0.25	2	17	37
	BS37-92-18-26	o	1	6.8	43	0.38	0.05	14	3.7	18	4	0.06	0.25	14	0.5	0.25	2	22	47
	BS37-92-18-31	o	1	4.2	25	0.05	0.16	29	7	15	5	0.05	0.25	30	0.5	0.25	2	20	71
MW37-92-18A	BS37-92-18A-11	o	1	5.5	150	0.07	0.05	18	3.7	6.9	3.4	0.08	0.8	15	2.1	0.5	2	14	22
	BS37-92-18A-20.5	o	1.1	6.2	44	0.14	0.05	11	3	4.3	4.7	0.06	0.25	16	0.5	0.25	2	7.8	21
	BS37-92-18A-31.5	o	1.9	9.6	48	0.42	0.05	14	6.1	11	4.1	0.05	0.25	17	5.2	0.25	2	21	43
	BS37-92-18A-41.3	gv	2.4	6.5	62	0.32	0.05	17	7.8	16	5.3	0.05	0.25	24	0.5	0.25	2	24	54
	BS37-92-18A-51	gv	2.1	29	96	0.59	0.05	27	13	42	8.6	0.12	0.49	41	16	0.25	2	38	88
	BS37-92-18A-60.7	gv	1.8	30	77	0.43	0.05	25	18	42	16	0.12	1.3	39	3.4	0.25	2	33	90
	BS37-92-18A-70.4	gv	1.5	9.4	120	0.45	0.05	24	37	32	4.7	0.11	0.25	72	2.1	0.25	2	27	108
MW7-92-19	BS7-92-19-6	f/c	1.3	8.4	70	0.17	0.05	34	14	20	5.8	0.05	0.25	34	2.3	0.25	2	46	36
	BS7-92-19-15.5	m	1.8	15	57	0.11	0.05	51	15	13	3.3	0.05	0.25	32	3.3	0.25	2	39	43
	BS7-92-19-26	m	1	6	36	0.09	0.05	38	11	12	1.8	0.05	0.25	18	0.5	0.25	2	27	35
	BS7-92-19-36	m	1.5	4.6	53	0.13	0.05	26	14	24	5.1	0.05	0.25	76	7.9	0.25	2	30	53
	BS7-92-19-45.5	m	1.2	3.2	49	0.12	0.05	47	14	23	2.8	0.05	0.25	110	2.7	0.25	2	47	44
	BS7-92-19-55.5	o	1	3.8	79	0.16	0.05	140	25	20	4.1	0.05	0.25	309	1.7	0.25	2	44	57
MW27-92-20	BS27-92-20-10.2	m	4.6	15	39	0.35	0.05	52	19	12	6.1	0.05	0.25	21	6	0.25	2	28	54
	BS27-92-20-20	m	1.5	3.9	26	0.05	0.05	51	15	17	3.4	0.05	0.25	22	1.1	0.25	2	34	54
	BS27-92-20-30.4	m	0.7	9.4	27	0.05	0.05	36	15	10	4.9	0.05	0.25	16	0.5	0.25	2	30	40
	BS27-92-20-45	m	1	9.6	43	0.05	0.05	57	15	15	1.2	0.05	0.25	18	12	0.25	2	32	43
	BS27-92-20-55	m	1.8	5.1	39	0.05	0.05	48	12	20	1.8	0.05	0.25	17	2.1	0.25	2	33	67
	BS27-92-20-60C	m	1	6.9	39	0.05	0.05	58	12	13	3.3	0.05	0.25	18	0.5	0.25	2	29	44
MW53-92-21	BS53-92-21-9.9	m	1	4.3	54	0.14	0.05	34	12	23	4	0.11	0.25	16	4.6	0.25	2	16	41
	BS53-92-21-20.3	m	1	4.7	46	0.05	0.05	36	13	11	2.3	0.06	0.25	19	4.9	0.25	2	22	38
	BS53-92-21-30.8	m	1	4.3	28	0.05	0.05	29	10	8.4	2.2	0.05	0.25	10	3.6	0.25	2	16	31
	BS53-92-21-39.1	m	1	3.2	20	0.05	0.05	24	9.6	8.9	1.9	0.05	0.25	9.4	2.8	0.25	2	24	30
	BS53-92-21-48.8	m	1	4.3	28	0.06	0.05	32	13	11	2.2	0.05	0.4	26	4.5	0.25	2	25	34
	BS53-92-21-58	m	1	3.1	31	0.05	0.05	28	11	25	2	0.05	0.25	14	2.5	0.25	2	15	40
	BS53-92-21-68.9	m	1	2.8	16	0.05	0.05	26	11	5.9	0.83	0.08	0.25	11	2.8	0.25	2	11	36
	BS53-92-21-78.8	m	1	4.3	38	0.05	0.05	25	12	11	1.1	0.05	0.25	18	2.1	0.25	2	15	38
	BS53-92-21-83.5	m	1	4.5	90	0.25	0.05	35	10	13	4.7	0.13	0.25	86	6.5	0.25	2	17	29
	BS53-92-21-95	o	1	5.2	71	0.08	0.05	27	6.8	28	3.5	0.12	0.25	37	3.8	0.61	2	26	35
	BS53-92-21-109	o	1.2	11	560	0.28	0.05	41	9	18	3.2	0.1	0.25	61	4.8	0.25	5.3	25	45
	BS53-92-21-115.7	o	1.2	18	190	0.05	0.05	41	9.4	20	3.6	0.05	0.25	73	21	0.88	9.3	30	54
	BS53-92-21-126.3	o	2.5	13	250	0.05	0.05	36	8.6	12	4.9	0.05	0.25	70	28	1.3	71	16	55
	BS53-92-21-135.3	o	1	8	310	0.49	0.05	52	8.9	29	8.3	0.1	0.43	80	3.1	0.25	2	23	91
	BS53-92-21-150.5	o	1	21	220	0.74	0.05	69	14	43	14	0.27	3.6	110	4.8	0.25	2	37	91
	BS53-92-21-165.5	o	1	51	130	0.49	0.05	23	8.5	22	10	0.23	32	71	3.8	0.25	2	20	47
	BS53-92-21-180.5	o	1	8.9	280	0.44	0.54	66	14	38	7.6	0.05	0.47	130	0.5	0.25	2	39	87
MW69A-92-22	BS69A-92-22-5.8	m	1	17	71	0.54	4.8	73	18	44	0.5	0.09	0.25	60	0.5	0.25	2	59	52
	BS69A-92-22-10	m	1	12	120	1.2	3.7	76	14	33	7.4	0.1	0.63	86	0.5	0.25	2	45	64
	BS69A-92-22-15	o	1	8.7	170	0.65	4.3	71	15	36	7.2	0.21	0.25	91	0.5	0.25	2	39	75
	BS69A-92-22-20.8	o	3.9	2.7	130	1.2	3.2	52	11	27	6.9	0.05	0.25	77	0.5	0.25	2	37	58
	BS69A-92-22-25.2	o	1	0.73	150	1.2	3.7	53	13	27	0.5	0.1	0.25	88	0.5	0.25	2	34	68
	BS69A-92-22-30	o	1	1.4	97	0.32	3.2	43	12	24	2.2	0.05	0.25	49	0.5	0.25	2	44	47
MW75-92-23	BS75-92-23-5.5	f/c	1.3	12	140	0.14	0.05	78	13	35	4	0.05	0.25	98	1.3	0.25	2	51	63
	BS75-92-23-15	f/c	1	14	87	0.5	0.05	32	8.1	0.3	5.2	0.1	0.25	68	0.5	0.25	2	0.79	45
	BS75-92-23-25	f/c	1.3	20	60	0.1	0.05	54	15	87	1.7	0.05	0.25	37	17	0.25	110	59	112
	BS75-92-23-35.5	f/c	1	5.1	31	0.08	0.05	46	15	78	1.8	0.05	0.25	31	1.9	0.25	2	42	51
	BS75-92-23-45.5	f/c	1	9	99	0.15	0.05	43	11	34	4.6	0.05	0.25	87	0.5	0.25	2	29	51
MW75B-92-24	BS75B-92-24-5	f/c	1	14	89	0.18	0.05	43	12	39	5.3	0.07	0.25	65	0.5	0.25	2	40	53
	BS75B-92-24-15	f/c	1.1	8.6	106	0.13	0.05	102	15	31	5	0.06	0.25	140	0.5	0.25	2	51	48
	BS75B-92-24-25	o	1.2	8.4	160	0.34	0.05	36	10	27	4.3	0.05	0.25	70	2.6	0.28	2	28	46
	BS75B-92-24-35	o	1	8	73	0.09	0.05	32	8.4	31	4.1	0.05	0.25	55	0.5	0.25	2	28	63
	BS75B-92-24-45	o	1	9	99	0.15	0.05	43	11	34	4.6	0.09	0.25	87	0.5	0.25	2	30	51
	BS75B-92-24-54	o	1	6.6	83	0.12	0.05	42	12	38	2.4	0.1	0.25	100	0.5	0.25	2	31	54
MW76-92-25	BS76-92-25-5.5	f/c	1	12	81	0.17	0.05	47	14	34	2	0.05	1	24	3	0.25	2	33	51
	BS76-92-25-16	o	1.6	8.9	71	0.37	0.05	26	9.4	26	2	0.05	0.25	67	2	0.25	2	21	110
	BS76-92-25-26	o	1	7.5	190	0.14	0.05	48	10	39	2.3	0.05	0.25	82	0.6	0.25	2	26	55
	BS76-92-25-36	o	1	7.1	110	0.16	2.5	42	10	27	2.5	0.06	0.35	66	0.5	0.25	2	27	67
MW62-92-26	BS62-92-26-6	f/c	1	13	120	0.38	0.05	25	2.5	9.8	2.8	0.06	0.25	18	5.7	0.25	90	14	39
	BS62-92-26-11	gv	1	11	170	0.39	0.05	21	5.2	27	8.4	0.05	0.25	23	2.5	0.25	2	17	140
	BS62-92-26-21	gv	1	11	84	0.17	0.05	23	4.6	30	2.6	0.05	0.25	26	0.9	0.25	2	16	60
	BS62-92-26-30.5	gv	1.3	21	53	0.11	0.05	26	13	46	11	0.11	0.25	28	0.5	0.25	2	43	98
	BS62-92-26-40.3	gv	1	26	39	0.16	0.05	29	14	53	9.9	0.08	0.25	31	0.5	0.25	2	51	95
	BS62-92-26-50.5	gv	1.3	28	37	0.07	0.05	27	17	41	12	0.09	0.25	38	0.5	0.25	2	38	90

TABLE 1
Metals Concentrations in soils used to calculate background (in mg/kg)

Location	Sample ID	Geol. Unit	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	Vn	Zn
MW62-92-27	BS62-92-27-5.5	f/c	1.2	16	103	0.17	0.05	19	6.3	11	6.1	0.05	0.68	14	2	0.25	2	38	49
	BS62-92-27-15.5	gv	1.9	17	51	0.11	0.05	32	11	60	12	0.08	0.25	33	0.5	0.25	2	40	130
	BS62-92-27-25.5	gv	1.8	18	320	0.57	0.05	31	10	77	9.2	0.05	0.25	28	0.5	0.25	2	47	130
	BS62-92-27-35.5	gv	1	25	36	0.09	0.05	26	16	45	12	0.07	0.25	38	0.5	0.25	2	34	93
	BS62-92-27-45.5	gv	1.2	18	41	0.15	0.05	29	11	44	9.6	0.08	0.25	37	0.5	0.25	2	37	107
	BS62-92-27-55.5	gv	1	24	53	0.23	0.05	34	12	50	11	0.08	0.25	37	0.5	0.25	2	43	105
	BS62-92-27-65	gv	1.9	18	55	0.13	0.05	32	9.3	53	8.9	0.06	0.25	28	0.5	0.25	2	45	107
MWCD-92-28	BSCD-92-28-9.5	f/c	3	10	160	0.49	2	26	6.4	20	8.4	0.09	0.58	22	0.5	0.25	2	35	60
	BSCD-92-28-19.5	f/c	1	12	1200	0.8	2.6	29	12	41	6.7	0.18	0.73	29	0.5	0.25	2	32	71
	BSCD-92-28-28.5	gv	3	42	52	0.4	2.4	17	15	22	15	0.42	1.9	42	0.96	0.25	2	21	74
	BSCD-92-28-38.5	gv	1.5	17	59	0.25	3.2	35	9.2	49	11	0.15	0.97	32	0.5	0.25	2	40	80
	BSCD-92-28-48.5	gv	1.5	25	56	0.28	3.1	31	17	42	17	0.27	1.2	42	0.5	0.25	2	37	78
MW71-93-1	BS71-93-1-4.5	m	1.1	0.25	37	0.14	1.6	41	16	11	0.5	0.05	2.6	13	0.5	0.25	2	37	47
	BS71-93-1-14.5	m	1.6	0.99	71	0.22	1.4	42	15	12	0.5	0.05	2.8	22	0.5	0.25	2	50	42
	BS71-93-1-24.7	m	1	0.25	65	0.39	1.2	43	14	12	0.5	0.05	1.8	29	0.5	0.25	2	46	37
	BS71-93-1-35	m	1	0.25	50	0.16	1.1	56	14	7.7	0.5	0.05	2.5	12	0.5	0.25	2	44	45
	BS71-93-1-44.9	m	1.3	0.25	86	0.13	0.88	72	11	29	0.5	0.35	1.9	84	0.5	0.25	2	56	3.8
	BS71-93-1-54.8	o	1	3.9	68	0.34	0.19	11	3.9	6.4	0.66	0.05	0.69	18	0.5	0.25	2	24	17
	BS71-93-1-64	o	1	1.1	68	0.34	0.5	27	8.9	21	0.5	0.05	1.7	38	0.5	0.25	2	36	31
MW71-93-2	BS71-93-2-10	m	2.5	0.25	26	0.48	1.1	29	12	17	0.5	0.05	2.4	15	0.5	0.25	2	22	44
	BS71-93-2-20	m	2.8	7.7	46	0.53	1.7	43	15	34	0.5	0.05	3.4	18	0.5	0.25	2	44	62
	BS71-93-2-30	m	3.1	0.3	49	0.45	1.7	56	20	35	0.5	0.05	3.3	22	0.5	0.25	2	44	69
	BS71-93-2-35.7	m	1	0.33	72	0.49	1.1	46	15	74	0.5	0.05	2.2	44	0.5	0.25	2	48	71
	BS71-93-2-41	m	2.4	3.5	41	0.32	1.2	52	14	36	0.5	0.05	1.8	18	0.5	0.25	2	34	59
	BS71-93-2-50	m	1	6.3	25	0.1	0.84	17	17	32	0.5	0.05	2.3	15	0.5	0.25	2	44	46
	BS71-93-2-60.6	m	1.2	3.5	46	0.16	0.52	36	19	37	0.5	0.05	1.9	24	0.5	0.25	2	34	60
	BS71-93-2-70	m	1.1	3.2	44	0.08	0.52	16	11	8.6	0.5	0.05	0.62	13	0.5	0.25	2	25	27
	BS71-93-2-80	o	1	0.25	73	0.38	0.77	41	14	26	0.5	0.05	2.3	72	0.5	0.25	2	37	50
MW6-93-4	BS6-93-4-6	f/c	1.3	0.25	99	0.26	2	44	13	75	9.8	0.06	1.3	53	0.5	0.25	2	37	110
	BS6-93-4-16	f/c	1	0.25	118	0.46	1.8	42	12	24	7.2	0.05	0.49	82	0.5	0.25	2	24	42
	BS6-93-4-26	f/c	1	0.25	105	0.5	1.5	44	15	19	4.4	0.05	0.25	58	0.5	0.39	2	46	31
	BS6-93-4-35.5	m	2.2	3.2	130	0.29	3.5	65	20	23	0.5	0.05	4.7	41	0.5	0.96	2	91	64
	BS6-93-4-45	m	1	3.7	58	0.1	2.5	40	15	10	0.5	0.05	2.8	23	0.5	2.1	2	28	49
MW37-93-5	BS37-93-5-11	o	1	0.25	140	0.45	2.9	26	11	22	0.5	0.06	2.3	22	0.5	2.3	2	49	53
	BS37-93-5-21	o	1	16	230	0.42	4.3	25	17	48	14	0.08	3.8	31	0.5	3.2	2	71	69
	BS37-93-5-30.5	gv	5	19	63	0.54	7.5	31	8.1	65	0.5	0.08	6.6	37	0.5	6.5	2	24	110
	BS37-93-5-40.5	gv	9	42	53	0.46	5.6	24	13	77	17	0.08	4.1	49	0.5	4.1	2	28	110
	37-93-5-50-50.3	gv	1	63	80	0.41	3.9	36	16	60	0.5	0.09	4.7	45	0.5	3.8	2	45	140
MW76-93-6	76-93-6-5.8-6.3	o	3	2.2	81	0.39	3.7	33	13	19	0.5	0.31	2.8	140	0.5	3	2	0.5	46
	76-93-6-15.4-15.9	o	5	7.9	110	0.31	3.3	67	15	38	0.5	0.2	5.7	120	0.5	3.4	2	47	50
	76-93-6-26-26.5	o	1	0.56	180	0.31	3.8	73	17	45	0.5	0.2	5.8	210	0.5	3.6	2	11	59
	76-93-6-35.2-35.7	o	7	0.25	64	0.34	3.8	52	15	38	0.5	0.11	63	120	0.5	4.1	2	0.5	40
	76-93-6-45.1-45.6	o	1	11	220	0.35	1.8	42	32	41	0.5	0.33	2.1	160	0.5	2	2	17	69
MW76-93-7	BS76-93-7-5.5	m	3	0.25	30	0.1	2.1	49	15	34	0.5	0.06	3.2	130	0.5	1	2	21	26
	BS76-93-7-15.5	o	1	0.25	54	0.28	3	38	8.8	42	0.5	0.06	3.7	130	0.5	1.1	2	42	58
	BS76-93-7-26	o	1	5	120	0.29	4	43	16	58	5.4	0.12	3.3	91	0.5	2	2	49	66
	BS76-93-7-35.5	o	3.1	13	180	0.36	2.9	34	13	25	0.5	0.05	5.7	68	0.5	1.8	2	20	43
MW77-93-8	77-93-8-5.7-6.2	f/c	1	0.25	48	0.21	1.5	47	13	26	6.1	0.2	1.7	110	0.5	3.1	2	8.6	45
	77-93-8-16-16.5	f/c	1	7	98	0.3	3.5	82	21	35	9.6	0.2	4.6	140	0.5	4	2	43	47
	77-93-8-25.6-26.1	o	3	0.25	86	0.23	2.3	31	10	38	3.5	0.2	1.6	62	0.5	4.4	2	22	50
MW53-93-9	BS53-93-9-10	m	1	0.25	82	0.15	2.5	36	20	20	7.1	0.05	2.8	15	0.5	1.8	2	47	48
	BS53-93-9-25	m	1	0.25	77	0.17	2.3	31		25	0.5	0.05	4.2	16	0.5	2.3	2	36	50
	BS53-93-9-40.5	m	1	0.25	90	0.53	4.6	61	24	22	0.5	0.05	2.5	19	0.5	1.9	2	59	65
	BS53-93-9-50	m	1	3.9	45	0.17	2.7	51	18	11	0.5	0.05	1.6	16	0.5	2	2	42	46
	BS53-93-9-60	m	1	0.25	67	0.16	4.2	51	17	18	0.5	0.05	3.1	17	0.5	2	2	34	49
	BS53-93-9-80	m	1	0.25	35	0.12	0.77	25	12	9.5	0.5	0.05	1.5	21	0.5	0.25	2	16	35
MW5-93-10	BS5-93-10-6	f/c	1	0.94	85	0.22	0.65	26	10	11	1.2	0.05	1.2	35	0.5	0.25	2	38	30
	BS5-93-10-15.3	f/c	1	0.25	67	0.19	0.23	18	9.4	19	0.5	0.05	1.6	60	0.5	0.25	2	42	31
	BS5-93-10-25.8	m	1	3	57	0.38	0.21	12	7.9	15	0.5	0.05	1.2	36	0.5	0.25	2	14	24
	BS5-93-10-35.2	o	1	1.3	84	0.14	0.05	17	7.5	21	3.3	0.03	1.1	44	0.5	0.25	2	14	33
MW88-93-11	BS88-93-11-5.5	gv	1	1.8	180	0.51	3.6	40	6.7	23	10	0.05	2.8	62	0.5	0.25	2	51	82
	BS88-93-11-15.3	gv	2.5	9.6	140	0.81	3.4	49	18	58	10	0.05	5.3	47	0.5	0.77	2	63	110
	BS88-93-11-25.7	gv	1.9	8.8	36	0.56	3.7	33	12	36	9.6	0.05	2.2	49	0.5	0.61	2	45	81
	BS88-93-11-36	gv	15	0.25	42	0.59	4.8	31	20	66	17	0.05	2.6	50	0.5	1.6	2	40	79
	BS88-93-11-45.2	gv	2.2	6.7	22	0.33	3.3	46	11	31	3.4	0.05	2.1	43	0.5	0.86	2	62	67
	BS88-93-11-55	gv	1	8.6	16	0.15	2.6	41	9.4	17	3.3	0.05	1.5	37	0.5	1.5	2	50	53
MW88-93-11A	BS88-93-11A-10.2	gv	5	8.7	196	0.82	0.5	68	13	57	13	0.2	2.5	59	0.5	1	5	63	113
	BS88-93-11A-20.3	gv	5	12	127	0.68	0.5	53	9.1	52	12	0.2	2.5	50	0.5	1	5	46	101
	BS88-93-11A-30.6	gv	5	1.9	54	0.5	0.5	42	16	49	9.7	0.2	2.5	47	0.5	1	5.6	45	89
	BS88-93-11A-40.8	gv	5	4.4	50	0.5	0.5	47	12	31	4.3	0.2	2.5	44	0.5	1	5	67	61
	BS88-93-11A-50.3	gv	5	5.4	53	0.5	0.5	42	15	36	5.1	0.2	2.5	46	0.5	1	5	57	69

TABLE 1
Metals Concentrations in soils used to calculate background (in mg/kg)

Location	Sample ID	Geol. Unit	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	Vn	Zn
MW88-93-11A	BS88-93-11A-65	gv	5	4.1	27	0.5	0.5	41	8.8	27	3.2	0.2	2.5	38	0.5	1	5	48	62
MW88-93-13	BS88-93-13-3.5	f/c	5	8.1	155	0.83	0.5	26	8.4	22	7	0.2	2.5	22	0.5	1	5	46	62
	BS88-93-13-19.6	gv	5	8.9	144	0.85	0.5	60	17	65	14	0.2	2.5	70	0.5	1	5	61	124
	BS88-93-13-29.3	gv	5	7.2	129	0.72	0.5	58	11	65	13	0.2	2.5	50	0.5	1	5	59	117
MW88-93-13	BS88-93-13-39.5	gv	5	34	54	0.57	1.3	46	39	83	16	0.27	7.4	102	2.2	1	6.5	74	174
	BS88-93-13-49.4	gv	5	8.9	80	0.59	0.5	52	18	64	9.2	0.2	2.5	41	0.5	1	5	66	107
	BS88-93-13-59.8	gv	5	9.8	120	0.61	0.5	50	18	60	9.8	0.2	2.5	38	0.5	1	5	66	102
	BS88-93-13-69	gv	5	16	116	0.53	0.5	51	22	59	15	2.2	2.5	41	0.5	1	5	65	115
	BS88-93-13-79	gv	5	6.6	104	0.58	0.61	59	14	48	7.7	0.2	2.5	36	0.5	1.1	5	68	102
	BS88-93-13-89	gv	5	6.3	63	0.5	0.5	41	10	143	17	0.2	2.5	22	0.5	1	5	58	69
	BS88-93-13-9	f/c	5	8.7	126	0.7	0.5	49	17	63	11	0.2	2.5	50	0.5	1	5	62	104
MW52-93-14	BS52-93-14-4.5	m	5	0.58	112	0.5	0.5	76	16	15	2.5	0.2	2.5	37	0.5	1	5	74	45
	BS52-93-14-15.8	m	5	0.5	48	0.5	0.5	69	16	14	2.5	0.2	2.5	25	0.5	1	5	41	52
	BS52-93-14-25.3	m	5	0.5	34	0.5	0.5	49	16	21	2.5	0.2	2.5	23	0.5	1	5	35	73
	BS52-93-14-35	m	5	0.64	51	0.5	0.5	38	11	16	2.5	0.2	2.5	18	0.5	1	5	24	42
	BS52-93-14-46.2	o	5	9.1	162	0.5	0.5	54	12	36	6.4	0.2	2.5	67	0.5	1	5	51	63
MW25-93-15	BS25-93-15-8.8	m	5	0.73	149	0.55	0.53	66	23	41	2.5	0.2	2.5	39	0.5	1	5	97	66
	BS25-93-15-13.8	m	5	0.5	0.5	0.5	0.5	35	17	48	2.5	0.2	2.5	23	0.5	1	5	37	84
	BS25-93-15-23.5	m	5	1.5	87	0.61	0.6	51	13	21	4.5	0.2	2.5	32	0.5	1	5	70	54
	BS25-93-15-33	m	5	0.5	69	0.66	0.5	57	17	95	2.5	0.2	2.5	43	0.5	1	5	104	92
	BS25-93-15-43.2	m	5	0.5	88	0.5	0.5	46	20	20	2.5	0.2	2.5	22	0.5	1	5	38	62
	BS25-93-15-57	m	5	0.5	81	0.5	0.5	72	22	37	2.5	0.2	2.5	33	0.5	1	5	61	84
	BS25-93-15-67.5	o	5	2	111	0.5	0.84	49	14	46	5.7	0.2	2.5	71	0.5	1	5	38	65
MW51B-93-18A	BS51B-93-18A-4.4	f/c	5	1.6	96	0.5	0.5	63	16	22	7.7	0.76	2.5	32	0.5	1	5	51	60
	BS51B-93-18A-9	f/c	5	6.9	118	0.52	0.5	64	14	36	6.8	0.2	2.5	92	0.5	1	5	50	79
	BS51B-93-18A-14	o	5	7.3	226	0.59	0.5	76	16	60	7.3	0.2	2.5	99	0.5	1	5	60	96
	BS51B-93-18A-19	o	5	7.6	270	0.67	0.5	82	17	36	7.8	0.2	2.5	105	0.54	1	5	67	97
	BS51B-93-18A-24	o	5	7.1	230	0.6	0.5	76	15	47	7.2	0.2	2.5	95	0.62	1	5	62	88
	BS51B-93-18A-29.3	o	5	5.7	231	0.58	0.5	80	15	69	6.9	0.2	2.5	97	0.5	1	5	61	75
	BS51B-93-18A-34	o	5	3	248	0.51	0.5	56	8.9	32	7.5	0.2	2.5	64	0.5	1	5	34	60
	BS51B-93-18A-39	o	5	4.3	232	0.58	0.5	72	12	35	6.8	0.2	2.5	77	0.5	1	5	53	71
	BS51B-93-18A-41	o	5	5.4	211	0.51	0.5	65	12	105	5.9	0.2	2.5	74	0.5	1	5	48	103
MW71-94-1	BS71-94-1-4	f/c	5	1.7	172	0.5	0.5	68	17	31	5.3	0.2	2.5	56	0.5	1	0.5	64	54
	BS71-94-1-8.5	f/c	5	1.8	133	0.5	0.5	69	18	27	6.3	0.2	2.5	60	0.5	1	0.5	68	52
	BS71-94-1-14.2	f/c	5	3.4	141	0.5	0.5	65	17	36	5.3	0.2	2.5	52	0.5	1	0.5	68	58
	BS71-94-1-23.7	m	5	0.5	103	0.5	0.5	24	24	25	2.5	0.2	2.5	27	0.5	1	0.5	83	57
	BS71-94-1-33.7	m	5	0.75	74	0.5	0.5	43	20	28	2.8	0.2	2.5	32	0.5	1	0.5	105	59
	BS71-94-1-48.5	m	5	1.2	98	0.5	0.5	55	15	13	2.5	0.2	2.5	25	0.5	1	0.5	78	54
MW77-94-5	BS77-94-5-4.3	f/c	5	0.5	74	0.5	0.5	45	17	16	2.5	0.2	2.5	26	0.5	1	5	32	43
	BS77-94-5-9.3	f/c	5	1.3	87	0.5	0.5	66	14	24	2.6	0.2	2.5	53	0.5	1	5	58	45
	BS77-94-5-14.1	f/c	5	4.1	125	0.5	0.5	39	9.8	21	4.5	0.2	2.5	62	0.5	1	5	29	46
	BS77-94-5-19	f/c	5	1.4	96	0.5	0.5	46	14	31	2.5	0.2	2.5	54	0.5	1	5	40	37
	BS77-94-5-29.5	f/c	5	6	131	0.54	0.5	60	16	36	5.2	0.31	2.5	104	0.5	1	5	39	73
	BS77-94-5-38.9	o	5	6.7	337	0.67	0.5	78	15	34	7	0.2	2.5	110	0.5	1	5	45	87
	BS77-94-5-48.5	o	5	3.4	384	0.61	0.5	72	19	41	9	0.27	2.5	126	0.5	1	5	41	71
	BS77-94-5-58.5	o	5	6.7	268	0.62	0.5	65	15	28	5	0.2	2.5	84	0.5	1	5	57	77
MW77-94-6	BS77-94-6-3.7	f/c	5	1.1	87	0.5	0.5	62	20	27	3	0.2	2.5	34	0.5	1	5	59	57
	BS77-94-6-9.3	f/c	5	0.71	63	0.5	0.5	61	18	18	2.5	0.2	2.5	28	0.5	1	5	52	58
	BS77-94-6-14.2	f/c	5	5.2	106	0.5	0.61	70	14	46	5.8	0.2	2.6	92	0.5	1	5	49	68
	BS77-94-6-24.2	f/c	5	4.6	211	0.5	0.5	66	13	36	6.9	0.2	2.5	89	0.5	1	5	43	64
	BS77-94-6-34	f/c	5	1.9	92	0.5	0.5	82	18	27	5.2	0.2	2.5	84	0.5	1	5	71	68
	BS77-94-6-44	f/c	5	2.1	139	0.5	0.5	52	17	46	3.8	0.2	2.5	61	0.5	1	5	62	51
	BS77-94-6-54.5	o	5	9.2	179	0.5	0.5	86	15	38	4.8	0.2	2.5	83	0.5	1	5	50	61
	BS77-94-6-63.5	o	5	5.1	141	0.5	0.5	67	13	48	5.6	0.2	2.5	81	0.5	1	5	48	70
MW74-94-7	BS74-94-7-5.1	f/c	5	3.7	94	0.5	0.52	38	9.2	16	4.3	0.2	2.5	41	0.5	1	5	42	47
	BS74-94-7-15.5	f/c	5	6.5	170	0.53	0.5	66	17	30	6.5	0.2	2.5	97	0.5	1	5	49	61
	BS74-94-7-25.5	sp	5	0.59	97	0.5	0.5	46	9.7	18	4.5	0.2	2.5	73	0.5	1	5	25	48
	BS74-94-7-35.7	sp	5	0.89	105	0.5	0.5	58	9.6	32	4.6	0.2	2.5	62	0.5	1	5	29	58
	BS74-94-7-44.7	sp	5	5.6	116	0.5	0.5	66	9.8	24	5.3	0.2	2.5	65	0.5	1	5	28	49
MW74-94-8	BS74-94-8-4.2	f/c	5	3.4	125	0.5	0.5	22	4.9	17	5.2	0.2	2.5	34	0.5	1	5	20	59
	BS74-94-8-10	f/c	5	3.9	136	0.5	0.59	18	4.6	25	5.5	0.2	2.5	37	0.5	1	5	15	82
	BS74-94-8-13.8	f/c	5	1.5	151	0.5	0.68	45	11	20	4.5	0.2	2.5	57	0.5	1	5	23	55
	BS74-94-8-19.5	f/c	5	1	90	0.5	0.5	25	8.2	18	2.5	0.2	2.5	45	0.5	1	5	37	46
	BS74-94-8-29	sp	5	11	92	0.5	0.5	19	4.3	12	5.6	0.2	2.5	34	0.5	1	5	12	43
MW37-94-9	BS37-94-9-4.2	f/c	5	6	138	0.5	0.5	33	9.1	27	6.7	0.2	2.5	30	0.5	1	5	36	63
	BS37-94-9-9.5	f/c	5	4.7	100	0.58	0.5	49	14	27	8.9	0.2	2.5	69	0.5	1	5	29	80
	BS37-94-9-14.2	f/c	5	2	114	0.5	0.5	29	4.3	13	3.4	0.2	2.5	23	0.5	1	5	16	33
	BS37-94-9-18.5	o	5	0.5	190	0.66	0.5	22	6.4	19	8.5	0.2	2.5	32	0.5	1	5	21	50
	BS37-94-9-24.3	o	5	3.8	51	0.5	0.5	23	5.2	6.6	3.8	0.2	2.5	22	0.5	1	5	14	29
	BS37-94-9-28.6	o	5	2.6	66	0.5	0.5	16	4.1	15	4.9	0.2	2.5	20	0.5	1	5	14	43
	BS37-94-9-34	o	5	5.2	210	0.54	0.5	28	12	30	7.7	0.2	2.5	39	0.5	1	5	45	93

TABLE 1
Metals Concentrations in soils used to calculate background (in mg/kg)

Location	Sample ID	Geol. Unit	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	Vn	Zn
MW37-94-9	BS37-94-9-38.7	gv	5	5.4	193	0.6	0.5	29	13	47	9.1	0.2	2.5	35	0.5	1	5	44	93
	BS37-94-9-44.5	gv	5	10	50	0.61	0.5	39	15	52	12	0.2	2.5	47	0.75	1	5	49	107
MW52-94-10	BS-MW52-94-10-4	m	5	1.1	109	0.5	0.5	63	21	40	2.6	0.2	2.5	37	0.5	1	5	65	69
	BS-MW52-94-10-9	m	5	0.94	100	0.5	0.5	62	20	29	2.5	0.2	2.5	37	0.5	1	5	71	65
	BS-MW52-94-10-13.9	m	5	3.2	82	0.5	0.5	65	17	47	2.5	0.2	2.5	54	0.5	1	5	86	103
MW52-94-10	BS-MW52-94-10-19	m	5	0.6	47	0.5	0.5	41	17	13	2.5	0.2	2.5	13	0.5	1	5	15	55
	BS-MW52-94-10-23.5	m	5	0.94	81	0.5	0.5	44	16	22	2.5	0.2	2.5	14	0.5	1	5	66	56
	BS-MW52-94-10-28.5	m	5	0.5	63	0.5	0.5	33	22	36	2.5	0.2	2.5	17	0.5	1	5	45	77
	BS-MW52-94-10-33.5	m	5	0.87	44	0.5	0.5	22	11	7	2.5	0.2	2.5	17	0.5	1	5	32	29
	BS-MW52-94-10-39.1	m	5	0.83	127	0.5	0.9	59	16	53	3.3	0.2	2.5	38	0.5	1	5	79	57
	BS-MW52-94-10-43.5	m	5	0.63	165	0.71	0.5	50	19	47	3.7	0.2	2.5	42	0.5	1	5	74	105
	BS-MW52-94-10-48.6	m	5	1.5	172	0.69	0.5	45	18	37	3.7	0.2	2.5	43	0.5	1	5	58	59
	BS-MW52-94-10-53.6	m	5	0.5	84	0.5	0.5	45	17	57	2.5	0.2	2.5	20	0.5	1	5	41	65
	BS-MW52-94-10-58.5	o	5	2.5	110	0.5	0.5	93	19	47	3.4	0.2	2.5	173	0.5	1	5	57	72
	BS-MW52-94-10-63.6	o	5	2	55	0.5	0.5	81	10	37	2.5	0.2	2.5	95	0.5	1	5	40	50
	BS-MW52-94-10-68.5	o	5	5.6	141	0.61	0.5	54	11	40	4.9	0.2	2.5	58	0.5	1	5	38	73
MW51-94-11	BS-MW51-94-11-2.6	m	5	3.4	153	0.52	0.5	62	14	41	4	0.2	2.5	95	0.5	1	5	47	87
	BS-MW51-94-11-5	m	5	2.9	190	0.5	0.5	92	17	38	2.5	0.2	2.5	132	0.5	1	5	52	63
	BS-MW51-94-11-14	m	5	8.9	185	0.5	0.5	75	14	29	3.6	0.2	2.5	85	0.5	1	5	64	65
	BS-MW51-94-11-19	o	5	10	232	0.5	0.5	43	9.3	21	3.8	0.2	2.5	63	0.5	1	5	39	51
	BS-MW51-94-11-24.3	o	5	6.5	242	0.5	0.5	48	11	28	4.4	0.2	2.5	61	0.5	1	5	34	56
	BS-MW51-94-11-29.3	o	5	2.9	188	0.5	0.55	30	8.2	47	3.7	0.2	2.5	45	0.5	1	5	25	57
	BS-MW51-94-11-9.3	m	5	0.95	175	0.5	0.5	86	14	33	2.5	0.2	2.5	84	0.5	1	5	66	58
MW25-94-12	BS-MW25-94-12-4.2	f/c	5	2.4	115	0.5	0.5	41	17	39	5.3	0.2	2.5	91	0.5	1	5	78	55
	BS-MW25-94-12-10	f/c	5	3.9	109	0.5	0.5	51	18	29	5.1	0.2	2.5	90	0.5	1	5	77	60
	BS-MW25-94-12-14.2	m	5	2.3	101	0.5	0.5	47	22	43	2.5	0.2	2.5	65	0.5	1	5	83	61
	BS-MW25-94-12-19	m	5	0.5	132	0.51	0.5	40	17	24	2.5	0.2	2.5	16	0.5	1	5	77	73
	BS-MW25-94-12-24	m	5	0.5	126	0.5	0.5	31	18	15	2.5	0.2	2.5	26	0.5	1	5	60	70
	BS-MW25-94-12-34	m	5	0.5	183	0.5	0.5	16	20	14	2.5	0.2	2.5	20	0.5	1	5	41	45
	BS-MW25-94-12-39.1	o	5	2.7	83	0.5	0.5	64	15	35	4.3	0.2	2.5	97	0.5	1	5	41	67
	BS-MW25-94-12-49	o	5	4.6	152	0.55	0.5	53	13	35	4.9	0.2	2.5	78	0.5	1	5	34	67
	BS-MW25-94-12-54.3	o	5	3.9	120	0.5	0.5	48	10	28	3.1	0.2	2.5	55	0.5	1	5	29	48
	BS-MW25-94-12-59.1	o	5	10	282	0.61	0.5	59	11	42	5.3	0.2	2.5	83	0.5	1	5	34	64
	BS-MW25-94-12-64.1	o	5	0.5	182	0.5	0.5	65	12	37	2.9	0.2	2.5	71	0.5	1	5	35	66
	BS-MW25-94-12-69	o	5	0.59	158	0.5	16	55	12	33	2.8	0.2	2.5	70	0.5	1	5	33	60
	BS-MW25-94-12-74	o	5	7.5	252	0.62	0.5	86	15	98	3.3	0.2	2.5	109	0.5	1	5	62	90
MW16-94-13	BS-MW16-94-13-6.5	f/c	5	2.2	85	0.5	0.5	94	16	31	5.1	0.2	2.5	132	0.5	1	5	56	50
	BS-MW16-94-13-11	m	5	2.3	133	0.5	0.52	478	18	48	3.7	0.29	2.5	166	0.5	1	5	80	63
	BS-MW16-94-13-15.7	o	5	1.9	91	0.5	0.5	43	15	38	7.1	0.2	2.5	86	0.5	1	5	28	57
	BS-MW16-94-13-20.2	o	5	1.3	129	0.5	0.5	46	14	47	6.3	0.23	2.5	67	0.5	1	5	34	67
	BS-MW16-94-13-25.4	o	5	1	152	0.5	0.5	46	12	44	4.6	0.2	2.5	71	0.5	1	5	37	64
	BS-MW16-94-13-30.8	o	5	0.5	236	0.55	0.6	27	8.1	33	7.7	0.2	2.5	46	0.5	1	5	83	45
	BS-MW16-94-13-35.1	o	5	3.4	169	0.56	0.5	60	16	48	7.7	0.2	2.5	82	0.5	1	5	55	73
	BS-MW16-94-13-40.3	o	5	5.1	236	0.51	0.5	61	15	66	6.4	0.2	2.5	101	0.5	1	5	51	75
	BS-MW16-94-13-45	o	5	26	206	0.5	0.58	43	12	27	5.5	0.2	2.5	74	0.5	1	5	38	53
MW58A-94-14	BS-MW58A-94-14-6	f/c	5	0.54	69	0.5	0.5	61	19	23	2.5	0.2	2.5	31	0.5	1	5	78	52
	BS-MW58A-94-14-11	f/c	5	0.98	99	0.5	0.5	92	18	31	7.5	0.2	2.5	71	0.5	1	5	81	65
	BS-MW58A-94-14-15	m	5	3.7	113	0.5	1.5	68	15	72	29	0.2	2.5	41	0.5	1	5	65	
	BS-MW58A-94-14-21	m	5	0.5	107	0.5	0.5	76	17	19	2.5	0.2	2.5	31	0.5	1	5	60	54
	BS-MW58A-94-14-23	m	5	0.5	48	0.5	0.5	70	14	19	2.5	0.2	2.5	26	0.5	1	5	42	57
	BS-MW58A-94-14-26	o	5	0.5	132	0.5	0.5	64	17	24	2.5	0.2	2.5	79	0.5	1	5	57	55
	BS-MW58A-94-14-31	o	5	0.5	117	0.5	0.5	80	17	29	2.5	0.2	2.5	33	0.5	1	5	70	46
	BS-MW58A-94-14-36	o	5	0.96	126	0.5	0.5	69	17	27	2.5	0.2	2.5	39	0.5	1	5	55	51
MW91-1	91-1-S1	f/c	2	3	48	0.3	0.2	45	17	13	3	0.2	0.6	27	2	0.2	3	33	40
	91-1-S2	o	2	4	110	0.5	0.2	42	8.4	14	7	0.2	0.6	51	2	0.2	3	25	42
	91-1-S3	o	2	2	73	0.6	0.2	58	13	31	6	0.2	0.6	82	2	0.2	3	54	56
	91-1-S4	o	2	2	290	0.7	0.2	63	17	20	9	0.2	0.6	96	2	0.2	3	46	68
	91-1-S5	o	2	2	120	0.5	0.2	57	13	25	6	0.2	0.6	88	2	0.2	3	39	52
	91-1-S6	o	2	4	170	0.7	0.2	87	16	63	2	0.2	0.6	110	2	0.2	3	51	140
	91-1-S7	o	2	5	140	0.7	0.2	66	15	31	7	0.2	0.6	98	2	0.2	3	36	58
	91-1-S8	o	2	6	57	0.5	0.2	72	13	26	4	0.2	0.6	90	2	0.2	3	38	48
	91-1-SC	o	2	6	210	0.8	0.2	81	16	32	8	0.2	0.6	110	2	0.2	3	47	69
MW91-2	91-2-S1	f/c	2	3	76	0.6	0.2	56	20	30	4	0.2	0.6	29	2	0.2	3	45	51
	91-2-S2	f/c	2	3	72	0.6	0.2	64	19	19	7	0.2	0.6	36	2	0.2	3	59	104
	91-2-S3	o	2	3	130	0.5	0.2	65	14	29	7	0.2	0.6	80	2	0.2	3	47	93
	91-2-S4	o	2	2	130	0.6	0.2	58	15	26	8	0.2	0.6	68	2	0.2	3	53	28
	91-2-S5	o	2	1	140	0.6	0.2	59	15	26	7	0.2	0.6	77	2	0.2	5	47	35
	91-2-S6	o	2	1	100	0.5	0.2	53	13	28	8	0.2	0.6	77	2	0.2	4	39	34
	91-2-S7	o	2	4	88	0.6	0.2	64	22	41	5	0.2	0.6	62	2	0.2	4	66	20
	91-2-S8	o	2	2	110	0.9	0.2	92	17	27	12	0.2	0.6	110	2	0.2	9	64	69
	91-2-S9	o	2	2	330	0.9	0.2	81	20	25	11	0.2	0.6	110	2	0.2	10	62	63

TABLE 1
Metals Concentrations in soils used to calculate background (in mg/kg)

Location	Sample ID	Geol. Unit	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	Vn	Zn
MW91-2	91-2-SC	o	2	3	490	0.6	0.2	83	16	28	9	0.2	0.6	91	2	0.2	3	58	65
MW91-3	91-3-S1	f/c	2	2	75	0.6	0.2	59	13	23	7	0.2	0.6	75	2	0.2	5	39	52
	91-3-S2	o	2	4	100	0.6	0.2	54	12	21	7	0.2	0.6	84	2	0.2	3	33	48
	91-3-S3	o	2	3	190	0.7	0.2	69	12	30	8	0.2	0.6	87	2	0.2	6	39	53
	91-3-S4	o	2	2	240	0.5	0.2	46	11	24	5	0.2	0.6	61	2	0.2	3	32	45
	91-3-S5	o	2	5	100	0.7	0.3	74	14	29	10	0.2	0.6	96	2	0.3	3	34	65
MW91-3	91-3-S6	o	2	4	180	0.5	0.2	56	16	31	7	0.2	0.6	82	2	0.2	3	46	59
	91-3-S7	o	2	3	180	0.6	0.2	64	15	27	7	0.2	0.6	99	2	0.2	3	41	65
MW91-4	91-4-S1	f/c	2	1	150	0.6	0.2	74	15	35	14	0.2	0.6	100	2	0.2	10	57	67
	91-4-S2	o	2	2	140	0.7	0.2	88	16	48	16	0.2	0.6	97	2	0.2	14	62	84
	91-4-S3	o	2	1	220	0.8	0.2	85	19	26	14	0.2	0.6	76	2	0.2	11	71	49
	91-4-S4	o	2	1	140	0.8	0.2	77	17	29	16	0.2	0.6	96	2	0.2	16	62	77
	91-4-S5	o	2	1	220	0.7	0.3	62	15	29	15	0.2	0.6	100	2	0.2	4	48	68
	91-4-S6	o	2	1	170	0.6	0.3	60	15	36	13	0.2	0.6	88	2	0.2	10	42	70
	91-4-S7	o	2	1	240	0.6	0.2	65	14	30	13	0.2	0.6	84	2	0.2	4	53	66
MW91-5	91-5-S1	f/c	2	4	130	0.6	0.2	59	13	27	6	0.2	0.6	84	2	0.2	3	39	53
	91-5-S2	f/c	2	4	84	0.7	0.2	65	17	23	8	0.2	0.6	94	2	0.2	3	53	62
	91-5-S3	o	2	3	51	0.5	0.2	67	18	39	3	0.2	0.6	50	2	0.2	3	59	27
	91-5-S4	o	2	4	40	0.3	0.2	58	17	37	3	0.2	0.6	44	2	0.2	3	60	30
	91-5-S5	o	2	16	400	0.9	0.2	69	13	35	10	0.2	0.6	89	16	0.2	3	44	69
	91-5-S6	o	2	3	490	0.6	0.8	52	12	21	9	0.2	0.6	80	2	0.3	3	41	61
	91-5-S7	o	2	3	190	0.6	0.2	48	11	20	6	0.2	0.6	68	2	0.2	3	43	47
	91-5-SC	o	2	3	270	0.8	0.2	82	16	31	8	0.2	0.6	93	2	0.2	3	62	68
MW91-6	91-6-S1	f/c	2	9	99	0.7	0.2	76	15	32	12	0.2	0.6	99	2	0.2	9	52	61
	91-6-S2	o	2	10	100	0.7	0.2	79	18	36	14	0.2	0.6	98	2	0.2	18	70	62
	91-6-S3	o	2	15	100	0.8	0.2	71	16	32	12	0.2	0.6	83	2	0.2	9	63	54
	91-6-S4	o	2	8	88	0.5	0.2	60	13	27	7	0.2	0.6	56	2	0.2	4	59	41
	91-6-S5	o	2	10	73	0.5	0.2	49	19	40	7	0.2	0.6	54	2	0.2	3	62	52
	91-6-S6	o	2	9	100	0.6	0.2	66	14	87	10	0.2	0.6	72	2	0.2	3	49	94
MW91-7	91-7-S1	f/c	2	3	130	0.9	0.2	70	19	18	12	0.2	0.6	32	2	0.2	72	72	43
	91-7-S2	f/c	2	4	170	1	0.2	73	23	19	8	0.2	0.6	31	2	0.2	77	77	41
	91-7-S3	m	2	2	110	0.9	0.2	41	18	10	4	0.2	0.6	28	2	0.2	130	130	27
	91-7-S4	m	2	2	150	0.8	0.2	67	23	24	7	0.2	0.6	31	2	0.3	59	59	51
	91-7-S5	m	2	1	93	0.6	0.2	66	23	24	5	0.2	0.6	32	2	0.2	40	40	52
	91-7-S6	m	2	2	100	0.5	0.2	49	16	20	4	0.2	0.6	23	2	0.2	52	52	48
	91-7-S7	m	2	2	46	0.4	0.2	46	16	11	4	0.2	0.6	21	2	0.2	42	42	40
	91-7-S8	m	2	1	29	0.3	0.2	35	12	6	2	0.2	0.6	18	2	0.2	22	22	37
	91-7-S9	m	2	1	50	0.4	0.2	70	18	26	4	0.2	0.6	35	2	0.2	54	54	62
	91-7-S10	m	2	1	33	0.3	0.2	73	23	13	3	0.2	0.6	34	2	0.2	27	27	70
	91-7-S11	m	2	1	27	0.2	0.2	34	13	14	2	0.2	0.6	16	2	0.2	18	18	45
	91-7-S12	m	2	1	36	0.3	0.2	36	13	14	2	0.2	0.6	19	2	0.2	27	27	45
MW91-8	91-8-S1	m	2	3	44	0.5	0.2	50	21	19	4	0.2	0.6	26	2	0.2	3	31	65
	91-8-S2	m	2	3	54	0.4	0.2	58	20	13	5	0.2	0.6	31	2	0.2	3	44	50
	91-8-S3	m	2	3	73	0.4	0.3	58	19	9	5	0.2	0.6	24	2	0.2	3	53	44
	91-8-S4	m	2	2	42	0.3	0.2	55	14	7	3	0.2	0.6	22	2	0.2	3	37	38
MW91-9	91-9-S1	f/c	2	11	120	0.6	0.3	86	19	17	12	0.2	0.6	86	2	0.2	66	66	34
	91-9-S2	o	2	8	120	0.7	0.2	57	16	21	10	0.2	0.6	54	2	0.2	64	64	58
	91-9-S3	o	2	8	130	0.6	0.4	47	13	27	10	0.2	0.6	73	2	0.2	39	39	58
	91-9-S4	o	2	5	82	0.3	0.4	81	12	20	8	0.2	0.6	77	2	0.2	41	41	39
MWP-1	MWP1-S1	f/c	2	2	110	0.7	0.2	56	14	22	9	0.2	0.6	40	2	0.2	3	52	48
	MWP1-S2	f/c	2	3	170	0.8	0.2	41	12	32	14	0.2	0.6	41	2	0.2	5	48	56
	MWP1-S3	f/c	2	9	130	0.7	0.2	33	13	41	11	0.2	0.6	33	2	0.2	4	44	77
	MWP1-S4	f/c	2	5	150	0.7	0.2	99	16	40	7	0.2	0.6	120	2	0.2	5	53	52
	MWP1-S5	f/c	2	4	110	0.6	0.2	67	14	33	7	0.2	0.6	91	2	0.3	5	43	50
	MWP1-S6	f/c	2	5	120	0.6	0.2	50	12	33	6	0.2	0.6	85	2	0.2	5	34	46
	MWP1-S7	f/c	2	6	130	0.7	0.2	56	11	24	8	0.2	0.6	52	2	0.2	3	44	56
	MWP1-S8	f/c	2	6	140	0.6	0.2	50	20	21	6	0.2	0.6	38	2	0.2	3	47	51
	MWP1-S9	gv	2	4	82	0.7	0.2	63	18	16	6	0.2	0.6	36	2	0.2	3	62	43
MWP-2	MWP2-S1	f/c	2	13	180	0.9	0.4	39	15	41	31	0.2	0.6	39	2	0.2	4	55	97
	MWP2-S2	gv	2	9	180	0.7	0.4	34	11	14	14	0.2	0.6	19	2	0.3	3	62	64
	MWP2-S3	gv	2	11	64	0.8	0.2	38	20	53	17	0.2	0.6	48	2	0.2	12	54	110
	MWP2-S4	gv	2	9	120	0.7	0.2	36	15	45	15	0.2	0.6	40	2	0.3	4	46	110
	MWP2-S5	gv	2	8	55	0.7	0.2	36	13	40	16	0.2	0.6	41	2	0.2	8	46	99
	MWP2-S6	gv	2	8	71	0.8	0.2	37	15	41	18	0.2	0.6	40	2	0.2	14	54	94
	MWP2-S7	gv	2	8	98	0.6	0.2	29	13	23	12	0.2	0.6	27	2	0.6	3	39	63
MWP-4	MWP4-S1	f/c	2	12	120	0.7	0.2	36	12	30	12	0.2	0.6	31	2	0.2	7	53	72
	MWP4-S2	gv	2	14	210	0.8	0.3	35	17	45	14	0.2	0.6	44	2	0.2	10	49	100
	MWP4-S3	gv	2	8	190	0.8	0.6	37	17	48	16	0.2	0.6	69	2	0.3	3	52	97
	MWP4-S4	gv	2	15	130	0.7	0.2	35	17	49	15	0.2	0.6	40	2	0.2	7	50	92
	MWP4-S5	gv	2	11	190	0.7	0.2	31	22	43	14	0.2	0.6	34	2	0.2	3	54	90
	MWP4-S6	gv	2	9	140	0.7	0.2	36	17	53	14	0.2	0.6	42	2	0.3	5	50	93

TABLE 1
Metals Concentrations in soils used to calculate background (in mg/kg)

Location	Sample ID	Geol. Unit	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	Vn	Zn
MWP-4	MWP4-S7	gv	2	14	67	0.6	0.2	33	14	43	13	0.2	0.6	39	2	0.2	7	49	85
	MWP4-S8	gv	2	12	110	0.7	0.2	38	15	50	14	0.2	0.6	40	2	0.3	6	57	90
	MWP4-S9	gv	2	9	76	0.7	0.2	31	15	43	13	0.2	0.6	36	2	0.3	5	42	89
MWP-5	MWP5-S1	f/c	2	6	210	0.7	0.2	37	14	37	14	0.2	0.6	41	2	0.4	3	38	90
	MWP5-S2	gv	2	7	270	0.9	0.2	38	15	41	16	0.2	0.6	39	2	0.2	3	54	78
	MWP5-S3	gv	2	14	200	0.8	0.2	35	14	47	16	0.2	0.6	38	2	0.2	7	44	93
	MWP5-S4	gv	2	8	130	0.5	0.2	27	20	38	13	0.2	0.6	30	2	0.2	4	40	78
MWP-5	MWP5-S5	gv	2	13	160	0.6	0.4	28	27	41	23	0.2	0.6	52	2	0.4	3	35	100
	MWP5-S6	gv	2	5	170	0.8	0.2	33	19	53	19	0.2	0.6	43	2	0.2	7	43	110
	MWP5-S7	gv	2	4	160	0.6	0.2	33	10	41	12	0.2	0.6	35	2	0.2	6	31	90
	MWP5-S8	gv	2	10	63	0.7	0.2	35	15	45	13	0.2	0.6	46	2	0.2	8	42	86
	MWP5-S9	gv	2	10	79	0.6	0.2	32	15	51	14	0.2	0.6	42	2	0.2	6	41	90
	MWP5-S10	gv	2	7	69	0.7	0.2	35	15	47	13	0.2	0.6	41	2	0.4	8	41	95
	MWP5-S11	gv	2	10	73	0.5	0.2	32	15	45	12	0.2	0.6	47	2	0.3	7	39	84
	MWP5-S12	gv	2	12	55	0.5	0.2	31	14	37	10	0.2	0.6	38	2	0.3	6	40	75
	MWP5-S13	gv	2	5	54	0.7	0.2	38	14	51	13	0.2	0.6	42	2	0.3	9	42	94
	MWP5-S14	gv	2	12	240	0.6	0.2	31	13	43	14	0.2	0.6	39	2	0.4	5	37	80
	MWP5-S15	gv	2	24	47	0.6	0.2	31	13	37	10	0.2	0.6	41	2	0.3	6	38	82
	MWP5-S16	gv	2	8	59	0.5	0.2	28	12	29	10	0.2	0.6	35	2	0.2	7	36	68
	MWP5-S17	gv	2	14	55	0.6	0.2	36	16	39	13	0.2	0.6	51	2	0.2	7	43	85
	MWP5-S18	gv	2	8	52	0.7	0.2	33	13	40	10	0.2	0.6	39	2	0.3	5	38	80
MWP-6	MWP6-S1	f/c	2	7	220	0.9	0.2	41	17	46	16	0.2	0.6	44	2	0.2	3	60	90
	MWP6-S2	gv	2	9	180	1	0.2	39	14	53	15	0.2	0.6	42	2	0.2	5	47	110
	MWP6-S3	gv	2	10	160	0.8	0.2	39	20	57	23	0.2	0.6	53	2	0.2	3	53	100
	MWP6-S4	gv	2	6	180	0.8	0.2	37	14	52	15	0.2	0.6	44	2	0.2	3	47	100
	MWP6-S5	gv	2	4	58	0.8	0.2	39	13	55	15	0.2	0.6	40	2	0.2	7	51	110
	MWP6-S6	gv	2	13	69	0.5	0.2	26	16	51	12	0.2	0.6	44	2	0.8	3	34	79
MWP-7	MWP7-S1	f/c	2	8	160	0.6	0.2	41	12	30	10	0.2	0.6	46	2	0.2	3	38	72
	MWP7-S2	o	2	8	210	0.7	0.2	61	14	40	12	0.2	0.6	70	2	0.2	3	50	120
	MWP7-S3	o	2	9	280	0.9	0.2	73	14	28	12	0.2	0.6	110	2	0.2	4	34	88
	MWP7-S4	gv	2	4	170	0.6	0.2	41	9	20	20	0.2	0.6	47	2	0.2	3	33	49
	MWP7-S5	gv	2	2	65	0.5	0.2	17	3.5	6	9	0.2	0.6	7	2	0.2	3	28	32
	MWP7-S6	gv	2	2	310	0.7	0.2	32	13	37	12	0.2	0.6	36	2	0.2	3	48	80
	MWP7-S7	gv	2	2	120	0.6	0.3	33	14	62	12	0.2	0.6	36	2	0.2	3	45	95
MWP-8	MWP8-S1	f/c	2	5	140	0.6	0.2	74	20	26	10	0.2	0.6	27	2	0.2	3	47	68
	MWP8-S2	f/c	2	3	84	0.6	0.2	58	12	32	8	0.2	0.6	74	2	0.2	3	37	53
	MWP8-S3	f/c	2	6	290	0.7	0.2	100	14	34	10	0.2	0.6	120	2	0.2	3	64	81
	MWP8-S4	o	2	2	110	0.5	0.2	22	7.6	18	8	0.2	0.6	24	2	0.2	3	26	45
	MWP8-S5	o	2	2	170	0.7	0.2	32	12	42	10	0.2	0.6	42	2	0.2	3	35	70
	MWP8-S6	o	2	1	110	0.3	0.2	21	6.1	8	7	0.2	0.6	24	2	0.2	3	14	33
	MWP8-S7	o	2	2	97	0.6	0.2	31	9.2	28	9	0.2	0.6	32	2	0.2	3	30	50
	MWP8-S8	o	2	4	88	0.5	0.2	37	8.5	17	8	0.2	0.6	29	2	0.2	3	27	47
	MWP8-S9	o	2	4	83	0.6	0.2	26	5.8	25	10	0.2	0.6	25	2	0.2	3	22	47
MWP-9	MWP9-S1	f/c	2	3	160	0.5	0.2	46	10	30	6	0.2	0.6	79	2	0.2	3	16	58
	MWP9-S11	o	2	7	82	0.3	0.2	36	5.5	7	4	0.2	0.6	47	2	0.2	3	24	30
	MWP9-S2	o	2	3	180	0.7	0.2	83	13	22	8	0.2	0.6	120	2	0.2	3	36	76
	MWP9-S3	o	2	3	140	0.6	0.6	59	8.8	25	7	0.2	0.6	73	2	0.2	3	39	55
	MWP9-S4	o	2	11	40	0.5	0.2	54	8.9	23	7	0.2	0.6	82	2	0.2	3	26	52
	MWP9-S5	o	2	3	87	0.5	0.2	59	8.8	21	6	0.2	0.6	71	2	0.2	3	27	45
	MWP9-S6	o	2	27	100	0.7	0.2	69	9	25	8	0.2	0.6	82	2	0.2	3	32	63
	MWP9-S7	o	2	3	60	0.5	0.2	46	10	27	8	0.2	0.6	79	2	0.2	3	24	54
	MWP9-S8	o	2	2	130	0.6	0.2	45	7.5	23	7	0.2	0.6	69	2	0.3	3	23	59
	MWP9-S9	o	2	4	140	0.6	0.2	45	8.2	25	7	0.2	0.9	65	2	0.2	3	26	51
	MWP9-S10D	o	2	12	140	0.7	0.3	57	11	32	8	0.2	0.9	78	2	0.2	5	26	64
MWP-10	MWP10-S1	f/c	2	3	110	0.5	0.2	67	14	39	7	0.2	0.6	81	2	0.2	3	44	64
	MWP10-S2	f/c	2	2	140	0.6	0.2	52	15	24	7	0.2	0.6	110	2	0.2	3	37	76
	MWP10-S3	f/c	2	4	110	0.6	0.3	68	17	16	9	0.2	0.6	140	2	0.2	3	34	79
	MWP10-S4	f/c	2	2	150	0.7	0.2	76	14	36	7	0.2	0.6	95	2	0.2	3	47	79
	MWP10-S5	o	2	3	130	0.4	0.2	59	13	34	6	0.2	0.6	84	2	0.2	3	33	66
	MWP10-S6	o	2	5	160	0.6	0.5	69	15	40	9	0.2	0.6	110	2	0.2	3	35	86
	MWP10-S7	o	2	3	220	0.5	0.2	67	9.9	42	8	0.2	0.6	94	2	0.2	3	32	72
	MWP10-S8	o	2	2	170	0.5	0.2	47	8	22	7	0.2	0.6	69	2	0.2	3	22	54
	MWP10-S9	o	2	4	130	0.4	0.2	41	7.1	25	6	0.2	0.6	54	2	0.2	3	23	50
	MWP10-S10	o	2	30	190	0.6	0.2	64	14	41	9	0.2	0.6	93	2	0.2	4	34	88
	MWP10-S11	o	2	9	180	0.6	0.2	63	12	28	8	0.2	0.6	95	2	0.2	3	35	66
	MWP10-S12	o	2	6	210	0.6	0.2	56	11	44	12	0.2	0.6	100	2	0.2	4	24	76
	MWP10-S13	o	2	7	190	0.7	0.2	64	10	37	9	0.2	0.6	89	2	0.2	3	33	64

Geologic Formations:
f/c - Fill/Colluvium
gv - Great Valley
m - Moraga
o - Orinda
sp - San Pablo

TABLE 2

Parameters Used to Determine Upper 95% Confidence Limit for Background Soil Metals Data

(Concentrations in mg/kg)

	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	Vn	Zn
Site Background	5.5	19.1	323.6	1	2.7	99.6	22.2	69.4	16.1	0.4	7.4	119.8	5.6	1.8	27.1	74.3	106.1
Colluvium & Fill																	
Mean (Xav)	2.77	5.39	126.33	0.50	0.46	51.34	13.67	29.05	6.86	0.17	1.26	59.23	1.60	0.55	7.72	44.49	57.37
Standard Deviation (σ)	1.62	4.47	120.84	0.21	0.55	20.81	4.33	15.90	4.05	0.09	0.99	31.67	2.09	0.57	18.07	17.50	17.74
Tolerance Factor (K)	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924
Great Valley																	
Mean (Xav)	2.63	12.53	107.43	0.58	0.73	36.06	14.40	46.95	12.21	0.19	1.24	41.46	1.62	0.56	4.24	45.49	90.00
Standard Deviation (σ)	1.90	9.59	73.30	0.22	1.31	11.93	5.78	27.43	4.84	0.22	1.32	14.68	1.68	0.86	2.33	12.37	23.87
Tolerance Factor (K)	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924
Moraga Formation																	
Mean (Xav)	2.74	2.82	71.80	0.36	0.71	52.80	15.76	24.26	2.84	0.13	1.61	36.50	1.35	0.68	7.41	45.68	52.44
Standard Deviation (σ)	1.77	3.35	42.78	0.22	0.98	46.38	3.82	15.52	3.13	0.08	1.14	33.22	1.76	0.68	16.38	23.08	16.76
Tolerance Factor (K)	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924	1.924
Orinda Formation																	
Mean (Xav)	2.55	6.31	169.83	0.56	0.65	54.48	12.54	31.91	7.17	0.18	1.77	75.39	1.85	0.58	5.16	39.87	60.89
Standard Deviation (σ)	1.46	6.27	131.30	0.28	1.45	22.16	4.41	19.05	4.17	0.06	5.25	37.49	2.83	0.70	7.96	16.02	20.33
Tolerance Factor (K)	1.838	1.838	1.838	1.838	1.838	1.838	1.838	1.838	1.838	1.838	1.838	1.838	1.838	1.838	1.838	1.838	1.838
San Pablo Group																	
Mean (Xav)	2.69	4.14	102.28	0.36	0.73	25.55	7.44	16.35	5.42	0.22	1.16	46.25	1.59	0.48	4.62	12.68	43.54
Standard Deviation (σ)	1.65	4.34	66.55	0.17	0.83	19.88	5.44	9.20	1.81	0.09	0.96	29.83	1.23	0.37	2.36	8.80	20.28
Tolerance Factor (K)	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67

TABLE 3
BACKGROUND CONCENTRATIONS OF METALS
(Concentrations in mg/kg)

	Number of Samples	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	Vn	Zn
Site Background	498	5.5	19.1	323.6	1.0	2.7	99.6	22.2	69.4	16.1	0.4	7.4	119.8	5.6	1.8	27.1	74.3	106.1
Colluvium & Fill	97	5.9	14.0	358.8	0.9	1.5	91.4	22.0	59.6	14.7	0.3	3.2	120.2	5.6	1.7	42.5	78.2	91.5
Great Valley Group	97	6.3	31.0	248.5	1.0	3.2	59.0	25.5	99.7	21.5	0.6	3.8	69.7	4.8	2.2	8.7	69.3	135.9
Moraga Formation	101	6.1	9.3	154.1	0.8	2.6	142.2	23.1	54.1	8.9	0.3	3.8	100.4	4.7	2.0	38.9	90.1	84.7
Orinda Formation	184	5.2	17.8	411.2	1.1	3.3	95.2	20.6	66.9	14.8	0.3	11.4	144.3	7.0	1.9	19.8	69.3	98.3
San Pablo Group	13	7.1	15.7	280.0	0.8	2.9	78.6	22.0	40.9	10.3	0.4	3.7	125.9	4.9	1.5	10.9	36.2	97.7

Note: Background concentrations determined for Upper 95% Confidence Limit (UCL) from data from 71 monitoring well borings.

SITE WIDE
REMEDIAL INVESTIGATION
PACIFIC STATES STEEL CORPORATION
UNION CITY, CALIFORNIA

VOLUME I

Prepared for:

Chemical Waste Management, Inc.
Remedial Services West
4227 Technology Drive
Fremont, California 94538

RECEIVED

Prepared by:

William Gilmour
Registerd Geologist - #4921

Evelyn A. Rudek
Project Geologist

Exp. 6/30/94

December 3, 1992

SEC DONOHUE
Environment & Infrastructure
42840 Christy Street, Suite 201, Fremont, California 94538

5.2 BACKGROUND SOIL SAMPLING

Eight background samples (P3BGSL1 - P3BGSL4, P3BGSL6 - P3BGSL9) were collected in the vicinity of the Site on the Phase III portion of the Site (Figure 7); however, only five of the sample locations P3BGSL1 - P3BGSL4, and P3BGSL9 are considered background samples. Samples collected at locations P3BGSL6 to P3BGSL8 are located on the Site and had concentrations characteristic of slag and impacted soil.

The five background samples were collected from the Clear Lake Clay and Rincon Clay Loam soil units, to evaluate typical background metals concentrations in the Site area.

Samples were collected with a hand auger and a composite sample, from the 0.5 to 2 foot bgs interval, was collected from each sample location and analyzed for metals using USEPA Test Method 6000/7000 series.

Analytical results for the background soil samples are presented in Table 31. Laboratory reports and chain-of-custody forms are in Appendix I. Metals results for the background samples indicated concentration ranges for cadmium (not detected at 0.5 mg/kg to 1.30 mg/kg), chromium (41.0 mg/kg to 112 mg/kg), copper (28.2 mg/kg to 51.5 mg/kg), lead (19.8 mg/kg to 148 mg/kg), and zinc (97.1 mg/kg to 474 mg/kg).

Average metals concentrations were calculated based on the results from the original five off-site background samples (as presented in Table 31). Additional background samples collected since the draft RI was submitted are presented in Appendix T. Concentrations reported at less than the detection limit were treated as one-half the detection limit for averaging purposes. The calculated average metals concentrations are:

Antimony: 2.5 mg/kg
Arsenic: 8.48 mg/kg
Barium: 228 mg/kg
Beryllium: 0.5 mg/kg
Cadmium: 0.83 mg/kg
Chromium: 72.6 mg/kg
Cobalt: 9.53 mg/kg
Copper: 37 mg/kg
Lead: 65 mg/kg
Mercury: 0.14 mg/kg
Molybdenum: 1.74 mg/kg
Nickel: 43 mg/kg
Selenium: 0.25 mg/kg
Silver: 0.25 mg/kg
Thallium: 0.25 mg/kg
Vanadium: 46.9 mg/kg
Zinc: 281.6 mg/kg

These values were used for determining the extent of soil metals concentrations that exceed background values at the Phase II and Phase III sites (see Section 3.4).

TABLE 31 BACKGROUND SAMPLES - GENERAL INFORMATION

#	SAMPLE ID	LAB ID	DATE SAMPLED	LAB REPORT ID	METHOD	DEPTH FEET	LOCATION	MEDIA
1	P38GSL06	L02950-12	7/03/91	8/08/91	TOTAL	0.5	ONSITE-East Corner of Phase III	SOIL
2	P38GSL07	L02950-13	7/03/91	8/08/91	TOTAL	0.5	ONSITE-West Corner of Phase III	SOIL
3	P38GSL08	L02950-14	7/03/91	8/08/91	TOTAL	0.5	ONSITE-South Corner of Phase III	SOIL
4	P38GSL09	L02950-15	7/03/91	8/08/91	TOTAL	0.5	75' NW of intersect ion of Zwissig Way and Bradford Way	SOIL
5	P38GSL1	L02946-6	7/02/91	7/29/91	TOTAL	0.5	Seventh and Mission Parcel	SOIL
6	P38GSL2	L02946-7	7/02/91	7/29/91	TOTAL	0.5	Vacant lot adjacent to 34400 Zwissig Way	SOIL
7	P38GSL3	L02946-8	7/02/91	7/29/91	TOTAL	0.5	Lot adjacent to Seventh and Mission Parcel	SOIL
8	P38GSL4	L02946-9	7/02/91	7/29/91	TOTAL	0.5	250' SW of intersection of Daggett and Mission Blvd.	SOIL
9	P38GSL4	L02946-9	7/02/91	7/29/91	WET	0.5	250' SW of intersection of Daggett and Mission Blvd.	SOIL

NOTES: MW01 = DESIGNATES MONITORING WELL

TABLE 31 BACKGROUND SAMPLES - TOTAL METALS ANALYSIS RESULTS

#	SAMPLE ID	LAB ID	DATE SAMPLED	LAB REPORT ID	METHOD	DEPTH FEET	UNITS	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CHROMIUM	COBALT	COPPER	LEAD	MERCURY	MOLYBDENUM	NICKEL	SELENIUM	SILVER	THALLIUM	VANADIUM	ZINC	HEX
1	P3BGSL06	L02950-12	7/03/91	8/08/91	TOTAL	0.5	mg/kg	(5.0)	11.4	313	0.74	2.04	100	12.0	70.9	166	0.12	(2.5)	57.3	(0.5)	(0.5)	(5.0)	51.1	592	NA
2	P3BGSL07	L02950-13	7/03/91	8/08/91	TOTAL	0.5	mg/kg	(5.0)	20.2	188	0.54	0.64	74.7	12.6	30.5	10.7	0.01	(2.5)	79.3	(0.5)	(0.5)	(5.0)	40.0	89.3	NA
3	P3BGSL08	L02950-14	7/03/91	8/08/91	TOTAL	0.5	mg/kg	17.9	87.8	73.5	(0.5)	43.3	360	44.0	1470	500	(0.1)	46.5	431	(0.5)	3.11	60.4	24.6	3490	NA
4	P3BGSL09	L02950-15	7/03/91	8/08/91	TOTAL	0.5	mg/kg	(5.0)	8.49	190	(0.5)	(0.5)	46.5	8.74	29.5	23.8	(0.1)	(2.5)	34.2	(0.5)	(0.5)	(5.0)	45.3	144	NA
5	P3BGSL1	L02946-6	7/02/91	7/29/91	TOTAL	0.5	mg/kg	(5.0)	8.91	306	0.81	1.22	112	10.0	51.5	148	0.36	(2.5)	60.6	(0.5)	(0.5)	(5.0)	45.6	411	NA
6	P3BGSL2	L02946-7	7/02/91	7/29/91	TOTAL	0.5	mg/kg	(5.0)	9.36	229	0.60	1.11	56.4	9.65	35.9	52.7	0.12	(2.5)	37.3	(0.5)	(0.5)	(5.0)	49.2	282	NA
7	P3BGSL3	L02946-8	7/02/91	7/29/91	TOTAL	0.5	mg/kg	(5.0)	8.71	244	0.56	1.30	107	9.76	40.1	82.5	0.11	3.69	50.4	(0.5)	(0.5)	(5.0)	47.7	474	NA
8	P3BGSL4	L02946-9	7/02/91	7/29/91	TOTAL	0.5	mg/kg	(5.0)	6.92	173	(0.5)	(0.5)	41.0	9.48	28.2	19.8	(0.1)	(2.5)	32.4	(0.5)	(0.5)	(5.0)	46.7	97.1	NA

REGULATORY LIMITS - CCR TITLE 26																			
TTLC (MG/KG)	500	500	10000	75	100	2500	8000	2500	1000	20	3500	2000	100	500	700	2400	5000	500
STLC (MG/L)	15	5	100	0.75	1	560	80	25	5	0.2	350	20	1	5	7	24	250	5

NOTES: ( ) = NOT DETECTED AT THE ENCLOSED ANALYTICAL DETECTION LIMIT; NA = NOT ANALYZED
MW01 = DESIGNATES MONITORING WELL
TTLC = TOTAL THRESHOLD LIMIT CONCENTRATION
STLC = SOLUBLE THRESHOLD LIMIT CONCENTRATION
CCR = CALIFORNIA CODE OF REGULATIONS

Table 4: Comparison of Area 2 Data to Site–Specific Background Data
Area 2 Investigation Completion Report
Roberts Landing Development Site
San Leandro, California

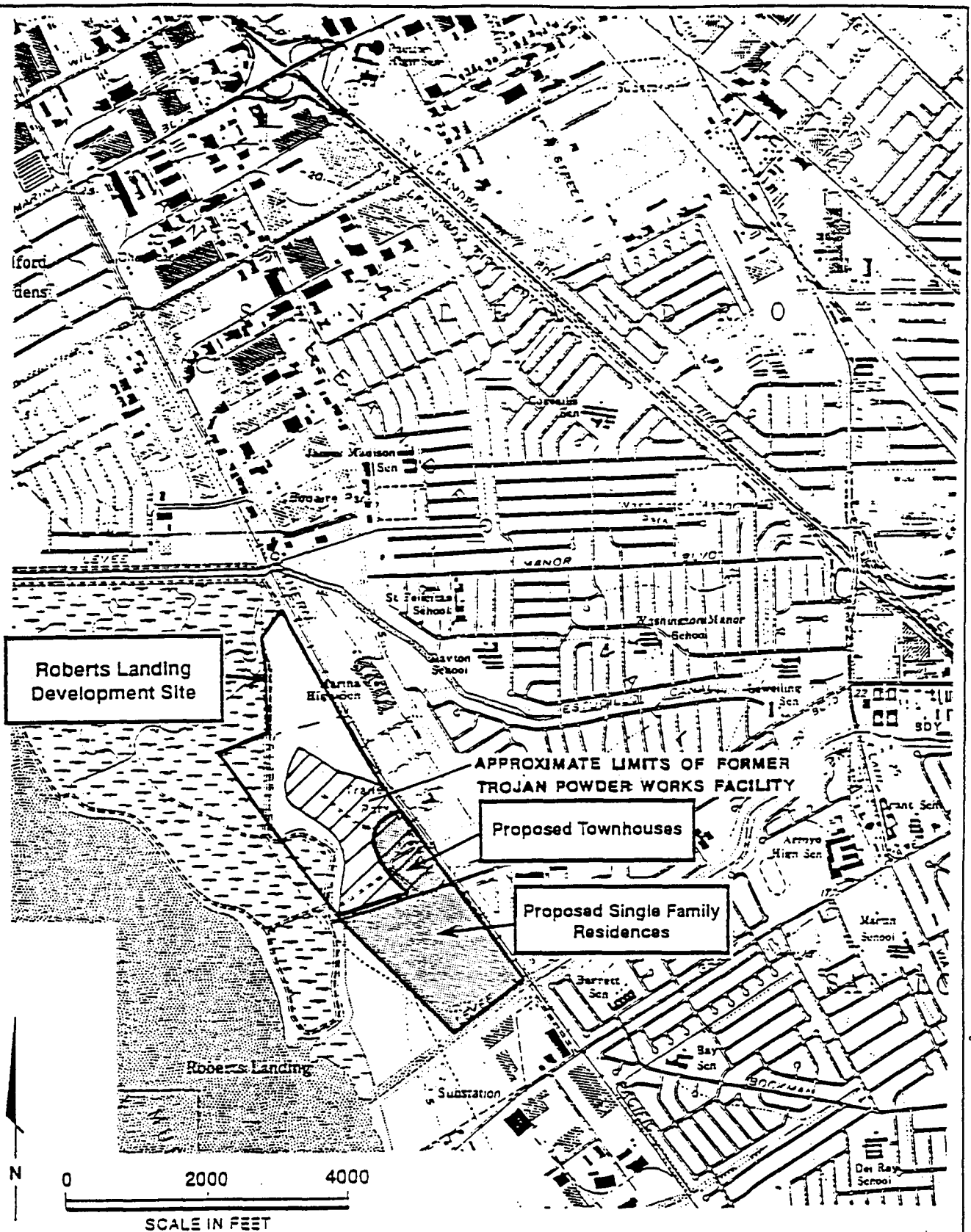
	Roberts Landing Development Site – Area 2							Site Specific Background							Statistical Difference?			
			Detections			All Data				Detections			All Data					
Compound	Det	Tot	Min	Max	Avg	Avg	StDev	Det	Tot	Min	Max	Avg	Avg	StDev	t–Test	Ln t–Test	Mann–Whit	Result
Ag	29	61	0.10	0.40	0.15	0.10	0.07	0	10				0.35	0.32	Yes	Yes	Yes	No Difference (no detects in Bk)
As	61	61	1.00	340.00	14.69	14.69	43.68	10	10	1.80	5.90	3.58	3.58	1.21	No	Yes	Yes	No Difference (means < 1stdev apart)
Ba	61	61	22.00	370.00	137.74	137.74	63.47	10	10	15.40	499.00	124.97	124.97	144.78	No	Yes	No	No Difference (means < 1stdev apart)
Be	57	61	0.10	0.60	0.31	0.29	0.14	7	10	0.28	0.52	0.38	0.35	0.17	No	No	No	No Difference
Cd	52	61	0.10	0.80	0.23	0.20	0.14	2	10	0.25	0.25	0.25	0.20	0.17	No	No	No	No Difference
Co	61	61	5.40	26.00	11.54	11.54	4.17	10	10	5.10	15.80	8.82	8.82	3.08	Yes	Yes	Yes	Area 2 > Bk
Cr	61	61	11.00	110.00	41.07	41.07	13.83	10	10	24.80	43.00	33.36	33.36	6.46	Yes	No	Yes	No Difference (means < 1stdev apart)
Cu	61	61	8.50	160.00	32.34	32.34	20.95	10	10	11.80	68.00	22.65	22.65	16.67	No	Yes	Yes	No Difference (means < 1stdev apart)
Hg	37	61	0.06	0.80	0.17	0.11	0.15	0	10				0.05	0.00	No	No	No	No Difference
Mo	32	61	0.06	2.50	0.65	0.42	0.42	2	10	0.55	0.67	0.61	0.82	0.47	Yes	Yes	Yes	Bk > Area 2
Ni	61	61	13.00	66.00	43.30	43.30	11.20	10	10	2.93	43.60	22.47	22.47	15.75	Yes	Yes	Yes	Area 2 > Bk
Pb	60	61	2.00	500.00	27.08	26.65	68.73	10	10	3.30	10.40	7.35	7.35	2.11	No	No	No	No Difference
Sb	0	61				0.50	0.00	0	10				2.10	1.90	Yes	Yes	Yes	No Detects
Se	0	61				1.00	0.00	1	10	0.25	0.25	0.25	0.35	0.38	Yes	Yes	Yes	No Detects
Tl	25	61	1.00	10.00	5.04	2.36	2.79	1	10	0.50	0.50	0.50	0.60	0.74	Yes	Yes	Yes	Area 2 > Bk
V	61	61	18.00	86.00	35.79	35.79	14.58	10	10	18.20	39.50	27.75	27.75	6.26	Yes	Yes	Yes	Area 2 > Bk
Zn	61	61	22.00	320.00	65.67	65.67	42.50	10	10	9.28	61.30	39.89	39.89	13.54	Yes	Yes	Yes	No Difference (means < 1stdev apart)

StDev = Standard Deviation

Table 8: Results of Chemical Testing on Background Soil Samples
Area 2 Investigation Completion Report
Roberts Landing Development Site
San Leandro, California

Sample	Date	Sb mg/kg	As mg/kg	Ba mg/kg	Be mg/kg	Cd mg/kg	Co mg/kg	Cr mg/kg	Cu mg/kg	Pb mg/kg	Hg mg/kg	Mo mg/kg	Ni mg/kg	Se mg/kg	Ag mg/kg	Tl mg/kg	V mg/kg	Zn mg/kg	pH std units
BK-1-1.0	04/26/94	< 3	2.0	25.9	0.28	< 0.25	5.8	40.2	14.8	5.3	< 0.10	0.55	2.93	< 0.25	< 0.50	< 0.50	27.4	45.3	4.6
BK-1-4.0	04/26/94	< 3	5.9	134.0	< 0.25	< 0.25	5.1	27.7	15.2	7.0	< 0.10	0.67	23.20	< 0.25	< 0.50	< 0.50	24.1	36.4	4.3
BK-2-1.0	04/26/94	< 3	3.8	20.5	0.37	< 0.25	8.5	35.9	13.8	7.0	< 0.10	< 0.50	31.30	< 0.25	< 0.50	< 0.50	31.8	43.1	4.9
BK-2-4.0	04/26/94	< 3	1.8	15.9	0.49	< 0.25	7.6	32.5	22.5	7.9	< 0.10	< 2.50	4.15	< 0.25	< 0.50	< 0.50	31.1	40.7	7.2
BK-3-1.25	04/26/94	< 3	4.4	15.4	< 0.25	< 0.25	6.3	43.0	18.3	3.3	< 0.10	< 2.50	32.20	< 0.25	< 0.50	< 0.50	28.1	45.9	4.1
BK-3-4.0	04/26/94	< 3	3.9	112.0	0.52	< 0.25	10.2	36.0	27.7	7.2	< 0.10	< 0.50	43.60	< 1.30	< 0.50	< 0.50	39.5	48.3	7.4
BK-5-1.0	04/26/94	< 3	2.8	104.0	0.30	< 0.25	8.6	25.0	11.8	6.7	< 0.10	< 2.50	2.95	0.25	< 0.50	0.50	18.2	30.3	8.0
BK-5-2.5	04/26/94	< 3	3.3	181.0	0.30	0.25	10.1	24.8	13.5	8.6	< 0.10	< 2.50	37.60	< 1.30	< 0.50	< 2.50	19.4	38.3	7.7
BK-6-1.0	04/26/94	< 15	3.6	499.0	< 1.30	< 1.30	15.8	39.0	68.0	10.4	< 0.10	< 2.50	11.50	< 2.50	< 2.50	< 5.00	31.1	9.3	7.7
BK-6-2.5	04/26/94	< 3	4.3	142.0	0.38	0.25	10.2	29.5	20.9	10.1	< 0.10	< 0.50	35.30	< 0.25	< 0.50	< 0.50	26.8	61.3	7.8
Maximum Background Concentration		< 3	3.6	499	0.52	0.25	15.8	43.0	68.0	10.4	< 0.10	0.67	43.6	0.25	< 0.50	0.5	31.8	61.3	8.0
Mean*		2.1	1.2	125	0.35	0.20	8.8	33.4	22.7	7.4	0.05	0.82	22.5	0.35	0.35	0.6	27.8	39.9	6.7
Standard Deviation		1.9	1.8	145	0.17	0.17	3.1	6.5	16.7	2.1	0.00	0.47	15.7	0.50	0.32	0.7	6.3	16.4	1.6

* Using half of the reporting limit as the values for calculations.



SOURCE : U.S.G.S. TOPOGRAPHIC MAP, SAN LEANDRO QUADRANGLE (1980)

Harding Lawson Associates
Engineering and Environmental Services

Vicinity Map
Area 2 Site Investigation Completion Report
Roberts Landing Development Site
San Leandro, California

PLATE 1

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
RK	20164 9.6.2		9/23/94	